Volume 3 of 4: Appendices

Los Angeles River Ecosystem Restoration Integrated Feasibility Report

FINAL Feasibility Report and Environmental Impact Statement/Environmental Impact Report

VOLUME 3: APPENDICES

E: Hydrology and Hydraulics
F: Air Quality
G: Habitat Evaluation- Combined Habitat Assessment Protocol (CHAP)
H: Supplemental Environmental Information: (Part 1) Supplemental Information; (Part 2) Monitoring and Adaptive Management Plan; (Part 3) Mitigation Monitoring and Reporting Program
I: Value Engineering Study
J: Real Estate Plan
K: Hazardous, Toxic and /or Radioactive Waste (HTRW) Survey Report
M: Clean Water Act Report 404(b)(1) Evaluation
N: US Fish & Wildlife Service Coordination Act Report (CAR) and Corps responses
O: Cultural Resources Programmatic Agreement
P: Letters and Guidance Memoranda
Q: Mailing List

Los Angeles County, California

September 2015

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VOLUME 1: Integrated Feasibility Report

VOLUME 2:

Appendix A: Design
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Appendix F: Air Quality
Appendix G: Habitat Evaluation- Combined Habitat Assessment Protocol (CHAP)
Appendix H: Supplemental Environmental Information: (Part 1) Supplemental Information; (Part 2) Monitoring and Adaptive Management Plan; (Part 3) Mitigation Monitoring and Reporting Program
Appendix I: Value Engineering Study
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Appendix L: Public Comments on the Draft Integrated Feasibility Report: (Part 1) Public Comments; (Part 2) Responses to Public Comments

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Los Angeles River Ecosystem Restoration

Feasibility Study

APPENDIX E

HYDROLOGY AND HYDRAULICS

September 2015

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LOS ANGELES RIVER
Ecosystem Restoration Study

HYDROLOGY & HYDRAULICS APPENDIX

Prepared By:

US Army Corps of Engineers, Los Angeles District
Engineering Division, Hydrology and Hydraulics Branch

September 2015

Subject: Addendum No. 1 to Los Angeles River Ecosystem Restoration Feasibility Study, Hydrology and Hydraulics Appendix, February 2015.

1. 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.

2. This additional analysis identified a more cost effective variation on Alternative 13 (referred to throughout the IFR 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.

3. 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. Because the analyses in this Appendix included all of the components of Alternative 13v, no separate or additional analysis is necessary.

4. The descriptions for Reaches 1-6 and 8 of Alternative 13v do not change from Alternative 13 and are shown in Section 18.1, Alternative Descriptions included in this Appendix. For the description of Alternative 13v for Reach 7, see the description for Reach 7 of Alternative 20 included in this appendix in Section 18.1.

5. This revised configuration of Reach 7 has no negative impacts on the hydraulics of the channel as compared to the Reach 7 configuration used for Alternative 13. There is no adverse effect to the water surface elevation in Reach 7 for Alternative 13v, whereas the Reach 7 used in Alternative 13 does have an adverse effect due to the additional vegetation along the channel walls. A revised Table 20a to show this additional Alternative 13v is shown below. The typical cross section for Alternative 13v Reach 7 is the same as depicted on Plate 29 for Reach 7 of Alternative 20.

6. Alternative 13v is the NER plan; Alternative 20 is the Recommended Plan.

Table 20a: Alternative 13v Water Surface Elevation

Reach	River Station	Scenario I	Scenario II	Scenario III	Scenario IV
Reach 1	625+77 to 547+45				
Reach 2	546+45 to 510+05				
Reach 3a	504+93 to 477+85				
Reach 3b	475+68 to 452+58				
Reach 4	432+16 to 359+75				
Reach 5	358+63 to 271+89				
Reach 6a	270+28 to 262+73				
Reach 6b	257+85 to 144+23				
Reach 7a	142+91 to 131+22				
Reach 7b	128+71 to 86+81				
Reach 8	86+07 to 10+31				
Note: letters a & b in Reach name denote a break in the reach due to a confluence or flow change. Color Codes:					
Does not increase the water surface elevation					
Increases the water surface elevation					
No change from design conditions					

ABBREVIATIONS AND ACRONYMS USED IN THIS APPENDIX

2-yr event	50% Annual Chance Exceedance Event
5-yr event	20% Annual Chance Exceedance Event
10-yr event	10% Annual Chance Exceedance Event
25-yr event	4% Annual Chance Exceedance Event
50-yr event	2% Annual Chance Exceedance Event
100-yr event	1% Annual Chance Exceedance Event
200-yr event	0.5% Annual Chance Exceedance Event
500-yr event	0.2% Annual Chance Exceedance Event
ACE	Annual Chance Exceedance
AFB	Alternatives Formulation Briefing
ARBOR	Alternative with Restoration Benefits and Opportunities for Revitalization
CADWR	California Department of Water Resources
CE/ICA	Cost Estimate/Incremental Cost Analysis
CIMIS	California Irrigation Management Information System
COE	Corps of Engineers
EIS	Environmental Impact Statement
EM	Engineering Manual
ER	Engineering Regulation
ETo	Evapotranspiration
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HEC	Hydrologic Engineering Center
HEC-RAS	River Analysis System computer program from HEC
LACDA	Los Angeles County Drainage Area
LACDPW	Los Angeles County Department of Public Works
LATC	Los Angeles Transfer Container Facility
MSL	Mean Sea Level
NAD	North American Datum
NAVD	North American Vertical Datum
NED	National Economic Development
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
RS	River Station
SPF	Standard Project Flood
SPS	Standard Project Storm
SWMP	Stormwater Management Plan
TIN	Triangulated Irregular Network
TSP	Tentatively Selected Plan
WRP	Water Reclamation Plant (Tillman)
WSE	Water Surface Elevation

UNITS USED IN THIS APPENDIX

ac	acres	ft/s	feet per second
af/yr	acre-feet per year	ft^3/s	cubic feet per second
af	acre-feet	ft/mi	feet per mile
cy	cubic yards	in	inch
ft	feet	mi^2	square miles

DISCLAIMER:

This Hydrology and Hydraulics Appendix is intended to supplement the Main Report and associated Appendices for the Los Angeles River Ecosystem Restoration Feasibility Study. This Appendix has been through all required levels of review and public comment.

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1. Introduction.

The purpose of this study is to investigate alternatives to improve the ecosystem function of the Los Angeles River specifically within the Los Angeles city limits. The Hydrology and Hydraulic Appendix contains a description of the existing and future hydrologic conditions and a description of the existing channel and appurtenant features. In addition, this appendix covers the modeling inputs and results for the with-project conditions for four selected alternatives. All elevations are based on the 1929 National Geodetic Vertical Datum (NGVD), unless otherwise noted.

The Corps of Engineers (COE) completed a feasibility level flood control review for the Los Angeles County Drainage Area (LACDA) in 1992 and summarized the results in a Main Report and Appendices. The main report and EIS for the Los Angeles County Drainage Area Review Final Feasibility Report was dated Dec. 1991, with revisions in Feb. 1992. There are separate Hydrology and Hydraulics Appendices, each dated Dec. 1991 (along with appendices for Economics, Recreation Inventory, Real Estate, Geotechnical, and Design). These documents went through extensive technical and independent review and were approved and certified prior to the final report date. The proposed project resulting from the Feasibility Study was completed in the late 1990s. The level of detail and adequacy of results is still sufficient for use in the current ecosystem restoration study. This document includes pertinent sections from the previous documents.

Currently, there is considerable public interest in the “revitalization” of the Los Angeles River. This Ecosystem Restoration study is running concurrently with several efforts from private and public interests, including the city of Los Angeles. It is important to note up front that the primary premise from the hydrology and hydraulics perspective is that any ecosystem project evaluated in this study must not negatively impact the flood risk management function of the system. This means any effort to alter the existing Los Angeles River channel must provide mitigation to offset any loss of conveyance. The existing flood risks are presented in this appendix as well as the methodology used to show the proposed alternatives will not increase the flood risks along the river.

The Los Angeles River Channel, for the most part, is a prismatic concrete channel. There are two stretches within the project extent that have natural inverts. These areas currently have a significant amount of vegetation growing along the invert. Funding for removal of vegetation has always been uncertain. In addition there are negative environmental impacts with removal. Thus, it was decided for this ecosystem restoration study the Existing Condition will include the vegetation and would be the condition against which all alternatives are compared. This decision does not imply there is any effort to change the design discharges for the channel.

2. Project Location.

A series of preliminary studies and decisions led to establishment of the project location for this study. Initially, the study covered the entire 32 mile stretch of the river within the city of Los Angeles. The portion of the Los Angeles River ultimately decided to focus on is called the ARBOR reach, which stands for the Alternative with Restoration Benefits and Opportunities for Restoration. The reasons for this decision are addressed in the main report. The location of the ARBOR reach is shown on Plate 1.

The modeling limits for the project extend approximately 11 miles from the western side of Forest Lawn Cemetery at Barham Blvd. downstream to the 1st St. bridge in downtown Los Angeles. The Los Angeles River channel configuration is primarily trapezoidal or rectangular prismatic reaches with concrete side slopes and concrete invert. However, some reaches within the study area are trapezoidal channels with grouted riprap side slopes and an earthen invert, or “soft” bottom, with vegetation. The soft bottom reaches include a 0.9 mile reach that begins about 500 feet downstream of the Burbank Western confluence and ends approximately 1,000 feet downstream of the 5 Freeway crossing, and an approximately 5.9 mile reach that begins 2,000 feet downstream of the Verdugo Wash confluence and ends at the 5 Freeway’s second crossing over the Los Angeles River.

3. General Description of the Drainage Area.

The LACDA watershed lies mostly in Los Angeles County, California, although portions lie in San Bernardino and Orange Counties. See Plate 2 for location of ARBOR in relation to LACDA. The watershed is abutted on the east by the Santa Ana River Watershed, on the north by the Antelope Valley and Santa Clara River Watersheds, and on the west by the Calleguas Creek Watershed. The project area is located along the mainstem Los Angeles River within the Los Angeles city limits.

Elevations in the San Gabriel and Santa Susana Mountains, which form the northern boundary of the watershed, vary from 3,000 feet in the west to over 9,000 feet in the east. The Santa Monica Mountains, Montebello Hills, and Puente Hills separate the San Fernando and San Gabriel valleys from the coastal plain, and range from 500 to 1,500 feet in height.

Principal streams in LACDA are the Los Angeles River, which has a drainage area of 824 mi^2 at the mouth (including the Rio Hondo above Whittier Narrows Dam and its tributaries), and the San Gabriel River, which has a drainage area of 635 mi^2 at the mouth. The Rio Hondo Diversion Channel brings water from the San Gabriel River system to the lower Los Angeles River by way of Whittier Narrows Dam and may effectively increase the drainage area of the Los Angeles River during periods of high runoff. The principal tributaries of the Los Angeles River include: Pacoima and Tujunga Washes, both of which drain portions of the Santa Susana Mountains and the San Fernando Valley, Verdugo Wash, which drains portions of the Verdugo Hills; and the Arroyo Seco, which starts in the San Gabriel Mountains and then heads south to the

Los Angeles River. The main channel of the Los Angeles River is approximately 51 miles long and its tributaries have an aggregate length of about 225 miles. Operations and maintenance for specific channel reaches is divided between the COE and Los Angeles County Department of Public Works (LACDPW).

4. Soils.

Soils in the LACDA watershed can be generally classified as either mountain or valley. Mountain soils consist of a relatively thin mantle of residual soils, which are coarse, porous, and rocky. The valley soils, classified as recent alluvium and older alluvium, vary from coarse sand and gravel at canyon mouths to silty clay, and clay in the lower areas. The soils underlying the project location fall primarily into Hydrologic Soil Group D (see Plate 3).

5. Vegetation.

Well-developed growths of ponderosa pine, incense cedar, juniper, and oak occur along the summits and in the higher ravines of the mountains. Cottonwoods, box elders, sycamores, oaks, willows, and alders grow along the watercourses at lower mountain elevations. In general, the remainder of the mountains is covered with chaparral, consisting of California lilac, scrub oak, mountain mahogany, sumac, laurel, sage, and manzanita. The chaparral is extremely susceptible to fires during the long, dry summers, and large areas of mountain watersheds are frequently denuded by fire. This causes a dramatic increase in the runoff and debris production potential in these areas. Few areas of native vegetation exist in the highly developed valleys. The pervious areas that remain are mostly landscaped.

6. Structures Affecting Runoff.

Most streams in the valleys and coastal plain are improved, while most mountain streams are natural. Channel improvements have significantly affected runoff: straightening and lining have reduced the amount of flood peak attenuation due to routing and have shortened flood flow travel time. Before manmade improvements, most of the water courses were poorly defined upon leaving the mouths of the mountain canyons. Stream alignments on the alluvial fans and coastal plain shifted with appreciable lateral movement in response to floods. Progressive stabilization has defined many of the present day stream alignments.

The water resources in LACDA are very intensely managed. Numerous multipurpose and special purpose dams and diversion structures, debris basins, channel improvements, and levees exist in the watershed. Leveed areas from the National Levee Database within the ARBOR reach are shown on Plate 4. The functions of major structures include flood control, water supply, water conservation, recreation, and debris control. There is an elaborate stormwater collection system in place that delivers interior runoff to the channels. Flood and debris flows are regulated at existing dams and debris basins. Debris pools exist at several reservoirs in the system.

Seven dams within LACDA are owned and operated by the Corps of Engineers. All were originally authorized as single purpose flood control projects. None have a permanent pool. Of the seven, only Whittier Narrows Dam currently has approved water conservation activities. Hansen, Lopez, and Santa Fe Dams at one time had water conservation activities, but difficulties with excessive reservoir sedimentation, along with funding from local agencies, have caused suspension of the programs. The remainder, Sepulveda, Brea, and Fullerton Dams are strictly flood control and have no water conservation activities. Lopez Dam is relatively small and currently the reservoir is almost filled with sediment. It offers little in the way of peak flow attenuation. Recently, there has been renewed interest in re-evaluating water conservation at several of these dams. There are 15 non-Federal dams within LACDA which are operated by LACDPW. All are multipurpose, most having both water conservation and some flood control functions. Hansen and Sepulveda Dams are operated by the Corps of Engineers and have the biggest impact on flows reaching the project area. Pertinent information for these two dams are listed below.

6.1. Hansen Dam.

Pertinent Information. The Hansen Dam (see Plate 2 for location) drainage area is 151.9 mi^2, and is formed by the San Gabriel Mountains on the north and west, and by the Verdugo Mountains and a secondary range of the San Gabriel Mountains on the south and east. The watershed above Hansen Dam is about 24 miles in length, is irregular in shape, and varies from 5.5 to 9 miles in width. Elevations in the watershed range from about 6,000 ft at the upper edge of the watershed to 980 ft at the dam site. Big Tujunga Creek originates on the southern slope of the San Gabriel Mountains; it flows in a winding course through canyons to the base of the mountains, then joins with Little Tujunga Creek to form Tujunga Wash. Tujunga Wash flows through Hansen Dam, then southward to the Los Angeles River. The Los Angeles River flows into the Pacific Ocean about 38 miles downstream of its confluence with Tujunga Wash.

Hansen Dam was completed in September 1940 as a single purpose flood control structure. It is an earth fill dam, 97 feet high with a top elevation of 1087.0 ft. The spillway is an ogee type with a crest elevation of 1060.0 ft and a net crest length of 284 feet. The outlet works consist of eight 5' x 8' gated conduits, 265 feet in length, with an entrance invert elevation of 990.0 ft and two 8' x 6' uncontrolled conduits, 265 feet in length, with an entrance invert elevation of 1011.0 ft. The capacity of the improved channel downstream is 21,000 ft^3/s. The original allocation for sedimentation at Hansen Dam was estimated at 5,000 af over a period of 50 years. This amount has already been exceeded (10,000 af of sediment had been deposited by 1977) and a revised 50-year sediment allowance of 10,500 af has been determined. Pertinent data for Hansen Dam is shown in Table 1. Hydrologic routing information is presented in Table 2.

6.2. Sepulveda Dam.

Pertinent Information. The Sepulveda Dam (see Plate 2 for location) drainage area is 152.0 mi^2, which is highly urbanized and responds quickly to rainfall. Sepulveda Dam is located across the Los Angeles River, 44 miles above the mouth of the river, and 6 miles above the confluence of Tujunga Wash and the Los Angeles River. The dam is in the south-central portion of the San Fernando Valley, just northwest of the junction of the Ventura Freeway (U.S. Highway 101) and the San Diego Freeway (Interstate Highway 405).

The drainage area boundary on the south is formed by the Santa Monica Mountains; on the west, by the Simi Hills; on the north, by the Santa Susana Mountains; and on the east by a line extending approximately north and south across the valley and generally along the San Diego Freeway.

The headwaters of the Los Angeles River are in the Simi Hills on the west, formed by Chatsworth Creek, Dayton Canyon Wash, Bell Creek, and Arroyo Calabasas. Other major tributaries above Sepulveda Dam include Devil Canyon, Brown's Canyon, Limekiln Canyon, Wilbur, and Aliso Canyon Washes; and Caballero and Bull Creeks. The longest watercourse above the dam is Devil Canyon-Brown's Canyon-Los Angeles River. This watercourse is about 19 miles long with an average slope of 143 ft/mi.

Approximately 85 mi^2 of the watershed above Sepulveda Dam is of relatively steep, mountainous terrain, and about 67 mi^2 is of comparatively flat valley floor. Elevations in the valley vary from 668 feet at the base of the dam to about 1,200 feet at the base of the foothills. The average elevation of the Santa Monica Mountains is about 1,700 feet; that of the Simi Hills is about 1,800 feet; and that of the Santa Susana Mountains is about 2,000 feet. The highest point in the drainage area is San Fernando Peak, in the Santa Susana Mountains, having an elevation of 3,741 feet.

Sepulveda Dam was completed in September 1941 as a single purpose flood control structure. It is an earth fill dam, 57 feet high, with a top elevation of 725.0 ft. The spillway is an ogee type with spillway gates. The elevation with the gates raised is 710.0 ft. The outlet works consist of four 6 ft W x 6.5 ft H ungated outlets, with an invert elevation at 668.0 ft and four 6 ft W x 9 ft H gated outlets, also with an invert elevation of 668.0 ft. The capacity of the improved channel downstream is 17,000 ft^3/s. There is no allocation for sedimentation at Sepulveda Dam. Pertinent data for Sepulveda Dam is shown in Table 3. Hydrologic routing information is presented in Table 4.

7. Runoff Characteristics.

In the mountains, runoff concentrates quickly from the steep slopes; hydrographs show that the stream flow increases rapidly in response to effective rainfall. High rainfall rates,

in combination with the effects of shallow surface soils, impervious bedrock, fan-shaped stream systems, steep gradients, and occasional denudation of the area by fire, result in intense debris-laden floods. However, flood and debris flows are regulated at existing dams and debris basins.

Runoff from urban watersheds is characterized by high flood peaks of short duration that result from high-intensity rainfall on watersheds that have a high percentage of impervious cover. Flood hydrographs from single storm events are typically of less than 12 hours duration and are almost always less than 48 hours duration.

8. Climate.

The climate of LACDA varies considerably with elevation and distance from the coast. The entire region is Mediterranean, with dry summers and mildly wet winters. The coastal zone is subtropical, with cool summers and mild winters. The intermediate valleys and foothills are temperate, with warm summers and mild winters. The climate in the mountains ranges from temperate, with warm summers and cool winters at the resort levels (5,000 - 6,000 ft), to alpine, with cool summers, and cold winters over the highest peaks (9,000 - 10,000 ft).

8.1. Temperature.

In Los Angeles County, the average daily minimum/maximum temperatures range from about 48/64 (degrees Fahrenheit) in winter to 65/75 in summer along the coast. In the intermediate valleys, the range is from about 42/66 in winter to about 62/95 in summer. Over the higher mountains, the respective seasonal values are about 22/40 and 50/70. All-time low/high extremes of temperature are about 26/113 along the coast, 22/118 in the valleys and foothills, 5/105 at mountain resort levels, and -10/85 over the highest peaks. The coastal area does not experience significant frosts, but freezing temperatures are common in the higher mountains from November through March and occur on occasion during the winter in the intermediate valleys.

At the city of Burbank, located near the upstream limit of the ARBOR reach at an elevation of 655 feet above sea level, the average temperature is about 65° F, with extremes of 22° F and 113° F on record. Pertinent daily data and monthly average temperature for the Burbank weather station are shown in Table 5.

8.2. Precipitation.

Precipitation characteristically occurs in the form of rainfall, although in the higher elevations, some falls as snow. In general, the quantity of precipitation increases with elevation. Normal annual precipitation in LACDA ranges from about 12 inches along the coast in Long Beach to more than 44 inches over Mt. Baden-Powell and Mt. San Antonio (Old Baldy) in the East Fork drainage of the San Gabriel River. About 90 percent of the season's total precipitation normally falls

from November through April, with December-March as the wettest months. Extreme monthly precipitation totals in the drainage range from zero at every location to more than 50 inches atop the wettest mountain peaks. As can be seen by these extremes, and as can be computed from NOAA Atlas 14 for any duration up to 24 hours or for any return period (out to well beyond 100 years), the rainfall depth over the higher mountains is considerably greater than the corresponding depth on the coastal plains. The mountain/coastline ratios can be as high as 3 to 1 for durations of 6 hours and as high as 4 to 1 for 24 hours.

The mean seasonal precipitation at the project location is about 17.5 inches. The Burbank weather station recorded a maximum daily precipitation of 7.76 in. in Jan 1943. Nearly all precipitation occurs during the months of November through April. Rainless periods of several months during the summer are common. Pertinent data and monthly average precipitation values for the weather station are shown in Table 6.

Frequency point precipitation estimates for selected frequencies are available from NOAA Atlas 14. Specific estimates for the project location are presented in Table 7. Note: For comparison, the 100-year 24-hour point precipitation for the entire LACDA area from the 1992 LACDA Review Study was 9.78 inches.

8.3. General Winter Storms.

Most precipitation in southern California coastal drainages occurs during the cool season, primarily from November through early April, as mid-latitude cyclones from the north Pacific Ocean occasionally move across the West Coast of the United States to bring precipitation to southern California. Most of these storms are of the general winter type, with hours of light to moderate steady precipitation, but with occasionally heavy showers or thunderstorms embedded. These storms frequently produce significant snow above 6,000 feet, with snow falling below 2,000 feet on rare occasions. Snowmelt can at times contribute to runoff in LACDA streams, but the amount of high-elevation area which receives snowfall is not sufficient to generate large peak flows on the upper San Gabriel or Los Angeles Rivers; snowmelt is not a factor in the low-elevation Rio Hondo drainage.

8.4. Local Thunderstorms.

Local thunderstorms can occur in southern California at any time of the year, but are least common and least intense during the late spring. These types of storms occur fairly frequently in the coastal areas during or just after general winter storms. They can also occur between early July and early October, when desert thunderstorms occasionally drift westward across the mountains into coastal areas, sometimes enhanced by moisture drifting northward from tropical storms off the west coast of Mexico. Local thunderstorms can also occur throughout the fall, as upper-level low-pressure centers sometimes trigger left-over summer

moisture. These local thunderstorms can at times result in very heavy rain for short periods of time over small areas, causing very rapid runoff from small drainages. Some of the smaller watersheds within LACDA are especially vulnerable to this type of storm.

8.5. General Summer Storms

General summer storms in southern California are quite rare; but on occasion a tropical storm from off the west coast of Mexico can drift far enough northward to bring rain, occasionally heavy, to southern California, sometimes with very heavy thunderstorms embedded. The season in which these storms are the most likely to significantly affect southern California is mid-August through early October, although there have been some effects in southern California from tropical storms as early as late June and as late as early November.

On rare occasions, southern California has received light rain from non-tropical general summer storms, some of which have exhibited characteristics of general winter storms.

8.6. Wind.

The prevailing wind in LACDA is the sea breeze. This gentle onshore wind is normally strongest during late spring and summer afternoons, with speeds of 10 to 15 miles per hour. The Santa Ana is a dry desert wind that blows from out of the northeast, most frequently during late fall and winter. It can be especially strong below mountain canyons, with peak gusts to more than 80 miles per hour at times. This type of wind can create very high fire hazards, but can also be instrumental in drying a saturated watershed, thus reducing the flood potential.

Rainstorm-related winds are the next most common type in southern California. Winds from the southeast ahead of an approaching storm average 20-30 mph, with occasional gusts to more than 40 mph. West to northwest winds behind storms can sometimes exceed 35 mph, with higher gusts.

9. Climate Change.

Climate change is a global-scale concern, but can be particularly important in the western United States where potential impacts on water resources can be significant to supplies for water agencies. The city of Los Angeles Department of Water and Power (LADWP) is considering impacts of climate change during development of its long-term water supply plan. LADWP prepared a report entitled "Draft 2010 Urban Water Management Plan" in January 2011. Chapter 12 of the report presents a discussion of the impact of climate change to the LADWP service area.

Scientists predict future climate change scenarios using highly complex computer global climate models to simulate climate systems. Although most of the scientific community

agrees that climate change is occurring and, as a result, mean temperatures for the planet will increase, the specific degree of this temperature increase cannot be accurately predicted. Predictions of changes in precipitation are even more speculative, with some scenarios showing precipitation increasing in the future and others showing the opposite, although the general consensus for climate change in the project area is that the region will experience longer droughts intermixed with less frequent but larger floods. Because there are only speculative precipitation changes estimated and no specific increases or decreases in precipitation or flood events available, no adjustments due to climate change were made to Future Condition discharges for this analysis. The project area is located far enough upstream that potential sea level changes are not a factor; thus no changes were made for downstream boundary conditions in the hydraulic models. Qualitative consideration of possible effects of climate change on water availability and larger flood events are described further in Section 7.1.12 of the IFR.

10. Water Budget.

The water budget characterizes the current conditions along the ARBOR reach of the Los Angeles River and provides comparison to each of the four alternatives. The methodology is consistent with the guidance presented in "The Guide Manual for Preparation of Water Balances," RD-16, U.S. Army Corps of Engineers, Hydrologic Engineering Center, dated April 1983. It is a systematic presentation of the data and use of water for specific periods of time. The pertinent factors presented in the guidance are included and both an annual and a seasonal period were analyzed. Water budget parameters were applied in a water budget analysis in order to confirm the long-term and seasonal availability of water to restore and sustain the vegetation and open water areas.

The water budget was calculated by determining the volume of water available from the sources and comparing to the water demands. The water sources include surface water and precipitation. The water demands include infiltration, evaporation, and evapotranspiration. Groundwater, although very important, was not included at this time so a conservative estimate of the water sources and demands could be assessed.

As part of the CHAP analysis described in the environmental sections of this report, the existing habitat areas within the ARBOR reach were delineated using GIS. Separate polygons were drawn for each habitat type including impervious areas, open areas, marsh/wetland areas, and areas for other types of vegetation. Proposed habitat features for each of the alternatives were then delineated using GIS. All polygons were assigned a value based on habitat type. The water demand of vegetation varies depending on the individual and combination of plant species within a habitat unit. Readily available information was used to determine average vegetation intake volumes. The water demand volumes were summed by type and by reach and then accumulated for all eight reaches. The total water source volumes were then compared against the total water demand volumes for each alternative.

For those features of the alternatives that have a direct connection to the Los Angeles River, there is enough flow in the Los Angeles River even during low flow periods, to support the proposed vegetation. For those features that derive their water source from local runoff and precipitation, the type, size, and density of vegetation will be driven by frequency, size, and duration of storms and excess urban runoff that enters the storm drain system from other sources. The LATC parcel, being the largest single parcel included in the alternatives, was subsequently evaluated separately since Alternatives 10 and 13 do not provide a direct hydrologic connection to the Los Angeles River. For Alternatives 10 and 13, precipitation by itself, will not support the proposed vegetated areas; there must be a connection to an adjacent storm drain to redirect storm flow through the LATC area. The direct connection to the river for Alternative 16 and 20 provides more than enough water to support the proposed vegetation. The water budgets for the selected alternatives are presented in Table 8.

10.1. Streamflow.

Streamflow in the Los Angeles River at the project location is perennial due to upstream urban runoff and treatment plant releases. During storm events, runoff concentrates quickly from the steep slopes in the mountains and rushes through the improved Los Angeles River channel. Flood hydrographs from single storm events are typically of less than 12-hours duration and are almost always less than 48-hours duration. High rainfall rates, in combination with the effects of shallow surface soils, impervious bedrock, fan-shaped stream systems, steep gradients, and occasional denudation of the area by fire, result in intense debris-laden floods. However, flood and debris flows are regulated at existing dams and debris basins. The downstream area is almost entirely developed and relatively little sediment enters the channel downstream from the dams aside from the fine material carried in suspension. At the project location, a large portion of the contributing drainage lies downstream from dams.

10.2. Stream Gages.

There are four stream gages located along the Los Angeles River. These gages used to be maintained by the USGS but are now under the operation of LACDPW. There is also a gage just downstream from Sepulveda Dam that measures outflow from the dam. The Los Angeles River gages from upstream to downstream are:

Los Angeles River at Tujunga Ave., Station no. F300-R (1950-present)
Los Angeles River above Arroyo Seco, Station no. F57C-R (1929-present)
Los Angeles River below Firestone Blvd., Station no. F34D-R (1928-present)
Los Angeles River below Wardlow Rd., Station no. F319 (1931-present)

The Los Angeles River above Arroyo Seco stream gage is closest to the project location and best represents the flow conditions for the project. The gage is located 800 feet above the confluence with the Arroyo Seco. The location has

changed 3 times during period of record with no significant impact on recorded flows. The drainage area at the gage is 511 mi^2. The period of record is from 1929 to present. Flow is partially regulated by Sepulveda, Pacoima, Big Tujunga, and Hansen Dams. Flow data for this stream gage is presented in Table 9.

For the period of record, the average annual daily flow at this location is 164 ft^3/s. During the summer months the average daily flow is 61 ft^3/s, but can be less than 10 and has been as low as 1-2 ft^3/s during some summer months. Subsequent to the Donald C. Tillman Water Reclamation Plant (WRP) coming online in 1985, the average daily flow at the project area has increased to 291 ft^3/s annually and 134 ft^3/s during the non-flood season.

Graphs of average daily flows for stream gages F300-R, F57C-R, and F34D-R are shown on Plates 5 to 7.

10.3. Local Runoff

The drainage area of the Los Angeles River at the upstream end of the project location is about 465 mi^2. At the downstream end, the drainage area of the Los Angeles River is approximately 580 mi^2. The total controlled drainage area for Hansen and Sepulveda dams is 304 mi^2. Therefore, there is about 276 mi^2 of uncontrolled area contributing flow to the project location (about half). Surface runoff from uncontrolled area enters the local drainage system and flows at relatively high velocities towards the Los Angeles River. The local storm drain system is operated and maintained primarily by LACDPW and some individual cities and is very efficient.

10.4. Recycled Water.

The Bureau of Sanitation under the City of Los Angeles Department of Public Works operates the Donald C. Tillman WRP located in the Sepulveda Flood Control Reservoir in Van Nuys, California. After leaving homes and businesses, most San Fernando Valley wastewater travels along some of the sanitation system's 6,400 miles of sewers on its way to the Donald C. Tillman WRP. The plant carries out tertiary treatment on much of the liquid sewage and sends the solid as a slurry to Hyperion Treatment Plant near Dockweiler Beach. After approximately 11 hours of treatment at the Tillman WRP, the water is ready to be reused. This water is used to fill Lake Balboa, water a golf course and Japanese gardens, and used by a company to grow lawns; excess water is released through Sepulveda Dam down the Los Angeles River. Before completion of Lake Balboa, most of the treated wastewater ended up flowing down the Los Angeles River to the harbor. The plant, which opened in 1985, operates around the clock and processes 65 million to 70 million gallons of raw sewage daily.

10.5. Imported Water.

There is currently no imported water passing the project site. There is a turnout located on Tujunga Wash that may potentially be used to offset or supplement Los Angeles River flows at the project location.

10.6. Precipitation.

General precipitation for the project location is summarized above in the Climate section. The mean seasonal precipitation at the project location is about 17.5 inches as recorded at the Burbank weather station.

10.7. Infiltration.

The infiltration capacity is the maximum or potential rate at which water can enter the soil at any point in time. Water losses due to infiltration can be a significant factor in the water budget, especially if ponded areas are to be included in the proposed project. Normally, you can expect channel infiltration to be about 0.3 – 2.0 feet per day in Southern California streams. These values were estimated during previous studies and are based on infiltration volumes from previous reports, measuring the stream widths and lengths, and calculating the rates. If the soil is not saturated, moisture will infiltrate into the ground at a rate controlled by the soil texture, vegetal cover, and degree of saturation. Infiltration rates are variable with time. Rates are highest when the soil is dry and lower after it is wetted. Infiltration rates decrease with time during a rainstorm and finally assume a uniform and minimum value. A large amount of rainfall on silt or clay surface will usually have limited infiltration. The presence of organic matter (loam) and vegetation will generally increase infiltration.

Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D, where group A generally has the highest infiltration rate and smallest runoff potential while group D has the lowest infiltration rate and greatest runoff potential. Details of this classification can be found in ‘Urban Hydrology for Small Watersheds’ published by the Engineering Division of the Natural Resource Conservation Service, United States Department of Agriculture, Technical Release 55 (TR-55).

Group A is sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.

Group B is silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

Group C soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.

Group D soils are clay loam, silty clay loam, sandy clay, silty clay or clay. This HSG has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

The soils underlying the project location fall primarily into Hydrologic Soil Group D (see Plate 3). The minimum infiltration rates for Hydrologic Soil Group D are shown in Table 10. For the project site, an average infiltration loss of 0.3 feet per day was used in the water budget.

10.8. Evaporation.

Evaporation, as used here, represents that portion of the water balance that evaporates from open water sources. Few formal studies of evaporation have been made in Los Angeles County; and, since most Corps of Engineers reservoirs are normally dry, with impoundments generally lasting only a few hours to a few days, evaporation is not typically measured. Studies from around the area indicate that mean daily evaporation ranges from about one-quarter inch in winter to more than one-half inch in summer. On days of very strong, dry Santa Ana winds, evaporation can be considerably greater than one inch.

For alternatives that incorporate ponding of water, evaporation may be an important factor. Evaporation rates were obtained in previous studies for nearby reservoirs, lakes, and spreading grounds in the region where measurements have been taken. Calculations for evaporation were made by LACDPW for the 2011 water year and published in their 2010-2011 Hydrologic Report**.** The average monthly evaporation rates for the Los Angeles area are shown in Table 11. As shown in the table, the rates are more significant during the non-flood season than during the flood season. Descanso Gardens are located closest to the project location. The average annual evaporation rate of 2.31 feet per year was used for this study.

10.9. Evapotranspiration.

The water demand of vegetation varies depending on the individual and combination of plant species within a habitat unit. The Department of Water Resources for California (CADWR) provides evapotranspiration data through the California Irrigation Management Information System (CIMIS; http://wwwcimis.water.ca.gov/). Reference evapotranspiration (ETo) is a term used to describe the evapotranspiration rate of a reference crop expressed in

inches. The reference crop used for the CIMIS program is grass, which is closely clipped, actively growing, completely shading the soil, and well watered. ETo varies by location, time, and weather conditions. The main factors that influence ETo include incoming radiation (energy from the sun), outgoing radiation (sensible energy leaving the earth), and the amount of moisture in the air, air temperature, and wind speed. ETo can be estimated quite accurately through the use of a “model” (a series of complex mathematical equations). Evapotranspiration rates were computed using the Glendale, Los Angeles Basin dataset as shown in Table 12.

The Corps of Engineers previously undertook a study for the Rio Salado (Salt River) in Arizona. During that study, the State Arizona Game and Fish Department provide plant consumption values for riparian vegetation. These estimates can be used for planning purposes to develop the final water budget for the proposed project. The original data sources are listed in Table 13.

For the project site, average evapotranspiration rates for Sycamores of 3.6 feet per year, for Valley Oak Woodland of 5.0 feet per year, and for Cottonwood-Willow of 8 feet per year were used.

11. Existing Conditions Discharges.

The Corps of Engineers, Los Angeles District completed a hydrologic analysis of the entire Los Angeles River watershed as part of the Los Angeles County Drainage Area (LACDA) Feasibility Study. A report was published in 1992 and included detailed Hydrology and Hydraulics Appendices. Hydrologic models were set up using the HEC-1 and HEC-5 computer programs.

Frequency discharges were adopted from the 1992 LACDA Review Study. As noted in that report and in the Future Conditions Hydrology section below, the Los Angeles River drainage area is essentially “built-out”; thus discharges from that report are still applicable. Frequency discharges at selected locations, including main tributaries, are included in Table 14. The design discharges are also included in Table 14.

12. Future Conditions Discharges.

The discharges presented in Table 14 are applicable for Future Conditions. Most new development occurring within the city limits is re-development. The few remaining developable properties are small and far enough away as to have an insignificant impact on mainstem flows (low flows or high flows). The undeveloped areas outside the city limits, but within the drainage area, are primarily public lands consisting of national forest and state or local parks. These areas will not be developed.

As presented in the 1992 LACDA Review Study, the impact of expected future development was addressed by estimating the likely urbanization and the associated increase in impervious area, and second, by determining the change in system runoff

attributed to that development. Future condition discharges were computed in an identical manner to present condition discharges, using estimated future impervious cover in determining subarea hydrographs. Future condition effective impervious cover was determined for all areas from land use planning maps for the year 2030 and then converting the total impervious cover using the relationship developed between total and effective impervious cover. The discharge-frequency determinations made for future conditions in the 1992 LACDA Review Study indicated no appreciable increase in peak runoff through the major reaches including the mainstem of the Los Angeles River.

13. LACDA Design Storm.

In general, the LACDA system was designed on a component basis (a flood control dam with an accompanying downstream channel) using 50-year frequency rainfall in older portions of the upper Los Angeles River, and a Standard Project Storm (SPS) based on the January 1943 SPS for San Gabriel components, including the Rio Hondo Diversion Channel and lower Los Angeles River. The rainfall depths from the SPS centered over the watershed are very similar to 24-hour, 50-year frequency rainfall determined during the 1992 LACDA Review Study. No evaluation of discharge-frequency was made during those early design phases because of short streamflow records upon which to base a statistical analysis and confidence that a high degree of protection would result from using the frequency-based design storm concept. The objective was to produce a Standard Project Flood (SPF; a large flood, one that is the largest event reasonably characteristic of the drainage area). However, the rainfall from the SPS, as indicated above, was not severe enough when measured during the 1992 hydrologic frequency analysis of the resulting runoff based on today's development. Design discharges for the Los Angeles River and Tujunga Wash within the project extent are shown on Plate 8. Velocities associated with the design discharges are shown on Plate 9.

14. Channel Hydraulics.

The main channel of the Los Angeles River is approximately 51 miles long and its tributaries have an aggregate length of about 225 miles. Most of the runoff from precipitation originates in the San Gabriel Mountains. The river flows through industrial and commercial areas and is bordered by railyards, freeways, and major commercial, industrial, and government buildings. The Los Angeles River, which once flowed freely over the coastal plain, was channelized between 1914 and 1970 to control the runoff and reduce the impacts of major flood events in the region. Construction on the stretch of the Los Angeles River within the ARBOR reach was started in the late 1930s and completed in the mid 1950s. The Corps of Engineers is responsible for operations and maintenance within the ARBOR reach. Today, the Los Angeles River is lined for most of its length. There are several stretches where the channel invert is not lined with concrete reinforcement: within the Sepulveda Flood Control Basin, through the Glendale Narrows, and south of Willow Street in Long Beach.

The Corps of Engineers, Los Angeles District completed a review of the entire LACDA system and published a Feasibility Report in 1992. Included with this was a Hydraulics Appendix (dated Dec. 1991) which documented the hydraulic analyses which were performed in support of the LACDA Review Study. The analyses included with- and without-project overflow analyses, preliminary alternative formulation and design, analyses to support the selection of the NED plan, and the final feasibility level design of the project. The HEC-2 computer program was used to calculate the water surface elevations under steady flow conditions for the channels and overbank areas. Cross sections were generated using 1:24,000 scale USGS quad maps.[1]

Essentially all of the upper Los Angeles River and most of Tujunga Wash have contiguous overflow conditions. For these watercourses, when flows exceed the channel capacity, flooding is confined relatively close to the channel by fairly narrow floodplains with significant cross slope back towards the channel, resulting in a water surface elevation that can be assumed constant across the channel and both overbanks.

The proposed project (now completed) from the 1992 LACDA study consisted of improvements to the lower Los Angeles River and the Rio Hondo Diversion Channel. These improvements do not impact the flood protection along the Los Angeles River within the current ARBOR ecosystem project extents; the ecosystem project limits are upstream from the LACDA improvements. It is important to note there are several locations within the ARBOR reach where the probability of flows breaking out from the channel within the ecosystem project area is greater than 1% in any given year (equivalent to the 100-yr flood), i.e., the channel has less than 100-yr level of protection in some locations.

There are two main stretches of the Los Angeles River within the ARBOR reach that do not have concrete inverts. These locations are shown on Plate 10 (they are interrupted briefly with concrete sections under some of the bridges). The two main sections without concrete inverts have mostly grouted riprap side slopes with some grouted rock paving and some concrete slab side walls. There are several rock stabilizers within the channel and along the outside curves of the channel, but the integrity of these structures is unknown since they are covered with a significant amount of vegetation.

15. Hydraulic Modeling.

Subsequent to the 1992 LACDA Review Study, the Corps of Engineers, Los Angeles District generated design models using HEC-RAS and prepared a report in July 2005 to present the updated hydraulic analyses. This report is referred to as the Stormwater Management Plan (SWMP). The 2005 LACDA Upper Los Angeles River HEC-RAS Hydraulic Models used as-built construction plans to develop the HEC-RAS model geometry. The geometries for these models only covered the channel area. An initial

[1] These cross sections were not used in the current HEC-RAS modeling, which is described in detail below in Section 15.

attempt at georeferencing the models was made at that time. The effort was to create HEC-RAS models for the channels and determine the water surface elevations for the design discharges. These are referred to in this report as the Design Conditions models. In addition, the 2005 report establishes the regulatory water surface elevations that are used as the basis against which all hydraulic impacts to the Upper Los Angeles River and Tujunga Wash are evaluated. These models include the Los Angeles River ARBOR reach.

In 2008, as part of an initial phase of the ecosystem restoration study, the Corps of Engineers used updated geospatial techniques and re-georeferenced a portion of the design models within the City of Los Angeles limits. The cross sections were extended to cover a portion of the overbank area which ultimately covered the 0.2% ACE event (500-yr) floodplain.

This study encompasses the development of hydraulic models for the portion of the Upper Los Angeles River called the ARBOR reach. The hydraulic models encompass the reach from Barham Blvd. to First St., as well as the downstream reaches of Burbank Western Channel, Verdugo Wash, and the Arroyo Seco.

For the current analyses, the first step in the hydraulic modeling was to generate models and floodplains for the Design Conditions and the Existing Conditions to understand the impact of the vegetation within the channel. This required two different model geometries; for the Design Conditions and the Existing Conditions (which includes vegetation). Both were analyzed under a steady, mixed flow regime. The Existing Conditions geometric data only varied from the Design Conditions geometry within the channel. This was due to increased roughness from vegetation growth in "soft" bottom stretches along the Los Angeles River as well the channel invert conditions based on the 2005 survey described below.

15.1. Mapping.

The Los Angeles District Corps of Engineers, through contract services, developed digital terrain models (DTMs and TINs) and ortho-rectified photographs for the project area are based on a 2005 aerial survey flight. The 2005 survey is based on the 1983 NAD horizontal datum, State Plane Zone 5 for California; units are in feet. Elevations are also in feet and based on the 1988 NAVD. The scale of the survey data was 1" = 200' with a 2-foot contour interval.

The hydraulic models are based on topographic data obtained from the 2005 survey by the COE supplemented with 2008 topographic data based on LiDAR from the City of Los Angeles. The City of Los Angeles' 2008 data was of similar accuracy and resolution. The additional 2008 data was required to cover the floodplain for the 0.2% ACE event.

15.2. Numeric Models.

The U.S. Army Corps of Engineers Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 4.2 beta was used for the hydraulic modeling. The current HEC-RAS version, 4.2 beta, allows the user to perform one-dimensional steady and unsteady flow river hydraulics calculations to determine water surface profiles and velocities. The system is comprised of graphical user interface (GUI), separate hydraulic analysis components, data storage and management capabilities as well as graphic output capabilities.

HEC-GeoRAS, is an ArcGIS v. 10 extension that provides the user with a set of procedures, tools, and utilities for the preparation of GIS data for import into the HEC-RAS and generation of GIS data from RAS output. The user can also export HEC-RAS results back to ArcGIS using HECGeoRAS to develop spatial datasets of the results.

15.3. River Stationing.

The Los Angeles River Channel was constructed in non-contiguous sections at different periods in time. As a result, river stations (RS) were not consecutive from Pacific Ocean all the way to the upstream end of the Los Angeles River channel. During development of the 2005 SWMP design models, the LACDA project was broken into separate sections and river stations were assigned to closely match the design as-builts drawings. In 2008, an attempt was made to update the stationing, but the models still broke the channel into three sections (there were still some computer memory limitations working with such large terrain files) within the City of Los Angeles limits and carried over the inconsistent river stationing from the earlier models.

The 2008 HEC-RAS model entitled 'Reach 1' detailed the portion of the Los Angeles River from 250 feet upstream of the Glendale Freeway at RS 1420+55.6 to just downstream of 26th St. at RS 1026+39.5. RS 1420+55.6 indicates that it is located 142055.6 feet above the outlet. For this reach of the Los Angeles River the 2008 model river stations match the 2005 models and correspond to the pertinent data tables.

The 2008 HEC-RAS model entitled 'Reach 2' extends from 607.06 feet downstream of Fletcher Dr. at RS 00+00 to Sepulveda Dam. RS 00+00 is the point where the 'Reach 1' model ends and the 'Reach 2' model begins. At this point, the river stationing no longer matches the 2005 SWMP models or the pertinent data tables.

The ARBOR reach of the Los Angeles River includes a portion of 'Reach 1' and a portion of "Reach 2'. These portions were extracted from the 2008 models and combined to form models covering the ARBOR reach. To update the models, river stations were initially copied from the 2008 HEC-RAS models. The 2008

models could not be used for this feasibility study because the cross sections did not extend far enough to capture the terrain required to cover the 0.2% ACE floodplain. The two different digital terrain models did not match up at their intersection because of the different level of detail and the different methods used to develop the surfaces. Therefore, cross sections could not be cut from the two surfaces and a work-around was developed to incorporate cross section information from both surveys. However, it was ideal to initially use the same river station locations as the 2008 models so the bridge and cross section data could be copied to the current ARBOR HEC-RAS model.

River stations for the ARBOR models were developed independently of the 2005 and the 2008 models. It was decided that the ARBOR reach river stations would be numbered according to cumulative stream length within the project area. RS 692+94 upstream of Barham Blvd. is the upstream cross section and RS 10+31 at First St. is the downstream cross section. Interpolated cross sections were added where needed to remove instabilities in the hydraulic calculations. The ARBOR project reaches are shown on Plate 11.The river stations corresponding to the ARBOR study reaches are as follows:

Reach 1: Pollywog Park/Headworks (RS 625+77)) to midpoint of Bette Davis Park (RS 547+45). See Plate 12.

Reach 2: Midpoint of Bette Davis Park (RS 546+45) to upstream edge of Ferraro Fields (RS 510+05). See Plate 13.

Reach 3: Ferraro Fields (RS 504+93) to Brazil Street (RS 452+58). See Plate 14.

Reach 4: Brazil Street (RS 432+16) to Los Feliz Boulevard (RS 359+75). See Plate 15.

Reach 5: Los Feliz Boulevard (RS 358+63) to Glendale (2) Freeway (RS 271+89). See Plate 16.

Reach 6: Glendale (2) Freeway (RS 270+28) to I-5 Freeway (RS 144+23). See Plate 17.

Reach 7: I-5 Freeway (RS 142+91) to Main Street (RS 86+81). See Plate 18.

Reach 8: Main Street (RS 86+07) to 1st Street (RS 10+31). See Plate 19.

15.4. Model Reach Assignments.

The feasibility study ARBOR reach is approximately 11 miles in length, however the hydraulic models cover a distance of about 13 miles along the Los Angeles

River to ensure smooth numeric transition into and out of the ARBOR reach. The models are divided into hydraulic reaches 1, 2, 3, and 4 according to the location of confluences with Burbank Western, Verdugo Wash, and the Arroyo Seco. These reach designations are for HEC-RAS model purposes only and do not correspond to the eight ARBOR study reaches. Model reach 4 is at the upstream end of the study area and reach 1 is at the downstream end of the study area. Burbank Western, Verdugo Wash, and Arroyo Seco are included as tributaries in the models.

15.5. Manning's N-Values.

15.5.1. Design Conditions Model.

The Manning's n-values for the main channel in the Design Conditions model were derived from the pertinent data tables for the Los Angeles River. The concrete portions of the channel were assigned a Manning's roughness coefficient of 0.014 (per the original design). The Manning's roughness coefficient for the soft bottom, grouted riprap side slope reaches was 0.03 (combined single n-value for the channel). There is a short reach with grouted riprap sides and concrete bottom where the channel n-value is 0.02. The Manning's n-values for the left and right overbanks in the Design Conditions models were set at 0.04 along the entire ARBOR reach. This value was estimated based on the topographic mapping, aerial photos and field reconnaissance. The overbanks of the Los Angeles River in the ARBOR reach are primarily urban, highly impervious areas and have dramatically varying horizontal n-values so it was ideal to simplify and group the n-values into a single value for the left- and right- overbank. The focus of the study was to ensure there is no increase in flood risk; i.e., no increase in water surface elevation. If the WSE for the with-project condition was greater than that for the existing condition then that restoration scenario was removed from further consideration. Therefore, the choice of Manning's n-value for the overbank is not important and does not affect the choice of the NER Plan and Recommended Plan.

15.5.2. Existing Conditions Model.

The Existing Conditions models use horizontally varying K values across the main channel. The geometry for these models were developed during a hydraulic analysis for Operations and Maintenance and documented in a memorandum entitled "Vegetation Clearing in Los Angeles River – Burbank Western Channel to Arroyo Seco", for COE Operations Branch, dated 17 March 2004. The hydraulic model was verified using high-water marks from a real-time event. The Existing Conditions models utilize the 2004 vegetation geometry as a reference for K values within the soft-

bottom portions of the channel. The vegetation model had K values for the channel portion, but not the overbanks.

As noted above, the Design Conditions models used an overbank Manning's n-value of 0.040 along the entire span of the ARBOR reach. The n-value of 0.040 was converted into a K value for a sample of cross-sections along the LA River by manipulating Manning's Equation for roughness.[2] The conversion yielded K values that ranged from approximately 1.5 to 2.5. A sensitivity analysis was performed using the Existing Conditions model where overbank K values of 1.5 and 2.5 were used. A 100-yr floodplain was created for the 1.5 value and then compared to a 100-yr floodplain generated for an overbank K value of 2.5. It was concluded that there was very little difference between the floodplains delimited for the two K values (only at RS 515+13, RS 388+25, and RS 418+25), so an average K value of 2.0 for the overbanks was selected.

15.6. Bridges.

All input parameters for bridges and culverts were based on the 2008 models. The parameters were determined from plan and profile drawings as well as from field measurements. See Table 15 for a list of the bridges, by reach, which cross the Los Angeles River within the ARBOR reach. Two feet of floating debris was added to each side of all piers that measure 6 feet or less in width (transverse direction). For piers with sloping noses, the debris depth was set to 6 feet below the water surface elevation. Floating debris was not added to piers greater than 6 feet in width. This complies with Hydrology & Hydraulics Policy Memorandum No. 4, dated August 2004. This practice is based on experience from past floods and physical model studies that indicate sloping pier extensions in high velocity flows are quite effective in moving debris up the slope out of the water and thereby preventing significant debris accumulation.

The bridge modeling approach for bridges without piers was set to the Energy Only (Standard Step) computational method. For bridges with piers, the highest energy solution between: (Energy Only (Standard Step), (2) Momentum, and (3) Yarnell (Class A only) was selected. Bridge locations are shown on the invert profiles presented on Plates 20 a & b.

15.7. Boundary Conditions.

Boundary conditions are necessary to establish the starting water surface at the ends of the river system (upstream and downstream). Table 16 summarizes the

[2] Manning's n values were converted to equivalent absolute roughness K values since K remains relatively constant with changing hydraulic radius (R) while n varies with the one-sixth power of R. Therefore, it was preferred to extrapolate from known conditions to unknown by the use of K rather than n.

boundary conditions (starting water surface at upstream and downstream ends of the river reach) for the ARBOR reach. On both the upstream and downstream ends of the ARBOR reach, known water surface elevations with associated flows were used as boundary conditions. Numerous side drains enter the Los Angeles River within the ARBOR reach. Detailed design for side drains will be provided in the design phase. Pertinent data for all drains will be included at that time. Water surface elevations in the Los Angeles River may impact storm drain hydraulics.

15.8. Flow Regime.

The project reach has mixed flow regimes wherein the concrete lined segments tend to flow supercritical and the segments with cobble bed inverts and vegetation tend to flow subcritical. The HEC-RAS output, which was used to define the flood profiles and the overflow boundaries, reflects a mixed flow regime with both supercritical and subcritical flow. The existing conditions models include the current vegetation. The design channel models do not include any vegetation. Localized hydraulic jumps, where the water surface elevation passed through critical depth, occurred within the model, typically upstream of bridges. At these locations additional freeboard was included in the original design of the project. Water surface undulations are accounted for with additional freeboard.

15.9. Flow Data.

Since the vegetation analysis described in the 2004 memorandum identified flows with an ACE of 10% or greater exceeding the channel capacity under Existing Conditions, the HEC-RAS models were set up to include discharges for the 10%, 4%, 2%, 1%, 0.5%, and 0.2% ACE events. These correspond to events from the 10-yr up to the 500-yr frequency. Discharges for the HEC-RAS models are included in Table 14.

16. Adequacy of the Hydraulic Models.

In applying the HEC-RAS numeric models, the flow is in a one-dimensional, uniform, steady state. The one-dimensional assumption is applicable for Without-Project Conditions since during high flows most of the flow travels downstream along the channel, allowing the model to analyze the flow in one direction. The uniform flow assumption is reasonable since in most instances flow is gradually changing. Steady flow assumes the change in depth is constant as a function of time.

Preliminary analyses of the alternatives using the one-dimensional HEC-RAS models to determine relative impacts and feasibility of a TSP was also determined to be justifiable. However, detailed numeric model evaluation of the TSP will require two-dimensional, and possibly, an unsteady flow model to more accurately simulate the proposed alterations in and adjacent to the channel. This can be done during a later phase of this study. For areas with significant modifications, physical modeling approach is highly recommended.

17. Floodplain Analyses.

Inundation maps were generated for the 4%, 2%, 1%, and 0.2% ACE events for both Existing and Design Conditions. The model results were exported from HEC-RAS into ESRI's ArcMap to automate the process of delineating the inundation boundaries using HEC-GeoRAS. The resulting inundation boundaries were then inspected and edited to remove spurious polygons and to ensure that all polygons contained other polygons with more frequent return periods. Floodplain delineations for Design and Existing Conditions are shown on Plates 21 a & b to 24 a & b. The Existing Conditions 100-year floodplain has two major breakout areas within the ARBOR reach. These correspond to the vegetated reaches of the Los Angeles River. The upstream area with extensive overbank flooding is between Barham Blvd. 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.
The 100-yr and 500-yr floodplains from the 1992 LACDA Review Study are shown on Plate 25 for comparison. The most noticeable difference is the large inundation area that has been removed in the current 1% ACE event (100-yr) in the downtown area from North Broadway to 1st St. The hydraulic model results were closely scrutinized and it was determined the volume and duration for flow exceeding the channel capacity was not sufficient to generate the relatively large inundation areas. The flow exceeding channel capacity was determined to cause street flooding close to the channel and be non-damaging. It should also be obvious the areas impacted due to vegetation within the channel. The current FEMA flood maps by contrast, show that all flow for the 100-yr event stays within the channel through the project reach. Portions of the FEMA maps have not been updated since the early 1980's and were determined to not represent current conditions.

18. With-Project Conditions.

The CE/ICA process documented in the Main Report and Economics Appendix utilized environmental and preliminary cost information to identify the top four alternatives for further analysis. The features in the alternatives were developed by a multidisciplinary team with consideration for riparian, floodplain, and fisheries values and needs. The four selected alternatives are identified as comprehensive alternatives 10, 13, 16, and 20 and denoted as such in this appendix. HEC-RAS was used to evaluate flood conveyance and flow velocities to confirm there would be no adverse flood impacts associated with the alternatives and determine which reaches were within target velocities for vegetation planting and in which reaches supplemental bank protection may be needed. The Combined Habitat Assessment Protocol (CHAP) was used to evaluate habitat impacts and benefits instead of a model such as HEC-EFM. The HEC-EFM model was not used because the proposed features will not have an effect on the overall flow regime, which is the focus of that model. CHAP was a better method for evaluation of habitat benefits. The use of CHAP is further described in IFR Section 4.9 and Appendix G.

18.1. Alternative Descriptions. These alternatives are described in detail in the Main Report, but are summarized as they pertain to the hydraulic modeling process below. Where a reach plan description states, “There are no modifications to the hydraulic models within this reach,” it indicates that there are no physical reconfigurations of the channel for that reach plan. Adjustments in the model were made for each alternative as described in Section 18.2 below.

Alternative 10.

Reach 1 - Restore riparian habitat corridors outside of the channel along the tops of both banks. There are no modifications to the hydraulic models within this reach.

Reach 2 - Restore riparian habitat corridors outside of the channel along the top of both banks. There are no modifications to the hydraulic models within this reach.

Reach 3 - Daylight large storm drain just downstream of Ferraro Fields on right bank in the Zoo Drive Area; freshwater marsh will be located in the daylighted area outside of the channel. Daylight two small storm drains on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance.

Reach 4 - Restore riparian habitat corridor outside of the channel along the top of left bank. Implement a side channel along right bank. Daylight one storm drain on right bank. Daylight six storm drains on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance.

Reach 5 - Restore riparian habitat corridor outside of the channel along the top of left bank. Daylight one storm drain on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance.

Reach 6 - Restore riparian habitat corridor outside of the channel along the top of left bank. Include a small terraced area along the left bank with vegetation from RS 261+80 to RS 256+00. The Los Angeles River channel is re-configured to take advantage of the Taylor Yard 'bowtie' parcel. At RS 243+17, the channel invert starts to widen into the left bank. The invert width increases to more than 100 feet before it contracts back to the original channel size at RS 201+76. The eastern edge of the widened invert is sloped back up at a 4:1 slope to the original ground elevation. Restore riparian habitat along the sloped channel wall of the widened channel.

Reach 7 - Daylight two storm drains on right bank. Daylight one storm drain on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance.

Reach 8 - Restore riparian habitat at LATC outside of the channel. There are no modifications to the hydraulic models within this reach.

Alternative 13.

Reach 1 - Restore riparian habitat corridors outside of the channel along the top of both banks. There are no modifications to the hydraulic models within this reach.

Reach 2 - Restore riparian habitat corridors outside of the channel along the top of both banks. There are no modifications to the hydraulic models within this reach.

Reach 3 - Restore riparian habitat corridors outside of the channel along the top of right bank. Implements a side channel along the right bank behind Ferraro Fields. Connect side channel to daylighted storm drain just downstream of Ferraro Fields on the right bank in the Zoo Drive Area; freshwater marsh will be located in the daylighted area outside of the channel. Daylight three small storm drains on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance. Water sources for the side channel will be determined and evaluated during the design phase.

Reach 4 - Restore riparian habitat corridor outside of the channel along the top of left bank. Implement a side channel along right bank. Daylight one storm drain on right bank. Daylight six storm drains on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance. Water sources for the side channel are evaluated separately.

Reach 5 - Restore riparian habitat corridor outside of the channel along the top of left bank. Daylight one storm drain on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance.

Reach 6 - Allow vegetation on right channel wall through entire reach. Allow vegetation on left channel wall from RS 270+28 to RS 262+72 and from RS 191+61 to RS 144+23. The Manning's roughness coefficients in the hydraulic models were adjusted to account for vegetation on the walls within the channel. Include a small area of widening up to 150 feet to accommodate in-channel geomorphology and vegetation along the left bank from RS 265+38 to RS

251+78. The Los Angeles River channel is re-configured to take advantage of the Taylor Yard 'bowtie' parcel. At RS 243+17, the channel invert starts to widen into the left bank. The invert width increases to more than 620 feet before it contracts back to the original channel size at RS 201+76. 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. Restore riparian habitat along the sloped channel wall of the widened channel.

Reach 7 - Allow vegetation on channel wall along right bank through entire reach and on left bank from RS 128+71 to downstream end of reach. Restore riparian habitat outside of the channel at the Arroyo Seco confluence along the top of both banks. The hydraulic model channel geometry was not changed, but the Manning's roughness coefficients were adjusted to account for vegetation on the walls within the channel. Restore riparian habitat along the Arroyo Seco Channel by removing concrete and re-configuring the channel cross section.

Reach 8 - Restore riparian habitat at LATC outside of the channel. There are no modifications to the hydraulic models within this reach.

Alternative 16.

Reach 1 - Restore riparian habitat corridors outside of the channel along the top of both banks. There are no modifications to the hydraulic models within this reach.

Reach 2 - Restore riparian habitat corridors outside of the channel along the top of both banks. There are no modifications to the hydraulic models within this reach.

Reach 3 - Restore riparian habitat corridors outside of the channel along the top of right bank. Implements a side channel along the right bank behind Ferraro Fields. Connect side channel to daylighted large storm drain just downstream of Ferraro Fields on the right bank in the Zoo Drive Area; freshwater marsh will be located in the daylighted area outside of the channel. Daylight two small storm drains on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance. Water sources for the side channel are evaluated separately.

Reach 4 - Restore riparian habitat corridors outside of the channel along the top of bank. Implement a side channel along right bank. Daylight one storm drain on right bank. Daylight six storm drains on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance. Water sources for the side channel are evaluated separately.

Reach 5 - Restore riparian habitat corridor outside of the channel along the top of left bank. Daylight one storm drain on left bank. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance. The right bank of the channel changes from trapezoidal to vertical configuration for entire reach. A 2-foot by 2-foot notch along the top of right channel wall is added for hanging vines. The left bank of the channel transitions from trapezoidal to vegetated terraces from RS 356+22 to RS 286+05. The five terraces are 12-feet wide by 4-feet deep and tie into the existing ground elevation at a 3:1 slope. The left bank then transitions from terraces to a vertical configuration from RS 286+05 to RS 271+89 and then transitions back into the design channel configuration starting at RS 274+78.29, before the channel passes under the Glendale Freeway.

Reach 6 - Allow vegetation on right channel wall through entire reach. Allow vegetation on left channel wall from RS 270+28 to RS 262+72 and from RS 191+61 to RS 144+23. The Manning's roughness coefficients in the hydraulic models were adjusted to account for vegetation on the walls within the channel. Include a small area of widening up to 150 feet to accommodate in-channel geomorphology and vegetation along the left bank from RS 265+38 to RS 251+78. The Los Angeles River channel is re-configured to take advantage of the Taylor Yard 'bowtie' parcel. At RS 243+17, the channel invert starts to widen into the left bank. The invert width increases to more than 620 feet before it contracts back to the original channel size at RS 201+76. 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. Restore riparian habitat along the sloped channel wall of the widened channel.

Reach 7 - Allow vegetation on channel wall along right bank through entire reach and on left bank from RS 128+71 to downstream end of reach. Restore riparian habitat outside of the channel at the Arroyo Seco confluence along the top of both banks. The hydraulic model channel geometry was not changed, but the Manning's roughness coefficients were adjusted to account for vegetation on the walls within the channel. Restore riparian habitat along the Arroyo Seco Channel by removing concrete and re-configuring the channel cross section.

Reach 8 - Include 3-foot deep terraces along the right bank within the extent of the LADWP parking lot and tie into the existing ground with a 3:1 slope. The terraced area begins with one 3-foot deep terrace at RS 83+61 and ends with seven 3-foot deep terraces at RS 68+38. The Los Angeles River channel is re-configured to take advantage of the LATC parcel. At RS 69+93, the channel invert starts to widen into the left bank. The invert width increases to more than 500 feet before it contracts back to the original channel size at RS 38+47. Within the LATC extent, a bench up to 1000-feet wide extends from RS 64+92 to RS 50+15. The bench is established at approximately the 2-year water surface elevation and includes marsh vegetation. The eastern edge of the bench is sloped back up to the original ground elevation to a point about 1800 feet from

the channel. The hydraulic models include "dummy bridges" to represent the railroad trestles over the 'widened' channel from RS 68+38 to RS 40+13.

Alternative 20.

Reach 1 - Restore riparian habitat corridors outside of the channel along the top of both banks. There are no modifications to the hydraulic models within this reach.

Reach 2 - Restore riparian habitat corridors outside of the channel along the top of both banks. From RS 542+40 to RS 509+00, the right bank of the channel changes from trapezoidal to vertical configuration and includes a 2-foot by 2-foot notch along the top of the channel for hanging vines. Along the left bank, from RS 542+40 to RS 525+56, a 2-foot by 2-foot notch along the top of the channel is added to allow for hanging vines. The vegetation on both sides was assumed to have minimal hydraulic impacts and no adjustments were made to the Manning's roughness coefficients in the hydraulic models.

Reach 3 - Restore riparian habitat corridors outside of the channel along the top of bank. Implements a side channel along the right bank behind Ferraro Fields. Connect side channel to daylighted large storm drain just downstream of Ferraro Fields on the right bank in the Zoo Drive Area; freshwater marsh will be located in the daylighted area outside of the channel. Daylight two small storm drains on left bank. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance. Verdugo Wash is changed to soft-bottom channel from the confluence of Verdugo Wash and the Los Angeles River to approximately 1,200 feet upstream. Verdugo Wash is also widened to allow for marsh vegetation. Vegetation is included in the hydraulic models by a change in Manning's roughness coefficients. Water sources for the side channel are evaluated separately.

Reach 4 - Restore riparian habitat corridors outside of the channel along the top of bank. Implement a side channel along right bank. Daylight one storm drain on right bank. Daylight six storm drains on left bank. There are no modifications to the hydraulic models within this reach. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance. Water sources for the side channel are evaluated separately.

Reach 5 - Restore riparian habitat corridor outside of the channel along the top of left bank. Daylight one storm drain on left bank. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance. The right bank of the channel changes from trapezoidal to vertical configuration for entire reach. A 2-foot by 2-foot notch along the top of right channel wall is added for hanging vines. The left bank of the channel transitions from trapezoidal to vegetated terraces from RS 356+22 to RS 286+05. The five terraces are 12 feet wide by 4 feet deep and tie into the existing ground elevation

at along a 3:1 slope. The left bank then transitions from terraces to a vertical configuration from RS 286+05 to RS 271+89 and then transitions back into the design channel configuration starting at RS 274+78.29, before the channel passes under the Glendale Freeway.

Reach 6 - Allow vegetation on right channel wall through entire reach. Allow vegetation on left channel wall from RS 270+28 to RS 262+72 and from RS 191+61 to RS 144+23. The Manning's roughness coefficients in the hydraulic models were adjusted to account for vegetation on the walls within the channel. Include a small area of widening up to 150 feet to accommodate in-channel geomorphology and vegetation along the left bank from RS 265+38 to RS 251+78. The Los Angeles River channel is re-configured to take advantage of the Taylor Yard 'bowtie' parcel. At RS 243+17, the channel invert starts to widen into the left bank. The invert width increases to more than 620 feet before it contracts back to the original channel size at RS 201+76. 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. Restore riparian habitat along the sloped channel wall of the widened channel.

Reach 7 - Daylight one storm drain on right bank. Daylighted storm drains will be evaluated separately to ensure they meet all appropriate Corps regulations and guidance. Four 4-foot deep terraces on the right bank from RS 102+15 to 97+99 are added adjacent to the Cornfields site. At Cornfields, the western edge of the terrace is sloped back up to the original ground elevation. The hydraulic models include “dummy bridges” to represent the railroad trestles from RS 102+15 to 98+98. Restore riparian habitat outside of the channel at the Arroyo Seco confluence along the top of both banks. Restore riparian habitat along the Arroyo Seco Channel by removing concrete and re-configuring the channel cross section.

Reach 8 - Includes 3-foot deep terraces along the right bank within the extent of the LADWP parking lot and ties into the existing ground with a 3:1 slope. The terraced area begins with one 3-foot deep terrace at RS 83+61 and ends with seven 3-foot deep terraces at RS 68+38. The Los Angeles River channel is re-configured to take advantage of the LATC parcel. At RS 69+93, the channel invert starts to widen into the left bank. The invert width increases to more than 500 feet before it contracts back to the original channel size at RS 38+47. Within the LATC extent, a bench up to 1000-feet wide extends from RS 64+92 to RS 50+15. The bench is established at approximately the 2-year water surface elevation and includes marsh vegetation. The eastern edge of the bench is sloped back up to the original ground elevation to a point about 1800 feet from the channel. The hydraulic models include "dummy bridges" to represent the railroad trestles over the 'widened' channel from RS 68+38 to RS 40+13.

18.2. Model Adjustments.

For With-Project Conditions, the geometry files for the HEC-RAS model were adjusted to best represent the selected alternatives. The geospatial files representing the selected alternatives were overlain on the cross sections in Arc-GIS. The cross sections impacted were then modified in HEC-RAS to account for any channel re-configurations and vegetated areas. Typical cross sections for selected reaches that include channel re-configuration are shown on Plates 26 to 30.

18.2.1. Manning's N-Values.

After the cross sections were adjusted spatially to account for any channel re-configurations, four scenarios of HEC-RAS model geometries were created with different Manning's n-values to reflect a range of vegetation densities and sizes. Manning's n-values representing 'heavy" (n=0.08), "moderate" (n=0.06), and "minimal" (n=0.045) vegetation were used. Manning's n-values were varied horizontally across the cross sections to reflect the proposed alternatives. Further detail on the selection of n-values is included in section 20.1 of this appendix. The scenarios are described as follows:

Scenario I consists of moderate vegetation along the channel invert with moderate vegetation on channel side slopes and heavy vegetation in expanded channel areas.

Scenario II consists of minimal vegetation along the channel invert with moderate vegetation on channel side slopes and heavy vegetation in expanded areas.

Scenario III consists of moderate vegetation along the channel invert with minimal vegetation on channel side slopes and minimal vegetation in expanded channel areas.

Scenario IV consists of heavy vegetation along the channel invert with heavy vegetation on channel side slopes and heavy vegetation in expanded channel areas.

18.2.2. Contraction/expansion.

Contraction/expansion loss coefficients were set to 0.3 and 0.5, respectively, in the cross sections near the bridges, based on standard coefficients used for one-dimensional hydraulic modeling. During PED, coefficients for each bridge would be verified or refined as needed.

18.2.3. Ineffective Flow Areas.

Ineffective flow areas were used in the models to account for non-conveying flow areas. These locations were determined to be areas where the flow has zero velocity. Ineffective areas were modeled due to backwater behind bridges, abrupt changes in channel geometry, tributaries, and in locations that experienced sudden contraction or expansion of flow. Such areas were determined using the alternative conceptual geospatial layouts, aerial photography, contours files, and site visits. Each cross section for the hydraulic models was meticulously reviewed and coded to include the necessary ineffective areas to ensure proper conveyance and water surface results.

19. Storm Drain Daylighting.

Storm drain "daylighting," as used herein, is the intentional re-exposing of storm drains that connect to the Los Angeles River Channel within the ARBOR reach. Several locations were pre-selected and included in the selected alternatives.

In urban design and urban planning, daylighting is the redirection of a stream into an above-ground channel. Typically, the goal is to restore a stream to a more natural state. Daylighting is intended to improve the riparian environment for a stream which had been previously diverted into a culvert, pipe, or a drainage system. Daylighting sections of storm drains allows for an increase in habitat, increased infiltration, and cleaning of flows by bioremediation processes. An example of a “daylighted” storm drain is shown on Figures 1 and 2.

No adjustments to the hydraulic models were made at this time for daylighted storm drains. Detailed hydraulic design for daylighted storm drains will be performed during PED. PED analysis will determine effective and ineffective flow areas. It is assumed any adverse impacts on the mainstem flows will be alleviated. This may include a 'hard' connection to the channel and/or flapgates. The hydraulic design will ensure the storm drain connection still meets the height above the invert, submergence, and angle of entry criteria as described in the "Hydrology and Hydraulics Policy Memorandum Number 1, Side Drain Connections into Flood Control Channels," dated 29 Dec. 1998. Opportunities to "daylight" sections of the storm drain system will be evaluated on a drain by drain basis.

Figure 1: Atwater Park - 'daylighted' storm drain, just after construction, Nov. 2011

Figure 2: Atwater Park - 'daylighted' storm drain, one year later, Oct. 2012

20. Evaluation of Alternatives.

One of the critical constraints for this ecosystem restoration study was that the proposed alternatives would have no impact on the flood control functions of the Los Angeles River Channel. In addition to the impacts on flood control, it is imperative the proposed alternatives do not create any adverse conditions related to high velocities.

Since the proposed alternatives are quite elaborate and extensive, the COE needed an efficient process for determining impacts and feasibility for each of the proposed alternatives. To evaluate the hydraulic impacts, it was decided to base the impacts on two factors: the change in maximum water surface elevation and the maximum velocity.[3]

20.1. Water Surface Elevation.

The primary focus was to compare the changes to the maximum water surface elevation during the design event for each reach. A major portion of the ARBOR reach has an unlined invert. These sections of the channel include significant amounts of vegetation. Although the COE has made several attempts to remove non-native vegetation, the amount of native riparian vegetation remaining has a significant impact on the channel capacity. Since it was decided to use the current channel configuration, with vegetation, as the Existing Condition, revised channel capacities needed to be determined. This decision was so the impacts of alternatives could be determined and does not imply there is any effort to change the design discharges for the channel.

Channel capacities were evaluated for two cases that include vegetation: (1) using an appropriate value of minimum freeboard according to present-day design standards, and (2) with no freeboard. The discharges corresponding to the two cases are referred to in this report as the "revised channel capacity" and the "bankfull discharge", respectively. The present-day freeboard standards used are as follows: 2 feet for rectangular channels, 2.5 feet or trapezoidal channels, and 3 feet for leveed channel sections. These values are provided in EM 1110-2-1601, "Hydraulic Design of Flood Control Channels". In some limited reaches the revised channel capacity increased from the original design discharge because more than adequate freeboard was included in the original design. The revised channel capacities and bankfull discharges were computed because the carrying capacity of the channel is significantly impacted by the amount of vegetation in the river. The river design discharge, along with the revised channel capacity and equivalent return periods of both, are based on results from the 1992 LACDA Feasibility Study for each reach and are shown in Table 17. Discharge frequency relationships were verified by a spot check of the period of record subsequent to the 1992 study, and the historic relationship remained the same.

The channel geometry files were modified to reflect the selected alternatives. In addition, Manning's n-values were adjusted to correspond to the vegetation within the channel. Each reach of each alternative was evaluated for a range of vegetation densities and sizes represented by Manning's n-values in the hydraulic models. Although the alternative descriptions may state "riparian" or "marsh," etc., these terms do not equate to a specific n-value and it is important

[3] These two factors were considered sufficient for the feasibility phase. Energy grade line, shear stress, and possibly stream power will be considered in PED for determination of vegetation size, density and extent.

to understand the hydraulic effects of unrestricted growth within the channel sections. Manning's n-values representing “heavy," "moderate," and "minimal" vegetation were selected based on guidelines in Chow's Open Channel Hydraulics, Open Channel Flow by Henderson, Roughness Characteristics of Natural Channels from the USGS, and engineering judgment. A Manning's n-value of 0.08 was assigned for “heavy” vegetation. For “moderate” vegetation, a Manning's n-value of 0.06 was used, and a Manning's n-value of 0.045 was used to represent “minimal” vegetation within a reach. Specific vegetation species types, sizes, and densities, and associated bending and/or breaking or washing out, would be further assessed during PED. Detailed analysis of vegetation roughness would include use of an appropriate tool such as ERDC’s HYDROCAL. Representative cross sections showing Manning's n-values and maximum water surface elevation for selected reaches are shown on Plates 31 to 38. Water surface profiles for the selected reaches and the selected alternatives are displayed on Plates 39 to 46. The discharge is the revised channel capacity.

20.2. Target Velocity.

The existing Los Angeles River is for the most part, a high-velocity, prismatic concrete-lined channel. Velocities in the unlined invert sections are also relatively high. Restoration projects must be designed to ensure that the vegetation placed within the channel or on the banks will be stable for the full range of conditions expected during the design life of the project. It can be acceptable if during the natural cycle of flows some of the vegetation washes out as long as the integrity of the channel is maintained. Traditionally, shear stress and/or velocity have been used to evaluate the erosion potential for various channel lining materials including vegetation. Theoretical and empirical data on shear stress and velocities are limited as related to differing types of vegetation. In order to evaluate the selected alternatives on their impact on vegetation within the channel, a 'maximum permissible' velocity, or 'target' velocity, was selected. The target velocity for the ARBOR reach used was based on COE engineering regulations and guidance, supplemented by other available information.

A cursory review of the available publications showed the range of permissible velocities depending on the source intents and goals as well as the channel lining material. Table 2-5 from EM 1110-2-1601 (Hydraulic Design of Flood Control Channels, U.S. Army Corps of Engineers, 1 July 1991), gives a set of permissible velocities that can be used as a guide to design non-scouring flood control channels.

EM 1110-2-1205 (Environmental Engineering for Flood Control Channels, U.S. Army Corps of Engineers, Nov. 1989) states that herbaceous or woody vegetation may be used to protect channel side slope areas (depending on the frequency of inundation, velocity, and geotechnical constraints to infrequent

flooding) and other bank areas where velocities are not expected to exceed 6 to 8 ft/s.

Hoag (1993) suggested that maximum flow velocities should not exceed 3 ft/s for herbaceous plantings, 3-5 ft/s for woody and herbaceous mixed plantings, 5-8 ft/s for woody plantings alone, and that maximum flows above 8 ft/s require soil-bioengineering approaches.

Lane (1955) presents curves showing permissible channel shear stress to be used for design, and the Soil Conservation Service (1954) presents similar information on grass-lined channels.

The designer should consider the maximum allowable velocity based on site specific conditions such as duration of flow, soils, temperature, debris load, plant species, as well as channel shape and planform (Streambank Soil Bioengineering Field Guide, NRCS, Dec. 2002).

Table 2-5
Suggested Maximum Permissible Mean Channel Velocities

Channel Material	Mean Channel Velocity, fps
Fine Sand	2.0
Coarse Sand	4.0
Fine Gravel[1]	6.0
Earth	
Sandy Silt	2.0
Silt Clay	3.5
Clay	6.0
Grass-lined Earth (slopes less than 5%)[2]	
Bermuda Grass	
Sandy Silt	6.0
Silt Clay	8.0
Kentucky Blue Grass	
Sandy Silt	5.0
Silt Clay	7.0
Poor Rock (usually sedimentary)	10.0
Soft Sandstone	8.0
Soft Shale	3.5
Good Rock (usually igneous or hard metamorphic)	20.0

Notes:
1. For particles larger than fine gravel (about 20 millimetres (mm) = 3/4 in.), see Plates 29 and 30.
2. Keep velocities less than 5.0 fps unless good cover and proper maintenance can be obtained.

The 2007 LARRMP from the city of Los Angeles suggested reducing flow velocities to less than 12 ft/s. This velocity was determined as a threshold necessary to maintain a vegetated channel (LARRMP, Hydraulics Appendix, Dec. 2006). Velocities of 12 ft/s are still very fast and it is unclear whether

vegetation could actually establish and/or remain for an extended period. Soils conducive to growing vegetation would definitely be erodible at such a velocity. If the vegetation could get established, it would contribute to slowing the flows at the tradeoff of a higher water surface elevation. Impacts from vegetation on terraces or sited above a water surface corresponding to an infrequent frequency event can be estimated using quasi-2D in HEC-RAS, but some areas may require a true 2-dimensional model to evaluate the velocities.

After the event of January 2001 along the Los Angeles River, COE personnel went out and measured high water marks. Using a peak flow of 37,000 ft^3/s (since updated to 37,500 ft^3/s from LACDPW data), roughness coefficients were back-calculated (Memorandum for CESPL-ED, Subject: Vegetation in Los Angeles River Channel, April 2001). From the HEC-RAS runs, the peak flow corresponded to an average velocity of about 8-9 ft/s through the Taylor Yard reach. Photographs showed significant portions of the smaller to moderate size vegetation had been completely bent over or washed away. However, many moderate to large-size trees still remained in the channel. Vegetation tends to bend over and may recover if flow duration is not too long or if the velocity is slow enough.

The permissible values of velocity should be determined so that damage exceeding normal maintenance will not result from any event that could be reasonably expected to occur during the service life of the channel (EM1110-2-1601, Hydraulic Design of Flood Control Channels, U.S. Army Corps of Engineers, 1 July 1991). Based on this information, it was decided to use 8 ft/s as the maximum permissible velocity for the unlined portions of the project reach without supplemental protection measures. Departures from suggested permissible velocity values should be based on reliable field experience or laboratory tests. Channels whose velocities exceed permissible values will require some kind of channel and/or bank protection. Both rigid and flexible armor systems can be used in or adjacent to the channel to protect the channel bed and/or banks from erosion and to stabilize side slopes. A wide array of different armor materials is available. Reaches where velocities exceed 12 ft/s are not recommended for planting. In areas where vegetated walls (planter boxes) are considered, any proposed vegetation should be sized appropriately to not affect the integrity of the channel walls and assumed to wash out at regular intervals. Areas with high velocities will need more detailed analyses for scour and deposition to ensure sufficient protective measures are incorporated into the design. The original design for the existing soft-bottom stretches of the Los Angeles River within the ARBOR reach included grade stabilizers and large quantities of dumped derrick stone in areas susceptible to scour.

21. Results.

The results of applying the above criteria for water surface elevation and target velocities on the proposed alternatives are as follows:

Alternative 10

In Reach 1, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 12 feet per second (ft/s). The water surface elevation results are shown in Table 18. The velocities can be found in Table 19.

In Reach 2, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically greater than 12 ft/s.

In Reach 3, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 8 ft/s.

In Reach 4, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically greater than 8 ft/s.

In Reach 5, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically greater than 8 ft/s.

In Reach 6, there is adverse effect to the water surface elevation at the downstream section of Taylor Yard as it transitions back to the existing channel configuration (see Plate 39). This adverse effect can be attributed to the contraction of the river. The velocities in this reach are typically less than 12 ft/s.

In Reach 7, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 12 ft/s because the reach has a concrete invert.

In Reach 8, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 12 ft/s because the reach has a concrete invert.

Alternative 13

In Reach 1, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 12 feet per second (ft/s). The water surface elevation results are shown in Table 20. The velocities can be found in Table 21.

In Reach 2, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically greater than 12 ft/s.

In Reach 3, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 8 ft/s.

In Reach 4, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically greater than 8 ft/s.

In Reach 5, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically greater than 8 ft/s.

In Reach 6, there is adverse effect to the water surface elevation at the downstream section of Taylor Yard as it transitions back to the existing channel configuration (see Plate 40). This adverse effect can be attributed to the contraction of the river. The velocities in this reach are typically less than 12 ft/s.

In Reach 7, there is adverse effect to the water surface elevation due to the vegetation on the channel walls. The velocities in this reach are typically greater than 12 ft/s because the reach has a concrete invert.

In Reach 8, there is no adverse effect to the water surface elevation.. The velocities in this reach are typically greater than 12 ft/s because the reach has a concrete invert.

Alternative 16

In Reach 1, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 12 feet per second. The water surface elevation results are shown in Table 22. The velocities can be found in Table 23.

In Reach 2, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically greater than 12 ft/s.

In Reach 3, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 8 ft/s.

In Reach 4, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically greater than 8 ft/s.

In Reach 5, there is adverse effect to the water surface elevation in the upstream end of the reach (see Plate 41). The velocities in this reach are typically between 8 to 12 ft/s.

In Reach 6, there is adverse effect to the water surface elevation at the downstream section of Taylor Yard as it transitions back to the existing channel configuration (see Plate 42). This adverse effect can be attributed to the contraction of the river. The velocities in this reach are typically less than 12 ft/s.

In Reach 7, there is adverse effect to the water surface elevation due to the vegetation on the channel walls. The velocities in this reach are typically greater than 12 ft/s because the reach has a concrete invert.

In Reach 8, there is no adverse effect to the water surface elevation except in Scenario IV (see Plate 43). From River Station 83+61 to River Station 76+68, the velocities are typically greater than 12 ft/s because of the concrete invert. Whereas, the velocities are typically between 8 and 12 ft/s for the soft bottom invert from River Station 74+43 to 40+13. Downstream of River Station 40+13 to the project limits, the velocities are greater than 12 ft/s because of the concrete invert.

Alternative 20

In Reach 1, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 12 feet per second. The water surface elevation results are shown in Table 24. The velocities can be found in Table 25.

In Reach 2, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically between 8 to 12 ft/s.

In Reach 3, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 8 ft/s.

In Reach 4, there is no adverse effect to the water surface elevation except in Scenario IV. The velocities in this reach are typically greater than 8 ft/s.

In Reach 5, there is adverse effect to the water surface elevation in the upstream end of the reach (see Plate 44). The velocities in this reach are typically between 8 to 12 ft/s.

In Reach 6, there is adverse effect to the water surface elevation at the downstream section of Taylor Yard as it transitions back to the existing channel configuration (see Plate 45). This adverse effect can be attributed to the contraction of the river. The velocities in this reach are typically less than 12 ft/s.

In Reach 7, there is no adverse effect to the water surface elevation. The velocities in this reach are typically greater than 12 ft/s because the reach has a concrete invert.

In Reach 8, there is no adverse effect to the water surface elevation except in Scenario IV (see Plate 46). From River Station 83+61 to River Station 76+68, the velocities are typically greater than 12 ft/s because of the concrete invert. Whereas, the velocities are typically between 8 and 12 ft/s for the soft bottom

invert from River Station 74+43 to 40+13. Downstream of River Station 40+13 to the project limits, the velocities are greater than 12 ft/s because of the concrete invert.

22. Flood Risks.

Existing vegetation within the channel has a significant impact on conveyance of the design flood within the ARBOR reach. If allowed to grow unchecked under either the Without- or With-Project Conditions, such vegetation could eventually create an adverse condition with respect to flood risk. The District plans to adopt a course of action that allows for ecosystem restoration while not significantly altering conveyance of the previously authorized design flood within the Los Angeles River. Under this approach, Los Angeles District would modify the existing Operation, Maintenance, Rehabilitation, Repair and Replacement (OMRRR) Plan for the Los Angeles County Drainage Area (LACDA) project within the study area to accommodate the restoration features of the proposed project and to allow some vegetation to remain in the Los Angeles River channel within the study area to the extent that there no more than minor effects on the channel's ability to convey the design flood.

22.1. Authorization of the Existing Flood Risk Management Project.

The Los Angeles River is a central component in the LACDA project, a flood risk management project constructed through a massive undertaking by the Corps and the Los Angeles County Flood Control District (now the Los Angeles County Department of Public Works - LACDPW). Federal construction efforts occurred from the 1930s through the 1950s. Construction of the Los Angeles River portion of LACDA was authorized and amended under several laws. The reach of the Los Angeles River being studied in this Feasibility Study, was first authorized for construction under Emergency Relief Acts, then authorized by the Flood Control Act of June 1936, as amended by the Flood Control Acts of 1937 and 1938. Modifications to the Los Angeles River channel have been addressed in later Flood Control Acts. Design discharges of the Los Angeles River for the authorized project range from 40,000 ft^3/s to 104,000 ft^3/s within the study area.

22.2. LACDA 1992 Review.

The Los Angeles River as originally constructed within the study area from the 1930s to the 1950s was designed to convey a design flood, not a specific frequency event such as the 1% ACE event. The Corps studied improvements to flood risk management conveyance capacity along the Los Angeles River in the 1992 LACDA Review. The 1992 LACDA Review Feasibility Study showed that the LACDA channel and dam flood control system had a relatively low level of flood protection for a metropolitan area. This low level of protection was and is attributable to the following factors: (1) the original design storm, which was based upon the Capital Flood/Standard Project Flood concept in use in the 1930s, generated floods with a magnitude that has an approximately 50-year

return period for portions of Los Angeles River when compared to the 1992 frequency curves; (2) modern day freeboard requirements for flood control channel design means that the safe conveyance capacity of a portion of the Los Angeles River is significantly lower than the original design capacity with a lesser freeboard; and (3) the increased runoff response of the watershed due to intensive urbanization produces a higher peak discharge for the same rainfall event. As a consequence of the 1992 LACDA Review Study, the Corps was eventually authorized to upgrade flood risk management features for the Los Angeles River downstream of the Rio Hondo confluence to provide 133-year level of protection (0.8% ACE), but no upgrades were authorized for the upper Los Angeles River including the ARBOR reach. Flood risk management upgrades within the study area were not found to be economically justified in the 1992 review.

22.3. Design Conditions.

Two scenarios of the Los Angeles River were evaluated as part of the ongoing ecosystem restoration feasibility study. The first, referred to as the original authorized project or "Design" Conditions, represents a clean channel with no vegetation within the river channel. The original design was developed to address specific conveyance capacities, in other words, a specific design discharge for a designated reach within the ARBOR, and was not intended to specifically provide protection for a probability-based event such as the 1% ACE event. Based on the updated frequency analysis, the minimum level of protection for the ARBOR reach under Design Conditions is about a 4% ACE event (25-yr). This lowest level of flood conveyance occurs in an entrenched section of the Los Angeles River upstream from the Verdugo Wash confluence.

22.4. Existing Conditions.

The second scenario, referred to as the present or "Existing" Conditions, represents the current channel including the existing amount of vegetation growing within the soft-bottom reaches of the Los Angeles River. The original design did not contemplate allowing any sediment and vegetation to establish in the channel, and the existing vegetation and the sediment held in place by the vegetation has reduced the conveyance capacity of the originally authorized project (see Table 17). Lack of OMRRR funding for many years to remove this vegetation and eventually the environmental issues associated with removing the well-established vegetation have resulted in this reduced conveyance capacity becoming the current Existing Condition. The minimum level of protection for the ARBOR reach under Existing Conditions is about an 11% ACE event (9-yr), which occurs in the soft-bottom section downstream from the Verdugo Wash confluence. At the same time, and despite its degraded condition, the existing vegetation in the channel provides important habitat and connections for wildlife, provides connections between proposed restoration features, and is favored by many in the community. The environmental baseline for the Study assumes that

existing vegetation remains in the river because of the Corps' lack of funding for regular channel maintenance and the environmental considerations involved with vegetation removal.

22.5. Sedimentation.

Given the existence of the Hansen and Sepulveda Dams, several LACDPW dams, numerous debris basins, and lined channels upstream of the project reach, sediment inflow (i.e., bed material load) to the project reach for the existing condition is minimal. Additionally, given the presence of grouted riprap sideslopes, a 'semi-armored' cobble bed with grade control structures, and dense stands of vegetation, bed material transport within the existing project reach is also minimal. The dominant sediment transport processes are limited to suspended transport of sand and smaller sized material during moderate to large discharges. The existing vegetation does trap some sediment during low to moderate events, but tends to wash out during larger events.

22.6. Other Important Points.

The conditions described above raise a number of issues regarding flood risks and the relationship to proposed ecosystem restoration along the Los Angeles River. Several related points were considered during the feasibility study. These points are included for consideration:

Point 1. Improvements to flood risk management is not within the scope of the current Ecosystem Restoration Feasibility Study. The Corps is not studying flood risk management options under the current study, as there is no interested sponsor.

Point 2. Under Design Conditions, the 1% ACE event cannot be contained within the channel in the ARBOR reach, but current FEMA mapping does not accurately represent these conditions. This generates a responsibility to alert FEMA and the public by way of a Letter of Map Revision (LOMR). The current FEMA mapping of the 100-yr (1% ACE event) floodplain indicates that the 100-yr event can be totally contained within the channel for the entire ARBOR reach. These 'old' FEMA floodplains are based on data from the early 1980s, which we have not been able to obtain. Although the Corps presented floodplain maps for the 1% ACE event as part of the 1992 study (which are consistent with those which we have produced more recently for use in the current Feasibility Study) FEMA did not update its maps for the upper Los Angeles River including the ARBOR reach. FEMA only elected to use the Corps' floodplain mapping for the lower Los Angeles River and the Rio Hondo Diversion Channel. This is a long-standing issue because FEMA has not remapped with current data. In summary, the Corps indicated over 20 years ago that the 1% ACE event cannot be contained within the channel in the ARBOR reach and is different than shown on FEMA maps, but FEMA mapping has not been updated.

Point 3. The vegetation growing within the channel in the ARBOR reach under Existing Conditions represents a significant decrease in flood protection compared to Design Conditions. Within the ARBOR reach, the level of protection is decreased from a little over a 4% ACE event (25-yr) to about an 11% ACE event (9-yr) by the present level of vegetation and sediment. The area of inundation from the 1% ACE event increases significantly, compared to the Design Conditions, at specific locations. That is, the depth of flooding and the area of flooding under the 1% ACE event are both changed by the existing vegetation and sediment in the channel compared to Design Conditions.

Point 4. Although the current Feasibility Study focuses on ecosystem restoration and has no flood risk management purpose, the impact on flood risk management from a recommendation to modify the OMRRR plan to authorize existing sediment and vegetation to remain consistent with Existing Conditions could trigger FEMA mitigation requirements. A memorandum dated June 2012 between FEMA and USACE entitled "Federal Emergency Management Agency (FEMA)/U.S. Army Corps of Engineers (USACE), Joint Actions on Planning for Flood Risk Management Projects" addresses the requirement to perform mitigation when proposed USACE flood risk reduction projects increase the Base (1-percent-annual-chance) Flood Elevation (BFE). An original constraint of the Feasibility Study is that the recommended project will have no negative impacts on the flood risk reduction capability of the Los Angeles River as compared to the Existing Conditions scenario. The proposed restoration features (new structures and vegetation put in place under the proposed project) will be designed to minimize impacts to conveyance capacity. The H&H analyses in PED will allow the District to assess whether and how the new features may result in minor differences to channel conveyance compared to Design Conditions, and existing vegetation and sediment not associated with the restoration features will also be considered to determine to what extent some of the existing vegetation can remain without having more than minor impacts upon Design Conditions.

22.7. Recommendations.

Based on the above and although the restoration project and a modified OMRRR plan for flood risk management to leave vegetation in the channel would not induce flooding compared with Existing Conditions, the Los Angeles District proposes to adopt a course of action that would not significantly alter the ability to achieve conveyance of the original design flood. That is, the District would adopt a plan that will minimize any uncertainty about the need to mitigate for induced flooding. The proposed restoration features would be designed to avoid any negative impacts on the conveyance capacity compared to the original Design Conditions. In addition, the LACDA OMRRR plan would be modified to allow some vegetation in the channel where existing vegetation grows as well as part of new features, but only to the extent that such vegetation would have no more than minor impacts upon Design Conditions.

23. Summary and Conclusions.

This appendix documents the hydrologic and hydraulic analyses that were performed in support of the Ecosystem Restoration Feasibility Study for the Los Angeles River. The focus of the study is the ARBOR reach which extends from Barham Blvd. upstream to 1st St. in downtown Los Angeles. Since there is no flood risk management component to this study, no risk and uncertainty analyses were performed. During PED, the Recommended Plan will be designed in more detail and risk and uncertainty will be documented to ensure there is no adverse impacts to existing conditions and also to quantify any incidental benefits that may possibly occur.

The Without-Project Condition is defined as the Existing Conditions, which incorporates the vegetation currently growing within the channel. The hydraulic impact of the vegetation in the channel causes a substantial reduction in channel capacity. Photographic evidence suggests that most of the grasses, reeds, shrubs, and smaller trees either bent over or washed out during moderate size events but many moderate to large-sized trees still remained in the channel. The smaller vegetation, including non-native plants, grew back rather quickly. The main governing criteria for conveyance is vegetation size and density and ability to bend with water flow. Even if the trees were to wash out, they could become lodged on bridge piers downstream and could create an obstruction greater than was allowed in that portion of the channel.

The Los Angeles River Channel was originally designed to convey a design flood, not a specific frequency event such as the 1% ACE event, with no vegetation within the channel. Even without vegetation in the channel, there are several locations within the ARBOR reach where the probability of flows breaking out from the channel within the ecosystem project area is greater than 1% in any given year (equivalent to the 100-yr flood), i.e., the channel has less than 100-yr level of protection in some locations. This is due to several factors including: the original design event was too small, the amount of urbanization was not anticipated to be so vast, and updated hydrologic and hydraulic criteria.

The alternatives that were analyzed are compared to the Existing Conditions to determine their impacts on the flood control function of the channel. If the WSE for the with-project condition was greater than that for the existing condition then that restoration scenario was removed from further consideration. Any of the four alternatives can work hydraulically given the constraint on maintaining vegetation to acceptable limits. Since the proposed alternatives are quite elaborate and extensive, the Corps of Engineers needed a expeditious method for determining impacts and decided to evaluate the impacts on two factors: the change in maximum water surface elevation and the maximum velocity.

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 to concrete or vice-versa). These areas can be mitigated by including OMRRR plan

requirements to prevent vegetation from getting established in these transition areas and to remove it as soon as possible. The LACDA OMRRR Plan will be revised to accommodate the restoration features of the proposed project and to allow some vegetation to remain in the Los Angeles River channel within the study area to the extent that there are no more than minor effects on the channel's ability to convey the design flood.

Another option may be to include open water areas within the transition zones. Open water would reduce the amount of vegetation, but brings up other concerns such as vector control and water quality. Studies for the Tres Rios project in Arizona show that if the open water area is long enough, wind fetch keeps enough circulation to prevent mosquito proliferation. Also, if the open water area is deep enough, vegetation does not get established. Open water areas could be designed with circulation pumps to prevent adverse water quality impacts and mosquito control. Detailed modeling and design for the Recommended Plan to include the n-value limitations based on vegetation for these transition areas will be conducted during PED.

Several reaches exhibited average velocities in excess of 12 ft/s. It is not recommended that any alternative that requires planting be allowed in these areas. Reaches with maximum velocities greater than 8 ft/s need to include supplemental protection measures to ensure no adverse impacts to the channel itself or appurtenant features such as bridge piers. The current soft-bottom stretches of the Los Angeles River include invert protection features. These stretches have exhibited a strong disposition for vegetation to get established on its own and also vegetation recovers very quickly after a flood event. These areas of high velocity need to be evaluated more thoroughly for scour erosion to ensure the structural integrity of the channel and appurtenant features are not compromised. Scour and erosion are very important parts of the hydraulic analyses. The study team determined these detailed calculations can be done in PED. Revised channel design discharges, including tributaries and storm drains will be provided in PED.

It should be clearly understood, the results in this Hydrology & Hydraulics Appendix are based on one-dimensional, steady flow HEC-RAS models and that the Recommended Plan will require two-dimensional, and possibly, unsteady flow models during PED to more accurately simulate the proposed alterations in and adjacent to the channel during PED. For areas with significant modifications, a physical modeling approach is highly recommended.

The PED work will include analysis of perennial effluent base flow, the channel-forming discharge, and flow duration. In addition, in PED the COE will clarify the hydrologic and hydraulic design of existing low flow channels, including the intended flow conveyance, and analyze impacts from the proposed project on the low flow channels in modified reaches. The PED analysis will also include sediment transport modeling, and development of a detailed sediment management plan for the recommended alternative to protect the project against failure from sedimentation and scour.

The water budget analysis shows the proposed vegetation scenarios for the alternatives can be supported with the available sources of water. Several features require new connections to the Los Angeles River or existing storm drains in order to support the proposed vegetation. Under Alternatives 10 and 13 there is no direct hydrologic connection from the Los Angeles River to the LATC parcel. Storm water must be redirected though the LATC area to support the proposed vegetation. The direct connection for Alternative 16 and 20 to LATC provides more than enough water to support the proposed vegetation. During PED, the COE will look for additional sources of existing data on groundwater-surface water interaction to include in the water budget.

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Table 1: Hansen Dam Pertinent Data

Drainage Area	151.9 mi²
Reservoir Elevation	
Debris Pool	1,010.5 ft
Flood Control Pool (spillway crest)	1,060.0 ft
100-yr Flood Event	1,043.7 ft
Top of Dam	1,087.0 ft
Reservoir Area	
Debris Pool	372 ac
Spillway Crest	826 ac
Top of Dam	1,154 ac
Reservoir Gross Capacity	
Debris Pool	3,756 af
Spillway Crest	33,348 af
Top of Dam	59,299 af
Allowance for Sediment (100-yr)	21,000 af
Dam: - Type	Earthfill
Height above Original Streambed	97 ft
Top Length	15,440 ft
Top Width	30 ft
Outlets:	
Uncontrolled	
Number and Size of Gates	2 - 8 ft W x 6 ft H
Gate Sill Elevation	1,011.0 ft
Controlled	
Type of Gates	Vertical Lift
Number and Size of Gates	8 - 5 ft W x 8 ft H
Gate Sill Elevation	990.0 ft
Maximum Capacity at Spillway Crest	22,000 ft³/s
Regulated Capacity at Spillway Crest	21,000 ft³/s
Spillway:	
Type	Concrete Ogee
Crest Length	284 ft
Design Discharge	99,700 ft³/s

Sources: Water Conservation and Supply Feasibility Study, Hansen Dam, dated April 1999, Hansen Dam Water Control Manual dated November 1990, LACDA Feasibility Study and appendices dated 1992, and updated survey dated Nov. 2004.

Table 2: Hansen Dam Hydrologic Data

Standard Project Flood	
Duration (inflow)	4 days
Total Inflow Volume (excl. base flow)	57,200 af
Inflow Peak	53,000 ft^3/s
Max. Storage	19,560 af
Max. Elevation	1065.50 ft
Probable Maximum Flood	
Duration (inflow)	5 days
Total Inflow Volume	246,000 af
Inflow Peak	105,000 ft^3/s
Peak. Outflow	99,700 ft^3/s
Max. Elevation	1081.22 ft
100-yr Flood	
Duration (inflow)	1 day
Inflow Peak	47,900 ft^3/s
Outflow Peak	18,900 ft^3/s
Max Storage	15,500 af
Max. Elevation	1043.7 ft

Sources: Hansen Dam Analysis of Design dated June 1940, H&H Review of Hansen Dam dated June 1978, Hansen Dam Water Control Manual dated November 1990, and LACDA Feasibility Study and appendices dated 1992.

Table 3: Sepulveda Dam Pertinent Data

Drainage Area	152.0 mi^2
Reservoir Elevation	
Spillway Crest (gates lowered)	700.0 ft
Flood Control Pool (spillway gates raised)	710.0 ft
100-yr Flood Event	712.1 ft
Top of Dam	725.0 ft
Reservoir Area	
Spillway Crest (gates lowered)	794 ac
Top of Spillway Gates (raised position)	1,348 ac
Top of Dam	2,591 ac
Reservoir Gross Capacity	
Spillway Crest (gates lowered)	7,280 af
Top of Spillway Gates (raised position)	18,129 af
Top of Dam	46,764 af
Allowance for Sediment	0 af
Dam: - Type	Earthfill
Height above Original Streambed	57 ft
Top Length	15,440 ft
Outlets:	
Uncontrolled	
Number and Size of Gates	4 - 6 ft W x 6.5 ft H
Gate Sill Elevation	668 ft
Controlled	
Type of Gates	Vertical Lift
Number and Size of Gates	4 - 6 ft W x 9 ft H
Gate Sill Elevation	668 ft
Maximum Capacity at Spillway Crest	16,500 ft^3/s
Regulated Capacity at Spillway Crest	16,500 ft^3/s
Spillway:	
Type	Concrete Ogee
Crest Length	399 ft
Design Discharge	99,540 ft^3/s

Sources: Sepulveda Dam Water Control Manual dated May 1989, LACDA Feasibility Study and appendices dated 1992, and updated survey dated Nov. 2004.

Table 4: Sepulveda Dam Hydrologic Data

Standard Project Flood	
Duration (inflow)	3 days
Total Inflow Volume	68,200 af
Inflow Peak	50,000 ft^3/s
Max. Storage	22,493 af
Max. Area	1,529 ac
Max. Elevation	713.52 ft
Probable Maximum Flood	
Duration (inflow)	4 days
Total Inflow Volume	163,200 af
Inflow Peak	114,000 ft^3/s
Peak Outflow	99,300 ft^3/s
Max. Storage	27,563 af
Max. Area	1,710 ac
Max. Elevation	716.66 ft
100-yr Flood	
Duration (inflow)	1 day
Total Rainfall	8.84 in
Rainfall Loss	3.77 in
Rainfall Excess	5.07 in
Inflow Peak	82,500 ft^3/s
Inflow Volume	41,100 af
Outflow Peak	17,000 ft^3/s
Max Storage	20,300 af
Max. Elevation	712.1 ft

Sources: Sepulveda Dam Analysis of Design dated August 1939, H&H Review of Sepulveda Dam dated June 1978, Sepulveda Dam Water Control Manual dated May 1989, and LACDA Feasibility Study and appendices dated 1992.

Table 5: Monthly Temperatures

Station Name: Burbank Valley Pump Plant — Station Number: 41194
Period of Record: 1939 to 2001 — Latitude: 34:11:00
Elevation: 655 feet — Longitude: 118:20:00

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Max.	67.5	69.5	70.6	74.9	77.5	83.2	88.9	89.9	87.1	81.5	73.5	67.9	77.7
Min.	42.0	44.3	46.2	49.5	54.2	58.3	62.1	62.4	59.9	53.6	45.4	41.3	51.6
Avg.	54.8	56.9	58.4	62.2	65.9	70.8	75.5	76.2	73.5	67.6	59.5	54.6	64.7

Mean daily temperatures in degrees Fahrenheit (F)

Data from Monthly Station Climate Summaries, 1971-2000, NWS, National Climatic Data Center (NCDC), Western Regional Climate Center.

Table 6: Monthly Precipitation

Station Name: Burbank Valley Pump Plant — Station Number: 41194
Period of Record: 1939 to 2001 — Latitude: 34:11:00
Elevation: 655 feet — Longitude: 118:20:00

Average Total Precipitation

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
3.56	4.29	3.88	1.02	0.37	0.12	0.02	0.18	0.30	0.55	1.05	2.15	17.49

Mean precipitation in inches

Data from Monthly Station Climate Summaries, 1971-2000, NWS, National Climatic Data Center (NCDC), Western Regional Climate Center

Table 7: Precipitation Frequency Estimates (Point Estimates)

Duration	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	1000-yr
5-min:	0.14	0.20	0.27	0.33	0.41	0.48	0.56	0.64	0.75	0.84
10-min:	0.21	0.28	0.38	0.47	0.59	0.69	0.80	0.92	1.08	1.21
15-min:	0.25	0.34	0.46	0.57	0.72	0.84	0.97	1.11	1.30	1.46
30-min:	0.34	0.46	0.63	0.77	0.97	1.14	1.31	1.50	1.76	1.97
60-min:	0.48	0.66	0.90	1.11	1.40	1.64	1.89	2.15	2.53	2.84
2-hr:	0.71	0.96	1.31	1.61	2.03	2.37	2.73	3.12	3.67	4.11
3-hr:	0.89	1.20	1.64	2.00	2.52	2.95	3.39	3.87	4.55	5.10
6-hr:	1.26	1.71	2.31	2.83	3.56	4.15	4.78	5.45	6.41	7.19
12-hr:	1.68	2.27	3.08	3.77	4.76	5.56	6.40	7.31	8.60	9.66
24-hr:	2.19	2.99	4.09	5.02	6.37	7.45	8.61	9.86	11.63	13.08
2-day:	2.75	3.79	5.24	6.49	8.29	9.75	11.31	13.00	15.43	17.43
3-day:	3.13	4.37	6.09	7.58	9.74	11.50	13.39	15.45	18.41	20.86
4-day:	3.39	4.77	6.70	8.37	10.80	12.79	14.93	17.26	20.63	23.42
7-day:	3.88	5.53	7.86	9.88	12.84	15.28	17.91	20.79	24.98	28.46
10-day:	4.16	5.98	8.55	10.79	14.07	16.80	19.74	22.97	27.70	31.64
20-day:	4.90	7.07	10.17	12.89	16.92	20.27	23.94	27.99	33.96	38.99
30-day:	5.78	8.27	11.85	15.02	19.71	23.66	27.98	32.79	39.91	45.94
45-day:	6.89	9.69	13.71	17.29	22.64	27.16	32.15	37.71	46.00	53.08
60-day:	8.01	11.02	15.38	19.27	25.11	30.07	35.56	41.72	50.93	58.82

Point precipitation frequency estimates (inches)
NOAA Atlas 14, Volume 6, Version 2
Data type: Precipitation depth
Time series type: Partial duration
Project area: Southwest
Latitude (decimal degrees): 34.1091
Longitude (decimal degrees): -118.2497

Table 8: Water Budget for Selected Alternatives

Alternative	Channel Streamflow Annual (af/yr)	Channel Streamflow Summer (af/yr)	Precip (af/yr)	Water Sources Annual (af/yr)	Water Sources Summer (af/yr)
10	210,479	96,852	832	211,310	97,684
13	210,479	96,852	832	211,310	97,684
16	210,479	96,852	869	211,348	97,722
20	210,479	96,852	869	211,348	97,722

Summer = Apr thru Sep

Alternative	Infiltration (af/yr)	Evaporation (af/yr)	ETo (af/yr)	Water Demand (af/yr)	Flow Out Annual (af/yr)	Flow Out Summer (af/yr)
10	62,435	91	3,037	65,562	145,748	32,122
13	62,435	101	3,357	65,893	145,418	31,791
16	65,272	139	3,145	68,556	142,793	29,166
20	65,272	139	3,118	68,529	142,819	29,193

ETo - evapotranspiration
Flow Out = Water Source - Water Demand

For Alternatives 10 and 13, there is no direct hydrologic connection from the Los Angeles River to the LATC; therefore there must be a daylighted storm drain connection along the northeast side of the LATC.

Table 9: Average Daily Flows for ARBOR Reach of Los Angeles River

Period of Record (WY1932-2012)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
162	120	780	271	65	44	42	32	33	73	64	74

Average daily flow Jan - Dec = 164 ft^3/s
Average daily flow Apr - Sep = 61 ft^3/s

Record Post - W.C. Tillman Treatment Plant (WY1985-2012)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
156	128	187	208	103	97	101	78	77	86	130	121

Average daily flow Jan - Dec = 291 ft^3/s
Average daily flow Apr - Sep = 134 ft^3/s

Flows in ft^3/s
Daily flows from LACDPW stream gage F57C-R; Los Angeles River at Figueroa St. Bridge

Table 10: Infiltration Rate Criteria for SCS Hydrologic Soil Groups

Group	Minimum Infiltration	
	(in/hr)	(ft/day)
A	0.30 – 0.45	0.6 – 0.9
B	0.15 – 0.30	0.3 – 0.6
C	0.05 – 0.15	0.1 – 0.3
D	0.0 – 0.15	0.0 – 0.3

Source: McCuen, R. H., *Hydrologic Analysis and Design*, 2nd ed., Prentice Hall, Upper Saddle River, New Jersey, 07458, 1998

Table 11: Monthly Summary of Evaporation Rates

ID	Station Name	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
33-A	Pacoima Dam	6.83	[7.59]	5.80	8.06	5.31	[5.38]	7.56	8.03	5.98	9.25	[9.68]	8.72	[88.19]
46-D	Big Tujunga Dam	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	6.63	8.24	[11.60]	[13.26]	[9.70]	[49.43]
63-C	Santa Anita Dam	2.96	3.96	2.30	3.25	2.48	2.53	3.20	[2.64]	[0.48]	[0.58]	[0.88]	[0.69]	[25.95]
89-B	San Dimas Dam	[2.74]	[1.96]	[2.67]	[1.52]	[1.59]	[2.64]	4.00	6.08	5.93	9.20	[8.11]	6.55	[52.98]
96-C	Puddingstone Dam	3.25	2.70	[0.99]	1.67	1.62	2.22	3.86	5.24	5.28	[7.64]	7.48	5.81	[47.76]
223-C	Big Dalton Dam	3.03	2.41	[0.95]	1.52	[1.77]	[2.53]	3.62	4.48	5.16	7.47	7.46	5.97	[46.37]
252-C*	Castaic Dam	8.20	3.98	2.57	3..81	3.26	5.34	11.03	10.35	7.83	11.02	11.81	8.85	88.05
334-B	Cogswell Dam	3.64	2.67	[1.94]	1.64	[1.96]	2.54	3.21	4.94	6.16	7.76	7.66	6.01	[50.10]
390-B	Morris Dam	4.86	4.83	3.22	4.62	4.10	5.42	6.85	[7.75]	8.69	11.03	10.67	8.58	[80.62]
409-B*	Pyramid Reservoir	[6.69]	4.29	3.50	[4.77]	4.01	6.02	[5.98]	11.39	10.53	18.15	14.96	[5.72]	[96.01]
425-B	San Gabriel Dam	5.05	4.92	[2.58]	3.60	[3.26]	3.74	5.14	6.95	6.86	9.22	9.77	8.41	[69.48]
598-D*	Check 43	[8.08]	[5.50]	[4.19]	[3.67]	5.22	[6.81]	[8.55]	[13.79]	[2.84]	[ ]	[ ]	[ ]	[58.65]
1058-B	Pamdale	3.25	2.72	1.47	1.67	1.62	3.30	3.86	5.24	10.65	13.20	12.85	7.70	[58.65]
1071-b	Descanso Gardens	[1.77]	[1.65]	[0.47]	[1.17]	[0.77]	[1.03]	[2.24]	[2.88]	[3.80]	[4.72]	4.24	2.92	67.53
1240*	Pearblosson	[7.49]	12.68	10.92	5.44	[6.85]	9.02	[11.00]	13.94	[14.67]	17.77	[11.57]	12.68	[134.03]

Source: LACDPW Hydrologic Report 2010 - 2011
Evaporation in inches
[ ] Records Incomplete
* CA Department of Water Resources

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Table 12: Monthly Evapotranspiration Rates

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
3.95	2.73	2.31	2.20	2.45	3.64	4.74	5.31	6.06	6.75	6.66	5.01	51.81

Monthly evapotranspiration rates in inches
Data from CADWR, CIMIS database
Data for Glendale, Los Angeles Basin

Table 13. Vegetation Evapotranspiration Values

Vegetation Type	Evapotranspiration Range (feet/year)	Evapotranspiration Average (feet/year)
Cottonwood Willow	4.1 – 8.5	8*
Salt Cedar	3 – 9.2	6.1
Honey Mesquite	3	3
Marsh	7.5 – 16	9*
Quailbush-Saltbush	3.2	3.2
Desert	2	2
Desert Wash (Xericriparian)	2	2

Source: Greeley and Hansen, 1998, Tres Rios, Arizona Feasibility Study Salt/Gila Groundwater Analysis. * Re-published in Rio Salado Oeste Feasibility Report and adjusted by COE, Mar. 2005.

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Table 14: Frequency Discharges Used in HEC-RAS Models

ARBOR Reach	RS	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Design
Reach 1	692+94	16,200	27,200	31,800	42,000	54,300	71,400	81,200	96,800	55,000
Reach 1	691+24	17,500	30,200	35,600	47,500	59,700	76,800	87,600	103,000	57,000
Reach 1	639+73	18,400	32,700	38,600	51,800	63,900	81,000	92,700	109,000	40,000
Reach 2	546+45	20,300	37,200	44,200	59,900	71,800	88,900	102,000	118,000	40,000
Reach 3a	475+68	20,300	37,200	44,200	59,900	71,800	88,900	102,000	118,000	40,000
Reach 3b	474+07	21,600	40,500	48,200	65,800	77,500	94,600	109,000	125,000	78,000
Reach 4	432+16	21,600	40,500	48,200	65,800	77,500	94,600	109,000	125,000	78,000
Reach 5	358+63	21,600	40,500	48,200	65,800	77,500	94,600	109,000	125,000	78,000
Reach 6a	270+28	21,600	40,500	48,200	65,800	77,500	94,600	109,000	125,000	78,000
Reach 6b	257+85	21,400	41,000	49,400	69,600	82,000	93,800	106,000	118,000	83,700
Reach 7a	142+91	21,400	41,000	49,400	69,600	82,000	93,800	106,000	118,000	83,700
Reach 7b	128+71	22,900	44,200	53,600	79,800	94,400	109,000	124,000	141,000	104,000
Reach 8	86+07	22,900	44,200	53,600	79,800	94,400	109,000	124,000	141,000	104,000
Burbank Western	18+04	2,150	4,320	4,990	7,040	8,360	12,400	14,200	16,900	15,000
Verdugo Wash	12+62	3,790	7,550	8,720	12,700	15,100	23,200	26,500	30,300	42,900
Arroyo Seco	9+26	1,500	3,200	4,190	10,200	12,500	17,700	22,200	26,400	43,000

River, Reach, and River Station (RS) from HEC-RAS Models
There are 3 discharge locations for Reach 1 because the HEC-RAS models extended upstream from the ARBOR reach.
Discharges in ft^3/s from 1992 LACDA Feasibility Study Hydrology Appendix

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Table 15: Bridges

River Station	Bridge
682+24	Barham Boulevard
661+97	Warner Brothers Studio Gate
596+22	Ventura Freeway (State Route 134)
529+43	Victory Boulevard
515+90	Golden State Freeway (Interstate Highway 5)
431+85	Colorado Boulevard
359+31	Los Feliz Boulevard
336+95	Sunnynook Drive (Pedestrian bridge)
283+78	Fletcher Drive
271+11	Glendale Freeway (State Route 2)
143+64	Golden State Freeway (Interstate Highway 5)
136+76	Riverside Drive
134+04	UPPR u/s of State Route 110
131+38	Pasadena Freeway (State Route 110)
110+96	MTA Bridge
102+52	N. Broadway
97+78	Spring Street
86+42	Main Street
65+75	UPPR d/s of Main Street
63+38	UPPR u/s of Cesar Chavez Avenue
38+15	Cesar Chavez Avenue
30+13	Santa Ana Freeway (U.S. 101)
10+69	First Street

Table 16: Boundary Conditions For HEC-RAS Models

Location	River Station	Flow Regime	Discharge (ft^3/s)	WSE (ft)
Upstream End of ARBOR Reach	692+94	Mixed	54,300	525.94
			71,400	528.50
			81,200	529.71
			96,800	531.71
			55,000	526.04
Downstream End of ARBOR Reach	10+31	Mixed	94,400	254.01
			109,000	255.38
			124,000	256.51
			141,000	257.83
			104,000	254.85

Table 17: Original Design Discharge and Existing Channel Capacity

Reach[a]	River Stations	Design[b] Discharge ft^3/s	Design Return Period [e] yr	Current Freeboard Criteria[c] ft	Existing[d] Channel Capacity ft^3/s	Existing Return Period [e] yr	100-Year Discharge[e] ft^3/s
Reach 1	625+77 to 547+45	40,000	12	3	29,300	4	81,000
Reach 2	546+45 to 510+05	40,000	7	3	25,800	3	88,900
Reach 3a	504+93 to 477+85	40,000	7	3	63,000[f]	32	88,900
Reach 3b	475+68 to 452+58	78,000	51	3	84,000[f]	69	94,600
Reach 4	432+16 to 359+75	78,000	51	3	34,700	4	94,600
Reach 5	358+63 to 271+89	78,000	51	3	34,000	4	94,600
Reach 6a	270+28 to 262+73	78,000	51	2.5	64,500	24	94,600
Reach 6b	257+85 to 144+23	83,700	57	2.5	50,500	11	93,800
Reach 7a	142+91 to 131+22	83,700	57	2.5	135,400[f]	>500	93,800
Reach 7b	128+71 to 86+61	104,000	83	3	83,700	32	109,000
Reach 8	86+07 to 10+31	104,000	83	3	89,600	42	109,000

Notes:

(a) Letters a & b in Reach names denote a change in the river due to a confluence or change in channel dimensions.
(b) Original design discharge for clean prismatic channel.
(c) Freeboard from EM 1110-2-1601; 3 feet for leveed sections and 2.5 feet for trapezoidal entrenched sections.
(d) Existing channel capacity with vegetation, sedimentation and freeboard. The values shown are the minimum within the reach. Discharges above these listed do not necessarily cause damages.
(e) Return periods for Design Discharge and Existing Channel Capacity are based on discharge frequency analysis for the 1992 LACDA Feasibility Study.
(f) In some limited reaches the existing channel capacity is greater than the original design discharge because of more than adequate freeboard.
(g) Refer to Plates 21a through 24b to see the floodplains for various return frequency flows within the study limits.

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Table 18: Alternative 10 Water Surface Elevation

Reach	River Station	Scenario I	Scenario II	Scenario III	Scenario IV
Reach 1	625+77 to 547+45				
Reach 2	546+45 to 510+05				
Reach 3a	504+93 to 477+85				
Reach 3b	475+68 to 452+58				
Reach 4	432+16 to 359+75				
Reach 5	358+63 to 271+89				
Reach 6a	270+28 to 262+73				
Reach 6b	257+85 to 144+23				
Reach 7a	142+91 to 131+22				
Reach 7b	128+71 to 86+81				
Reach 8	86+07 to 10+31				

Note: letters a & b in Reach name denote a break in the reach due to a confluence or flow change.

Color Codes:

Does not increase the water surface elevation

Increases the water surface elevation

No change from design conditions

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Table 19: Alternative 10 Velocities

Reach	River Station	Scenario I						Scenario II						Scenario III					
		Bank full	2-yr	5 yr	10-yr	25-yr	50-yr	Bank full	2-yr	5-yr	10-yr	25-yr	50-yr	Bank full	2-yr	5-yr	10-yr	25-yr	50-yr
Reach 2	546+45 to 510+05																		
Reach 3a	504+93 to 477+85																		
Reach 3b	475+68 to 452+58																		
Reach 4	432+16 to 359+75																		
Reach 5	358+63 to 271+89																		
Reach 6a	270+28 to 262+73																		
Reach 6b	257+85 to 144+23																		
Reach 7a	142+91 to 131+22																		
Reach 7b	128+71 to 86+61																		
Reach 8	86+07 to 10+31																		
Arroyo Seco	n/a																		

Note: Letters a & b in Reach name denote a break in the reach due to a confluence or flow change.
n/a = not applicable

Color Codes:

0-8 ft/s
8 to 12 ft/s
> 12 ft/s

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Table 20: Alternative 13 Water Surface Elevation

Reach	River Station	Scenario I	Scenario II	Scenario III	Scenario IV
Reach 1	625+77 to 547+45				
Reach 2	546+45 to 510+05				
Reach 3a	504+93 to 477+85				
Reach 3b	475+68 to 452+58				
Reach 4	432+16 to 359+75				
Reach 5	358+63 to 271+89				
Reach 6a	270+28 to 262+73				
Reach 6b	257+85 to 144+23				
Reach 7a	142+91 to 131+22				
Reach 7b	128+71 to 86+81				
Reach 8	86+07 to 10+31				

Note: letters a & b in Reach name denote a break in the reach due to a confluence or flow change.

Color Codes:

Does not increase the water surface elevation
Increases the water surface elevation
No change from design conditions

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Table 21: Alternative 13 Velocities

Reach	River Station	Scenario I						Scenario II						Scenario III					
		Bank full	2-yr	5-yr	10-yr	25-yr	50-yr	Bank full	2-yr	5-yr	10-yr	25-yr	50-yr	Bank full	2-yr	5-yr	10-yr	25-yr	50-yr
Reach 2	546+45 to 510+05																		
Reach 3a	504+93 to 477+85																		
Reach 3b	475+68 to 452+58																		
Reach 4	432+16 to 359+75																		
Reach 5	358+63 to 271+89																		
Reach 6a	270+28 to 262+73																		
Reach 6b	257+85 to 144+23																		
Reach 7a	142+91 to 131+22																		
Reach 7b	128+71 to 86+61																		
Reach 8	86+07 to 10+31																		
Arroyo Seco	n/a																		

Note: Letters a & b in Reach name denote a break in the reach due to a confluence or flow change.
n/a = not applicable

Color Codes:

0-8 ft/s
8 to 12 ft/s
> 12 ft/s

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Table 22: Alternative 16 Water Surface Elevation

Reach	River Station	Scenario I	Scenario II	Scenario III	Scenario IV
Reach 1	625+77 to 547+45				
Reach 2	546+45 to 510+05				
Reach 3a	504+93 to 477+85				
Reach 3b	475+68 to 452+58				
Reach 4	432+16 to 359+75				
Reach 5	358+63 to 271+89				
Reach 6a	270+28 to 262+73				
Reach 6b	257+85 to 144+23				
Reach 7a	142+91 to 131+22				
Reach 7b	128+71 to 86+81				
Reach 8	86+07 to 10+31				

Note: letters a & b in Reach name denote a break in the reach due to a confluence or flow change.

Color Codes:

Does not increase the water surface elevation

Increases the water surface elevation

No change from design conditions

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Table 23: Alternative 16 Velocities

Reach	River Station	Scenario I						Scenario II						Scenario III					
		Bank full	2-yr	5-yr	10-yr	25-yr	50-yr	Bank full	2-yr	5-yr	10-yr	25-yr	50-yr	Bank full	2-yr	5-yr	10-yr	25-yr	50-yr
Reach 2	546+45 to 510+05																		
Reach 3a	504+93 to 477+85																		
Reach 3b	475+68 to 452+58																		
Reach 4	432+16 to 359+75																		
Reach 5	358+63 to 271+89																		
Reach 6a	270+28 to 262+73																		
Reach 6b	257+85 to 144+23																		
Reach 7a	142+91 to 131+22																		
Reach 7b	128+71 to 86+61																		
Reach 8	86+07 to 10+31																		
Arroyo Seco	n/a																		

Note: Letters a & b in Reach name denote a break in the reach due to a confluence or flow change.
n/a = not applicable

Color Codes:

0-8 ft/s
8 to 12 ft/s
> 12 ft/s

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Table 24: Alternative 20 Water Surface Elevation

Reach	River Station	Scenario I	Scenario II	Scenario III	Scenario IV
Reach 1	625+77 to 547+45				
Reach 2	546+45 to 510+05				
Reach 3a	504+93 to 477+85				
Reach 3b	475+68 to 452+58				
Reach 4	432+16 to 359+75				
Reach 5	358+63 to 271+89				
Reach 6a	270+28 to 262+73				
Reach 6b	257+85 to 144+23				
Reach 7a	142+91 to 131+22				
Reach 7b	128+71 to 86+81				
Reach 8	86+07 to 10+31				

Note: letters a & b in Reach name denote a break in the reach due to a confluence or flow change.

Color Codes:

Does not increase the water surface elevation
Increases the water surface elevation
No change from design conditions

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Table 25: Alternative 20 Velocities

Reach	River Station	Scenario I						Scenario II						Scenario III					
		Bank full	2-yr	5-yr	10-yr	25-yr	50-yr	Bank full	2-yr	5-yr	10-yr	25-yr	50-yr	Bank full	2-yr	5-yr	10-yr	25-yr	50-yr
Reach 2	546+45 to 510+05																		
Reach 3a	504+93 to 477+85																		
Reach 3b	475+68 to 452+58																		
Reach 4	432+16 to 359+75																		
Reach 5	358+63 to 271+89																		
Reach 6a	270+28 to 262+73																		
Reach 6b	257+85 to 144+23																		
Reach 7a	142+91 to 131+22																		
Reach 7b	128+71 to 86+61																		
Reach 8	86+07 to 10+31																		
Arroyo Seco	n/a																		
Verdugo Wash	n/a																		

Note: Letters a & b in Reach name denote a break in the reach due to a confluence or flow change.
n/a = not applicable

Color Codes:

0-8 ft/s
8 to 12 ft/s
> 12 ft/s

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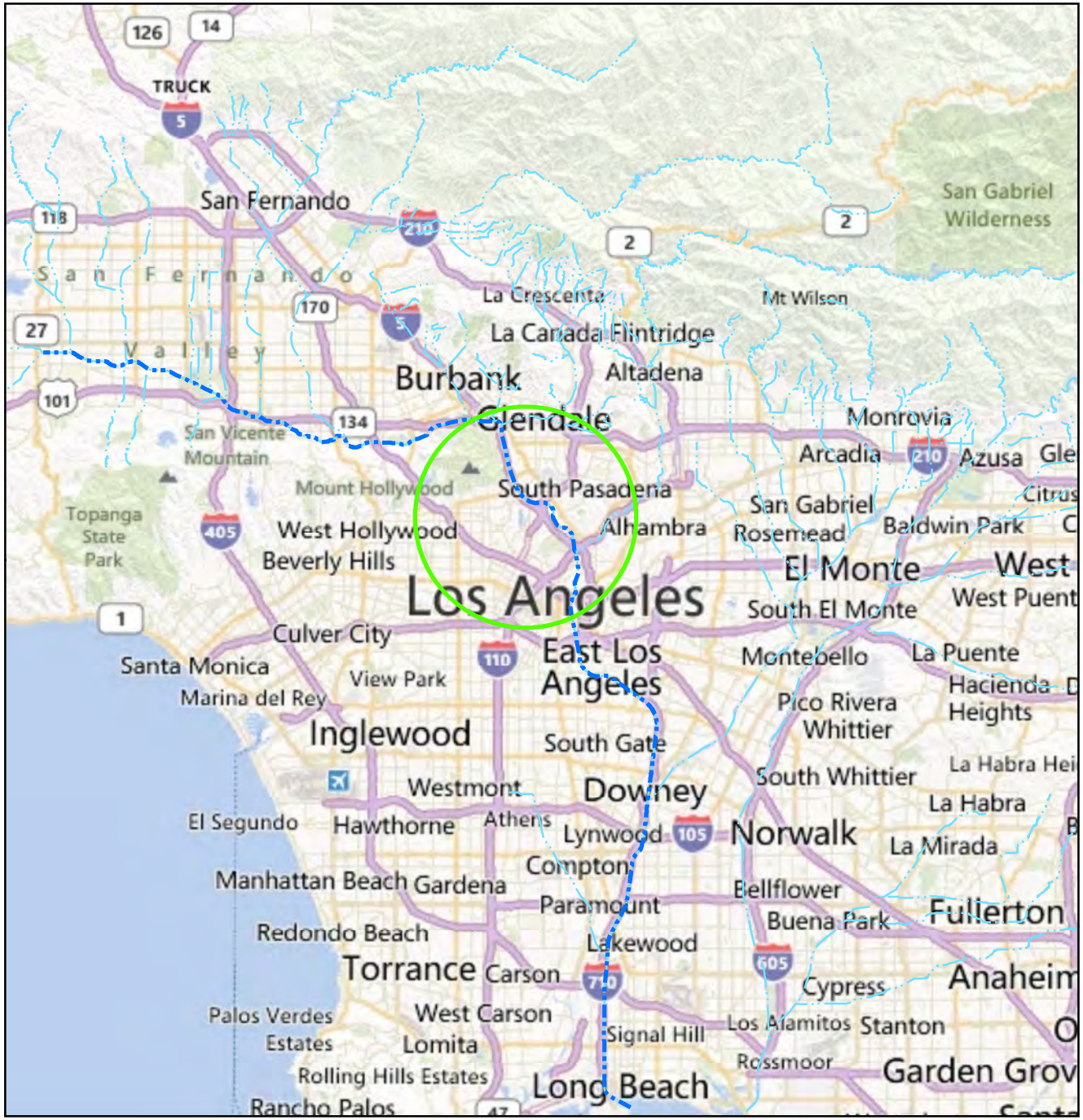


N

Legend

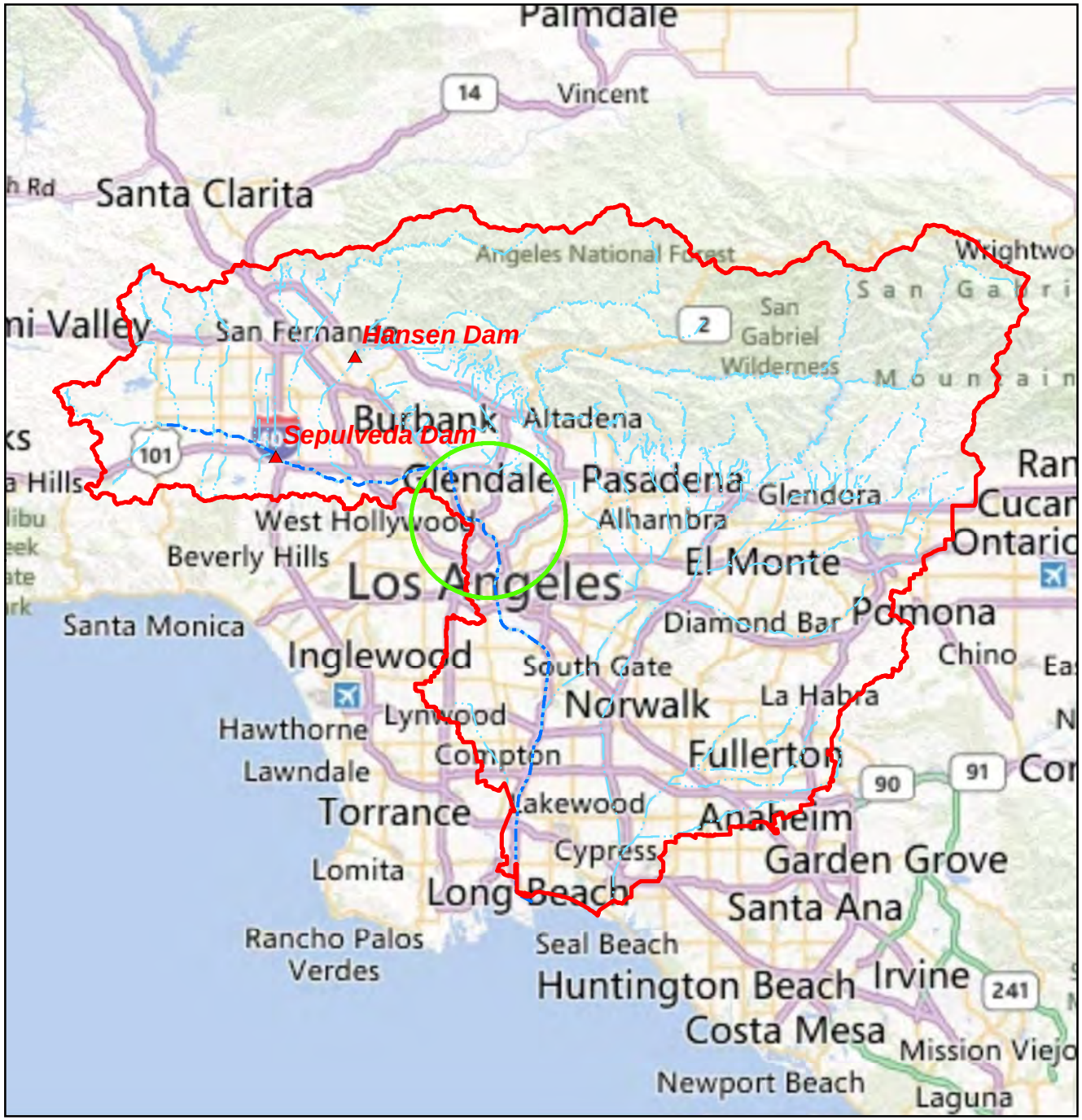
- Los Angeles River
- Watercourse
- Study Area

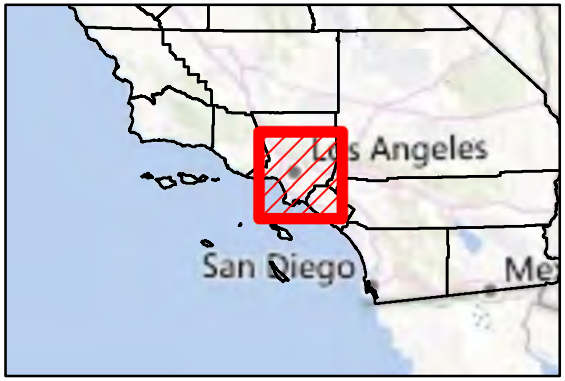
0 5 10
Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
ARBOR REACH
LOCATION MAP

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

Legend

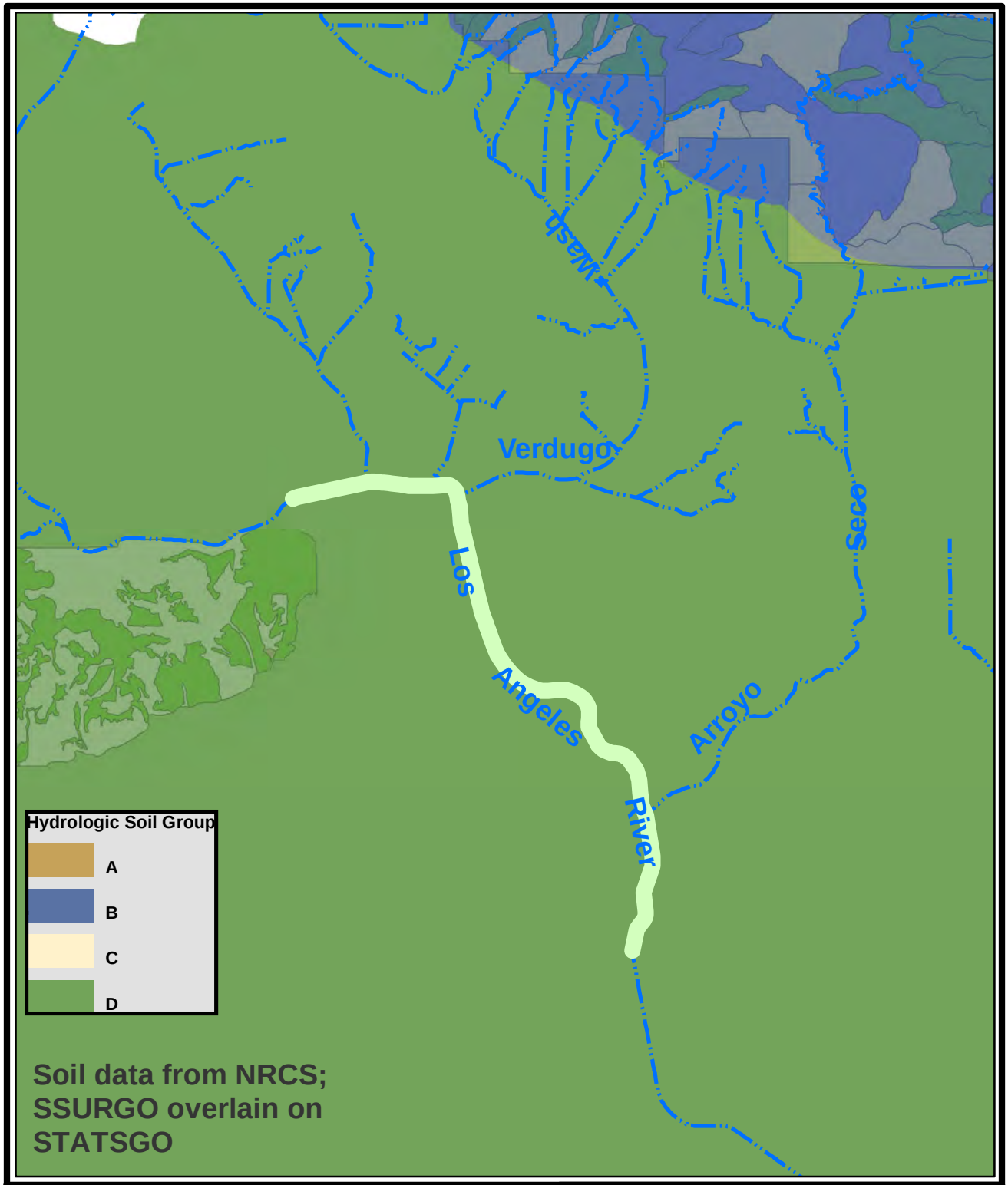
- LACDA Watershed Boundary
- Los Angeles River
- Watercourse
- Corps Dam
- Study Area

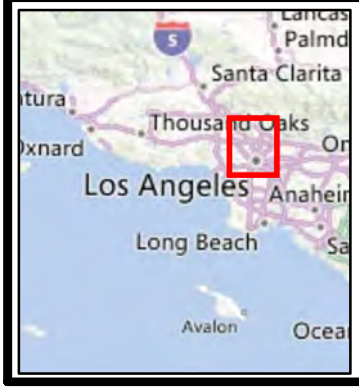
0 5 10
Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES COUNTY DRAINAGE AREA (LACDA)

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N **Legend**

Watercourse

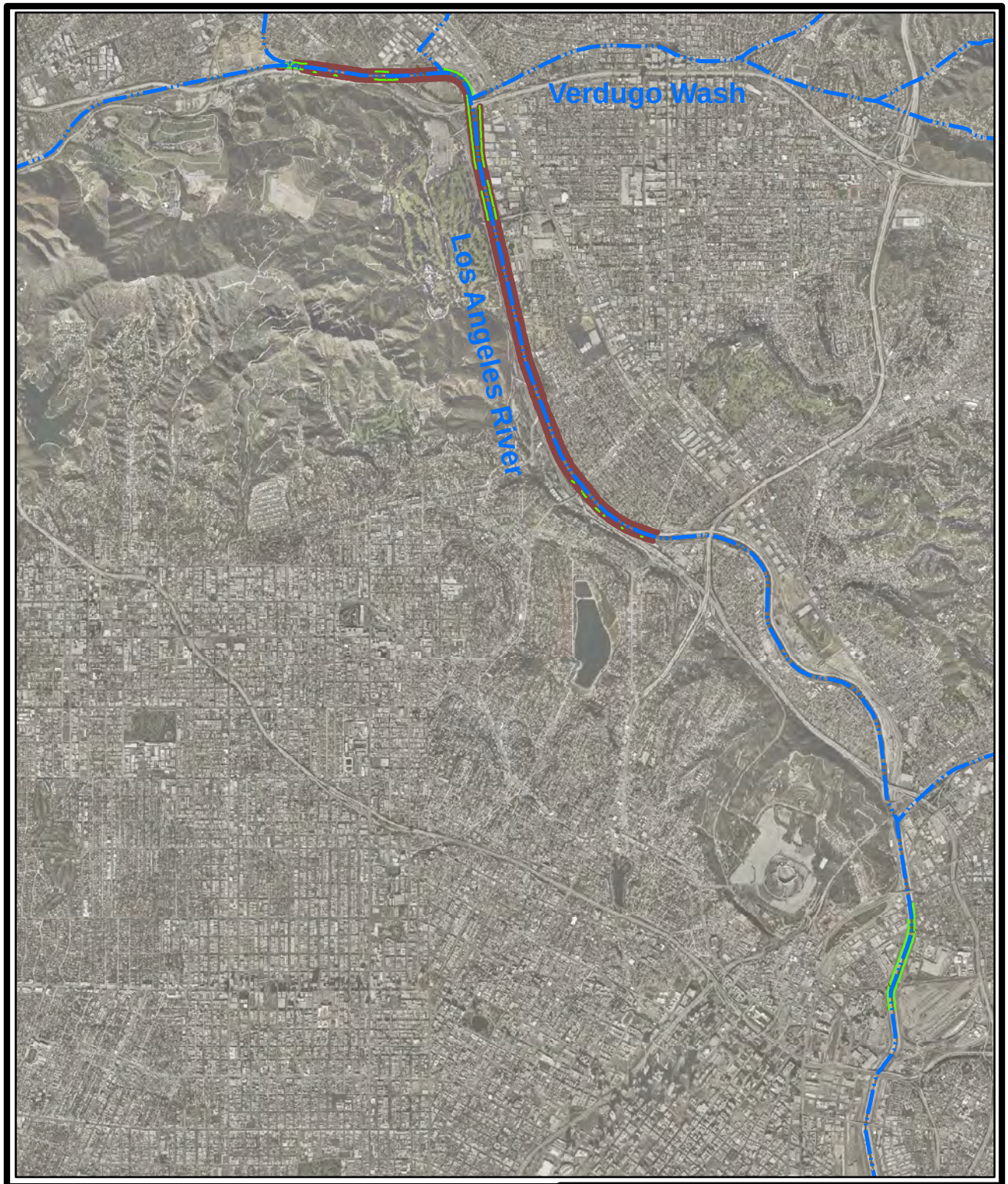
ARBOR Reach

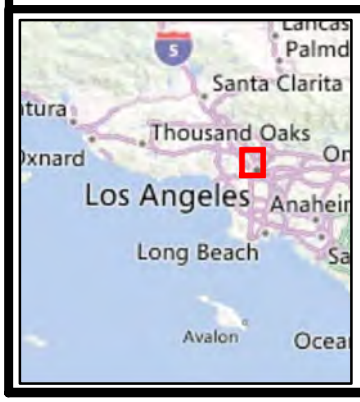
0 1.5 3
Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

ARBOR AREA AND VICINITY HYDROLOGIC SOIL GROUPS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

Legend

Watercourse

Levee

Floodwall

Leveed reaches from National Levee Database (NLD) July 2012

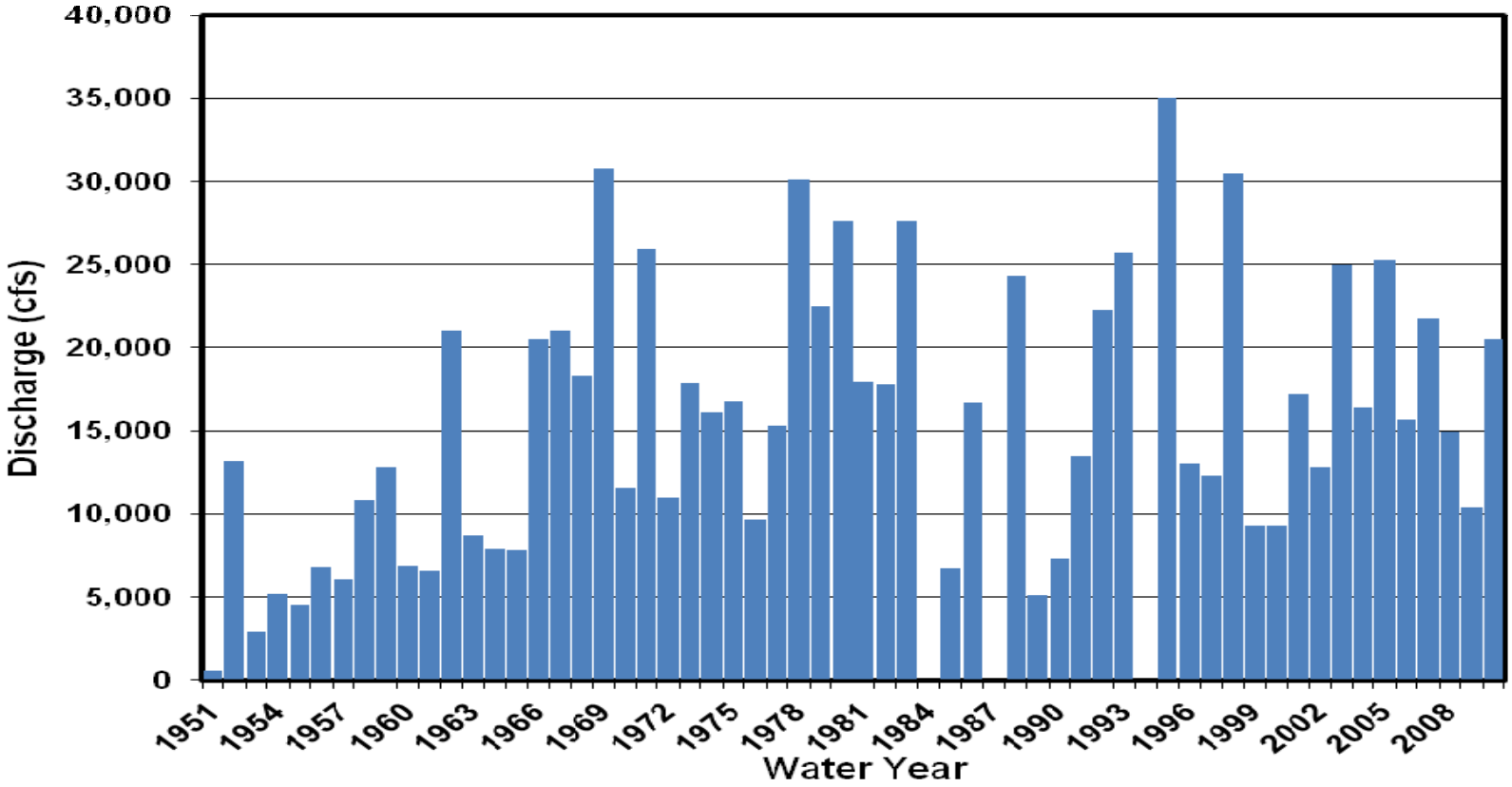
0 0.5 1

Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER LEVEED REACHES ARBOR AREA

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



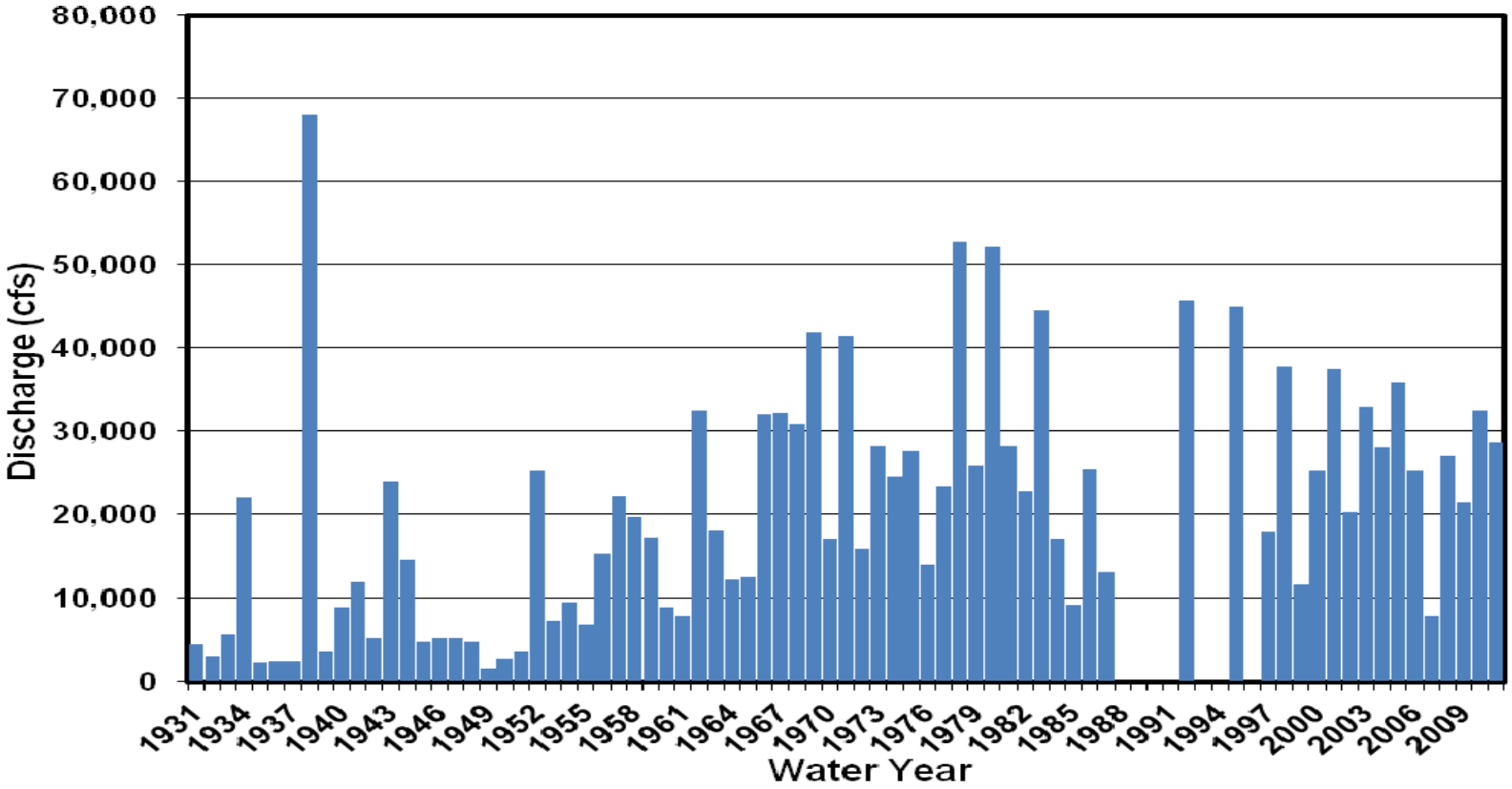
Peak annual flows for period of record.

Ref: Los Angeles County Department of Public Works (LACDPW) Gage F300-R; Los Angles River at Tujunga Ave.

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER AT TUJUNGA AVE.
PERIOD OF RECORD FLOWS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



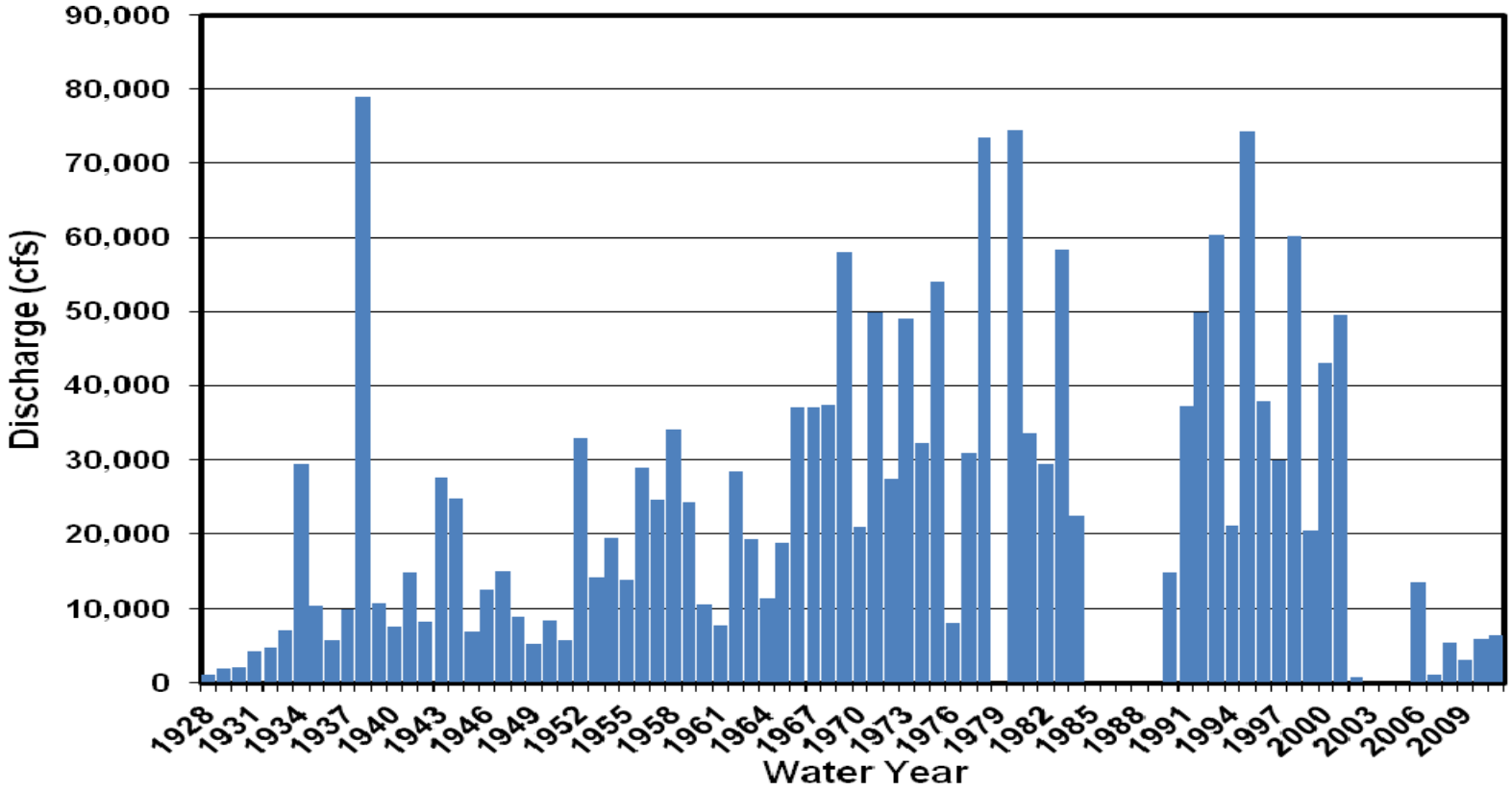
Peak annual flows for period of record.

Ref: Los Angeles County Department of Public Works (LACDPW) Gage F57C-R; Los Angles River above Arroyo Seco.

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER ABOVE ARROYO SECO
PERIOD OF RECORD FLOWS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



Peak annual flows for period of record.

Ref: Los Angeles County Department of Public Works (LACDPW) Gage F34D-R; Los Angles River below Firestone Blvd.

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER BELOW FIRESTONE BLVD.
PERIOD OF RECORD FLOWS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

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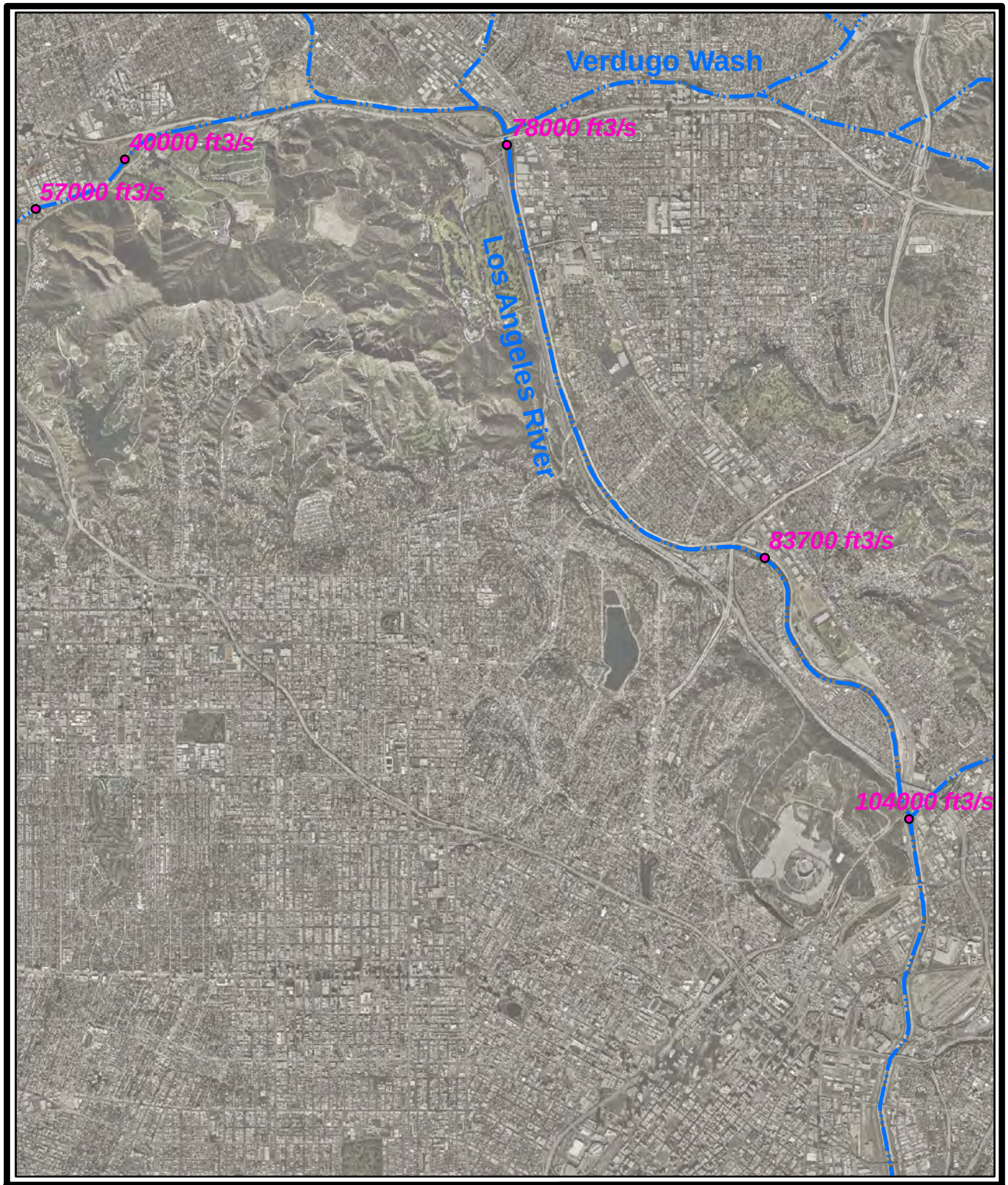
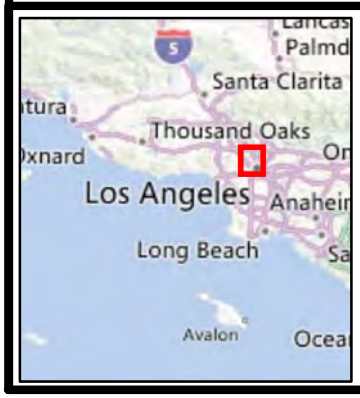




N **Legend**

Watercourse

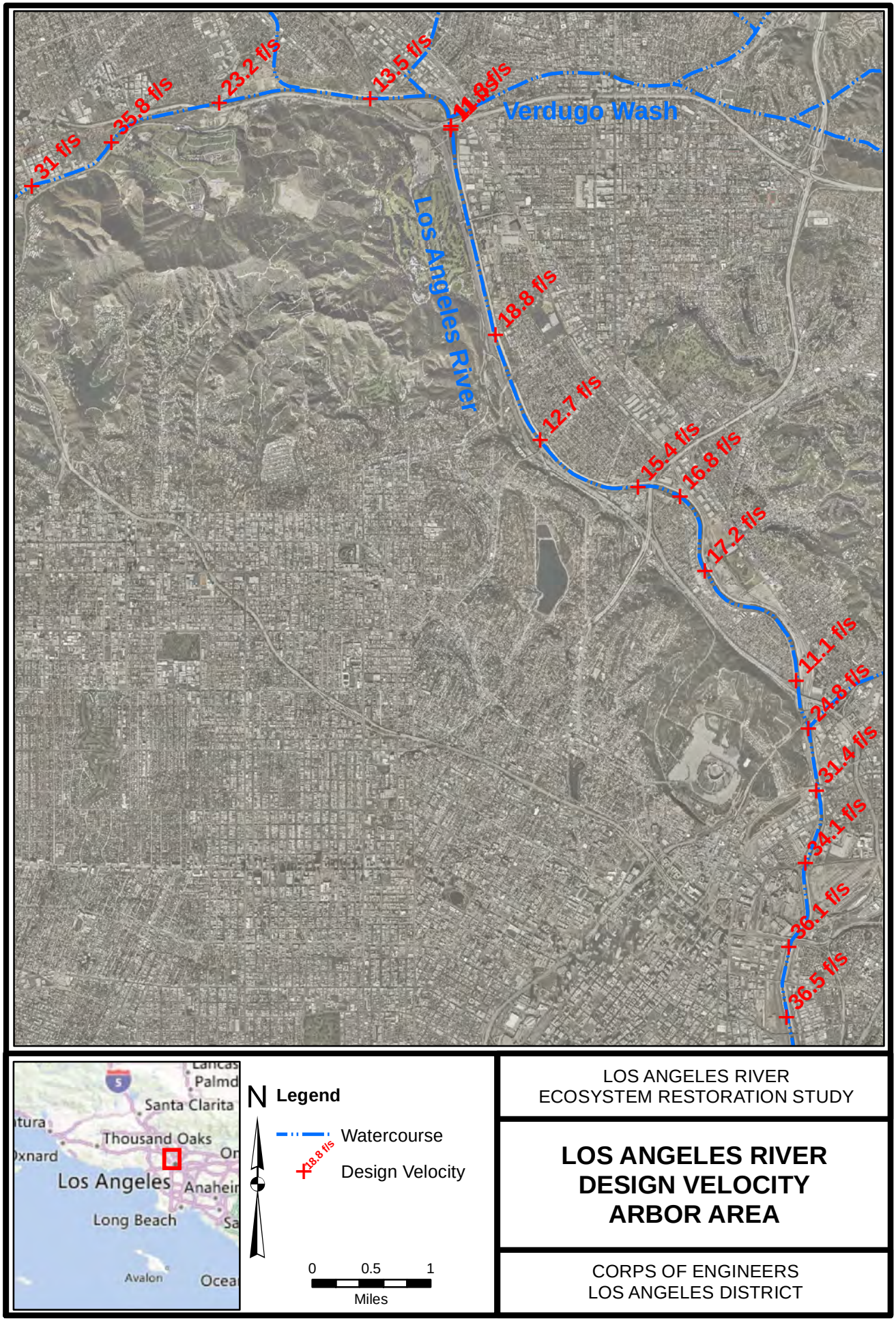
78,000 ft3/s
Design Discharge

0 0.5 1
Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER DESIGN DISCHARGE ARBOR AREA

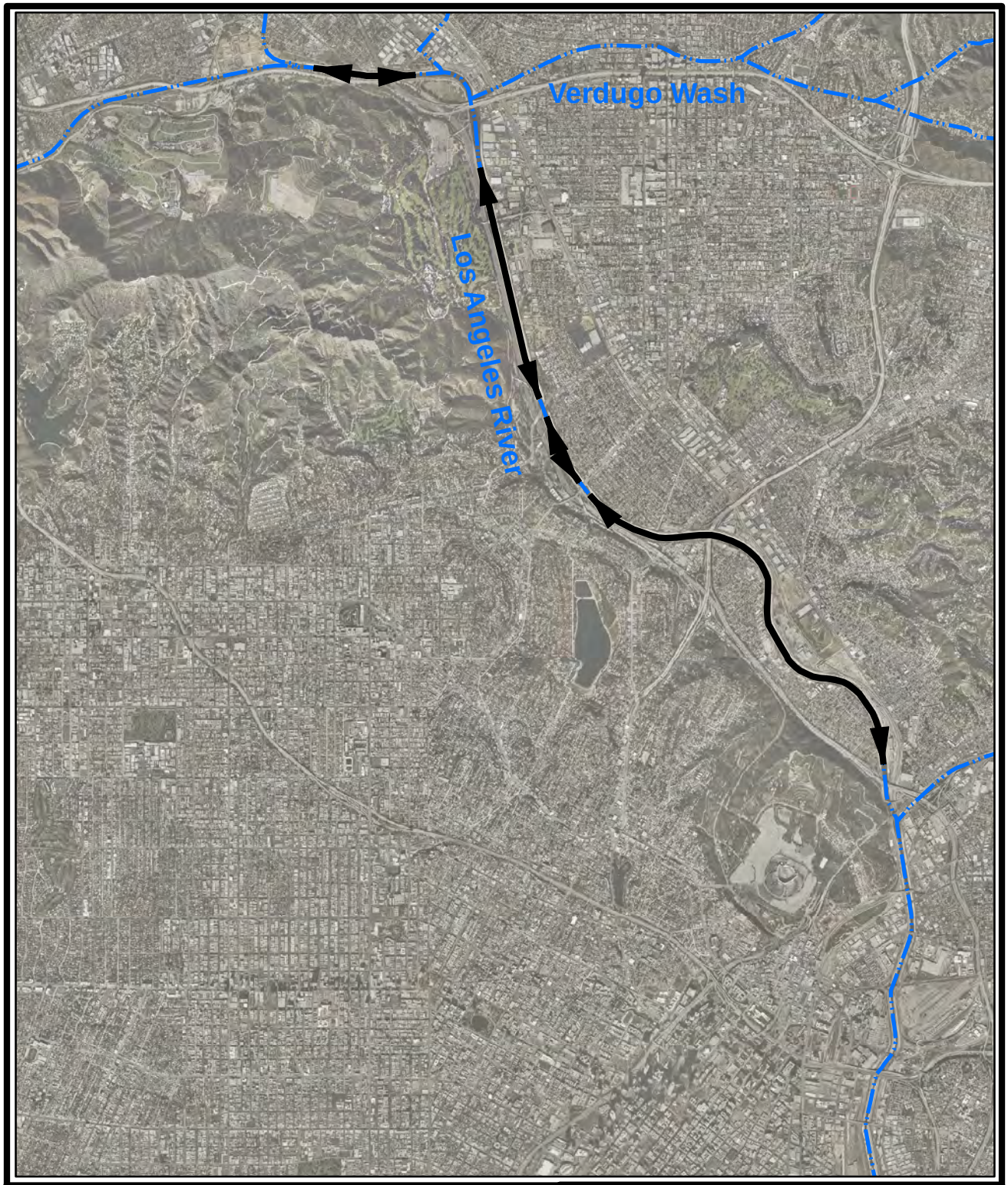
CORPS OF ENGINEERS
LOS ANGELES DISTRICT

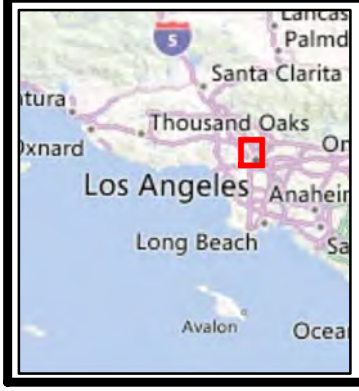


LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
DESIGN VELOCITY
ARBOR AREA

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

Legend

Watercourse

Unlined Invert Section

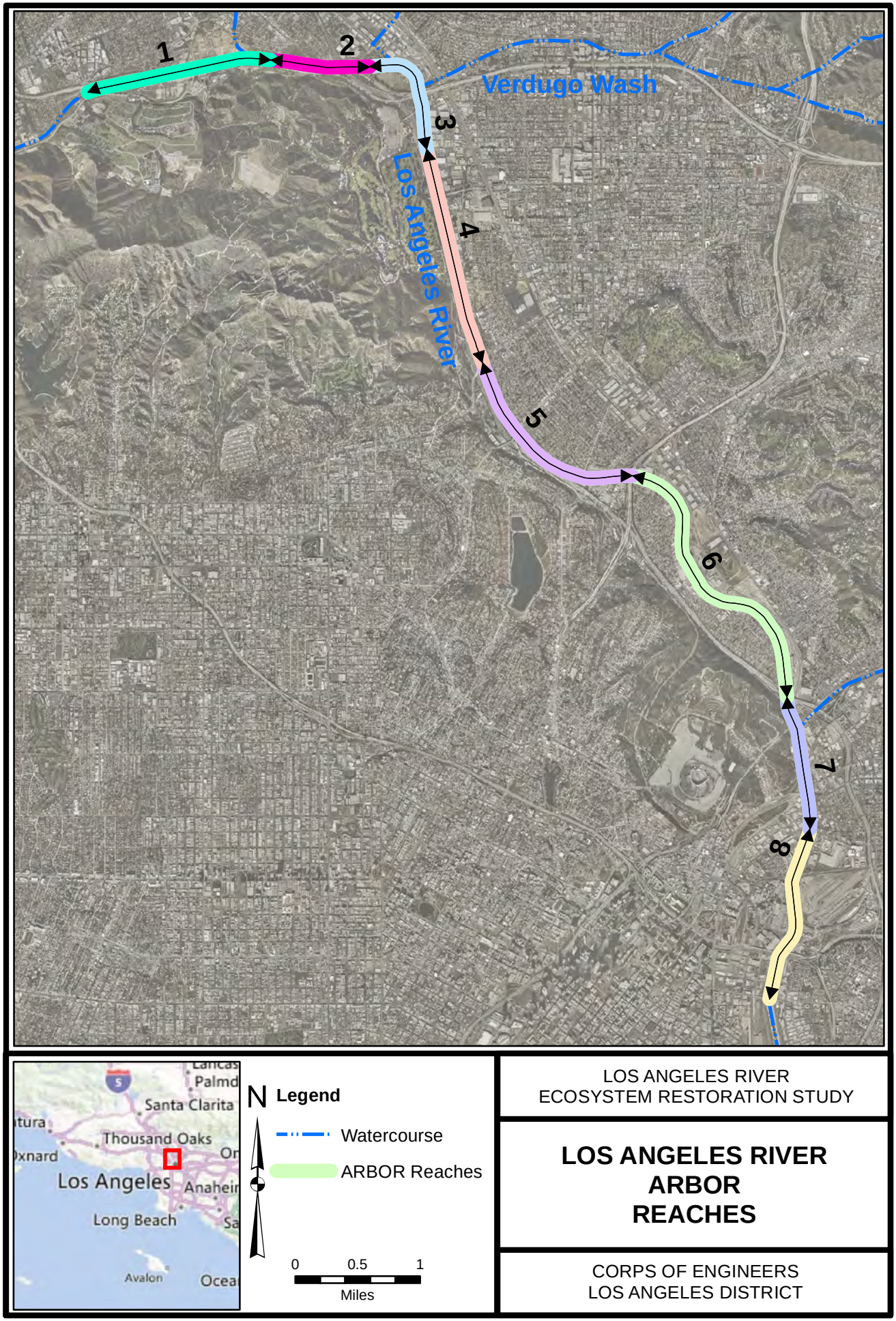
0 0.5 1

Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
UNLINED INVERT SECTIONS
ARBOR AREA

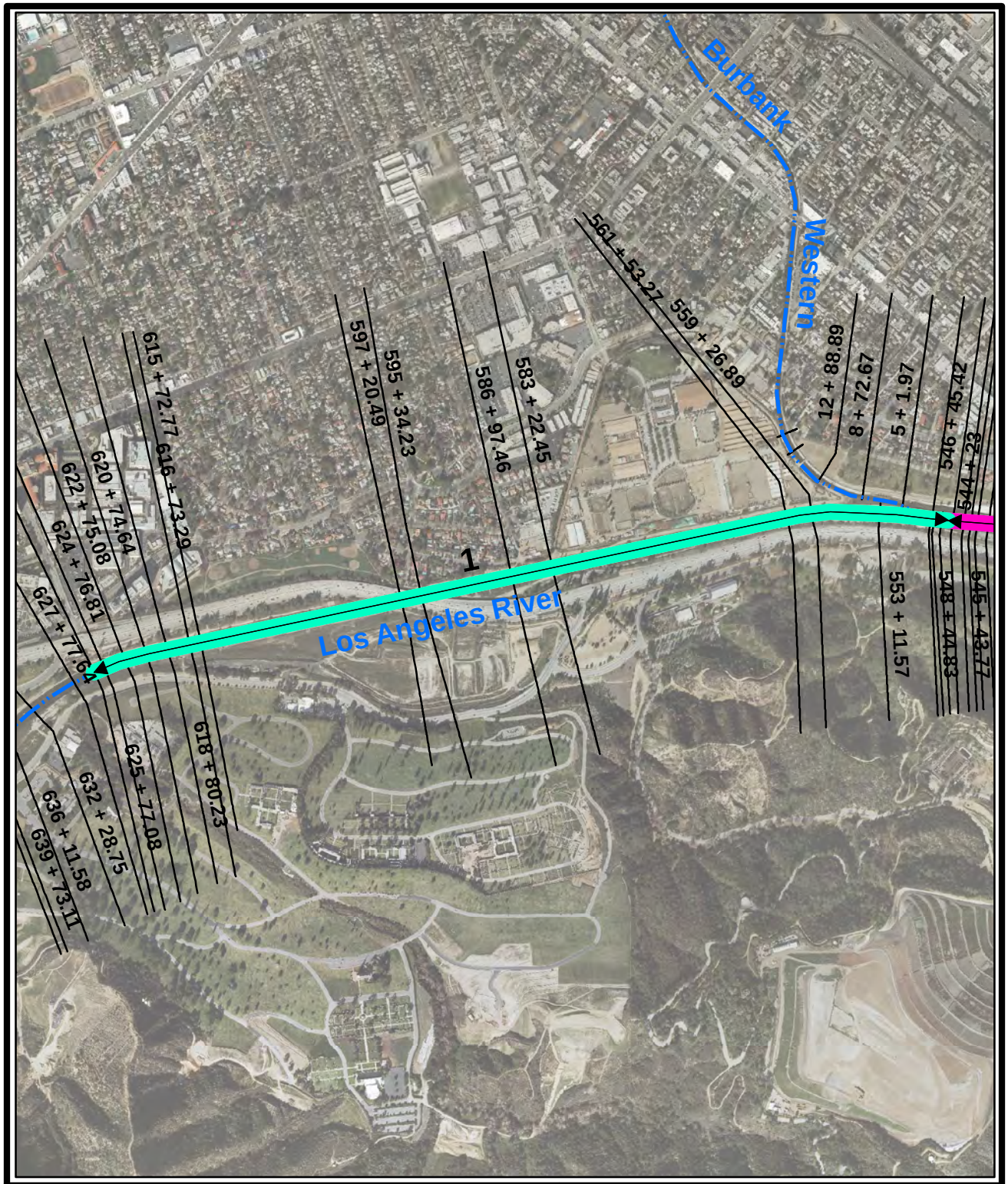
CORPS OF ENGINEERS
LOS ANGELES DISTRICT

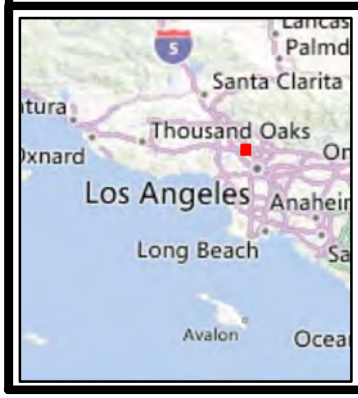


LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER ARBOR REACHES

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

Legend

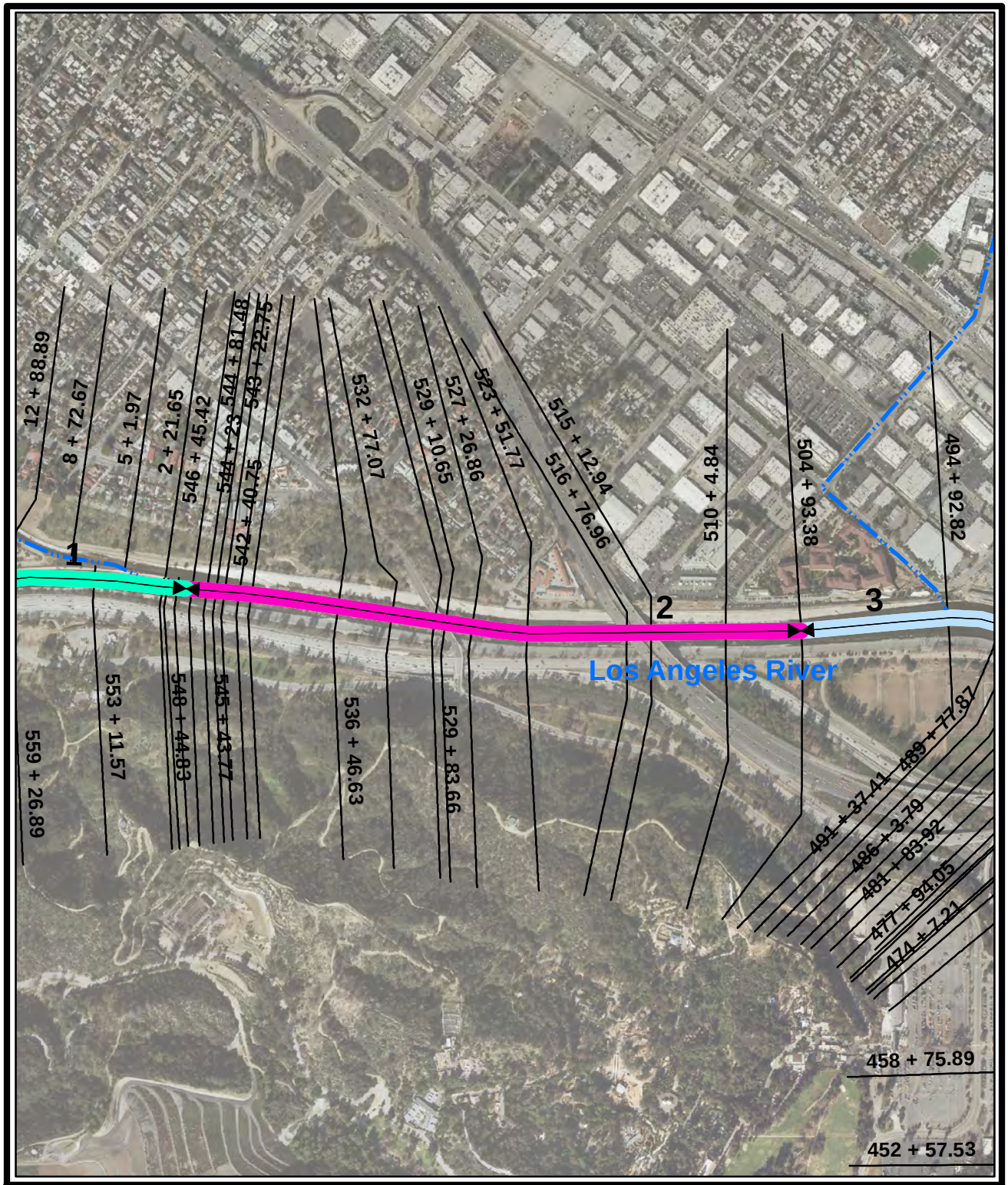
- Watercourse
- ARBOR Reaches
- Cross Section

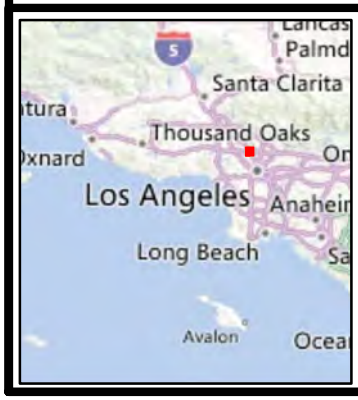
0 1,000 2,000
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER CROSS SECTIONS REACH 1

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

Legend

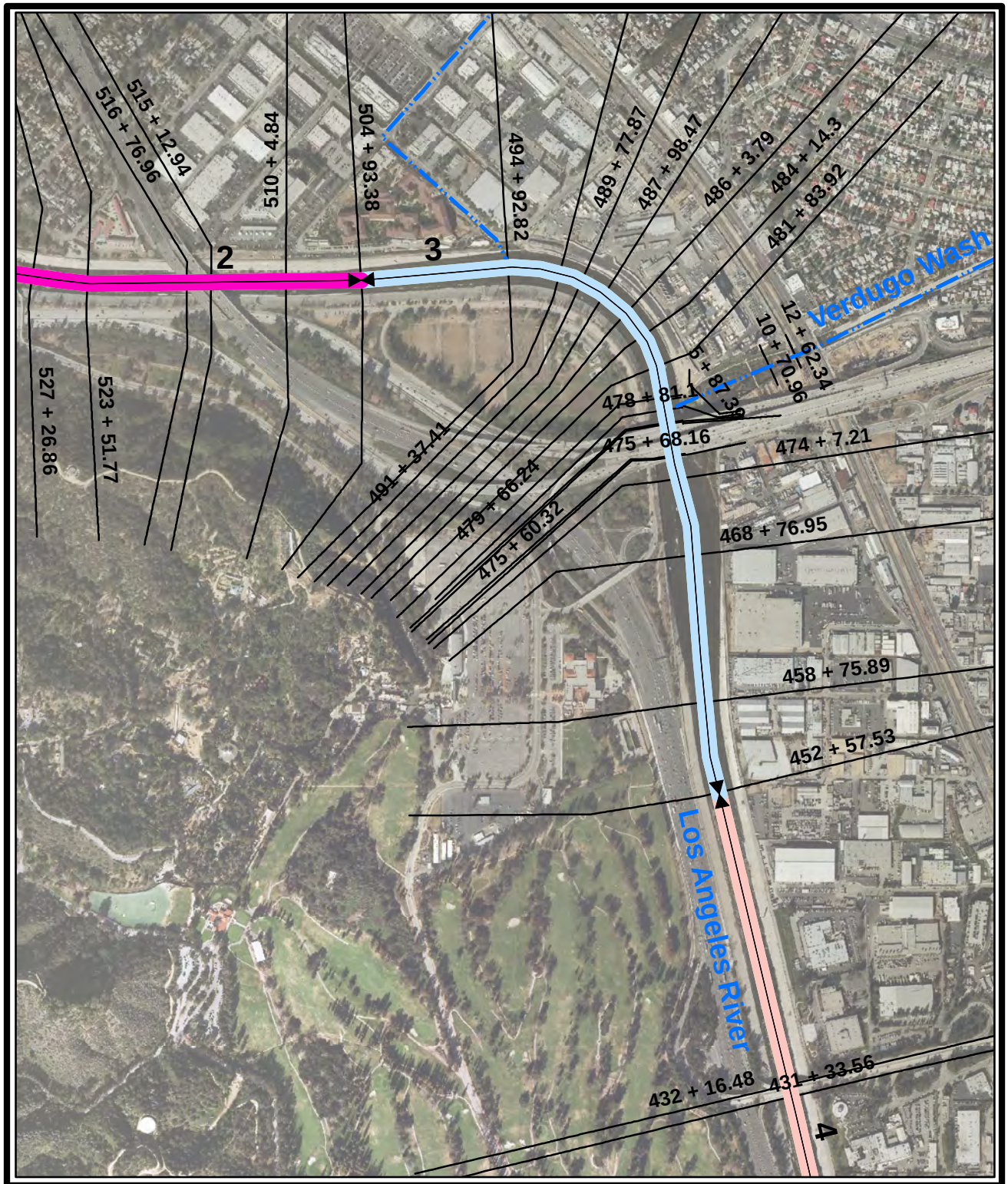
- Watercourse
- ARBOR Reaches
- Cross Section

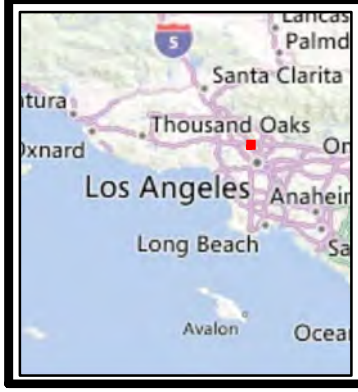
0 750 1,500
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER CROSS SECTIONS REACH 2

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

Legend

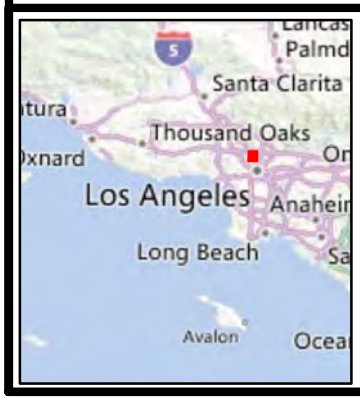
- Watercourse
- ARBOR Reaches
- Cross Section

0 750 1,500
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER CROSS SECTIONS REACH 3

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

Watercourse

ARBOR Reaches

Cross Section

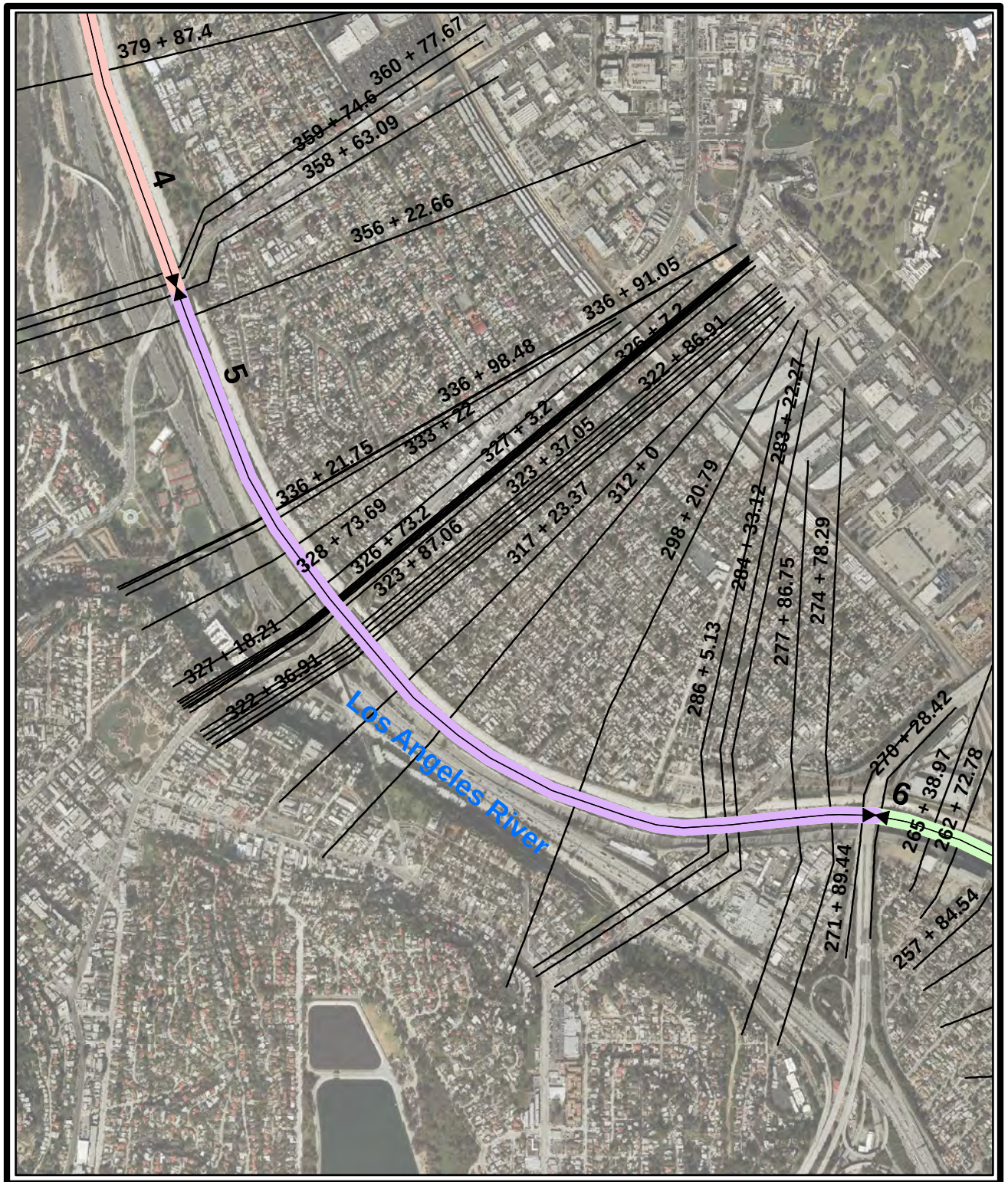
0 1,000 2,000

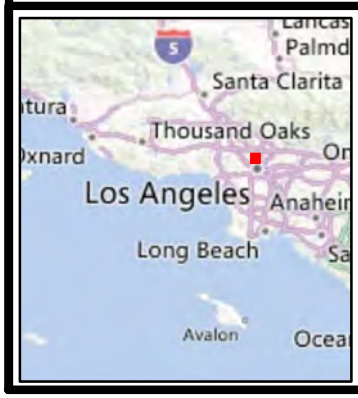
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER CROSS SECTIONS REACH 4

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

Legend

Watercourse

ARBOR Reaches

Cross Section

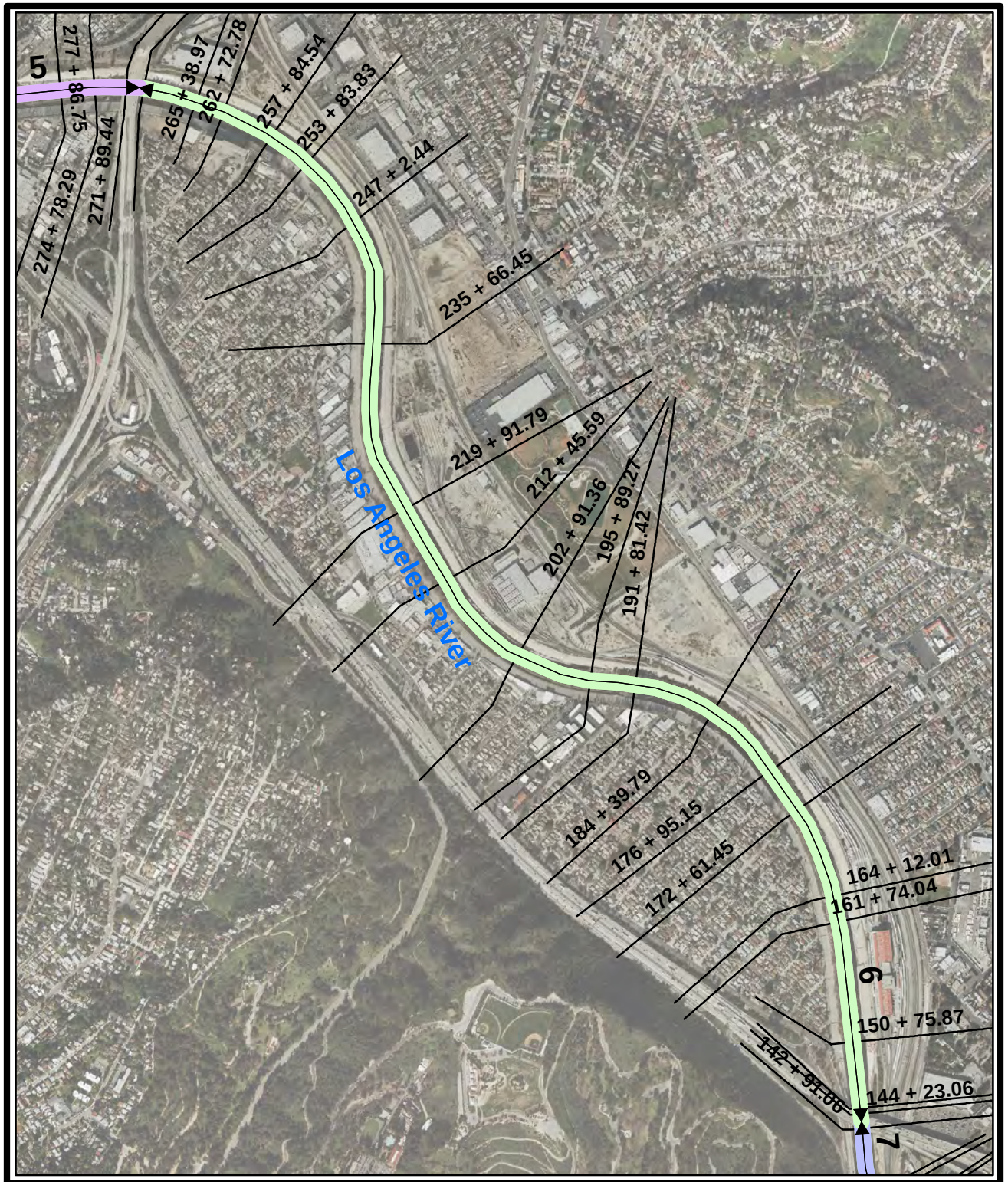
0 1,000 2,000

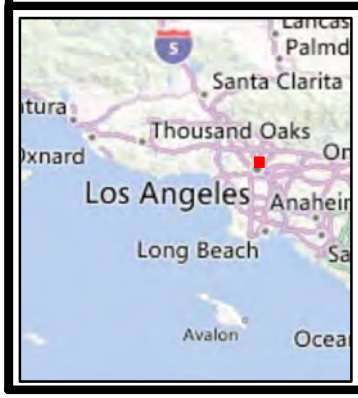
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER CROSS SECTIONS REACH 5

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

Legend

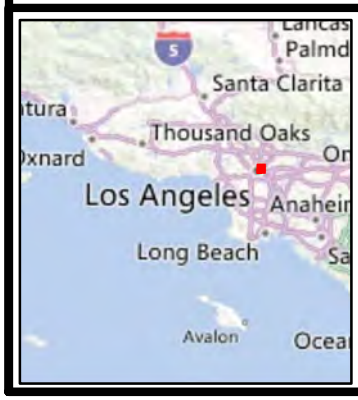
- Watercourse
- ARBOR Reaches
- Cross Section

0 1,000 2,000
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER CROSS SECTIONS REACH 6

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

Watercourse

ARBOR Reaches

Cross Section

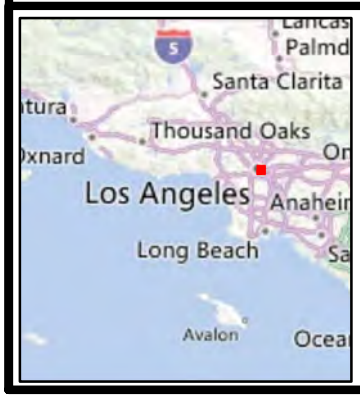
0 750 1,500

Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER CROSS SECTIONS REACH 7

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

Watercourse

ARBOR Reaches

Cross Section

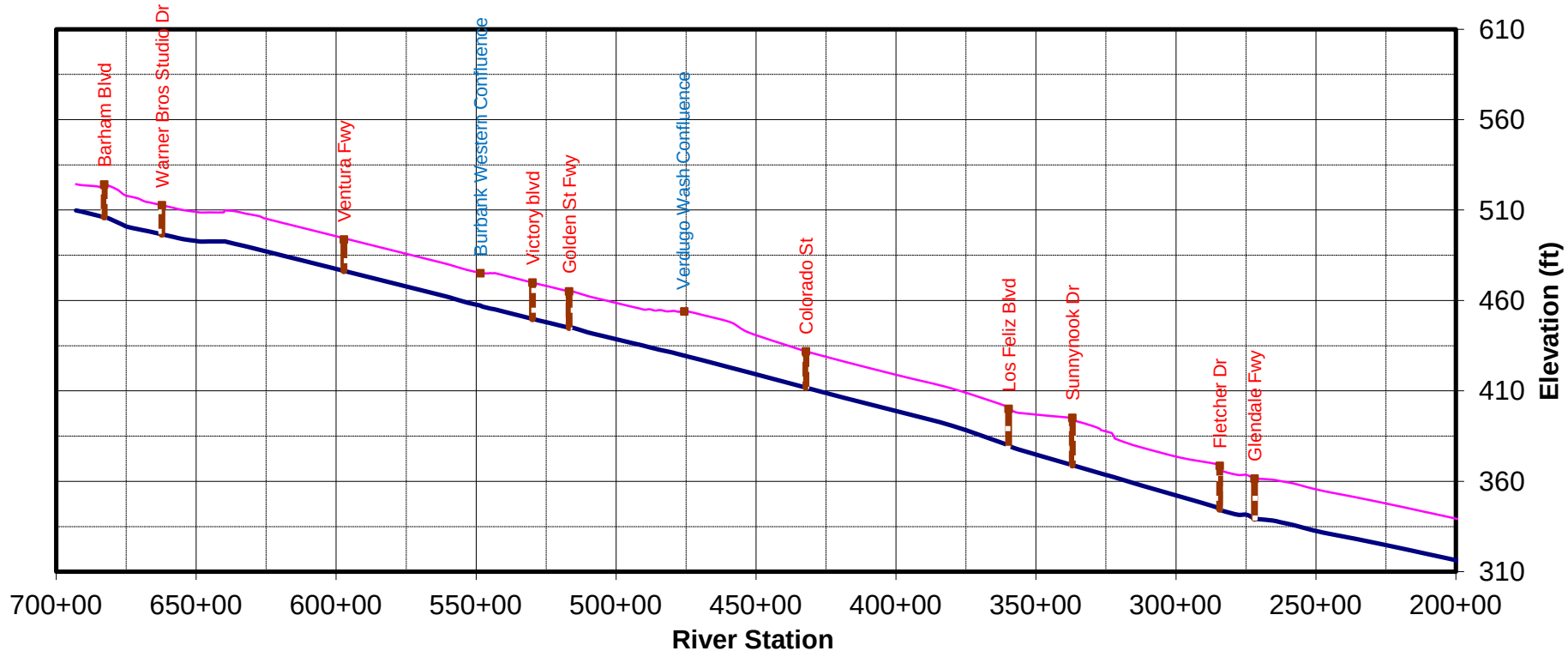
0 750 1,500

Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER CROSS SECTIONS REACH 8

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



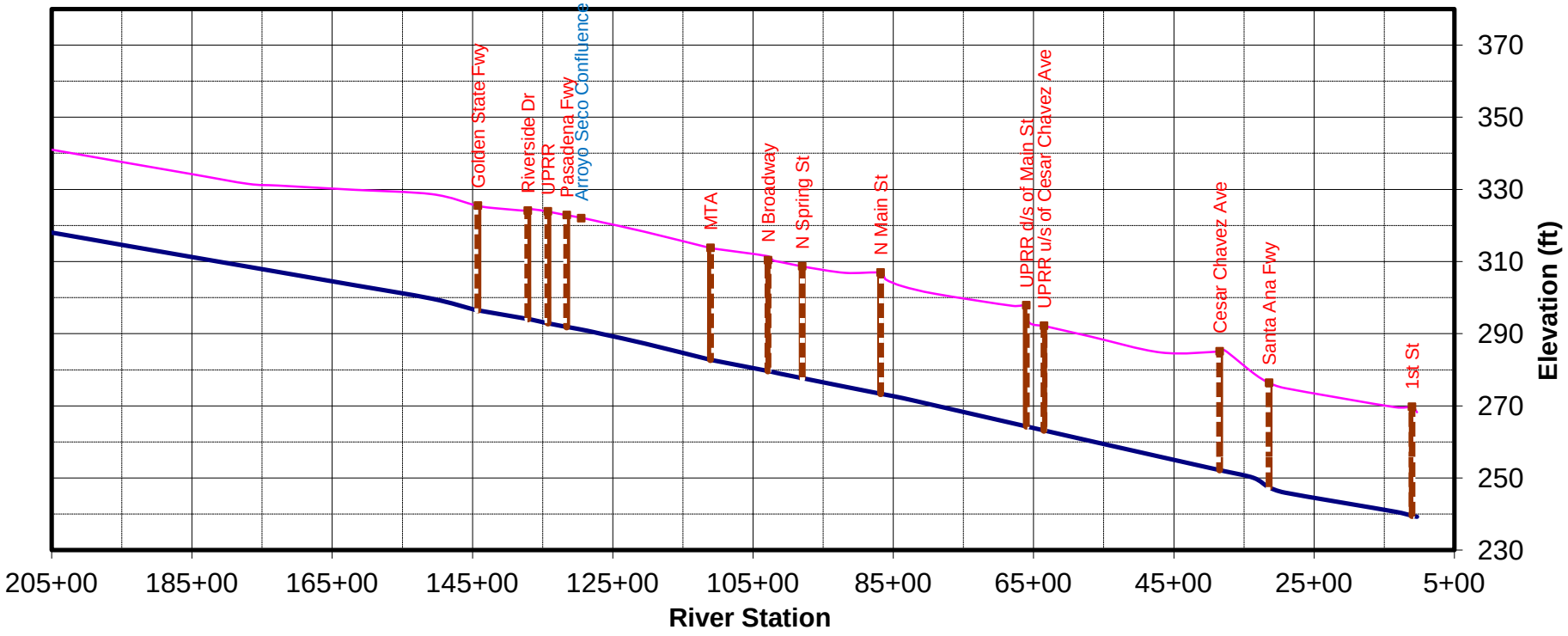
Streambed elevations based on lowest elevation in cross section from HEC-RAS models for the existing conditions.

LAR Invert — Top of Channel — Bridge

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER INVERT PROFILE WITH BRIDGE LOCATIONS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



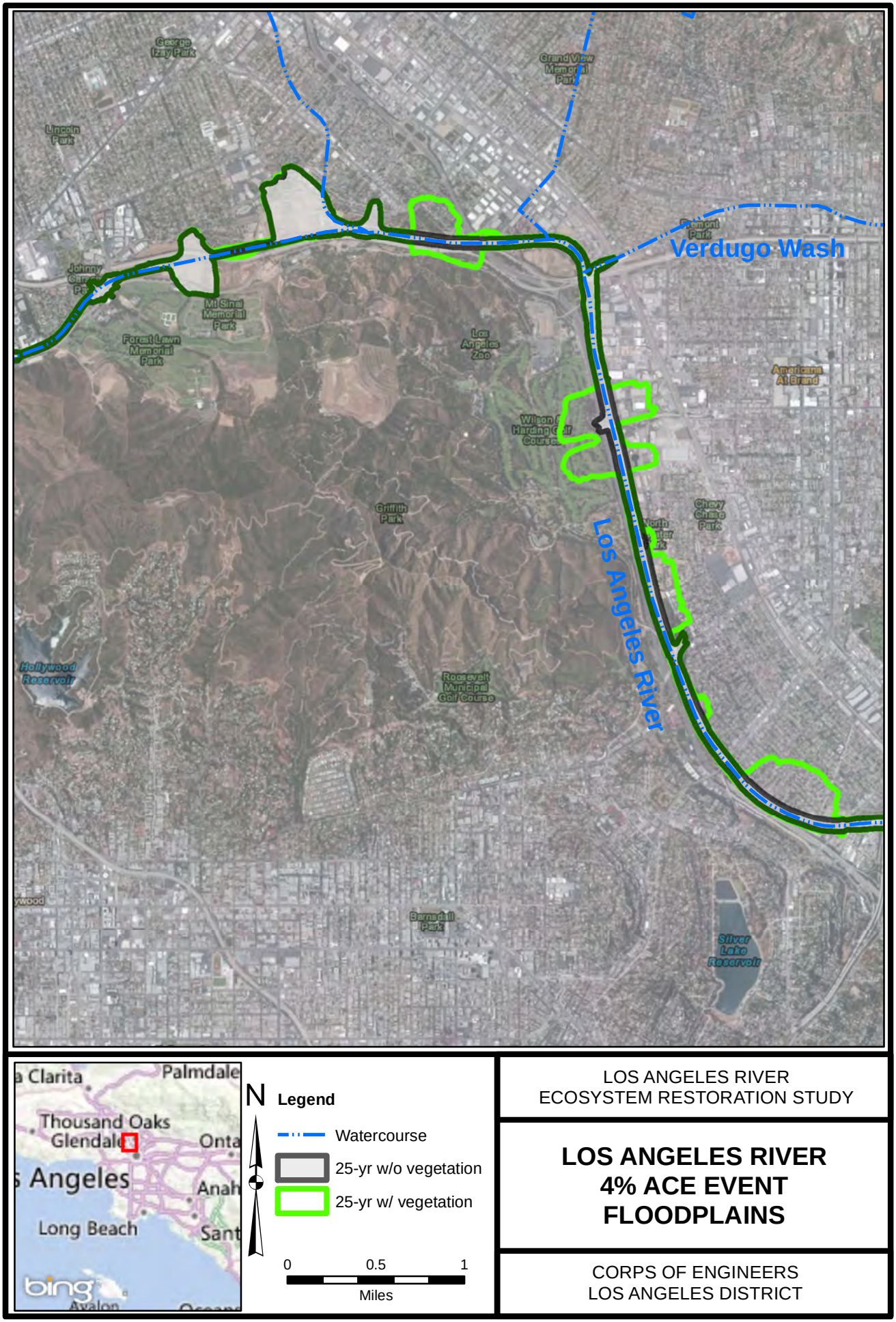
Streambed elevations based on lowest elevation in cross section from HEC-RAS models for the existing conditions.

LAR Invert — Top of Channel — Bridge

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER INVERT PROFILE WITH BRIDGE LOCATIONS

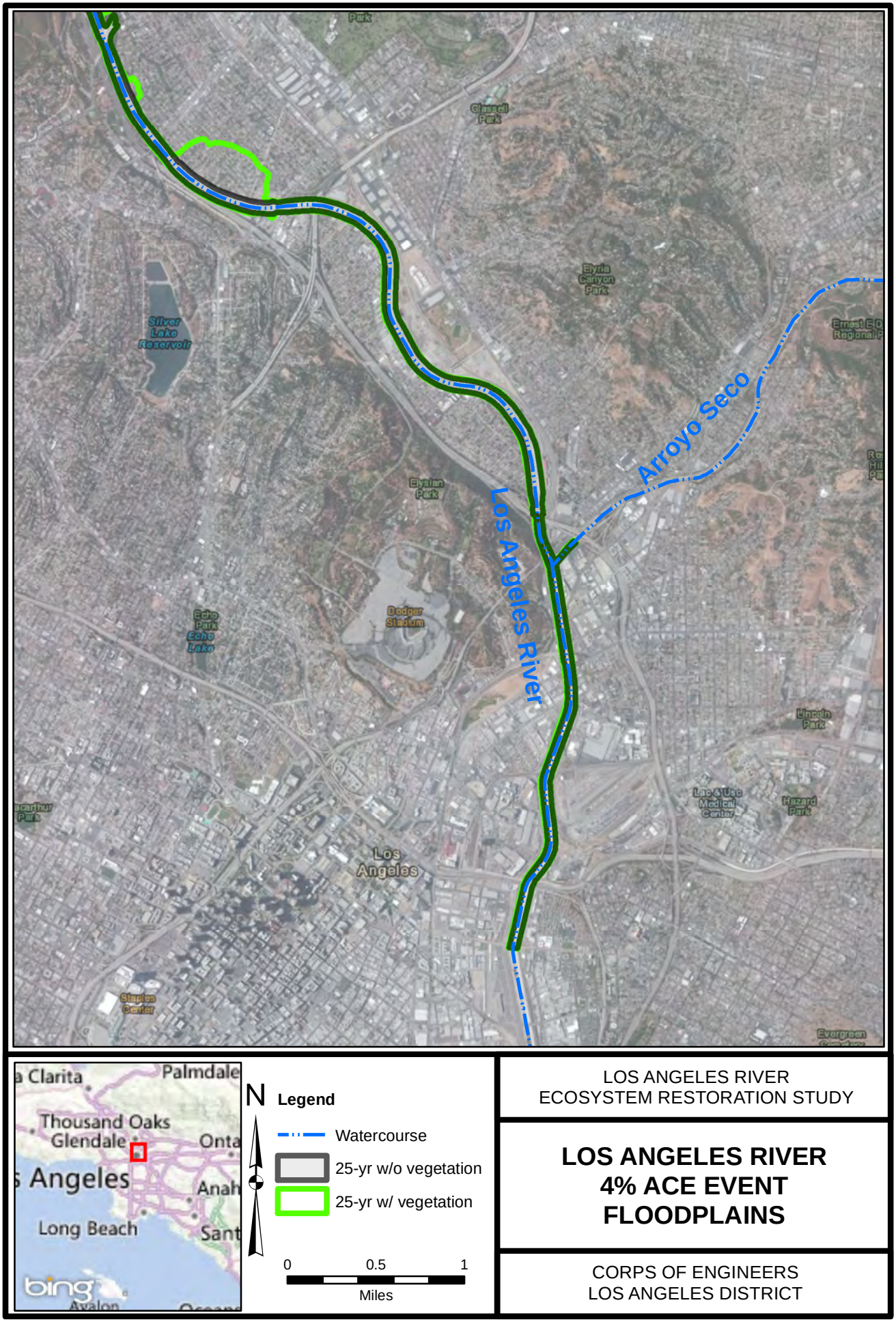
CORPS OF ENGINEERS
LOS ANGELES DISTRICT



LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
4% ACE EVENT
FLOODPLAINS

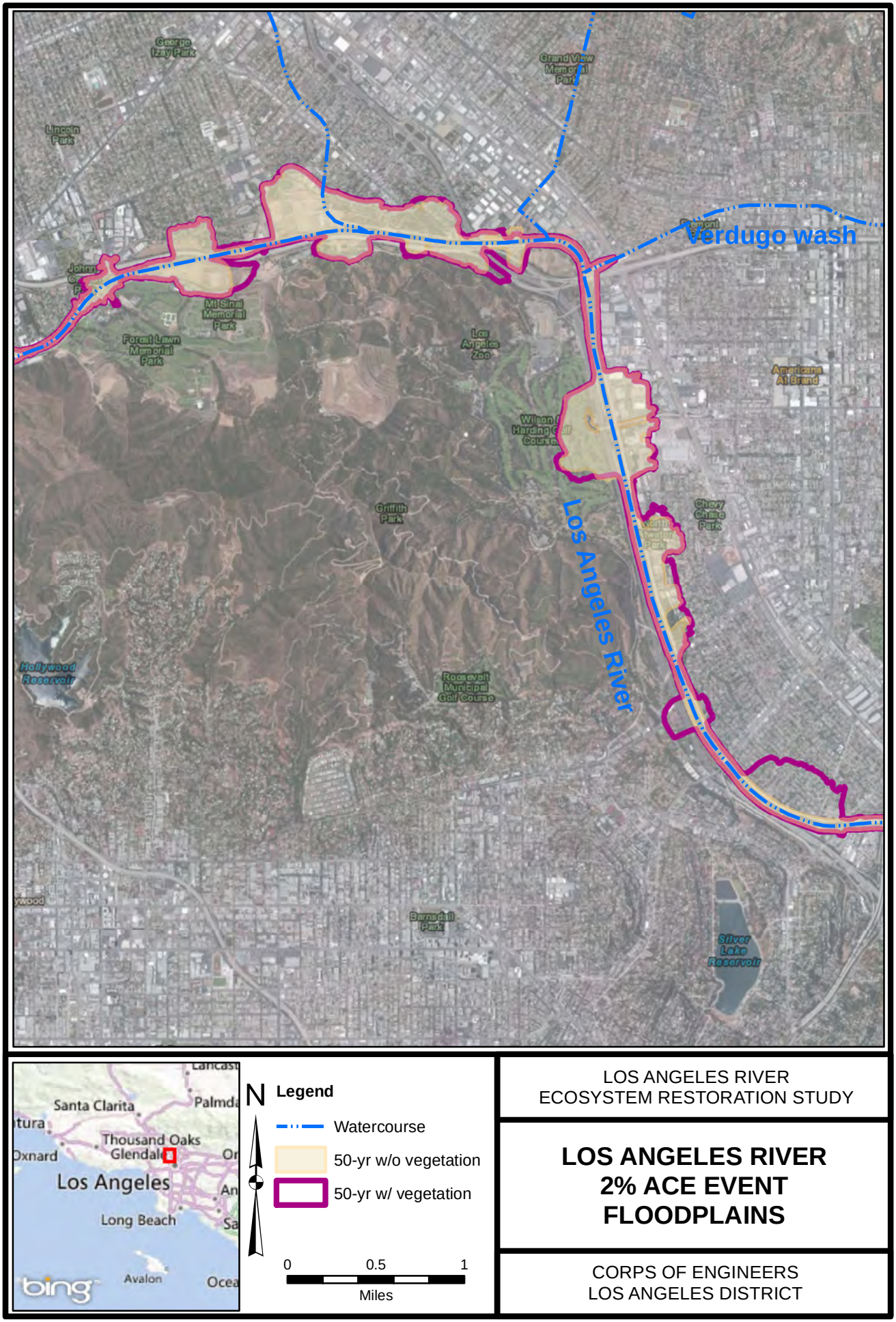
CORPS OF ENGINEERS
LOS ANGELES DISTRICT



LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
4% ACE EVENT
FLOODPLAINS

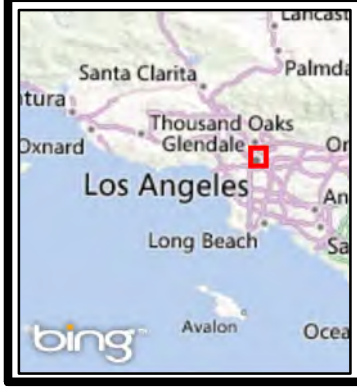
CORPS OF ENGINEERS
LOS ANGELES DISTRICT



LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
2% ACE EVENT
FLOODPLAINS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

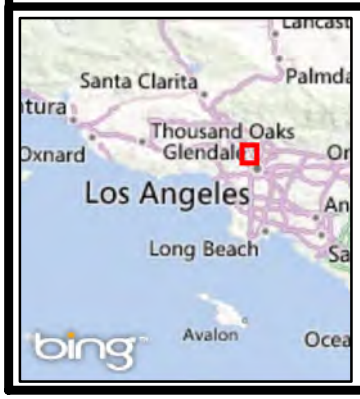
- Watercourse
- 50-yr w/o vegetation
- 50-yr w/ vegetation

0 0.5 1
Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER 2% ACE EVENT FLOODPLAINS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

- Watercourse
- 100-yr w/o vegetation
- 100-yr w/ vegetation

0 0.5 1
Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
1% ACE EVENT
FLOODPLAINS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

N **Legend**

- Watercourse
- 100-yr w/o vegetation
- 100-yr w/ vegetation

0 0.5 1
Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

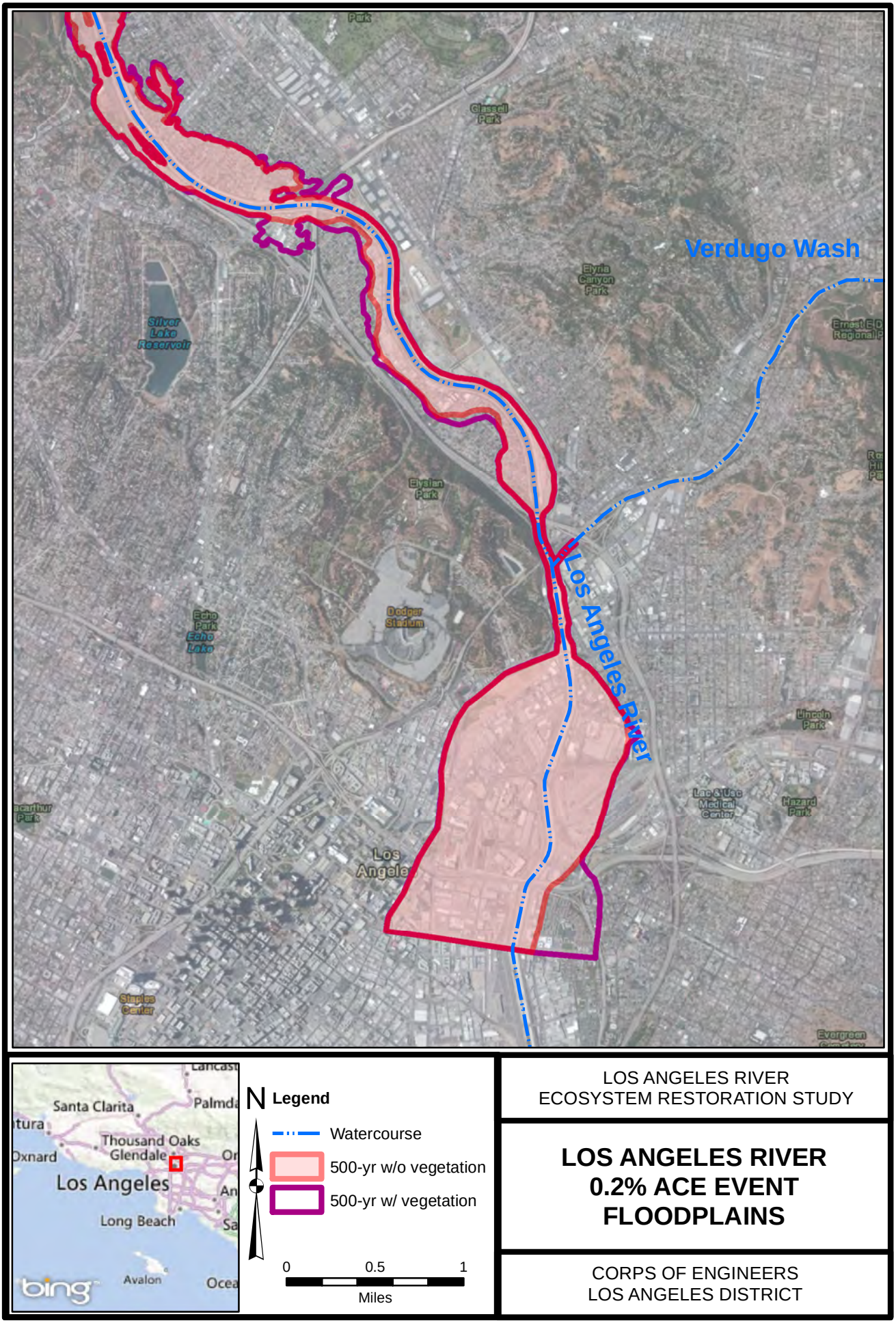
LOS ANGELES RIVER
1% ACE EVENT
FLOODPLAINS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
0.2% ACE EVENT
FLOODPLAINS

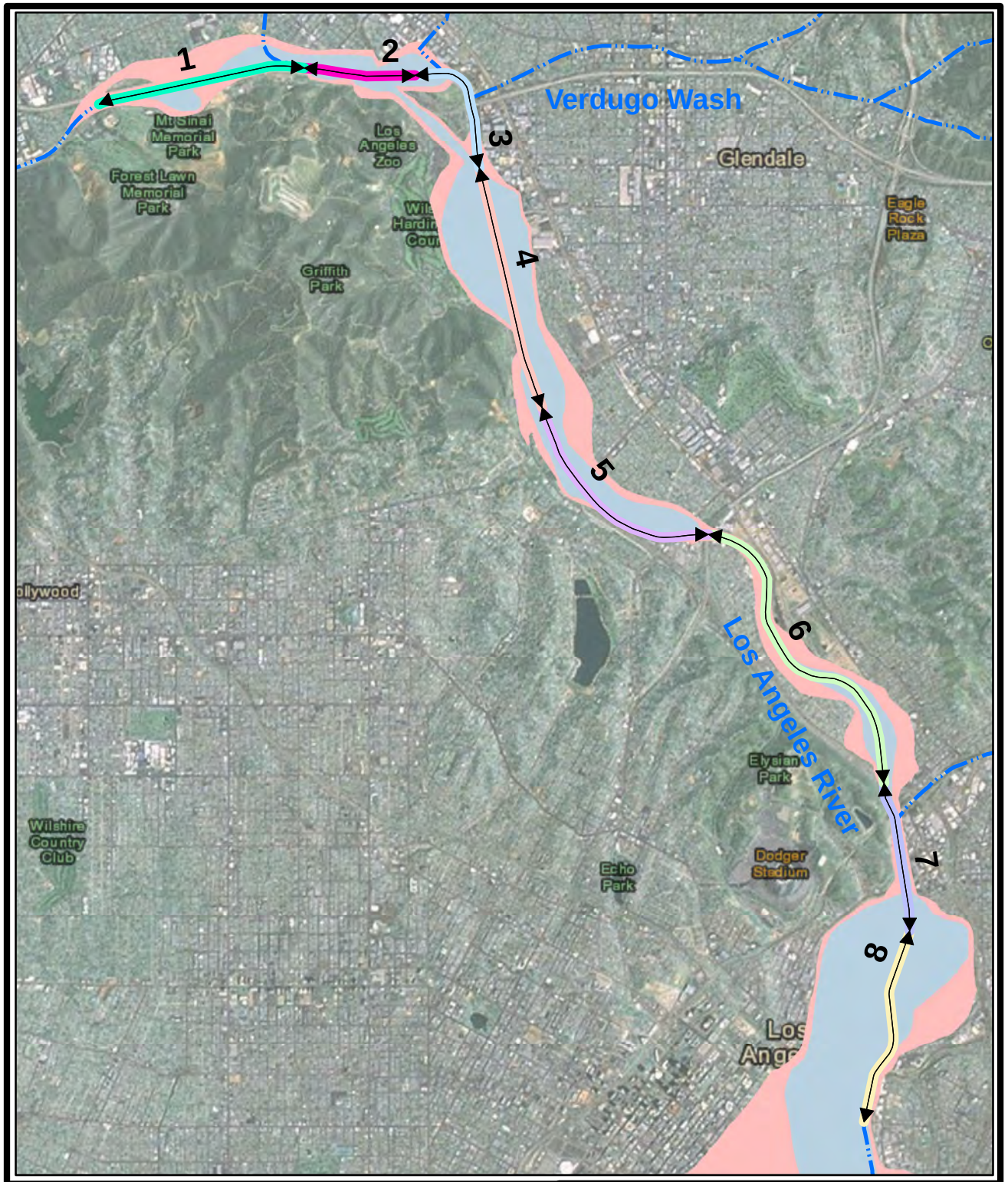
CORPS OF ENGINEERS
LOS ANGELES DISTRICT

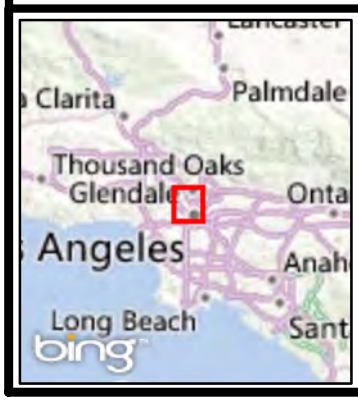


LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
0.2% ACE EVENT
FLOODPLAINS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





N

Legend

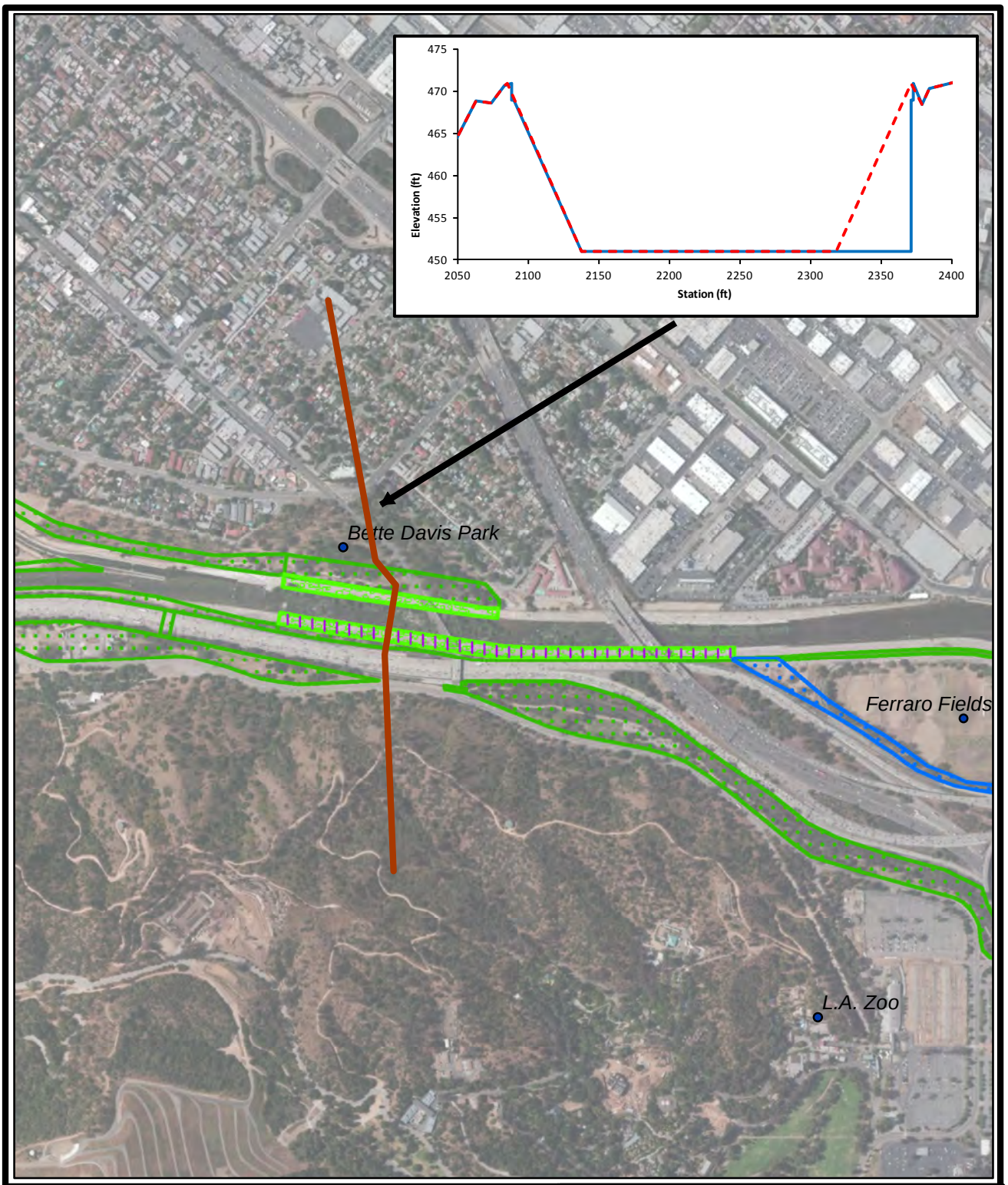
- Watercourse
- ARBOR Reaches
- 100-yr (COE 1992)
- 500-yr (COE 1992)

0 0.5 1
Miles

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

LOS ANGELES RIVER
1% & 0.2% ACE EVENTS
FLOODPLAINS
(from 1992 LACDA Study)

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

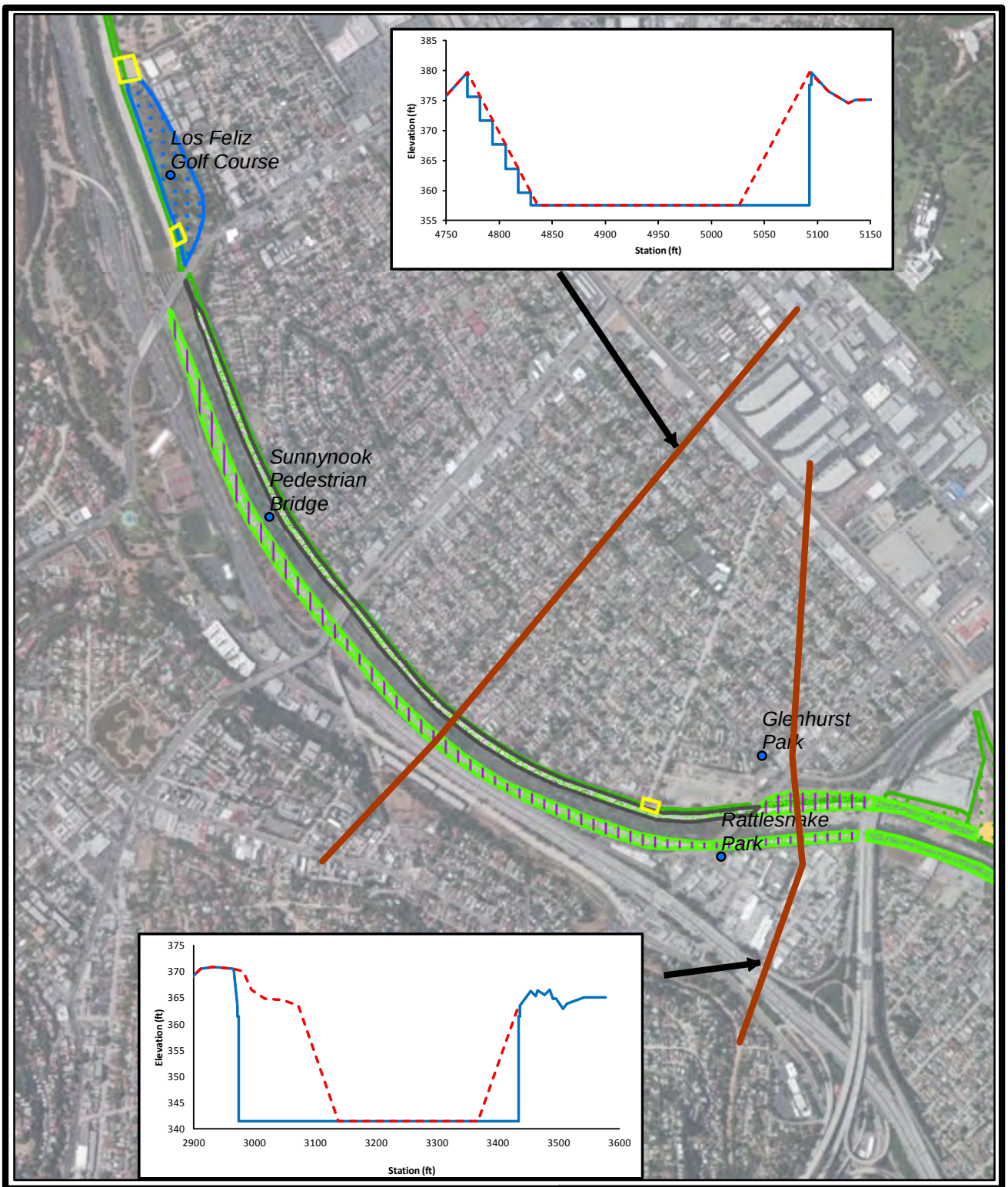
- Side Channel
- Vertical Side Walls
- Hanging Vines
- Habitat Corridor

0 750 1,500
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 2 TYPICAL CROSS SECTION

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

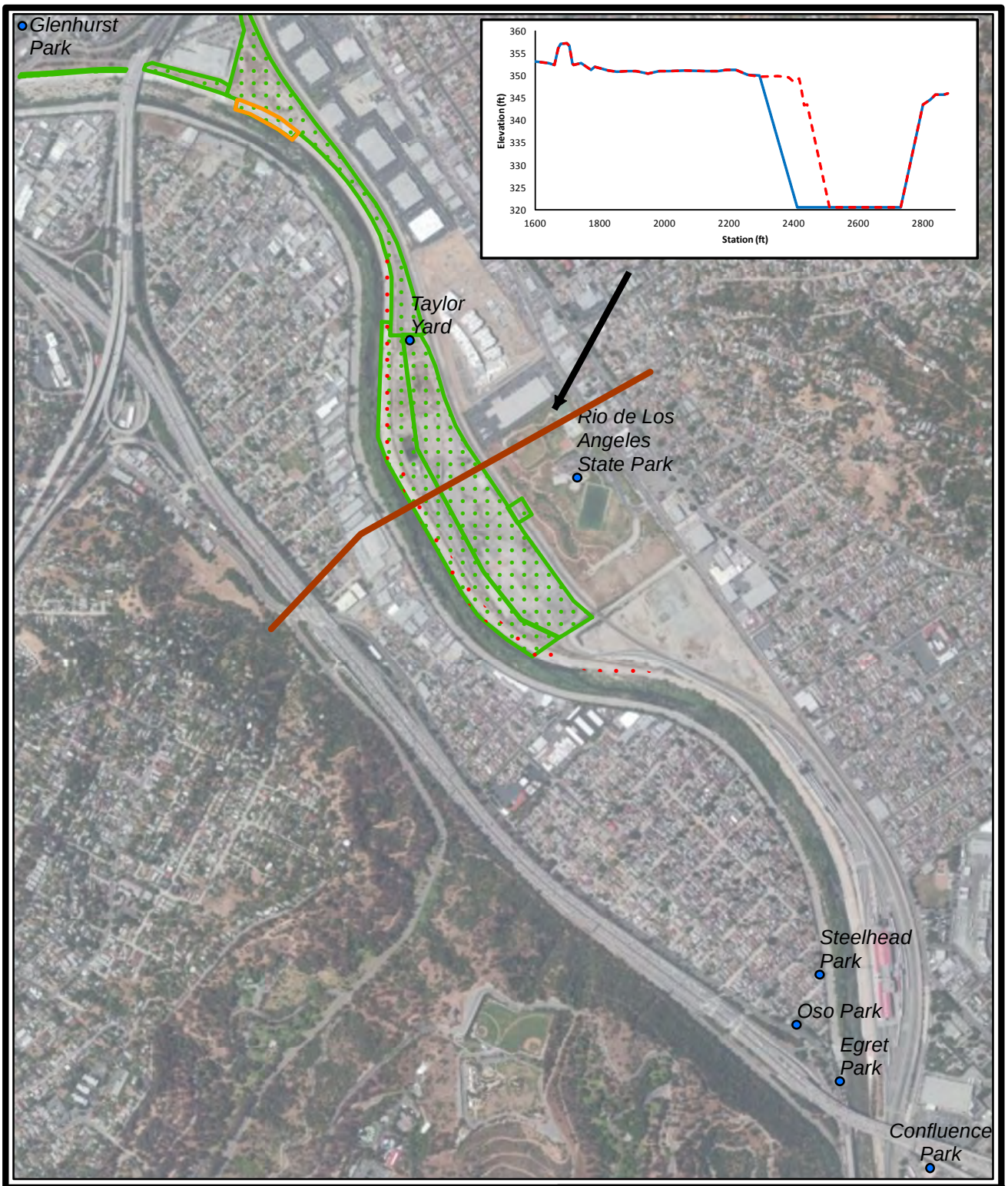
- Daylight Storm Drain
- Terrace Bank
- Side Channel
- Vertical Channel Wall
- Hanging Vines
- Habitat Corridor
- Freshwater Marsh

0 1,000 2,000
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 5 TYPICAL CROSS SECTIONS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

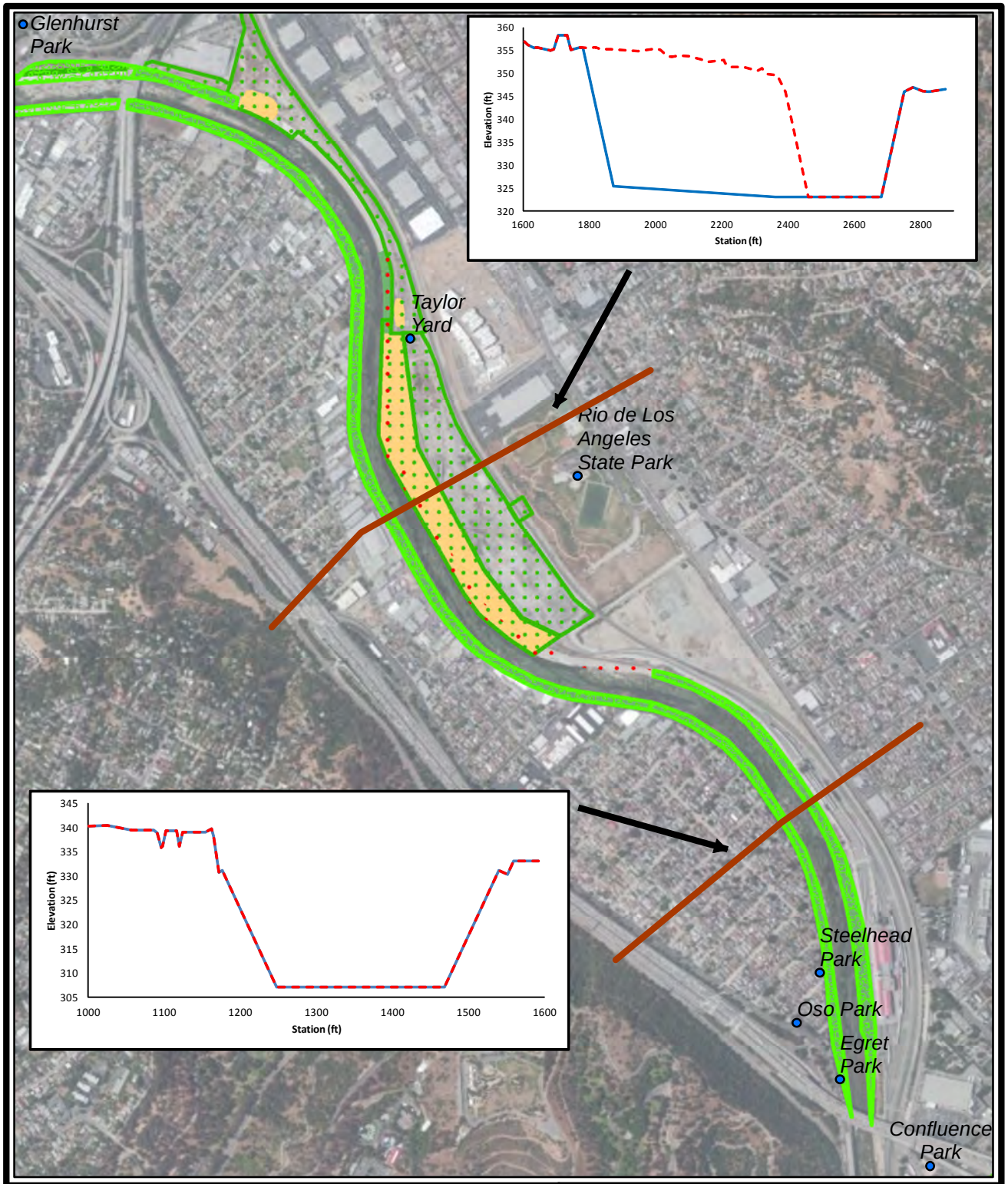
- Lower Channel Bank
- Widen Channel
- Habitat Corridor

0 1,000 2,000
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

ALT. 10 REACH 6 TYPICAL CROSS SECTIONS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

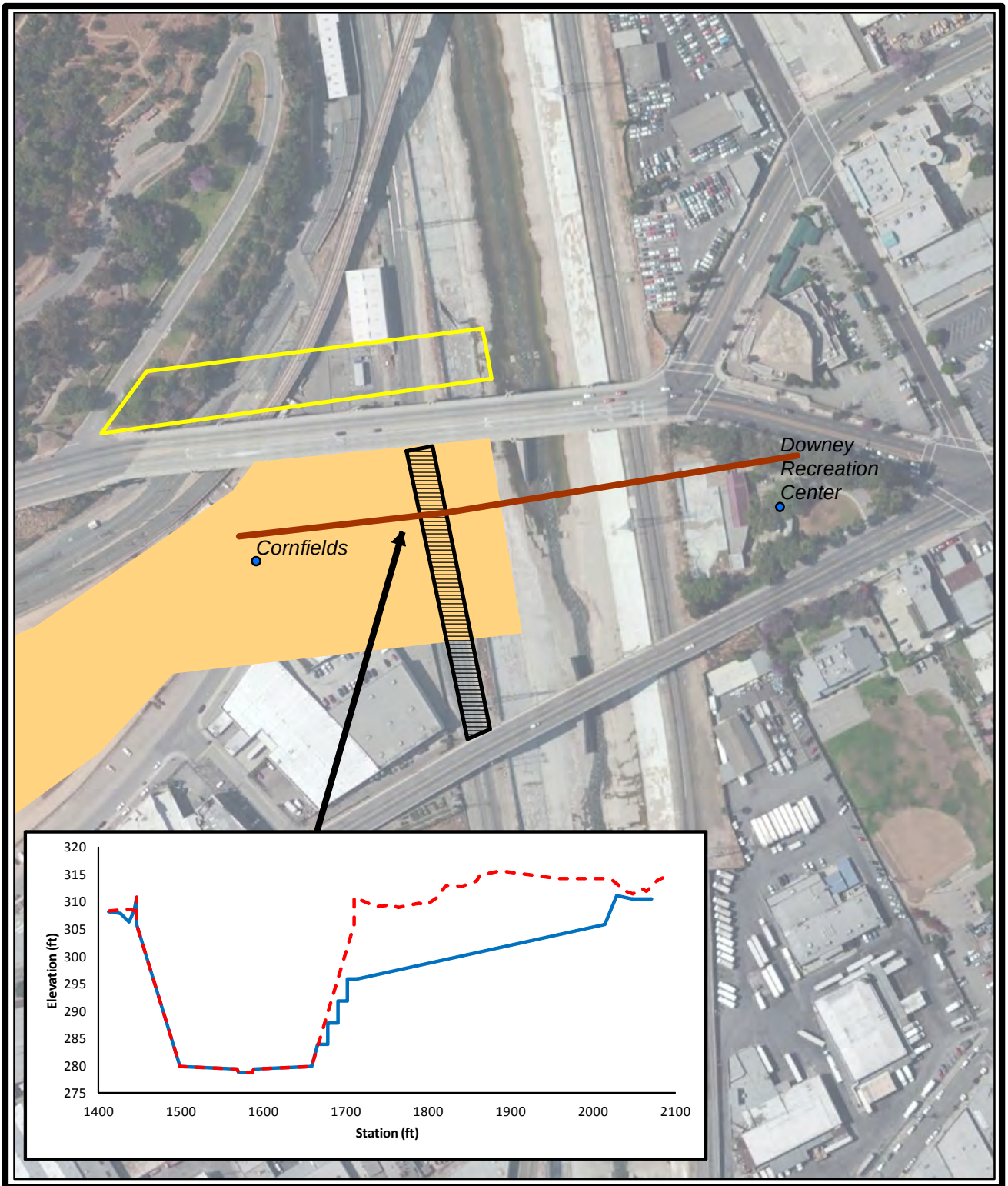
- Elevate Railroad
- Widen Channel
- Hanging Vines
- Habitat Corridor
- Planter Boxes
- Freshwater Marsh

0 1,000 2,000
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 6 TYPICAL CROSS SECTIONS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

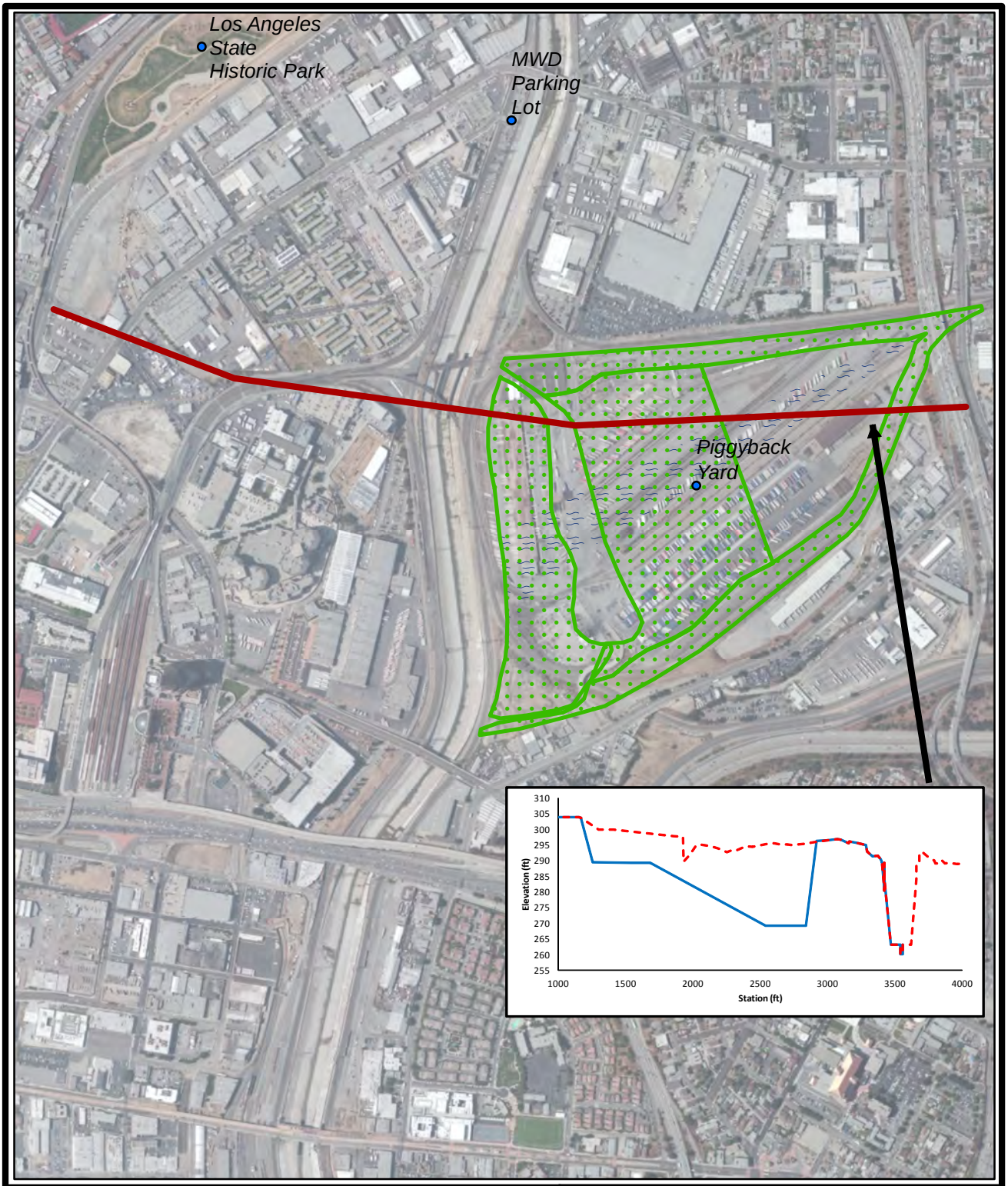
- Elevate Railroad
- Daylight Storm Drain
- Freshwater Marsh

0 200 400
Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 7 TYPICAL CROSS SECTION

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



N

Legend

Habitat Corridor

Historic Wash

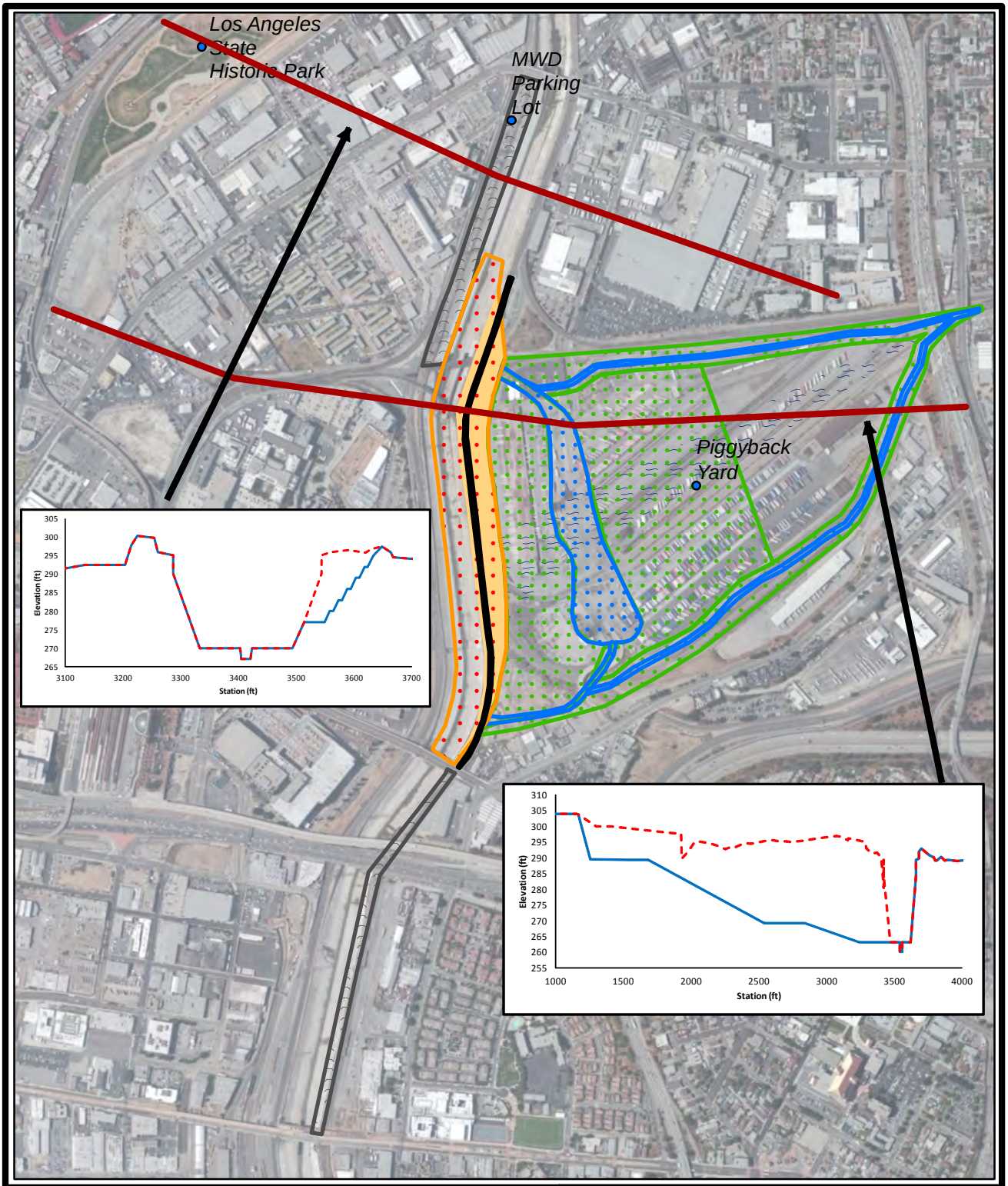
0 750 1,500

Feet

LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

ALT. 13 REACH 8 TYPICAL CROSS SECTIONS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



Legend

N

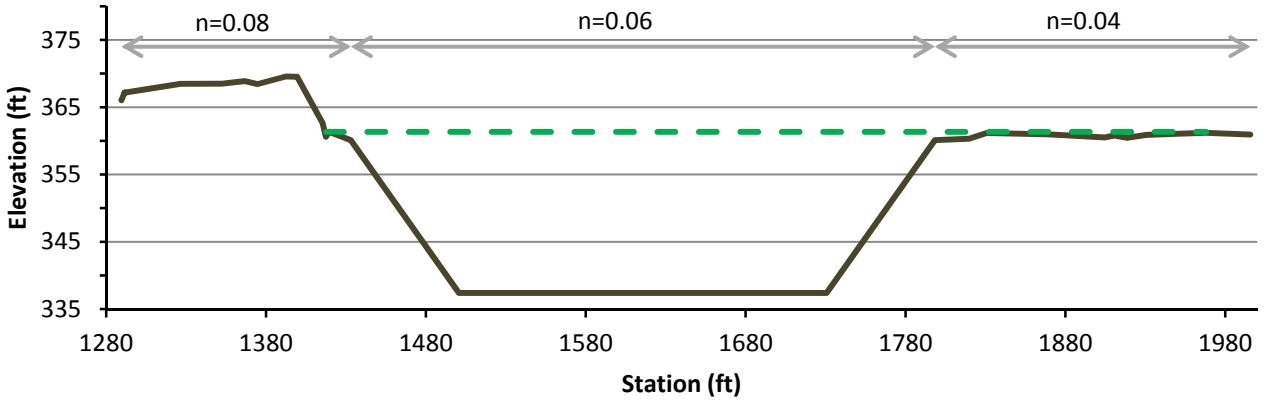
- Elevate Railroad
- Lower Channel Bank
- Terrace Bank
- Side Channel
- Widen Channel
- Habitat Corridor
- Historic Wash
- Freshwater Marsh

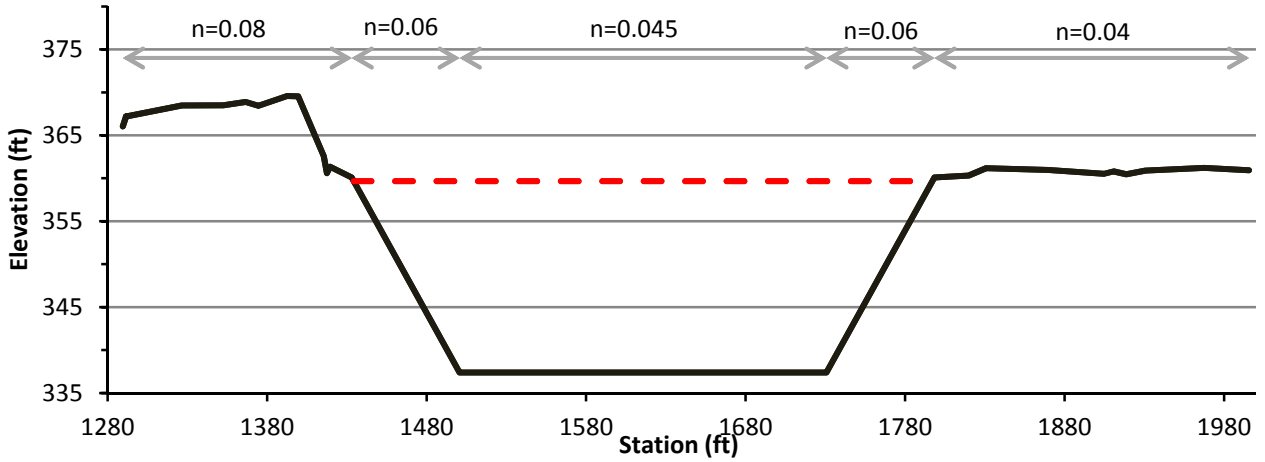
0 750 1,500
Feet

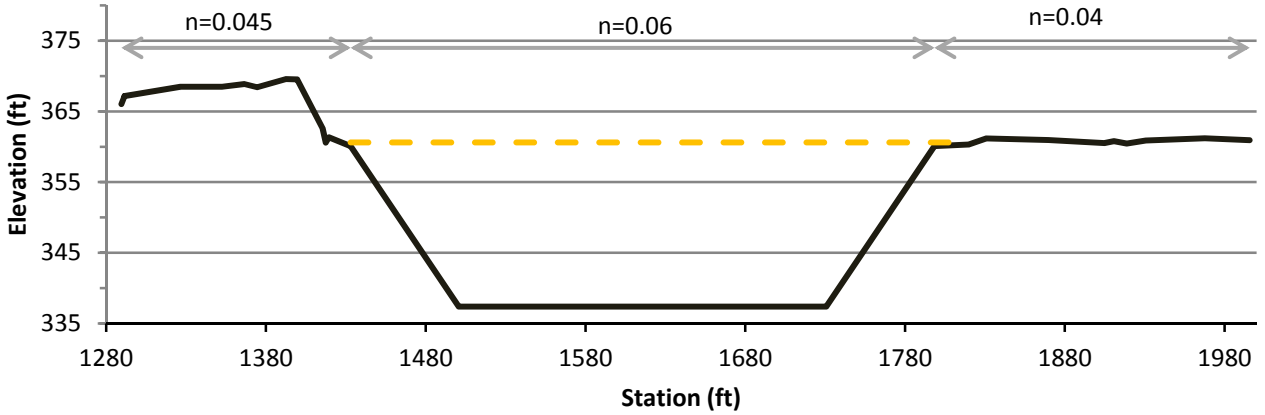
LOS ANGELES RIVER
ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 8 TYPICAL CROSS SECTIONS

CORPS OF ENGINEERS
LOS ANGELES DISTRICT





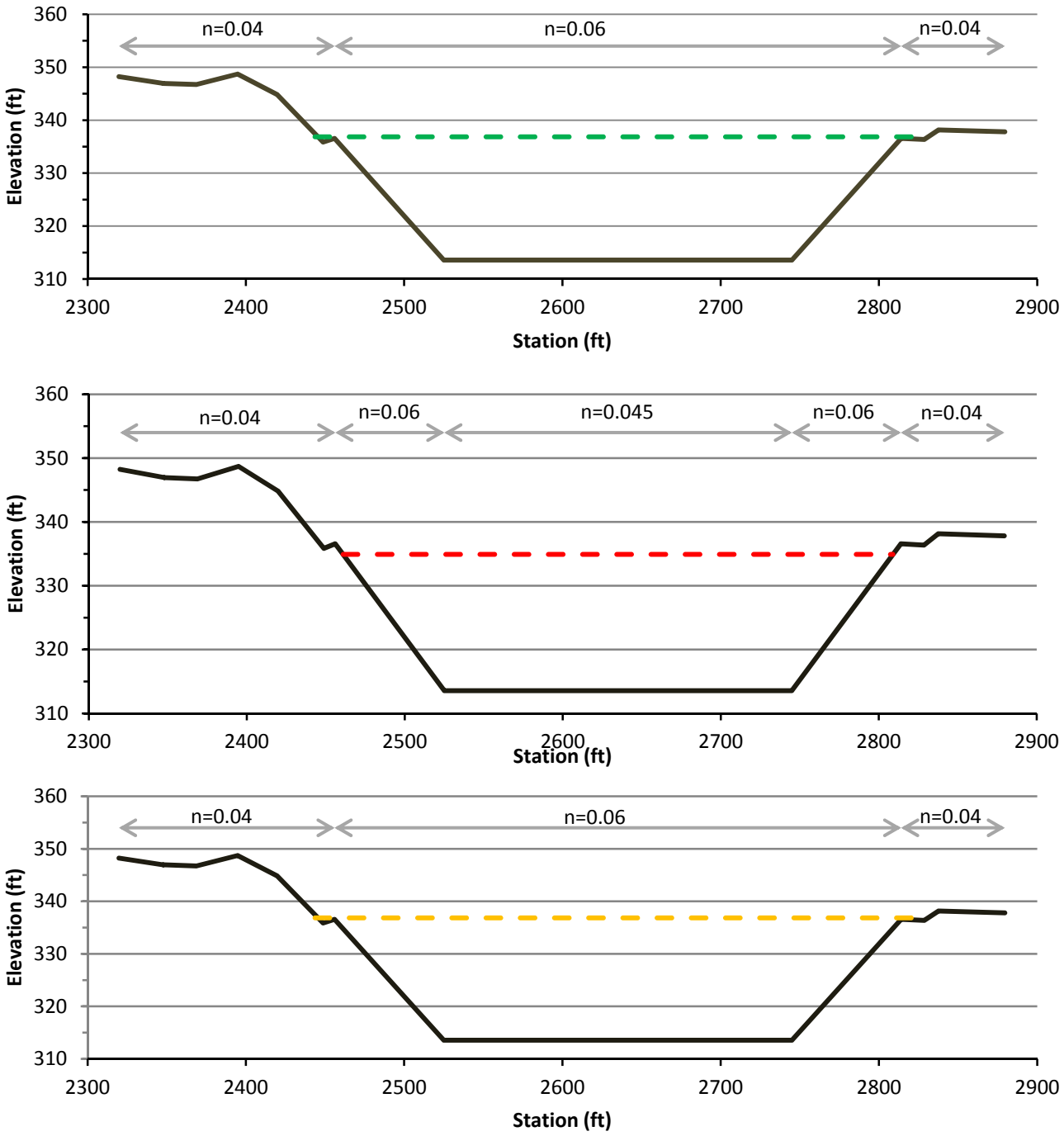


- Heavy Overbank Vegetation, Moderate Channel Vegetation
- Heavy Overbank Vegetation, Minimal Channel Vegetation
- Minimal Overbank Vegetation, Moderate Channel Vegetation

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 10 REACH 6 WSE COMPARISON CROSS SECTION 262+72

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

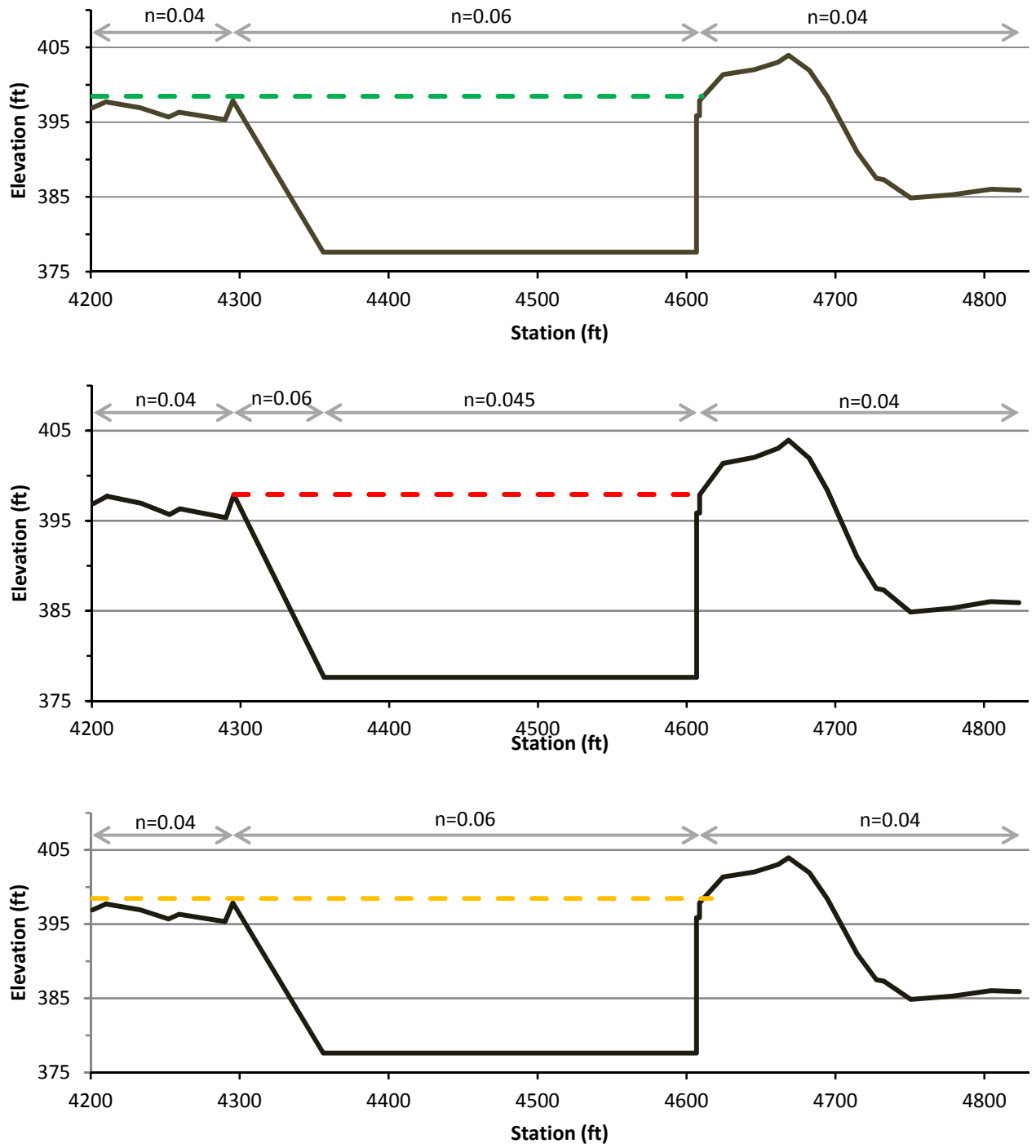


Heavy Overbank Vegetation, Moderate Channel Vegetation
Heavy Overbank Vegetation, Minimal Channel Vegetation
Minimal Overbank Vegetation, Moderate Channel Vegetation

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 13 REACH 6 WSE COMPARISON CROSS SECTION 191+81

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

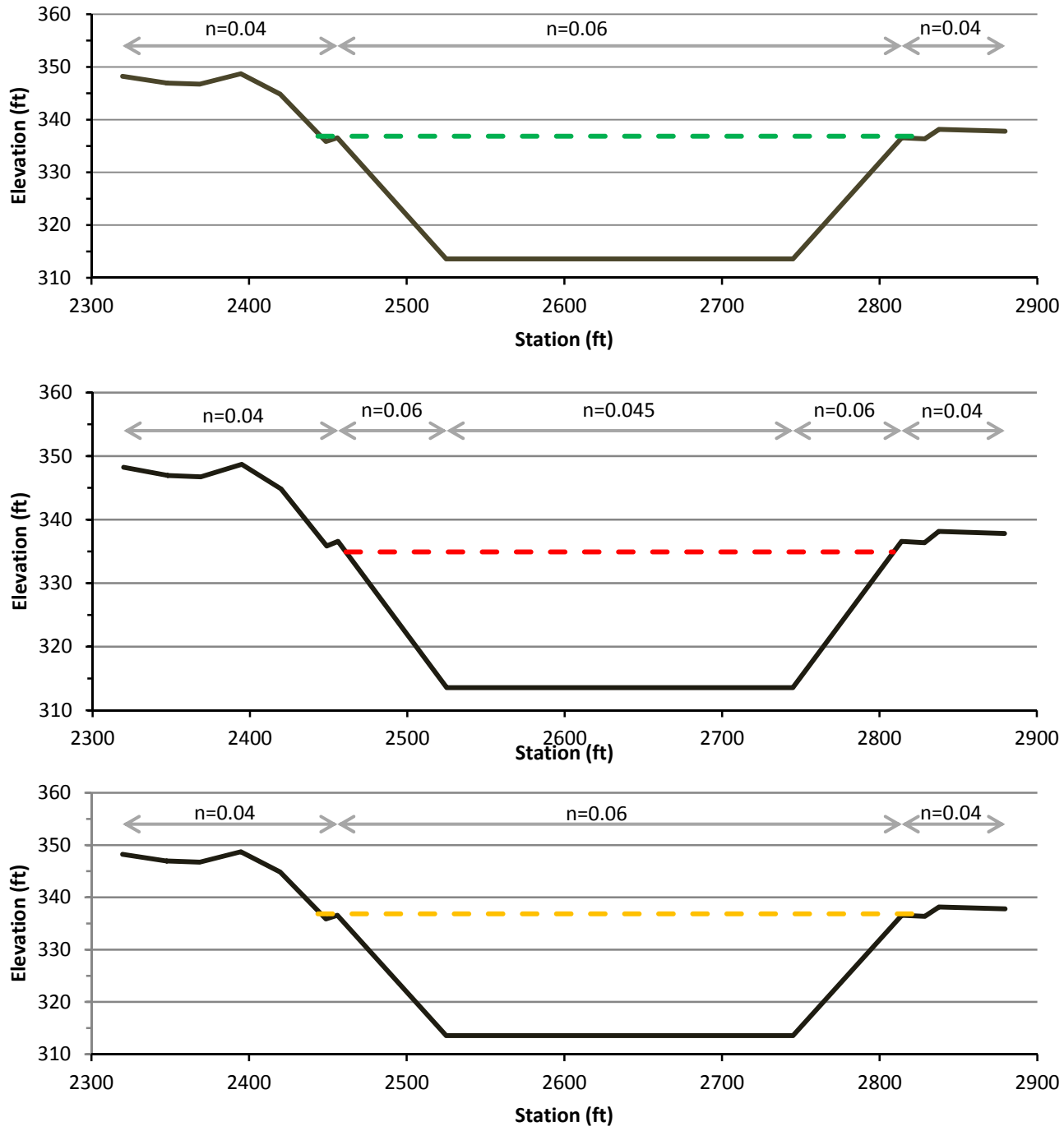


Heavy Overbank Vegetation, Moderate Channel Vegetation
Heavy Overbank Vegetation, Minimal Channel Vegetation
Minimal Overbank Vegetation, Moderate Channel Vegetation

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 16 REACH 5 WSE COMPARISON CROSS SECTION 356+22

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

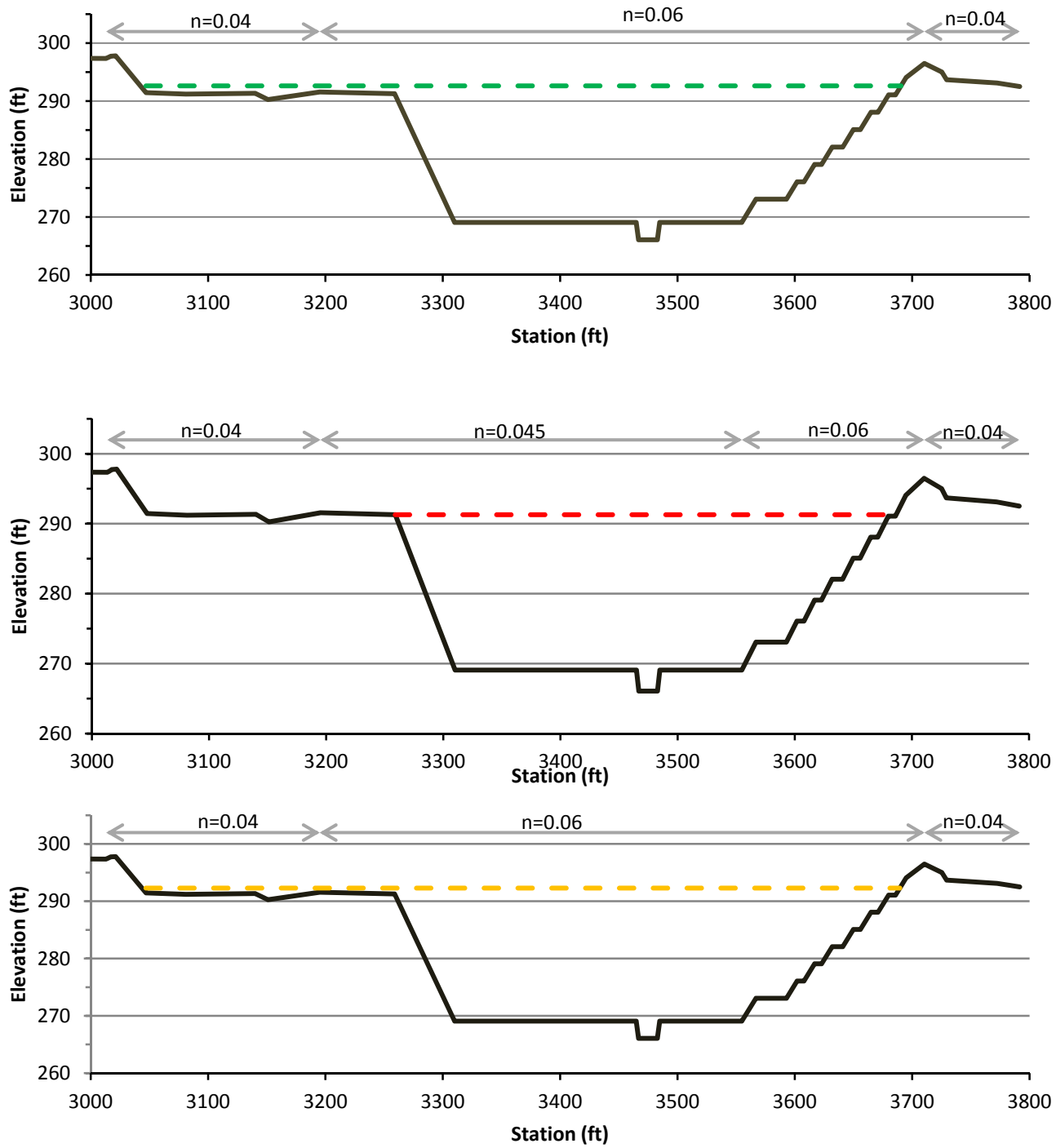


Heavy Overbank Vegetation, Moderate Channel Vegetation
Heavy Overbank Vegetation, Minimal Channel Vegetation
Minimal Overbank Vegetation, Moderate Channel Vegetation

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 16 REACH 6 WSE COMPARISON CROSS SECTION 191+81

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

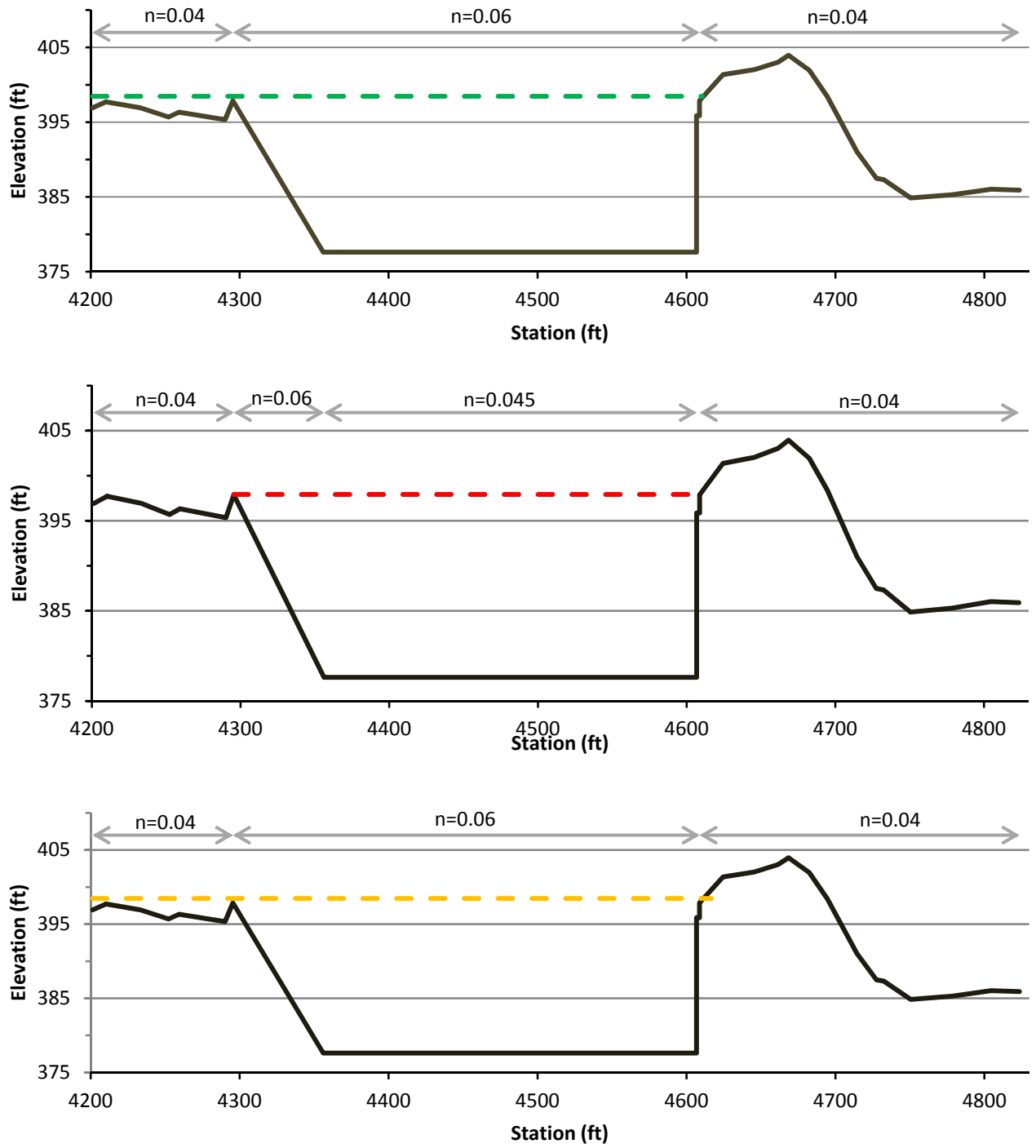


Heavy Overbank Vegetation, Moderate Channel Vegetation
Heavy Overbank Vegetation, Minimal Channel Vegetation
Minimal Overbank Vegetation, Moderate Channel Vegetation

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 16 REACH 8 WSE COMPARISON CROSS SECTION 69+93

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

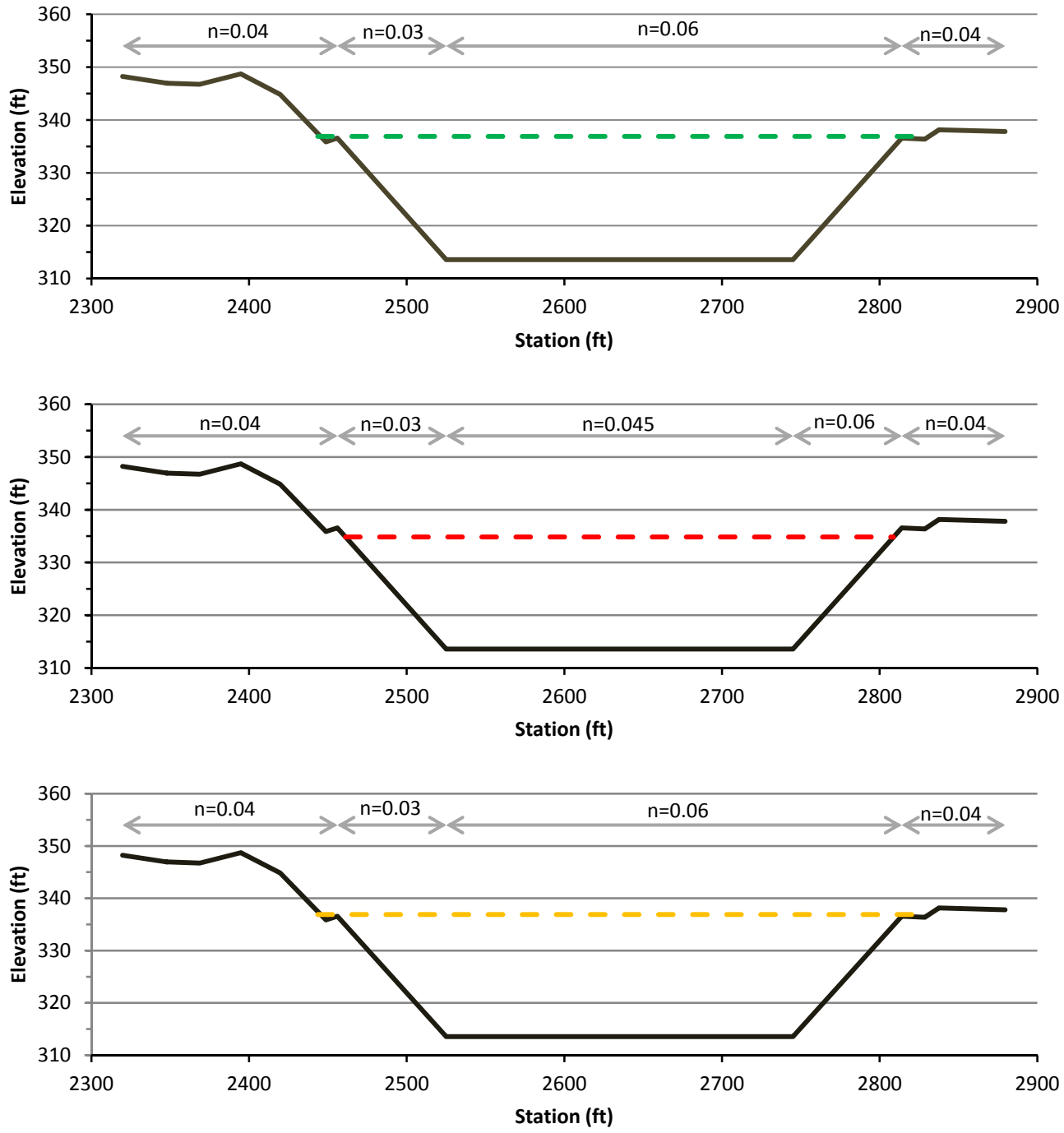


Heavy Overbank Vegetation, Moderate Channel Vegetation
Heavy Overbank Vegetation, Minimal Channel Vegetation
Minimal Overbank Vegetation, Moderate Channel Vegetation

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 5 WSE COMPARISON CROSS SECTION 356+22

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

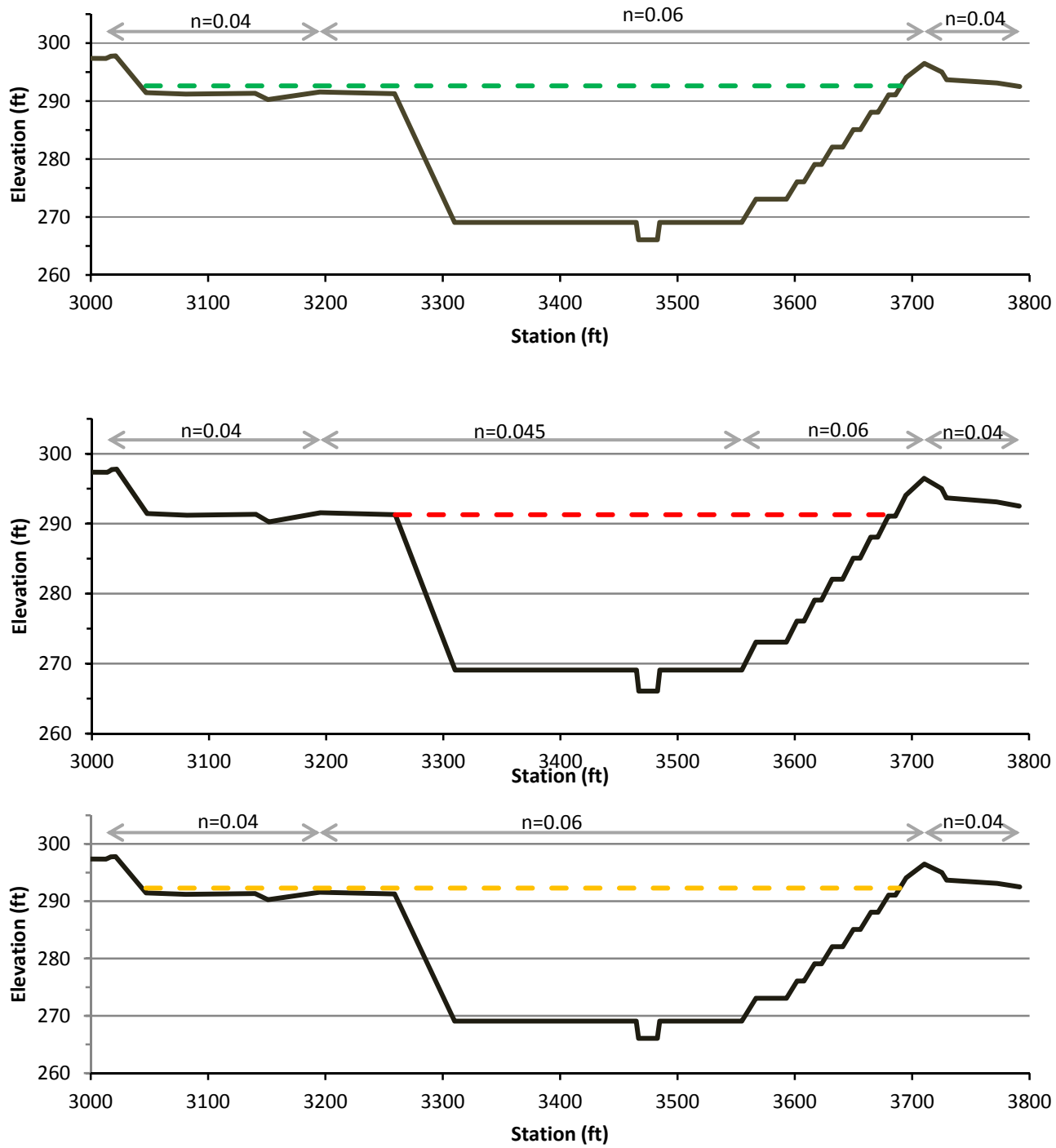


Heavy Overbank Vegetation, Moderate Channel Vegetation
Heavy Overbank Vegetation, Minimal Channel Vegetation
Minimal Overbank Vegetation, Moderate Channel Vegetation

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT.20 REACH 6 WSE COMPARISON CROSS SECTION 191+81

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

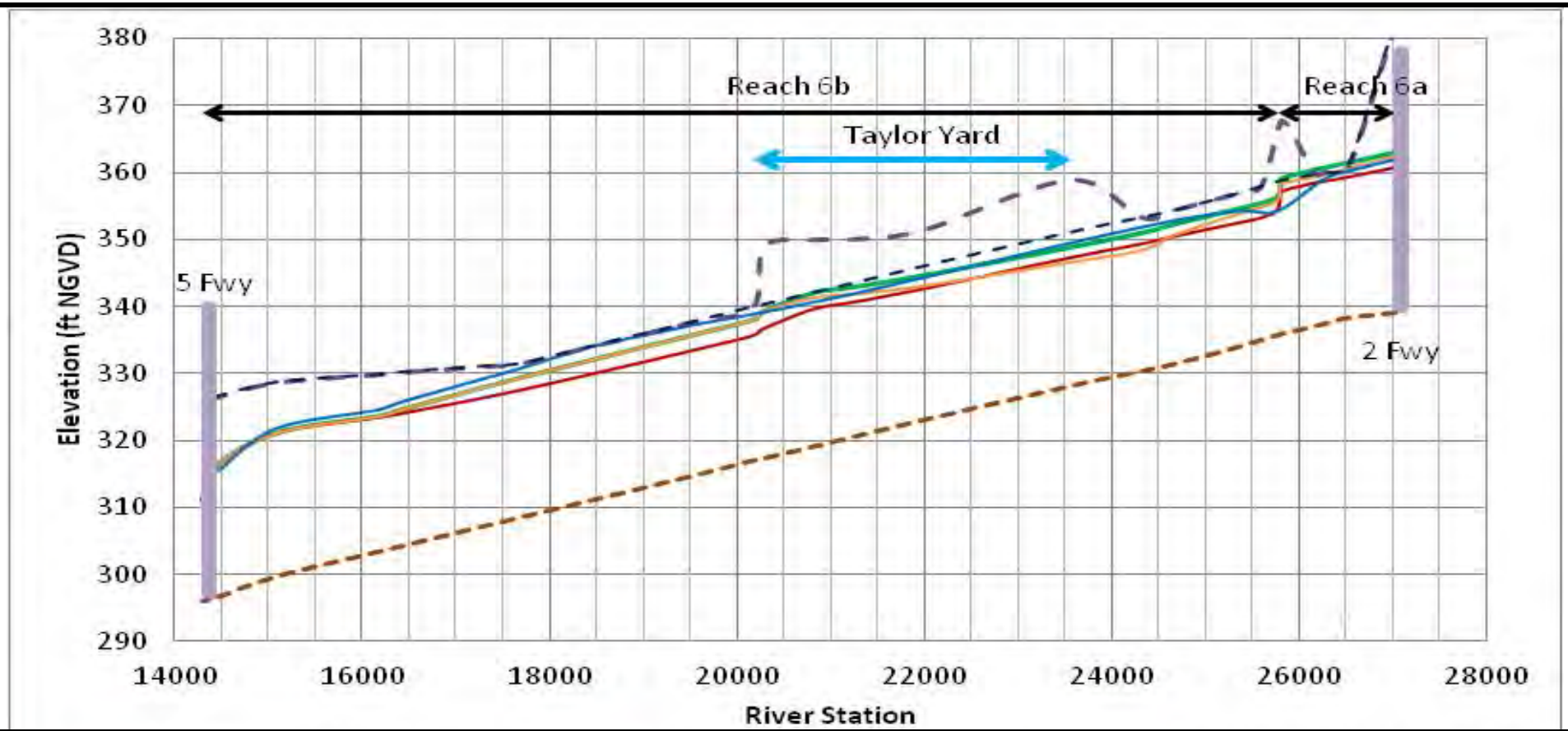


Heavy Overbank Vegetation, Moderate Channel Vegetation
Heavy Overbank Vegetation, Minimal Channel Vegetation
Minimal Overbank Vegetation, Moderate Channel Vegetation

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 8 WSE COMPARISON CROSS SECTION 69+93

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



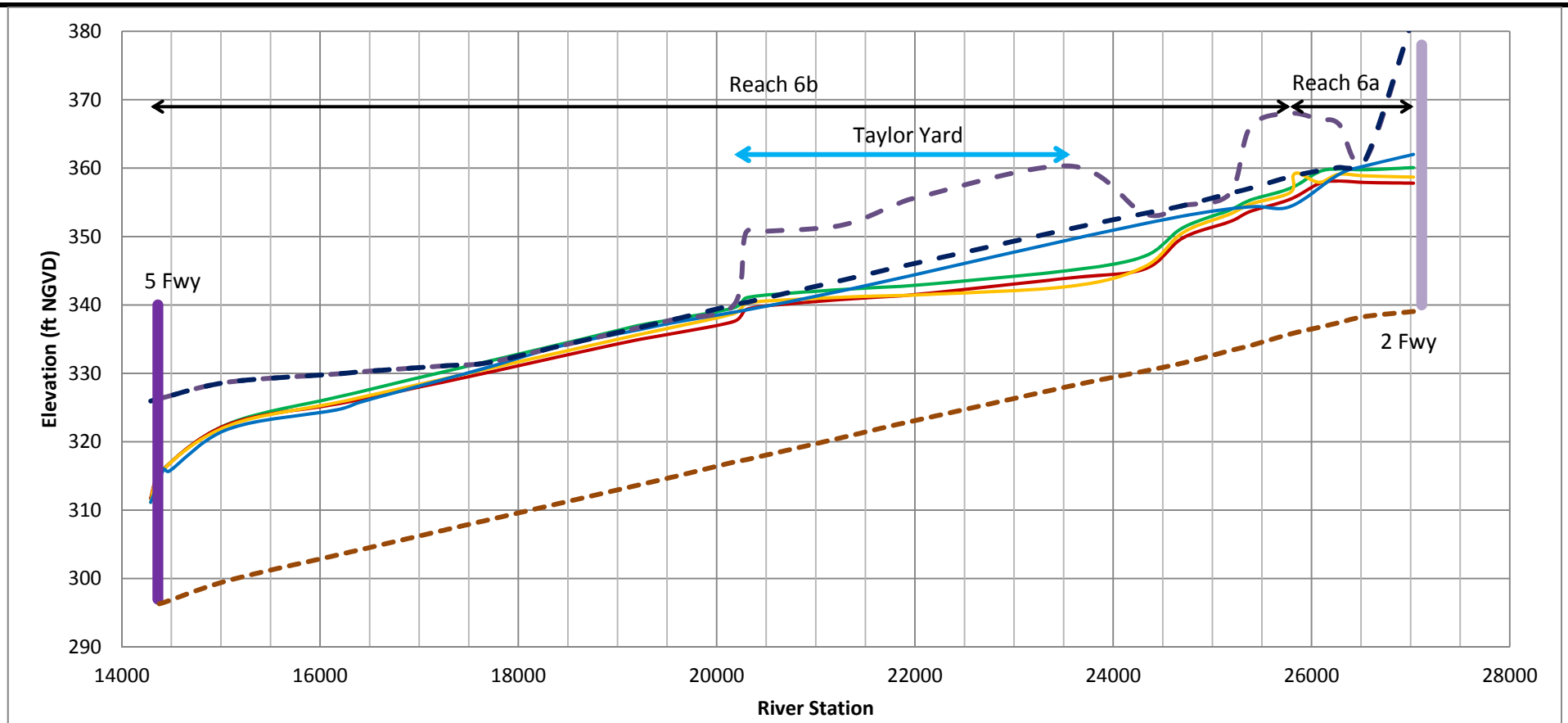
Streambed elevations based on lowest elevation in cross section from HEC-RAS models for shown alternative.

- Moderate Vegetation Channel, Heavy Vegetation Overbank
- Minimum Vegetation Channel, Heavy Vegetation Overbank
- Moderate Vegetation Channel, Minimum Vegetation Overbank
- Existing Conditions With Vegetation
- Left Bank
- Right Bank
- Channel Invert

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 10 REACH 6 LOS ANGELES RIVER WATER SURFACE PROFILES

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



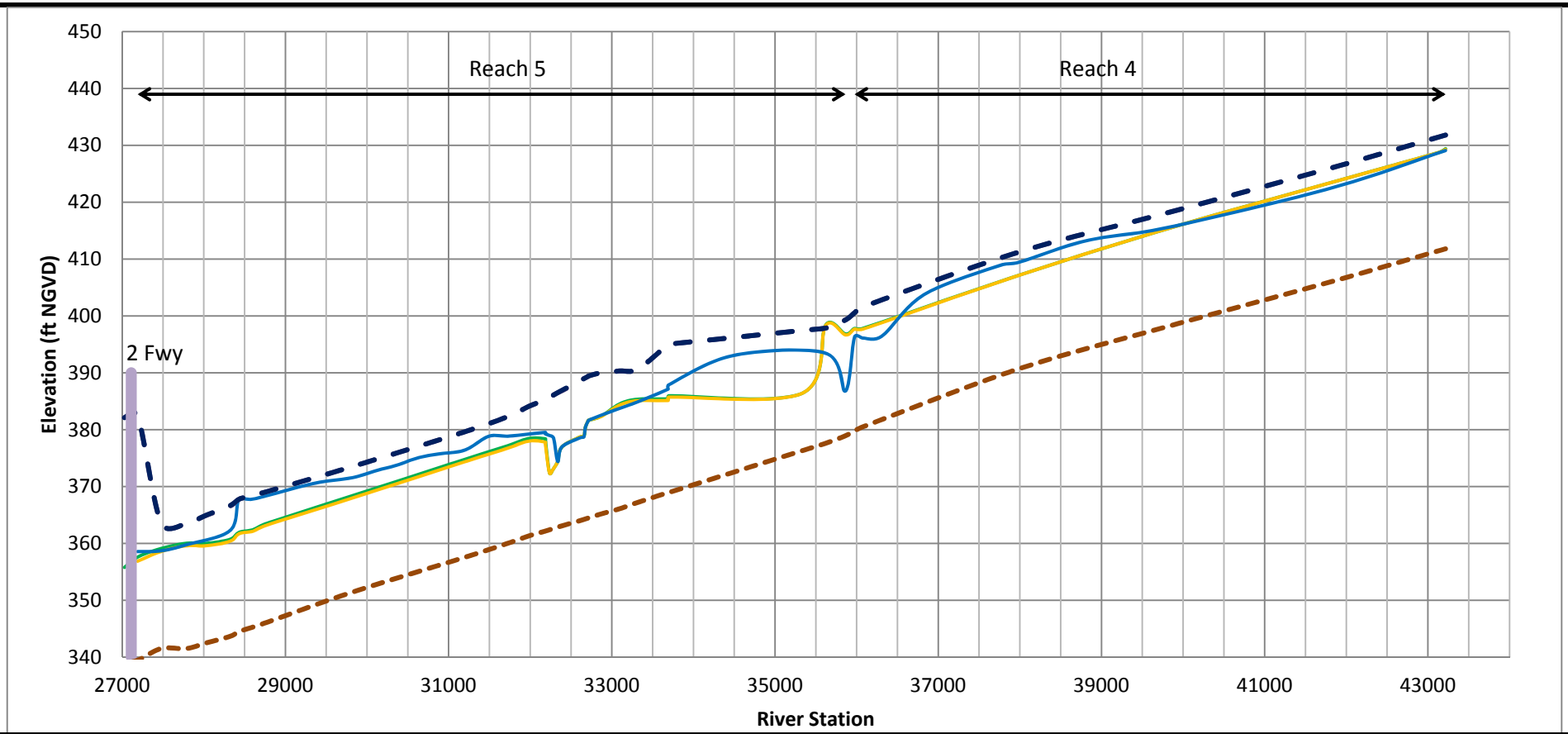
Streambed elevations based on lowest elevation in cross section from HEC-RAS models for shown alternative.

- Moderate Vegetation Channel, Heavy Vegetation Overbank
- Minimum Vegetation Channel, Heavy Vegetation Overbank
- Moderate Vegetation Channel, Minimum Vegetation Overbank
- Existing Conditions With Vegetation
- Left Bank
- Right Bank
- Channel Invert

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 13 REACH 6 LOS ANGELES RIVER WATER SURFACE PROFILES

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



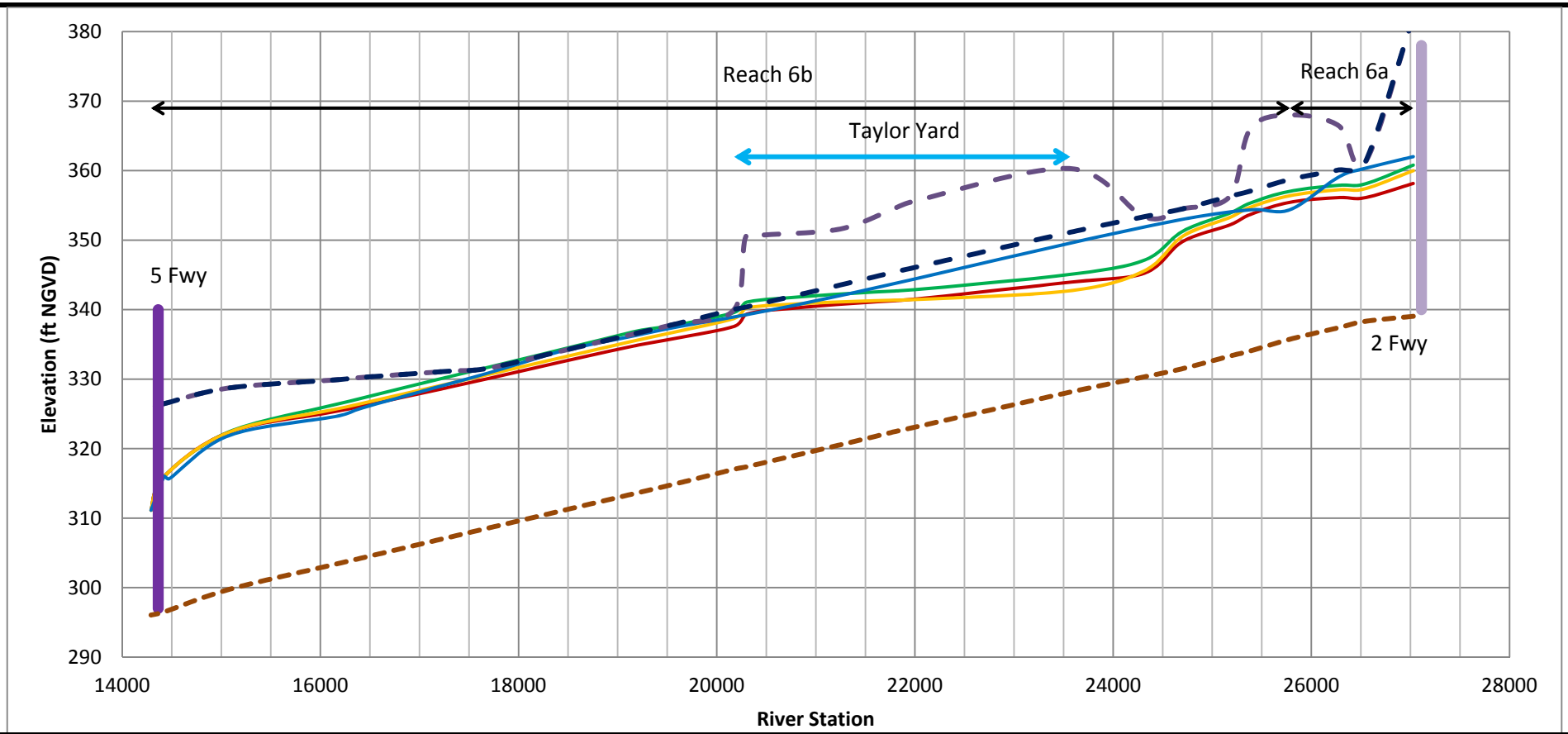
Streambed elevations based on lowest elevation in cross section from HEC-RAS models for shown alternative.

- Moderate Vegetation Channel, Heavy Vegetation Overbank
- Minimum Vegetation Channel, Heavy Vegetation Overbank
- Moderate Vegetation Channel, Minimum Vegetation Overbank
- Existing Conditions With Vegetation
- Left Bank
- Right Bank
- Channel Invert

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 16 REACH 5 LOS ANGELES RIVER WATER SURFACE PROFILES

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



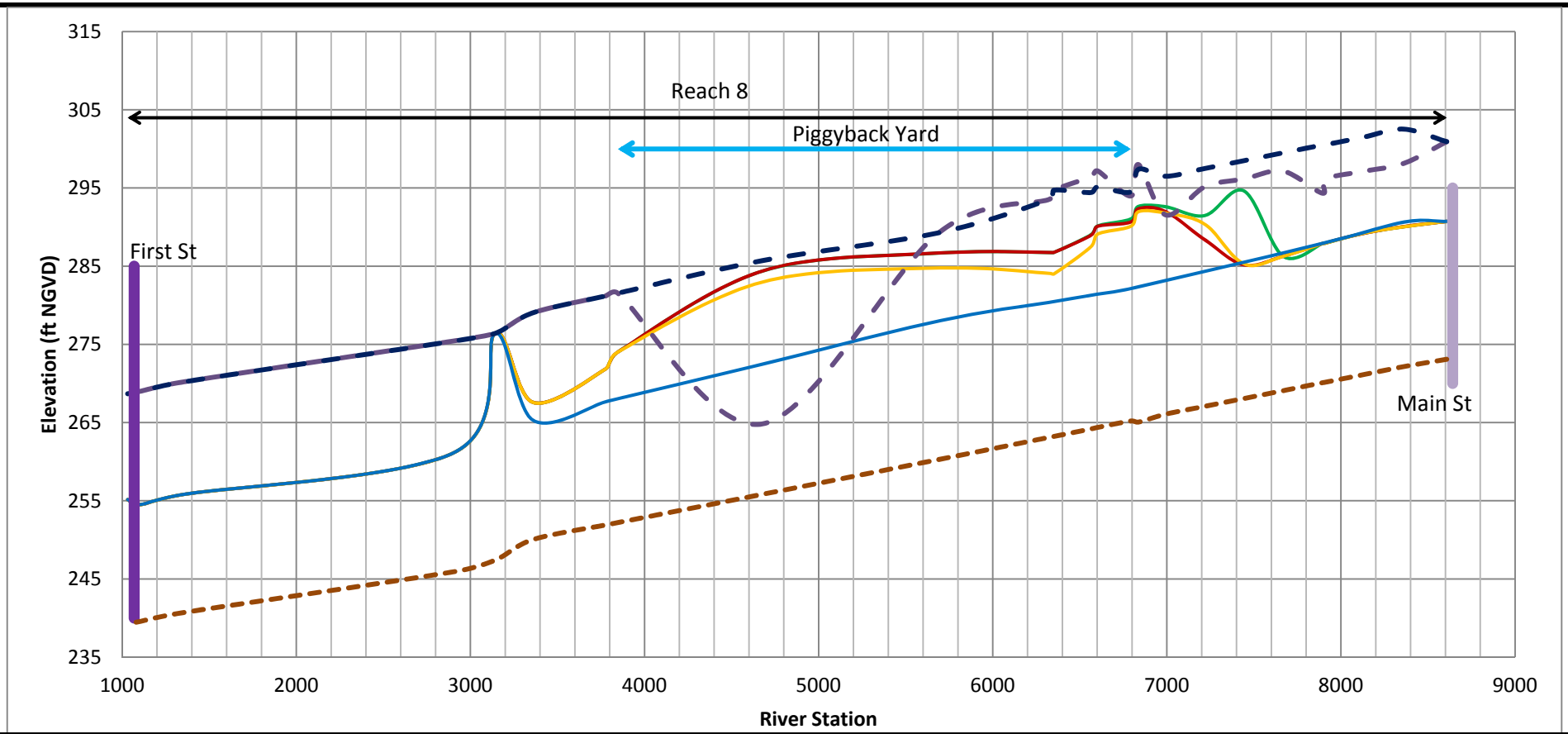
Streambed elevations based on lowest elevation in cross section from HEC-RAS models for shown alternative.

- Moderate Vegetation Channel, Heavy Vegetation Overbank
- Minimum Vegetation Channel, Heavy Vegetation Overbank
- Moderate Vegetation Channel, Minimum Vegetation Overbank
- Existing Conditions With Vegetation
- Left Bank
- Right Bank
- Channel Invert

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 16 REACH 6 LOS ANGELES RIVER WATER SURFACE PROFILES

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



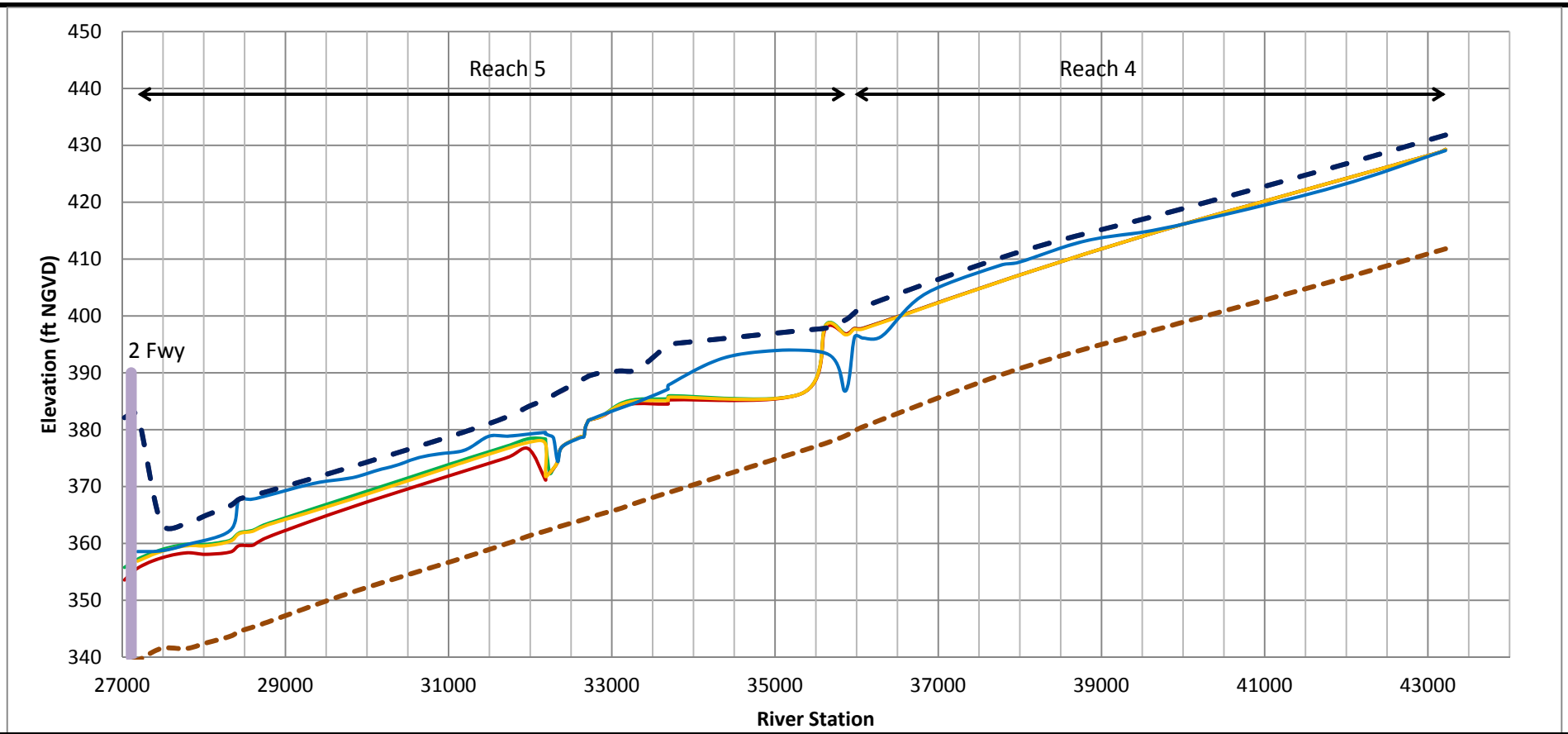
Streambed elevations based on lowest elevation in cross section from HEC-RAS models for shown alternative.

- Moderate Vegetation Channel, Heavy Vegetation Overbank
- Minimum Vegetation Channel, Heavy Vegetation Overbank
- Moderate Vegetation Channel, Minimum Vegetation Overbank
- Existing Conditions With Vegetation
- Left Bank
- Right Bank
- Channel Invert

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 16 REACH 8 LOS ANGELES RIVER WATER SURFACE PROFILES

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



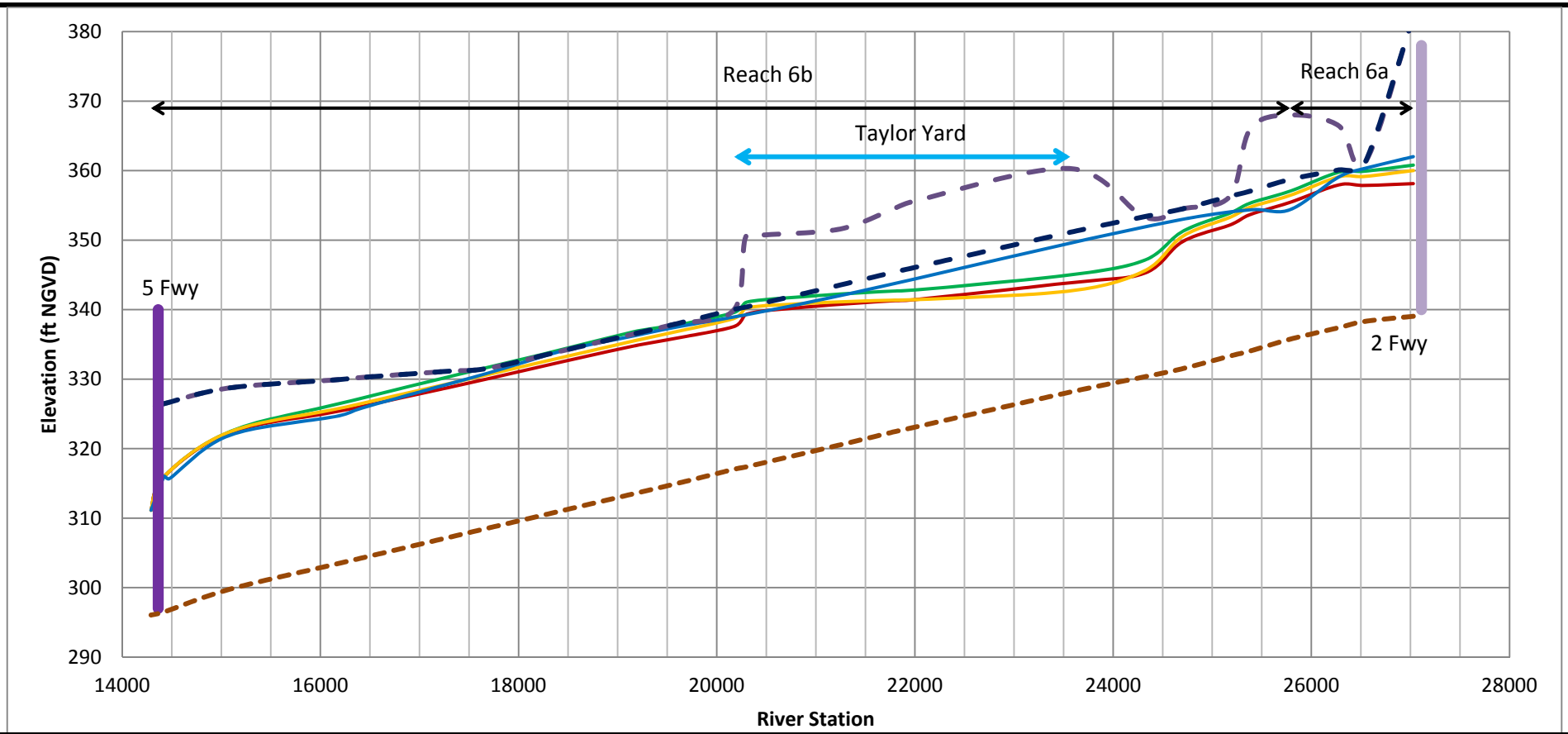
Streambed elevations based on lowest elevation in cross section from HEC-RAS models for shown alternative.

- Moderate Vegetation Channel, Heavy Vegetation Overbank
- Minimum Vegetation Channel, Heavy Vegetation Overbank
- Moderate Vegetation Channel, Minimum Vegetation Overbank
- Existing Conditions With Vegetation
- Left Bank
- Right Bank
- Channel Invert

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 5 LOS ANGELES RIVER WATER SURFACE PROFILES

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



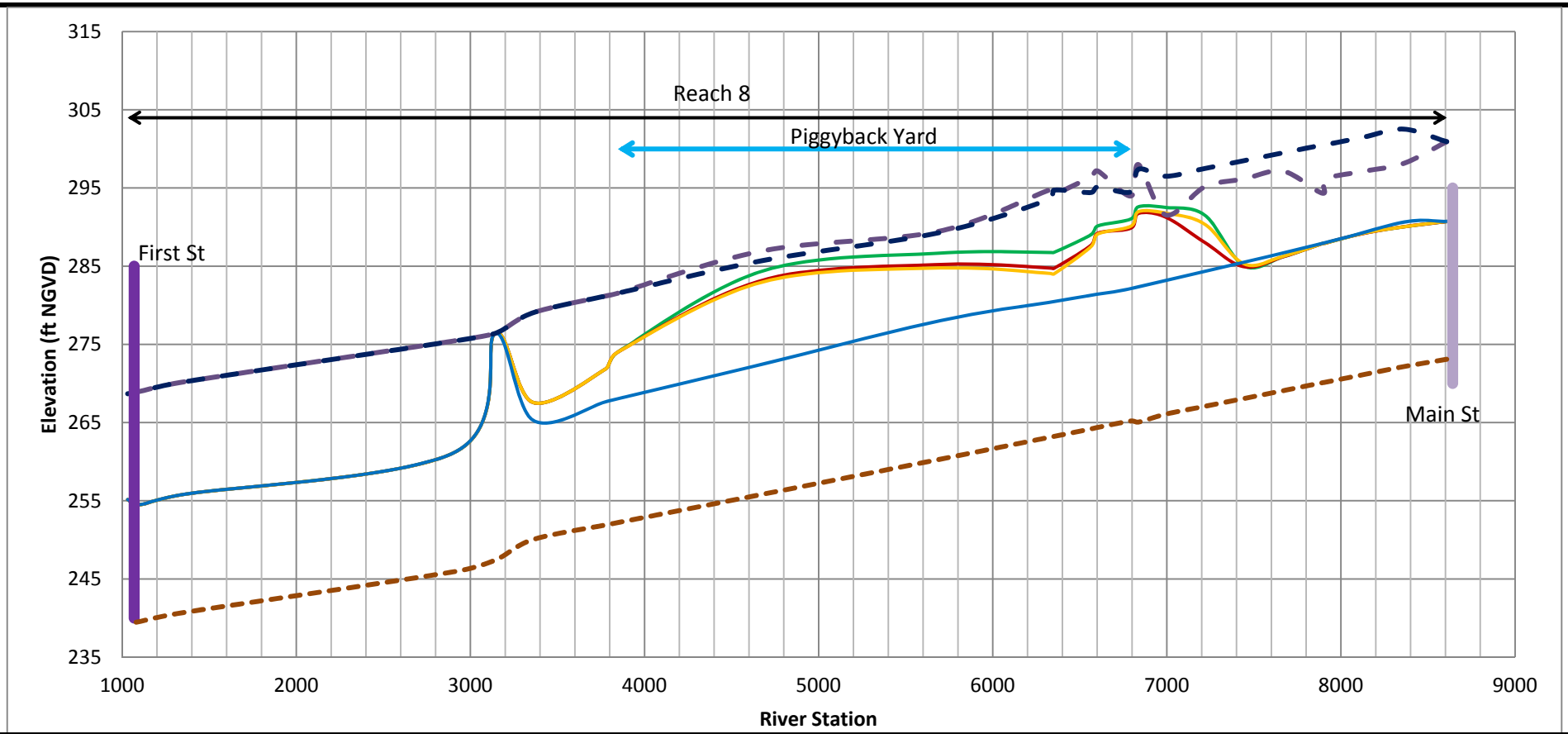
Streambed elevations based on lowest elevation in cross section from HEC-RAS models for shown alternative.

- Moderate Vegetation Channel, Heavy Vegetation Overbank
- Minimum Vegetation Channel, Heavy Vegetation Overbank
- Moderate Vegetation Channel, Minimum Vegetation Overbank
- Existing Conditions With Vegetation
- Left Bank
- Right Bank
- Channel Invert

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 6 LOS ANGELES RIVER WATER SURFACE PROFILES

CORPS OF ENGINEERS
LOS ANGELES DISTRICT



Streambed elevations based on lowest elevation in cross section from HEC-RAS models for shown alternative.

- Moderate Vegetation Channel, Heavy Vegetation Overbank
- Minimum Vegetation Channel, Heavy Vegetation Overbank
- Moderate Vegetation Channel, Minimum Vegetation Overbank
- Existing Conditions With Vegetation
- Left Bank
- Right Bank
- Channel Invert

LOS ANGELES RIVER ECOSYSTEM RESTORATION STUDY

ALT. 20 REACH 8 LOS ANGELES RIVER WATER SURFACE PROFILES

CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Los Angeles River Ecosystem Restoration Integrated Feasibility Study

Appendix F
Air Quality

Appendix F-1: Clean Air Act Applicability Analysis

Appendix F-2: Air Quality Calculations Methodology and Data

Appendix F-1
Clean Air Act Applicability Analysis

1 Introduction

The General Conformity Rule at Section 176(c) of the Clean Air Act (CAA) ensures that federal actions comply with the national ambient air quality standards (NAAQS). In order to conform with the rule, a federal agency must demonstrate that an action it undertakes, approves, permits, or supports will conform to the appropriate state implementation plan (SIP). The conformity evaluation ensures that projects using federal funds or requiring federal approval not:

- cause or contribute to any new violation of a NAAQS,
- increase the frequency or severity of any existing violation, or
- delay the timely attainment of any standard, interim emission reduction, or other milestone.

A conformity determination is required for each criteria pollutant or precursor where the total of direct and indirect emissions of the criteria pollutant or precursor in a nonattainment or maintenance area caused by the Federal action would equal or exceed any of the rates listed in Table 2-1.

Direct emissions means those emissions of a criteria pollutant or its precursors that are caused or initiated by the Federal action and originate in a nonattainment or maintenance area and occur at the same time and place as the action and are reasonably foreseeable. 40 CFR 93.152.

Indirect emissions means those emissions of a criteria pollutant or its precursors:

1. That are caused or initiated by the Federal action and originate in the same nonattainment or maintenance area but occur at a different time or place as the action;
2. That are reasonably foreseeable;
3. That the agency can practically control; and
4. For which the agency has continuing program responsibility.

For the purposes of this definition, even if a Federal licensing, rulemaking or other approving action is a required initial step for a subsequent activity that causes emissions, such initial steps do not mean that a Federal agency can practically control any resulting emissions (40 CFR 93.152).

Total of direct and indirect emissions means the sum of direct and indirect emissions increases and decreases caused by the Federal action; i.e., the "net" emissions considering all direct and indirect emissions. The portion of emissions which are exempt or presumed to conform under § 93.153 (c), (d), (e), or (f) are not included in the "total of direct and indirect emissions." The "total of direct and indirect emissions" includes emissions of criteria pollutants and emissions of precursors of criteria pollutants (40 CFR 93.152).

Direct emissions include construction emissions and indirect emissions include operational emissions from maintenance activities. Maintenance activities are considered exempt under 40 CFR 93.153(c)(2)(iv), and are therefore not included in the total of direct and indirect emissions evaluated in this analysis. Emissions from increased visitation by the public as a result of construction of the project cannot be practically controlled by the USACE and are therefore not considered indirect emissions caused by the Federal action. Thus, this analysis is limited to construction emissions.

Because all build alternatives would convert the existing LATC site to restored habitat, a functionally equivalent facility is anticipated to be constructed elsewhere in the Los Angeles Basin. Emissions from

replacement of site functions elsewhere in the basin cannot be practically controlled by the Corps, and the Corps does not have continuing program responsibility; therefore, such emissions are not considered indirect emissions caused by the Federal action in the applicability analysis. Construction of replacement site functions would result in temporary increases in emissions. Operation of replacement site functions may increase localized emissions in and around the replacement site. However, the replacement of the site functions within the Los Angeles Air Basin would not transfer the operational impacts of the site functions to a different air basin. The CEQA lead sponsor will conduct a detailed CEQA analysis in analyzing the replacement of LATC site functions, including air emissions.

2 Applicability

An applicability analysis is the process of determining if a Federal action must be supported by a conformity determination (40 CFR 93.152). In this instance, the applicability analysis is applied to Alternative 13v, the National Ecosystem Restoration Plan and Alternative 20, the Recommended Plan.

Federal regulation at 40 CFR 93.153 prescribes rates for criteria pollutants based on area attainment status as presented in Table 2-1.

Table 2-1. General Conformity Rates

Pollutant	Federal Attainment Designation	Rates (Tons/Year)
Ozone (precursors: VOC or NO_x)[a]	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside of an ozone transport region	100
CO, SO_2, and NO_2	All nonattainment and maintenance areas	100
PM_{10}	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
$PM_{2.5}$	All nonattainment and maintenance areas	100
Pb (Lead)	All nonattainment and maintenance	25

Source: 40 CFR 93.153

[a] Ozone precursors (NOx and VOCs): Gasoline and diesel engines do not directly emit ozone. Ozone is a product of NOx and VOCs reacting in the presence of sunlight. Since engines directly emit NOx and VOCs, their values function as surrogates for ozone emissions.

The federal action will occur in the South Coast Air Basin (SCAB), which is currently in extreme nonattainment for ozone (precursors: VOC or NOx); nonattainment for PM2.5; maintenance for PM10; maintenance for NO2; attainment for SO2; and maintenance for CO; partial nonattainment for lead. Based on the present NAAQS attainment designation for the SCAB, implementation of Alternative 13v or Alternative 20 would conform to the SIP if annual emissions for ozone precursors (VOC or NOx), NO2, PM2.5, PM10, CO, and lead remain below the rates listed in Table 2-2.

Table 2-2. Federal Attainment Designations for the South Coast Air Basin and Applicable Rates

Air Pollutants	SCAB Federal Attainment Designation	Rates (Tons/Year)
Ozone (precursors: VOC or NO_x)	Extreme Nonattainment	10
PM2.5	Nonattainment	100
PM10	Maintenance	100
NO2	Maintenance	100
CO	Attainment/Maintenance	100
SO_2	Attainment	100
Pb (Lead)	Nonattainment (Partial)[a]	25

Source: USEPA, Green Book Nonattainment Areas (Accessed at http://www.epa.gov/airquality/greenbook/ on March 6, 2015)

[a] U.S. EPA designated the Los Angeles County portion of the SCAB (excluding the high desert areas, and San Clemente and Santa Catalina Islands) as nonattainment for the recently revised (2008) federal lead standard (0.15 µg/m3, rolling 3-month average). South Coast Air Quality Management District, 2012 Air Quality Management Plan, p. 2-10. Since the project is located within Los Angeles County, lead is Nonattainment for the purpose of this analysis.

Air quality analysis methodology and results for Alternative 13v and Alternative 20 are found in Appendix F – Methodology and Data Tables.

Annual construction emissions for Alternative 13v and Alternative 20 are shown in Tables 3-1 through 3-2, respectively.

Table 3-1. Alternative 13v Estimated Direct Annual Emissions (Construction)

Pollutants	General Conformity Rates (tons/yr)	2017 Estimated Emissions (tons/year)	2018 Estimated Emissions (tons/year)	2019 Estimated Emissions (tons/year)	2020 Estimated Emissions (tons/year)	2021 Estimated Emissions (tons/year)	2022 Estimated Emissions (tons/year)	2023 Estimated Emissions (tons/year)	2024 Estimated Emissions (tons/year)	2025 Estimated Emissions (tons/year)	2026 Estimated Emissions (tons/year)	2027 Estimated Emissions (tons/year)
Ozone (VOC)	10	0.007	0.11	0.07	0.10	0.11	0.09	0.04	0.08	0.06	0.09	0.05
Ozone (NOX)	10	0.08	1.32	0.78	1.09	1.18	0.98	0.44	0.80	0.08	0.21	0.14
NO2	100	0.08	1.32	0.78	1.09	1.18	0.98	0.44	0.80	0.08	0.21	0.14
CO	100	0.03	0.75	0.50	0.78	0.91	0.78	0.45	0.78	0.54	0.83	0.48
PM10	100	0.005	0.06	0.04	0.05	0.06	0.04	0.02	0.04	0.02	0.05	0.03
PM2.5	100	<0.005	0.05	0.03	0.04	0.05	0.03	0.01	0.03	0.02	0.04	0.02

Table 3-2. Alternative 20 Estimated Direct Annual Emissions (Construction)

Pollutants	General Conformity Rates (tons/yr)	2018 Estimated Emissions (tons/year)	2019 Estimated Emissions (tons/year)	2020 Estimated Emissions (tons/year)	2021 Estimated Emissions (tons/year)	2022 Estimated Emissions (tons/year)	2023 Estimated Emissions (tons/year)	2024 Estimated Emissions (tons/year)	2025 Estimated Emissions (tons/year)	2026 Estimated Emissions (tons/year)	2027 Estimated Emissions (tons/year)	2028 Estimated Emissions (tons/year)	2029 Estimated Emissions (tons/year)	2030 Estimated Emissions (tons/year)	2031 Estimated Emissions (tons/year)	2032 Estimated Emissions (tons/year)
Ozone (VOC)	10	<0.005	0.13	0.01	0.01	0.22	0.21	0.24	0.10	0.06	0.06	0.08	0.13	0.07	0.08	0.14
Ozone (NOX)	10	<0.005	1.38	1.17	1.14	2.14	1.92	2.16	0.83	0.50	0.51	0.71	1.14	0.27	0.32	0.56
NO2	100	<0.005	1.38	1.17	1.14	2.14	1.92	2.16	0.83	0.50	0.51	0.71	1.14	0.27	0.32	0.56
CO	100	<0.005	0.85	0.80	0.84	1.77	1.82	2.12	0.92	0.66	0.64	0.82	1.21	0.64	0.54	0.87
PM10	100	<0.005	0.07	0.07	0.06	0.11	0.10	0.12	0.04	0.03	0.03	0.04	0.06	0.02	0.02	0.03
PM2.5	100	<0.005	0.06	0.06	0.05	0.09	0.08	0.09	0.03	0.02	0.02	0.03	0.05	0.01	0.01	0.02

Estimates of lead emissions were not calculated for construction and operational phases. Lead emissions from mobile sources in California have significantly decreased due to the near elimination of lead in fuels. Thus, CalEEMod, the South Coast Air Quality Management District-approved emission modeling software, does not provide estimated emissions for lead. Little to no quantifiable and foreseeable lead emissions would be generated by the alternatives.

Based on the above, total direct and indirect emissions of ozone precursors (VOC or NOx), NO2, PM2.5, PM10, CO, and lead caused by the Federal action do not equal or exceed the emission levels listed in Table 2-2.

3 Conclusion

The applicability analysis shows that direct and indirect emissions for Alternative 13v, the NER Plan, and Alternative 20, the Locally Preferred Plan and Recommended Plan, would not equal or exceed the prescribed emission levels. Neither alternative would cause or contribute to any new violation of a NAAQS, increase the frequency or severity of any existing violation, or delay the timely attainment of any standard, interim emission reduction, or other milestones. Thus, a general conformity determination is not required.

Appendix F-2
Air Quality Calculations Methodology and Data

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 Integrated Feasibility Report (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 Alt 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.

Modeling Software

Air pollutant emissions associated with each alternative were estimated using CalEEMod Version 13.2.2 software. The air emissions modeling software developed by the Southern California Air Quality Management District (SCAQMD) in collaboration with other air districts in California to estimate criteria air pollutant and greenhouse gas emissions from various land use development projects. The emission modeling software is used by air districts within California.

Model Assumptions:

The "cascade defaults" option in CalEEMod was deselected for all data entry and report outputs.

- Project Characteristics: The project location is within the South Coast Air Basin with the following defaults within CalEEMod: 2.2 m/s wind speed, 31 days precipitation frequency, Climate Zone 9, and urban land use setting. No utility company was selected since construction and operational phases of the project are not expected to utilize electrical power on a long-term basis.
- Land Use: The land use type is Recreational (user-defined recreational) with 100 acre project area.

Construction Emissions

For construction emissions an equipment inventory was developed for specific tasks required to implement management measures listed in Section 4.4.5 of the Integrated Feasibility Report (See Attachment 1). Equipment information included off-road and on-road equipment types, quantity of equipment, hours of off-road equipment operation, and on-road transportation distances. For each alternative, a general multi-year construction schedule (Attachment 2) and detailed construction phasing for each management measure (Attachment 9 of the Cost Appendix) were entered into CalEEMod. Each measure entered into CalEEMod was correlated with information from the equipment inventory.

Maximum daily and annual emissions were estimated for each construction year for all alternatives. Results were compared to applicable regulatory thresholds in Chapter 5 of the Integrated Feasibility Report.

Operational Emissions (Maintenance)

Maintenance activities would likely entail annual vegetation maintenance activities over a 30 day period. Required equipment would include approximately five medium duty pickup trucks, two backhoes, two loaders, one excavator, two chippers, and two dump trucks. In so far as all build alternatives share many common restoration features, the scope, nature, and duration of maintenance activities are not expected to be notably different. As a result, operational emissions for all build alternatives are not expected to be substantially different. Furthermore, operational emissions are not expected to substantially change from year to year. As a result, maximum daily and annual emissions estimates were limited to one year.

Operational Emissions (Increased Visitations)

An increase of approximately 572 average daily visitors is projected with implementation of any build alternatives (See Recreational Analysis Appendix, Tables 3 and 4). It was not feasible to use CalEEMod to estimate emissions for vehicle trips not associated with recognized land uses and associated square footages. Emissions were estimated in Microsoft Excel using SCAQMD emissions factors for passenger vehicles (model years 1982-2026). Daily and annual CO2e emissions were calculated using U.S. Environmental Protection Agency's CO2e calculator at http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results.

Lead (Pb) Emissions

Estimates of lead emissions were not calculated for construction and operational phases. Lead emissions from mobile sources in California have significantly decreased due to the near elimination of lead in fuels. Thus, CalEEMod does not provide estimated emissions for lead. Little to no quantifiable and foreseeable lead emissions would be generated by the alternatives.

Greenhouse Gas Emissions

The SCAQMD adopted a quantitative significance threshold of 10,000 metric tons (MT) per year for industrial (stationary source) projects. In the absence of applicable greenhouse gas (GHG) thresholds for ecosystem restoration projects, the 10,000 metric ton threshold for GHG is adopted for use in this analysis. GHG emissions are reported as CO2 equivalents (CO2e).

All three sources of GHG emissions were included: construction, maintenance, and increased visitation. Maintenance and increased are considered operational emissions. The SCAQMD recommends that the total construction emissions be amortized over the lifetime of the project and then added to annual operational emissions. If the lifetime of a project is not known, then a 30-year lifetime is assumed. Construction related GHG emissions were amortized over a 30 year period by summing the annual GHG emissions over the duration of construction and dividing by 30. The amortized values were added to operational GHG emissions. Unlike construction emissions, operational GHG emissions were assumed to remain the same from year to year.

General and Detailed Schedules

General schedules for each alternative are found in Attachment 2. Detailed construction schedules for Alternative 20 and 10 were developed (see Attachment 9 of the Cost Appendix). Detailed construction

schedules for Alternative 16 and 10 were not. However, Alternative 16 is a truncated variation of Alternative 20. Likewise, Alternative 10 is a truncated variation of Alternative 13. As a result, appropriate construction phases entered into CalEEMod for Alternative 20 were deleted to estimate emissions for Alternative 16. Likewise, appropriate construction phases entered into CalEEMod for Alternative 13 were deleted to estimate emissions for Alternative 10. Deleted construction phases for Alternative 13 and 16 are shown below:

Alternative 10 (model derivations from ALT 13 multi-year schedule):

1. The construction duration is a 10-year period between March 16, 2017 and December 25, 2026.

- REACH 7 only includes daylighting of 3 storm drains:
- Removed measure 21 – lower channel banks and provide setback levees or berms
- Removed measure 17 – habitat corridors/riparian planting on banks

2. REACH 6 includes primary riparian corridor planting in Taylor Yard and concrete removal on left bank.

- Removed measure 16 – bioengineering channel walls
- Removed measure 17 – habitat corridors/riparian planting on banks

3. REACH 3 only includes modification of 1 storm drain, and riparian planting along Zoo Drive.

- Removed measure 3/5 – create geomorphology and planting
- Removed measure 10 – divert tributary and river flow into side channel
- Moved mobilization and preparatory work (40 days) from February 2024 to February 2025.
- NO construction takes place in 2024

Alternative 16 (model derivations from ALT 20 multi-year schedule):

1. The construction duration is a 15-year period between October 21, 2018 and February 16, 2032.

2. Removed the following measures from Reach 7:

- Measure 8 – creation of wetland flood control basin (corn field)
- Measure 27 – tributary channels/widen channel (Arroyo Seco)
- Measure 26 – terrace banks

3. Reach 7: Added Measure 21 – Lower channel banks and provide setback levees or berms

4. Removed the following measures from Reach 2:

- Measure 27 – modify trapezoidal channel to vertical sides
- Measure 16 – bioengineer channel walls
- Reduced mobilization/prep from 30 days to 12 days.

Attachment 1: Equipment List

	Off Road			On Road		
	Equipment	**Quantity**	**Hrs./Day**	**Equipment**	**Trips/Day**	**Mile/Trip**
Aggregate Base & Asphalt	Loader	1	8	Haul: 15-cy trucks	6	30
	Grader	1	8	crew	6	14.7
	Roller	1	8			
Backfill & Compacted Fill	Loader	2	8	Haul:	1	8
	Dozer	1	8	Crew:	6	14.7
	Roller	1	8			
Chain link Fence	Backhoe	1	8	Haul: flatbed trucks	1	6
				crew	3	14.7
Clearing & Grubbing	Rubber-tired dozer	1	8	Haul: 15-cy trucks	6	30
				crew	3	14.7
Cofferdam Installation	Crane	1	8	Haul: flatbed trucks	1	15
	Excavator	1	1	crew	4	14.7
Concrete Planters	Forklift	1	8	Haul: flatbed trucks	4	30
Demolition concrete/riprap	Excavator	1	8	Haul: 15-cy trucks	4	30
	Rubber-tired loaders	2	8	crew	5	14.7
Demolition storm drain	excavator	1	8	Haul: flatbed trucks	1	20
Erosion Control	Backhoe	1	8	Haul: 0		
	Crane	1	8	crew	4	
Excavate Embankments	Scraper	1	8	Haul: 15-cy trucks	6	30
	Loader	1	8	Crew	5	14.7
Excavate, Grade Control	Excavator	1	8	Haul: 15-cy trucks	1	10
	Grader	1	8	Crew:	3	
Install storm drain	Fork lift	1	8	Haul: concrete truck	1	72
Impermeable Layer	Fork lift	1	8	Haul: flatbed trucks	1	25
	Crane	1	8	Crew:	5	
Irrigation	Ditch Digger	1	8	Haul	0	0
				Crew:	2	
Mobilization				Haul: flatbed trucks	1	30
				crew	3	14.7
Planting	Backhoe	1	8	Haul:	1	12
				Crew:	3	
Restrooms	Fork lift	1	8	Haul:	1	17
	crane	1	8	Crew:	4	
Riprap Placement	Loader	1	8	Haul: 15-cy trucks	6	30
	Excavator	1	8	Crew	5	
Sheet Pile & Asphalt Demolition	Excavator	1	8	Haul: 15-cy trucks	4	30
Stone placement & tie-in	Excavator	1	8	Haul: 15-cy trucks	1	17
	Loader	1	8	Crew:	3	
Topsoil	Grader	1	8	Haul:	1	15
	Loader	1	8	Crew:	5	14.7
	Dozer	1	8			
Trail, viewpoints, parking lots	Roller	1	8	Haul: 15-cy trucks	1	10
	Grader	1	8	Crew:	8	
	dozer	1	8			
	Loader	1	8			
Utility Towers	Crane	1	8	Haul: concrete truck	1	20
				Haul: flatbed trucks	2	20
				Crew:	6	

Attachment 2: General Multi-Year Schedule

Alternative 10

LERRDS, Plans & Specs, Procurement Actual Construction

Reach Name	TOTAL #YRS	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Reach 8	0												
Reach 7	0												
Reach 6	0												
Reach 5	0												
Reach 4	0												
Reach 3	0												
Reach 2	0												
Reach 1	0												

Assumptions:

1. Prep time (P&S, procurement) is shown immediately preceeding construction

Alternative 13

LERRDS, Plans & Specs, Procurement Actual Construction

Reach Name	TOTAL #YRS	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Reach 8	0												
Reach 7	0												
Reach 6	0												
Reach 5	0												
Reach 4	0												
Reach 3	0												
Reach 2	0												
Reach 1	0												

Alternative 13V

LERRDS, Plans & Specs, Procurement Actual Construction

Reach Name	TOTAL #YRS	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Reach 6	4												
Reach 5	1.9												
Reach 4	3.4												
Reach 3	3.7												
Reach 2	2												
Reach 1	2.4												
Reach 8	3.7												
Reach 7	4												

Alternative 16

LERRDS, Plans & Specs, Procurement | Actual Construction

	TOTAL #YRS	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Reach 6	5																	
Reach 5	6																	
Reach 4	3.4																	
Reach 7	4.7																	
Reach 3 -	6																	
Reach 2	2																	
Reach 1	2.4																	
Reach 8	7																	

Alternative 20

LERRDS, Plans & Specs, Procurement | Actual Construction

	TOTAL #YRS	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Reach 6	0																	
Reach 5	0																	
Reach 4	0																	
Reach 7	0																	
Reach 3	0																	
Reach 2	5																	
Reach 1	0																	
Reach 8	0																	

Attachment 3: CalEEMod Data Tables (Annual and Daily) for Construction and Maintenance Emissions & Calculations for Visitation Emissions

Table 5-5: Alternative 10 Estimated Annual Emissions

Pollutants	General Conformity Rates (tons/yr)	2017 Estimated Emissions (tons/year)	2018 Estimated Emissions (tons/year)	2019 Estimated Emissions (tons/year)	2020 Estimated Emissions (tons/year)	2021 Estimated Emissions (tons/year)	2022 Estimated Emissions (tons/year)	2023 Estimated Emissions (tons/year)	2024 Estimated Emissions (tons/year)	2025 Estimated Emissions (tons/year)	2026 Estimated Emissions (tons/year)
Ozone (VOC)	10	0.12	0.12	0.06	0.11	0.05	0.07	0.07	0.00	0.06	0.06
Ozone (NOX)	10	1.38	1.21	0.62	1.20	0.49	0.66	0.64	0.00	0.50	0.51
NO2	100	1.38	1.21	0.62	1.20	0.49	0.66	0.64	0.00	0.50	0.51
CO	100	0.81	0.80	0.41	0.77	0.36	0.62	0.63	0.00	0.60	0.57
PM10	100	0.07	0.07	0.03	0.06	0.03	0.04	0.03	0.00	0.03	0.03
PM2.5	100	0.06	0.06	0.03	0.05	0.02	0.03	0.03	0.00	0.02	0.02
CO2e	10000	130	104	57	138	51	105	106	0.00	94	89

Table 5-6: Alternative 10 Estimated Daily Emissions

Pollutants	Regional Sigfinicant Rates (lbs/day)	Local Significant Rates (lbs/day)	2017 Estimated Emissions (lbs/day)	2018 Estimated Emissions (lbs/day)	2019 Estimated Emissions (lbs/day)	2020 Estimated Emissions (lbs/day)	2021 Estimated Emissions (lbs/day)	2022 Estimated Emissions (lbs/day)	2023 Estimated Emissions (lbs/day)	2026 Estimated Emissions (lbs/day)	2025 Estimated Emissions (lbs/day)	2026 Estimated Emissions (lbs/day)
VOC	75	n/a	2.90	5.97	5.69	2.53	4.14	2.50	1.74	0.00	1.72	1.87
NOX	100	46	32.47	63.55	58.21	26.89	41.99	23.89	16.69	0.00	14.95	16.90
CO	550	231	18.95	40.57	38.50	18.09	31.16	23.16	16.23	0.00	16.40	17.60
SO2	150	n/a	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.00	<0.005	<0.005
PM10	150	4	1.67	3.53	3.07	1.46	2.19	1.26	0.88	0.00	0.81	0.93
PM2.5	55	3	1.46	3.05	2.65	1.25	1.89	1.05	0.75	0.00	0.66	0.76
CO2e	n/a	n/a	3474	5909	5807	2844	4835	4153	3867	0.00	2995	3217

Table 5-7: OPERATIONS ANNUAL: MAINTENANCE AND VISITATIONS COMBINED (ALL ALTERNATIVES)

Pollutants	General Conformity Rates (tons/yr)	Estimated Emissions (tons/year)	Estimated Emissions (tons/year)
		Maintenance	Visitations
Ozone (VOC)	10	0.03	6.14
Ozone (NOX)	10	0.40	0.51
NO2	100	0.40	0.51
CO	100	0.28	0.78
PM10	100	0.02	0.18
PM2.5	100	0.02	0.11
CO2e	10000.00	48.00	2079.00

Table 5-8: OPERATIONS DAILY: MAINTENANCE AND VISITATIONS COMBINED (ALL ALTERNATIVES)

Pollutants	Regional Sigfinicant Rates (lbs/day)	Local Significant Rates (lbs/day)	Estimated Emissions (lbs/day)	Estimated Emissions (lbs/day)
			Maintenance	Visitations
VOC	55	n/a	2.40	4.80
NOX	55	46.00	26.60	3.10
CO	550	231.00	18.90	37.60
SO2	150	n/a	0.03	0.12
PM10	150	4.00	1.35	1.10
PM2.5	55	3.00	1.19	0.73
CO2e	n/a	n/a	3563.00	12720.00

Table 5-9: Alt 10 GHG

Annual CO2e Emissions Sources	SCAQMD GHG Rates (MT/yr)	Annual Estimated Emissions (MT/year)
Construction	n/a	29
Maintenance	n/a	48
Visitations	n/a	2079
Total CO2e	10,000	2156

Table 5-10: Alternative 13 Estimated Annual Emissions

Pollutants	General Conformity Rates (tons/yr)	2017 Estimated Emissions (tons/year)	2018 Estimated Emissions (tons/year)	2019 Estimated Emissions (tons/year)	2020 Estimated Emissions (tons/year)	2021 Estimated Emissions (tons/year)	2022 Estimated Emissions (tons/year)	2023 Estimated Emissions (tons/year)	2024 Estimated Emissions (tons/year)	2025 Estimated Emissions (tons/year)	2026 Estimated Emissions (tons/year)
Ozone (VOC)	10	0	0.22	0.16	0.11	0.10	0.07	0.07	0.09	0.06	0.06
Ozone (NOX)	10	1	2.28	1.69	1.20	1.02	0.66	0.64	0.87	0.50	0.51
NO2	100	1	2.28	1.69	1.20	1.02	0.66	0.64	0.87	0.50	0.51
CO	100	1	1.45	1.09	0.77	0.75	0.62	0.63	0.85	0.60	0.57
PM10	100	0	0.12	0.08	0.06	0.06	0.04	0.03	0.04	0.03	0.03
PM2.5	100	0	0.11	0.07	0.05	0.05	0.03	0.03	0.03	0.02	0.02
CO2e	10000	130	226	188	138	114	105	106	178	94	89

Table 5-11: Alternative 13 Estimated Daily Emissions

Pollutants	Regional Sigfinicant Rates (lbs/day)	Local Significant Rates (lbs/day)	2017 Estimated Emissions (lbs/day)	2018 Estimated Emissions (lbs/day)	2019 Estimated Emissions (lbs/day)	2020 Estimated Emissions (lbs/day)	2021 Estimated Emissions (lbs/day)	2022 Estimated Emissions (lbs/day)	2023 Estimated Emissions (lbs/day)	2024 Estimated Emissions (lbs/day)	2025 Estimated Emissions (lbs/day)	2026 Estimated Emissions (lbs/day)
VOC	75	n/a	2.90	7.45	5.68	2.53	4.57	2.50	1.74	3.31	1.72	1.87
NOX	100	46	32.47	77.96	58.18	26.89	45.97	23.89	16.69	30.75	14.95	16.90
CO	550	231	18.95	46.59	38.35	18.09	35.52	23.16	16.23	28.81	16.40	17.60
SO2	150	n/a	0.03	0.08	0.06	0.03	0.06	0.04	0.04	0.07	0.03	0.03
PM10	150	4	1.67	4.28	3.04	1.46	2.49	1.26	0.88	1.48	0.81	0.93
PM2.5	55	3	1.46	3.74	2.64	1.25	2.14	1.05	0.75	1.20	0.66	0.76
CO2e	n/a	n/a	3474	8142	5772	2844	5420	4153	3867	6841	2995	3217

Table 5-12: Alt 13 GHG

Annual CO2e Emissions Sources	SCAQMD GHG Rates (MT/yr)	Annual Estimated Emissions (MT/year)
Construction	n/a	46
Maintenance	n/a	48
Visitations	n/a	2079
Total CO2e	10,000	2173

Table 5-13: Alternative 13 V Estimated Annual Emissions

Pollutants	General Conformity Rates (tons/yr)	2017 Estimated Emissions (tons/year)	2018 Estimated Emissions (tons/year)	2019 Estimated Emissions (tons/year)	2020 Estimated Emissions (tons/year)	2021 Estimated Emissions (tons/year)	2022 Estimated Emissions (tons/year)	2023 Estimated Emissions (tons/year)	2024 Estimated Emissions (tons/year)	2025 Estimated Emissions (tons/year)	2026 Estimated Emissions (tons/year)	2027 Estimated Emissions (tons/year)
Ozone (VOC)	10	0.007	0.11	0.07	0.10	0.11	0.09	0.04	0.08	0.06	0.09	0.05
Ozone (NOX)	10	0.08	1.32	0.78	1.09	1.18	0.98	0.44	0.80	0.08	0.21	0.14
NO2	100	0.08	1.32	0.78	1.09	1.18	0.98	0.44	0.80	0.08	0.21	0.14
CO	100	0.03	0.75	0.50	0.78	0.91	0.78	0.45	0.78	0.54	0.83	0.48
PM10	100	0.005	0.06	0.04	0.05	0.06	0.04	0.02	0.04	0.02	0.05	0.03
PM2.5	100	<0.005	0.05	0.03	0.04	0.05	0.03	0.01	0.03	0.02	0.04	0.02
CO2e	10000	7	130	100	123	151	155	76	113	122	148	90

Table 5-14: Alternative 13 V Estimated Daily Emissions

Pollutants	Regional Sigfinicant Rates (lbs/day)	Local Significant Rates (lbs/day)	2017 Estimated Emissions (lbs/day)	2018 Estimated Emissions (lbs/day)	2019 Estimated Emissions (lbs/day)	2020 Estimated Emissions (lbs/day)	2021 Estimated Emissions (lbs/day)	2022 Estimated Emissions (lbs/day)	2023 Estimated Emissions (lbs/day)	2024 Estimated Emissions (lbs/day)	2025 Estimated Emissions (lbs/day)	2026 Estimated Emissions (lbs/day)	2027 Estimated Emissions (lbs/day)
VOC	75	n/a	0.67	1.56	1.04	2.27	2.26	1.58	1.47	3.80	0.09	2.34	1.44
NOX	100	46	7.75	19.22	11.15	23.56	22.88	16.21	14.65	36.33	8.15	20.93	12.76
CO	550	231	3.10	10.60	8.70	16.36	17.93	11.77	11.35	34.00	6.95	20.09	13.09
SO2	150	n/a	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.05	0.02	0.04	0.02
PM10	150	4	0.44	0.89	0.55	1.22	1.23	0.74	0.67	1.90	0.36	1.05	0.68
PM2.5	55	3	0.34	0.77	0.48	1.06	1.05	0.64	0.58	1.60	0.30	0.80	0.56
CO2e	n/a	n/a	1296	2187	1168	2449	2744	2312	2312	5141	2115	4529	2399

Table 5-15: Alt 13v GHG

Annual CO2e Emissions Sources	SCAQMD GHG Rates (MT/yr)	Annual Estimated Emissions (MT/year)
Construction	n/a	41
Maintenance	n/a	48
Visitations	n/a	2079
Total CO2e	10,000	2168

Table 5-16: Alternative 16 Estimated Annual Emissions

Pollutants	General Conformity Rates (tons/yr)	2018 Estimated Emissions (tons/year)	2019 Estimated Emissions (tons/year)	2020 Estimated Emissions (tons/year)	2021 Estimated Emissions (tons/year)	2022 Estimated Emissions (tons/year)	2023 Estimated Emissions (tons/year)	2024 Estimated Emissions (tons/year)	2025 Estimated Emissions (tons/year)	2026 Estimated Emissions (tons/year)	2027 Estimated Emissions (tons/year)	2028 Estimated Emissions (tons/year)	2029 Estimated Emissions (tons/year)	2030 Estimated Emissions (tons/year)	2031 Estimated Emissions (tons/year)	2032 Estimated Emissions (tons/year)
Ozone (VOC)	10	<0.005	0.13	0.01	0.01	0.22	0.21	0.10	0.10	0.06	0.06	0.05	0.10	0.07	0.08	0.14
Ozone (NOX)	10	<0.005	1.38	1.17	1.14	2.14	1.92	0.92	0.83	0.50	0.51	0.46	0.88	0.27	0.32	0.56
NO2	100	<0.005	1.38	1.17	1.14	2.14	1.92	0.92	0.83	0.50	0.51	0.46	0.88	0.27	0.32	0.56
CO	100	<0.005	0.85	0.80	0.84	1.77	1.82	0.90	0.92	0.66	0.64	0.50	0.96	0.64	0.54	0.87
PM10	100	<0.005	0.07	0.07	0.06	0.11	0.10	0.05	0.04	0.03	0.03	0.03	0.05	0.02	0.02	0.03
PM2.5	100	<0.005	0.06	0.06	0.05	0.09	0.08	0.04	0.03	0.02	0.02	0.02	0.04	0.01	0.01	0.02
CO2e	10000	1	148	117	159	357	347	175	197	126	121	80	210	144	175	289

Table 5-17: Alternative 16 Estimated Daily Emissions

Pollutants	Regional Sigfinicant Rates (lbs/day)	Local Significant Rates (lbs/day)	2018 Estimated Emissions (lbs/day)	2019 Estimated Emissions (lbs/day)	2020 Estimated Emissions (lbs/day)	2021 Estimated Emissions (lbs/day)	2022 Estimated Emissions (lbs/day)	2023 Estimated Emissions (lbs/day)	2024 Estimated Emissions (lbs/day)	2025 Estimated Emissions (lbs/day)	2026 Estimated Emissions (lbs/day)	2027 Estimated Emissions (lbs/day)	2028 Estimated Emissions (lbs/day)	2029 Estimated Emissions (lbs/day)	2030 Estimated Emissions (lbs/day)	2031 Estimated Emissions (lbs/day)	2032 Estimated Emissions (lbs/day)
VOC	75	n/a	0.01	3.83	8.21	3.59	5.00	5.05	3.25	2.98	2.53	4.36	3.67	2.91	1.70	2.07	4.22
NOX	100	46	0.04	38.52	83.67	36.56	47.71	48.36	30.24	25.50	19.95	38.54	32.95	25.72	7.81	8.86	17.39
CO	550	231	0.17	25.37	59.37	29.02	41.55	45.42	28.35	27.16	26.24	39.56	35.77	26.40	14.73	18.47	31.22
SO2	150	n/a	<0.005	0.04	0.09	0.07	0.10	0.11	0.05	0.07	0.06	0.08	0.06	0.05	0.04	0.05	0.10
PM10	150	4	0.04	2.13	4.61	1.76	2.31	2.51	1.60	1.27	1.05	2.08	1.87	1.38	0.35	0.46	0.97
PM2.5	55	3	0.01	1.82	3.99	1.44	1.88	2.15	1.35	1.01	0.82	1.72	1.54	1.15	0.25	0.36	0.74
CO2e	n/a	n/a	40	3970	9043	6545	9775	10471	4824	6837	5752	7224	6132	5167	3897	4706	9631

Table 5-18: Alt 16 SPL GHG

Annual CO2e Emissions Sources	SCAQMD GHG Rates (MT/yr)	Annual Estimated Emissions (MT/year)
Construction	n/a	88
Maintenance	n/a	48
Visitations	n/a	2079
Total CO2e	10,000	2215

Table 5-19: Alternative 20 Estimated Annual Emissions

Pollutants	General Conformity Rates (tons/yr)	2018 Estimated Emissions (tons/year)	2019 Estimated Emissions (tons/year)	2020 Estimated Emissions (tons/year)	2021 Estimated Emissions (tons/year)	2022 Estimated Emissions (tons/year)	2023 Estimated Emissions (tons/year)	2024 Estimated Emissions (tons/year)	2025 Estimated Emissions (tons/year)	2026 Estimated Emissions (tons/year)	2027 Estimated Emissions (tons/year)	2028 Estimated Emissions (tons/year)	2029 Estimated Emissions (tons/year)	2030 Estimated Emissions (tons/year)	2031 Estimated Emissions (tons/year)	2032 Estimated Emissions (tons/year)
Ozone (VOC)	10	<0.005	0.13	0.01	0.01	0.22	0.21	0.24	0.10	0.06	0.06	0.08	0.13	0.07	0.08	0.14
Ozone (NOX)	10	<0.005	1.38	1.17	1.14	2.14	1.92	2.16	0.83	0.50	0.51	0.71	1.14	0.27	0.32	0.56
NO2	100	<0.005	1.38	1.17	1.14	2.14	1.92	2.16	0.83	0.50	0.51	0.71	1.14	0.27	0.32	0.56
CO	100	<0.005	0.85	0.80	0.84	1.77	1.82	2.12	0.92	0.66	0.64	0.82	1.21	0.64	0.54	0.87
PM10	100	<0.005	0.07	0.07	0.06	0.11	0.10	0.12	0.04	0.03	0.03	0.04	0.06	0.02	0.02	0.03
PM2.5	100	<0.005	0.06	0.06	0.05	0.09	0.08	0.09	0.03	0.02	0.02	0.03	0.05	0.01	0.01	0.02
CO2e	10000	1	148	117	159	357	347	412	197	126	121	153	254	144	175	289

Table 5-20: Alternative 20 Estimated Daily Emissions

Pollutants	Regional Sigfinicant Rates (lbs/day)	Local Significant Rates (lbs/day)	2018 Estimated Emissions (lbs/day)	2019 Estimated Emissions (lbs/day)	2020 Estimated Emissions (lbs/day)	2021 Estimated Emissions (lbs/day)	2022 Estimated Emissions (lbs/day)	2023 Estimated Emissions (lbs/day)	2024 Estimated Emissions (lbs/day)	2025 Estimated Emissions (lbs/day)	2026 Estimated Emissions (lbs/day)	2027 Estimated Emissions (lbs/day)	2028 Estimated Emissions (lbs/day)	2029 Estimated Emissions (lbs/day)	2030 Estimated Emissions (lbs/day)	2031 Estimated Emissions (lbs/day)	2032 Estimated Emissions (lbs/day)
VOC	75	n/a	0.01	3.83	8.21	3.59	5.00	5.05	6.77	2.98	2.53	4.36	1.99	3.80	1.70	2.07	4.22
NOX	100	46	0.04	38.52	83.67	36.56	47.71	48.36	59.25	25.50	19.95	38.54	18.02	32.50	7.81	8.86	17.39
CO	550	231	0.17	25.37	59.37	29.02	41.55	45.42	62.11	27.16	26.24	39.56	18.91	34.54	14.73	18.47	31.22
SO2	150	n/a	<0.005	0.04	0.09	0.07	0.10	0.11	0.14	0.07	0.06	0.08	0.04	0.08	0.04	0.05	0.10
PM10	150	4	0.04	2.13	4.61	1.76	2.31	2.51	3.19	1.27	1.05	2.08	1.00	1.78	0.35	0.46	0.97
PM2.5	55	3	0.01	1.82	3.99	1.44	1.88	2.15	2.53	1.01	0.82	1.72	0.80	1.41	0.25	0.36	0.74
CO2e	n/a	n/a	40	3970	9043	6545	9775	10471	13602	6837	5752	7224	3941	7928	3897	4706	9631

Table 5-21:Alt 20 GHG

Annual CO2e Emissions Sources	SCAQMD GHG Rates (MT/yr)	Annual Estimated Emissions (MT/year)
Construction	n/a	100
Maintenance	n/a	48
Visitations	n/a	2079
Total CO2e	10,000	2227

MAINTENANCE ANNUAL

Pollutants	General Conformity Rates (tons/yr)	Estimated Emissions (tons/year)
ROG	10	0.03
NOX	10	0.40
CO	100	0.28
PM10	100	0.02
PM2.5	100	0.02
CO2e	10000	48

MAINTENANCE DAILY

Pollutants	Regional Sigfinicant Rates (lbs/day)	Local Significant Rates (lbs/day)	Estimated Emissions (lbs/day)
VOC	55	n/a	2.4
NOX	55	46	26.6
CO	550	231	18.9
SO2	150	n/a	0.03
PM10	150	4	1.35
PM2.5	55	3	1.19
CO2e	n/a	n/a	3563

DAILY VISITATION

Pollutants	Emissions factors	average miles per car	number of cars per day	pounds per day	Metric tons per year	CO2e Daily (lbs/day)	CO2e Annual
CO	**0.00328779**	20	572	37.61232	6.141837		
NOx	**0.00027141**	20	572	3.104927	0.507014		
ROG	**0.00042052**	20	572	4.810804	0.785572		
SOx	**0.00001076**	20	572	0.123075	0.020097		
PM10	**0.00009687**	20	572	1.108248	0.180969		
PM2.5	**0.00006415**	20	572	0.733871	0.119836		
CO2	**1.11105829**	20	572	12710.51	2075.54		
CH4	**0.00003518**	20	572	0.402427	0.065714		
CO2e						12,720	2079

metric tons per year = lbs/day * 360 days * 0.00045359237 metric tons/lb
Annual CO2e calculated with EPA CO2e calculator at http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results gasses used are CO2 (2075 metric tons) and CH4 (0.065 metric tons)
emissions factors from SCAQMD on-road factors for passenger vehicles; all model years from 1982-2026
Daily CO2e = (12710+0.402) = 12720 lbs per EPA CO2e calculator

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Final
Habitat Evaluation (CHAP) Appendix G

September 2015

Los Angeles River near Downtown, circa 1900
from Blake Gumprecht's "The Los Angeles River"

CHAP Habitat Evaluation Appendix
Los Angeles River Ecosystem Restoration Study

U.S. Army Corp of Engineers
Los Angeles District

and

Northwest Habitat Institute

September 2015

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1.0 INTRODUCTION

This Appendix provides a habitat assessment analysis of alternatives proposed for the Los Angeles (LA) River Ecosystem Restoration (ER) Feasibility Study (the "Study"), Los Angeles, California. The Study examines restoration opportunities within an 11-mile segment of the LA River, referred to as the ARBOR (Alternative with Restoration Benefits and Opportunities for Revitalization) reach (hereafter referred to as Study area) (Figure 1-1). The Study alternatives evaluate restoration of the area to a condition characteristic of the historic, natural riparian river channel, as limited by the surrounding highly urbanized City of LA and the channel's purpose for flood risk management. Development of restoration alternatives was based on the following study objectives:

- Restore Valley Foothill Riparian Strand and Freshwater Marsh Habitat.
- Increase Habitat Connectivity.

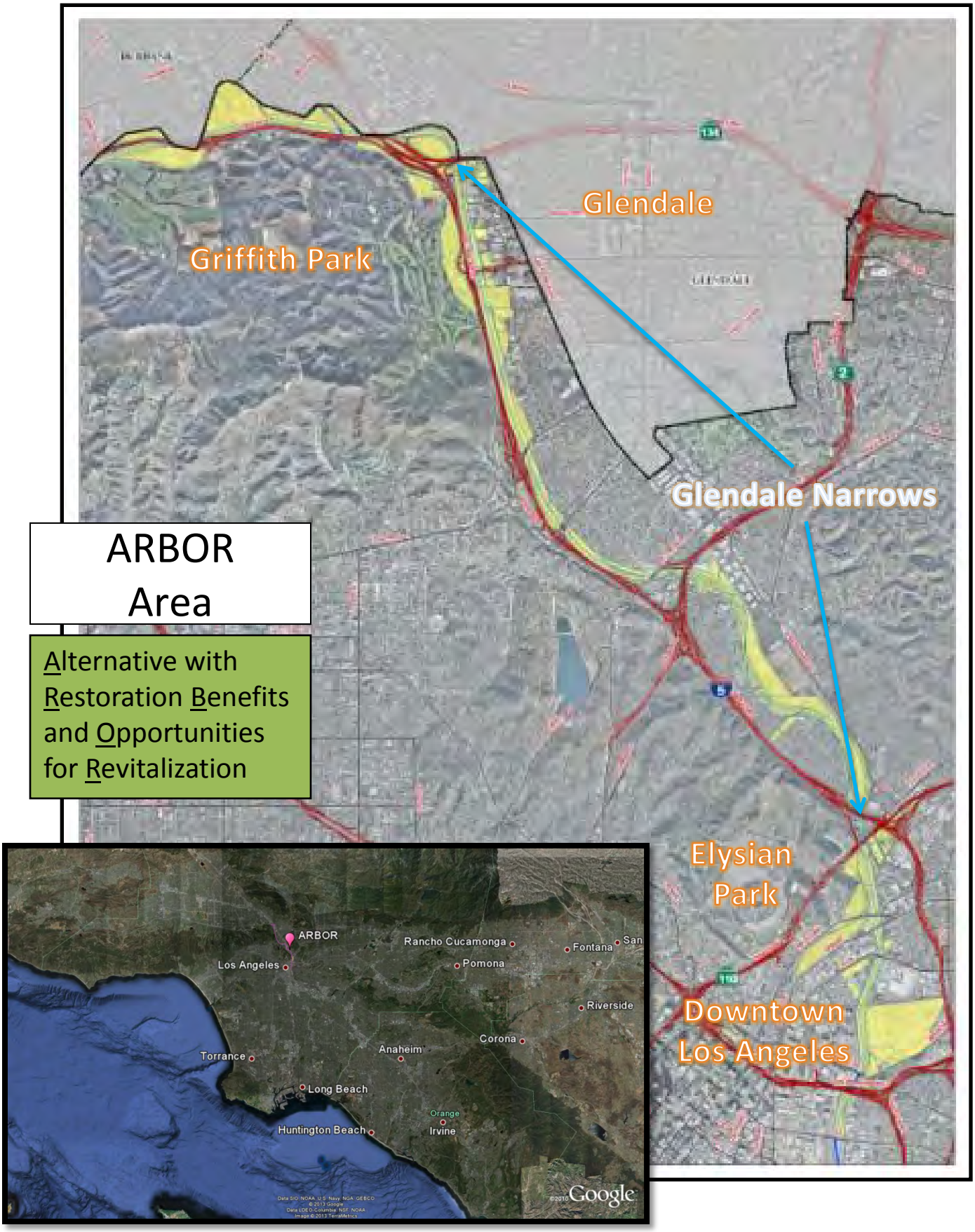
2.0 STUDY BACKGROUND

The U.S. Army Corps of Engineers' (Corps') involvement with the LA River began in the 1930s after devastating floods destroyed homes, businesses, and infrastructure in the early 20th Century. The City of Los Angeles and Los Angeles County initiated the flood control program that channelized the river after these floods. Congress authorized the Corps to undertake, with the County as partner, a modified version of the County's comprehensive plan. The Corps then joined the efforts, which led to the further channelization of the River in the 1930s and 1940s and the current concrete configuration. This configuration drastically altered the remaining riparian and freshwater marsh habitats as well as ecosystem functions in the once natural River system. The flood risk management project also allowed for increased urbanization and development in the floodplain, further reducing the marsh and riparian habitats that had naturally occurred on the river and its tributaries. The Corps' involvement on the LA River continues today in sharing operation and maintenance responsibilities with the LA County Flood Control District. The Corps has operation and maintenance responsibility for the portion of the river within the Study Area.

The U.S. Congress directed the Corps to undertake the LA River Ecosystem Restoration Study in 2006. The Study initially focused on the first 32 miles of river, and was subsequently narrowed to focus on the 11.5-mile Study area (aka ARBOR reach), which exhibits the greatest potential for ecosystem restoration. This reach includes the "soft-bottomed" Glendale Narrows that connects Griffith Park to Downtown LA and that currently supports degraded riparian habitat. The soft-bottomed reaches currently support a natural bed with concrete banks due to a high groundwater table that did not allow the bed to be constructed with concrete.

In 2007, the City of LA adopted the long-range LA River Revitalization Master Plan that calls for the creation of a 64-mile network of trails, parks, and recreation along both sides of the first 32 miles of the LA River, from the San Fernando Valley to the City of LA's border with the City of Vernon, an area home to more than one million people. The entire Study area is within the Master Plan's focus area.

Figure 1-1. ARBOR Study Area



The Feasibility Scoping Meeting milestone[1] for the LA River ER Study occurred in November 2007. The Study is currently in the Plan Formulation and Evaluation Phase with the City of LA as the non-Federal local sponsor. Planning workshops were held in December 2009, and the Corps used the information from these workshops to develop 19 preliminary alternatives defined by combinations of more than 200 measures. Elements from these preliminary 19 alternatives were later recombined and eventually reduced to four final alternatives for detailed consideration based on preliminary design and cost-benefit analyses. A final recommended plan will be chosen from this group of four alternatives.

3.0 SITE DESCRIPTION

The 11-mile Study area encompasses the soft bottom Glendale Narrows as well as portions of the concrete channel from Griffith Park to northern downtown LA. The Study area includes the LA River channel and select adjacent areas, beginning upstream at Pollywog Park, across from the Forest Lawn Cemetery. Further downstream, Verdugo Wash enters the LA River from the east, and the River then flows south through the Glendale Narrows. Just downstream of the Glendale Narrows, the Arroyo Seco enters the River from the east, and the River continues to flow south into downtown. The project area ends in downtown at First Street.

Large (i.e. in acreage) River-adjacent areas considered in the Study area include Pollywog Park, Burbank-Western Channel confluence, Bette Davis Park, Ferarro Fields, Verdugo Wash confluence, Griffith Park Golf Course (a.k.a. Harding Municipal Golf Course), Los Feliz Golf Course, Bowtie Parcel, Taylor Yard (a.k.a. G-2 Parcel), Arroyo Seco confluence, Cornfields (a.k.a. Los Angeles State Historic Park), and Piggyback Yard (Figure 3-1). The Study area encompasses approximately 842 acres.

The Study area is split into eight geomorphic reaches (Figure 3-2) generally defined by Study landmarks as follows:

1) Pollywog Park to Bette Davis Park (concrete bottom)
2) Bette Davis Park to Ferraro Fields (soft bottom)
3) Ferraro Fields to upstream Glendale Narrows (concrete bottom)
4) Upstream Glendale Narrows to Los Feliz Boulevard (soft bottom)
5) Los Feliz Boulevard to Bowtie Parcel (soft bottom)
6) Bowtie Parcel to downstream Glendale Narrows/Arroyo Seco (soft bottom)
7) Downstream Glendale Narrows/Arroyo Seco to Main Street (concrete bottom)
8) Main Street to First Street (concrete bottom)
   *Note that all reaches have concrete banks

1 Feasibility Scoping Meeting (FSM) = The purpose of the FSM is to bring the Corps vertical management team, the non-Federal sponsor, and resource agencies together to agree on the problems and solutions to be investigated by a Study, and the scope of analyses required. An FSM will address the problems, opportunities, and needs; refine study constraints; identify the key alternatives; and further define the scope, depth, and methods of analyses required.

Figure 3-1. Key River Adjacent Areas

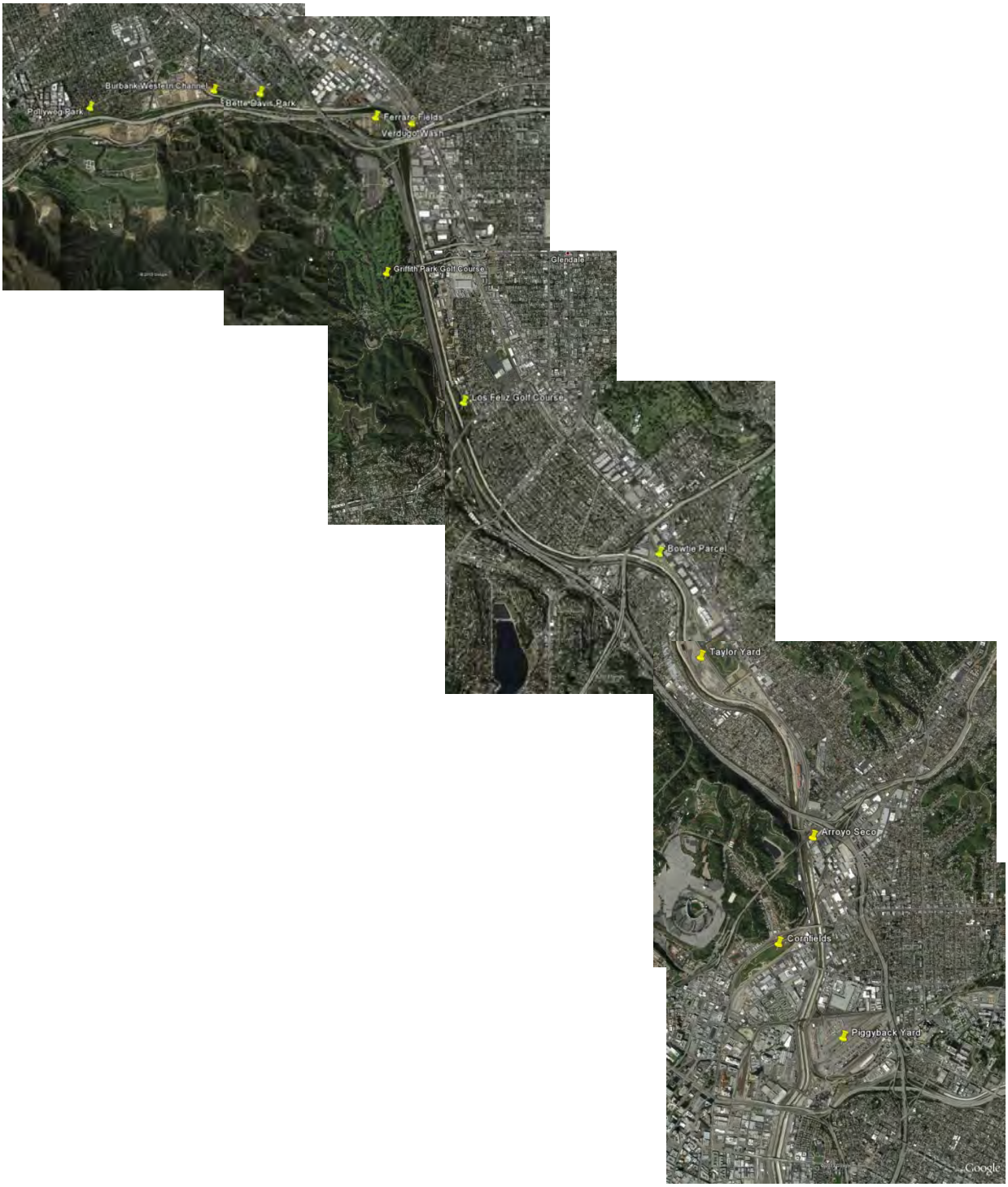
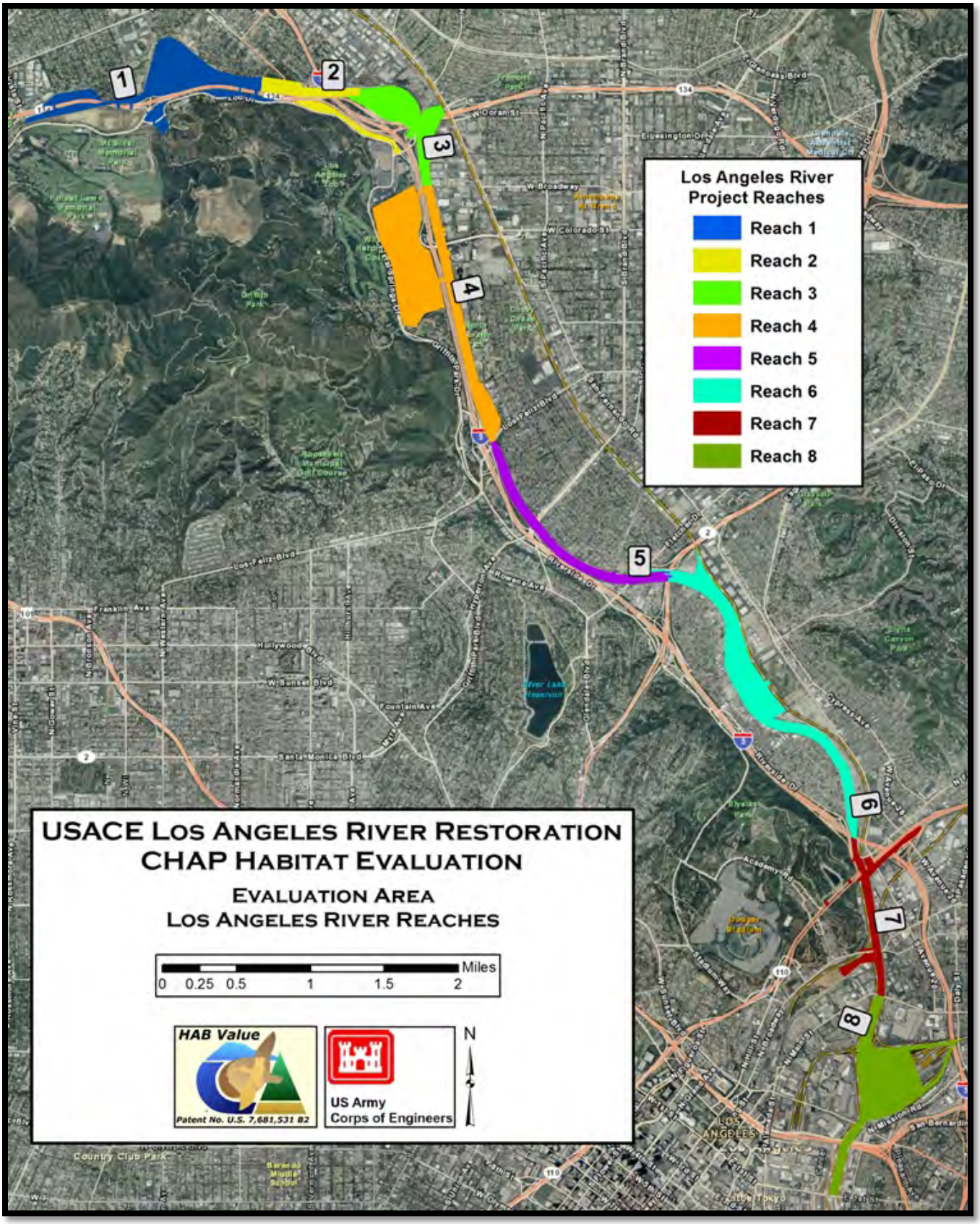


Figure 3-2. Geomorphic Reaches



The reaches of the River with a concrete bottom have three configurations in the Study area, including box and trapezoidal, or a combination of the two. The "soft" bottom areas have predominantly rock and cobble substrate that support riparian and wetland vegetation within trapezoidal concrete slopes.

4.0 STUDY AND METHODOLOGY ASSUMPTIONS AND CONSTRAINTS

Due to its highly urbanized setting and the hydrologic alterations that the River has undergone prior to and since its channelization, there are several constraints that were considered in defining alternatives and assessing how these alternatives can achieve the Study objectives.

Historic hydrologic conditions that are extremely important to riverine, riparian, and marsh ecosystems have been irreversibly altered along most of the LA River. Complete restoration of historic conditions is not feasible; therefore, to the greatest extent possible, the Study aims to restore riparian and wetland vegetation communities and habitats that were known to occur historically.

Residential, commercial, and industrial land uses border the River, thereby limiting the area adjacent to the River available for restoration. This is an important determinant in the potential acreage of each community type in the habitat analysis. More importantly, it influences the spatial and structural diversity that can be attained, as well as the quality of riparian habitat in terms of characteristics such as availability of water to River adjacent restoration areas and the relationship between interior versus edge space. Presently, the Study area (i.e., width of the restoration corridor) has been predominantly defined by existing easements and rights of way, existing structures, availability of adjacent lands for acquisition, local topography, and the historic floodplain. Furthermore, several of the River-adjacent areas that would provide substantial lands for restoration, if acquired, require cleanup of hazardous and toxic wastes from previous uses, such as rail yards.

Overall, water availability in the project area during the non-flood season, is predominated by upstream releases from the Tillman Water Reclamation Plant, as well as local surface runoff. Ongoing water conservation efforts include holding more water at upstream reservoirs with the intent of percolating in spreading basins. The City also has plans to remove dry weather flows from the River as part of its Integrated Regional Plan, specifically the Department of Water and Power's Recycled Water Master Plan. Lack of a more significant, reliable water source for the Study area poses constraints on the ability to sustain important functions of stream, riparian, and wetland habitats that currently exist, as well as proposed habitats in the alternative plans. However, the City is committed to maintaining flows necessary for the restoration plan to be implemented as a result of this study.

Several other ecosystem restoration studies and projects are on-going on LA River tributaries, including the Headworks, Sun Valley, and Arroyo Seco Ecosystem Restoration Continuing Authority Program Studies, and the Tujunga Wash project was recently completed. These Studies and projects will positively affect the LA River riverine system by restoring upstream habitat and functions, and by increasing ecosystem value. However, the implementation of these projects will also require a portion of the scarce water resources to support the restoration efforts.

The California High Speed Train (HST) project is also a factor in the extent to which the riparian ecosystem can be restored and the success of the restoration project in achieving its goals. Certain proposed alignment alternatives near the Study area may impact the restoration project. While HST project implementation is considered long-term and not precisely defined at this point, the alignments that abut and cross the Study area would have a negative impact on the value of wildlife habitat. Other development, transportation, and infrastructure projects occurring within or adjacent to the Study area would generally have a negative effect on restoration.

Ultimately the LA River in its current state is a flood risk management structure. The purpose of flood risk management must be maintained and there can be no increase in flood risk, thereby limiting the amount vegetation that can be sustained in the channel. Acquisition of river adjacent areas that would allow for widening of the River would allow for more vegetation in the channel; however these opportunities are limited.

Despite these constraints and limitations, the ARBOR reach retains the potential for substantial improvements to habitat quality in highly degraded areas, providing or enhancing wildlife movement corridors, and increasing nesting opportunities for native resident and migratory species.

5.0 HABITAT EVALUATION: COMBINED HABITAT ASSESSMENT PROTOCOL (CHAP)

5.1 CORPS RESTORATION POLICY

Under Corps authority, restoration opportunities that are associated with wetlands, riparian and other floodplain and aquatic systems are most appropriate for Corps involvement. The objective of Corps ecosystem restoration projects is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Even partial restoration may provide significant and valuable improvements to degraded ecological resources (USACE 2000).

Restored ecosystems should mimic, as closely as possible, conditions that would occur in the area in the absence of human changes to the landscape and hydrology. Indicators of successful restoration would include the presence of a large variety of native plants and wildlife, the ability of the area to sustain larger numbers of key indicator species[2] or more biologically desirable species, and the ability of the restored area to continue to function and produce the desired habitat benefits with a minimum of continuing human intervention (USACE 2000).

Additional guidance for ecosystem restoration in the Civil Works Program assures that civil work investments in ecosystem restoration have the intended beneficial effects and would be conducted in the most cost effective manner (USACE 2000).

Corps guidance requires that the ecosystem related benefits of proposed alternatives be subjected

2 An indicator species is an organism whose presence, absence or abundance reflects a specific environmental condition. Indicator species can signal a change in the biological condition of a particular ecosystem, and thus may be used as a proxy to diagnose the health of an ecosystem.

to detailed economic analysis, allowing an explicit comparison of the costs and benefits associated with the alternatives. Consequently, it is necessary that the environmental benefits of the alternatives be based on some quantifiable unit of value. Since restoration value is difficult to monetize, instead of calculating benefits in monetary terms, the Corps ecosystem restoration projects calculate the value and benefits of restored habitat using established habitat assessment methodologies. Comparing the alternatives in this manner facilitates the determination of the most cost-effective restoration alternative that meets restoration goals (USACE 2000).

5.2 HABITAT ASSESSMENTS

Evaluating habitat quality is the approach most often taken to compare ecosystem restoration alternatives because habitat is thought of as a surrogate for ecosystems; it is the setting where plants and animals live, interact, and reproduce. Habitat is frequently viewed in conjunction with species information to gain insight to various uses, structures, and functions existing within a landscape or site.

Few methods for habitat assessment exist; however, most are focused only on aquatic habitats, wetland habitats, or habitat for a single species. One such habitat assessment methodology used by the Corps is the U.S. Fish and Wildlife Service's (USFWS) single species model known as the Habitat Evaluation Procedure/Habitat Suitability Index Models (HEP/HSI) (1980). HEP evaluates single species, a species guild, or a species assemblage using models comprised of measureable habitat variables and associated mathematical aggregations to estimate habitat suitability/quality (NHI 2007). The preliminary output of the HEP model is a habitat suitability index (HSI), which ranges from 0 (poor habitat quality) to 1.0 (optimum habitat quality). Habitat value is finally calculated in terms of Habitat Units (HUs) by multiplying the HSI by site acreage.

HUs are then used to rate and compare the value of one ecosystem restoration alternative to another. While HUs are a simple and useful form for presenting habitat quality as a numerical value, HEP assumes a linear relationship between habitat suitability and species response. In other words, HEP assumes that as HSI increases the wildlife population should also increase. This implies that the model has the ability to predict population response without errors (NHI 2007).

Furthermore, the single species method assumes that an entire community is represented by that species, which may result in a narrow representation of habitat quality (NHI 2007). The single species method does not account for substantial benefits that are afforded by the ecosystem as a whole, which includes multiple species and multiple habitats. Furthermore, it does not account for all functions or habitat components potentially present at a site.

Throughout the U.S. there is a shift towards assessing restoration and other conservation activities at the ecosystem level (Perkins 2002). Determining habitat structure and functional integrity of an area for all species potentially using it is more supportive of an ecosystem management approach. A habitat assessment methodology that measures functionality, which is critical to the success of many restoration projects, should incorporate multiple components such as vegetation, structure, surrounding landscape, and habitat size and shape (Breaux et al. 2005, Store and Jokimaki 2003).

5.3 CHAP BACKGROUND

Recently, an ecosystem-based habitat evaluation framework known as HAB (or the Habitat Accounting and Appraisal methodology) was developed by the Northwest Habitat Institute (NHI). This approach involves a triad assessment of species, habitat, and functions (O'Neil et al. 2005), and includes an inventory of habitat components and their relationship to ecological functions performed by species. The Combined Habitat Assessment Protocols (CHAP) method, which incorporates the HAB methodology, generates HUs based on an assessment of multiple species, habitat features, and functions by habitat type.

In the HAB approach, fish and wildlife with the potential to occur at a given site are identified. Potential species are determined using range maps in conjunction with information on vegetation types and habitat types, structural conditions, and habitat elements, also known as Key Environmental Correlates (KECs). KECs represent habitat elements (physical and biological) that are known to most influence a species distribution, abundance, fitness, and viability. KECs include habitat elements such as down wood, snags, litter layer, shrub layer, flowers, burrows, boulders, or riffles and pools. For the Master list of CHAP KECs, see Appendix A.

Habitat is defined as "the place, including physical and biotic conditions, where a plant or animal usually occurs" (Johnson and O'Neil 2001). Habitat types are often characterized by a dominant plant form or physical characteristic. Structural conditions of the habitat are also considered.

Function refers to the principal way organisms influence the environment, also known as Key Ecological Functions (KEF) (NHI 2007). KEFs refer to the principal set of ecological roles performed by each species in its ecosystem (NHI 2007). More specifically, KEFs refer to the main ways organisms use, influence, and alter their biotic and abiotic environments. KEFs include functions that organisms perform in the environment, such as a grazer, sap feeder, carrion feeder, seed disperser, nest parasite, primary cavity excavator, or impounds water by creating dams. For the Master list of CHAP KEFs see Appendix B.

While other methods consider habitat components, the HAB approach considers over 350 different KECs and over 100 KEFs as seen in Appendices A and B. KECs and KEFs are key components in determining the wildlife habitat unit values.

The HAB approach can be combined with elements of HEP to address habitat value at evaluation sites, with HUs as the output. Such a combined approach is referred to as CHAP (Combined Habitat Assessment Protocol) (NHI 2007).

The CHAP evaluation described herein utilizes the ecosystem-based approach to quantitatively characterize the ecological value of wildlife habitat associated with the restoration alternatives proposed for the LA River ER Study. Habitats for the following groups of animals were evaluated as part of the CHAP analysis and would be benefited by implementation of the alternatives:

- Resident and Migratory Birds, including raptors
- Reptiles
- Amphibians

- Mammals
- Fish

5.4 CORPS PLANNING PROCESS

In order to solve water resources and ecosystem restoration issues, the Corps Planning process identifies problems and opportunities, inventories and forecasts conditions, and formulates, evaluates, and compares alternative plans in order to select the best, most cost effective project alternative for implementation and construction.

In identifying problems and opportunities, project objectives and constraints are also developed that guide the formulation of alternatives. When inventorying and forecasting, the historic, existing, and future conditions are examined to establish a baseline for alternative comparison. Alternative formulation develops a suite of management measures[3] that are combined together in various ways to create a set of project alternative plans. The alternative plans are evaluated by forecasting conditions "with project" implementation and comparing them to the forecasted "without project" condition. The plans are then compared to one another based on how they meet project objectives, and on cost effectiveness and cost-benefit analyses, policy compliance, and acceptability by the public and stakeholders. The best plan, based on these factors, becomes the recommended plan for implementation.

The habitat assessment serves to quantify restoration benefits that inform the cost effectiveness and cost-benefit analyses and that contribute to the comparison of alternative plans.

6.0 CHAP ANALYSIS

The HAB approach, which is largely spatially based, uses Geographic Information Systems (GIS) to delineate habitat polygons[4] and map habitat types (cross-walked with associated vegetation types) within the Study area. These habitat type classifications are based on the California Wildlife Habitat Relationships (CWHR) habitat classification scheme, derived from the CDFG publication titled "A Guide to Wildlife Habitats of California" (Mayer and Laudenslayer 1988). For each habitat polygon, wildlife species associated with these CWHR habitat types are linked to key environmental correlates (KECs) (i.e. habitat elements) and key ecological functions (KEFs)(i.e. functions performed by species), which are derived from NHI's Interactive Habitat and Biodiversity Information System (IBIS) database[5] (Johnson and O'Neil, 2001).

The detailed steps of compiling KECs and KEFs are outlined in Section 6.1.1.

3 A management measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. It may be a "structural" feature that requires construction or assembly on-site, or it may be a "non-structural" action that requires no construction (USACE 1996).
4 In GIS, a polygon is a map feature that bounds an area at a given scale, such as a county on a world map or a district on a city map. In habitat mapping, the polygon bounds a specific habitat type.
5 The datasets for KECs and KEFs have been developed through a multiple expert panel process. IBIS is an extensively peer reviewed system that contains current ecological information on more than 1,000 fish and wildlife species, organized in searchable databases.

The subsequent analysis of these habitats, species, and functions results in a quantitative value for existing and forecasted with and without project habitats in the Study area.

6.1 BASELINE: EXISTING CONDITIONS

6.1.1 Baseline: Existing Conditions Methods

A fine level scale approach was used to calculate habitat value for the LA River ER study. The baseline CHAP approach, incorporating the HAB methodology, involves: 1) preliminary mapping, 2) field inventory, 3) species list, 4) data compilation and analysis, 5) conversion to HUs, and 6) Annualizing HUs.

1. Preliminary Mapping
   Using GIS and geo-referenced aerial imagery, the LA River ER study site was mapped by delineating potential habitat types or structural conditions within the site. Habitat types were identified using visual differences in land formations, vegetation, and structural condition, as detected and interpreted in the imagery. Preliminarily, the National Agriculture Imagery Program (NAIP) imagery was used, and later high-resolution imagery supplied by the Corps was used.

2. Field Inventory
   The field inventory included an ocular survey that verified the polygon delineations. Habitat type, structural conditions, and key environmental correlates within each polygon were identified and recorded. Invasive plant species and the presence of stressors within each polygon were also recorded.

   Stratified random verification transects were then employed to measure in detail the site's vegetation characteristics. These transects substantiate site variables including percent cover and species of trees, shrubs, herbaceous and invasive vegetation and serve as a double sampling technique to confirm the ocular field inventory.

3. Species List
   The CWHR was used to produce a site-specific species list by considering ecological and geographical connections between species and the habitat types within the Study area. Factors used to generate the species list are potential species linked to each of the habitat types and potential species linked to the Study area based on species range maps and known existing conditions.

   References from local experts including the Griffith Park Draft Wildlife Management Plan (Cooper and Mathewson 2008), The Biota of the Los Angeles River (Garrett 1993), and The State of the River – the Fish Study (FoLAR 2008), were also employed to develop an initial species list.

   The species list was reviewed and refined by a habitat evaluation team (See Section 8.0) comprised of Corps and City of LA staff and local resource agency experts including the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), Regional Water Quality Control Board (RWQCB), and a

local fish expert from the University of California Cooperative Extension, Los Angeles County. The team decided that seasonal migrants and infrequent visitors would be included on the species list, as creating an arbitrary limit for including a species as "occurring" would not account for all species that are known to use the project area. Additional review and input was requested from local experts including Dan Cooper (Cooper Ecological Monitoring, Inc.) and Drew Stokes (San Diego Natural Museum of History) to verify the presence or absence of certain species of interest. The resulting species list is included in Appendix C.

4. Data Compilation and Analysis
   Data from the mapping and field inventory was used to generate two relationship matrices including 1) a potential species by function (KEFs) matrix and 2) a habitat (KECs) by function (KEFs) matrix (for definitions of KEC and KEF See Section 5.3; for further details on the matrices see Appendix D).

   To create these matrices, the species list was sorted by its association with the CWHR habitat types and the list of taxa was linked to the associated habitat elements (KECs) and functions (KEFs).

   The first matrix determines the mean functional redundancy index (MFRI), which is based on the number of species performing functions in a habitat type (KEFs). More specifically, it is the number of species that are associated with the habitat type and performing each function divided by the number of potential functions associated with the habitat type. The result of the first matrix is the number of potential functions characterized by species specific to that polygon.

   The second matrix is based on the results of the field inventory of the Study area and the list of habitat elements (KECs) observed. The result of the second matrix is the number of functions characterized by habitat elements (KECs) specific to that polygon.

   Per-acre values were then computed for each polygon by adding the species-function matrix (MFRI) value and the habitat-function matrix value (for further details on calculations see Appendix D). In sum, for each polygon MFRI + KEC matrix = Per Acre Value.

   The per-acre value represents the intrinsic worth of an area to fish and wildlife, determined by accounting for species, habitats, and functions. Additional factors that may negatively impact this habitat value are accounted for as described in Section 6.1.2.

5. Conversion to HUs
   To determine HUs for site conditions, in order to compare Study alternatives and inform alternative cost-benefit analyses, each polygon's per-acre value was multiplied by its acreage. These values were then summed across all polygons to calculate the

total HUs for a particular condition or alternative scenario. In sum, for each polygon Per Acre Value x Acres = HUs.

Unlike HEP, where the preliminary output (HSI) ranges from 0 to 1 (as described in Section 5.2), CHAP's per-acre values are not limited to this range. In this way, where the HUs in HEP are dependent on acreage (HSI x acreage = HU; IE more acreage = more HUs), the HUs generated by CHAP are not dependent on acreage and reflect the intrinsic value of a particular habitat type based on species, functions, and habitat.

Results of the baseline CHAP analysis are provided in the form of GIS maps and Microsoft excel spreadsheets. GIS maps generated depict the habitat values (HUs) of each of the 172 polygons. Supporting maps illustrate: a) study area boundaries; b) polygon numbering; c) percentage of non-native plant species by polygon (See Section 6.1.2); d) wildlife habitat types by polygon (See Section 6.1.3); e) structural conditions by polygon (See Section 6.1.3); f) per-acre habitat value (See Section 6.1.3); and g) HUs (See Section 6.1.3).

Spreadsheets were developed that contain the calculations of the species-function and habitat-function matrices, along with calculations of Study area habitat values. Due to the large volume of data, maps, and spreadsheets, the complete set of files is available upon request from the Corps, Los Angeles District. Sample figures are provided in Figures 6.1.1-1, 6.1.2-1, and 6.1.3-1 to 6.1.3-8. Summary tables are included in Tables 6.1.3-1 and 6.1.3-3, and discussed in the following Sections 6.1.2 and 6.1.3.

6.1.2 Per-Acre Adjustment Value for Habitat Stressors

Since the LA River ER project area is located within a highly urbanized setting, there are several ecosystem drivers and stressors that affect the Study area and how it is currently managed. There are four noteworthy influences including: 1) invasive plant species, 2) potential use of the area for encampments by people who are homeless, 3) horseback riding in the river, and 4) excessive refuse/trash in the river.

Prior to conversion to HUs, the per-acre baseline value of each polygon was adjusted based on the presence of these stressors, in order to capture the value lost due to these factors within the Study area. The HAB method allows for these modifications when the habitat evaluation team deems them to be appropriate.

Invasive Plant Species

Each polygon was assigned an invasive plant value for each of three structural layers (grass/herbaceous, shrub, and tree) based on the presence and abundance of invasive species in that layer, as documented in the field inventory. Because invasive species generally negatively influence ecosystem function, the per-acre values were then discounted for the presence of invasives, to begin to arrive at a corrected per-acre value for each polygon. The value of discount applied based on presence of invasive species is described in Table 6.1.2-1. The deduction factor was multiplied by the per-acre value to reach the adjusted value. In sum, per-acre value x deduction factor = adjusted per-acre value.

The percent abundance of invasive species by polygon can also be spatially displayed in a map to show their influence on the habitat value. Sample maps are included in Figure 6.1.2-1.

Table 6.1.2-1. Invasive plant species deduction factors[6]

Invasive species cover	*X*
0-10%	1.0
11-35%	0.9
36-65%	0.7
66-90%	0.5
>90%	0.3

Homeless, Horseback Riding, Excessive Refuse

During the habitat evaluation team meetings, the subject of homeless encampments, horseback riding, and excessive refuse/trash and their influence on wildlife habitat was raised. The team members were reluctant to assign an arbitrary value of influence to weight the polygons based on these stressors, so to address these concerns a literature review was conducted. Activities noted as potential effects to wildlife habitat from these stressors include trampling, camping, sewage, erosion, and covering. KECs that are influenced by these activities are found in Table 6.1.2-2. Since the CHAP identifies KECs as absent or present within each polygon, the stressor influenced KECs are adjusted by changing their status from present to absent. For example, the presence of homeless encampments would result in camping/trampling, which would damage vegetation. KECs such as flowers, forbs, shrubs, and saplings would, therefore, be identified as absent for those polygons. In applying this to the Study Area, these local stressors influenced the site's overall habitat value approximately 7%.

6.1.3 Baseline: Existing Conditions Results

Habitat Types and Vegetation Communities

The 172 polygons in the LA River ER Study area were determined by delineating the California Wildlife Habitat types that occur within the Study area. The mapping performed by NHI within the Study area in 2011 documented several habitat types, each of which are an aggregation of several vegetation communities. Habitat types as described by the CWHR System included Coastal Scrub, Eucalyptus, Open Water/Riverine, Pasture, Perennial Grassland, Valley Foothill Riparian, Tree Farm, and Urban (High Density, Golf Course, and Low Density). Structural conditions included: grass-forb, shrub, and tree layers along with constrained river channel and urban with various levels of impervious surfaces.

6 Deduction factors for invasive plant species were developed by NHI in a team environment during the Oregon Bridge Replacement Program, where agencies wanted to receive credit for controlling invasive species at a site. The team was comprised of representatives from: U.S. Army Corps of Engineers, Bureau of Land Management, NOAA Fisheries Service, Environmental Protection Agency, U.S. Forest Service, U.S. Fish and Wildlife Service, Federal Highway Administration, Oregon Department of Transportation, Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, Oregon Department of State Lands, and the State Historic Preservation Office.

Figure 6.1.1-1. Sample Maps – Baseline Existing Conditions – Polygon Identification Numbers

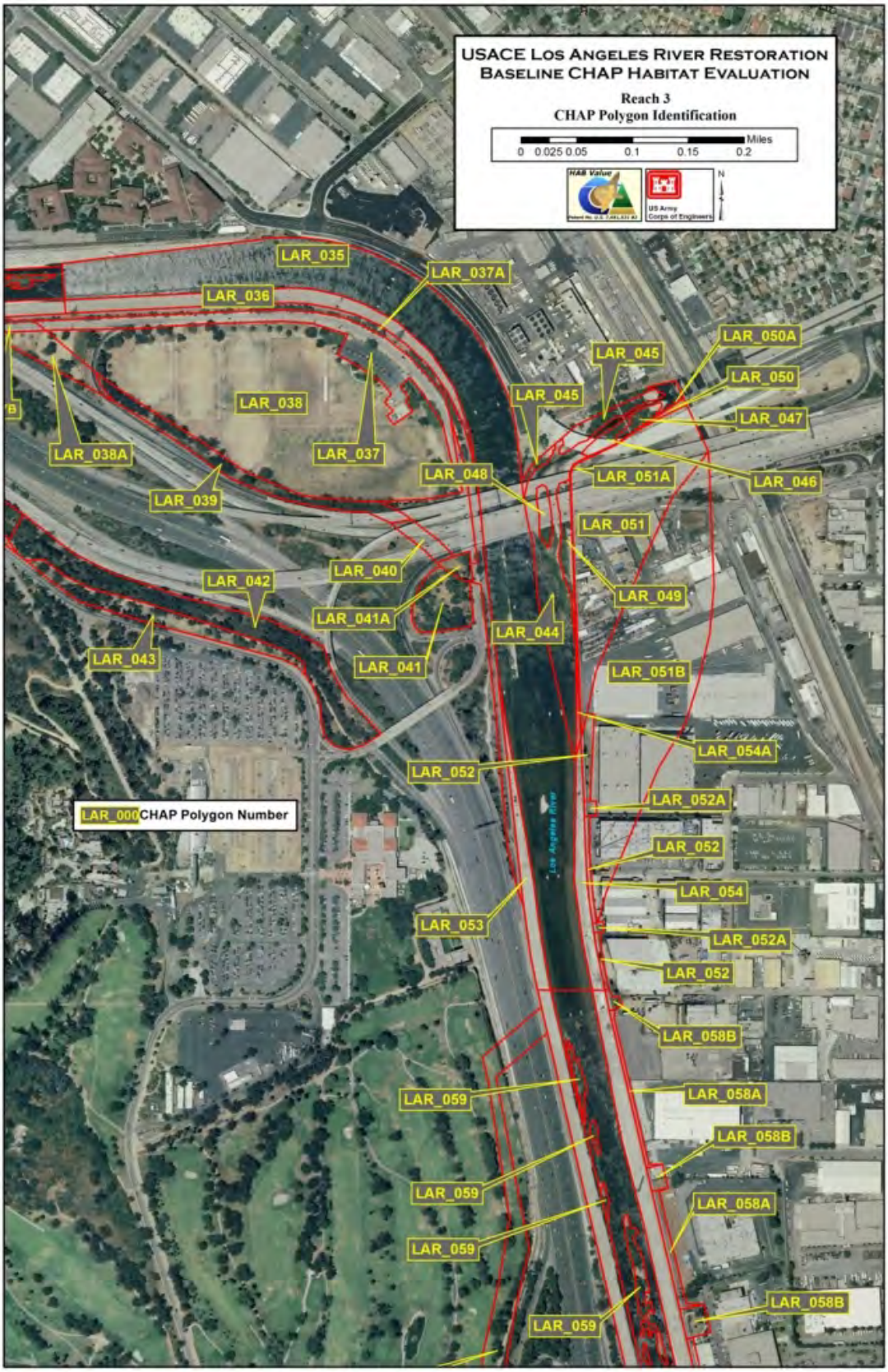


Figure 6.1.1-1. Sample Maps – Baseline Existing Conditions – Polygon Identification Numbers

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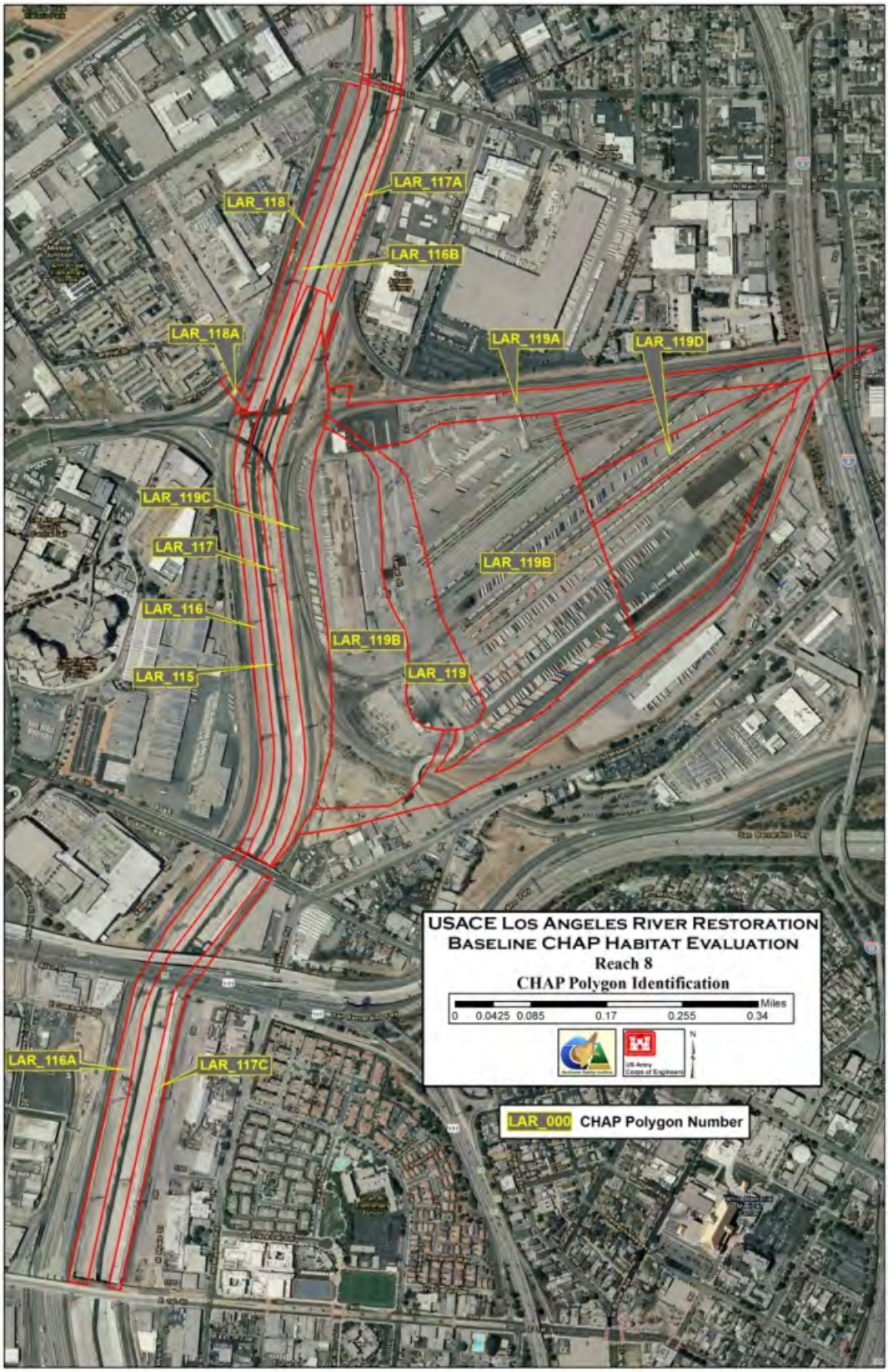


Figure 6.1.2-1. Sample Maps – Baseline Existing Conditions – Percentage of Non-native Plant Species – Herbaceous Species

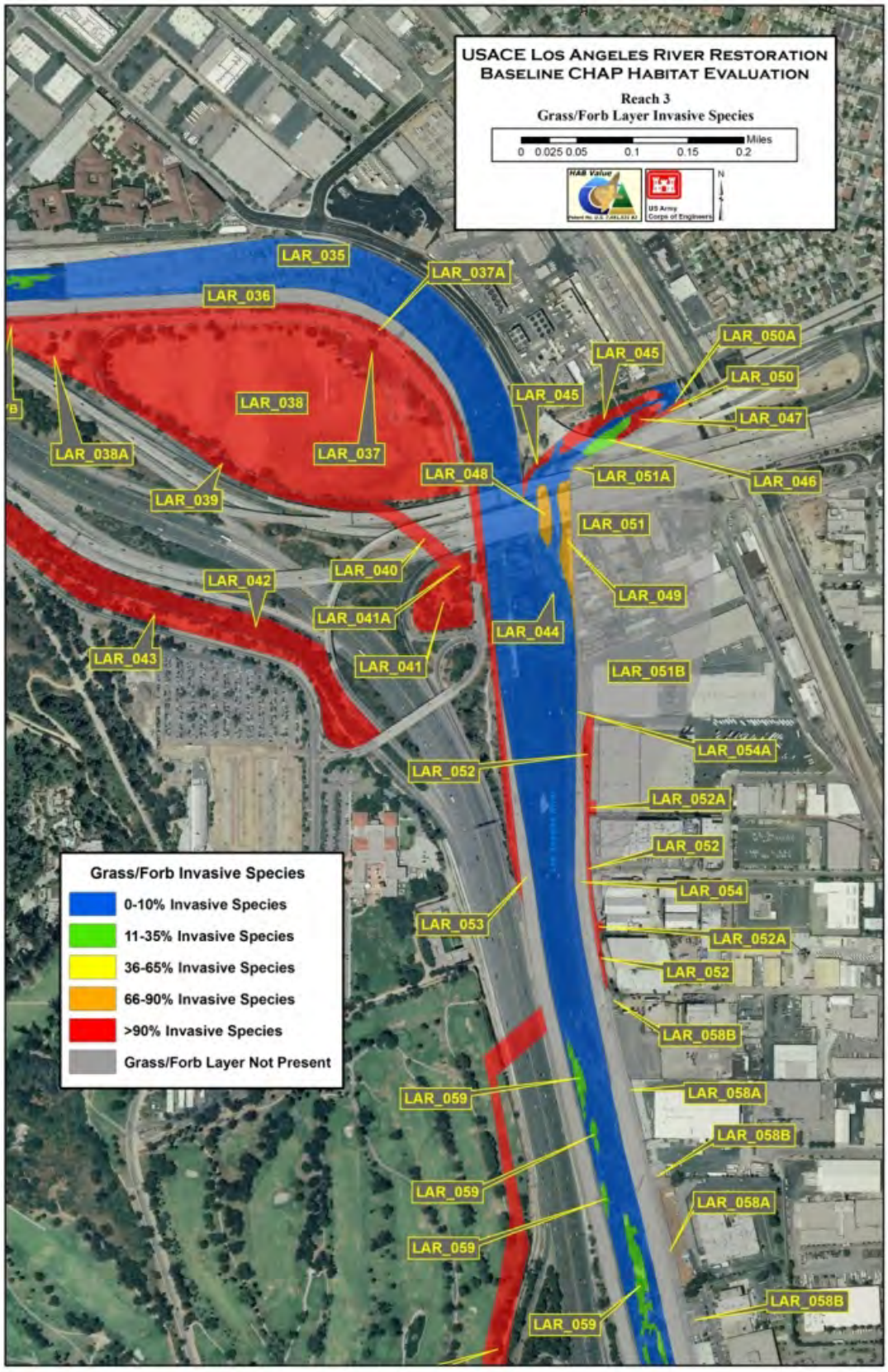


Figure 6.1.2-1. Sample Maps – Baseline Existing Conditions – Percentage of Non-native Plant Species – Herbaceous Species

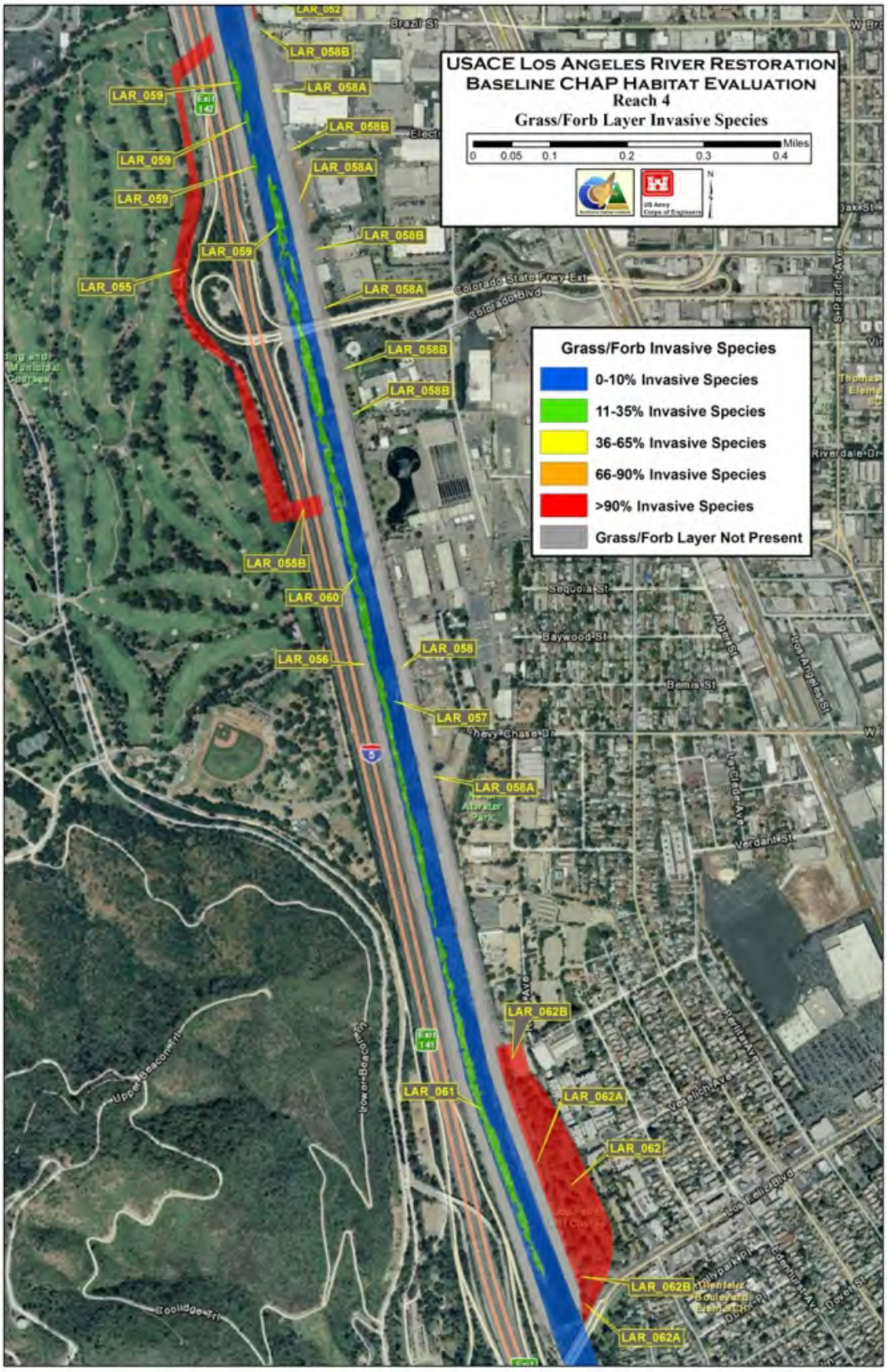


Figure 6.1.2-1. Sample Maps – Baseline Existing Conditions – Percentage of Non-native Plant Species – Herbaceous Species

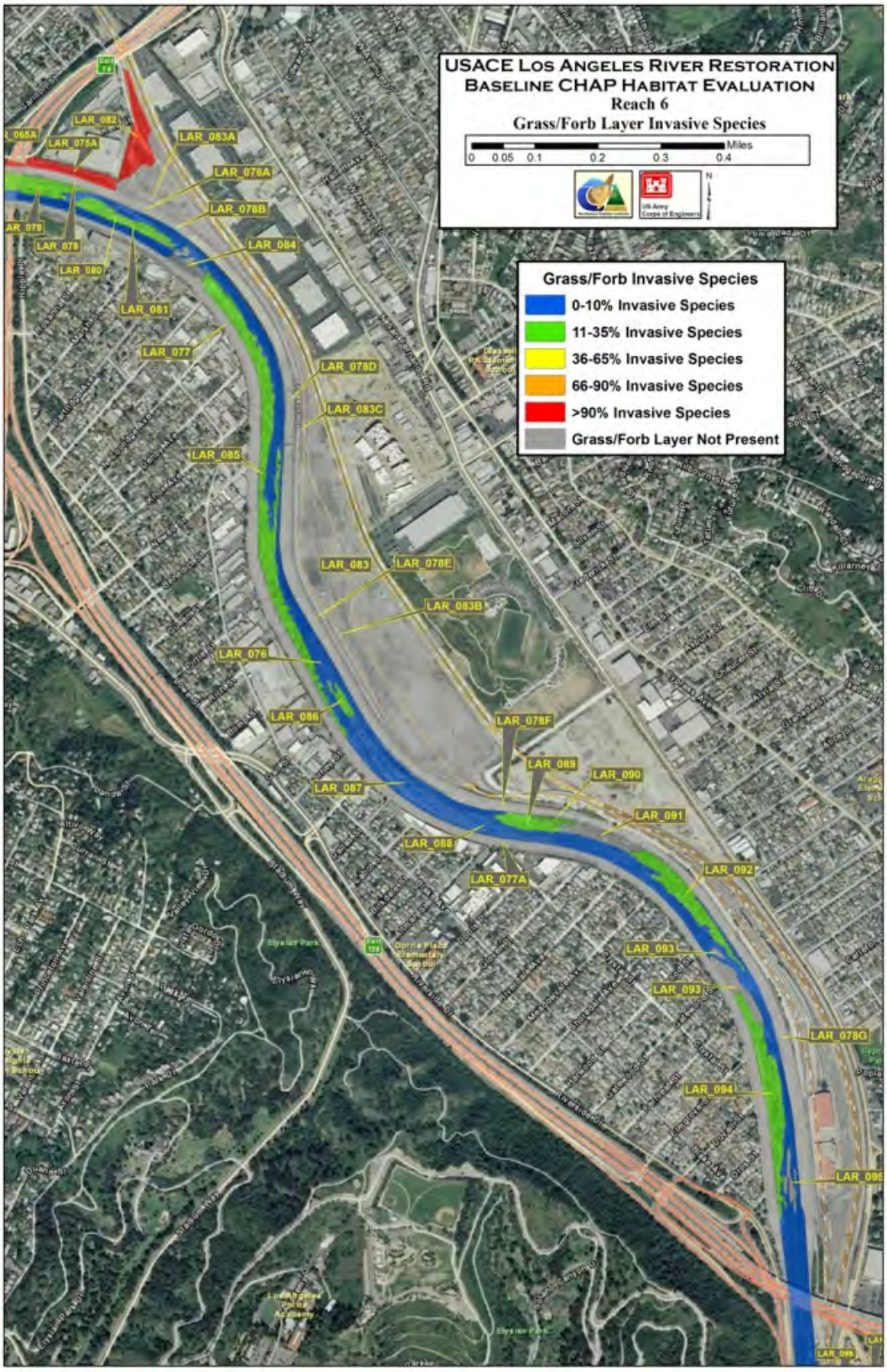


Figure 6.1.2-1. Sample Maps – Baseline Existing Conditions – Percentage of Non-native Plant Species – Herbaceous Species

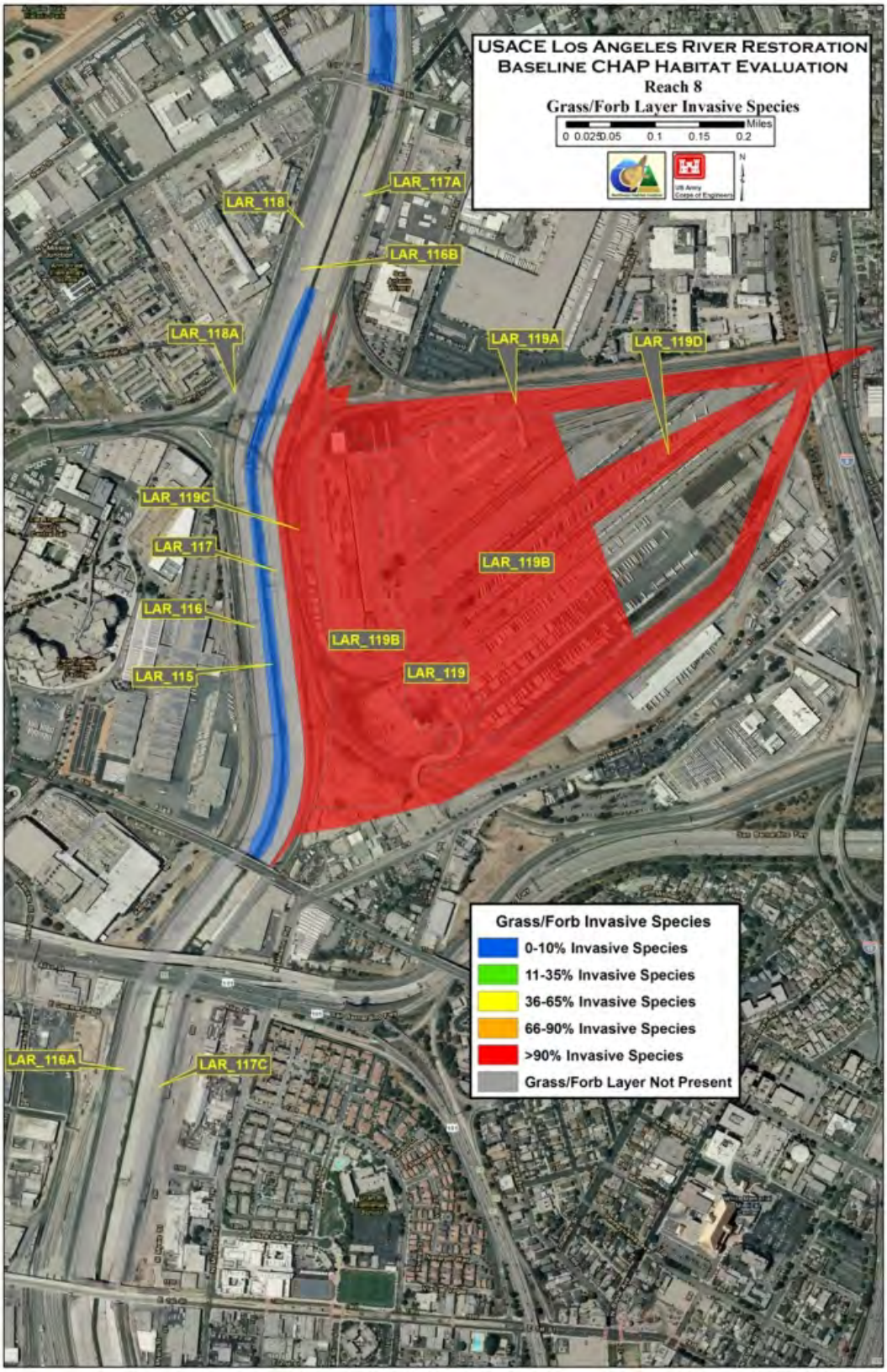


Table 6.1.2-2. KECs influenced by Stressors (homeless encampments, horseback riding, excessive refuse/trash)

Human Impact	KEC Code	KEC	Action
Homeless Encampments	1.2.1	herbaceous layer	camping/tramping
Homeless Encampments	1.2.5	flowers	camping/tramping
Homeless Encampments	1.2.8	forbs	camping/tramping
Homeless Encampments	1.2.6.1.1	shrubs small	camping/tramping
Homeless Encampments	1.2.6.1.2	shrubs medium	camping/tramping
Homeless Encampments	1.2.6.1.3	shrubs large	camping/tramping
Homeless Encampments	1.1.14.3.1	live tree seedling	camping/tramping
Homeless Encampments	1.1.14.3.2	live tree sapling	camping/tramping
Homeless Encampments	1.1.14.3.3	live tree small	camping/tramping
Homeless Encampments	1.1.14.3.4	live tree medium	camping/tramping
Homeless Encampments	1.1.14.3.5	live tree large	camping/tramping
Homeless Encampments	1.1.14.2.3	snag, small	camping/tramping
Homeless Encampments	4.1.12	aquatic nutrient enrichment	sewage
Human Impact	**KEC Code**	**KEC**	**Action**
Horse riding	1.1.3	duff	trampling
Horse riding	1.2.1	herbaceous layer	trampling
Horse riding	1.1.1.4.1	shrubs, small	trampling
Horse riding	1.1.1.4.2	shrubs, medium	trampling
Horse riding	1.1.5	moss	trampling
Horse riding	4.7.4	marshes	trampling/erosion
Horse riding	1.1.14.3.1	live tree, small	trampling/erosion
Horse riding	1.2.8	forbs	trampling/erosion
Horse riding	1.2.10	grasses	trampling/erosion
Horse riding	4.1.3	dissolved solids, aquatic	defecation/erosion
Horse riding	4.1.7	water tubidity	trampling/erosion
Horse riding	4.2.3.3	shorelines	trampling/erosion
Horse riding	4.1.12	aquatic nutrient enrichment	defecation/erosion
Horse riding	4.2.4.5	aquatic bentic structure	trampling/erosion
Horse riding	5.9	water clarity	trampling/erosion
Human Impact	**KEC Code**	**KEC**	**Action**
Refuse/Trash	1.2.1	herbaceous layer	covering
Refuse/Trash	1.2.8	forbs	covering
Refuse/Trash	1.1.1.2	down wood in riparian	covering
Refuse/Trash	1.1.4.1.1	small tree	covering
Refuse/Trash	1.1.4.1.2	medium tree	covering
Refuse/Trash	1.1.4.1.3	large tree	covering
Refuse/Trash	1.1.14.3.1	tree seedling	covering
Refuse/Trash	1.1.14.3.2	tree sapling	covering
Refuse/Trash	1.1.14.2.3	small snag	covering
Refuse/Trash	1.1.14.2.4	medium snag	covering
Refuse/Trash	1.1.14.2.5	large snag	covering
Refuse/Trash	4.2.4.5	aquatic bentic structure	covering
Human Impact	**KEC Code**	**KEC**	**Action**
Refuse/Trash	4.7.4	marshes	covering
Refuse/Trash	4.7.5	wet meadows	covering
Refuse/Trash	1.2.1	herbaceous layer	covering
Refuse/Trash	1.2.8	forbs	covering
Refuse/Trash	4.1.11	metals in water	depending on type
Refuse/Trash	8.19.3	pollution in water	depending on type
Refuse/Trash	5.9	water clarity	covering/depending on type

Vegetation communities associated with each habitat type are described below, as applicable, as documented in both "A Manual of California Vegetation" (2nd Edition) (Sawyer and Keeler-Wolf 2009) and "Preliminary Descriptions of the Terrestrial Communities of California" (Holland 1986).

1. **Coastal Scrub**

   Vegetation Communities

   Holland 1986
   - Riversidean Sage Scrub 32700

   Sawyer and Keeler-Wolf 2009
   - *Artemisia californica* Shrubland Alliance (California sagebrush scrub)

   Dominant species include California sagebrush (*Artemisia californica*) and California buckwheat (*Eriogonum fasciculatum*). This community is typically found on xeric sites such as steep slopes or well drained soils. Co-dominant species include brittlebush (*Encelia farinosa*), deerweed (*Lotus scoparius*), chaparral mallow (*Malacothamnus fasciculatus*), and white and black sage (*Salvia apiana* and *S. mellifera*).

2. **Eucalyptus**

   Vegetation Communities

   Sawyer and Keeler-Wolf 2009
   - *Eucalyptus* (*globules*, *camaldulensis*) Alliance (Eucalyptus groves) (semi-natural woodland stands)

   Several species of eucalyptus including blue gum, red gum, and silver gum are established in dense, pure stands and are typically adjacent to urban areas and non-native grasses.

3. **Open Water - Riverine**

   Vegetation Communities

   Holland 1986
   - Freshwater Marsh 52400

   Sawyer and Keeler-Wolf 2009
   - *Arundo donax* Semi-Natural Herbaceous Stands (Giant reed breaks)
   - *Typha* (*angustifolia*, *domingensis*, *latifolia*) Herbaceous Alliance (Cattail marshes)
   - *Schoenoplectus californicus* Herbaceous Alliance

Dominant species include cattails (*Typha* sp.), sedges, and rushes, as well as non-native invasive arundo (*Arundo donax*), in areas permanently saturated or flooded by freshwater.

Intermittent or continually running water distinguishes river and stream communities. Streams originate at an elevated source, such as a spring or lake, and flow velocity generally declines at progressively lower altitudes (Mayer and Laudenslayer 1988). These areas are considered to have a minimum of vegetation components, except along the edges, which may be mapped (in this case) as types such as freshwater marsh.

In the higher velocity stretches of natural streams, riffle/pool complexes are dominant and vegetation includes water moss and filamentous algae that are attached to rocks. In slower moving waters, with increasing temperatures, decreasing velocities and accumulating bottom sediment, emergent freshwater marsh vegetation, such as rushes, sedges, and cattails, establishes along river banks (Mayer and Laudenslayer 1988).

4. Pasture

Vegetation Communities

Holland 1986

- Non-native grassland 42200

Sawyer and Keeler-Wolf 2009

- *Conium maculatum – Foeniculum vulgare* Semi-Natural Herbaceous Stands (Poison hemlock or fennel patches)

Dominant species include non-natives such as fennel (*Foeniculum vulgare*), bromes (*Bromus sp.*), wild oat (*Avena sp.*), red-stem filaree (*Erodium cicutarium*), fescues (*Vulpia sp.*), and mustard (*Brassica sp.*). Scattered trees may also be present.

5. Perennial Grassland (Invasive)

Vegetation Communities

Holland 1986

- Non-native grassland 42200

Sawyer and Keeler-Wolf 2009

- *Conium maculatum – Foeniculum vulgare* Semi-Natural Herbaceous Stands (Poison hemlock or fennel patches)

Invasive Perennial Grassland is similar in composition to Pasture, where relic perennial grassland occurs in habitats now dominated by annual grasses and forbs (Mayer and Laudenslayer 1988).

6. Valley Foothill Riparian

Vegetation Communities

Holland 1986

- Southern Cottonwood-Willow Riparian Forest 61330
- Southern Willow Scrub 63320

Sawyer and Keeler-Wolf 2009

- *Salix gooddingii* Woodland Alliance (black willow thickets)
- *Salix laevigata* Woodland Alliance (red willow thickets)
- *Populous fremontii* Forest Alliance (Fremont cottonwood forest)

Dominant species include cottonwood (*Populus fremontii*), western sycamore (*Platanus racemosa*), and willows (*Salix* sp.). Forest understory may consist of shrubby willows and mule fat (*Baccharis salicifolia*) with herbaceous species including sedges, rushes, and mugwort (*Artemisia douglasiana*). Scrub habitat has less vertical structure, with shorter willows dominant.

7. Tree Farm

Ornamental or non-native hardwood species dominate this community, although other non-native conifers, shrubs, and grasses may be present. These communties are usually in developed areas, including urban and residential landscapes, parks, recreational areas, highways, and cemeteries, etc. and may include potted landscaping trees (USFS 2009).

8. Urban

This category includes landscapes dominated by urban structures, residential units, industrial areas, highways, parks, and other such structures (USFS 2009). Park areas may include alternately categorized vegetation such as non-native or ornamental. Urban areas are categorized as:

- High density
- Low density
- Golf course

The acreage of each habitat type by reach is shown in Table 6.1.3-1. To demonstrate the habitat mapping results, sample maps depicting habitat type and structural conditions are included in Figures 6.1.3-1 and 6.1.3-2.

Table 6.1.3-1. Acreage of Habitat Type by Reach

	Habitat Type (acres)										
Reach	**Coastal Scrub**	**Eucalyptus**	**Open Water (Channel)**	**Pasture**	**Perennial Grassland**	**Riparian**	**Tree Farm**	**Urban**	**Urban (Golf Course)**	**Urban (Low Density)**	**TOTAL**
1			22.80	11.75	2.19	2.97		108.12		7.98	155.81
2		12.37	9.02			4.01		12.78		9.82	48.00
3			30.84			7.07		38.62		24.61	101.14
4			29.00			7.94		35.90	20.33		93.16
5			28.02			8.97		30.72			67.71
6			32.42			28.90		103.01			164.33
7	0.29		23.14			2.55	6.30	21.48		5.15	58.90
8			6.97					146.35			153.32
TOTAL	0.29	12.37	182.21	11.75	2.19	62.42	6.30	496.97	20.33	47.55	842.37

Figure 6.1.3-1. Sample Maps – Baseline Existing Conditions – Wildlife Habitat Types

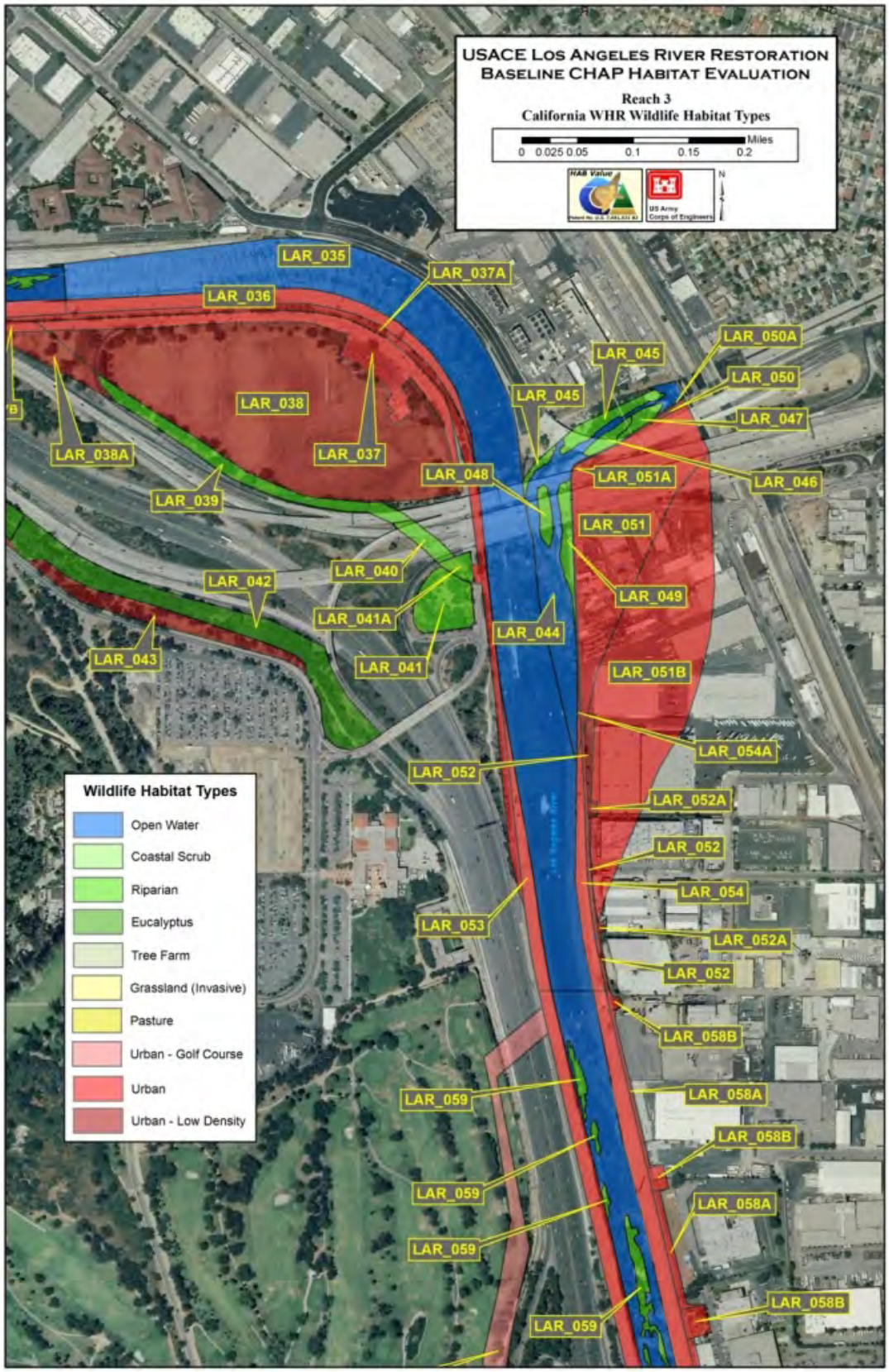


Figure 6.1.3-1. Sample Maps – Baseline Existing Conditions – Wildlife Habitat Types

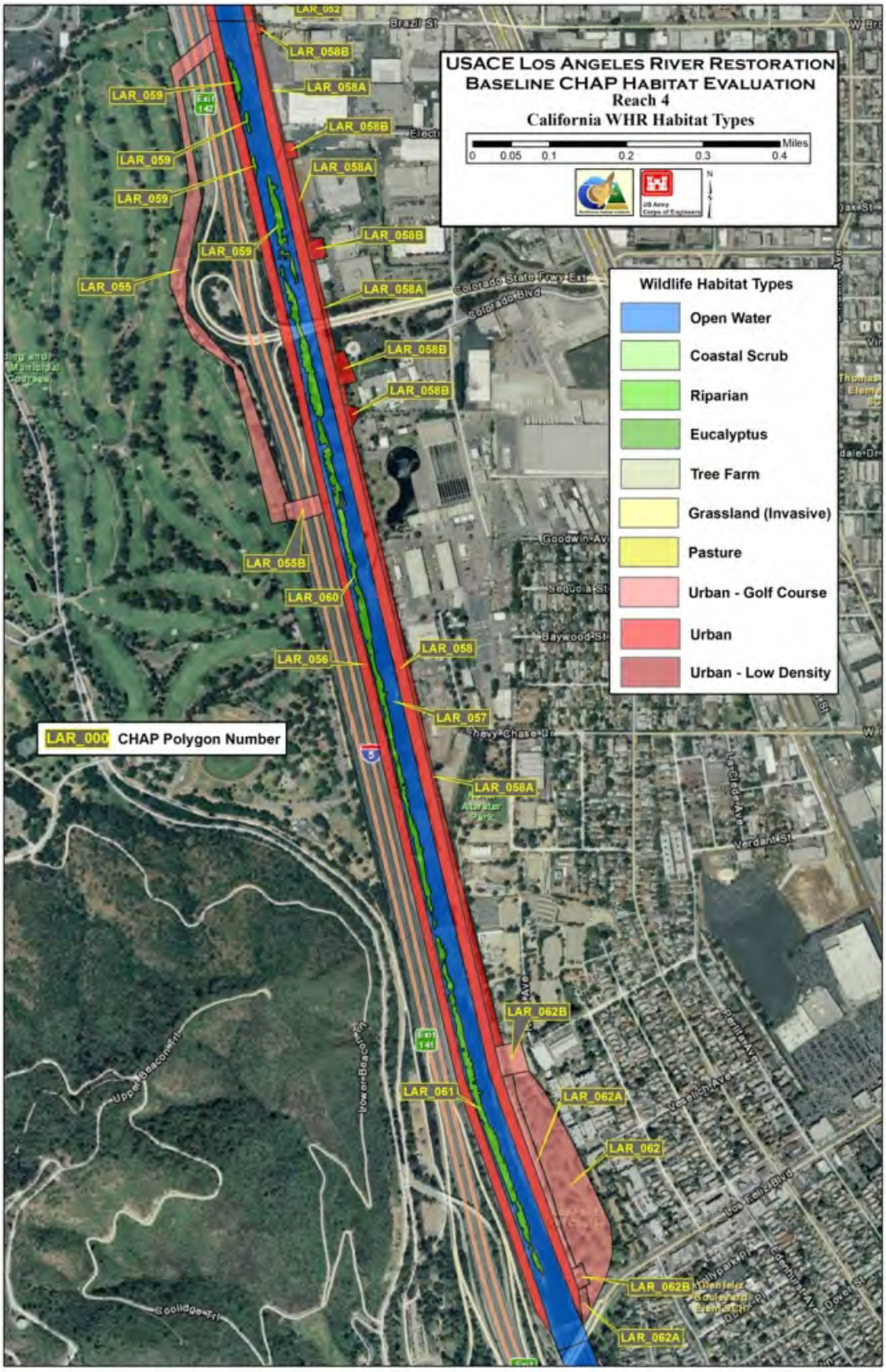


Figure 6.1.3-1. Sample Maps – Baseline Existing Conditions – Wildlife Habitat Types

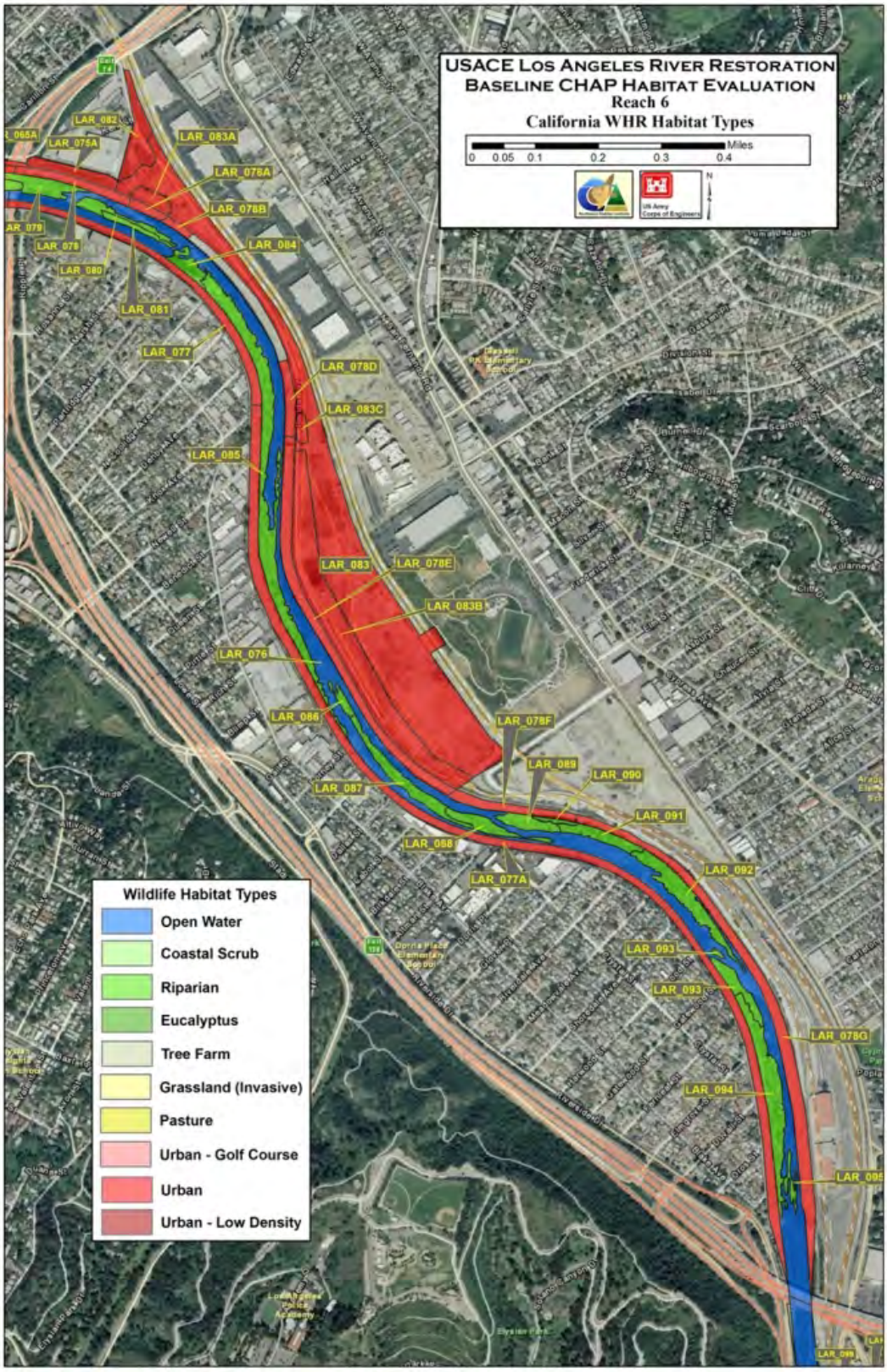


Figure 6.1.3-1. Sample Maps – Baseline Existing Conditions – Wildlife Habitat Types

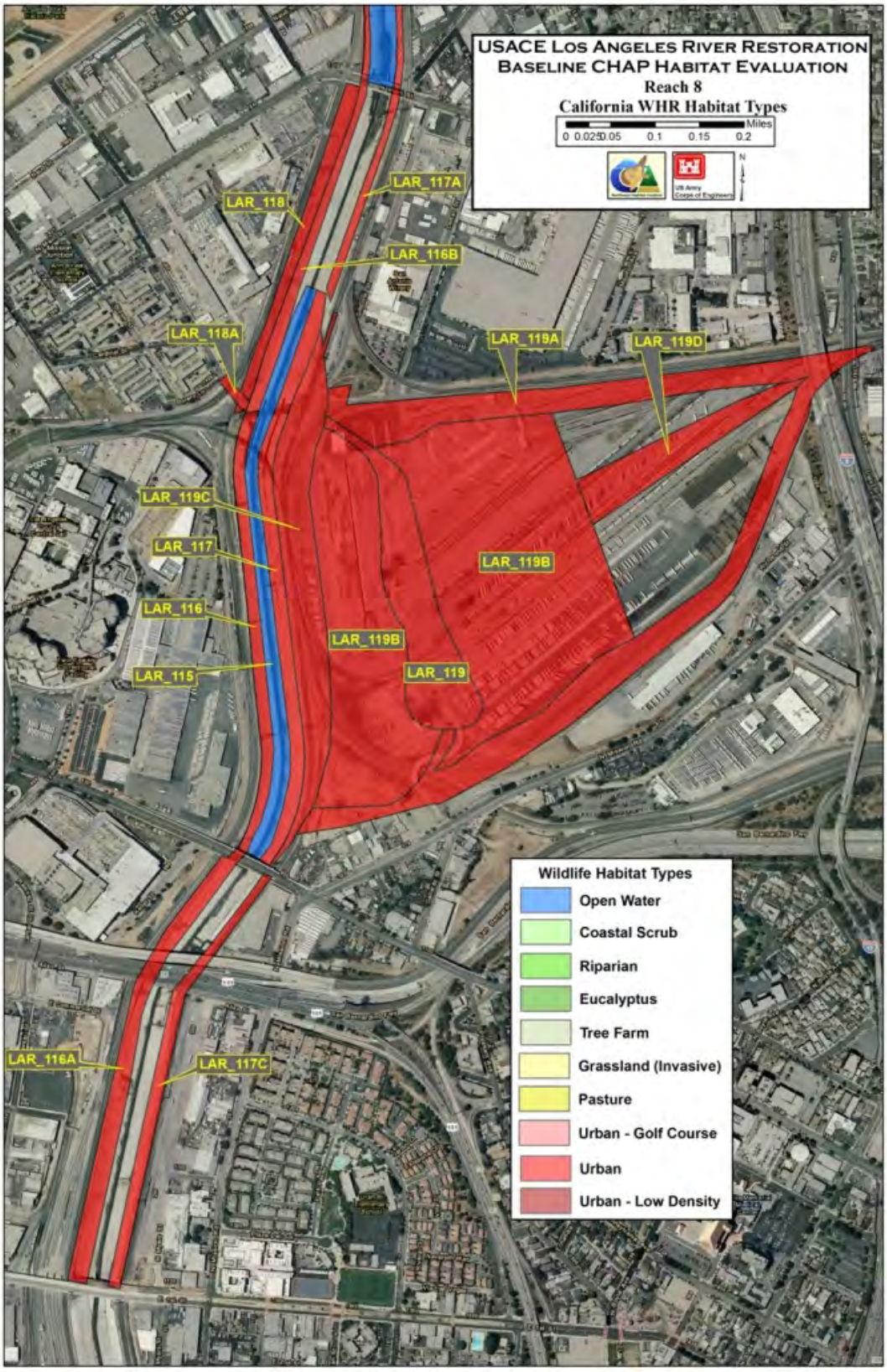


Figure 6.1.3-2. Sample Maps – Baseline Existing Conditions – Structural Conditions

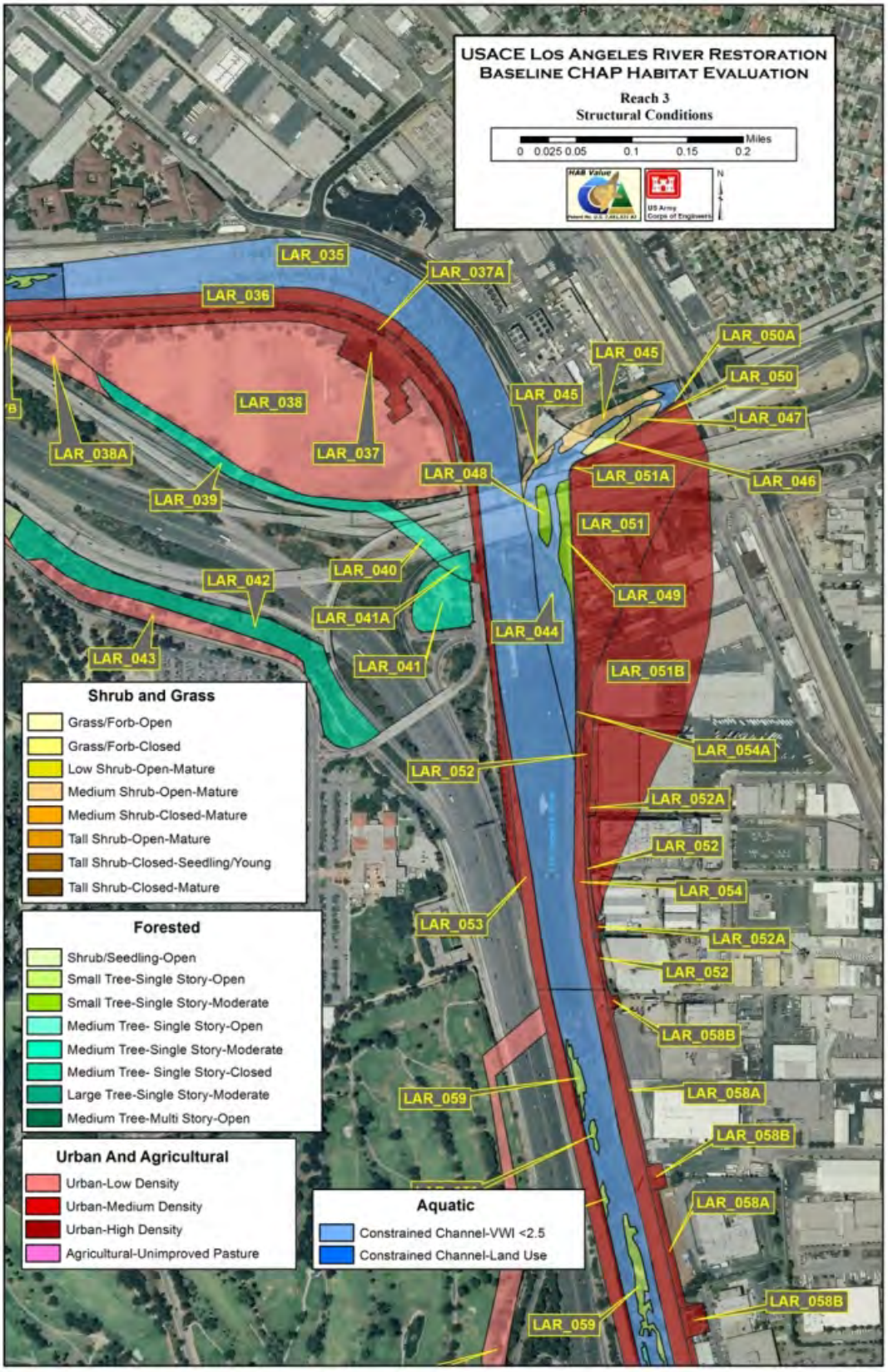


Figure 6.1.3-2. Sample Maps – Baseline Existing Conditions – Structural Conditions

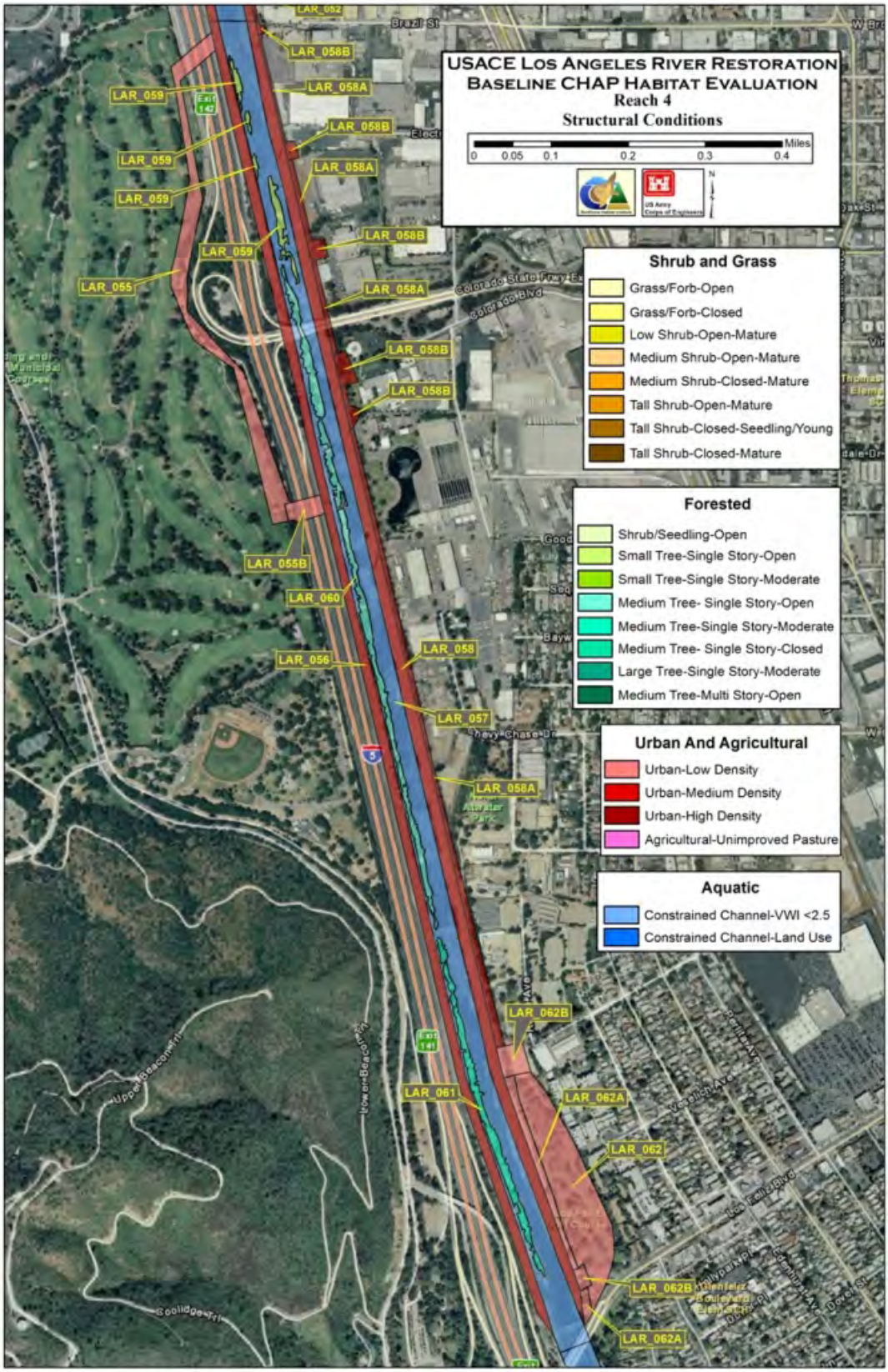


Figure 6.1.3-2. Sample Maps – Baseline Existing Conditions – Structural Conditions

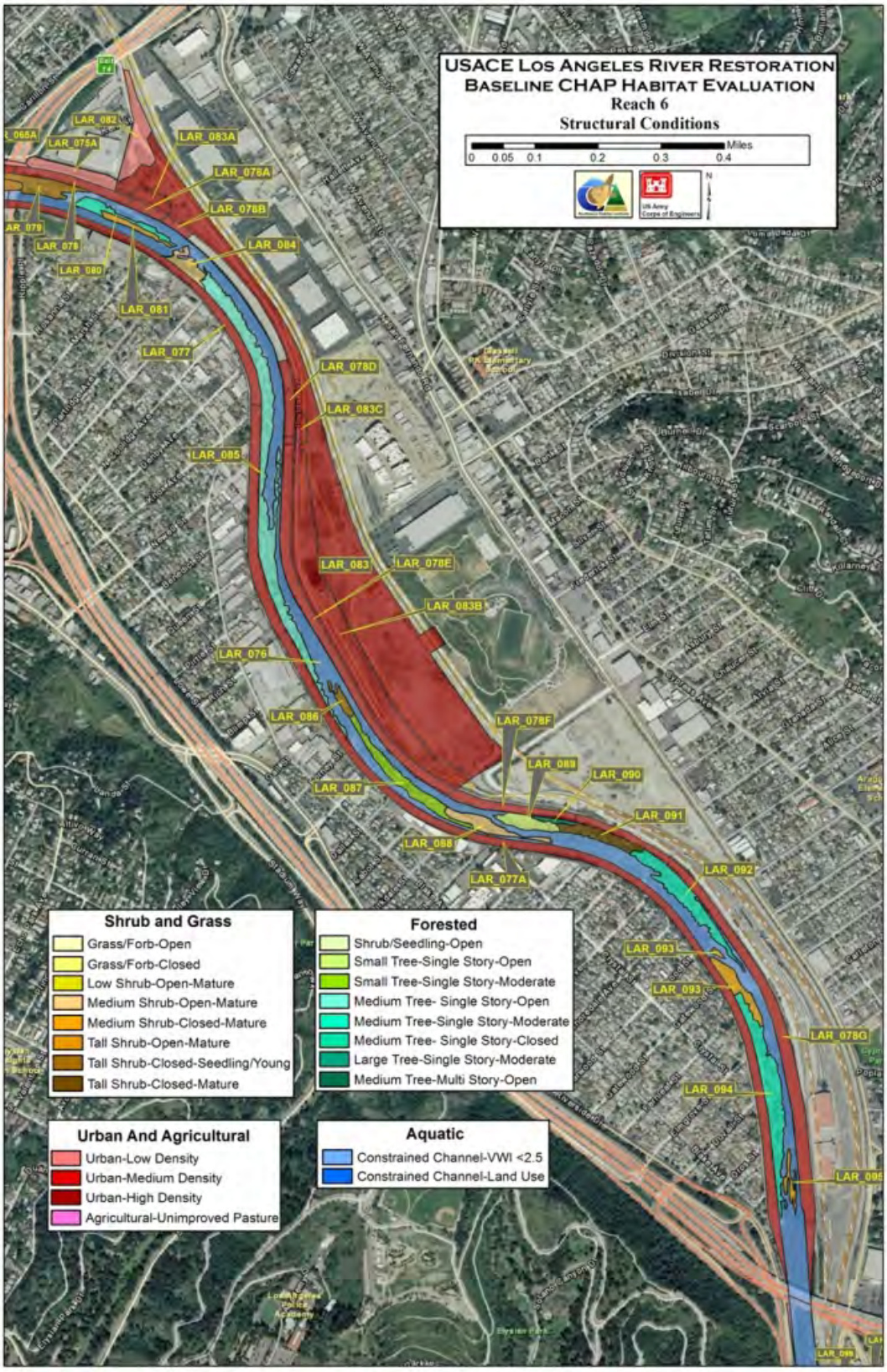
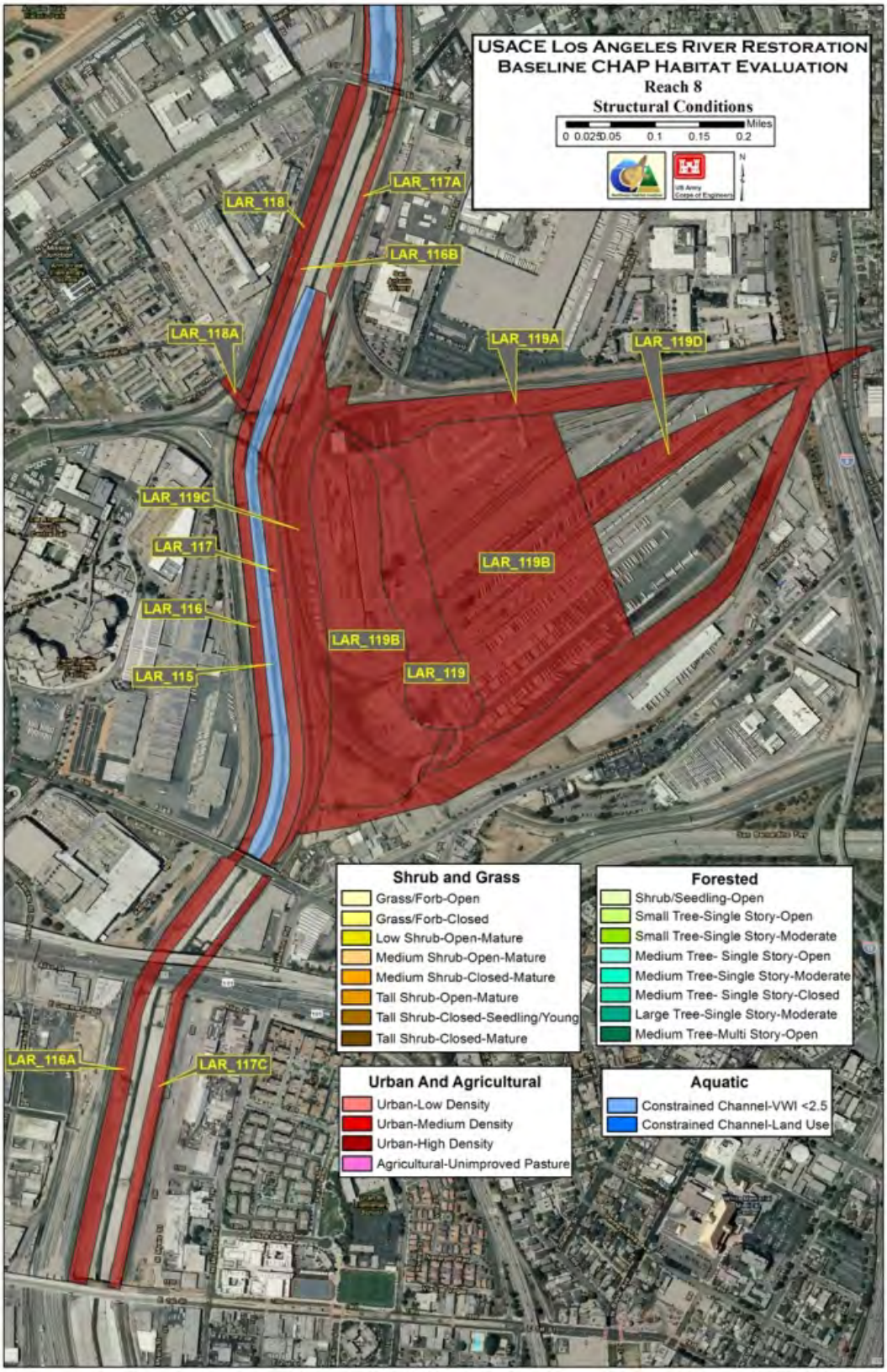


Figure 6.1.3-2. Sample Maps – Baseline Existing Conditions – Structural Conditions



Habitat Findings

Vegetation transects were employed to verify the results of the habitat inventory that occurred at the LA River ER Study site. Results of these verification transects are included in the LA River CHAP Verification Transect Report (Ashley 2010) (Appendix E). Figure 6.1.3-3 shows the location of the verification transects. Table 6.1.3-2 outlines a list of plant species encountered either along or near the verification line transects.

Habitat Units

The habitat assessment shows ten habitat types currently existing within the Study area, totaling approximately 842 acres. The acreage of each of the habitat types and their proportion of the total study area are depicted in Table 6.1.3-3. The baseline existing condition assessment calculated that these acres have a total value of 6,119 HUs. Graphs depicting acreage by habitat type and per-acre habitat value by habitat type follow in Figures 6.1.3-4 and 6.1.3-5. Sample figures depicting per-acre value and HUs are included in Figures 6.1.3-6 and 6.1.3-7.

Mapping of habitat types for baseline existing conditions shows that approximately 67% of the Study area (564.85 acres) is urban (including low density and golf course), providing an average 4.64 HUs per acre. Existing riparian habitat accounts for only 7% of the Study area (62.42 acres), however it provides 16.84 HUs per acre. These riparian areas occupy 9 times fewer acres than the urban areas, yet provide almost four times more HUs per acre than the urban areas. The open water areas also provide substantial HUs per acre, totaling 22% of the Study area (182.21 acres) and providing 11.89 HUs per acre. Other habitat types account for less than 4% of the Study area.

These conditions show that riparian and riverine restoration has the potential to provide substantial restored habitat function and value in the highly urban setting of Los Angeles, and that maximizing acreage of these habitats would benefit ecosystem functioning and species diversity in the area.

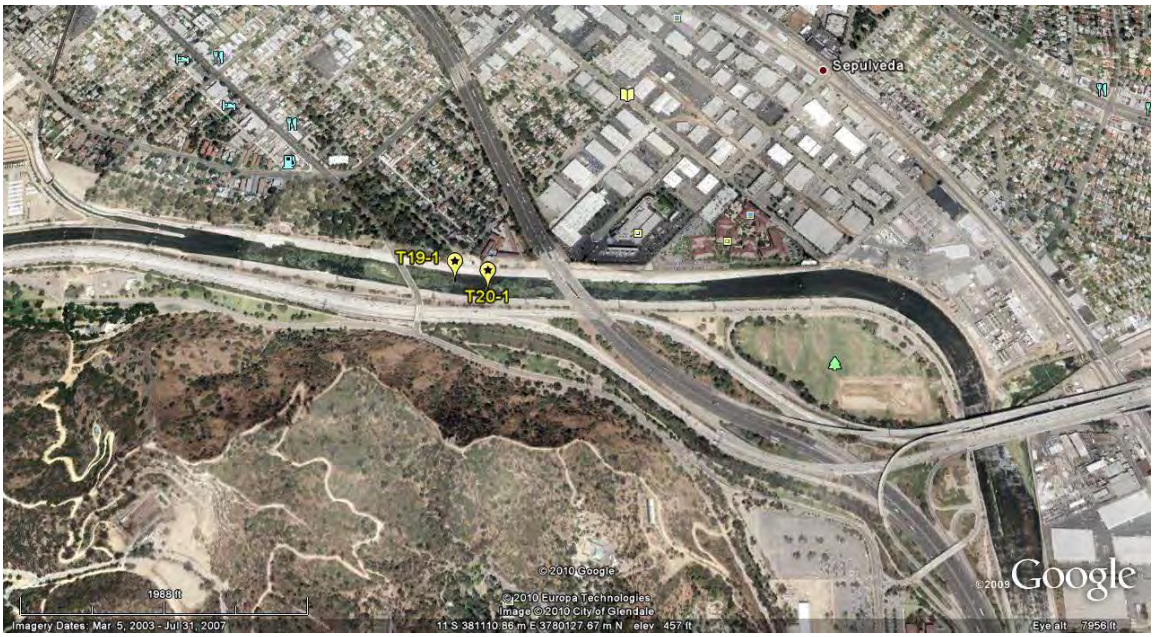
6.2 BASELINE: FIFTY YEAR FUTURE WITHOUT PROJECT

The future without project analysis forecasts the conditions in the Study area 50 years into the future assuming that no project is implemented (i.e. No Action alternative). The 50-year future without project analysis assesses two future time periods, 25 years and 50 years.

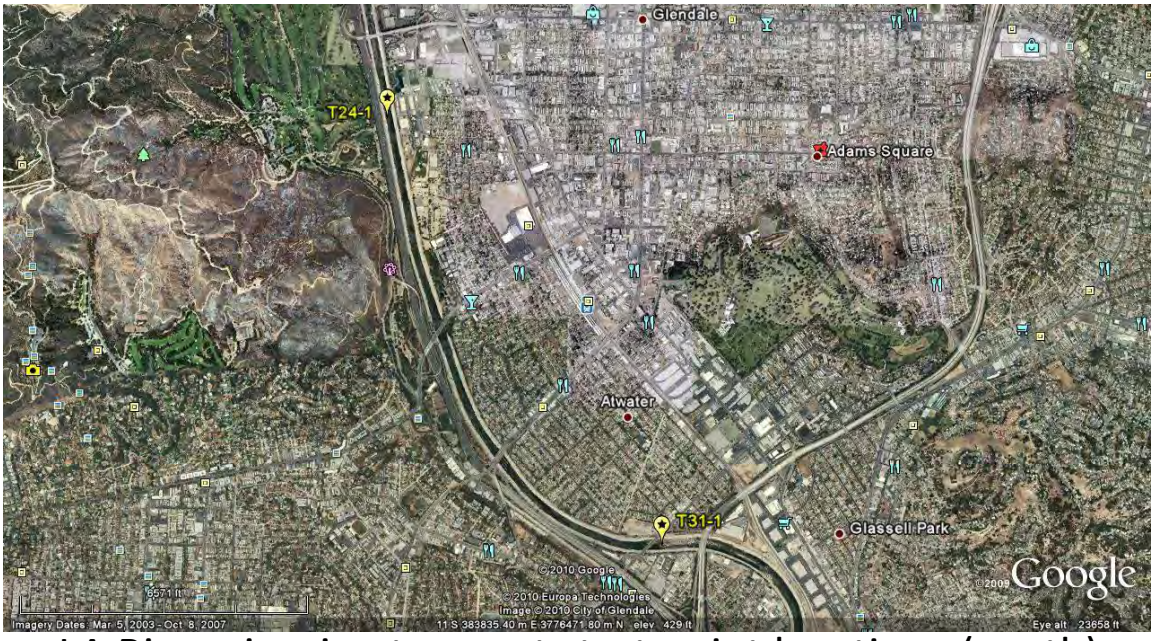
To undertake this assessment, several projections were made to assess habitats over the 50-year time period. These projections are based on past and current trends in habitat condition in the area. Specifically, reasonable predictions include: 1) an increase in presence of invasive plant species throughout the LA River ER Study area, 2) a large flood event (i.e. 500-year event) is likely to occur, and 3) fires threatening the project area will be suppressed.

The habitat evaluation team discussed a reduction in the number of fish and wildlife taxa present within the project area over time. However, in this case, it was the consensus of the habitat evaluation team that the current highly urban landscape conditions would prevail over time. Despite intense development pressure along certain areas of the river corridor, large swaths of existing open space (especially at Griffith Park) were expected to be conserved, consistent with long-established land use policies. Furthermore, it was assumed that native species are already

Figure 6.1.3-3. Verification Transect Locations (Ashley 2010)



LA River riparian transect start point locations (north)



LA River riparian transect start point locations (south)

Table 6.1.3-2. List of Plant Species Encountered on or Near Verification Transects

Common Name	*Scientific Name*	Native	Transect #			
			Los Angeles River			
Arroyo	*Salix lasiolepis*	Yes	19 -1	20 -1	24-1	31-1
Sage	*Salvia columbariae*	Yes	19 -1			
Castor Bean	*Ricinus communis*	No			24-1	
Eucalyptis	*Eucalyptis sp.*	No				31-1
Mexican Fan Palm	*Washingtonia robusta*	No			24-1	31-1
Mulefat	*Baccharis salicifolia*	Yes		20 -1	24-1	31-1
Red	*Salix laevigata*	Yes	19 -1		24-1	31-1
Shamel Ash	*Fraxinus uhdei*	No	19 -1	20-1	24-1	
Sycamore	*Platanus racemosa*	No		20 -1		
White Mulberry	*Morus alba*	No	19 -1	20 -1		

Common Name	*Scientific Name*	Native
Alkali bulrush	*Schoenoplectus maritimus*	Yes
Ash	*Fraxinus velutina*	Yes
Arundo	*Arundo donax*	No
Black mustard	*Brassica nigra*	No
bulrush	*Schoenoplectus californicus*	Yes
Sedge	*Carex spp.*	Yes
Cheatgrass	*Bromus tectorum*	No
Chickweed	*Cerastium sp.*	No
Dock	*Rumex salicifolius*	Yes
Datura	*Datura wrightii*	Yes
Fennel	*Foeniculum vulgare*	No
Foxtail chess brome	*Bromus madritensis*	No
Lemonade berry	*Rhus integrifolia*	Yes
Mustard	*Brassica sp.*	No
Narrow Leaved Cat tail	*Typha angustifolia*	Yes
Pepper tree	*Schinus molle*	No
Plantain	*Plantago major*	No
Poa spp.	*Poa spp.*	**
Prickly lettuce	*Lactuca serriola*	No
Rattail Fescue	*Vulpia myuros*	No
Redstem fillaree	*Erodium cicutarium*	No
Ripgut brome	*Bromus diandrus*	No
Slender oats	*Avena barbata*	No
Tabacco Tree	*Nicotiana glauca*	No
Bull Thistle	*Cirsium vulgare*	No
Fescue	*Vulpia sp.*	**
White sage	*Salvia apiana*	Yes
Wild cucumber	*Marah macrocarpus*	Yes
Wild radish	*Raphanus raphanistrum*	No
Yellow sweet clover	*Melilotus officinalis*	No

Table 6.1.3-3. Proportion of Acreage and Habitat Value by Wildlife Habitat Type

	Coastal Scrub	Eucalyptus	Open Water (Channel)	Pasture	Perennial Grassland	Riparian	Tree Farm	Urban	Urban (Golf Course)	Urban (Low Density)	TOTAL
Acres	0.29	12.37	182.21	11.75	2.19	62.42	6.30	496.97	20.33	47.55	842.37
Proportion of Acreage	0.00	0.01	0.22	0.01	0.00	0.07	0.01	0.59	0.02	0.06	1
Habitat Units (HUs)	2.38	129.51	2166.22	54.95	14.77	1051.38	42.18	2361.82	104.74	191.49	6119.44
Proportion of Habitat Value	0.00	0.02	0.35	0.01	0.00	0.17	0.01	0.39	0.02	0.03	1
Habitat Units (HUs) per Acre	8.29	10.47	11.89	4.68	6.74	16.84	6.69	4.75	5.15	4.03	

Figure 6.1.3-4. Baseline Existing Conditions – Acres by Habitat Type

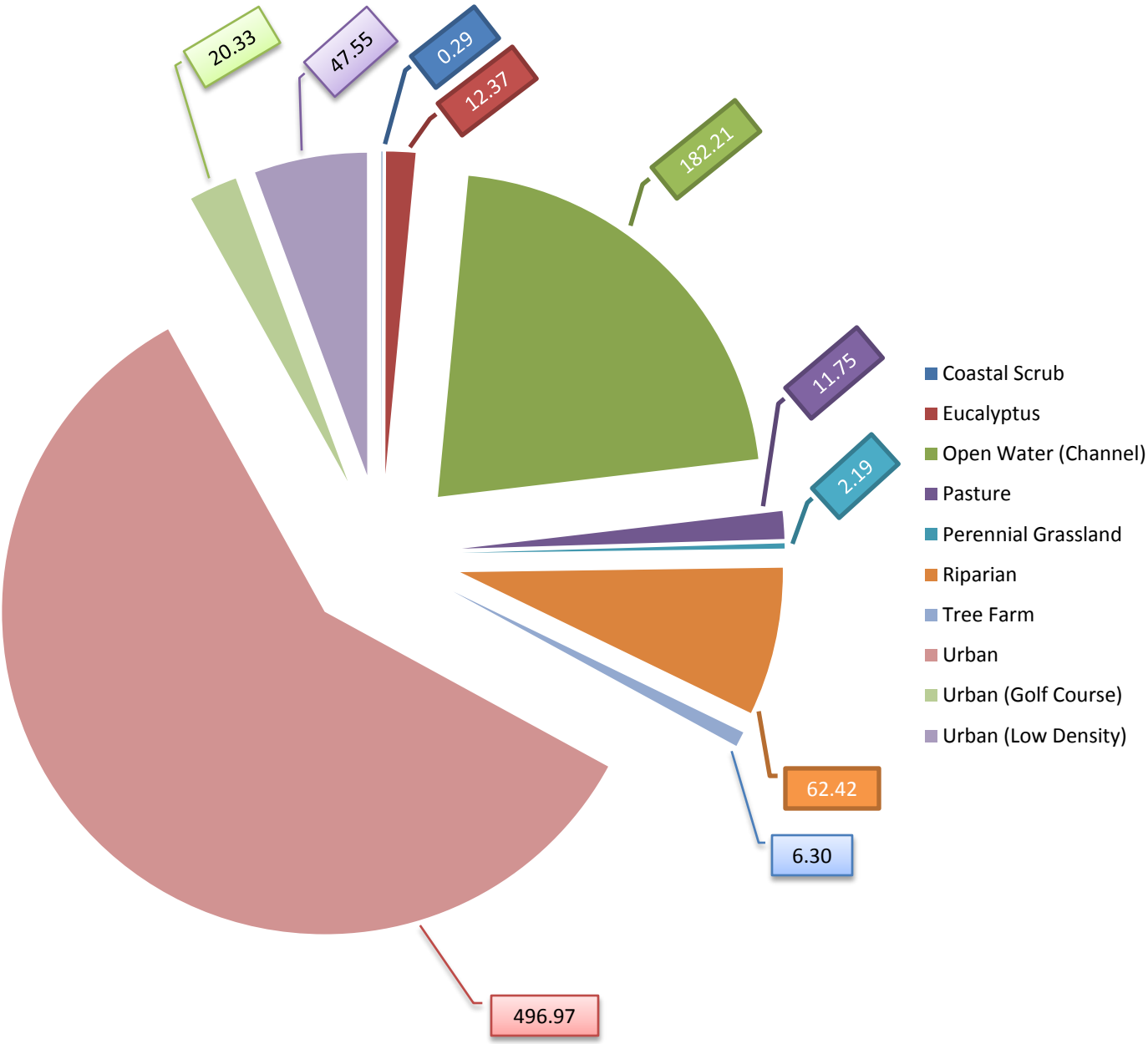


Figure 6.1.3-5. Baseline Existing Conditions – Per Acre Habitat Value by Habitat Type

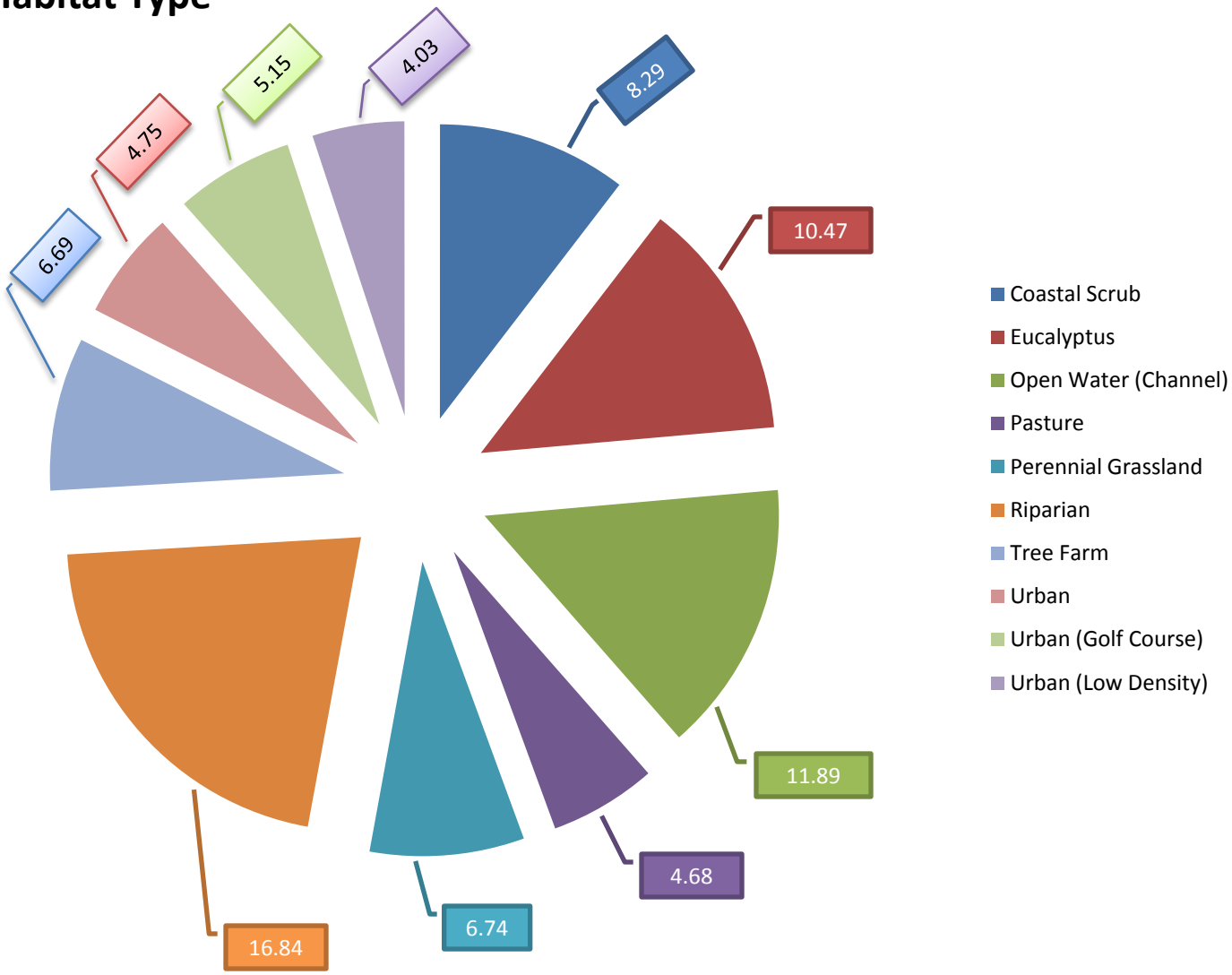


Figure 6.1.3-6. Sample Maps – Baseline Existing Conditions – Per-Acre Value

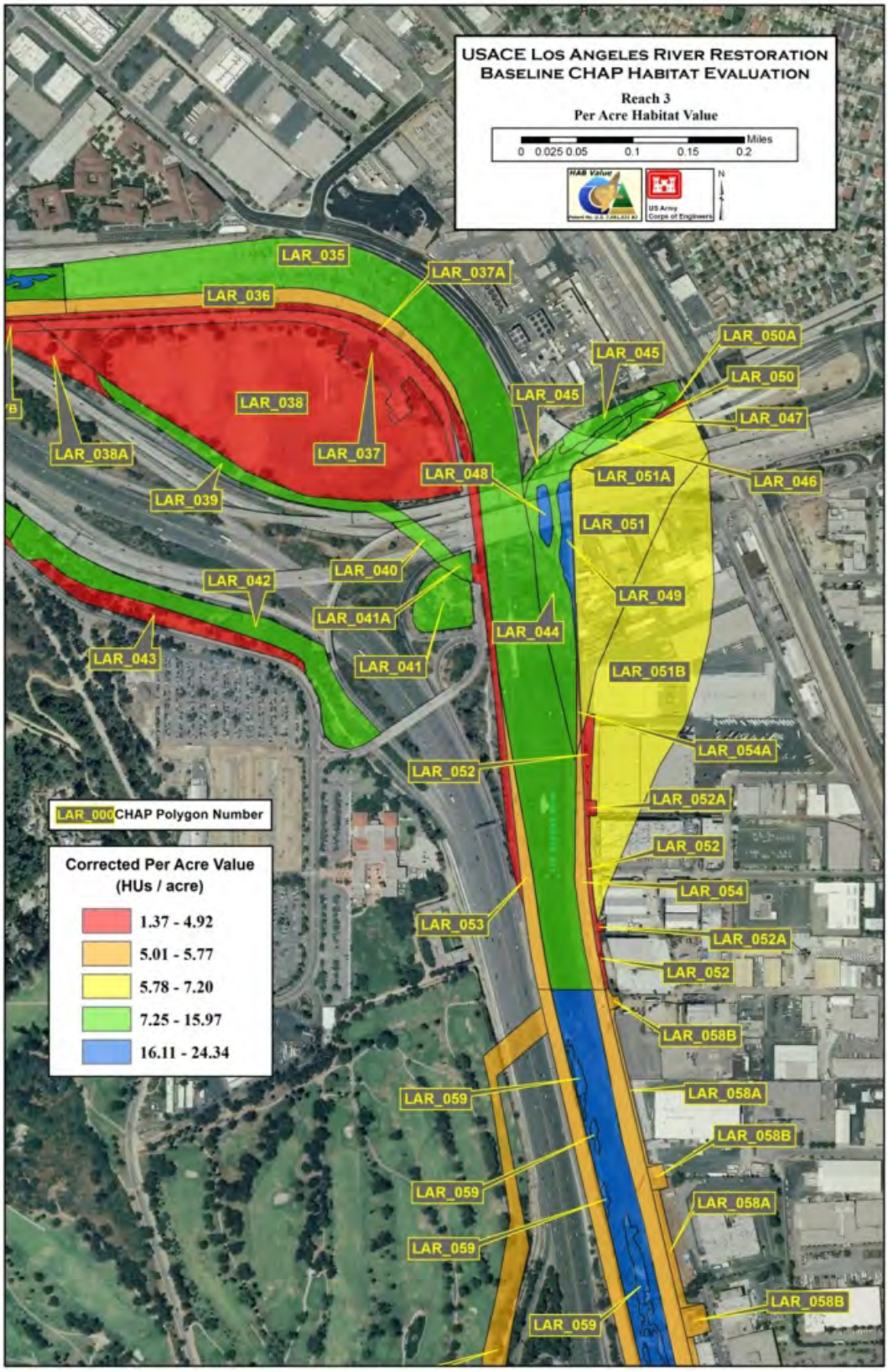


Figure 6.1.3-6. Sample Maps – Baseline Existing Conditions – Per-Acre Value

Figure 6.1.3-6. Sample Maps – Baseline Existing Conditions – Per-Acre Value

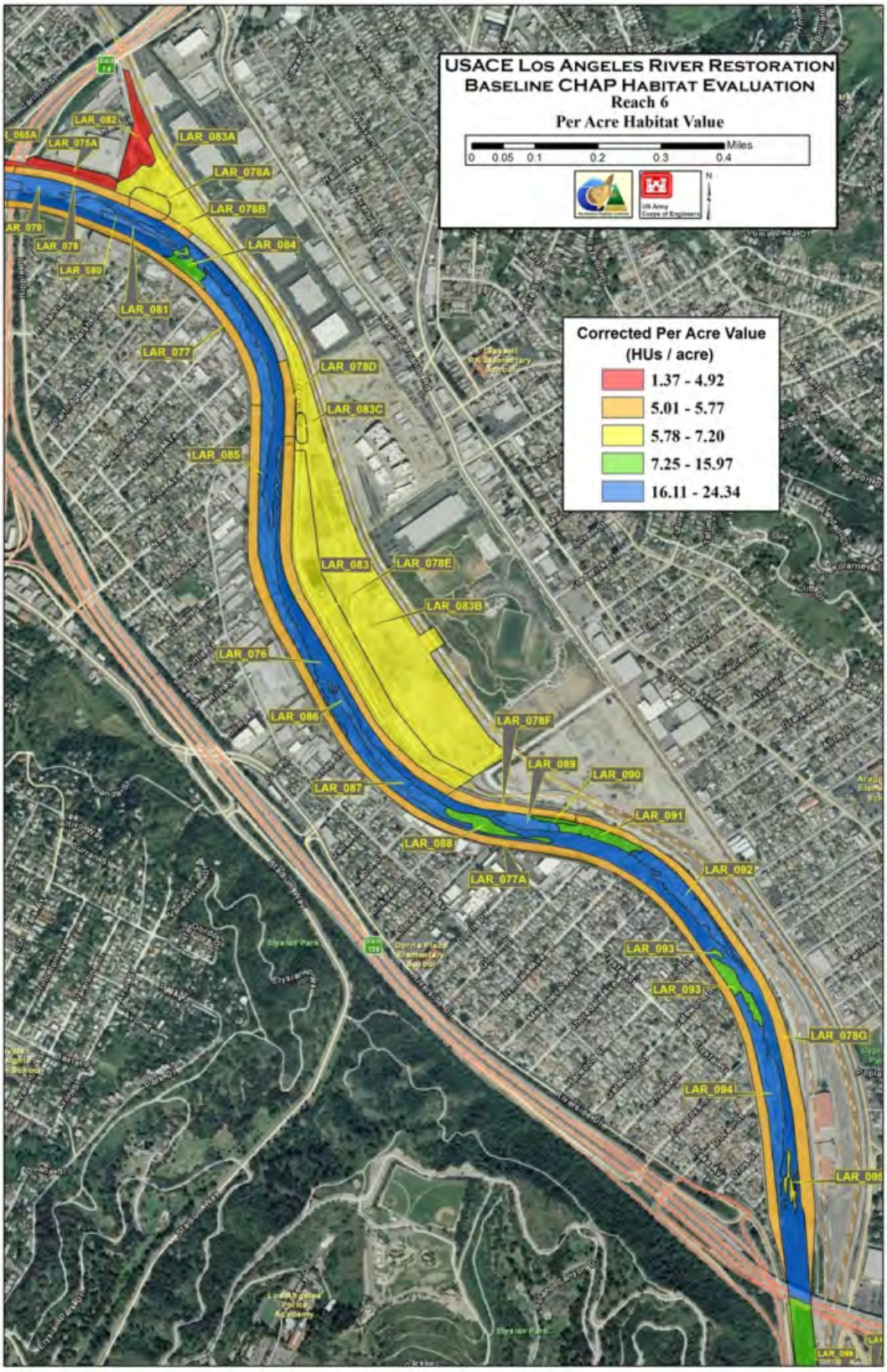


Figure 6.1.3-6. Sample Maps – Baseline Existing Conditions – Per-Acre Value

Figure 6.1.3-7. Sample Maps – Baseline Existing Conditions – Baseline HUs by Polygon Number

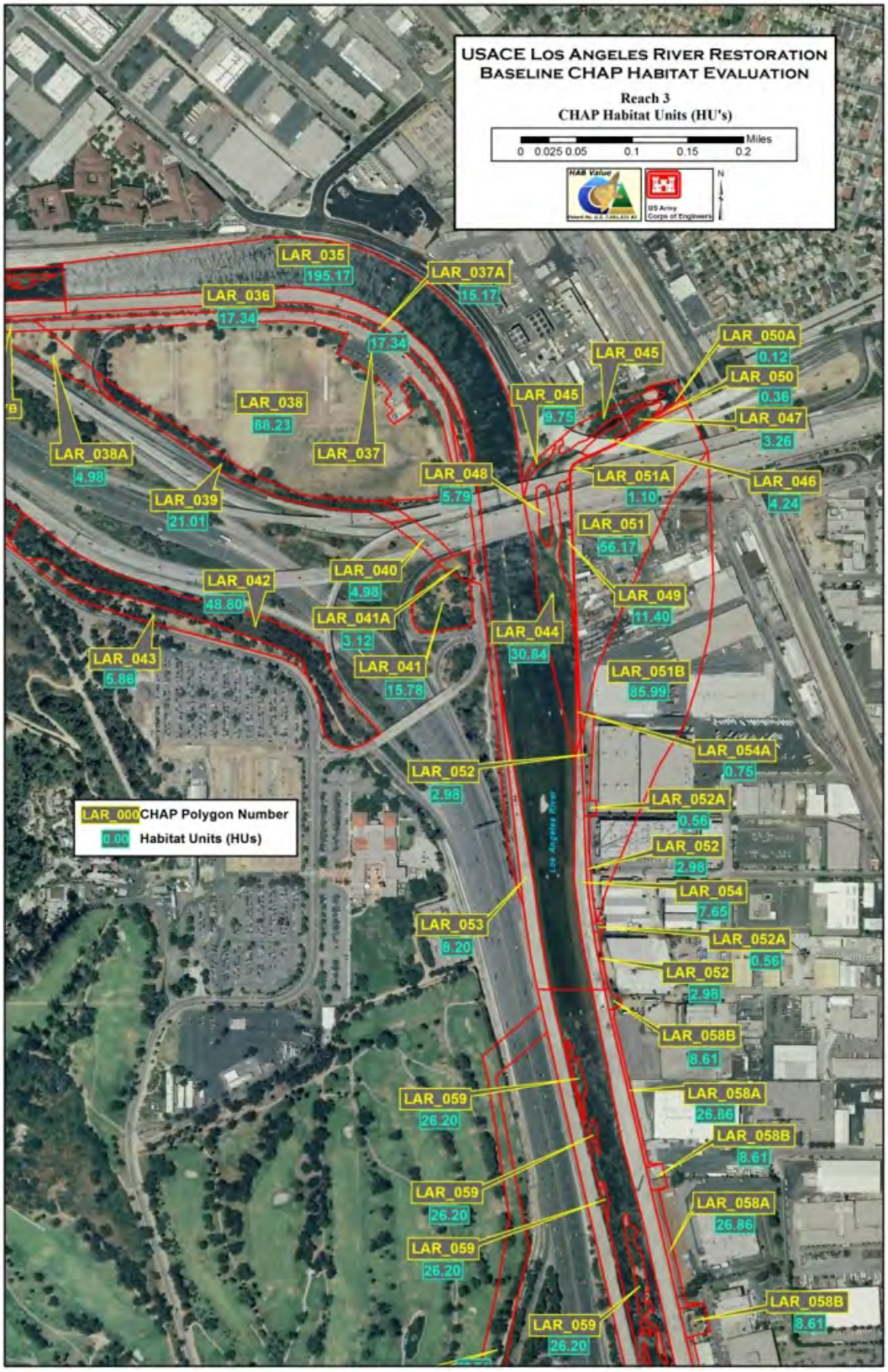
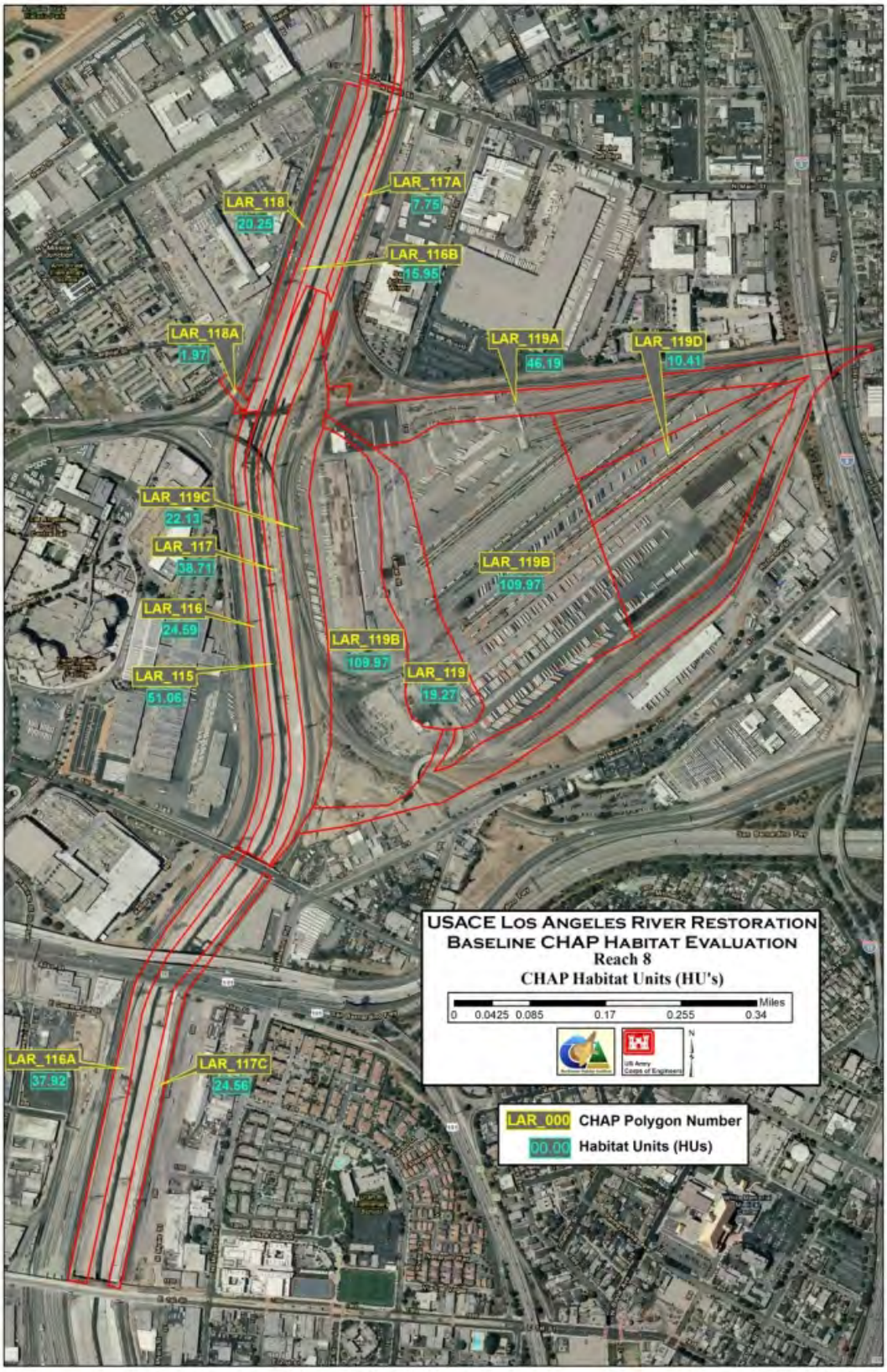


Figure 6.1.3-7. Sample Maps – Baseline Existing Conditions – Baseline HUs by Polygon Number

Figure 6.1.3-7. Sample Maps – Baseline Existing Conditions – Baseline HUs by Polygon Number

Figure 6.1.3-7. Sample Maps – Baseline Existing Conditions – Baseline HUs by Polygon Number



severely depressed, to nearly the maximum extent, given the impacts from urbanization. Therefore, it is assumed that the fish and wildlife species currently identified in the Study area, even under continued pressure from such stressors as invasive species, homeless encampments, horseback riding, and other urban uses, would likely prevail in the future. Thus, there were no adjustments made to the species list over the 50-year period.

Similarly, only minor adjustments to structural conditions were expected to occur from a simulated flood event. Due to the heavily urbanized environment surrounding the river and the engineered structure of the channel, conversion of wildlife habitat type and use by additional wildlife species would be unlikely. The riparian vegetation in the channel through the Glendale Narrows area has the potential to wash out during high flows, but would quickly recover, and has persisted through recent storm events.

6.2.1 Baseline: Future Without Project Methods

To determine a change in habitat values over time from the existing conditions, projections are needed to estimate changes to the species, habitat, and/or function parameters in the future. Applying these changes over several time periods requires some forecasting and theorizing to estimate the amount of alteration that might be expected during each time period. To display the future without project conditions and visualize these changes in value over time, changes to the habitat are applied to the fine scale habitat mapping, while changes to the species and functions, if any, are applied to their respective data sets.

The 25- and 50-year future without project analyses were built upon the baseline existing conditions analysis that illustrates the California wildlife habitat types within the Study area by GIS polygon (Figure 6.1.3-1). By modifying the species-habitat-function input information, which is based on the future projections for the area, a comparative time series evaluation over the 50-year period was generated.

Adjusting Species, Habitat or Functions

The habitat evaluation team met to generate projections for the 50-year future without project conditions. The rationale used by the habitat evaluation team, including logic and decision points, is included as follows.

1. Potential non-viable wildlife populations – The habitat evaluation team discussed the possibility of reducing or modifying the species list, however the team concluded that the current taxa, which are adapted to the highly urban environment surrounding the River, would most likely persist. It was assumed at the time of discussion that despite development pressure on the River, large open space areas, such as Griffith Park, were expected to be conserved due to high demand by the residents and established land use policies.

2. Invasive species would expand in area and abundance – Invasive plant species occurrence for baseline existing conditions was originally collected for three structural levels (the grass/forb layer, the shrub layer, and the tree layer) in each polygon. A discount factor

was applied based on the percentage of invasive species cover present, as shown in Table 6.1.2-1.

To determine the influence of invasive species for the future without project conditions, the habitat evaluation team forecasted that the presence and abundance of the invasive species would increase over time without implementation of a restoration project. Although occasional non-native and trash removal efforts are conducted by the Corps (and others) in certain reaches of the river, these efforts are not frequent or consistent, and are dependent on limited and unpredictable funding. They are also not conducted watershed-wide, so areas cleared of non-natives one year may be subject to re-infestation in later years. Therefore, it was estimated that the percentage of invasive species for each polygon at the baseline condition would advance to the next highest percentage level for the first 25 years, and to the subsequent level beyond that for the last 25 years. For example, if the baseline existing condition of a polygon exhibits 36-65% invasive cover in the grass/forb layer, then the condition at Year 25 would be assessed at 66-90% invasive cover, and the condition at Year 50 would be assessed at >90% invasive cover.

3. Flooding – A simulated 500-year flood event would likely have little influence on how the current wildlife population interacts with the landscape. It is possible that the riparian vegetation in the River within the soft-bottomed portions of the channel could be partially or even completely washed out by a 500-year event; however, historic photos indicate that current structural conditions are likely to persist in the soft-bottomed sections of the project area if no action is taken for the next 50 years. Riparian vegetation rapidly re-establishes after flood events, and this would be expected in the LA River channel. The project area outside the channel is extremely urbanized and any semi-natural areas would likely return to invasive shrub and grass conditions post-flood.

   While a 500-year storm event may wash larger amounts of urban trash and detritus into the river, in its current state the River already contains substantial levels of trash in the Study area. The impacts of trash in the River were, therefore, expected to persist in the event of major flooding without project implementation. Overall, it was not expected that the number of species present or how those species interact with the landscape (habitat function) would be altered by flooding in the absence of a restoration project. Figure 6.2.1-1 depicts the overflow area for a 500-year flood event.

4. Fire – Griffith Park may be threatened by wildfire, however extreme effort is placed on suppressing the spread of wildfire near the Study area due to the threat to human life and property (infrastructure). The 2007 Griffith Park fire burned 817 acres, and a similar fire in 1961 burned 814 acres. Neither fire impacted the habitat within the Study area. There may be a greater concern over time for a potential increase in wildfire due to increased drought conditions associated with climate change. Maturing vegetation types and senescence would increase fuel loading and the potential for wildfire to spread to the Study area.

   Therefore, the likelihood for at least one occurrence of a wildfire within the 50-year period has been projected based on the County's past fire history (Figure 6.2.1-2).

Figure 6.2.1-1. 500-year Flood Event – Overflow Area

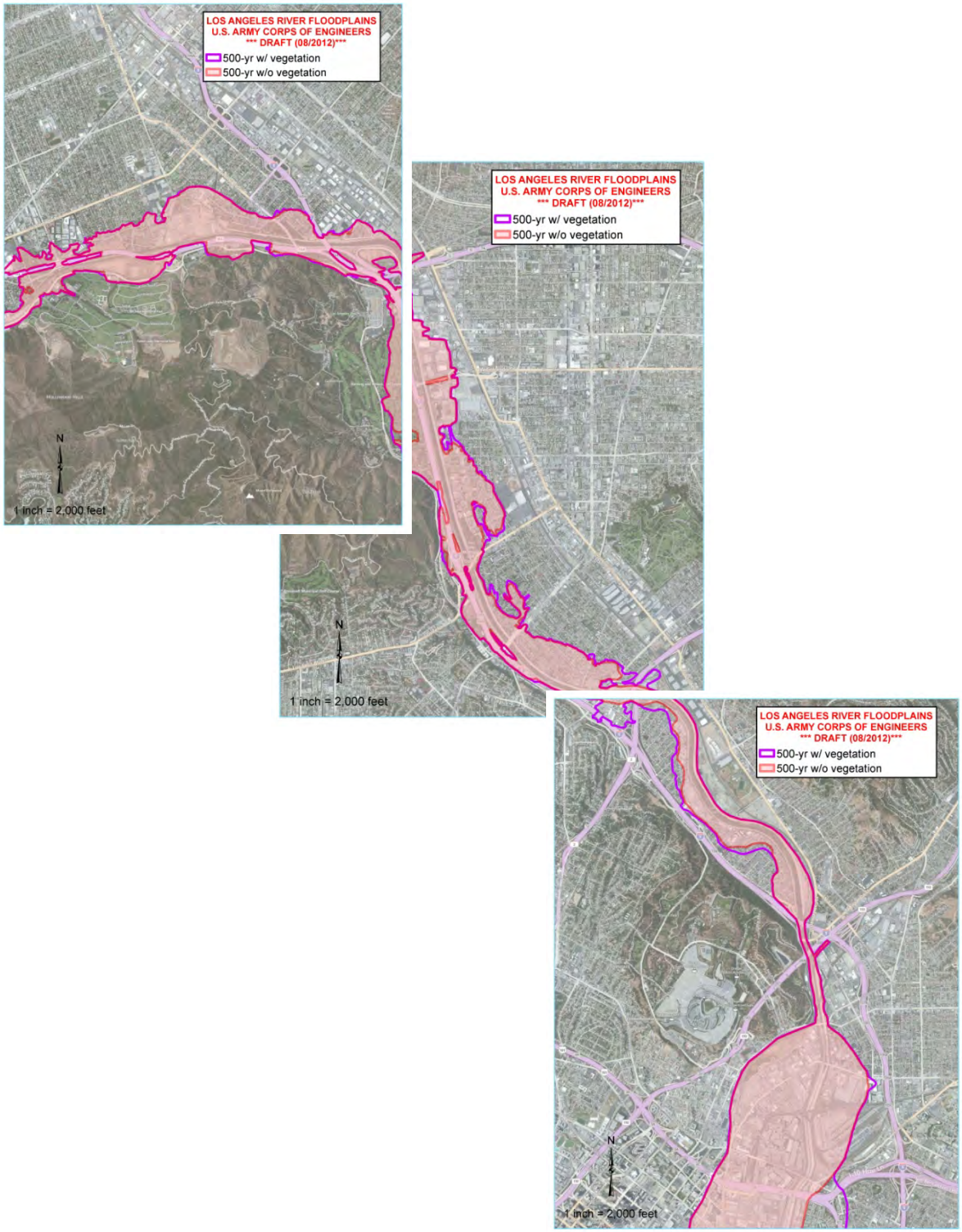
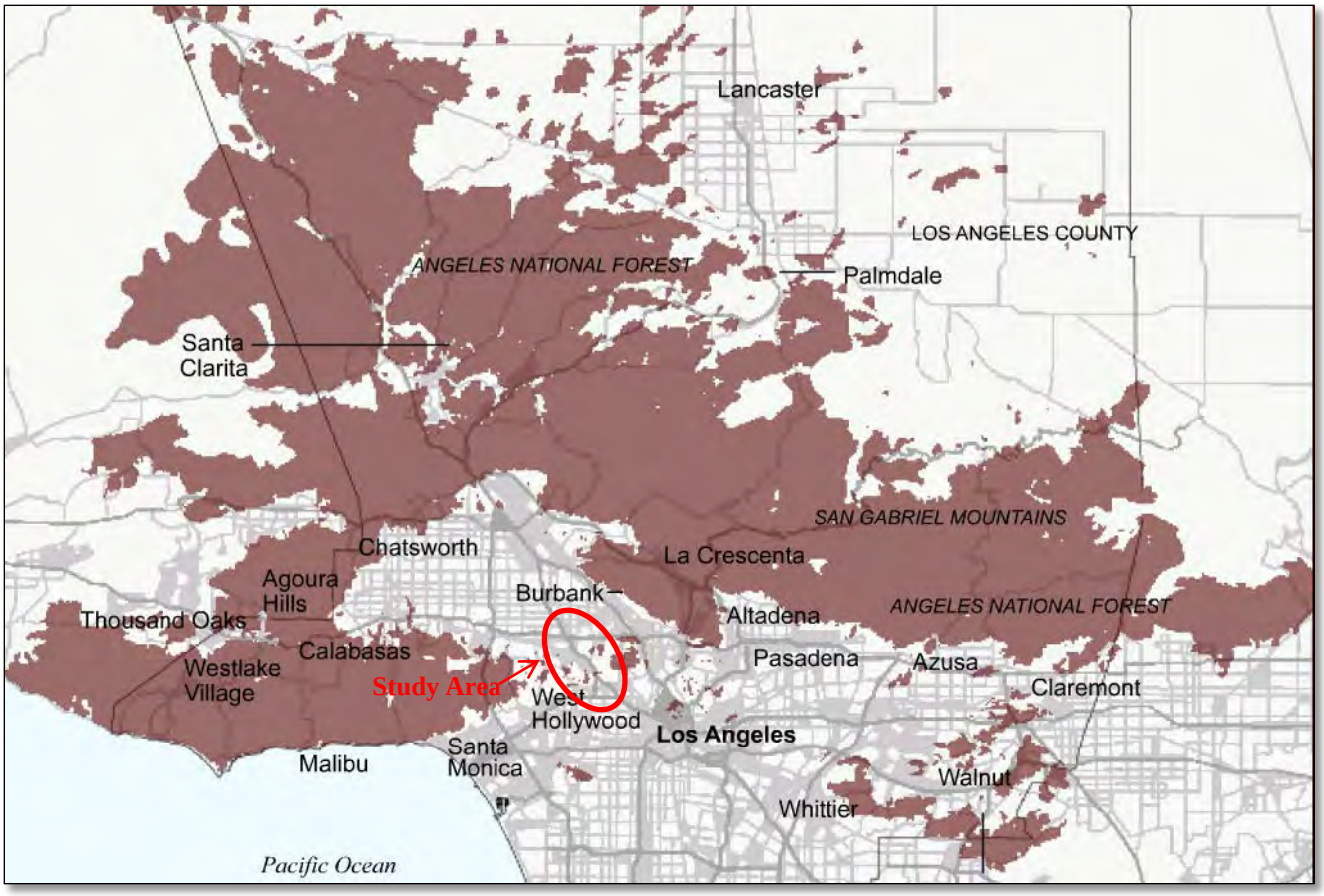


Figure 6.2.1-2. LA County Fire History



Fire History from the Los Angeles County Fire Department illustrating the fires that have occurred from 1870s to 2005 [as reported in LA Times 08-05-2007].

Depending on the severity of a fire in the Study area, burned trees that do not suffer mortality may re-sprout from remnant vegetation and weedy species would likely return as ground cover. Over time some riparian vegetation in the Study area may re-establish from upstream seed sources, however weedy species would be expected to colonize quickly in the absence of established native vegetation. Without maintenance of non-native weeds, these species would be expected to further degrade existing riparian areas over time.

Some wildlife may benefit immediately after a fire, such as insectivorous birds that feed from post-fire insect outbreaks and cavity nesting birds and perching birds that find shelter and snags in the standing dead and damaged trees. Species that prefer structural diversity are generally expected to be negatively affected by a large stand-replacing fire in the Study area. A severe fire may change the water chemistry, leading to mortality of fish and other aquatic organisms. Loss of vegetation and the associated increase in sedimentation would also affect water quality for these species.

The Santa Ana winds, which can fan a wildfire into a major fire storm, were not considered a contributor to fire as the winds do not blow uniformly across Southern California and some areas, including the Study area, are relatively sheltered from the winds (Figure 6.2.1-3).

5. Planned Development – Currently, several development projects are anticipated to occur near the Study area. At the Headworks site, LA County Department of Water and Power is actively installing water tanks at the west end of the site. The Headworks site currently consists of a pile of fill dirt and hole for the future water tanks; therefore, KECs were altered for the area under the future without project condition to account for grass and shrub components that would be planted if no other action is taken at the site.

   The California High Speed Train project is currently developing alternative alignments near the Study area. While the final alignment has not been determined, the alignment alternatives that abut and cross the Study area (if chosen) would have an impact on the value of wildlife habitat in the Study area under the future-without project scenario.

   In the absence of an ecosystem restoration project on the River, urbanization will continue near the Study area, particularly in Downtown LA. Other development, transportation and infrastructure projects occurring within or adjacent to the Study area would generally have a negative effect on habitat value.

6. Earthquakes – Earthquakes and tremors occur frequently in the Southern California area. Figure 6.2.1-4 depicts the seismic activity that occurred in and around the Los Angeles area from 1800 thru 2000. In the event of an earthquake, the primary impact would be to infrastructure along the corridor. It is expected that the design and engineering of the channel, including pipelines and tanks, would withstand predictive earthquakes for the area. If this infrastructure failed, flooding may occur, although surface water would eventually flow back in the Los Angeles River.

Figure 6.2.1-3. Santa Ana Winds

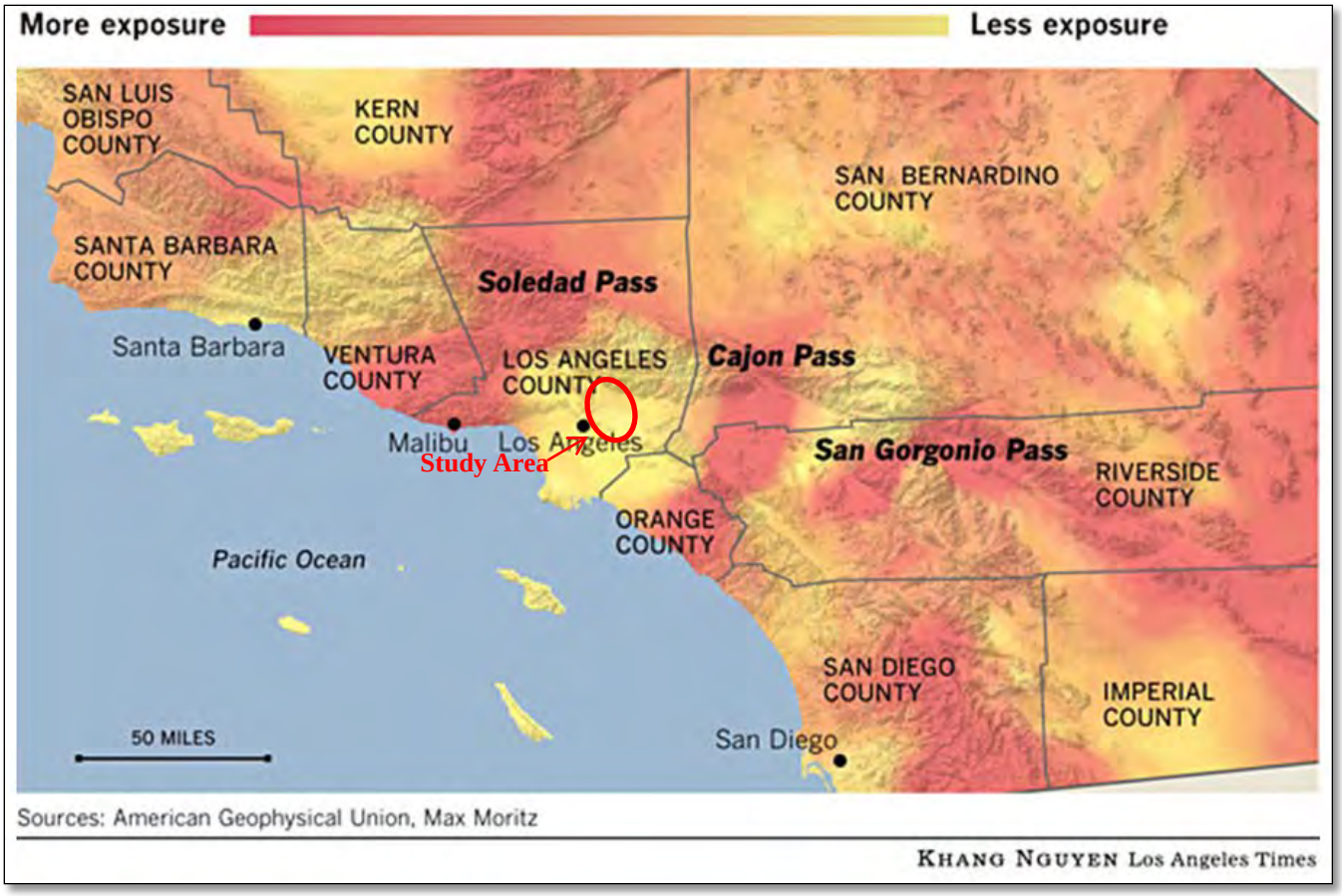
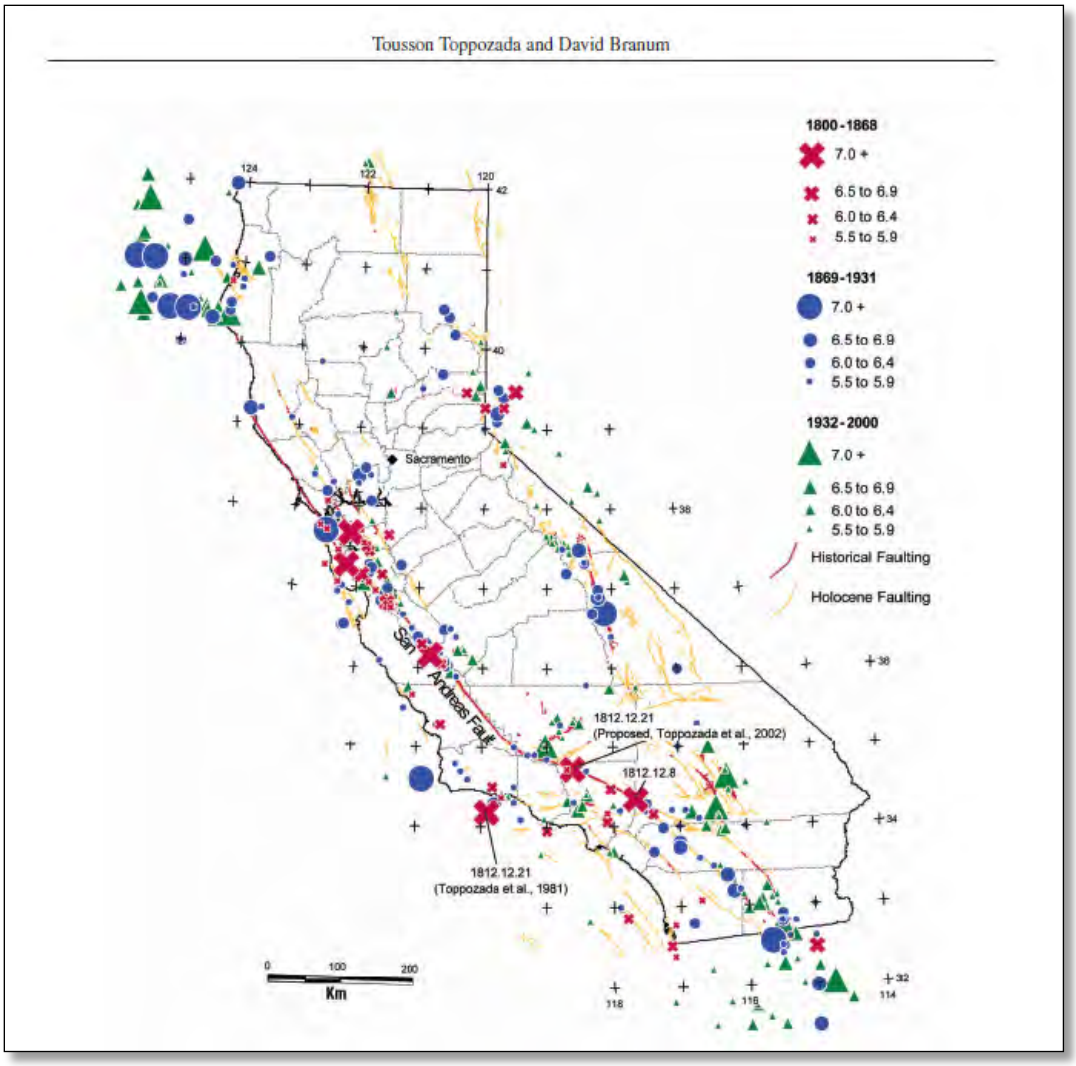


Figure 6.2.1-4: Earthquakes in Southern California



Magnitude greater or equal to 5.5 California earthquakes, 1800-2000 (modified from Toppozada and Branum, 2002).

7. Proximity to Other Natural Areas – The Study area is in close proximity to other natural areas, most notably Griffith Park, which is the eastern terminus of the Santa Monica Mountains (Figure 6.2.1-5). It was expected that these substantial nearby open space areas and habitat connections would persist in the future.

6.2.2 Baseline: Future Without Project Results

After adjusting the percent of cover of invasive species and adjusting the KECs of each polygon based on planned development, flood and fire events, and climate change, habitat values were generated for the 25 and 50-year time periods.

As expected, habitat value is projected to substantially decline within the Study area assuming no restoration activity is implemented over the next 50 years. Open water areas and urban areas mostly comprised of impervious surfaces (including the concrete channel banks) showed no change from the current habitat value. The remainder of the Study area is projected to decline steadily in habitat value, with an overall decline of 7% after 25 years and 14% after 50 years (Figure 6.2.2-1). In the absence of restoration in the Study area, the existing riparian areas that currently provide the most habitat value per acre will continue to degrade. Ecosystem functions in the Study area will also continue to diminish.

The future without project CHAP calculations are included in Microsoft excel spreadsheets and displayed in a GIS geodatabase. Due to the large volume of these spreadsheets and data, the complete set of files is available upon request from the Corps, Los Angeles District.

6.2.3 Annualizing HUs

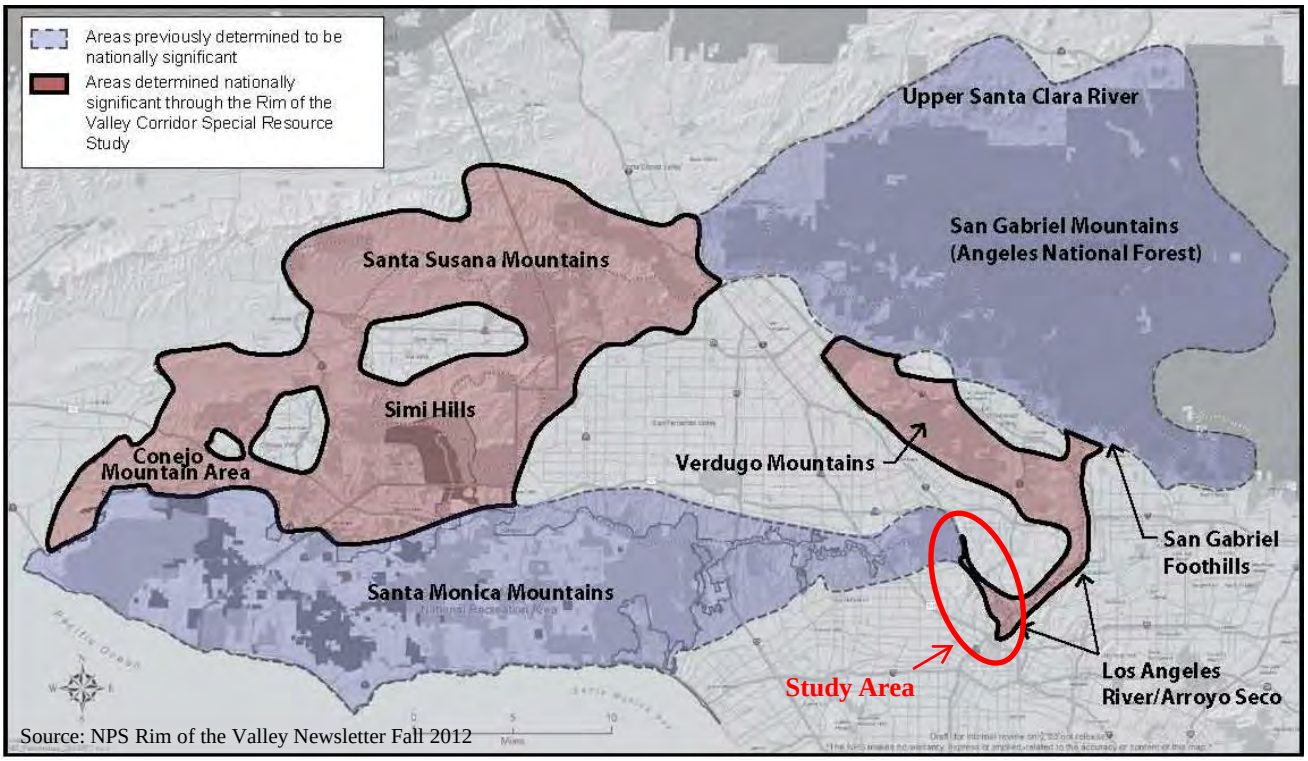
Since the amount and value of habitat found within the Study area is likely to vary over time, to account for time dependent variation habitat units were forecasted over the 50 year period of analysis. These 50 annualized values were then averaged to produce an average annual habitat unit value.

Annualized habitat unit values were generated by forecasting the amount and value of habitat expected to exist within the study area at discrete points of time during the period of analysis (i.e. the number of habitat units expected to exist in the 1st, 25th and 50th year of the period of analysis). The habitat values expected to exist in years between the forecast points were created by interpolating (linearly) between these forecast values. The resulting 50 habitat unit values (one for each year in the period of analysis) were then averaged to produce a single average annual habitat unit value. This annualized habitat value was compared to annualized costs in the economic cost effectiveness and incremental cost analyses (CE/ICA)(See Appendix B of the Main Feasibility Report).

6.3 ALTERNATIVES ANALYSIS

Through the Corps' Plan Formulation process, 19 preliminary ecosystem restoration alternatives were developed based on input from local stakeholders and resource agency groups provided at workshops throughout the planning process.

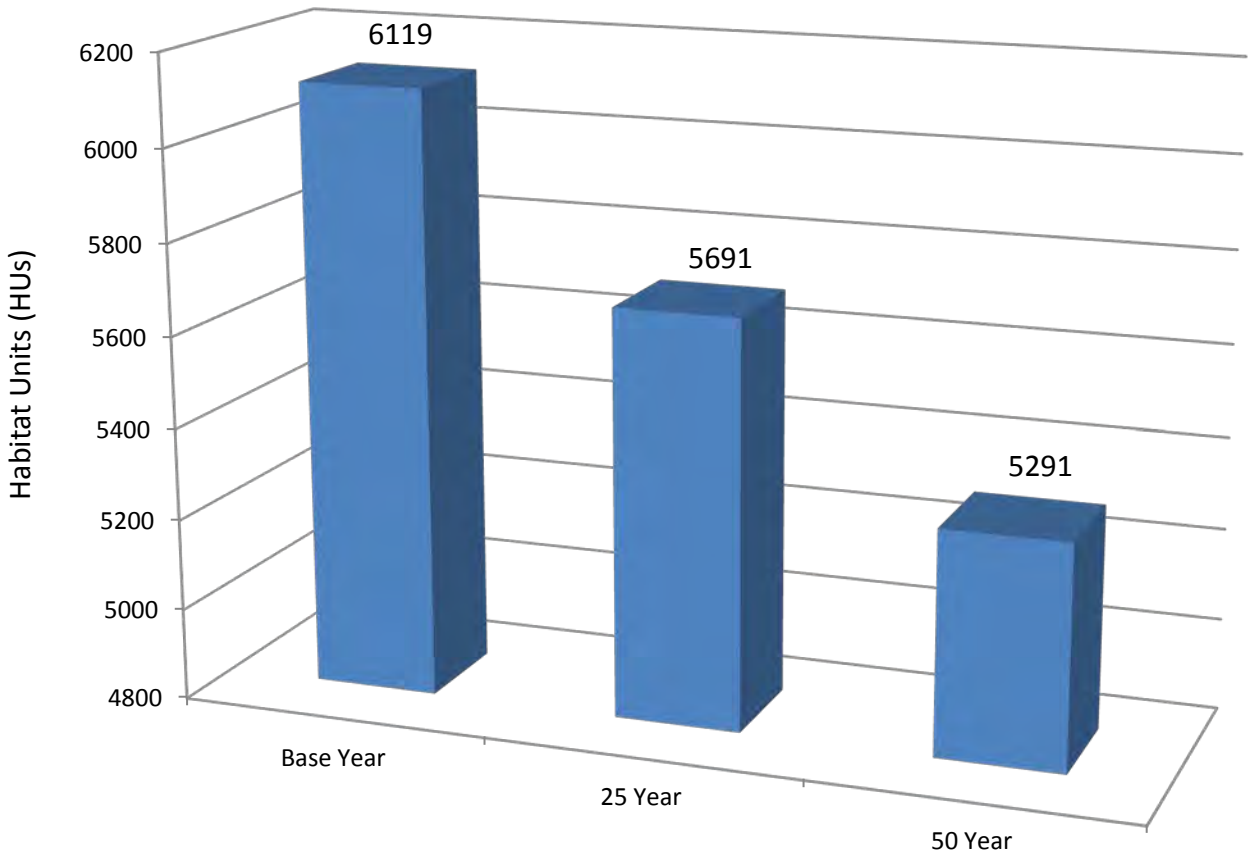
Figure 6.2.1-5. Proximity to other Natural Areas



Regional Connectivity to Local Mountain Ranges and Nationally Significant Areas

Opportunities for Connections to Griffith Park

Figure 6.2.2-1. Without Project HUs



HUs were calculated for each restoration alternative by evaluating specific habitat creation, improvement, and management actions within the Study area, where preliminary design specifications and future with project assumptions were clearly, spatially defined. Informed predictions of habitat value for each of the 19 preliminary restoration alternatives were made by altering the inputs to the CHAP to match the anticipated outcomes of the different restoration alternatives. Habitat value results were then tabulated for each alternative by reach.

6.3.1 Alternatives Methods

To calculate habitat value for each alternative, the species by function matrix values are adjusted when the species list changes or there is a conversion of habitat type. The habitat by function values are adjusted when KECs (i.e. habitat elements) are added or removed. Restoration activities can increase the values of either or both matrices within the CHAP accounting system.

By converting dense, urban uses to functioning riparian, open water, and marsh habitats, which are all aquatic ecosystems, the number of potential species linked to those habitats greatly increases in that area. The number of species performing functions and the number of functions provided by the habitat type also increases for that area. These adjustments in species, habitat, and functions lead to increased species by function matrix value for a given polygon. Adding KECs, such as by planting vegetation and creating a more natural geomorphic character, or enhancing structures for wildlife use and connectivity, increases the habitat by function matrix values for a given polygon.

To calculate initial and future with project habitat values, representing the benefit of each alternative's proposed restoration activities, each of the total 172 CHAP polygons must be analyzed in terms of habitat type, structural conditions, and KECs expected to be present after restoration. For the purposes of the Study, habitat values were forecasted at initial HUs, after 25 years with project, and after 50 years with project. This provides a direct comparison to the baseline future without project conditions, at 25 and 50 years into the future.

The baseline CHAP polygons were delineated based on differences in habitat type or structural condition. During the alternatives analysis, some of the polygons established during baseline had to be split because different restoration actions were proposed in multiple areas within a given baseline polygon. In these cases the original CHAP baseline polygon number was retained, and any additional polygons resulting from split were labeled with a letter (e.g. polygon LAR_007 was split to LAR_007, LAR_007A and LAR_007B). Maintaining this continuity allowed for simplified spatial tracking.

After the polygons were split where necessary, and the new polygon acreages were calculated, each restoration measure was evaluated as to the habitat type it would create, and the structural condition and KECs expected to be present. The Corps' alternative matrix, describing alternative measures for each alternative per reach (Appendix F), was used to identify the sub-measures that occurred in each river reach for each alternative. Application of these sub-measures in certain areas dictated where habitat conversions would occur within the Study area for each alternative. Evaluations were also based on the proposed preliminary design cross sections (Appendix G),

habitat assumptions made by the design team related to management measures[7] (Table 6.3.1-1), discussions with the CHAP habitat evaluation team, as well as projections of what current features would persist in a given polygon. To further assist in evaluating which sub-measures were to be implemented in each polygon, the design team's alternative GIS mapping (Tetra Tech 2012) was used as a spatial reference (Figure 6.3.1-1 and 6.3.1-2).

The following descriptions document the adjustments made to CHAP inputs (i.e. habitat type, KECs, percent invasives) to reflect the forecasted changes that would occur in each polygon with implementation of sub-measures from the restoration alternatives. Trash removal and invasives removal for the life of the project was included as a measure in any reach where restoration activities are proposed. For the complete list of measures, sub-measures, and their detailed descriptions, refer to Section 4.4 of the Main Feasibility Report. The master list of KECs and their numerical codes are included in Appendix A.

These descriptions are generalized for each sub-measure, and do not include polygon specific KECs such as roads, fences, bridges, buildings, and other anthropogenic features that were evaluated additionally for a given polygon.

For example, in polygons where the following sub-measures are implemented,

- Restore riparian and marsh by day lighting streams
- Creation of attenuation basin with wetlands

the following KECs were altered:

- Convert habitat type to Freshwater Emergent Wetland
- Restore all invasive species levels to 0-10%
- Remove trash and pollution KECs if applicable: 8.19.1 Chemical, 8.19.2 Sewage, 8.19.3 Water, 8.9 Refuse
- Add KECs: 4.1.2 Water Depth, 4.6.3.2 Emergent Vegetation, 4.7.1 Wetlands, 4.7.2.2 Non-Forest, 4.7.3 Size <2 ha, 4.7.4 Marsh Characteristics, 4.9 Seasonal Flooding, 8.16 Culverts, 8.24 Water Diversion

In other words, in polygons where a particular alternative designates that streams currently in storm drains be day lighted and the outlets/confluences be naturalized with created wetlands , it is expected that freshwater marsh would be restored and that invasives management would be implemented. Therefore, those KECs (habitat elements) should be accounted for in that polygon for the future with project condition. Trash management would also be implemented, which would remove certain existing habitat elements including chemical, sewage, and water pollution, and refuse. The restoration of wetlands would add KECs associated with that habitat such as emergent vegetation, seasonal flooding, and water diversions.

7 For the complete list of measures, sub-measures, and their detailed descriptions, refer to Section 4.4 of the Main Feasibility Report.

Table 6.3.1-1: Habitat Design Assumptions Related to Management Measures

Sub-Measure	Assumption
Restore riparian and marsh by day lighting streams	Average 1 acre wetland per site (confluence).
Create geomorphology* and plant for freshwater marsh in adjacent side channel/in main LA River Channel. Create geomorphology for open water adjacent to the channel/in main LA River Channel.	Assume same percentage of wetland/riparian/open water as in existing soft bottom reaches.
Rebuild geomorphology for historic wash	Riparian.
Creation of attenuation basin with wetlands	Wetland.
Divert tributary & river flow into side channels	25% riparian/75% wetland.
Restructure/vegetate LA River concrete channel walls	This is applied to most of the channel banks but it is assumed that the banks will not be fully covered by vegetation. Assume 50% herbaceous riparian/50% concrete.
Habitat corridors/Riparian planting on over banks of the main channel or tributaries	50% riparian/50% shrub.
Terrace concrete banks/Planting built into modified channel walls	50% riparian/50% concrete**
Establish/improve open water habitat on concrete bottom areas within the main channel of the LA River	This measure is only in Reach 3. Assume 25% wetland (toe of the banks). Remaining stays as existing conditions.
Lower channel banks	One polygon adjacent to Verdugo Wash. Assume riparian.
Widen channel banks	Riparian.
Major tributary channels/widen channel	One polygon at Verdugo Wash. Assume same wetland/riparian percentage as existing conditions.
Terraces with earthen banks	Riparian.
In Soft Bottom Reaches 2, 4, 5, 6: Assume that the existing configuration of habitat in the channel bottom not modified. Assume trash cleanup and invasives management will be conducted for the life of the project in reaches where measures are implemented. Assume only occasional non-native/trash removal without the project.	

*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.

**Habitat composed of 50% riparian and 50% concrete would provide half of the benefits attained by the fully restored riparian habitat. While it does not provide as much benefit as the comprehensive riparian restoration, this habitat is an important component for wildlife movement and connectivity within the project area for small animals (mammals, birds, reptiles) in more restricted reaches, providing opportunities for foraging and cover.

While concrete surfaces are not natural or a restored habitat, they do provide value to certain species, even if minimal value, in such a highly urbanized environment. Shorebirds benefit in areas of perennial flow where algae accumulates on the surface of the concrete. This provides them roosting and foraging habitat. This also serves as a linear open space corridor that wildlife can traverse without contending with traffic or other human intrusion. While persistence of concrete is not a restoration measure, it will continue to be a usable element for wildlife that will exist within the study area.

The main purpose of the habitat evaluation is to ensure that with-project values are significantly better than without project for the overall study area. Concrete is an existing condition, and while the value may be low it is not zero in this particular case. If concrete surfaces are assigned zero value then the overall value of the entire study area (for both existing and future conditions) would be undervalued. With the project, there will be less concrete and less non-native vegetation.

For the complete list of measures, sub-measures, and their detailed descriptions, refer to Section 4.4 of the Main Feasibility Report.

Figure 6.3.1-1. Sample Alternative Mapping – Alternative 1 – Reach 3

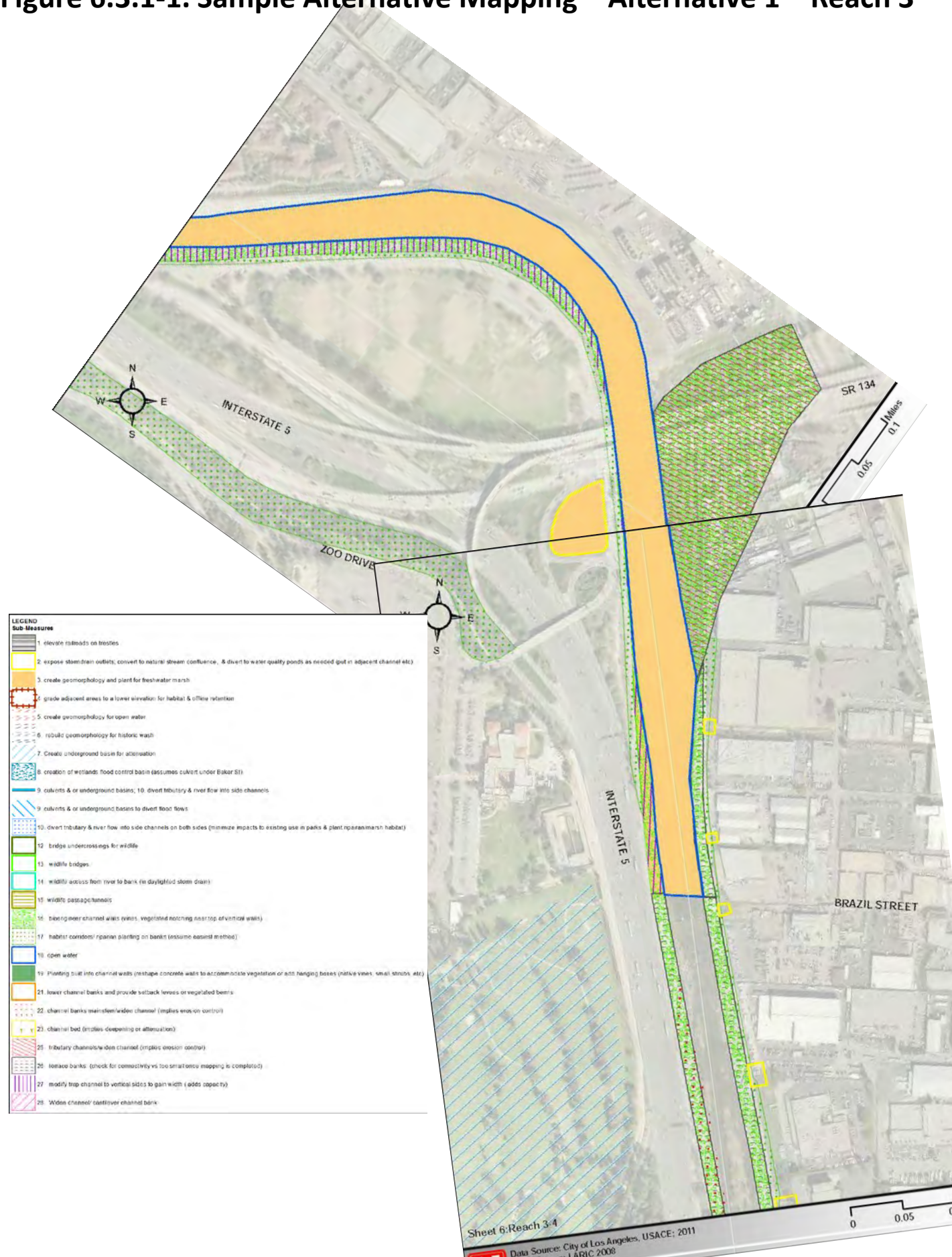
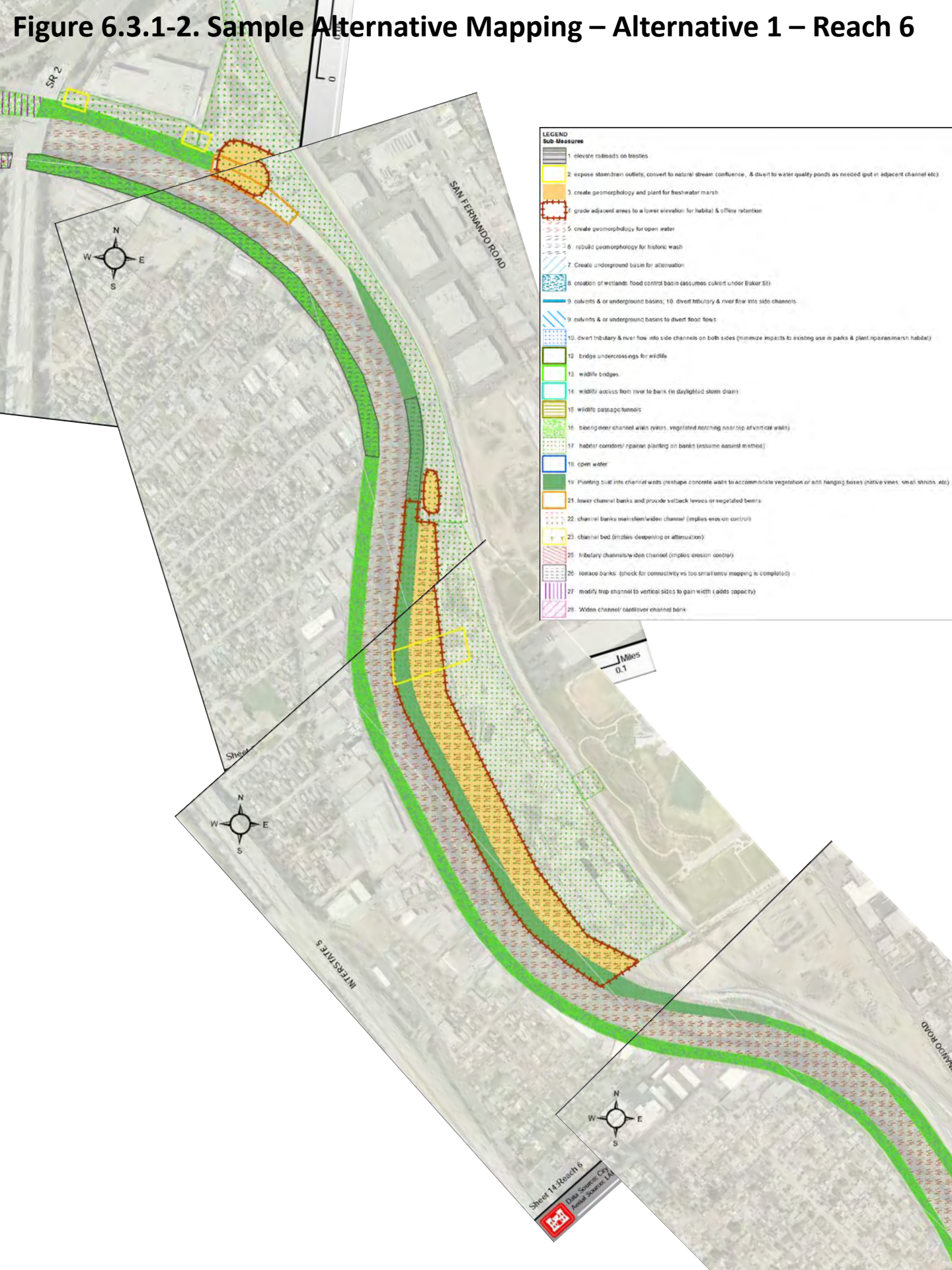


Figure 6.3.1-2. Sample Alternative Mapping – Alternative 1 – Reach 6



Similarly, the other sub-measures (below) would add or remove KECs to applicable polygons under the alternative future with project condition, based on the activities expected to occur for a particular alternative. The adjustments for each sub-measure are outlined as follows:

Create geomorphology and plant for freshwater marsh in adjacent side channel/in main LA River Channel
Create geomorphology for open water adjacent to the channel/in main LA River Channel

- Convert habitat type to Freshwater Emergent Wetland
- Restore all invasive species levels to 0-10%
- Remove trash and pollution KECs if applicable: 8.19.1 Chemical, 8.19.2 Sewage, 8.19.3 Water, 8.9 Refuse
- Add KECs: 4.1.2 Water Depth, 4.7.1 Riverine Wetland Characteristics, 4.6.3.2 Emergent Vegetation, 4.7.2.2 Non-Forest, 4.7.4 Marsh, 4.9 Seasonal Flooding, 8.16 Culverts, 8.24 Water Diversion Structures

Rebuild geomorphology for historic wash
Habitat corridors/Riparian planting on over banks of the main channel or tributaries
Widen channel banks
Terraces with earthen banks

- Convert habitat type to Valley Foothill Riparian
- Restore all invasive species levels to 0-10%
- Remove trash and pollution KECs if applicable: 8.19.1 Chemical, 8.19.2 Sewage, 8.19.3 Water, 8.9 Refuse
- Add KECs: 1.1.14.3.1 Seedling, 1.1.14.3.2 Sapling/Pole, 1.1.5 Moss, 1.1.6 Flowers, 1.1.7 Lichens, 1.1.8 Forbs, 1.1.13 Herbaceous Layer, 1.2.6.1.1 Small Shrub, 1.2.6.1.2 Medium Shrub, 3.2.3 Soil Moisture, 3.2.4 Soil Organic Matter

Divert tributary and river flow into side channels

- Convert habitat type to Freshwater Emergent Wetland
- Restore all invasive species levels to 0-10%
- Remove trash and pollution KECs if applicable: 8.19.1 Chemical, 8.19.2 Sewage, 8.19.3 Water, 8.9 Refuse
- Add KECs: 1.1.14.3.1 Seedling, 1.1.14.3.2 Sapling/Pole, 1.1.5 Moss, 1.1.6 Flowers, 1.1.7 Lichens, 1.1.8 Forbs, 1.1.13 Herbaceous Layer, 1.2.6.1.1 Small Shrub, 1.2.6.1.2 Medium Shrub, 3.2.3 Soil Moisture, 3.2.4 Soil Organic Matter, 8.24 Water Diversion, 4.7.1 Riverine Wetlands, 8.29 Regulated Hydrologic Regime

Restructure/vegetate LA River concrete channel walls
Terrace concrete banks/Planting built into modified channel walls

- Convert habitat type to Valley Foothill Riparian
- Restore all invasive species levels to 0-10%

- Remove trash and pollution KECs if applicable: 8.19.1 Chemical, 8.19.2 Sewage, 8.19.3 Water, 8.9 Refuse
- Add KECs: 1.1.5 Moss, 1.1.6 Flowers, 1.1.7 Lichens, 1.1.8 Forbs, 1.1.13 Herbaceous Layer, 1.2.6.1.1 Small Shrub, 1.2.6.1.2 Medium Shrub, 3.2.3 Soil Moisture, 3.2.4 Soil Organic Matter
- Apply restoration benefits to half of area (other half to remain concrete/baseline)

Establish/improve open water habitat on concrete bottom areas within the main channel of the LA River

- Convert habitat type to Open Water
- Remove trash and pollution KECs if applicable: 8.19.1 Chemical, 8.19.2 Sewage, 8.19.3 Water, 8.9 Refuse
- Add KECs: 4.1.2 Water Depth, 4.1.6 Water Velocity, 4.2.3.1 Open Water, 4.2.12 Banks

By adjusting the CHAP inputs based on the proposed restoration sub-measures, adjusting the individually unique inputs to each polygon, and calculating the CHAP matrices, per-acre HU values were generated for each polygon in each restoration alternative. KECs representing maturation of forecasted habitats (i.e. additional tree and shrub size classes, formation of downed wood and snags) were added to each polygon to predict the anticipated increased benefits of the restoration alternative at 25 and 50 years into the future. The per-acre value was then multiplied by the polygon acreage to obtain the total HUs for each polygon in each alternative.

The future with project CHAP calculations of habitat value are included in Microsoft excel spreadsheets and displayed in a GIS geodatabase. The design team's alternative mapping is also included in GIS. Due to the large volume of these spreadsheets and GIS data, the complete set of files is available upon request from the Corps, Los Angeles District. Sample figures depicting the alternative mapping and with project HUs are included in Figures 6.3.1-1 to 6.3.1-3. Summary tables are included in Table 6.3.2-1 and Appendix H, as discussed in the following Section 6.3.2.

6.3.2 Alternatives Results

By comparing the total with-project habitat value for each alternative to the baseline and without-project value, it is possible to isolate the benefits of the ecosystem restoration alternatives to fish and wildlife habitat. Table 6.3.2-1 outlines the gross and net benefits in HUs for the base year[8], 25 years with project, and 50 years with project for each of the 19 preliminary alternatives. Gross benefits are the total benefits afforded by the alternative. Net benefits are the difference in benefits between the with- and without-project value; in other words the with project value minus the without project value. Here, the net benefits describe the increase in benefits afforded by the alternative over the without-project condition. Results are also presented in terms of Gross and Net Benefits by reach for each alternative in tables in Appendix H. Figure 6.3.2-1 depicts the gross benefits for each of the 19 alternatives at the base year, 25 years with project, and 50 years with project. Note that the names associated with each

8 Base year: the year when the proposed project is expected to be operational (USACE 2000)

Figure 6.3.1-3. Sample Alternative Mapping – Alternative 1 Gross HUs

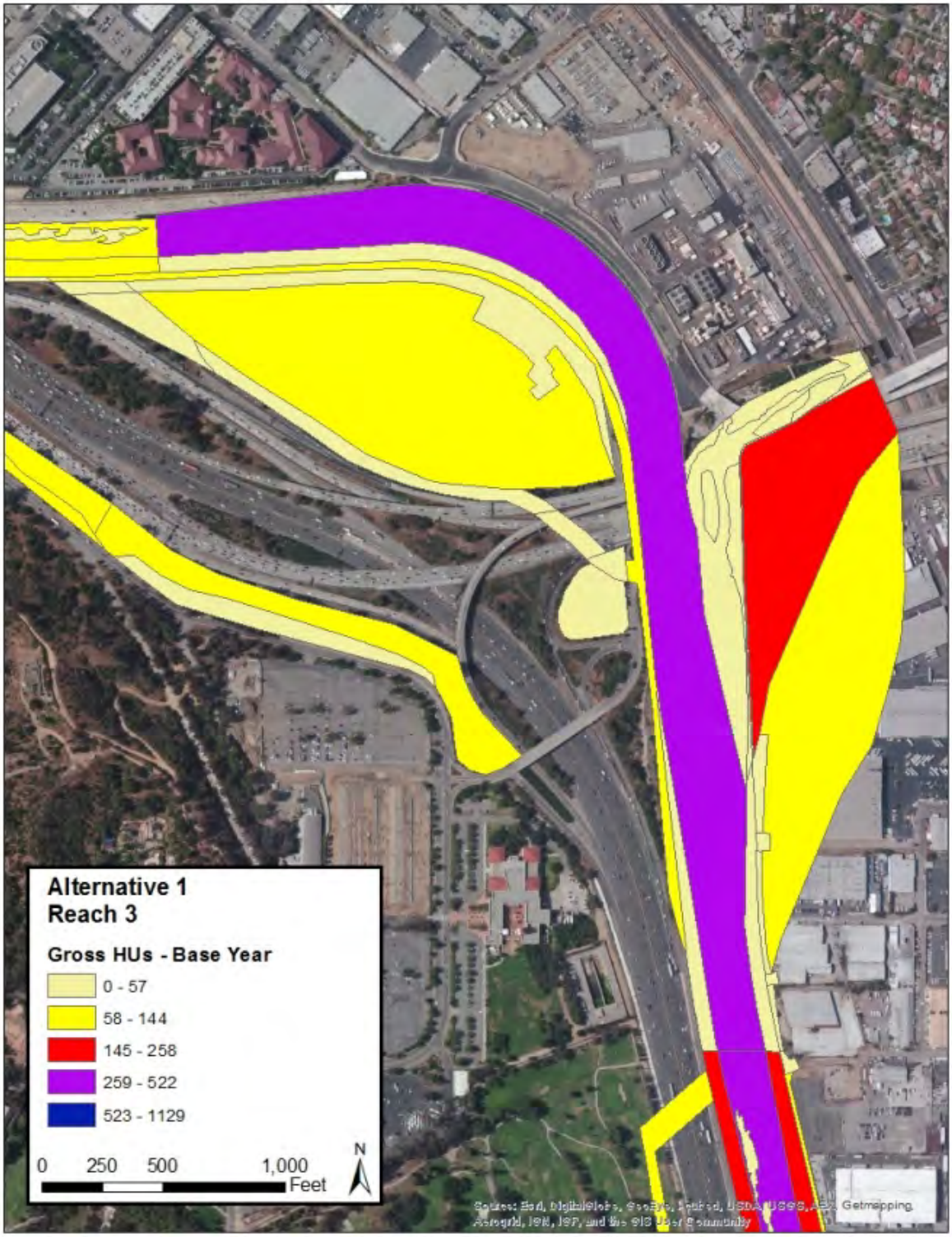


Figure 6.3.1-3. Sample Alternative Mapping – Alternative 1 Gross HUs

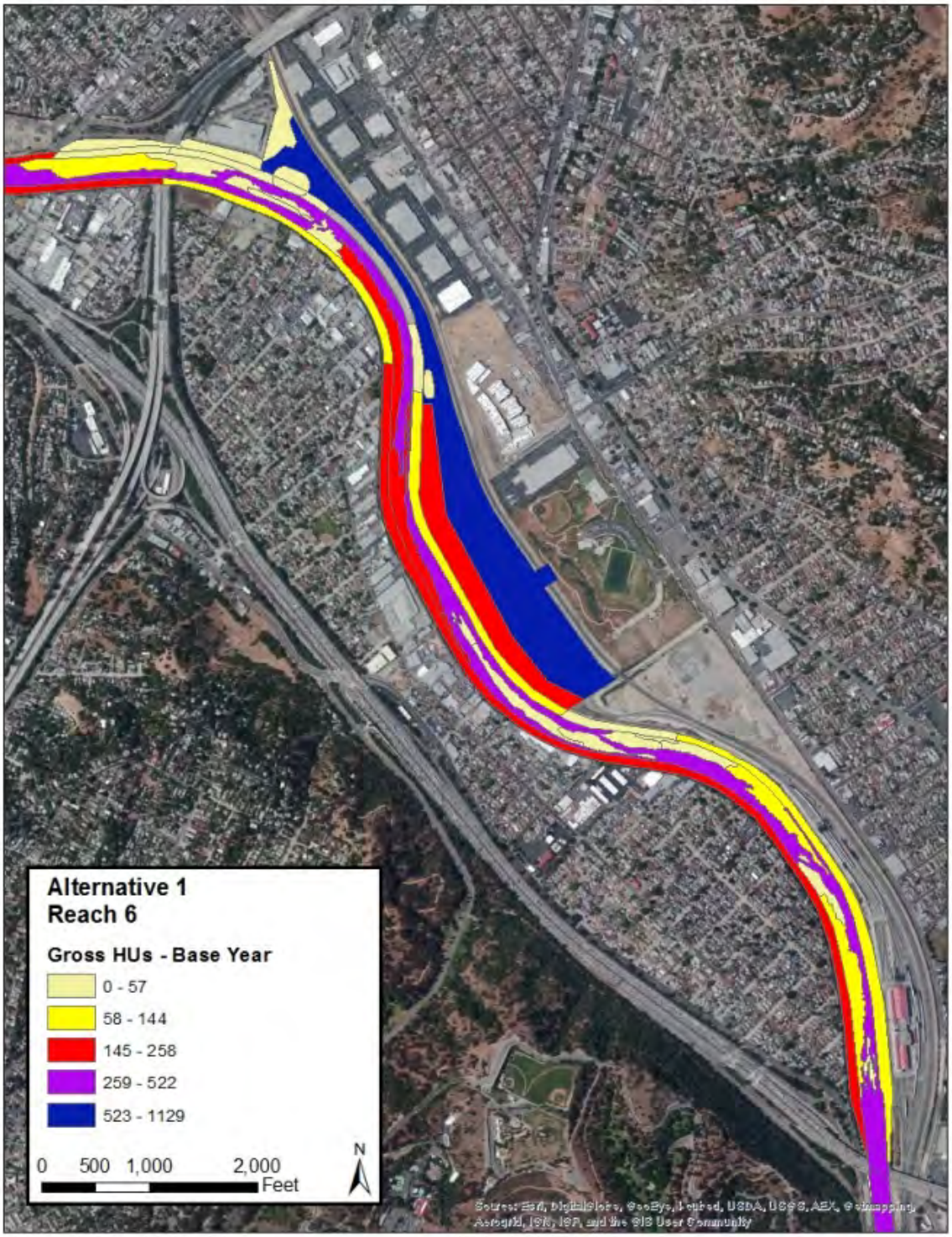


Figure 6.3.1-3. Sample Alternative Mapping – Alternative 1 Gross HUs

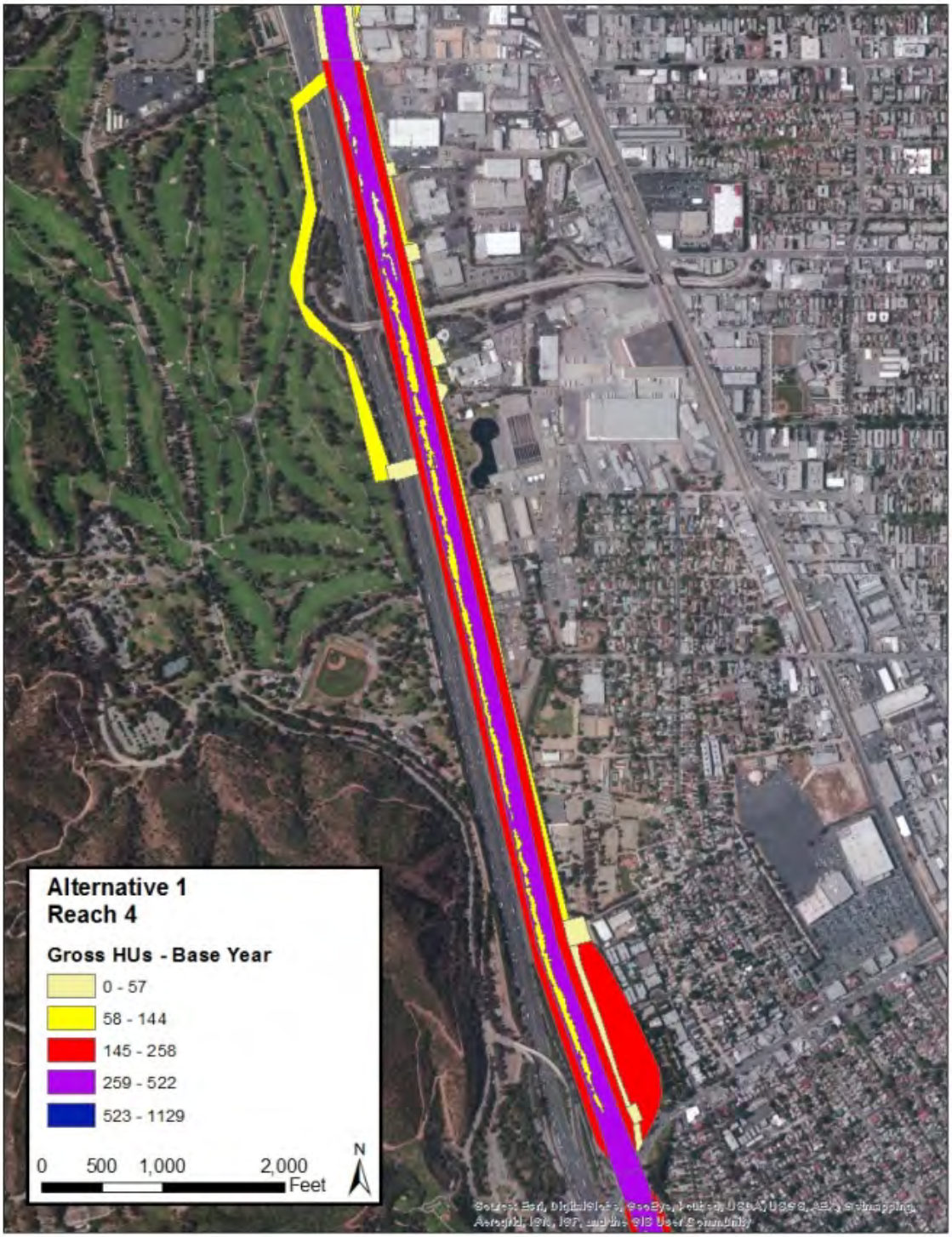


Figure 6.3.1-3. Sample Alternative Mapping – Alternative 1 Gross HUs

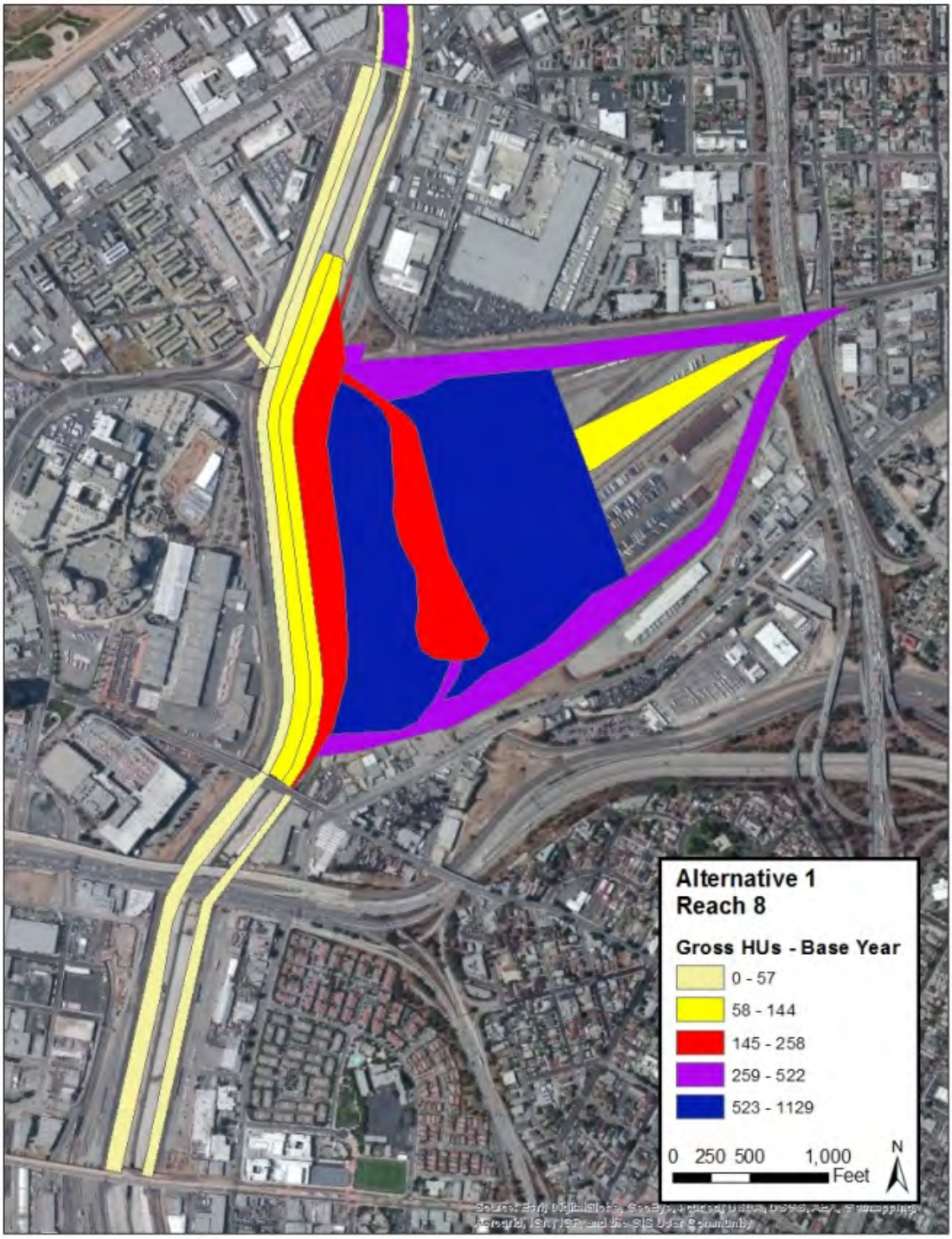


Table 6.3.2-1. Gross and Net Benefits for With Project Alternatives

	Without Project			
		Base Year	25 Year	50 Year
	Acres	Habitat Units (HUs)	Habitat Units (HUs)	Habitat Units (HUs)
Baseline	842.37	6,119.38	5,690.71	5,291.32

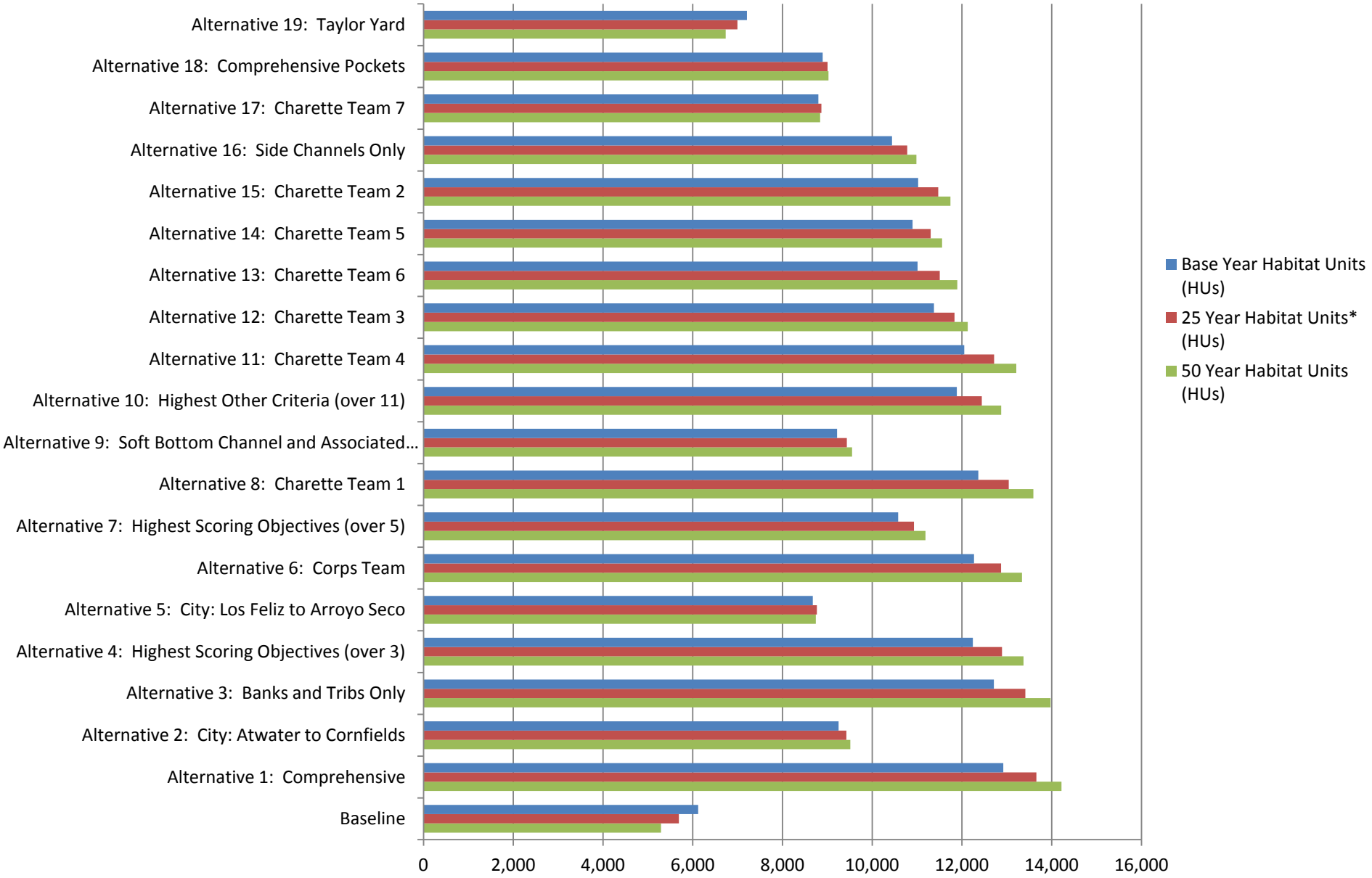
	With Project – Gross*				With Project – Net*		
		Base Year	25 Year	50 Year	Base Year	25 Year	50 Year
	Acres**	Habitat Units (HUs)***	Habitat Units (HUs)***	Habitat Units (HUs)***	Habitat Units (HUs)***	Habitat Units (HUs)***	Habitat Units (HUs)***
Alternative 1: Comprehensive	621.26	12,920.89	13,657.14	14,216.86	6,801.51	7,966.43	8,925.55
Alternative 2: City: Atwater to Cornfields	350.39	9,250.21	9,423.75	9,510.22	3,130.83	3,733.04	4,218.90
Alternative 3: Banks and Tribs Only	592.39	12,711.76	13,411.89	13,973.13	6,592.38	7,721.18	8,681.81
Alternative 4: Highest Scoring Objectives (over 3)	531.18	12,241.40	12,891.42	13,369.81	6,122.02	7,200.71	8,078.49
Alternative 5: City: Los Feliz to Arroyo Seco	285.75	8,674.95	8,766.52	8,743.87	2,555.57	3,075.81	3,452.55
Alternative 6: Corps Team	548.22	12,268.67	12,872.59	13,338.28	6,149.29	7,181.88	8,046.97
Alternative 7: Highest Scoring Objectives (over 5)	417.69	10,577.63	10,928.89	11,187.12	4,458.25	5,238.18	5,895.80
Alternative 8: Charette Team 1	596.19	12,365.07	13,042.78	13,591.57	6,245.69	7,352.07	8,300.25
Alternative 9: Soft Bottom Channel and Associated Banks	299.94	9,216.04	9,434.10	9,550.47	3,096.66	3,743.39	4,259.15
Alternative 10: Highest Other Criteria (over 11)	520.75	11,884.26	12,441.81	12,872.80	5,764.88	6,751.10	7,581.48
Alternative 11: Charette Team 4	529.43	12,050.11	12,716.92	13,210.78	5,930.73	7,026.21	7,919.46
Alternative 12: Charette Team 3	465.47	11,374.23	11,833.42	12,128.88	5,254.85	6,142.71	6,837.56
Alternative 13: Charette Team 6	520.22	11,009.62	11,504.09	11,896.13	4,890.24	5,813.38	6,604.81
Alternative 14: Charette Team 5	404.66	10,897.76	11,302.94	11,555.62	4,778.38	5,612.23	6,264.30
Alternative 15: Charette Team 2	407.04	11,022.81	11,470.26	11,742.84	4,903.43	5,779.55	6,451.52
Alternative 16: Side Channels Only	339.45	10,441.76	10,779.91	10,983.74	4,322.38	5,089.19	5,692.42
Alternative 17: Charette Team 7	236.88	8,799.73	8,865.86	8,837.49	2,680.35	3,175.15	3,546.17
Alternative 18: Comprehensive Pockets	285.38	8,895.97	9,005.18	9,023.68	2,776.59	3,314.47	3,732.36
Alternative 19: Taylor Yard	101.76	7,208.52	6,995.24	6,734.65	1,089.14	1,304.53	1,443.34

*Gross Benefits = Total Benefits afforded by an alternative; Net Benefits = With Project Value – Without Project Value

** acreage values represent acres experiencing a change in habitat value, and are not necessarily consistent with total project acreage

*** total Habitat Units (HUs) for entire 842 acre Study area

Figure 6.3.2-1. Gross Benefits (HUs) for With Project Alternatives at Base Year, 25 Years With Project, and 50 Years With Project and the Baseline Condition



of the 19 alternatives in Table 6.3.2-1 were used by the project team to more simply distinguish between alternatives. Generally, for each alternative, there is an increase in habitat value over the without project conditions.

Alternatives 5 and 17 show a decrease in gross benefit from the 25 years future with project to 50 years future with project condition. Alternative 19 shows a decrease in gross benefits from the base year to 25 years future with project to 50 years future with project. This decrease in gross benefits over time is due to the degradation of other reaches in the Study area where no restoration activity would occur. For example, in Alternative 19, restoration activity would only occur in Reach 6. The remaining 7 of the 8 reaches in the project area would have no restoration activity implemented; therefore, over time the degradation of those remaining 7 reaches would depress the HUs for the entire Study area. While gross benefits decrease over time from the base year in those cases, net benefits remain positive for all alternatives. This means that all 19 alternatives have increased benefits over the without project condition.

Figure 6.3.2-2 further depicts the net benefits as HUs per reach per alternative at the base year, 25 years with project, and 50 years with project.

As expected, the Comprehensive Alternative 1, which includes all measures implemented in all reaches, provides the greatest increase in habitat value from without project conditions (i.e. net benefit), with a 111% increase in HUs at the base year over without project conditions and a 169% increase in HUs at year 50 over without project conditions. However, even the most minimal alternative 19, which includes measures in only one reach (Reach 6/Taylor Yard), still provides an 18% increase in HUs at the base year over the without project conditions and a 27% increase in HUs after 50 years over the without project conditions. The range of increase in net benefits among all 19 alternatives can be seen in Table 6.3.2-2.

6.3.3 Economic Analysis

The results of the CHAP analysis were annualized, as described in Section 6.2.3, to inform the Corps' economic analyses, which includes a Cost Effectiveness Analysis and an Incremental Cost Analysis (CE/ICA). These analyses are used to determine which alternative plans are the most cost effective, or produce a given amount of habitat value at the lowest possible cost, and which alternative plans are the best buys, or produce the most additional habitat value for the lowest additional cost.

In performing the CE/ICA analysis, the alternatives are broken down by reach, and alternative reaches are recombined to produce the most cost effective, best buy plans. In other words, different measures are implemented in each of the 8 reaches for each of the 19 alternative plans, resulting in a total of 8 x 19 (152) alternative reaches. These 152 alternative reaches are recombined, based on the CHAP benefits (HUs) and the restoration costs, into new cost effective/best buy alternative plans, such that (for example) the measures from Reach 1 in Alternative 11 are combined with the measures from Reach 2 in Alternative 16, and the measures from Reach 3 in Alternative 1, and so on.

The original 19 alternatives are not cost effective in themselves in that the best (i.e. most cost effective) ideas for each reach could not be expected to be produced in a single alternative plan

Figure 6.3.2-2. Net Benefits (HUs) for With Project Alternatives at Base Year, 25 Years With Project, and 50 Years With Project - Showing Increase in HUs over Without Project Conditions

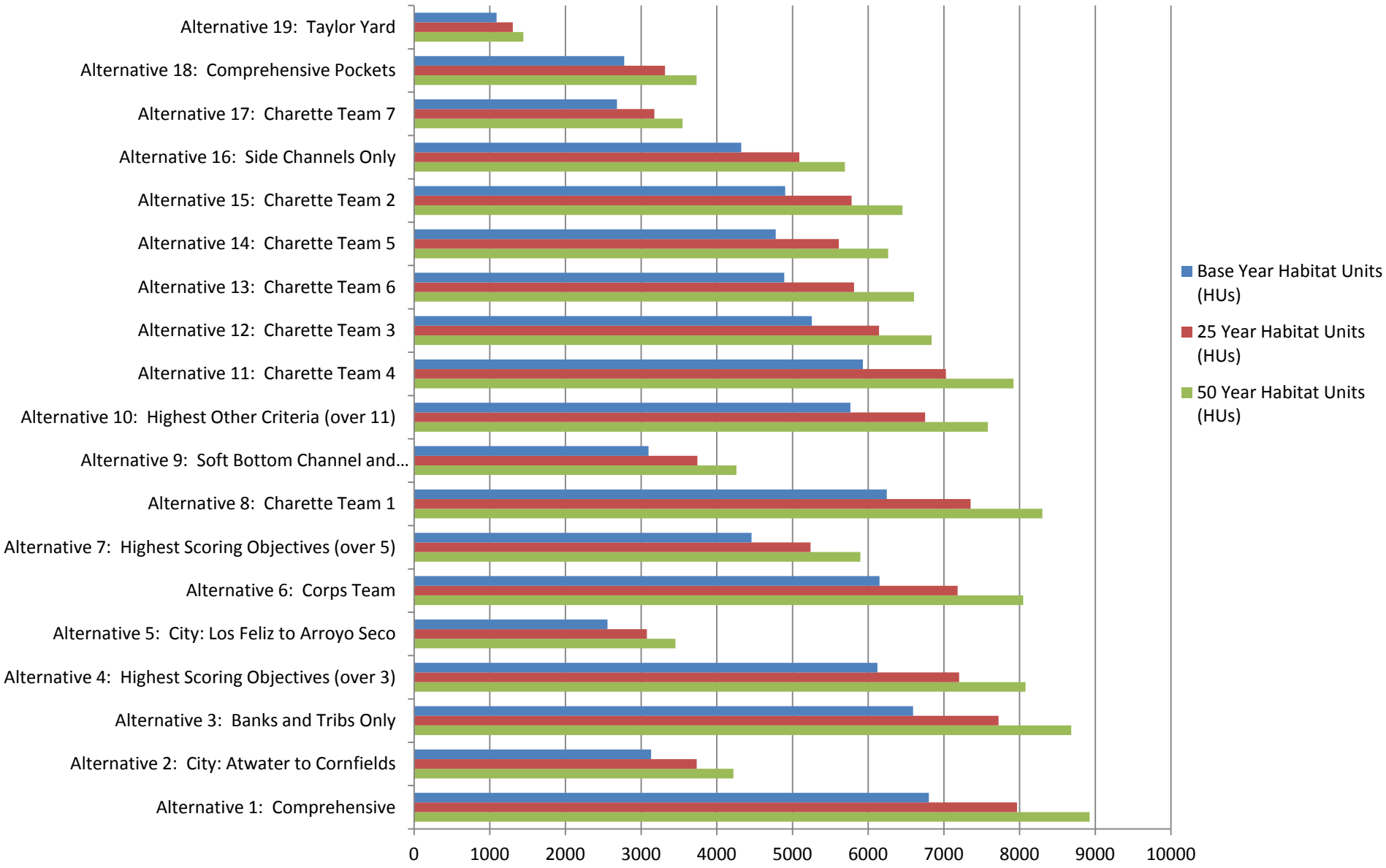


Table 6.3.2-2. Percent Increase in HUs for With Project Alternatives

	Without Project			
		Base Year	25 Year	50 Year
	Acres	Habitat Units (HUs)	Habitat Units (HUs)	Habitat Units (HUs)
Baseline	842.37	6,119.38	5,690.71	5,291.32

	With Project – Net*						
		Base Year		25 Year		50 Year	
	Acres**	Habitat Units (HUs)	% increase in HUs***	Habitat Units (HUs)	% increase in HUs***	Habitat Units (HUs)	% increase in HUs***
Alternative 1: Comprehensive	621.26	6,801.51	111%	7,966.43	140%	8,925.55	169%
Alternative 2: City: Atwater to Cornfields	350.39	3,130.83	51%	3,733.04	66%	4,218.90	80%
Alternative 3: Banks and Tribs Only	592.39	6,592.38	108%	7,721.18	136%	8,681.81	164%
Alternative 4: Highest Scoring Objectives (over 3)	531.18	6,122.02	100%	7,200.71	127%	8,078.49	153%
Alternative 5: City: Los Feliz to Arroyo Seco	285.75	2,555.57	42%	3,075.81	54%	3,452.55	65%
Alternative 6: Corps Team	548.22	6,149.29	100%	7,181.88	126%	8,046.97	152%
Alternative 7: Highest Scoring Objectives (over 5)	417.69	4,458.25	73%	5,238.18	92%	5,895.80	111%
Alternative 8: Charette Team 1	596.19	6,245.69	102%	7,352.07	129%	8,300.25	157%
Alternative 9: Soft Bottom Channel and Associated Banks	299.94	3,096.66	51%	3,743.39	66%	4,259.15	80%
Alternative 10: Highest Other Criteria (over 11)	520.75	5,764.88	94%	6,751.10	119%	7,581.48	143%
Alternative 11: Charette Team 4	529.43	5,930.73	97%	7,026.21	123%	7,919.46	150%
Alternative 12: Charette Team 3	465.47	5,254.85	86%	6,142.71	108%	6,837.56	129%
Alternative 13: Charette Team 6	520.22	4,890.24	80%	5,813.38	102%	6,604.81	125%
Alternative 14: Charette Team 5	404.66	4,778.38	78%	5,612.23	99%	6,264.30	118%
Alternative 15: Charette Team 2	407.04	4,903.43	80%	5,779.55	102%	6,451.52	122%
Alternative 16: Side Channels Only	339.45	4,322.38	71%	5,089.19	89%	5,692.42	108%
Alternative 17: Charette Team 7	236.88	2,680.35	44%	3,175.15	56%	3,546.17	67%
Alternative 18: Comprehensive Pockets	285.38	2,776.59	45%	3,314.47	58%	3,732.36	71%
Alternative 19: Taylor Yard	101.76	1,089.14	18%	1,304.53	23%	1,443.34	27%

*Net Benefits = With Project Value – Without Project Value

** acreage values represent acres experiencing a change in habitat value, and are not necessarily consistent with total project acreage

*** % increase in HUs over the without project condition

during formulation. The determination of cost effectiveness is only made with detailed economic analysis. With the recombinations, therefore, the most cost effective ideas from each of the original 19 alternatives are combined into various new cost effective alternative plans. The final array of 4 of these new plans was chosen to be carried forward for further analysis in the Feasibility Study. The final array of 4 alternatives is described in detail in Section 4.14 of the Main Feasibility Report.

For additional detail on the CE/ICA analysis and the recombined cost effective alternative plans, see the Economic Appendix B in the Main Feasibility Report. For additional detail on the choice of alternative plans for the Final Array, see Section 4 of the Main Feasibility Report.

7.0 OTHER BENEFITS NOT CAPTURED IN CHAP

7.1 CONNECTIVITY

The CHAP analysis accounts for benefits provided by restored ecosystem functions, habitats, and species. There are, however, other types of benefits afforded by the restoration alternatives, including restoration of a more natural hydrologic regime, that influence and support restoration of biological systems. Restoration of movement corridors for wildlife is another benefit of restoration. Both hydrologic and wildlife connectivity has been lost since urbanization of the Study area and the channelization of the LA River in the early 20th century.

These benefits were considered in addition to the CHAP benefits to evaluate and compare the final array of alternatives, as described in Section 6.6 of the Main Feasibility Report.

7.1.1 Hydrologic and Hydraulic Connectivity - Reconnection of River to Floodplain

Hydrologic connections may be made naturally, by widening the river channel, removing artificial barriers, and allowing the river to naturally meander and reshape the adjacent floodplain area. Natural connections also support natural ecological processes such as exchange of sediment, nutrients, and energy between the river and floodplain. Connections may also be made artificially to support habitat, using river water to feed overbank sites via pipes, culverts, or pumps. Artificial connections are valuable to establish habitat, but are less capable of supporting other ecosystem processes and exchanges.

Maintaining ecological and evolutionary processes includes natural disturbance regimes, hydrologic processes, nutrient recycling and biotic interactions (EPA 1999). This benefit can only be achieved with reconnection of the river to its floodplain. This will protect the integrity of the ecosystem and increase sustainability. Biogeochemical interactions between the river and terrestrial sources are not as vital to riparian systems as overbank flow from floodplain connections (Hein 2003).

Floodplain connectivity also benefits restoration of fish habitat. Floodplain habitats provide critical spawning and rearing habitats for many large-river fishes. The standard that floodplains are essential habitats is often a key reason for restoring altered rivers to natural flow regimes (Burgess 2012).

Removal of concrete and widening restores ecosystem processes such as natural disturbance, a

more natural hydrologic regime, nutrient cycling, biotic interactions, population dynamics, and evolution, which determine the species composition, habitat structure, and ecological health of an ecosystem (EPA 1999). Channel widening would allow the river to connect to the overbank, which restores a dynamic floodplain and supports diverse riparian and in stream habitat for plants and wildlife.

7.1.2 Wildlife Connectivity

River channels in arid and semi-arid regions provide important wildlife movement corridors because they support continuous chains of vegetation that wildlife can use for cover and food (which may not be supported in drier upland habitats). These river corridors naturally guide wildlife movement, both daily and generationally, which is essential to species survival (Levick et al. 2008).

The remaining fragments of habitat in the urban landscape (or habitat "nodes") benefit the integrity of the larger ecosystem by supporting metapopulations (assemblages of local populations connected by migration) (Hanski & Gilpin 1991). By increasing patches and reducing the distances between them, colonization among populations improves (Hanski & Thomas 1994). Metapopulations depend on seed dispersal and wildlife movements to persist, and such dispersal is in turn dependent on the connectivity of the landscape (Schippers et al 1996).

Nodes may be larger or smaller. Large habitat nodes support colonization of wildlife in the smaller nodes, while smaller nodes act as peripheral refuge habitat (Rudd et al. 2002). Large nodes tend to have high biodiversity and provide important breeding and seeding habitat for interior species, as well as edge species and transients. Smaller nodes are partly or entirely dependent on individuals immigrating from the larger nodes as they have a higher rate of extinction and therefore need to be repopulated constantly (Hansson 1991; van Apeldoorn et al. 1992). Smaller nodes (those under 250 acres) may not be able to support large numbers of species on their own but are able to provide important peripheral habitat to species in the larger nodes (Hansson 1991).

Generally, nodes have a greater overall interaction when they are larger and closer together (Linehan et al 1995). Well connected systems prevent inbreeding depression and disease, and have a lower extinction rate as populations can more easily colonize if they are highly connected (Noss 1983; Schippers et al 1996). Without connections between habitat areas, isolation and loss of genetic diversity is imminent (Hobbs & Saunders 1990).

In order to benefit the biological integrity of a landscape, corridors should be restored to allow for dispersal between habitat areas. More corridors equal more routes to suitable habitat, creating more opportunities for dispersal. A complex network of nodes and corridors is therefore critical to restoration in an urban environment, as suitable habitat often remains unused if isolated (Hanski & Thomas 1994).

Restoring connectivity for wildlife and movement between patches of habitat provides several benefits including reconnecting genetically isolated populations of species and preventing inbreeding depression, providing necessary interactions between predators and prey to control

population size and providing a healthy ecosystem balance, and connecting individual wildlife to required resources that may not be present within one isolated area.

7.2 ECONOMIC

Other benefits include installation of recreational features and regional economic development (RED) benefits. RED benefits may include increases in employment and regional income/gross regional product (GRP) resulting from the project. Benefits may also include other social effects that have value that were not explicitly valued in monetary terms, such as increases in "community cohesion" or carbon offsets from the installation of carbon sequestering vegetation.

These benefits are accounted for in the narrative of the Main Feasibility Report in Section 6.6.

8.0 CHAP HABITAT EVALUATION TEAM

8.1 PARTICIPANTS

The CHAP Habitat Evaluation Team consisted of the following representatives from the USACE environmental and plan formulation branches, City of Los Angeles Bureau of Engineering (BOE), Northwest Habitat Institute (NHI), U.S. Fish and Wildlife Service (USFWS), Regional Water Quality Control Board (RWQCB), California Department of Fish and Game (CDFG), and U.C. Cooperative Extension. The CHAP analysis team members based their evaluation on expertise in local ecology, plants and wildlife, study objectives, and field visits to the project site. The team members are listed below:

- Erin Jones, Biologist, U.S. Army Corps of Engineers, Planning Division
- Kathleen Bergmann, Study Manager, U.S. Army Corps of Engineers, Planning Division
- Larry Hsu, City of Los Angeles, formerly Bureau of Engineering
- Tom O'Neil, Northwest Habitat Institute
- Andy Hackethorn, Northwest Habitat Institute
- Scott Estergard, Tetra Tech
- Peter Beck, U.S. Fish and Wildlife Service
- Shirley Birosik, Regional Water Quality Control Board, Los Angeles Region
- Scott Harris, California Department of Fish and Game
- Sabrina Drill, U.C. Cooperative Extension, Los Angeles County

8.2 MEETINGS

Habitat evaluation team meetings were held at the Corps' Los Angeles District Office to discuss baseline existing conditions, baseline future without project conditions, and future with project conditions. Meetings were held on January 7, 2010; April 21, 2010; and November 3, 2011.

9.0 CONCLUSION

The CHAP analysis is a habitat assessment tool that evaluates habitats, functions, and species to quantify habitat value. For the LA River ER Feasibility Study, CHAP was used to quantify the value, or benefits, of various restoration alternatives in terms of Habitat Units (HUs) in order to

compare alternative plans. Habitat value was calculated for baseline conditions including the future without project conditions at 25 and 50 years into the future. Habitat value was also calculated for the 19 restoration alternatives developed during the plan formulation process.

The benefits of each restoration alternative were used with project costs to inform the economic cost effectiveness and incremental cost analysis. This analysis recombined the 8 reaches among the 19 alternatives, resulting in an array of new cost effective alternative plans. The final array of 4 of these new plans was chosen to be carried forward for further analysis in the Feasibility Study.

Additional benefits not captured in CHAP were used to evaluate and compare the final array of alternatives. These benefits include hydrologic connectivity to support biotic and abiotic functions, and nodal connectivity to support wildlife movement and dispersal. An assessment of these benefits is applied outside of the CHAP analysis as part of the environmental impact analysis.

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CHAP Appendix
Appendix A
Master List Key Environmental Correlates (KECs)

KEC #	KEC Name	KEC Definition
1.1.1	down wood	Includes downed logs, branches, and rootwads, in a forested context.
1.1.1.1	decay class	System by which down wood is classified based on its deterioration.
1.1.1.1.1	hard [class 1,2]	Little wood decay evident; bark and branches present; log resting on branches, not fully in contact with ground; includes classes 1 and 2 as described in Thomas (1979).
1.1.1.1.2	moderate [class 3]	Moderate decay present; some branches and bark missing or loose; most of log in contact with ground; includes class 3 as describedin Thomas (1979).
1.1.1.1.3	soft [class 4, 5]	Well decayed logs; bark and branches missing; fully in contact with ground; includes classes 4 and 5 as described in Thomas (1979).
1.1.1.2	down wood in riparian areas	Includes down wood in the terrestrial portion of riparion zones in forest habitats. Does not refer to in-stream woody debris.
1.1.1.3	down wood in upland areas	Includes downed wood in upland areas of forest habitats.
1.1.1.4	size of down wood	Count all down wood >/= 6 feet long.
1.1.1.4.1	small	</= 5 inches large end diameter
1.1.1.4.2	medium	>5 to <20 inches large end diameter
1.1.1.4.3	large	>/= 20 inches large end diameter
1.1.2	litter	The upper layer of loose, oreganic (primarily vegetative) debris on the forest floor. Decomposition may have begun, but components still recognizable.
1.1.3	duff	The matted layer of organic debris beneath the litter layer. Decomposition more advanced than in litter layer; intergrades with uppermost humus layer of soil.
1.1.4	shrub layer	Refers to the shrub strata within forest stands.
1.1.4.1	shrub size	Refers to shrub height. Select all categories present within the map unit.
1.1.4.1.1	small shrubs	< 20 inches
1.1.4.1.2	medium shrubs	20 inches - 6.5 feet
1.1.4.1.3	large shrubs	6.6 feet - 16.5 feet
1.1.4.2	percent shrub canopy cover	Percent of ground covered by vertical projection of shrub crown diamter.
1.1.4.3	shrub canopy layers	Within a shrub community, differences in shrub height and growth-form produce multi-layered shrub canopies in the forest understory.
1.1.5	moss	Large group of nonvascular green plants without flowers but with small leafy stems growing in clumps.
1.1.6	flowers	A modified plant branch for the production of seeds and bearing leaves specialized into floral organs.
1.1.7	lichens	Any of a various complex of lower plants made up of an alga and a fungus growing as a unit on a solid surface.
1.1.8	forbs	Borad-leaved herbaceous plants. Does not include: grasses, sedges or rushes.
1.1.9	cactus	Any of a large group of drought-resistant plants with fleshy, ususally jointed stems and leaves replaced by scales or prickles.
1.1.10	fungi	Mushrooms, molds, yeasts, rusts, etc.
1.1.11	roots, tubers, underground plant parts	Any underground part of a plant that functions in nutrient absorbtion, aeration, storage, reproduction and/or anchorage.
1.1.12	ferns	Any of a group of flowerless, seedless vascular green plants.
1.1.13	herbaceous layer	Understory non-woody vegetation layer beneath shrub layer (forest context). May include forbs, grasses, and ferns.
1.1.14	trees	Includes both coniferous and hardwood species.
1.1.14.1	snags	Standing dead trees.
1.1.14.1.1	decay class	System by which snags are classified based on their deterioration.
1.1.14.1.1.1	hard [class 1, 2]	Little wood decay evident; bark, branches, top, present; recently dead; includes class 1 as described in Brown
1.1.14.1.1.2	moderate [class 3]	Moderately decayed wood; some branches and bark missing and/or loose; top broken; includes classes 2 and 3 as describe din Brown (1985).
1.1.14.1.1.3	soft [class 4, 5]	Well-decayed wood; bark and branches generally absent; top broken; includes classes 4 and 5 as described in Brown (1985).
1.1.14.2	snag size (dbh)	Measured in diameter at breast height (dbh), the standard measurement for standing trees taken at 4.5 feet above the ground.
1.1.14.2.1	seedling	< 1 inch
1.1.14.2.2	sapling/pole	1 - 9 inches
1.1.14.2.3	small tree	10 - 14 inches
1.1.14.2.4	medium tree	15 - 19 inches
1.1.14.2.5	large tree	20 - 29 inches
1.1.14.2.6	giant tree	>= 30 inches
1.1.14.3	tree size (dbh)	Measured in diameter at breast height (dbh), the standard measurement for standing trees taken at 4.5 feet above the ground.
1.1.14.3.1	seedling	< 1 inch
1.1.14.3.2	sapling/pole	1 - 9 inches
1.1.14.3.3	small tree	10 - 14 inches
1.1.14.3.4	medium tree	15 - 19 inches
1.1.14.3.5	large tree	20 - 29 inches
1.1.14.3.6	giant tree	>= 30 inches
1.1.14.4	mistletoe brooms/witches brooms	Dense masses of deformed branches caused by any type of broom-forming parasite (fungal or plant).
1.1.14.5	dead parts of live tree	Portions of live trees with rot; can include broken tops; branches with decay; tree base with rot.
1.1.14.6	hollow living trees (chimney trees)	Tree bole with large hollow chambers.
1.1.14.7	tree cavities	Smaller chamber in a tree; can be in bole, limbs, or forks of live or dead trees. May be excavated or result from decay or damage.
1.1.14.8	bark	Includes crevices/fissures, loose or exfoliating bark.
1.1.14.9	live remnant/legacy trees	A live mature or old-growth tree remaining from the previous stand. Context is remnant trees in recently harvested or burned stands up through young forested stands. See dead parts of live trees, hollow living trees, tree cavities, an bark to see which species benefit from remnant trees with these attributes.
1.1.14.10	large live tree branches	Large branches often growing horizontally out from the tree bole.
1.1.14.11	tree canopy layer	Referes to the strata occupied by tree crowns.
1.1.14.11.1	sub-canopy	The space below the predominant tree crowns.
1.1.14.11.2	above canopy	The space above the predominant tree crowns.
1.1.14.11.3	tree bole	The tree trunk.
1.1.14.11.4	canopy	The more or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees and other woodly growth.
1.1.15	fruits/seeds/nuts	Plant reproductive bodies that are used by animals.
1.1.16	edges	The place where plant communities meet or where successive stages or vegetative conditions within plant communitites come together; an edge between 2 different habitat types; only record this one time (i.e. don't record for both of the habitat types).

1.2	Shrubland/Grassland Vegetative Elements or Substrates	Biotic components found within a shrubland or grassland context. Positive influences only.
1.2.1	herbaceous layer	Zone of understory non-woody vegetation beneath shrub layer (non-forest context). May include forbs, grasses.
1.2.2	fruits/seeds/nuts	Plant reproductive bodies that are used by animals.
1.2.3	moss	Large group of nonvascular green plants without flowers but with small leafy stems growing in clumps; record moss found in trees, shrubs, etc.; do NOT record moss found on soil surface (this is recorded in KEC 1.2.11).
1.2.4	cactus	Any of a large group of drought-resistant plants with fleshy, usually jointed stems and leaves replaced by scales or prickles.
1.2.5	flowers	A modified plant branch for the production of seeds and bearing leaves specialized into floral organs.
1.2.6	shrubs	Plant with persistent woody stems and less than 16 feet tall; usually produces several basal shoots as opposed to a single bole.
1.2.6.1	shrub size	Refers to height.
1.2.6.1.1	small	< 20 inches
1.2.6.1.2	medium	20 inches - 6.5 feet
1.2.6.1.3	large	6.6 feet - 16.5 feet
1.2.6.2	percent shrub canopy cover	Percent of ground covered by vertical projection of shrub crown diameter.
1.2.6.2.1	<5%	
1.2.6.2.2	21-35%	
1.2.6.2.3	36-50%	
1.2.6.2.4	>50%	
1.2.6.3	shrub canopy layer	Within a shrub community, differences in shrub height and growth form produce multi-layered shrub canopies.
1.2.6.3.1	sub-canopy	The space below the predominant shrub crowns.
1.2.6.3.2	above canopy	The space above the predominant shrub crowns.
1.2.7	fungi	Mushrooms, molds, yeasts, rusts, etc.
1.2.8	forbs	Broad-leaved herbaceous plants. Does not include: grasses, sedges or rushes.
1.2.9	bulbs/tubers	Any underground part of a plant that functions in nutrient absorbtion, aeration, storage, reproduction and/or
1.2.10	grasses	Members of the Poaceae (Graminae) family.
1.2.11	cryptogamic crusts	Non-vascular plants that grow on the soil surface. Primarily lichens, mosses and algae. Often found in arid or semi-arid regions. May form soil surface "pinnacles".
1.2.12	trees (located in a shrubland/grassland context)	Small groups of trees or isolated individuals.
1.2.12.1	snags	Standing dead trees.
1.2.12.1.1	decay class	System by which snags are classified based on their deterioration.
1.2.12.1.1.1	hard	Little wood decay evident; bark, branches, top, present; recently dead; includes class 1 as described in Brown
1.2.12.1.1.2	moderate	Moderately decayed wood; some branches and bark missing and/or loose; top broken; includes classes 2 and 3 as describe din Brown (1985).
1.2.12.1.1.3	soft	Well-decayed wood; bark and branches generally absent; top broken; includes classes 4 and 5 as described in Brown (1985).
1.2.12.2	snag size (dbh)	Measured in diameter at breast height (dbh), the standard measurement for standing trees taken at 4.5 feet above the ground.
1.2.12.2.1	seedling	< 1 inch
1.2.12.2.2	sapling/pole	1 - 9 inches
1.2.12.2.3	small tree	10 - 14 inches
1.2.12.2.4	medium tree	15 - 19 inches
1.2.12.2.5	large tree	20 - 29 inches
1.2.12.2.6	giant tree	>= 30 inches
1.2.12.3	tree size (dbh)	Measured in diameter at breast height (dbh), the standard measurement for standing trees taken at 4.5 feet above the ground.
1.2.12.3.1	seedling	< 1 inch
1.2.12.3.2	sapling/pole	1 - 9 inches
1.2.12.3.3	small tree	10 - 14 inches
1.2.12.3.4	medium tree	15 - 19 inches
1.2.12.3.5	large tree	20 - 29 inches
1.2.12.3.6	giant tree	>= 30 inches
1.2.13	edges	The place where plant communities meet or where successive stages or vegetative conditions within plant communitites come together.
2.0	Influences by Other Organisms	Selected interspecies relationships within the biotic community. Both positive and negative influences.
2.1	exotic species	When checked, these KECs refer to the relationship between an exotic species and the species queried by the user. This relationship may be positive or negative, and the user should refer to the comments section for further information. Exotic species are defined as any non-native plant or animal, including cats, dogs, and cattle.
2.1.1	exotic plants	This field refers to the relationship between an exotic plant species and the animal species queried by the user. This relationship may be positive or negative, and the user should refer to the comments section for further information. If no specific species of interest is known, only check if exotic plant presence is obvious and list the
2.1.2	exotic animals	This field refers to the relationship between an exotic animal species and the animal species queried by the user. This relationship may be positive or negative, and the user should refer to the comments section for further information. If applicable, the user will also find clarification of how the species queried is affected by the exotic species in HE subcategories 2.1.2.1 - 2.1.2.3. If no specific species of interest is known, only check if exotic animal presence is obvious and list the species.
2.1.2.1	predation	The species queried is preyed upon by or preys upon an exotic species. If no specific species of interest is known, only check if exotic animal predation is obvious and list the species.
2.1.2.2	direct displacement	The species queried is physically displaced by an exotic species, either by competition or actual disturbance. If no specific species of interest is known, only check if direct displacement by an exotic animal is obvious and list the species.
2.1.2.3	habitat structure change	The species queried is affected by habitat structural changes caused by an exotic species, for example, cattle grazing. If no specific species of interest is known, only check if habitat structure changes by exotic animals are obvious and list the species.
2.1.2.4	other	Any other effects of an exotic species on a native species (not used by panelists).
2.2	insect population irruptions	The queried species directly benefits from insect population eruptions (i.e., benefits from the insects themselves, not the resulting tree mortality or loss of foliage).
2.2.1	mountain pine beetle	The queried species directly benefits from Mountain Pine Beetle eruptions.
2.2.2	spruce budworm	The queried species directly benefits from Spruce Budworm eruptions.
2.2.3	douglas-fir tussock moth	The queried species directly benefits from Douglas-fir Tussock Moth eruptions (not used by panelists).
2.2.4	other	

2.3	beaver/muskrat activity (dams, lodges, ponds)	The results of beaver activity including dams, lodges, and ponds, that are beneficial to other species.
2.4	burrows (aquatic or terrestrial)	Aquatic or terrestrial cavities produced by burrowing animals that are beneficial to other species.
2.5	pathogens	Fish pathogens
3.0	Non-Vegetative, Abiotic Habitat Elements	Non-living components found within any ecosystem. Primarily positive influences with a few exceptions as indicated.
3.1	rocks	Solid mineral deposits.
3.1.1	gravel	Particle size from 0.1-3.0-inches diameter; gravel bars associated with streams and rivers are a separate category.
3.1.2	talus	Accumulations of rocks at the base of cliffs or steep slopes; rock/boulder sizes varied and determine what species can inhabit the spaces between them.
3.1.3	talus-like habitats	Refers to areas that contain many rocks and boulders but are not associated with cliffs or steep slopes.
3.2	soils	Various soil characteristics.
3.2.1	soil depth	Enter the distance from the top layer of the soil to the bedrock or hardpan below, measured in feet. Note, only complete this field if you are actually sampling soil depth.
3.2.2	soil temperature	Enter the measure of soil temperature or range of temperatures that are key to the queried species, measured in degrees F. Note, only complete this field if you are actually sampling soil temperature.
3.2.3	soil moisture	Enter the amount of water contained within the soil as a percentage. Note, only complete this field if you are actually sampling soil moisture.
3.2.4	soil organic matter	The accumulation of decomposing plant and animal materials found within the soil.
3.2.5	soil texture	Refers to size distribution and amount of mineral particles (sand, silt, and clay) in the soil; examples are sandy clay, sandy loam, silty clay etc.
3.2.6	no correlation	
3.3	rock substrates	Various rock formations.
3.3.1	avalanche chute	An area where periodic snow or rockslides prevent the establishment of forest conditions; typically shrub and herb dominated (Sitka alder and/or vine maple).
3.3.2	cliffs	A high, steep formation, usually of rock. Coastal cliffs are a separate category under Marine Habitat Elements.
3.3.3	caves	An underground chamber open to the surface with varied opening diameters and depths; includes cliff-face caves, intact lava tubes, coastal caves, and mine shafts.
3.3.4	rocky outcrops and ridges	Areas of exposed rock.
3.3.5	rock crevices	Refers to the joint spaces in cliffs, and fissures and openings between slab rock; crevices among rocks and boulders in talus fields are a separate category (talus).
3.3.6	barren ground	Bare exposed soil with >40% of area not vegetated; includes mineral licks and bare agricultural fields; natural bare exposed rock is under the rocky outcrop category.
3.3.7	playa (alkaline, saline)	Shallow desert basins without natural drainage-ways where water accumulates and evaporates seasonally.
3.3.8	no correlation	
3.4	snow	Selected features of snow. Can be negative or positive.
3.4.1	snow depth	Any measure of the distance between the top layer of snow and the ground below.
3.4.2	glaciers, snow field	Areas of permanent snow and ice.
3.5	insect fall	The accumulation of dead insects in an aquatic environment. Note: complete this field only for aquatic map units.
3.6	litter fall	The accumulation of dead plant material in an aquatic water environment. Note: complete this field only for aquatic map units.
3.7	precipitation	Accumulation of rainfall and/or snowfall in an aquatic environment. Note: complete this field only for aquatic map
3.8	wind stress	Effects of wind on the turbidity and movement of hydrologic forces. Can influence fish through upwelling of nutrients and mortality of young in turbulent waters. Note: complete this field only for aquatic map units.
4.0	Freshwater Riparian & Aquatic Bodies Habitat Elements	Includes selected forms and characteristics of any body of freshwater.
4.1	Water Characteristics	Various freshwater attributes. Ranges of continuous attributes that are key to the queried species, if known, will be in the comments.
4.1.1	dissolved oxygen	The amount of oxygen passed into solution. Note, only complete this field if you are actually sampling for DO.
4.1.2	water depth	Enter the distance from the surface of the water to the bottom substrate.
4.1.3	dissolved solids	A measure of dissolved minerals in water. Note, only complete this field if you are actually sampling for dissolved
4.1.4	water pH	A measure of water acidity or alkalinity. Note, only complete this field if you are actually sampling for pH.
4.1.5	water temperature	Water temperature range that is key to the queried species, if known, is in the comments field. Note, only complete this field if you are actually sampling water temperature.
4.1.6	water velocity	The speed or momentum of water flow. Note, only complete this field if you are actually sampling water velocity.
4.1.7	water turbidity	Refers to the amount of roiled sediment within the water and the resulting clarity of the water. Note, only complete this field if you are actually sampling for turbidity.
4.1.8	free water (derived from any source)	Water derived from any source
4.1.9	salinity and alkalinity	The presence of salts.
4.1.10	icing in inland rivers and streams (scouring action)	Freezing of water columns and benthic substrate; especially important to fish and invertebrates in small and headwater stream and rivers that may freeze solid. Substrate scouring comes during spring runoff.
4.1.11	metals in water column	A measure of metals present in water.
4.1.12	nutrient enrichment	Enrichment of the water column with nutrients (i.e., decaying salmon carcasses)
4.2	Rivers & Streams	Various characteristics of streams and rivers.
4.2.1	oxbows	A pond or wetland created when a river bend is cut off from the main channel of the river.
4.2.2	order and class	Systems of stream classification.
4.2.2.1	intermittent	Streams/rivers, which contain non-tidal flowing water for only part of the year, water may remain in isolated pools.
4.2.2.2	upper perennial	Streams/rivers with a high gradient, fast water velocity, no tidal influence, some water flowing throughout the year, substrate consists of rock, cobbles, or gravel with occasional patches of sand, little floodplain development.
4.2.2.3	lower perennial	Streams/rivers with a low gradient, slow water velocity, no tidal influence, some water flowing throughout the year, substrate consists mainly of sand and mud, floodplain is well developed.
4.2.3	zone	System of water body classification based on the horizontal strata of the water column.
4.2.3.1	open water	Open water areas not closely associated with the shoreline or bottom.
4.2.3.2	submerged/benthic	Relating to the bottom of a body of water, includes the substrate and the overlaying body of water within one meter of the substrate.
4.2.3.3	shoreline	Continually exposed substrate that is subject to splash, waves, and/or periodic flooding. Includes gravel bars, islands, and immediate nearshore areas.
4.2.4	in-stream substrate	The bottom materials in a body of water.
4.2.4.1	boulders	Rocks (Boulders) > 256 mm (10") in diameter.
4.2.4.2	cobble/gravel	Rocks or pebbles, 4-256 mm in diameter (10"), substrata may consist of cobbles, gravel, shell, and sand with no one substratum type exceeding 70 percent cover.
4.2.4.3	sand/mud	Fine substrata < 4 mm in diameter, little gravel present, may be mixed with organics.
4.2.4.4	bedrock	Reflects bedrock as a substrate in aquatic environs (e.g., stream, river, lake).
4.2.4.5	aquatic bentic structure	Embeddedness, interstitial space

4.2.5	vegetation	Herbaceous plants
4.2.5.1	submergent vegetation	Rooted aquatic plants that do not emerge above the water surface.
4.2.5.2	emergent vegetation	Rooted aquatic plants that emerge above the water surface.
4.2.5.3	floating mats	Unrooted plants that form vegetative masses on the surface of the water.
4.2.6	coarse woody debris in streams and rivers	Any piece of woody material (debris piles, stumps, root wads, fallen trees) that intrudes into or lies within a river or stream.
4.2.6.1	rootwads	Lower stem and root fan of a dead tree.
4.2.6.2	large woody debris (tree stems)	“Large” is considered stems that are 10 cm (4 in) in diameter or larger, and 2 m (6 ft) in length or longer.
4.2.6.3	small woody debris (branches, twigs,etc.)	“Small” is considered stems that are less than 10 cm (4 in) in diameter.
4.2.7	pools	Portions of the stream with reduced current velocity, often with water deeper than surrounding areas.
4.2.7.1	secondary channel pools	formed by merging-flow scour from secondary channels
4.2.7.2	backwater pools	eddy or slack water along the channel margin separated from the main current by a gravel bar or small channel obstruction.
4.2.7.3	trench pools	long, usually deep slot in a stable substrate (often bedrock).
4.2.7.4	plunge pools	basin scoured by a vertical drop over a channel obstruction.
4.2.7.5	lateral scour pools	scoured basin near the channel margin caused by flow being directed to one side of the stream by a partial channel obstruction.
4.2.7.6	dammed pools	Dammed pools: pool impounded upstream from a complete or nearly complete channel blockage (including beaver ponds).
4.2.8	riffles	Shallow rapids where the water flows swiftly over completely or partially submerged obstructions to produce surface agitation, but where standing waves are absent.
4.2.8.1	low gradient riffles	shallow reach of gradient <4% with moderate current velocity and moderate turbulence.
4.2.8.2	rapids	shallow reach of gradient >4% with high current velocity and considerable turbulence.
4.2.8.3	cascades	series of small steps of alternating small waterfalls and small pools.
4.2.9	runs/glides	Areas of swiftly flowing water, without surface agitation or waves, which approximates uniform flow and in which the slope of the water surface is roughly parallel to the overall gradient of the stream reach.
4.2.10	overhanging vegetation	Herbaceous plants that cascade over stream and riverbanks and are < 1 meter above the water surface.
4.2.11	waterfalls	Steep decent of water within a stream or river.
4.2.12	banks	Rising ground that borders a body of water.
4.2.12.1	undercut banks	Stream or river banks that have been undercut by hydrologic forces resulting in the bank overhanging the water. This feature is critical to many fish species for cover from predation.
4.2.13	seeps or springs	A concentrated flow of ground water issuing from openings in the ground.
4.2.14	channel morphology	the general shape of a channel
4.2.14.1	Channel length	a measure of the length of a reach of stream channel
4.2.14.2	Channel width	a measure of the width of a reach of stream channel
4.2.15	flow	Rate of water flow, typically given in cubic feet per second (ft3/sec)
4.2.15.1	high flow	Change in interannual variability in high flows.
4.2.15.2	low flow	Change in interannual variablility in low flows.
4.2.15.3	diel flow	Intra-daily variation in flow level (regulated rivers influenced by sotrm water runoff).
4.2.15.4	intra-annual flow	The average extent of intra-annual flow variation during a month (stream "flashiness").
4.3	ephemeral pools	Pools that contain water for only brief periods of time usually associated with periods of high precipitation.
4.4	sand bars	Exposed areas of sand or mud substrate.
4.5	gravel bars	Exposed areas of gravel substrate.
4.6	Lakes/Ponds/Reservoirs	Various characteristics of lakes, ponds, and reservoirs.
4.6.1	zone	System of water body classification based on the horizontal strata of the water column.
4.6.1.1	open water	Open water areas not closely associated with the shoreline or bottom substrates.
4.6.1.2	submerged/benthic	Relating to the bottom of a body of water, includes the substrate and the overlaying body of water within one meter of the substrate.
4.6.1.3	shoreline	Continually exposed substrate that is subject to splash, waves, and/or periodic flooding. Includes gravel bars, islands, and immediate nearshore areas.
4.6.2	in-water substrate	The bottom materials in a body of water.
4.6.2.1	boulders	Rocks (Boulders) > 256 mm (10 inches) in diameter.
4.6.2.2	cobble/gravel	Rocks or pebbles, 4-256 mm in diameter (10"), substrata may consist of cobbles, gravel, shell, and sand with no one substratum type exceeding 70 percent cover.
4.6.2.3	sand/mud	Fine substrata < 4 mm in diameter, little gravel present, may be mixed with organics.
4.6.3	vegetation	Herbaceous plants.
4.6.3.1	submergent vegetation	Rooted aquatic plants that do not emerge above the water surface.
4.6.3.2	emergent vegetation	Rooted aquatic plants that emerge above the water surface.
4.6.3.2.1	Sedges and rushes	Emergent vegetation characterized by a predominance of sedges and rushes.
4.6.3.3	floating mats	Unrooted plants that form vegetative masses on the surface of the water.
4.6.3.4	Riparian (including woody vegetation)	Emergent vegetation characterized by a predominance of woody vegetation.
4.6.4	size	Refers to whether or not the species is differentially associated with water bodies based on their size.
4.6.4.1	ponds	< 2 ha
4.6.4.2	lakes	>= 2 ha
4.7	Wetlands/Marshes/Wet Meadows/Bogs and Swamps	Various components and characteristics related to any of these systems.
4.7.1	riverine wetlands	Wetlands found in association with rivers.
4.7.2	context	When checked, indicates that the setting of the wetland, marsh, wet meadow, bog or swamp is key to the queried species.
4.7.2.1	forest	Wetlands within a forest.
4.7.2.2	non-forest	Wetlands that are not surrounded by forest.
4.7.3	size	When checked, indicates that the queried species is differentially associated with a wetland, marsh, wet meadow, bog or swamp based on the size of the water body.
4.7.4	marshes	Frequently or continually inundated wetlands characterized by emergent herbaceous vegetation (grasses, sedges, reeds) adapted to saturated soil conditions.
4.7.5	wet meadows	Grasslands with waterlogged soil near the surface but without standing water for most of the year.
4.8	islands	A piece of land made up of either rock and/or unconsolidated material that projects above and is completely surrounded by water.
4.9	seasonal flooding	Flooding that occurs periodically due to precipitation patterns.
4.10	Littoral zone	Area of shallow water where some fish migrate, find protection and find key food resources. Typically regarded as the shoreline (<5m depth) of lakes, reservoirs, and large rivers.
5.0	Marine Habitat Elements	Selected biotic and abiotic components and characteristics of marine systems.
5.1	zone	System of marine classification based on water depth, and relationship to substrate.

5.1.1	supratidal	The zone that extends landward from the higher high water line up to either the top of a coastal cliff or the landward limit of marine process (i.e., storm surge limit).
5.1.2	intertidal	The zone between the higher high water line and the lower low water line.
5.1.3	nearshore subtidal	The zone that extends from the lower low water line seaward to the 20 meter isobath, typically within 1 kilometer of shore i.e.
5.1.4	shelf	The area between the 20 and 200-meter isobath, typically within 60 kilometers of shore.
5.1.5	oceanic	The zone that extends seaward from the 200-meter isobath.
5.2	substrates	The bottom materials in a body of water.
5.2.1	bedrock	The solid rock underlying surface materials.
5.2.2	boulders	Large, worn, rocks > 256 mm (10 inches) in diameter.
5.2.3	hardpan	Consolidated clays forming a substratum firm enough to support an epibenthos and too firm to support a normal infauna (clams, worms, etc.), but with an unstable surface which sloughs frequently.
5.2.4	cobble	Rocks or pebbles, 64-256 mm in diameter, may be a mix of cobbles, gravel, shells, and sand, with no one type exceeding 70 percent cover.
5.2.5	mixed-coarse	Substrata consisting of cobbles, gravel, shell, and sand with no one substratum type exceeding 70 percent cover.
5.2.6	gravel	Small rocks or pebbles, 4-64 mm in diameter.
5.2.7	sand	Fine substrata < 4 mm in diameter, little gravel present, may be mixed with organics.
5.2.8	mixed-fine	Mixture of sand and mud particles < 4 mm in diameter, little gravel present.
5.2.9	mud	Fine substrata < 0.06 mm in diameter, little gravel present, usually mixed with organics.
5.2.10	organic	Substrata composed primarily of organic matter such as wood chips, leaf litter, or other detritus.
5.2.11	clay	Substrata composed primarily of clayey materials.
5.2.12	shell	Substrata composed of mainly marine organism shells.
5.2.13	Artificial substrata (riprap)	Substrata consisting of artificial (man-made) material including riprap.
5.3	energy	Degree of exposure to oceanic swell, currents, and wind waves.
5.3.1	degree of exposure	Measure of how exposed a shoreline is to the hydrologic forces of a large body of water.
5.3.1.1	Protected	No sea swells, little or no current, and restricted wind fetch.
5.3.1.2	Semi protected	Shorelines protected from sea swell, but may receive waves generated by moderate wind fetch, and/or moderate to weak tidal currents.
5.3.1.3	Partially exposed	Oceanic swell attenuated by offshore reefs, islands, or headlands, but shoreline substantially exposed to wind waves, and/or strong to moderated tidal currents.
5.3.1.4	Exposed	Highly exposed to oceanic swell, wind waves, and/or very strong currents.
5.3.2	Sources of energy	Hydrodynamic forces in a marine environment.
5.3.2.1	Upwelling	A process in which cold, often nutrient-rich waters from the ocean depths rise to the surface.
5.3.2.2	Local jets and eddies	strong currents moving in different directions from the main current, often in a circular motion in eddies.
5.3.2.3	Outflow plume	pattern of circulation of one body of water flowing into another.
5.3.2.4	Fresh water inflow	area of flow where a freshwater source meets marine waters.
5.4	vegetation	Includes herbaceous plants and plants lacking vascular systems.
5.4.1	species dominated communities	Species dominated communities
5.4.1.1	mixed macro algae	Includes brown, green, and red algae.
5.4.1.1.1	algal blooms	Quickly growing concentrations of algae that may be harmful to the environment, plants, or animals.
5.4.1.1.2	toxic blooms	High concentrations of cyanobacteria that are highly toxic to plants and animals.
5.4.1.2	kelp	Subaquatic rooted vegetation found in the nearshore marine environment.
5.4.1.3	eelgrass	Subaquatic rooted vegetation found in an estuarine environment
5.4.1.4	pickleweed	A salt loving plant (Salicornia europeae) found in estuarine environments.
5.4.2	vegetation zone	Tidally influenced vegetation zones
5.4.2.1	Low sandy marshes	Occur on sandy substrate with a gradual slope, typically on the low-energy side of bay mouth sand spits or as fringing marshes on islands with coarse-textured sediments. They are flooded by nearly all high tides and drain diffusely (i.e., there are not tidal creeks) over the marsh surface. Near the tidal flat edge, the vegetation is scattered, but becomes continuous up the slope.
5.4.2.2	Low silty marshes	Develop on fine-textured sediments, silt, or mud substrates in low energy parts of esturaries and are relatively flat. These marshes develop in areas of rapid sedimentation and are flooded by nearly all high tides; have diffuse drainage patterns with some defined channels around clumps of plants.
5.4.2.3	Sedge marshes	Form on silt and have a nearly level surface. They are oftenfound on islands or delta edges with elevations somewhat above the first two marsh types. They are flooded by most high tides and drain via creeks in the higher sedge marshes and diffusely in the lower ones.
5.4.2.4	Immature high marshes	Relatively level with some bare depressions and are located on silty substrates. Organic matter accumulation is abundant here as it is in sedge wetlands. Immature high marshes occur above sedge and low sandy marshes, ususally at least 40 cm above the tidal flat; often the transition is an abrupt rise. Many of the high tides (especially the higher highs) cover the soil surface. A well-defined system of channels drain and flood these marshes.
5.4.2.5	Mature high marshes	They are level and have developed extensive peaty soils. A dendritic network of steep-sided stream channels circulates water to the soil surface on higher high tides. Shallow saline pools produce openings in the otherwise continuous sward of vegetation. Salinities fluctuate widely and depend on rainfall, tidal input, and evaporation.
5.4.2.6	Bulrush and sedge marshes	Low marshes in brackish parts of the estuary. The substrate is silt or sand, and inundation occurs with most high tides. Drainage is diffuse; vegetation is continuous and its composition is dependent on the salinity.
5.4.2.7	Intertidal gravel marshes	Rare forms; develop on sand and gravel bars near the mouths of relatively high-energy estuaries with large volumes of freshwater. Vegetation is discontinous and of a type which indicates low salinities. The salt from the tidal water is probably leached by rainwater and freshwater runoff through the coarse substrates.
5.4.2.8	Diked salt marshes	Manmade habitats that develop when the tides are excluded from immature and mature high marshes. Althouugh non-salt marsh plants may invade, the area retains some wetland characteristics due to seepage, high water tables, and perhaps residual salinity. Vegetation is continuous over the marsh surface and the old dendritic stream channels system has collapsed.
5.4.2.9	Riparian zone (freshwater influenced)	Reflects the terrestrial vegetation community immediately alongside marine, estuarine, lagoon, and inlet water environs. This area contributes nutrients, insects (i.e., “insect rains”), minerals, vegetation, soil, and woody stems directly to marine/estuarine systems.
5.4.2.9.1	coniferous	Riparian vegetation community dominated by coniferous forests.
5.4.2.9.2	deciduous	Riparian vegetation community dominated by deciduous forests.
5.4.2.9.3	mixed coniferous/deciduous	Riparian vegetation community dominated by a mixture of coniferous and deciduous forests.
5.4.2.9.4	sedges	Riparian vegetation community dominated by sedges.
5.4.2.9.5	forbs	Riparian vegetation community dominated by forbs.
5.5	water depth	Refers to the vertical layering of the water column.
5.5.1	surface layer	The uppermost part of the water column.
5.5.1.1	fronts (e.g. tide rips, and confluence zones)	A current of water disturbed by an opposing current, especially in tidal water or by passage over an irregular bottom.
5.5.1.2	surface microlayer (neuston)	The thin uppermost layer of the water's surface.

5.5.2	euphotic	Upper layer of a water body that receives sufficient sunlight for the photosynthesis of plants.
5.5.3	disphotic	Area below the euphotic zone where photosynthesis ceases.
5.5.4	demersal/benthic	Submerged lands including vegetated and unvegetated areas.
5.6	water temperature	Measure of ocean water temperature.
5.7	salinity zone	The presence and concentration of salts; salinity range that is key to the species, if it is known, will be in the comments field. Positive or negative influences.
5.7.1	tidal fresh	Tidal freshwater
5.7.2	mixing	Area with recurrent mixing of freshwater and seawater; brackish waters.
5.7.3	seawter	Highly saline water from marine waters.
5.8	forms	Morphological elements within marine areas.
5.8.1	beach	An accumulation of unconsolidated material (sand, gravel, angular fragments) formed by waves and wave-induced currents in the intertidal and subtidal zones.
5.8.2	off-shore islands/rocks/sea stacks/off-shore cliffs	A piece of land made up of either rock and/or unconsolidated material that projects above and is completely surrounded by water at higher high water for large (spring) tide. Includes off-shore marine cliffs.
5.8.3	marine cliffs (mainland)	A sloping face steeper than 20 degrees usually formed by erosional processes and composed of either bedrock and/or unconsolidated materials.
5.8.4	delta	Accumulations of sand, silt, and gravel deposited at the mouth of a stream where it discharges into the sea.
5.8.5	dune	In a marine context; a mound or ridge formed by the transportation and deposition of wind-blown material (sand and occasionally silt).
5.8.6	lagoon	Shallow depression within the shore zone continuously occupied by salt or brackish water lying roughly parallel to the shoreline and separated from the open sea by a barrier.
5.8.7	salt marsh	A coastal wetland area which is periodically inundated by tidal brackish or salt water and which supports significant (15% cover) non-woody vascular vegetation (e.g., grasses, rushes, sedges) for at least part of the year.
5.8.8	reef	A rock outcrop, detached from the shore, with maximum elevations below the high-water line.
5.8.9	tidal flat	A level or gently sloping (less than 5 degrees) constructional surface exposed at low tide, usually consisting primarily of sand or mud with or without detritus, and resulting from tidal processes.
5.8.10	tide pools	Pools of water left behind after tides recede.
5.8.11	high tide current channels	Channels formed by the moment of water at high tides.
5.8.12	complex dendritic channel morphology	Dendritic channel complexity reflects the extensive dissection of the inter-tidal environment; the many naturally-deepened aquatic channels offer important structures providing food and refuge environs (even short-term) for estuarine and marine fishes
5.8.13	spit berms	Berms of sand that are formed on spits due to wave action.
5.8.14	underwater channels	Channels formed by the movement of water, such as at a river or stream mouth on a larger body of water, that are permanently underwater.
5.9	water clarity	As influenced by sediment load.
6.0	No Data	
7.0	Fire as a Habitat Element	Fire can influence species in a positive or negative way.
8.0	Anthropogenic Disturbances and Elements	Anthropogenic - Related Habitat Elements: This section contains selected examples of human-related Habitat Elements that may be a key part of the environment for many species. These HE's may have either a negative or positive influence on the queried species.
8.1	campgrounds/picnic areas	Sites developed and maintained for camping and picnicking.
8.2	roads	Roads that are either paved or unpaved.
8.2.1	paved	Roads that are paved with asphalt or concrete.
8.2.2	un-paved	Roads or trails that are not paved (i.e., gravel or dirt roads).
8.3	buildings	Permanent structures.
8.4	bridges	Permanent structures typically over water or ravines.
8.5	diseases transmitted by domestic animals	Some domestic animal diseases may be a source of mortality or reduced vigor for wild species.
8.6	harvest/persecution (of animals)	Includes illegal harvest/poaching, incidental take (resulting from fishing net by-catch, or by hay mowing, for example), and targeted removal for pest control.
8.7	fences/corrals	Wood, barbed wire, or electric fences.
8.8	supplemental food	Food deliberately provided for wildlife (e.g. bird feeders, ungulate feeding programs, etc.) as well as spilled or waste grain along railroads and cattle feedlots.
8.9	refuse (includes landfills)	Any source of human-derived garbage (includes landfills).
8.10	supplemental boxes, structures and platforms	Includes birdhouses, bat boxes, raptor and waterfowl nesting platforms.
8.11	guzzlers and waterholes	Water sources typically built for domestic animal use.
8.12	toxic chemical use	Proper use of regulated chemicals; documented effects only.
8.12.1	herbicides/fungicides	Chemicals used to kill vegetation and fungi.
8.12.2	insecticides	Chemicals used to kill insects.
8.12.3	pesticides	Chemicals used to kill vertebrate species.
8.12.4	fertilizers	Chemicals used to enhance vegetative growth.
8.12.5	fire fighting chemicals	Chemicals used to suppress fire.
8.13	hedgerows/windbreaks	Woody and/or shrubby vegetation either planted or that develops naturally along fence lines and field borders.
8.14	sewage treatment plant	Settling ponds associated with sewage treatment plants.
8.15	repellents	Various methods purposely used against wildlife species that damage crops or property (excluding pesticides and insecticides)..
8.15.1	chemical (taste or smell)	Chemical substances that repel wildlife.
8.15.2	noise or visual disturbance	Non-chemical methods to deter wildlife.
8.16	culverts	Drain crossings under roads or railroads.
8.17	irrigation ditches/canals	Ditches built to transport water to agricultural crops or to handle runoff.
8.18	powerlines/corridors	Utility lines, poles, and rights-of-way associated with transmission, telephone, and gas lines.
8.19	pollution	Human-caused environmental contamination.
8.19.1	chemical	Contamination caused by chemicals.
8.19.2	sewage	Contamination caused by human waste.
8.19.3	water	Aquatic contamination from any source.
8.20	piers	A structure built out over water.
8.21	mooring piles, dolphins, buoys	Floating objects anchored out in the water for nautical purposes.
8.22	bulkheads, seawalls, revetment	Retaining structures built to protect the shoreline from wave action.
8.23	jetties, groins, breakwaters	Structures built to influence the current or protect harbors.
8.24	water diversion structures	Structures built to funnel or direct water, including dams, dikes and levies.
8.25	log boom	A raft of logs lashed together either to transport the logs or as barriers to boat traffic near marinas or dams.
8.26	boats/ships	Watercraft, either motorized or non-motorized.
8.27	dredge spoil islands	Sediment deposited from dredging operations.

8.28	hatchery facilities and fish	Fish that are hatched in captivity and later released into the wild. For simplicity this refers to freshwater areas, though marine birds and mammals likely feed on hatchery-released fish too.
8.29	hydrologic regime - regulated (river)	Rivers that are altered and controlled by human activities.
8.30	obstructions (to fish passage)	Obstructions or blockages to fish passage (e.g., poorly situated culverts; fences; piers; warm thermal pulses).
8.31	weirs	A fence or wattle placed in a stream to catch or retain fish.
8.32	other	Any other anthropogenic-related habitat elements not described by KECs 8.1-8.31)

CHAP Appendix
Appendix B
Master List Key Ecological Functions (KEFs)

SHP-KEF	KEFDescription
~	added by fish review
1	Trophic relationships
1.1	heterotrophic consumer
1.1.1	primary consumer (herbivore) (also see below under Herbivory)
1.1.1.1	foliovore (leaf-eater)
1.1.1.2	spermivore (seed-eater)
1.1.1.3	browser (leaf, stem eater)
1.1.1.4	grazer (grass, forb eater)
1.1.1.5	frugivore (fruit-eater)
1.1.1.6	sap feeder
1.1.1.7	root feeders
1.1.1.8	nectivore (nectar feeder)
1.1.1.9	fungivore (fungus feeder)
1.1.1.10	flower/bud/catkin feeder
1.1.1.11	aquatic herbivore
1.1.1.12	feeds in water on decomposing benthic substrate
1.1.1.13	bark/cambium/bole feeder
1.1.1.14	periphyton eater (including algae) ~
1.1.1.15	phytoplankton eater (including algae) ~
1.1.2	secondary consumer (primary predator or primary carnivore)
1.1.2.1	invertebrate eater
1.1.2.1.1	terrestrial invertebrates
1.1.2.1.2	aquatic macroinvertebrates
1.1.2.1.3	freshwater or marine zooplankton
1.1.2.2	vertebrate eater (consumer or predator of herbivorous vertebrates)
1.1.2.2.1	piscivorous (fish eater)
1.1.2.3	ovivorous (egg eater)
1.1.2.4	prey (fish) for secondary consumers ~
1.1.3	tertiary consumer (secondary predator or secondary carnivore)
1.1.4	carrion feeder
1.1.5	cannibalistic
1.1.6	coprophagous (feeds on fecal material)
1.1.7.1	aquatic (e.g. offal and bycatch of fishing boats)
1.1.7.2	terrestrial (e.g. landfills)
1.1.7	feeds on human garbage/refuse
1.2	prey relationships
1.2.1	prey for secondary or tertiary consumer (primary or secondary predator)
1.2.2	fish prey for secondary or tertiary consumer (primary or secondary predator)
2	aids in physical transfer of substances for nutrient cycling (C,N,P, etc.)
2.1	significant carrier of nutrients ~
2.1.1	within aquatic system ~
2.1.2	within terrestrial systems (including wetlands) ~
2.2	significant carrier of heavy metals ~
2.2.1	within aquatic systems ~
2.2.2	within terrestrial systems (including wetlands) ~
3	organismal relationships
3.1	controls or depresses insect population peaks
3.1.1	influences aquatic invertebrate population peaks ~
3.1.2	influences zooplankton population peaks ~
3.2	controls terrestrial vertebrate populations (through predation or displacement)
3.3	pollination vector
3.4	transportation of viable seeds, spores, plants or animals ^
3.4.1	disperses fungi

3.4.2	disperses lichens
3.4.3	disperses bryophtes, including mosses
3.4.4	disperses insects and other invertebrates
3.4.4.1	disperse aquatic invertebrates ~
3.4.5	disperses seeds/fruits (through ingestion or caching)
3.4.6	disperses vascular plants
3.5.1	creates feeding opportunities (other than direct prey relations)
3.5.1.1	creates sapwells in trees
3.5.2	creates roosting, denning, or nesting opportunities
3.5	creates feeding, roosting, denning, or nesting opportunities for other organisms
3.6.1	aerial structures
3.6.2	ground structures
3.6.3	aquatic structures
3.6	primary creation of structures (possibly used by other organisms)
3.7.1	aerial structures
3.7.2	ground structures
3.7.3	aquatic structures
3.7	user of structures created by other species
3.8.1	interspecies parasite
3.8.2	common interspecific host
3.8	nest parasite
3.9	primary cavity excavator (in aquatic and/or terrestrial systems)
3.10	secondary cavity user
3.11.1	creates large burrows (rabbit-sized or larger)
3.11.2	creates small burrows (less than rabbit-sized)
3.11	primary burrow excavator (fossorial or underground burrows)
3.12	uses burrows dug by other species (secondary burrow user)
3.13	creates runways (possibly used by other species)
3.14	uses runways created by other species)
3.15	pirates food from other species
3.16	interspecific hybridization
3.16.1	interspecific hybridization with native species
3.16.2	interspecific hybridization with exotic species
4	carrier, transmitter, or reservoir of vertebrate diseases
4.1	diseases that affect humans
4.2	diseases that affect domestic animals
4.3	diseases that affect other wildlife species
4.4	diseases that affect other fish species ~
5	soil relationships
5.1	physically affects (improves) soil structure, aeration (typically by digging)
5.2	physically affects (degrades) soil structure, aeration (typically by trampling)
5.3	physically affects aquatic soils and bed materials (typically by digging or spawning actions)
6	wood structure relationships (either living or dead wood)
6.1	physically fragments down wood
6.2	physically fragments standing wood
7	water relationships
7.1	impounds water by creating diversions or dams
7.2	creates ponds or wetlands through wallowing
8	vegetation structure and composition relationships
8.1	creates standing dead trees (snags)
8.2	herbivory on trees or shrubs that may alter vegetation structure and composition (browsers)
8.3	herbivory on grasses or forbs that may alter vegetation structure and composition (grazers)

CHAP Appendix
Appendix C
Study Area - Species - Potential List

Largemouth bass	*Micropterus salmoides*
Black bullhead	*Ictalarus (Ameiurus) melas*
Carp	*Cyprinus carpio*
Mosquitofish	*Gambusia affinis*
Green sunfish	*Lepomis cyanellus*
Tilapia	*Oreochromis spp.*
Western toad	*Bufo boreas*
California Treefrog	*Pseudacris regilla*
Bullfrog	*Rana catesbeiana*
Red-eared Slider	*Trachemys scripta elegans*
Southern Alligator Lizard	*Elgaria multicarinata*
Western Fence Lizard	*Sceloporus occidentalis*
Side-blotched lizard	*Uta stansburiana*
Two-Striped Garter Snake	*Thamnophis hammondii*
Pied-billed Grebe	*Podilymbus podiceps*
Eared Grebe	*Podiceps nigricollis*
Double-crested Cormorant	*Phalacrocorax auritus*
Great blue heron	*Ardea herodias*
Great Egret	*Ardea alba*
Snowy Egret	*Egretta thula*
Green Heron	*Butorides virescens*
Black-crowned Night-Heron	*Nycticorax nycticorax*
Turkey Vulture	*Cathartes aura*
Canada Goose	*Branta canadensis*
Gadwall	*Anas strepera*
American Wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Cinnamon teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Northern Pintail	*Anas acuta*
Green-winged Teal	*Anas crecca*
Bufflehead	*Bucephala albeola*
Hooded Merganser	*Lophodytes cucullatus*
Ruddy Duck	*Oxyura jamaicensis*
Muscovy Duck	*Cairina moschata*
Osprey	*Pandion haliaetus*
White-tailed Kite	*Elanus leucurus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
Sora	*Porzana carolina*
Common Moorhen	*Gallinula chloropus*
American Coot	*Fulica americana*
Killdeer	*Charadrius vociferus*

Black-necked Stilt	*Himantopus mexicanus*
Greater Yellowlegs	*Tringa melanoleuca*
Lesser Yellowlegs	*Tringa flavipes*
Spotted Sandpiper	*Actitis macularia*
Western sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
Wilson's Snipe	*Gallinago delicata*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Western Gull	*Larus occidentalis*
Caspian Tern	*Sterna caspia*
Rock Pigeon	*Columba livia*
Mourning Dove	*Zenaida macroura*
Barn Owl	*Tyto alba*
Great Horned Owl	*Bubo virginianus*
Vaux's Swift	*Chaetura vauxi*
White-throated Swift	*Aeronautes saxatalis*
Black-chinned Hummingbird	*Archilochus alexandri*
Anna's Hummingbird	*Calypte anna*
Rufous Hummingbird	*Selasphorus rufus*
Allen's Hummingbird	*Selasphorus sasin*
Belted Kingfisher	*Ceryle alcyon*
Acorn Woodpecker	*Melanerpes formicivorus*
Red-breasted Sapsucker	*Sphyrapicus ruber*
Nuttall's Woodpecker	*Picoides nuttallii*
Downy Woodpecker	*Picoides pubescens*
Northern Flicker	*Colaptes auratus*
Western Wood-pewee	*Contopus sordidulus*
Willow Flycatcher	*Empidonax traillii*
Pacific-slope Flycatcher	*Empidonax difficilis*
Black Phoebe	*Sayornis nigricans*
Say's Phoebe	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Cassin's Kingbird	*Tyrannus vociferans*
Western Kingbird	*Tyrannus verticalis*
Loggerhead Shrike	*Lanius ludovicianus*
Bell's Vireo	*Vireo bellii*
Cassin's Vireo	*Vireo cassinii*
Hutton's Vireo	*Vireo huttoni*
Warbling Vireo	*Vireo gilvus*
Western Scrub Jay	*Aphelocoma californica*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern rough winged swallow	*Stelgidopteryx serripennis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Oak Titmouse	*Baeolophus inornatus*
Bushtit	*Psaltriparus minimus*

Bewick's Wren	*Thryomanes bewickii*
House Wren	*Troglodytes aedon*
Ruby-crowned Kinglet	*Regulus calendula*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Western Bluebird	*Sialia mexicana*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Wrentit	*Chamaea fasciata*
Northern mockingbird	*Mimus polyglottos*
California Thrasher	*Toxostoma redivivum*
European Starling	*Sturnus vulgaris*
American Pipit	*Anthus rubescens*
Cedar Waxwing	*Bombycilla cedrorum*
Phainopepla	*Phainopepla nitens*
Orange-crowned Warbler	*Vermivora celata*
Nashville Warbler	*Vermivora ruficapilla*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
Townsend's Warbler	*Dendroica townsendi*
Hermit Warbler	*Dendroica occidentalis*
MacGillivray's Warbler	*Oporornis tolmiei*
Common Yellowthroat	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*
Yellow-breasted Chat	*Icteria virens*
Western Tanager	*Piranga ludoviciana*
Spotted Towhee	*Pipilo maculatus*
California Towhee	*Pipilo crissalis*
Chipping Sparrow	*Spizella passerina*
Lark Sparrow	*Chondestes grammacus*
Savannah Sparrow	*Passerculus sandwichensis*
Song sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Dark-eyed Junco	*Junco hyemalis*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Blue Grosbeak	*Guiraca caerulea*
Lazuli Bunting	*Passerina amoena*
Red-winged blackbird	*Agelaius phoeniceus*
Western Meadowlark	*Sturnella neglecta*
Brewer's Blackbird	*Euphagus cyanocephalus*
Great tailed Grackle	*Quiscalus mexicanus*
Brown-headed Cowbird	*Molothrus ater*
Hooded Oriole	*Icterus cucullatus*
Bullock's Oriole	*Icterus bullockii*
Purple Finch	*Carpodacus purpureus*
House Finch	*Carpodacus mexicanus*
Lesser Goldfinch	*Carduelis psaltria*

Lawrence's Goldfinch	*Carduelis lawrencei*
American Goldfinch	*Carduelis tristis*
House Sparrow	*Passer domesticus*
Virginia opossum	*Didelphis virginiana*
California Myotis	*Myotis californicus*
Yuma Myotis	*Myotis yumanensis*
Silver-haired Bat	*Lasionycteris noctivagans*
Western Pipistrelle	*Pipistrellus hesperus*
Big Brown Bat	*Eptesicus fuscus*
Western Red Bat	*Lasiurus blossevillii*
Hoary Bat	*Lasiurus cinereus*
Townsend's Big-eared Bat	*Corynorhinus townsendii*
Brazilian Free-tailed Bat	*Tadarida brasiliensis*
Desert Cottontail	*Sylvilagus audubonii*
California ground squirrel	*Spermophilus beecheyi*
Eastern Fox Squirrel	*Sciurus niger*
Little Pocket Mouse	*Perognathus longimembris*
Western Harvest Mouse	*Reithrodontomys megalotis*
Deer Mouse	*Peromyscus maniculatus*
Dusky-footed Wood Rat	*Neotoma fuscipes*
Black Rat	*Rattus rattus*
Norway Rat	*Rattus norvegicus*
House Mouse	*Mus musculus*
Coyote	*Canis latrans*
Raccoon	*Procyon lotor*
Striped skunk	*Mephitis mephitis*
Bobcat	*Lynx rufus*
Amazon sailfin catfish	*Pterygoplichthys pardalis*
African clawed frog	*Xenopus laevis*
Gopher snake	*Pituophis catenifer*
Southern Pacific Rattlesnake	*Crotalus helleri*
Ring-Necked Duck	Aythya collaris
Domestic Dog	Canis familiaris
Domestic Cat	Felis catus

CHAP Appendix
Appendix D
Relationship Matrix Descriptions
HU Calculation Overview

Relationship Matrix Descriptions

MATRIX 1: Potential Species by Function (KEF) Matrix

The potential species list generated by IBIS is aligned with Key Ecological Functions (KEFs) that could potentially be performed in the habitat type and structural condition represented by the polygon. For example, if the polygon represents a "shrub-steppe" habitat type, the KEFs thought to be performed in that habitat type by the potential species are included in the relationship matrix. This information is acquired from IBIS. The result of this matrix is the number of potential species performing key functions in that habitat type. Example follows:

Lowland Mixed Conifer Habitat Type (Potential)	Function 1 Transportation of Viable Seeds, Spores or Plants	Function 2 Breaks up Down Wood	Function 3 Primary Excavator	Function 4 Eats Terrestrial Invertebrates
American Beaver	1			
Pileated Woodpecker		1	1	1
Black Bear	1	1	1	1
Black-tailed Deer	1	1		
Steelhead Salmon	1			1

Relationship Matrix Descriptions

MATRIX 2: Habitat (Actual KEC) by Function (KEF) Matrix

In this matrix, the functions, or KEFs, are again related to Key Environmental Correlates (KECs), but this time the KECs are those actually present at the site (based on field data inventory). Because this is an actual account, those KEFs not correlated to an actual KEC are then removed. The result of this matrix is the number of KEFs characterized by KECs specific to that polygon. Example follows:

Lowland Mixed Conifer Habitat Type (Actual)	Function 1 Creates Snags	Function 2 Breaks up Down Wood	Function 3 Pollination Vector	Function 4 Primary Excavator	Function 5 Filtering Water	Function 6 Eats Terrestrial Insects
Down Wood		1				1
Snags	1			1		1
Tree Cavities	1	1		1		1
Hollow Living Trees		1				1
Flowers			1			
Emergent Vegetation					1	

Calculations

For Each Matrix

Divide: $$\frac{\textbf{total number of 1s in matrix}}{\textbf{total number of non-zero functions*}}$$

1

Total # of 1s = 12

Total # non-zero fxns = 4

2

Total # of 1s = 13

Total # non-zero fxns = 6

$$\frac{\text{Number of species performing functions}}{\text{Total number of potential functions}} = \frac{12}{4} = 3.0 + \frac{\text{Number of KECs at site}}{\text{Total number of functions characterized}} = \frac{13}{6} = 2.17$$

= **Per-Acre Habitat Value 5.17**

*non-zero functions refer to function columns in the matrix that have at least one "1" in that column

CHAP Appendix
Appendix E
Verification Transect Report

Lone Pine Butte Consulting

LA River CHAP Verification Transect Report

Combined Habitat Assessment Protocols (CHAP)

Paul R Ashley
4/11/2010

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Introduction

Northwest Habitat Institute (NHI) staff evaluated habitat quality on and along selected portions of the Los Angeles River (LAR) within the city limits of Los Angeles, California in late March and early April 2010. NHI staff used Combined Habitat Assessment Protocols (CHAP) to assess habitat quality.

CHAP methodology includes delineating and displayed habitat types, structural conditions, and attributes as Geographic Information System (GIS) data, which is verified in the field with ocular observations and measured verification transects. Ocular observations and verification transect data is then used to modify initial habitat quality/attribute estimates.

Funding for the LAR habitat assessment project and assistance with data collection was provided by the US Army Corps of Engineers (USACOE). This report includes only the results of the verification transects.

Study Area

The study area is located on the south side of Burbank, California just east of Universal City and includes the Los Angeles River channel and adjacent uplands. The general project area is shown in Figure 1. CHAP verification transects were limited to “soft bottom” areas in the LA River channel and the “Head Works” area.

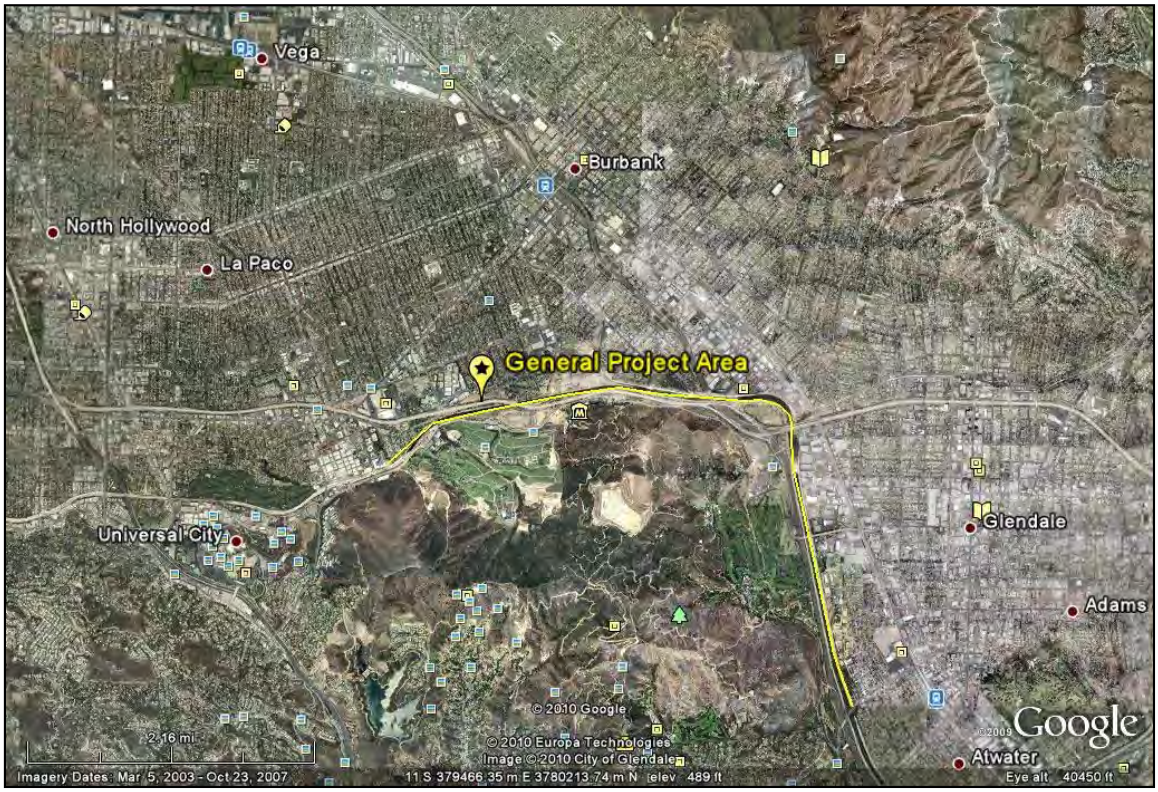


Figure 1 General location of LA River CHAP study

Verification Transect Locations

Habitat variable data was collected on 11 transects to verify and support GIS map layers and associated ocular habitat attribute estimates. Seven verification transects were established at the Head Works location (Figure 2) while four transects were disbursed in "soft bottom" areas of the LA River (Figure 3 and Figure 4). A transect overview map is shown in Figure 5.

Figure 2 Head Works transect start point locations

Figure 3 LA River riparian transect start point locations (north)

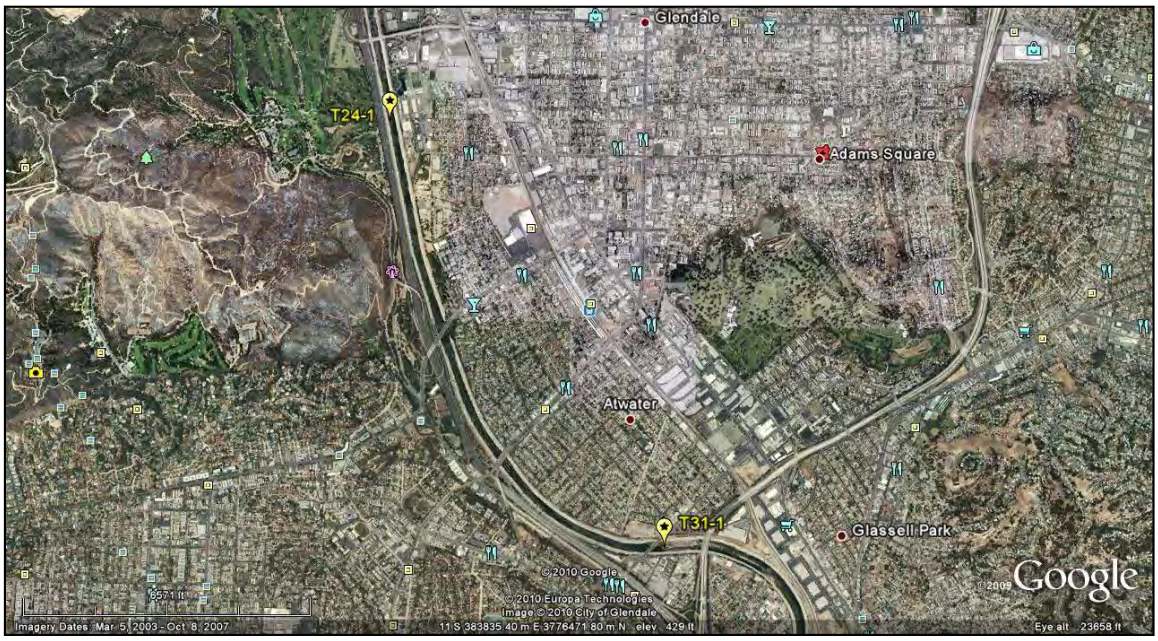


Figure 4 LA River riparian transect start point locations (south)

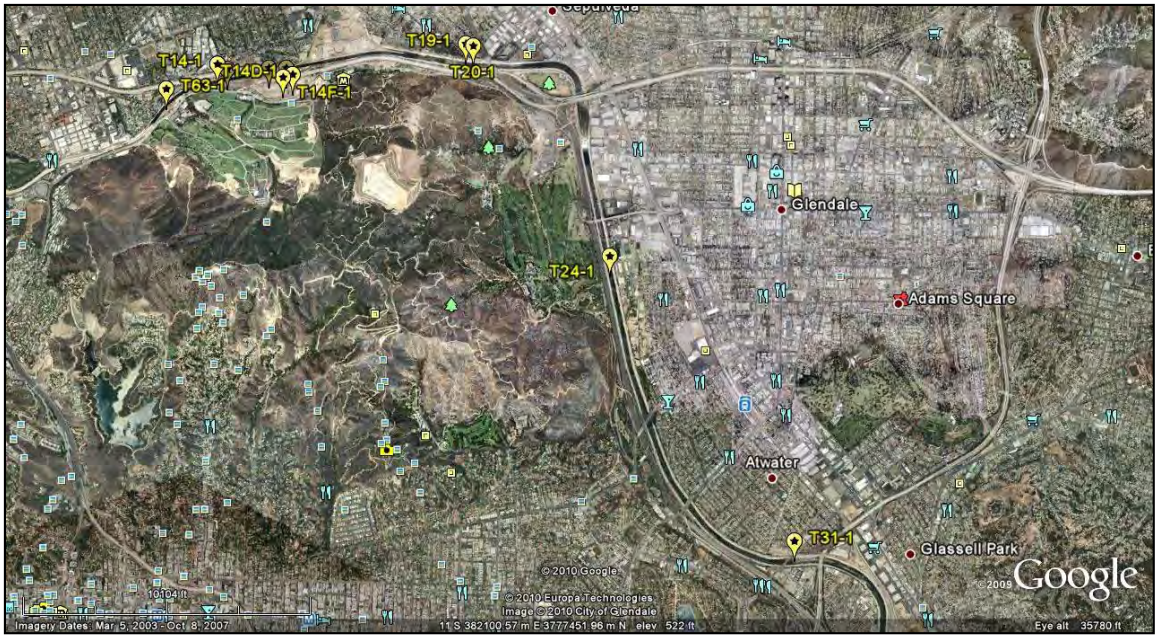


Figure 5 Verification transect start point overview map (all transect start locations)

Transect start points were established at random locations. Transect azimuths were selected from a random numbers table whenever possible (the narrow, linear nature of riparian habitats/transects precluded use of random azimuths). Once an azimuth was determined, a 300' measuring tape was used as the transect line from which habitat variable measurements were taken.

Transect start and end UTM coordinates were recorded on a Garmin 60CSx® global positioning system (GPS) and are displayed Table 1. The end point for transect 24-1 was unavailable due to limited GPS satellite coverage.

Transect length was 300 feet wherever possible. Transect 19-1, however, was only 250 feet in length because of the limited amount of riparian forest habitat available. Similarly, transect 63-1 extended only 150 feet.

Table 1 LA River project transect UTM coordinates, azimuths, and lengths

Site	Transect Number	Point	UTM Coordinates (NAD 83)		Magnetic Azimuth	Transect Length (FT)
			E	N		
LA River	19-1	Start	0380805	3780223	275	250
		End	0380735	3780227		
	20-1	Start	0380891	3780198	080	300
		End	0380976	3780196		
	24-1	Start	0382423	3777918	156	300
		End	Unknown	Unknown		
	31-1	Start	0384453	3774886	075	300
		End	0384540	3774889		
	63-1	Start	0377536	3779670	052	150
		End	0377575	3779686		
Head Works	14-1	Start	0378089	3779962	097	300
		End	0378174	3779949		
	14B-1	Start	0378654	3779919	230	300
		End	0378585	3779865		
	14D-1	Start	0378915	3779852	245	300
		End	0378904	3779941		
	14F-1	Start	0378811	3779819	245	300
		End	0378719	3779805		
	14G-1	Start	0378843	3779920	178	300
		End	0378812	3779844		
	15-1	Start	0378198	3779907	265	300
		End	0378110	3779918		

Methods

Verification transects (n = 11) were established in riparian forest, floodplain riparian shrub, grassland, and shrubland cover types located on LA River "soft bottom" sites and/or the Head Works area. Ashley (2010) describes the specific methods used to measure habitat attributes in Habitat Measurement Techniques.

Habitat attributes measured in this study included:

1. Tree and shrub species
2. Tree and shrub canopy cover
3. Tree and shrub height
4. Diameter breast height (DBH)
5. Snag density, size, and class (only one snag was detected)
6. Percent herbaceous plant cover
7. Herbaceous cover height
8. Percent grass cover
9. Percent cover forbs
10. Percent cover exotic/invasive herbaceous vegetation

Tree and shrub data was collected using the point intercept method. Tree canopy point cover was collected at five foot intervals while shrub point intercept data was collected at either five foot or two intervals foot intervals predicated on initial shrub cover estimates (two foot intervals are applied when estimated shrub cover is < 30%).

A rectangular 0.10m^2 quadrat was used to estimate total herbaceous cover, grass cover, forbs cover, and percent cover of invasive herbaceous species (percent cover = aerial cover). Quadrats were placed adjacent to the transect line at 25 foot intervals. Herbaceous vegetation height measurements were taken within the quadrats with a "pocket rod" and recorded in 10ths of feet (Ashley 2010).

Results

Verification transect results for the LA River and Head Works sites are summarized below. Percent cover estimates are rounded to the nearest whole number. Actual data sets, including species information, can be viewed at the data link locations included in the summary tables. Transect photographs are shown in Appendix A.

LA River

Three verification transects were established in the riparian forest cover type, one transect in shrub-scrub floodplain, and one transect in disturbed grassland. Snag, shrub, and tree data was collected on the riparian forest and shrub-scrub transects (only one snag was detected which had an 8.5 inch dbh). Only herbaceous habitat attribute data was recorded on Transect 63-1 (shrubs were not present).

Tree canopy cover ranged from 17% to 77%. The average minimum tree height was just over 17 feet while the maximum tree height was slightly more than 49 feet. Tree species detected included

eucalyptus (*Eucalyptus* globules), shamel ash (*Fraxinus* uhdei), white mulberry (*Morus alba*), sycamore (*Paltanus* sp.), and red willow (*Salix* laevigata).

Shrub cover ranged from 48% to 64% while mean shrub height varied little extending from approximately 3.5 feet to just over 4 feet. Shrub species (included trees < 16 feet in height) detected included castor bean (*Ricinus* spp.), Mexican fan palm (*Washingtonia robusta*), arroya willow (Salix lasiolepis), shamel ash, white mulberry, mule fat (*Baccharis salicifolia*), red willow, and California sagebrush (*Artemisia californica*).

Total herbaceous cover on transect 63-1 was 81%, which was comprised entirely of invasive plant species. Summarized LA River transect results and data spreadsheet links are provided in Table 2.

Table 2 Summarized LA River verification transect results and data links

Cover Type	Transect Number	Habitat Stratum	Percent Cover	Mean Height (Feet)	DBH Class Range (Inches)	Data Link
Riparian Forest	19-1	Trees	58%	49.20	<4 to >20	19
		Shrubs	64%	3.53	N/A	
Riparian Forest	20-1	Trees	72%	37.50	4 to 20	20
		Shrubs	50%	3.77	N/A	
Riparian Forest	24-1	Trees	77%	38.00	4 to >20	24
		Shrubs	53%	4.22	N/A	
Shrub-scrub Floodplain	31-1	Trees	17%	17.30	<4 to 20	31
		Shrubs	48%	4.00	N/A	

Cover Type	Transect Number	Habitat Stratum	Percent Herb. Cover	Mean Height	Percent Grass	Percent Forbs	Percent Exotics	Data Link
Disturbed Grassland	63-1	Herbaceous Stratum	81%	6”	71.50	23.50	80.50	63

Head Works

Four shrubland and two grassland verification transects were established at the Head Works site. Both shrub and herbaceous habitat attribute data was collected on most transects.

Percent shrub cover ranged from 11% to 92% while shrub height was between 5 feet and 6 feet on three transects and just over 10 feet on the fourth transect. Shrub species detected included Spanish broom (*Spartium* junceum), poison oak (*Toxicodendron diversilobum*), mule fat, Mexican elderberry (*Sambucus mexicana*), laurel sumac (*Malosma laurina*), coyote brush (*Baccharis pilularis*), deerweed (*Lotus scoparius*) (half shrub), and California sagebrush (Table 3).

Table 3 Head Works site shrub verification transect results

Cover Type	Transect Number	Habitat Stratum	Percent Cover	Mean Height (Feet)	Data Link
Shrubland	14B-1	Shrubs	11%	5.82	14B-1
Shrubland	14D-1	Shrubs	35%	5.04	14D-1
Riparian Shrub	14F-1	Shrubs	53%	5.75	14F-1
Shrubland	15-1	Shrubs	92%	10.22	15-1

Percent cover of herbaceous vegetation ranged from 67% to 88% with only a trace amount (<1%) comprised of native species while the average height ranged from four to 15 inches. Herbaceous transect results are summarized in Table 4.

Table 4 Head Works site herbaceous stratum verification transect results

Cover Type	Transect Number	Habitat Stratum	Percent Herb. Cover	Mean Height	Percent Grass	Percent Forbs	Percent Exotics	Data Link
Shrubland	14B-1	Herbaceous	67%	4”	31%	50%	67%	14B-1
Grassland	14-1	Herbaceous	84%	13”	82%	5%	83%	14-1
Shrubland	14D-1	Herbaceous	88%	7”	79%	36%	88%	14D-1
Grassland	14G-1	Herbaceous	70%	15”	35%	60%	70%	14G-1

References

Ashley, P. R. 2010. Habitat Measurement Techniques. Regional HEP Team. Columbia Basin Fish and Wildlife Authority. Portland, OR.

Appendix A – Transect Photographs

Transect 14-1

Transect 14B-1

Transect 14D-1

Transect 14F-1

Transect 14G-1

Transect 15-1

Transect 19-1

Transect 20-1

Transect 24 -1

Transect 63-1

CHAP Appendix
Appendix F
Alternative Measures Matrix

Alternatives Submeasure Matrix by River Reach

Reach	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 associated banks &Soft Bottom Channl	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 nsive PocketsComprehe	19 Taylor Yard
1. Pollywog Park/Headworks to Midpoint of Betty Davis Park	3/5. create geomorphology and plant for freshwater marsh, open water Ie 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			
	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	X		X			X			X					X		X		X	
	9. culverts & or underground basins to divert flood flows	X		X	X		X	X	X	X						X		X		
	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	
	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		
	27. modify trap channel to vertical sides to gain width (adds capacity)	X			X			X						X						

Reach	Submeasure	Comprehensive 1	City: Atwater to Cornfields 2	Banks & Tribs Only 3	Highest Scoring Objectives (over 3) 4	City: Los Feliz to Arroyo Seco 5	Corps Team 6	highest objectives (over 5) 7	Charette Team 1 8	associated banks &Soft Bottom Channl 9	Highest Other Criteria (over 11) 10	Charette Team 4 11	Charette Team 3 12	Charette Team 6 13	Charette Team 5 14	Charette Team 2 15	Side Channels Only 16	Charette Team 7 17	Comprehensive Pockets 18	Taylor Yard 19
2. Midpoint Betty Davis Park to upstream end of Ferraro Fields	3/5. create geomorphology and plant for freshwater marsh, open water Ie 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			
	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	X		X	X		X	X	X	X						X		X		
	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			
	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							
	27. modify trap channel to vertical sides to gain width (adds capacity)	X			X			X						X						

Reach	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 associated banks &Soft Bottom Channl	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
3. Ferraro Fields to Brazil St	3/5. create geomorphology and plant for freshwater marsh, open water Ie 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		
	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	X	X	X	X		X	X	X	X				X		X		X		
	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		
	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						
	27. modify trap channel to vertical sides to gain width (adds capacity)	X	X		X			X					X	X						

Reach	Submeasure	Comprehensive 1	City: Atwater to Cornfields 2	Banks & Tribs Only 3	Highest Scoring Objectives (over 3) 4	City: Los Feliz to Arroyo Seco 5	Corps Team 6	highest objectives (over 5) 7	Charette Team 1 8	associated banks &Soft Bottom Channl 9	Highest Other Criteria (over 11) 10	Charette Team 4 11	Charette Team 3 12	Charette Team 6 13	Charette Team 5 14	Charette Team 2 15	Side Channels Only 16	Charette Team 7 17	Comprehensive Pockets 18	Taylor Yard 19
4. Brazil to Los Feliz Blvd	3/5. create geomorphology and plant for freshwater marsh, open water Ie 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		
	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	X		X					X				X	X			X			
	9. culverts & or underground basins to divert flood flows	X	X	X	X	X	X	X	X	X						X		X		
	12. bridge undercrossings for wildlife	X	X													X				
	15. wildlife passage/tunnels	X	X	X			X							X		X				
	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			
	21/22 widenchannel, provide erosion control may lower channel banks and provide setback levees or vegetated berms	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	X		X	X					
	27. modify trap channel to vertical sides to gain width (adds capacity)	X	X		X	X		X						X						

Reach	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 associated banks &Soft Bottom Channl	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
5. Los Feliz to Glendale Fwy (2)	3/5. create geomorphology and plant for freshwater marsh, open water Ie 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			
	9. culverts & or underground basins to divert flood flows	X	X	X	X	X	X	X	X	X						X		X		
	14. wildlife access from river to bank (in daylighted storm drain)	X	X			X	X		X		X					X				
	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			
	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								
	27. modify trap channel to vertical sides to gain width (adds capacity)	X	X		X	X		X						X						

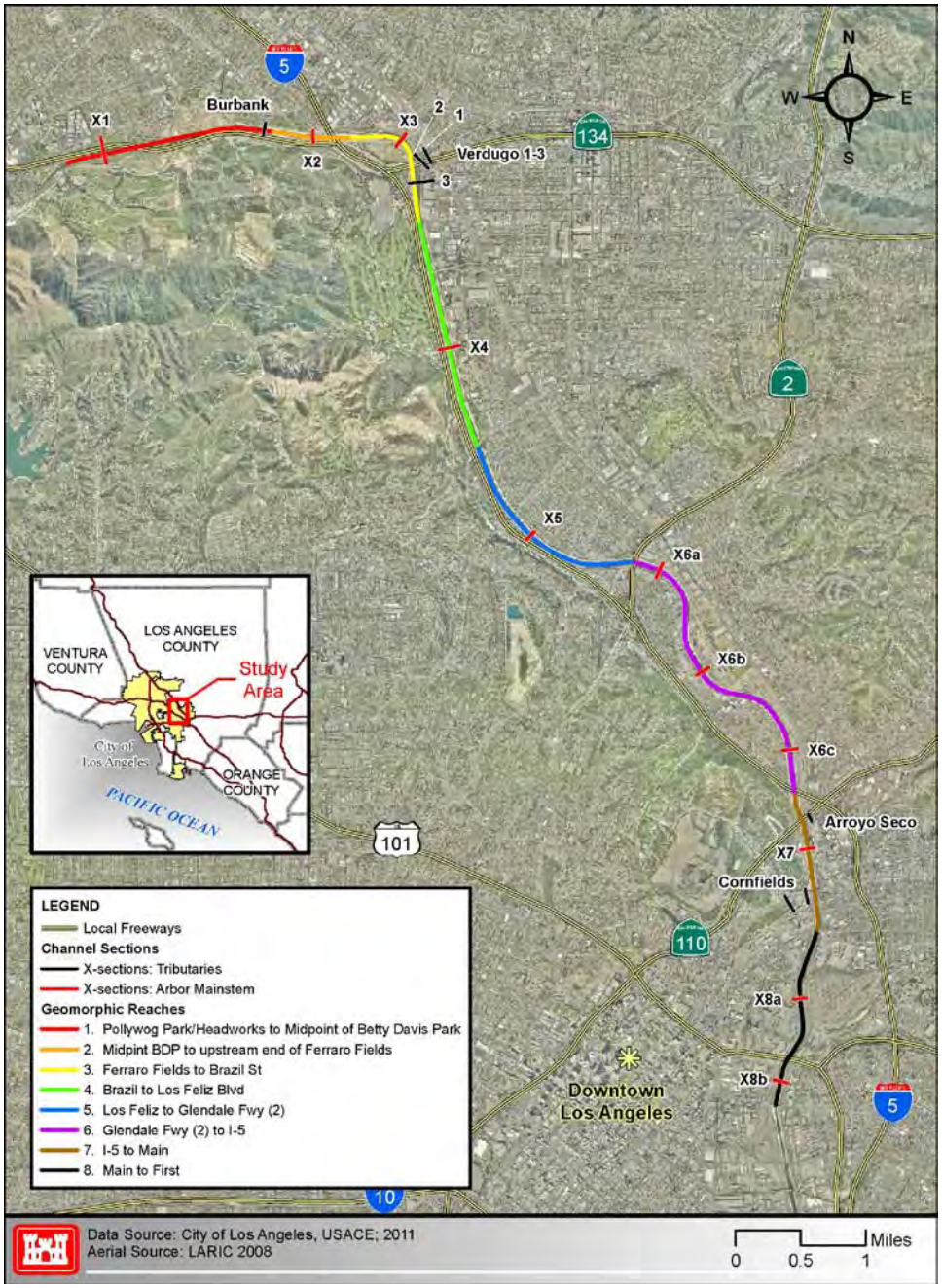
Reach	Submeasure	Comprehensive 1	City: Atwater to Cornfields 2	Banks & Tribs Only 3	Highest Scoring Objectives (over 3) 4	City: Los Feliz to Arroyo Seco 5	Corps Team 6	highest objectives (over 5) 7	Charette Team 1 8	associated banks &Soft Bottom Channl 9	Highest Other Criteria (over 11) 10	Charette Team 4 11	Charette Team 3 12	Charette Team 6 13	Charette Team 5 14	Charette Team 2 15	Side Channels Only 16	Charette Team 7 17	Comprehensive Pockets 18	Taylor Yard 19
6. Glendale Fwy (2) to I-5	3/5. create geomorphology and plant for freshwater marsh, open water Ie 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
	9. culverts & or underground basins to divert flood flows	X	X	X	X	X	X	X	X	X						X		X		
	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					X	
	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
	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
	27. modify trap channel to vertical sides to gain width (adds capacity)	X	X		X	X		X						X						

Reach	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 associated banks &Soft Bottom Channl	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
	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 Ie pool/riffle system	X	X	X	X	X	X		X		X	X		X		X	X	X	X	
	3. 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			
	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	
	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	X	X	X	X	X	X	X	X	X						X		X		
	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	
	26. terrace banks (check for connectivity vs too small once mapping is completed)	X	X	X		X	X		X		X	X		X						
	27. modify trap channel to vertical sides to gain width (adds capacity)	X	X		X	X		X						X						

Reach	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 associated banks &Soft Bottom Channl	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
8. Main to First	1. elevate railroads on trestles (consider other locations when necessary - is this an "all alts" measure?)	X		X					X				X					X		
	3/5. create geomorphology and plant for freshwater marsh, open water Ie 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				
	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	X		X	X		X	X	X	X						X		X		
	15. wildlife passage/tunnels	X		X			X					X				X				
	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			
	26. terrace banks (check for connectivity vs too small once mapping is completed)			X			X					X								
	27. modify trap channel to vertical sides to gain width (adds capacity)	X			X			X						X						

CHAP Appendix
Appendix G
Preliminary Design - Channel Cross Sections

Key to Cross Section Locations



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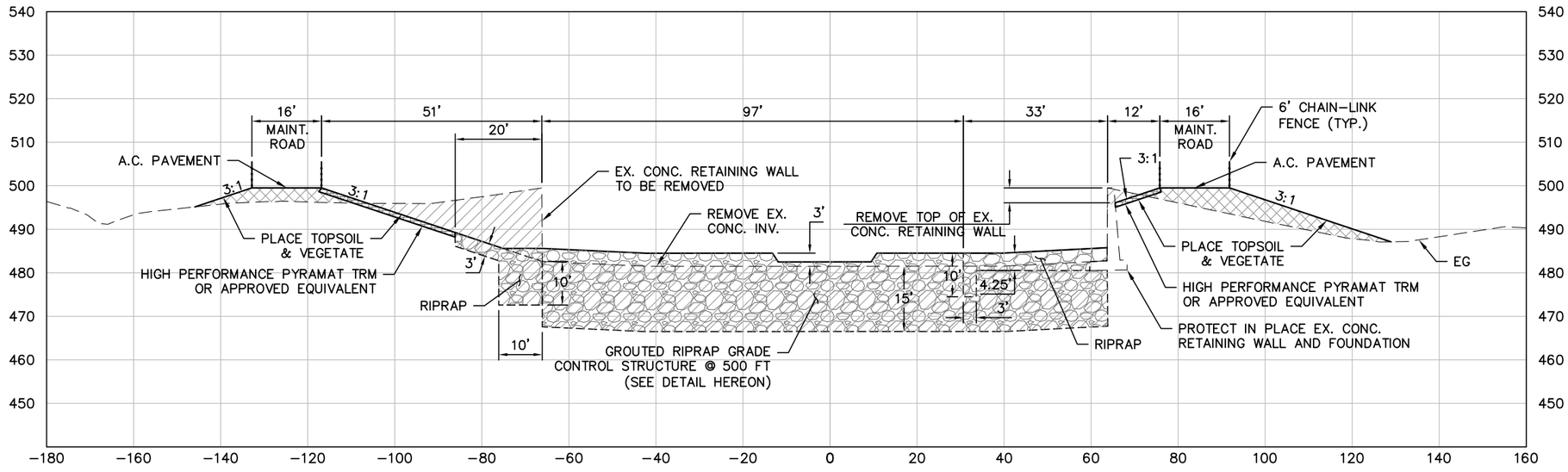
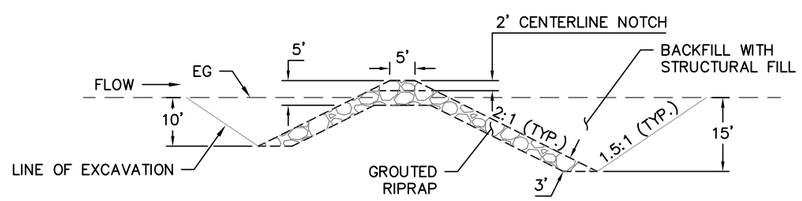
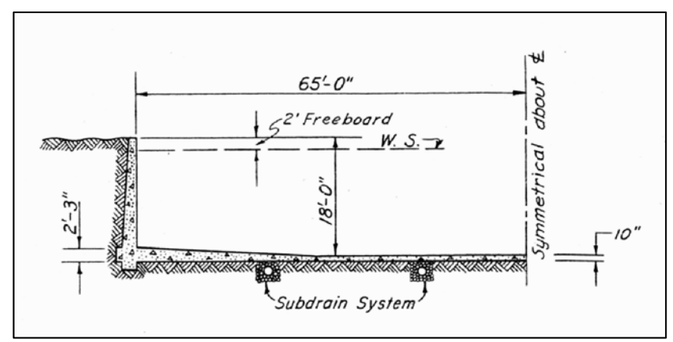




GRADE CONTROL STRUCTURE DETAIL
NTS



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		

REVISIONS			
MARK	DATE	DESCRIPTION	BY

TETRA TECH, INC.
17885 Von Karman Avenue, Suite 500
Irvine, CA 92614
Phone (949) 809-5103, FAX (949) 809-5003

LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 1

DATE 10/25/11

SHT NO. 1 OF 19

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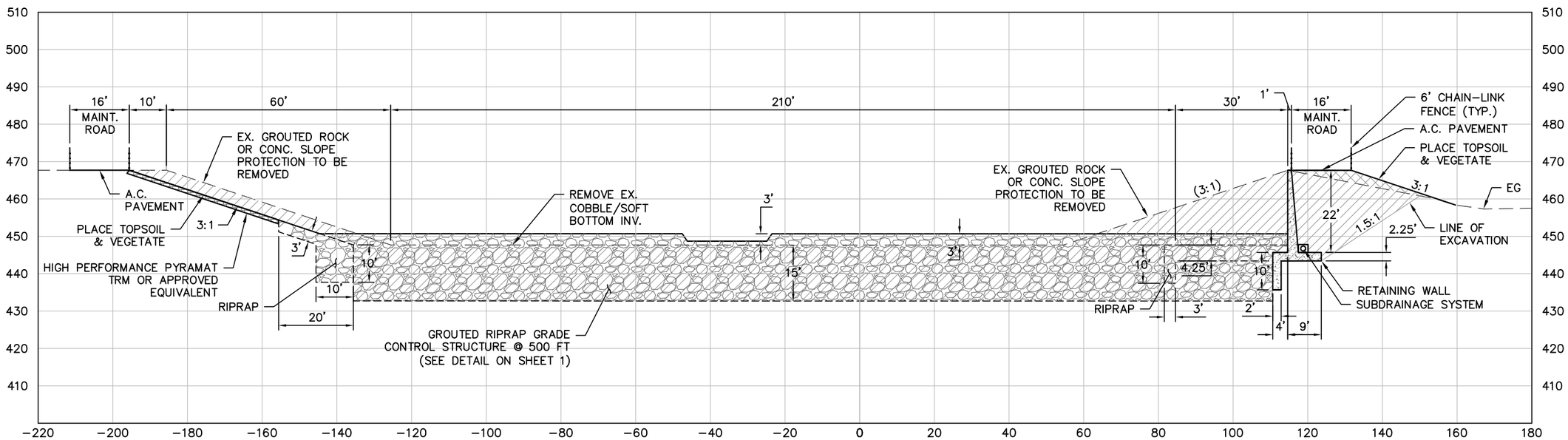

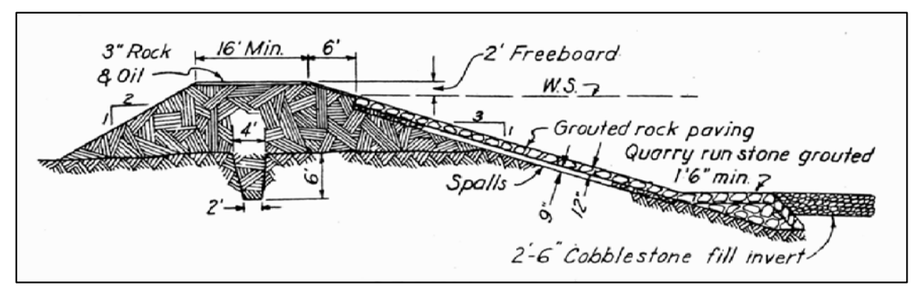

EXISTING TYPICAL SECTION
NTS

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		

REVISIONS			
MARK	DATE	DESCRIPTION	BY

TETRA TECH, INC.
17885 Von Karman Avenue, Suite 500
Irvine, CA 92614
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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 2

DATE 10/25/11

SHT NO. 2 OF 19

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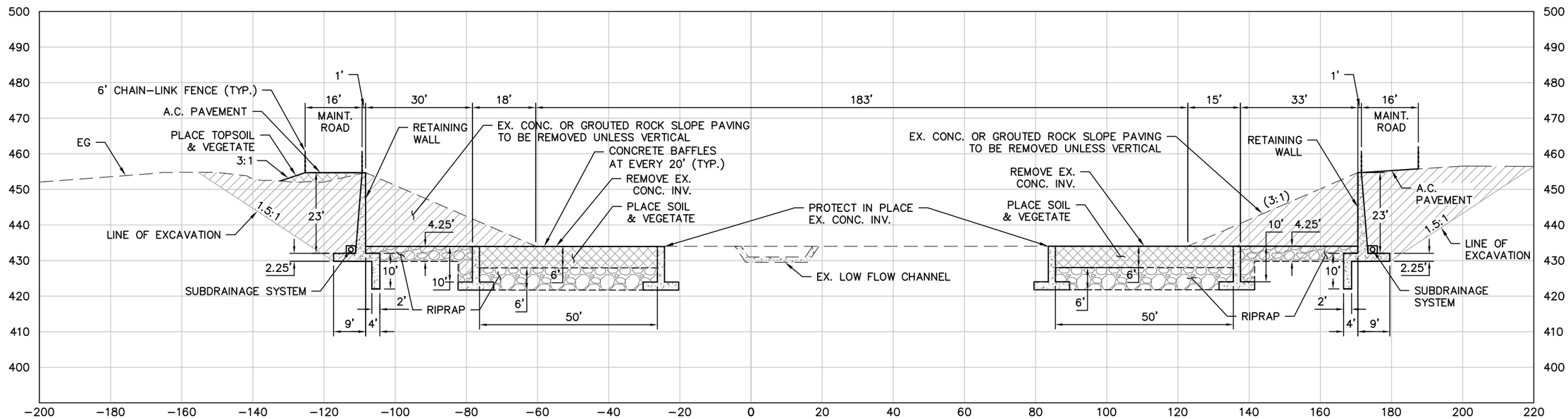

LEGEND

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

0 15 30 60

REVISIONS			
MARK	DATE	DESCRIPTION	BY

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 3

DATE
10/25/11

SHT NO.
3 OF 19

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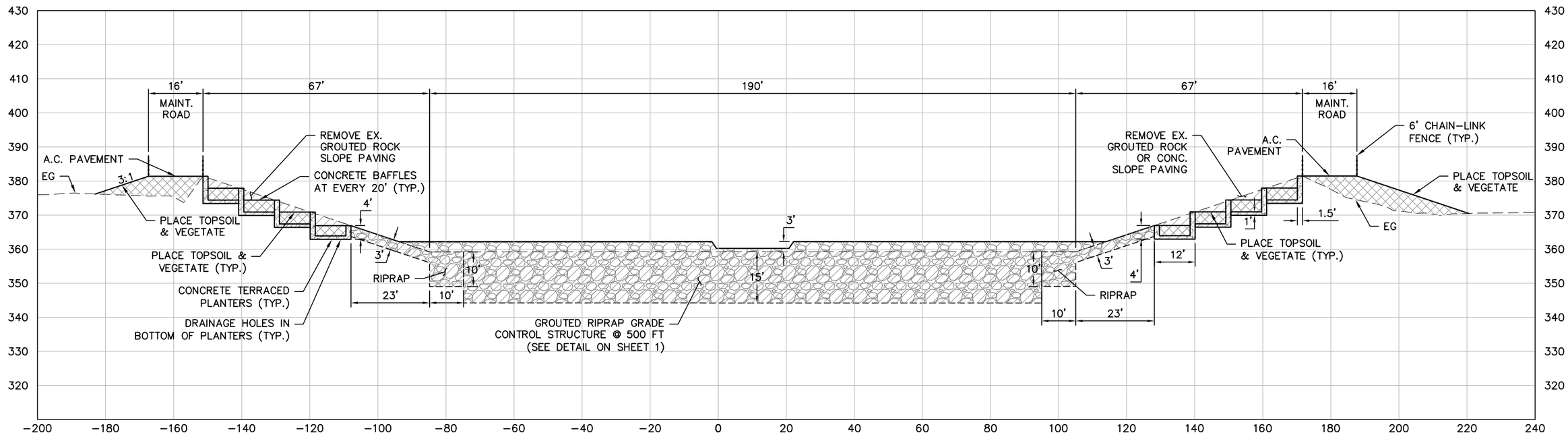

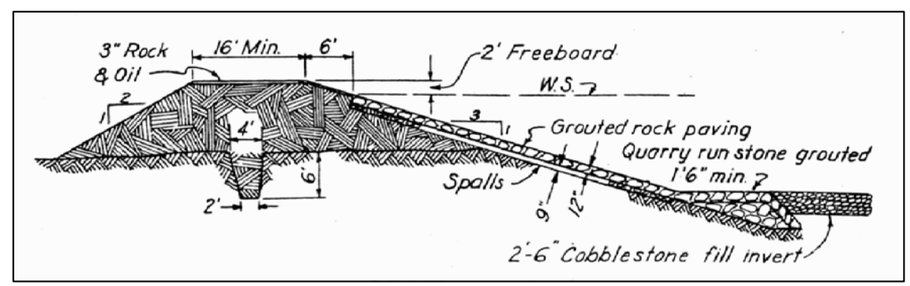

EXISTING TYPICAL SECTION
NTS

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		

REVISIONS			
MARK	DATE	DESCRIPTION	BY

TETRA TECH, INC.
17885 Von Karman Avenue, Suite 500
Irvine, CA 92614
Phone (949) 809-5103, FAX (949) 809-5003

LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 4

DATE 10/25/11

SHT NO. 4 OF 19

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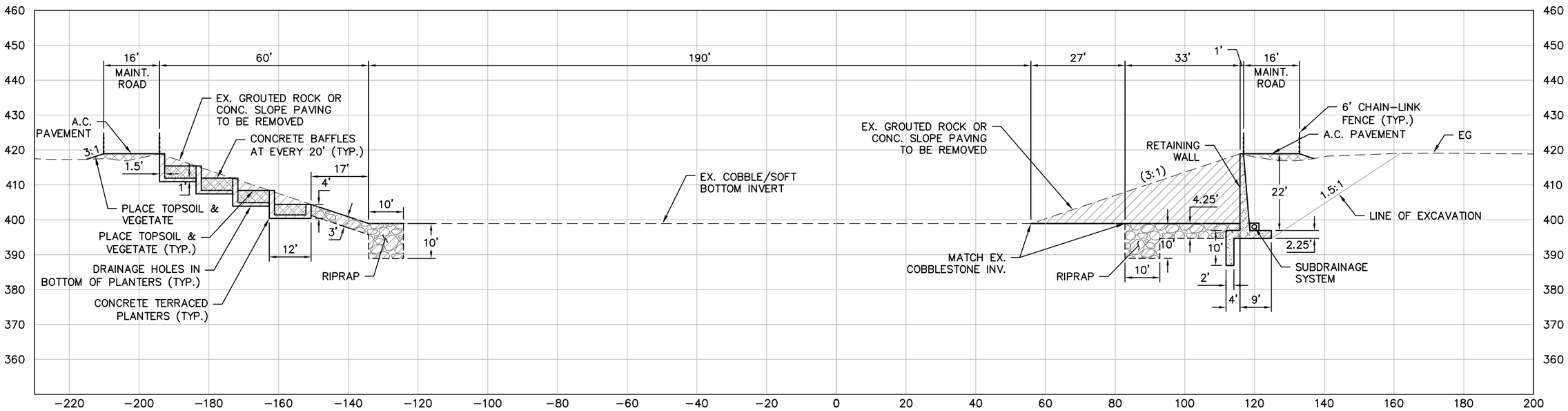

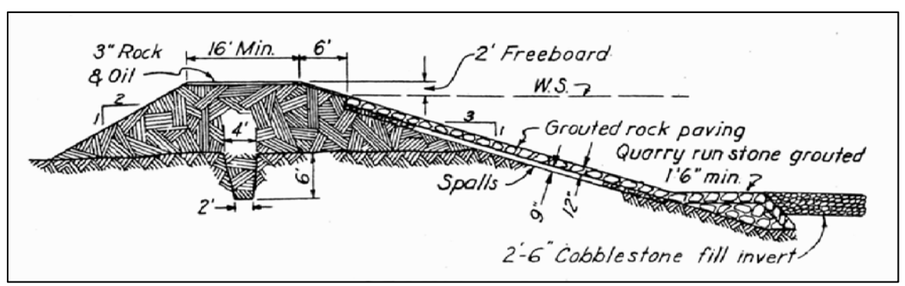

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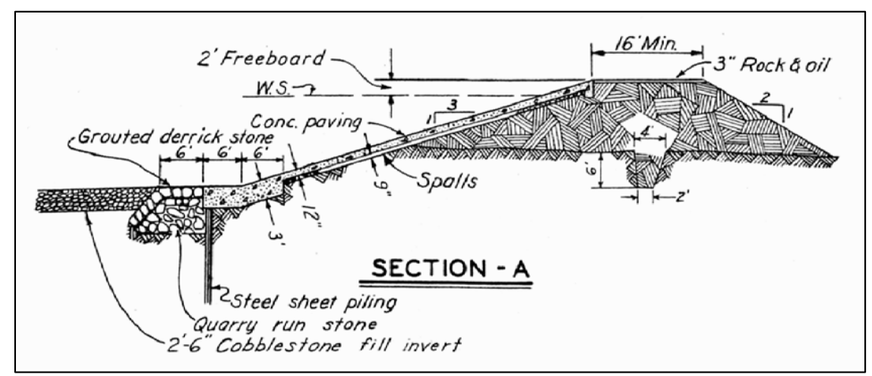
NTS



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		

REVISIONS			
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TETRA TECH, INC.
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Irvine, CA 92614
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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 5

DATE
10/25/11

SHT NO.
5 OF 19

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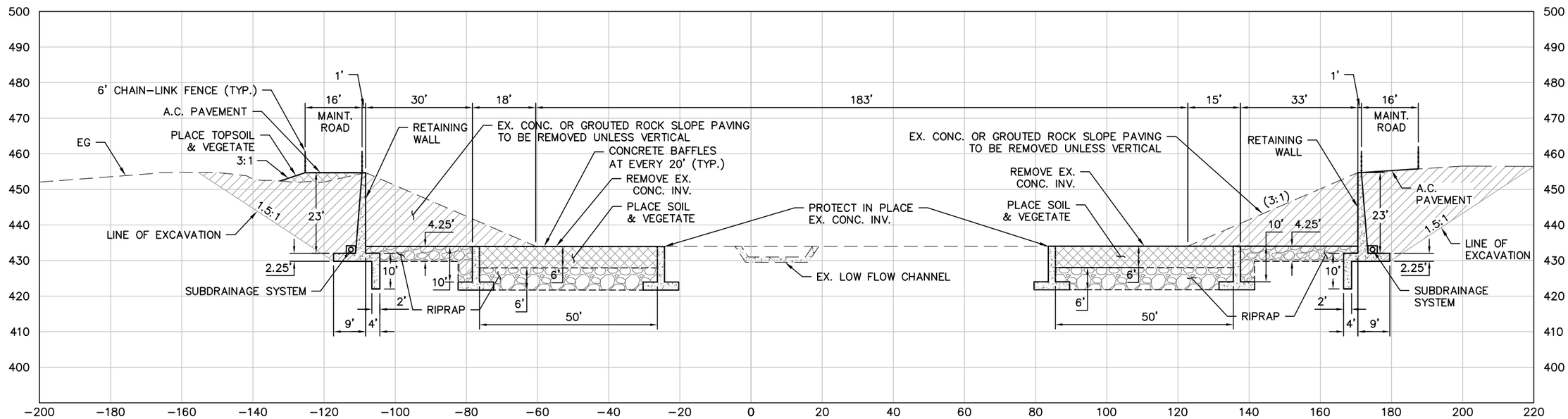

LEGEND

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

0 15 30 60

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 3

DATE
10/25/11

SHT NO.
3 OF 19

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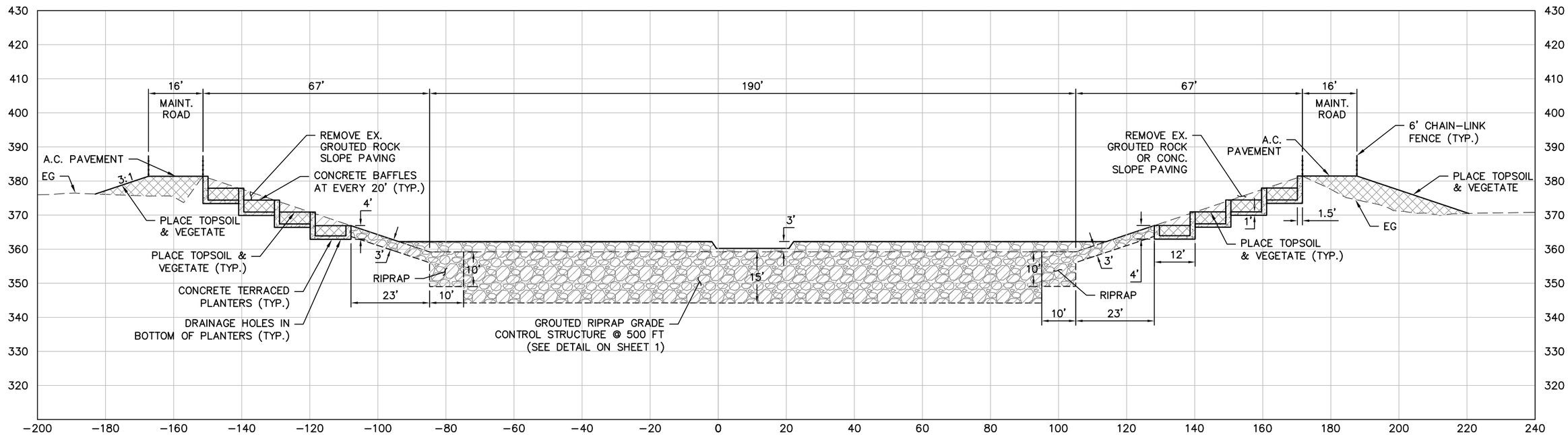

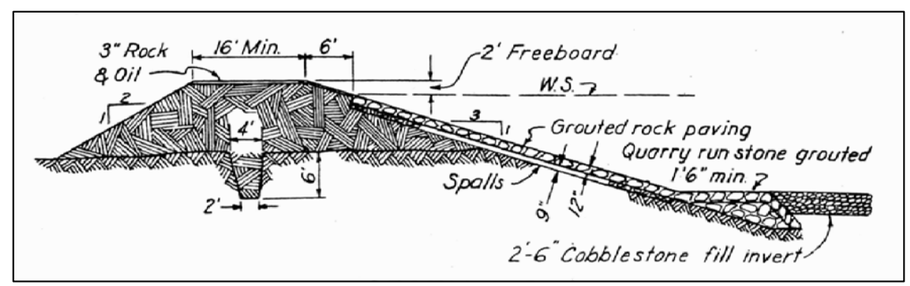

EXISTING TYPICAL SECTION
NTS

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		

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LOS ANGELES RIVER FEASIBILITY STUDY
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ARBOR REACH
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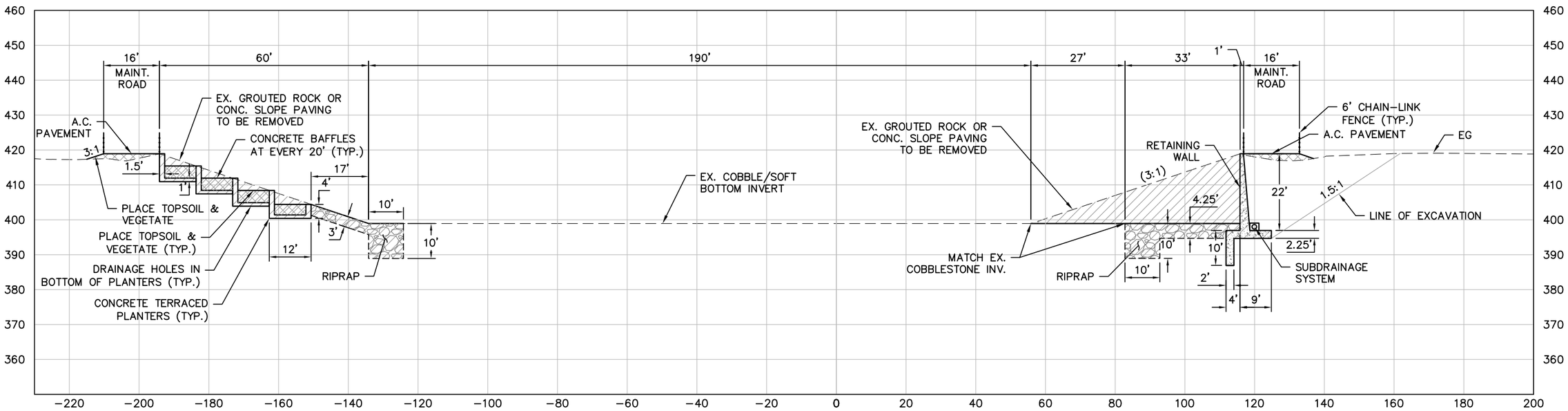

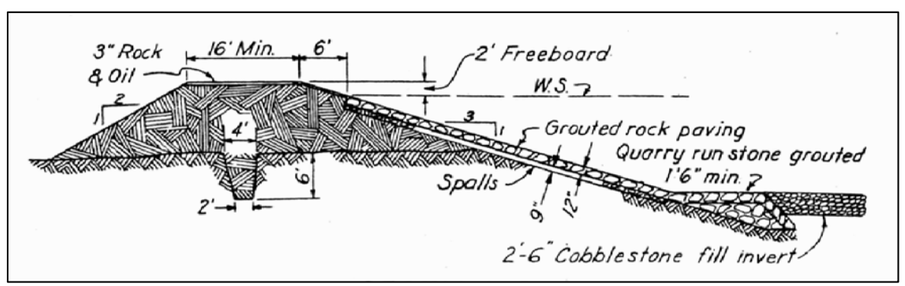

EXISTING TYPICAL SECTION
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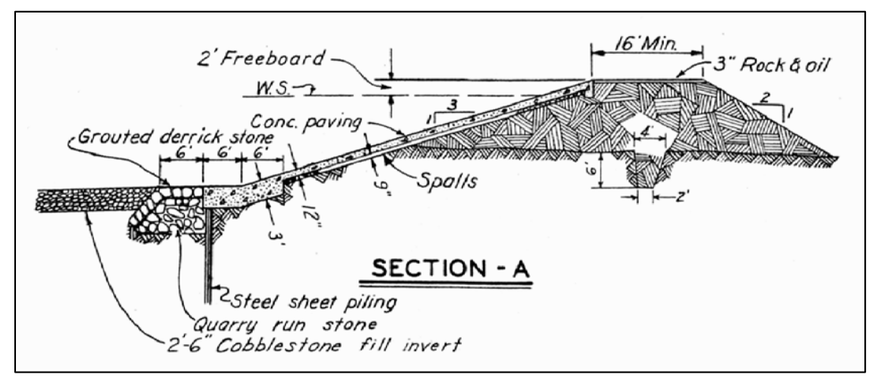

EXISTING TYPICAL SECTION
NTS

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		

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LOS ANGELES RIVER FEASIBILITY STUDY
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ARBOR REACH
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10/25/11

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5 OF 19

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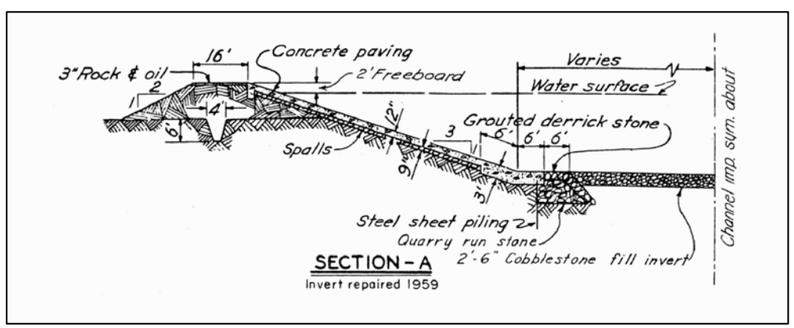

EXISTING TYPICAL SECTION
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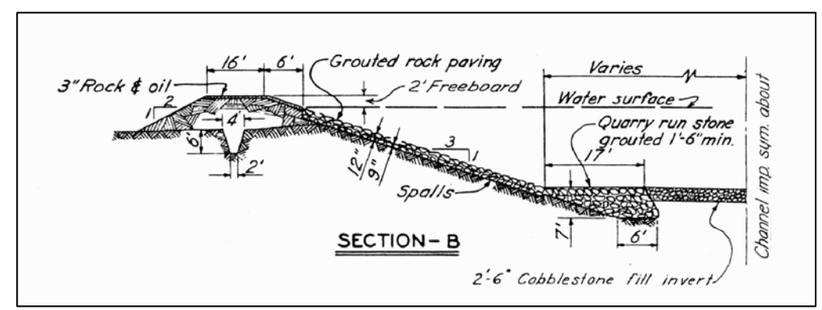

EXISTING TYPICAL SECTION
NTS

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		

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 6a

DATE 10/25/11

SHT NO. 6 OF 19

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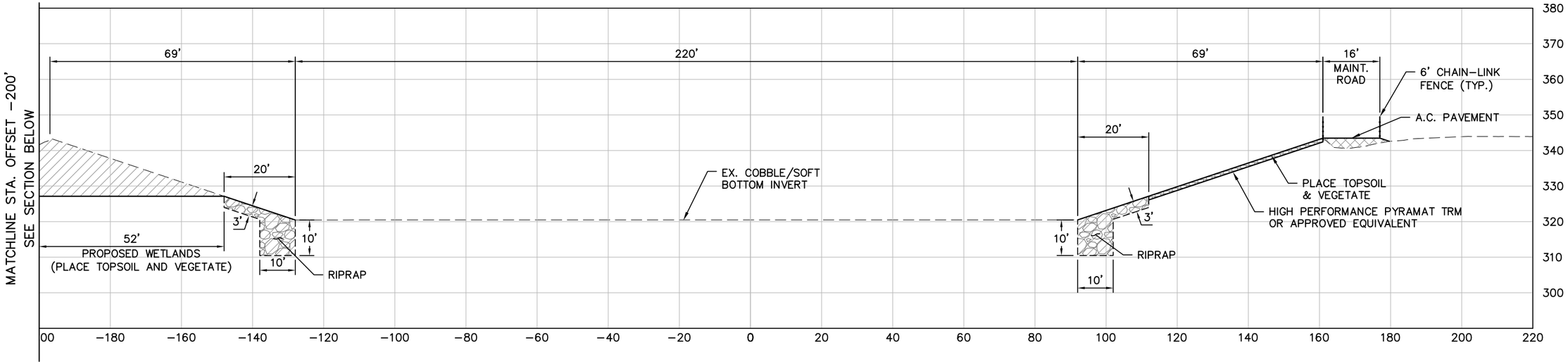

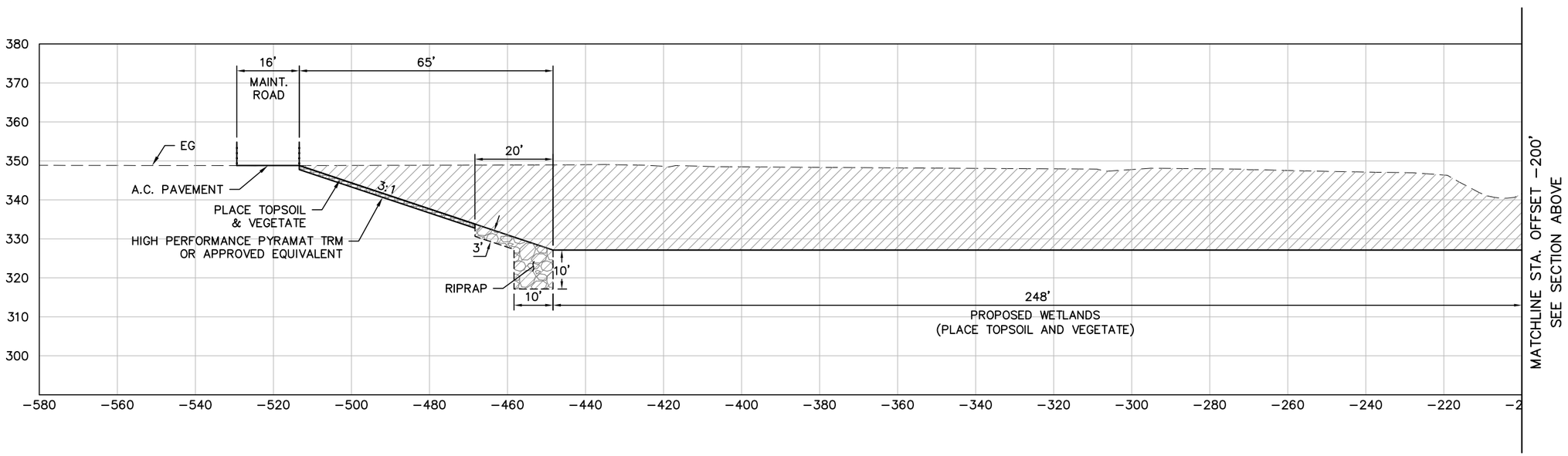

0 15 30 60

LEGEND

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

NOTE: EXISTING TYPICAL SECTIONS PER SHEET 6

REVISIONS			
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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 6b

DATE 10/25/11

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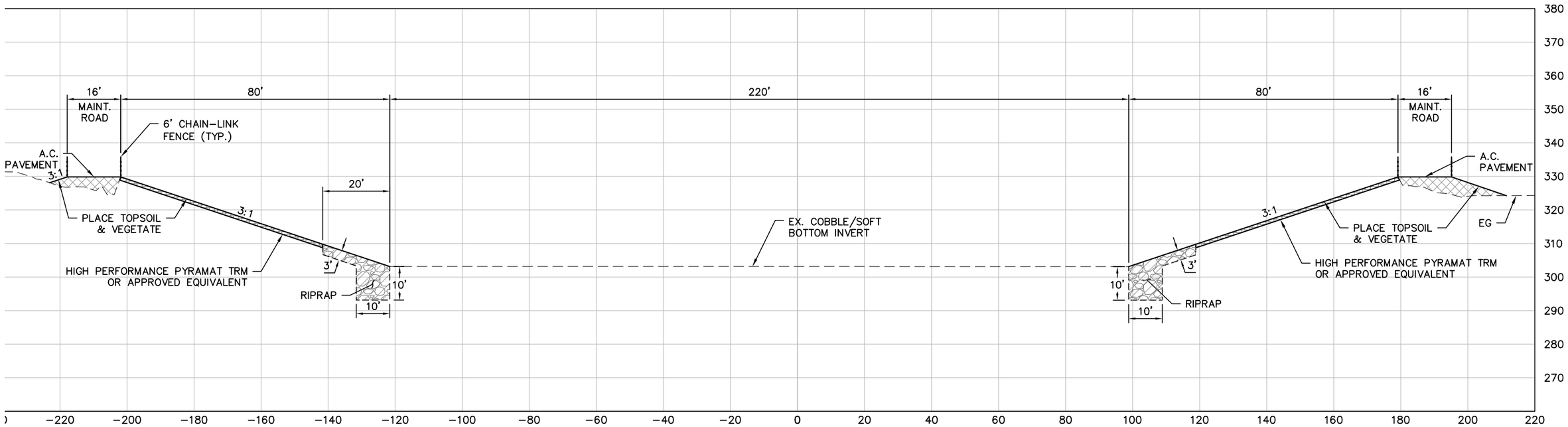

LEGEND

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

0 15 30 60

NOTE: EXISTING TYPICAL SECTIONS PER SHEET 6

REVISIONS			
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TETRA TECH, INC.
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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 6c

DATE
10/25/11

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8 OF 19

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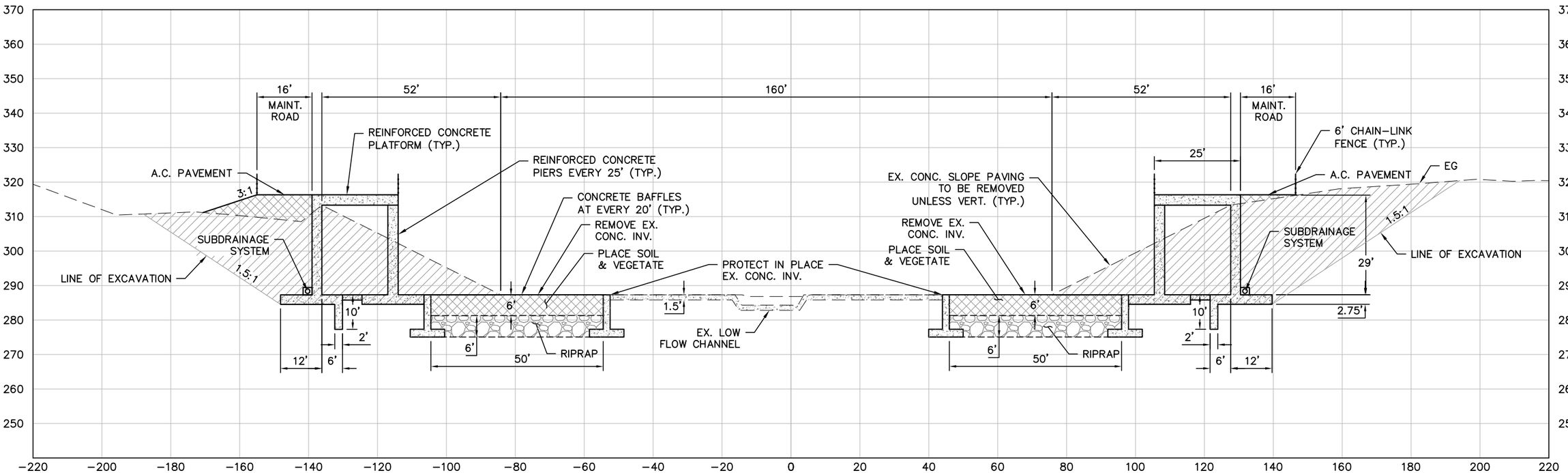

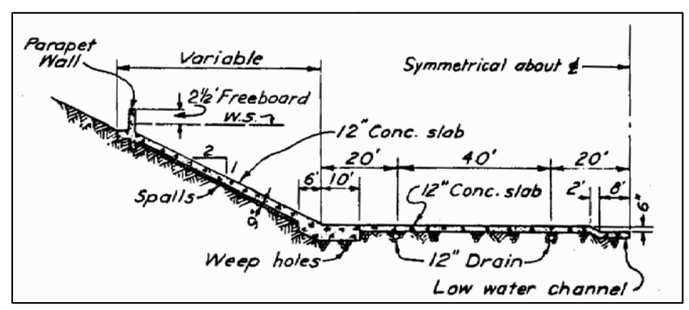

EXISTING TYPICAL SECTION
NTS

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		

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 7

DATE
10/25/11

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9 OF 19

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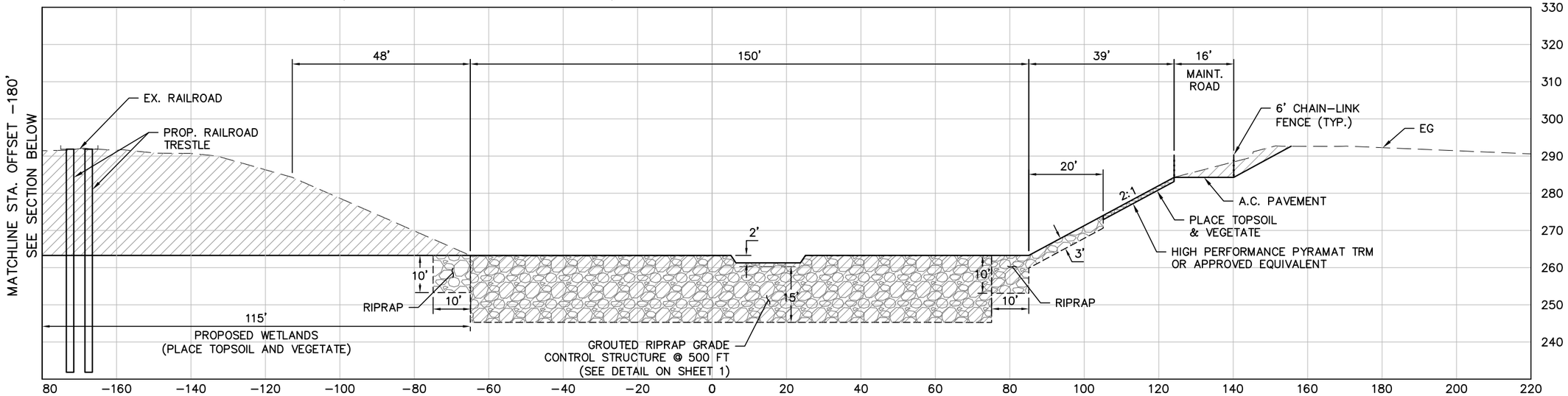

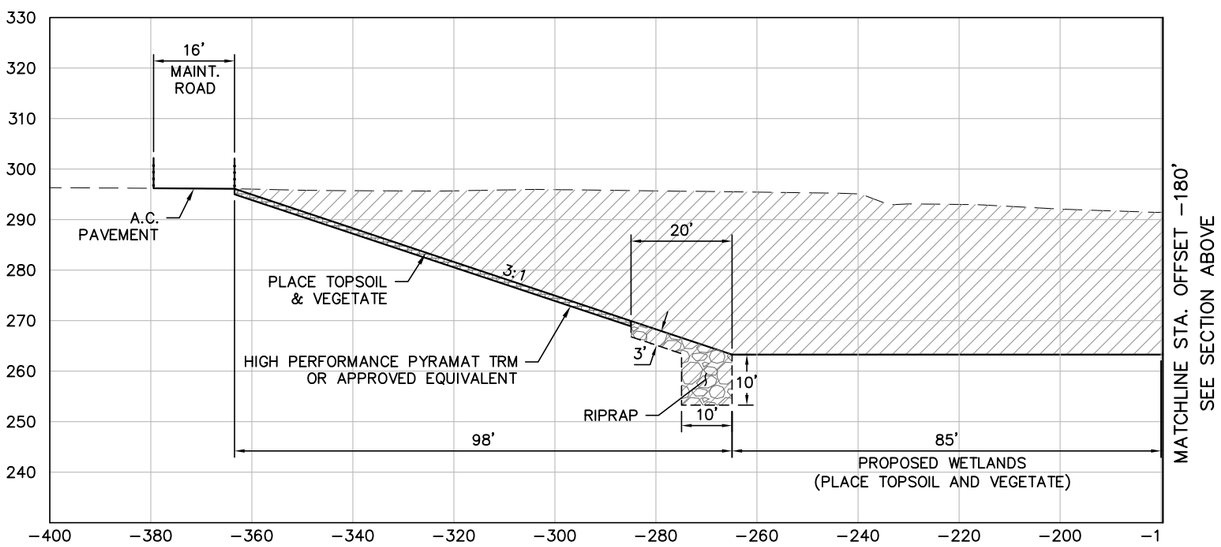

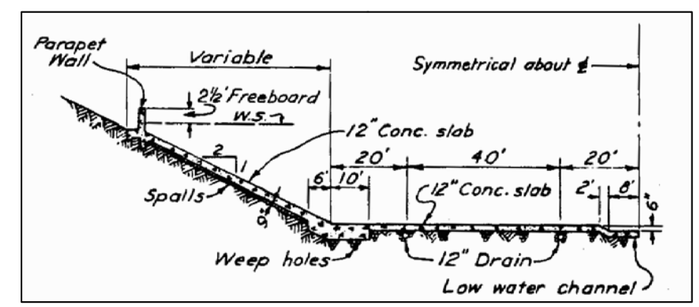

EXISTING TYPICAL SECTION
NTS

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

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LOS ANGELES RIVER FEASIBILITY STUDY
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CROSS SECTION 8a

DATE 10/25/11

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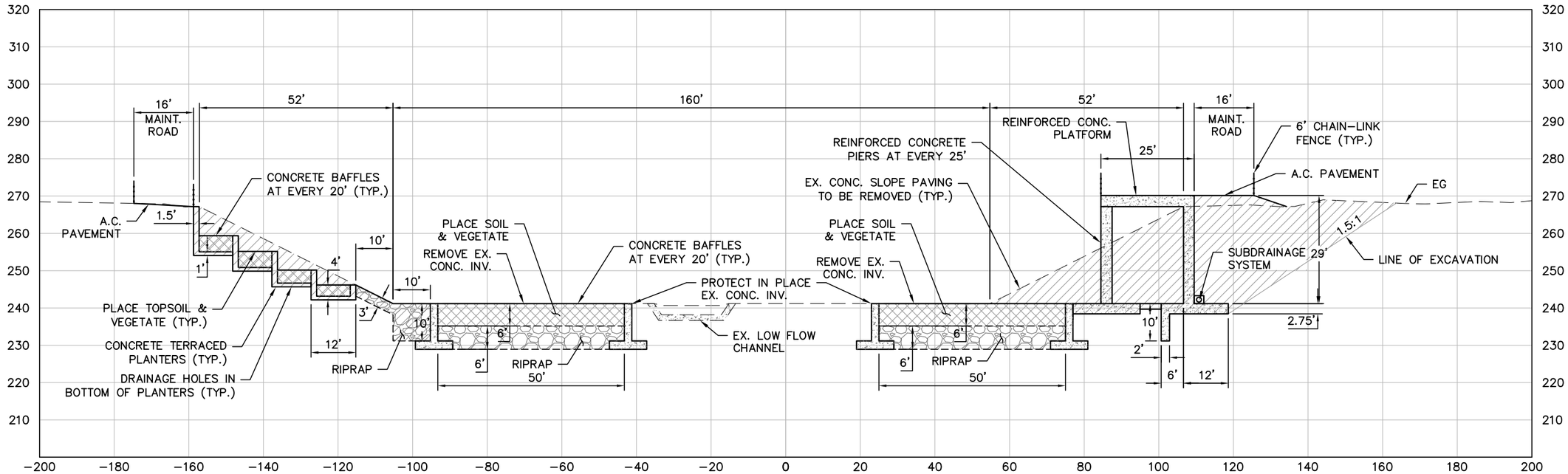

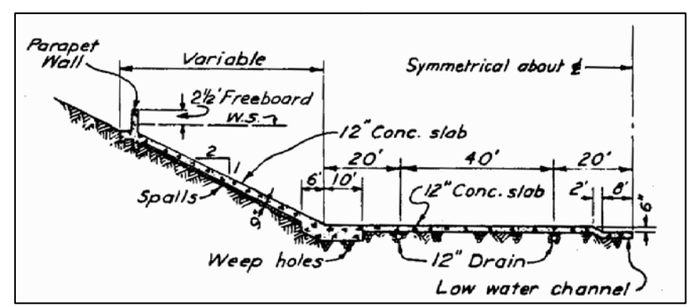

EXISTING TYPICAL SECTION
NTS

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		

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARBOR REACH
CROSS SECTION 8b

DATE
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11 OF 19

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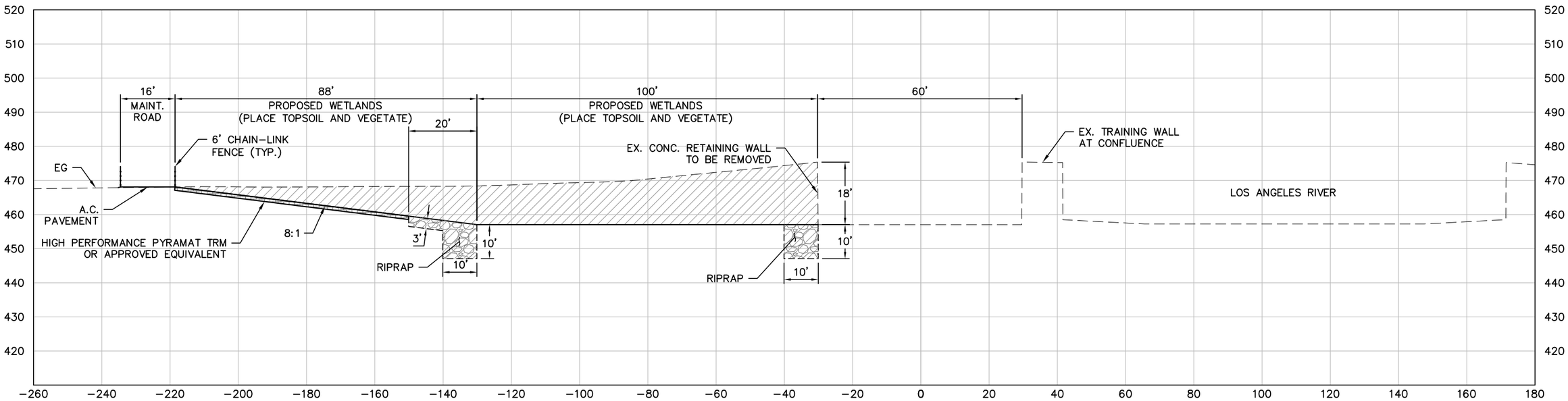

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LEGEND

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

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

BURBANK CHANNEL
CROSS SECTION

DATE
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12 OF 19

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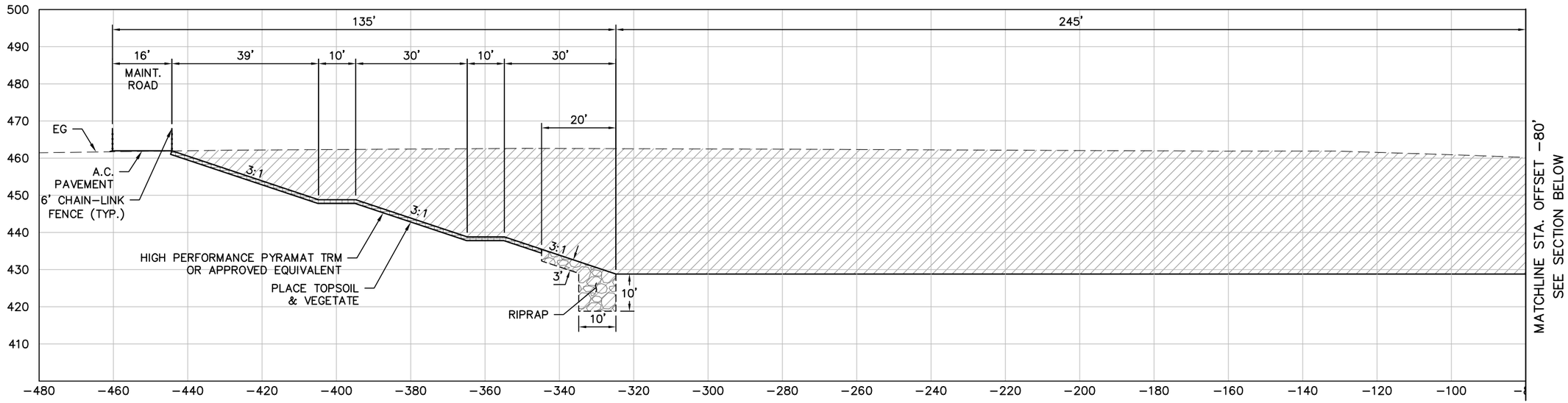

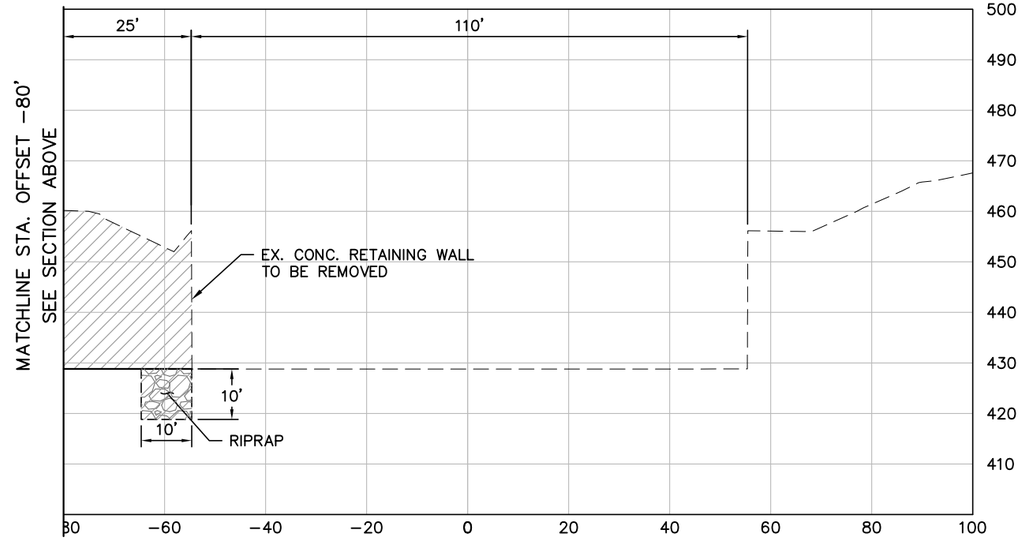

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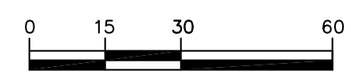
AS-BUILT DRAWING INFORMATION BEING AQUIRED.



LEGEND

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

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

VERDUGO WASH
CROSS SECTION 1

DATE
10/25/11

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13 OF 19

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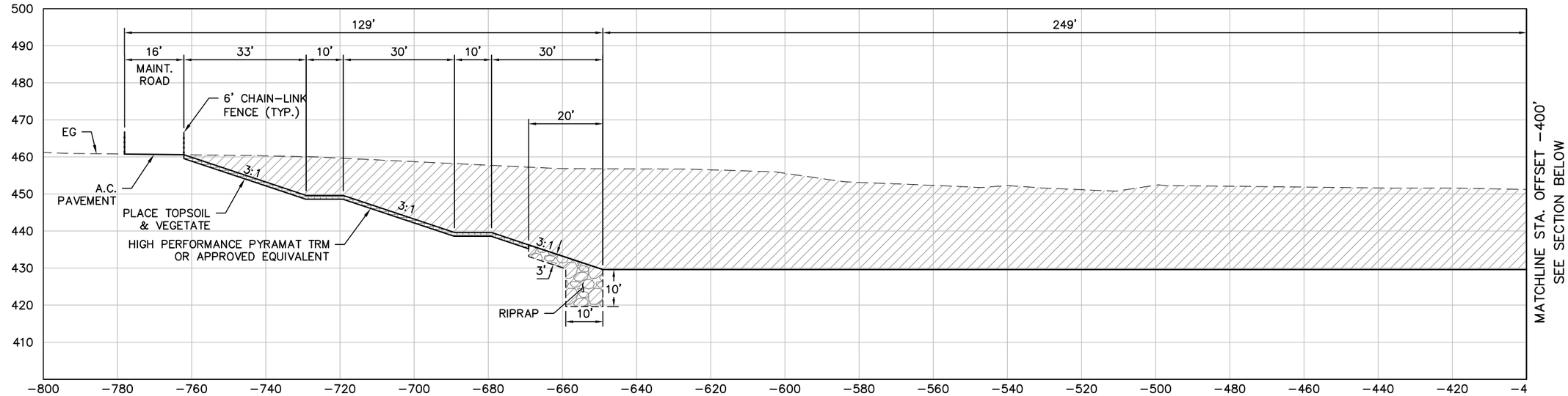

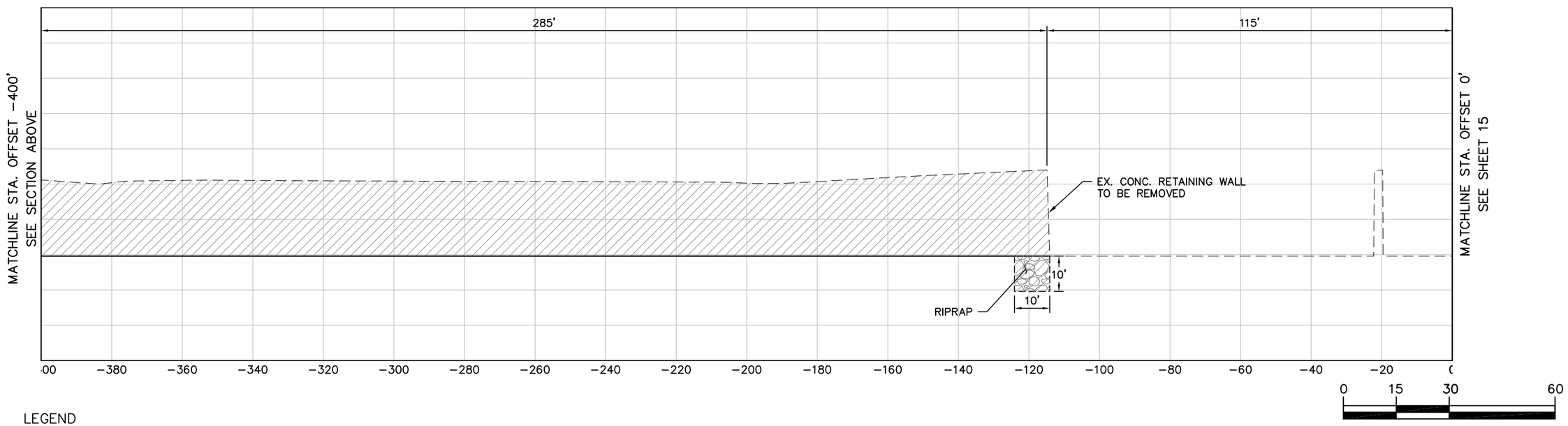

LEGEND

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

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LOS ANGELES RIVER FEASIBILITY STUDY
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VERDUGO WASH
CROSS SECTION 2

DATE
10/25/11

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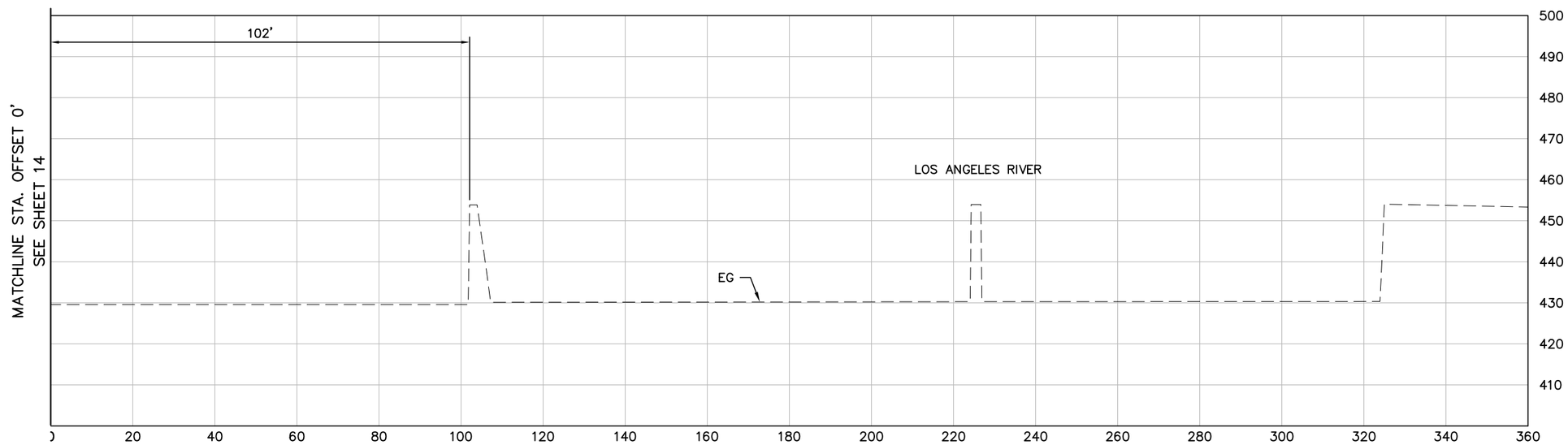

0 15 30 60

LEGEND

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

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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

VERDUGO WASH
CROSS SECTION 2 CONT.

DATE
10/25/11

SHT NO.
15 OF 19

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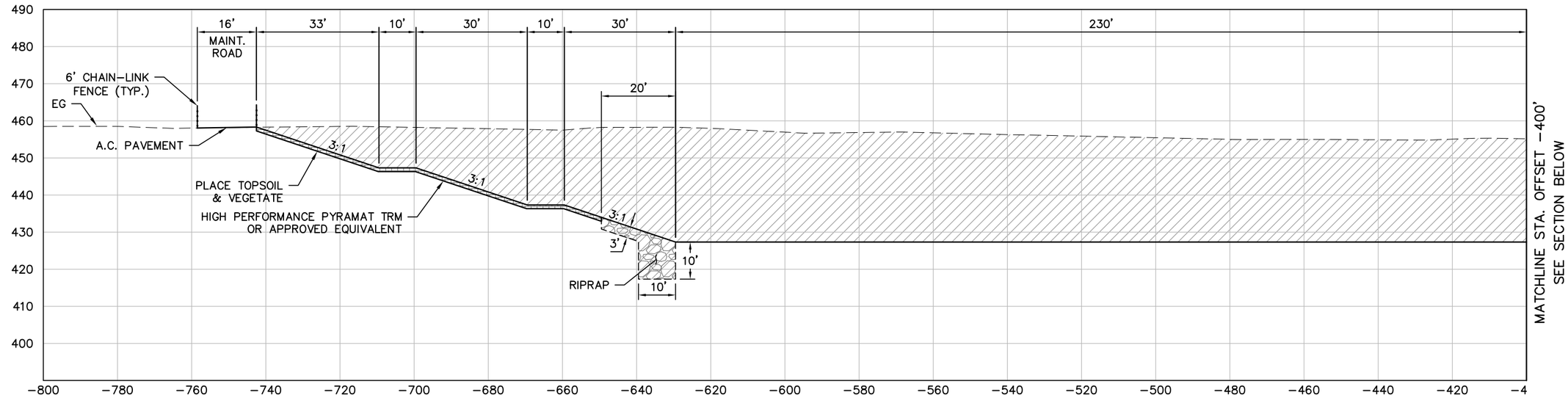

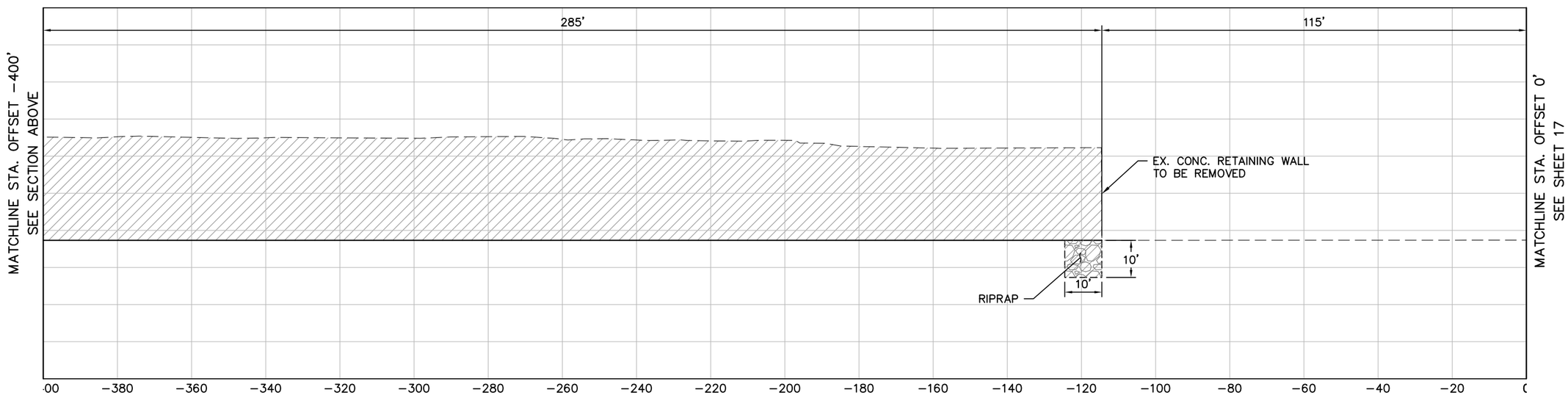

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LEGEND

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

REVISIONS			
MARK	DATE	DESCRIPTION	BY

TETRA TECH, INC.
17885 Von Karman Avenue, Suite 500
Irvine, CA 92614
Phone (949) 809–5103, FAX (949) 809–5003

LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

VERDUGO WASH
CROSS SECTION 3

DATE
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SHT NO.
16 OF 19

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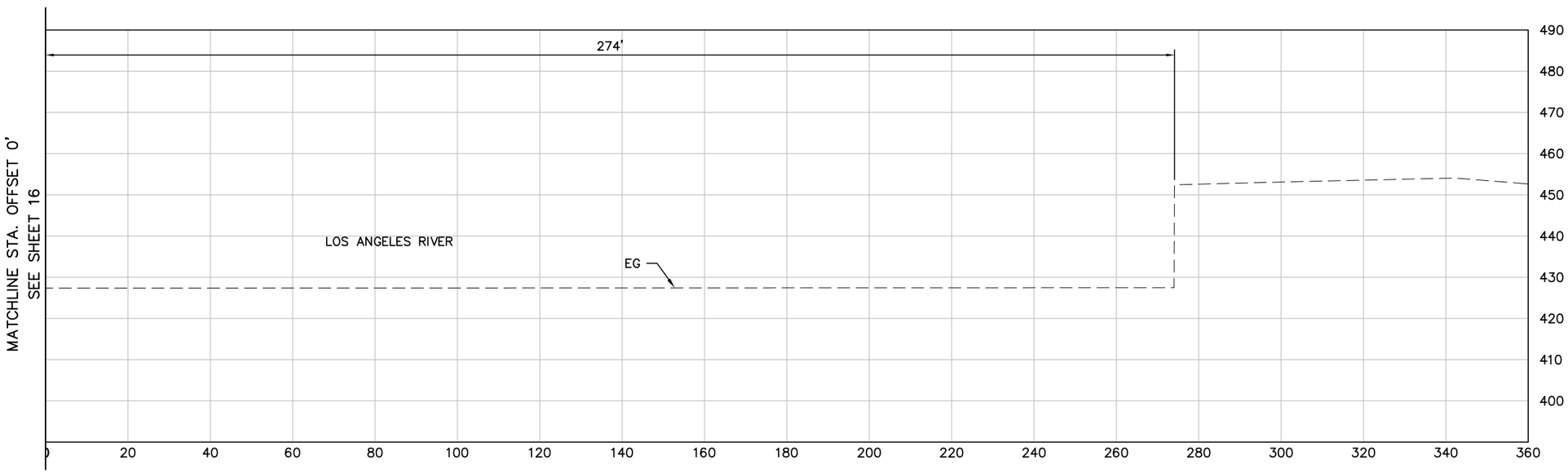

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LEGEND

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

REVISIONS			
MARK	DATE	DESCRIPTION	BY

TETRA TECH, INC.
17885 Von Karman Avenue, Suite 500
Irvine, CA 92614
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LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

VERDUGO WASH
CROSS SECTION 3 CONTINUED

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17 OF 19

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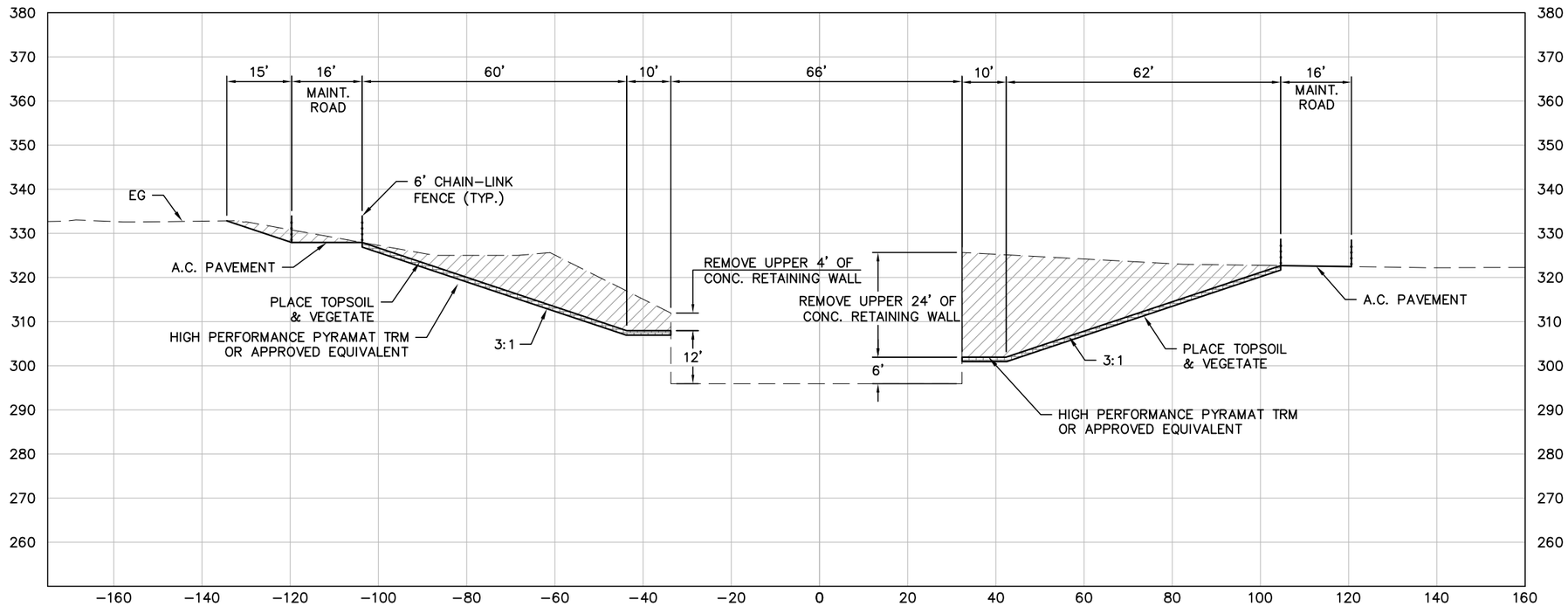

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LEGEND

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

REVISIONS			
MARK	DATE	DESCRIPTION	BY

TETRA TECH, INC.
17885 Von Karman Avenue, Suite 500
Irvine, CA 92614
Phone (949) 809–5103, FAX (949) 809–5003

LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

ARROYO SECO
CROSS SECTION

DATE
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18 OF 19

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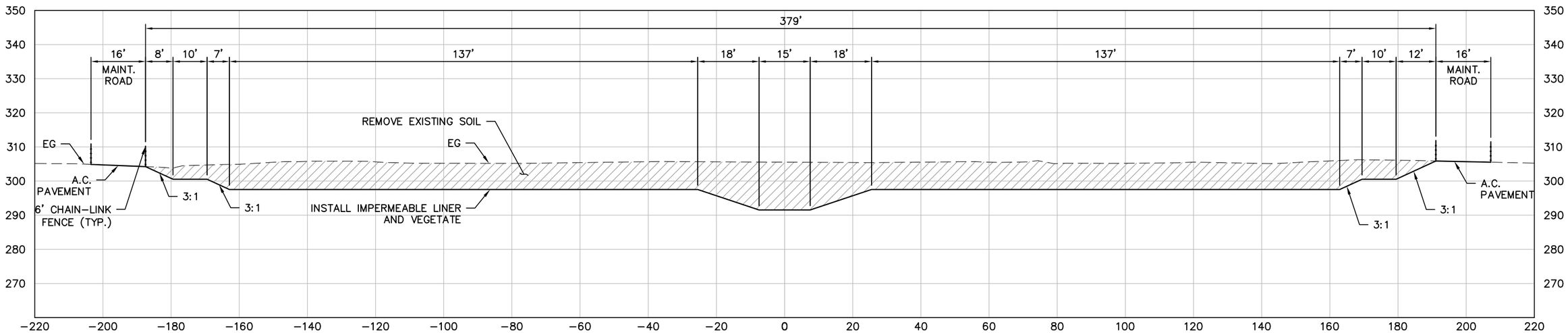

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LEGEND

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

REVISIONS			
MARK	DATE	DESCRIPTION	BY

TETRA TECH, INC.
17885 Von Karman Avenue, Suite 500
Irvine, CA 92614
Phone (949) 809-5103, FAX (949) 809-5003

LOS ANGELES RIVER FEASIBILITY STUDY
PRELIMINARY DESIGN

CORN FIELD
CROSS SECTION

DATE
10/25/11

SHT NO.
19 OF 19

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CHAP Appendix
Appendix H
Gross & Net HUs
by Reach by Alternative

Gross Benefits by Reach		Baseline	Alternative 1: Comprehensive	Alternative 2: City: Atwater to Cornfields	Alternative 3: Banks and Tribs Only	Alternative 4: Highest Scoring Objectives (over 3)	Alternative 5: City: Los Feliz to Arroyo Seco	Alternative 6: Corps Team	Alternative 7: Highest Scoring Objectives (over 5)	Alternative 8: Charette Team 1	Alternative 9: Soft Bottom Channel and Associated Banks	Alternative 10: Highest Other Criteria (over 11)	Alternative 11: Charette Team 4	Alternative 12: Charette Team 3	Alternative 13: Charette Team 6	Alternative 14: Charette Team 5	Alternative 15: Charette Team 2	Alternative 16: Side Channels Only	Alternative 17: Charette Team 7	Alternative 18: Comprehensive Pockets	Alternative 19: Taylor Yard
Reach 1	Initial (HUs)	901.86	1,939.13	901.86	1,904.93	1,817.34	901.86	1,820.24	907.33	1,845.32	1,711.96	1,904.93	1,615.61	1,786.86	1,821.07	1,871.93	1,808.59	1,648.99	1,871.55	1,615.61	901.86
155.81	25 year (HUs)	761.22	1,974.53	761.22	1,936.04	1,858.72	761.22	1,827.05	766.69	1,855.08	1,716.79	1,936.04	1,629.78	1,812.45	1,850.94	1,922.21	1,849.03	1,644.39	1,921.43	1,629.78	761.22
Acres	50 year (HUs)	618.23	1,980.58	618.23	1,938.46	1,857.86	618.23	1,825.17	623.70	1,856.66	1,714.91	1,938.46	1,624.45	1,815.74	1,857.87	1,929.81	1,848.00	1,633.87	1,929.03	1,624.45	618.23
Reach 2	Initial (HUs)	432.76	798.41	432.76	742.37	774.55	432.76	767.35	774.55	798.42	767.35	767.35	735.55	760.52	779.11	735.55	735.55	742.38	519.69	432.76	432.76
48.00	25 year (HUs)	392.01	856.32	392.01	791.02	827.16	392.01	821.16	827.16	856.32	821.16	821.16	788.16	818.30	839.33	788.16	788.16	791.02	506.65	392.01	392.01
Acres	50 year (HUs)	361.62	905.96	361.62	833.04	871.51	361.62	866.57	871.52	905.96	866.57	866.57	832.52	866.06	905.44	832.52	832.52	833.04	500.68	361.62	361.62
Reach 3	Initial (HUs)	613.67	1,038.07	927.86	1,064.28	916.25	613.67	913.45	782.06	981.51	952.23	896.48	949.51	846.07	1,035.65	789.49	712.92	776.98	642.28	890.77	613.67
101.15	25 year (HUs)	585.23	1,085.32	950.50	1,129.73	947.88	585.23	932.87	780.61	1,013.24	994.35	928.11	991.29	851.63	1,093.42	786.11	694.23	784.30	626.67	916.28	585.23
Acres	50 year (HUs)	510.27	1,106.16	960.21	1,179.83	970.27	510.27	940.46	767.89	1,037.04	984.42	950.51	982.55	817.69	1,133.61	734.47	629.71	745.65	559.87	889.12	510.27
Reach 4	Initial (HUs)	937.93	1,657.21	1,657.21	1,574.76	1,657.21	1,500.94	1,657.21	1,657.21	1,529.90	1,341.77	1,574.76	1,386.36	1,330.53	1,500.84	1,303.91	1,029.24	1,344.67	1,029.24	937.93	937.93
93.16	25 year (HUs)	890.93	1,741.15	1,741.15	1,642.86	1,741.15	1,564.35	1,741.15	1,741.15	1,589.63	1,365.59	1,642.86	1,419.78	1,353.32	1,556.15	1,321.50	1,011.99	1,387.55	1,011.99	890.93	890.93
Acres	50 year (HUs)	860.53	1,821.73	1,821.73	1,711.55	1,821.73	1,623.66	1,821.73	1,821.73	1,652.06	1,401.05	1,711.55	1,465.59	1,376.28	1,617.53	1,355.41	1,004.91	1,425.59	1,004.91	860.53	860.53
Reach 5	Initial (HUs)	811.23	1,083.85	1,083.85	984.26	978.05	1,083.85	970.54	977.96	1,017.04	860.73	811.23	1,094.07	811.23	1,017.04	811.23	811.23	860.73	811.23	811.23	811.23
67.71	25 year (HUs)	754.59	1,113.52	1,113.52	985.24	978.05	1,113.52	970.91	977.96	1,038.01	845.40	754.59	1,110.74	754.59	1,038.01	754.59	754.59	845.40	754.59	754.59	754.59
Acres	50 year (HUs)	729.35	1,143.96	1,143.96	1,002.51	978.05	1,143.96	970.97	977.96	1,059.75	845.46	729.35	1,128.01	729.35	1,059.75	729.35	729.35	845.46	729.35	729.35	729.35
Reach 6	Initial (HUs)	1,623.73	2,892.08	2,892.07	2,879.59	2,696.25	2,892.07	2,739.04	2,740.28	2,926.65	2,739.04	2,870.14	2,923.61	2,879.59	2,854.73	2,686.92	2,739.04	2,094.06	2,173.79	2,879.59	2,712.87
164.33	25 year (HUs)	1,534.70	3,041.53	3,041.53	3,027.83	2,818.04	3,041.53	2,868.82	2,883.89	3,096.69	2,868.82	3,017.13	3,093.68	3,027.83	2,999.28	2,808.70	2,868.82	2,119.24	2,209.45	3,027.83	2,839.23
Acres	50 year (HUs)	1,484.72	3,153.51	3,153.51	3,138.55	2,901.35	3,153.51	2,960.41	3,000.84	3,241.02	2,960.41	3,126.57	3,238.04	3,138.55	3,106.18	2,892.01	2,960.41	2,123.70	2,224.76	3,138.55	2,928.05
Reach 7	Initial (HUs)	367.49	923.89	923.89	897.37	846.09	819.08	872.61	649.14	896.70	394.01	896.70	896.70	588.80	897.37	536.04	846.09	671.68	677.54	897.37	367.49
58.90	25 year (HUs)	346.46	998.25	998.25	968.19	910.78	883.09	940.85	677.24	967.90	376.52	967.90	967.90	607.23	968.19	547.68	910.78	697.68	709.56	968.19	346.46
Acres	50 year (HUs)	311.25	1,035.60	1,035.60	1,004.70	940.63	917.27	971.53	699.25	1,004.50	342.15	1,004.50	1,004.50	603.36	1,004.70	536.76	940.63	690.86	715.11	1,004.70	311.25
Reach 8	Initial (HUs)	430.71	2,588.27	430.71	2,664.22	2,555.66	430.71	2,528.23	2,089.10	2,369.54	448.95	2,162.68	2,448.70	2,370.63	1,103.82	2,162.68	2,340.14	2,302.25	1,074.41	430.71	430.71
153.31	25 year (HUs)	425.58	2,846.53	425.58	2,930.99	2,809.65	425.58	2,769.79	2,274.19	2,625.92	445.47	2,374.01	2,715.58	2,608.07	1,158.78	2,374.01	2,592.65	2,510.32	1,125.51	425.58	425.58
Acres	50 year (HUs)	415.36	3,069.37	415.36	3,164.50	3,028.42	415.36	2,981.45	2,424.22	2,834.58	435.50	2,545.29	2,935.12	2,781.84	1,211.05	2,545.29	2,797.32	2,685.56	1,173.78	415.36	415.36
Total	Initial (HUs)	6,119.38	12,920.89	9,250.21	12,711.76	12,241.40	8,674.95	12,268.67	10,577.63	12,365.07	9,216.04	11,884.26	12,050.11	11,374.23	11,009.62	10,897.76	11,022.81	10,441.76	8,799.73	8,895.97	7,208.52
842.36	25 year (HUs)	5,690.71	13,657.14	9,423.75	13,411.89	12,891.42	8,766.52	12,872.59	10,928.89	13,042.78	9,434.10	12,441.81	12,716.92	11,833.42	11,504.09	11,302.94	11,470.26	10,779.91	8,865.86	9,005.18	6,995.24
Acres	50 year (HUs)	5,291.32	14,216.86	9,510.22	13,973.13	13,369.81	8,743.87	13,338.28	11,187.12	13,591.57	9,550.47	12,872.80	13,210.78	12,128.88	11,896.13	11,555.62	11,742.84	10,983.74	8,837.49	9,023.68	6,734.65

Net Benefits by Reach		Baseline	Alternative 1: Comprehensive	Alternative 2: City: Atwater to Cornfields	Alternative 3: Banks and Tribs Only	Alternative 4: Highest Scoring Objectives (over 3)	Alternative 5: City: Los Feliz to Arroyo Seco	Alternative 6: Corps Team	Alternative 7: Highest Scoring Objectives (over 5)	Alternative 8: Charette Team 1	Alternative 9: Soft Bottom Channel and Associated Banks	Alternative 10: Highest Other Criteria (over 11)	Alternative 11: Charette Team 4	Alternative 12: Charette Team 3	Alternative 13: Charette Team 6	Alternative 14: Charette Team 5	Alternative 15: Charette Team 2	Alternative 16: Side Channels Only	Alternative 17: Charette Team 7	Alternative 18: Comprehensive Pockets	Alternative 19: Taylor Yard
Reach 1	Initial (HUs)	0.00	1,037.27	0.00	1,003.07	915.48	0.00	918.38	5.48	943.46	810.10	1,003.07	713.76	885.01	919.21	970.08	906.73	747.13	969.69	713.76	0.00
155.81	25 year (HUs)	0.00	1,213.31	0.00	1,174.82	1,097.51	0.00	1,065.84	5.48	1,093.86	955.58	1,174.82	868.57	1,051.23	1,089.72	1,160.99	1,087.81	883.18	1,160.22	868.57	0.00
Acres	50 year (HUs)	0.00	1,362.35	0.00	1,320.23	1,239.63	0.00	1,206.94	5.48	1,238.43	1,096.68	1,320.23	1,006.22	1,197.52	1,239.64	1,311.58	1,229.77	1,015.65	1,310.80	1,006.22	0.00
Reach 2	Initial (HUs)	0.00	365.65	0.00	309.61	341.79	0.00	334.59	341.79	365.66	334.59	334.59	302.79	327.76	346.35	302.79	302.79	309.62	86.93	0.00	0.00
48.00	25 year (HUs)	0.00	464.31	0.00	399.01	435.15	0.00	429.15	435.15	464.31	429.15	429.15	396.15	426.29	447.32	396.15	396.15	399.01	114.65	0.00	0.00
Acres	50 year (HUs)	0.00	544.34	0.00	471.42	509.90	0.00	504.96	509.90	544.34	504.96	504.96	470.90	504.44	543.83	470.90	470.90	471.42	139.07	0.00	0.00
Reach 3	Initial (HUs)	0.00	424.40	314.19	450.60	302.58	0.00	299.78	168.39	367.84	338.56	282.81	335.84	232.40	421.98	175.82	99.25	163.31	28.61	277.10	0.00
101.15	25 year (HUs)	0.00	500.09	365.27	544.51	362.65	0.00	347.64	195.38	428.01	409.12	342.88	406.06	266.40	508.19	200.88	109.01	199.07	41.44	331.05	0.00
Acres	50 year (HUs)	0.00	595.89	449.95	669.56	460.01	0.00	430.19	257.63	526.77	474.16	440.24	472.28	307.43	623.34	224.20	119.45	235.39	49.60	378.86	0.00
Reach 4	Initial (HUs)	0.00	719.28	719.28	636.83	719.28	563.01	719.28	719.28	591.97	403.84	636.83	448.43	392.60	562.91	365.98	91.31	406.75	91.31	0.00	0.00
93.16	25 year (HUs)	0.00	850.22	850.22	751.93	850.22	673.42	850.22	850.22	698.70	474.66	751.93	528.85	462.39	665.22	430.57	121.06	496.62	121.06	0.00	0.00
Acres	50 year (HUs)	0.00	961.20	961.20	851.02	961.20	763.13	961.20	961.20	791.53	540.52	851.02	605.07	515.76	757.01	494.89	144.38	565.06	144.38	0.00	0.00
Reach 5	Initial (HUs)	0.00	272.62	272.62	173.03	166.82	272.62	159.31	166.73	205.80	49.50	0.00	282.84	0.00	205.80	0.00	0.00	49.50	0.00	0.00	0.00
67.71	25 year (HUs)	0.00	358.93	358.93	230.64	223.46	358.93	216.31	223.37	283.42	90.81	0.00	356.15	0.00	283.42	0.00	0.00	90.81	0.00	0.00	0.00
Acres	50 year (HUs)	0.00	414.60	414.60	273.16	248.70	414.60	241.61	248.61	330.39	116.11	0.00	398.66	0.00	330.39	0.00	0.00	116.11	0.00	0.00	0.00
Reach 6	Initial (HUs)	0.00	1,268.34	1,268.34	1,255.86	1,072.52	1,268.34	1,115.31	1,116.55	1,302.92	1,115.31	1,246.41	1,299.88	1,255.86	1,231.00	1,063.18	1,115.31	470.33	550.06	1,255.86	1,089.14
164.33	25 year (HUs)	0.00	1,506.83	1,506.83	1,493.13	1,283.33	1,506.83	1,334.12	1,349.19	1,561.98	1,334.12	1,482.43	1,558.98	1,493.13	1,464.58	1,274.00	1,334.12	584.54	674.74	1,493.13	1,304.53
Acres	50 year (HUs)	0.00	1,668.80	1,668.80	1,653.83	1,416.63	1,668.80	1,475.69	1,516.12	1,756.31	1,475.69	1,641.85	1,753.32	1,653.83	1,621.46	1,407.29	1,475.69	638.99	740.04	1,653.83	1,443.34
Reach 7	Initial (HUs)	0.00	556.40	556.40	529.88	478.60	451.60	505.12	281.65	529.21	26.52	529.21	529.21	221.31	529.88	168.55	478.60	304.19	310.05	529.88	0.00
58.90	25 year (HUs)	0.00	651.79	651.79	621.73	564.33	536.63	594.39	330.78	621.45	30.06	621.45	621.45	260.78	621.73	201.22	564.33	351.22	363.11	621.73	0.00
Acres	50 year (HUs)	0.00	724.35	724.35	693.45	629.38	606.02	660.28	388.00	693.25	30.90	693.25	693.25	292.11	693.45	225.51	629.38	379.61	403.87	693.45	0.00
Reach 8	Initial (HUs)	0.00	2,157.55	0.00	2,233.51	2,124.95	0.00	2,097.52	1,658.38	1,938.83	18.24	1,731.97	2,017.99	1,939.91	673.10	1,731.97	1,909.43	1,871.54	643.70	0.00	0.00
153.31	25 year (HUs)	0.00	2,420.95	0.00	2,505.41	2,384.07	0.00	2,344.22	1,848.62	2,200.34	19.89	1,948.43	2,290.01	2,182.49	733.20	1,948.43	2,167.07	2,084.74	699.93	0.00	0.00
Acres	50 year (HUs)	0.00	2,654.00	0.00	2,749.14	2,613.05	0.00	2,566.09	2,008.86	2,419.22	20.13	2,129.93	2,519.76	2,366.47	795.68	2,129.93	2,381.95	2,270.20	758.41	0.00	0.00
Total	Initial (HUs)	0.00	6,801.51	3,130.83	6,592.38	6,122.02	2,555.57	6,149.29	4,458.25	6,245.69	3,096.66	5,764.88	5,930.73	5,254.85	4,890.24	4,778.38	4,903.43	4,322.38	2,680.35	2,776.59	1,089.14
842.36	25 year (HUs)	0.00	7,966.43	3,733.04	7,721.18	7,200.71	3,075.81	7,181.88	5,238.18	7,352.07	3,743.39	6,751.10	7,026.21	6,142.71	5,813.38	5,612.23	5,779.55	5,089.19	3,175.15	3,314.47	1,304.53
Acres	50 year (HUs)	0.00	8,925.55	4,218.90	8,681.81	8,078.49	3,452.55	8,046.97	5,895.80	8,300.25	4,259.15	7,581.48	7,919.46	6,837.56	6,604.81	6,264.30	6,451.52	5,692.42	3,546.17	3,732.36	1,443.34

CHAP Appendix
Appendix I
Net HUs by Reach
for Final Array of Alternatives

Final Array: Net HUs by Reach

River Reach		Future Without Project			Alternative 10 (ART)			Alternative 13 Alt 13 (ACE)		
	Acres	Base HUs	25 yr HUs	50 yr HUs	Base Net HUs	25 yr Net HUs	50 yr Net HUs	Base Net HUs	25 yr Net HUs	50 yr Net HUs
1	155.81	901.86	761.22	618.23	713.76	868.57	1,006.22	713.76	868.57	1,006.22
2	48.00	432.76	392.01	361.62	302.79	396.15	470.90	302.79	396.15	470.90
3	101.14	613.67	585.23	510.27	28.61	41.44	49.60	163.31	199.07	235.39
4	93.16	937.93	890.93	860.53	406.75	496.62	565.06	406.75	496.62	565.06
5	67.71	811.23	754.59	729.35	49.50	90.81	116.11	49.50	90.81	116.11
6	164.33	1623.73	1534.70	1484.72	1,063.18	1,274.00	1,407.29	1,231.00	1,464.58	1,621.46
7	58.90	367.49	346.46	311.25	26.52	30.06	30.90	221.31	260.78	292.11
8	153.32	430.71	425.58	415.36	1,909.43	2,167.07	2,381.95	1,909.43	2,167.07	2,381.95
	842.37	6119.38	5690.71	5291.32	4,500.54	5,364.72	6,028.03	4,997.85	5,943.65	6,689.20

River Reach	Alternative 13v			Alternative 16 (AND)			Alternative 20 (RIVER)		
	Base Net HUs	25 yr Net HUs	50 yr Net HUs	Base Net HUs	25 yr Net HUs	50 yr Net HUs	Base Net HUs	25 yr Net HUs	50 yr Net HUs
1	713.76	868.57	1,006.22	713.76	868.57	1,006.22	713.76	868.57	1,006.22
2	302.79	396.15	470.90	302.79	396.15	470.90	346.35	447.32	543.83
3	163.31	199.07	235.39	163.31	199.07	235.39	277.10	331.05	378.86
4	406.75	496.62	565.06	406.75	496.62	565.06	406.75	496.62	565.06
5	49.50	90.81	116.11	272.62	358.93	414.60	272.62	358.93	414.60
6	1,231.00	1,464.58	1,621.46	1,231.00	1,464.58	1,621.46	1,231.00	1,464.58	1,621.46
7	304.19	351.22	379.61	221.31	260.78	292.11	304.19	351.22	379.61
8	1,909.43	2,167.07	2,381.95	2,233.51	2,505.41	2,749.14	2,233.51	2,505.41	2,749.14
	5,080.73	6,034.09	6,776.70	5,545.05	6,550.11	7,354.88	5,785.28	6,823.70	7,658.78

Alternative 10 (ART) [R1A11; R2A11; R3A17; R4A16; R5A16; R6A14; R7A9; R8A15]*
Alternative 13 Alt 13 (ACE) [R1A11; R2A11; R3A16; R4A16; R5A16; R6A13; R7A12; R8A15]*
Alternative 13v [R1A11; R2A11; R3A16; R4A16; R5A16; R6A13; R7A16; R8A15]*
Alternative 16 (AND) [R1A11; R2A11; R3A16; R4A16; R5A5; R6A13; R7A12; R8A3]*
Alternative 20 (RIVER) [R1A11; R2A13; R3A18; R4A16; R5A5; R6A13; R7A16; R8A3]*

*R#A#: This represents which of the original 19 alternatives each reach is derived from. For example, R1A11 means that Reach 1 of that final array alternative was derived from the original alternative 11.

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Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX H
Supplemental Environmental Information

Part 1- Supplemental Information

Part 2- Monitoring and Adaptive Management Plan

Part 3- Mitigation Monitoring and Reporting Program

September 2015

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Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX H, Part 1
Supplemental Environmental Information

April 2015

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Appendix H Supplemental Environmental Information

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1.0 Special Status and Sensitive Species

The greater Los Angeles Basin includes portions of the Angeles National Forest, the Santa Monica Mountains, and coastal areas where a number of sensitive plants and animals may occur. Sensitive species include plants or wildlife listed as threatened or endangered under the Federal Endangered Species Act (ESA) or as threatened, endangered, fully protected, or a species of concern under the state Endangered Species Act (CESA). Special status species also include plant species designated by the California Native Plant Society (CNPS) as presumed extinct in California (List 1A); plants designated as rare, threatened, or endangered in California and elsewhere (List 1B); and plants designated as being rare, threatened, or endangered in California but more common elsewhere (List 2).

The complete list of species that may occur in the study area was compiled by reviewing Federal, state, and other databases and comparing the habitat requirements of the species found in these lists to the types of habitat that occur in riparian areas of southern California waterways. These databases include the California Natural Diversity Database (CNDDB), which reports verifiable occurrences of sensitive species by USGS topographic quadrant (CNDDB 2012); U.S. Fish and Wildlife and California Department of Fish and Wildlife sensitive species lists for Los Angeles County (USFWS 2012a, and CDFW, 2012, respectively); and sensitive plant species lists developed by the California Native Plant Society (CNPS 2012).

From this initial list, those species that could occur in habitats that were identified in the CHAP appendix (Appendix G) were considered in greater detail. Although focused surveys for the species below were not performed, it was still determined that the potential for most of the species to exist there was low, for the following reasons: 1) Habitat patch size was very small, and although suitable habitat characteristics may occur, the size of the habitat patch may be too small or of insufficient quality to support the species, or 2) suitable habitat characteristics may occur, but the habitat patch itself is surrounded by highly unsuitable habitat such as developed areas, streets or freeways, golf courses, or other features that would act as barriers to passage into or out of the habitat patch. Species for which suitable habitat occurs in the study area are discussed in the EIS. All others were identified as “not likely to occur” and are listed below.

Table 1-1. Special Status Plant Species in the Greater Los Angeles Basin

Scientific Name	Common Name	Status Fed/State/ CNPS[1]	Habitat Requirements and Probability of Occurrence in Study Area[2]
Acmispon argophyllus var. adsurgens	San Clemente Island bird's-foot trefoil	NA/CE/ CNPS 1B	Coastal bluff scrub, coastal scrub. **Not expected**. Minimal suitable habitat onsite.
Acmispon dendroideus var. traskiae	San Clemente Island lotus	FE/CE/ CNPS 1B	Coastal bluff scrub, coastal scrub, valley and foothill grassland. **Not expected**. Some suitable habitat onsite.
Arenaria paludicola	Marsh sandwort	FE/CE/ CNPS 1B	Freshwater marsh, marsh and swamp, wetland. **Not expected**. Some suitable habitat onsite.
Astragalus brauntonii	Braunton's milk-vetch	FE/NA/ CNPS 1B	Coniferous forest, chaparral, coastal scrub, valley and foothill grasslands. **Not expected**. Some suitable habitat onsite.

Scientific Name	Common Name	Status Fed/State/ CNPS[1]	Habitat Requirements and Probability of Occurrence in Study Area[2]
Astragalus pycnostachyus var. lanosissimus	Ventura Marsh milk-vetch	FE/CE/ CNPS 1B	Marsh and swamp, salt marsh, wetland. **Not expected**. Some suitable habitat onsite.
Astragalus tener var. titi	Coastal dunes milk-vetch	FE/CE/ CNPS 1B	Coastal bluff scrub, coastal dunes. **Not expected**. Minimal suitable habitat onsite.
Berberis nevinii	Nevin's barberry	FE/CE/ CNPS 1B	Chaparral, cismontane woodland, coastal scrub, riparian scrub. **Not expected**. Some suitable habitat onsite.
Brodiaea filifolia	Thread-leaved brodiaea	FT/CE/ CNPS 1B	Vernal pools. **Not expected.** No suitable habitat onsite.
Chorizanthe parryi var. fernandina	San Fernando Valley spineflower	FC/CE/ CNPS 1B	Coastal scrub, sandy soils. Elevation 3 – 1035 meters. **Not expected**. Minimal suitable habitat onsite.
Delphinium variegatum ssp. kinkiense	San Clemente Island larkspur	FE/CE/ CNPS 1B	Valley and foothill grassland. **Not expected**. Some suitable habitat onsite.
Dithyrea maritima	Beach spectaclepod	NA/CT/ CNPS 1B	Coastal dunes, coastal scrub. **Not expected**. Minimal suitable habitat onsite.
Dodecahema leptoceras	Slender-horned spineflower	FE/CE/ CNPS 1B	Chaparral, coastal scrub, alluvial sage scrub. **Not expected**. Minimal suitable habitat onsite.
Dudleya cymosa ssp. agourensis	Agoura Hills dudleya	FT/NA/ CNPS 1B	Chaparral, cismontane woodland. **Not expected**. No suitable habitat onsite.
Dudleya cymosa ssp. marcescens	Marcescent dudleya	FT/CR/ CNPS 1B	Chaparral. **Not expected**. No suitable habitat onsite.
Dudleya cymosa ssp. ovatifolia	Santa Monica dudleya	FT/NA/ CNPS 1B	Chaparral, coastal scrub. **Not expected**. Minimal degraded habitat onsite.
Dudleya verityi	Verity's dudleya	FT/NA/NA	Chaparral, Foothill Woodland, Coastal Sage Scrub. **Not expected**. Some degraded habitat onsite.
Galium catalinense ssp. acrispum	San Clemente Island bedstraw	NA/CE/ CNPS 1B	Valley and foothill grassland. **Not expected**. Some degraded habitat onsite.
Helianthemum greenei	Island rush-rose	FT/NA/ CNPS 1B	Chaparral. **Not expected**. No suitable habitat onsite.
Malacothamnus clementinus	San Clemente Island bush-mallow	FE/CE/ CNPS 1B	Valley and foothill grassland. **Not expected**. Some degraded habitat onsite.
Nasturtium (Rorippa) gambelii	Gambel's water cress	FE/CT/ CNPS 1B	Brackish marsh, freshwater marsh, marsh and swamp, vernal pool, wetland. **Not expected**. Some suitable habitat onsite.
Navarretia fossalis	Spreading navarretia	FT/NA/ CNPS 1B	Vernal pools, chenopod scrub, marshes and swamps, wetland, playa. **Not expected**. Some suitable onsite.

Scientific Name	Common Name	Status Fed/State/ CNPS[1]	Habitat Requirements and Probability of Occurrence in Study Area[2]
Orcuttia californica	California Orcutt grass	FE/CE/ CNPS 1B	Vernal pool, wetland. **Not expected.** Some suitable habitat onsite.
Pentachaeta lyonii	Lyon's pentachaeta	FE/CE/ CNPS 1B	Chaparral, valley and foothill grassland. **Not expected**. Some degraded habitat onsite.
Phacelia stellaris	Brand's star phacelia	FC/NA/ CNPS 1B	Coastal dunes, coastal scrub. **Not expected**. Minimal degraded habitat onsite.

1 Status: USFWS: FE – Federal Endangered, FT – Federal Threatened, FC- Federal Species of Concern, NA – Not Applicable CDFG: CE – California Endangered, CT – California Threatened, CC – California Species of Special Concern, CR – California Rare, NA – Not Applicable. CNPS: 1A – Plants presumed extinct in California, 1B – Plants rare, threatened, or endangered in California, and elsewhere, NA – Non Applicable.

2 Probability to Occur Onsite: High – Observed in similar habitat in region, or habitat on the site is a type often utilized by the species and the site is within the known range of the species. Moderate – Reported sightings in surrounding region, or site is within the known range of the species and habitat on the site is a type occasionally used by the species. Low – Site is within the known range of the species but habitat on the site is rarely used by the species. Not Expected – A focused study failed to detect the species, or, no suitable habitat present.

Table 1-2. Special Status Animal Species in the Greater Los Angeles Basin

Scientific Name	Common Name	Status Federal/ State[1]	Habitat Requirements Probability of Occurrence in Study Area[2]
Ammospermophilus nelsoni	Nelson's antelope squirrel	NA/CT	Chenopod scrub. **Not expected.** No suitable habitat onsite.
Amphispiza belli clementeae	San Clemente sage sparrow	FT/NA	Coastal scrub. **Not expected**. Minimal degraded habitat onsite.
Anaxyrus (Bufo) californicus	Arroyo toad	FE/NA	Desert wash, riparian scrub, riparian woodland, south coast flowing waters, south coast standing waters. **Not expected**. Some suitable habitat onsite.
Anniella pulchra pulchra	Silvery legless lizard	NA/CC	Loose soils in chapparal or pine-oak woodlands. **Not expected.** No suitable habitat onsite.
Anniella stebbinsii	Southern CA legless lizard	NA/CC	Loose soils found under sparse vegetation of beaches, chaparral, sandy washes and stream terraces. **May occur.** Some suitable habitat onsite.
Athene cunicularia	Burrowing owl	NA/CC	Grasslands with friable soils. **Not expected.** No suitable habitat onsite.
Branchinecta lynchi	Vernal pond fairy shrimp	FT/NA	Vernal pools. **Not expected**. No suitable habitat onsite.
Buteo swainsoni	Swainson's hawk	NA/CT	Great Basin grassland, riparian forest, riparian woodland, valley and foothill grassland. **Not expected.** Some degraded habitat onsite
Catostomus santaanae	Santa Ana sucker	FT/NA	South coast flowing waters. **Not expected**. Some degraded habitat onsite.
Charadrius alexandrinus nivosus	Western snowy plover	FT/NA	Great Basin standing waters, sand shore, wetland **Not expected.** Some suitable habitat onsite.
Coccyzus americanus occidentalis	Western yellow-billed cuckoo	FC/CE	Riparian woodlands. **Not expected**. Some suitable habitat onsite.
Dipodomys merriami parvus	San Bernardino kangaroo rat	FE/NA	Coastal scrub. **Not expected.** Minimal degraded habitat onsite.
Empidonax traillii extimus	Southwestern willow flycatcher	FE/CE	Riparian woodlands. **Moderate**. Low quality suitable habitat onsite.
Eumops perotis californicus	Western mastiff bat	NA/CC	Chaparral, coastal scrub, forest and woodland. Roosts in rocky canyons and cliffs. **Not expected.** Minimal degraded habitat onsite.
Euphilotes battoides allyni	El Segundo blue butterfly	FE/NA	Coastal dunes. **Not expected.** Minimal degraded habitat onsite.
Euphydryas editha quino	Quino checkerspot butterfly	FE/NA	Coastal scrub. **Not expected**. Minimal degraded habitat onsite.

Scientific Name	Common Name	Status Federal/ State[1]	Habitat Requirements Probability of Occurrence in Study Area[2]
Gasterosteus aculeatus williamsoni	Unarmored threespine stickleback	FE/CE	South coast flowing waters. **Not expected.** Some degraded habitat onsite.
Glaucopsyche lygdamus palosverdesensis	Palos Verdes blue butterfly	FE/NA	Coastal scrub. **Not expected**. Minimal degraded habitat onsite.
Gymnogyps californianus	California condor	FE/CE	Valley and foothill grassland. **Not expected**. Some degraded habitat onsite.
Lanius ludovicianus mearnsi	San Clemente loggerhead shrike	FE/NA	Coastal scrub. **Not expected.** Minimal degraded habitat onsite.
Laterallus jamaicensis coturniculus	California black rail	NA/CT	Brackish marsh, freshwater marsh, marsh and swamp, salt marsh, wetland. **Not expected.** Some degraded habitat onsite.
Neotoma lepida intermedia	San Diego desert woodrat	NA/CC	Sagebrush scrub, chaparral. **Not expected.** Minimal habitat onsite.
Oncorhynchus mykiss irideus	Southern steelhead - southern California DPS	FE/NA	Aquatic, south coast flowing waters. **Not expected.** Some degraded habitat onsite.
Passerculus sandwichensis beldingi	Belding's savannah sparrow	NA/CE	Marsh and swamp, wetland. **Not expected.** Some degraded habitat onsite.
Perognathus longimembris pacificus	Pacific pocket mouse	FE/NA	Coastal scrub. **Not expected**. Minimal degraded habitat onsite.
Phrynosoma blainvilli	Coast horned lizard	NA/CC	Loose soils in grasslands, woodlands, and chaparral. **Not expected.** Minimal degraded habitat onsite.
Polioptila californica californica	Coastal California gnatcatcher	FT/NA	Coastal bluff scrub, coastal scrub. **Low**. Minimal degraded habitat onsite.
Rana draytonii	California red-legged frog	FT/NA	Aquatic, artificial flowing waters, artificial standing waters, freshwater marsh, riparian forest or scrub, riparian woodland, south coast flowing water, south coast standing waters, wetland. **Not expected.** Some degraded habitat onsite.
Rana muscosa	Sierra Madre yellow-legged frog	FE/CC	Aquatic. **Not expected**. Some degraded habitat onsite.
Riparia riparia	Bank swallow	NA/CT	Riparian scrub, riparian woodland. **Not expected**. Some suitable habitat onsite.
Sternula antillarum browni	California least tern	FE/CE	Wetland. **Not expected**. Some degraded habitat onsite.

Scientific Name	Common Name	Status Federal/ State[1]	Habitat Requirements Probability of Occurrence in Study Area[2]
Streptocephalus woottoni	Riverside fairy shrimp	FE/NA	Vernal pools, ponds, and other ephemeral pool-like bodies of water. **Not expected**. No suitable habitat onsite.
Thamnophis hammondii	Two-striped garter snake	NA/CC	Pools, creeks with nearby oak woodlands, chaparral, scrub-shrub. **Not expected.** Minimal viable habitat.
Vireo bellii pusillus	Least Bell's vireo	FE/CE	Riparian forest, riparian scrub, riparian woodland. **LOW**. Marginal habitat onsite.
Xerospermophilus mohavensis	Mohave ground squirrel	NA/CT	Chenopod scrub. **Not expected**. No suitable habitat onsite.

1 Status Designation: USFWS: FE – Federal Endangered, FT – Federal Threatened, FC- Federal Species of Concern, NA – Not Applicable. CDFG: CE – California Endangered, CT – California Threatened, CC – California Species of Special Concern, NA – Not Applicable.

2 Probability to Occur Onsite: High – Observed in similar habitat in region, or habitat on the site is a type often utilized by the species and the site is within the known range of the species. Moderate – Reported sightings in surrounding region, or site is within the known range of the species and habitat on the site is a type occasionally used by the species. Low – Site is within the known range of the species but habitat on the site is rarely used by the species. Not Expected – A focused study failed to detect the species, or, no suitable habitat present.

2.0 Recreational Resouces in the Study Area

Table 1-3 includes a listing of recreational resources in the Study Area including name, type, and amenities included. This supplements information found in Section 3.9.2 of the main report.

Table 2-1. Recreational Resources in the 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
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 2012c, 2012d, City of Los Angeles 2012c, 2012d, and 2012e.

3.0 Lands Screened from the Project Area

Table 1-4 supplements section 4.5.2 of the main report and lists lands that were screened from the project area.

Table 3-1. Lands Screened from the Project Area

Name	Description
Equestrian Center	The current uses of the 75-acre world class horse show complex and equestrian center along the river are an important recreational activity in the local community that, because of various urban land use constraints, cannot occur elsewhere. In addition to hosting shows at least 45 days a year, the center is a location frequently used for local community meetings, banquets, and weddings. Its over 500 boarding stalls, 17 trainers, tack shop, and equestrian gift shop are heavily used. The site is often used as a movie location as well. Many of those who use the facility have chosen to live in that area because of the center's location. Relocation to an area with equal access to Griffith Park and the Santa Monica Mountains is not possible. This nexus is important because of the intense urbanization of the Los Angeles area which is not conducive to horseback riding activities. Conversion of the Equestrian Center parcel to include a riparian area or detention basin was considered publicly unacceptable because it would be obtained at the expense of the long-standing equestrian community use that is virtually irreplaceable. A thin strip in the current right-of-way may be available for a riparian corridor. The preliminary cost-benefit analysis confirmed that the costs associated with moving/ relocating/ cleaning/ preparing/ redeveloping the site for use as an underground basin would not provide substantial local benefits and could not accommodate the retention of enough peak flows (in isolation or combination with other river-adjacent sites) to facilitate meaningful restoration downstream.
Bette Davis Park Restoration to River Level	Measures, such as bringing the entire park down to river level, reestablishing geomorphology through the park area, establishing open water areas, creating side channels through the park with freshwater marsh wetlands and habitat corridors, lowering channel banks and protecting them with setback levees, were screened out for implementation on the entire site. The park currently has relatively dense tree cover and provides functioning habitat for avian and small-scale terrestrial species. Given that it could be relatively easily connected to the restored riparian corridor as envisioned in the Study with minimal disruption to the existing park, the decision was made to preserve much of this scarce resource while including a portion for restoration along the river's edge.
Ferraro Fields	The current use of Ferraro Fields for soccer is an important recreational activity in the local community. The community fought for years to locate the facility in the area. The present use of the site is important because of a lack of open space options that could/can be used for more intensive recreation (additional soccer fields were and are not supported within Griffith Park and the proximity to freeway access was and is deemed critical). While conversion of all of the parcel to a riparian area, lowering it to become a part of the riverbed, or conversion to a detention basin with riparian habitat is considered publicly–unacceptable, a strip in the current right-of-way may be available for a riparian corridor and a side channel with a riparian fringe along the outer edge may be possible and will continue to be considered in the alternatives. Because of the importance of soccer facilities to residents of communities that are considered to have been historically-underserved from a lack of access to such recreational amenities, retention of this area for soccer use is considered an environmental justice issue. A portion of Ferraro Fields would be used in project alternatives, but use of the entire parcel is not feasible. Throughout the two-year development and implementation of the City's LA River Revitalization Master Plan, numerous groups expressed interest in creating new soccer facilities at/near the river, including Anahuak Youth Soccer Association, The City Project, and the Alianza de los Pueblos del Rio. In general soccer playing is

Name	Description
	discouraged in open spaces because of the damage to grass and potential conflicts with other uses—such as habitat establishment/restoration. Soccer is also a very popular activity for populations that have been historically underserved in terms of access to natural and recreational spaces in LA, so there is an environmental justice component. Therefore, it is important to balance the availability of resources and accommodate established soccer-playing facilities in close proximity to the river and multiple modes of transportation in a way that also facilities connections to natural open space resources—reducing negative interaction effects as much as is possible. Given the established use of Ferraro Fields for soccer and the ability of the river's ecosystem restoration to benefit from an off-stream channel near the Fields, the compatible use scenario was chosen so as not to displace/disrupt an established recreational use that could not be replaced as part of the ecosystem project. However, a portion of this site would be available to use for the restoration project without impacting the soccer fields.
Zoo Parking Lot Habitat Corridor	This real estate was determined to be unavailable to the project because an extensive City-sponsored storm water/water quality project was recently completed in the same area and the parking itself is necessary to support activity at the zoo, the Autry Museum of Western Heritage, and other nearby uses in Griffith Park. Disruption of the parking was not considered to be feasible given the high demand for use by visitors to these important regional amenities. Moreover, the site is separated from the river by the I-5 freeway and any diversions would require costly infrastructure, including tunnels, and extensive, expensive channel modifications at the access point/s. The site remains potentially useful as a shared parking facility to accommodate future visitors to the Study area.
Griffith Park Golf Course	This real estate was determined to be unavailable to the project because of the overall cost of the extensive infrastructure that would be required to bring off-channel flows to the course from the river, the considerable modifications that would be made to the I-5 Freeway, and the substantial disruption of use at a heavily-used facility. Preliminary analysis indicated that the peak flow reduction accommodated by the off stream flows and use as an underground basin would be negligible in accommodating additional habitat in the downstream channel even though the local habitat connection could be meaningful. This area has been designated a Significant Ecological Area (SEA) for the City of Los Angeles and the open space has extensive tree cover. It remains important for avian species and is a reservoir for native species, but near term hydrologic/hydraulic connections were deemed too expensive and extensive given the freeway and utility infrastructure barriers and opportunity costs associated with the disrupted use. However, a side channel using existing tunnels/culverts under the freeway was feasible at this site and is included in the remaining measures.
Department of Recreation and Parks Central Service Yard	The Central Service Yard (CSY) is a 24.6 acre site owned by the City of Los Angeles Department of Recreation and Parks (RAP) located on the eastern bank of the Los Angeles (LA) River. It is situated across from Griffith Park and upstream of North Atwater Park. It was considered as a potentially-available property in initial plan formulation of the Los Angeles River Ecosystem Restoration Feasibility Study (Study), but the CSY was subsequently deemed infeasible for inclusion in the Study because of the prohibitive costs associated with relocating and replicating its current uses elsewhere. The CSY is the primary support facility and service yard for RAP and services the entire recreation and park system of the City of Los Angeles (City). The CSY houses irreplaceable uses of vital necessity to the operation and maintenance of all parks and recreation facilities in the City. The CSY is centrally located within the City and provides RAP with quick, trouble-free access to the region's major north-south and east-west highways. The centralized location of the CSY permits RAP a number of positive operational and budgetary efficiencies, which are of increasing benefit to the

Name	Description
	City given the ongoing fiscal and budgetary challenges it continues to face. In December 2012, the City conducted an initial analysis of the cost and feasibility of relocating the functions of the CSY to other parcels currently for sale in Los Angeles County. From this investigation, the City estimates that the cost of purchasing new land would be approximately $70-110 million, and the cost to construct new facilities and relocate the existing uses would be approximately $130-140 million, yielding a total cost of approximately $200-250 million. Moreover, no available parcel was identified that is large enough to accommodate the existing uses in one place, and the largest available parcels are not located in areas of the City that are as advantageously located as CSY. Until a location of acceptable size and proximity is identified to facilitate the relocation of the CSY's functions, it must continue to support its current uses. In the near-term, a linear habitat corridor along the river's edge that does not encroach upon the site remains a feasible option for inclusion in the Study.
Albion Dairy	This location was eliminated because of current plans and agreements already in place to use this site for storm water quality treatment, which would preclude bringing river water into the site. This site was purchased under agreements for this specific use. Moreover, hydrologic/hydraulic connections between the site and the river are complicated by existing at-grade railroad tracks. Whereas connections at/under rail tracks remain desirable in other locations, such as the Cornfield/LA State Historic Park and the Piggyback Yard, the connection at this site is less feasible given the much smaller amount of ecosystem restoration that would be accomplished at/near/on the Albion site.
DWP/Main Street Facility	This real estate was determined to be unavailable to the project because of the costs associated with moving/relocating/cleaning/preparing/redeveloping the site for the ecosystem use. New use of the entire site would drastically impact existing City service provision and current rail uses and would require an extremely expensive and logistically undesirable relocation of a power transmission station. The approximately 3-acre parking lot on the river-side of the rail tracks could function as a linear habitat corridor and buffer along the river's edge next to the site and therefore this remains a viable option.
Metro Union Bus Service Yard (Division 13 Bus Maintenance Facility)	Al'ong the river's western bank near Union Station across from Piggyback Yard was not considered because it is a property belonging to the Los Angeles County. The County recently invested over $1 million to renovate and expand the facility for bus maintenance and storage. The County has been clear that it is unwilling due to economic considerations to consider selling the property for expansion of Union Station, high speed rail, or ecosystem restoration purposes, because of the costs associated with moving and relocating the recently upgraded facilities. The site is under the ownership/control of others, therefore, it was considered unavailable.
Area with Restoration Benefits and Opportunities for Revitalization (ARBOR) Outlet	Terrace, Remove Concrete, and Create Habitat Corridor. This reach is constrained by a series of active and parallel rail lines along both sides of the river. The bridges are critical locations for conveying flow through this area. Removal of concrete requires alternate measures to offset the loss in conveyance. Modifications to this area of the river were determined to be infeasible because of extensive rail and roadway infrastructure and because it may need to be used as a transition between any restoration and the downstream flood risk management project.
Consolidated North Central District Yard.	The Consolidated North Central District Yard (CNCDY) is a 10 acre site owned by the City of Los Angeles. It is located on the south bank of the Arroyo Seco and upstream of the confluence with the LA River. It was considered as a potentially-available property in initial plan formulation of the Study but was subsequently deemed infeasible for inclusion in the Study because of the prohibitive costs associated with relocating and replicating its current uses elsewhere. Past investigations have yielded a

Name	Description
	necessity to locate the uses of the CSY near Griffith Park because they serve Park operations and maintenance functions. To preserve the natural open space value of the Park, the Griffith Park Master Plan working group has discouraged the location of any new maintenance yards in the park itself. Given this, a comparable site of considerable size would need to be identified at/near the Park to accommodate the CSY uses. This has not yet been accomplished and does not seem likely in the near-term. The CNCDY provides for the storage and maintenance of Bureau of Sanitation and Bureau of Street Services vehicles, including refuse trucks serving a large portion of the City. Its location offers fast and efficient access to major roads and freeways. In 2007, the City conducted an initial analysis of the cost and feasibility of relocating the functions of the site to other parcels currently for sale in Los Angeles County. From this investigation, the City estimates that the cost of purchasing new land would be approximately $70-75 million, and the cost to construct new facilities and relocate the existing uses would be approximately $130-170 million, yielding a total cost of approximately $200-245 million.
LACDA Footprint Only	The District also examined whether an alternative wholly within the existing LACDA footprint in the study area was feasible. The LACDA boundary includes the channel bottom and sides with very limited rights of way on either side, much of which is occupied by bicycle paths on the west/south side of the river. The team concluded after consideration that a LACDA-footprint-limited alternative would not meet objectives because it would not meet the objective for restoring regional connectivity, and it would also be likely to fail the objective for restoring habitat because flow velocities would not be reduced sufficient to support restored habitat. Lands within the LACDA boundary are included in the alternatives including the TSP, but the lands within the boundary are not sufficient in themselves to support restoration objectives.

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Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX H, Part 2
Monitoring and Adaptive Management Plan

September 2015

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1.0 INTRODUCTION

This document outlines the feasibility level Monitoring and Adaptive Management Plan (MAMP) for the Los Angeles River Ecosystem Restoration Project (LARERP) in Los Angeles, California. The U.S. Army Corps of Engineers, Los Angeles District (USACE) in partnership with the City of Los Angeles (City), has developed feasibility level plans to restore approximately 11 miles of the Los Angeles River from approximately Griffith Park to downtown Los Angeles, identified as the Area with Restoration Benefits and Opportunities for Revitalization (ARBOR) reach. This plan identifies and describes the monitoring and adaptive management activities proposed and estimates their cost and duration.

The general purpose of the MAMP is to provide a systematic approach for improving resource management outcomes and a structured process for recommending decisions, with an emphasis on uncertainty about resources response to management actions and the value of reducing that uncertainty to improve management.

More specifically, the MAMP will:

- Establish the framework for effective monitoring, assessment of monitoring data, and decision making for implementation of adaptive management activities in the project area.
- Provide the process for identifying adaptive management actions in the project area.
- Establish decision criteria for vegetation and wildlife evaluation and modification of adaptive management activities.

This plan will be reviewed and revised as needed during the Preconstruction, Engineering, and Design (PED) phase as specific design details are made available.

1.1 Statutory Basis for Monitoring and Adaptive Management

Section 2039 of Water Resources Development Act (WRDA) 2007 directs the Secretary of the Army to ensure that, when conducting a feasibility study for a project (or component of a project) for ecosystem restoration, the recommended project includes a plan for monitoring the success of the ecosystem restoration.

Section 2039 of WRDA 2007 requires that the monitoring plan include a description of the monitoring activities, the criteria for success, and the estimated cost and duration of the monitoring, and specifies that monitoring will be performed until restoration success is achieved.

The Corps' implementation guidance for Section 2039, in the form of a memo dated 31 August 2009, also requires that an adaptive management plan (i.e., contingency plan) be developed for all ecosystem restoration projects.

This MAMP includes all elements required by the WRDA 2007 implementation guidance for section 2039, including:

- the rationale for monitoring (Section 2.2), including:
  - key project specific parameters to be measured (Section 2.3.2)
  - how the parameters relate to achieving the desired outcomes or making a decision about the next phase of the project (Sections 2.3.2, 6.1),
- the intended use(s) of the information obtained (Section 2.3.4)
- the nature of the monitoring including duration and/or periodicity (Sections 2.3.2, 2.3.3),
- the disposition of the information and analysis (Sections 2.3, 5.0)
- the cost of the monitoring plan (Section 7.0)
- the party responsible for carrying out the monitoring plan (Section 1.2)
- a project closeout plan (Section 6.3).

1.2 Adaptive Management Team

The MAMP provides the framework and guidance for an Adaptive Management Team (AMT) to review and assess monitoring results and consider and recommend adaptive management actions when ecological success is not achieved and decision criteria are triggered. The AMT members shall work together to make recommendations relevant to implementing the MAMP. The AMT is composed of the Corps, the City of Los Angeles (City), and interested resource agencies. Although the Corps and City have coordinated with the entities that will comprise the AMT in development of this Integrated Feasibility Report (IFR), the AMT will be officially established during PED.

The AMT focuses on the ecological function of the habitats through related management actions to maintain and provide functional riverine habitat for general species and special status (threatened and endangered species) within the project area. This MAMP provides a monitoring plan and identifies triggers upon which an adaptive management action may be implemented. The AMT shall review the monitoring results and advise on and recommend actions that are consistent with the project goals and reflect the current and future needs of the habitat and the species they support within the project area. The Corps shall have final determination on all adaptive management actions recommended.

The Corps is responsible for ensuring that monitoring data and assessments are properly used in the adaptive management decision-making process. If the Corps determines that adaptive management actions are needed, it will coordinate with the AMT on implementation of those actions. The Corps is also responsible for project documentation, reporting, and external communication.

The AMT shall meet at a minimum of once per year, as scheduled by the Corps during the monitoring period, to review the results of monitoring and assess whether project objectives are being met. If objectives are not being met, the AMT may recommend that adaptive management actions be taken in response to monitoring results as compared to decision-making triggers.

The AMT may also consider other related projects along the River and its tributaries in determining the appropriate adaptive management actions, and may consult with other recognized experts or stakeholders as appropriate, to achieve project goals.

Recommendations for adaptive management should be based on:

- Monitoring data from previous years
- Consideration of current habitat conditions
- Consideration of current and potential threats to habitat establishment success
- Past and predicted response by target species

1.2.1 Team Structure

The Management Team shall include representatives from the U.S. Army, Corps of Engineers, Los Angeles District and the non-Federal sponsor, City of Los Angeles,.

U.S. Army Corps of Engineers

The Corps may be represented by the Project Ecologist as well as the Project Hydrology and Hydraulics (H&H) representative and the Project Geotechnical representative as needed. Other Corps attendees may include the Project Manager, the Project Environmental Coordinator, and/or Operations and Maintenance designees, as needed.

City of Los Angeles

The City, as the non-Federal sponsor for the project, will ultimately be responsible for all OMRRR activities once the Corps notifies the City of project completion. Prior to final project completion, the Corps will transfer responsibility of functional elements of the project to the City as they are completed. The City may be represented by its Bureau of Engineering designee. Other City participants may include the City Manager, Director of Planning, City Engineer, and Public Works Division Manager, or their designees.

The AMT shall also include representatives from resource agencies who would serve in an advisory capacity, to assist in evaluation of monitoring data and assessment of adaptive management needs. The agencies shall include, upon their acceptance:

- U.S. Fish and Wildlife Service, Carlsbad Field Office
- California Department of Fish and Wildlife, South Coast Region 5
- California Regional Water Quality Control Board, Los Angeles Region
- United States Geological Survey (USGS), Western Ecological Research Center (WERC)

Additional expertise may be provided by other entities and stakeholders with knowledge of the Los

Angeles River ecosystem, hydrology, and wildlife species, at the discretion of the primary AMT participants.

2.0 MONITORING

An effective monitoring program will be required to determine if the project outcomes are consistent with original project goals and objectives. The power of a monitoring program developed to support adaptive management lies in the establishment of feedback between continued project monitoring and corresponding project management. A carefully designed monitoring program is the central component of the project adaptive management program as it supplies the information to assess whether the project is functioning as planned.

2.1 Project Objectives

The specific restoration objectives of the LARERP are to:

1) Restore Valley Foothill Riparian Strand and Freshwater Marsh Habitat: Restore Valley Foothill Riparian wildlife habitat types, aquatic freshwater marsh communities, and native fish habitat within the ARBOR reach throughout the period of analysis, including restoration of supporting ecological processes and biological diversity, and a more natural hydrologic and hydraulic regime that reconnects the river to historic floodplains and tributaries, reduces velocities, increases infiltration, and improves natural sediment processes.

2) Increase Habitat Connectivity: Increase habitat connectivity between the river and the historic floodplain, and increase connectivity for wildlife between restored habitat patches and nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis.

3) Increase passive recreation: Include recreation that is compatible with the restored environment in the ARBOR reach.

2.2 Rationale for Monitoring

Monitoring must be closely integrated with the adaptive management components because it is the key to the evaluation of adaptive management needs. Objectives must be considered to determine appropriate indicators to monitor. In order to be effective, monitoring must be able to distinguish between ecosystem responses that result from project implementation (i.e., management actions) and natural ecosystem variability.

Achieving objectives will require monitoring that focuses on the target habitats and the hydrologic and geomorphic processes that support them.

2.3 Monitoring Plan

According to the Corps' implementation guidance memo for WRDA Section 2039, dated 31 August 2009, "Monitoring includes the systemic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain project benefits."

The following discussion outlines a monitoring plan that will support the LARERP Adaptive Management Program. The plan identifies performance measures along with desired outcomes and monitoring design in relation to specific objectives. A performance measure includes specific feature(s) to be monitored to determine project performance. Additional monitoring is identified as supporting information needs that will help to further understand the interrelationships of restoration features and external environmental variability and to corroborate project effects.

Decision-making triggers are related to each performance measure and desired outcome and identify the need to discuss potential implementation of adaptive management actions with the AMT. These criteria/triggers are identified in Section 6.1.

Overall, monitoring results will be used to evaluate the progress of habitat restoration toward meeting project objectives and to inform the need for adaptive management actions to ensure successful restoration is achieved.

2.3.1 Monitoring Period

Upon completion of construction of each phase or feature of the LARERP, cost-shared monitoring for ecological success and adaptive management will be initiated and will continue for five years or until restoration success is achieved, for no longer than ten years. Concurrent monitoring of one or more nearby reference sites with similar conditions to the desired restored habitat, such as the Santa Ana River or San Gabriel River, is recommended to differentiate changes at the restoration site that are attributable to the restoration activity versus normal environmental variability affecting the region.

This monitoring plan includes the minimum monitoring actions to evaluate success and to determine adaptive management needs. Assuming that multiple construction contracts will be required to implement all of the restoration elements associated with the recommended plan, monitoring and adaptive management will be initiated at the completion of each phase of construction.

Although WRDA 2007 allows for up to ten years of cost-shared monitoring when necessary, this plan anticipates that only five years of monitoring and adaptive management would be required for each feature, for habitat to mature sufficiently to be self-sustaining, and to meet performance criteria for project objectives. Once the Corps determines that ecological success for a feature has been fully achieved, even if this occurs in less than five years, no further monitoring will be performed. For each phase, if performance criteria for project objectives have not been met within the first five years, then cost-shared monitoring and adaptive management would continue within those areas until performance criteria are met or for a maximum of five additional years, whichever is less. If success cannot be determined within the ten-year period of cost-shared monitoring allowed by law, any additional monitoring and management will be a non- Federal responsibility. Cost-shared monitoring shall not continue beyond ten years.

2.3.2 Performance Measures and Monitoring Design

Performance Measure 1a: Vegetative community, cover, and structure

Desired Outcome: Increase percent cover of native riparian and marsh habitat.

Desired Outcome: Maintain appropriate structural diversity of native riparian habitats to support target wildlife species.

Desired Outcome: Increase percent vegetative cover over water to reduce water temperatures to support native fish.

Desired Outcome: Decrease percent cover of non-native invasive species that out-compete natives.

Monitoring Design and Rationale: Permanent vegetation monitoring stations will be established for assessing project area vegetation communities. These stations will be sampled annually for five years post construction.

Supporting Information Need - Depth to Groundwater: Depth to groundwater will be monitored seasonally for five years, along with the hydrologic monitoring as set forth below in performance measure 1b.

Supporting Information Need - Wildlife Surveys: Inventories of general wildlife would be documented during the annual vegetation monitoring effort.

Wildlife surveys will be performed annually for five years post construction in coordination with the vegetation monitoring to provide supporting information on the establishment of target habitats. Data on large mammal use will be compiled from studies performed by existing USGS WERC monitoring programs.

Monitoring of vegetation (including percent cover, structural diversity, cover over water, and cover of invasives) and depth to groundwater, as well as inventorying wildlife will indicate if target habitats and the hydrology that supports them have been successfully restored. Shallow depth to groundwater is essential for riparian habitats to persist and be self-sustaining.

Wildlife surveys serve to provide supplemental information on restoration success for target habitats and habitat connectivity While wildlife presence is not a requirement to confirm success, presence of riverine obligate and facultative species (such as least Bell's vireo, yellow warbler, and yellow breasted chat) that use the habitat for all or a portion of their life requirements is an indicator of successful habitat establishment, as well as the successful establishment of a self-sustaining ecosystem and its underlying functions. If vegetative cover and structure criteria are not being met, wildlife species presence, distribution, and diversity may provide supporting information to help identify which habitat elements and underlying ecosystem functions have not been achieved in target habitats.

Results of monitoring for vegetation communities would also indicate whether habitat components necessary to provide habitat connectivity and support increased wildlife

movement have been successfully established.

Decision-making triggers can be found in Section 6.1.1

Performance measure 1b: Stream channel native fish habitat

Desired Outcome: Increase structure and diversity of in-channel form and habitats.

Desired Outcome: Increase and maintain availability of gravel and cobble substrates.

Monitoring Design and Rationale: Permanent monitoring stations will be established for monitoring of geomorphic and in-channel habitat elements such as large woody debris; stream gradient; channel form, dimensions, and dynamics; gravel bars or riffle-pool-run complexes and distributions; flood refugia and back-channel areas; and substrate composition and distribution. Monitoring will be performed twice annually (wet season and dry season) post construction for five years in soft bottom areas of the main channel and in widened areas.

Bathymetry/topography surveys to evaluate widespread geomorphic changes, such as sediment aggradation and degradation, would be performed at the end of Year 1 after construction and at the end of Year 5 after construction in soft bottom areas of the main channel and in widened areas. Scour and erosion will also be assessed as part of geotechnical O&M procedures.

Supporting Information Need - Hydrology: Water quality, flow, and hydroperiod will be assessed seasonally for five years post construction to support evaluation of suitable fish habitat.

Monitoring of these features is necessary to determine the successful establishment of native fish habitat, including for Santa Ana sucker and arroyo chub, which require gravel and cobble substrates for foraging and spawning, shade over water that supports cooler water temperatures, inputs of large woody debris to support structural diversity and refugia, in-channel geomorphic diversity to support all stages of life requirements, and perennial flowing water.

Furthermore, changes to geomorphic processes will affect the vegetation component of target habitats. If vegetative cover and structure criteria are not being met, data from monitoring of geomorphic and hydrologic processes may provide additional information on the underlying causes of failure. Bathymetry/topography surveys will also provide data on sedimentation that can be used to assess channel conveyance capacity.

Results of monitoring for native fish habitat would also indicate whether habitat components necessary to provide habitat connectivity and support increased wildlife movement have been successfully established.

Decision-making triggers can be found in Section 6.1.2

2.3.3 Monitoring Procedures

The following monitoring procedures will provide the information necessary to evaluate the previously identified project objectives for the LARERP:

Vegetation: Vegetation sampling will occur annually at 12 sites per reach and at a reference site for the duration of the monitoring period. Sampling will occur during spring months, at the peak of growing season, and will consist of permanent field monitoring plots along one or more transects either perpendicular to the stream centerline or parallel to the floodplain slope and hydraulic gradient. Plots will be located randomly within each reach/feature, and the distance between plots and along transects will be dependent on the project site area and variability. Monitoring will measure percent cover of native and non-native plant species, structural diversity, and percent cover over water. Photograph stations are also important for documenting vegetation conditions. All plots and photograph stations will be documented via Global Positioning System (GPS) coordinates to reoccupy in each year of sampling.

General observations, such as fitness and health of plantings, native plant species recruitment, and signs of drought stress would be noted during the surveys. Additionally, potential soil erosion, flood damage, vandalism and intrusion, trampling, and pest problems would be qualitatively identified.

A general inventory of all wildlife species observed and detected using the project area would be documented. Nesting sites, roosting sites, animal burrows, and other signs of wildlife use of the newly created habitat would be recorded. These notes would be important for early identification of species colonization patterns.

In-Channel Stream Habitat: To assess the overall stream health and available habitat for native fish, a California Stream Bio-assessment Worksheet (CDFG 1999) will be completed annually at permanent monitoring stations. This assessment is meant to rapidly assess the stream and be able to give it a habitat value score based on the physical characteristics of the site. Some of the physical factors that are assessed include the stream gradient, substrate composition, organic material in the stream (woody debris and leaf litter), and vegetative cover above the stream.

In-stream characteristics will also be recorded annually by taking channel cross-sections at permanent monitoring stations. Methods involve placing a transect line perpendicular to flow at the up and downstream extents of 100 meter monitoring sites. Substrate composition (silt, sand, gravel, cobble, boulder, sandbars, and emergent vegetation), channel width, channel depth, and mid-column current velocity will be measured at 1.0 meter intervals along each transect line.

Bathymetry and topography surveys would occur at Year 1 and Year 5, and may be generated using LiDAR or a ground survey crew.

Supporting Information Need – Wildlife Surveys: A general inventory of all wildlife species observed and detected using the project area would be documented annually in coordination with vegetation monitoring. During the general inventory, station counts will be conducted for sensitive and target species including least Bell's vireo, yellow-breasted chat, and yellow warbler. Amphibian surveys may also be performed using station counts, fence arrays or pit fall traps. Presence of non-native and nuisance wildlife species will be noted.

Data on wildlife use by large mammals will be gathered from existing monitoring being performed by USGS WERC.

Supporting Information Need - Hydrology: Hydrology will be assessed seasonally each monitoring year and at storm events. Mid-column current velocities will be measured at 1.0 meter intervals along each in-stream cross-section transect line. Measurements for current velocity will be taken using a hand-held flow meter, such as the Global Water Flow Probe, following methods described in Gore (2007). Hydroperiod metrics (depth, duration, and frequency of flooding) will be obtained from documented elevations and recorded water levels. Depth to groundwater will be assessed using installed piezometers.

Supporting Information Need - Water Quality: Water quality parameters will be measured seasonally each monitoring year to assess the quality of native fish habitat. Parameters to be measured include water temperature (°F), dissolved oxygen ([DO]%, saturation. and mg/L), turbidity (neophelometric turbidity units [NTUs]), pH levels, conductivity (uS/cm), and salinity (mg/g). Measurements will be taken using Hanna HI 9928 and HI 93703 water quality meters or other similar water quality meters.

2.3.4 Use of Monitoring Results and Analysis

Results of the monitoring will be assessed in comparison to project objectives and decision-making triggers to evaluate whether the project is functioning as planned and whether adaptive management actions are needed to achieve project objectives. The results of the monitoring will be provided to the AMT who will evaluate and compare data to project objectives and decision making triggers. The AMT will use the monitoring results to assess habitat responses to management, evaluate overall project performance, and make recommendations for adaptive management actions as appropriate. If monitoring results, as compared to desired outcomes and decision making triggers, show that project objectives are not being met, the AMT will evaluate causes of failure and recommend implementation of adaptive management actions, as identified in Section 6.2, to remedy the underlying problems.

As data is gathered through monitoring, more information will also be available to address uncertainties and fill information gaps. Uncertainties such as effective operational regimes, urban restoration design needs, benefits generated by restored features, and accuracy of hydrologic models can be evaluated to inform adaptive management actions and future restoration needs.

3.0 PROJECT ADAPTIVE MANAGEMENT PLANNING

The MAMP outlines how the results of the project-specific monitoring program would be used to adaptively manage the project, including specification of conditions that will define project success.

The MAMP reflects a level of detail consistent with the feasibility study phase. The primary intent was to develop monitoring and adaptive management actions appropriate to assess and achieve the project's restoration goals and objectives. The specified management actions, as well as expected timelines for achieving successful establishment and self-sustaining maturity of restored habitat features, were used to develop an estimation of the adaptive management program costs and duration for the project.

The following section outlines restoration actions that will be undertaken to achieve the project objectives and lists sources of uncertainty that may impact the need for adaptive management actions. Subsequent sections describe assessment of monitoring results, data management, and decision-making on the implementation of adaptive management.

The level of detail in this plan is based on currently available data and information developed during plan formulation as part of the feasibility study. Uncertainties may remain concerning the exact project features, monitoring elements, and adaptive management opportunities. Components of the MAMP, including costs, were similarly estimated using currently available information. Uncertainties will be addressed in the preconstruction, engineering, and design (PED) phase, and the MAMP may be amended to incorporated additional detail as part of the design phase.

3.1 Management and Restoration Actions

The PDT performed a thorough plan formulation process to identify potential management measures and restoration actions that address the project objectives. Many alternatives were considered, evaluated, and screened in producing a final array of alternatives. The Corps subsequently identified a Recommended Plan.

The Recommended Plan, which is also the Locally Preferred Plan (LPP), is referred to as Alternative 20, also known as the RIVER (for Riparian Integration via Varied Ecological Reintroduction) Alternative. The restoration actions have been divided into 8 reaches based on the geomorphology of the ARBOR reach to assist with planning (see Figure 1-2 of the Integrated Feasibility Report (IFR)).

The proposed action includes restoration in all 8 reaches and provides transitions or connections between existing riparian corridors and concrete lined river reaches. The RIVER Alternative would riparian, wetland, and riverine habitats and functions and would provide 6,782 habitat units (HU). Large habitat nodes that support native riparian and riverine habitat would be created where the river is widened at Verdugo Wash, Taylor Yard, and the LATC site. Increased habitat connectivity would be achieved with these restored widened areas in combination with restoration of overbank habitat patches, riparian corridors, and daylighted streams, as well as restoration at the Arroyo Seco and Verudgo Wash confluences and the Cornfields site. The Recommended Plan is described in detail in Section 7 of the IFR. Potential plant palettes for each proposed vegetation community are

included in Section 4.4 of the IFR.

3.2 Sources of Uncertainty

Adaptive management provides a coherent process for making decisions in the face of uncertainty. Scientific uncertainties and technological challenges are inherent with any large- scale ecosystem restoration project. Below is a list of uncertainties associated with restoration of the riverine habitats included in the LARERP.

- Correct engineering and design to fully address project objectives
- Correct operational regime to fully achieve project objectives
- Ability of CHAP (Combined Habitat Assessment Protocol) method to predict project benefits
- Ability of hydrologic models to predict project impacts/benefits
- Imprecise relationships between management actions and corresponding outcomes
- Future availability of water for restored habitats due to extreme drought or other climate change issues.
- Other factors which are not completely within the Corps' or Sponsor's control or ability to predict, such as high flow events that may occur before the restored habitat has fully established, vandalism, or upstream watershed changes that may affect the project area.

4.0 RATIONALE FOR ADAPTIVE MANAGEMENT

The primary incentive for implementing an adaptive management program is to increase the likelihood of achieving desired project outcomes given the identified uncertainties listed above.

Given these uncertainties, adaptive management provides an organized, coherent, and documented process that suggests management actions in relation to measured project performance compared to desired project outcomes. The adaptive management program for the LARERP will use the results of continued project monitoring to manage restoration actions in order to achieve the previously stated project objectives. Adaptive management establishes the critical feedback of information from project monitoring to inform project management and promote learning through reduced uncertainty.

Implementation of the MAMP will provide flexibility to account for changing environmental conditions and new information and will allow project success to be measured, though it will not alleviate all uncertainty. The MAMP provides a mechanism to evaluate the effectiveness of the restoration measures implemented in this project and to implement adaptive changes, if required, to realize project objectives.

5.0 ASSESSMENT

The assessment phase of the adaptive management framework describes the process by which the results of the monitoring efforts will be compared to the project performance measures, which reflect the objectives of the restoration action.

The results of the LARERP monitoring program will be assessed annually through the AMT. Monitoring results will be compared to the desired project outcomes as set forth by the project performance measures. This assessment process will measure the progress of the project in relation to the stated project objectives.

The AMT will compare monitoring results to decision-making triggers to evaluate project effectiveness and consider if adaptive management actions are needed.

The assessments will indicate if the habitat responses to management actions are undesirable (e.g., are moving away from restoration goals) or if the responses have met the success criteria for the project. Assessments will also inform the AMT if other factors are influencing the response that may warrant further research.

5.1 Database Management

Database management is an important component of the monitoring plan and the overall adaptive management program. As part of the AMT, individuals with responsibility for data management activities (data managers) in support of an adaptive management program will be identified from the Corps. The data managers should collaborate with the AMT in developing a data management plan to support the adaptive management program. The data management plan should describe how and where data will be archived, data standards, data upload process and format, quality assurance and quality control procedures, metadata standards, and public data release. Storage of all data will be handled by the Corps

Data analysis and reporting will be the responsibility of the Corps, who will provide reports for the AMT to facilitate evaluation of adaptive management needs.

5.2 Documentation and Reporting

The Corps will document the monitoring results, assessments, and the results of the AMT deliberations. The Corps will produce annual reports that will measure progress towards meeting project objectives as characterized by the performance measures. Results of assessments will be used to evaluate adaptive management needs and inform decision-making.

6.0 DECISION-MAKING

Decisions on the implementation of adaptive management actions are informed by the assessment of monitoring results. The information generated by the monitoring plan will be used by the Corps and City in consultation with the other AMT members to guide decisions on adaptive management that may be needed to ensure that the ecosystem restoration project achieves success. Final decisions on implementation of adaptive management actions are made by the Corps.

6.1 Decision Criteria

Decision criteria, also referred to as adaptive management triggers, are used to determine if and when adaptive management opportunities should be implemented. They can be qualitative or quantitative based on the nature of the performance measure and the level of information necessary to make a decision. Desired outcomes can be based on reference sites, predicted values, or comparison to historic conditions. Several decision criteria are identified below, based on the project objectives and performance measures.

If assessments show that any of these triggers are met, the Corps would consult with the AMT to discuss which adaptive management action, as described in Section 6.2, is warranted. Investigations may be required to determine the cause of failure in order to inform which of the adaptive management actions identified should be implemented, if needed.

6.1.1 Vegetative community, cover, and structure triggers:

1) Desired Outcome: Increase percent cover of native riparian and marsh habitat.

   Triggers: 50% cover of native riparian and marsh habitats is not achieved (based on locations of restoration of each habitat) within 3 years. 75% cover of native riparian or marsh habitat is not achieved (based on locations of restoration of each habitat) within 5 years.

2) Desired Outcome: Maintain appropriate structural diversity of native riparian habitats to support target wildlife species.

   Trigger: Suitable structural diversity is not achieved within 5 years, whereby canopy cover exceeds 60% and/or shrub cover does not achieve 50%.

3) Desired Outcome: Increase percent vegetative cover over water to reduce water temperatures to support native fish.

   Trigger: Percent cover over water does not achieve 25% within 3 years, and 40% within 5 years.

4) Desired Outcome: Decrease percent cover of non-native invasive species that out-compete natives.

   Trigger: Non-native percent cover does not achieve less than 10% after 3 years. Non-native percent cover does not achieve less than 5% after 5 years.

Riparian and marsh vegetation may not achieve the target percent cover or structural conditions (needed to support habitat and connectivity) due to improper geomorphic conditions. Such conditions may include excessive distance to groundwater, sedimentation, channel incision, or scour of soils. These conditions may be created naturally, such as during storm events, or may be the consequence of design. Lack of water due to drought may affect the establishment and persistence of vegetation, and subsequently the percent cover. Plantings may fail due to predation or trampling.

Invasive infestation may occur due to upstream inputs of seed/source material. It is expected that invasives will be adequately controlled through O&M procedures. However, if invasive infestation control is found to be ineffective, the Corps may recommend adjustments to invasive control methods utilized under O&M.

Adaptive management actions that may be implemented to address problematic conditions and achieve project objectives are outlined in Section 6.2.

6.1.2 Stream channel native fish habitat triggers:

1) Desired Outcome: Increase structure and diversity of in-channel form and microhabitats.

   Trigger: Geomorphic and in-channel habitat elements do not achieve diversity within 3 years and 5 years, as compared to reference sites, with monitoring results showing trends of channel incision that create uniform channel form (i.e., lack of sinuosity and riffle-pool-run complexes, uniform depth).

2) Desired Outcome: Increase and maintain availability of gravel and cobble substrates.

   Trigger: Substrates do not achieve gravel and cobble composition of comparable reference sites within 5 years.

Desirable geomorphic conditions would be evaluated using reference sites at the San Gabriel and/or Santa Ana Rivers or other sites of similar hydrologic character and gradient to determine quantitative thresholds for channel form and substrates.

In-channel fish habitat may not achieve the target composition due to improper geomorphic conditions caused by natural events or design. Channel incision could develop due to lack of upstream sediment inputs in a highly hydrologically altered system. Flood events may wash gravel and cobble substrates out of the study area.

Adaptive management actions that may be implemented to address problematic conditions and achieve project objectives are outlined in Section 6.2.

6.2 Potential Adaptive Management Measures

The results of monitoring will be used by the AMT to evaluate project status and adaptive management needs. Identified adaptive management actions for this project are described below. Prior to implementing adaptive management measures, the Corps and City shall assess whether supplemental environmental analysis is required.

Irrigation/Supplemental Water: Irrigation and/or supplemental water may be needed if triggers for vegetative cover and/or structure are met. Assessment of monitoring results may show that drought conditions are causing poor establishment or die off of planted vegetation. Adaptive management actions would include supplemental water to support achievement of percent cover criteria and successful restoration of target vegetation communities.

Replanting: Replanting may be needed if triggers for vegetative cover and/or structure are met.

Monitoring results should be used to assess the underlying cause of inadequate cover, which may require that additional adaptive management actions be implemented to support successful replanting. For instance, monitoring results may show that channel incision has prevented successful establishment of vegetative communities. Adaptive management would include actions to remedy the incision (i.e., re-grading as described below), which would be required for successful replanting.

Plant Protection: Plant protection may be needed if triggers for vegetative cover and/or structure are met. Monitoring results may show that plantings are failing due to predation or trampling from recreational use or homeless encampments. Adaptive management actions would include measures such as plant cages or protective fencing that could be installed to protect plantings.

Invasives Control: It is expected that invasives will be adequately controlled through O&M procedures. However, if monitoring results show that triggers for invasives are met, the Corps may recommend adjustments to invasive control methods under O&M.

Erosion Control: Erosion control may be needed if triggers for vegetative cover are met. Monitoring results may show that vegetative cover is inadequate due to slope erosion issues. Adaptive management actions would include erosion control measures such as installation of straw wattles or erosion mats. Additional information may be required to determine the cause of erosion, and additional adaptive management measures may be required to be implemented (i.e., re-grading as described below).

Importing of Substrates: Substrates may need to be imported if triggers for native fish habitat are met. Suitable substrates would be provided during construction, however monitoring results may show that substrates are not sufficient to support native fish (i.e., homogeneity). Adaptive management actions would include importing of additional gravel and cobbles. It is assumed that frequent or routine import of substrates would not be required as part of O&M. If monitoring shows that importing of substrates is required as adaptive management more than once during the monitoring period, adjustments to O&M may be made to require recurring substrate import based on appropriate triggers informed by monitoring results.

Re-grading: Re-grading or re-distribution of sediments may be needed if triggers for vegetative cover or native fish habitat are met. Monitoring results may determine that sedimentation, scour of soils, channel incision or erosion has impacted the successful establishment of target vegetative communities in habitat nodes and corridors or that channel incision has prevented establishment of in-channel diversity. Adaptive management actions would include re-grading or re-distributing sediments to support the appropriate geomorphic conditions for successful establishment of habitat.

6.3 Conclusion of Monitoring for Project Features

Ecological success of a project feature will be confirmed when desired outcomes have been achieved, measured by meeting or exceeding the 5-year achievement thresholds identified in the triggers in Section 6.1 (e.g., for vegetative cover, 75 percent cover is achieved; for non-native cover, less than 5 percent is achieved; for native fish habitat, channel and substrate diversity is

achieved). Once ecological success has been documented by the District Engineer in consultation with the Federal and State resources agencies, and a determination has been made by the Division Commander that ecological success has been achieved, no further monitoring will be required. Ecological success will be documented through an evaluation of the predicted outcomes as measured against the actual results.

7.0 COSTS FOR IMPLEMENTATION OF MONITORING AND ADAPTIVE MANAGEMENT PROGRAMS

The costs associated with implementing the monitoring and adaptive management plan were estimated based on currently available data, methods, and comparable projects. The potential adaptive management actions as described in Section 6.2 and potential expected frequency of need were used as a basis for cost estimating. Costs were estimated based on the overall area of monitoring over 8 reaches. Because uncertainties remain as to detailed designs and adaptive management needs and opportunities, the costs estimated in Table 1 may be refined in PED during the development of the detailed monitoring and adaptive management plans for each project phase/feature.

7.1 Costs for Implementation of Monitoring Program

Cost calculations for monitoring are displayed as a five-year total. If ecological success is determined earlier, the monitoring program will cease and costs will decrease accordingly.

The current total estimate for implementing the monitoring plan is approximately $4.9 million for the Recommended Plan and $4 million for the NER Plan.

7.2 Costs for Implementation of Adaptive Management Program

Costs for the adaptive management program were based on estimated level of effort and potential frequency of need, and include participation in the Adaptive Management Team and reporting. The current total estimate for implementing the adaptive management program is approximately $3.8 million for the Recommended Plan and $3.6 million for the NER Plan.

7.3 Total Costs for Monitoring and Adaptive Management

The cost figures above are provided at October 2014 price levels and prior to contingency. The monitoring and adaptive management costs at October 2015 price levels, as included in the certified total project cost summary, total $12.25 million for the Recommended Plan and $10.4 million for the NER Plan including contingency.

8.0 REFERENCES

Gore, J. A. 2007. Discharge Measurements and Streamflow Analysis. Pages 51-78. In R. F. Hauer and G.A. Lamberti (Eds.). Methods in Stream Ecology. 2nd ed. Academic Press, San Diego, CA.

TABLE 1: PRELIMINARY COST ESTIMATES FOR MONITORING AND ADAPTIVE MANAGEMENT

Task	Assumed Tasks for Recommended Plan	Frequency	Cost Assumptions for Recommended Plan	Total Cost RP for 5 years	Total Cost NER for 5 years	Cost Differential
Monitoring						
Vegetation Monitoring	Assume monitoring of project area and 1 reference site, including transects for percent cover of natives, non-natives, structural diversity, canopy cover over water using transect/plot monitoring. Assume vegetation mapping, inventories of general wildlife, and observations of damage to habitat would be recorded. Assume monitoring of all parameters would be done concurrently during each monitoring event.	annually for 5 Years	Monitoring: Assume 3 hours/plot/2 biologists. Assume 12 plots per reach/site on avg, with 8 reaches and 1 reference site. Mapping: Assume 2 biologists over 4 days (2 reaches/day), plus GIS work of 1 person over 5 days	$ 470,000.00	$ 436,250.00	Costs for the NER plan were slightly decreased due to a decreased area of monitoring, as the NER plan does not include the Verdugo Wash site or in-channel retoration in Reach 8. The number of monitoring plots is therefore slightly reduced based on the reduced monitoring area.
Native Fish Habitat Monitoring	Assume monitoring of geomorphology, in-channel habitat elements, and substrates (i.e., composition and distribution of cobble, gravel, sands; riffle/pool/run complexes; stream gradient; channel form). Assume need for this monitoring in widened areas such as Verdugo Wash, Taylor Yard, LATC, and Arroyo Seco, and in-channel soft bottom areas.	annually for 5 Years	Costs referenced from similar existing monitoring contract on the Santa Ana River	$ 2,694,000.00	$ 2,216,000.00	Costs for the NER plan were slightly decreased due to a decreased area of monitoring, as the NER plan does not include the Verdugo Wash site.
	Assume monitoring of topography/bathymetry to assess widespread geomorphic changes. Assume need for this monitoring in widened areas such as Verdugo Wash, Taylor Yard, LATC, and Arroyo Seco, and in-channel soft bottom areas.	Years 1 and 5	assume $1500-$2000/acre	$ 1,300,000.00	$ 966,000.00	Costs for the NER plan were slightly decreased due to a decreased area of monitoring, as the NER plan does not include the Verdugo Wash site.
Supporting Information Need - Hydrologic Monitoring	Assume monitoring of flow, hydroperiod seasonally (i.e., 4 times per year, plus at storm events (assume 4 times per year on avg)) to evaluate suitability of habitat for native fish. Assume monitoring of depth to groundwater seasonally (i.e., 4 times per year) to evaluate ability to support riparian vegetation.	seasonally for 5 Years	Assume 16 piezometers (2 per reach on avg), 16 stream gagues (2 per reach on avg). Assume installation by 2 people over 2 days. Assume 1 biologist monitoring data per event times 12 events per year.	$ 200,000.00	$ 200,000.00	costs are expected to be similar

TABLE 1: PRELIMINARY COST ESTIMATES FOR MONITORING AND ADAPTIVE MANAGEMENT

Task	Assumed Tasks for Recommended Plan	Frequency	Cost Assumptions for Recommended Plan	Total Cost RP for 5 years	Total Cost NER for 5 years	Cost Differential
Supporting Information Need - Hydrologic Monitoring	Assume monitoring of water quality seasonally (i.e., 4 times per year) to evaluate suitability of habitat for native fish.	seasonally for 5 Years	Assume 2 biologists over 4 days per year	$ 40,000.00	$ 40,000.00	costs are expected to be similar
Supporting Information Need - Wildlife Surveys	Assume that general wildlife observations would be performed during vegetation monitoring. Assume focused amphibian surveys with pitfall traps. Assume that data for large mammal use would be gathered from existing USGS movement studies.	annually	Assume 2 biologists over 5 days per survey, performed in time with vegetation monitoring.	$ 240,000.00	$ 192,000.00	Costs for the NER plan were slightly decreased due to a decreased area of monitoring, as the NER plan does not include the Verdugo Wash site or in-channel retoration in Reach 8.
			TOTAL MONITORING	**$ 4,944,000.00**	**$ 4,050,250.00**	

Adaptive Management Actions						
Irrigation/Supplemental Water	Assume 1/4 of the area needs supplemental water (approx. 3 river miles)	Assume twice in 5 years	Assuming $50K per river mile per year to maintain.	$ 300,000.00	$ 250,000.00	Costs for the NER plan were slightly decreased due to a decreased area of monitoring, as the NER plan does not include the Verdugo Wash site or in-channel retoration in Reach 8.
Re-planting	Assume that natural recruitment with invasives control will be the primary means of vegetation re-establishment post flood in widened areas. Assume that assume 25% of vegetation may require replanting over 5 years.		Cost of vegetation was estimated at $16,500 per planted acre, based on project costs.	$ 1,125,000.00	$ 1,000,000.00	Costs for the NER plan were slightly decreased due to a decreased area of monitoring, as the NER plan does not include the Verdugo Wash site or in-channel retoration in Reach 8.
Plant Protection & Fencing	Assume 3000 plant cages, 3 miles fencing may be needed.		Assume $8/plant cage; $3/linear foot for fencing; plus $50,000 installation. Costs referenced from existing restoration contracts.	$ 121,520.00	$ 109,600.00	Costs for the NER plan were slightly decreased due to a decreased area of monitoring, as the NER plan does not include the Verdugo Wash site or in-channel retoration in Reach 8.
Erosion Control	Assume installation of erosion control such as straw waddles, erosion mats.	Assume annually for 5 Years	Assume $10K/year as rough estimate.	$ 50,000.00	$ 50,000.00	costs are expected to be similar
Importing substrates for fish habitat	Assume importing cobbles/gravels in widened areas such as Verdugo Wash, Taylor Yard, LATC, and Arroyo Seco.	Assume once in 5 years	Costs referenced from similar existing contract on the Santa Ana River, which totaled $50K for a smaller area.	$ 250,000.00	$ 200,000.00	Costs for the NER plan were slightly decreased due to a decreased area of monitoring, as the NER plan does not include the Verdugo Wash site.

TABLE 1: PRELIMINARY COST ESTIMATES FOR MONITORING AND ADAPTIVE MANAGEMENT

Task	Assumed Tasks for Recommended Plan	Frequency	Cost Assumptions for Recommended Plan	Total Cost RP for 5 years	Total Cost NER for 5 years	Cost Differential
Regrading	Assume 12 sites would need re-grading over 5 years.		Costs refereced from existing construction contracts, at $20K for small fixes	$ 240,000.00	$ 200,000.00	Costs for the NER plan were slightly decreased due to a decreased area of monitoring, as the NER plan does not include the Verdugo Wash site or in-channel retoration in Reach 8.
Adaptive Management Team & Reporting						
Team Meetings	Assume 1 meeting per year over 20 years (20 years accounts for some phased construction, needing 5 years of monitoring for each phase, staggered over time).	annually for 5 years	Assume $3K per meeting	$ 60,000.00	$ 60,000.00	costs are expected to be similar
Investigations (studies/surveys to determine cause of problems)	As needed, assume over 20 years (20 years accounts for some phased construction, needing 5 years of monitoring for each phase, staggered over time)		Assume $10K per year	$ 200,000.00	$ 200,000.00	costs are expected to be similar
Annual Report		annually for 5 years per reach	assume $37,500 per report, annually for 5 years per reach, 8 reaches	$ 1,500,000.00	$ 1,500,000.00	costs are expected to be similar based on overall area of monitoring
			TOTAL ADAPTIVE MANAGEMENT	**$ 3,846,520.00**	**$ 3,569,600.00**	
			PROGRAM TOTAL	**$ 8,790,520.00**	**$ 7,619,850.00**	

*Costs were referenced from current Southern California projects including Reach 9 Santa Ana River, Santa Maria, feedback from Prado Construction Division, Design Engineer, H&H, Environmental PDT members

US Army Corps
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Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX H, Part 3
Mitigation Monitoring and Reporting Program

May 2015

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Mitigation Monitoring and Reporting Program

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1.0 Introduction

This Mitigation Monitoring and Reporting Program (MMRP) has been prepared pursuant to the California Environmental Quality Act (CEQA) and the State CEQA Guidelines. It provides for the monitoring of mitigation measures required of the U.S. Army Corps of Engineers (USACE) and the City of Los Angeles (City) in the Los Angeles River Ecosystem Restoration Project (proposed project), as set forth in the Environmental Impact Statement/Environmental Impact Report (EIS/EIR).

Section 21081.6 of the California Public Resources Code and Sections 15091(d) and 15097 of the State CEQA Guidelines require public agencies "to adopt a reporting or monitoring program for changes to the project which it has adopted or made a condition of project approval in order to mitigate or avoid significant effects on the environment." An MMRP is required for the proposed project because the EIR identified potentially significant adverse impacts, and identified best management practices (BMPs)/mitigation measures to reduce some of those impacts to a less-than-significant level. All measures are intended to offset, to the degree possible, potential adverse effects under both CEQA and the National Environmental Policy Act (NEPA). Some thresholds for significant air quality impacts are different under the two statutes, but common measures were applied to all air quality impacts since those impacts cannot be mitigated to less than threshold values under either law.

This MMRP will be adopted by the City Council when it approves the project. It will be kept on file at the City of Los Angeles, Department of Public Works, Bureau of Engineering, 1149 S. Broadway, Suite 600, Los Angeles, CA 90015.

2.0 Purpose

This MMRP has been prepared to ensure that all required BMP/mitigation measures are implemented and completed according to schedule and maintained in a satisfactory manner throughout implementation of the proposed project. The MMRP may be modified by the USACE or the City in response to changing conditions or circumstances. A summary table (attached) has been prepared to assist the responsible parties in implementing the MMRP. The table identifies individual BMP/mitigation measures, and for each measure identifies monitoring/mitigation procedures and timing, responsible agencies, and a record of implementation of the mitigation measures. Impacts for which BMP/mitigation measures are proposed are listed under the various resource categories in the EIS/EIR. The order in which BMP/mitigation measures are presented (by resource category) follows the sequence established in the EIS/EIR.

3.0 Roles and Responsibilities

Unless otherwise specified herein, the USACE and City are responsible for taking all actions necessary to implement the BMP/mitigation measures according to the provided specifications and demonstrating that each action has been successfully completed. The USACE and the City, at their discretion, may delegate implementation responsibility or portions thereof to a licensed contractor.

4.0 Changes to BMP/Mitigation Measures

Any substantive change to the MMRP shall be documented in writing. Modifications to the best management practices/mitigation measures may be made by the USACE and the City subject to one of the following findings and documented by evidence included in the record:

1. The measure included in the EIS/EIR and the MMRP is no longer required because the significant environmental impact identified in the EIS/EIR has been found not to exist, or to occur at a level which makes the impact less than significant as a result of changes in the project, changes in conditions of the environment, or other factors.

OR

2. The modified or substitute BMP/ mitigation measure to be included in the MMRP provides a level of environmental protection equal to or greater than that afforded by the mitigation measure included in the EIS/EIR and the MMRP.

AND

3. The modified or substitute mitigation measures do not have significant adverse effects on the environment in addition to or greater than those which were considered by the USACE or City Council in its decisions regarding the EIS/EIR and the proposed project.

AND

4. The modified or substitute mitigation measures are feasible, and the USACE or City, through measures included in the MMRP or other established procedures, can assure their implementation.

Findings and related documentation supporting the findings involving modifications to mitigation measures shall be maintained in the project file with the MMRP and shall be made available to the public upon request.

5.0 Summary Table

The table that follows should guide the USACE and City in evaluating and documenting implementation of mitigation measures. The columns identified in the table are described below:

Mitigation Measure or Best Management Practice – Provides the text of the BMP/ mitigation measures identified in the EIR.

Timing/Schedule – Identifies the time frame or milestone at which the BMP/mitigation measure will be implemented.

Implementation Responsibility – Identifies the entity responsible for complying with BMP/ mitigation measure requirements.

Implementation and Verification – These fields are to be completed as the MMRP is implemented. The "Status/Verification" column describes the type of action taken to verify implementation, and is to be filled out by USACE or City staff based on the documentation provided by qualified contractors, or through personal verification.

Table 5-1. Mitigation Monitoring and Reporting Program Summary Table

MITIGATION MONITORING AND REPORTING PROGRAM SUMMARY TABLE (Includes Text for Best Management Practices and Mitigation Measures)				
BMPs / Mitigation Measures	**Responsibility for Implementation**	**Schedule**	**Monitoring/Report Responsibility**	**Status/ Verification**
Geology, Seismology, Soils, and Minerals				
Construction **GEO 1:** Minimizing the extent of areas to be cleared, graded, or recontoured, **GEO 2:** Erecting construction fencing in all areas that require clearing, grading, revegetation, or recontouring, **GEO 3:** Conducting all construction work in accordance with site-specific construction plans that minimize the potential for sediment to enter the stream, **GEO 4:** Applying mulch or chemical stabilizers to disturbed areas as needed, and/or using a water truck to reduce fugitive dust, **GEO 5:** Stabilizing and reseeding disturbed areas with native grasses after construction is complete, **GEO 6:** Installing silt fences to prevent silt and sediment from entering the River channel, **GEO 7:** Grading spoil sites to minimize surface erosion and prevent sediment from entering water courses or the stream channel to the maximum extent feasible, **GEO 8:** Designing and implementing a dewatering plan to avoid operating equipment in flowing water by using temporary cofferdams or some other suitable diversion to divert channel flow around the channel and bank construction area, and **GEO 9:** Limiting certain aspects of in-channel construction to the low-flow period between April 15 and October 31 (non-flood season) to minimize soil erosion. **GEO 10:** Soils and all materials used for backfilling or stabilization must be certified to be free of contaminants. **GEO 11:** In-channel work would be isolated from existing flows by the use of dewatering structures such as cofferdams constructed from k-rails and other suitable materials. a. Cofferdam construction will be adequate to prevent seepage into or from the work area. b. Cofferdams may be constructed from sand bags, concrete k-rails, sheet piles or other appropriate materials that would not leach contaminants into the water column or increase downstream turbidity. c. Ensure that dewatering structures and coffer dams are in place and functional prior to in-water work.	USACE	Throughout project construction; In-channel construction limited to low-flow period between April 15 and October 15 (non-flood season)	USACE	USACE PM to verify compliance during construction. Considered complete after end of project construction.

MITIGATION MONITORING AND REPORTING PROGRAM
SUMMARY TABLE
(Includes Text for Best Management Practices and Mitigation Measures)

BMPs / Mitigation Measures	Responsibility for Implementation	Schedule	Monitoring/Report Responsibility	Status/ Verification
d. Visually inspect all cofferdam components on a regular basis. e. Check for water seepage under the dam and general integrity of the dam. f. Fix all leaks immediately. g. If turbid water is discharged from the work area despite the cofferdam, place wattles, filter fabric, silt fencing across the flow stream downstream of the work area as appropriate. h. All cofferdams and associated structures will be removed upon completion of work. **GEO 12:** Require the construction contractor to prepare a storm water pollution prevention plan (SWPPP) consistent with State Water Board policy and guidelines. At a minimum, the SWPPP would include the following elements: a. Work areas, staging areas, or stockpile areas that could be subject to erosion during storm events would be stabilized with erosion control measures as appropriate. These measures could typically include silt fencing, straw bales, sand bags, filter fabric, coir rolls or wattles. b. Erosion control methods used to prevent siltation would be monitored weekly and maintained as needed. c. Stabilize and reseed disturbed upland areas with native grasses, shrubs, and trees upon completion of construction. d. Stationary equipment such as motors, pumps, generators and welders located within or adjacent to the channel or basin will be positioned over drip pans. e. Any equipment or vehicles driven and/or operated within or adjacent to the channel or basin should be checked and maintained daily, to prevent leaks. All maintenance will occur in a designated offsite area. The designated area will include a drain pan or drop cloth and absorbent material to clean up spills. f. Fueling and equipment maintenance will be done in a designated area removed from the area of the channel or basin such that no petroleum products or other pollutants from the equipment may enter these areas via rainfall or runoff. The designated area will include a drain pan or drop cloth and absorbent materials to clean up spills. g. Materials for the containment of spills (i.e., absorbent materials, silt fencing, filter fabric, coir rolls) will be identified and be available onsite prior to commencement of construction or maintenance activities. h. Any accidental spill of hydrocarbons or coolant that may occur within the				

MITIGATION MONITORING AND REPORTING PROGRAM
SUMMARY TABLE
(Includes Text for Best Management Practices and Mitigation Measures)

BMPs / Mitigation Measures	Responsibility for Implementation	Schedule	Monitoring/Report Responsibility	Status/ Verification
work area will be cleaned immediately. Absorbent materials will be maintained within the work area for this purpose. i. No wet concrete product will come into contact with any flowing or standing water at any time. Areas where raw cement or grout are applied or where concrete curing or finishing operations are conducted will be separated from any ponded or diverted water flows by a cofferdam or silt-free, exclusionary fencing. All equipment involved with the concrete or grouting operations will be located within a contained area while using any slurry or concrete product. A protective berm or other structure will be in place prior to maintenance and/or repair activities. **GEO 13:** Any spill of the grout, concrete, concrete curing or wash water adjacent to or within the work area will be removed immediately.				
Air Quality and Greenhouse Gases				
AQ 1: Tier 4 equipment and haul trucks no older than 2010 would be utilized to the extent practicable during construction years when emissions are expected to exceed Local Significance Thresholds. ***Mobile Emission Attenuating Measures*** **AQ 2:** Provide temporary traffic controls such as a flag person, during all phases of construction to maintain smooth traffic flow. **AQ 3:** Provide dedicated turn lanes for movement of construction trucks and equipment on-and off-site. **AQ 4:** Reroute construction trucks away from congested streets or sensitive receptor areas. **AQ 5:** Utilize electricity from power poles rather than temporary diesel or gasoline power generators to the extent practicable. ***Fugitive Dust Attenuating Measures*** **AQ 6**: Appoint a construction relations officer to act as a community liaison concerning on-site construction activity including resolution of issues related to PM_{10} generation. **AQ 7:** Suspend all excavating and grading operations when wind speeds (as instantaneous gusts) exceed 25 miles per-hour. **AQ 8:** Require frequent street sweeping surrounding the project site to minimize fugitive dust emissions from track-out. All street sweeping shall use alternatively	USACE	Prior to and throughout project construction	USACE	USACE PM to verify compliance during construction. Considered complete after end of project construction.

MITIGATION MONITORING AND REPORTING PROGRAM
SUMMARY TABLE
(Includes Text for Best Management Practices and Mitigation Measures)

BMPs / Mitigation Measures	Responsibility for Implementation	Schedule	Monitoring/Report Responsibility	Status/ Verification
fueled sweepers that are equivalent to those specified in SCAQMD Rules 1186 and 1186.1. **AQ 9:** Install wheel washers where vehicles enter and exit the construction site onto paved roads or wash off trucks and any equipment leaving the site each trip. **AQ 10:** Apply water three times daily, or non-toxic soil stabilizers according to manufacturer's specifications, to all unpaved parking or staging areas or unpaved road surfaces. **AQ 11:** Replace ground cover in disturbed areas as quickly as possible. **AQ 12:** Apply non-toxic soil stabilizers according to manufacturers' specifications to all inactive construction areas (previously graded areas inactive for ten days or more).				
Water Resources				
Construction **WR 1:** Limiting most in-channel construction to the low-flow period between April 15 and October 31 to minimize soil erosion. **WR 2:** Soils and all materials used for backfilling or stabilization must be certified to be free of contaminants. **WR 3:** All sites with known and suspected HTRW soil contamination will be investigated and remediated prior to project construction. All groundwater contamination that cannot be remediated prior to project construction will be subject to appropriate handling, treatment and disposal ensured by the non-Federal sponsor. All work shall be consistent with Engineering Regulations 1165-2-132. **WR 4:** In-channel work would be isolated from existing flows by the use of dewatering structures such as cofferdams constructed from k-rails and other suitable materials. a. Cofferdam construction will be adequate to prevent seepage into or from the work area. b. Cofferdams may be constructed from sand bags, concrete k-rails, sheet piles or other appropriate materials that would not leach contaminants into the water column or increase downstream turbidity. c. Ensure that dewatering structures and coffer dams are in place and functional prior to in-water work. d. Visually inspect all cofferdam components on a regular basis. e. Check for water seepage under the dam and general integrity of the dam. f. Fix all leaks immediately. g. If turbid water is discharged from the work area despite the cofferdam, place	USACE	Throughout project construction; In-channel construction limited to low-flow period between April 15 and October 15 (non-flood season)	USACE	USACE PM to verify compliance during construction. Considered complete after end of project construction.

MITIGATION MONITORING AND REPORTING PROGRAM
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BMPs / Mitigation Measures	Responsibility for Implementation	Schedule	Monitoring/Report Responsibility	Status/ Verification
wattles, filter fabric, silt fencing across the flow stream downstream of the work area as appropriate. h. All cofferdams and associated structures will be removed upon completion of work. **WR 5:** Require the construction contractor to prepare a storm water pollution prevention plan (SWPPP) consistent with State Water Board policy and guidelines. At a minimum, the SWPPP would include the following elements: a. Work areas, staging areas, or stockpile areas that could be subject to erosion during storm events would be stabilized with erosion control measures as appropriate. These measures could typically include silt fencing, straw bales, sand bags, filter fabric, coir rolls or wattles. b. Erosion control methods used to prevent siltation would be monitored weekly and maintained as needed. c. Stabilize and reseed disturbed upland areas with native grasses, shrubs, and trees upon completion of construction. d. Stationary equipment such as motors, pumps, generators and welders located within or adjacent to the channel or basin will be positioned over drip pans. e. Any equipment or vehicles driven and/or operated within or adjacent to the channel or basin should be checked and maintained daily, to prevent leaks. All maintenance will occur in a designated offsite area. The designated area will include a drain pan or drop cloth and absorbent material to clean up spills. f. Fueling and equipment maintenance will be done in a designated area removed from the area of the channel or basin such that no petroleum products or other pollutants from the equipment may enter these areas via rainfall or runoff. The designated area will include a drain pan or drop cloth and absorbent materials to clean up spills. g. Materials for the containment of spills (i.e., absorbent materials, silt fencing, filter fabric, coir rolls) will be identified and be available onsite prior to commencement of construction or maintenance activities. h. Any accidental spill of hydrocarbons or coolant that may occur within the work area will be cleaned immediately. Absorbent materials will be maintained within the work area for this purpose. i. No wet concrete product will come into contact with any flowing or standing water at any time. Areas where raw cement or grout are applied or				

MITIGATION MONITORING AND REPORTING PROGRAM SUMMARY TABLE (Includes Text for Best Management Practices and Mitigation Measures)				
BMPs / Mitigation Measures	**Responsibility for Implementation**	**Schedule**	**Monitoring/Report Responsibility**	**Status/ Verification**
where concrete curing or finishing operations are conducted will be separated from any ponded or diverted water flows by a cofferdam or silt-free, exclusionary fencing. All equipment involved with the concrete or grouting operations will be located within a contained area while using any slurry or concrete product. A protective berm or other structure will be in place prior to maintenance and/or repair activities. **WR 6:** Any spill of the grout, concrete, concrete curing or wash water adjacent to or within the work area will be removed immediately.				
Biological Resources				
Construction **BIO 1:** To the maximum extent practicable, vegetation clearing activities would not occur during the breeding season, which generally runs from March 1-August 31. **BIO 2:** If vegetation removal must occur during the avian breeding season, a qualified biologist will perform nesting bird surveys following established protocol prior to construction. If nests are detected during these surveys, a 300-foot no construction buffer will be delineated around the nest (500-foot buffer for raptors). **BIO 3:** Construction will be monitored by a qualified biologist. **BIO 4:** Construction will be phased to minimize impacts to wildlife species, so that the entire study area will not be under construction at the same time. **BIO 5:** Pre-construction surveys for special-status plants and wildlife would be performed as needed in coordination with USFWS. **BIO 6:** Protocol level surveys for least Bell's vireo would be performed during the detailed design phase and prior to construction to avoid impact to this species. If paired and potentially nesting vireo or other listed species are found, the Corps will coordinate with USFWS and consult as applicable, if it is later determined that the project would affect the species. **BIO 7:** Trails and other recreational features will be designed and located to be compatible with restoration features and goals. For instance, trails may be placed around the perimeter, rather than through restored areas.	USACE	Throughout project construction; Moratorium on vegetation clearing from March 1-August 31 will be maintained if feasible	USACE	USACE PM to verify compliance during construction. Considered complete after end of project construction.
Operations **BIO 8:** Invasives control or maintenance of vegetation to maintain restoration success and comply with constraints would be performed outside of the bird nesting season,	City (maintenance)	In perpetuity. Moratorium on vegetation clearing from March 1-August 31 will be maintained if	City (maintenance)	USACE and City PMs to verify compliance. No completion date has

MITIGATION MONITORING AND REPORTING PROGRAM SUMMARY TABLE (Includes Text for Best Management Practices and Mitigation Measures)				
BMPs / Mitigation Measures	**Responsibility for Implementation**	**Schedule**	**Monitoring/Report Responsibility**	**Status/ Verification**
BIO 9: Sensitive habitat types will be avoided to the maximum extent practicable during maintenance. Designated access points for maintenance vehicles will be created to reduce impacts to restored areas. ***Construction and Operations*** **BIO 10**: Informational signs will be installed to educate the public regarding the restored habitat, sensitive resources, and the impact that human intrusion may have. Exclusionary fencing will also be installed where and if necessary, as part of the Adaptive Management program (see Appendix H).		feasible		been set, as maintenance is assumed to continue for the life of the project.
Cultural Resources				
CR 1: An archeologist meeting the Secretary of the Interior's Qualification Standards shall monitor all construction activities in areas where there is a potential for buried resources. The monitor shall immediately notify the USACE's on-site construction supervisor of any discovery. The USACE on-site construction supervisor shall temporarily stop construction in the area of the discovery. The discovery area and a surrounding buffer zone shall then be clearly delineated. Ground disturbing activities can resume outside of the delineated buffer zone. Should previously unknown historic or archaeological remains be discovered, the USACE would comply with 36 CFR 800.13. At the conclusion of monitoring activities, a detailed letter report shall be prepared. This report shall be submitted to the SHPO for review and comment. **CR 2:** When construction crews are working within 50 meters of an eligible or unevaluated cultural resource, the edge of the site, including a 25 meter site buffer will be fenced off, thus ensuring that no construction equipment inadvertently strays into the culturally sensitive area. **CR 3:** Cultural resource block inventories and evaluations shall be conducted early in the next design phase so that avoidance and impact minimization measures for cultural resources can be incorporated in project design. **CR 4:** Recordation and evaluation of the constructed features of the flood risk management system on the river and lower tributaries within the APE will be prioritized in PED. The recordation and evaluation shall be conducted in one effort and in reference to and in the context of the entirety of the flood risk management system constructed on the Los Angeles River and lower tributaries. **CR 5:** Comply with the terms and conditions of the PA executed by and between the Corps and SHPO, and any amendments thereto.	USACE	Prior to and throughout project construction	USACE	USACE PM to verify compliance during construction. Considered complete after end of project construction.

MITIGATION MONITORING AND REPORTING PROGRAM
SUMMARY TABLE
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BMPs / Mitigation Measures	Responsibility for Implementation	Schedule	Monitoring/Report Responsibility	Status/ Verification
Traffic and Circulation				
Construction **TRAF 1**: The location and duration of any lane or street closures, including impacts on public transit, railroads, bicycle lanes, sidewalks, and parking will be fully coordinated with local cities and nearby residents. **TRAF 2:** Detour routes will be provided if needed (including detour routes for public transit, bicycles, and pedestrians when affected). **TRAF 3:** Local traffic and emergency vehicle access will be maintained or accommodated. **TRAF 4:** Traffic protective devices and control measures will be implemented such as barricades, cones, flaggers, lights, warning beacons, temporary turning restrictions, temporary traffic signals, and warning signs. **TRAF 5:** Advance notice will be provided to affected residents, businesses, emergency services providers (police, fire, ambulance), and public transit providers. **TRAF 6:** Temporary bus stops will be located within a reasonable walking distance of any displaced bus stops when public transit stops are affected. **TRAF 7:** Safety improvements would be made to existing at-grade street-rail crossings where traffic increases would be expected. **TRAF 8:** The project will coordinate with railroad companies to ensure continuous operation and appropriate safety measures	USACE	Prior to and throughout project construction	USACE	USACE PM to verify compliance during construction. Considered complete after end of project construction.
Noise				
Noise 1: Develop and implement a project noise control plan that identifies when construction activities would occur and where and how avoidance measures shall be used. Construction activities would generally occur between the hours of 8 a.m. and 6 p.m. Monday through Friday, and 8 a.m. and 5 p.m. Saturday. Construction and operations would not occur on Sunday or a national holiday. The plan will require the identification of a Noise Control Coordinator, who will be available to receive and respond to any concerns from residents regarding construction noise. Residents shall be notified prior to the start of construction activities and informed of the Coordinator's contact information. Signage will also be posted on the construction site with Noise Control Coordinator's contact information. **Noise 2:** Use power construction equipment with state-of-the-art noise shielding and muffling devices.	USACE	Throughout project construction.	USACE	USACE PM to verify compliance during construction. Considered complete after end of project construction.

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BMPs / Mitigation Measures	Responsibility for Implementation	Schedule	Monitoring/Report Responsibility	Status/ Verification
Noise 3: Whenever construction occurs within 500 feet of occupied residences, temporary barriers shall be constructed around the construction sites to shield the ground floor of the noise-sensitive uses. These barriers shall be of ¾-inch medium density plywood sheeting, or equivalent, and shall achieve a Sound Transmission Class of 30 or greater, based on certified sound transmission loss data taken according to American Society for Testing and Materials Test Method E90 or as approved by the City of Los Angeles Building Department. **Noise 4:** Construction equipment staging areas shall be located as far as practicable from residential areas. **Noise 5:** Quieter "sonic" pile drivers shall be used as necessary, unless engineering studies are submitted to the City of Los Angeles showing this is not feasible and cost effective, based on geotechnical considerations. **Noise 6:** Routes for heavy construction site vehicles shall be identified to minimize noise impacts to residences and noise-sensitive receptors. **Noise 7:** Impose construction hours that are more restrictive than those set forth in the LAMC if necessary and when practical. **Noise 8:** Require vehicle parking and deployment activities to be separated and buffered from sensitive uses. **Noise 9:** Limit haul truck or other vehicle speed on roads adjacent to residences and on unpaved roadways. **Noise 10:** Notify residents about type and schedule of construction.				
Recreation				
Construction **Rec 1:** Public media/meetings to provide clear information on the types and durations of disruptions to the River and adjacent resources. **Rec 2:** Signed detour routes for affected roads as well as pedestrian, bicycle, and equestrian trails, and river access points. **Rec 3:** Signage at construction areas with information relevant to recreation users (length of closure, alternative access points, etc.). **Rec 4:** Work with park representatives on timing of park and golf club closures to minimize effects on recreational access and use. **Rec 5:** Consult with park maintenance personnel prior to implementation of measures to coordinate maintenance during construction and operations.	USACE and City	Throughout project construction	USACE and City	USACE PM to verify compliance during construction. Considered complete after end of project construction.

MITIGATION MONITORING AND REPORTING PROGRAM SUMMARY TABLE (Includes Text for Best Management Practices and Mitigation Measures)				
BMPs / Mitigation Measures	**Responsibility for Implementation**	**Schedule**	**Monitoring/Report Responsibility**	**Status/ Verification**
Public Health and Safety, Including Hazardous, Toxic, and Radioactive Waste				
PHS 1: A rigorous review of the HTRW sites identified as those with potential impacts on the project would be conducted. The review would include obtaining and reviewing regulatory files, site visits, and discussions with regulators and others about the severity of the contamination. Following this review, Phase I or II environmental site assessments would be conducted as necessary. In areas where existing information is limited, environmental investigations shall follow industry approved protocols for conducting Phase I and Phase II investigations as needed. The sponsor shall not provide lands for project construction without first ensuring that it has undertaken adequate investigation and determined there is no contamination of concern for the relevant parcel or, where contamination is identified, has remediated or ensured remediation of the parcel to the standards necessary to support the restoration project, as agreed by the relevant regulatory agency and USACE. Coordination and consultation with the appropriate regulatory agencies, including the USEPA and California lead agency (usually the LARWQCB or the DTSC), and responsible parties, as necessary, would begin as early as possible regarding investigation and remediation at the San Fernando Valley Superfund Site and Taylor Yard G1 and G2 sites, as well as the LATC site as needed. The City would conduct remediation at contaminated sites prior to construction of restoration features at those sites. **PHS 2:** A new ecological risk assessment would be performed for the Taylor Yards G1 and G2 properties. The risk assessment would include risk calculations and analyses for recreational human health standards. **PHS 3:** Prior to the start of construction, the USACE will develop engineering specifications and plans that will include a written environmental protection plan. This plan will include a written pollution prevention plan that outlines the actions needed to respond to spills or release of hazardous materials during construction or maintenance activities. The environmental protection plan will describe hazardous materials management and spill prevention and response methods. The plan will be reviewed with all site workers.	USACE and City	Prior to construction of each phase	USACE and City	USACE and City PMs to verify compliance prior to construction.
Construction **PHS 4:** City will request increased police presence within the project area, particularly during episodes of increased water levels and flow velocities. **PHS 5:** Fire extinguishers or other firefighting equipment (such as drums of water) will be close at hand during construction, regularly inspected, and maintained in proper	USACE and City	Throughout project construction	USACE and City	USACE and City PMs to verify equipment requirements as of first day of construction.

MITIGATION MONITORING AND REPORTING PROGRAM SUMMARY TABLE (Includes Text for Best Management Practices and Mitigation Measures)				
BMPs / Mitigation Measures	**Responsibility for Implementation**	**Schedule**	**Monitoring/Report Responsibility**	**Status/ Verification**
working condition. **PHS 6:** Equipment with internal combustion engines will be placed so that exhaust is not near combustible materials. **PHS 7:** Combustible or flammable materials will be properly stored and proper clearance around these materials would be maintained. **PHS 8:** A site-specific health and safety plan will be prepared and reviewed with all workers detailing methods of compliance with occupational health and safety regulations, emergency response actions, and include the route to the nearest emergency medical facility. **PHS 9:** Relevant paperwork such as material safety data sheets and chain-of- custody documents recording the transport and disposal of hazardous materials and waste will be maintained and available for inspection. **PHS 10:** All hazardous materials would be removed from the site when construction or maintenance activities were completed if not before. **PHS 11:** Construction sites will be fenced to prevent unauthorized access. **Post-Construction** **PHS 12:** Operations of the project would include public education on hazards associated with the river channel, including risk of water-related injury and drownings. **PHS 13:** City will coordinate as needed with vector control agencies after completion of construction.				USACE and City PMs to verify delivery of environmental protection plan to workers on first day of construction.
Utilities and Public Services				
Construction **UPS 1:** Develop a utility management plan. **UPS 2:** Obtain a Private Solid Waste Hauler Permit from the City's Bureau of Sanitation prior to collecting, hauling and transporting waste. **UPS 3:** Recycle/reuse construction debris to the extent possible. **UPS 4:** Dispose of excess debris to City-certified waste processing facility. **UPS 5:** Stagger construction of daylighting outfalls in order to minimize reduction in capacity of the stormwater system.	USACE	Prior to and during project construction	USACE	USACE PM to verify compliance during construction. Considered complete after end of project construction.

MITIGATION MONITORING AND REPORTING PROGRAM SUMMARY TABLE (Includes Text for Best Management Practices and Mitigation Measures)				
BMPs / Mitigation Measures	**Responsibility for Implementation**	**Schedule**	**Monitoring/Report Responsibility**	**Status/ Verification**
Socioeconomics and Environmental Justice				
SEJ 1: Carry out acquisition and compensation of affected businesses in accordance with the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, Pub. L. 91-646, 42 U.S.C. 4601. As a component of the acquisition, businesses would have the opportunity to participate in the relocation assistance program. USACE will actively participate in relocation of these businesses to ensure fair and equitable compensation.	City	Prior to project construction	USACE	USACE PM to verify compliance during construction. Considered complete after end of project construction.

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX I
Value Engineering

April 2015

US Army Corps
of Engineers

LOS ANGELES RIVER
ECOSYSTEM RESTORATION

VALUE ENGINEERING STUDY SUMMARY REPORT

PROJECT SPONSOR:
THE LOS ANGELES DISTRICT

ARPIL 2013

DOD SERVICE: USACE
CONTROL NO: CESPL-13-02
VALUE ENGINEERING OFFICER: Arnecia Williams, AVS

Value Engineering Study on

Los Angeles River Ecosystem Restoration

Final 29 April 2013
U.S. Army Engineer District, Los Angeles

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Michael Affeldt
Mike Scuderi (webmeeting)
Klaire Desamparo
Megan Whalen
Mike Wyatt
Carol Armstrong

VALUE ENGINEERING TEAM STUDY

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VALUE ENGINEERING TEAM STUDY

PROJECT DESCRIPTION AND BACKGROUND

PROJECT TITLE: Los Angeles River Ecosystem Restoration
PROJECT LOCATION: Los Angeles, California

The U.S. Army Corps of Engineers (Corps) involvement with the LA River began after devastating floods destroyed homes, businesses, and infrastructure in the early 20th Century. The Corps then began examining options for flood risk management, which led to the channelization of the River in the 1930s and 1940s and the current concrete configuration. This configuration destroyed and drastically altered riparian and freshwater marsh habitats as well as ecosystem functions in the once natural river system. The flood control project also allowed for increased urbanization and development in the floodplain, further reducing the marsh and riparian habitats that had naturally occurred on the river and its tributaries. The Corps' involvement on the LA River continues today in sharing operation and maintenance responsibilities with the LA County Flood Control District.

The U.S. Congress directed the Corps to undertake the LA River Ecosystem Restoration Study in 2006. The Study initially focused on the first 32 miles of river, and was subsequently narrowed to focus on the 10-mile Study area (aka ARBOR reach), which exhibits the greatest potential for ecosystem restoration. This reach includes the "soft-bottomed" Glendale Narrows that connects Griffith Park to Downtown LA and that currently supports degraded riparian habitat. The soft bottomed reaches currently support a natural bed with concrete banks due to a high groundwater table that did not allow the bed to be constructed with concrete. In 2007, the City of LA adopted the long-range LA River Revitalization Master Plan that calls for the creation of a 64-mile network of trails, parks, and recreation along both sides of the first 32 miles of the LA River, from the San Fernando Valley to the City of LA's border with the City of Vernon, an area home to more than one million people. The entire Study area is within the Master Plan's focus area.

This value engineering study focused on the current state of design, and the aforementioned 10-mile Study area. Opportunities for increased value and decreased cost were investigated. Please see the CHAP Habitat Evaluation Appendix, Los Angeles River Ecosystem Restoration Study for further information.

VALUE ENGINEERING TEAM STUDY
EXECUTIVE SUMMARY

Value Engineering is a process used to study the functions a project is to provide. As a result, it takes a critical look at how these functions are met and develops alternative ways to achieve the same function while increasing the value of the project. In the end, it is hoped that the project will realize a reduction in cost, but adding value over reducing cost is the focus of VE.

The Value Engineering Study was initiated during the week of 25 to 29 March, 2013 at the Los Angeles District. The project was studied using the Corps of Engineers standard Value Engineering (VE) methodology, consisting of five phases:

Information Phase: The team studied drawings, figures, descriptions of project work, and cost estimates to fully understand the work to be performed and the functions to be achieved. Cost Models (see Appendix C) were compared to determine areas of relative high cost to ensure that the team focused on those parts of the project which offered the most potential for cost savings. The team visited the construction sites to gain knowledge of the area.

Speculation Phase: The Team speculated by conducting brainstorming sessions to generate ideas for alternative designs. All team members contributed ideas and critical analysis of the ideas was discouraged (see Appendix B).

Analysis Phase: Evaluation, testing and critical analysis of all ideas generated during speculation was performed to determine potential for savings and possibilities for risk. Ideas were ranked by priority for development. Ideas which did not survive critical analysis were deleted.

Development Phase: The priority ideas were developed into written proposals by VE team members during an intensive technical development session. Proposal descriptions, along with sketches, technical support documentation, and cost estimates were prepared to support implementation of ideas. Additional VE Team Comments were included for items of interest which were not developed as proposals, and these comments follow the study proposals.

Presentation Phase: Presentation is a two-step process. The published VE Study Report is distributed for review by project supporters and decision makers. A briefing is later conducted to decide which proposals merit implementation into project design. The Summary of Proposals follows on the next page.

VALUE ENGINEERING TEAM STUDY
SUMMARY OF PROPOSALS

Seventy one ideas for ways to improve the projects or reduce costs were generated during the Speculation Phase of this study. The Analysis Phase of the study reduced the number of ideas to thirty six for development, of which twenty eight ideas were designated as design comments and are included in this report.

Of all the ideas from the Analysis and Development Phases, eight ideas became proposals which, when accepted, can result in the savings shown below. The idea that shows a negative number is not recommended.

PROPOSAL NO.	DESCRIPTION	SAVINGS
1	Develop Mass Balance for Materials	$19,597,000
2	Down Scale the Planter Boxes	$36,203,000
3	Use Pre-Cast Concrete Planters and/or Modularize Planters	$90,507,000
4	Modify the Terraces	$120,736,000
5	Use Random Material for Grade Control Structures Cores	$4,700,000
6	Use Sheet Pile Walls in Lieu of Concrete for Planter Boxes	-$861,625,000
7	Delete the Fences	$10,206,000
8	Use Wrought Iron Fence In Lieu of Chain-Link	$0

Disposition of Recommendations

Below are the VE recommendations, potential savings, and an explanation as to whether these recommendations are valid, and accepted or rejected. The decision to accept or reject a proposal is based on the technical, environmental, and cost feasibility of the proposal, as well as input from the PDT.

VE Study Recommendations:

Rec #	Description	Projected Savings	Comment
1	Develop Mass Balance for Materials	$19,597,000	Valid recommendation and conditionally accepted. Additional technical analysis during PED.
2	Down Scale the Planter Boxes	$36,203,000	Valid recommendation and conditionally accepted. Proposal not applicable for Reach 4.
3	Use Pre-Cast Concrete Planters and/or Modularize Planters	$90,507,000	Valid recommendation and conditionally accepted. Proposal not applicable for Reach 4. Additional technical analysis during PED.
4	Modify the Terraces	$120,736,000	Valid recommendation and conditionally accepted. Proposal not applicable for Reach 4. Additional technical analysis during PED.
5	Use Random Material for Grade Control Structures Cores	$4,700,000	Valid recommendation and conditionally accepted. Additional technical analysis during PED.
6	Use Sheet Pile Walls in Lieu of Concrete for Planter Boxes	-$861,625,000	Not valid and rejected due to extensive cost.
7	Delete the Fences	$10,206,000	Not valid and rejected due to safety concerns.
8	Use Wrought Iron Fence In Lieu of Chain-Link	$0	Valid recommendation and accepted.

TOTAL POTENTIAL CUMULATIVE SAVINGS: $ 281,949,000

TOTAL OF ACCEPTED/CONDITIONALLY ACCEPTED RECOMMENDATIONS = $ 271,743,000

TOTAL OF QUALITY IMPROVEMENT RECOMMENDATIONS = $0

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 1 PAGE NO: 1 OF 2
DESCRIPTION: Develop Mass Balance for Materials

ORIGINAL DESIGN:

The original design calls for material from excavations to be hauled off site, and material for embankments to be hauled in.

PROPOSED DESIGN:

The proposed design is to create a “Mass Balance” of materials. This would be accomplished by using all excavated materials from the entire job as fill material in other locations in the project area.

ADVANTAGES:

- Faster construction.
- Reduced cost.
- Less wear and tear on local roads and streets.
- More environmentally friendly.
- Less soil testing.

DISADVANTAGES:

- Slight decrease in quality of some embankments.

JUSTIFICATION:

From the unit costs available, the cost for material hauled off site is $28.50 per cubic yard. The cost for compacted fill is $33.50. These costs go down if the material is kept on site. From the estimate if only 15% is hauled off and replaced the cost drops to $7.00 and $13.00 per cubic yard respectively. For purposes of this proposal, it was assumed that an additional 10%, or 25% of the total of the required cut could be used or wasted on site. This results in a savings of $21.50 for excavation and $20.50 for embankment. This could be accomplishable since the fills are not part of critical structure where settlement and instability are an issue. The following spreadsheet presents the data by reach.

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Reach 1 Excavation	CY	359,700		$0
Reach 1 Embankment	CY	88,952		$0
Reach 2 Excavation	CY	30,000		$0
Reach 2 Embankment	CY	0		$0
Reach 3 Excavation	CY	117,685		$0
Reach 3 Embankment	CY	0		$0
Reach 3 Excavation	CY	1,524,592		$0
Reach 3 Embankment	CY	0		$0
Reach 4 Excavation	CY	133,711		$0
Reach 4 Embankment	CY	0		$0
Reach 5 Excavation	CY	94,065		$0
Reach 5 Embankment	CY	42,289		$0
Reach 6 Excavation	CY	1,463,100		$0
Reach 6 Embankment	CY	0		$0
Reach 7 Excavation	CY	918,331		$0
Reach 7 Embankment	CY	0		$0
Reach 8 Excavation	CY	1,886,602		$0
Reach 8 Embankment	CY	0		$0
				$0
Total Excavation Hauled Off	CY	6,527,786		$0
Total Embankment Hauled In	CY	131,241		$0
Excess Material	CY	6,396,545		$0
				$0
Assumed an additional 10% Remains on Site	CY	639,655	$21.50	$13,752,572
				$0
				$0
		Total Deletions		$13,752,572
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
None				$0
				$0
		Total Additions		$0
		Net Cost Decrease		$13,752,572
		Mark-ups	42.50%	$5,844,843
		Total Cost Decrease		$19,597,415

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 2 PAGE NO: 1 OF 2

DESCRIPTION: Down Scale the Planter Boxes

ORIGINAL DESIGN:

The current design calls for 158,784 Cubic Yards of steel reinforce planter boxes.

PROPOSED DESIGN:

The proposed design is to downsize the planter box features, as the team identified it as a high cost item.

ADVANTAGES:

- Reduce cost.
- Faster construction.

DISADVANTAGES:

- Reduced scope.

JUSTIFICATION:

The following spreadsheet shows that a modest decrease in planter boxes of 20% would result in a substantial savings, while at the same time providing most of the project value. However, this is a decrease in scope. If this modest decrease can fulfill the project purpose it is recommended. This would be accomplished in final design by optimizing the planter box location.

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete Planters				$0
Reach 4	CY	119253		$0
Reach 5	CY	29187		$0
Reach 8	CY	10344		$0
				$0
Concrete Planters 20% Reduction				$0
Reach 4	CY	23850.6	$800.00	$19,080,480
Reach 5	CY	5837.4	$800.00	$4,669,920
Reach 8	CY	2068.8	$800.00	$1,655,040
				$0
				$0
				$0
		Total Deletions		$25,405,440
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$0
		Net Cost Decrease		$25,405,440
		Mark-ups	42.50%	$10,797,312
		Total Cost Decrease		$36,202,752

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 3 PAGE NO: 1 OF 4

DESCRIPTION: Use Pre-Cast Concrete Planters and/or Modularize Planters

ORIGINAL DESIGN:

The original design utilizes 158,794 cubic yards of concrete planters which would be cast on site. Planters are integrated as ecosystem restoration features through use of riparian vegetation to provide edge habitat adjacent to the river.

PROPOSED DESIGN:

The Proposed design is to incorporate either individual or modular pre-cast concrete planters in lieu of custom-fit planters cast at the site.

ADVANTAGES:

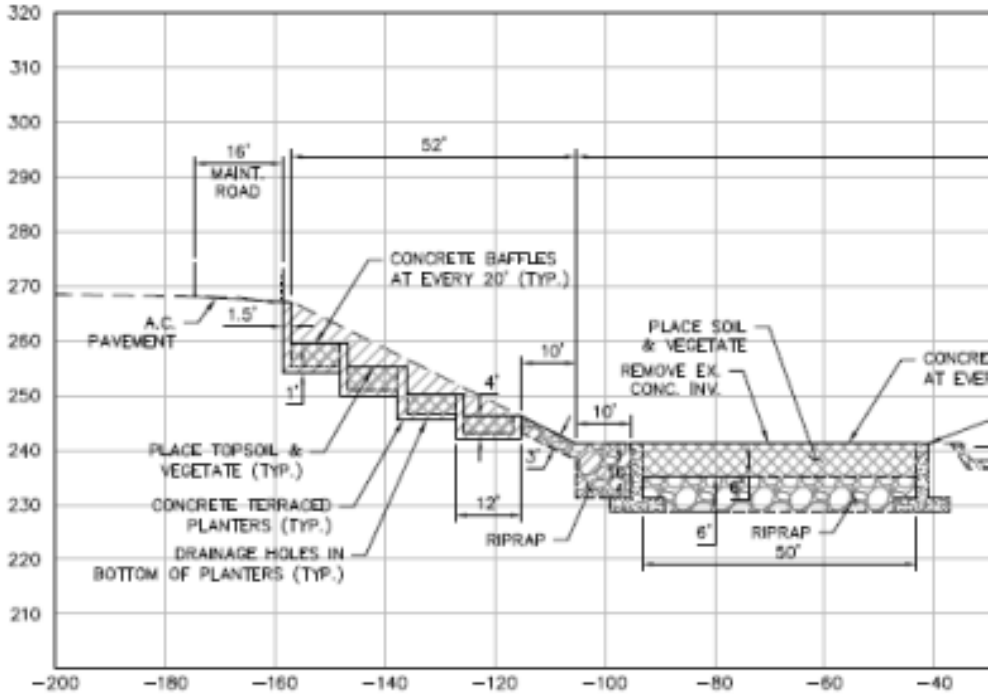
- Reduces cost while maintaining functionality.
- Quick turnaround and reduced cycle time
- Meets International Building Code requirements
- Durability

DISADVANTAGES:

- Would not provide custom fit of the planters to the site.

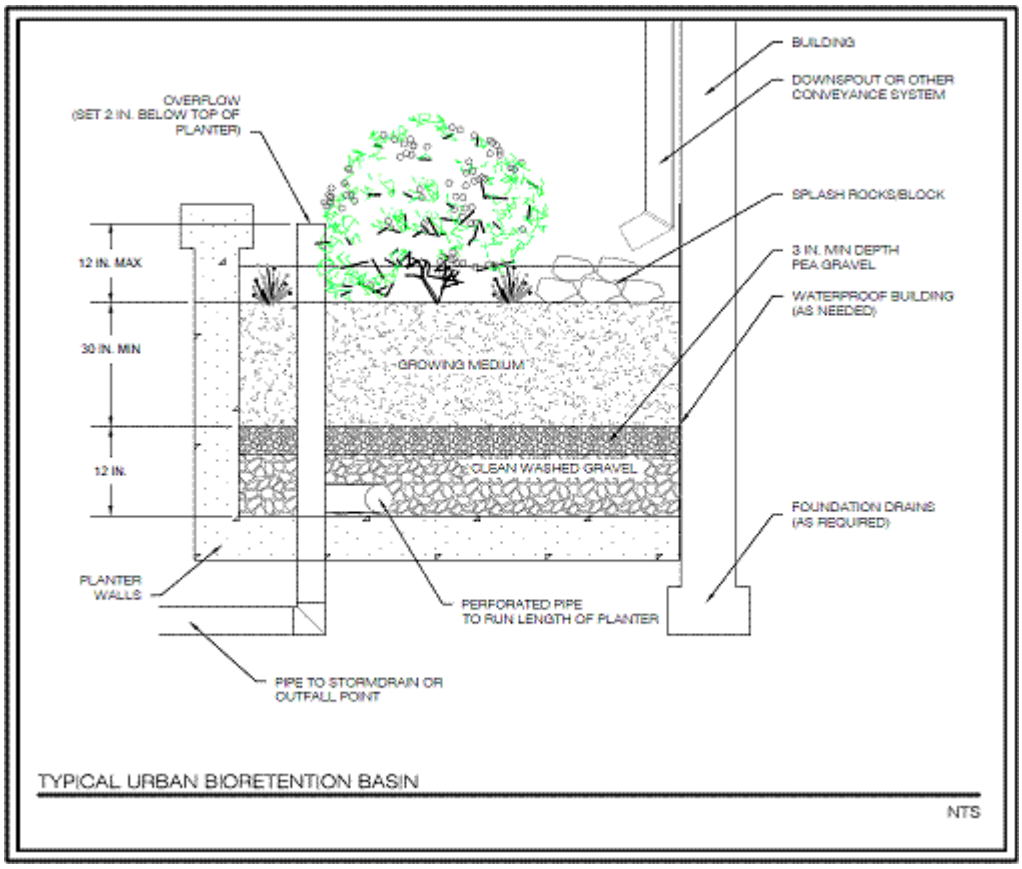
JUSTIFICATION:

Using modular pre-cast concrete planters will reduce the cost of using custom planters while maintaining functionality. Using precast concrete planters provide for a quicker turnaround. It allows for the ability to begin casting components for the superstructure while foundation work is in progress. Precast concrete components can also be cast and erected year-round, without delays caused by harsh weather. Additionally, the new systems have a variety of textures, colors, finishes and inset options that can be used.



Concrete planter cross-section

Examples of pre-cast concrete planters



COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete Planter Boxes	CY	158,784	$800.00	$127,027,200
Assume 2 CY per planter Box				$0
79392 Planter Boxes				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$127,027,200
ADDITIONS				
	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete Planter Boxes	CY	158,784	$400.00	$63,513,600
Assume 2 CY per planter Box				$0
79392 Planter Boxes				$0
and a reduction to $500 per Cubic Yard				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$63,513,600
		Net Cost Decrease		$63,513,600
		Mark-ups	42.50%	$26,993,280
		Total Cost Decrease		$90,506,880

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 4 PAGE NO: 1 OF 3

DESCRIPTION: Modify the Terraces

ORIGINAL DESIGN:

Terraces are incorporated throughout each reach to reduce the angularity of the trapezoidal channel, serve as a medium for vegetative restoration and provide public access points to the river. Terraces require demolition of the existing channel surface, change to the channel geometry and reconstruction through the use of concrete planters and surface walkways.

PROPOSED DESIGN:

The proposed design is to reduce the scale of the terraces by 33% to achieve cost savings for the project.

ADVANTAGES:

- Reduces the total project costs and footprint of impact.

DISADVANTAGES:

- May reduce the overall benefits of the project. The PDT will need to evaluate which areas may be suitable candidates based on a cost-benefit analysis of the effects of the terraces.

JUSTIFICATION:

Terraces compose a significant portion of the total project costs. Reduction in the scale of the terraces may be able to be achieved while maintaining high priority ecosystem restoration areas.

Examples of terraces with existing and proposed conditions. Proposed condition 1 will maximize the vegetation on the terraces and proposed condition 2 allows for minimum vegetation.

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete Planter Boxes	CY	158,784	$800.00	$127,027,200
Assume 2 CY per planter Box				$0
79392 Planter Boxes				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$127,027,200
ADDITIONS				
	UNITS	QUANTITY	UNIT COST	TOTAL
Assumes a 33% reduction	CY	105,750	$400.00	$42,300,058
in quantity				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$42,300,058
		Net Cost Decrease		$84,727,142
		Mark-ups	42.50%	$36,009,036
		Total Cost Decrease		$120,736,178

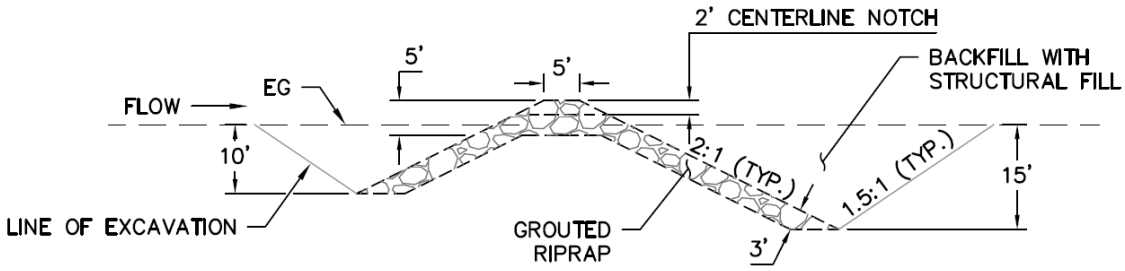
VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 5 PAGE NO: 1 OF 2

DESCRIPTION: Use Random Material for Grade Control Structures Cores

ORIGINAL DESIGN:

The original design calls for grouted rip-rap grade control structures with a compacted fill core.



GRADE CONTROL STRUCTURE DETAIL
NTS

PROPOSED DESIGN:

The proposed design calls for a random fill core. From the available data the quantities and units costs were derived. A 25% reduction in the cost of the core fill was assumed.

ADVANTAGES:

- Reduce cost.
- Faster construction.

DISADVANTAGES:

- Reduced scope.

JUSTIFICATION:

The following spreadsheet shows a modest decrease in core material costs, if a random material is used. This would result in a savings, while at the same time providing most of the project value. However, this is a small decrease in scope. If this modest decrease can fulfill the project purpose it is recommended. This would be accomplished in final design by optimizing the core fill.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 5 PAGE NO: 2 OF 2

DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Total Compacted Fill	CY	1,552,056		$0
				$0
25% of Total Compacted Fill	CY	388,014	$21.50	$8,342,301
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$8,342,301
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
25% of Total Compacted Fill	CY	388,014	$13.00	$5,044,182
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$5,044,182
		Net Cost Decrease		$3,298,119
		Mark-ups	42.50%	$1,401,701
		Total Cost Decrease		$4,699,820

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 6 PAGE NO: 1 OF 2

DESCRIPTION: Use Sheet Pile Walls in Lieu of Concrete for Planter Boxes

ORIGINAL DESIGN:

The original design calls for steel reinforced concrete planter boxes.

PROPOSED DESIGN:

The proposed design calls for sheet pile cells.

ADVANTAGES:

- None.

DISADVANTAGES:

- Increase cost.

JUSTIFICATION:

The assumption that follows is that a 2 CY concrete planter box would be replaced by a sheet pile cell. The assumption was a PZ 27 with 3 feet exposed and 9 feet driven. As is shown on the following spreadsheet the cost is much higher and this proposal is not recommended.

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete Planter Boxes	CY	158,784	$800.00	$127,027,200
Assume 2 CY per planter Box				$0
79392 Planter Boxes				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$127,027,200
ADDITIONS				
	UNITS	QUANTITY	UNIT COST	TOTAL
Sheet Pile (PZ 27) 12' Stick 3 Up 9 Down				$0
288 Face Feet per Box				$0
79392 Planter Boxes				$0
Sheet Pile (PZ 27) 12' Stick 3 Up 9 Down	SF	22,864,896	$32.00	$731,676,672
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$731,676,672
		Net Cost Decrease		-$604,649,472
		Mark-ups	42.50%	-$256,976,026
		Total Cost Decrease		-$861,625,498

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 7 PAGE NO: 1 OF 2

DESCRIPTION: Delete the Fences

ORIGINAL DESIGN:

The original design utilizes 239,000 linear feet of chain-link fence to protect sensitive restoration areas, manage public traffic and improve site safety.

PROPOSED DESIGN:

The proposed design is to remove 100% of the fences proposed for the eight major reaches, but maintain fencing within tributary areas.

ADVANTAGES:

- Reduces overall costs.
- Increases aesthetics of viewscape.
- Promotes ecosystem connectivity.

DISADVANTAGES:

- Elimination of fencing would result in loss of protection of a large portion of the project footprint and may have public safety impacts.

JUSTIFICATION:

Cost reduction only.

COST ESTIMATE WORKSHEET				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Chain Link Fence	LF	238,732	$30.00	$7,161,960
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$7,161,960
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$0
		Net Cost Decrease		$7,161,960
		Mark-ups	42.50%	$3,043,833
		Total Cost Decrease		$10,205,793

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 8 PAGE NO: 1 OF 3

DESCRIPTION: Use Wrought Iron Fence In Lieu of Chain-Link

ORIGINAL DESIGN:

The original design utilizes 239,000 linear feet of chain-link fence to protect sensitive restoration areas, manage public traffic and improve site safety.

PROPOSED DESIGN:

The proposed design is to reduce the quantity of chain-link fence by 86% and replace with wrought iron fence.

ADVANTAGES:

- Improves aesthetics and durability.
- Reduces vandalism.
- Increases long-term reliability of protection.

DISADVANTAGES:

- Significantly more expensive. Would require reduction in quantity in order to remain cost-neutral.
- Reductions in quantities would result in loss of protection of a large portion of the project footprint.

JUSTIFICATION:

In order to remain cost-neutral, an 86% reduction would need to occur in the linear feet of fence proposed for the project. This would result in reducing the fence footprint from 239,000 linear feet to 32,500 linear feet. Locations for elimination of fencing would need to be undertaken by the PDT. Since this is a neutral cost with no change, no cost sheet is shown.

Example of 6’ chain-link fence

Example of wrought-iron fence

VALUE ENGINEERING COMMENTS

1. ***Redesign the Terraces*** The terraces should accommodate plantings and wildlife passage to and from the channel bottom. Consider designing fences with fewer steps, and potentially incorporate an access path that can accommodate people and maintenance vehicles also. Terraces are an important feature for wildlife mobility in and out of the river. They are also beneficial to human access and enjoyment. The form terraces take can be varied and differ at different places in the project area. Whereas the costs were estimated with a design including a certain number of terraces, fewer, larger steps could be utilized.

2. ***Acquire More Land*** To maximize value (i.e. increase habitat units per cost to project), an effective way would be to add land to the project area under the following conditions:

- The land is adjacent to a site of restoration already in the project.
- The presumed restoration would be similar to or the same as the adjacent restoration, so it could be treated as an expansion of the existing area.
- No significant landscape/ excavation would be needed.
- The acquisition cost would be low compared to the other areas.

Under these conditions, ad expansion of planned restoration areas would be valuable, in an increase in total cost.

3. ***Recycle Existing Concrete.*** Concrete that is removed from the LA River channel and adjacent infrastructure should be recycled and/or incorporated into the new ecosystem restoration project. The recycled concrete can be used in other capacities and to reduce concrete cost, e.g. as fill or aggregate.

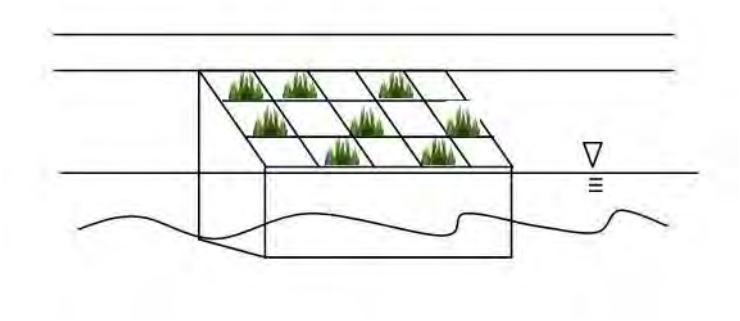
4. ***Recycle All Hard Material.*** All hard material (steel, concrete, etc) that is removed with the construction of the new project should be recycled with a preference of re-using the materials. Additionally the reduced cost associated with hauling and disposing of these materials from the demolition of previous structures is a benefit.

5. ***Increase Vehicular Access*** Adding access for motorized vehicles provides for a multiple-use function. Currently the LA River only has two access points. This will allow for the community to have several access points for entering the channel as well as habitat connectivity. Balance the popular use of using motorized vehicles and having it done in an environmentally-sensitive way.

6. ***Increase Shade.*** Where possible, design pathways, viewing towers, and other project elements to create shaded spots to aid in habitat establishment and health. For example, (a) cantilever paths, (b) design towers with awnings, and (c) create boulder-based refuge areas in the channel.

7. ***Use Differently Armored Banks.*** Instead of terraces at some places, or to replace grouted riprap slopes, or where geo-engineered banks are infeasible, use an armored bank that will allow vegetation to grow in gaps. This could be a concrete "egg carton" inset into the bank or box concrete storm culverts could be repurposed and inset vertically to create a structural slope with infill that is vegetated. This could present a significant cost saving to cast-in-place boxes while offering some habitat.

Illustration Provided



8. ***Add Viewing Stations.*** Viewing stations can be used to monitor how geomorphology is performing over time, can aid in habitat and wildlife health evaluation, can provide public educational value, and can keep people away from direct interference in habitat areas. They may also be able to provide bird perches and/or bat habitat and their bases could support vegetation such as vines.

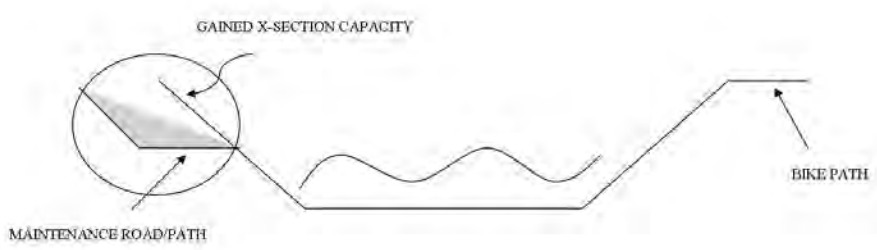
9. ***Creatively Finance Across Corp Mission.*** Acknowledge if it may be possible to consolidate Corps investments in O&M, ecosystem, recreation and/or flood protection if a project's implementation can be shown to affect or be impacted by each. For example, O&M has been historically underfunded and new ecosystem and recreation funds will be needed. Could the aggregate needs/requests in the separate accounts be reduced if a blended investment is made with reduced transaction costs associated with the overhead, administration, etc in the 3 separate bureaucratic channels? This could be a 'special case' applicable only to urban cases recognized as Urban Waters Federal Partnership pilots by the Obama administration (there are seven (7) and USACE is a partner agency of this).

10. ***Use Adjacent Areas for Any Mitigation.*** When and where feasible, given that adjacent land acquisition is critical – consider using lands that will be needed for future phases of the project for staging, storage, etc, thereby acquiring those for future ecosystem use. For example, to avoid long hauls to distant places (an air quality problem) or dumping of materials in distant landfills (expensive and accumulative/climate change impacts) store materials on nearby parcel, recycle them, break them up, etc. to reuse them (cap or cover lay soil as part of geomorphology is landscape). This way lands are acquired for staging, construction but reused as ecosystem areas and result in acquisition mitigation, etc.

11. ***Allow Natural Sedimentation to Act as Fill.*** Allowing natural sedimentation processes to establish islands and banks in certain areas would save costs of fill importing and placement, and would allow the river to form a more natural geomorphology. This may be especially appropriate at the areas of major channel reconfiguration like Verdugo Wash Confluence, Taylor Yard, and Piggybank Yard. For instance at Taylor Yard, if modular concrete armoring sheet curves were placed in the bed of the river and allowed to catch debris and sediment, then the deposits would form in a more natural way. Additionally, the process would be studied by local researchers for future optimization.

12. ***Increase Capacity by Lowering Maintenance Roads.*** In strategic places it may make sense to change the location of the maintenance roads and notch it into the channel (see illustration). This would be most beneficial where we know there is a chance of break-out during a rare rain event, or the maintenance part is wide enough at the top to still accommodate emergency access during rain even, or there would be little impact to existing structures at the top of the bank. The road should be placed at the level of storm event for optimized access (say 20% storm). The excess capacity could offset increase vegetation (roughness) elsewhere in the channel.

Illustration provided



13. ***Build One Small Area First, as an Example.*** Construct a portion of the total project first, showcasing what is possible and what will work well in a given area or reach. This may be useful if only partial funding is available and sequencing construction (based on a small area) is more feasible at the time. Also, the entire project may need to be constructed in smaller pieces overtime as funding and resources are allocated. This project area can act as a pilot for the overall larger project and offer solutions for future design and engineering challenges.

14. ***Build the Most Intensive Areas First.*** By sequencing or phasing construction strategically, and building the largest most intense areas first, the most ecological value would be realized earlier. This could be considered during the completion of the feasibility report.

15. ***Use Strategic Maintenance Methods.*** Do invasive plant/vegetation work upstream in the LA River and tributaries first, and then work in project area. This will maximize performance of the overall project. Due to seed transport, it is highly likely that seeds from invasives will re-plant themselves in the project area, if they are not managed upstream from the project area.

16. ***Establish Plant Harvesting Area.*** The construction of the recommended project will be done in phases over several years, and there is a significant amount of vegetation and trees that will be installed. These will be specific native species. It may be possible to save money be having an initial phase of the project include establishing a nursery of plant farm that will be used by the rest of the project. For example, if the Taylor Yard area was started right away with the trees that will be needed in 10 years at Piggyback, then the cost of buying mature trees in 10 years is eliminated or reduced and replaced with the cost of nurturing the trees, which may be lower. This offers a significant aesthetic and ecosystem benefits as well by establishing mature plants in restoration areas. This could also be done with bushes and other plants.

17. ***Increase In-Channel Vegetation***. Focusing on increasing in-channel vegetation, in part at the expense of the terrace/bank vegetation will increase the value of the habitat created since the riparian vegetation will be closer to the water. In combination with focusing on the primary areas for connectivity to the mountains (item 54), will increase the functionality of the riparian areas. Focusing on maintaining and improving in-channel vegetation will reduce O&M costs due to the reduction in watering required.

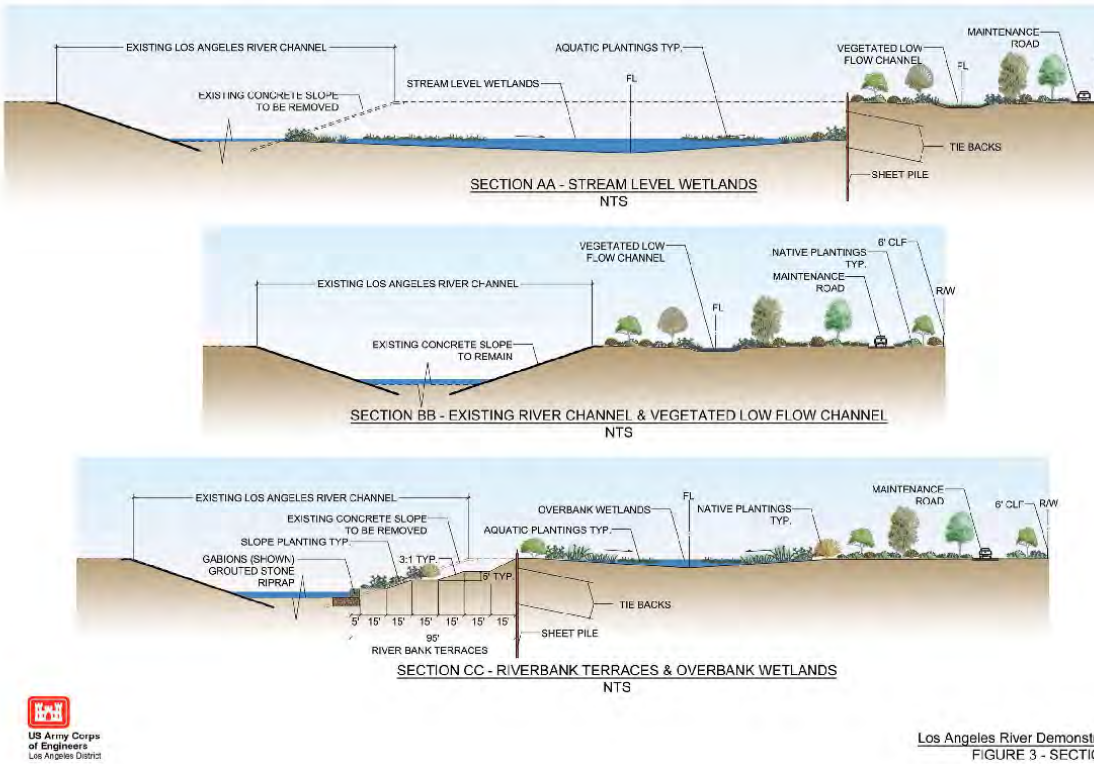
18. ***Use Different Armoring Techniques***. While the traditional bank protection method for the Los Angeles River has been a concrete lined trapezoidal channel, this technique has become outdated and carries with it significant environmental impacts. Especially in areas where levees are not present, an examination of alternative bank protection methods should be evaluated. As long as a significant toe is established, riprap or other structures could be used in various locations on the project alignment. As one progresses further up the bank and velocities drop, the integration of vegetation with the protection can be accomplished to increase environmental benefits.

19. ***Prioritize Projects with Connectivity to Santa Monica and San Gabriel Mountains***. Because the project is focusing on establishing the "bones" of the ecosystem which can be built upon via other restoration projects, emphasis/priority should be placed on first building the projects which will establish connectivity to the Santa Monica and San Gabriel Mountains. Establishing these connections first will allow for increased wildlife usage of the riparian areas.

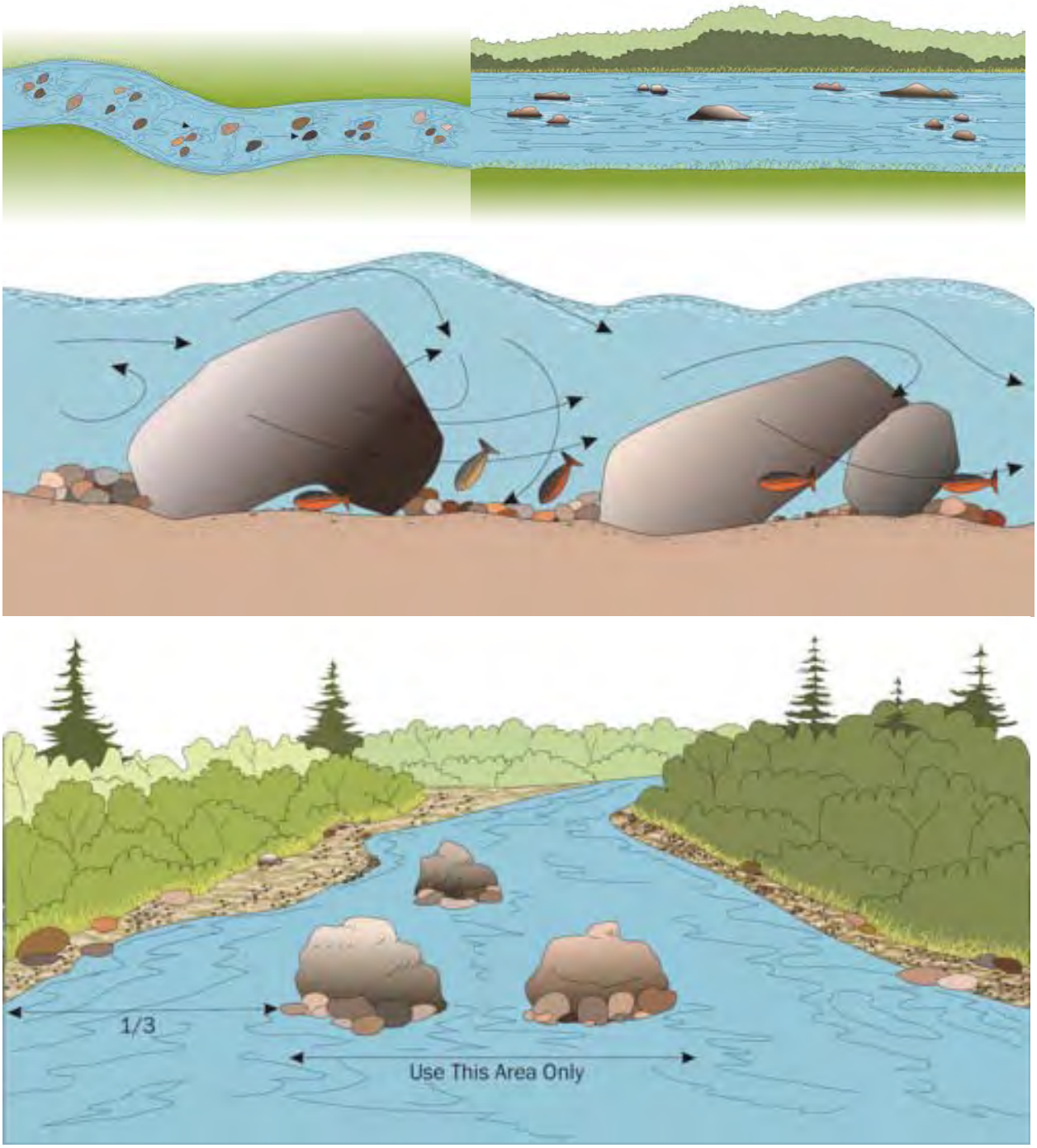
20. ***Reevaluate Roughness Coefficient***. The values used for vegetation roughness in the hydraulic analysis should be reevaluated. Researchers at ERDC (Fischenich and Derrick) have additional information that could be used in adjusting the Manning's N for vegetation. A decrease in Manning's N could significantly change project design as well as increase project benefits due to increased planting of vegetation and reduction in maintenance costs and frequency while at the same time maintaining the existing level of protection.

21. ***Increase Channel Complexity.*** The VE team suggested that the project increase the channel complexity. Some ideas are as follows:
Restore freshwater marsh areas at the confluence of the main stem of the LA River and tributaries such as Burbank Channel, Verdugo Wash and Arroyo Seco.
Incorporate boulder fields in bottom of channel through the marsh areas to provide in-stream habitat refuge and resting areas for aquatic species. Boulders provide velocity breaks during high flows to disperse energy and allow for refuge areas for aquatic species. Boulder fields may mobilize during high flows and will require evaluation. Integration of channel complexity into the marsh design will require consideration of maintenance for replacement of lost material. Addition of boulder fields will increase project benefits at minimal cost.

Example side channel with freshwater marsh through golf course



Cross-section examples of freshwater marsh areas



Conceptual diagrams of in-stream boulder placement

22. ***Use Vegetated Reinforced Soil Slopes in Lieu of Concrete Walls.*** There are several turf reinforcement products on the market that could be used on a steep slope, in lieu of concrete walls. At this stage of design, the team did not feel that a defendable cost and quantity could be developed. It is recommended that, during final design, these types of products on steep slopes could be recommended. However, maintenance is increased.

23. ***Identify and Acquire the Footprint (Real Estate) as Soon as Possible.*** This project involves a substantial amount of real estate acquisition. It would help the project progress if the real estate requirement were established early on in the process and identified. This may preclude construction of new buildings and infrastructure that would have to then be removed at a higher cost.

24. ***Externalize Relocation Cost.*** This project involves a substantial amount of utility relocations. As with real estate as discussed above the requirement should be identified as soon as possible and communicated to the effected utilities.

25. ***Use Project Features for Multi Purposes.*** Every project element should have at least two functions, e.g. paths for O&M may also function as wildlife passages, towers keep people out of the habitat while providing bird perches, public education, and O&M functions.

26. ***Add Bird Towers.*** Birds are an important, and highly visible part of the ecosystem. Birds are important ecologically as well as economically. They are vital links in many food webs, and often serve as biological indicators of overall ecosystem health. Providing bird towers/areas provide essential habitat for one or more species of bird, including sites for breeding, wintering, and/or migrating birds. This will include bird monitoring, habitat restoration, land protection, and proposing changes to municipal land use policies.

27. ***Identify Multi-Uses for Staging Areas.*** Construction staging areas can also be used to host shop and job activities to support the project, such as materials remanufacturing.

28. ***Examine Types and Costs of Plants and Trees to be Purchased.*** Consider life cycle cost of selected trees/plants, including their ability to thrive, survive high flow events, the need for water, need to be replaced, what kind of maintenance required, etc. Also purchasing plants at cheaper unit costs should be evaluated and possibilities to use non-certified or non-traditional suppliers (to reduce cost) should be explored. Seed banking for future use is also an option to reduce cost.

SUPPORTING DOCUMENTS

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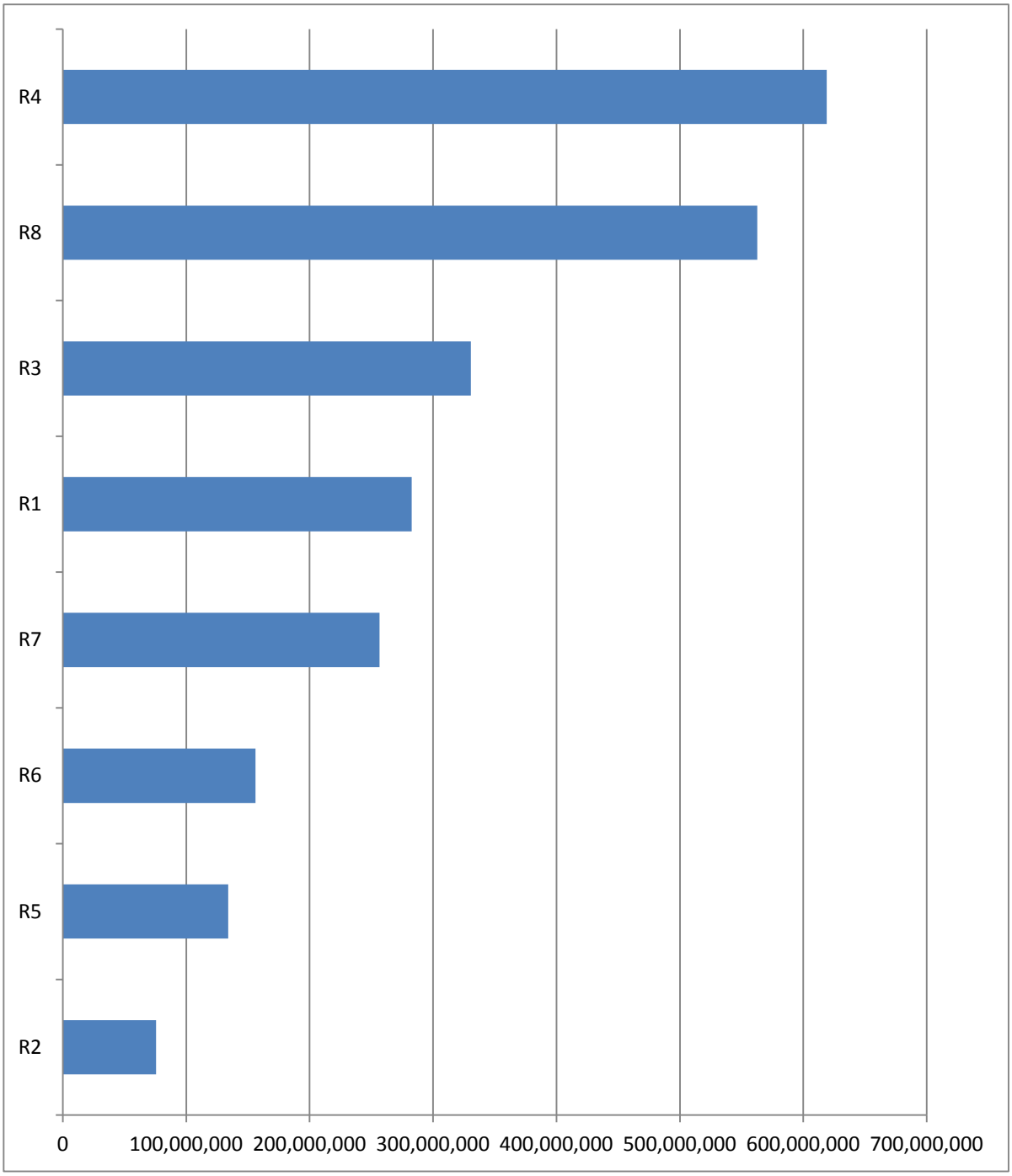
SPECULATION LIST

P	1	modify the terraces
C	2	redesign terraces - see 31
P	3	down scale the planter boxes
C	4	aquire more land
X	5	use alternative materials for concrete
C	6	increase in-channel vegetation
C	7	recycle existing concrete
C	8	recycle all hard material
C	9	use project features for multi purposes
C	10	increase vehicular access
C	11	increase shade
C	12	use vegitated reinforced soil slopes in lieu of concrete walls
C	13	use differently armored banks
C	14	add viewing stations
C	15	add bird tower
X	16	bury the railroads
P	17	develop mass balance from materials
X	18	bury the freeways
C	19	creatively finance across Corp mission
C	20	use adjacent areas for any mitigation
X	21	examine additional flood control feature during project
P	22	increase the channel complexities
X	23	cover the channel
P	24	use wrought iron fence in lieu of chain link
P	25	remove most of the fences
C	26	allow natural sedimentation to act as fill
X	27	conduct a sediment study
X	28	use islands for borrow
P	29	use random material for grade control structures
X	30	use inflatable dams to increase open water habitat
P	31	use sheet pile walls in lieu of concrete
X	32	use vinyl sheet pile
X	33	reduce the geotechnical factors of safety
X	34	reduce the structural factores of safety
X	35	use temporary structures

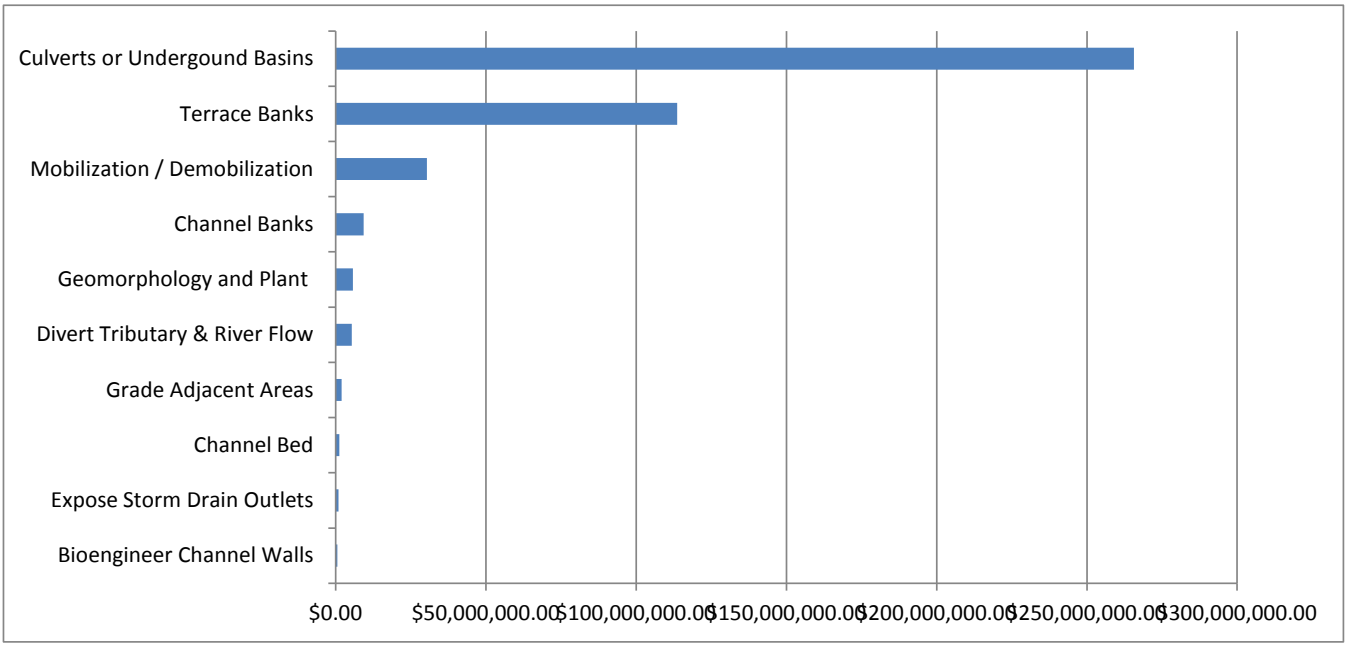
C	36	increase capacity by lowering maintainance roads
X	37	use shot crete for terraces
P	38	use pre cast planters
X	39	all materials should be sourced locally
X	40	use a supply contractor for pre cast planters
C	41	identify multi uses for staging areas
P	42	build pre cast planters into existing riprap - see 38
P	43	modularize the terrace planters
X	44	use gabions with or without recycled concrete
X	45	use a-jacks for riprap and concrete
X	46	use untreated wood for planters
X	47	concentrate investment in one area
C	48	build one small area first as an example
C	49	build the most intensive areas first
X	50	build it all in one contract
X	51	use design build contracts
C	52	use strategic maintainance methods
BD	53	use local labor and organizations for maintainance
C	54	focus sites which improves connectivity with the San Gabriel and Santa Monica Mountains
C	55	reduce the roughness coefficients in the hydrualic analysis
C	56	examine types and costs of plants and trees to be purchased
X	57	establish area to grow plant then harvest (i.e. plant farm)
X	58	add injection wells
X	59	add wells for water supply
X	60	capturing up stream flows to improve downstream habitat
X	61	reduce sediment transport (improve downstream habitat) and reduce cost of dredging
X	62	Sediment traps for island creation
X	63	use colored concrete
C	64	use scarified concrete surfaces
X	65	do not build to seismic standards
C	66	identify and acquire the footprint (real estate) as soon as possible
C	67	externalize relocation cost
X	68	use rock columns in lieu of concrete planters
X	69	use geo-grid
BD	70	use adaptive management
X	71	narrow the maintainance road

COST MODELS

Cost by Reach

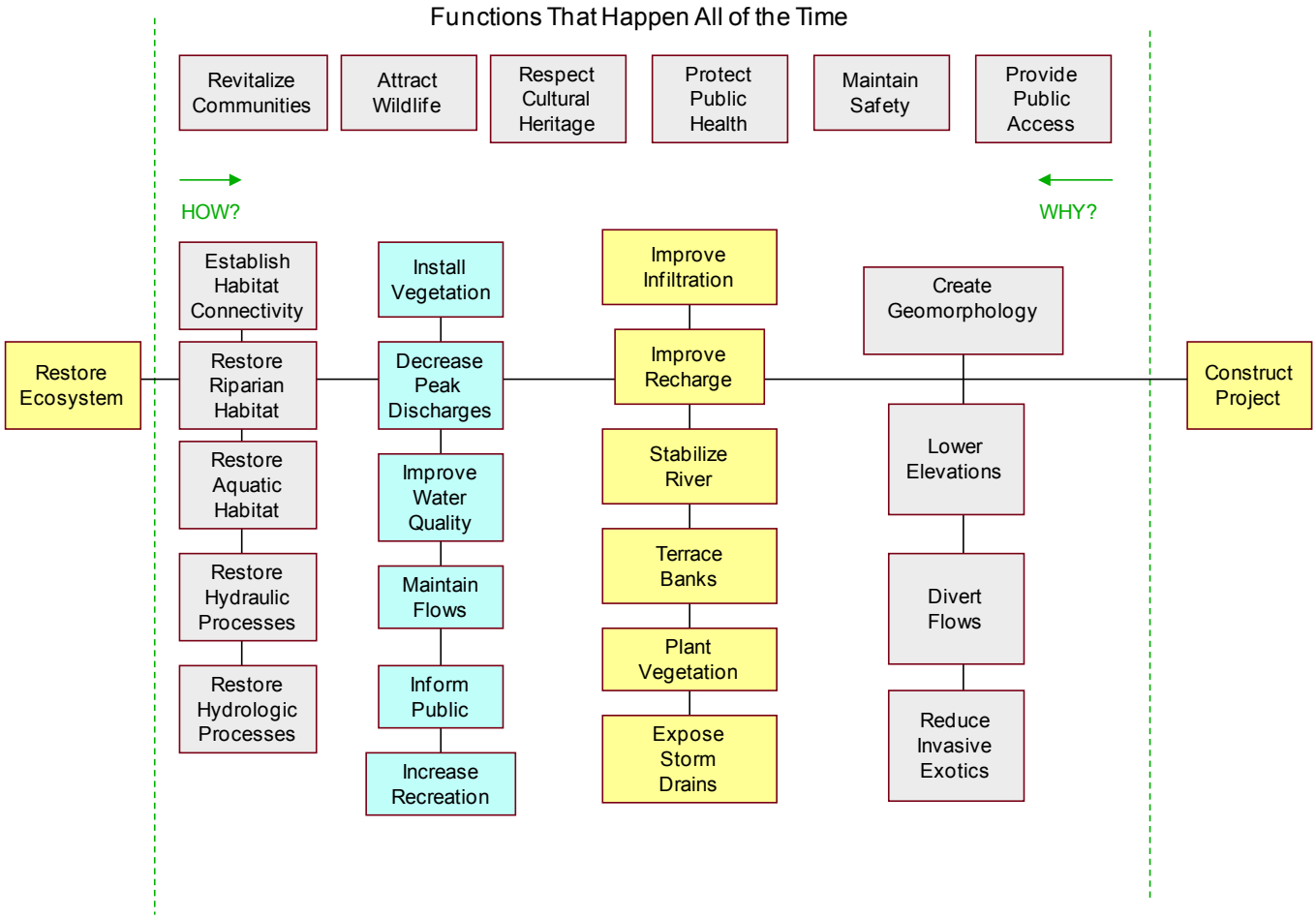


The cost for Reach Four is presented below as an example.
The underground basins have since been removed.



FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

FAST DIAGRAM FOR THE LA RIVER ECOSYSTEM RESTORATION



US Army Corps
of Engineers

Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX J
Real Estate Plan

May 2015

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1. PURPOSE

This appendix is prepared in accordance with Engineering Regulation (ER) 405-1-12, 12-16, Real Estate Plan, and presents the real estate requirements for the Los Angeles River Ecosystem Restoration Study Locally Preferred Plan (LPP), described below. The City of Los Angeles (City) is the non-Federal sponsor for the study.

1.1 Project Purpose

The primary purpose of the proposed project and alternatives considered in the study is to restore 11 miles of the Los Angeles River from approximately Griffith Park to downtown Los Angeles by reestablishing riparian strands, freshwater marsh, and aquatic habitat communities and reconnecting the river to major tributaries, its historic floodplain, and the regional habitat zones of the Santa Monica, San Gabriel, and Verdugo Mountains while maintaining existing levels of flood risk management. A secondary objective is to provide recreational opportunities consistent with the restored ecosystem within this 11-mile reach of the river. This reach is identified as the "Area with Restoration Benefits and Opportunities for Revitalization" reach, or ARBOR reach (referred to herein as ARBOR reach or study area).

The Los Angeles River, once the backbone for a vast natural system of riparian foothill and freshwater marsh habitat, carrying seasonal rains and subterranean flows to the coastal plain and the Pacific Ocean, has been degraded over time by a cycle of increasing urban development, flooding, and channelization, culminating in the mid-20th century with the Federal flood risk management project known as Los Angeles County Drainage Area (LACDA). LACDA was undertaken by the US Army Corps of Engineers (USACE) in partnership with the Los Angeles County Flood Control District (LACFCD), today known as the Los Angeles County Department of Public Works but referred to as

LACFCD throughout this real estate plan for consistency). The LACFCD, the non-Federal sponsor for LACDA, and the City of Los Angeles, the non-Federal sponsor for the restoration study, are separate governmental bodies. The LACDA project encased the river in concrete banks and a partially concrete bed which straightened the river's course, diminishing its plant and wildlife diversity and quality, disconnecting it from its floodplain and significant ecological zones, and dramatically changing its appearance.

The ARBOR reach has the greatest potential for restoration compared to the rest of the river because it includes the Glendale Narrows, one of the few reaches in the river with a non-concrete bed with natural flows fed by underground sources, and has connections to the Verdugo Wash and Arroyo Seco tributaries that can link to significant habitat areas as well as adjacency to Griffith Park, the eastern terminus of the Santa Monica Mountains. For these reasons, the ARBOR reach is the focus of the restoration alternatives.

1.2. Study Authority

This Study is authorized as a partial response to Senate Committee on Public Works Resolution, approved June 25, 1969, reading in part:

> *Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on the Los Angeles and San Gabriel Rivers and Ballona Creek, California, published as House Document Numbered 838, Seventy-sixth Congress, and other pertinent reports, with a view to determining whether any modifications contained therein are advisable at the present time, in the interest of providing optimum development of all water and related land resources in the Los Angeles County Drainage Area.*

Section 4018 of the Water Resources Development Act of 2007 (Public Law 110-114) provided authorization for a "feasibility study for environmental ecosystem restoration,

flood control, 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…." The Corps of Engineers (Corps) implementation guidance for this section identified that the scope and substance of the study under the Senate resolution is identical to the study mandated by section 4018 and directed that the ongoing study incorporate the section 4018 study.

1.3. Locally Preferred Plan – Alternative 20

This Real Estate Plan will focus on the real estate requirements for the locally preferred plan, Alternative 20, "ARBOR Riparian Integration via Varied Ecological Reintroduction (RIVER)," referred to herein as the Locally Preferred Plan or LPP.

Alternative 20, RIVER, includes restoration features throughout the 11-mile project reach. Alternative 20 widens the river at Verdugo Wash, Taylor Yard, and the Los Angeles Trailer and Container Intermodal Facility (LATC). Alternative 20 also restores the confluence with the Arroyo Seco tributary, restores habitat at the Los Angeles State Historic Park, and includes several daylighted streams and side channels.[1]

In this Real Estate Plan, an appendix to the Integrated Feasibility Report, the Corps must, for each project purpose and feature, fully describe the lands, easements, and rights-of-way, relocations, and disposal sites (LERRD) required for construction, operation, and maintenance of the project, including the acreage, estates, number of tracts/parcels, ownership, and estimated value. The Corps must include other relevant information on sponsor ownership of land, proposed non-standard estates, existing Federal projects and ownership, required relocations under the Uniform Relocation Assistance and Real Property Acquisition Policies Act (P.L. 91-646, as amended) ("the

[1] More detailed feature descriptions are provided, relative to the LERRD required, below.

Uniform Act"), presence of contaminants, and other issues as required by ER 405-1-12. This real estate plan does not contain a comparison of LERRD requirements and costs of the LPP with the NER Plan, Alternative 13v, because the Federal share of total ecosystem restoration cost for the LPP excludes any LERRD cost and is not affected by the difference in LERRD cost between the NER and LPP, as identified in the main IFR and in Section 20 of this real estate plan. The LERRD requirements for the NER Plan are on file with the Los Angeles District. This real estate plan is tentative in nature for planning purposes only and both the final real estate acquisition lines and the estimate of value are subject to change even after approval of the report.

2. DESCRIPTION OF LANDS, EASEMENTS, RIGHTS OF WAY, RELOCATIONS AND DISPOSAL SITES (LERRD)

The Los Angeles River Ecosystem Restoration Feasibility Study is analyzing the ecosystem restoration opportunities along the ARBOR reach. The non-Federal sponsor owns lands within and adjacent to the river in several cases, discussed in Section 3, below. As noted above, the study area also overlaps with a part of the existing Federal flood risk management project on the Los Angeles River, LACDA. The interests previously provided for that project and their inadequacy to fully support the restoration project are discussed in Section 5, below.[2] The study area has been divided into 8 reaches based on their physical characteristics for purposes of formulation and evaluation of restoration measures and alternatives. The lands required for each reach are described below, with discussion of number of parcels, acreage, non-Federal sponsor ownership,

[2] Because the interests in land previously provided for the LACDA flood risk management project are not sufficient to support the proposed restoration project features, and the restoration project sponsor must provide the remaining interests needed, the lands affected by the LACDA project are identified below as "within the existing LACDA project boundary" rather than "previously provided for the LACDA project." This complex issue is discussed in detail in Section 5 of this real estate plan.

public and private ownership, and whether the lands are within the existing LACDA project boundary. A discussion of the type of estates required for the project is also discussed for each reach. A brief discussion of non-standard estates is included for each reach and discussed in greater detail in Section 4 of this report. In addition to the lands required for specific constructed restoration features by reach, the channel bottom of the river and lower tributaries is required for the general measure of invasives removal during construction and invasives management during operation and maintenance of the project. These acreages are discussed in Section 2.2 below rather than by reach and are included in the summary table in Section 2.4.5.

2.1 Description by Reach

2.1.1 Reach 1 Pollywog Park Area of Griffith Park

Reach 1 extends from Pollywog Park/Headworks to the downstream edge of the concrete portion of the river. It is approximately 1.5 miles in length. In this reach, lands for the LPP will be used for riparian planting on the overbanks of the river, overbank of the Burbank Western Channel, and in the Pollywog Park area of Griffith Park. Overbanks are defined in the report as "…areas adjacent to the river where overland flow in flood events could occur in a natural river environment."

There are 33 parcels needed for this reach. The 33 parcels total 48.58 acres, of which 12.87 acres are within the existing LACDA project boundary. The non-Federal sponsor owns fourteen parcels in fee totaling 35.56 acres, of which 12.01 acres are within the existing LACDA project boundary. Six other parcels in public and private ownership total 0.86 acres and are within the existing LACDA project boundary. The non-Federal sponsor would need to acquire fee interest in the six parcels that are under public and private ownership.

There are also 13 parcels totaling 12.16 acres that do not have Assessor Parcel Numbers (APNs) and do not show an owner according to county assessor data. These parcels are adjacent to and may be a part of existing road and highway rights of way. Currently, it is anticipated that, for ten parcels of land, the non-Federal sponsor will request to acquire a lesser estate (perpetual ecosystem restoration easement) since in these areas the land in question is within Caltrans right of way. The remaining three parcels appear to be adjacent to street rights of way and may already be owned by the non-Federal sponsor. The non-Federal sponsor will provide fee where it is the fee owner and acquire fee where a private entity is determined to be the owner of the underlying fee. If a public entity is determined to be the underlying fee owner, the non-Federal sponsor may request to acquire a perpetual ecosystem restoration easement.

The following table lists the acreages needed for Reach 1 of the LPP:

	Acres outside of LACDA Boundary	Acres in LACDA Boundary	Total Acres needed for project including LACDA in Reach 1	Number of Parcels	Recommended Estates
Non Federal Sponsor	23.55	12.01	35.56	14	Fee
Public other than NFS	0	0.78	0.78	4	Fee
Private	0	0.08	0.08	2	Fee
Non-APN (owner not defined in gross appraisal)	12.16	0	12.16	13	Perpetual Easement (10 parcels) Fee (3 parcels)
TOTAL	35.71	12.87	48.58	33	

2.1.2 Reach 2 Bette Davis Park Area of Griffith Park

Reach 2 begins at the midpoint of Bette Davis Park to just past the bridge crossing of Interstate 5. It is approximately ¾ miles in length. The plan in this reach would create riparian habitat corridors along the overbanks of the river similar to Reach 1. Restoration of the Bette Davis Park area of the right bank of the river and a portion of Griffith Park of the left bank will also take place in this reach. In the LPP, there will also be modifications

to the channel changing the right bank from trapezoidal to a vertical bank with overhanging vines, creating an additional 80 feet of soft bottom channel width.

A total of 28 parcels have been identified as necessary for the implementation of the LPP. The non-Federal sponsor owns 12 parcels in this reach with a total acreage of 35.33 acres. Seven parcels totaling 0.53 acres that are located within the LACDA right of way will need to be acquired from other public agencies. Nine parcels with a total acreage of 5.82 acres do not have APNs. It is anticipated that the non-Federal sponsor will request a lesser estate (perpetual ecosystem restoration easement) from Caltrans for five of the nine non-APN parcels that are between the existing LACDA right of way and the 134 freeway and within Caltrans right of way. The other four non-APN parcels are within city road rights of way. For those parcels, the non-Federal sponsor will provide fee where it is the fee owner and acquire fee where a private entity is determined to be the owner of the underlying fee. If a public entity is determined to be the underlying fee owner, the non-Federal sponsor may request to acquire a perpetual ecosystem restoration easement.

The following table lists the acreages needed for Reach 2 of the LPP:

	Acres outside of LACDA Boundary	Acres in LACDA Boundary	Total Acres needed for project including LACDA in Reach 2	Number of Parcels	Recommended Estates
Non Federal Sponsor	25.55	9.78	35.33	12	Fee
Public other than NFS	0	0.53	0.53	7	Fee
Private	0	0	0	0	
Non-APN (owner not defined in gross appraisal)	5.82		5.82	9	Perpetual Easement (5 parcels) Fee (4 parcels)
TOTAL	31.37	10.31	41.68	28	

2.1.3 Reach 3 Ferraro Fields/Verdugo Wash Area of Griffith Park

Reach 3 begins at Ferraro Fields and ends at Brazil Street. It is approximately 1 mile long. Under the LPP, the Corps will construct a side channel along Ferraro Fields to divert water from the river. A stream will also be daylighted on the right bank of the river in the Zoo Drive area. Two smaller streams will be daylighted on the left bank. Daylighted streams will support a riparian fringe, open water and freshwater marsh at their confluence. In the Verdugo Wash confluence, the channel mouth would be widened and the south slope would be sloped back to the existing overbank elevation, thus creating a combined riparian and marsh community.

A total of 49 parcels (53.18 acres) will need to be acquired for Reach 3. A total of 10 parcels, 17.87 acres, are owned by the non-Federal sponsor. Of the 17.87 acres, 7.40 acres is within the existing LACDA right of way. The non-Federal sponsor will need to acquire 28 parcels totaling 26.35 acres from other public agencies and private parties within the reach. There are also 11 non-APN parcels, totaling 8.96 acres, which are within existing highway and street right of way. Six of the 11 parcels are within the Verdugo Wash area where the LPP would widen the channel, and the remaining five are in the area where the LPP would construct a side channel to divert water flows adjacent to where the 134 freeway connects with Interstate 5. Of these parcels, eight are believed to be within Caltrans right of way. For those parcels, it is likely the non-Federal sponsor will request a non-standard estate (perpetual ecosystem restoration easement) with rights to construct, operate and maintain the project. The other three non-APN parcels are within city road rights of way. For those parcels, the non-Federal sponsor will provide fee where it is the fee owner and acquire fee where a private entity is determined to be the owner of the underlying fee. If a public entity is determined to be the underlying fee

owner, the non-Federal sponsor may request to acquire a perpetual ecosystem restoration easement.

The following table lists the acreages needed for Reach 3 of the LPP:

	Acres outside of LACDA Boundary	Acres in LACDA Boundary	Total Acres needed for project including LACDA in Reach 3	Number of Parcels	Recommended Estates
Non Federal Sponsor	10.47	7.40	17.87	10	Fee
Public other than NFS	0	4.69	4.69	4	Fee
Private	21.35	0.31	21.66	24	Fee
Non-APN (owner not defined in gross appraisal)	8.96	0	8.96	11	Perpetual Easement
TOTAL	40.78	12.4	53.18	49	

2.1.4 Reach 4 Griffith Park

Reach 4 starts at Brazil Street and ends at Los Feliz Boulevard. It is 1.75 miles long. The restoration in this reach would daylight streams in eight areas, create a side channel through the Griffith Park Golf Course on the right side of the river, lower the Los Feliz Golf Course on the left bank to allow seasonal flooding, and provide a riparian habitat corridor. The storm drains in this reach will be opened and naturalized as tributaries within the right of way of the existing LACDA project and adjacent lands.

In this reach, 17 parcels (totaling 17.42 acres) are needed for the LPP. Eight parcels totaling 13.70 acres are already owned in fee by the non-Federal sponsor. Of those 13.70 acres, 1.59 acres is part of the existing LACDA footprint. The non-Federal sponsor will also need to acquire two parcels (0.60 acres) within the existing LACDA right of way from the LACFCD. Two parcels totaling 0.60 acres will need to be acquired in fee from private owners. In addition, a total of five parcels identified as necessary for the project do not have APNs, four within Caltrans right of way and one within the non-

Federal sponsor's road right of way. It is anticipated the non-Federal sponsor will request a lesser estate (perpetual ecosystem restoration easement) for the four parcels within Caltrans right of way. In this area, the LPP would divert river flows into a side channel and plant on the banks of the channel. For the non-APN parcel within existing City road right of way, the non-Federal sponsor will provide fee where it is determined to be the fee owner and acquire fee where a private entity is determined to be the fee owner; if it is determined that a public entity is the underlying fee owner, the non-Federal sponsor may request to acquire a perpetual ecosystem restoration easement.

The following table lists the acreages needed for Reach 4 of the LPP:

	Acres outside of LACDA Boundary	Acres in LACDA Boundary	Total Acres needed for project including LACDA in Reach 4	Number of Parcels	Recommended Estates
Non Federal Sponsor	12.11	1.59	13.70	8	Fee
Public other than NFS	0	.60	.60	2	Fee
Private	0	.41	.41	2	Fee
Non-APN (owner not defined in gross appraisal)	2.71	0	2.71	5	Perpetual Easement (4 parcels) Fee (1 parcel)
TOTAL	14.82	2.60	17.42	17	

2.1.5 Reach 5 Riverside Drive

Reach 5 starts at the Los Feliz Boulevard Bridge and ends at the Glendale Freeway. It is approximately 1.55 miles in length and the right bank would be modified from a trapezoidal bank to a vertical bank. This would increase the width of the soft bottom of the riverbed by over 100 feet. Overhanging vines will be planted on the top of the new bank. The left bank will be terraced and planted with herbaceous vegetation. Erosion measures will be taken by installing concrete-lined beds which would then be

planted with riparian vegetation. At the downstream end of this reach, the river will also be widened.

A total of 63 parcels totaling 32.05 acres are needed for this reach of the LPP. Of the 32.05 acres, 29.34 acres are within the existing LACDA right of way. The non-Federal sponsor will need to acquire 23 parcels totaling 9.92 acres within the LACDA boundary from the LACFCD and 8 parcels from private owners which are also within the existing LACDA footprint. There are also 2.40 acres, 16 parcels, without APNs. Two of the 16 parcels are within existing Caltrans highway rights of way and it is anticipated the non-Federal sponsor will request to acquire a lesser estate (perpetual ecosystem restoration easement) to plant riparian vegetation. The remaining 14 parcels are within existing City road rights of way which are under the City's control. The City will provide fee where it is the fee owner and acquire fee where a private entity is determined to be the owner of the underlying fee for the 14 parcels. If a public entity is determined to be the fee owner, the City may request to acquire a perpetual ecosystem restoration easement. In this area the channel walls will be modified from trapezoidal to vertical and bioengineered.

The following table lists the acreages needed for Reach 5 of the LPP:

	Acres outside of LACDA Boundary	Acres in LACDA Boundary	Total Acres needed for project including LACDA in Reach 5	Number of Parcels	Recommended Estates
Non Federal Sponsor	0	16.47	16.47	16	Fee
Public other than NFS	0	9.92	9.92	23	Fee
Private	0.31	2.95	3.26	8	Fee
Non-APN (owner not defined in gross appraisal)	0	2.40	2.40	16	Perpetual Easement (2 parcels) Fee (14 parcels)
TOTAL	2.71	29.34	32.05	63	

2.1.6 Reach 6 Taylor Yard

Reach 6 extends from the Glendale Freeway to the Interstate 5 freeway. It is approximately 2.34 miles in length. In this reach, the LPP includes riparian corridors and widening of the soft bottom river bed by over 300 feet into Taylor Yard with additional slope back to the overbank elevation along the length of the reach. At the upstream end of the reach, a back water wetland will be developed in the Bowtie parcel at river level. There will also be a small terraced area on the downstream end of the Bowtie parcel as the channel transitions into the widening at Taylor Yard. In this reach, the entirety of the right bank and a portion of the left bank of the river will also be restructured to support overhanging vines and other vegetation.

Reach 6 contains the parcel known as Taylor Yard, a key opportunity area. The Taylor Yard area is considered an important parcel in the study because it provides an opportunity for restoration of large contiguous expanses of riparian and aquatic habitat. The Taylor Yard area is also one of the main areas in the LPP where the channel will be widened and connectivity between the river and the historic floodplain will be restored. Widening of the channel will allow the river and overbank to approach more natural dynamics, enhancing riparian and in-stream habitat for plants and wildlife.

A total of 76 parcels are needed in this reach. The total acreage needed for this reach is 94.53 acres, of which 33.01 acres are within the existing LACDA project boundary. The non-Federal sponsor has ownership of 5 parcels (6.12 acres) within the existing LACDA project boundary. The non-Federal sponsor will need to acquire 28 parcels (44.88 acres, of which 6.04 acres are within the existing LACDA project boundary) from private owners and 22 parcels (40.71 acres, of which 20.85 acres are within the existing LACDA project boundary) under public ownership from the

California State Parks, the Mountains Recreation and Conservation Authority (MRCA) and the LACFCD. Twenty-one parcels do not have APNs and are part of existing highway or street right of way. It is anticipated that the non-Federal sponsor will request approval to acquire a lesser interest (perpetual ecosystem restoration easement), for 5 State-owned parcels (17.58 acres) at the Rio de Los Angeles State Park and for two of the 21 non-APN parcels which are within Caltrans highway rights of way, as discussed in Section 4, below. The remaining 19 non-APN parcels are within the LACDA right of way and at the end of the city streets. For these parcels, the City will provide fee where it is the fee owner and acquire fee where a private entity is determined to be the owner of the underlying fee. If a public entity is determined to be the owner of the underlying fee of a non-APN parcel, the City may request to acquire a perpetual ecosystem restoration easement.

In this reach the LPP calls for planting built into the walls of the channel.

As stated above, there is also one parcel within LACDA right of way owned in fee by the MRCA, a local government public entity established pursuant to the Joint Powers Act. Although the non-Federal sponsor will seek to acquire this small parcel in fee, it is possible the non-Federal sponsor may request approval of a lesser estate (perpetual ecosystem restoration easement) as discussed in Section 4.

The following table lists the acreages for Reach 6 of the LPP:

	Acres outside of LACDA Boundary	Acres in LACDA Boundary	Total Acres needed for project including LACDA in Reach 6	Number of Parcels	Recommended Estates
Non Federal Sponsor	0	6.12	6.12	5	Fee
Public other than NFS	19.86	20.85	40.71	22	Perpetual Easement (5 parcels) Fee (17 parcels)
Private	38.84	6.04	44.88	28	Fee
Non-APN (owner not defined in gross appraisal)	0	2.82	2.82	21	Perpetual Easement (2 parcels) Fee (19 parcels)
TOTAL	61.52	33.01	94.53	76	

2.1.7 Reach 7 Arroyo Seco/LA State Historic Park

Reach 7 extends from the Interstate 5 freeway downstream to Main Street. It is about 1 mile in length. In this reach of the project the Arroyo Seco tributary will be restored with riparian habitat. The stream itself will have its banks and bed softened for approximately one-half mile upstream. At the confluence of the Arroyo Seco and the River a backwater riparian wetland will be established. Downstream, freshwater marsh would be restored at the LA State Historic Park, and the right bank of the river would be terraced to connect the restored area with the river. The railroad line along the bank would be trestled to allow for the terracing (further discussed in Section 16 below).

A total of 81 parcels are required for this reach. The total acreage needed for this reach is 48.11 acres, of which 28.58 acres are within the existing LACDA right of way. The non-Federal sponsor owns 23 parcels in this reach totaling 24.22 acres. Of the 24.22 acres, 22.92 acres are within the existing LACDA right of way. In this reach, 28 parcels under private ownership will need to be acquired. Approximately 1.37 acres are within the LACDA right of way, and 1.2 acres are out of the existing LACDA right of way footprint. The non-Federal sponsor will need to acquire 10 parcels totaling 12.24 acres

from the Los Angeles County Metropolitan Transportation Authority (LACMTA), LACFCD, MRCA, and California State Parks. It is anticipated the non-Federal sponsor will contemplate a lesser estate (perpetual ecosystem restoration easement) for parcels owned by LACMTA in which we plan to plant riparian vegetation within parts of the right of way without affecting the operations of the railroad track, and to daylight a stream which will run below the tracks. Although the non-Federal sponsor will seek to acquire fee title for the two parcels owned by LACMTA where we plan to trestle the railroad track and daylight a stream on the west bank of the channel in this reach, it is possible the non-Federal sponsor may request approval of a lesser estate (perpetual ecosystem restoration easement). It is also contemplated the non-Federal sponsor will request a lesser estate (perpetual ecosystem restoration easement) for lands owned by the California State Parks at the Los Angeles State Historic Park. Lastly, there are 20 non-APN parcels identified as being part of existing highway and road right of way. It is contemplated the non-Federal sponsor will request a lesser estate (perpetual ecosystem restoration easement) for six of the 20 non-APN parcels, which have been identified as within Caltrans highway right of way. The remaining 14 of the 20 non-APN parcels are within existing City road right of way. The non-Federal sponsor will provide fee where it is the fee owner and acquire fee where a private entity is determined to be the owner of the underlying fee. If a public entity is determined to be the owner of the underlying fee, the non-Federal sponsor may request to acquire a perpetual ecosystem restoration easement.

Lastly, this reach also has one parcel within LACDA right of way owned in fee by the MRCA, a local government public entity established pursuant to the Joint Powers Act. Although the non-Federal sponsor will seek to acquire this small parcel in fee, it is

possible the non-Federal sponsor may request approval of a lesser estate (perpetual ecosystem restoration easement).

The following table lists the acreages required for Reach 7 of the LPP:

	Acres outside of LACDA Boundary	Acres in LACDA Boundary	Total Acres needed for project including LACDA in Reach 7	Number of Parcels	Recommended Estate
Non Federal Sponsor	1.30	22.92	24.22	23	Fee
Public other than NFS	7.95	4.29	12.24	10	Perpetual Easement
Private	1.2	1.37	2.57	28	Fee
Non-APN (owner not defined in general appraisal)	8.71	0.37	9.08	20	Fee
TOTAL	19.53	28.58	48.11	81	

2.1.8 Reach 8 Los Angeles Trailer and Container Intermodal Facility (LATC)

This reach extends from Main Street to First Street. It is approximately 1 mile in length and will restore riparian habitat, restore a historic wash, and create a fresh water marsh at the Los Angeles Trailer and Container Intermodal Facility (LATC). The channel would be changed from concrete to soft bottom and the left bank of the channel adjacent to the LATC site would be removed. The marsh would extend into the LATC site 500 feet, with the riparian area extending another 1,000 feet into the property. A trestle (further discussed in Section 16 below) will be required to allow the active rail lines to remain in place and create connectivity between the river and the adjacent restored lands. In this reach, the right bank of the channel upstream of LATC and the left bank of the channel downstream of LATC will be modified to incorporate terracing and the planting of riparian vegetation.

LATC is a key opportunity area due to its location, close proximity to Downtown Los Angeles, lot size, number of owners and lack of buildings. It is also one of two

parcels identified in the LPP which provide an opportunity to restore large expanses of riparian and aquatic habitat which is rare in highly-urbanized Los Angeles. It is a key site because it allows for restoration of the historic floodplain including restoration of a historic wash marsh and riparian habitat.

In this reach, 51 parcels are required for the project (141.7 acres, of which 25.95 acres are within the existing LACDA project boundary). The non-Federal sponsor owns 8 parcels totaling 25.40 acres which are part of the existing LACDA right of way. Eleven parcels are owned by the Los Angeles County Metropolitan Transportation Authority (LACMTA) for a total of 7.68 acres. There are active rail lines located on the 11 parcels owned by the LACMTA; currently we are assuming the non-Federal sponsor will acquire fee for two of the parcels where the river would be reconnected to the LATC, with the non-Federal sponsor trestling the active railroad tracks adjacent to the LATC. We anticipate the non-Federal sponsor will propose to acquire a lesser estate (perpetual ecosystem restoration easement) for the remaining nine parcels in Reach 8 outside of trestled railroad tracks to plant vegetation in part of the right of way. A total of 25 privately owned parcels (108.08 acres) will need to be acquired in fee. Eleven of the 25 parcels make up the area known as the LATC. There are also six non-APNs that are within existing City road right of way and one non-APN parcel that is within Caltrans right of way. It is anticipated the non-Federal sponsor will request to provide a lesser estate (perpetual ecosystem restoration easement) for the one parcel within Caltrans right of way. For the parcels in City road rights of way, the non-Federal sponsor will provide fee where it is the fee owner and acquire fee where a private entity is determined to be the owner of the underlying fee. If a public entity is determined to be the owner of the

underlying fee for a non-APN parcel, the non-Federal sponsor may request to acquire a perpetual ecosystem restoration easement.

The following table lists the acreages needed for Reach 8 of the LPP:

	Acres outside of LACDA Boundary	Acres in LACDA Boundary	Total Acres needed for project including LACDA in Reach 8	Number of Parcels	Recommended Estates
Non Federal Sponsor	0	25.40	25.40	8	Fee
Public other than NFS	7.13	0.55	7.68	11	Perpetual Easement
Private	108.08	0	108.08	25	Fee
Non-APN (owner not defined in gross appraisal)	0.21	0.33	0.54	7	Perpetual Easement (1 parcel) Fee (6 parcels)
TOTAL	115.75	25.95	141.7	51	

2.2 Other lands and rights of way

The LPP is designed with specific project features on the lands discussed above. In addition to the lands identified for construction and operation of specific features, the project also includes a general measure for removal of invasive species throughout the features and existing channel and lower tributary bottom areas, and the project requires management of invasives throughout the same area as part of the non-Federal sponsor's operation and maintenance of the project. Therefore, the LERRD required for the project includes 236.66 acres within the channel and tributary bottom areas (both hard and soft bottom) that is not required for other specific restoration measures. These areas are within the existing LACDA right of way and are already subject to the LACDA project encumbrances (generally flood risk management easement), as further described below in Section 5. The existing interests are not considered sufficient to allow for the removal of

invasive species vegetation from the channel on a recurring basis to ensure restoration benefits throughout the life of the project.

2.2.1 Rights of way to be further defined during PED

Geotechnical analysis has identified that tie backs or counterforts may be determined to be needed during the detailed design (PED) phase to support features such as vertical walls. A scouring analysis and other technical evaluations are scheduled to take place during detailed design which may modify the identified right of way required to construct and maintain such features. A permanent easement (such as a flood protection levee or rock anchor easement) is the likely interest, but the interest and estate required will be determined once the feature(s) has (/have) been further designed and analyzed.

In addition, design refinements for locations of measures such as wildlife access slopes and maintenance ramps could in some cases require minor additional real estate interests within the existing LACDA right of way if they extend into areas not included in the identified restoration footprint. Although such design refinements are expected to be located within the identified restoration footprint, specific locations for such design refinements will be further developed during the detailed design phase, as they are dependent on data and hydraulic analysis to be generated during that phase to ensure they are consistent with the constraints of the restoration project, including the function and conveyance of the existing LACDA project. These refinements may require small portions of land in fee with low remaining value, as the affected lands are already subject to the LACDA project encumbrances (generally flood risk management easement), as further described below in Section 5.

2.3 Staging areas

Throughout the 8 reaches of the project, potential staging areas have been identified. In most cases, the staging areas identified are areas the non-Federal sponsor owns in fee. The LPP identifies the non-Federal sponsor already owns approximately 32 acres in various locations of the project area that would be used for staging areas.

Currently, the LPP identifies the following additional staging areas to be acquired through a temporary work area easement:

-In Reach 4 and 5, three parcels (11.77 acres).

-In Reach 5, one parcel (three acres) (site known as North East Interceptor Sewer 2 Shaft Site).

-In Reach 6, parcels totaling 10 acres owned by Los Angeles Community College District, State of California, and a private owner.

-In Reach 7, four acres in private ownership.

-In Reach 8, 6.5 acres in private ownership.

Additionally, in some cases in Reaches 3, 4, and 6, the study team has identified potential to use lands to be acquired in fee for restoration as staging areas prior to construction at those sites if the timeline permits. These areas total 32.14 acres.

2.4 Borrow and Disposal Site Assumptions

No LERRD for borrow and disposal sites has been identified as required for this project.

2.4.1 Borrow sites

Borrow material for construction is expected to come from within the project footprint whenever practicable; however, to the extent that small amounts of borrow material are needed from outside the project footprint, it will be supplied by the

construction contractor through use of a commercial site or sites. Because of the urbanized character of the Los Angeles region and the length of project construction (15 years), borrow from a designated borrow site (as LERRD) is not anticipated to be practicable.

2.4.2 Borrow required for future maintenance

At this time, borrow material is not anticipated to be required for future maintenance. However, if monitoring identifies insufficient substrate being retained in the system to support aquatic habitat (e.g., sufficient cobble/gravel for native fish habitat compared), adaptive management may include import of such substrate. According to the Monitoring and Adaptive Management Plan (Appendix H), if import of substrate is required more than once during the monitoring period, adjustments to O&M may be made to require substrate import. This substrate would be anticipated to come from a commercial source as well.

2.4.3 Disposal

Project assumptions include a least-cost disposal plan that includes disposal capacity for excavated earth material exceeding quantities re-used for project purposes being provided by the contractor through use commercial facilities. Disposal facilities were limited to a 20-mile radius in part to reduce/minimize air quality impacts. The cost for commercial disposal facilities was captured in the cost appendix as a construction cost item.

2.4.4 Disposal required for future maintenance

No disposal sites are anticipated to be required for maintenance. Maintenance activities would generally gather debris and trash for commercial disposal.

All assumptions associated with borrow and disposals are captured in the risk register for the project.

2.4.5. Summary

The Figure below provides a summary of the LERRD required for the LPP.

Fig. 1 – Summary Table – acreages and ownerships

	Acres Outside LACDA Boundary	**Acres Within LACDA Boundary**	**Total Acreage**
Lands Required for Specific Restoration Measures			
Non-Federal Sponsor owned	72.98	101.69	174.67
Public parcels to be acquired (Fee)	15.08	42.14	57.22
State parcels to be acquired with Ecosystem Restoration Easement (Non-Standard Estates)	19.86	0.07	19.93
Non-APN parcels (Owners not defined by gross appraisal)	38.57	5.92	44.49
Private parcels to be acquired (Fee)	169.78	11.16	180.94
Sub-Total	**322.19**	**155.06**	**477.25**
Lands Identified as Channel Bottom Needed for General Restoration Measures*			
Soft Bottom Channel	0	145.64	145.64
Hard Bottom Channel	0	91.02	91.02
Sub-Total	**0**	**236.66**	**236.66**
Staging Area			
Non-Federal Sponsor owned	32	0	32
Staging areas within lands being acquired for restoration (no additional credit)**	32.14	0	32.14
Temporary Work Area Easement (TWAE) to be acquired	35.27	0	35.27
Sub-Total	**99.41(67.27 for TWAE credit)**	**0**	**99.41 (67.27 for TWAE credit)**
Other Rights of Way (for design refinements)	TBD	TBD	TBD
Grand Total	389.46	391.72	781.18

* This is the channel bottom acreage required for general measures for invasives removal during construction and operation and maintenance of the project that is not otherwise required for specific restoration features.

**This acreage is included in fee acquisitions under “lands required for restoration” above and would not be additionally credited for staging area use.

3. SPONSOR-OWNED LERRD

The non-Federal sponsor for the Los Angeles River Ecosystem Restoration Study is the City of Los Angeles. The non-Federal sponsor currently owns approximately 96 parcels of land, 345.93 acres out of the 713.91 acres needed, for the Locally Preferred Plan. Of the 345.93 acres owned by the non-Federal sponsor, 272.95 acres are within the existing LACDA project boundary. The 96 parcels, although owned by the City of Los Angeles, are managed by different departments within the City. The 96 parcels do not include non-APN parcels for which the City may have fee or easement interest, as described in Section 1 and further discussed in Section 4. Ownership of these parcels will be further defined during PED.

4. PROPOSED NON-STANDARD ESTATES

The standard estate for an ecosystem restoration project is fee simple. The Los Angeles District has reviewed the capability of the non-Federal sponsor to acquire fee simple and assessed that there are instances where LER required is owned by a public entity and where acquisition of a fee simple estate may be infeasible for the non-Federal sponsor. As briefly discussed in Section 2 above, State Parks, LACMTA, Caltrans, and the MRCA are currently the fee owners of some of the LER required to implement the project.

We have reviewed the standard estates provided in exhibit 5-29 to EC 405-1-11, which have been incorporated into ER 405-1-11, and determined that the standard estates provided, other than the fee simple estate, do not include sufficient rights to establish, operate and maintain an ecosystem restoration project. Based upon preliminary discussions with the non-Federal sponsor, we understand that fee simple cannot be acquired in some locations which are owned by public entities; therefore, we anticipate

that the non-Federal sponsor will request approval to acquire a perpetual ecosystem restoration easement for cases in which fee simple estate cannot be acquired. ER 405-1-12, while indicating fee as the appropriate estate for ecosystem restoration, allows that a lesser, or easement estate, may be appropriate based on the extent of interest required for the operation or requirements of a project. An easement estate will serve the intended project purpose, and will not increase costs nor result in potential liability of the Government. A perpetual ecosystem restoration easement would provide sufficient perpetual rights necessary to construct, operate, and maintain the affected project features. Because each site is unique, we anticipate that sites may require language that takes into consideration specific site requirements. Where the lands are also required for compatible passive recreation features such as trails, the interest for construction, operation, and maintenance of those features would also be proposed as part of the specific easement language. We acknowledge that each site-specific perpetual easement would require careful legal and policy review to ensure that appropriate prohibitions on conflicting activities are included, and we are prepared to work closely with the non-Federal sponsor to ensure that project needs and the federal investment are satisfied. This REP presents the non-standard estates based upon the assumption that each perpetual ecosystem restoration easement will require separate Headquarters US Army Corps of Engineers (HQUSACE) and South Pacific Division (SPD) approval. A description of the needs and requirements for each public-entity-owned site for which a non-standard estate is proposed is below.

With respect to the lands owned by California State Parks, we anticipate that the non-Federal sponsor will request approval to acquire a perpetual ecosystem restoration easement. State Parks is a state entity established pursuant to the California Public

Resources Code, entrusted with the jurisdiction and management of public lands for the benefit of the people of the State and whose stated mission includes preservation of ". . . the state's . . .biological diversity, protecting its most valued natural and cultural resources . . .." Granting of a fee simple estate to the non-Federal sponsor for LER required in Reaches 6 and 7 at the Rio de Los Angeles State Park and the Los Angeles State Historic Park would not be consistent with State Parks' mission. Fee acquisition of these lands is not considered practicable as the state has acquired the lands for use as a state park and would not allow for the negotiated sale of the property. The non-Federal sponsor has indicated that, as a practical matter, it generally cannot condemn lands owned by or under the jurisdiction of the State of California as discussed further in Section 13.

With respect to the proposed perpetual ecosystem restoration easement, State Parks has determined that ecosystem restoration is compatible with its park land and supports the implementation of the ecosystem restoration features proposed to be constructed at the two State Park areas identified. Therefore, a perpetual ecosystem restoration easement would be the most efficient means of satisfying the real estate requirements necessary to support the project. Both the Corps and non-Federal sponsor continue to coordinate with the State Parks on specific perpetual ecosystem restoration easement language. Sample language attached to this document as Attachment "A" has been provided to State Parks for discussion purposes. As required by ER 405-1-12, the specific language of the proposed perpetual ecosystem restoration easement, once fully negotiated, will be submitted for approval separate from this Real Estate Plan to HQUSACE through SPD.

The second proposed non-standard estate is for a site-specific perpetual ecosystem restoration easement on land owned by the LACMTA in Reaches 7 and 8. In Reach 7, the project proposes to daylight a stream to run below the LACMTA tracks outside of the trestle component, described in section 2.1.7, and in Reach 8, proposes to plant riparian vegetation. Where relocation of active rail lines to trestles at grade has been identified as required to facilitate construction of restoration features, as described in Section 17, the non-Federal sponsor will pursue acquisition of fee simple underlying LER, but may need to acquire a non-standard perpetual ecosystem restoration easement, if fee simple acquisition is too difficult to obtain through negotiated transaction. As required by ER 405-1-12, the specific language of a proposed ecosystem restoration easement, once fully negotiated, will be submitted for approval separate from this Real Estate Plan to HQUSACE through SPD.

The third proposed non-standard estate is for a site-specific perpetual ecosystem restoration easement to be acquired on lands which, based on the best available information,[3] we understand are owned in fee by the California Department of Transportation (Caltrans). The specific parcels at issue are located adjacent to freeway on-ramps and underneath the freeway overpasses. The areas of Caltrans ownership include parcels in all reaches, mainly needed for establishment of riparian planting. Additionally, in Reach 3, LER required includes areas for widening of the confluence of the river with the Verdugo Wash within and adjacent to existing LACDA right of way, and in Reaches 3 and 4, for diversion of tributary and river flow into small side

[3] Because the subject parcels do not have APNs assigned to them, it was not possible to identify an owner as part of development of the Gross Appraisal.

channels.[4] As required by ER 405-1-12, the specific language of a proposed ecosystem restoration easement, once fully negotiated, will be submitted for approval separate from this Real Estate Plan to HQUSACE through SPD. In limited circumstances, a perpetual ecosystem restoration easement may also be proposed for parcels without APNs that are part of existing City street right of way. For these parcels, the City may be the fee owner or hold an easement. Where the City is determined to be the fee owner, the City will provide the fee interest to the project, and where a private entity is determined to own the underlying fee, the City will acquire and provide the fee interest. However, if a public entity is determined to be the fee owner, the City may request to acquire a perpetual ecosystem restoration easement. As required by ER 405-1-12, the specific language of a proposed ecosystem restoration easement, once fully negotiated, will be submitted for approval separate from this Real Estate Plan to HQUSACE through SPD.

Lastly, on two small parcels within the LACDA right of way in Reach 6 and 7, the sponsor may request to acquire a site-specific perpetual ecosystem restoration easement from MRCA, the fee owner, to implement alterations to the channel wall to facilitate implanting of vegetation. MRCA provides natural resources and scientific expertise and other educational and park services, and is one of the lead agencies for the revitalization of the Los Angeles River. In the MRCA-owned areas identified as LER, lands are used primarily for pocket parks along the river, outside the LACDA right of way. The two MRCA-owned areas identified as LER required for the project are the portions of such parcels that extend into the LACDA right of way. While the non-Federal sponsor will make best efforts to acquire the standard fee estate for land owned by

[4] It is anticipated that additional LER may be identified that would be necessary for sub-surface tiebacks and/or counter forts for which a standard estate, rock anchor easement, may be acquired, as identified in Section 2.2, under "*Rights of way to be further defined during PED.*" It is not anticipated at this time that a non-standard estate would be required for these areas.

MRCA, the non-Federal sponsor may request approval to acquire a site-specific perpetual ecosystem restoration easement in lieu of fee. MRCA is a local joint powers entity dedicated to the preservation and management of local open space and parkland, watershed, lands, trails and wildlife habitat. As a public entity managing a recreational zone in this stretch of the river, it may not support the sale of land in fee. If negotiated acquisition of fee simple is unsuccessful, the Corps will, as required by ER 405-1-12, submit the specific language of a proposed ecosystem restoration easement, once fully negotiated, for approval to HQUSACE through SPD.

5. EXISTING FEDERAL PROJECT

Where there is an existing Federal project within the area proposed for a new project, such lands must be identified, and the sufficiency of those lands for the proposed project must be evaluated. In addition, the value of lands provided as an item of local cooperation for a previous Federal project should not be included in the valuation of lands for the current project, and no credit may be afforded for such interests.[5] In this case, the existing project footprint/boundary for LACDA overlaps with the lands required for the restoration project LPP. The interests previously provided for the LACDA project are not sufficient to support the full construction, operation and maintenance of the ecosystem restoration project because they are less than fee, but they do not conflict with the restoration project. The interests previously provided by the LACFCD for the flood risk management project would not be required to be provided by or credited to the City as restoration project sponsor. The underlying fee ownership would generally be needed to support the construction, operation and maintenance of restoration features of a

[5] This is the rule regardless of whether the sponsors of the existing and proposed projects are different, as they are in this case.

restoration project, and that is the interest that would be required to be provided. Valuation is discussed briefly at the end of this section.[6]

As described above, the study area includes part of the existing LACDA flood risk management project. The portion of LACDA within the study area was constructed by the Corps from the 1930s through the 1950s with the partnership of the LACFCD. The existing LACDA project within the study area consists of channel and levee, some reaches with stone side slopes and other reaches with concrete side slopes. A portion of the lands within the LACDA right of way within the study area would be included in the LPP features, for the specific restoration measures as well as the general measure for invasives removal and management, as discussed in Section 2, above.

The LACDA project in the study area was constructed under several authorizations with evolving requirements. Portions of the project were begun under the Emergency Relief Acts, under which the LACFCD was required to make a cash contribution and provide rights of way. The project was further authorized and expanded under the Flood Control Acts (FCAs) of the 1930s and 1940s. According to the Flood Control Act of June 22, 1936, LACFCD was responsible for acquiring all lands, easements and rights of way for the construction of the project, some of which it already held at the time of the project.[7] Although certain lands for the LACDA project outside

[6] The credit to be afforded to the non-Federal sponsor for the value of LERRD required to be provided for the project is subject to limitations specific to this project. This project includes a policy exception allowing the sponsor to forgo reimbursement for LERRD exceeding its statutory share, and it also considers alternative cost sharing that includes a limitation on LERRD credit to be afforded to the sponsor. These issues are further described in Section 20 of this REP and in Chapter 7 of the IFR.

[7] The Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRRR) Manual for the LACDA project, LADM No. 1130-2-13, summarizes the history of the real estate and operations and maintenance responsibility changes in the early years of the project. The June 22, 1936, Flood Control Act directed the local sponsor to provide all LER needed for the construction of the project. However, the action of June 28, 1938 amended this provision to direct that title to all LER should be acquired by the United States or obtained by the local sponsor and conveyed to the United States, and that the United States should operate and maintain the system. According to the manual, in response to the 1938 law, the United

the study area, such as lands within flood control basins, were acquired in fee and are owned by the United States, a lesser interest or right was generally acquired for construction and operation of channels, and the existing LACDA project area within the study area contains a patchwork of ownerships, easements, and permits.

Due to the age of the existing LACDA project, the Corps does not have detailed records showing what specific interests were required to be provided for the project as the necessary "rights of way" within the LACDA boundary in the study area. The understanding at this time is that for most parcels, LACFCD, and in a few cases both LACFCD and the United States, hold(s) an easement "for the purpose of the construction and maintenance thereon of a channel and appurtenant works to carry and confine the flood and storm waters of the Los Angeles River and its tributaries in, over and across [the described real property]" or similar language. In other cases, LACFCD is the fee owner of parcels within the existing project boundary in the study area, but based on the rest of the LACFCD ownerships in the study area and other channel reaches, it does not appear fee was required to be provided for LACDA.[8] Where the City of Los Angeles is the fee owner of LACDA lands, as it is for a portion of the existing LACDA project area within the study area as described in Section 3 above, it granted permits for construction and long-term operation of the flood risk management project rather than an easement,

States retained or took on operation and maintenance responsibilities for facilities completed after the date of the law and arranged for responsibilities for completed facilities to be transferred back to the Corps. The FCA of 1941 repealed certain parts of the 1938 law and reinstated the parts of the June 1936 law directing local sponsors to operate and maintain the project after completion, but the Corps continued to operate certain features. The FCA of 1941 approved the general comprehensive plan for the LACDA project. Other FCAs further amended and appropriated funds for the LACDA project.

[8] If additional research during project design and implementation identifies, contrary to the current understanding, that LACFCD was required to provide the fee interest for the LACDA project in the areas where it owns fee, the non-Federal sponsor for the restoration project would not be required to acquire, nor would it be credited for, the underlying fee interest in the areas with LACFCD fee ownership within the LACDA boundary.

and committed under City ordinance that river lands shall not be transferred from City ownership. Permit language from the City to the County and United States is similar to the easement language. These ownerships and interests will be confirmed through the course of the acquisition process.

The easements and permits provided for the LACDA project by LACFCD would not be sufficient to support construction and operation of all aspects of an ecosystem restoration project. The underlying fee ownership would generally be needed to support a restoration project, and that is the interest that would be required to be provided. This remaining interest has a very low value compared to unencumbered fee. Although a detailed examination of all easements, permits, and other rights in land for existing LACDA LER has not been conducted, as noted above, the easements reviewed do not contain language that would directly conflict with an ecosystem restoration project. The Corps is in the process of a longer-term effort with LACFCD to assess rights in the portion of the river the Corps must OMRRR and ensure that the Corps has adequate assignment of rights from LACFCD. Compatibility with the purpose of the existing project as a flood risk management channel is a central constraint of the proposed project alternatives, and the two OMRRR manuals will be complementary.

The valuation of LERRD for this project excludes the value of the interests and rights in land (the easement interests and permit rights) previously provided for the LACDA project or held by the Federal government. To avoid “double-counting” lands previously provided for the LACDA project, the City, as sponsor of the restoration project, will be required to provide the underlying fee interest to support the restoration project, with LACFCD (and the United States in some limited cases) continuing to hold

the existing easements and permits. This encumbrance and previous provision of LERRD is reflected in the land valuation conducted for these parcels in the Gross Appraisal.

6. FEDERALLY OWNED LAND

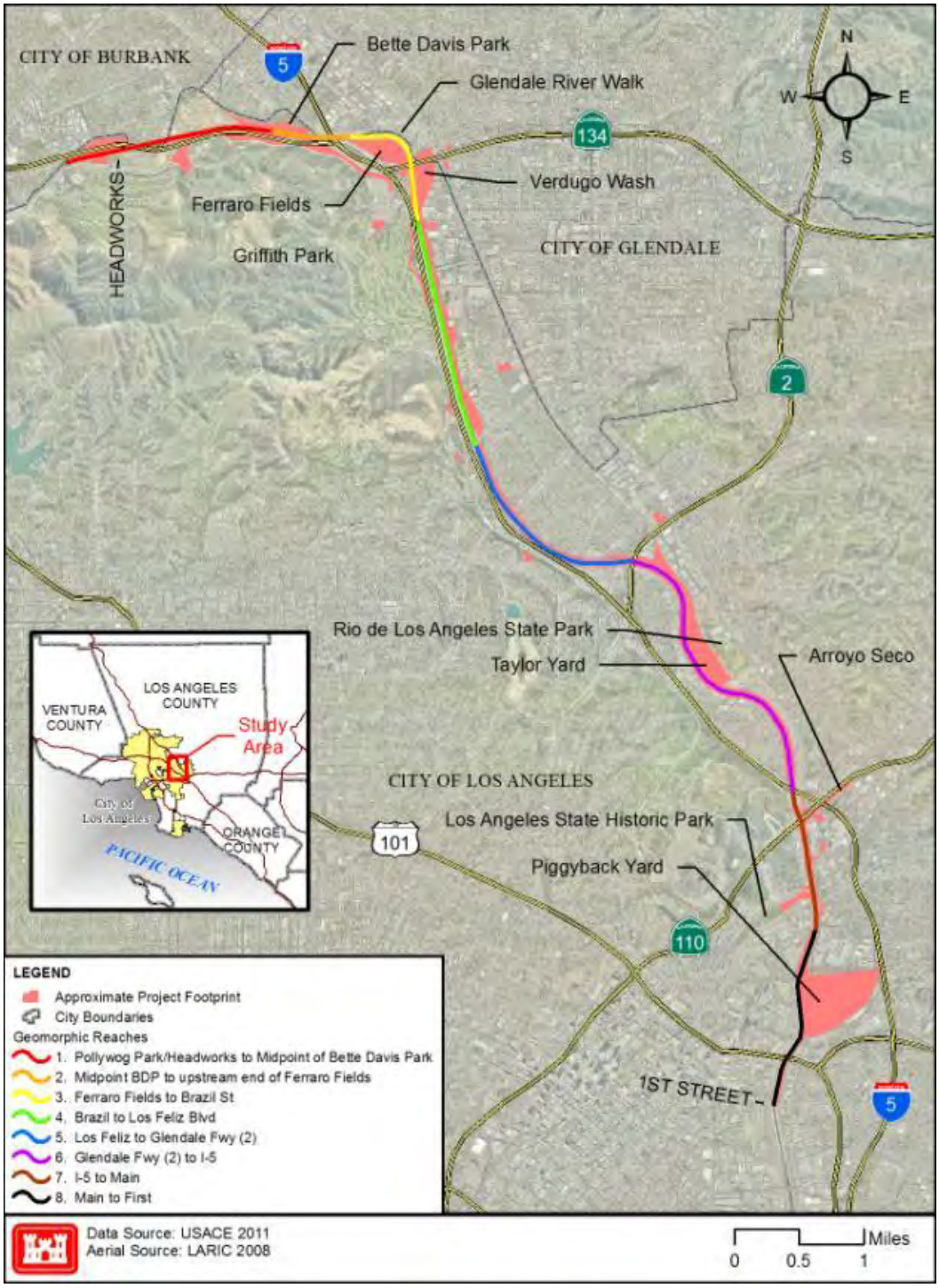
Although the Corps has operation and maintenance responsibility for LACDA in all 8 reaches of the Los Angeles River within the study area, no land is owned in fee by the United States. As discussed in Section 5 above, in some cases the United States has easements that were transferred from the LACFCD. In other cases where the study non-Federal sponsor, City of Los Angeles, has ownership within the existing Los Angeles River, permits were issued to both the LACFCD and the United States to construct, operate, and maintain the LACDA, as discussed in Section 5 above. The value of interests and rights previously provided for the LACDA project or held by the United States is excluded from the LERRD cost estimate, and no credit shall be afforded for such interests and rights previously provided or held by the United States.

7. EXTENT OF NAVIGATIONAL SERVITUDE

Navigational servitude is the dominant right of the Government under the Commerce Clause of the U.S. Constitution that allows use, control and regulation of navigable waters of the United States and the submerged lands.

Exercise of Federal navigational servitude is not applicable to this project and is not being invoked.

8. MAP



This map shows the overall project. More detailed maps by reach are included at the end of this Real Estate Plan as Attachment "B."

9. EXTENT OF INDUCED FLOODING

As stated in the Hydrology and Hydraulics Appendix, the restoration project will not create induced flooding compared to existing conditions. The study screened out any alternatives that adversely impacted the water surface elevation in a way that could not be addressed through detailed design.

While initial assessment by the Hydrology and Hydraulics Branch of the Engineering Division identified that an increase in water surface elevation could occur at transition areas (areas where the channel has geometric changes (transitioning from trapezoidal to rectangular or from a widened section to a narrow section)) or changes in construction material (transitioning between soft-bottom and concrete) in the final array of alternatives, including the LPP, any change in water surface in the transition areas will be avoided through design refinements to the project modifications to channel geometry and/or avoidance of introduction of vegetation and enforcing requirements limiting vegetation growth in those areas. With implementation of such design refinements, there will be no increase in flood damages as compared to existing conditions. Therefore, no flooding would be induced by the project.

10. BASELINE COST ESTIMATE

The Baseline Cost Estimate for Real Estate (BCERE) is presented below. A gross appraisal of the LPP was completed, which forms the basis for the Lands portion of the BCERE. The BCERE also includes an estimate of administrative and incidental costs associated with the acquisition of the real estate required for the project. The incidental costs include those costs associated with title work, appraisals and their review, review of documents, review of P.L. 91-646 actions, legal support and other costs associated with acquisition and provision of LERRD required for the project. The BCERE also includes

the estimate of costs for facility/utility relocations currently expected to be required for the project.

The BCERE includes contingencies for lands and relocations. A contingency was added to the estimated land costs pursuant to information provided by the Corps appraiser during the gross appraisal process. The estimate and contingency for the sponsor's costs of constructing facility/utility relocations was provided by the Corps' Engineering Division. The costs of preconstruction engineering and design (PED) and construction management for relocations were calculated separately and are thus displayed as a sub-line item in the table below. Note that the cost shown below is the Estimated Cost using 2014 year price levels rather than the First Cost of LERRD (including PED and Construction Management) shown in the IFR's cost apportionment tables. The table below includes references to the different accounting codes the Corps uses to organize cost estimates for Civil Works. Those accounting codes are known as the "Work Breakdown Structure" (WBS).

Locally Preferred Plan	(LERRDs)[9]	Contingency%[10]	Contingency Value
Non-Federal Sponsor Cost			
Land and Damages (01)			
Lands	**$402,649,086**	**15.1%**	**$60,939,573**
PL 91-646 Entitlements	**$22,617,000**	**15.1%**	**$3,423,006**
Non-Federal Admin	**$16,141,875**	**15.1%**	**$2,443,018**
Sub-Total	**$441,407,961**	**15.1%**	**$66,805,597**
Facility/Utility Relocations (02)			
Relocations Facility/Utility	**$165,624,000**	**35.5%**	**$58,746,000**
PED - Relocations[11]	**$10,412,422**	**36.7%**	**$3,821,359**
Construction Management - Relocations[12]	**$5,419,549**	**36.6%**	**$1,983,555**
Sub-Total	**$181,455,971**		**$64,550,914**
Total Non-Federal Cost	**$ 754,220,443**		
Federal Cost			
Federal Admin.[13]	**$5,380,625**	**15.1%**	**$814,339**
Total Federal Cost	**$ 6,194,964**		
Total Real Estate	**$ 760,415,407**		

[9] BCERE shows the estimated cost for LERRD and Federal administrative cost using 2014 year price levels. According to ER 405-1-12, Section 12-18, a Baseline Cost estimate for Real Estate (BCERE) is the estimated cost for LERRD. The BCERE includes Fair Market Value of LER required for the project, cost of PL 91-646 entitlements, incidental cost for both the Federal government and the sponsor, and estimated risk based contingencies.

[10] Contingencies are rounded to the tenth of a percent for the table. The actual contingency used to come up with the contingency is 15.1346608% for the Lands and Damages (01) account and 35.4694971% for the Relocations (02) account.

[11] This cost is shown in the 30 account in the cost tables by WBS in the IFR and Cost Appendix.

[12] This cost is shown in the 31 account in the cost tables by WBS in the IFR and Cost Appendix.

[13] Federal administrative costs are part of the overall real estate costs and part of the 01 account but not part of sponsor LERRD requirements.

11. PL 91-646 RELOCATION ASSISTANCE BENEFITS

Currently, the LPP identifies displacement of businesses in Reaches 3, 7, and 8 of the project. In Reach 3, where the project calls for the widening of the Verdugo Wash confluence with the river, 11 businesses have been identified as being displaced due to the project features. These businesses currently consist of a recycle plant, yogurt manufacturer, window and door manufacturing plant, entertainment lighting company, film industry rental equipment business and a large scale printer. In Reach 7, two buildings have been identified for acquisition, and the businesses they house would be displaced in order to create connectivity between the river and Los Angeles State Historic Park. Reach 8 has land that is leased out for a concrete recycling plant and windshield repair shops, which would be displaced in addition to the LATC facility discussed in facility relocations below.

The non-Federal sponsor is aware of and will comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Act of 1970, Public Law 91-646, as amended, in acquiring the lands, easements and rights-of-way and performing relocations. According to Public Law 91-646, each business is entitled to search expense payments not to exceed $2,000, reestablishment expenses not to exceed $25,000, moving costs, and lost revenue. Preliminary relocation costs for Reach 3, 7, and 8 total approximately $26,032,000. These estimates were based on information provided for Reaches 3 and 7 by contract appraisers hired by the non-Federal sponsor and data acquired by the Corps for Reach 8. A preliminary inventory was put together by internet and visual research (driving past the businesses), as well as moving-companies providing average costs for moving office and specialized equipment. Databases were also used in formulating the final PL 91-646 entitlements estimates.

12. DESCRIPTION OF PRESENT OR ANTICIPATED MINERAL ACTIVITY

There are no present or anticipated mineral activities in the proposed project area.

13. PROJECT SPONSOR'S LAND ACQUISITION ABILITY

A thorough assessment of the non-Federal sponsor's legal and professional capability and experience to acquire and provide the LER has been completed through the Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability, which is in the format prescribed in ER 405-1-12, Chapter 12 & Appendix 12-E. Based on the information provided by the non-Federal sponsor, the District's overall assessment is that the non-Federal sponsor is "anticipated to be highly capable." The assessment was coordinated with the non-Federal sponsor and is attached to the real estate plan as Attachment C. The District's assessment is based upon the overall capability to acquire the LER required and perform the necessary relocations. The District supports this assessment, acknowledging that the non-Federal sponsor is limited in its capacity to acquire the fee simple estate for LER required for the project on certain lands.

The non-Federal sponsor has limited condemnation authority that does not extend to all lands. The eminent domain provisions of the California Code of Civil Procedure do not contain specific authority that would allow the non-Federal sponsor to acquire for ecosystem restoration purposes land owned by the State of California, including parcels owned by Caltrans or State Parks, and they create presumptions that the non-Federal sponsor has accurately concluded would preclude it from being able to take a fee estate in these parcels.

Section 1240.610 of the California Code of Civil Procedure permits generally that the power of eminent domain may be exercised to acquire property that is already appropriated to public use "if the use for which the property sought is to be taken is a

more necessary public use than the use to which the property is appropriated." Other provisions of the Code further limit the exercise of this authority by creating presumptions affecting the burden of proof. Section 1240.640 states that "[w]here property has been appropriated to public use by the state, the use thereof by the state is presumed to be a more necessary use than any other use to which such property might be put by any person." Section 1240.660 creates a similar presumption in favor of a local public entity which has already appropriated the property sought to public use. Section 1240.680 states that "property is presumed to have been appropriated for the best and most necessary public use" if used as "(1) A state park, regional, county, or city park, open space, or recreation area. . . . (3) A historic site included in the National Register of Historic Places or state-registered landmarks."

Where property is sought to be taken under section 1240.610, section 1240.630 provides that "the defendant is entitled to continue the public use to which the property is appropriated if the continuance of such use will not unreasonably interfere with or impair, or require a significant alteration of the more necessary public use as it is then planned." If the taking is contested and the court determines that the defendant is entitled to continue use of the property, the court will direct the parties to "make an agreement determining the terms and conditions" concerning, among other things, "the manner and use of the property by each party." The non-standard estates that the non-Federal sponsor proposes for acquiring interests in land appropriated to public use by other public entities is the type of agreement that a court would likely direct if the non-Federal sponsor brought a successful condemnation action to acquire these parcels.

As discussed in Section 4, the Corps and non-Federal sponsor have evaluated the potential for acquiring a lesser estate, a site-specific perpetual ecosystem restoration

easement, and found that acquisition of this estate would support the project purposes and protect the federal investment. The continued use of the land by the current public owner which would be permitted by such an easement will not unreasonably interfere with, impair, or require a significant alteration of the project as planned. Initial discussions with State Parks about the proposed restoration and passive recreation features that would occupy State Parks lands at the Rio De Los Angeles State Park and Los Angeles State Historic Park have been successful to the extent that State Parks understands and supports the construction, operation and maintenance of the proposed ecosystem restoration and passive recreation features on their land. The Corps and non-Federal sponsor have been and are closely coordinating with State Parks, to ensure that the proposed ecosystem restoration and passive recreation features of the Federal project are consistent with State Parks' general plans for these areas. We anticipate that an acceptable perpetual ecosystem restoration easement would be proposed for review and approval as a non-standard estate and that the non-Federal sponsor is capable of acquiring sufficient real estate interests from State Parks.

With respect to Caltrans, as noted in Section 4, the lands required for restoration are largely for riparian planting, although some lands in Reach 3 are required for the widening of the Verdugo Wash confluence and construction of a combined riparian and marsh community. Caltrans generally does not support sale of lands it holds in fee, but a review of Caltrans general plans indicate that the proposed planting and improvements would be compatible with Caltrans use of these areas. The non-Federal sponsor has indicated in the "Assessment of Non-Federal Sponsor's Real Estate Acquisition Capabilities" that it is unlikely it would pursue fee acquisition or condemnation of lands owned by Caltrans and would seek a non-standard estate. Based upon past dealings with

Caltrans, we anticipate that an easement could be acquired through a negotiated transaction. As stated in Section 4, a perpetual ecosystem restoration easement would adequately address the needs of the project. The Corps and non-Federal sponsor will coordinate closely with Caltrans during design, as Caltrans requires design plans in order to review grants of rights of way. We anticipate that an acceptable perpetual ecosystem restoration easement would be proposed for review and approval as a non-standard estate and that the non-Federal sponsor is capable of acquiring sufficient real estate interests from Caltrans.

In addition, with respect to active railroad lines and facilities, the provisions of the Interstate Commerce Commission Termination Act (ICCTA) preempt state law allowing the City to condemn property. One railroad facility owned by UPRR and two rail lines owned by the LACMTA would be affected by the LPP, as discussed in Sections 2 and 16. The City would work with UPRR on relocation of the existing LATC site functions to a new location within the Los Angeles Basin, as described in Section 16.5. UPRR has expressed willingness to cooperate with the City in a sale or exchange of the property subject to relocation of the site functions to a comparable facility, as discussed in Section 18. Although we anticipate a negotiated transaction based upon discussions with UPRR, if the City cannot reach agreement with UPRR, the City may apply to the Surface Transportation Board for abandonment and relocation of the facility. Based upon our assessment, the non-Federal sponsor is capable of acquiring sufficient real estate interests through the two options described above.

Two active rail lines owned by the LACMTA would be affected by the project, along the right bank of the channel in Reach 7 and along the left bank of the channel in Reach 8. To allow terracing of the channel bank in Reach 7 and to allow restoration of

more natural water movement and habitat between the river and the LATC site in Reach 8, the existing rail lines would have to be removed for lengths of 500 ft. and 1500 ft., respectively. As identified in Section 16, these lines would be relocated at grade on trestles. The project has taken into account design considerations such as maintaining the grade of the existing lines and will minimize effects on rail service during physical relocation. Coordination between the Corps and non-Federal sponsor and the LACMTA during the study period has identified no issues with the relocation of the lines to trestles at grade, and other LACMTA needs, such as those outlined above, have been incorporated into the planning for the restoration project. Although we anticipate a negotiated transaction based upon discussions with LACMTA, if the City cannot reach agreement with LACMTA, the City may apply to the Surface Transportation Board for abandonment and relocation of the lines if necessary. Based upon our assessment, the non-Federal sponsor is capable of acquiring sufficient real estate interests through the two options described above.

The non-Federal sponsor is aware of and will comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Act of 1970, Public Law 91-646, as amended, in acquiring the lands, easements and rights-of-way and performing relocations. The non-Federal sponsor has been advised of the requirement to document expenditures and maintain records for LERRD valuation and crediting purposes.

14. ENACTMENT OF ZONING ORDINANCE

After consulting with the project delivery team and the non-Federal sponsor it was determined that at this time there are no foreseen enactments of zoning ordinances to facilitate acquisition of real property.

15. LAND ACQUISITION SCHEDULE AND MILESTONES

Currently, the study is anticipated to be implemented in phases by reach; thus the acquisition of rights of way needed for the LPP will be accomplished over an 11-year period. The following is a preliminary acquisition schedule for each reach:

REACH	CALENDAR YEAR	LERRDS ACQUISTION NUMBER OF MONTHS
REACH 6	February 2017- August 2018	18 MONTHS
REACH 5	May 2019 – November 2020	18 MONTHS
REACH 4	May 2020 – October 2021	17 MONTHS
REACH 7	June 2022 – November 2023	17 MONTHS
REACH 3	May 2023 – October 2024	17 MONTHS
REACH 1 & 2	June 2026- November 2027	17 MONTHS
REACH 8	May 2027 – November 2028	18 MONTHS

16. DESCRIPTION OF FACILITY/UTILITY RELOCATIONS

A preliminary assessment of the utilities within the LPP has been completed using a desktop survey of utilities within the study area in the design appendix and guidance set forth in Real Estate Policy Guidance Letter No. 31. Based on the preliminary assessment of the utilities, Reaches 6, 7 and 8 have been identified as having potential facility and/or utility relocations. The total potential relocations are more than 30% of the estimated total project cost; therefore, preliminary opinions of compensability have been prepared. The identified utilities or facilities are generally of the type eligible for compensation under the substitute facilities doctrine, and the District has consulted data or evidence that demonstrates that it has identified an owner with a compensable interest in the property.

16.1 Electrical Transmission Towers

There are six electrical transmission tower structures identified in Reach 6 of the LPP that will be impacted by the project as they are situated on parcels identified for restoration. The LPP plans to widen the channel in this section of the river (thus removing the existing channel wall where the transmission tower structures are located) and expand the channel to create marsh/wetland on the property. Based on the Corps' assessment, the transmission towers are of the type eligible for compensation and LADWP has been identified as having a compensable interest in the property. Four out of the six towers identified as requiring relocation are on parcels owned in fee by the LADWP. The other two transmission towers that will need to be relocated in Reach 6 are on land owned by the non-Federal sponsor with an easement to the LADWP.

The second area identified as having utility towers requiring relocation is Reach 7. There are two electrical transmission towers identified for relocation on the west bank of the channel. These structures are also of the type generally eligible for compensation. Based on aerial photography, the two towers sit on land owned by the non-Federal sponsor and the Los Angeles County Metropolitan Transportation Authority (LACMTA). The LADWP is believed to have an easement for the transmission towers in this reach. The LPP would require these towers be moved to allow restructuring of the banks of the river to create a terraced connection between the LA State Historic Park's restored freshwater marsh and the river.

The third area identified with transmission tower relocations is the left bank of the channel in Reach 8. The non-Federal sponsor owns the real estate on which the transmission towers are located, with the LADWP possessing an easement. Similar to

Reach 6, these towers must be moved to allow widening of the channel into the LATC site, restoring the connection to the historic floodplain.

16.2 Railroad lines

A portion of the active rail lines in Reaches 7 and 8 have also been identified as requiring relocation in order to create connectivity between restored habitat and the river. LACMTA owns the property where the active rail lines are located and has use agreements with Metrolink, Union Pacific, and Amtrak. LACMTA holds a compensable interest. To allow construction and operation of project features planned in these reaches, the rail lines will be placed on trestles at grade for a length of approximately 500 ft in Reach 7 and approximately 1,500 ft in Reach 8.

16.3 Sewer lines

Two LADWP sewer lines running parallel to the river on the left bank, along the LATC site in Reach 8, would require relocation in order to create connectivity between marsh land and the river. These lines would otherwise be affected by flows from the river into the historic floodplain once restored. The land is owned by Southern Pacific Railroad, with an easement to LADWP for the two sewer lines. It has been determined that the sewer lines are of the type generally eligible for compensation and LADWP has a compensable interest. One of the sewer lines is in regular use, while the other is a backup/emergency line for recurring use during maintenance and emergency situations.

16.5 LATC

Lastly, the Union Pacific Railroad's LATC has been identified as a facility subject to relocation to implement the LPP. Union Pacific Railroad is the fee owner of the land and operator of the LATC facility. According to the Los Angeles County Assessor, the LATC facility is approximately 141.67 acres, of which 102.67 acres of the

LATC site will be required for the project for conversion to restored habitat. Under the LPP, the majority of the LATC site would be restored to a historic wash with braided channels and fresh water marsh connecting to the Los Angeles River. According to correspondence received from Union Pacific Railroad, the LATC was described as follows:

"UP first established its rail maintenance facility at the LATC in the early 1900s. Today, UP's modern 120 acre intermodal, i.e., truck to rail and rail to truck container facility receives, sorts and distributes approximately 240,000 cargo containers per year, ninety-five percent of which are domestic (UP Operating Data, October 2013). Activities at the LATC include receiving inbound trains, switching cars, loading and unloading intermodal trains, storing intermodal containers and chassis, building and departing outbound trains, and repairing freight cars and intermodal containers and chassis. The LATC also provides forty-seven percent of California car transport…serves as a relief valve for the Port of Los Angeles traffic…"

According to published UPRR documents, LATC is one of four intermodal facilities operated by UPRR in the Los Angeles Basin. The other facilities are East Los Angeles, City of Industry, and the Intermodal Container Transfer Facility (ICTF) in Long Beach. Relocation of the site functions is anticipated to occur within the Los Angeles Basin at a site within an industrial zone, with proximity to existing rail lines, able to host equivalent functions. The IFR analyzes the relocation impacts in Chapter 5, "Evaluation of Alternative Plans and Environmental Consequences," by resource area. Prior to site selection, the lead CEQA agency would conduct a detailed CEQA analysis of the relocation of site functions. Should any additional NEPA documentation be required, it would be undertaken by the NEPA lead agency.

Relocation cost for purposes of the feasibility phase was based on relocation of equivalent site functions, including improvements and fixtures, to a parcel of similar size within the parameters identified above. Because only a portion of the LATC site would be required for the project and the remainder of the existing parcel was determined to be an economic unit with access, no severance damages were estimated or included in the cost estimate.

Any conclusion or categorization contained in this report that an item is a utility or facility relocation to be performed by the non-Federal sponsor as part of its LERRD responsibilities is preliminary only. The government will make a final determination of the relocations necessary for the construction, operation, or maintenance of the project after further analysis and completion and approval of final attorney's opinions of compensability for each of the impacted utilities and facilities.

17. KNOWLEDGE OR SUSPECTED PRESENCE OF CONTAMINANTS

The study area is located in a highly urbanized corridor that has been home to industrial development, with associated Hazardous, Toxic, and Radioactive Waste (HTRW) contamination and petroleum product contamination. The District has identified HTRW sites in accordance with ER 1165-2-132 (26 Jun 92) and is avoiding them wherever practicable. Where HTRW-contaminated lands cannot be avoided, the appropriate procedures and requirements as described in ER 1165-2-132 will be applied.

A preliminary assessment of HTRW sites has identified three known HTRW sites that cannot be avoided by any proposed project alternative, including the LPP. These sites are the Taylor Yard G1 and G2 parcels, in Reach 6, and the San Fernando Valley

Superfund Site (SFVSS), a groundwater plume that runs underneath the majority of the study area. For sites with soil contamination, the sponsor must undertake or ensure the remediation of the sites to the standards necessary to support the restoration project prior to providing the lands to the project for construction. This cost is 100 percent sponsor cost and not a project cost. The sponsor understands its responsibility to ensure the remediation of the sites prior to providing the lands to the project.

The SFVSS is currently being remediated through pumping and treatment under the oversight of Los Angeles Department of Water and Power. However, the project would be unable to avoid all contact with the plume during construction activities such as dewatering, and the sponsor would be responsible for ensuring the proper treatment, handling and disposal of contaminated groundwater during construction at 100% non project cost.

One additional site within the project footprint, LATC, has undetermined levels of HTRW contamination, but based on the similarity of historical use at this site to Taylor Yard, some HTRW contamination can reasonably be anticipated. Further information on the nature and extent of contamination, remediation status, and impacts to the restoration project alternatives is contained in Appendix K, HTRW Survey Report. Like the Taylor Yard sites, any contamination at the LATC would be required to be remediated to the level required for the project prior to the lands being provided to the project. The sponsor understands its responsibility to ensure the remediation of the site at 100% non-project cost prior to providing the land to the project.

The survey of HTRW sites identified 19 smaller sites within 500 feet of the LPP footprint that would be avoided by the LPP. However, remaining contamination on these sites may have some indirect impacts to the LPP if groundwater contamination from

these sites enters the LPP area. If localized groundwater contamination is identified, such contamination would require an approach similar to addressing ancillary SFVSS contamination during dewatering activities, but the HTRW impacts of these sites on the project are likely to be more limited because none of these sites are included in the LERRD required for the project. These sites are in various stages of remediation, and there are groundwater monitoring wells in several locations to provide information on the location and levels of contamination. A fuller discussion of these issues is contained in Appendix K and the IFR.

18. SUPPORT/OPPOSITION FOR PROJECT

The project is supported by Federal, State, and local governmental entities and several non-profit organizations, as well as the public, and it has strong Congressional support. Several local non-profit organizations have an active involvement in the river from organizing cleanups to building pocket parks. Both residents and non-residents are in favor of a restored Los Angeles River. One such group that advocates for a restored River is Friends of the Los Angeles River (FOLAR). FOLAR has been instrumental in bringing people out to the river for cleanups, walking tours and studying adjacent parcels that can connect to the river. FOLAR has won six planning awards for the work it did in studying restoration potential at LATC, a key location for this restoration study. Another group involved in working for a natural restored river is North East Trees. North East Trees has been instrumental in building pocket parks affording passive recreation, removal of non-native vegetation and planting native vegetation. Currently, North East Trees and FOLAR are working together on the Forest Lawn-Sennett Creek Los Angeles River Greenway. According to the project description this project aims to create a public park and green space on an 8.3-acre parcel just above where the Los Angeles River

Ecosystem Restoration Study begins. Along with creating recreational opportunities on this site both FOLAR and North East Trees plan to plant native vegetation, create a riparian area that will capture and treat urban runoff and create an inviting healthy environment for birds and other wildlife. A further discussion of public and institutional support for the project is contained in the main IFR.

By letter dated November 18, 2013, received during the public comment period on the Draft IFR, Union Pacific Railroad (UPRR) indicated that it currently has no intention of moving the LATC. The November letter expressed UPRR's opposition to the action alternatives ". . . to the extent they impact the LATC." In a subsequent letter dated March 28, 2014, UPRR stated that it has a long history of working cooperatively with the City of Los Angeles on a variety of matters and that a future sale or exchange agreement for the LATC could be reached if the City were to acquire, in cooperation with UPRR, a suitable replacement facility with all necessary permits and approvals necessary for UPRR's use as a rail yard fully comparable to the current facility at LATC. This represents a modification of UPRR's previous position as expressed in its letter of November 18, 2013.

19. LAND ACQUISITION PRIOR TO PPA

The non-Federal sponsor has been advised in writing of the risks associated with acquiring land prior to the execution of the project partnership agreement. A copy of the letter has been attached to this appendix as Attachment D.

20. OTHER RELEVANT REAL ESTATE ISSUES

One relevant real estate issue for the study is that of high land costs. In addressing the issue of high land costs and high LERRD percentage of total project costs, the study team has undertaken several efforts, including (1) a sequenced search of public lands

within the study area to ensure all lands are adequately considered and the reasons for not including them well-documented, and (2) submittal of a request by the non-Federal sponsor to the Assistant Secretary of the Army (Civil Works) (ASA (CW)) to allow it to forgo reimbursement for LERRD value above its required share of ecosystem restoration costs. The ASA(CW) granted the requested policy exception on August 8, 2013, and directed that the IFR document the offer and grant of waiver of reimbursement.

Although land acquisition was minimized as part of the planning process, the high land values unavoidable in urban Los Angeles resulted in each alternative having LERRD costs that substantially exceeded 35 percent of the total ecosystem restoration plan costs, with higher LERRD percentages for the smaller alternatives. Lands outside the existing LACDA flood risk management channel boundary, including high-cost private lands at critical opportunity areas (Taylor Yard, Verdugo Wash, and LATC), are essential to meeting the planning objectives. Because of these issues, the District was unable to identify best buy plans or highly cost effective plans that would have LERRD percentages under 35 percent of total ecosystem restoration costs. As part of its commitment to the study and the proposed project, the non-Federal sponsor offered to waive reimbursement of LERRD. The policy exception for waiver of reimbursement for LERRD has been approved, and the sponsor's request letter and the ASA (CW)'s approval of the policy exception are included as part of Appendix P, "Letters and Guidance Memoranda."

Subsequent to the circulation of the Draft IFR, the City of Los Angeles requested that Alternative 20 be the plan recommended to Congress for authorization and proposed cost sharing different from that generally applicable to ecosystem restoration projects under WRDA 1986. The ASA (CW) granted consideration of Alternative 20 as a Locally

Preferred Plan and granted the Corps permission to consider recommending alternative cost sharing to Congress, subject to certain restrictions, including a limitation that no reimbursement or credit shall be given for LERRD costs exceeding 35 percent of total ecosystem restoration costs. The IFR therefore outlines two cost sharing options: one consistent with statutory cost sharing applicable to Locally Preferred Plans, and one consisting of a non-standard cost sharing option in response to a request by the non-Federal sponsor. As stated above, the highly effective plans, including the NER Plan and LPP, all had LERRD percentages exceeding 35 percent of the total ecosystem restoration cost including the NER and LPP; therefore the Federal share of total ecosystem restoration cost of the LPP is not affected by the difference in LERRD cost between the NER and LPP.

US Army Corps
of Engineers
Los Angeles District

Attachment A: Estates

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Attachment A

STANDARD ESTATES

<u>TEMPORARY WORK AREA EASEMENT</u>

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____), for a period not to exceed _____, beginning with date possession of the land is granted to the City of Los Angeles or the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the _____ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

<u>ROCK ANCHOR EASEMENT</u>

A perpetual and assignable right and easement to construct, operate and maintain underground anchors or tie-backs under and through Tract Nos. ___, ___ and ___, where needed, as part of the _____ Project, with such anchors or tie-backs installed from (name of stream or river) located at a minimum, ___ feet below ground level; limited, however, to such rights and easement hereby acquired as may be used without disturbing the surface of the land and without interfering with or abridging the surface owner's right to use the surface of the land except to the extent the surface owner's use does not include removal, excavating or constructing around the anchor or tie-back; subject however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

NON-STANDARD ESTATES

<u>PERPETUAL ECOSYSTEM RESTORATION EASEMENT (PERE)</u>

A perpetual and assignable right, easement, and right-of-way in, on, over and across the land described in Appendix A attached hereto (Tract No(s). ____; hereinafter the “Easement Area”), to construct, operate, maintain, repair, rehabilitate, and replace aquatic ecosystem restoration features, and appurtenances thereto, including: [features], which structures are illustrated generally on Exhibits(s) __attached hereto, to [do what], all for the purposes of providing for aquatic ecosystem restoration and protection in connection with the Los Angeles River Ecosystem Restoration Project, Los Angeles County, California, implemented under the authority of [insert authority once authorized] and otherwise conserving, restoring, and managing the use of natural resources; TOGETHER WITH the right to plant vegetation in the Easement Area and to trim, cut, fell, and remove therefrom all trees, underbrush, and other vegetation; to remove and dispose of any and all obstructions, structures, debris, or obstacles within the Easement Area; to excavate and place soil, stone, rock, and other materials within the Easement

Attachment A

Area that may be required in connection with said features; to post signs and Easement Area boundary markers; and TOGETHER WITH the right to construct, install, maintain, repair, rehabilitate, and replace: [other features] all in the approximate locations as depicted on Exhibit __ attached hereto; and TOGETHER WITH the right of ingress and egress over and across the Easement Area for the purpose of exercising the rights set forth herein; subject, however, to existing easements for [are there any existing easements].

The Grantor(s), (his) (her) (its) (their) (heirs), successors and assigns, reserves unto (itself) (themselves) all such other rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired. However, any activity on or use of the Easement Area inconsistent with the purposes of this easement is prohibited. Without limiting the generality of the foregoing, the following uses by Grantor(s), (his) (her) (its) (their) (heirs), successors and assigns, agents or third parties are expressly prohibited in or on the Easement Area:

(a) constructing, locating, placing, or installing any building or structure of any kind, whether permanent or temporary, or any signage of any type including billboards;
(b) removal, destruction, cutting, or altering of trees, shrubs, or other vegetation by mechanical, chemical, manual or other means;
(c) filling, excavation, or other alteration to the surface or subsurface including, without limitation, the excavation or removal of soil, sand, gravel, rock, peat, or sod;
(d) dumping or other disposal or storage of rubbish, garbage, debris, hazardous or other waste material; and
(e) agricultural use or activities including grazing or watering of livestock; except that watering of livestock may occur at constructed livestock stream crossings and off-stream oxbow areas that are depicted on Exhibit__ attached hereto.

US Army Corps
of Engineers
Los Angeles District

Attachment B: Parcel Ownership Mapping

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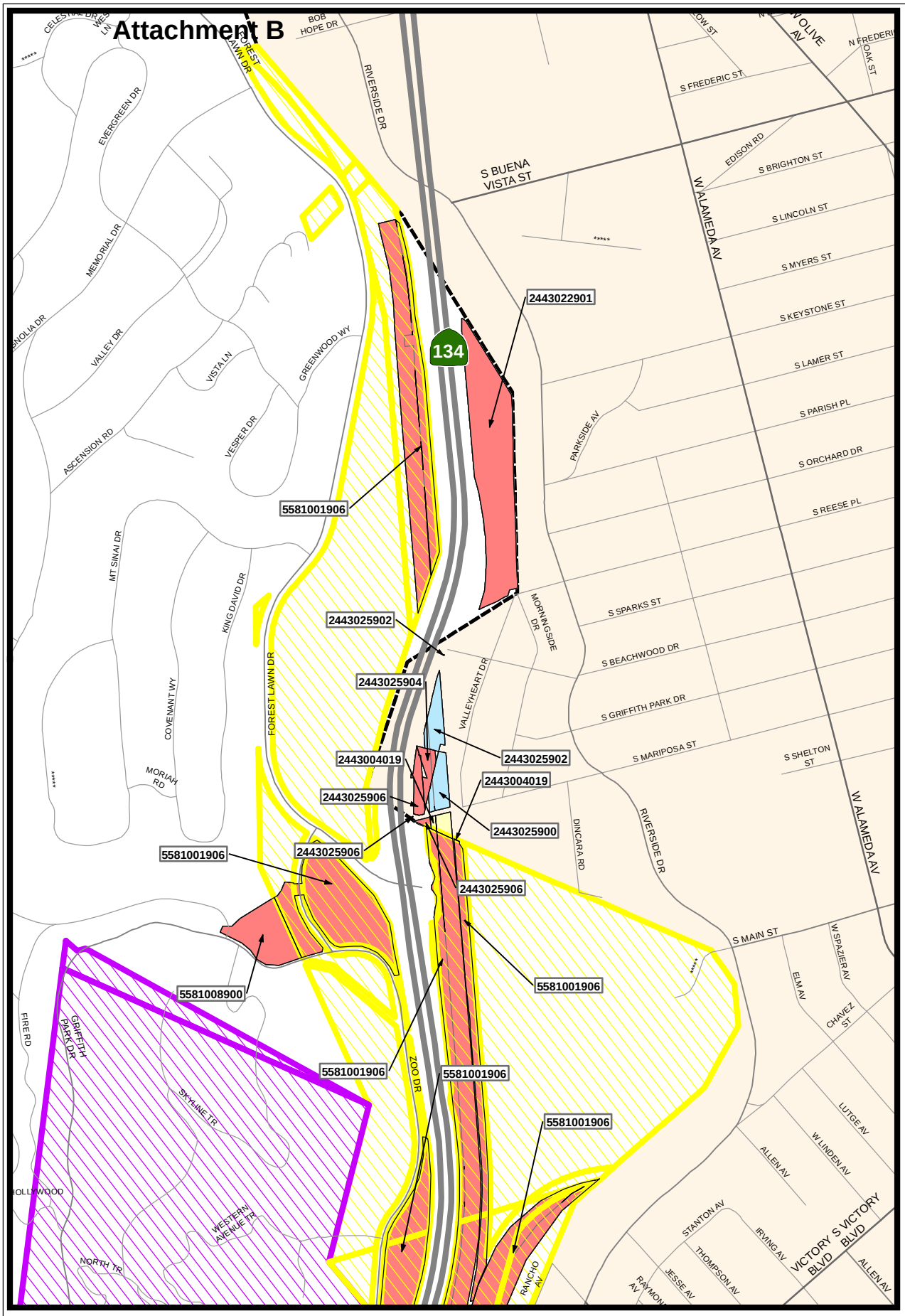
Attachment B

LA River Project

Page 1



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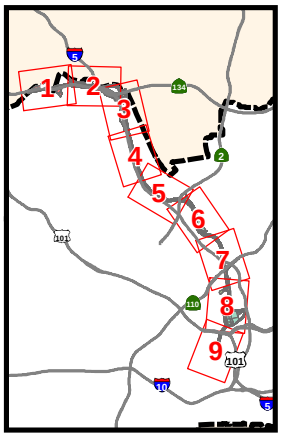

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Mayor

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City Engineer

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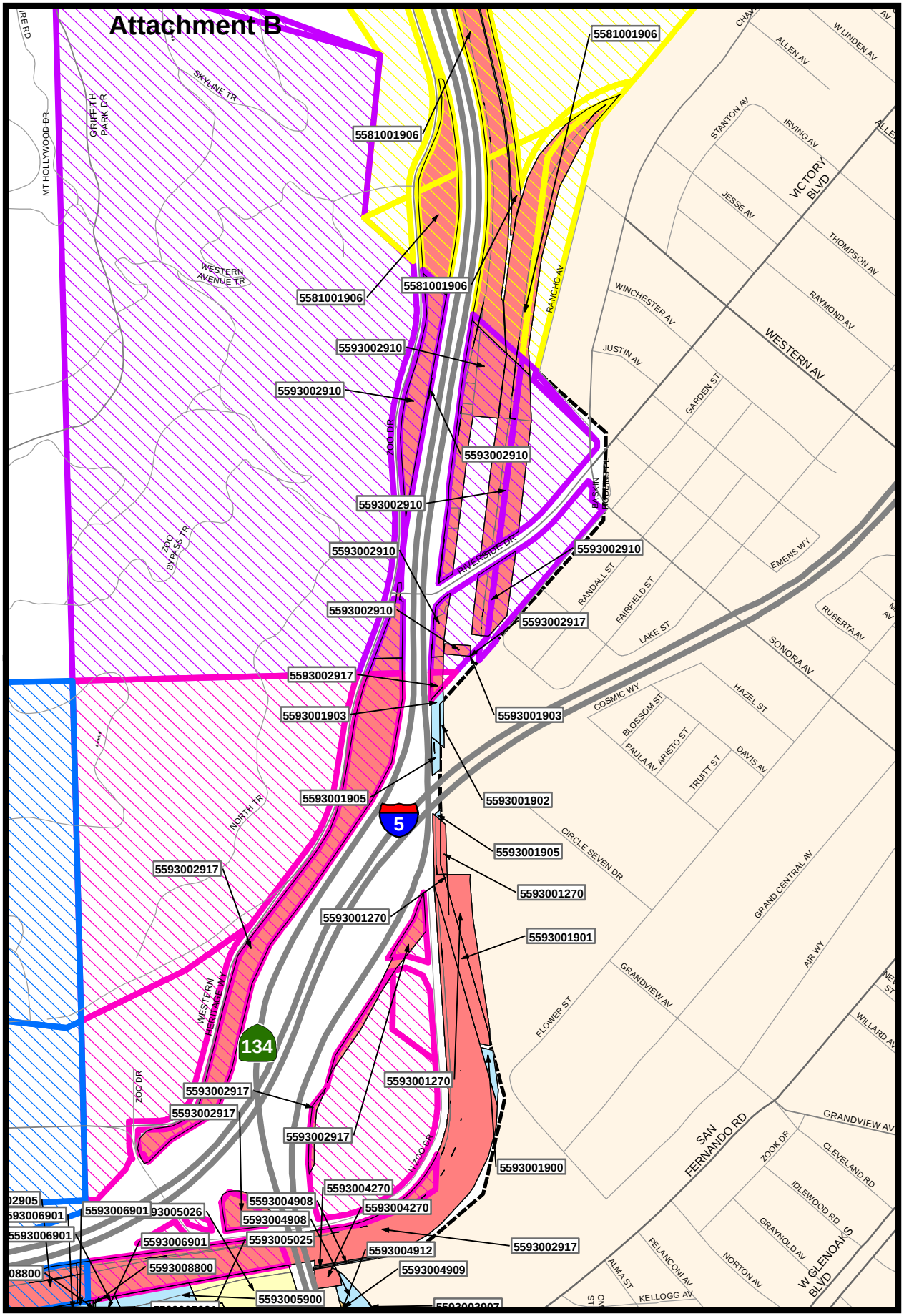

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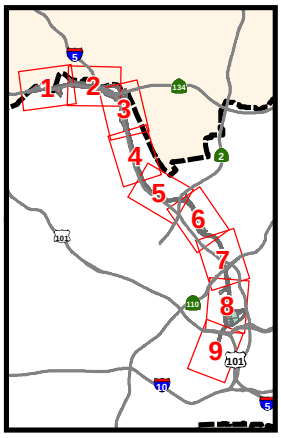

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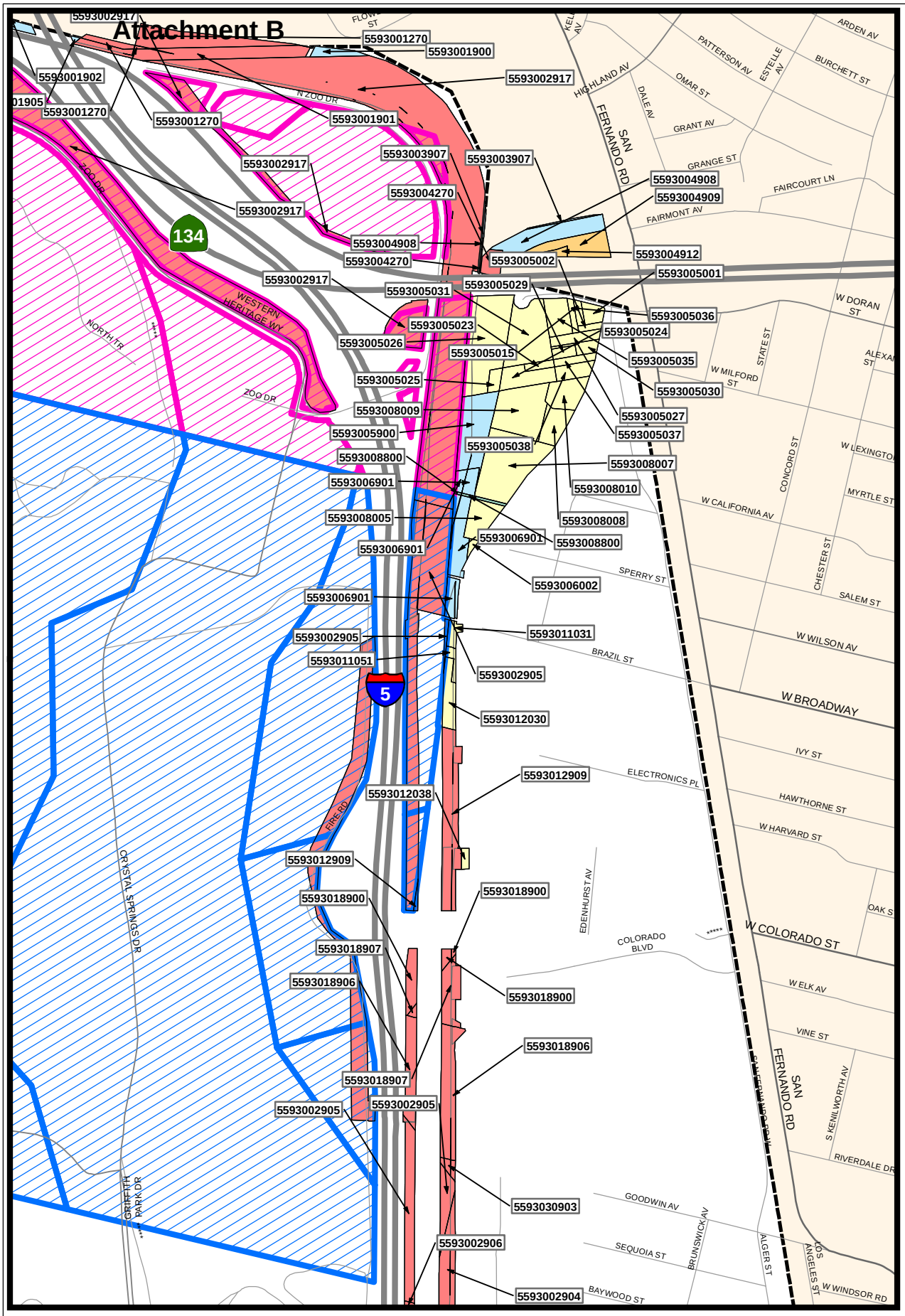

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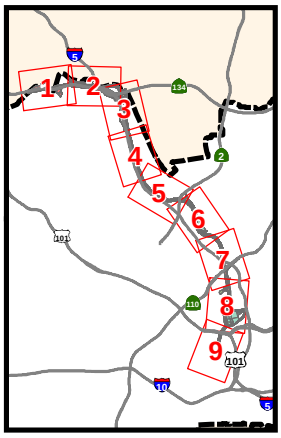

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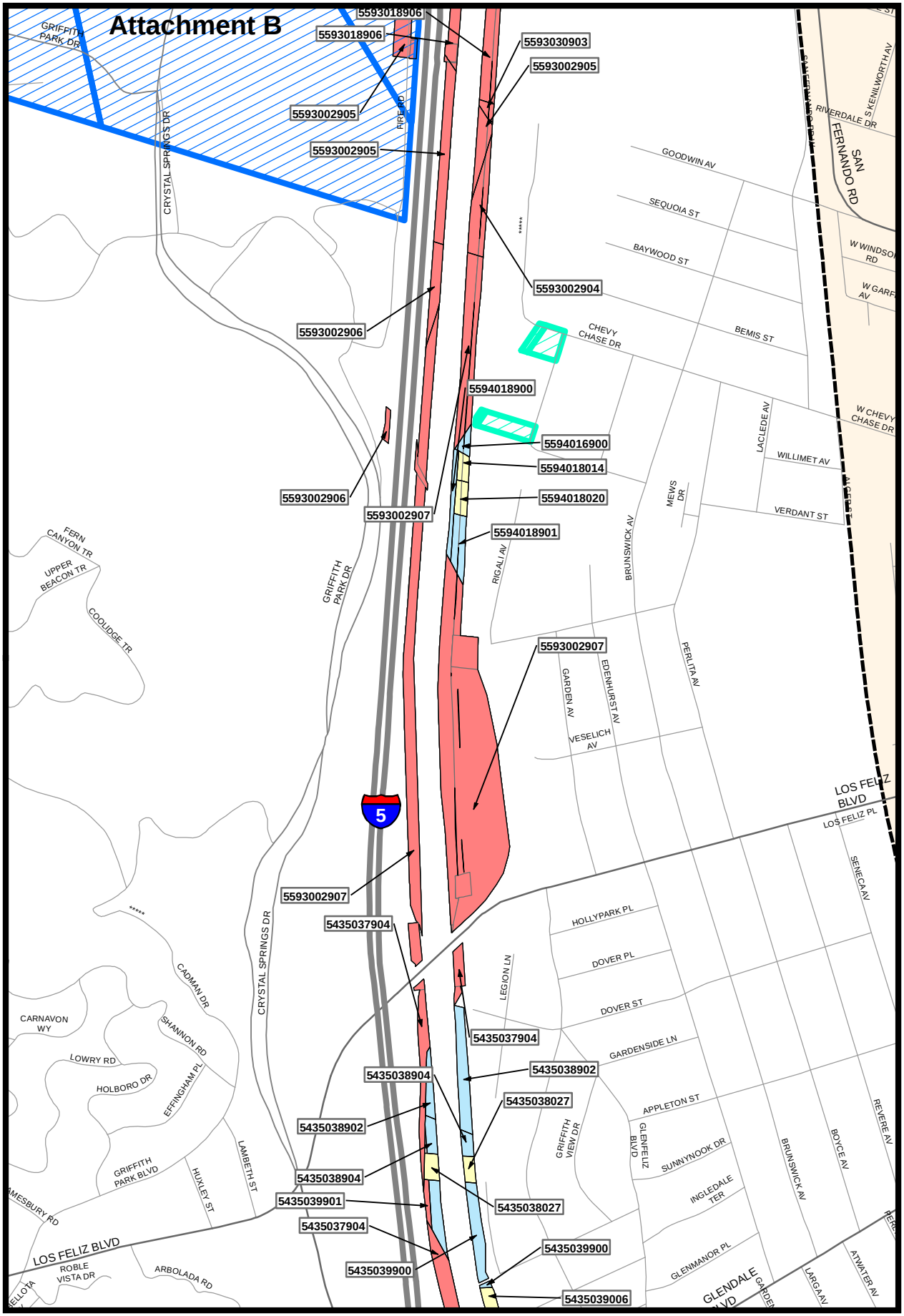

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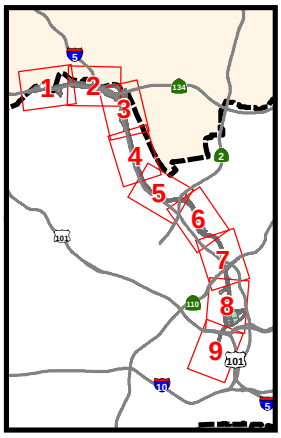

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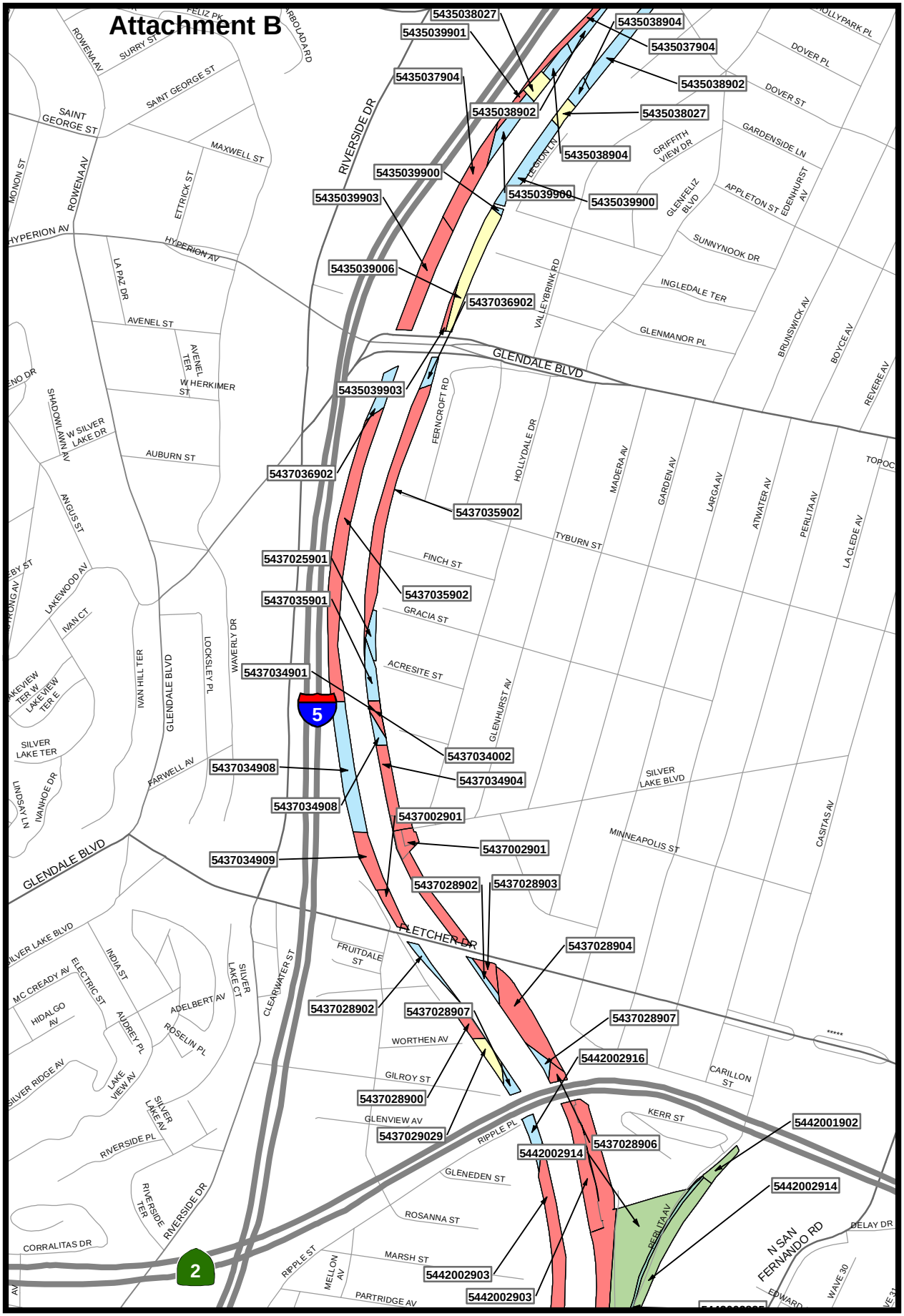

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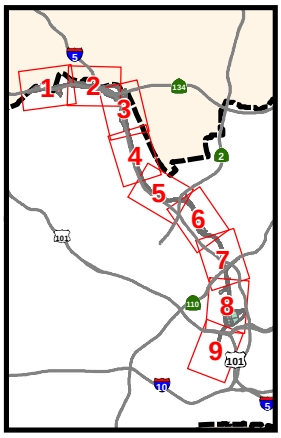

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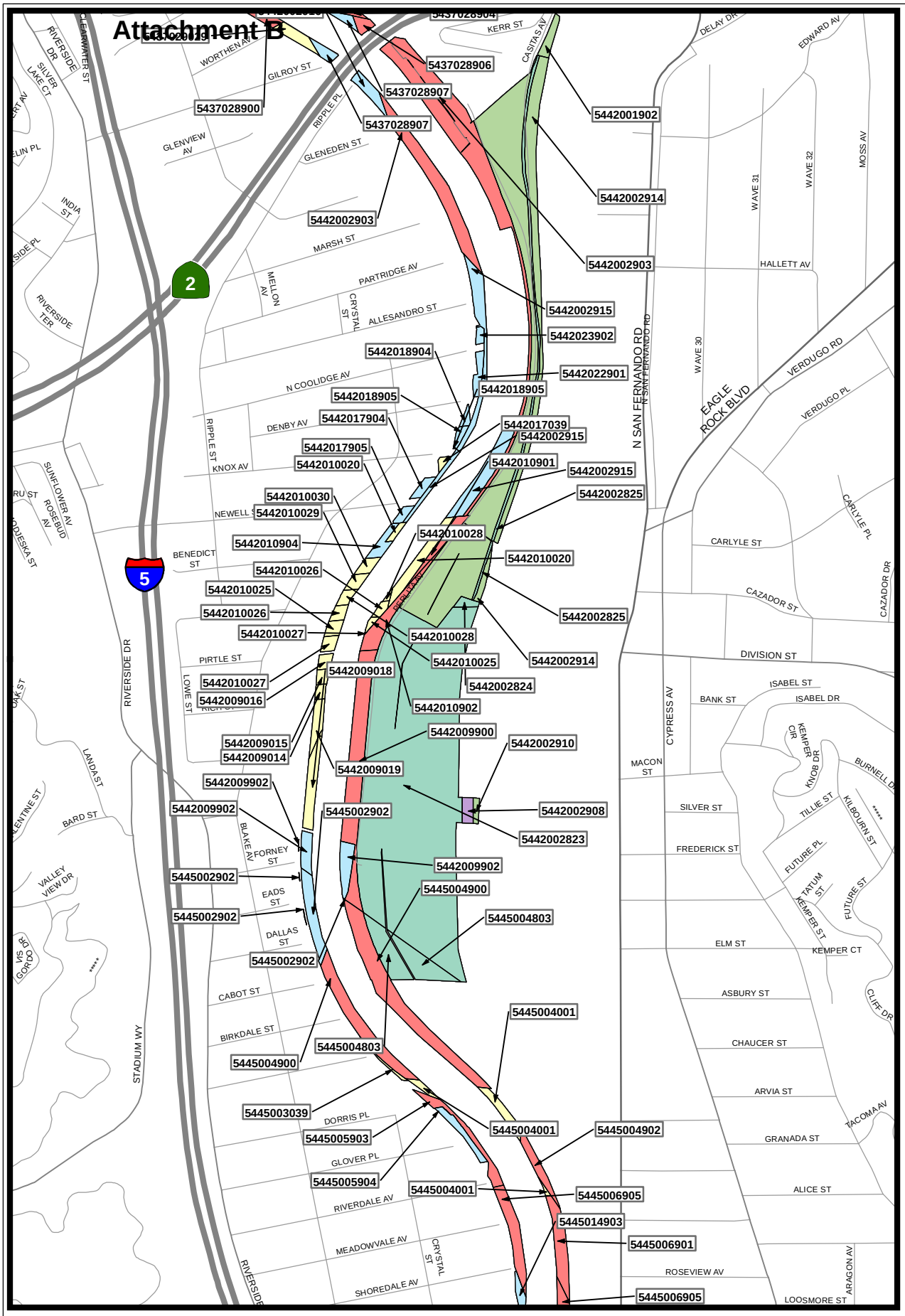

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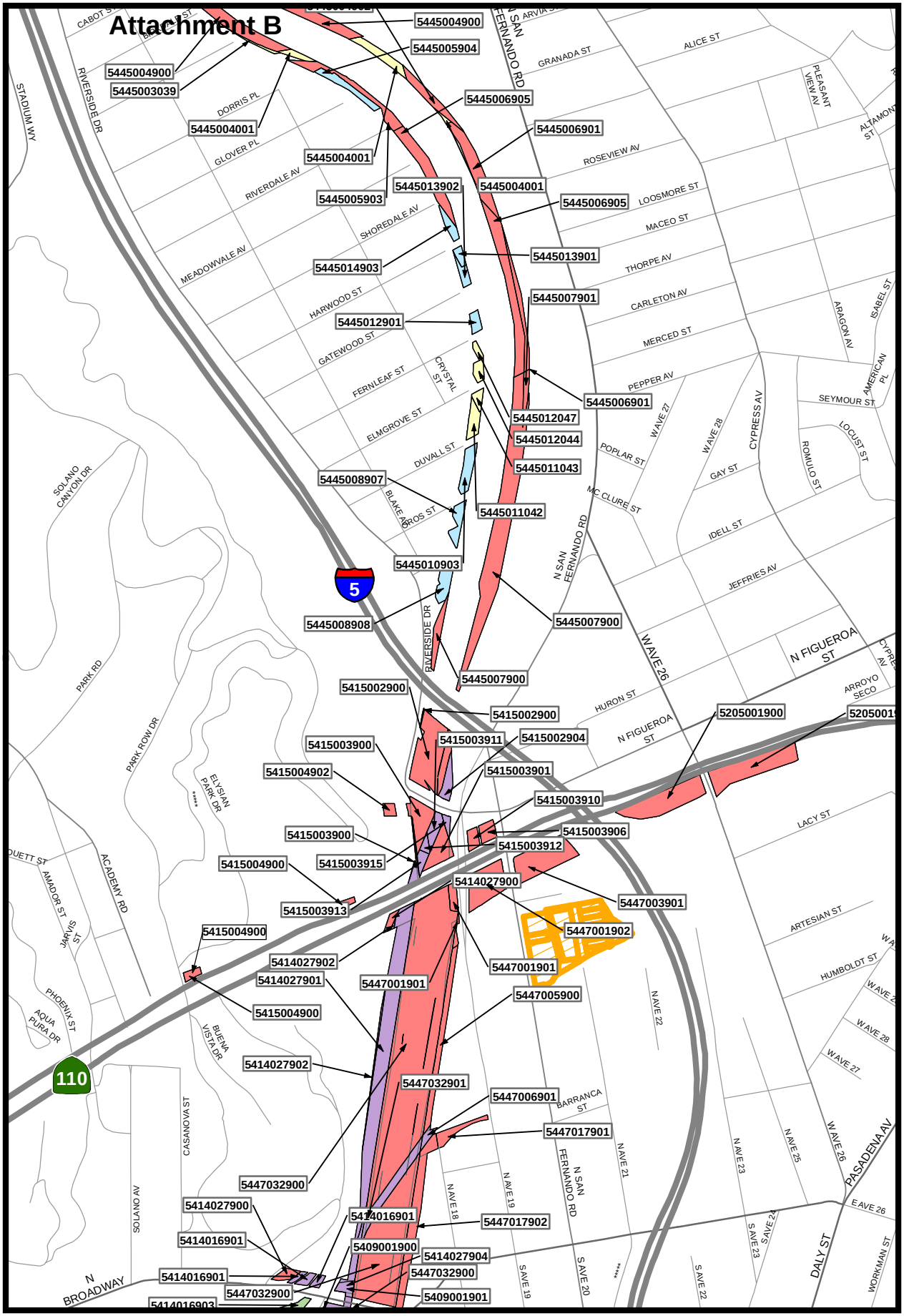

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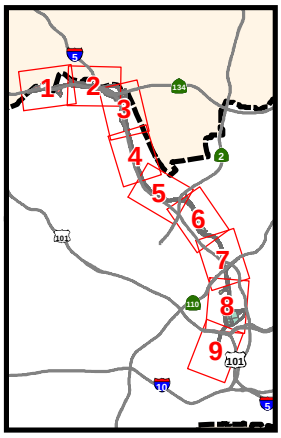

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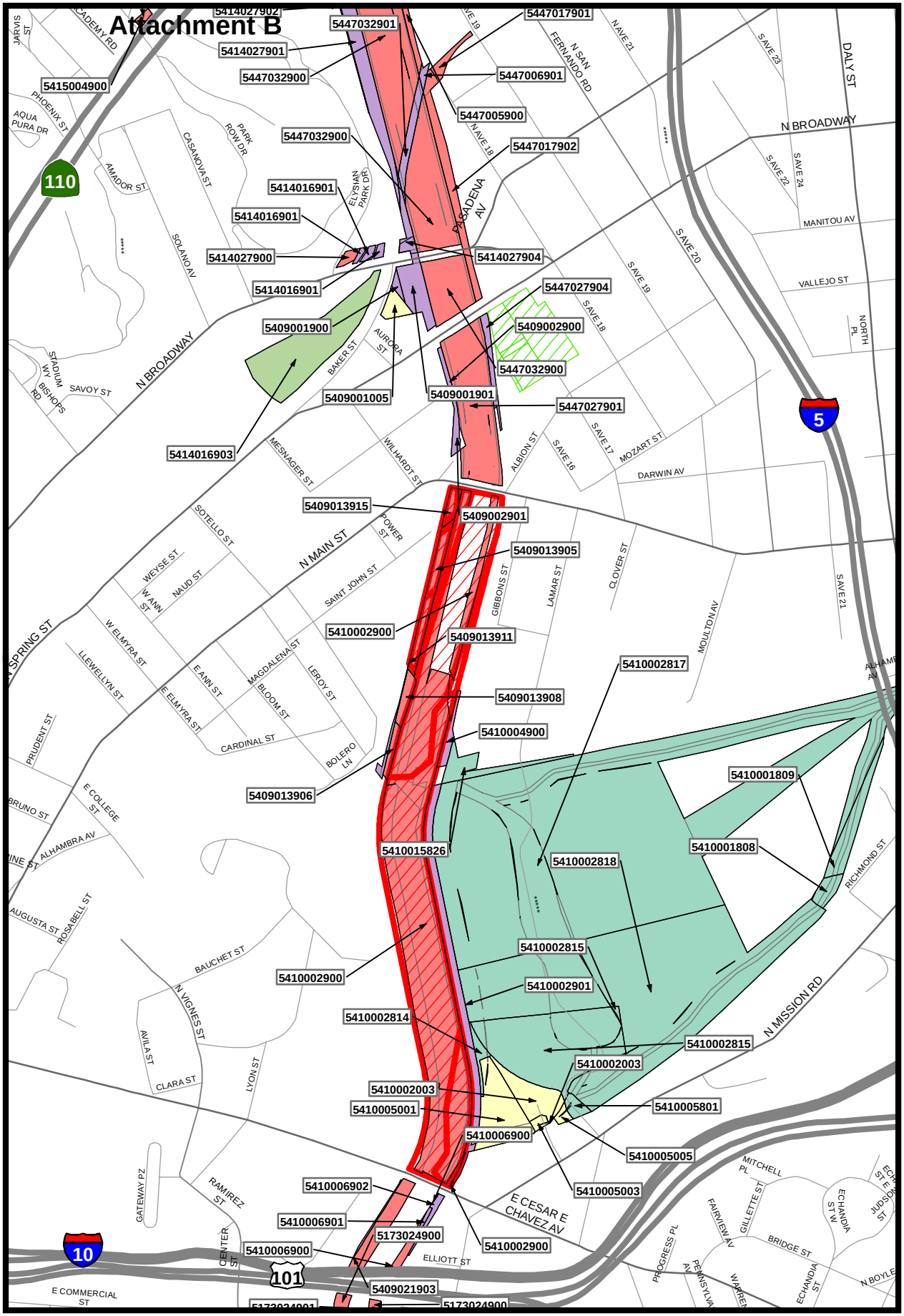

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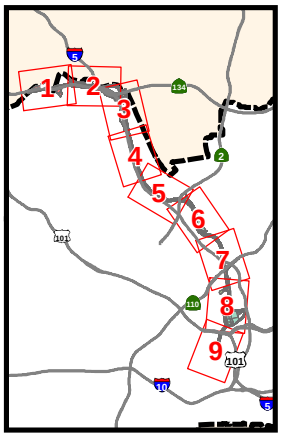

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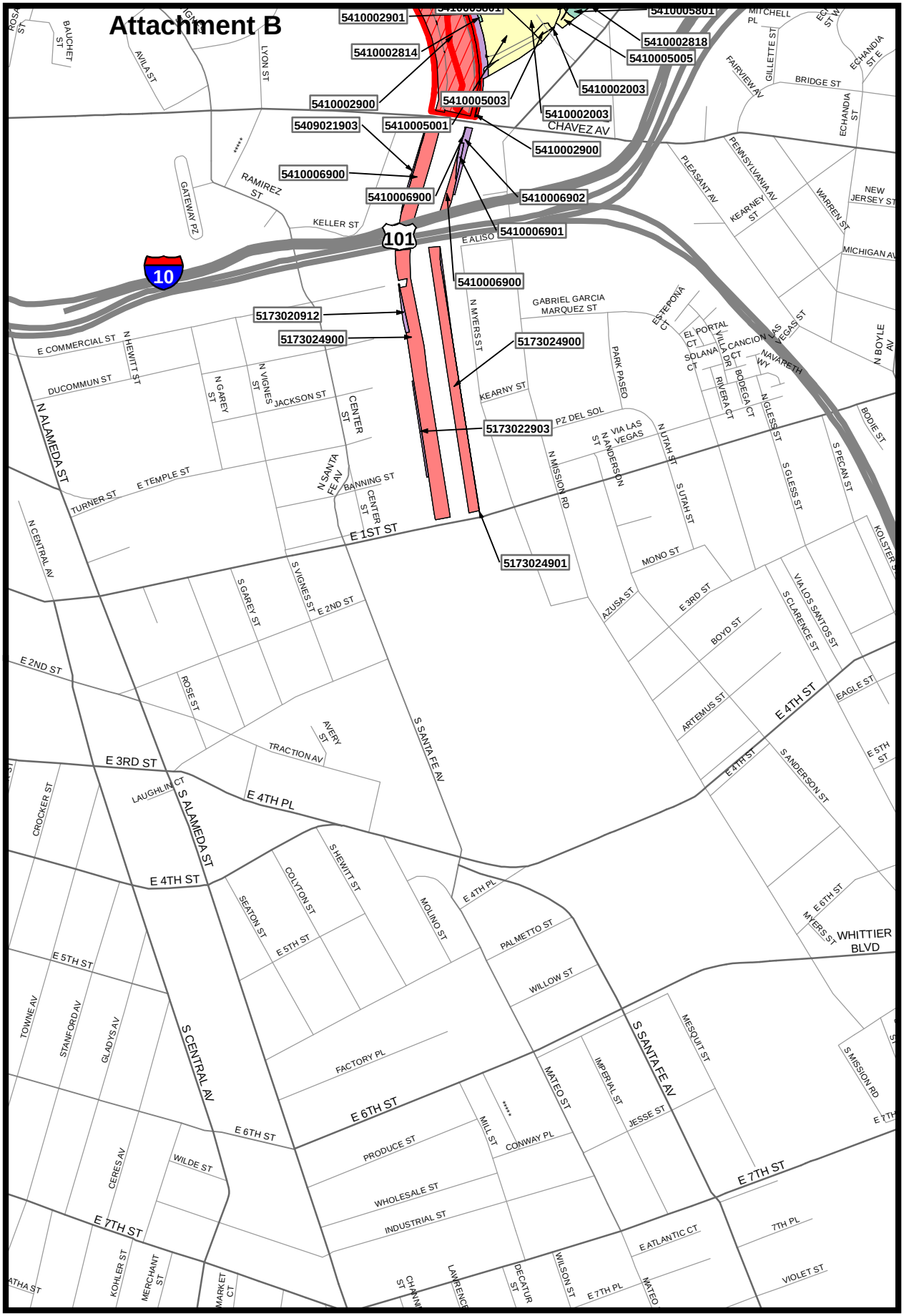

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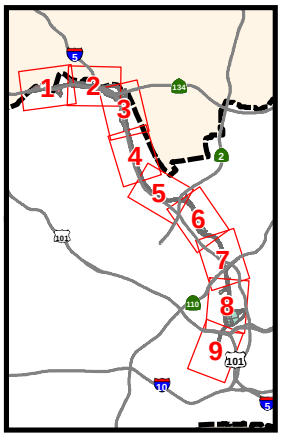

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US Army Corps
of Engineers
Los Angeles District

Attachment C: Assessment of Non-Federal Sponsor's Real Estate Acquisition Capabilities

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Attachment C

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITIES

January 27, 2015

I. Legal Authority:

a. Does the Sponsor have legal authority to acquire and hold title to real property for project purposes?

Yes

b. Does the Sponsor have the power of eminent domain for this project?

Yes

c. Does the Sponsor have "quick-take" authority for this project?

Yes
State of California law gives a public entity authority to seek immediate possession of a condemned property by depositing probable compensation with the court; under the California Code of Civil Procedure 1255.410 and 1255.450.

For example: (*Mt. San Jacinto Community College Dist. v. Superior Court* (2007)40 Cal.4th 648, 653 [54 Cal.Rptr.3d 752, 151 P.3d 1166]

d. Are any of the lands/interests in land required for the project located outside the Sponsor's political boundary?

Yes
A relatively small portion of the project area is within the City of Glendale. The land in the City of Glendale's political boundary includes two parcels for only approximately 2 acres of restoration at the Verdugo Wash confluence with the Los Angeles River.

The City of Glendale has been supportive of Los Angeles River Revitalization and has improved its riverfront with the Glendale Riverwalk project, providing public access and recreational space to its citizens. On October 29, 2013, the Glendale City Council passed a resolution in support of the project and identifying Alternative 20 is its preferred alternative. Alternative 20 includes the land that falls within the City of Glendale's political boundary.

Attachment C

e. Are any of the lands/interests in land required for the project owned by an entity whose property the Sponsor cannot condemn?

Yes
The project area includes land owned by or under the jurisdiction of the State of California, including California State Parks (State Parks) and the California Department of Transportation (Caltrans). State Parks has been a strong supporter of Los Angeles River Revitalization and is specifically supportive of their land in the project area being used for this project. It is extremely unlikely that any sort of condemnation action would be necessary for inclusion of State Parks land in the project area.

The project area includes land alongside and beneath Caltrans freeways. It is unlikely that the City would pursue fee acquisition or condemnation of that land. Rather, a lesser estate, such as a restoration easement or encroachment permit is the likeliest scenario for the City to provide that land to the project.

II. Human Resource Requirements:

a. Will the Sponsor's in-house staff require training to become familiar with the real estate requirements of federal projects including P.L. 91-646, as amended?

No

b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training?

N/A

c. Does the Sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?

Yes

d. Is the Sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule?

Yes

e. Can the sponsor obtain contractor support, if required in a timely fashion?

Yes

Attachment C

f. Will the sponsor likely request U. S. Army Corps of Engineers assistance in acquiring real estate?

No

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?

Yes

b. Has the sponsor approved the project/real estate schedule/milestones?

Yes
The City has been an integrated member of the project team and has participated fully in discussions regarding the project schedule and the real estate milestones for the Study. The Study milestones as included in the Project Management Plan have been approved by the City. Formal approval of the implementation schedule and real estate actions will follow the Feasibility Phase.

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other U. S. Army Corps of Engineers projects?

Yes
The City regularly works with the Army Corps on projects that involve Army Corps property and or property over which the Army Corps has jurisdiction. These projects are planned and with Army Corp participation in the review and approval of plans project scope.

Among these projects are bridge rehabilitations that have taken place over the Los Angeles River, and projects that involve the Tillman plant such as; the Berm Improvements Project, the Multi-Purpose and Office Building Exhibits, the In Plant Storage; and the Advanced Water Purification Facility.

b. With regard to this project, the sponsor is anticipated to be:

Highly Capable

V. Coordination:

a. Has this assessment been coordinated with the sponsor?

Yes

Attachment C

b. Does the sponsor concur with this assessment?

Yes

Prepared by:

Uriel Jiménez
Chief Real Estate Officer
City of Los Angeles

Reviewed by:

Lisa Sandoval
Real Estate Specialist
US Army Corps of Engineers

Reviewed and Approved by:

Theresa M. Kaplan
Chief, Real Estate Division
US Army Corps of Engineers

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of Engineers
Los Angeles District

Attachment D: Risk of Early Acquisition Letter to Sponsor

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Attachment D

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, U.S. ARMY CORPS OF ENGINEERS
915 WILSHIRE BOULEVARD, SUITE 930
LOS ANGELES, CALIFORNIA 90017

March 25, 2015

Office of the Chief
Asset Management Division

SUBJECT: Los Angeles River Ecosystem Restoration Study- Real Estate Acquisition

Mr. Gary Lee Moore, P.E. City Engineer
City of Los Angeles
Department of Public Works Bureau of Engineering
1149 South Broadway Suite 700
Los Angeles, California 90015-2213

Dear Mr. Moore:

The intent of this letter is to formally advise the City of Los Angeles as the non-Federal sponsor for the proposed project, of the risk associated with land acquisition prior to the execution of the Project Partnership Agreement (PPA) or prior to the Government's formal notice to proceed with acquisition. If a non-federal sponsor deems it necessary to commence acquisition prior to an executed PPA for whatever reason, the non-federal sponsor assumes full and sole responsibility for any and all costs, responsibility, or liability arising out of the acquisition effort.

Generally, these risks include but may not be limited to, the following:

a. Congress may not appropriate funds to construct the proposed project;

b. The proposed project may otherwise not be funded or approved for construction;

c. A PPA mutually agreeable to the non-Federal sponsor and the Government may not be executed and implemented;

d. The Non-Federal sponsor may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of CERCLA, as amended;

e. The non-Federal sponsor may acquire interests or estates that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project

f. The non-Federal sponsor may initially acquire insufficient or excessive real property acreage which may result in additional negotiations and/or benefit payments under P.L. 91-646 as well as the payment of additional fair market value to affected landowners which could have been avoided by delaying acquisition until after PPA execution and the Government's notice to commence acquisition and performance of LERRD; and

g. The non-Federal sponsor may incur costs or expenses in connection with its decision to acquire or perform LERRD in advance of the executed PPA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662 or the PPA otherwise not required for the project.

We appreciate the City's participation in this project. Should you have questions or concerns pertaining to this letter please feel free to contact Ms. Lisa M. Sandoval at (213) 452-3147 or by email at lisa.m.sandoval@usace.army.mil.

Sincerely,

Theresa M. Kaplan

Theresa M. Kaplan
Chief, Asset Management Division
Real Estate Contracting Officer

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX K
HAZARDOUS, TOXIC and RADIOACTIVE WASTE SURVEY REPORT

April 2015

US Army Corps
of Engineers

Los Angeles District

Geotechnical Branch, Geology & Investigations Section

HTRW Survey Report of the
Los Angeles River Ecosystem Restoration Project Study Area, Los Angeles County, CA

July 2014

ACRONYMS USED IN THIS APPENDIX

AAI: All Appropriate Inquiry (ASTM abbreviated ESA method)

ASTM: American Society for Testing and Materials

CAA: Clean Air Act (federal environmental law)

CERCLA: Comprehensive Environmental Response Cleanup and Liability Act (federal environmental law)

CFR: Code of Federal Regulations

CWA: Clean Water Act (federal environmental law)

DTSC: Department of Toxic Substances Control (California environmental regulatory agency for soil)

EA: Environmental Assessment

EDR: Environmental Data Resources (private environmental data search record storehouse)

EIR: Environmental Impact Report (state environmental impact report)

EIS: Environmental Impact Statement (federal environmental reporting requirement)

ER: Engineering Regulation (Corps of Engineers internal regulations)

ERA: Ecological Risk Assessment

ESA: Environmental Site Assessment (general environmental reporting guideline by ASTM)

ESASs: Environmental Site Assessment Standards (category of environmental ASTM standards within the ASTM standards)

F4: Feasibility 4 (level 4 of the Corps of Engineers feasibility study process)

FS: Feasibility Study (CERCLA step)

HHRA: Human Health Risk Assessment

HTRW: Hazardous, Toxic and Radioactive Waste (Corps of Engineers program terminology)

IRA: Interim Removal Action (CERCLA step)

IRAP: Interim Removal Action Plan (CERCLA step)

LARWQCB: Los Angeles Regional Water Quality Control Board (California regulatory agency for Los Angeles area water)

LUST: Leaking Underground Storage Tank

NEPA: National Environmental Policy Act (federal environmental law)

NPL: National Priority List (list of USEPA Superfund sites)

OMRRR: Operation and Maintenance Repair, Rehabilitation, and Replacement (Corps of Engineers operations and maintenance phase for Civil Works projects)

OSHA: Occupational Safety and Health Act (federal safety law)

PAH: Poly Aromatic Hydrocarbon

PCE: Tetrachloroethylene

PED: Planning Engineering Design (Corps of Engineers combined planning and engineering process/phase; occurs prior to actual construction of project)

Phase I ESA: Phase I Environmental Site Assessment (ASTM method)

Phase II ESA: Phase II Environmental Site Assessment (ASTM method)

PPA: Project Partnership Agreement (Agreement between Corps and non-Federal Sponsor to construct, operate and maintain a project)

PRP: Potential Responsible Party

RAP: Remedial Action Plan (CERCLA step)

RCRA: Resource Conservation and Recovery Act (federal environmental law)

REC: Recognized Environmental Condition

RI: Remedial Investigation (CERCLA step)

RP: Responsible Party

SARA: Superfund Amendments and Reauthorization Act (federal environmental law amending CERCLA)

SFVSS: San Fernando Valley Superfund Site (CERCLA-USEPA regulated)

SI: Site Investigation (CERLCA step)

SWRCB: State Water Resources Control Board (California environmental regulatory agency for water)

TCE: Trichloroethylene

TSCA: Toxic Substances Control Act (federal environmental law)

USACE: U.S. Army Corps of Engineers

USDOT: U.S. Department of Transportation

USEPA: U.S. Environmental Protection Agency (federal environmental regulatory agency)

UST: Underground Storage Tank

VOC: Volatile Organic Carbon

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1.0 PURPOSE

The Los Angeles River (LAR) Ecosystem Restoration Feasibility Study (Study) evaluates and proposes alternatives that will provide habitat restoration and associated benefits to portions of the river near downtown Los Angeles and Burbank. The purpose of this report is to identify and list potential hazardous, toxic, and radioactive waste (HTRW) impacts to the alternative plans that will be considered for this Study. This report also provides general recommendations and costs associated with any such identified HTRW impacts.

2.0 INTRODUCTION

The introduction begins with Section 2.1, HTRW. This section includes discussion and definition of the U.S. Army Corps of Engineers (Corps) HTRW terminology and its programmatic relationship to federal environmental laws, Corps Civil Works policy and the ASTM standards for environmental HTRW surveys. It also provides cursory explanation of the difference between NEPA environmental, biological, and CERCLA type environmental HTRW surveys.

Sections 2.2 through 2.4 discuss definitions of and differences among hazardous substances, hazardous wastes and hazardous materials and their relationship to HTRW.

Section 2.5 provides further discussion of the relationship between HTRW and the civil works program and other Corps programs.

Section 2.6 provides a short history, definition and discussion of the ASTM standards that can be applied for performing HTRW environmental surveys.

Section 3 is the HTRW report for the project area with results. Section 4 is a concise summary of the report results.

Sections 5and 6 discuss the HTRW impacts to the project and without project scenario and groundwater conditions.

Sections 7 to 8 provide a summary of the overall report findings and a detailed summary of the Corps HTRW Regulations related to Civil Works projects. It also provides recommendations for future HTRW work that needs to be completed for this project.

Section 9 provides a random order of magnitude cost due to the high HTRW impacts that were identified for this project.

2.1 Hazardous, Toxic, and/or Radioactive Waste

Corps, Engineering Regulation (ER) 1165-2-132, “Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects”, dated June 26, 1992, provides guidance for consideration of HTRW issues and problems within project boundaries or which may affect/be affected by Corps Civil Works projects. HTRW is a term used by the Corps, and it primarily addresses “hazardous substances” as defined under CERCLA. CERCLA-regulated hazardous substances do not include pure petroleum substances, such as those that are derived or from commercial fuel or natural gas products. CERCLA-regulated hazardous substances include hazardous substances from the other major federal laws of CWA (toxic pollutants), CAA (hazardous air pollutants), TSCA (imminently hazardous chemical substances or mixtures) and RCRA (hazardous wastes). These laws can be thought of as fitting under the one umbrella of CERCLA for regulation of federal hazardous substances. The term HTRW generally does not include pure petroleum substances that emanate from fuel or natural gas products. However, ER 1165-2-132 also provides guidance for identifying and addressing petroleum substances of concern.

ER 1165-2-132 outlines procedures to facilitate early identification and consideration of HTRW issues in all phases of a study or project.

To accomplish early identification, the Corps schedules and performs HTRW surveys and reports during the initial Civil Works planning and design portions of the Civil Works project phases. These surveys are performed often at the reconnaissance level. Such surveys are conducted most often by following the procedures found in the commercial Environmental Site Assessment Standards (ESAs) written by the American Society for Testing and Materials (ASTM). Surveys can also be conducted by following any other type of Federal, local and/or state guidance or procedures that may be applicable to the HTRW concerns of the Corps project. ASTM Environmental Site Assessment Standards are specifically written for application to the environmental engineering field (discipline). The ASTM standards for ESAs are written as separately numbered, titled, but closely related ASTM standards within the set of ASTM ESAs. The standards are titled “Environmental Site Assessments (ESA)”.

The two ASTM titles and their procedures most commonly used by the Corps for HTRW surveys and reports are ASTM E-1527-05, "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process" (Phase I ESA) and ASTM E-1528-06, "Practice for Environmental Site Assessments: Transaction Screen Process (AAI)”. Federal regulations and additional information directly related to ESA (HTRW survey) procedures can be found in the United States Environmental Protection Agency (USEPA) "Standards and Practices for All Appropriate Inquiries" (AAI, 40 CFR Part 312). Either a Phase I ESA or AAI or both are typically selected and used during the early stages of a Civil Works project development phase. In the planning development phase, the AAI is most typically selected, followed by a Phase I ESA, if warranted. A Phase I ESA was not conducted for this F4 Feasibility HTRW Survey Report. A brief AAI was conducted as part of the Corps’ previous F3 Feasibility Main Report for this project. This F4 HTRW Survey Report is instead based on summary results and information from the F4 HTRW AAI and recent information gathered from the State Water Resources Control Board (SWRCB) online “Geotracker” HTRW environmental database. The “Geotracker” website was accessed for this project as recently as May 2013.

Of additional note, ESAs are sometimes confused with Environmental Assessments (EAs) conducted in accordance with National Environmental Policy Act (NEPA). A NEPA EA is a brief evaluation of environmental resources and the potential impacts on these resources from a proposed action, used to determine whether such an action may have significant impacts and thus must be evaluated in a more comprehensive study, an Environmental Impact Statement (EIS). In the case of the current study, an EIS is being performed, and the information in this appendix will be used in the impact analysis in that EIS.

The HTRW survey only considers project-area HTRW impacts which are a recognized and known material threat to human health and the environment. These HTRW impacts surveyed are all CERCLA hazardous substances, RCRA hazardous waste and/or non-CERCLA petroleum product contaminants already released or have a material threat potential to be released within the study area land or on adjacent lands. The HTRW survey also considers those known properties, lands and businesses that are identified or regulated as having or generating hazardous waste or possessing or using hazardous substances or petroleum products that are in general compliance with CERCLA and RCRA laws. HTRW impacts are not intended to include those impacts that generally do not present a threat to human health or the environment. Additional details on the proper ASTM selection process and use are explained in more detail within Section 2.6 below, titled *ASTM Standards for Corps of Engineers Environmental (HTRW) Surveys.*

It is important to note that there may be <u>unknown</u> HTRW impacts to the study area which were not fully disclosed and listed from the set of known sites or properties found during the HTRW site search performed for this HTRW survey. This survey was prepared using the list of HTRW sites supplied as part of the previous 2009 F3 HTRW abbreviated AAI efforts and according to sites found on the latest online web update of the CWQB's Geotracker HTRW site listings specific to Los Angeles, California. <u>Unknown</u> HTRW impacts could also consist of newly discovered HTRW or buried historical type HTRW that is not observed on the land surface or not found from the list of known HTRW search sites. Newly discovered HTRW is sometimes encountered during the future construction phases of work for a typical Civil Works project. Also, newly discovered HTRW can sometimes be derived from residual (leftover) forms of contamination existing within the soils, soil vapor, air, surface water and groundwater media from known and listed HTRW sites. This occurs when undefined portions of the remaining known residual HTRW are encountered at known HTRW properties.

The most common way HTRW can have impacts is if it is released into the surrounding property environment and remains there and is a current material threat to human health or the environment. The most persistent HTRW is often found as residual forms of HTRW contamination in the soils, surface and groundwater of the surrounding land near the release. Except for soil vapor, HTRW found in air is not as common because releases of HTRW into air are usually instantaneous and do not linger for long around HTRW properties. Air contaminants in the form of soil vapor do linger for longer around HTRW properties and thus soil vapor is the most common medium where HTRW air contamination is persistent.

The HTRW survey analysis for this report focused on these types of releases into the adjacent property and environment within a 500 foot distance of the habitat footprint areas. The analysis does not include evaluation of hazardous materials stored or used at or near the study area. Generally, hazardous materials are not considered part of HTRW impacts, unless or until they have been released to the environment, at which point they would be considered a hazardous substance or waste, according to CERCLA and RCRA. Further details on how hazardous materials, hazardous waste and hazardous substances are regulated by law and addressed in this HTRW survey report are explained in the following subsections.

2.2 Hazardous Materials

Hazardous materials are the common chemicals and chemical products used for various reasons within the workplace. This use or safe use is specifically regulated by the Occupational Safety and Health Act (OSHA). The transportation of hazardous materials in commerce is also regulated, but by the U.S. Department of Transportation (USDOT). HTRW hazardous substances are found as chemical ingredients in many commonly used industrial and household hazardous materials, which are manufactured in the form of liquids, solids, gases and/or mixtures. Hazardous materials can be relatively stable and harmless to humans and the environment, but only if certain precautions are followed such as: proper use in accordance with directions and intended uses; proper storage; proper management; proper disposal; and control with the proper engineering, environmental and personal protective measures and/or equipment. Hazardous materials can be quite dangerous if any such precautions are not followed. Releases of HTRW from hazardous materials most often occur as a result of accidental leaks and releases to soil and surface water, etc. This is often caused by improper storage and disposal. Under these situations the releases become HTRW impacts. It is important to note that hazardous materials by themselves (in useable form or as properly used in the workplace) are not hazardous substances, nor regulated as such, until such materials are released to the environment. In such a case they would become a hazardous substance. In all cases, hazardous materials are not supposed to be released to the environment, unless it is properly permitted or regulated to do so, otherwise it is unlawful. The most common example of a lawful or permitted way that hazardous materials are released into the environment is by properly disposing of them as a hazardous waste into a landfill in accordance with RCRA procedures.

2.3 Hazardous Waste

Most hazardous waste in the U.S. is generated directly from the waste byproduct activities of active industries or businesses and is a regulated form of solid waste. This special type of solid waste must be managed, transported, labeled and disposed of in a manner far different from ordinary solid waste (garbage). Hazardous waste is defined and regulated under the Federal environmental law of the Resource Conservation and Recovery Act (RCRA)[1]. Its basic definition under RCRA is a solid waste (or combination of solid wastes) which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may: (1) cause or contribute to an increase in mortality or an increase in serious irreversible, or incapacitating illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. In addition, under RCRA, USEPA establishes four characteristics that will determine whether a substance or solid waste is considered hazardous, including ignitability, corrosiveness, reactivity, and toxicity. Any solid waste that exhibits one or more of these characteristics is classified as a hazardous waste under RCRA. In addition to the characteristic definition, a hazardous waste is also defined as that found on the hazardous waste list. This list is prepared by the USEPA where the hazardous wastes are found by common name, chemical name, etc. Any hazardous waste not found on this list could still be a hazardous waste according to its characteristics. Indeed most of the hazardous wastes disposed of in the U.S. are defined as characteristic type wastes.

Hazardous waste could become an HTRW impact if it is previously known to have been released onto properties or it is observed as being improperly stored or managed and e.g., shows evidence of leaking containers and of staining soil, etc.

2.4 Hazardous Substance

Hazardous substances are most often found on properties as a result of being released in the surrounding environment. The releases from properties often manifest in the form of pollutants or contaminants into the surrounding environment. Once released, hazardous substances become regulated and defined according to the Federal environmental law of CERCLA . Hazardous substances are regulated and defined in terms of those substances either specifically designated in a listed form as hazardous under CERCLA. They are also those hazardous substances identified under the other major federal environmental laws of RCRA and the Toxic Substances Control (TSCA), Clean Water and Clean Air Acts (CWA and CAA).

Hazardous substances thus could also become HTRW impacts if they were previously known to have been released onto properties, e.g., a known active or non-active CERCLA Superfund hazardous substance contaminated site or any other such related regulated site, e.g. such as a California State Regional Water Quality Control Board or Department of Toxic Substance Control hazardous substance contaminated site, etc.

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[1] 1 RCRA "hazardous waste": Hazardous wastes are usually generated by active commercial or industrial activities and may be classified as "listed" hazardous wastes or "characteristic" hazardous wastes by the EPA.

2.5 HTRW and the Corps of Engineers Civil Works Program

HTRW has implications across all programs within the Corps but affects the Civil Works program differently than other Corps programs, such as the military appropriated FUDS and Army appropriated O&M programs. HTRW issues at Civil Works studies and projects are addressed as outlined in ER 1165-2-1320. The ER states the Corps policy for addressing HTRW issues and outlines the timing and cost sharing requirements for HTRW encountered during the standard Civil Works project Planning, PED and Construction phases. Goals of the ER are to identify the level of detail for HTRW investigation for each Civil Works phase of the project, promote early detection and response by appropriate responsible parties, determine viable options to avoid HTRW problems, and establish a mechanism for resolution of HTRW issues. The Corps policy provides the following:

a. Civil Works project funds are not be used for HTRW related activities except as specifically stated in the policy or provided for specifically in law (see paragraph 6a, ER 1165-2-132).

b. The construction of Civil Works projects should be avoided in HTRW contaminated areas, where practicable. The Corps and project Sponsor will cost share environmental investigations to identify existence of HTRW (see paragraph 6b, ER 1165-2-132).

c. If it is not practical to avoid HTRW for a project, the Sponsor is responsible for ensuring that development and execution of HTRW response actions (CERCLA response) are accomplished at 100% Sponsor provided cost. The Sponsor is responsible for all costs associated with the required response (remediation) of any known or unknown HTRW contamination existing at the project throughout all of the Corps Reconnaissance, Feasibility, Planning, Engineering and Design (PED), Construction and Operation Maintenance, Repair, Replacement and Rehabilitation (OMRRR) programmatic project phases. The Sponsor is also 100% responsible for all costs associated with the required response plan, i.e. CERCLA remedial action plans. The Sponsor is also responsible for ensuring that response actions are accomplished in accordance with federal, state and local environmental laws. No in-kind project cost credit will be given to the Sponsor for these activities. The response action is determined during the investigation and study activities leading up to the actual response. The purpose of the cost sharing agreement and its timing are to ensure that all known HTRW is accounted for prior to construction as much as possible. This will ensure that quantities of known HTRW identified and to be removed from the project in areas that cannot be avoided are accounted for. This will further ensure a more accurate cost estimate for that HTRW identified as having to be remediated during the construction phase of the project (see paragraph 6c, ER 1165-2-132).

d. Costs for remediation and handling of contaminants not regulated under CERCLA will be credited to the Sponsor if the cost of these activities is required as part of a validly promulgated federal, state or local regulation (i.e. costs can be project shared for remediation of petroleum or natural gas pure product contaminants, etc. that are released at project properties). Petroleum related contaminants are typically regulated under Federal and State petroleum cleanup programs, i.e. leaking underground storage tank programs, etc. In such cases, the cost will be calculated in the economic analysis as the fair market value of the land considering the non-CERCLA contamination, and the cost of remediation will be a construction cost. Credit will not be allowed for both costs of the remediation and for the value of the land as if it were clean (see ER 1165-2-132).

The ER further provides that the Civil Works project must include the appropriate article in the Project Partnership Agreement (PPA) to address the Sponsor's responsibility for addressing hazardous substances. The Sponsor is encouraged to pursue recovery costs for investigations/studies and response from PRPs or RPs, as applicable, for all properties where unknown, known or potential HTRW contamination exists. The PPA between the Corps and the Sponsor does not limit the Sponsor's rights to recover any response costs.

In short, Corps policy is to identify HTRW issues early in the project process and avoid construction within HTRW-contaminated areas or properties, where practicable. Where impracticable to do so, the Corps will share the costs of survey to identify the existence and extent of HTRW, but any response or remediation activities required, including studies to determine the appropriated response are 100 % non-Federal costs and should be completed prior to construction. Although response costs are not cost shared, the presence of HTRW can affect alternative plan selection.

USACE's ER 1165-2-132, HTRW Guidance for Civil Works Projects is summarized in Section 2.5 above. This ER also outlines the timing and cost sharing requirements for HTRW encountered during the standard Civil Works project Planning, PED and Construction phases. The Corps will cost share for investigations and studies for known and unknown HTRW contamination, except for the response plan and the actual response throughout all Corps Civil Works programmatic project activity/category type phases. This is clearly shown below in Table.1 (page 5) from ER 1165-2-132:

TABLE 1

COST SHARING OF HTRW ACTIVITIES WITH
CIVIL WORKS PROJECTS AND STUDIES
ON NON-FEDERAL LANDS

HTRW ACTIVITY	PROJECT PHASE	COST SHARING
1. Environmental investigation to identify any existence of HTRW.	Reconnaissance	Reconnaissance
	Feasibility	Feasibility
	PED	Construction
	Construction	Construction
	OMRRR	OMRRR
2. Studies required for recognizing existence and extent of any HTRW, and studies required to evaluate alternative project plans.	Reconnaissance	Reconnaissance
	Feasibility	Feasibility
	PED	Construction
	Construction	Construction
	OMRRR	OMRRR
3. Development of a response plan for dealing with the HTRW. Includes studies and determine the appropriate response.	Any	100% Non-Federal (including responsible parties)
4. Response measures to relocate HTRW or to treat the HTRW in place.	Any	100% Non-Federal (including responsible parties)

NOTE: The costs for studing and remediating HTRW on Federally-owned lands will be assigned on a case-by-case basis.

2.6 ASTM Standards and Corps of Engineers Environmental HTRW Surveys

As stated in the HTRW introduction above, the Corps often utilizes ASTM standards and procedures in the performance of Environmental HTRW Surveys.

The ASTM Standard E-1527 was originally published in 1993. The purpose of the standard is to define good commercial and customary practice for performing ESAs of real estate parcels. The original purpose of an ESA was to satisfy the "Innocent Landowner" provisions of the CERCLA, thereby reducing the liability associated with taking ownership of property where hazardous substances or wastes are present. The ASTM Standard has been revised periodically since 1993 in response to changes in good customary practices and in response to changes or amendments the CERCLA in the form of Superfund Amendments and Reauthorization Act of 1986 (SARA); the Asset Conservation, Lender Liability, and Deposit Insurance Protection Act of 1996 (Lender Liability Amendments); and Small Business Liability Relief and Brownfields Revitalization Act of 2001 (Brownfields Amendments). The recent changes in the 2005 Standard are a result of the AAI requirements. The goal of the ASTM Standard is to determine if "Recognized Environmental Conditions" are present on the property being assessed. The term "recognized environmental condition" (REC) is defined in the standard as:".the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include de minimis conditions that generally do not present a threat to human health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be de minimis are not recognized environmental conditions." The AAI Regulations were developed to establish specific standards and requirements for investigating the prior ownership and historical use of a property in order to qualify for certain landowner liability protections to property owners under CERCLA.

3.0 F4 FEASIBILITY LEVEL HTRW SURVEY REPORT

The Los Angeles River Ecosystem Restoration project study area is very large in extent and the current land use is mixed residential and medium to light industrial. The land use history of the study area indicated that HTRW impacts would be moderate to heavy. This is because historic land use in much of the study area has been made up of densely compact residential, extensive infrastructure (construction of flood channels, bridges, railroads and major highways, airports and dams) and industrial (medium to heavy manufacturing/industry). From the late 1930s to the early 1950s the area was involved in heavy manufacturing of aircraft, automotive, as well as medium durable goods manufacturing. The heavy manufacturing use has given way to medium to light industrial use from 1960 to present.

There is plentiful evidence of historic operations involving HTRW from particularly intense industrial land use within the San Fernando Valley, plus light to medium industry and small service business adjacent to the study area. Much of the current larger HTRW impacts to the study area are due to pollution from the older heavy to medium aircrafts, durable goods and transportation industry. There are many numerous smaller HTRW impacts from contemporary light to medium industry and service businesses (i.e. gasoline stations, small businesses, dry cleaners, auto repair shops, etc). The sheer size of the study area was too large for a detailed site visit and interview of every property owner of every potential HTRW site that is known and listed from the previous F3 AAI summary of HTRW records, which was performed in 2005.

This AAI summary listing was gathered from the 2005 HTRW environmental database archive search of a mile wide corridor plot of the habitat study area. This search included all known Indian tribes, and state/local and federal government RCRA and CERCLA related environmental information and records. This archive was purchased by the Corps from Environmental Data Resources (EDR) Inc., one of several commercial clearinghouse retailers that sell HTRW archival database information for use in preparing Site Assessments according to the Standards. The EDR archive database was used to prepare an abbreviated AAI type of HTRW survey inquiry. This inquiry was part of the previous F3 Feasibility Main Report.

As most of the AAI inquiry database work had been partially completed beforehand and was not formally written, and because the number of HTRW sites within 1 mile to the study area is extensively large, the full ASTM Phase I ESA was not followed as the procedure for preparing this HTRW Survey Report. Instead, this F4 type HTRW Survey Report is a refinement of the original abbreviated AAI inquiry. It is a formal ASTM AAI report and is based on the HTRW summary results from the previous F3 AAI HTRW Survey and the "Geotracker" online website. An online inquiry was made of this website for recent and available online HTRW environmental records pertaining only to "active and open" HTRW properties near or within 500 feet of the habitat footprint of the study area. In addition, select listed active and open sites from the older 2005 AAI database search from within the 500 foot buffer were also included. The 500 foot buffer was chosen as a cutoff distance instead of a larger distance, i.e. one mile or more, for the HTRW environmental database listed properties, because this distance represents a reasonable search distance based on the land use history of the area and because most of the potential HTRW contamination risk to the project is from the list of HTRW impacted properties that are closest to the study area of concern. This HTRW search/inquiry did not specifically consider or target any particular one of the final array of habitat alternative footprint plans considered for this project. This AAI search and analysis includes all detailed alternatives considered for the project. As previously mentioned, only "active and open" HTRW listed properties within approximately 500 feet of the alternatives were considered as part of this HTRW Survey Report.

This approach is more useful and practical at this stage of planning, because it focuses on the latest known "active and open" HTRW site records listing from Geotracker and the older 2005 AAI database listings closest to the project footprints that are likely to pose the greatest HTRW risk or concern or human and environmental exposure to the study area. There are also "closed and inactive" HTRW sites listed as well, but these sites are <u>not</u> included in this survey, as HTRW contamination within them is considered by State, Federal and local CERCLA/RCRA regulatory authorities, as mitigated. This means these are "closed case" sites that require no further remedial

action because any residual HTRW contamination still present on these closed sites has been remediated to the extent that it is no longer a threat to the public health or environment.

After review of the previous 2005 AAI listing and the latest Geotracker website data search, any remaining listed HTRW sites (properties) of potential concern were judged as to their significance according to Recognized Environmental Conditions (RECs) for HTRW. Significant RECs or HTRW impacts for this project are those properties/sites that are routinely moved forward for recommendation for either a follow up ASTM Phase I or Phase II ESA HTRW survey. The Phase I ESA could include a further detailed site visit, property owner interview, and additional historical HTRW records search of files such as fire insurance maps, land title searches, historical topography and aerial photos, if available. The Phase II ESA site investigation is typically reserved only after conducting a full Phase I ESA. However, it could be implemented if RECs from the AAI screening are conclusively evident enough to preclude or skip the use of a Phase I ESA. In such case, the Phase II would involve additional steps of providing a field work plan and performing an actual environmental HTRW field site assessment. A Phase II site assessment would involve the collection and laboratory analysis of environmental samples to confirm the presence, extent and concentration of hazardous substances believed to have been released into the environmental media such as soil, sediment, groundwater, air and surface water.

3.1 Summary of F3 Feasibility AAI Summary Records and Geotracker Search Listing

Table 1 shows the 2005 AAI and Geotracker listings of all known CERCLA/RCRA type environmental records and data from potential HTRW sites or properties, with addresses that could be mapped within approximately a 500 foot distance of the habitat footprints. It contains those listings that are of significant HTRW impact to the project RECs, recognized environmental conditions or those impacts that are a material threat to human and ecological environment. The database search yielded a list of approximately 22 open and active environmentally regulated properties that are considered as having a potential HTRW impact to the project, i.e. they are all RECs. All of these 22 properties have had undergone previous HTRW investigations equal to or beyond the level of either an ASTM Phase I and/or ASTM Phase II (equivalent to a CERCLA PA/SI and RI/FS, etc.). Based on this survey, some of the RECs have more of a potential HTRW impact to the study project than others. 3 of the 22 are of a high HTRW impact to the study compared to the remaining 19. The 3 high HTRW impact sites are the one NPL Federal site (San Fernando Valley Superfund Site) and the two California State DTSC (Taylor Yard G1 and G2) regulated parcel sites, while the rest of the 19 sites are of low impact. The 22 impacted HTRW properties are shown in Maps 1 to 5 at back of this report.

Table 1 **Results of the HTRW Database Inquiry/Search for Mapped REC Properties Only**		
Database	**Brief Database Description**	**Records Found**
Federal Records		
NPL	National Priority List (Superfund) Database Listed: • San Fernando Valley Superfund Site (SFVSS) (**High Impact**)	1
State Records		
SWRCB	State Water Resources Control Board (Los Angeles Regional Water Quality Control Board) Listed: • San Fernando Consolidated Facility • Three Chevron Gas Stations • former Bortz Oil • Shell Gas Station • former Triangle Gas Station • former Hawkes Finishing • Mt Sinai (Forest Lawn) cemetery • former Albion Dairy • BNSF Tower • Valspar Corp • Chromal Plating & Grinding Co • Infinity Outdoor Co • Gannett Outdoor Systems Inc • MTA • Morton Intl Whittaker Corp • Union Pacific Railroad-Cornfield Yard	16
DTSC	California Department of Toxic Substances and Control Listed: • former Manufacture Gas Plant • former Manufacture Gas Plant • Bortz Oil • Taylor Yd G1 (**High Impact**) • Taylor Yd G2 (**High Impact**) • Union Pacific Railroad-Cornfield Yard (also listed as a SWRCB site, but only counted once)	5
	Total <u>Mapped and Listed</u> REC Records Found	**22**

The complete HTRW records data for the more than 1,400 properties listed from the F3 Corps Feasibility Report AAI HTRW environmental database search are not shown on this table. This is because the records shown in this Table 1 are only those from the list of environmental records that were found to have HTRW impact, i.e. “actual RECs”, at a distance of 500 feet from the habitat footprints.

Instead, these records are available as an electronic archive report within the Los Angeles District Corps of Engineers Planning Division (office) working files for this project. If needed, copies of this entire database can be made available upon request to the Corps study project manager, Ms. Kathleen Bergmann or the Corps Geotechnical Branch, POC: Mr. Jeffrey Devine (213) 452-3579.

Further discussion of the results, project conditions and recommendations for this HTRW Survey Report are found in the following sections.

3.2 Follow Up Identification of One Additional Potential High Impact HTRW Site at LATC Property

The Los Angeles Trailer and Container Intermodal Facility (LATC) is a modern railroad freight transfer yard, used for the intermodal (truck to rail and rail to truck) transport of semi-truck cargo containers. It is located at the southern end of the LAR study boundary. The address for this property is: Union Pacific Railroad Company Los Angeles Transit Center; 750 Lamar Street, Los Angeles, CA 90031. A portion of the LATC property, over 100 acres, is included as part of the habitat footprint of the LAR project. It makes up a large portion of the overall acreage of the project and is included in all alternatives in the final array. Currently, the LATC property is utilized for sorting and transfer of shipping containers to and from rail and truck transport modes. To facilitate these activities, most of the ground surface is covered with asphalt pavement. Additional improvements include rail sidings, container storage areas and loading and handling facilities. There are no maintenance facilities or similar buildings on this property, nor are there any activities that involve the use, treatment, or storage of large amounts of hazardous materials.

The AAI search conducted for this report indicated no HTRW concerns for the LATC property. That is, no records of active or open environmental regulatory CERCLA-related HTRW concerns for this property were found. The environmental records for this property listed a few minor regulatory actions, for small, one-time spills of hazardous materials from railcars unloaded at the property. The spills were remedied to the satisfaction of the local California environmental regulatory authorities, and no further regulatory action was required.

However, based upon the recognized past use of the LATC property, some concern remains regarding the potential for HTRW on the site. Evaluation of the 1955 historic USGS topographic maps of the Los Angeles area revealed the presence of a railroad maintenance yard at the LATC property. This yard is expressed as a cluster of elongated buildings centered about a railroad round table and is labeled “Union Pacific Maintenance Yard.” This map is included as Map 6 at the back of this report. This same map also showed similar facilities and labeling for the Taylor Yard property to the north. The map clearly shows that both properties, Taylor Yard and LATC, were railroad maintenance facilities until at least 1953. Historic topographic maps published after 1953 showed that the maintenance facilities at both properties had been removed.

The AAI search did not find that any Phase I or II site assessments, or other CERCLA investigations or actions have been conducted to date at the LATC property. As such, the actual presence of HTRW at the LATC property has not been confirmed. However, based on the similar land use history for the Taylor Yard and LATC properties and the fact that HTRW is known to be present at Taylor Yard, similar HTRW conditions to those at Taylor Yard may reasonably be anticipated at the LATC property. It is important to note that the historical maintenance activities

at Taylor Yard contributed to the majority of HTRW contamination at that site. Because LATC and Taylor Yard were in use at the same time, similar activities most likely occurred at these properties. Based on the historical similarities of these two properties, the LATC property is likely to contain similar HTRW contamination and is therefore carried forward as a REC.

Table 2 **Results of the Follow Up Discovery of LATC Property,** **Non HTRW Database Inquiry/Search and Non-mapped REC Description**	
Database or Source	**Records found**
• USGS Historical Topographic Map Database (online), 1953 USGS Topographic Map of Los Angeles, showing LATC	1
Total non-Mapped and non-Listed REC Records Found	**1**

4.0 SUMMARY OF THE F3 AAI AND GEOTRACKER DATABASE HTRW SEARCH SITES THAT ARE RECS AND THE NON-MAPPED REC OF LATC

The F3 AAI and Geotracker database inquiry/search results reported within this F4 HTRW Survey Report include 22 listed HTRW sites total (Table 1), plus one additional HTRW site (Table 2) that is a non-mapped REC. The total HTRW sites for this report are **twenty three**. All of these listed and mapped sites are RECs, because each property or site is still open and subject to State of California environmental regulatory enforcement by the Regional Water Quality Control Board, Department of Toxic Substances and Control, and/or the Federal U.S. Environmental Protection Agency, there has been a detected release of a combination of fuel, solvents (VOCs), metals, PAHs and related contaminants into the surrounding groundwater or soils from these sites, and residual contaminants still remain at the sites. The LATC site is a REC because of additional information obtained from the 1953 historical USGS topographic map of Los Angeles, which shows this property and Taylor Yard under use for similar purposes in the mid-20th century.

Of the 23 properties (sites), 3 are of high HTRW impact concern for the project study alternatives. These properties are the SFVSS, which is a widespread and pervasive HTRW contaminated groundwater plume, and the two Taylor Yard parcel G1 and G2 properties. These two properties are most heavily contaminated by HTRW in soils and soil vapor. The rationale for the 3 high impacts sites are as follows:

SFVSS: A very large release of solvent petroleum contamination exists within the surrounding groundwater from the one San Fernando Valley Superfund (SFVSS) site. This release is primarily a mapped groundwater plume of VOCs and metals that extend into a very large southern portion of the entire San Fernando Valley and run all along the east side of the Los Angeles River, which is where a large portion of the habitat footprint is planned, affecting project Reaches 1 through 6. This plume is shown on Figures 2 to 5 at the back of this report. It is currently being remediated by the USEPA via a large series of pump and treatment wells that are

strategically located amongst the plume. One such set of wells, the Pollock Well Field, is located approximately less than 1/2 mile northwest from the Taylor Yard G1 and G2 properties. The Los Angeles Department of Water and Power (LADWP) operates the wellhead treatment facility at Pollock. This treatment has been ongoing for approximately 10 years and has effectively stabilized much of the higher HTRW concentration impacted areas of the plume. Because of the existence of this facility and its ongoing operation, the EPA considers the Pollock Well Field as an adequate remedy for addressing the HTRW groundwater contamination in this area of the SFVSS site and has concluded that further remedy is unnecessary. Figures 2 to 5 show the extent of plume as of 2010, which shows the inner portions of the plume at higher concentrations than the outer portions. It is assumed that the plume will take some additional time (approximately 10 to 20 years) to further reduce in its size and concentration, as much of this depends on the ongoing treatment efficiency of the USEPA pump and treat response. For the purposes of projecting the impacts of SFVSS on the project, it is assumed that the plume will shrink over time, but may not likely be reduced in scale soon enough such that it would no longer impact the project properties closest to it before the construction phase begins. Therefore, it is assumed that the relative shape and concentrations mapped as of 2010 will be the same or similar during construction phase of the LAR Ecosystem project.

The Sponsor is responsible at 100% non- project costs for the response of any HTRW contamination for the SFVSS property that affects the construction activities for the restoration project. Dewatering during construction is the most likely activity that will be affected by the HTRW contamination in groundwater from this property. It is likely that this response will consist primarily of short term pump-treatment and disposal of treated discharge water on or near the study area. This is the most direct and effective remediation method. There are other remediation methods such as long term pump and treat and bioremediation/enhancement that are effective but require more time for cleanup, and therefore, are not suitable for the short time frame needed to construct the habitat. Requirements for disposal and discharge of HTRW contaminated groundwater will also have to be identified and complied with prior to determining the final pump type treatment technology for the contaminated water

It is important to note that the habitat footprint crosses mostly the outer edge of the SFVSS HTRW groundwater plume as shown on the maps at the back of this report. However, it is also likely that HTRW contaminants encountered could still have concentrations that are near or exceed those near the center of the plume." The final pump and treat remedy will be selected that addresses either likelihood.

Taylor Yard G1 and G2: The contamination at the G1 and G2 sites is a complex mixture of metals, solvents (VOCs), PAHs and fuels. Even though some contamination has been remediated by the RP, significant residual HTRW still exists at both of these properties. The contamination at G2 in particular is still very extensive and is a complex mixture of the aforementioned contaminants. An additional amount of it is scheduled to be remediated again in the future. However, some amount of residual contamination is planned to remain at G2 under the RP's remediation scenario. Both sites have had screening-baseline level human health risk assessment reports prepared. A screening-baseline level ecological risk assessment report was only prepared for the G2 site and not the G1 site. The planned amount of residual contamination leftover from the planned remediation at both these sites is such that it will satisfy primarily industrial human health standards. The habitat footprint for these two sites under the study alternatives is very large and includes coverage for 100% of these sites/properties. If the residual contamination is left on

these properties according to current conditions for land use, it will most likely not meet the future conditions for land use needed to meet the ecological or human health risk and exposure standards for land use of the restoration project. The Sponsor is responsible for 100% costs for the response of any HTRW contamination for these two properties such that it meets the future land use requirements for this LAR project. The Sponsor has committed to undertaking necessary remediation and providing "clean sites" prior to construction of the LAR restoration project. These costs would not be cost shared as part of the restoration project. It is likely that this response will consist primarily of excavation-removal- hauling efforts directed towards remediation of soil and soil vapors. This is the most direct and effectively remediation method. There are other remediation methods such as soil vapor extraction, bioventing, etc. that are effective but require more time for cleanup, and therefore, are not suitable for the short time frame needed to construct the habitat.

The rest of the 19 listed and mapped HTRW REC properties are low impacts to the restoration project because existing contamination is not as extensive or widespread and the habitat footprints are adjacent to and not within these REC properties. However, these 19 properties may still have HTRW impacts to a restoration project, because there is a possibility that future study project construction activities, especially dewatering, will encounter this residual contamination. It is likely that undefined portions of the known residual groundwater contamination at these properties could be encountered as wandering plumes and such. This is because groundwater contaminants of fuel, solvents and metals still exist as residual contaminants within the known/defined groundwater plumes at these 19 properties. This type of contamination is persistent and highly mobile. It is likely that there are remnant or relic plumes that may have migrated away from these properties, and are, therefore, likely to be encountered during project future construction activities.

The 22 known HTRW impacted properties are shown on Maps 1 to 5 at back of this report. The extent of the HTRW contaminated shallow groundwater for the SFVSS is shown on Figures 2 to 5 at back of this report. These figures show the extent of the Total Chromium, Hexavalent Chromium (metals), PCE and TCE (solvents) present within the upper approximately 50 feet of shallow groundwater for the end of year 2010, as reported by the USEPA.

LATC is one additional non-listed and non-mapped HTRW REC property that impacts the restoration project, because the extent and presence or existence of HTRW is unknown. The property has historic similarity with Taylor Yard, which is presently contaminated with HTRW, and is shown on Map 6 at the back of this report.

5.0 PROJECT CONDITIONS

5.1 Future Without Project Conditions

The RECs for the 22 properties/sites will continue to exist for the foreseeable future because:

- Remediation, monitoring, sampling and testing of the contaminants at most of these properties continues; residual contamination exists that is not yet safe to the public health and/or environment; the regulatory case files are still "open"; and the properties will continue to be managed under the authority of the appropriate California environmental regulatory agencies.

The RECs for the LATC property/site will continue to exist for the foreseeable future because:

- This property has a land use history similar to that of Taylor Yard, which is still heavily contaminated by HTRW. Information regarding the presence and extent of the HTRW contamination at LATC is unknown at this time.

5.2 Future With Project Conditions

The RECs for the 22 properties and the LATC will not continue to exist because:

- The HTRW impacts that now exist to the LAR study project are due to material threat of the undefined portions of the existing residual HTRW and contaminants that are likely to be encountered during construction of this project near the 19 low HTRW impact properties. The same impacts also exist for the 3 high HTRW impact properties due to the material threat of the defined portions of the existing residual HTRW, the contaminants that are highly likely to be encountered during future project construction activities, and because these 3 properties are directly within a large percentage of the habitat footprint needed for this project and cannot be avoided. The RECs (HTRW and contaminants) from these 22 properties will not exist in the future, because they will be properly addressed by the remediation (response) activities. The response for each property will be specifically tailored (site specific) to the final land use for each property. All response will be undertaken at 100% non-cost-shared costs by the Sponsor. As part of the cost sharing eligible portions of this project, these properties must be properly identified/investigated by both the Sponsor and the Corps prior to construction of this LAR study project. In addition, the strategy/purpose under each step for the investigation activities specific to each property must also be reviewed and agreed to by the local environmental regulatory agencies (either the DTSC and the LARWQCB, depending on the site). The extent of any of final response will be resolutely dependent on satisfying the specific land use for the LAR project and the human/ecological health risks specific to this project land use.

5.3 Current Conditions

- The Recognized Environmental Condition is: There is an existing HTRW impact to the project because as there is a potential for contamination to the groundwater and soils within a 500 feet distance of the habitat study area or directly beneath the habitat footprint areas.

6.0 GROUNDWATER CONDITIONS

6.1 Summary of Groundwater Conditions and Related Discussion

The groundwater throughout most of the project study area is best depicted as an unconfined aquifer. The upper surface of the aquifer is roughly coincident with the floor of the existing LAR channel. This aquifer contains both shallow and deep groundwater portions that differ in general water quality. The shallow portion extends from ground surface to approximately 100 feet below ground surface, while the deeper part extends from 100 feet below ground surface to approximately 200 feet. Both portions of the aquifer are co-mingled and are contaminated with known HTRW in the form of VOCs and Chromium metals. As previously discussed in Section 4.0, this groundwater contamination is officially known as the SFVSS, a Federal CERCLA Superfund site. It is being addressed through an ongoing response consisting of groundwater well pump and treatment that has been active for approximately 10 years. Because it is a Superfund site, the response is being conducted by Los Angeles Department of Water and Power and overseen by the USEPA.

The pump and treatment response for the SFVSS has captured much of the higher concentrations of the HTRW contaminants within the shallow groundwater aquifer. Lower and residual concentrations of contamination remain at the peripheral edges of the plume (see Figures 2 to 5 at back of this report). Portions of the existing LAR channel/levee were constructed with an open bottom, and the remaining concrete paved segments were equipped with subdrains and weep holes to relieve groundwater pressures. These devices provide a continuous open pathway for discharge of contaminated groundwater if it is present from the peripheral edge of the SFVSS into the LAR channel.

Much of the property required for this project will lay within or immediately adjacent to the SFVSS site. Due to the shallow, widespread and persistent nature of the SFVSS, it is likely that HTRW contaminated groundwater will be encountered where dewatering is needed for construction. Dewatering is temporary and will only be necessary where construction excavation extends beneath the groundwater surface. Any HTRW contaminated groundwater encountered during dewatering, either from the SFVSS or from a nearby local source, will be treated and disposed of in accordance with all local and California State water quality requirements. Unlike soil contamination, which can be remediated prior to construction, the widespread and persistent groundwater contamination associated with SFVSS cannot, from a time and economic perspective, be effectively addressed prior to construction. Addressing contaminated groundwater during construction, including treatment and disposal, will be the responsibility of the Sponsor at 100% non project cost.

Based on the data presented in figures 2 through 5, it is very likely that the edge of the SFVSS plume has in the past discharged, and is currently discharging, HTRW contaminated groundwater into the LAR channel, but at low levels given the progress of remediation. Due to the relatively limited nature of the proposed project features such as wetland and open bottom areas, it is anticipated that the magnitude of discharge from the SFVSS will remain roughly the same as current levels. Therefore, the presence of certain project features such as wetland and open bottom areas should not interfere or promote migration of this plume. The construction of restoration features should not significantly interfere with or alter the existing pathways of migration of contaminated groundwater beneath the Study area. As discussed above the upper surface of the aquifer is roughly coincident with the floor of the existing LAR channel. The position of the groundwater surface at any given time is a function of permeability and the quantity of recharge. The permeability of the alluvial deposits beneath the river is a fundamental physical property that cannot be altered or changed by construction of any of the proposed features. Recharge to the groundwater system is largely a function of weather and climate conditions which are not controllable. Therefore, the existing contamination plume associated with the SFVSS will not be impacted by implementation of the proposed restoration features.

In addition, the anticipated high HTRW impact properties, Taylor Yard and LATC, will largely be utilized to construct wetland and open bottom areas. These types of features have shown in the past to be beneficial and are known to naturally degrade HTRW contaminants. The presence of these particular features when combined with the ongoing groundwater well pump and treatment system should further reduce migration of HTRW contamination into the LAR after the project is completed.

Irrigation to initially establish vegetation within restoration features is not expected to adversely impact the existing groundwater system. This conclusion is based on the premise that sites will be free of soil contamination at the time of project construction; without soil contamination, any irrigation and subsequent infiltration is likely to have a beneficial impact on existing groundwater contamination. However, in keeping with good practices, irrigation should be limited to the extent necessary to establish vegetation and minimize infiltration, surface runoff and erosion. To this end, the habitat plans will include irrigation only to the extent necessary for plant establishment and survival.

Further details regarding the recommendations and costs for HTRW contaminated groundwater are mentioned in Section 9 below.

7.0 SUMMARY OF HTRW SURVEY REPORT

7.1 Extent of HTRW impacts

This appendix identifies 23 properties that are impacted by HTRW and contamination within 500 feet of the project footprint. Three of these properties are of high HTRW impact to the project. Nineteen are low impact. One is of unknown impact but has historic use characteristics similar to high impact sites.

The REC for 22 of 23 sites/properties exists based on the environmental database screening and record listing that still shows ongoing HTRW related remediation, monitoring, sampling, testing and residual contamination occurring at most of these sites. This residual contamination is not yet deemed safe to the public health and/or environment, according to environmental laws and requirements of the appropriate environmental regulatory agencies, and as a result, the individual HTRW property/site case files remain "open". From the record list, there is no listing of any of these 22 cases as having been closed. The residual solvent/metal contamination in the groundwater is pervasive in major portions of the shallow groundwater throughout the project study area, particularly at the SFVSS property. Dewatering of the shallow groundwater table that will occur during future project construction activities is highly likely to encounter solvent/metals HTRW contaminants that reside from the SFVSS groundwater plume. However, it is anticipated that low concentrations of contaminants will be encountered from this property during future construction dewatering activities adjacent or near it. This is because much of the habitat footprint alternatives are located on the outer edges of the SFVSS groundwater plume.

The REC for the one LATC property exists based on the historical similarities between this property and the Taylor Yard property, which is currently a high impact HTRW site with existing known amounts of heavy HTRW contamination. The presence and extent of the HTRW contamination at LATC is unknown at this time because it has never had cause to or has never before been formally investigated for the presence of HTRW. The full impact of HTRW at this site on this project will continue to remain unknown until such time a formal investigation is undertaken. Any HTRW impacts for LATC are assumed to be the same as that existing for Taylor Yard at this time. Further CERCLA type investigations and studies (PA/SI to RI/FS or ASTM Phase I to II steps) will need be undertaken before the impacts are ascertained fully.

The extent of the <u>undefined</u> portions of the known residual groundwater and/or soils contamination at all 23 properties is not known at this time. Only the extent of the known residual groundwater and/or soils contamination is currently being addressed. There is a possibility that future activities related to construction and maintenance of the habitat project will encounter portions of both known or undefined but known residual groundwater and/or soils contamination. In addition, the water discharge from these activities will need to be approved and permitted prior to release according to the Los Angeles RWQCB water quality standards and in a manner that is protective of both the existing groundwater and surface water resources in the area. This may involve a 401 certification, NPDES or waste discharge permits specific to the dewatering discharge method chosen for this project. Petroleum, solvent and metal related contamination exists within approximately a 500 feet distance to the habitat study area footprints and is, therefore, a material threat. This is a Recognized Environmental Condition according to the ASTM AAI standard and is in turn a HTRW impact to the Corps of Engineers Los Angeles River Ecosystem Restoration project study area.

7.2 Project related actions to be undertaken

The 3 properties of Taylor Yard G1 and G2 and the SFVSS are identified as HTRW impacted properties that <u>cannot</u> be avoided for any of the final array of alternatives selected for this project. Because of this, the Sponsor should begin coordination and consultation with the USEPA, appropriate California environmental regulatory agencies, and/or PRPs or RPs regarding investigation/studies and remediation activities for these properties. These negotiations will need

to be undertaken prior to their purchase and acquisition as part of this project. This should commence long before the formal project PPA for construction of this project is signed. Ideally this should begin now during the planning feasibility phase of this project, because much lead time is needed to complete environmental negotiations with the regulators for these two properties. The HTRW concerns for these properties to the project can be effectively addressed by further investigations/studies, reviews and analyses, along with selecting the most effective remediation methods. This should be done by early negotiations with the environmental regulators, along with developing a clear strategy that follows the CERCLA cleanup process. Because they are project cost sharing partners, both the Sponsor and the Corps will need to collaborate in these activities as well. Both the Corps and the Sponsor should also begin the strategy of and cost allocation sharing for the required HTRW investigation/study for remediation activities needed prior to land acquisition of these two properties.

The relative project costs for addressing the 3 high HTRW impact properties range from approximately **$2,575,000 to $6,825,000.** These are random order magnitude costs given for direct activities related to addressing the HTRW impacts and do not include Corps or Sponsor related supervision/administration and technical review costs. A major portion of this cost involves remediation related to future construction dewatering activities.

A more intensive ecological risk assessment needs to be performed for both the Taylor Yard G1 and G2 high HTRW impact properties in order to determine the impact that leftover residual contamination will have on the habitat and ecological system that is planned for these properties. In addition, the human health risk assessment should be further refined for these two sites and include risk calculations and analyses using the recreational/park human population planned uses for the habitat project. Only the industrial exposure for humans has been studied or made part of the current human health risk assessment performed by the current landowner/responsible party (Union Pacific Rail Road). The full impact to all human populations that will use the planned habitat area for recreation or park use still needs to be addressed and analyzed. This needs to be done in the form of a revised human health risk assessment in order to address the HTRW impacts to humans for the habitat park setting.

The 19 low impact HTRW properties may have HTRW impacts for the future construction dewatering activities. This is because there is a possibility that undefined portions of the known residual HTRW contaminated groundwater at these properties could be intercepted or encountered during dewatering. The Sponsor and the Corps should begin a strategy for addressing this possibility before the PPA and before construction. This can be accomplished by performing a limited groundwater review, investigation and study, along with a limited groundwater modeling exercise to help predict responses to future dewatering activities to this concern. The relative project cost for addressing the 19 low HTRW impact properties ranges from approximately **$750,000 to $1,500,000.** The low end range of cost involves a limited ASTM Phase II or CERCLA SI type study/investigation to ascertain the actual amounts/extent of undefined HTRW contamination that potentially exist for the 19 properties. The high range of cost is for remediation/monitoring/permitting in the event that a significant amount of undefined HTRW groundwater contamination is encountered during future construction dewatering activities. These costs are also for direct activities related to addressing the HTRW impacts and do <u>not</u> include Corps or Sponsor related supervision/administration and technical review costs.

There is insufficient information from the search/inquiry to determine the true extent or level of contamination, or severity of the HTRW impact that the entire 22 properties pose to the project planning activities. This is particularly the case for the 19 low impact HTRW properties. The recommended actions are to perform a more rigorous review of the available HTRW environmental reports or data case files of each of the 22 sites. The review would involve visiting and obtaining the files from the LARWQCB and DTSC for the listed REC sites. The review would also likely involve more intense discussions with regulatory agency personnel or scientists about the severity of the HTRW contamination at the 22 sites. A site visit to all 22 sites is also recommended to gain a clearer understanding of the nearby topography and features of each site. Until a more rigorous review of the Board files are performed, additional and more accurate planning recommendations such as whether future full Phase I or Phase II type ESAs are needed cannot be made at this time.

Approximate random order of magnitude costs are given for the assumed HTRW impacts for this project in Section 10 below.

7.3 Construction sequencing for cost efficiency

The response for excavation/haul/removal of HTRW contaminated soils at the high impact HTRW properties and any other HTRW impacted properties should stop after the final haul and removal that is required to clear all areas of these properties found to be impacted with HTRW. Areas leftover after excavation and free of HTRW, i.e. soils with contamination below the action levels (cleanup levels) specific to each property should <u>not</u> <u>be</u> <u>further</u> backfilled with fresh or uncontaminated soils or materials. Backfilling should be minimized to the freshly excavated ground surface elevations (grades). This finished ground should resemble an uneven hummocky surface with depressions where HTRW contaminated soils have been removed.

The sequencing of these events will reduce future construction costs associated with re-handling the clean filled areas devoid of HTRW, i.e. will reduce costs associated with double-handling of soils and materials used during final grading of project. This is expressed in Figure 1 below.

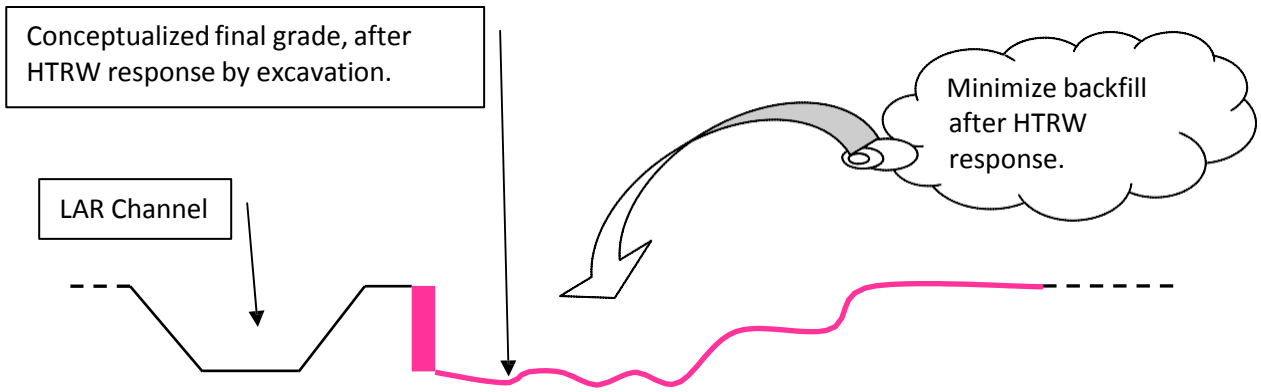


Figure 1 - Conceptual Grading of HTRW Sites

8.0 RECOMMENDATIONS

8.1 Additional Environmental Investigation

Additional environmental investigation will be required to characterize the distribution and chemical constituents of the contaminated soil and groundwater conditions throughout much of the feasibility area. The scope of these studies should be directed to the development of Remedial Action Plans that are ultimately approved by the local environmental regulatory agencies and compatible with the needs of the future restoration project. General recommendations are as follows:

a. To establish a rational basis for development of a work plan that will be approved by the local regulatory agencies; the initial phase of work should focus on a thorough review and evaluation of the publicly available data. In areas where a significant amount of environmental data has been compiled, such as the Taylor Yard properties, investigation will be limited to the extent necessary to establish criteria for evaluation of potential human and ecologic health risks. In areas where existing information is limited, such as LATC Yard, additional environmental investigation should follow industry approved protocols for conducting Phase I and Phase II investigations in compliance with regulatory requirements. For the 19 HTRW sites adjacent to the project footprint, a review and evaluation of existing Phase I documentation could be beneficial and should be considered.

b. The Sponsor should begin to take the lead on negotiations and coordination with the appropriate Federal and California state environmental regulatory agencies for the 2 high HTRW impact properties of Taylor Yard G1 and G2 and for LATC regarding specific investigation/studies and remedial activities for these properties. This needs to be done in order to more fully ascertain and identify the future CERCLA phases of work as well as their schedule and costs. The Corps will need to collaborate in these efforts as well.

c. An environmental scientist/toxicologist and the necessary additional Corps HTRW specialists need to be added as part of the Project Delivery Team. The toxicologist is a critical team member whose expertise is especially needed to review and provide technical input and recommendations for future CERCLA phases of work. This expertise is also needed to address the human and ecological health risks associated with future land use requirements.

8.2 Approach to HTRW Impacted Soil

All HTRW impacted soil within the project footprint must be remediated by the Sponsor to the requirements of the local environmental regulatory agencies, which include the DTSC and the LARWQCB, and be compatible with the future land uses for and needs of the restoration project. At this time, those areas with HTRW impacted soil to be addressed by the Sponsor are anticipated to be the Taylor Yard G1 and G2 sites and the LATC. The methodologies utilized to remediate HTRW impacted soils, regardless of their location, extent and degree of contamination must be compatible with the planned ecosystem restoration features. To preclude the adverse impact of contaminated soil leaching downward and further contaminating the shallow groundwater system, all contaminated soil should be removed from areas that are planned as wetlands, areas that will be

irrigated and areas that will be subject to erosion and infiltration of surface water runoff. Within areas where contaminated soil is remediated by removal and off-site disposal, the resulting excavations should not be filled with clean soil beyond the level of the planned ecosystem restoration grades. The Sponsor must complete remediation that is acceptable to the environmental regulatory agencies and according to the land use for the project selected final alternatives prior to restoration project construction at those sites.

8.3 Approach to HTRW Impacted Groundwater

Contaminated groundwater within the limits of the SFVSS site is on-going and is expected to continue for the foreseeable future. Localized groundwater contamination from remnant contamination at some of the 19 adjacent sites may also be encountered during dewatering activities. Contaminated groundwater encountered in excavations during construction and during dewatering operations must be treated and disposed of in accordance with the requirements of the local regulatory agencies. The persistent and shallow nature of the groundwater beneath the proposed restoration features, the widespread nature of the groundwater contamination, and potential impacts associated with local soil contamination make environmental cleanup of the groundwater prior to construction of the restoration features infeasible. As a result, it is anticipated that cleanup of contaminated groundwater will occur concurrently with construction of the ecosystem restoration facilities. It is recognized that the Sponsor will design, implement, coordinate and fully fund all treatment and disposal of contaminated groundwater encountered during construction. Dewatering and treatment operations should be designed so that they do not adversely impact the ongoing pump and treatment operations for the SFVSS at the nearby Pollock Well Field.

9.0 COSTS

A preliminary cost estimate was prepared for the 3 high impact HTRW properties within the project study area because they encompass almost 100% of the habitat footprint for the final array of alternatives selected for this study project. This is a random order of magnitude estimate and was also prepared as an aide to help determine the choice of the final project alternative. It includes a summary of the CERCLA/HTRW phases of work needed to complete investigations and studies leading up to the remediation, as well as the remediation itself. All costs are <u>direct</u> costs and are shown in the following table. The direct costs are given and are the costs for the actual investigation and response work needed to be performed in order to complete the HTRW response requirements for this study project. The required indirect costs for supervision and administration by the Corps and Sponsor, and inflation/escalation costs are not included. Costs shown in the table for investigations and studies, i.e. SI, RI to FS, etc., are eligible to be cost shared between the Sponsor and the Corps as part of the overall project costs. Costs shown in the table for the actual HTRW response, i.e. IRAP, RAP and Remediation or RA, are 100% paid for as a cost by the Sponsor. The HTRW cost estimate herein has been prepared as a separate cost for this feasibility study. This is the only HTRW cost estimate prepared for this project, and is a separate HTRW cost estimate that is not part of the overall parametric project costs shown in this project's general cost appendix. The current cost estimate provided in this report is considered sufficient for the feasibility phase and no update is needed or planned at this time. However, as the sponsor acquires properties impacted by HTRW and develops a response plan with the regulator and other relevant parties, the cost for response should be refined by the sponsor to more accurately account for actual site conditions.

Table 3 Preliminary HTRW Costs for 3 High HTRW Impact Properties			
CECRLA/HTRW environmental phase of work	HTRW property	Random Order Magnitude Total Cost	Rationale
Remedial Investigation = RI	Taylor Yard G1 and G2	$325,000.	Overall costs for RI through FS lower because both properties are assumed to be combined into single timed level of work effort throughout all of these environmental phases of work. Note: size of existing HTRW contamination is smaller than G2.
Revised human health and ecological risk assessment = HHRA & ERA		$125,000.	
Feasibility Study = FS		$225,000.	
Remedial Action Plan = RAP		$250,000.	
Remediation or RA		$1 million to $3.5 million.	Costs for remediation are conservative and difficult to determine at this time (during feasibility study). Actual remediation methods will depend on final land use and habitat project alternatives and negotiations with environmental regulators and current property owner (RP). None of these actions are yet fully developed. Accurate remediation costs are typically developed later on during commencement of the CERCLA FS.
Total Cost for Taylor Yard G1 and G2 = **$1,925,000 to $5,425,000.**			
Site Investigation and Remedial Investigation = SI/RI	SFVSS	$350,000.	These phases of work are combined and abbreviated because the assumed magnitude and complexity of unknown HTRW contamination/impacts to project properties is low (groundwater remediation is the only expected response action), and the timing is accelerated since most of this HTRW type will be encountered <u>during</u> <u>Construction</u> phases of dewatering. This abbreviated work activity is needed in order to stay within the Construction phase schedule of the project. This SI/RI work may <u>not</u> need to occur if IRA is accepted by regulatory agencies as substitute.
Interim Removal Action Plan = IRAP		$50,000.	Substitute for RAP. Will consist of general dewatering plans and CWA permitting actions/applications and coordination/approvals with LARWQCB.
Interim Removal Action = IRA		$250,000 to $1,000,000.	Conservative and based on large quantity of HTRW contaminated groundwater encountered w/shallow groundwater at random areas at properties and includes treatment prior to discharge or disposal. This phase is assumed to substitute in place of a formal Remediation with FS and will consist mainly of dewatering pump and treatment during Construction phase.
Total Cost for SFVSS = **$650,000 to $1,400,000 million; or $300,000 to $900,000 (lower cost assumes no SI/RI needed and can go directly to IRA).**			
Total Cost for all 3 High HTRW Impact Properties = **$2,575,000 to $6,825,000.**			

Table 4 Preliminary HTRW Costs for 19 Low HTRW Impact Properties*			
CECRLA/HTRW environmental phase of work	HTRW property	Random Order Magnitude Total Cost	Rationale
Remedial Investigation = RI or Site Investigation = SI	19 low HTRW impact properties	$350,000.	Overall costs for RI or SI.
Interim Removal Action Plan = IRAP		$50,000.	Substitute for RAP. Will consist of general dewatering plans and CWA permitting actions/applications and coordination/approvals with LARWQCB.
Interim Removal Action = IRA		$350,000 to $1,100,000.	Conservative and based on moderate quantity of HTRW contaminated groundwater encountered w/shallow groundwater at random areas at properties and includes treatment prior to discharge or disposal. This phase is assumed to substitute in place of a formal Remediation with FS and will consist mainly of dewatering pump and treatment during Construction phase.
Total Cost for all 19 Low HTRW Impact Properties = **$750,000 to $1.5 million; or $400,000 (lower cost assumes no SI/RI needed and can go directly to IRA).**			

*Note: Table 4 does not include HTRW costs for LATC as the extent and characterization of HTRW is unknown.

MAP FIGURES 1 TO 4: SHOWING EXTENT OF 2010 HTRW GROUNDWATER CONTAMINATION AT SAN FERNANDO VALLEY SUPERFUND SITE

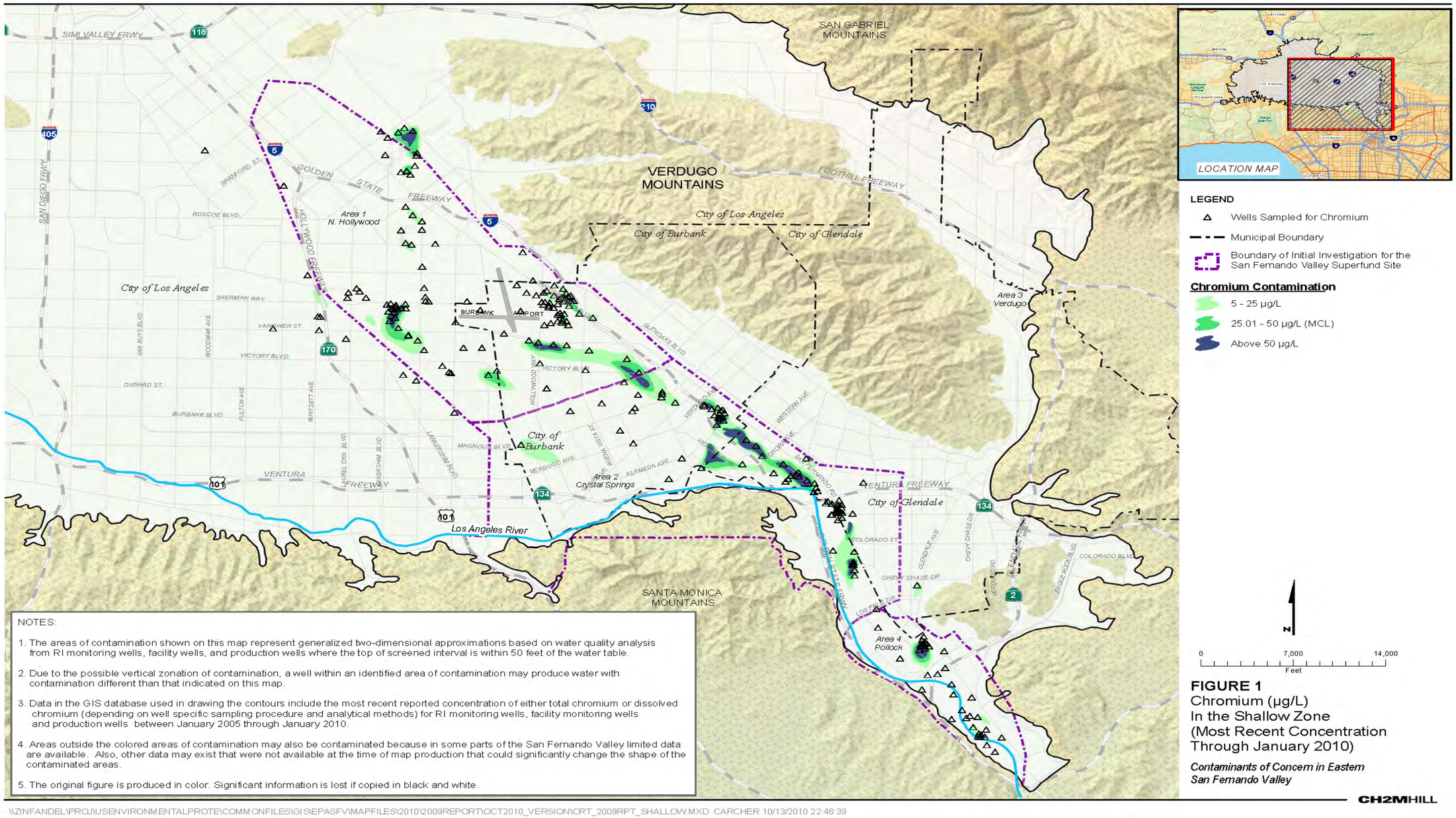


Figure 1. SFVSS/Total Chromium shallow groundwater contamination extent 2010. (from USEPA).

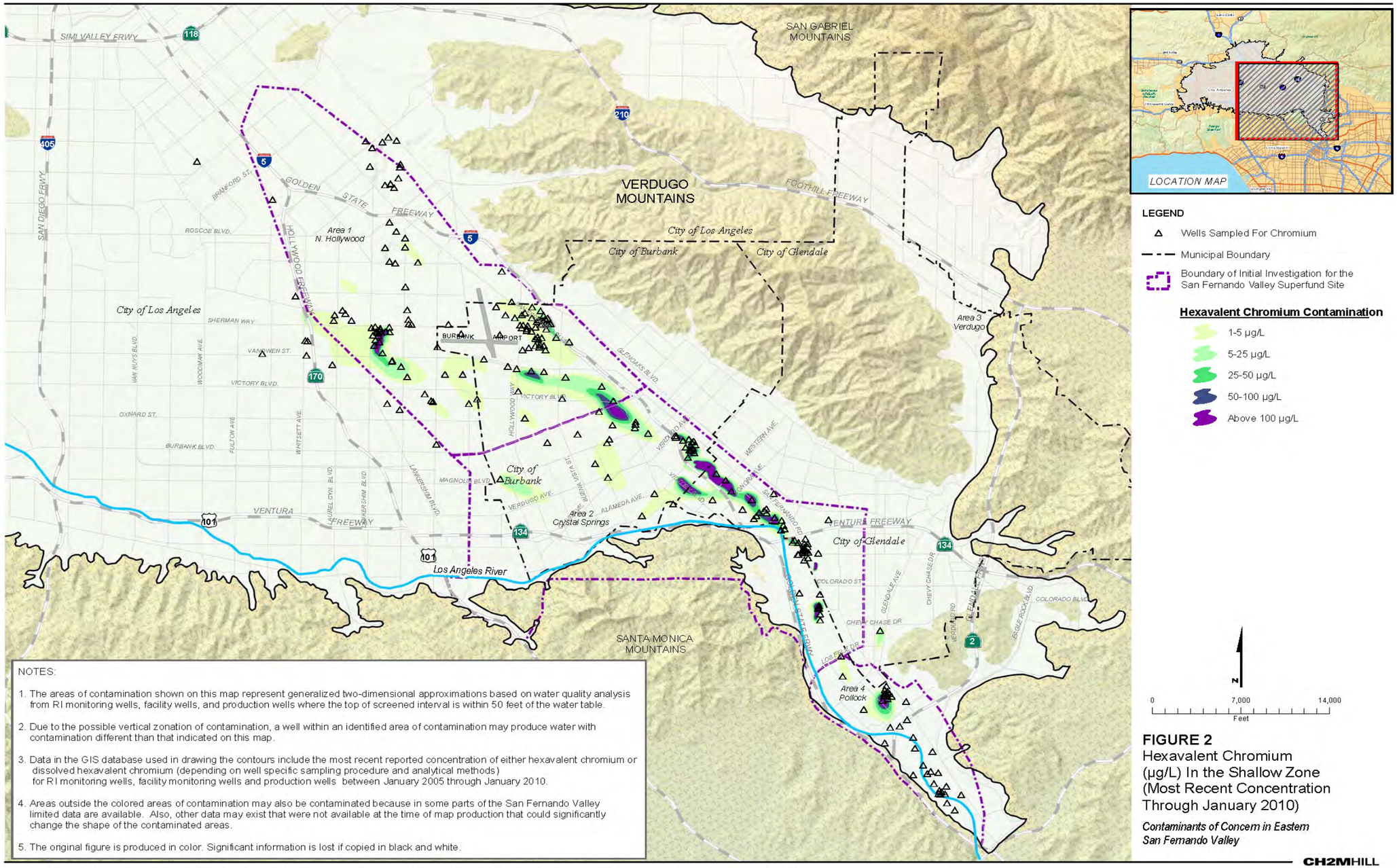


Figure 2. SFVSS/Hex Chromium shallow groundwater contamination extent 2010. (from USEPA).

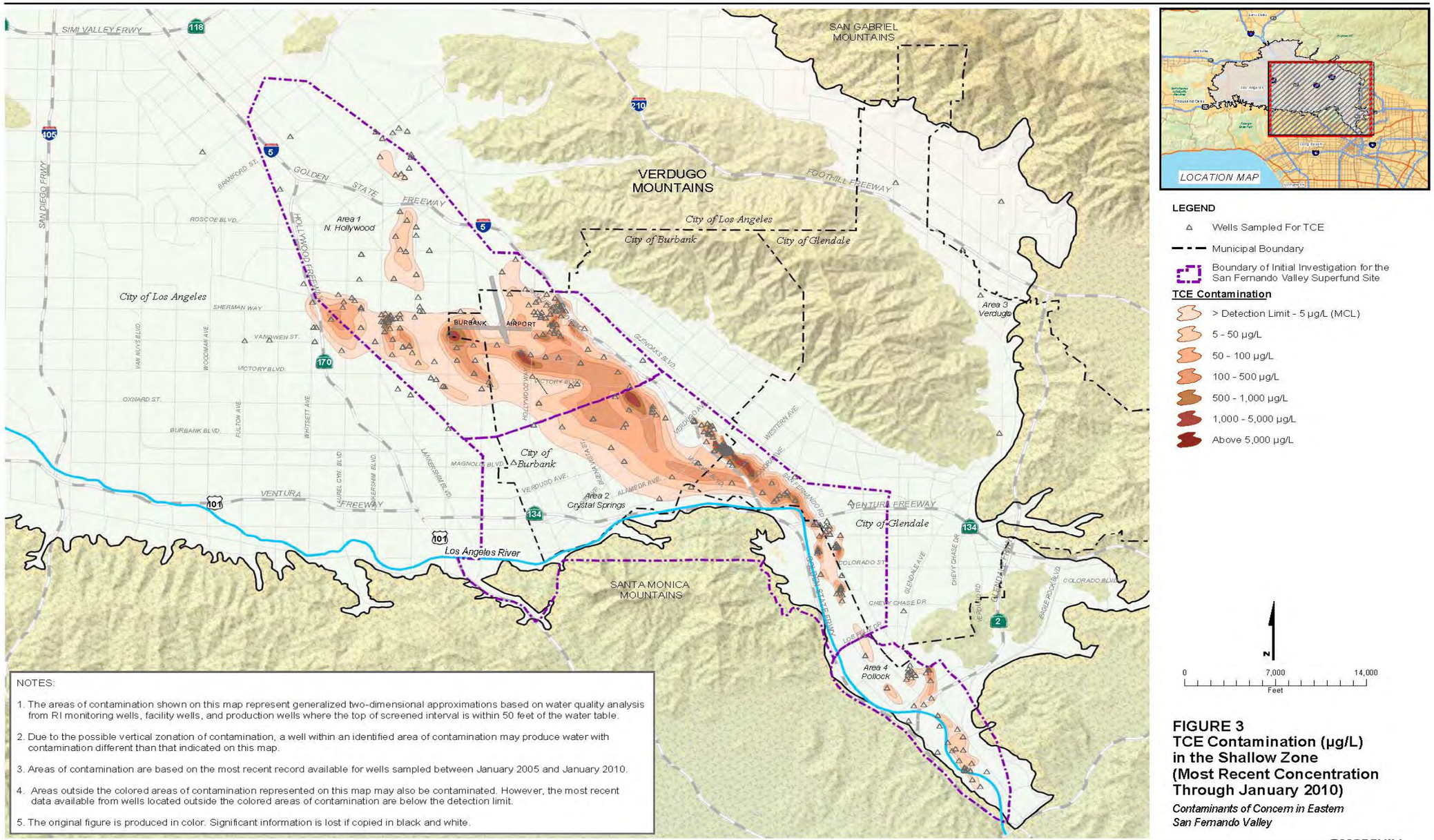


Figure 3. SFVSS/TCE shallow groundwater contamination extent 2010. (from USEPA).

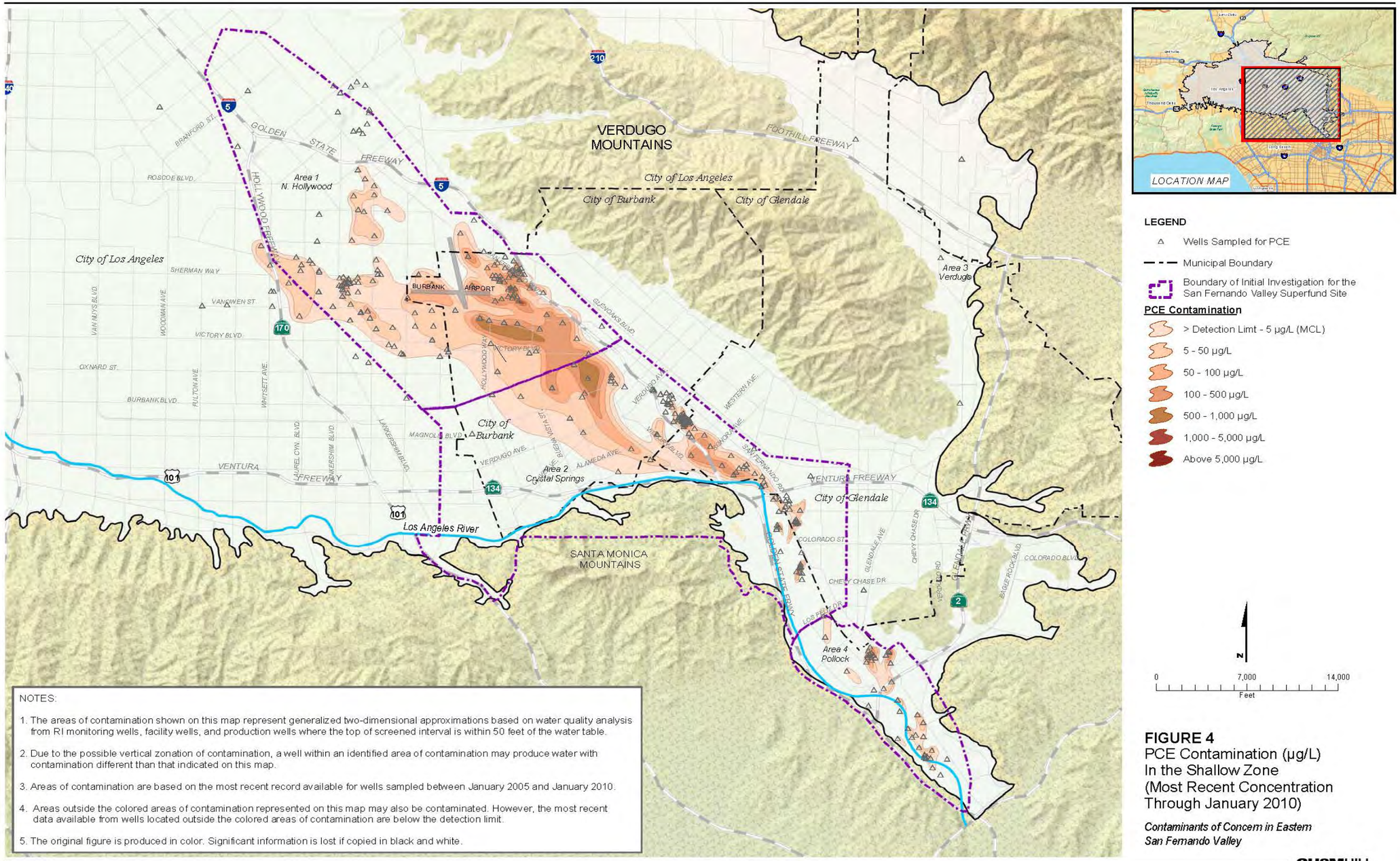
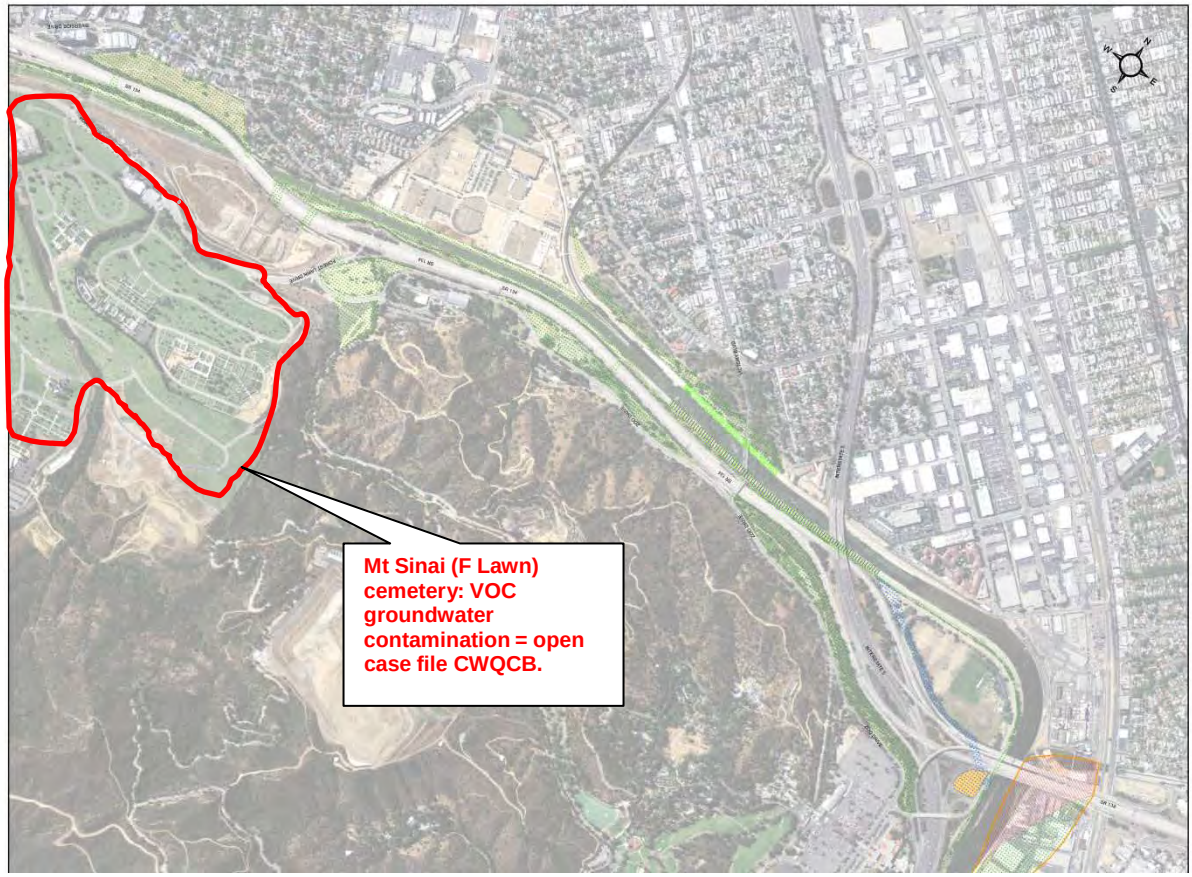


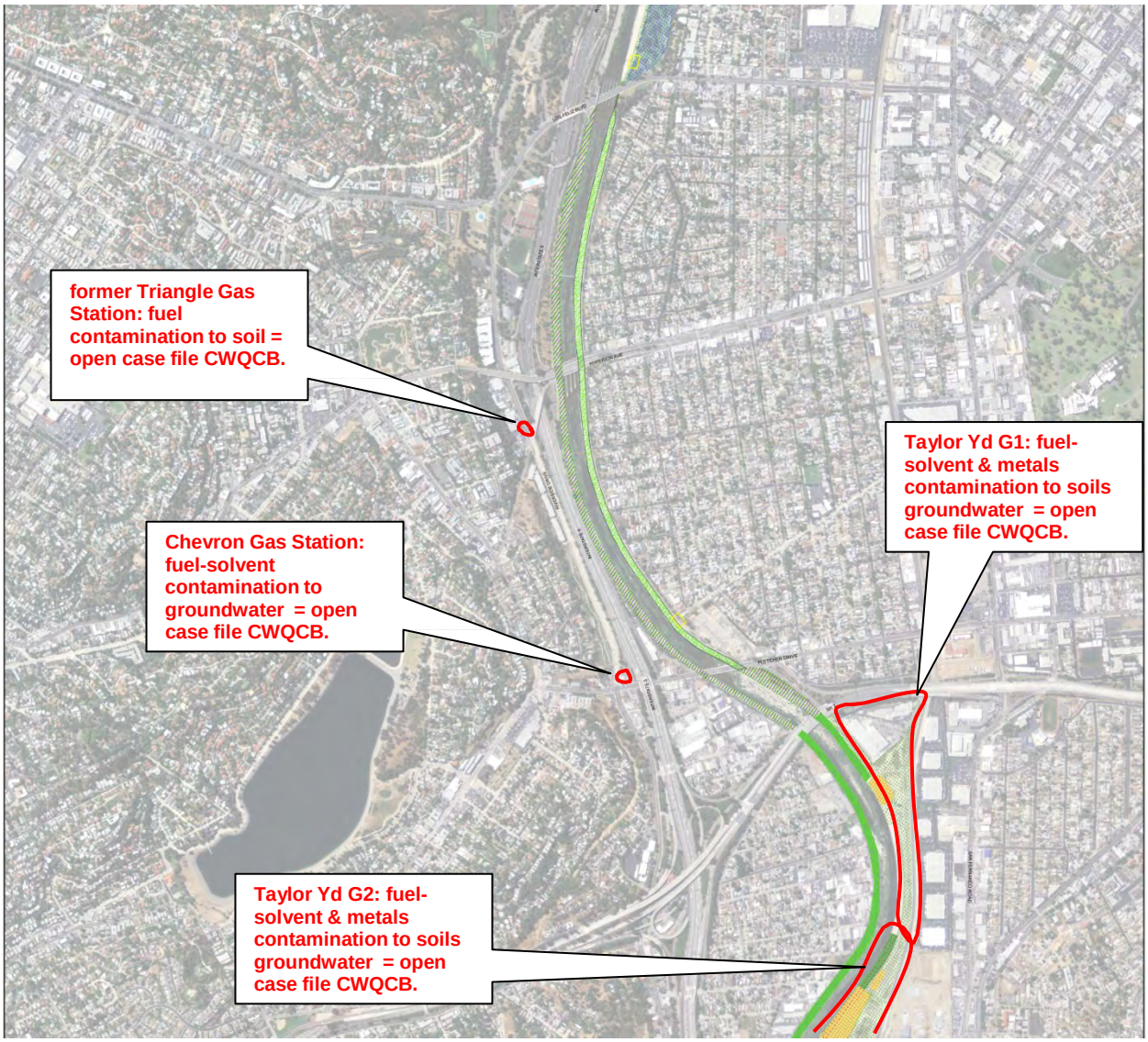
Figure 4. SFVSS/PCE shallow groundwater contamination extent 2010. (from USEPA).

MAPS 1 TO 5: SHOWING ALL 22 HTRW IMPACTED PROPERTIES MAPPED FOR LOS ANGELES RIVER ECOSYSTEM RESTORATION PROJECT

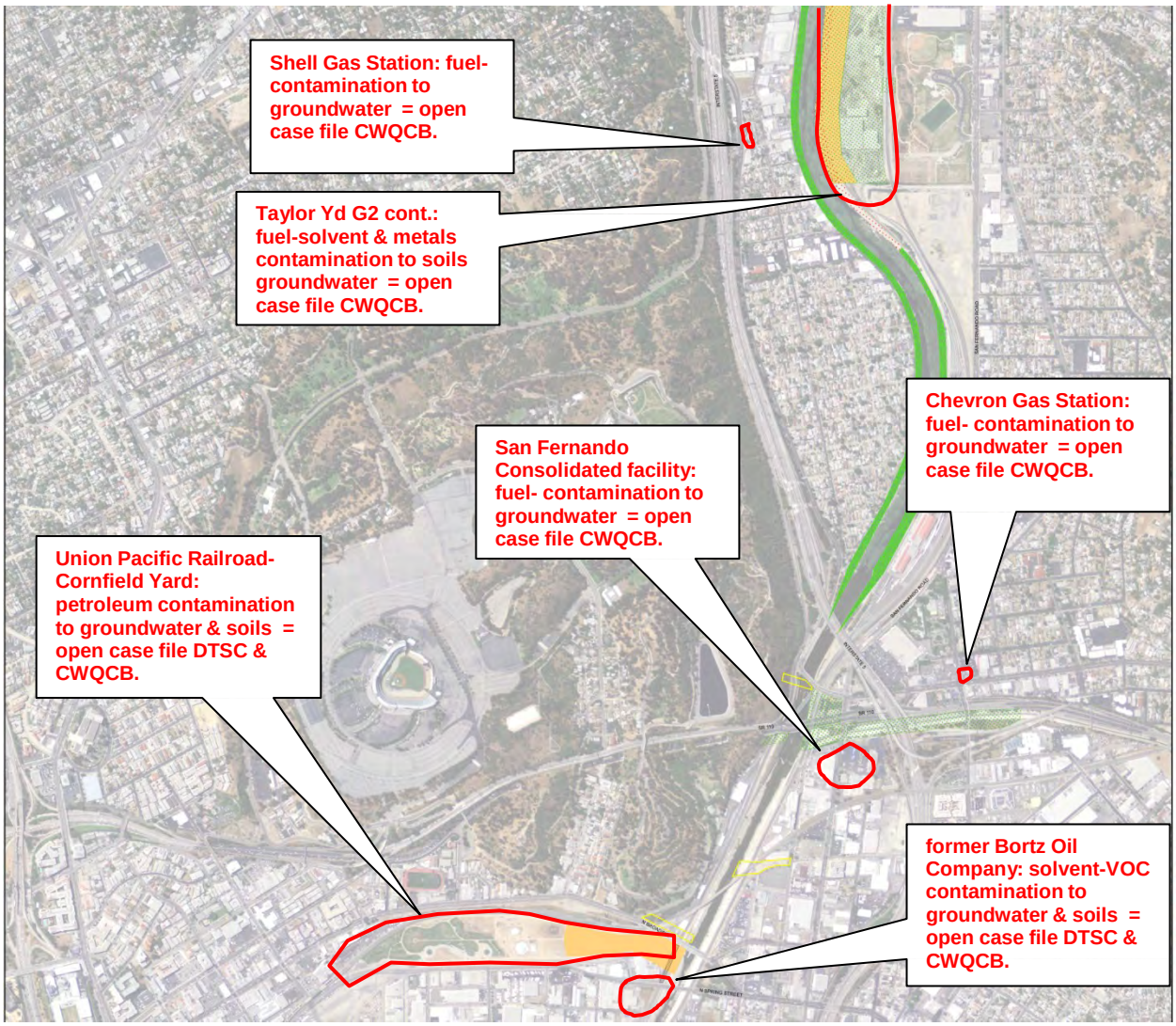


Map 1. Mt Sinai property, one of twenty two HTRW impacted properties.

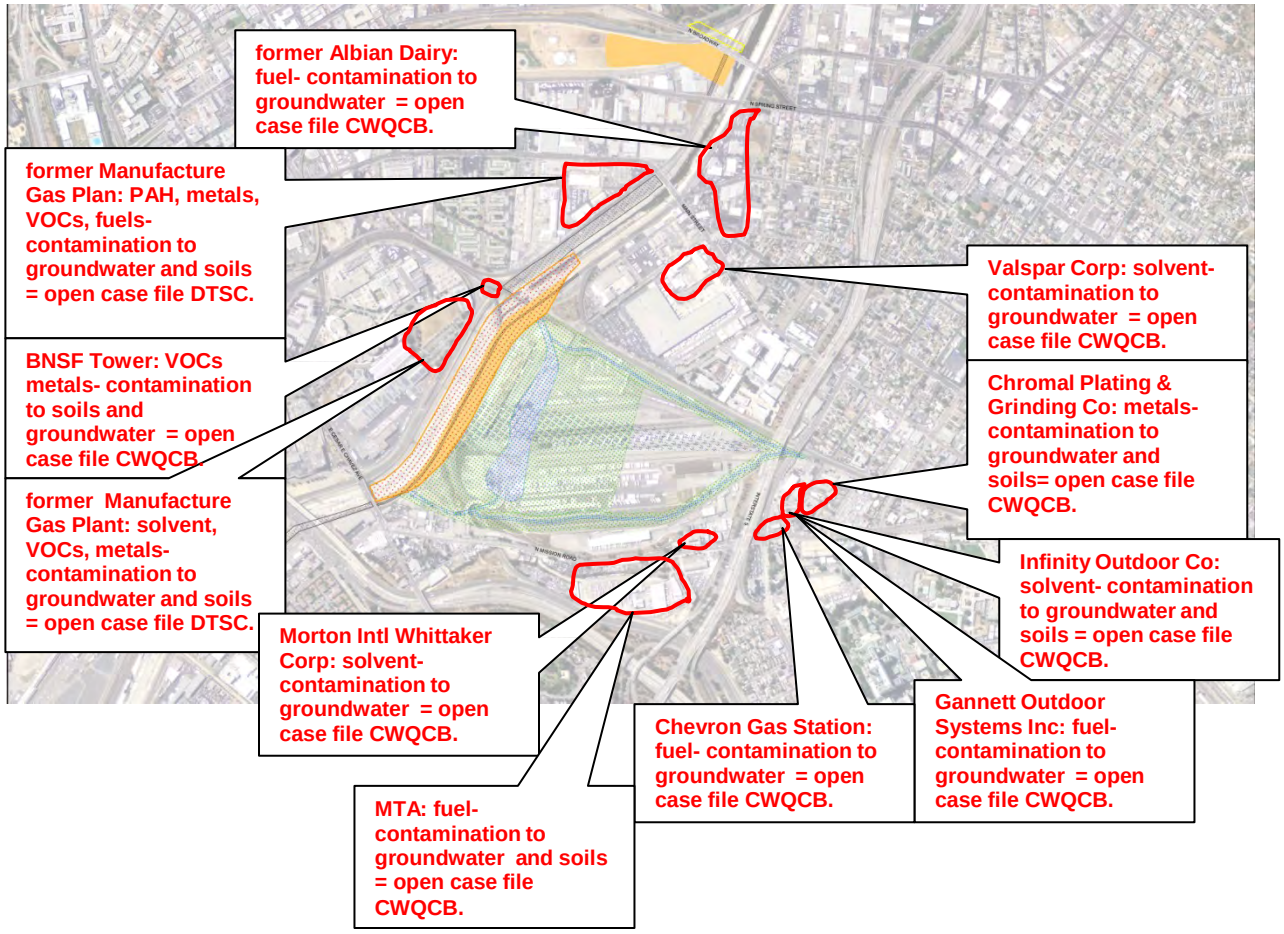
Map 2. former Hawkes Finishing property, one of twenty two HTRW impacted properties.



Map 3. Triangle Gas, Chevron Gas, Taylor Yd G2 and G2 properties, four of twenty two HTRW impacted properties.

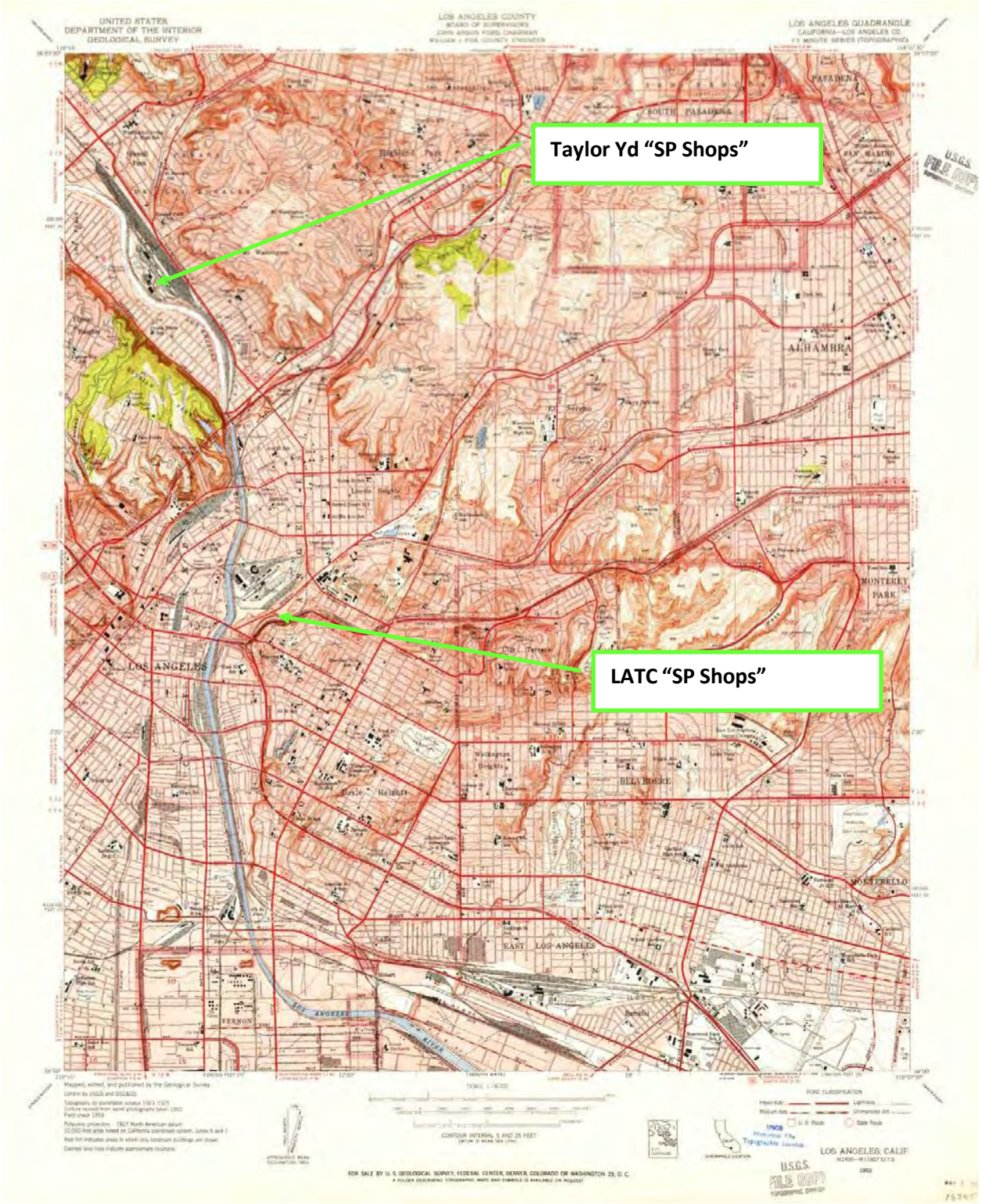


Map 4. Taylor Yd G2 cont., Shell Gas, Chevron Gas, SF Consolidated and Bortz Oil properties, four of twenty two HTRW impacted properties.

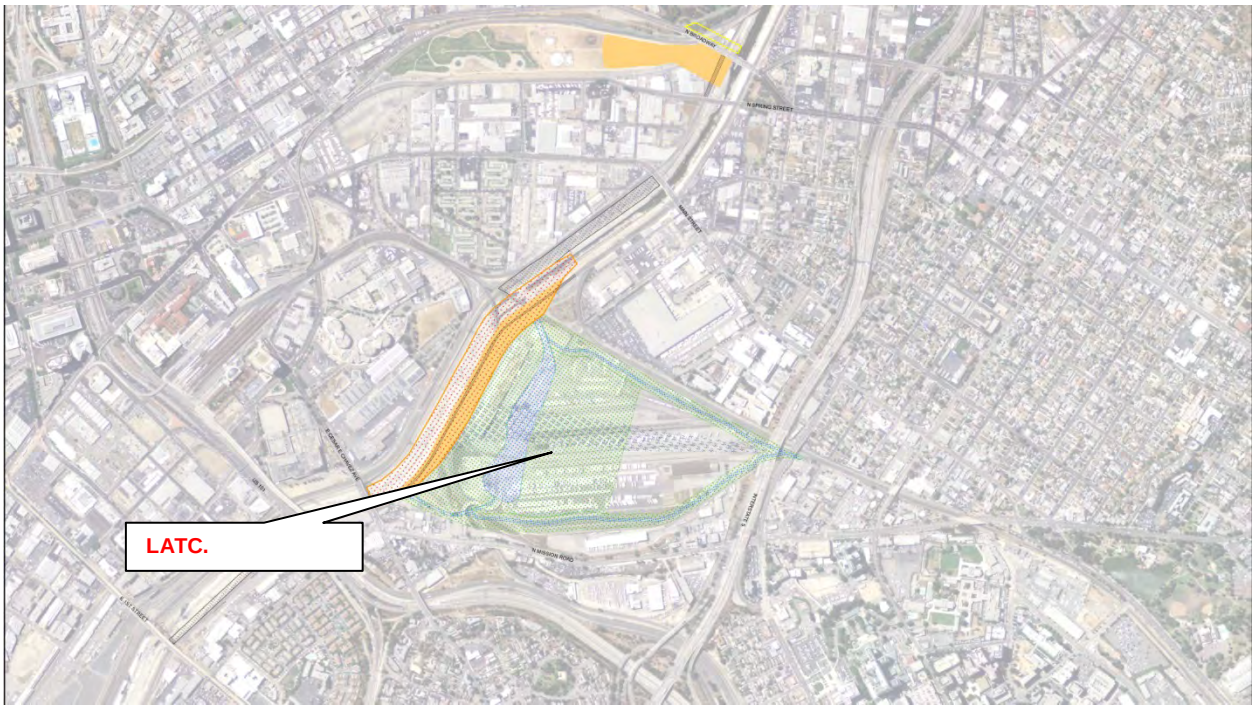


Map Figure 5. Albian Dairy, MFG plant, BNSF Tower, MFG plant, Morton Intl, Valspar Corp, Chromal Plating, Infinity Outdoor, Gannett Outdoor, Chevron Gas and MTA properties, eleven of twenty two HTRW impacted properties.

MAPS 6a and 6b: SHOWING 1 HTRW IMPACT PROPERTY OF LATC



Map Figure 6a. LATC & Taylor Yard, "SP Shops", 1953 USGS historic topographic map.



Map Figure 6b. LATC, one of twenty three HTRW impacted properties.

US Army Corps
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Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX M

Draft Clean Water Act Section 404(b)(1) Evaluation

September 2015

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Appendix M Draft Clean Water Act Section 404(b)(1) Evaluation

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1.0 Clean Water Act Section 404(b)(1) Regulatory Background

Section 404 of the Clean Water Act (CWA) governs the discharge of dredged or fill material into waters of the U.S. Although the Corps does not process and issue permits for its own activities, the Corps authorizes its own discharges of dredged or fill material by applying all applicable substantive legal requirements, including application of the Section 404(b)(1) Guidelines, 33 C.F.R. 336.1(a).

Under the Section 404(b)(1) Guidelines, an analysis of practicable alternatives is the primary tool used to determine whether a proposed discharge is prohibited. The Section 404(b)(1) Guidelines prohibit discharges of dredged or fill material into waters of the U.S. if a practicable alternative to the proposed discharge exists that would have less adverse impacts on the aquatic ecosystem, including wetlands, as long as the alternative does not have other significant adverse environmental impacts (40 C.F.R. 230.10(a)). An alternative is considered practicable if it is available and capable of being implemented after considering cost, existing technology, and logistics in light of overall project purpose (40 C.F.R. 230.10(a)(2)). The Section 404(b)(1) Guidelines follow a sequential approach to project planning that considers mitigation measures only after the project proponent shows no practicable alternatives are available to achieve the overall project purpose with less environmental impacts. Once it is determined that no practicable alternatives are available, the guidelines then require that appropriate and practicable steps be taken to minimize potential adverse effects on the aquatic ecosystem (40 C.F.R. 230.10(d)). Such steps may include actions controlling discharge location, material to be discharged, the fate of material after discharge or method of dispersion, and actions related to technology, plant and animal populations, or human use (40 C.F.R. 230.70-230.77).

Beyond the requirement for demonstrating that no practicable alternatives to the proposed discharge exist, the Section 404(b)(1) Guidelines also require the Corps to compile findings related to the environmental impacts of discharge of dredged or fill material. The Corps must make findings concerning the anticipated changes caused by the discharge to the physical and chemical substrate and to the biological and human use characteristics of the discharge site.

These guidelines also indicate that the level of effort associated with the preparation of the alternatives analysis be commensurate with the significance of the impact and/or discharge activity (40 C.F.R. 230.6(b)).

2.0 Basic and Overall Project Purpose

2.1 Basic Project Purpose

The basic project purpose comprises the fundamental, essential, or irreducible purpose of the proposed project, and is used by the Corps to determine whether a project is water dependent. The Section 404(b)(1) Guidelines state that if an activity associated with the discharge proposed for a special aquatic site does not require access or proximity to, or siting within, the special aquatic site in question to fulfill its basic purpose, the activity is not water-dependent.

The basic project purpose is aquatic ecosystem restoration. The activity is water dependent. See Section 5.5 of the Integrated Feasibility Report (IFR) for in-water construction required for all action alternatives.

2.2 Overall Project Purpose

The overall project purpose serves as the basis for the Corps' section 404(b)(1) alternatives analysis and is determined by further defining the basic project purpose in a manner that more specifically describes the goals and accounts for logistical considerations for the project, and which allows a reasonable range of alternatives to be analyzed. It is critical that the overall project purpose be defined to provide for a meaningful evaluation of alternatives. It should not be so narrowly defined as to give undue deference to the preferred alternative, thereby unreasonably limiting the consideration of alternatives. Conversely, it should not be so broadly defined as to render the evaluation unreasonable and meaningless.

As indicated in Section 1.1.1 of the IFR, the overall project purpose is to restore approximately 11 miles of the Los Angeles River (River) from Griffith Park to downtown Los Angeles by reestablishing riparian strand, freshwater marsh, and aquatic habitat communities and reconnecting the River to major tributaries, its historic floodplain, and the regional habitat zones of the Santa Monica, San Gabriel, and Verdugo mountain ranges while maintaining existing levels of flood risk management.

There is a secondary objective of the project to provide passive recreational opportunities consistent with the restored ecosystem, which is considered incidental to the overall project purpose and therefore not part of the overall project purpose under the CWA. There are no impacts to waters of the U.S. associated with recreation features corresponding to the restoration alternatives.

2.3 Study Area Description

There are eight geomorphically different reaches within the study area as shown in Figure 1 (see Section 2.2 of the IFR for additional information). 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. The reaches are described as follows:

- **Reach 1**: Reach 1 is the upstream segment of the study area and is approximately 1.5 river miles in length. In this reach the River's channel has a rectangular concrete-lined configuration with subdrains and no low flow channel.
- **Reach 2**: Reach 2 is approximately 0.75 mile in length. The bed transitions from concrete-lined to a cobblestone bed, and then transitions back to concrete. 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.
- **Reach 3**: This reach is approximately 1 mile in length. From upstream to downstream, the bed transitions from cobbles to concrete and back to cobbles. The channel in this area has a rectangular concrete configuration.
- **Reach 4**: This reach is approximately 1.75 miles long. 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. Sediment deposited in the channel has formed sand bars/islands, which are stabilized by the root systems of the many trees and other vegetation.
- **Reach 5**: This reach is approximately 1.55 miles long. The bed transitions from concrete under each of the large bridges to a trapezoidal channel with a cobblestone bed and grouted derrick stone banks between the bridges. Banks are toed-down with sheet pile and quarry run stone. 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.
- **Reach 6**: This reach is approximately 2.34 miles long. From upstream to downstream, the bed transitions from cobblestone 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. 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.
- **Reach 7**: This reach is approximately 1-mile-long. 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.
- **Reach 8**: This approximately 1-mile-long reach is a trapezoidal concrete channel approximately 30 feet deep.

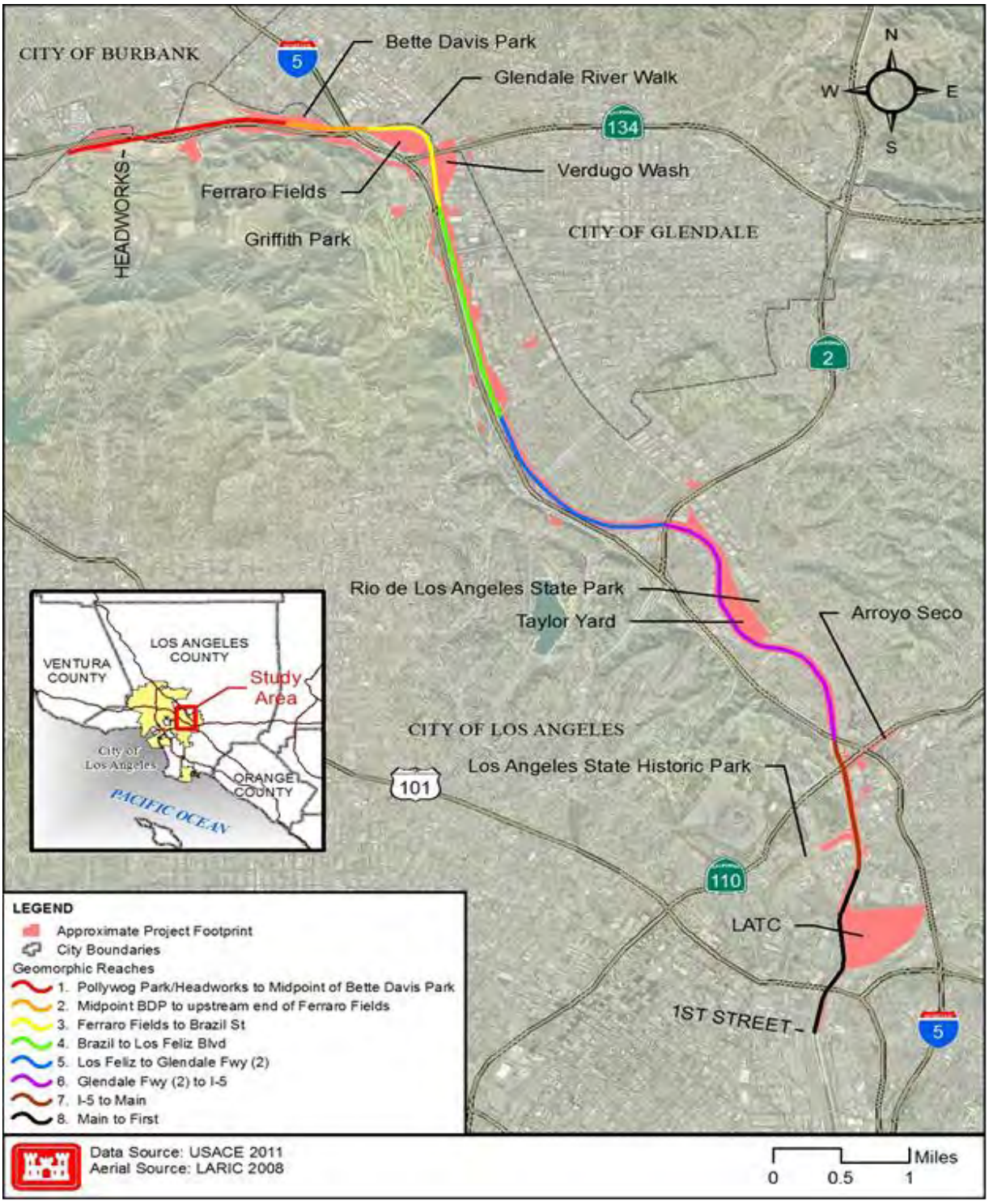

Figure 1: Study Area Reaches

2.4 Jurisdictional Determination of Waters of the U.S.

The study area encompasses 11 miles of the River and approximately 1,500 feet of the lower reaches of Verdugo Wash, Arroyo Seco Channel, and Burbank Western Channel.

Los Angeles River

In the 2010 Special Case Evaluation Regarding Status of the River, the U.S. Environmental Protection Agency documented the historical and current navigability of the River and deemed the River to be a Traditional Navigable Water (TNW), a water of the U.S. pursuant to 33 C.F.R. 328.3(a)(1).

In the absence of adjacent wetlands, jurisdictional limits in non-tidal waters of the U.S. extend to the ordinary high water mark (OHWM). When adjacent wetlands are present, jurisdiction extends beyond the OHWM to the limit of the adjacent wetlands. No adjacent wetlands were identified in the River study area. Wetlands within the non-concrete bottom portions of the River are located on sand banks and are variable, prone to changes in size and location depending on the severity of storm flows.

OHWM within the River was established by examining debris lines deposited on the trapezoidal embankments during and after storm flows. Based on a conservative interpretation of physical evidence, the OHWM is halfway up the embankment.

Arroyo Seco,Verdugo Wash, Burbank Western Channel

Per the 2008 joint U.S. Environmental Protection Agency-Department of the Army guidance implementing the Supreme Court's decision in the consolidated cases Rapanos v. United States and Carabell v. United States which address the jurisdiction over waters of the U.S. under the CWA, the agencies will assert jurisdiction over relatively permanent non-navigable tributaries of TNWs. A non-navigable tributary of a TNW is a non-navigable water body whose waters flow into a TNW either directly or indirectly by means of other tributaries. Non-navigable tributaries of TNWs are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g., typically three months). Relatively permanent waters do not include ephemeral tributaries which flow only in response to precipitation and intermittent streams which do not typically flow year-round or have continuous flow at least seasonally.

The Arroyo Seco Channel is a direct tributary to the River. Due to a high ground water table in unlined reaches as well as nuisance flows and runoff from golf courses, daily base flow ranges from 0.25-1 cubic feet per second (cfs). As such, flows are perennial. Arroyo Seco Channel is therefore a relatively permanent non-navigable tributary of a TNW, and a jurisdictional water of the U.S. pursuant to 33 C.F.R. 328.3(a)(5). No adjacent wetlands were identified. OHWM was established by examining the extent of concrete stains on the vertical wall. Based on the physical evidence, the OHWM is halfway up the vertical walls.

Verdugo Wash is a relatively permanent non-navigable tributary of a TNW. The wash is a direct tributary to the River, draining an urbanized area within the City of Glendale as well as the Verdugo Hills. Due to nuisance flows and runoff from golf courses, daily base flow ranges from 1-3 cfs. As such, flows are perennial. Verdugo Wash is therefore a relatively permanent non-navigable tributary of a TNW, and a jurisdictional water of the U.S. pursuant to 33 C.F.R.

328.3(a)(5). No adjacent wetlands were identified. Examination of available photographs does not indicate presence of concrete stains or other physical evidence of OHWM. Thus, based on the available evidence at Arroyo Seco, the OHWM is assumed to be halfway up the vertical walls.

The Burbank Western Channel is a relatively permanent non-navigable tributary of a TNW. The channel is a direct tributary to the River, draining an urbanized area within the City of Burbank as well as the Verdugo Hills. Daily base flow averages at approximately 10 cfs. As such, flows are perennial. Burbank Western Channel is therefore a relatively permanent non-navigable tributary of a TNW, and a jurisdictional water of the U.S. pursuant to 33 C.F.R. 328.3(a)(5). No adjacent wetlands were identified. Examination of available photographs does not indicate presence of concrete stains or other physical evidence of OHWM. Based on the available evidence at Arroyo Seco, the OHWM is assumed to be halfway up the vertical walls.

3.0 Alternatives Considered

3.1 Management Measures and Associated Discharges of Fill

Alternatives were formulated from a combination of management measures. See Chapter 4 of the IFR for additional information. This section describes the management measures and qualitatively characterizes the anticipated discharges of fill material associated with each management measure.

Daylight Streams

This management measure entails excavation of currently enclosed drainages in the historic floodplain of the River. Once excavated, the drainages would be naturalized in areas within the vicinity of their respective confluences with the River. Many of the enclosed drainages convey storm flows from the uplands into the River through existing storm water outfalls. Materials to be excavated/removed from the drainages include, but are not limited to, corrugated metal pipes and reinforced concrete boxes. Once excavated, the drainages would be graded, contoured, and planted with native riparian vegetation. In some cases, storm drains that are not being daylighted (naturalized) may need to be reconfigured or new outfalls constructed, due to other restoration work occurring in the vicinity. These activities may also result in discharges of fill material. Discharges of fill material into existing waters of the U.S. for all storm drain modification activities would entail placement of concrete for new outfalls, and would entail like-for-like replacement of existing outfalls. Temporary discharges of fill material would include potential placement of dewatering structures within the invert in the area of the outfalls.

Widen River and Tributaries

This management measure entails excavation of uplands behind the existing embankment, construction of a new embankment in the uplands, and removal of the existing embankment of the River, Verdugo Wash, or Arroyo Seco. The activity would require discharge of native substrate associated with grading in the vicinity of the existing embankment as well as temporary discharges of fill material for dewatering structures, such as k-rails, to divert water around the work area during construction; establishment of access ramps; and establishment of staging areas.

Creation of Side Channels

This management measure entails the excavation of new drainages in the uplands parallel to the River. Once excavated, the drainages would be graded, contoured, and planted with native riparian vegetation. The principal sources of hydrology could be storm water or existing flows from the River. Discharges of fill material into existing waters of the U.S. would be limited to discharges of fill material associated with the construction or reconstruction of concrete outfalls or construction of intake structures in the River. In many cases, the discharges would entail like-for-like replacements.

Vegetated Channel Walls

This management measure supplements the existing riparian vegetation in the River by attaching turf reinforcement mat, a pre-seeded turf matrix, to the existing sloped embankments of the River. The portion of the turf laid upon the sloped embankments would be anchored with

fasteners. The portion of the turf within the invert would be anchored with engineered rock keys. The work would also require the temporary discharges of fill material for dewatering structures, such as k-rails, to divert water around the work area during construction; establishment of access ramps; and establishment of staging areas.

Modify Channel Banks

This management measure would remove a portion of the upper sloped embankments of the River to create a two-tiered sloped embankment profile. It would include excavation to create basins or terraces that tie into the channel and adjacent topography. These modifications would have slopes at a 3 to 1 transition ratio or more gradual and be interspersed with freshwater marsh (retention basins) and riparian vegetation. In other cases, the trapezoidal embankments of the River would be replaced with a vertical wall to widen the channel. The work would also require the temporary discharge of dewatering structures, such as k-rails, to divert water around the work area during construction.

3.2 Alternatives and Impacts to Waters of the U.S.

The IFR evaluated an array of alternatives in Chapter 4. A number of alternatives were deemed impracticable due to costs while one would not have met the overall project purpose. Due to the need to maintain existing flood risk levels, several alternatives incorporated tunnels to divert flood flows around the study area. These alternatives were determined to be impracticable due to the approximately $1.5 billion cost of tunneling (see Section 4.10 of the IFR). Another alternative that would have widened the channel width by 3 to 5 times to accommodate a natural riparian river system was determined to be impracticable due to the approximately $7.6 billion real estate acquisition cost (see Section 4.10.1 of the IFR). One alternative limiting the ecosystem restoration to the Los Angeles County Drainage Area (LACDA) right–of-way (i.e., channel and bicycle paths) would not meet the overall project purpose (see Section 4.10.1 of the IFR). Chapter 4 of the IFR provides complete descriptions of these alternatives as well as discussions of alternatives considered but not carried forward for further analysis.

Subsequent to the application of measures to screen alternatives, four action alternatives (Alternatives 10, 13, 16, and 20) as well as the No Federal Action Alternative were further evaluated in the IFR, constituting a reasonable range of alternatives. Furthermore, after additional economic analysis, a more cost effective variation was identified for one alternative; this variation alternative, known as Alternative 13v, is identical to Alternative 13 except in Reach 7, where it includes restoration measures in Reach 7 identical to those proposed under Alternative 20. Specifically, the Reach 7 plan in Alternative 20 includes the three daylighted streams in the Reach 7 plan from Alternative 10, the Arroyo Seco softening and backwater wetland creation from Alternative 13, and adds restoration of wetland habitat at the Los Angeles State Historic Park (LASHP) along with terracing of the right bank of the channel adjacent to the LASHP.

No Federal Action

Under the No Federal Action alternative, none of the proposed management measures would be implemented. The Corps would continue to maintain the channel for flood risk management purposes, but would not seek to restore habitat values. There would be no impacts to wetlands or

other waters of the U.S. from restoration activities as none would occur. Channel maintenance activities would continue to include vegetation and sediment removal as funding allows.

Alternative 10

Alternative 10 is called the ART (for ARBOR Riparian Transitions) as it provides some restoration in all reaches and provides transitions or connections between existing riparian corridors and concrete lined river reaches. In Reach 1, it establishes riparian corridors along the overbanks of both sides of the River channel, improving potential wildlife connections from the river to the Headworks study site and the Santa Monica Mountains. It also restores riparian habitat at the Pollywog Park Area of Griffith Park and along the left overbank of the Burbank Western Channel. In Reach 2, the plan continues the establishment of the riparian corridor along the overbank on both sides of the River, with habitat connections to the Santa Monica Mountains. In Reach 3, it continues the riparian corridor on the right side of the River along Zoo Drive and daylights and restores riparian and freshwater marsh habitat at three streams currently encased in culverts, two on the east side of the River and one on the west side. In Reach 4, it establishes a riparian corridor on the left overbank, creates a side channel at the edge of Griffith Park Golf Course with inlet and outlet to the River under I-5 on the right bank, lowers a portion of the Los Feliz Golf Course on the left bank of the River to allow seasonal flooding through existing culverts, and daylights eight streams. In Reach 5, this alternative continues the riparian corridor on the left overbank and includes a daylighted stream at the downstream end. In Reach 6, it widens the channel approximately 80 feet along Taylor Yard, restores riparian habitat in the widened area and overbank, and creates a small terraced area in the Bowtie parcel. Restoration is continued in Reach 7 with three daylighted streams. In Reach 8, at the LATC site, it restores a historic wash and riparian habitat. This restoration would allow flows from the ephemeral wash to enter the River through existing culverts under the railroad lines. In addition to the specific features outlined above, this alternative removes invasive vegetation throughout the restoration features and within the River and tributary channel bottom throughout the project footprint. Table 3-1 below details measures that either fill waters of the U.S. or create new waters of the U.S. In total, Alternative 10 would discharge fill material into approximately 4.63 acres of waters of the U.S. Permanent fill material would be discharged into 4.52 acres. Dewatering structures would temporarily discharge fill material into 0.11 acre. Alternative 10 would establish approximately 56 acres of new waters of the U.S.

Maintenance of ecosystem restoration features would be conducted under this alternative by the City of Los Angeles, the non-Federal sponsor. Maintenance in general would include removal of invasive species throughout the project footprint, including the River and tributary channel bottom; repair and replacement of irrigation pipes and sprinklers; maintenance of constructed trails, terraces, and viewing areas; trimming of native vegetation; removal of trash and accumulated sediment; graffiti abatement; vector management; and like-for-like structural repair. Project areas subject to invasive removal include the channel bottom of the River, Verdugo Wash-River confluence, Burbank-Western Channel-confluence and short distance upstream, and the Arroyo Seco-River confluence as well as constructed restoration features. The Corps would continue to be responsible for maintaining all other aspects of the portion of the LACDA project that overlaps with the restoration project footprint.

Maintenance activities within waters of the U.S. may require use of excavators, backhoes, or grapple trucks for removal of trash, debris, and sediment. Maintaining design grades, elevations,

contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases, there may be discharges of fill material associated with the use of earthmoving equipment such as bulldozers within newly established waters of the U.S. Impacts would be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges of fill material into waters of the U.S. However, temporary or permanent discharges of fill material would not decrease the amount of newly established waters of U.S. Invasive species in the River and tributary channel bottom within the study area would typically be removed by hand tools. Thus, the activity would not result in discharges of fill material in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, impacts would be temporary and there would be no loss of waters of the U.S.

Table 3-1 Alternative 10 – Summary of Fill Material in Existing Waters of the U.S. and Establishment of New Waters of the U.S.

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
3. Ferraro Fields area of Griffith Park	Daylight Streams	5	None: activity is occurring in overbank area outside of existing waters of the U.S.	NA	NA	NA
4. Griffith Park	Daylight Streams	9	None: activity is occurring in overbank area outside of existing waters of the U.S.	NA	NA	NA
	Side Channel	1	None: Removal of materials at inlet and outlet connections	NA	(200 CY)	0
			Backfill as needed to create stable inlet and outlet	Perm.	100 CY	.02
			Install k-rails or sandbags	Temp.	220 linear feet (LF)	0.01
5. Riverside Drive	Daylight Streams	1	None: activity is occurring in overbank area outside of existing waters of the U.S.	NA	NA	NA
6. Taylor Yard	Modify Channel Banks/Widen Channel	12	None: Excavate embankment to channel bed to within the waters of the U.S.	Perm.	(145,381 CY)	0
			Backfill with clean topsoil	Perm.	8,066 CY	4.5
			Install k-rails or sandbags	Temp.	4,224 LF	0.10
7. Arroyo Seco	Daylight Streams	3	None: activity is occurring in overbank area outside of existing waters of the	NA	NA	NA

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
			U.S.			
8. LATC	Restore historic wash	25	None: activity is occurring in overbank area outside of existing waters of the U.S.	Perm.	NA	NA

Alternative 13

Alternative 13 is named ACE (for ARBOR Corridor Extension). Alternative 13 has the same restoration features as Alternative 10 in Reaches 1, 2, 4, 5, and 8 and provides additional restoration in Reaches 3, 6, and 7. In Reach 3, in addition to the measures identified in Alternative 10, this alternative would create a side channel entering upstream from the River behind Ferraro Fields and re-entering the River at the downstream end of the reach. In Reach 6, this alternative widens the river channel by over 300 feet into Taylor Yard with restoration of the floodplain and freshwater marsh in the widened channel. It also creates a backwater wetland at the Bowtie parcel, and it restructures the left bank upstream of the backwater wetland and downstream of Taylor Yard, as well as the entirety of the right bank, in this reach with implanted vegetation. In Reach 7, this alternative restores a portion of the Arroyo Seco tributary and makes nodal connections on the left side of the River to the Arroyo Seco watershed. This is accomplished through softening of the bed and banks with development of a riparian corridor in the tributary confluence and for one half mile upstream. The Arroyo Seco restoration supports connections through the River from the Santa Monica Mountains to the San Gabriel Mountains. Instead of the daylighted streams included in this reach in Alternative 10, this alternative lines the banks of the River downstream from the Arroyo Seco with overhanging vines and implanted vegetation. In addition to the specific features outlined above, this alternative removes invasive vegetation throughout the restoration features and within the River and tributary channel bottom throughout the project footprint. Table 3-2 below summarizes the measures that either fill waters of the U.S. or create new waters of the U.S. In total, Alternative 13 would discharge fill material into approximately 27.51 acres waters of the U.S. Permanent fill material would be discharged into 26.84 acres. Dewatering structures would temporarily discharge fill material into 0.67 acre. Alternative 13 would establish approximately 86 acres of new waters of the U.S.

Maintenance of ecosystem restoration features would be conducted under this alternative by the City of Los Angeles. Maintenance in general would include removal of invasive species throughout the project footprint, including the River and tributary channel bottom; repair and replacement of irrigation pipes and sprinklers; maintenance of constructed trails, terraces, and viewing areas; trimming of native vegetation; removal of trash and accumulated sediment; graffiti abatement; vector management; and like-for-like structural repair. Project areas subject to invasive removal include the channel bottom of the River, Verdugo Wash-River confluence, Burbank-Western Channel-confluence and short distance upstream, and the Arroyo Seco-River confluence as well as constructed restoration features. The Corps would continue to be

responsible for maintaining all other aspects of the portion of the LACDA project that overlaps with the restoration project footprint..

Maintenance activities within waters of the U.S. may require use of excavators, backhoes, or grapple trucks for removal of trash, debris, and sediment. Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases, there may be discharges of fill material associated with the use of earthmoving equipment, such as bulldozers, within newly established waters of the U.S. Impacts would be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges of fill material into waters of the U.S. However, temporary or permanent discharges of fill material would not decrease the amount of newly established waters of U.S. Invasive species in the River and tributary channel bottom within the project area are typically removed by hand tools. Thus, the activity would not result in discharges of fill material in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, impacts would be temporary and there would be no loss of waters of the U.S.

Table 3-2 Alternative 13 – Summary of Fill Material in Existing Waters of the U.S. and Establishment of New Waters of the U.S.

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
3. Ferraro Fields area of Griffith Park	Daylight Streams	5	None: activity is occurring in overbank area outside of existing waters of the U.S.	NA	NA	NA
	Side Channel	6	Removal of materials at inlet and outlet connections, above existing waters of the U.S.	Perm.	(200 CY)	0
			Backfill to create stable inlet and outlet	Perm.	100 CY	.02
			Install k-rails or sandbags	Temp.	220 LF	.01
4. Griffith Park	Daylight Streams	9	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
	Side Channel	1	Removal of materials at inlet and outlet connections, above existing waters of the U.S.	Perm.	(200 CY)	0
			Backfill as needed to create stable inlet and outlet, above existing waters of the U.S.	Perm.	100 CY	.02
			Install k-rails or sandbags	Temp.	220 LF	0.01

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
5. Riverside Drive	Daylight Streams	1	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
6. Taylor Yard	Vegetated Channel Walls (Right Bank)	NA	Install vegetation anchor materials	Perm.	67,819 Square Yards (SY)	14
			Rock at vegetation anchor tie-in	Perm.	2,833 CY	
			Install k-rails or sandbags	Temp.	7,392 LF	0.2
	Vegetated Channel Walls (Left Bank)	NA	Install vegetation anchor materials	Perm.	16,855 SY	3.3
			Rock at vegetation anchor tie-in	Perm.	778 CY	
			Install k-rails or sandbags	Temp.	11,960 LF	0.25
	Modify Channel Banks/Widen Channel	12	None: Excavate embankment to channel bed to within the waters of the U.S.	Perm.	(145,381 CY)	0
			Backfill with clean topsoil	Perm.	8,066 CY	4.5
			Install k-rails or sandbags	Temp.	4,224 LF	0.10
	Create New Wetlands Behind Bank	13	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
7. Arroyo Seco/Los Angeles River State Park	Modify Channel Banks	14	None: Excavate embankment to channel bed to within the waters of the U.S.	Perm.	(79,723 CY)	0
			Backfill with clean topsoil	Perm.	3,000 CY	5
			Install k-rails or sandbags	Temp.	4,200 LF	0.10
8. LATC	Restore Historic Wash	25	None: activity is occurring in overbank area outside of existing waters of the U.S.	NA	NA	NA

Alternative 16

Alternative 16 is called AND (for ARBOR Narrows to Downtown). This alternative includes the same features as Alternative 13 in Reaches 1-4 and 6-8 and includes greater restoration in Reaches 5 and 8. In Reach 5, this alternative widens the River channel by modifying the right

bank from a trapezoidal bank to a vertical wall and modifies the left bank from trapezoidal to a terraced vegetated bank. At the downstream end of this reach, the River channel will also be widened by modifying the left bank. The daylighted stream in Alternatives 10 and 13 is also included in this reach. In Reach 8, the alternative includes additional restoration by terracing upstream of LATC on the right bank of the River, terracing downstream on the left bank, and removing the left bank and the concrete bed adjacent to LATC. The channel bed will be naturalized to support freshwater marsh in the River. This alternative widens the River into the LATC site by 500 feet on a low terrace and another 1000 feet on a second terrace. The restoration features at the LATC site would also include the restoration of the historic wash, along with wetland habitat. In addition to the specific features outlined above, this alternative removes invasive vegetation throughout the project footprint, including the River and tributary channel bottom. Table 3-3 below summarizes the measures that either fill waters of the U.S. or create new waters of the U.S. In total, Alternative 16 would permanently discharge fill material into approximately 50.25 acres waters of the U.S. Permanent fill would be discharged into 49.21 acres. Dewatering structures would temporarily discharge fill material into 1.04 acres. Alternative 16 would establish approximately 145.6 acres of new waters of the U.S.

Maintenance of ecosystem restoration features would be conducted under this alternative by the City of Los Angeles. Maintenance in general would include removal of invasive species throughout the project footprint; repair and replacement of irrigation pipes and sprinklers; maintenance of constructed trails, terraces, and viewing areas; trimming of native vegetation; removal of trash and accumulated sediment; graffiti abatement; vector management; and like-for-like structural repair. Project areas subject to invasive removal include the channel bottom of the River, Verdugo Wash-River confluence, Burbank-Western Channel-confluence and short distance upstream, and the Arroyo Seco-River confluence as well as constructed restoration features. The Corps would continue to be responsible for maintaining all other aspects of the portion of the LACDA project that overlaps with the restoration project footprint.

Maintenance activities within waters of the U.S. may require use of excavators, backhoes, or grapple trucks for removal of trash, debris, and sediment. Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases, there may be discharges of fill material associated with the use of earthmoving equipment, such as bulldozers, within newly established waters of the U.S. Impacts would be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges of fill material into waters of the U.S. However, temporary or permanent discharges of fill material would not decrease the amount of newly established waters of U.S. Invasive species in the river and tributary channel bottom within the project area are typically removed by hand tools. Thus, the activity would not result in discharges of fill material in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, impacts would be temporary and there would be no loss of waters of the U.S.

Table 3-3 Alternative 16 – Summary of Fill Material in Existing Waters of the U.S. and Establishment of New Waters of the U.S.

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
3. Ferraro Fields area of Griffith Park	Daylight Streams	5	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
	Side Channel	6	Removal of materials at inlet and outlet connections	Perm.	(200 CY)	0
			Backfill to create stable inlet and outlet	Perm.	100 CY	.02
			Install k-rails or sandbags	Temp.	220 LF	.01
4. Griffith Park	Daylight Streams	9	None: activity is occurring in overbank area, outside of existing waters of the U,S,	NA	NA	NA
	Side Channel	1	Removal of materials at inlet and outlet connections	Perm.	(200 CY)	0
			Backfill as needed to create stable inlet and outlet	Perm.	100 CY	.02
			Install k-rails or sandbags	Temp.	220 LF	0.01
5. Riverside Drive	Daylight Streams	1	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
	Terrace/Vegetated Channel Walls	NA	Install vegetation anchor materials	Perm.	14,520 SY	3
			Rock at vegetation anchor tie-in	Perm.	778 CY	0.02
			Install k-rails or sandbags	Temp.	11,960 LF	0.25
	Modify Trapezoidal Channel to Vertical Banks	20.6	Demolition and materials removal	Perm.	(140,763 CY)	0
			Backfill for stabilization	Perm.	113,991 CY	6.2
			Install k-rails or sandbags	Temp.	8,448 LF	0.02
6. Taylor Yard	Vegetated Channel Walls (Right Bank)	NA	Install vegetation anchor materials	Perm.	67,819 CY	14
			Rock at vegetation anchor tie-in	Perm.	2,833 CY	0.2

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
			Install k-rails or sandbags	Temp.	7,392 LF	0.2
	Vegetated Channel Walls (Left Bank)	NA	Install vegetation anchor materials	Perm.	16,855 SY	3.3
			Rock at vegetation anchor tie-in	Perm.	778 CY	.05
			Install k-rails or sandbags	Temp.	11,960 LF	0.25
	Modify Channel Bed and Banks	12	Excavate embankment to channel bed within waters of the U.S.	Perm.	(145,381 CY)	0
			Backfill with clean topsoil	Perm.	8,066 CY	4.5
			Install k-rails or sandbags	Temp.	4,224 LF	0.10
	Create New Wetlands Behind Bank	13	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
7. Arroyo Seco/Los Angeles River State Park	Modify Channel Banks	14	Excavate embankment to channel bed to within the waters of the U.S.	Perm.	(79,723 CY)	0
			Backfill with clean topsoil	Perm.	3,000 CY	5
			Install k-rails or sandbags	Temp.	4,200 LF	0.10
8. LATC	Create Side Channel	13	Demolition and materials removal	NA	(46,826 CY)	0
			Backfill for stabilization	Perm.	42,476 CY	0.2
			Install k-rails or sandbags	Temp.	220 LF	0.01
	Modify Channel Bed and Banks	26	Excavate embankment and channel bed to within the waters of the U.S.	Perm.	(397,871 CY)	0
			Backfill with clean topsoil	Perm.	18,996 CY	11.3
			Install k-rails or sandbags	Temp.	3,168 LF	0.08
	Restore Historic Wash	25	Demolition and materials removal within waters of the U.S.	Perm.	(48,340 CY)	0
			Backfill for stabilization	Perm.	2,193 CY	1.4
			Install k-rails or sandbags	Temp.	3,168 LF	0.01

Alternative 20

Alternative 20 is called RIVER (for Riparian Integration via Varied Ecological Reintroduction) as it includes the same features as Alternative 16 in Reaches 1, 4, 5, 6, and 8 and includes greater restoration in Reaches 2, 3 and 7. In Reach 2, this alternative widens the the River channel by modifying the right bank from a trapezoidal bank to a vertical wall. In Reach 3, the alternative restores the confluence with Verdugo Wash by softening the bed of the stream and significantly widening the mouth of the wash, thus providing riparian habitat and an additional connection to the San Gabriel Mountains through the Verdugo Hills. In Reach 7, this alternative includes the same Arroyo Seco restoration as Alternative 13, and in addition, reintroduces the daylighted streams included in Alternative 10 in lieu of the channel bank vegetation features that were in Alternatives 13 and 16. Also in Reach 7, this alternative restores freshwater marsh at the Los Angeles State Historic Park and creates a terraced bank connection to the River. In addition to the specific features outlined above, this alternative removes invasive vegetation throughout the project footprint, including within the River and tributary channel bottom. Table 3-4 below summarizes the measures that either fill waters of the U.S. or create new waters of the U.S. In total, Alternative 20 would permanently discharge fill material into approximately 67.29 acres waters of the U.S. Permanent fill would be discharged into 65.61 acres. Dewatering structures would temporarily discharge fill material into 1.68 acres. Alternative 20 would establish approximately 168.6 acres of new waters of the U.S.

Maintenance of ecosystem restoration features would be conducted under this alternative by the City of Los Angeles. Maintenance in general would include removal of invasive species throughout the project footprint; repair and replacement of irrigation pipes and sprinklers; maintenance of constructed trails, terraces, and viewing areas; trimming of native vegetation; removal of trash and accumulated sediment; graffiti abatement; vector management; and like-for-like structural repair. Project areas subject to invasive removal include the channel bottom of the River, Verdugo Wash-River confluence, Burbank-Western Channel-confluence and short distance upstream, and the Arroyo Seco-River confluence as well as constructed restoration features. The Corps would continue to be responsible for maintaining all other aspects of the portion of the LACDA project that overlaps with the restoration project footprint.Maintenance activities within waters of the U.S. may require use of excavators, backhoes, or grapple trucks for removal of trash, debris, and sediment. Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases, there may be discharges of fill material associated with the use of earthmoving equipment, such as bulldozers, within newly established waters of the U.S. Impacts would be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges of fill material into waters of the U.S. However, temporary or permanent discharges of fill material would not decrease the amount of newly established waters of U.S. Invasive species in the River and tributary channel bottom within the study area would typically be removed by hand tools. Thus, the activity would not result in discharges of fill material in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, impacts would be temporary and there would be no loss of waters of the U.S.

Table 3-4 Alternative 20 – Summary of Fill Material in Existing Waters of the U.S. and Establishment of New Waters of the U.S.

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
2. Bette Davis Park area of Griffith Park	Vegetated Channel Walls	NA	Install vegetation anchor materials	Perm.	8,206 SY	1.7
			Rock at vegetation anchor tie-in	Perm.	424 CY	0.02
			Install k-rails or sandbags	Temp.	11,960 LF	0.25
	Modify Trapezoidal Channel to Vertical Banks	5.5	Demolition and removal of materials	Perm.	(7,020 CY)	0
			Backfill for stabilization	Perm.	41,625 CY	1.75
			Install k-rails or sandbags	Temp.	8,448 LF	0.2
3. Ferraro Fields/Verdugo Wash area of Griffith Park	Daylight Streams	2	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
	Side Channel	6	Removal of materials at inlet and outlet connections, above OHWM	Perm.	(200 CY)	0
			Backfill to create stable inlet and outlet	Perm.	100 CY	0.02
			Install k-rails or sandbags	Temp.	220 LF	0.01
	Widen Tributaries	8	Demolition and removal of materials	Perm.	(509,058 CY)	0
			Backfill for stabilization and add vegetation anchoring materials	Perm.	24,115 CY	6.5
			Install k-rails or sandbags	Temp.	2,000 LF	0.02
4. Griffith Park	Daylight Streams	9	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
	Side Channel	1	Removal of materials at inlet and outlet connections, above OHWM	Perm.	(200 CY)	0
			Backfill as needed to create stable inlet and outlet	Perm.	100 CY	0.02
			Install k-rails or sandbags	Temp.	220 LF	0.01
5. Riverside Drive	Daylight Streams	1	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
	Vegetated Channel Walls (Both Banks)	NA	Install vegetation anchor materials	Perm.	14,520 CY	9
			Rock at vegetation anchor tie-in	Perm.	2,333 CY	0.05
			Install k-rails or sandbags	Temp.	11,960 LF	0.25
	Modify Trapezoidal	20.6	Demolition and materials removal	Perm.	(140,763 CY)	0

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
	Channel to Vertical Banks		Backfill for stabilization	Perm.	113,991 CY	6.2
			Install k-rails or sandbags	Temp.	8,448 LF	0.02
6. Taylor Yard	Vegetated Channel Walls (Right bank)	NA	Install vegetation anchor materials	Perm.	67,819 SY	14
			Rock at vegetation anchor tie-in	Perm.	2,833 CY	0.2
			Install k-rails or sandbags	Temp.	7,392 LF	0.2
	Vegetated Channel Walls (Left bank)	NA	Install vegetation anchor materials	Perm.	16,855 SY	3.3
			Rock at vegetation anchor tie-in	Perm.	778 CY	0.05
			Install k-rails or sandbags	Temp.	11,960 LF	0.25
	Modify Channel Banks	12	Excavate embankment to channel bed to within the waters of the U.S.	Perm.	(145,381 CY)	0
			Backfill with clean topsoil	Perm.	8,066 CY	4.5
			Install k-rails or sandbags	Temp.	4,224 LF	0.1
	Create New Wetlands Behind Bank	13	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
7. Arroyo Seco and Los Angeles State Historic Park	Daylight Streams	3	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA.	NA	NA
	Create Wetland	9	Install vegetation stabilization features, concrete, riprap, and topsoil	Perm.	NA	NA
	Modify channel Banks	14	Excavate embankment to channel bed to within the waters of the U.S.	Perm.	(79,723 CY)	0
			Backfill with clean topsoil	Perm.	3,000 CY	5
			Install k-rails or sandbags	Temp.	4,200 LF	0.1
	Terrace banks	0.5	Demolition and removal of materials to within waters of the U.S.	Perm	(3,771 CY)	0
			Backfill for stabilization and add vegetation anchoring materials	Perm	3,052 SF	0.5
		0	Install k rails or sandbags	Temp	595 LF	0.5
8. LATC	Create Side Channel	13	Demolition and materials removal	Perm.	(46,826 CY)	0
			Backfill for stabilization	Perm.	42,476 CY	0.1
			Install k-rails or sandbags	Temp.	220 LF	0.01
	Modify Channel Bed	26	Excavate embankment and channel bed within waters of the U.S.	Perm.	(397,871 CY)	0

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
	and Banks		Backfill with clean topsoil	Perm.	18,996 CY	11.3
			Install k-rails or sandbags	Temp.	3,168 LF	0.08
	Restore Historic Wash	25	Excavate embankment to channel bed within waters of the U.S.	Perm.	(48,340 CY)	0
			Backfill with clean topsoil	Perm.	2,193 CY	1.4
			Install k-rails or sandbags	Temp.	3,168 LF	0.01

Alternative 13v

Alternative 13v would include all measures and impacts of Alternative 13. Moreover, Alternative 13v would add restoration measures in Reach 7 identical to those proposed under Alternative 20. Within Reach 7, streams would be daylighted; freshwater marsh would be created; embankments would be terraced; and channel banks would be modified. Like the other alternatives, this alternative includes invasive vegetation removal throughout project footprint, including the River and tributary channel bottom. This Alternative has been identified as the National Ecosystem Restoration plan. Table 3-5 below summarizes the measures that either fill waters of the U.S. or create new waters of the U.S. In total, Alternative 13v would permanently discharge fill material into approximately 27.51 acres waters of the U.S. Permanent fill would be discharged into 26.84 acres. Dewatering structures would temporarily discharge fill material into 0.67 acre. Alternative 13v would establish approximately 98.5 acres of new waters of the U.S.

Maintenance of ecosystem restoration features would be conducted under this alternative by the City of Los Angeles. Maintenance in general would include removal of invasive species throughout the the project footprint; repair and replacement of irrigation pipes and sprinklers; maintenance of constructed trails, terraces, and viewing areas; trimming of native vegetation; removal of trash and accumulated sediment; graffiti abatement; vector management; and like-for-like structural repair. Project areas subject to invasive removal include the channel bottom of the River, Verdugo Wash-River confluence, Burbank-Western Channel-confluence and short distance upstream, and the Arroyo Seco-River confluence as well as constructed restoration features. The Corps would continue to be responsible for maintaining all other aspects of the portion of the LACDA project that overlaps with the restoration project footprint.

Maintenance activities within waters of the U.S. may require use of excavators, backhoes, or grapple trucks for removal of trash, debris, and sediment. Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases, there may be discharges of fill material associated with the use of earthmoving equipment, such as bulldozers, within newly established waters of the U.S. Impacts would be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges of fill material into waters of the U.S. However, temporary or

permanent discharges of fill material would not decrease the amount of newly established waters of U.S. Invasive species in the River and tributary channel bottom within the project area would typically be removed by hand tools. Thus, the activity would not result in discharges of fill material in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, impacts would be temporary and there would be no loss of waters of the U.S.

Table 3-5 Alternative 13v – Summary of Fill Material in Existing Waters of the U.S. and Establishment of New Waters of the U.S.

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
3. Ferraro Fields area of Griffith Park	Daylight Streams	5	None: activity is occurring in overbank area outside of existing waters of the U.S.	NA	NA	NA
	Side Channel	6	None: Removal of materials at inlet and outlet connections, above existing waters of the U.S.	Perm.	(200 CY)	0
			Backfill to create stable inlet and outlet	Perm.	100 CY	0.02
			Install k-rails or sandbags	Temp.	220 LF	0.01
4. Griffith Park	Daylight Streams	9	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
	Side Channel	1	None: Removal of materials at inlet and outlet connections, above existing waters of the U.S.	Perm.	(200 CY)	0
			Backfill as needed to create stable inlet and outlet, above existing waters of the U.S.	Perm.	100 CY	0.02
			Install k-rails or sandbags	Temp.	220 LF	0.01
5. Riverside Drive	Daylight Streams	1	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
6. Taylor Yard	Vegetated Channel Walls (Right Bank)	NA	Install vegetation anchor materials	Perm.	67,819 (SY)	14
			Rock at vegetation anchor tie-in	Perm.	2,833 CY	
			Install k-rails or sandbags	Temp.	7,392 LF	0.2
	Vegetated Channel Walls (Left Bank)	NA	Install vegetation anchor materials	Perm.	16,855 SY	3.3
			Rock at vegetation anchor tie-in	Perm.	778 CY	
			Install k-rails or sandbags	Temp.	11,960 LF	0.25
	Modify	12	None: Excavate embankment to channel bed to	Perm.	(145,381	0

Reach	Management Measures	Acres of New Waters of the U.S.	Fill Material in Existing Waters of the U.S.			
			Discharge Material and Activity	Impacts (Perm./ Temp.)	Quantity	Acres Filled
	Channel Banks/Widen Channel		within the waters of the U.S.		CY)	
			Backfill with clean topsoil	Perm.	8,066 CY	4.5
			Install k-rails or sandbags	Temp.	4,224 LF	0.1
	Create New Wetlands Behind Bank	13	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
7. Arroyo Seco and Cornfields	Daylight Streams	3	None: activity is occurring in overbank area, outside of existing waters of the U.S.	NA	NA	NA
	Create Wetland	9	Install vegetation stabilization features, concrete, riprap, and topsoil	NA	NA	NA
	Terrace banks	0.5	None: Demolition and removal of materials to within waters of the U.S.	Perm	(3,771 CY)	0
	Modify Channel Banks	14	None: Excavate embankment to channel bed to within the waters of the U.S.	Perm.	(79,723 CY)	0
			Backfill with clean topsoil	Perm.	3,000 CY	5
			Install k-rails or sandbags	Temp.	4,200 LF	0.1
8. LATC	Restore Historic Wash	25	None: activity is occurring in overbank area outside of existing waters of the U.S.	NA	NA	NA

3.3 Impacts to Waters of the U.S.

All action alternatives would entail both temporary and permanent discharges of fill material into waters of the U.S. None of the alternatives would entail permanent loss of waters of the U.S.

There are incremental increases in permanent and temporary discharges of fill material from Alternative 10 through Alternative 20. Likewise, there are incremental increases in the scope of restoration activities from Alternative 10 through Alternative 20.

The types of fill material include restoration fill and stabilization fill.

- **Restoration fill** includes fill that would enhance aquatic functions and services.
    - **Seeded Turf Mat:** The management measure to vegetate channel walls (See Section 3.1.4) with seeded turf would entail discharge of a seeded mat on top of the existing concrete embankments. The discharge of the seeded mat would not change the channel configuration, or reduce groundwater recharge area. Alternatives 13, 13v, 16, and 20 would include the discharge of this fill material. The turf reinforcement mat is a pre-seeded mat that would be put in place to facilitate the process of formation of riparian and wetland plant communities.
    - **Clean Backfill:** Another management measure entails removal of concrete from waters of the U.S. and discharge of backfill into the excavated areas to support riparian vegetation. The discharge of clean backfill would not change the channel configuration, but would increase the area of riparian vegetation and surface area for groundwater recharge. In both cases, the discharge of permanent fill material would not lead to the permanent loss of existing waters of the U.S. All action alternatives include the discharge of clean backfill. Clean fill material would be placed to allow formation of wetland and riparian habitat where concrete is excavated from the channel.
- **Stabilization fill** is fill material required to stabilize the substrate of newly created waters of the U.S. Alternatives 13, 13v, 16 and 20 would entail measures that would set back the existing levees which in turn would widen channel invert. Fill material such as rocks or concrete would be discharged as appropriate within the widened channel invert to stabilize the substrate. The discharge of this material would not result in the permanent loss of existing waters of the U.S. All action alternatives include the discharge of concrete or rock backfill. This type of fill material would be installed in areas where trapezoidal channel walls were set back to increase the invert width, thereby exposing erodible soils; where the channel banks were notched to allow for creation of inlets and outlets for new side channels; and where existing concrete banks were terraced to allow for plantings.

Table 3-6 Classes of Permanent Fill Material for Restoration Activities

Alternative	Permanent Fill Within Existing Waters of the U.S. (Acres)	Classes of Permanent Fill		
		Seeded Turf (Acres)	Soil Backfill Within Excavated Concrete (Acres)	Fill to Stabilize Expanded Waters of the U.S.
10	4.52	0	4.5	0.02
13	26.84	17.3	9.5	0.04
13v	26.84	17.3	9.5	0.04
16	49.21	20.57	20.8	7.84
20	65.61	28.32	22.20	15.09

3.4 Permanent Losses of Existing Waters of the U.S.

The discharge of permanent fill material would not result in the permanent loss of waters of the U.S. Typical examples of changes that constitute permanent loss of waters of the U.S. include permanent decrease in surface area available for water recharge or permanent loss of riparian habitat.

- **Ground Water Recharge**: All action alternatives would discharge permanent fill material into existing waters of the U.S. However, the fill material would not result in an increase of impermeable surfaces. Seeded reinforced mats would be placed on top of existing embankments. Excavated concrete would be replaced with either soil backfill or rocks. Furthermore, all action alternatives would create new, soft bottom waters of the U.S., resulting in an increase of permeable surface areas to enhance groundwater recharge functions.

- **Riparian Habitat:** There would be no permanent loss of aquatic habitat associated with discharges of fill under any of the action alternatives. The discharges of fill material would entail placement of reinforced vegetated mats or rocks and clean soil for the establishment of vegetation in open water area and soft river bottom area, and at side channels and tributaries.

Table 3-7 Fill and Loss of Existing Waters of the U.S. and New Waters of the U.S. Established

Alternative	Fill Within Existing Waters of the U.S. (Acres)		Permanent Loss of Existing Waters of the U.S. (Acres)	New Waters of the U.S. Established (Acres)
	Permanent	Temporary		
10	4.52	0.11	0	56
13	26.84	0.67	0	86
13v	26.84	0.67	0	98.5
16	49.21	1.04	0	145.6
20	65.61	1.68	0	168.6

4.0 Alternatives Analysis

4.1 Restrictions on Discharge

The 404(b)(1) Guidelines prohibit the discharge of dredged or fill material into waters of the U.S. if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem[1], so long as the alternative does not have other significant adverse environmental consequences. 40 C.F.R. 230.10(a). To be "practicable," an alternative must be "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." 40 C.F.R. 230.10(a)(2).

4.2 Overall Project Purpose

With the exception of the No Federal Action Alternative all alternatives meet the overall project purpose. The No Federal Action Alternative has been dropped from consideration in the 404(b)(1) evaluation since it does not meet the overall project purpose.

4.3 Practicability (Technology)

All action alternatives can be constructed with existing technology. All action alternatives would utilize conventional construction techniques and conventional construction equipment.

4.4 Practicability (Logistics)

As detailed in Appendix J of the IFR, all action alternatives would require acquisition of approximately 145 acres of privately-owned lands and relocation of private businesses and industrial operations which include two railway yards: 93 acres at LATC (existing yard) and 43 acres at Taylor Yard (former yard, no existing business/operations). Acquisition of up to 8 acres of private land with business operations would occur at the confluence of Verdugo Wash under Alternative 20. Implementation of any action alternative would require the acquisition of land, changes in zoning, and relocation of the rail facilities and operations. The City of Los Angeles is responsible for acquisition of lands, easements and rights-of-way and performing relocations (Appendix J, Section 11). Furthermore, City of Los Angeles is fully capable of fulfilling its responsibility (Appendix J, Section 13). Based on the above, all action alternatives are practicable with respect to logistics.

4.5 Practicability (Cost)

Per Engineer Regulation (ER) 1105-2-100 the economic analysis associated with the IFR is required to identify the alternative that reasonably maximizes benefits, the NER. Under ER 1105-2-100, the NER plan is the recommended plan unless a waiver is granted to consider an alternative plan as the Locally Preferred Plan. Though not bound to do so, the U.S. Congress

[1]In this instance, the terms *aquatic environment* and *aquatic ecosystem* mean waters of the U.S., including wetlands that serve as habitat for interrelated and interacting communities and populations of plants and animals. 40 C.F.R. 230.3.

may select the recommended plan for authorization and appropriation. Alternatively, the U.S. Congress may select another plan from the final array of alternatives for authorization and appropriation. All alternatives are considered practicable in terms of cost.

The cost comparison discussion is a summary of a detailed cost analysis prepared for the action alternatives in Chapters 4 and 6 of the IFR. As summarized in Tables 6-2 and 6-3 of the IFR, all action alternatives from Alternative 10 through Alternative 20 would incrementally increase the scope of ecosystem restoration activities. Likewise, there is an incremental increase in total construction costs from Alternative 10 through Alternative 20. See Table 6-6 of the IFR and Table 7, below. Alternative 10 would entail the smallest scope of restoration activities and would cost the least. In contrast, Alternative 20 would entail the largest scope of restoration activities and would cost the most. However, as summarized in Table 4-10 of the IFR, the incremental-increase pattern is not evident in more refined measurements. With respect to incremental construction cost Alternative 13v would result in the smallest incremental construction cost. In contrast, Alternative 16 would result in the largest incremental construction cost. With respect to habitat output, Alternative 13v would result in the largest incremental output while Alternative 20 would result in the smallest incremental output. In sum, Alternative 13v maximizes incremental habitat output and minimizes total construction costs. Therefore, Alternative 13v is identified as the plan that maximizes NER benefits (See Section 6.6 of the IFR).

However, the City of Los Angeles has requested the Corps recommend Alternative 20 as a Locally Preferred Plan. The Assistant Secretary of the Army (Civil Works) has permitted the Corps to consider Alternative 20 as a Locally Preferred Plan for recommendation to Congress.

Table 4-1 Comparison of Costs[2] and Habitat Output (October 2014 Price Levels)

	Alternative 10	Alternative 13	Alternative 13v*	Alternative 16	Alternative 20
First Cost	$591,371,000	$707,800,000	$703,062,000	$1,050,057,000	$1,309,332,000
Average Annual Costs (AAC)	$26,722,000	$32,089,000	$31,851,377	$49,271,000	$60,656,000
Annual Average Habitat Output (AAHU)	5,321	5,902	5,989	6,509	6,782
Cost/Habitat Output (AAC/AAHU)	$5,022	$5,437	$5,318	$7,570	$8,944

* The IFR identifies Alternative 13v as the plan that maximizes NER benefits.

[2] Costs in Table 4-1 are based upon estimates in December 2014. MCACES estimates have only been prepared for Alternatives 13v and 20 and therefore these will differ from more refined estimates found elsewhere in the IFR.

Table 4-2 Comparison of 404(b)(1) Evaluation Criteria

Alternatives	Practicability Test			Significant Environmental Impacts to Non-Aquatic Resources?	Permanent Fill Within WoUS (acres)	Permanent Loss of WoUS (acres)	Meets Overall Project Purpose?
	Cost (Amount)	Logistics	Technology				
Alternative 10	Yes ($591M)	Yes	Yes	Yes	4.52	0	Yes
Alternative 13	Yes ($708M)	Yes	Yes	Yes	26.84	0	Yes
Alternative 13v	Yes ($703M)	Yes	Yes	Yes	26.84	0	Yes
Alternative 16	Yes ($1,050M)	Yes	Yes	Yes	49.21	0	Yes
Alternative 20	Yes ($1,309M)	Yes	Yes	Yes	65.61	0	Yes
No Federal Action Alternative	N/A	N/A	N/A	No	0	0	No

5.0 Environmental Effects

5.1 Effects on Aquatic Resources

The potential impacts of the construction associated with all action alternatives have been analyzed in the IFR.

The purpose of the Section 404(b)(1) Guidelines is to restore and maintain the chemical, physical, and biological integrity of the waters of the U.S. through the control of discharges of dredged or fill material. Except as provided under CWA Section 404(b)(2), no discharge of dredged or fill material will be authorized if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, as long as the alternative does not have other significant adverse environmental consequences. In accordance with the Section 404(b)(1) Guidelines, the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment must be determined.

All action alternatives would entail the discharge of fill material into waters of the U.S. The following discussion evaluates impacts of all action alternatives on environmental resources identified in Subpart C through Subpart F of the Section 404(b)(1) Guidelines.

5.2 Effects on Non-Aquatic Resources

All action alternatives would result in significant impacts to:

- **Land Use:** Restoration of the LATC site and other properties in Reach 8 would result in a conflict with the existing industrial land use designation, constituting a significant impact to land use. See Section 5.3 of the IFR. Alternative 20 would also convert lands designated industrial to restored habitat in Reach 3, constituting a significant impact to land use.

5.3 Potential Direct and Secondary Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)

Substrate

Construction: All alternatives would entail excavation or disturbance of substrate during the construction process. In some cases, excavated materials would be replaced with materials such as natural substrate and vegetation that would support the proposed habitat restoration measures. In other cases, fill material such as concrete would be discharged to create grade stabilizers or similar features at key transition points to ensure that flood damage reduction is not impaired. Native substrates that are supportive of riparian or wetland vegetation will be left in place to the degree possible.

Alternative 10 would have minimal disturbance on existing substrates at or below the OHWM, and would require minimal permanent fill. Excavation of the channel wall and some soil removal would occur to allow upstream and downstream River connections to a proposed side channel at Griffith Park. Approximately 100 cy of concrete and topsoil would be removed at each of the connections for a total of 200 cy of excavated substrate. Each connection would be backfilled with approximately 50 cy of clean topsoil and riprap and/or concrete for a total of approximately 100 cy of permanent fill. These and all other construction areas would be temporarily isolated from the River during construction by installation of k-rails or sandbags, resulting in up to 4,440 linear feet of temporary fill. It is estimated that these materials would be used in the River channel for no more than one month at any given location, after which this temporary fill would be removed.

Under Alternative 10, up to 12 acres of new waters of the U.S. would be created at Taylor Yard by excavating and permanently removing approximately 145,381 cy of mostly earthen substrate to lower the channel banks, reconnecting the River with a portion of the historic floodplain. Revegetating this area would require backfilling with up to 8,066 cy of clean topsoil, meaning that on balance the prism of waters of the U.S. would increase by up to 137,315 cy at this location. Backfilling would not entail discharge into waters of the U.S. since the temporary isolation of the construction area would prohibit establishment of the OHWM. Both the excavation and backfill would occur in order to allow wetland and riparian conditions to develop.

Alternative 13 would include the measures described under Alternative 10, and would include additional measures that would increase the amount of permanent substrate removal, permanent backfill, and temporary fill. Additional excavation of 79,723 cy of concrete and soil would occur by lowering the channel banks at Arroyo Seco, and additional backfilling with 3,000 cy of clean topsoil would then occur at this location. Toe of the bank on both sides would be moved outward to create a vertical wall and widen the Riverbed in Reach 5. Twelve storm drains would

be daylighted. An additional side channel would be created, which would double both the permanent and temporary fill and excavation amounts relative to Alternative 10, but which would also double the amount of waters of the U.S. in the newly created side channels. In newly created waters of the U.S., engineered substrates such as concrete, asphalt, or corrugated metal pipe as well as compacted earthen substrates would be replaced with earthen vegetated substrate similar to those found in natural riparian systems. Within existing waters of the U.S., concrete would be discharged for the construction or modification of existing outfalls. Therefore, in many instances the change in substrate would be like-for-like.

Vegetating the channel walls would require permanent fill in the form of pre-seeded turf reinforcements matting, which is a thin geotextile mesh that is installed to allow for retention of soil and vegetation in relatively steep areas. This mesh would cover approximately 84,650 square yards (sy) of waters of the U.S. and would be anchored by approximately 3,600 cy of rock. Both the pre-seeded turf reinforcements matting and rock would constitute permanent fill, but would allow wetland vegetation to occur in areas that are now covered by concrete.

Alternative 16 would include the same measures as Alternative 13, and additional measures that would increase the amount of both permanent substrate removal, permanent backfill, and temporary fill. The toe of the bank would be moved outward to create a vertical wall and widen the Riverbed in Reach 5. Twelve storm drains would be daylighted. Addition of a side channel relative to Alternative 13 would increase the amount of permanently removed concrete and topsoil by excavating an additional inlet and outlet, and would increase the amount backfill with stabilizing rock and/or concrete in these locations. Temporary fill would also increase in the form of sandbags or k-rails to allow for dewatering at construction areas. An additional 14,520 sy of pre-seeded turf reinforcements matting would be installed in Reach 5, and would be anchored by 778 cy of rock, constituting permanent fill to allow for retention of soil and vegetation. K-rails or sandbags would be installed at 11 locations to allow for dewatering, and would constitute temporary fill. Backfilling with clean topsoil to allow for wetland and riparian vegetation establishment would occur at 3 locations, all of which would be newly created waters of the U.S. that were isolated from the River by dewatering devices.

Terracing banks would allow for increased wetland and riparian vegetation in Reach 5 and at LATC. This measure would entail both excavation of existing materials, primarily concrete, and backfill with both concrete and clean topsoil. Temporary fill in the form of sandbags or k-rails would also occur at these locations. Additional waters of the U.S. would be created by modifying the trapezoidal channel. The toe of the bank would be moved outward to create a vertical wall and widen the Riverbed in Reach 5. Backfill would occur at this location to stabilize the bank, but would occur in newly created waters of the U.S. which would be isolated from the River by dewatering structures, such as k-rails or sandbags. Dewatering structures at this location would add approximately 8,450 lf of temporary fill.

In these existing and newly created waters of the U.S., engineered substrates such as concrete, asphalt, or corrugated metal pipe as well as compacted earthen substrates would be replaced with earthen vegetated substrate similar to those found in natural riparian systems. Within existing waters of the U.S., concrete would be discharged for the construction or modification of existing outfalls. Therefore, in many instances the change in substrate would be like-for-like.

Alternative 20 would entail all measures specified above, and increase the amount of waters of the U.S. over Alternative 16, including by widening the trapezoidal channel in Reach 2 and excavating upland areas to create wetland and riparian habitat at the Verdugo Wash confluence in Reach 3. Thirteen storm drains would be daylighted. Within Reach 7, streams would be daylighted and wetlands be created and channel banks modified at the Arroyo Seco confluence and the LASHP. Permanent and temporary fill would be most extensive under this alternative, as would creation of new waters of the U.S.

In these existing and newly created waters of the U.S., engineered substrates such as concrete, asphalt, or corrugated metal pipe as well as compacted earthen substrates would be replaced with earthen vegetated substrate similar to those found in natural riparian systems. Within existing waters of the U.S., concrete would be discharged for the construction or modification of existing outfalls. Therefore, in many instances the change in substrate would be like-for-like.

Alternative 13v would include all measures and impacts of Alternative 13. Moreover, Alternative 13v would add restoration measures in Reach 7 identical to those proposed under Alternative 20. Within Reach 7, streams would be daylighted; wetlands would be created; embankments would be terraced; and channel banks would be modified.

In these existing and newly created waters of the U.S., engineered substrates such as concrete, asphalt, or corrugated metal pipe as well as compacted earthen substrates would be replaced with earthen vegetated substrate similar to those found in natural riparian systems. Within existing waters of the U.S., concrete would be discharged for the construction or modification of existing outfalls. Therefore, in many instances the change in substrate would be like-for-like.

Under all action alternatives, invasive species would be removed throughout the project area, including the River channel and tributary bottom. Invasive species in channel within the project area would typically be removed by hand tools. Thus, the activity would not result in discharges of fill in most instances and the existing substrate would be left intact. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, the fill would be identical to the existing native substrate.

Secondary effects of the fill would be de minimis for all alternatives. Concrete, rocks, and soils discharged in waters of the U.S. would not be substantially different from the existing concrete, rocks, and soils at the site.

Operation: Maintenance activities within waters of the U.S. for all action alternatives may require use of excavators, backhoes, or grapple trucks for removal of trash, debris, and sediment. Invasive species removal throughout the project footprint, including the River channel and tributary channel bottom, would typically be performed with hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, the fill would be identical to the existing native substrate. Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases there may be discharges of fill material associated with the use of earthmoving equipment, such as bulldozers, within newly established waters of the U.S. Impacts will be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges of fill material

into waters of the U.S. However, temporary or permanent discharges of fill would not decrease the amount of existing or newly established waters of U.S.

Secondary effects of the fill would be de minimis for all maintenance activities. Concrete, rocks, and soils discharged in waters of the U.S. would not be substantially different from the existing concrete, rocks, and soils at the site.

Suspended particulates and turbidity

Construction: Alternative 10 would require construction activities within waters of the U.S. Work areas within the channel invert would be isolated from flows with k-rails or sandbags during construction. In total, Alternative 10 would result in the temporary discharge of approximately 4,444 lf of the k-rails. Movement of vehicles across earthen substrate during the placement and removal of dewatering structures would temporarily elevate turbidity in the water column. When fully isolated from surrounding flows, work within River would result in minimal or no increases in turbidity.

Alternative 13 would require construction activities within waters of the U.S. Work areas within the channel invert would be isolated from flows with k-rails or sandbags during construction. In total, Alternative 13 would result in the temporary discharge of approximately 24,544 lf of the k-rails. Movement of vehicles across earthen substrate during the placement and removal of dewatering structures would temporarily elevate turbidity in the water column. When fully isolated from surrounding flows, work within River would result in minimal or no increases in turbidity.

Alternative 16 would require construction activities within waters of the U.S. Work areas within the channel invert would be isolated from flows with k-rails or sandbags during construction. In total, Alternative 16 would result in the temporary discharge of approximately 61,276 lf of the k-rails. Movement of vehicles across earthen substrate during the placement and removal of dewatering structures would temporarily elevate turbidity in the water column. When fully isolated from surrounding flows, work within River would result in minimal or no increases in turbidity.

Alternative 20 would require construction activities within waters of the U.S. Work areas within the channel invert would be isolated from flows with k-rails or sandbags during construction. In total, Alternative 20 would result in the temporary discharge of approximately 118,639 lf of the k-rails. Movement of vehicles across earthen substrate during the placement and removal of dewatering structures would temporarily elevate turbidity in the water column. When fully isolated from surrounding flows, work within River would result in minimal or no increases in turbidity.

Alternative 13v would include all measures and impacts of Alternative 13 in Reaches 1-6 and 8. Moreover, Alternative 13v would include restoration measures in Reach 7 identical to those proposed under Alternative 20. Within Reach 7, streams would be daylighted; wetlands would be created; embankments would be terraced; and channel banks would be modified. When fully isolated from surrounding flows, work within River would result in minimal or no increases in turbidity.

Secondary effects of the fill would mostly be identical for all alternatives. Concrete and rocks discharged into waters of U.S. would not increase turbidity. The increase in soft bottom waters of the U.S. would likely increase the potential for turbidity beyond existing baseline levels. The potential increase would be commensurate with increased project footprints. However, most of the soft bottom areas would be vegetated. The vegetation would attenuate turbidity levels. Secondary impacts over the long-term would be minimal.

The amount of in-channel work would increase from Alternative 10 through Alternative 20. However, active construction areas would be dewatered and isolated from active flows to minimize water quality impacts. Furthermore, adherence to the storm water pollution prevention plan (SWPPP) and permitting requirements, and implementation of best management practices (BMPs) described in Section 5.6 of the IFR, would further reduce water quality impacts. Furthermore, because most of the surfaces in the River channel are hardened, channel modifications are not expected to result in water quality impacts due to excessive erosion, scour, and head cuts. Thus, long term impacts to water quality across all alternatives are expected to be approximately the same.

Under all action alternatives, invasive species would be removed throughout the project area, including the River channel and tributary bottom, during construction. Invasive species in the channel would typically be removed by hand tools. Thus, the activity would not result in discharges of fill in most instances and there would be no temporary increases in turbidity. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, any increase in turbidity would be temporary.

Secondary effects of the fill would mostly be identical for all alternatives. Concrete and rocks discharged into waters of U.S. would not increase turbidity. The increase in soft bottom waters of the U.S. would likely increase the potential for turbidity beyond existing baseline levels. The potential increase would be commensurate with increased project footprints. However, most of the soft bottom areas would be vegetated. The vegetation would attenuate turbidity levels. Furthermore, much of the permanent fill would also be chemically inert, and would consist of materials such as concrete, rock from a certified source, or pre-seeded turf reinforcement matting, none of which would leach contaminants into the water column. Topsoil would be acquired from a certified contaminant-free source, and would be free of most weed seeds and free of hazardous toxic, and radioactive wastes (HTRW) or other contaminants. Thus, potential for long-term leaching of contaminants into the water column would be minimal.

Operation: Maintenance activities within waters of the U.S. may require use of excavators, backhoes, or grapple trucks for removal of trash, debris, and sediment. Invasive species removal throughout the project footprint, including the River channel and tributary channel bottom, would typically be performed with hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, the fill would be identical to the existing native substrate. Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases, there may be discharge of fill material associated with the use of earthmoving equipment, such as bulldozers, within newly established waters of the U.S. Impacts will be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges of fill material. However,

temporary or permanent discharges of fill material would not decrease the amount of existing or newly established waters of U.S.

Maintenance may require use of excavators, backhoes, or grapple trucks for removal of trash, debris, and sediment. Maintenance activities requiring in-water work would likely require the use of water diversion structures, such as k-rails or sandbags. Movement of vehicles across earthen substrate during the placement and removal of dewatering structures would temporarily elevate turbidity in the water column. When fully isolated from surrounding flows, maintenance work within aquatic areas would result in minimal or no increases in turbidity.

Secondary effects of the fill associated with maintenance activities would be minimal. Discharge of concrete or rocks within waters of the U.S. would be associated with associated with like-for-like repairs. Thus, impacts would be small in scope. Furthermore, concrete and rocks discharged into waters of U.S. would you not increase turbidity. Vegetation within restoration elements would attenuate turbidity from soils. Discharge of soils would also be limited in scope. Furthermore, much of the permanent fill would also be chemically inert, and would consist of materials such as concrete, rock from a certified source, or pre-seeded turf reinforcement matting, none of which would leach contaminants into the water column. Topsoil would be acquired from a certified contaminant-free source, and would be free of most weed seeds, and free of HTRW, or other contaminants. Thus, potential for long-term leaching of contaminants into the water column would be minimal.

Contaminants

Construction: All temporary fill would be chemically inert and would consist of either concrete k-rails or sandbags comprised of clean sand obtained from a source that is certified in providing contaminant-free materials. Much of the permanent fill would also be chemically inert, and would consist of materials such as concrete, rock from a certified source, or pre-seeded turf reinforcement matting, none of which would leach contaminants into the water column. Topsoil would be acquired from a certified contaminant-free source, and would be free of most weed seeds, HTRW, or other contaminants.

All alternatives would entail excavation at or below the OHWM, potentially allowing for release or suspension of contaminants at or below the ground surface into the water column. All HTRW impacted soil within the project footprint must be remediated to the requirements of the local environmental regulatory agencies and be compatible with the future land uses for and needs of the restoration project prior to the City of Los Angeles providing those lands to the restoration project. At this time, those areas with HTRW impacted soil to be addressed by the City of Los Angeles are anticipated to be the Taylor Yard G1 and G2 sites and the LATC. In addition, groundwater contamination is known to be present due to the San Fernando Valley Superfund Site (SFVSS), and other localized groundwater contamination may also be present. With respect to groundwater contamination that cannot be remediated prior to construction, the City of Los Angeles will design, implement, coordinate and fully fund all treatment and disposal of contaminated groundwater during construction, with regulator concurrence and any necessary permits. These temporary operations should also be consistent with current management of contaminated groundwater at SFVSS and Pollock Well Field. Furthermore, all work areas would be isolated from the River during construction, and storm water runoff at construction locations would be contained according to SWPPP conditions.

Use of construction vehicles increases the potential for accidental release of fuels, solvents, or other petroleum-based contaminants. Although releases of such substances in any part of the construction footprint could drain to the River and thereby affect aquatic resources, releases in the overbank area are most removed from the River and most likely to be contained and removed before reaching the River, compared to releases occurring below the top of the bank. Also, under any alternative, BMPs designed to minimize the potential for release of toxic substances will be implemented. These BMPs are listed in Section 5.11.4 of the IFR.

Under Alternative 10, most of the ground-disturbing work and work involving heavy machinery will occur in the overbank area, outside of the River channel. As with all alternatives, some use of machinery in the channel is anticipated to assist in removing invasive species and to install dewatering equipment. Additional ground-disturbing work and use of construction equipment in the River channel would occur in Reach 4 to create an inlet and outlet for a side channel, and in Reach 6 to lower the channel banks.

Alternative 13 would require ground-disturbing work and use of construction equipment at up to 6 locations within the River channel, not including invasive species removal areas. Measures under this alternative that could increase the potential for releases of contaminants from ground sources into waters of the U.S. include the same measures as under Alternative 10, as well as creation of additional side channels and additional lowering of channel banks.

Alternative 16 would require ground-disturbing work and use of construction equipment at up to 12 locations within the River channel, not including invasive species removal areas. Measures under this alternative that could increase the potential for releases of contaminants from ground sources into waters of the U.S. include the same measures as under Alternative 13, as well as creation of additional side channels, additional lowering of channel banks, terracing banks, and modifying the trapezoidal channel to vertical banks.

Alternative 20 would require ground-disturbing work and use of construction equipment at up to 15 locations within the River channel, not including invasive species removal areas. Measures under this alternative that could increase the potential for releases of contaminants from ground sources into waters of the U.S. include the same measures as under Alternative 16, and would excavate upland area at the mouth of Verdugo Wash in Reach 3 to create additional wetland and riparian habitat.

Alternative 13v would include all measures and impacts of Alternative 13 in Reaches 1-6 and 8. Moreover, Alternative 13v would include restoration measures in Reach 7 identical to those proposed under Alternative 20. Within Reach 7, streams would be daylighted; wetlands would be created; embankments would be terraced; and channel banks would be modified. Ground-disturbing work will be undertaken at Arroyo Seco-River confluence and LASHP.

The potential for accidental release of contaminants from construction equipment into the water column increases as the amount of in-channel work increases. However, impacts would be short term and would be minimized with the implementation of BMPs, such as use of water diversion structures or regulatory requirements such as SWPPPs. Per requirements of ER 1165-2-132 discussed above, long term release of HTRW into the water column under all alternatives would be unlikely.

Under all action alternatives, invasive species would be removed throughout the project area, including the River channel and tributary bottom, during construction. Invasive species in the channel would typically be removed by hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, the fill would be identical to the existing native substrate.

Secondary effects of the fill would mostly be identical for all alternatives. Much of the permanent fill would also be chemically inert, and would consist of materials such as concrete, rock from a certified source, or pre-seeded turf reinforcement matting, none of which would leach contaminants into the water column. Topsoil would be acquired from a certified contaminant-free source, and would be free of most weed seeds; HTRW, or other contaminants. Thus, potential for long-term leaching of contaminants into the water column would be minimal.

Operation: Maintenance activities within waters of the U.S. may require use of excavators, backhoes, or grapple trucks for removal of trash, debris, and sediment. Invasive species removal throughout the project footprint, including the River channel and tributary channel bottom, would typically be performed with hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, the fill would be identical to the existing native substrate. Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases, there may be discharges of fill material associated with the use of earthmoving equipment, such as bulldozers, within newly established waters of the U.S. Though minimal, there is potential for accidental release of petroleum based products from construction equipment into the water column during maintenance activities. However, impacts would be short term and would be minimized with the implementation of BMPs such as use of water diversion structures or regulatory requirements, such as SWPPPs.

Secondary effects of the fill associated with maintenance activities would be minimal. Discharge of concrete, rocks, or soils within waters of the U.S. would be associated with associated with like-for-like repairs. Thus, impacts would be small in scope. Much of the permanent fill would also be chemically inert, and would consist of materials such as concrete, rock from a certified source, or pre-seeded turf reinforcement matting, none of which would leach contaminants into the water column. Topsoil would be acquired from a certified contaminant-free source, and would be free of most weed seeds and free of HTRW or other contaminants. Thus, potential for long-term leaching of contaminants into the water column would be minimal.

Water Flow

Construction: For all alternatives, restoration measures would be designed to not impair flood risk management functions in any portion of the study area or areas downstream. It is assumed that in-channel construction and modification of the project reaches would be conducted outside of the winter storm season (April 15 - October 15) to avoid wet weather storm flows, or that work areas would be adequately protected and not affect flood conveyance. In areas where in-channel construction would occur, diversions would be implemented to bypass dry weather flows downstream. Base flows may be temporarily affected in the immediate construction zone, but would not be affected upstream or downstream of the study area.

Under all alternatives, modifications to the channel will not increase the maximum water surface elevation. Under all alternatives, modifications to the channel are not expected to result in substantial changes to water velocity and circulation. While initial assessment identified that an increase in water surface elevation could occur at transition areas (areas where the channel has geometric changes (transitioning from trapezoidal to rectangular or from a widened section to a narrow section) or changes in construction material (transitioning between soft-bottom and concrete)) 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 will be avoided through design refinements to the project modifications to channel geometry and/or avoidance of introduction of vegetation and enforcing O&M requirements limiting vegetation growth in those areas. Additional hydraulic analysis will be conducted and design modifications will be implemented during the design phase to provide more detail on the channel hydraulics with the recommended plan in place. Under all the alternatives, with implementation of such design refinements, there will be no increase in flood damages through the project area as compared to existing conditions.

Under all action alternatives, invasive species would be removed throughout the project area, including the River channel and tributary bottom, during construction. Invasive species in the channel would typically be removed by hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. Removal of invasive vegetation from in-channel areas would facilitate conveyance of flows and would not increase flood risks.

Operation: Maintenance activities within waters of the U.S. required to maintaining design flow velocity and water surface elevations would primarily entail vegetation maintenance especially in areas where ecosystem restoration features transition to flood risk management elements of LACDA. An operation and maintenance would be developed as part of the project. Full implementation of the maintenance regimen would ensure that maintenance activities do not impact flow velocity, circulation, and water surface elevation.

Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases there may be discharge of fill associated with the use of earthmoving equipment such as bulldozers or temporary stockpiling within newly established waters of the U.S. Impacts will be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges of fill material into waters of the U.S. However, temporary or permanent discharges of fill would not change the design elevations or contours. Invasive species removal throughout the project footprint, including the River channel and tributary channel bottom, would typically be performed with hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, the fill would be identical to the existing native substrate. Removal of invasive vegetation from the project footprint would facilitate conveyance of flows and would not increase flood risks. Thus, changes in velocity and circulation are not expected.

Cumulative Impacts

Due to the reduced flood risks subsequent to the channelization of the River, development increased within the vicinity of the study area, with residential, commercial, and industrial uses

abutting the channel. As development increased, the channel was further modified for bridge crossings, utility crossings, and construction of storm drain outfalls. In addition, maintenance activities were conducted. These modifications and maintenance activities resulted in the discharge of concrete structural fill below the OHWM. Since the River was channelized, concrete-on-concrete discharges would not have resulted in significant impacts to substrate.

Previous construction likely resulted in temporary impacts to water quality during construction. However, increased development in the uplands has resulted in long-term water quality impairments from nuisance flows. The River is consistently listed on the CWA Section 303(d) List from 1998-2010 for water quality impairments. The 2010 Integrated Report CWA Section 303(d) List indicates that the water quality of the River traversing the study area is impaired due to presence of ammonia, copper, lead, algae, and trash.

All action alternatives would entail direct impacts on the physical and chemical characteristics of the aquatic ecosystem due to the discharge of temporary and permanent fill. Furthermore, the potential for impacts to water quality, circulation, and water surface elevations from construction and maintenance would increase from Alternative 10 to Alternative 20 as the amount of in-channel work and required maintenance incrementally increases. However, with implementation of design refinements increase in water surface elevations across all alternatives would be attenuated to a sufficiently acceptable level that would not compromise the flood risk management functions of the River. Furthermore, with implementation of BMPs to fully isolate work areas from surrounding flows, and implementation of SWPPPs, short-term impacts to water quality would be minimal and remain the same across all action alternatives.

Under all action alternatives, there would be incidental benefits to functions of the aquatic environment through increase adsorption and absorption of contaminants. Furthermore, there would be increased structural and functional heterogeneity as concrete structures are modified into vegetative connections, side channels, and in some cases restoration of restoration of full floodplain connectivity within particular reaches. See Section 5.4 of the IFR for further information.

Under all action alternatives, invasive species would be removed throughout the project area, including the River channel and tributary bottom, during construction. Invasive species in the channel would typically be removed by hand tools. Thus, the activity would not result in discharges of fill in most instances and there would be no temporary increases in turbidity. In cases where limited earthmoving may be required, there would be discharges of earthen fill. Impacts to turbidity would be minimal. There would be no impacts to substrate, contaminants or flow characteristics.

In addition to project construction, constructed ecosystem features would be maintained and invasives management conducted throughout the project footprint under all alternatives. Furthermore, the Corps would continue to conduct maintenance for flood risk management operation of the LACDA project in the channel areas outside the restoration features except for invasives removal throughout the in-channel areas. Maintenance would continue to include native vegetation management. Under both maintenance programs there may be discharge of fill associated with the use of earthmoving equipment such as bulldozers or temporary stockpiling within existing or newly established waters of the U.S. Impacts will be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges

of fill material into waters of the U.S. However, temporary or permanent discharges of fill would not change the design elevations or contours. Thus, changes in velocity and circulation are not expected.

Removal of invasive vegetation from the project footprint, including the River channel and tributary channel bottom, would typically be performed with hand tools. Thus, this activity is not expected to result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. Such fill would be identical to the existing native substrate. Impacts to turbidity would be minimal. There would be no impacts to substrate, contaminants or flow characteristics.

The channel is currently surrounded by a developed urban landscape consisting of commercial, public, and residential uses in adjacent areas. As a result, present and future projects in the uplands within the study area would likely entail redevelopment or conversion of existing land uses. Minor modifications to the River channel associated with construction, modifications, and maintenance of existing and future infrastructure such as bridges and utilities are anticipated. Changes to circulation, velocity, and water surface elevations would be mitigated as appropriate for actions requiring Rivers and Harbors Act Section 408, 33 U.S.C. 408, approvals and reviews. Impacts to water quality would be temporary and would be attenuated through CWA Section 401 and Section 404 permitting requirements.

With a renewed public interest in the revitalized River, additional projects within the study area are likely. Future projects include the Atwater Pedestrian-Equestrian Bridge and the Los Angeles Waterwheel. Construction would temporarily affect water quality. However, land uses are expected to remain urban. Thus, the existing water quality impairments are unlikely to change substantially. Therefore, construction of the ecosystem restoration project would not result in cumulative significant impacts to the physical and chemical characteristics of the aquatic ecosystem. See Chapter 5 if the IFR for additional discussion on cumulative impacts.

5.4 Potential Direct and Indirect Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D)

Threatened and Endangered Wildlife

Construction: The only listed species with a potential to occur in the study area is the least Bell's vireo, a federally listed bird species associated with the riparian areas. The study area does not include any designated critical habitat for vireo. Due to the linear and confined nature of existing habitat and the lack of breeding pairs in the most recent survey conducted in 2009, presence of the vireo is unlikely. Pre-construction surveys would be performed with all the action alternatives. If nesting vireos are found, construction in those areas would be halted until the Corps completes consultation with the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act. Construction in areas not occupied with vireo would continue as scheduled. At this time, however, the Corps has determined that no effects to listed species will occur under any of the action alternatives. Please refer to Section 5.5.3 of the IFR for additional discussion. No other special status species are expected to occur due to the degraded conditions within the study area and lack of suitable habitat.

During construction, noise and presence of visual forms associated with an active construction site may discourage establishment of nests or foraging within the vicinity of the construction footprint. Under all action alternatives, invasive species would be removed from the project footprint, including the River and tributary channel bottoms, during construction.

However, construction would not occur simultaneously within the entire project area. The construction footprint would migrate from one location to another over a number of years through the project area. As a result, avian and wildlife species within the active construction zone should be able to relocate to and utilize unaffected areas. Upon completion of construction, presence of native vegetation within the restoration project footprint would indirectly benefit wildlife by restoring regional connectivity to the Santa Monica Mountains, San Gabriel Mountains, and the Verdugo Mountains.

Operation: Maintenance activities within waters of the U.S. required for maintaining habitat restoration or recreational features would primarily entail vegetation maintenance especially in areas where ecosystem restoration features transition to flood risk management elements of LACDA. Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases there may be discharges of fill material associated with the use of earthmoving equipment such as bulldozers or temporary stockpiling within existing or newly established waters of the U.S. Impacts will be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in permanent discharges of fill material into waters of the U.S. However, temporary or permanent discharges of fill material would not change the design elevations or contours.

The only listed species with a potential to occur in the study area is the least Bell's vireo, a federally listed bird species associated with the riparian areas.

The Corps has determined that there will be no effect to least Bell's vireo from operations of the proposed project. Removal of non-native vegetation and trimming of in-channel vegetation to maintain flood conveyance would occur outside the breeding season. Overall, operations will support the establishment and expansion of native riparian vegetation in the restored areas, which has the potential to support future populations of vireo, and may support foraging and stop over habitat for southwestern willow flycatcher and coastal California gnatcatcher. Presence/absence surveys for these species will be performed during operation of the proposed project as part of the Monitoring and Adaptive Management Plan. The Corps and non-Federal sponsor will continue to coordinate with the U.S. Fish and Wildlife Service and the California Department of Wildlife during operations of the proposed project.

Vegetation management activities, including removal of invasive vegetation from the project footprint, including the River channel and tributary bottom, would be scheduled outside of migratory bird nesting season to the extent practicable. However, vegetation management or other types of maintenance may be required during the nesting season in order to maintain design flow velocities; water surface elevations; and conveyance capacity. In such cases, pre-construction surveys for the vireo would be performed prior to maintenance activities. If nesting vireos are found, maintenance activities would be coordinated with a qualified biologist to avoid take, or consultation with the USFWS would first be required.

No other special status species are expected to occur due to the degraded conditions within the study area and lack of suitable habitat. Impacts to threatened and endangered species are not expected to occur.

During maintenance activities, noise and presence of visual forms associated with an active construction site may discourage establishment of nests or foraging within the vicinity of the work area. However, the duration of maintenance activities would be approximately 30 days. Furthermore, the work area would be small and would migrate from one location to another as needed. Other vegetated areas within the ecosystem restoration project and the flood risk minimization project will continue to be available for nesting and foraging. As a result, there would be no indirect impacts to the vireo or other avian species within the project area. Maintenance of the ecosystem restoration elements would indirectly benefit wildlife by maintaining established regional connectivity to the Santa Monica Mountains, San Gabriel Mountains, and the Verdugo Mountains.

Other Wildlife

Construction: Wildlife species that utilize the open aquatic areas, wetlands, and riparian areas along the River channel may be temporarily impacted by construction in those areas, and will experience long-term beneficial impacts from restoration in those areas. In general, species present in the study area are those that are opportunistic and/or habituated to human presence. These species are able to move to alternative locations if they are disturbed by construction activities and, therefore, are not anticipated to be impacted adversely. Alternative 10 would result in the least overall temporary impacts to wildlife, while each subsequent alternative would result in incremental increases in temporary impacts and benefits to wildlife. BMPs would be implemented under all action alternatives to avoid or minimize impacts to wildlife during construction, including but not limited to:

- Vegetation clearing activities would be avoided to the maximum extent practicable in any areas identified as breeding or nesting habitat for any bird species during the breeding season, which generally runs from March 1-August 31.
- If vegetation removal must occur during the breeding season, a qualified biologist would perform nesting bird surveys following established protocol prior to construction. If nests are detected during these surveys, a 300-foot no construction buffer would be delineated around the nest (500 feet for raptors).
- Construction in breeding areas would be monitored by a qualified biologist.
- Construction would be phased to minimize impacts to wildlife species, so that the entire study area would not be under construction all at once to minimize human intrusion.

Under all action alternatives, invasive species would be removed throughout the project area, including the River channel and tributary bottom, during construction. Invasive species in the channel have typically been removed by hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. All BMPs listed above would be implemented during invasive vegetation removal operations.

There would be no permanent loss of native habitat or impacts to wildlife under any action alternatives. Thus, no significant adverse impacts will result. All action alternatives will result

in beneficial impacts to the aquatic ecosystem through the expansion of open water area, soft river bottom area, riparian zones, wetlands, and connection to side channels and tributaries. Beneficial impacts would be commensurate with the footprint of restoration. Thus, long-term beneficial impacts will increase with Alternatives 13, 13v, and 16, with the greatest amount of beneficial impact occurring under Alternative 20.

Operation: Maintenance activities within waters of the U.S. required for maintaining habitat restoration or recreational features would primarily entail vegetation maintenance especially in areas where ecosystem restoration features transition to flood risk management elements of LACDA. Invasive species removal throughout the project footprint, including the River channel and tributary channel bottom, would typically be performed with hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, the fill would be identical to the existing native substrate.

Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases there may be discharges of fill associated with the use of earthmoving equipment such as bulldozers or temporary stockpiling within existing or newly established waters of the U.S. Impacts will be temporary in nature. In other cases, like-for-like structural repair below the OHWM could result in discharges of permanent fill. However, temporary or permanent discharges of fill material would not change the design elevations or contours.

Wildlife species that utilize the open aquatic areas, wetlands, and riparian areas along the River channel may be temporarily impacted by noise and temporary changes in the acreage of invasive vegetation as well as height and density of all vegetation. In general, species present in the study area are those that are opportunistic and/or habituated to human presence. These species are able to move to alternative locations if they are disturbed by construction activities and, therefore, are not anticipated to be impacted adversely. Maintenance of Alternative 10 would result in the least overall temporary impacts to wildlife, while maintenance of each subsequent alternative would result in incremental increases in temporary impacts to wildlife. BMPs would be implemented under all action alternatives to avoid or minimize impacts to wildlife during construction. There would be no permanent loss of habitat or impacts to wildlife under any action alternatives. Thus, no significant adverse impacts will result.

Aquatic Organisms

Construction: As indicated in Section 3.5.3 of the IFR, the study area supports nonnative fish species such as mosquito fish, catfish, and green sunfish, and carp throughout the study reach. Native fish species are not present. In-channel activities during construction will require dewatering. However, dewatering would only occur with phased construction designed to impact isolated areas for short periods of time. As with impacts to wildlife, temporary adverse impacts will be least in Alternative 10, increasing with each alternative, but overall would be temporary and not significant. There would be no permanent adverse impacts to aquatic organisms under any build alternative. Instead, with each increasing footprint in each alternative, a greater area of aquatic habitat will be created or enhanced, resulting in improved conditions for aquatic organisms. This indirectly benefits the rest of the fish and wildlife assemblage in the area through creating more abundant food sources.

Operation: Maintenance activities within waters of the U.S. required for maintaining habitat restoration or recreational features would primarily entail vegetation maintenance especially in areas where ecosystem restoration features transition to flood risk management elements of LACDA. Furthermore, the City of Los Angeles would also be responsible for removal of invasive species throughout the project footprint, including the River channel and tributary bottom. Invasive species within the project footprint would typically be removed by hand tools. Thus, in most instances there would be no impacts to aquatic organisms.

Maintaining design grades, elevations, contours, and conveyance may require in-water work on a periodic basis. In-water work would likely require the use of water diversion structures, such as k-rails or sandbags. Movement of vehicles across earthen substrate during the placement and removal of dewatering structures would temporarily elevate turbidity in the water column. When fully isolated from surrounding flows, maintenance work within aquatic areas would result in minimal or no increases in turbidity. As indicated in Section 3.5.3 of the IFR, the study area supports nonnative fish species such as mosquito fish, catfish, and green sunfish, and carp throughout the study reach. Native fish species are not present. As a result, impacts would result in de minimis impacts to fish population.

Vegetation

Construction: Within each alternative, a number of measures are designed to create additional riparian and wetland habitats, which are closely associated with water and may be indirectly affected by changes to water during construction or operation. During construction, in-water work may temporarily affect riparian vegetation. Impacts would be temporary. Due to the existing seed bank and perennial flow, affected vegetation is expected to recover soon after completion of construction. Under all action alternatives, invasive species would be removed throughout the project area, including the River channel and tributary bottom, during construction. Invasive species in the channel would typically be removed by hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. Invasive species removal would result in a more natural and functional plant community. There would be no permanent loss or impact to existing native vegetation under any action alternative. After construction is complete, under each alternative, new acres of riparian and wetland habitat would be present within the study area. Day lighting uplands culverts will create riparian corridors which will provide additional filtration of storm water entering the system. Riparian and wetland vegetation, along with vegetated embankments, will combine to increase shading of the River, which may reduce microclimate temperatures. Alternative 10 provides the least total area of new vegetation, with increasing areas in each subsequent Alternative, meaning that beneficial impacts increase with each alternative. Alternative 20 provides the greatest area of beneficial impacts.

Operation: Maintenance activities within waters of the U.S. for maintaining habitat restoration or recreational features would primarily entail vegetation maintenance especially in areas where ecosystem restoration features transition to flood risk management elements of LACDA. Invasive species removal throughout the project footprint, including the River channel and tributary channel bottom, would typically be performed with hand tools. Thus, the activity would not result in discharges of fill in most instances. In cases where limited earthmoving may be required, there would be discharges of earthen fill. However, the fill would be identical to the existing native substrate.

Vegetation maintenance would result in temporary changes in the acreage of invasive vegetation as well as the height and density of all vegetation. Maintaining design grades, elevations, contours, and conveyance may require in-water work on a periodic basis. Impacts to during construction would be temporary. Due to the existing seed bank and perennial flow, affected vegetation is expected to recover soon after completion of construction. Impacts would be temporary and less than significant.

Cumulative Impacts

The study area for biological resources includes the River watershed. The River was once a 51-mile-long backbone of a vast system of riparian foothill, riverine, and freshwater marsh habitat that carried seasonal rains and subterranean flows to the coastal plain and the Pacific Ocean. Over time, the River has been degraded by a cycle of increasing urban development, flooding, and channelization, culminating in the mid-20th Century with the LACDA system. The LACDA project encased the River in concrete banks and a mostly concrete bed, and straightened the river's course, thereby significantly diminishing its plant and wildlife diversity and quality, and disconnecting it from its floodplain and significant ecological zones. The entire River corridor is degraded due to historic activities.

During construction activities, noise and presence of visual forms associated with an active construction site may discourage establishment of nests or foraging within the vicinity of the work area. However, construction would not occur simultaneously within the entire project area. The construction footprint would migrate from one location to another over a number of years through the project area. As a result, avian and wildlife species within the active construction zone should be able to relocate to and utilize unaffected areas. Upon completion of construction, presence of vegetation within ecosystem restoration elements would indirectly benefit wildlife by restoring regional connectivity to the Santa Monica Mountains, San Gabriel Mountains, and the Verdugo Mountains. No other special status species are expected to occur due to the degraded conditions within the study area and lack of suitable habitat in the immediate future. Impacts to threatened and endangered species are not expected to occur.

In addition to project construction, constructed ecosystem features would be maintained under all alternatives. Furthermore, the City of Los Angeles would also be responsible for removal of invasive species from the project footprint, including the River channel and tributary bottom areas. The Corps would continue to be responsible for maintaining all other aspects of the portions of the LACDA project that overlap with the restoration project footprint.

Under both maintenance programs vegetation within LACDA project and the ecosystem restoration project would be managed in accordance with the respective operating manuals. Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. During maintenance activities noise and presence of visual forms associated with an active construction site may discourage establishment of nests or foraging within the vicinity of the work area. However, the duration of maintenance activities for both projects would be approximately 30 days. Furthermore, the work area would be small and would migrate from one location to another as needed. Other vegetated areas within the ecosystem restoration project and the flood risk management project will continue to be available for nesting and foraging. As a result, avian and wildlife species within the active construction zone should be able to relocate to and utilize unaffected areas.

The restoration measures in Alternatives 10, 13, 13v, 16, and 20 would contribute to beneficial cumulative impacts to biological resources. These impacts would increase the amount of fish and wildlife habitat; provide greater ecological/biological benefits; aid in linking isolated habitats; help increase the amount of open space; help expand species diversity; and reduce the amount of impermeable surface area in the study area. These impacts would be beneficial from a regional perspective since they would benefit fish and wildlife species that may migrate outside of the study area. These benefits would also accrue to past, present, and reasonably foreseeable projects including the Albion Dairy Park, Griffith Park on the East Bank, Sennett Creek Park, and the Rio de Los Angeles State Parks that are located along or in the vicinity of the River. Cumulative impacts have been assessed in Chapter 5 of the IFR.

5.5 Potential Direct and Indirect Impacts on Special Aquatic Sites (Subpart E)

Sanctuaries and refuges

Construction: There are no sanctuaries or refuges designated under state or federal laws within the footprint of any of the action alternatives. Therefore, no alternative would directly or indirectly impact sanctuaries or refuges.

Operation: There are no sanctuaries or refuges designated under state or federal laws within the footprint of any of the action alternatives. Operations and maintenance would not directly or indirectly impact sanctuaries or refuges.

Wetlands

Construction: Wetlands are known to occur in the soft bottom areas in Reach 2 and in the Glendale Narrows (Reaches 4-6) and at the River-Verdugo Wash confluence. When there is low-energy, sediment-laden flow within these reaches, the sediments will occasionally form sandbars, and remain intact as flow diminishes. Wetland vegetation will establish temporarily on these sandbars until high flows wash them away. Wetland vegetation establishment will vary from year to year due to flows and ongoing LACDA maintenance activities. Because wetland vegetation in the channel does not expand jurisdictional waters and is highly variable, prior to each phase of construction, the project area would be surveyed for the current location of jurisdictional wetlands.

Aside from invasive species removal efforts, the only actions that would occur in the River channel under Alternative 10 would be creation of an inlet and outlet for a side channel in Reach 4 and lowering the channel banks to widen the River in Reach 6. Primary construction for these measures would occur relatively high on the River channel banks, away from any wetlands, which would be found at the bottom of the channel. Construction at the toe of the slope in Reach 6 could occur close to wetlands and may necessitate working in wetland areas, resulting in temporary adverse impacts to this resource. Construction would avoid or minimize impacts to wetlands to the maximum extent practicable.

Unavoidable impacts to wetlands during construction would be temporary. Due to the existing seed bank and perennial flow, affected wetland vegetation is expected to recover soon after completion of construction. Subsequent to construction, Alternative 10 would result in a net gain in wetlands in the study area. Because Alternative 10 has the least amount of construction in the River channel in Reaches 2, 4, 5, and 6, it also has the least potential for adverse impacts to wetlands of any action alternative. New riparian areas would be created in the overbank areas where streams would be daylighted and a side channel constructed, and additional wetlands may form where channel banks are lowered in Reach 6. With presence of sufficient hydrology either seasonally or on a relatively permanent basis, the riparian areas could develop hydric soils, one indicator of jurisdictional wetlands.

Potential for impacts to wetlands under Alternative 13 would be similar to Alternative 10, since the amount of in-channel construction remains similar. Construction would avoid or minimize impacts to wetlands to the maximum extent practicable. Unavoidable impacts to wetlands during construction would be temporary. Due to the existing seed bank and perennial flow, affected

wetland vegetation is expected to recover soon after completion of construction. New riparian areas would be created in Reaches 3 and 4 where streams would be daylighted and side channels constructed in the overbank areas; in Reaches 6 and 7 where channel banks would be lowered; and in Reach 8 where a historic wash would be restored. With presence of sufficient hydrology either seasonally or on a relatively permanent basis, the riparian areas could develop into wetlands.

Potential for impacts to wetlands under Alternative 16 would increase relative to Alternative 13 due to the increased amount of in channel construction associated with terracing the banks and modifying the trapezoidal channel in Reach 5. Construction would avoid or minimize impacts to wetlands to the maximum extent practicable. Unavoidable impacts to wetlands during construction would be temporary. Due to the existing seed bank and perennial flow, affected wetland vegetation is expected to recover soon after completion of construction. New riparian areas would be created in Reaches 3 and 4 where streams would be daylighted and side channels constructed in the overbank areas; in Reach 5 where streams would be daylighted and a concrete-lined, tropical channel would be converted into a soft bottom rectangular channel; in Reaches 6 and 7 where channel banks would be lowered and additional riparian areas would be treated behind the banks; and in Reach 8 where a historic wash would be restored and channel banks would be modified. With presence of sufficient hydrology either seasonally or on a relatively permanent basis, the riparian areas could develop into wetlands.

Potential for impacts to wetlands under Alternative 20 would be similar to Alternative 16. Construction would avoid or minimize impacts to wetlands to the maximum extent practicable. Unavoidable impacts to wetlands during construction would be temporary. Due to the existing seed bank and perennial flow, affected wetland vegetation is expected to recover soon after completion of construction. Furthermore, modifying the trapezoidal channel in Reach 2 to increase the amount of soft bottomed surface area under Alternative 20 could yield additional wetlands.

Under all action alternatives, invasive species would be removed from the project footprint, including the River and tributary channel bottom, during construction. Invasive species within the project footprint would typically be removed by hand tools. Thus, in most instances there would be no impacts to wetlands.

In general, long-term direct or indirect impacts to wetlands are not anticipated. Subsequent to the completion of construction and sufficient growth of plants and vegetation, the ecosystem restoration elements would provide increased wetland functions and services such as increasing foraging and nesting habitat for wildlife especially avian species. Though not designed as treatment wetlands, wetlands within newly created waters of the U.S. would provide some level of filtration commensurate with the duration of water residence times within these areas. There would be an increase in turbidity minimization functions.

Operation: Maintenance activities within waters of the U.S. required for maintaining habitat restoration or recreational features would primarily entail vegetation maintenance especially in areas where ecosystem restoration features transition to flood risk management elements of LACDA. Furthermore, the City of Los Angeles would also be responsible for removal of invasive species throughout the project footprint. Invasive species within the project footprint

would typically be removed by hand tools. Thus, in most instances there would be no impacts to wetlands.

Maintaining design grades, elevations, contours, and conveyance may require in-water work on a periodic basis. Impacts to during construction would be temporary. Due to the existing seed bank and perennial flow, affected vegetation is expected to recover soon after completion of construction. Impacts would be temporary and less than significant.

Long-term direct or indirect impacts to wetlands are not anticipated for maintenance activities within ecosystem restoration elements. Maintenance and adaptive management of habitat elements (such as non-native removal) would ensure that benefits continue to be realized for the life of the project.

Mudflats

Construction: Mudflats are generally found in intertidal, estuarine or near-shore habitats, in deltas, or at river mouths. None of these conditions occur in the study area. Sediment deposits may occur on occasion in some parts of the River, but they do not function as mudflats, which are generally rich biologically and support benthic organisms that are supportive of fish and avian species. The action alternatives would not directly or indirectly affect mudflats.

Operation: As no mudflats are present or will result from construction of restoration features, operations and maintenance activities would not directly or indirectly affect mudflats.

Vegetated shallows

Construction: Vegetated shallows are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as sea grasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems. Vegetated shallows are not present in the study area. The action alternatives would not directly or indirectly affect vegetated shallows.

Operation: As no vegetated shallows are present or will result from construction of restoration features, operations and maintenance activities would not directly or indirectly affect vegetated shallows.

Coral reefs

Construction: Coral reefs consist of skeletal deposits, usually of calcareous or silicaceous materials, and occur in marine environments, which does not exist in the study area. Therefore, there would be no direct or indirect effects to coral reefs.

Operation: As no coral reefs are present or will result from construction of restoration features, operations and maintenance activities would not directly or indirectly affect coral reefs.

Riffle and pool

Steep gradient sections of streams are sometimes characterized by riffle and pool complexes. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a coarse substrate in riffles results in a rough flow, a turbulent surface, and high

dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. Although this habitat type is generally associated with higher-gradient streams, some form of riffle and pool complex may occur where boulders and gravel have accumulated to the extent that they can back up flows to cause pools and allow for increased water velocity or formation of eddies on the downstream side.

Occasional riffle and pool complexes may be found in the soft bottom reaches of the study area and are subject to variation based on flows and maintenance activities (Reaches 2, 4, 5 and 6). Prior to initiation of construction, the study area would be surveyed for the current location of riffle and pool complexes. Per recommendations of the Fish and Wildlife Coordination Act Report, feasibility of constructing riffle and pool complexes in the soft bottom reaches would be further evaluated during the design phase. During construction, the potential for impacts would increase from Alternative 10 through Alternative 20, commensurate with the amount of in-channel work. Construction would avoid or minimize impacts to these features to the maximum extent practicable. Furthermore, the project would create conditions that would allow for the natural formation of riffle and pool complexes.

Under all action alternatives, invasive species would be removed from the project footprint, including the River and tributary channel bottom, during construction. Invasive species within the project footprint would typically be removed by hand tools. Thus, in most instances there would be no impacts to riffle and pool complexes.

Long-term impacts to aeration and downstream scour would be de minimis since the River downstream of the project area would remain channelized. Furthermore, as indicated in Section 3.5.3 of the IFR, the study area supports nonnative fish species such as mosquito fish, catfish, and green sunfish, and carp throughout the study reach. Native fish species are not present. As a result, impacts would result in de minimis impacts to fish population. Under all action alternatives, direct and indirect impacts to functions and services associated with riffle and pool complexes would be temporary.

Implementation of any action alternative may result in indirect long term benefits to aquatic species. Per recommendations of the Fish and Wildlife Coordination Act Report, feasibility of implementing design refinements and placement of measures to support native fish habitat in the study area would be examined during the design phase. The measures in the soft bottom reaches include but are not limited to water shaded by riparian vegetation, riffle and pool complexes, refugia, in-channel woody debris, and gravel and cobble substrates. In concrete reaches the measures may include installation of boulder clusters to provide some refugia for native fish between widened areas depending on results of design analysis.

Operation: Maintenance activities within waters of the U.S. required for maintaining habitat restoration or recreational features would primarily entail vegetation maintenance especially in areas where ecosystem restoration features transition to flood risk management elements of LACDA. Furthermore, the City of Los Angeles would also be responsible for removal of invasive species throughout the project footprint. Invasive species within the project footprint would typically be removed by hand tools.

Maintaining design grades, elevations, contours, and conveyance may require in-water work on a periodic basis. Maintenance activities would avoid or minimize impacts to riffle and pool

complexes to the maximum extent practicable. If disturbed during maintenance activities, riffle and pool complexes would be restored to match pre-construction configurations to the maximum extent practicable. Furthermore, the project would create conditions that would allow for formation of additional riffle and pool complexes.

Long-term impacts to aeration and downstream scour would be de minimis since the River downstream of the project area would remain channelized. Furthermore, as indicated in Section 3.5.3 of the IFR, the study area supports nonnative fish species such as mosquito fish, catfish, and green sunfish, and carp throughout the study reach. Native fish species are not present. As a result, impacts would result in de minimis impacts to fish population. For all maintenance activities, direct and indirect impacts to functions and services associated with riffle and pool complexes would be de minimis.

Cumulative impacts

The River was once a 51-mile-long backbone of a vast system of riparian foothill, riverine, and freshwater marsh habitat that carried seasonal rains and subterranean flows to the coastal plain and the Pacific Ocean. Coral reefs and mudflats have not been present historically within the study area. However, wetlands as well as riffle pool and complexes were likely present. Over time, the River has been degraded by a cycle of increasing urban development, flooding, and channelization, culminating in the mid-20th Century with the LACDA system. The LACDA project encased the river in concrete banks and a mostly concrete bed, and straightened the river's course, thereby significantly diminishing the range and size of special aquatic sites.

In addition to project construction, constructed ecosystem features and invasives removal throughout the project footprint would be maintained under all alternatives. The Corps would continue to be responsible for maintaining all other aspects of the portions of the LACDA project that overlap with the restoration project footprint. Removal of invasive vegetation would benefit recruitment of riparian vegetation and establishment of wetlands.

In-channel work under both maintenance programs may require work within wetland areas. Impacts to wetlands during construction would be temporary. Due to the existing seed bank and perennial flow, affected wetland vegetation is expected to recover soon after completion of construction. Naturally formed or engineered riffle and pool complexes within the ecosystem restoration project would be maintained.

5.6 Potential Direct and Indirect Effects on Human Use Characteristics (Subpart F)

Municipal and private water supplies

Construction: The River is not a source for municipal or private water supplies. It conveys storm flows and discharge from wastewater treatment plants, which are not suitable for potable use. Furthermore, the proposed action alternatives would not alter flows through the system. Therefore, there would be no direct or indirect effects on municipal or private water supplies under any alternative.

Operation: Maintenance activities within waters of the U.S. required for maintaining habitat restoration or recreational features would primarily entail vegetation maintenance especially in

areas where ecosystem restoration features transition to flood risk management elements of LACDA. Furthermore, the City of Los Angeles would also be responsible for removal of invasive species throughout the project footprint. Invasive species within the project footprint would typically be removed by hand tools.

Maintaining design grades, elevations, contours, and conveyance may require limited earthmoving activities on a periodic basis. In such cases there may be discharge of fill associated with the use of earthmoving equipment such as bulldozers or temporary stockpiling within newly established waters of the U.S. Impacts will be temporary in nature. In other cases like-for-like structural repair below the OHWM could result in discharge of permanent fill. However, temporary or permanent discharges of fill would not change the design elevations or contours. Because the River is not a source for municipal or private water supplies, in-channel work would not directly or indirectly affect municipal or private water supplies.

Recreational and commercial fisheries

Construction: Recreational fishing at the Elysian Valley area (Reaches 4-6) is authorized during the summer months from Memorial Day through Labor Day by the Mountains Recreation and Conservation Authority and City of Los Angeles in cooperation with the Corps and County of Los Angeles. Though access is generally discouraged or unauthorized during other times of the year, recreational fishing still occurs. Fish within the Glendale Narrows reach are nonnative, primarily mosquito fish, catfish, and green sunfish, and carp. There is no commercial fishery associated with the River.

Short-term adverse impacts may occur to the recreational fishery if pools where fish may occur are made inaccessible during construction. Due to construction phasing, the amount of area made inaccessible at any given time would be a minor amount of the available area, so adverse impacts would likewise be minor and short-term. This type of effect would be least under Alternative 10 since it has the smallest amount of in channel construction, and greatest under Alternative 20 since it has the greatest amount of in channel construction. Under all action alternatives, impacts would be temporary.

Implementation of any build alternative may result in indirect long term benefits to aquatic species and recreational fishing. Per recommendations of the Fish and Wildlife Coordination Act Report, feasibility of implementing design considerations and placement of measures to support native fish habitat in the study area would be examined during the design phase. The measures in the soft bottom reaches include but are not limited to water shaded by riparian vegetation, riffle and pool complexes, refugia, in channel woody debris, gravel and cobble substrates. In concrete reaches the measures may include installation of bolder clusters to provide some refugia for native fish between widened areas.

Water-related recreation

Construction: Kayaking and fishing are permitted in the Elysian Valley area (Reaches 4-6) from Memorial Day to Labor Day each year through the Mountains Recreation and Conservation Authority and City of Los Angeles in cooperation with the Corps and County of Los Angeles. Under all alternatives, access may be limited during construction if parts of these reaches need to be restricted for dewatering. Impacts would be temporary.

Alternative 10 proposes the least construction in Reaches 4-6, and would therefore have the least temporary effect on water-related recreation.

Alternative 13 proposes additional restoration measures. These measures may require construction access in the River channel. Thus, a larger portion part of the channel maybe restricted during construction than under Alternative 10.

Alternatives 16 and 20 propose the same measures in Reaches 4 and 6 as Alternative 13, and add the measure of modifying the banks to a vertical wall on one side and primarily terracing the bank on the other in Reach 5. This additional measure may require construction access in the River channel, meaning that a larger portion of the channel may be restricted during construction than under Alternative 13.

Alternative 13v would include all measures and impacts of Alternative 13 in Reaches 1-6 and 8. Moreover, Alternative 13v would include restoration measures in Reach 7 identical to those proposed under Alternative 20. Within Reach 7, streams would be daylighted; wetlands would be created; embankments would be terraced; and channel banks would be modified. This additional measure may require construction access in the River channel. However, since water related recreation is not supported in Reach 7, impacts to water-related recreation would be identical to Alternative 13.

There would be long-term, indirect benefits to water-related recreation upon completion of the ecosystem restoration project. As noted above, the study area already supports water-related recreation through the Mountains Recreation and Conservation Authority. With increasing public interest in a revitalized River, the ecosystem restoration project would likely catalyze implementation of future water-related recreational programs.

Operation: Maintenance activities within waters of the U.S. required for maintaining habitat restoration or recreational features primarily entail vegetation maintenance especially in areas where ecosystem restoration features transition to flood risk management elements of LACDA as well as invasive management throughout the project footprint, including the River and tributary channel bottom. Maintaining design grades, elevations, contours, and conveyance may require in-water work on a periodic basis. In-water work during from Memorial Day to Labor Day may temporarily disrupt kayaking, fishing, or other authorized recreation programs. However, since work would likely be localized, impacts would be de minimis and temporary.

Indirect benefits to water-related recreation from maintenance activities would be limited. In general, maintenance activities would ensure that the ecosystem research elements are maintained to design specifications and would not interfere with flood risk minimization functions of the LACDA project.

Aesthetics

Construction: As noted in the IFR, minor, short-term adverse impacts to aesthetic resources are likely to occur under all action alternatives during construction. The proposed restoration measures under all alternatives require large equipment to be present to conduct extensive earthwork and in-channel construction. The extent and duration of temporary impacts is commensurate with the scope of the construction footprint, increasing from Alternative 10 to Alternative 20.

The fewest temporary adverse impacts would occur under Alternative 10, since it entails the smallest construction footprint and would occur over the shortest timeframe (9 years). There would be no significant adverse impacts from this alternative.

Alternative 13 and 13v would have more adverse and beneficial impacts than Alternative 10 due to the larger footprint of construction, and would occur over a longer time period (10 years). There would be no significant adverse impacts from this alternative.

Alternative 16 and 20 would have more adverse and beneficial impacts than Alternative 13 and 13v due to the larger footprint of construction, and would occur over a longer time period (15 year). There would be no significant adverse impacts from this alternative.

Long-term beneficial impacts would occur under all action alternatives. The benefits are commensurate with the scope of the construction footprint, increasing from Alternative 10 to Alternative 20. Management measures common to all alternative would benefit aesthetics. Riparian plantings would occur under all action alternatives as would non-native plant removal, trash removal, installation of linear strips for biofiltration, greening of River channel walls, and creation of buffer zones and planted swales. These common elements require little to no machinery, can be implemented quickly, and would have less than significant impacts on aesthetic resources.

There would be long-term, indirect benefits to aesthetics upon completion of the ecosystem restoration project. Currently, views from waters of U.S. are composed of trapezoidal concrete or rectangular channels, urban development at the top of banks, perennial water, debris, graffiti, and intermittent vegetation. With the project, existing views of the River composed of linear lines, sharp angles and other geometric forms as well as industrial colors and textures associated with an engineered channel would be attenuated by non-linear forms, heterogeneous textures and a natural color palette associated with a vegetated River. Furthermore, future projects within waters of the U.S., such as the Atwater Pedestrian-Equestrian Bridge or the Los Angeles Waterwheel, would juxtapose unique architectural elements against the enhanced natural views. With increasing public interest in a revitalized River, the ecosystem restoration project may catalyze implementation of future projects that would further accentuate the aesthetic elements described above.

Operation: Maintenance activities within waters of the U.S. for maintaining habitat restoration or recreational features would primarily entail vegetation maintenance especially in areas where ecosystem restoration features transition to flood risk management elements of LACDA. Furthermore, the City of Los Angeles would also be responsible for removal of invasive species throughout the project footprint. Invasive species within the project footprint would typically be removed by hand tools. Removal of invasive vegetation would benefit recruitment of riparian vegetation and establishment of wetlands.

Vegetation maintenance would result in temporary changes in the height and density of vegetation, affecting aesthetics. Impacts to during construction would be temporary. Due to the existing seed bank and perennial flow, affected vegetation is expected to recover soon after completion of construction. Furthermore, since work would likely be localized, impacts would be de minimis and temporary.

Indirect impacts to aesthetics from maintenance activities would be limited.

Parks, national and historical monuments, national seashores, wilderness areas, and research sites

Two state parks and several city parks are located in the study area, and would be affected by construction. There are no national parks, national or historical monuments or seashores, wilderness areas, or research sites in the study area.

Temporary partial closure of Harding Park Golf Course, and temporary full closure of Los Feliz Golf Course, would occur under all alternatives. This is considered a less than significant adverse impacts because closures would be phased and golfers would have options to golf elsewhere during construction. Conversion of a small portion of the LASHP to wetland habitat is proposed under Alternative 20, but this is not expected to result in a significant impact as the new use is consistent with the parks' general plan.

Operation: Maintenance activities within waters of the U.S. within the River would not affect parks. However, maintenance of restored historic channels in the uplands could be located in parks and result in temporary closure of the immediate area surrounding the restoration feature. Impacts would be de minimis and temporary.

Cumulative impacts

The study area encompasses a built out urban environment with residential, commercial, industrial, and recreational land uses. As a result, present and future projects within the study area would likely entail redevelopment or conversion of existing land uses. Thus, the existing urban viewshed is unlikely to change substantially. The views from waters of U.S. are composed of trapezoidal concrete or rectangular channels, urban development at the top of banks, perennial water, debris, graffiti, and intermittent vegetation. The project would substantially alter the views from waters of the U.S. Existing views of the River composed of distinctive form, line, color, and texture associated with an engineered channel would be attenuated by non-linear forms, textures and color palette associated with a vegetated channel. Furthermore, future projects within waters of the U.S., such as the Atwater Pedestrian-Equestrian Bridge or the Los Angeles Waterwheel, would add unique architectural elements to views from waters of the U.S. Cumulative impacts to aesthetics would be beneficial and significant.

Existing recreational uses within the vicinity of the study area includes a number of parks. Immediately adjacent to the study area is Griffith Park, a large regional recreational area that supports many recreational activities. Recreational opportunities along the study reach include year-round jogging and biking trails. In addition, annual kayaking and fishing in the River during summer months is offered through the Mountains Recreation and Conservation Authority. The project would indirectly increase recreational opportunities within the study area. Demand for recreation is expected to increase proportionally to population growth in the study area. Furthermore, due to the increasing public interest in revitalizing the River, implementation of additional recreational programs or construction of recreational amenities within the vicinity of the study reach in the future is likely. Cumulative impacts to recreation would be beneficial and significant.

The River is not a source for municipal or private water supplies. It conveys storm flows and discharge from wastewater treatment plants, which are not suitable for potable use. In consideration of the on-going drought in the Los Angeles area and an increasing emphasis on water conservation to augment water supplies, future implementation of programs and infrastructure to utilize existing flows remains a possibility. Due to real estate requirements and technical challenges for establishment of large groundwater recharge basins within the vicinity of the study area, future projects would likely entail small-scale demonstration or pilot programs. Impacts to water supplies would be less than significant.

Please refer to Section 5 of the IFR for the scope of analysis and discussion of past, present, and reasonably foreseeable future projects.

5.7 Evaluation and Testing (Subpart G)

All action alternatives would entail discharges of fill materials within waters of the U.S. Temporary discharges of fill would entail dewatering structures such as k-rails and sand bags. Dewatering structures would be removed upon completion of each phase of construction. Permanent discharges of fill would entail discharges of rock, concrete, reinforced vegetated matting, and top soil.

Both temporary and permanent fills would be chemically inert and would not leach contaminants into the water column. Topsoil would be acquired from a certified contaminant-free source to ensure that fill material is most likely to be free from chemical, biological, or other pollutants. Thus, topsoil would be suitable for discharge into the aquatic environment. Per 40 C.F.R. 230.60(a), additional chemical, biological, and physical evaluation testing would not be required.

6.0 Measures to Minimize Adverse Impacts (Subpart H)

Under any alternative, the following measures will be taken prior to and during construction to monitor the degree of impacts related to wetland and riparian construction, and to ensure that materials used in construction or operations are appropriate for use in an aquatic restoration project.

- Sources of seeds used for revegetation and soils used for backfilling will be required to show that they are weed free to the degree possible.
- Soils and all materials used for backfilling or stabilization must be certified to be free of contaminants.
- All sites with known and suspected HTRW soil contamination will be investigated and remediated prior to project construction. All groundwater contamination that cannot be remediated prior to project construction will be subject to appropriate handling, treatment and disposal ensured by the non-Federal sponsor. All work shall be consistent with ER 1165-2-132.

Construction plans will identify optimum phasing and timing and specify the guidelines for minimum standards necessary to protect soils, biological resources, and water and prevent generation of fugitive dust. Specific guidelines may include;

- Limiting certain aspects of in-channel construction outside of the winter storm season (April 15 - October 15) to minimize soil erosion.
- Installing silt fences around construction areas to prevent silt and sediment from entering the River channel.
- Designing and implementing a dewatering plan to avoid operating equipment in flowing water by using temporary cofferdams or some other suitable diversion to divert channel flow around the channel and bank construction area.
- Complying with an established Spill Prevention and Response Plan, which would define requirements for storage, handling, and containment of hazardous materials.
- Developing and implementing a storm water pollution prevention plan.
- Vegetation clearing activities would be avoided to the maximum extent practicable in any areas identified as breeding or nesting habitat for any bird species during the breeding season, which generally runs from March 1-August 31.
- If vegetation removal must occur during the breeding season, a qualified biologist would perform nesting bird surveys following established protocol prior to construction. If nests are detected during these surveys, a 300-foot no construction buffer would be delineated around the nest (500 feet for raptors).
- Construction in breeding areas would be monitored by a qualified biologist.
- Construction would be phased to minimize impacts to wildlife species, so that the entire study area would not be under construction all at once to minimize human intrusion.
- Stabilizing and reseeding disturbed areas with native grasses, shrubs, and trees after construction is complete.
- Conducting operation and maintenance during times of the year when wildlife is not likely to be breeding or nesting.
- Avoiding sensitive habitat types to the degree possible when performing maintenance,
- Prior to initiation of construction of each project phase, the relevant portion of the project area would be surveyed for wetlands. Construction would avoid or minimize impacts to wetlands to the maximum extent practicable.
- Prior to initiation of construction of each project phase, the relevant portion of the project area would be surveyed for riffle and pool complexes. Construction would avoid or minimize impacts to these features to the maximum extent practicable.

7.0 Summary of Effects to the Aquatic Environment

In general, potential for temporary impacts during construction would increase from Alternative 10 through Alternative 20, commensurate with the increasing scope for a number of aquatic resources. However, with implementation of measures to minimize adverse impacts, there would be no permanent loss or reduction of aquatic functions and services for any build alternative.

8.0 Conclusion

Alternatives 10, 13, 13v, 16, and 20 meet the overall project purpose and are practicable with respect to cost, technology, and logistics (See Section 4.3, 4.4, and 4.5). All action alternatives would entail significant impacts to non-aquatic resources (See Section 4.7). *The long term benefits to aquatic services and functions would be commensurate with the scale of construction and associated impacts.* The acreage of permanent fill within existing waters of the U.S. would increase from Alternative 10 (4.52 acres) through Alternative 20 (65.61 acres). The acreage of temporary fill would also increase correspondingly. However, all temporary fill would be removed upon completion of construction. Likewise, the acreage of new waters of the U.S. created will increase from Alternative 10 (56 acres) through Alternative 20 (156.9 acres).

All action alternatives would entail discharges of permanent fill into waters of the U.S. The discharge of fill material is required for the restoration of aquatic functions and services within waters of the U.S, and stabilization of new waters of the U.S. The discharge of permanent fill material would not result in the permanent loss of existing waters of the U.S.

All action alternatives would require implementation of environmental commitments to further avoid and minimize effects to the aquatic environment. No significant adverse impacts to aquatic resources have been identified in the IFR. No take of protected or sensitive aquatic species would occur under any build alternative.

Based on the preliminary analysis above, the project is in compliance with the Section 404(b)(1) Guidelines. The final 404(b)(1) evaluation and Findings of Compliance will be included with the Record of Decision for this project.

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

Final
USFWS Coordination Act Report (CAR)
Appendix N

September 2015

Appendix N: U.S. Fish and Wildlife Service (USFWS) Coordination Act Report (CAR)

Summary

The U.S. Army Corps of Engineers (Corps) has coordinated with the U.S. Fish and Wildlife Service (USFWS) on the Los Angeles River (LAR) Ecosystem Restoration Feasibility Study throughout the planning process. USFWS participated in the project's stakeholder charettes in December 2009 and throughout the Habitat Evaluation (CHAP) process.

The Corps also coordinated with USFWS per the Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. 703, et seq.), which provides the authority for involvement of the USFWS in evaluating impacts to fish and wildlife from proposed water resource development projects. Federal agencies undertaking water projects are required to fully consider recommendations made by the USFWS regarding the conservation, maintenance, and management of wildlife resources and habitat, which are provided in a Coordination Act Report (CAR) or Planning Aid Letter (PAL). For this project, USFWS was funded to prepare a CAR.

USFWS provided preliminary CAR recommendations on the project in November 2013, and the Draft CAR was submitted to the Corps in January 2014. The Corps coordinated with USFWS during development of the CAR from November 2013 to January 2015. The Corps met with USFWS regarding the CAR recommendations on September 29, 2014 and on October 30, 2014. The Corps fully considered the CAR recommendations and committed to continued coordination with USFWS during the detailed design phase of the project. The Corps received the revised Final CAR on January 5, 2015. The CAR and the Corps' responses to the CAR's recommendations are included in this Appendix N.

The Corps will continue coordination with USFWS regarding the CAR recommendations and ways to improve project designs for fish and wildlife resources.

The following documents the specific recommendations from the U.S. Fish and Wildlife Service's (USFWS) Coordination Act Report (CAR) and the Corps' responses to these recommendations. The Corps has coordinated with USFWS throughout development of this CAR. The complete CAR is included in this Appendix N.

RECOMMENDATIONS SUMMARY

The FWCA states that "…wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs through the effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation." With the following recommendations we are suggesting "…measures that should be adopted to prevent the loss of or damage to …wildlife resources, as well as to provide concurrently for the development and improvement of such resources."

Available funding for fish and wildlife conservation is sparse and usually competitive, normally limiting related actions. Expending conservation resources in areas of high human density is quite costly and often considered less likely to succeed. Yet, coastal southern California contains a large fraction of endemic at-risk species and (now) rare ecosystems, as well as the state's three largest metropolitan regions. As such, understanding the context and capacity to enhance, restore, conserve, and access ecosystems and native fish and wildlife species within this highly urbanized coastal region is a conservation/societal priority. The values of partially restoring and enhancing the ecosystems of the River are greater than the potential biological conservation benefits alone.

As outlined below, we generally suggest that the designs for proposed Project be developed with a stronger focus on principles of restoration of stream natural communities and processes. We understand that the Study Area is within a heavily populated urban area, and we acknowledge that the varied constraints to ecological restoration of the River are tremendous; we are also well aware that the Project design selected cannot increase flood risks.

Based on our Project discussions, the Corps appears to define partial ecological restoration as improvements in habitats or ecological functions. As we have noted above, we expect that full or partial restoration also includes a self-sustaining component as essential to the definition of restoration, even in highly constrained project areas. This is more than semantics, due to the considerable number of restoration projects continuing to be developed and reviewed by our agencies; it is important that we understand each of our respective definitions. While ecological improvements and benefits such as artificial enhancements are highly important and valuable in many areas, we continue to stress the essential long-term importance of at least partial recovery of self-sustaining ecological functions for restoration projects. For example, this would mean evaluating whether proposed native vegetation in some planting areas would not only survive in the long-term without permanent irrigation, but would it also effectively reproduce and replace itself (or naturally succeed) both over time and following expected disturbances such as periodic flooding events.

In part, the current proposed Project designs (all alternatives) appear substantially compromised by proposed recreational, and aesthetic features, often at the expense of otherwise practicable ecological restoration potential (e.g., restoration of relatively natural complexities of processes, substrates, channel/floodplain forms, and natural communities/habitats in some areas). The current designs in many locations are also heavily compromised by the lack of channel widening; this is understandable given the consistent need to maintain channel flood flow capacity and the surrounding constraints. It is understood that widening the channel and floodplain cannot be practicably accomplished throughout the whole Study Area with the subject Project. The resultant potential for partial restoration of ecological functions in these areas of unwidened channel is quite low.

RESPONSE TO SUMMARY:

The Corps appreciates the summary comments from the USFWS and, as has been expressed at meetings between the two agencies, we share the goal of restoring a self-regulating, dynamic ecosystem within the constraints imposed by the existing flood risk management project along this highly urbanized river. Corps restoration guidance supports restoring ecological functions that "mimic, as closely as possible, conditions which would occur in the area in the absence of human changes to the landscape and hydrology" (ER 1105-2-100). As the USFWS has noted, channel widening throughout all project reaches in order to restore ecological functions is constrained by the need to maintain the flow capacity requirements of the existing flood damage reduction project.

Corps planning guidance values the "ability of the restored area to continue to function and produce the desired outputs with a minimum of continuing human intervention" and emphasizes the development of restoration projects, to the extent possible, "in a systems context… in order to improve the potential for long-term survival as self-regulating, functioning systems" (USACE 2000). Corps guidance on ecosystem restoration underscores the importance of restoring structure, function, and dynamic processes that have been degraded, as well as reestablishing attributes of a naturalistic and interconnected systems (EP 1165-2-501; EP 1165-2-502). While a fully functioning ecological system is not achievable in every portion of the project area, the project as a whole meets the Corps' criteria for ecosystem restoration, in that all features collectively contribute to habitat, function, and ecological connectivity creation and improvement.

As documented in the IFR (Integrated Feasibility Report), the project restores native vegetation, wildlife habitat, and ecosystem functions within each reach at varying levels. Wherever possible with available lands, river widening has been included as a project measure to maximize restoration of natural hydrologic functions and support self-sustaining ecologic functions. Other areas rely on surface flows to support native vegetation on the overbank. The proposed project also supports ecological connectivity between widened areas.

With recent input from USFWS, opportunities for additional connectivity have been identified in reaches 1, 3, and 7. The Corps has committed to further evaluate these areas in the design phase, in partnership with USFWS, to ensure that opportunities for wildlife movement are provided throughout the project area.

The proposed project would restore self-sustaining riverine and riparian functions in widened areas and provide opportunities for both aquatic and terrestrial wildlife foraging, shelter, and movement between widened areas in order to meet the Corps' criteria for ecosystem restoration.

The Corps disagrees that the project is compromised by recreational and aesthetic features. As required by Corps policy, the project's Recreation Plan was developed after restoration features were planned and is designed to be compatible with restoration features. Recreation features include passive activities such as hiking, walking, and wildlife viewing. Widened areas supporting restoration of a more natural hydrologic regime such as Taylor Yard and LATC (a.k.a. Piggyback Yard) will also support a limited length of dirt/gravel trails that will not impede hydrologic and ecologic functioning. No features were developed purely for aesthetic improvement.

The Corps has reaffirmed its commitment to the environment by formalizing a set of "Environmental Operating Principles," which are applicable to all of its decision-making and programs. The principles are described in Engineering Circular 1105-2-404 "Planning Civil Work Projects under the Environmental Operating Principles," 1 May 2003. The Implementation Guidance for the Corps Environmental Operating Principles defines environmental sustainability as "a synergistic process whereby environmental and economic considerations are effectively balanced through the life cycle of project planning, design, construction, operation and maintenance to improve the quality of life for present and future generations." In accord with this definition, the Corps' goal is to strive to achieve the appropriate balance between the economic and environmental benefits provided by a project.

The Corps values the close working relationship it has with the USFWS and appreciates the USFWS's continued willingness to discuss the proposed project and assist with project refinements to maximize restoration potential.

RECOMMENDATION 1

We promote the restoration and enhancement of fully functioning and self-sustaining ecosystems, where and to the extent practicable. As we have noted otherwise herein, the River is not restorable to a self-sustaining, full function stream system, even within the proposed widened floodplain areas of the Project, due to the constraints of the Study Area and watershed (e.g., reduced fluvial sediment supply from upstream, modified hydrograph, water quality and temperature, etc.). On the

other hand, substantial enhancement and partial restoration of the River is practicable in respective portions of the Study Area. The proposed Project has good basic goals and objectives in relation to general fish and wildlife resources, though they (combined with the Project description and figures) are currently too vague for us to assess the fundamental ecological functions and values of restoration and enhancement that would be implemented. Pursuant to the current Project goals and objectives (to the extent practicable), we suggest the Project designs be modified to more clearly focus on restoration of substantially more natural function of riverine and riparian natural communities in the Project. The proposed channel/streamside ecological structures and natural communities within the River reaches to be partially restored/widened (e.g., former rail yards) should be designed to be more like similarly situated southern California River reference sites (e.g., less open/slow moving water areas), including designing in greater channel/aquatic and riparian area complexity and utilizing natural community compositions and substrates that support higher sensitive taxa richness. The current proposed designs and descriptions for restoration areas read more like landscaping plans than restoration plans. The objectives, designs, and Project description should indicate enough specificity to allow evaluation of the rough elemental ecological gains that would be made (for example, specify the individual minimum acreage of valley foothill riparian strand, freshwater marsh, etc., that would be created or enhanced in each reach, instead of consistently lumping this information); these data are currently lacking. We commend the integrated multi-project, step-wise approach planned for partial restoration and enhancement of the River that would be hopefully continued with future projects.

RESPONSE 1:
As described in previous coordination with USFWS, the objectives as currently defined are appropriate and reflective of the naturally occurring habitat that the project restoration is proposing to achieve. Objectives are described in Section 4.2 of the IFR, with measurable objectives criteria outlined in Section 4.2.2. The final array of alternatives meets these objectives' criteria based on Corps standards as described in Section 6.2, Tables 6-2 and 6-3. These objectives allow us to optimize conceptual designs to achieve benefits for multiple species within variable urban site conditions and constraints. In the design phase, the next phase in the process, the Corps will elaborate on the current conceptual plans and further delineate the complexities of the proposed habitats. The overall goal of the restoration effort is to restore more natural functioning of riverine and riparian communities in the study area. Especially based on recent discussions with the USFWS, the Corps is confident that the ecological value of the identified habitat types will be maximized.

The Corps has proposed full functioning ecological restoration wherever it can be achieved, which because of the urban context of the study area, occurs primarily in widened areas of the river where properties containing historic floodplain adjacent to the river can be acquired. In planning these features, the Corps strived to use any available lands within and outside the river to provide opportunities for restoration of a more natural hydrologic regime that will support complex, self-sustaining native southern California river habitat. The detailed designs will further describe and

delineate the specific suite and interrelationships of substrates, hydrologic and geomorphic features, and vegetation to be restored in these areas. Most similarly situated southern California rivers, i.e., larger perennial systems, with similar flow and gradient both in the watershed and in southern California, generally also have altered hydrologic and hydraulic functioning. Given the constraints in the study area, the project would not be able to reproduce these altered conditions or mimic reference site responses exactly. However, reference conditions from these other sites could be extrapolated to align with the dynamics of the Los Angeles River through the project area. Reference sites to be considered for detailed design, particularly for design of habitat for Santa Ana sucker and Least Bell's vireo, may include portions of the Santa Ana River which currently supports target habitats and populations of both species.

The plans provided are at a conceptual level and contain planting plans and habitat configurations for the purposes of restoration; the plans are not appropriate for nor do they contain the specificity of landscape plans. Many of the proposed restoration areas are currently comprised of urban land uses, where concrete will be removed. Since the majority of restored areas are being graded from current urban (often industrial) uses, some amount of planned planting is expected to be needed in the initial stages of restoration, as native vegetation in these areas is currently limited to nonexistent (i.e., limited seed bank for natural recruitment). Active planting and temporary irrigation will initially be required in these areas to begin establishing native vegetation. The plans provided in the report are indicative of the planting to be implemented initially; however, over time, storm events will bring seed material from upstream, actively planted vegetation will establish a new seed bank in the soil, the restored natural hydrologic regime will develop dynamic braided channels will form, and areas denuded through scour or other disturbance are expected to naturally re-establish. Once these processes are reestablished, O&M consisting mainly of invasives removal can be implemented as necessary to support passive restoration in widened areas.

Temporary irrigation will be used to establish restored vegetation in widened and overbank areas, after which vegetation is expected to be self-sustaining, requiring minimal maintenance and relying on groundwater and surface flows to persist. Temporary irrigation will also be used to establish vegetation in the concrete channel walls (e.g., vegetated terraces, vegetation hanging from top of bank). Detailed design will identify all water sources to support the proposed vegetation within the concrete channel walls, including surface flows and runoff that may be redirected to sustain this vegetation and avoid permanent irrigation (See Section 4.4.5 of the Final IFR, measure 4a).

Passive restoration will also be implemented for existing vegetation in the soft bottom portions of the channel where trash and invasives removal will occur. The Final IFR document includes clarifications regarding passive restoration and provisions for natural

hydrologic functioning in widened areas.

Information regarding acreages of habitats created is provided in Table 6-7 of the IFR. Chapter 7 of the IFR describes the Recommended Plan and NER Plan in terms of features restored by reach. The Corps will continue to provide detailed restoration and habitat information during the PED (Pre-Construction Engineering & Design) phase as coordination with USFWS on detailed project features continues.

RECOMMENDATION 2

Of the Project alternatives currently proposed, we recommend Alternative 20, with modifications (as noted below). Alternative 20 has the highest potential of the proposed alternatives to restore considerable ecological functions of the River. In order to perform any substantial riverine and riparian restoration or enhancement on the River (and maintain current flood flow capacities for flood risk management), the right-of-way (ROW) and floodplain currently utilized by the River will need to be re-widened in considerable River reaches (as noted in the 2013 EIS/EIR). This is because effective restoration cannot be performed within the confines of the existing channelized River without reducing flood carrying capacity of that same channelized reach (e.g., due to channel "roughness" associated with mature woody vegetation) unless a wider/larger area to carry the same flood flows is provided. As such, truly effective ecological restoration of the River (partial restoration) can only occur in areas of widened River ROW.

We recommend substantive modification of any approved Project alternative to increase the focus of proposed Project resources on practicable levels of restoration of River hydrology and geomorphology. We expect that the current proposed designs (all proposed alternatives), if implemented, would result in improvements, but relatively small native fish and wildlife resource net gains and overall low ecological integrity and function for these species within Project restoration and enhancement areas, due to very important remaining stressors such as: a) resultant low complexities of substrates/ geomorphology/ hydrology/ natural communities; b) large areas of artificial (slow moving low flow) open water and channel; c) high human disturbance near stream banks; d) low cover levels, structure, and diversity (e.g., age classes) of native riparian and riverine vegetation; and e) substantial use of proposed hard structures. These stressors can be reduced with potential Project designs, such as maintenance of relatively natural lotic (flowing water; we suggest less area of still, open water) conditions over the length of the Study Area, but some of these stressor would remain with all practicable designs. Considering the constraints involved, we nevertheless suggest that it is practicable for the designs for Project restoration areas (areas of widened floodplain) to be more "wild" and less "naturalistic"[15]/ordered (such as by hard structures and slope protection) than as shown within Project concept drawings and designs.[16]

[15] Naturalistic: looking similar to what appears in nature; not looking artificial or man-made. Not necessarily retaining the functional characteristics of natural ecosystems, such as self-sustainability, functional food webs/native species interactions, etc.

[16] In email attachment to us dated 25 November 2014, the Corp[s] noted: "The Corps' intent is that the stressors described will be addressed in widened areas, where increased flood capacity will allow for varied substrates

We suggest that riverine and riparian ecological (partial) restoration be more clearly the primary goal within the specific River reaches to be widened. For instance, most widened floodplain areas should be designed for riparian scrub-woodland-forest communities relatively similar to those that existed historically in the Project reaches, including providing for cyclical and episodic succession of riparian natural community age classes over time following denudation events (floods). Proposed Project designs should rely on utilization of existing groundwater (e.g., less than 6 to 8 ft from the ground surface for riparian natural communities) and natural surface water flows for native vegetation needs (e.g., see Stromberg et al. 1996; Stromberg 1998). Restoration of widened floodplain areas should also be designed with the expectation of some channel form changes over time: large flood events should be allowed to provide some channel re-setting (geomorphic change) action within the necessary outside flood risk management sideboards of widened River reaches.

RESPONSE 2:
Alternative 20 is the Locally Preferred Plan (LPP) and the Corps' recommended plan. The Corps agrees that it has the potential to restore considerable ecological functions of the River.

As outlined in the feasibility study, aquatic ecosystem restoration is the primary goal and the driver for development of all alternatives. Each alternative strives to maximize aquatic and riparian restoration. The Corps has worked closely with the non-Federal sponsor to consider all areas within the project footprint that can be acquired for widening, with Alternative 20 supporting the maximum amount of widening. The Corps has proposed full functioning ecological restoration wherever it can be achieved, which because of the urban context of the study area, occurs primarily in widened areas of the river where properties containing historic floodplain adjacent to the river can be acquired. In planning these features, the Corps strived to use any available lands within and outside the river to provide opportunities for effective restoration of a more natural hydrologic regime that will support complex, self-sustaining native southern California river habitat while maintaining the necessary flood protection. Passive recreation is included where it is compatible with the ecosystem restoration features.

The Corps' intent is that the stressors described will be addressed in widened areas,

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and natural hydrology, high vegetative cover and structural diversity, and very limited and well-buried hard structures. Open water areas will be designed to support native fish such as Santa Ana sucker and Arroyo chub, including riffle/pool/glide sequences. Human disturbance is expected to be minimal in widened areas, where recreational dirt trails will be designated. In widened areas, it is expected that the active channel will migrate and change form and that sediments will be redistributed with storm events. Vegetation is expected to be denuded with natural higher flows and velocities, and be re-established naturally. Any grade stabilizers in these areas will be well buried, and not visible from the surface."

where increased flood capacity will allow for varied substrates and a more natural hydrologic regime, high vegetative cover and structural diversity of historically occurring riparian communities, and very limited and well-buried hard structures. Monitoring of depth to groundwater will be included as part of the Monitoring and Adaptive Management Plan to ensure riparian habitats can persist. Open water areas will be designed suitable to support native fish such as Santa Ana sucker and arroyo chub, including riffle/pool/glide sequences. Human disturbance is expected to be minimal in widened areas, where recreational dirt trails will be designated. In widened areas, it is expected that the active channel will migrate and change form and that sediments will be redistributed with storm events. Vegetation is expected to be denuded with natural episodic higher flows and velocities, and be re-established naturally. Any grade stabilizers in these areas will be limited to those necessary to maintain the integrity of the flood damage reduction project, and are not intended to further constrain the restoration of the aquatic or riparian system. Given the constraints of this highly urbanized system, all stressors may not be entirely removed from the restored areas of the channel; however, high ecological function and integrity sufficient to support these objectives can be achieved.

Alternative 20 will provide large restored widened areas (such as Verdugo Wash, Taylor Yard, and the LATC site) to serve as riparian habitat patches with a more natural hydrologic regime. Vegetation and habitat elements in these widened areas will be restored with the goal to support a large number of territories for various riparian obligate birds, including least Bell's vireo, yellow warbler, and yellow breasted chat, stop over habitat for migrants, as well as habitat and refugia for amphibians, reptiles, and mammals, including larger carnivores such as coyote and possibly bobcat. River channels in widened areas will be designed to support habitat for Santa Ana sucker and arroyo chub. These restored widened patches will be connected in part via soft bottom reaches 2, 4, 5, and 6 and restored in-channel habitat in Reach 8.

The remaining project areas that are not widened will support varying levels of restored native vegetation and function. In these areas, some of the described stressors may remain due to urban constraints and the requirement to maintain flood conveyance. The Corps is committed to working with USFWS to develop methods during detailed design to reduce any remaining stressors while not compromising the flood risk management function of the channel including channel conveyance.

Movement on a regional scale is expected to be accommodated to Griffith Park via wildlife use of existing equestrian tunnels in Reaches 1 and 4. Recent studies using wildlife cameras indicate tunnels have been used by coyote and deer, with one bobcat sighting. Other species that could use the tunnels, if presence of appropriate habitat were available surrounding them, include raccoons, skunks, and gray foxes. Future opportunity for movement to further open space areas such as the Verdugo and San Gabriel Mountains is provided via restoration of the confluences of the Verdugo Wash

and Arroyo Seco. Restoration upstream on the remainder of these tributaries is needed via additional projects to complete the connection between the River and these mountainous areas.

In existing hard-bottom reaches 1, 3 and 7, which cannot be widened, opportunities for aquatic connectivity, to maximize restoration potential for aquatic wildlife, will be further evaluated during detailed design. These measures would create in-channel diversity and heterogeneity needed to support passage of wildlife, including aquatic species such as native fish. Such measures may include 1) use of anchored boulders and a new meandering low flow channel in the existing concrete, 2) "speed bumps" perpendicular to flow that can trap sediment and allow small to moderate sized vegetation to grow, and 3) a new v-shaped low flow channel with varying widths and depths. These measures may, in particular, improve passage for aquatic and terrestrial wildlife in Reach 3 from the Verdugo Wash confluence to the upstream edge of the soft bottom Reach 4, and in Reach 7 from the downstream edge of the soft bottom Reach 6 to Arroyo Seco. In addition, terrestrial wildlife may then more easily move from Griffith Park using the equestrian tunnel in Reach 4 upstream to Verdugo Wash or downstream to Arroyo Seco. Additional restoration of these tributaries outside the project area would facilitate further regional movement in the future. This restoration may be accomplished by other federal, state, or local stakeholders.

Specific features for wildlife access will be considered during the detailed design stage, and would depend on the detailed design and hydraulic analysis developed during the detailed design phase, to ensure that they are not in conflict with flood damage reduction and flow conveyance requirements or other constraints on the project. Movement for bobcats will be the standard for design of access, and such designs will be implemented wherever practicable.

Placement of wildlife access measures may include access in Reach 1 from Pollywog Park into the river channel, as practicable. In this area, wildlife access may be achieved through the creation of a slope along the currently vertical bank, as described in measure 3b in Section 4.4.5. Such a design would allow wildlife moving from Griffith Park into the river channel access to the restored Pollywog Park site, which is currently disconnected from the River by a vertical wall. Implementation of specific methods and location of access would be dependent on the detailed hydrologic and hydraulic modeling developed during the design phase.

Considerations for segregation of “spring fed waters” from surface water flows would also be made during the detailed design phase. This segregation would be considered to support refugia for fish, where groundwater would feed the refugia while surface flows might bypass such areas.

The Corps will further evaluate these measures during the design phase, as their implementation or placement is likely to require hydrologic and hydraulic modeling data and/or more detailed design. Prior to implementation of the measures identified, the Corps will assess whether supplemental analysis is required to address new or different effects than those already assessed.

For the project area as a whole, the restoration features provide an overall gain in ecologic function and integrity, as well as connectivity for aquatic and terrestrial species. The Final IFR document includes these clarifications regarding provisions for natural hydrologic functioning in widened areas.

The Corps will develop detailed designs for the widened reaches during the PED phase that will carefully evaluate and consider USFWS recommendations. The Corps will continue to coordinate with USFWS during the PED phase and development of detailed designs to ensure that restoration in widened reaches achieves the maximum level of ecological function, focusing on passive restoration, a more natural hydrologic regime, and more natural geomorphic character. The Corps is committed to restoring the maximum ecological function while meeting flood conveyance requirements.

RECOMMENDATION 3

Project recreation/access features involving hard structures should be limited to the outside periphery of widened/restored River stretches (such as Taylor Yard and Piggyback Yard). Many of the design drawings show substantial "hard-scaped" recreational features well within widened-reach restoration areas. Limiting recreational structures within the interior of restoration areas would both reduce potential for flood damage/maintenance of expensive structures, and would likely increase the biological function in these widened reaches for native species. The proposed construction of instream and floodplain hard structures that are out of context with naturally functioning systems (e.g., retaining walls, curbs, formal paved or heavily compacted or surfaced paths, boardwalks, grade control structures, etc.) should be minimized within restored areas in widened reaches (Kauffman et al. 1993). Also, such hard structures typically reduce the actual and perceived "wild" nature of areas, reducing the effective nature experience for people (Louv 2012, Cookson 2013).[17] We recognize that recreation enhancement projects within the River should inspire new River "stewards," who would be fundamental in the protection of these natural systems in the future. As such, we suggest designing "organic" recreation enhancement features

[17] In email attachment to us dated 25 November 2014, the Corp[s] noted: "As required, the Recreation Plan was developed after restoration features were planned. Recreation features include passive activities such as hiking, walking, and wildlife viewing. Widened areas supporting restoration of more natural hydrology such as Taylor Yard and LATC (a.k.a. Piggyback Yard) will support a limited length of dirt/gravel trails that will not impede hydrologic and ecologic functioning. Recreation structures such as restrooms and parking lots will be limited to the outside edges of widened areas and along overbank recreation trails. New trails throughout the project area will be unpaved, and certain currently paved access roads will be converted to dirt/gravel."

that instill "adventure" and "challenge," in part through subtle engineering solutions that accommodate River recreation without degrading development of natural River ecosystem features and functions (e.g., see Borgman 1995). Pursuant to our Connecting People with Nature policies, we suggest that Project designs be modified with a greater emphasis on restoration of (and access to) the "wildness" of the River within these widened reaches, to the fullest extent practicable. Compared to current designs, such restoration would likely result in higher abundance of native fish and wildlife and greater levels of native biodiversity, with resultant enhanced opportunities for uncommon wildlife observation and nature experiences.[18]

RESPONSE 3:
As documented in previous coordination and as referenced in footnote 17, recreation features are proposed for passive activities such as hiking, walking, and wildlife viewing where they will not conflict with the restored habitat. Widened areas supporting restoration of a more natural hydrologic regime such as Taylor Yard and LATC will support a limited length of dirt/gravel trails that will not impede hydrologic and ecologic functioning. Hard structures such as restrooms and parking lots will be limited to the outside edges of widened areas.

The Recreation Analysis in Appendix B (Economics) of the IFR showed a restroom located in the middle of the LATC site. This restroom has been moved to the edge of the site in the Final IFR to be consistent with Corps policy. Section 4.16, Recreation Plan, of the IFR also has been revised to further emphasize that recreation features are designed after restoration features are planned, and per Corps policy must be compatible with the restoration function.

The Corps will continue to coordinate with USFWS during the development of detailed designs (PED) to ensure that recreation features are designed and implemented compatible with restoration. The Corps will ensure that the passive recreational use is compatible with the more in depth design of restoration features.

RECOMMENDATION 4
Similar to our suggestions regarding Project recreation structures above, we suggest that the potential ecological interactions between the riparian and aquatic ecosystems be reflected more fully in the Project restoration and flood damage reduction features proposed. We suggest minimization of instream flow-control hard structures and unburied hard stream bank slope protection in widened reaches, particularly along the riverine-riparian interface. These features often result in severed linkages between aquatic and riparian ecosystems (Kauffman et al. 1997). Any new essential instream and riparian hard-structure features (e.g., flow control and retaining walls, culverts, etc.) should be naturally complex (e.g., buried rock instead of surface concrete

[18] Please see additional information at: http://www.fws.gov/home/fwn/pdf/NewsSuFall07.pdf, https://www.facebook.com/USFWSPacificCPWN, and http://www.fws.gov/letsgooutside/families.html

where practicable), accelerate riparian recovery, and imitate natural processes and functions (Kauffman et al. 1997). While acknowledging the context of the Study Area, the hydrology designs for widened River reaches to be restored (such as Taylor Yard and Piggyback Yard) should accommodate, to the maximum extent practicable, the dynamic and episodic nature of surface low and high River flows and the fluvial processes that were natural to the River, including water inlet and outlet structures that provide for a relatively natural high-flow hydrograph to newly created riparian areas. Restoration designs for low-flow channel paths and water inlet/outlet structures for widened reaches should emulate the full range of natural flow events and groundwater levels that original riverine and riparian terrace natural communities were subjected to before development. Restoration designs should reflect and emulate the fact that the natural River channel and riparian zones were (historically) dynamic both spatially and temporally, and that episodic denudation flood flows are natural and necessary to riparian integrity (e.g., cycling of seral stages) in the Study Area.

While we understand the major design constraints of the Project area, we suggest that the current proposed Project designs (even though an improvement over existing conditions) would retain many of the existing rather simplified ("naturalistic") features of the River in widened/restored areas. These reaches of low natural heterogeneity, as designed, would have continuing negative influences on local channel hydrodynamics, channel morphology, and native stream bank surface cover and function for native species. As such, these features would likely have long-term detrimental influences on important riparian/aquatic interactions by reducing shade over water, stream nutrient inputs, and woody debris inputs, and ecosystem productivity would not meet its full potential.

The riverine and riparian ecosystems that are expected to be at least partially restored by the proposed Project are episodic disturbance oriented/dependent ecosystems. As such, in areas where the River would be substantially widened, we suggest that Project designs should not intend to fully "lock" the low-flow channel in one place, but instead should allow for some limited amount of channel migration over time between the "sideboards" otherwise necessary for flood damage reduction capacities (in the heavily constrained context of the Project area). Almost all restored floodplain terrace ground surfaces should be well within the distances to groundwater that can be utilized naturally by the expected native riparian vegetation and designed for appropriate episodic succession- setting flooding events necessary to sustain the target natural communities (e.g., willow-cottonwood woodland) and habitats (e.g., vireo habitat) in the long-term, with no reliance on periodic replanting for replacement recruitment.[19]

[19] In email attachment to us dated 25 November 2014, the Corp[s] noted: "…the Corps' intent is that that widened areas will support high levels of heterogeneity. The active channel will migrate and change form and terraces and sediments will be redistributed with storm events. Initial grading during construction of widened areas will be heterogeneous and diverse topography will be created. The dynamic and episodic nature of the River flows will be accommodated in these areas, allowing the River to carve new channel configurations over time. Vegetation is expected to be denuded with natural higher flows and velocities, and be re-established naturally. Any grade stabilizers in these areas will be well buried perpendicular to flows, and not visible from the surface. Once initially planted and a seed bank established, passive recovery will be the method for re-vegetation after flood events. Such natural hydrologic

RESPONSE 4:
As outlined in previous coordination and as documented in your footnote 19, under Alternative 20, we agree that the widened areas should be designed to support high levels of heterogeneity, and the existing plan provides for that. The active channel will be allowed to migrate and change form, and terraces and sediments will be redistributed with storm events. Initial grading during construction of widened areas will create diverse topography. The dynamic and episodic nature of the River flows will be accommodated in these areas, allowing the River to carve new channel configurations over time, creating the complexities of a natural river system. Vegetation is expected to be denuded with natural higher flows and velocities, and be re-established naturally. Any grade stabilizers in these areas will be well buried perpendicular to flows, and not visible from the surface. Once initially planted and a seed bank established, passive recovery will be the method for re-vegetation after flood events. Such natural hydrologic functions would support riparian/aquatic interactions by providing habitat elements including shade over water, and stream nutrient and woody debris inputs. The Final IFR document includes these clarifications regarding provisions for natural hydrologic functioning.

As described in Response 1, temporary irrigation will be used to establish restored vegetation in widened and overbank areas, after which vegetation is expected to be self-sustaining, requiring minimal maintenance and relying on groundwater and surface flows to persist. Detailed design will identify all water sources to support the proposed vegetation. Monitoring of depth to groundwater will be included as part of the Monitoring and Adaptive Management Plan to ensure riparian habitats can persist. Active planting and temporary irrigation will initially be required in these areas to begin establishing native vegetation. The plans provided in the report are indicative of the planting to be implemented initially; however, over time, storm events will bring seed material from upstream, actively planted vegetation will establish a new seed bank in the soil, a restored natural hydrologic regime will develop dynamic channel forms, and areas denuded through scour or other disturbance are expected to naturally re-establish.

The Corps will continue to coordinate with USFWS during the development of detailed designs to ensure that restoration in widened reaches mimics a natural hydrologic regime and fluvial processes to the extent possible, allowing for channel migration and reworking of restored widened areas following flood events, while not compromising existing levels of flood protection. Flood damage reduction features are not proposed as part of this project. Additional H&H (hydrology and hydraulics) modeling will be conducted during the detailed design phase to inform design refinements that will

functions would support riparian/aquatic interactions by providing habitat elements including shade over water, and stream nutrient and woody debris inputs."

achieve a sustainable balance between flood damage reduction and natural hydrologic functioning.

RECOMMENDATION 5

Within the Project portions of the River that would not be widened by the proposed Project, we suggest that ecological enhancement, native landscaping, recreation, buffer, and/or stream water shading be the stated goals for and focus of Project activities in most of these areas. While providing some ecological improvement, we suggest that these features be treated as ecological enhancement because the substantial constraints in these reaches preclude self-sustaining full or partial restoration of most of the important riverine or riparian ecological functions of the River. Expectations of substantial occupation or connectivity use by typical target native species in portions of the River that would not be widened should be low, with the exceptions of any implementation of specific artificial enhancements (such as developed artificial snags, nesting cavities and shelves, and riverine hardscape pools and riffles). Establishment of native trees on the south side of the River where water shading can be accomplished would enhance stream water temperature reductions that may help provide for limited use of other Project areas by native fish. We find this distinction between restoration and enhancement to be important due to the precedent this could set for ecological restoration within other projects.[20]

RESPONSE 5:

The project provides native vegetation, wildlife habitat, and ecosystem functions within each reach at varying levels, within existing constraints. Each project feature is designed for restoration benefit. The Corps recognizes that in some cases the possible features are highly constrained by the need to maintain flood conveyance or to work within existing major infrastructure constraints such as freeways, railroad, and residential uses.

The proposed project maximizes ecological restoration where it can be achieved, primarily in widened areas of the river where floodplain property adjacent to the river can be acquired. In other portions of the project area, the Corps has planned for construction of features that would improve value for wildlife in the vicinity and for connectivity between restored widened areas. Constrained areas planted with native vegetation still provide opportunities for foraging and shelter, as well as cover for movement, and contribute value to the project as a whole, especially when considering the complex limitations afforded by the urban landscape.

[20] In email attachment to us dated 25 November 2014, the Corp[s] noted: "The Corps disagrees that individual project features should be parsed out as "restoration" vs. "landscaping" vs. "greening". While the definition of "restoration" as provided by USFWS is not achievable in every portion of the project area, the project as a whole meets the Corps' criteria for ecosystem restoration, in that all features collectively contribute to habitat and connectivity creation and improvement throughout the project area. In this way, wildlife is provided new large areas (e.g. 35+ acre sites such as Verdugo Wash, Taylor Yard, and LATC (a.k.a. Piggyback Yard)) of restored habitat with a means to move between them, as well as into other surrounding natural areas."

As documented in your footnote 20, the Corps disagrees that individual project features should be parsed out as restoration versus enhancement. While the definition of "restoration" as provided by USFWS is not achievable in every portion of the project area, the project as a whole meets the Corps' criteria for ecosystem restoration, in that all features collectively contribute to habitat and connectivity restoration and improvement throughout the project area. In this way, wildlife is provided new large areas (e.g. 35+ acre sites such as Verdugo Wash, Taylor Yard, and LATC) of restored habitat with a means to move between them, as well as into other surrounding natural areas. A description of potential features to accommodate such movement is provided above in the response to Recommendation 2.

Restoration of habitat and wildlife movement at a more regional level is expected to be a collaborative effort, whereby other federal, state, and local agencies and stakeholders have expressed interest in contributing to meet restoration goals along the LA River, within the watershed, and in surrounding natural areas. Restoration associated with this project as a whole has been considered by many local NGOs as the backbone of future restoration efforts that may be undertaken by others to improve other portions of the river and tributaries.

RECOMMENDATION 6

We suggest that the Project ecological guidelines and designs for restoration be based on typical restoration ecology[21] science and terminology, and less on landscape architecture[22] science and terminology. Baseline and post-Project implementation surveys/assessments for fish, amphibians, reptiles, and the associated parameters of potential habitats for target species should be performed in the Study Area. Non-native species with considerable potential to adversely affect Project restoration success should also be assessed, including potential source populations in the watershed.

The following water quality parameters of specific Project reaches should be evaluated and mapped as part of Project planning and implementation: water temperature, dissolved oxygen, pH, conductivity, turbidity, substrates, water velocities, channel forms (e.g., deep or exotic predator-free pools), flood refugia and back-channel areas, woody debris and leaf litter. These parameters and natural community mapping should be analyzed relative to current non-native fish, amphibian, and reptile occupation of the Study Area. These parameters should then be compared to known ideal (and minimum) necessary natural parameters and conditions of habitats normally

[21] Restoration ecology: the scientific study of repairing disturbed ecosystems through human intervention. Ecological restoration implementation aims to recreate, initiate, or accelerate the recovery of an ecosystem that has been disturbed.

[22] Landscape architecture: the art and practice of designing the outdoor environment, especially designing parks or gardens together with buildings and roads.

utilized by species such as Santa Ana sucker, arroyo chub, two-striped garter snake, California toad, Baja California tree frog, and other appropriate restoration indicator and surrogate/umbrella species. This survey information should be used to inform basic Project design development (e.g., to provide functional habitats for specific native fish and aquatic wildlife species), as well as post-construction adaptive management decisions, and future restoration projects in the watershed.[23]

RESPONSE 6:

As described in the above Response to Summary and Response 1, the Corps ecosystem restoration guidance and policy followed by this study is grounded in restoration science and terminology; recreation features are designed after restoration plans are in place, are designed to be compatible with restoration plans, and utilize standard landscape architecture principles. As described in previous coordination and as documented in your footnote 23, the Monitoring and Adaptive Management Plan (MAMP) included in Appendix H of the Final IFR includes restoration monitoring to evaluate the performance of restoration actions. As described in Section 5.5.4 of the Final IFR, pre-construction surveys would be performed for least Bell's vireo and for special status plant and wildlife species, and the Corps would continue to coordinate with the USFWS throughout the design and construction period. Monitoring includes an inventory of wildlife species based on observations of wildlife and signs of usage, mapping of habitat, as well as inventory of habitat elements present within the project footprint.

Monitoring of riparian, marsh, and fish habitat is outlined in the MAMP, which evaluates various habitat parameters including, but not limited to, invasive plants, hydrology, soils, sedimentation, water quality, in-stream structure, and also includes bird, fish, and amphibian species surveys. The water quality parameters suggested in this recommendation will be monitored as part of the MAMP. These habitat parameters can be compared to reference conditions, as suggested in Response 1, to inform adaptive management decisions and direct restoration actions. The MAMP includes a list of target species in order to direct restoration of habitat elements in

[23] In email attachment to us dated 25 November 2014, the Corp[s] commented: "The Monitoring and Adaptive Management Plan (MAMP) to be included in the Final IFR document includes pre- and post- restoration monitoring to evaluate the performance of restoration actions. Habitat evaluations will be performed as restoration progresses to assess habitat values of restored features and inform adaptive management decisions. These [cont'd next page] evaluations require an inventory of wildlife species based on observations of wildlife and signs of usage, mapping of habitat, as well as inventory of habitat elements present within the project footprint. Monitoring of riparian, marsh, and fish habitat is outlined in the MAMP, which evaluates various habitat parameters including, but not limited to, invasive plants, hydrology, soils, sedimentation, water quality, in-stream structure, and also includes bird, fish, and amphibian species surveys. These habitat parameters can be compared to ideal reference conditions to inform adaptive management decisions and direct restoration actions. The MAMP will be revised to include a list of target species in order to direct restoration of habitat elements in ways that would benefit the life history requirements of those species."

ways that would benefit the life history requirements of those species.

Non-native plant species will also be removed as part of construction and managed as part of operation and maintenance of the project. Removal of non-native wildlife could be performed by resource agencies or other interested entities separate from this project. If a removal program were to be proposed, the Corps and non-Federal sponsor would coordinate with the proponent and the agencies with jurisdiction over such removals to ensure compatibility of the program with the restoration project, including project operation and maintenance.

The Corps will coordinate further with the USFWS and other resource agencies during the detailed design phase to identify any additional parameters or methodologies that may be appropriate in specific locations or circumstances.

RECOMMENDATION 7

In relation to the needs of any of the seven native fish that could potentially be re- established in the River (such as arroyo chub), the proposed Project as currently designed would appear to: a) lack necessary complexity of habitats; b) lack necessary substrates and channel forms, including refugia; c) provide low food availability; d) be subject to excessive water temperatures; e) have an overabundance of large areas of open water; and f) provide/retain competitive advantage for exotic fish species over native species. The Project ecological restoration designs should provide higher priority to creating the natural parameters and conditions needed for the restoration of at least one specific native fish species, to the extent practicable, so as to both support their basic survival and to give them competitive advantages over exotic species that would likely continue to occupy the Study Area following Project implementation (e.g., see Moyle and Light 1996). Assessments of whether proposed Project designs would likely provide these specific natural conditions for target species, including expectations of associated non- native species competition, should be provided before Project designs are developed further.[24]

RESPONSE 7:

As described in our previous discussions (and documented in your footnote 24), the design drawings at the feasibility level are conceptual and will be revised and refined during the detailed design stage to include the necessary parameters that

[24] In email attachment to us dated 25 November 2014, the Corp[s] commented: "The design drawings at the feasibility level are conceptual, and will be revised and refined during the detailed design stage to include the necessary parameters that would support native fish habitat in widened areas and in overbank areas during the detailed design phase. In concrete reaches, where features are more limited by maintenance of flood capacity, designs will focus on providing refugia and passage. As discussed with USFWS, designs will focus on providing the hydrology, substrates, and habitat elements required by Arroyo chub and Santa Ana sucker. In the Draft IFR, in Section 4.2.2, Santa Ana sucker are identified as a target for restoration of native fish habitat. Other target fish species for restoration as well as their general requirements will be clarified in the Final IFR document."

would support native fish habitat in widened areas and in overbank areas during the detailed design phase. In concrete reaches, where features are more limited by maintenance of flood capacity, designs will focus on providing refugia and passage.

As discussed with USFWS, designs will focus on providing the hydrologic regime, substrates, and habitat elements required by arroyo chub and Santa Ana sucker. In the IFR, in Section 4.2.2, Santa Ana sucker are identified as a target for restoration of native fish habitat. Other target fish species for restoration as well as their general requirements are clarified in the Final IFR document. The Corps will continue to coordinate with USFWS during the development of detailed designs to ensure that the appropriate habitat parameters and design elements are captured.

Text added to the IFR includes the following:

> "In widened areas, restored river channels will be designed to support habitat for native fish including arroyo chub and Santa Ana sucker, and provide the necessary constituent elements including but not limited to water shaded by riparian vegetation, riffle/run/pool/glide sequences and refugia, in channel woody debris, gravel and cobble substrates."
>
> "In existing hard-bottom reaches 1, 3 and 7, which cannot be widened, opportunities for aquatic connectivity, to maximize restoration potential for aquatic wildlife, will be further evaluated during detailed design. These measures would create in-channel diversity and heterogeneity needed to support passage of wildlife, including aquatic species such as native fish. Such measures may include 1) use of anchored boulders and a new meandering low flow channel in the existing concrete, 2) "speed bumps" perpendicular to flow that can trap sediment and allow small to moderate sized vegetation to grow, and 3) a new v-shaped low flow channel with varying widths and depths. Implementation of these measures would depend on the detailed design and hydraulic analysis developed during the detailed design phase, to ensure that they are not in conflict with flow conveyance requirements or other constraints on the project."

RECOMMENDATION 8

In our opinion, the various alternatives proposed would provide limited restored functions for typical stream restoration target species. Considering the heavy constraints of the Study Area, some excellent opportunities exist for artificial enhancement measures, particularly where restoration is not practicable. Additionally, these types of features (e.g., large hollow snags, tall steep river banks) are not likely to otherwise develop in the short-term or over time in significant number/area within the Study Area due to the limited floodplain widths and modified hydrology in even the widest proposed restoration sites of the Project. The directed artificial measures suggested below would likely be substantially and quickly utilized by some uncommon or sensitive bird and

bat species and could provide very attractive and important watchable wildlife opportunities along the River for residents and visitors. These features could be effectively incorporated into many otherwise heavily constrained channel reaches and off-channel adjacent areas that otherwise lack the space to support aquatic or riparian restoration features (such as artificial features added to walls, bridges, and other hard structures). These include: provision of various nest cavities and structures (e.g., for wood duck, barn owl, osprey, tree swallow, white throated swifts, and western bluebird) such as nest holes/crevices created in/on new and existing hard structures, and nest platforms/shelves/boxes; placed/erected large hollow snags and suitable vertical shafts with heavy inside texture (e.g., swifts); and creation of artificial large steep sandy/earth banks (e.g., northern rough-winged swallow and belted kingfisher; note that these supported banks could functionally occur along channel tops in some areas, without affecting flood conveyance). Directed artificial enhancement measures for some local bat species (e.g., Yuma myotis, western pipistrelle, Mexican free-tailed bat, and big brown bat) should include increasing availability of roosts in the Project area by providing large hollow vertical snags and shafts, rock outcrops, bat boxes, and artificial roost cavities designed into new hard structures. Almost all of these artificial features would require some limited periodic maintenance or replacement.

RESPONSE 8:
The design drawings at the feasibility level are conceptual, and are revised and refined during the detailed design stage. Installation of artificial habitat features as recommended could be considered in the detailed design stage in coordination with USFWS, as practicable in relation to meeting project objectives.

The Final IFR will include additional text as follows clarifying the inclusion of such directed restoration measures.

> "Other design features specific to certain species may be incorporated in the detailed design phase and accommodated where practicable and appropriate. It is expected that while these features could potentially be installed artificially during restoration activities, many of these features will also evolve naturally over time as vegetation matures and natural hydrologic forces continue to shape the hydrologic regime of widened areas. These features may include, but are not limited to, artificial nest cavities (which could be used by wood duck, barn owl, tree swallow, and western bluebird among other species), large hollow snags (used by swifts), and artificial steep sandy banks (used by northern rough-winged swallow and belted kingfisher)."

RECOMMENDATION 9
Brown-headed cowbird occupation of the Study Area should be assessed during Project planning, including potential source populations in the region within several miles. Cowbird feeding areas (e.g., outdoor human feeding areas, stables and other equestrian facilities, and some turf zones) should be reduced or modified in the Project general region, to the extent practicable. If brown-

headed cowbird parasitism levels are still likely to be problematic for sensitive birds potentially occurring within the Project area, then management of cowbird numbers should be performed by the Project for the life of the Project, such as through trapping at local horse stables and other cowbird source or breeding areas, with standard cowbird traps. We recommend a long-term management strategy for cowbirds be developed by the City and Corps for the lowland region of the River.

RESPONSE 9:
Corps guidance on ecosystem restoration directs the Corps to focus on restoring structure, function, and dynamic processes of habitats that have been degraded (EP 1165-2-501; EP 1165-2-502). Focus on presence of particular species of wildlife, and absence of undesirable wildlife species, is expected to be within the jurisdiction of wildlife resource agencies or local entities. General wildlife surveys are included as part of monitoring in the Monitoring and Adaptive Management Plan. If surveys document a large population of cowbirds in the project area, as well as the presence of vireo, the Corps would inform the Adaptive Management Team member agencies, one or more of which may implement a removal program separate from the restoration project or identify other entities interested in doing so. If a removal program were to be proposed, the Corps and non-Federal sponsor would coordinate with the proponent and the agencies with jurisdiction over such removals to ensure compatibility of the program with the restoration project, including project operation and maintenance.

RECOMMENDATION 10
Restoration of basic natural stream features is a highly important first design step in the re-establishment of any of the native fish to the River (e.g., channel substrates, water quality/flow, channel configuration/complexity). Nevertheless, many of the factors affecting the current extirpation of most native fish in the River extend well beyond the riparian/stream ecotone. We suggest that riparian and riverine native fish restoration designs within the Project's widened reaches include specific measures (where practicable) for development of: a) water shaded by riparian woody vegetation; b) sediment and leaf-fall inputs to aquatic areas; c) channels with steep native-soil stream banks and in-channel woody debris; d) substantial channel diversity including riffle-run-pool-glide sequences, point bars; e) back channel refugia that utilizes upwelling groundwater (low temperature water of higher quality) and provides protected waters during larger flood flow events; f) appropriate channel substrates, including sand, gravel and cobble; g) potential for some channel movement/meander over time in widened channel areas; h) minimal areas of wide ponded or open water; i) riparian hiding cover for native fish (e.g., herbaceous plants and woody shrubs providing overhanging vegetation on stream banks for hiding cover); and j) target fish species passage and appropriate water temperatures and oxygenation levels, including shading of water surfaces through native tree landscaping on the south side of non-widened channel reaches, where practicable and appropriate. Periodic

artificial substrate import (e.g., sand and gravel) into the upper end of the Study Area during the Project life will likely be necessary to maintain some important fluvial processes and conditions for native fish through the Study Area, considering the artificial fluvial conditions of the watershed and upstream channel. The Project should initiate an aquatic exotic species control program for the Study Area: complementary to the level of competitive advantages to native target species provided by the Project (e.g., through channel morphology, riparian cover, etc., as outlined above), periodic direct control of the problematic exotic aquatic species should be implemented in the Study Area, including mosquito fish, tilapia, common carp, green sunfish, fathead minnow, bullfrog, red swamp crayfish (*Procambarus clarkii*), and other species, as appropriate. The closer the River is restored to natural conditions, the greater the competitive advantage for native species over exotic species, with concomitantly less control of exotic species needed. Considering the conditions of the watershed and the constraints of the Study Area, it is very likely that periodic control of some exotic aquatic species would be needed in perpetuity in order to maintain native fish and their habitats in the Study Area.

RESPONSE 10:
As described in the response to Recommendation 7, detailed designs will focus on providing the hydrologic regime, substrates, and vegetation required by arroyo chub and Santa Ana sucker. Detailed designs will also consider the incorporation of opportunities for aquatic and terrestrial passage in hard bottom reaches. Implementation of such measures would depend on the detailed design and hydraulic analysis developed during the detailed design phase, to ensure that they are not in conflict with flow conveyance requirements or other constraints on the project. The Corps will continue to coordinate with USFWS during the development of detailed designs to ensure that the appropriate habitat parameters and design elements are captured.

Sediment import is included as a potential adaptive management action in the Monitoring and Adaptive Management Plan. If monitoring determines that additional sediment is needed to achieve suitable native fish habitat, sediment import could be implemented.

As described in Response 9, Corps guidance on ecosystem restoration directs the Corps to focus on restoring structure, function, and dynamic processes of habitats that have been degraded (EP 1165-2-501; EP 1165-2-502). Focus on presence of particular species of wildlife, and absence of undesirable wildlife species, is expected to be within the jurisdiction of wildlife resource agencies or local entities. Removal of non-native fish could be implemented by resource agencies or other interested entities separate from this project. The Corps and non-Federal sponsor would coordinate with the proponent and the agencies with jurisdiction over such removals to ensure the compatibility of the program proposed with the restoration project, including operation and maintenance activities.

RECOMMENDATION 11

Feral mammal populations should be controlled in Project restoration areas, as practicable and appropriate. As part of restoration designs, competitive advantage over exotic mammals should be provided to native species to the extent practicable.

RESPONSE 11:

As described in Response 9 and 10, focus on presence of particular species of wildlife, and absence of undesirable wildlife species is expected to be within the jurisdiction of wildlife resource agencies or local entities. General wildlife surveys are included as part of monitoring in the Monitoring and Adaptive Management Plan. If monitoring documents feral or nuisance mammals, the Corps would inform the Adaptive Management Team member agencies, one or more of which may implement a removal program separate from the restoration project or identify other entities interested in doing so. The Corps and non-Federal sponsor would coordinate with the proponent and the agencies with jurisdiction over such removals to ensure the compatibility of the program proposed with the restoration project, including operation and maintenance activities.

RECOMMENDATION 12

Project designs and objectives should include greater specificity regarding minimum levels of ecological functions and values to be created or enhanced. As currently written, the designs, objectives, and criteria are difficult to assess as to the basic or minimum ecological functions that would be gained. We suggest the use of appropriate umbrella species to help briefly outline/translate minimum ecological functions to be restored in meaningful ways, and for planning, design, and implementation purposes.

As such, we suggest that the Project include restoration of specified minimum acreages of functional habitats in the long-term for typical restoration planning species for southern California riparian areas, including vireo, chat, and yellow warbler.[25] These species are excellent umbrella planning species that guide restoration for a variety of currently uncommon or extirpated native riparian wildlife species in the Project area by targeting the necessary components of relatively high-function riparian natural communities with a variety of vegetation structures, densities, and seral stages. For example, vireo, yellow warbler, and chat typically utilize different forms, configurations, and seral stages of riparian scrub/woodland/forests.

RESPONSE 12:

As described in Response 1, the objectives as currently defined are appropriate and

[25] The 2013 EIS/EIR provides a proposed target objective to restore a "minimum of one habitat node with a minimum width of 250 meters (820 feet) to support high frequencies" of vireo. In our opinion this and the other related objectives remain too vague to effectively evaluate the minimum that would be accomplished for target species from an ecological restoration perspective.

reflective of the naturally occurring habitat that the project restoration is proposing to achieve. Objectives are described in Section 4.2 of the IFR, with measurable objectives criteria outlined in Section 4.2.2. The final array of alternatives meet these objectives criteria based on Corps standards as described in Section 6.2, Tables 6-1 and 6-2. Detailed designs will provide more specificity in terms of habitat, ecological, and hydrologic features to be created and restored based on the necessary habitat components for such recommended target species.

The Corps will continue to coordinate with USFWS during the development of detailed designs to ensure that the appropriate habitat parameters for such umbrella species are captured.

RECOMMENDATION 13

Any federally listed species occupying the Project footprint should be the subject of consultation under the Endangered Species Act, as appropriate. An unknown number of vireo likely occupy the Project direct activity footprint and would likely be positively affected by the beneficial aspects of the Project and temporarily adversely affected (through loss of habitat and function) by the action's construction activity of riparian vegetation clearing within seasonally occupied habitat in the River. As such, the action would likely warrant consultation. Appropriate surveys should be performed to determine occupation and usage areas (protocol surveys of the Study Area for vireo have apparently not been performed in the last decade; recent surveys of all appropriate vireo habitat should have been performed and reported during development of the 2013 EIS/EIR). Any listed species expected to be attracted to the Project area that would subsequently be potentially adversely affected by Project operations or maintenance should also be monitored and addressed through consultation (for instance, potential translocation and establishment of Santa Ana sucker).[26]

RESPONSE 13:

As described in previous coordination and in footnote 26, Section 5.5.1 of the IFR outlines that Section 7 of the ESA requires consultation with USFWS if the project would affect listed species. As documented in Section 10.1 of the IFR, the Corps determined that the proposed project would have no effect on federally listed threatened or endangered species.

[26] In email attachment to us dated 25 November 2014, the Corp[s] commented: "Section 5.5.1 of the Draft IFR outlines that Section 7 of the ESA requires consultation with USFWS if adverse impacts to listed species are anticipated. Under Section 10.1 of the Draft IFR, the Corps determined that the proposed project would have no effect on federally listed threatened or endangered species. The Corps will continue to review conditions to determine if endangered species may be present, and coordinate or consult with USFWS as necessary through the design and construction of each project phase/feature. Endangered species surveys will be conducted during the detailed design phase and in the nesting season(s) immediately prior to construction within any potentially suitable areas to confirm presence or absence of federally and state listed threatened and endangered species. The Corps will continue to coordinate with the USFWS throughout the design and construction period, and consult under ESA if necessary."

Marginal habitat for the federally endangered least Bell's vireo (*Vireo bellii pusillus*) exists within the vegetated portions of the channel within the study area in Reaches 2, 4, 5, and 6. Riparian vegetation in these reaches is linear and confined, and lacks suitable adjacent foraging habitat. Vireo were observed within the study area in 2007; however the most recent protocol surveys in 2009 did not detect vireo. An incidental observation of an unpaired male vireo near Taylor Yard was documented in April 2013 during a one-day nesting bird survey of the area. A similar one-day nesting survey of the area in May 2013 did not detect vireo.

The recommended plan will avoid impacts to least Bell's vireo. Least Bell's vireo are not expected to be present in the study area and are not known to nest in the study area due to the marginal existing habitat. In the locations where vireos were observed during 2007 protocol surveys and from incidental observations in 2013 (Glendale Narrows Reach 6), the proposed construction will target removal only of existing non-native vegetation. In areas where marginal habitat for the least Bell's vireo exists, vegetation would be removed outside of the breeding season. Potential nesting habitat would be avoided. The Corps has determined that there will be no effect to least Bell's vireo.

Protocol level surveys for least Bell's vireo would be performed during the detailed design phase and in the nesting season(s) immediately prior to construction of each feature within any potentially suitable areas to confirm presence or absence of this species within the study area. The Corps will continue to coordinate with the U.S. Fish and Wildlife Service and the California Department of Wildlife throughout the design and construction period, and would consult under the Endangered Species Act if conditions change such that the Corps determines the project may affect the vireo or other listed species. With implementation of the alternative, riparian vegetation would be further expanded through widening and restoration of river adjacent areas, which could potentially support future populations of vireo.

No other special status species, including the southwestern willow flycatcher and coastal California gnatcatcher, are expected to occur due to the degraded conditions within the study area and lack of suitable habitat. Impacts to threatened and endangered species are not expected to occur. Construction would be temporary, and overall would benefit endangered species by expanding native riparian, riverine, and wetland habitat.

The Corps will continue to coordinate with the U.S. Fish and Wildlife Service and the California Department of Wildlife throughout the design and construction period.

RECOMMENDATION 14

A table describing the various acreages of all of the existing conditions in the Project alternatives' direct activity footprints should be developed. Only portions of this information

were available in the 2013 EIS/EIR in any form. This table (and related map) should describe land uses, wetlands, and natural communities acreages (pre- and post-Project alternative), and should clearly demonstrate the specific biological impacts and gains that would be provided by the proposed Project alternatives, by acreage and natural community/land use type. In this way the Project can be evaluated for what resources would be lost and gained with implementation. We suggest that this be standard practice for most Corps projects.

RESPONSE 14:
Information regarding acreages of habitats created is provided in Table 6-7 of the IFR. Chapter 7 of the IFR describes the Recommended Plan and NER Plan in terms of features restored by reach. The Corps will continue to provide detailed restoration and habitat information during the PED (Pre-Construction Engineering & Design) phase as coordination with USFWS on detailed project features continues.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
2177 Salk Avenue, Suite 250
Carlsbad, California 92008

In Reply Refer To:
FWS-14B0040-15CPA0063

JAN 05 2015

Colonel Kimberly M. Colloton, PMP District Engineer
U.S. Army Corps of Engineers, Los Angeles District
915 Wilshire Boulevard, Suite 930
Los Angeles, California 90017-3409

Subject: Revised Final Fish and Wildlife Coordination Act Report on the Los Angeles River Ecosystem Restoration Project, Los Angeles County, California

Attention: Josephine Axt, PhD

Dear Colonel Colloton:

Enclosed is our Revised Final Fish and Wildlife Coordination Act Report (Report) for the proposed Los Angeles River Ecosystem Restoration Project (Project) in Los Angeles County, California. This Report is provided in fulfillment of Scope of Work Agreement Number W81EYN72434461 between our agencies, requesting us to provide Draft and Final Fish and Wildlife Coordination Act reports for the Project. This Report is prepared in accordance with the Fish and Wildlife Coordination Act (FWCA; 48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*) and constitutes the revised final report of the Secretary of the Interior on the Project as required by section 2(b) of the Act.

The primary concern and mandate of the U.S. Fish and Wildlife Service (Service) is the protection of public fish and wildlife resources and their habitats. The Service has legal responsibility for the welfare of migratory birds, anadromous fish, and endangered animals and plants occurring in the United States. Specifically, the Service administers the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*), the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703 *et seq.*), and the FWCA. The purposes of the FWCA are to recognize the contribution of fish and wildlife resources to the Nation and the increasing public interest and significance thereof due to expansion of our national economy and other factors, and to ensure that fish and wildlife conservation receives equal consideration and is coordinated with other features of water-resources development programs (16 U.S.C. 661). Because the Project would involve changes to a water body, pursuant to Section 2(a) of the FWCA, the Corps is consulting with the Service on the action. Per Section 2(b) of the FWCA, our goal herein with our report is to provide "justifiable means and measures" for fish and wildlife conservation purposes that we "find should be adopted to obtain overall project benefits."

If you have any questions regarding the Report, please contact Jon Avery at 760-431-9440, extension 309.

Sincerely,

G. Mendel Stewart
Field Supervisor

REVISED FINAL
FISH AND WILDLIFE
COORDINATION ACT REPORT

for the proposed

Los Angeles River Ecosystem Restoration Project
Los Angeles County, California

Prepared for the
U.S. Army Corps of Engineers
Los Angeles District
Los Angeles, California

By the
U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
Carlsbad, California

FWS-LA-14B0040-15CPA0063

January 2015

EXECUTIVE SUMMARY

Consistent with the requirements of the FWCA, the Service's goal with this report is to: suggest appropriate measures for restoring or enhancing fish and wildlife resources in the Project region; determine the possible damage from proposed Project activities on fish and wildlife resources; and make recommendations for preventing, minimizing, and mitigating loss or damage to these resources from the proposed Project. This report was authored by Jon Avery of the Carlsbad Fish and Wildlife Office. In January 2014 we provided a Preliminary Draft Coordination Act Report on the proposed Project to the Corps.[1] In September 2014 we delivered a Final Draft Coordination Act Report to the Corps. Based on a series of meetings between the Service and the Corps, and a revised proposed Project description and background information subsequently provided by the Corps in November 2014, we developed this Revised Final Coordination Act Report.

The Corps published a Feasibility Study and Environmental Impact Statement/Environmental Impact Report (2013 Draft EIS/EIR) for the proposed Project in September 2013. The Corps Los Angeles District is the Federal lead agency for the proposed Project under the National Environmental Policy Act (NEPA) of 1969. The local lead agency and non-Federal sponsor responsible for implementing the California Environmental Quality Act (CEQA) is the City of Los Angeles (City). The Corps and City prepared the 2013 Draft EIS/EIR, jointly with a Feasibility Study (together also known as an Integrated Feasibility Report), which evaluates various alternatives for the Project purpose of partially restoring approximately 11 linear miles (mi) of the Los Angeles River (River), while providing recreation and maintaining existing levels of flood risk management. This 11-mi stretch of the River, also known as the Glendale Narrows, stretches from approximately Griffith Park (in the City of Burbank) downstream to downtown Los Angeles, in Los Angeles County, California (see Figure 1). This historically perennial reach of the River ranges from about 23 to 33 mi upstream of the Pacific Ocean.

The River lies within the coastal plain of the Los Angeles Basin and has been very highly modified for flood damage reduction purposes. Restoration measures considered for the proposed Project include enhancement and reestablishment of riparian strand, freshwater marsh, and aquatic natural communities, and partial reconnections of the River to major tributaries, portions of its historical floodplain, and the ecological areas of the Santa Monica and San Gabriel mountains and Verdugo Hills. Stated restoration goals for the Project include increased or re-established populations of native wildlife and fish, and enhanced ecological connectivity (e.g., wildlife corridors and linkages) within the Study Area and regionally. Proposed restoration measures would also include the reestablishment of some ecological and physical processes. The 2013 Draft EIS/EIS also evaluates and proposes passive recreation and associated facilities in the River. It evaluates the No Action Alternative and four action alternatives, termed Alternatives 10, 13, 16, and 20. The 2013 Draft EIS/EIR describes the proposed Project's need, goals, objectives, and the potential environmental effects in detail. As of September 2013 the Corps' tentatively selected plan was Alternative 13. In May 2014 the Corps gave approval to

[1] At the time we provided a relatively brief preliminary draft report, rather than a typical draft report, per a request from the Corps for the Service to provide a Draft CAR within a short period of time.

Alternative 20 as the Corps preferred alternative.[2] Alternative 20 is the Locally Preferred Plan and the Corps' recommended plan (USACOE 2014c).

The Planning Objectives for the proposed Project, as identified in the 2013 Draft EIS/EIR, are to:

1. Restore valley foothill riparian strand and freshwater marsh natural communities: Restore valley foothill riparian natural community types, aquatic freshwater marsh communities, and native fish habitats within the "Area with Restoration Benefits and Opportunities for Revitalization" (ARBOR) reach throughout the Project period of analysis, including restoration of supporting ecological processes and biological diversity, and a more natural hydrologic and hydraulic regime that reconnects the River to some historic floodplains and tributaries, reduces velocities, increases infiltration, and improves natural sedimentary processes.

2. Increase habitat connectivity: Increase connectivity of habitats between the River and the historical floodplain, and increase nodal connectivity for wildlife between restored natural community patches and nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis.

3. Increase passive recreation: Include recreation that is compatible with the restored environment in the ARBOR reach throughout the period of analysis.

The proposed Project would, over the long-term, provide partial re-establishment and enhancement of the currently highly degraded or eliminated aquatic/riverine and riparian natural communities within the Glendale Narrows portion of the River.

The riparian and riverine natural communities of the Study Area and environs are currently highly fragmented and generally isolated, and they would largely continue to be so following Project implementation, though with some improvements in connectivity due to Project partial restoration and enhancement as proposed. The ecological functions of such fragments normally depend not only their contiguous size and internal characteristics, but also on their configuration relative to one another and the characteristics of the surrounding landscape (Andren 1992 & 1994; Sisk et al. 1997; Saab 1999; Tewksbury et al. 2002). As such, additional projects would need to be implemented outside of the Project area in order to restore many of the important riparian and riverine ecosystem functions within the Project footprint. Nevertheless, substantial restoration potential exists within the Study Area, and we view the Project as an incremental step to partial restoration of the River in an urban context.

The Project could have direct, indirect, and cumulative impacts on biological resources during and following the activities of: demolition, clearing, grading, construction, maintenance, and operations throughout the Project life. These potential effects include: a) physical disturbance

[2] On May 28, 2014, Assistant Army Secretary for Civil Works Jo-Ellen Darcy decided to recommend approval of Alternative 20 as the Corps preferred alternative for the proposed Project.

of currently degraded natural communities from these activities; b) impacts on terrestrial, aquatic, and riparian-associated native biota from equipment use; and c) effects from increased/modified noise and human activities (e.g., construction, maintenance, and recreation), nighttime lighting, contaminant release/exposure (from construction vehicles and equipment, maintenance activities, disturbance of existing soils, etc.), and increased siltation and contaminants release into the River waters on site and downstream. Most of these impacts would likely be short-term or temporary; some could be recurrent, such as recreation activities. The proposed Project would likely result in net and long-term gains in ecological functions and values for almost all native species that currently use the areas in the Project reach of the River, depending on Project designs ultimately implemented.

Proposed increases/re-establishment of riparian and riverine natural communities (in both acreage and function) as a result of the Project would likely provide expanded or restored habitats for several resident/migratory/transient native birds, as well as a limited number of native of reptile, amphibian, and smaller mammal species. With some modifications to the proposed designs the Project has potential to re-establish some native fish species that are currently extirpated from the Project area. Additional increases in ecological functions from restoration and enhancement could be gained with some modifications to proposed Project designs, as outlined in our Recommendations below.

The least Bell's vireo (*Vireo bellii pusillus*; "vireo"), a federally listed endangered species, occurs in the Project footprint and environs in small (undetermined) numbers. The vireo could be adversely affected by Project-related equipment use, nighttime lighting, and/or other human activities associated with construction or operations, including clearing (e.g., temporary or permanent loss of riparian vegetation in some specific locations) of extant vireo habitat, likely during the non-breeding season. Project operations (including recreation) or maintenance activities could potentially disturb breeding vireos attracted to Project restoration areas following Project implementation. Net increases through restoration and enhancement of riparian woodland and scrub areas proposed within the Project footprint as part of the Project would likely provide overall benefits to the vireo, including an undetermined increase in the currently limited (potential) breeding use and carrying capacity of the area, particularly if brown-headed cowbird (*Molothrus ater*) parasitism is controlled in the Project area.

The existing heavily degraded and fragmented ecological conditions within all of the Project Study Area indicate that potential for other Federal or state listed species of any taxa occurring in the Project area during construction is low. As such, other listed species besides the vireo are not likely to be adversely affected by proposed construction activities. Depending on the ecological restoration and enhancement designs ultimately implemented and maintained as part of the Project (see Recommendations below), the Santa Ana sucker (*Catostomus santaanae*), a federally listed threatened species, has some potential to utilize restored riverine reaches in the Project area during the Project life as a result of improved habitat conditions, including water flow and quality parameters, channel form, and riverine substrates. Occasional adverse effects to this species from Project maintenance or operations could occur following any re-establishment of the species in the Project area. Re-establishment of Santa Ana sucker would likely require translocation of the species from extant populations elsewhere in the region following

appropriate restoration measures. Without additional restoration projects implemented beyond the scope of the proposed Project, occupation of the Project area by other federally listed species of any taxa does not currently appear of substantial potential to occur.

In general, while the Project as designed would improve ecological conditions of the Study Area to a less degraded condition, we expect that the proposed Project can be practicably modified to better utilize the restoration potential of the River and provide substantially greater ecological gains from the Project. Compared to current proposed designs, within Project floodplain/channel areas where the existing channel would be widened we generally recommend that Project design plans include:

a) fewer new hard structures be utilized at the ground/channel surface, including those that would modify/control stream flows;
b) increased creation of riverine (aquatic stream) areas with tree-shaded flowing water and native fish refugia within a relatively natural stream geomorphology and associated substrates (e.g., sand and gravel), with concomitant reductions in proposed areas of artificial open or ponded water; and
c) expanded areas of unmaintained native riparian scrub, woodland, and forest natural communities that are situated within the widened/restored floodplain so as to be subject to a relatively natural flooding regime (including periodic denudation flood flows consistent with natural seral stage compositions over the Project life).

We understand that ecologically healthy and accessible urban streams can help expand local businesses and enhance economic, educational, recreational, and social opportunities in nearby communities. Restoring and enhancing urban streams helps re-connect metropolitan residents—youth in particular—to natural open spaces and a relationship with nature. We suggest that the above noted modifications to the Project can be made consistent with all of the stated goals and objectives of the Project, including maintenance of flood risk management capacity, as well as considerable increases and improvements in appropriate recreation, "greening,"[3] and human access to the River. .

PREFACE

This is the U.S. Fish and Wildlife Service's (Service) Revised Final Coordination Act Report for the U.S. Army Corps of Engineers' (Corps) proposed Los Angeles River Ecosystem Restoration Project (Project). Pursuant to the mandates of the Fish and Wildlife Coordination Act (FWCA) of 1958, as amended (87 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Corps is consulting with the Service to ensure that equal consideration is provided for fish and wildlife resources

[3] Greening: the process of transforming spaces into more environmentally friendly and/or more naturalistic versions, such as urban green spaces, sustainable landscape improvement projects, and greenways. Planning for a greener townscape involves provision or preservation of greenery with greater sensitivity to the balance between hard-surfaced built-up areas and green vegetated areas.

during the planning of the Corps' proposed Project. The goal of the FWCA is to ensure that fish and wildlife conservation is an integral part of the development of our Nation's water resources.

The FWCA directs Federal agencies that plan and/or implement water-use projects to incorporate elements into their projects to improve fish and wildlife resources, and to avoid and minimize damages to these resources where feasible (Hearing on Coordination Act Amendments 1958; McBroom 1958). The purpose of the FWCA is to recognize the contribution of wildlife resources to the Nation, the increasing public interest and significance of these resources due to expansion of our national economy and other factors, and to provide that wildlife conservation receives equal consideration and be coordinated with other features of water-resources development programs (16 U.S.C. 661).

This document constitutes the Revised Final FWCA Report in fulfillment of a Military Interdepartmental Purchase Request between the Service and the Corps regarding the potential effects of the proposed Los Angeles River Ecosystem Restoration Project in Los Angeles County, California, on fish and wildlife resources. We have prepared this FWCA Report on behalf of the Secretary of the Interior pursuant to the requirements section 2(b) of the FWCA and in keeping with the intent of the NEPA (P.L. 91-190).

Our analysis of the proposed Project and the recommendations provided herein are based on information in: 1) the Corps' 2013 Draft EIS/EIR; 2) other reports and data provided by the Corps; 3) the Los Angeles River Revitalization Master Plan (City of Los Angeles 2007); 4) a review of the published and unpublished literature on the history, biota, and ecosystems of the region; 5) field visits by Service personnel; 6) discussions and meetings with professional biologists and representatives from other Federal, state and local agencies; 7) revised proposed Project description, commitments, and information provided to the Service by the Corps by email in November 2014; and 8) our best collective professional judgment.

Our goals in the analysis in this report are to: a) identify and evaluate the potential effects of the proposed Project on fish and wildlife resources and the ecosystems they depend upon within the action area; b) provide suggestions for improving the currently proposed Project designs for ecological restoration and fish and wildlife recreational/nature access; c) recommend methods for avoiding, minimizing, and offsetting potential negative ecological effects of the Project; and d) suggest other actions that the lead agencies can plan and/or implement that would partially restore the natural ecosystems, and/or improve or enhance native fish and wildlife resources, associated with the River.

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INTRODUCTION

The Los Angeles region's history is inseparably intertwined with the River. The historic occupation, settlement, and development patterns of the region were centered on the River due to its huge importance for residential, municipal, and agricultural water supply. Several large Native American Tongva villages and the first Spanish settlement in the region (in the area of what is now downtown Los Angeles) were developed adjacent to the River near the Study Area, mostly due to the perennial supply of surface water the River provided along its middle reaches (Crespí 2001; Gumprecht 1999). An extensive series of contiguous riparian natural communities, including woodlands and forests, sided the River in the Project area during this period (Crespí 2001; Gumprecht 1999). In the Project area the River's floodplain provided relatively flat and fertile agricultural land that was heavily used during and following the 18th /19th century Spanish settlement period. Competing uses of the River corridor and floodplain in modern society (including flood damage reduction facilities), combined with large-scale alteration the River's watershed over the last hundred years, have drastically reduced the abundance and function of the aquatic and riparian natural communities of the River (Garrett 1993).

Streams and rivers, with their associated floodplain and riparian ecosystems, provide essential or highly important habitat elements for much of the region's native non-marine fish and wildlife species. Much of southern California's native terrestrial vertebrate wildlife species depend on riparian ecosystems for essential portions of their life histories (Schoenherr 1992).

Over the past century, increasing urbanization of watersheds in southern California has resulted in large losses and degradation of wetlands and riparian areas (Dahl 1990, Holland et al. 1995). As a result of the wholesale changes to the River and its watershed over the last 100-plus years, the current abundance and diversity of native flora and fauna along the River has drastically diminished as compared to its pre-channelization state, as evidenced by a comparison of current biota with that documented by literature, collections, and historical photographs (Garrett 1993). Commensurate with these reductions in River ecosystems has been the urban development of the surrounding areas, and the concomitant greatly diminished opportunities for exposure and experiences in nature for local residents. The River, as with most low-lying points in the landscape, is strongly influenced by the stormwaters, pollutants, and streamflow warming that characterize this urban development and the associated water catchment.

Historically, typical open channel flood damage reduction ("flood control") systems in the U.S. have been designed for mostly a single function: to enhance human safety by reducing flood damage to human landscape infrastructure. This single-purpose objective is increasingly an untenable practice (Williams and Swanson 1989; Greco and Larsen 2014). Because river and stream systems in human-dominated landscapes often play important conservation roles for biota (e.g., habitats for sensitive species) and exposing/connecting people with nature, it is important that flood risk management planning be integrated with conservation planning principles and goals where practicable. In river and stream systems, we suggest that flood damage reduction channels should be multifunctional where feasible, and be designed to accommodate native vegetation as well as geomorphic processes. In many cases, expanding the flood channel

footprint and unlined channel bottom while increasing design channel roughness coefficients (Manning's n[4]) with vegetation can be performed while still effectively meeting multifunctional objectives (Greco and Larsen 2014).

The stated primary purpose of the proposed Project alternative plans (including Corps preferred alternative) considered in the 2013 Draft EIS/EIR is to restore approximately 11 mi of the River from Griffith Park to downtown Los Angeles by reestablishing or increasing riparian strand, freshwater marsh, and aquatic natural communities and reconnecting the River to major tributaries, its historic floodplain, and the regional ecological zones of the Verdugo Hills and Santa Monica and San Gabriel mountains at the central nexus of the River watershed's former and existing ecosystems, while maintaining existing levels of flood risk management. A secondary purpose is to provide recreational opportunities consistent with the restored ecosystem within the 11-mi Project reach of the River.

Implementation of any substantial project in the Corps' Study Area[5] may indirectly affect biological resources beyond the political or jurisdictional boundaries used to delimit the Study Area chosen by the Corps. For example, most water and a substantial portion of the sediments and contaminants that enter or occur in the Study Area move downstream along the River and ultimately move beyond the Study Area limits. Also, many invasive exotic and native plant, fish, and wildlife species typically move through and beyond the Study Area limits, both upstream and downstream. Therefore, the analysis in this Final FWCA Report considers all potential appreciable ecological effects associated with the alternatives to be evaluated, not just those effects limited to the Study Area. We also considered in our analysis the potential effects to biological resources resulting from the possible interactions between the proposed Project and other known regional planning efforts.

Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity, and sustainability (Society for Ecological Restoration 2004). Frequently, the ecosystem that requires restoration has been degraded, damaged, transformed, or entirely destroyed as the direct or indirect result of human activities. Restoration attempts to return an ecosystem to its historic ecological trajectory. Historic conditions are therefore the ideal starting point for restoration design. The restored ecosystem will not necessarily recover its full former state, since contemporary constraints and conditions may cause it to develop along an altered or limited trajectory. The historic conditions and trajectory of a severely degraded ecosystem may be difficult or impossible to determine with accuracy. Nevertheless, the general direction and boundaries of that trajectory can be established through a combination of knowledge of the damaged ecosystem's pre-existing structure,

[4] The empirical Manning roughness coefficient characterizes channel surface roughness and thus characterizes the resistance or impedance to flow. Small values of n such as <0.012 describe a smooth surface with little resistance (such as concrete), whereas large values of n such as >0.15describe a rough surface consisting of trees and boulders posing greater resistance (Mount 1995). The Manning equation is a key tool used by civil engineers to design open channel flood control structures.

[5] Study Area – the Study Area refers to the area that was studied in the 2013 Draft EIS/EIR.

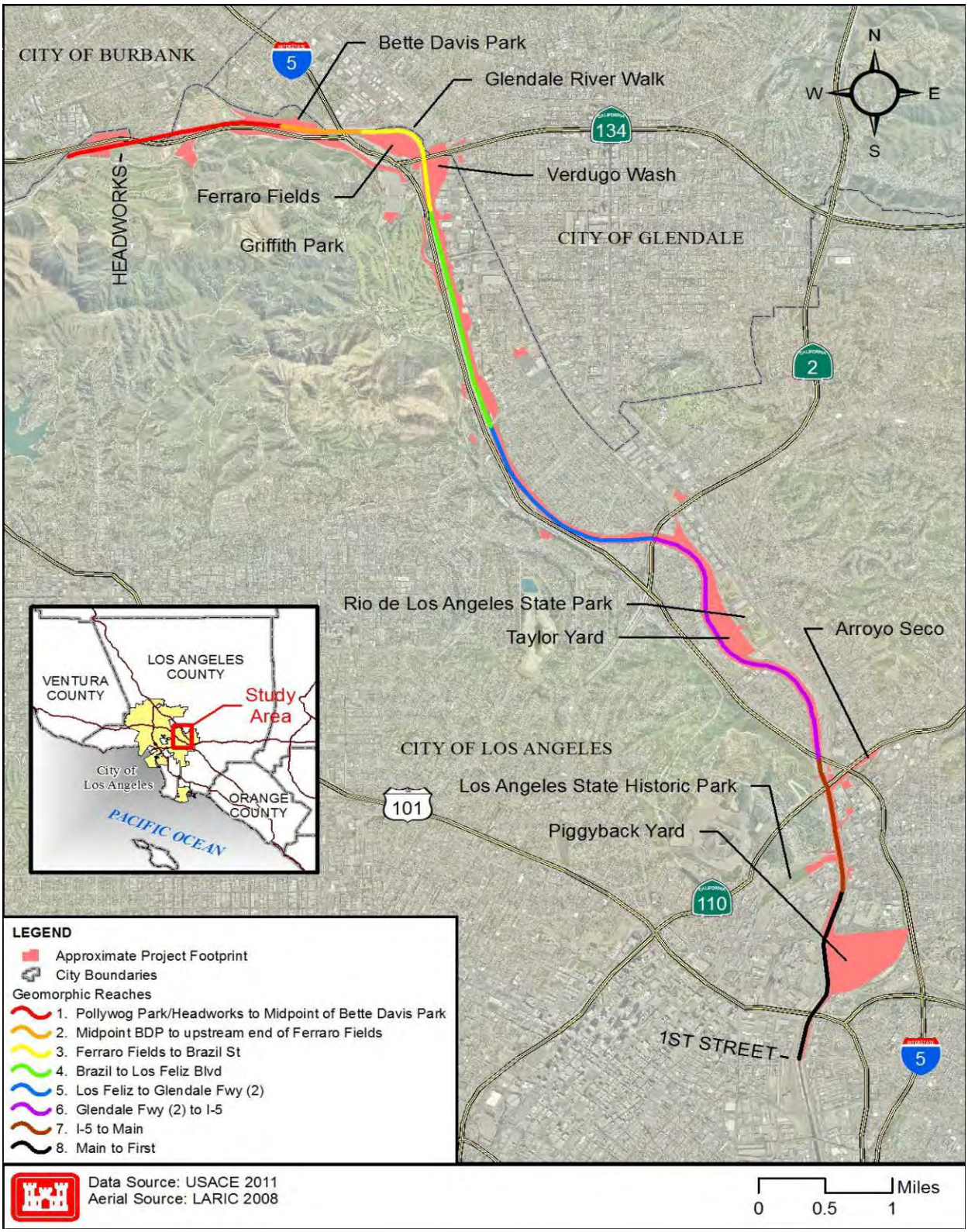

Figure 1. Project Study Area

composition and functioning, studies on comparable intact ecosystems, information about regional environmental conditions, and analysis of other ecological, cultural and historical reference information. These combined sources allow the historic trajectory or reference conditions to be charted from baseline ecological data and predictive models, and its emulation in the restoration process should aid in piloting the ecosystem towards improved ecological health and integrity.

An ecosystem is considered recovered/restored when it contains sufficient biotic and abiotic resources to continue its normal development without further assistance or subsidy. It will sustain itself structurally and functionally and will demonstrate resilience to normal ranges of environmental stress and disturbance. The eight attributes listed below provide a basis for determining when partial or full restoration would be been accomplished (Society for Ecological Restoration 2004). The full expression of all of these attributes is not essential -- it is only necessary for these attributes to demonstrate an appropriate trajectory of ecosystem development towards the intended goals or reference.

1. The restored ecosystem contains a characteristic assemblage of the native species that occur in the reference ecosystem and that provide appropriate community structure.
2. All functional groups necessary for the continued development and/or stability of the restored ecosystem are represented or, if they are not, the missing groups have the potential to colonize by natural means.
3. The physical environment of the restored ecosystem is capable of sustaining reproducing populations of the species necessary for its continued stability or development along the desired trajectory.
4. The restored ecosystem apparently functions normally for its ecological stage of development, and signs of dysfunction are absent.
5. The restored ecosystem is suitably integrated into a larger ecological matrix or landscape, with which it interacts through abiotic and biotic flows and exchanges.
6. Potential threats to the health and integrity of the restored ecosystem from the surrounding landscape have been eliminated or reduced as much as possible.
7. The restored ecosystem is sufficiently resilient to endure the normal periodic stress events in the local environment that serve to maintain the integrity of the ecosystem.
8. The restored ecosystem is self-sustaining to the same degree as its reference ecosystem, and has the potential to persist indefinitely under existing environmental conditions.

Ecosystem restoration is a primary mission of the Corps Civil Works program (USACE 2014a). Pursuant to Corps policy, ecosystem restoration projects should examine the need for improving or re-establishing both the structural components and the functions of the natural system (USACE 2014b). Restored ecosystems should mimic, as closely as possible, conditions which would occur in the area in the absence of human changes to the landscape and hydrology. In some instances, a return to pre-disturbance conditions may not be feasible (USACE 2014a), such as within the Study Area. In situations where partial restoration may be possible, the goal of Corps Civil Works projects is typically significant and valuable improvements of degraded ecological resources (USACE 2014a). Indicators of successful restoration would include the presence of a large variety and number of native plants and animals, the ability of the area to sustain larger numbers of certain indicator species or more biologically desirable species, and the

ability of the restored area to continue to function and produce the desired outputs with a minimum of continuing human intervention (USACE 2014b). Those restoration opportunities that are associated with wetlands, riparian and other floodplain and aquatic systems are most appropriate for USACE involvement (USACE 2014b).

After examining the needs and potential for improving or re-establishing both the structural components and ecological functions of the Study Area, we expect that partial reestablishment of the attributes and functions of the former natural self-regulating ecosystems of the River is practicable. Our design analysis and Recommendations herein take, in part, a realistic hydrological and geomorphic approach to the substantial constraints and opportunities presented by the River and environs in their current state. We have evaluated past development impacts, historical uses, fluvial sediment transport, current and potential channel forms, riparian and riverine functions, hydraulics (e.g., channel water flow), flood damage reduction and right-of-way constraints, and potential recreation in the watershed and Study Area. The past and ongoing anthropogenic impacts along the River have drastically altered the geomorphic processes and disconnected the River from its former floodplain. Sediment erosion/transport/deposition potential within most of the length of the River is currently artificially very low (and would remain so with the Project) due to channelization and hard surface bottom and slope protection along most of the River, and development within the watershed. Floodplain interaction with the River and overbank flows are vital to maintaining balanced riparian and riverine ecosystems of moderate to high function and integrity; as such, even partial restoration of these processes (e.g., within future proposed widened River floodplain reaches) is essential to partial restoration of basic River ecosystem functions and biological integrity. Our Recommendations also take a whole system approach to River restoration that, if implemented, would result in appreciably increased riparian and riverine systems regeneration and improved ecological sustainability and function. Nevertheless, even partially restoring substantial ecological connections (such as wildlife corridors from areas within the Study Area to larger natural areas outside) in and with the Study Area will remain highly challenging, considering the existing fragmented conditions, hard structures, and extensive development within and surrounding the Study Area, as well as the Project scope, competing proposed uses, and likely available resources.

FISH AND WILDLIFE COORDINATION ACT

The FWCA directs or authorizes consultation, reporting, consideration, and in many cases, installation/implementation of fish and wildlife conservation features. The authorities of the FWCA are considered to be “supplementary legislation” to the various Federal project authorizations, such as the Corps public works authorizations (Smalley and Mueller 2004). The FWCA conditions or supplements other water development statutes to require consideration of recommendations generated under the FWCA procedures, including portions of the Clean Water Act (Zabel v. Tabb, 430 F2d 199 [5th Cir. 1970] cert. denied 401 U.S. 910 [1972]). For Federal water resources development projects, the FWCA requires that fish and wildlife conservation receive equal consideration by Federal agencies with other project purposes, and that such conservation be coordinated with other project features. The FWCA authorizes the project implementation of means and measures for both mitigating losses of fish and wildlife resources, and for enhancing these resources beyond offsetting project effects (Smalley and Mueller 2004).

Sections 1 and 2 of the FWCA direct and authorize Federal agencies that they have an affirmative duty to both conserve and improve wildlife resources in connection with water development projects (Metcalf 1958; Smalley and Mueller 2004). While acceptance of Service's conservation recommendations is not mandatory, the FWCA does provide clear, general authority for the Corps to fund and construct measures that will provide for fish and wildlife conservation and enhancement as part of their water projects, and directs that fish and wildlife conservation is a goal of all Federal water projects (Smalley and Mueller 2004). Similarly, while the results of the FWCA consultation with the Service are not binding, the Federal agency must strongly consider input received during consultation to prevent loss or damage to wildlife resources and to provide for measures to mitigate such impacts.

To help accomplish the above outlined requirements, Section 2(a) of the FWCA establishes that preconstruction planning on water project development shall be coordinated with the Service through consultation. The findings and recommendations of the Service under the FWCA are communicated to project decision makers by three main means: orally in the interactive planning process, through notes and memoranda/letters, and through the formal reporting authorized by section 2(b). Section 2(b) requires that the Service provide a report and recommendations that determine "the possible damage to wildlife resources" and provide "means and measures that should be adopted to prevent the loss of or damage to such wildlife resources, as well as to provide concurrently for the development and improvement of such resources." The "means and measures" refer to both those for mitigation of impacts, and for enhancement fish and wildlife resources (Smalley and Mueller 2004). The purpose of the Section 2(b) report is to document and recommend: it should document the results and findings of the Service's study, planning, and coordination. It should recommend those actions considered necessary by the Service to accomplish the fish and wildlife conservation goals of the FWCA.

Section 2(b) also requires Federal agencies to give "full consideration to the report and recommendations" of the Service and directs Federal agencies that "the project plan shall include such justifiable means and measures for wildlife purposes as the reporting agency finds should be adopted to obtain maximum overall project benefits." The 2(b) report must be made available to the Congress or other authorizing agents when decisions are made to authorize (or not to authorize, or authorize with modifications) a project. Section 2(c) of the FWCA authorizes the Service to: conduct surveys and investigations to determine the possible damage of proposed developments on wildlife resources; to make recommendations for preventing their loss or damage; and to offer measures for developing and improving these wildlife resources.

The definitions of the terms "mitigation," "compensation," and "loss prevention," (associated with "conservation of wildlife resources by preventing loss of and damage to such resources") contained in Section 2 of the FWCA are sometimes subject to confusion. The objective of mitigation under the FWCA is to "prevent loss of or damage to" fish and wildlife. Mitigation under the FWCA is accomplished through the use of a five step process for reducing or eliminating losses from a project: avoidance, minimization, rectification, rectification over time, and compensation. Compensation is used to mitigate for unavoidable losses after the first four

components of mitigation have been applied. The terms "wildlife" and "wildlife resources," as used in the FWCA, "include birds, fishes, mammals and all other classes of wild animals and all types of aquatic and land vegetation upon which wildlife is dependent" [Section 6(b)]. Thus, although the FWCA uses the term wildlife, it is representing all fish and wildlife and their habitats/ecosystems. Evaluations made under the FWCA can, therefore, take into consideration a wide spectrum of environmental factors, including a watershed or ecosystem approach (Smalley and Mueller 2004). Per Section 2(d) of the FWCA, fish and wildlife conservation costs (mitigation and enhancement) are to be considered Federal project costs. No regulations for implementing the provisions of the FWCA currently exist.

APPROACHES TO FLOOD RISK REDUCTION, RIVERINE AND RIPARIAN MANAGEMENT, AND ECOLOGICAL DESIGN OF OPEN CHANNELS

In most developed countries, rivers proximate to urban development typically have open channel flood damage reduction systems designed with fixed parameters and narrow objectives that frequently overlook important ecological functions of river systems, making these channels of limited value to ecological conservation. The conventional single objective for open channel design is to convey water as efficiently as possible, and historically such designs have been implemented to help protect to urban and rural infrastructure. Using this utilitarian goal, flood water is efficiently routed with the goal of reducing property damage and loss of human lives, and the open channel design is mainly driven by minimizing channel right-of-way space and construction costs. The most extreme form of this open channel design replaces the entire river channel and its floodplain by smooth trapezoidal- or rectangular-shaped concrete conveyance structures with slopes high enough to contain design flows.

We herein suggest that open channel flood risk management designs consistently should have co-equal goals of flood damage reduction and ecological conservation. This multifunctional approach necessitates adopting a ‘regenerative design’ paradigm (Cole 2012; Zari 2012) combined with ‘reconciliation ecology’ (Rosenzweig 2003) to create and sustain viable and productive river systems. Our approach builds on previous work such as the “space for the river” concept proposed in the Netherlands and elsewhere (Nienhuis & Leuven 1998). In recent decades it has been increasingly recognized that riverine and riparian ecosystems have highly important ecological conservation values and provide human communities with numerous ecosystem services (Opperman et al. 2009; Thorp et al. 2010). Various aspects of the fundamental mechanics of these ecosystems have been described relatively recently in the literature and they illustrate why conventional open channel flood channel design has been detrimental to ecological conservation. Key essential natural community and ecosystem patterns, processes, and concepts, which are not considered in conventional flood damage reduction channel design, include: naturalized flow regimes (Poffet al., 1997), flood-pulse (Junk, Bayley & Sparks, 1989), geomorphically effective stream power (Larsen, Fremier, & Greco,2006), channel meander (Hickin, 1974), floodplain age (Greco,Fremier, Larsen, & Plant 2007; Hooke, Harvey, Miller, & Redmond 1990), bedload transport (Kondolf 1997), vegetation dynamics(Amoros and Wade 1996), patch dynamics and minimum dynamic area (Greco 2013; Pickett & Thompson 1978; Wu & Loucks 1995), minimum dynamic area for channel meander using set-back levees (Larsen, Girvetz, & Fremier 2006); river continuum (Vannote, Minshall,

Cummins, Sedell, & Cushing 1980), large woody debris recruitment (Latterell & Naiman 2007), large river ecology (Johnson, Richardson, & Naimo 1995), and riparian landscape ecology (Malanson 1993). It is important that in the planning of river and stream projects that these riverine-riparian landscape patterns, processes, and concepts are considered and integrated into multifunctional open channel design processes where possible, such that essential ecological functions and values are maintained or enhanced for ecological conservation.

Because conventional flood damage reduction channel design seeks to minimize right-of-way width and economic costs, the typical open channel footprint (land area utilized) is minimized, the channel depth is increased with the use of floodwalls or levees, and the roughness coefficient is minimized. Herein lie the two main reasons why conventional flood channel design is of little conservation value. First, channel water flow capacity is created or increased by artificial means to constrict the floodplain instead of using floodplain width to expand capacity and decrease depth. Second, the design use of very smooth roughness coefficient values requires the routine,systematic removal of any trees, shrubs or woody debris that subsequently grow or get deposited within the channel that act to increase the roughness of the channel beyond its design roughness value. However, it is precisely this roughness component that has critically important value as habitats for most native aquatic and terrestrial organisms. Engineers will frequently design channels to create additional capacity (e.g., flood conveyance) by creating higher levees along a narrow channel to contain floodwaters to a smaller footprint thus reducing the width of the floodplain and lowering land acquisition costs. At the design (peak) flow the water is typically deep and the velocity is high. Consequently any non-flying terrestrial animals living in the flood channel typically must be able to reach refugia or drown. Refugia from floodwaters can be provided by high ground, a nearby tree, or a debris pile that rises above the flood water surface. In large river systems flood damage reduction channels can be wide with few or no trees in the floodplain, and for many terrestrial organisms, traversing long distances to safety is dubious. In a study on the Sacramento River researchers found an 86 percent decline in the presence of small mammals in areas subject to flooding as compared to non-flooded areas (Golet, Hunt, & Koenig 2013). The use of setback levees (i.e., widening the distance between levees to increase channel width) to reduce channel depth and create additional capacity and conveyance is a more ecologically beneficial design practice (Mount 1995) and also provides opportunities for refugia habitats from floodwaters.

The second problem with a conventional engineering approach is designing the channel with very smooth Manning roughness coefficients and requiring that the n value be maintained overtime to pass the peak flow. Around the world millions of dollars are spent to remove vegetation that grows near the channel or in the floodplain to maintain these smooth roughness coefficients. In those same landscapes where flood damage reduction channels are cleared of their riparian vegetation are often sensitive terrestrial and aquatic species whose floodplain habitats are increasingly rare.

DESCRIPTION OF PROJECT REGION AND STUDY AREA

Region

Coastal southern California is a semi-arid region with a Mediterranean climate dominated by long dry summers and usually brief winters with short, sometimes intense cyclonic winter storms. The taller mountains in the region receive a portion of their precipitation as snow, which typically contributes water to streams until mid- to late-summer. Much of the higher elevations of the region are undeveloped and remain partially protected in national forests and a network of national, state, and county parks. The lower elevations in the region have been pervasively altered by urbanization or conversion to agriculture (Mazor et al. 2011). Wildfires and drought are frequent in the region. By area, the overall coastal southern California region is 59 percent undeveloped open space, 28 percent urban, and 13 percent agricultural (NOAA 2001). Watersheds within the Project surrounding region fall into two basic types: those characterized by short coastal streams draining mountain ranges immediately adjacent to the coast and those watersheds containing larger river systems, such as the River, that extend inland through gaps in the coastal ranges.

The River is located within the California Floristic Province, an 8-million-acre (ac) region that extends from southern Oregon to northern Baja, Mexico, and encompasses areas west of the interior deserts. The California Floristic Province is considered one of the world's 25 most biologically rich and threatened terrestrial ecoregions (Myers et al. 1999). Indeed, while these 25 ecological hotspots cover less than 1.5 percent of the earth's land surface, they account for roughly 60 percent or more of the remaining diversity of life on earth (Mittermeier et al. 1998, 1999). The California Floristic Province is a biological hotspot for nearly every taxonomic group (except freshwater fish) including plants, invertebrates, birds, mammals, and reptiles, in part due to the region's mild Mediterranean climate. The California Floristic Province harbors more endemic plant and animal taxa and more identifiable subspecies than any other area of comparable size in North America (Calsbeek et al. 2003); 44 percent of its plant and vertebrate species are endemic (restricted) to California (Myers et al. 1999). The California floristic province harbors more plant species than the central and northeastern United States and Canada combined, and over 30 percent of the known North American insect species north of Mexico (Raven & Axelrod 1978; Arnett 1985; Raven 1988; Messick 1997). California supports the second-greatest number of species listed under the Endangered Species Act in the United States, following to the State of Hawaii (USFWS 2001). This concentration of endangered and threatened species stems predominately from a combination of very high biological diversity and ongoing losses and threats from growing human population and associated development.

The River watershed/drainage dominates the geographical setting of the nation's second largest urban area (Garrett 1993). Los Angeles County has the largest human population of any county in the nation, and is exceeded by only eight states. Approximately 27 percent of California's residents live in the County. More than 1 million of the 10.4 million Los Angeles County residents live in unincorporated areas with the other 9.3 million living in 88 cities, located throughout a 4,084-square-mile (mi^2) area (County of Los Angeles 2013). Rainfall in the Project region typically falls between November and April, with monthly precipitation rarely exceeding

4 inches (in) (Kwan et al. 2010). Annual average rainfall since 1877 in the Study Area is approximately 15 in (Los Angeles Almanac 2013). Daily high temperatures range from 68 deg. Fahrenheit (F) to 86 deg. F, and lows range between 48 deg. F and 68 deg. F (California Department of Water Resources 2013).

The River within the City of Los Angeles was, and is, much more than the approximately 750 ac/32 mi (City of Los Angeles 2007) of existing flood channel facility. The River remains closely associated and dependent upon the watershed surrounding it (see Figure 2 below) (Garrett1993). Before channelization, the River was naturally an alluvial river that migrated and flooded periodically across a wide flood plain that is now occupied by developed portions of Los Angeles, Long Beach, and other communities (Gumprecht 1999). Much of the precipitation within the River's watershed, predominately rainwater, historically and currently collects within a large groundwater basin underlying the San Fernando Valley. This groundwater basin historically and currently drains as surface water flow in the River through the Project Study Area (Gumprecht 1999).

The River drains an 834 mi^2 watershed, with an overall length of the River and tributaries combined of 322 mi. Within the watershed, current land use (all tributaries combined) is approximately 40 percent open, 1 percent agricultural, and 59 percent urban (Mazor et al. 2011).

The River was historically a 51-plus-mi-long interconnected system of riparian and riverine natural communities (Gumpect 1999, Garrett 1993). It was and remains one of the largest sources of fresh water along the southern California coast (Friends of the Los Angeles River 2008). The River provided a source of water and food for the Gabrielino Indians prior to European occupation of the region. The Gabrielinos were gatherers and hunters who lived primarily off the acorns from the abundant oak trees that formerly occurred along the River's floodplain, as well as on fish and mammals (Gumpect 1999). Before Spanish settlement of the area at least 45 Gabrielino villages were located near the River, concentrated in the San Fernando Valley and the Elysian Valley, in what is present-day Glendale.

The natural path of the River was historically relatively unstable. In the 18th and early 19th centuries, the alignment of the River ran southwest downstream of the Glendale Narrows (near present-day downtown Los Angeles), where it joined what is now Ballona Creek, and the River discharged into Santa Monica Bay in present-day Marina del Rey; this course is drastically different than the River's alignment today (Gumprecht 1999). During a large flood in 1825, the River's course diverted itself to approximately its present one, flowing due south just east of downtown and discharging into San Pedro Bay (Gumprecht 1999; Dark et al. 2011). Between 1825 and the "Great Flood" of 1862, the River was joined by the San Gabriel River in present-day Long Beach, but in 1862 the San Gabriel River carved out a new course 6 mi to the east, and has discharged into Alamitos Bay ever since.

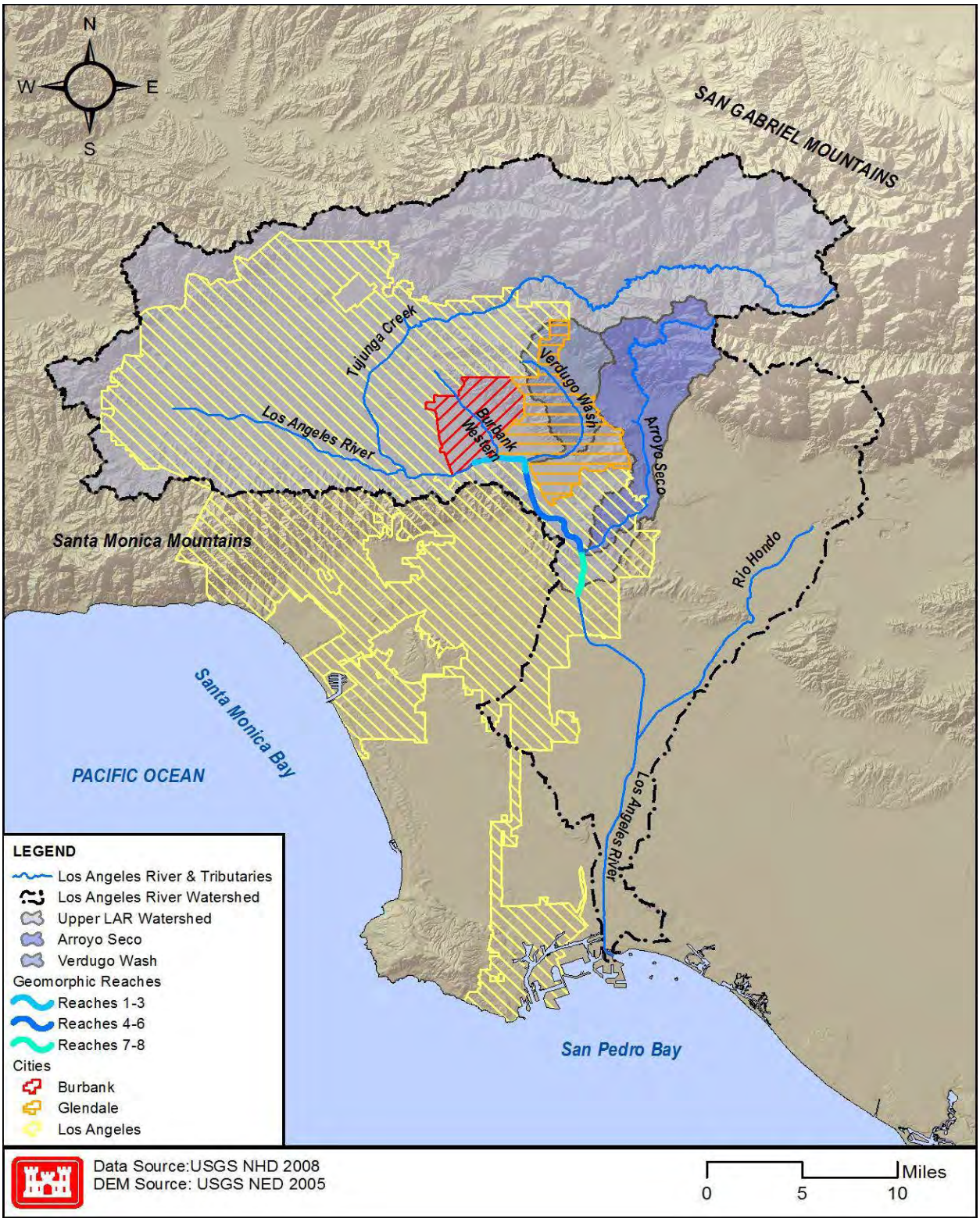

Figure 2. Watersheds and tributaries of the Los Angeles River (figure taken from the Los Angeles River Ecosystem Restoration Integrated Feasibility Report/2014 Draft EIS/EIS)

Until the completion of the Los Angeles Aqueduct for the importation of water , the River was the primary agricultural, industrial, and domestic water source for the Los Angeles region, through River surface water diversions and groundwater pumping. Floods continued to affect the partially developed floodplain areas along the River into the 1930s, leading to calls for additional flood damage reduction measures. The Corps then began a project of channelizing the River. Since completion of this project, the River has served primarily as a flood channel. The only portions of the River that are not both completely channelized and covered with hard structures are: a flood-damage reduction basin behind the Sepulveda Dam near Van Nuys; an approximately 3-mi stretch east of Griffith Park (the Glendale Narrows Project area, where groundwater levels continue to mostly be at the ground surface) where the channel is unlined (soft-bottomed) and along the last few mi of the River in Long Beach where the channel is also soft-bottomed. Treated wastewater from three wastewater reclamation plants currently increase surface flows in the River, starting at the Sepulveda Basin.

Based on past accounts, the River's surface flow through the Project area was historically perennial (Crespí 2001; Gumprecht 1999; etc.), although common current perceptions are often that it was naturally intermittent or that the River was normally "dry" (e.g., see Smith 2013). For example, Juan Crespí reported considerable surface flow of the River near what is now downtown Los Angeles in the mid-summer of 1769 (Crespí 2001), and significant perennial surface baseflows were consistently reported in the Project area of the River throughout the 19th century (Gumprecht 1999). Portions of this surface water was consistently diverted from the Project area of the River in all seasons during the late 18th and 19th centuries as the primary source for regional irrigation and domestic use in the "Zanja" ditch water distribution system; this canal-ditch water supply was key to the early agricultural and urban development of the area (Gumprecht 1999).

The natural year-round surface water flow of the River in the Study Area was predominately from surfacing groundwater continually draining the large upstream groundwater basin that underlies the San Fernando Valley (Gumprecht 1999). The River's surface flow was reportedly historically intermittent in stretches upstream of the Project area in the San Fernando Valley and downstream of downtown (Gumprecht 1999).

The first written description of the inland River was made by Juan Crespi during the Portola Expedition in summer of 1769, as they explored the area around what is now downtown Los Angeles (Crespí 2001):

> Wednesday, August 2—On going three hours, in which we must have made about three leagues as well, we came to the water found by the scouts yesterday, another river with another very green lush valley in no wise inferior to the two past ones [noting the San Gabriel and Santa Ana rivers to the south]; rather, of all of them, I should say that this one bears away the prize. This river here [the Los Angeles River] is a bit smaller than the last ones, its bed being where we crossed about some seven yards wide. It is not deep. It flows from the north-north west, from the quite high mountains lying next by here; while by the same mountains, there is a dry creek [the Arroyo Seco] to the northeast, with a very large bed, closing with the river here; it is plain what large torrents this must carry in

> the season, with many dead trees that must have come down from the mountains. The beds of both are lined with large trees, sycamore, willows, cottonwoods, and very large live oaks….The river flows on down nearly at ground level through a very green, lush, wide-reaching valley of level soil some leagues in extent…upon one and the other side of the river, which runs continually onward [downstream to the west] with a great amount of trees, lie very large, very green bottomlands, looking from afar like nothing so much as large cornfields…The waters of all three rivers are very fresh and pure, and in point of flow this one here is very slightly less than the other two…There are a great many [pronghorn] antelopes at all of these rivers, and very large hares, the latter especially here at this spot.

Today the mostly-concrete channel of the River continues to carry a relatively constant low-flow through much of the region (LARRC 2011). Some of this flow comes from water reclamation plant discharge and street runoff. A substantial portion of the treated water in the River flows from the Donald C. Tillman Water Reclamation Plant (WRP), located upstream of the Project area adjacent to the Sepulveda Basin Wildlife Reserve. The Tillman WRP adds approximately 60 million gallons of reclaimed water to the River each day. Additional treated discharge runs to the River from the Burbank WRP, the Los Angeles/Glendale WRP in North Atwater, and the Whittier Narrows WRP on the Rio Hondo tributary.

Over the last 150 years the River has been substantially degraded by water diversions, agriculture and development within its watershed and floodplain, and channelization of almost all of its floodway. Urbanization of the watershed has deprived the River of needed sediment for riverine and riparian ecosystem function, while also degrading water quality. Like most other larger coastal Los Angeles County streams, the watershed of the River is now heavily urbanized. Much of the River's original watershed land surface is now underneath impermeable surfaces such as pavement and buildings. As a result, rain runoff now enters the River faster—making the River storm flows "flashier" (increased flood flow peaks and short-term volumes for a given rainfall event). In the 1920s and 1930s, substantial flood events damaged many structures on large developed portions of floodplains in southern California; the River flood of 1938 was one of the most famous flooding episodes of this period.

The state and Federal governments have been building dams, debris basins, bridges and channel structures on the River for more than 70 years to reduce the human impacts from recurrent flooding. The primary purpose of the River has been flood damage reduction since Congress made that declaration in the Flood Control Act of 1936 and five years later authorized the Corps to build and operate major flood-control facilities. When concrete channelization of the River began during the 1930s Depression, it was a national era of big public works projects that produced jobs. Major flood damage reduction projects on the River culminated in the mid-20th century with a Federal flood risk management project, the Los Angeles County Drainage Area project (LACDA project). The River has been completely channelized though its lowland reaches; the LACDA project channelized and lined the River in concrete banks and a mostly concrete bed and straightened/shortened the River's course (Garrett 1993).

The combination of flood damage reduction projects eliminated most of the riverine and riparian natural communities along the River, greatly reducing its plant and wildlife diversity and numbers. The combination of channelization and surrounding development also essentially eliminated the landscape linkages and corridors of the River to surrounding ecosystems such as the Santa Monica Mountains. The entire River corridor is now heavily degraded ecologically.

Apart from the Sepulveda Basin, the San Fernando Valley area of the River (upstream of the Study Area) is characterized by large segments of channel that are entirely concrete-covered, with dense adjacent development of the former floodplain; this has created substantial challenges for adjacent land acquisition that would be necessary for River widening and restoration in this stretch. The lower reaches of the River (downstream of the Study Area) are also highly constrained by development, including downtown Los Angeles and an adjacent heavy industrial corridor that also includes a major powerline transmission corridor and a freeway system along the River. The reaches of the River above and below the Study Area also have lower potential to connect to regional ecological "core areas" (e.g., the Santa Monica Mountains) because of this dense surrounding existing development, as compared to the Study Area.

A decision by the U.S. Environmental Protection Agency in 2010 reversed an earlier decision by the Corps and recognized the River as a navigable waterway. Several projects have been implemented on the River recently, and more are planned: for example, the 32-ac Chinatown-Cornfields site north of downtown Los Angeles was originally slated for industrial development but has become the Los Angeles State Historic Park. The Los Angeles River Revitalization Master Plan has identified more than 240 potential projects to increase recreation and public access all along the River and to provide some ecological enhancement and restoration along the River (City of Los Angeles 2007).

Study Area

The Corps in the 2013 Draft EIS/EIR identifies the Study Area as the "ARBOR Reach" of the River. The 11.5-mi Study Area stretch of the River stretches from approximately Griffith Park (City of Burbank) downstream to downtown Los Angeles (see Figure 1). The Study Area is dominated by a portion of the River that was altered and engineered as part of the Corps' LACDA project. The principal River tributaries of the Study Area include Burbank Western Channel, Verdugo Wash, and Arroyo Seco (see Figures 1 and 2).

Despite its highly degraded condition, the ARBOR reach of the Study Area has higher potential for restoration along the River than the other reaches because it includes the Glendale Narrows, one of the few reaches in the River with a non-concrete (soft-bottom consisting mostly of cobblestones) bed and relatively natural perennial River baseflows fed by surfacing groundwater. The Glendale Narrows currently supports some of the only remaining riparian and freshwater marsh natural communities on the River. These existing riparian and marsh areas and the perennial baseflow maintain one of the most diverse assemblages of wildlife remaining on the River today. The Study Area portion of the River has connections to the tributaries of Verdugo Wash and Arroyo Seco; these are channelized streams that could eventually (with substantial

restoration) provide ecological linkages or corridors to significant ecological areas; additionally, the Study Area reach has potential for corridors to relatively large natural areas in Griffith Park).

Griffith Park covers over 4,000 acres at the eastern end of the Santa Monica Mountains, and supports various natural community types (chaparral, coastal sage scrub, oak-walnut woodland, riparian), with southern mixed chaparral as the dominant form, as well as exotic and ornamental vegetation. Its topography is rugged, with elevations ranging from 384 ft to 1,680 ft, including deep canyons, rocky outcrops and escarpments, perennial and ephemeral streams, and portions of the River in the Study Area. Land use in the park is overwhelmingly dominated by recreation, with no area of the park formally protected for ecological preservation. However, the ruggedness of the topography has kept human disturbance minimal over large areas of the park's interior. Although Griffith Park lies within the Santa Monica Mountains Range, it, along with an adjacent block of privately-held open space north of the Hollywood Reservoir, is relatively isolated from undeveloped areas in the main part of the range by urbanization. Griffith Park and this adjacent open space is bordered by Burbank and the 134 Freeway to the north, Glendale and Interstate-5 to the east, Los Angeles to the south, and by a variety of urban land uses, including the 101 Freeway, to the west (Remington and Cooper 2009).

The existing open bed portions of the River, existing natural communities, and perennial surface flows in the Study Area provide a base for enhancement and partial restoration. Additionally, some of the railroad facilities along the River in the Study Area have been abandoned or removed, providing increased opportunity for widening the channel and restoring former floodplain in these areas while maintaining existing flood capacity levels for the River.

Reaches

Figure 3. Aerial photo of a portion of Reach 1 of the Study Area

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

Reach 1 is the furthest upstream segment of the Study Area and is about 1.5 mi in length. The reach runs west to east, adjacent to and near the Pollywog Park area of Griffith Park and the Corps Headworks project site. In this reach the River channel is a rectangular concrete-lined configuration with subdrains and no low-flow channel (a low-flow channel is located in the bottom center in the other, all-concrete reaches of the Study Area). A small temporary dam exists within the River bed near the upstream end of this reach that was once used to divert River surface water to the Headworks spreading grounds that were operated by the Los Angeles Department of Water and Power for many years to percolation River surface water to supply domestic water use. The channel in this reach is approximately 18 feet (ft) deep and the top of bank to top of bank width is approximately 115 ft.

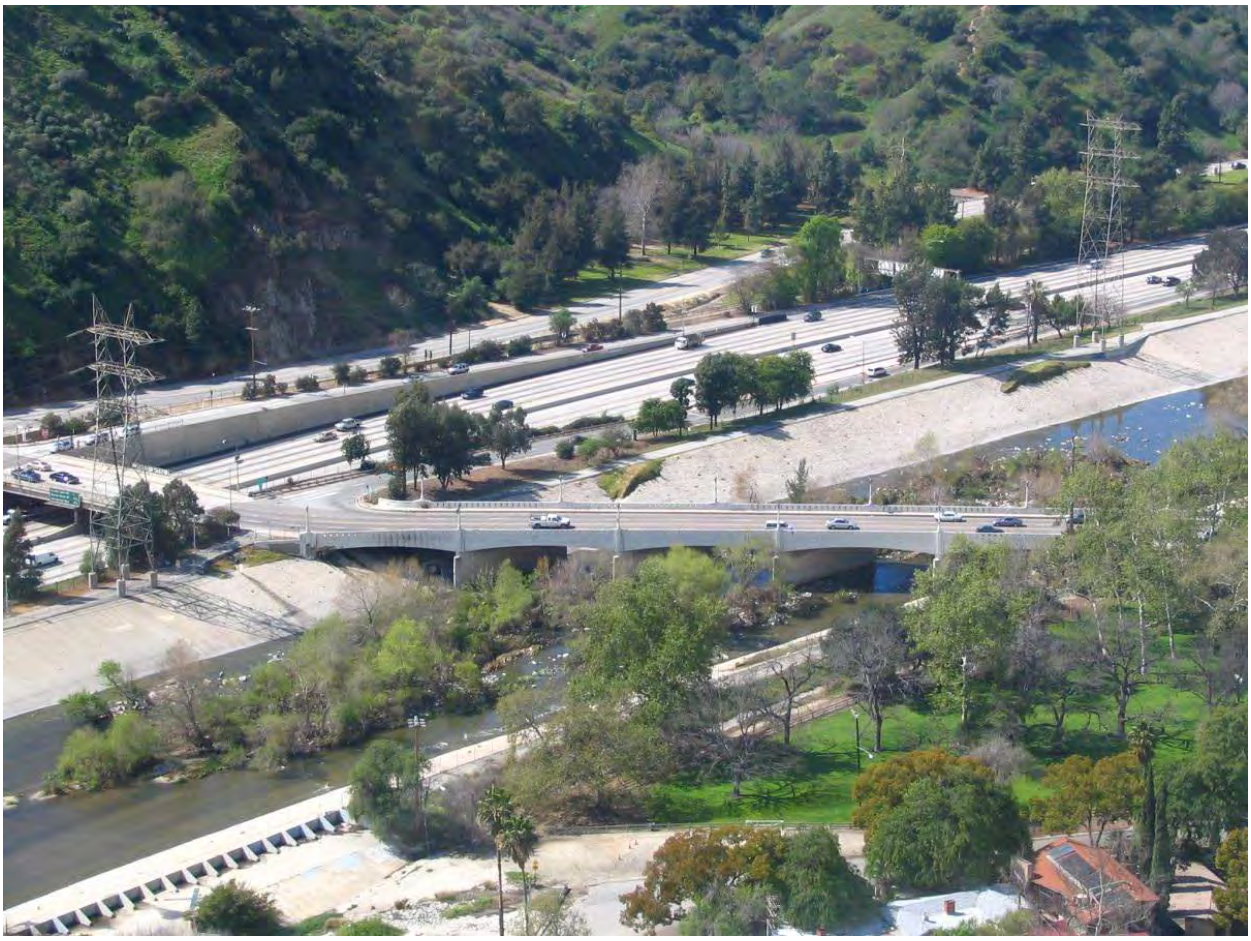

Figure 4. Aerial photo of a portion of Reach 2 of the Study Area

Reach 2: Midpoint of Bette Davis Park to Upstream End of Ferraro Fields

This reach is approximately 0.8 mi in length and extends from the midpoint of the Bette Davis Park to the Ferraro Fields, a public soccer field facility. In this reach the River bed transitions from concrete-lined to a cobblestone bed, and then transitions back to concrete. The channel has a trapezoidal configuration with grouted 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 ft deep from the top of banks and approximately 175 ft wide. Sediment deposited in the channel has formed sand bars/islands partially stabilized by vegetation. This reach is not as densely vegetated as the River bed areas farther downstream in Reaches 4 to 6.

Figure 5. Aerial photo of a portion of reach 3 of the Study Area

Reach 3: Ferraro Fields to Brazil Street

This reach is approximately 1.0 mi in length. It begins at the upstream edge of the Ferraro Fields where the River bed transitions from cobbles to concrete. The River alignment makes an approximately 90-degree curve to the south around Griffith Park and the bed transitions back to cobbles at approximately Brazil Street. The channel in this area is trapezoidal and concrete lined. The bed is approximately 18 to 23 ft deep from the top of bank and approximately 180 ft wide, widening to 380 ft just downstream of the Verdugo Wash confluence. State Route (SR)-134/Ventura Freeway crosses the River at Verdugo Wash.

Figure 6. Aerial photo of a portion of reach 4 of the Study Area

Reach 4: Brazil Street to Los Feliz Boulevard

This reach of the River is approximately 1.8 mi long and extends from Brazil Street on the left bank downstream to the Los Feliz Boulevard Bridge. The River bed in this reach transitions from a concrete-lined rectangular channel to a trapezoidal channel with a cobble bed and grouted stone banks. The banks are toed-down with sheet pile and quarry run stone. The bed was constructed approximately 18 ft deep from the top of the slope, and the channel ranges from approximately 130 to 160 ft wide at the bank tops. Sediment deposited in the channel over time has formed sand bars/islands that are partially stabilized by 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.

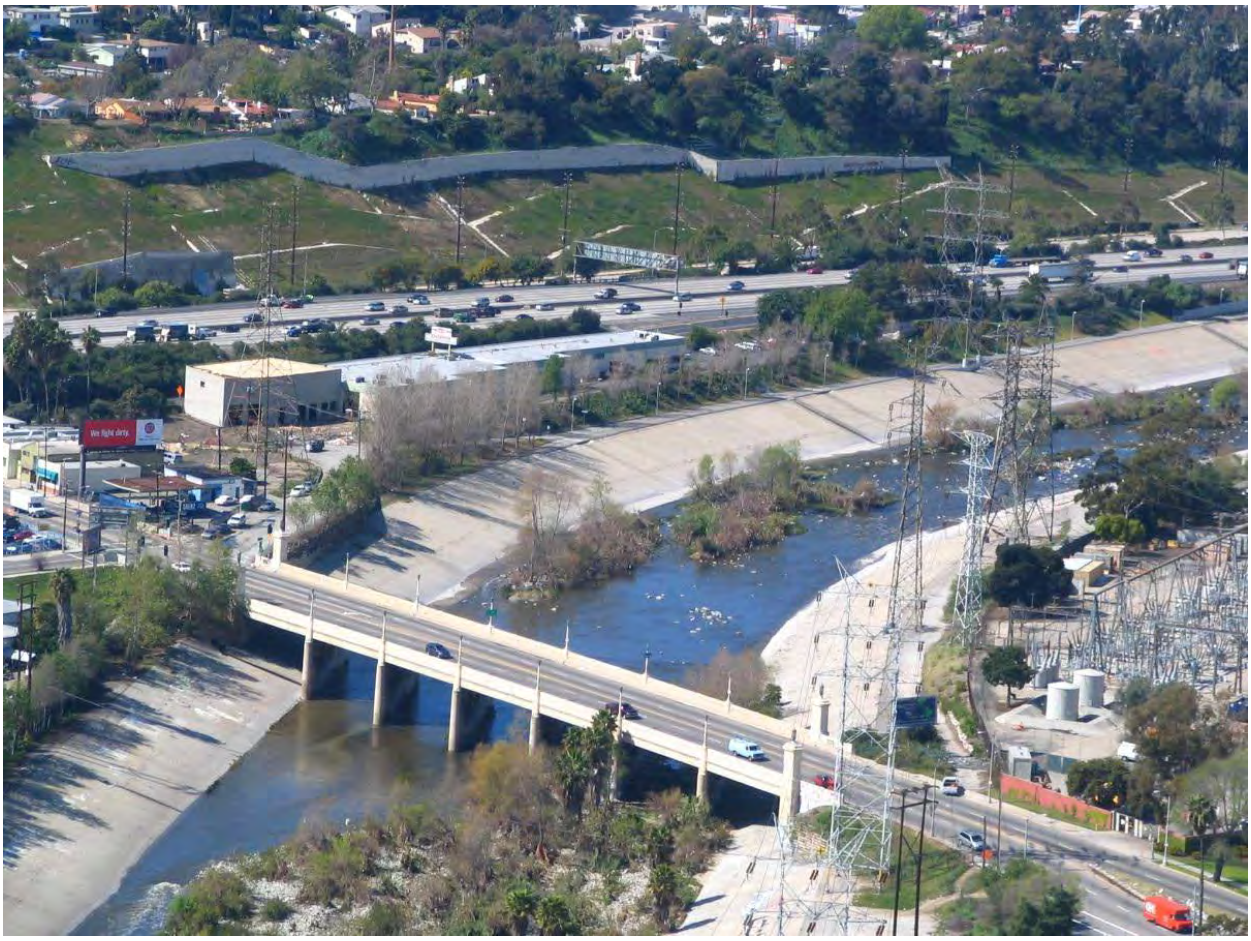

Figure 7. Aerial photo of a portion of reach 5 of the Study Area

Reach 5: Los Feliz Boulevard to Glendale Freeway

Within this approximately 1.6 mi reach the River alignment flows east between Hyperion Ave. and SR-2/Glendale Freeway. The reach extends from the Los Feliz Boulevard Bridge, under the Sunnynook pedestrian bridge and the Hyperion Ave. Bridge, downstream to the Fletcher Drive Bridge and ends at the SR-2 Bridge. The River bed transitions from concrete under each of the large bridges (e.g., Los Feliz Boulevard, Hyperion Ave.) to a trapezoidal channel with a cobblestone bed and grouted stone banks between the bridges. Banks are toed-down with sheet pile and quarry run stone. The bed is approximately 18 ft deep and the channel at the bank tops is approximately 130 to 160 ft wide. Sediment deposited in the channel over time has currently formed bars that are somewhat stabilized by the root systems of vegetation. This reach ends as the River alignment begins to curve back east as it approaches Taylor Yard.

Figure 8. Aerial photo of a portion of reach 6 of the Study Area

Reach 6: Glendale Freeway to I-5 Freeway

This reach is approximately 2.3 mi long and flows through three bends of the River. The reach extends from the SR-2 Bridge to the downstream crossing of Interstate 5 (I-5), where the River bed transitions from cobblestone to concrete-lined. Here the channel is in a trapezoidal configuration with a cobble bed and grouted stone banks. The banks are toed-down with sheet pile and stone. The bed is approximately 30 ft deep from the top of the slope and the top of the channel ranges from approximately 190 to 215 ft wide. Sediment deposited in the channel has formed bars that have become partially stabilized by vegetation. The channel narrows to 170 ft wide and transitions to a rectangular configuration just upstream of the I-5/SR-110 interchange.

Figure 9. Aerial photo of a portion of reach 7 of the Study Area

Reach 7: I-5 Freeway to Main Street

This approximately 1-mi-long reach begins at the I-5 Bridge and extends to the Main Street Bridge. The channel in this reach transitions out of the rectangular concrete channel at the confluence with the Arroyo Seco, and becomes a trapezoidal concrete channel that is approximately 30 ft deep, with top of bank widths that range from approximately 150 to 190 ft. 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.

Figure 10. Aerial photo of a portion of reach 8 of the Study Area

Reach 8: Main Street to First Street

This approximately 1-mi-long reach is the most downstream portion of the Study Area: it begins at the Main Street Bridge and extends downstream to the First Street Bridge. The trapezoidal concrete channel in this reach is approximately 30 ft deep with top of channel widths that range from approximately 170 to 200 ft. Rail lines run adjacent to the channel along both banks, and two railroad bridges cross the River. Bridges for US-101 cross the River between César Chàvez Ave. and First Street.

PROPOSED PROJECT PURPOSE

The primary purpose of the proposed Project Alternatives considered in the 2013 Draft EIS/EIR is to ecologically restore approximately 11 mi of the River from Griffith Park to downtown Los Angeles (known within the 2013 Draft EIS/EIR as the ARBOR reach) by reestablishing riparian strand, freshwater marsh, and aquatic natural communities and reconnecting the River to major tributaries, its historic floodplain, and the regional ecological zones of the Verdugo Hills and Santa Monica and San Gabriel mountains while maintaining existing levels of flood risk management (Figure 1). A secondary purpose is to provide recreational opportunities consistent with the restored ecosystem. The ARBOR reach provides the backbone for restoring significant habitats and reconnecting the River to other vital ecological areas. Expansion of riparian and marsh natural communities along this portion of the River and at the confluences of key tributaries is considered a first step in putting the portions of the once vast riverine ecosystem back together (USACE 2013a).

DESCRIPTION OF PROPOSED PROJECT ALTERNATIVES

Four Project action alternatives in addition to the No Action Alternative compose the array of proposed plans; these proposed alternatives received detailed analysis in the Corps' 2013 Draft EIS/EIR. Under the **No Action Alternative**, human intervention and activities associated with urban development would likely continue to further degrade the ecosystems in the Study Area. Alternative 20 is the Corps preferred alternative and recommended plan (USACE 2014c).

Alternative 10 is described by the Corps as a minimally-acceptable alternative that would increase aquatic community connectivity through riparian corridors and daylighted streams by providing restoration measures on a total of 528 ac. In **Reach 1**, riparian corridors would be restored on both sides of the channel with connections under Highway 134 to the Pollywog Park Area of Griffith Park, which would be restored with riparian vegetation. In **Reach 2**, the restored riparian corridor would continue on both sides with connectivity to Griffith Park and subsequently the Santa Monica Mountains. **Reach 3** would daylight currently confined streams and would restore riparian and freshwater marsh vegetation on the east bank of the River. A single daylighted stream would be restored on the west bank of the River. **Reach 4** would be restored with: a riparian corridor on the east bank of the River, a riparian side channel along the edge of the Griffith Park Golf Course with an inlet and outlet to the River under the I-5 freeway, a riparian side channel through Los Feliz Golf Course, and several daylighted streams. In **Reach 5**, the riparian corridor would continue on the east bank and would include a daylighted stream at the downstream end. In **Reach 6**, the channel would be widened by approximately 80 ft along the Taylor Yard site with a small terraced area in the "Bowtie" parcel. In addition, the channel banks would be vegetated with overhanging vines and implanted vegetation. Restoration would be continued in **Reach 7** with daylighted streams on both sides of the channel. In **Reach 8**, the Piggyback Yard site would be restored with riparian vegetation and a historic wash. The restored site would be artificially hydrologically connected to the River, allowing stream flows from the restored ephemeral wash to enter the River through culverts under the existing railroad tracks. The restoration plan for Alternative 10

would include minimal River widening at Taylor Yard and would exclude restoration at both major confluence areas at the Arroyo Seco and Verdugo Wash.

Alternative 13 would include most of the features in Alternative 10 (restoration of the historic wash at Piggyback Yard, terracing at the Bowtie Parcel, and restoration of side channels, riparian corridors, and daylighted streams) and restoration of the full Taylor Yard site and the Arroyo Seco tributary. Additional restoration would occur in 3 reaches. In **Reach 3**, a riparian side channel would be restored at the Ferraro Fields site. This riparian channel would connect to the River upstream of the Ferraro Fields site and would re-enter the River through a daylighted stream and marsh area at the downstream end of Ferraro Fields. In **Reach 6**, additional widening of over 300 ft at the Taylor Yard site would be implemented (compared to Alternative 10); restoration of the floodplain and freshwater marsh would occur in the widened channel area. In **Reach 7**, restoration of the Arroyo Seco confluence with riparian and wetland vegetation would be implemented, with some nodal connectivity to the Arroyo Seco watershed and San Gabriel Mountains. Restoration would be accomplished through removal of concrete, softening of the River bed and banks, and development of riparian vegetation at the tributary confluence and for 0.5 mi upstream along the Arroyo Seco. This alternative would support regional connectivity through the River from the Santa Monica Mountains (via Griffith Park) to the San Gabriel Mountains. Instead of the daylighted streams included in Reach 7, as in Alternative 10, the banks of the River downstream from the Arroyo Seco would be lined with overhanging vines and implanted vegetation. Alternative 13 would provide restoration measures on an additional 60 ac compared to Alternative 10, for a total restoration of 588 ac, and it would increase regional nodal connectivity for wildlife through restoration measures at the Arroyo Seco confluence.

Alternative 16 would include the features of Alternative 13 and implement additional restoration measures in reaches 5 and 8. It would also remove concrete from portions of the bed of the River. Additionally, the existing concrete bank would be removed between the River and Piggyback Yard. This alternative would widen **Reach 5** along the west bank of the River, modifying the trapezoidal bank to a vertical wall, and would add vegetated terracing on the east bank of the River. In **Reach 8**, additional restoration would be implemented by terracing upstream of Piggyback Yard on the west bank, and through removal of the concrete east bank and the concrete bed in the River adjacent to Piggyback Yard for 0.75 mi. The channel bed would be naturalized to support freshwater marsh in the River and through the restored Piggyback Yard adjacent to the River. The River would be widened in Piggyback Yard by 500 ft on a low terrace and another 1000 ft on a second, higher terrace. Another set of vegetated terraces would be constructed along the east bank of the River downstream of Piggyback Yard. Alternative 16 would provide restored features on an additional 71 ac compared to Alternative 13, for a total restoration of riparian/wetland features on 659 ac, and it would increase local nodal connectivity through removal of concrete between the River and Piggyback Yard.

Alternative 20 would include elements of Alternatives 10 and 13/16, with additional features in reaches 2, 3 and 7. It would include restoration measures in the Verdugo Wash confluence and the Cornfields site. In **Reach 2**, the River channel would be widened on the west bank by modifying the trapezoidal bank to a vertical wall. In **Reach 3**, Alternative 20 would soften the

concrete bed of the Verdugo Wash and widen its mouth at the confluence with the River to support riparian community vegetation and to expand regional connectivity to the Verdugo Hills. In **Reach 7**, daylighted streams that are described in Alternative 10 would be re-established in lieu of the channel bank vegetation features that were described in Alternatives 13 and 16. Also in Reach 7, freshwater marsh would be restored at the Los Angeles State Historic Park (a.k.a. Cornfields site) with a terraced connection to the River. In Alternative 20, some degree of channel naturalization and restoration would be accomplished in nearly all Study Area reaches and both major River confluences (Arroyo Seco and Verdugo Wash). Alternative 20 would restore features on an additional 60 ac compared to Alternative 16, for a total restoration of riparian/wetland features on 719 ac, and it would increase local and regional nodal connectivity through restoration at the Cornfields site and the Verdugo Wash confluence.

Below is a modified version of a table provided to the Service by the Corps for evaluation purposes.

Table 1. Project Alternatives Summary

Project Reach	**Proposed Conservation Measures**	**Proposed Project Alternatives**			
		10	**13**	**16**	**20**[6]
1. Pollywog Park area of Griffith Park	Riparian corridors	**X**	**X**	**X**	**X**
2. Bette Davis Park area of Griffith Park	Restructure top of bank to support vines				**X**
	Riparian 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 freshwater marsh		**X**	**X**	**X**
	Daylight streams and plant riparian fringe and freshwater marsh	**X**	**X**	**X**	
	Divert flow into side channels with riparian fringe and then return flow to the River		**X**	**X**	**X**
	Riparian corridors		**X**	**X**	**X**
	Open water restoration	**X**			
	Widen River mainstem				**X**
	Widen tributaries				**X**
4. Griffith Park	Create pool & riffle system	**X**	**X**	**X**	**X**

[6] Alternative 20 is the Corps preferred alternative and recommended plan.

Project Reach	Proposed Conservation Measures	Proposed Project Alternatives			
		10	13	16	20[6]
	and plant freshwater marsh				
	Daylight streams and plant riparian fringe and freshwater marsh	X	X	X	X
	Divert flow into side channels with riparian fringe and then return flow to the River	X	X	x	X
	Riparian corridors	X	X	X	X
5. Riverside Drive	Create pool & riffle system and plant freshwater marsh			X	X
	Daylight streams plant 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 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 freshwater marsh		X	X	X
	Restructure channel walls to support vegetation		X	X	X
	Riparian corridors	X	X	X	X
	Restructure 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 freshwater marsh				X
	Daylight streams plant riparian fringe and freshwater marsh	X			X
	Divert flow into side channels with riparian fringe and return flow to				X

Project Reach	Proposed Conservation Measures	Proposed Project Alternatives			
		10	13	16	20[6]
	the River				
	Riparian 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. Piggyback Yard	Create pool & riffle system and plant freshwater marsh			X	X
	Restore historic wash with riparian vegetation	X	X	X	X
	Divert flow into side channels with riparian fringe and return flow to the River			X	X
	Wildlife access from River to bank	X	X	X	X
	Riparian corridors	X	X	X	X
	Widen channel			X	X
	Terrace banks			X	X

Supplemental Proposed Project Commitments and Information (Provided by the Corps in November 2014; USACE 2014c and USACE 2014d)

> *The Corps' intent is that Alternative 20 will provide large restored widened areas (such as Verdugo Wash, Taylor Yard, LATC (a.k.a. Piggyback yard)) to serve as riparian habitat patches with natural hydrology. Vegetation and habitat elements in these widened areas will be restored with the goal to support a large number of territories for various riparian obligate birds, including least Bell's vireo, yellow warbler, and yellow breasted chat, stop over habitat for migrants, as well as habitat and refugia for amphibians, reptiles, and mammals, including larger carnivores such as coyote and possibly bobcat. River channels in widened areas will be designed to support habitat for Santa Ana sucker and Arroyo Chub. These restored widened patches will be connected in part via existing soft bottom reaches 2, 4, 5, and 6 and restored in-channel habitat in Reach 8.*
>
> *In existing hard-bottom reaches 1, 3 and 7, opportunities for connectivity may be possible through use of anchored boulders and a new meandering low flow channel on top of the existing concrete, which would provide pockets of aquatic vegetation to support movement of wildlife and refugia for native fish. Such opportunities will be explored during the detailed design phase, including "speed bumps", perpendicular to flow, that*

can trap sediment and allow small to moderate sized vegetation to grow, as well as a new v-shaped low flow channel with varying widths and depths. These features would be designed to support passage of Santa Ana sucker and Arroyo chub. Installation of these features would entail filling in the existing low flow channel. The remainder of the existing trapezoidal main channel would remain unaltered.

These design ideas, to be further explored during the detailed design phase, will be documented in the Corps' Final Integrated Feasibility Report (IFR).

Wildlife movement on a regional scale is expected to be accommodated to Griffith Park via wildlife use of existing equestrian tunnels in Reaches 1 and 4. Recent studies using wildlife cameras indicate tunnels have been used by coyote and deer, with one bobcat sighting. Other species that could use the tunnels, if presence of appropriate habitat were available surrounding them, include raccoons, skunks, and gray foxes. Future opportunity for movement to further open space areas such as the Verdugo and San Gabriel Mountains is provided via restoration of the confluences of the Verdugo Wash and Arroyo Seco. Restoration upstream on the remainder of these tributaries is needed via additional projects to complete the connection between the River and these mountainous areas.

Text added to the IFR will include the following:

"In widened areas, habitat will be restored for native fish including Arroyo Chub and Santa Ana Sucker. This will include restoration of the necessary constituent elements to support these species including but not limited to water shaded by riparian vegetation, riffle/run/pool/glide sequences and refugia, in channel woody debris, gravel and cobble substrates. In concrete reaches, aquatic connectivity may be achieved by installation of anchored boulder clusters and reconfiguration of the low flow channel. This will restore sinuosity of the low flow channel and provide some refugia for native fish between widened areas. Details of these features will be considered and evaluated during the project's detailed design phase. The Corps will continue to coordinate with the Fish and Wildlife Service during detailed design to ensure these elements are included."

"Design features and directed restoration measures specific to certain species will be added in the detailed design phase and accommodated wherever possible, in coordination with USFWS. It is expected that while these features can be installed artificially during restoration activities, many of these features will also evolve naturally over time as vegetation matures and natural hydrologic forces continue to shape the hydrology widened areas. These features may include, but are not limited to, nest cavities (which could be used by wood duck, barn owl, tree swallow, and western bluebird among other species), large hollow snags (used by swifts), and steep sandy banks (used by northern rough-winged swallow and belted kingfisher)."

1. To demonstrate the Corps' intent for restoration features to be self-sustaining, with minimal O&M and temporary irrigation, the following text will be added to the IFR.

General location for text addition – Chapter 4 on description of alternatives, Chapter 7 "Temporary irrigation will be used to establish restored vegetation in widened and overbank areas, after which vegetation is expected to be self-sustaining, requiring minimal O&M and relying on groundwater and surface flows to persist. Temporary irrigation will also be used to establish vegetation in the concrete channel walls. Detailed design will identify all water sources to support the proposed vegetation in the concrete channel walls, including surface flows and runoff that may be redirected to sustain this vegetation and avoid permanent irrigation. During extreme drought supplemental water may be used to protect the investment in the restored vegetation."

In addition, measure 4a (section 4.4.5) will be revised to delete "permanent irrigation".

2. To demonstrate the Corps' intent to provide wildlife access and facilitate wildlife movement through the project footprint, the following text will be added to the IFR.
General location for text addition - Chapter 6 on connectivity
"Measures for wildlife access are described in Section 4.4.5, measures 3a-c. Specific features for wildlife access will be further defined during the detailed design stage. Movement for bobcats will be the standard for design of access, and such designs will be implemented wherever possible. It is expected that wildlife may use the three existing equestrian tunnels in the project area to access the restored river near Griffith Park, and use restored vegetation and in-channel features to move through the project area.

In the recommended plan, wildlife access/passage within the project footprint will be added in the following areas:
-Reach 1 from Pollywog Park into the river channel (measure 3b),
-Reach 3 from Verdugo Wash confluence to upstream edge of soft bottom Reach 4 (surficial improvements),
-Reach 7 from downstream edge of soft bottom Reach 6 to Arroyo Seco (surficial improvements).
The specific features of this access will be further defined during the detailed design phase. With this access/passage, wildlife may move from Griffith Park using the equestrian tunnel in Reach 4 upstream to Verdugo Wash or downstream to Arroyo Seco. Additional restoration of these tributaries outside the project area would facilitate further regional movement in the future. This restoration may be accomplished by other federal, state, or local stakeholders.

The Corps examined whether additional access could be provided in Reach 7 from the river channel into Elysian Park, however this may not be possible based on the many constraints in this area (freeways, railroad, bridges, topography). The Corps will continue to investigate any opportunities in this area during detailed design, where further analysis will examine alternative methods of providing access."

Note: In Section 4.4.5, measure 3, the Draft IFR describes that the wildlife access is a measure common to all alternatives, to be added where possible and reasonable. For this reason, specific locations for wildlife access were not originally included in the alternative descriptions as part of the Draft IFR.

Note: In Section 4.4.5, measure 3c, the Draft IFR describes that wildlife passage would only be created to connect wildlife to habitat areas, and that it should not connect wildlife to urban areas that would not be beneficial to their survival.

3. To demonstrate the existing use of equestrian tunnels in the project area by wildlife, the following text will be added to the IFR.
General location for text addition - Chapter 6 on connectivity
"Equestrian tunnels near Griffith Park at Reaches 1, 2, and 4 are expected to support movement of wildlife to and from the project area. Recent studies using wildlife cameras indicate tunnels have been used by coyote and deer, with one bobcat sighting. Tunnels are primarily used at night, when human presence is decreased. Other species that could use the tunnels, if presence of appropriate habitat were available surrounding them, include raccoons, skunks, and gray foxes. Use of these tunnels to move to and from the project area supports regional connectivity for wildlife with Griffith Park and the Santa Monica Mountains."

4. To demonstrate connectivity to Griffith Park through Headworks/Sennet Creek tributary, the following text will be added to the IFR.
General location for text addition - Chapter 6 on connectivity
"On-going restoration plans at the Headworks site (Corps/City of LA DWP) adjacent to Reach 1, as well as the outlet of Sennet Creek (FoLAR/North East Trees) upstream of Reach 1, will contribute to connectivity between Griffith Park and the LA River project area. Access to the LA River from these sites will be available through the existing equestrian tunnel downstream of the Headworks site."

5. To demonstrate that in areas where the trapezoidal channel is converted to vertical walls, the Corps is able to allow vegetation to grow with minimal maintenance and not impact conveyance, the following text will be added to the IFR.
General location for text addition - Chapter 7
"Vegetation within the channel has a significant impact on conveyance of the design flood within the ARBOR reach. If allowed to grow unchecked under the With-Project Conditions, such vegetation could eventually create an adverse condition with respect to flood risk. The District plans to adopt a course of action that allows for ecosystem restoration while not significantly changing the current level of flood risk management provided by the channel.

In reaches where the Corps is proposing to construct a vertical wall to replace the trapezoidal side slopes, vegetation will be allowed to grow to the extent that it does not affect the conveyance of the channel. During the detailed design phase, the Corps will identify the methods for measurement to determine impacts on flow conveyance. It is anticipated that limitations to vegetation growth will be modest because of the increased conveyance caused by changing the wall to a vertical orientation. The Corps will develop an Operation, Maintenance, Rehabilitation, Repair and Replacement (OMRRR) Plan in the design phase, in coordination with natural resource agencies. The intent will be to codify in the OMRRR the minimal need for O&M activities in the restored areas. OMRRRs are enacted after project construction in order to keep project features functioning as designed, and it will be important to clarify and specify in the OMRRR under what specific conditions maintenance will be required in restored areas. In general, this will include required annual inspections

and maintenance, periodic repair and/or replacement of project features, management of invasives, and (rarely, only when necessary) provision of irrigation during drought. Annual monitoring will allow the Corps to evaluate growth of vegetation and its impact to flood conveyance, which will help minimize the frequency of O&M activities."

6. To demonstrate the ability of proposed features to support aquatic connectivity in hard bottom reaches 1, 3, and 7, the following text will be added to the IFR.
General location for text addition - Chapter 6 on connectivity
"In the recommended plan, opportunities for aquatic connectivity in certain hard-bottom reaches (1, 3 and 7) may be possible through use of anchored boulders and a new meandering low flow channel on top of the existing concrete, which would support pockets of aquatic vegetation and refugia for native aquatic species moving between larger habitat patches in the project area. Target native fish species include Arroyo Chub and Santa Ana Sucker.

Such opportunities will be explored during the detailed phase, including "speed bumps", perpendicular to flow, that can trap sediment and allow small to moderate sized vegetation to grow, as well as a new v-shaped low flow channel with varying widths and depths. These features would be designed to support passage of Santa Ana sucker and Arroyo chub. Installation of these features would entail filling in the existing low flow channel. The remainder of the existing trapezoidal main channel would remain unaltered."

7. To demonstrate the Corps' intent to conduct non-native fish/aquatic wildlife removal, the following text will be added to the IFR.
General location for text addition - Adaptive Management Plan Appendix H
"Removal of non-native fish and other aquatic invasive wildlife would be performed in the project area during construction of restoration features and for 5-7 years post-construction to support recruitment of native Arroyo chub and Santa Ana sucker. Reintroductions of native fish could be proposed and performed by other agencies or organizations with expertise in this field. Beyond the 5-7 year post-construction period, with successful establishment of restored vegetation and a self-sustaining system, it is expected that the native species will be capable of resisting intrusion by non-natives."

8. To present the Corps' intent to investigate in the detailed design phase the possibility of creating "spring fed" fish refugia, the following text will be added to the IFR.
General location for text addition - Chapter 7
"Considerations for segregation of "spring fed waters" from surface water flows would be made during the detailed design phase. This segregation would be considered to support refugia for fish, where groundwater would feed the refugia while surface flows might bypass such areas. Parameters required for engineering design would include groundwater levels as well as anticipated local fluctuations in groundwater conditions."

9. To demonstrate to other agencies/entities that sites at the perimeter of the project area that support wildlife movement (i.e. equestrian tunnels) should avoid development (i.e. nighttime lighting, increased human activity), the following text will be added to the IFR.
General location for text additions - Chapter 6 on connectivity and Executive Summary

"In areas where wildlife movement into the project area is supported, such as at the three existing equestrian tunnels near Griffith Park, additional development should be avoided in the immediate vicinity so as not to negatively impact the planned restoration and wildlife movement. Such development would likely increase nighttime lighting and human presence, which may deter wildlife from using these access points."

10. To demonstrate that in Reach 6 the turf reinforced mats will not restrict growth of vegetation, the following text will be added to the IFR.

General location for text addition - Chapter 7

"In Reach 6, turf reinforced mats would be used to protect against erosion on the west slope. Vegetation growing through these mats would be allowed to grow as large as possible without impacting conveyance. Vegetation is not expected to compromise the integrity of the mat, and would only require maintenance if flood conveyance is impacted. Modeling during the detailed design phase will inform the size of vegetation that can persist without impeding conveyance. The mat would be monitored for tearing, which may create a local scour problem, and may require maintenance around vegetation. Integrity of the mat would be evaluated regularly, where the density and size of trees growing through the mat would be monitored as part of O&M activities."

11. To demonstrate the constraints of installing a riparian strip in concrete reaches, the following explanation is provided.

In trapezoidal channel reaches with concrete bottoms, it was suggested that the Corps could convert one or both banks (side slopes) to vertical and create a soft-bottom riparian strip either along the wall or in the center of the channel (and keep the remaining section concrete-lined - but with structural enhancements). Kerry Casey put forth at the last meeting with FWS that this may only be possible in Reach 7 and the upper part of Reach 8 because Reaches 1 and 3 were primarily vertical wall reaches already.

For expediency in modeling, we just assumed there were no utility or other constraints and that all sections under bridges could be converted to vertical walls (ignoring any bridge structural constraints). There are no maintenance roads on either side of the channel in Reaches 7 and 8 and there is limited ROW. The channel is concrete-lined trapezoidal with shorter vertical walls on both sides of the upper banks (side slopes). The channel here has a bottom width of 160 ft and is about 30 ft deep. By converting one wall to vertical we could get an additional ~50 ft of width. After some quick model runs, the Corps has concluded this is not a feasible alternative for the following reasons:

1) Even though it may be possible between some of the bridges, it does create adverse conditions at several locations, primarily bridges. Thus it increases flood risks which is a constraint of the study. The Corps would have to leave these sections of the channel unaltered and would have to transition from trapezoidal to vertical and back to trapezoidal sections (using transition ratios of about 10:1). Since some of these bridges are relatively close together, the length of the transitions would eliminate these reaches from channel re-configuration.

2) The design velocities in Reaches 7 and 8 are about 30 fps. When adding a riparian strip, the design velocities would decrease slightly, but would increase water surface and increase flood risk. Additionally, the velocities during moderate to large events with a riparian strip would still be above 20 fps, which is too high to add a soft-bottom strip due to scour

potential. A soft-bottom strip would also compromise the integrity of the remaining concrete channel. Even with a lined bottom there is still concern that the strip would be washed out completely even during moderate flows and the reach would remain unvegetated. Ungrouted riprap placed along the bottom would also move during velocities of that magnitude.

As an alternative to the riparian strip, a proposal to create a new low-flow channel on top of the existing concrete with strategically placed and anchored boulders warrants further analysis. Boulder placement options that we can explore during the detailed design phase include "speed bumps", perpendicular to flow, that can trap sediment and allow small-moderate size vegetation to grow. A new v-shaped low flow channel with varying widths and depths could also be explored, or a combination of these features. These features would entail filling in the existing low flow channel. The rest of the existing trapezoidal main channel would remain un-altered.

12. To demonstrate that design features for certain species will be included during the detailed design phase, the following text will be added to the IFR.
General location for text addition - Chapter 7 and Executive Summary

"Design features and directed restoration measures specific to certain species will be considered in the detailed design phase and accommodated wherever possible, in coordination with USFWS. It is expected that while these features can be installed artificially during restoration activities, many of these features will also evolve naturally over time as vegetation matures and natural hydrologic forces continue to shape they hydrology in widened areas. These features may include, but are not limited to, nest cavities (which could be used by wood duck, barn owl, tree swallow, and western bluebird, among other species), large hollow snags (used by swifts), and creation/maintenance of artificial steep sandy banks (used by northern rough-winged swallow and belted kingfisher."

RELATIONSHIP OF THE PROPOSED PROJECT TO EXISTING MASTER PLAN

In April 2007 the City of Los Angeles published the Los Angeles River Revitalization Master Plan (Master Plan); this Master Plan provides general planning guidance for 32 mi of the River that flow within the City of Los Angeles (City of Los Angeles 2007). It provides planning for the enhancement of aesthetic, recreational, flood risk management, and environmental values by creating a community resource, enriching the quality of life for residents and recognizing the River's primary purpose for flood risk management. This plan and its associated goals, objectives, and design guidelines serves as a guide to the development of subsequent River planning and development efforts. The Master Plan calls for transforming portions of the River for new, multiple-benefit uses, including natural system restoration, treatment of storm water runoff, establishment of a continuous River greenway, and an interconnected network of parks and trails. The Master Plan also calls for the creation of a 64-mile network of trails, parks, and recreation along both sides of the first 32 miles of the River, from the San Fernando Valley to the border of the City of Los Angeles with the City of Vernon, an area home to more than one million people. The goals of the Master Plan are to: a) **Revitalize the River**, including enhance flood storage and water quality, enabling safe public access, and restoring ecosystems; b) **Green the Neighborhoods**, including continuous River greenway and extending open space, recreation,

and water quality features into neighborhoods; c) **Capture Community Opportunities**, including making the River the focus of human activity; d) **Create Value**, including improving the quality of life for human residents. The proposed Project was apparently developed based on the Master Plan and reflects its goals and design concepts.

DESCRIPTION OF BIOLOGICAL RESOURCES

Historically the River covered a major swath of the Los Angeles River Basin (consisting of the Los Angeles, San Gabriel, and Santa Ana river systems) with alluvial washes, forests, woodlands, thickets, and marshes, depending on location (Garrett 1993; Gumprecht 2001). The lowlands along the River were covered by dense floodplain riparian forests dominated by cottonwoods and willows (Garrett 1993). Marshland that supported cattails and bulrushes (coastal and valley freshwater marsh) occurred in extensive areas where River water ponded/slowed and soils were perennially saturated, particularly downstream of what is now downtown Los Angeles (Garrett 1993; Gumprecht 2001; Dark et al. 2011). The River system historically supported badger (*Taxidea taxus neglecta*), mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), mountain lion (*Felis concolor californica*), and California grizzly bear (*Ursus arctos horribilis*) along the lowlands (Bell 1881; Storer 1955; Garrett 1993; Gumprecht 2001; Crespi 2001; USACE 2013a). The last California grizzly bear known in southern California was killed on Big Tujunga Creek, a tributary of the River, in 1916 (Barkley 1993). A wide variety of now rare birds such as California condor (*Gymnogyps californianus*), burrowing owl (*Athene cunicularia*), California gnatcatcher (*Polioptila californica*), yellow-billed cuckoo (*Coccyzus americanus*), bank swallow(*Riparia riparia*), vireo, and willow flycatcher (*Empidonax traillii*) historically utilized the lowland portions of the River and environs (Garrett 1993). At least seven species of native fish historically occurred in the River (Friends of the Los Angeles River 2008). The floodplain forests formerly supported one of the most biologically diverse and abundant ecosystems in southern California (Garrett 1993).

Over 300 species of birds have been recorded on the River (including its estuary) in recent times, and about half of the total recorded birds in Los Angeles County have even been spotted along the channelized portions of the rivers and streams of the County (The River Project 2001). While the list of birds seen on the River is impressive, with the development of the River's floodplain and adjacent uplands and the channelization of the River itself, the alluvial scrub, cottonwood/willow forests, oak woodlands, and freshwater marshlands were almost totally destroyed. Concomitant with the loss of these natural communities was the functional loss of almost all of the native fish and wildlife species that heavily depended on these systems (Garrett 1993). While small natural community remnants are currently supported in certain portions of the River (including soft-bottom portions within the Study Area), the historic natural communities along the River have been almost entirely eliminated (see Figure 11 below) (Garrett 1993).

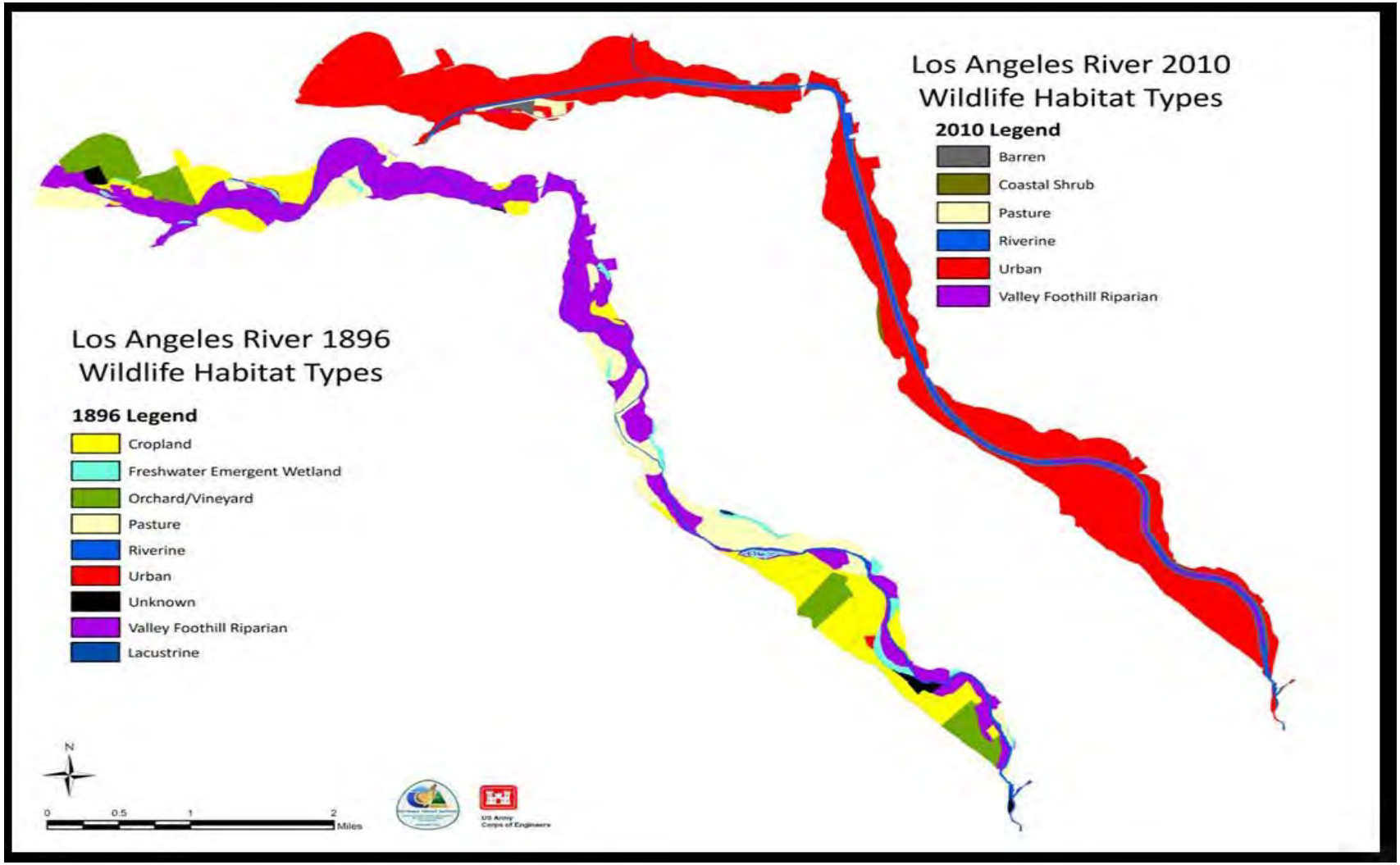

Figure 11. Natural community types along the Los Angeles River, 1896 and 2010 (figure taken from the Los Angeles River Ecosystem Restoration Integrated Feasibility Report/2014 Draft EIS/EIS)

The aquatic animal taxa of the River have likely experienced the greatest change, compared to the River's pre-channelization state, with large-scale replacement of native species (particularly fish and mollusks) with exotic ones (Garrett 1993). Taxa of riparian communities and other wetland associations have also suffered high rates of local extirpation. The vascular plant flora of the lowland portions of the River is highly modified, characterized by Garrett (1993) as 30 percent to 62 percent exotic species. Despite the severe fragmentation of natural communities, the loss of numerous native taxa, and the establishment of many exotic plant and animal species, the River and its tributaries continue to harbor considerable remnant native biota in certain soft-bottom channel areas, flood basins, and unchannelized foothill and montane reaches (Garrett 1993).

The River channel is soft-bottomed in the Glendale Narrows from a point about 600 ft upstream from the Pasadena (110)/Golden State Freeway (I-5) interchange to the vicinity of the Victory Blvd. bridge over the River just west of the Golden State (I-5)/Ventura (134) Freeway interchange (Garrett 1993). The predominant vegetation in the channel in this area is similar over most of this stretch, but is generally sparser upstream from Los Feliz Blvd.

Aquatic Ecosystems

The Mediterranean climate of southern California creates streams that have strong seasonal patterns of water flow: low-flows (or dry at the surface) in the rainless summer and typically high flows in winter and spring in response to rainfall (Moyle and Light 1996). Year to year variability in precipitation in the region is very high, and extended droughts, with low stream flow, are common (Moyle and Light 1996). The native fish fauna of southern California as a consequence is naturally depauperate and highly endemic, with life history adaptations for dealing with extreme conditions (Moyle and Herbold 1987). Today the natural variability in environmental conditions of many southern California streams has been greatly reduced by channelization, dams, and reservoirs; partially as a result, local fish faunas are often dominated by non-native species (Moyle 1976; Herbold and Moyle 1986).

Many invertebrates and fish inhabiting streams in arid regions naturally face conditions that regularly subject subpopulations to local extirpation. In arid southern California, many streams seasonally undergo natural extreme changes in local surface flow, ranging from completely dry during the summer to substantial flooding during the wet winter (Gasith and Resh 1999). These extreme flow fluctuations often have major effects on aquatic invertebrate and fish populations. During the dry season, subpopulations inhabiting intermittent streams either become extirpated, move to other stream sections, or have a resistant stage (such as a diapausing cyst for some invertebrates), while dramatic temporary reductions in population size often result from flooding events (Meffe and Minckley 1987; Gasith and Resh 1999).

Natural extirpation and recolonization cycles of aquatic animals in almost all coastal southern California streams have been altered by human induced changes to natural surface flow regimes and modifications in stream connectivity and refugia. The effects of these changes on ecological (e.g., population) dynamics is poorly explored. For example, many southern California streams that were once intermittent are now perennial, because of agricultural and/or urban runoff and

treated wastewater releases, including what was initially imported water to the watershed. Conversely, water diversions and groundwater pumping have substantially reduced surface low-flows in many (sometime overlapping) areas, with the concomitant conversion of many formerly perennial streams to intermittent. Both diversions/groundwater pumping, and urban/wastewater releases, are substantially occurring or have occurred on the River. Reservoirs/basins created for water storage or flood risk management facilities have altered the natural hydrological and fluvial cycles of most southern California streams; associated dams, artificial open water, and greatly simplified streams through channelization have changed stream connectivity patterns and reduced or eliminated functions for most native riverine species.

Urban runoff is recognized as a major source of contaminants (Characklis and Wiesner 1997; Paul and Meyer 2001), and wetlands can accumulate contaminants over time. Risks to wildlife from contaminant toxicity may be substantial in urban aquatic and wetland environs such as the Study Area portion of the River. Bioaccumulation of contaminants and toxicological effects on wildlife have been documented for wetlands receiving nonpoint source runoff (Ohlendorf et al. 1989; Schuler et al. 1990; Welsh and Maughan 1994; Glenn et al. 1999; Garcia-Hernandez et al. 2001). Impacts can range from increased turbidity to direct toxicity to algae and aquatic plants, wetland fauna including wetland invertebrates, amphibians, reptiles, fish, and birds, resulting in the loss of biodiversity and simplification of the food chain (Wren et al. 1997; Adamus et al. 2001). These impacts have been demonstrated for organophosphates and pyrethroid pesticides (Katznelson et al. 1995; Harris et al. 1998), polyaromatic hydrocarbons (Maltby et al. 1995), polychlorinated biphenyls (Dunier and Siwicki 1993; Wren et al. 1997; Adamus et al. 2001), and heavy and trace metals such as Hg, Pb, Zn, Cu, and Cd (Galli 1988; Yousef et al. 1990, Campbell 1994; Brown and Bay 2006). The presence and relative severity of effects depends on many site-specific factors, such as the wetland type, contaminant loading rates and concentrations, landscape position, hydrology, nature of sediment storage and transport, and structure of the biotic communities (Schueler 2000). In one study, sediment toxicity, chemistry and benthic macroinvertebrate richness were characterized for 21 freshwater urban wetlands and 2 reference sites in southern California; benthic macroinvertebrate species richness was negatively correlated with sediment contamination, suggesting that toxicity may have affected organisms at the base of the food web in some of these wetlands (Brown et al. 2008).

Freshwater Marsh

The planning objectives for the Project include restoring an undetermined acreage of the Study Area to freshwater marsh natural community. For this Project, freshwater marsh is noted by the Corps as equivalent to (USACE 2013b): freshwater marsh (pursuant to Holland 1986); and *Arundo donax* semi-natural herbaceous stands (giant reed breaks), *Typha* (*angustifolia, domingensis, latifolia*) herbaceous alliance (cattail marshes), and *Shoenoplectus californicus* herbaceous alliance (pursuant to Sawyer and Keeler-Wolf 2009).

Freshwater marshes are freshwater wetlands that grow in shallow standing or slow-flowing water, or on perennially saturated ground. The vegetation is adapted to an anaerobic soil environment (Kramer 1988). Restoration variables that can affect freshwater marshes include rate of water flow, fluctuations in water level, water depth, water and air temperatures, pH and dissolved salts, depth and nature of bottom sediments, organic content of the water and past

history of the body of water (Holland and Keil 1995). Freshwater marsh typically occurs along the margins of lakes, ponds, and slow-flowing stream channels (Barbour and Major 1977).

Freshwater marsh historically and currently occurs in the Study Area; it typically is dominated by perennial monocots up to 6 ft in height (Kramer 1988). Freshwater marsh normally includes cattails (*Typha* spp.), bulrush (*Scirpus* spp.), sedges (*Carex* spp.), spike rushes (*Eleocharis* spp.), flatsedges (*Cyperus* spp.), smartweed (*Polygonum* spp.), watercress (*Rorippa* spp.) and yerba mansa (*Anemopsis californica*) (Barbour and Major 1977; Holland and Keil 1995; Sawyer and Keeler-Wolf 1995). Rooted aquatic plant species with floating stems and leaves also may be present, such as pennywort (*Hydrocotyle* spp.), water smartweed (*Polygonum amphibium*), pondweeds (*Potamogeton* spp.) and water-parsley (*Oenanthe sarmentosa*) (Holland and Keil 1995). The non-native invasive plant arundo (*Arundo donax*) also dominates some freshwater marsh areas (USACE 2013b).

Open Water

Open water communities typically are unvegetated due to a lack of light penetration and water depth. However, open water areas may contain suspended organisms such as filamentous green algae, phytoplankton (including diatoms) and desmids (Grenfell 1988). Floating plants such as duckweed *(Lemna* spp.), water buttercup (*Ranunculus aquatilis*) and mosquito fern (*Azolla filiculoides*) also may be present (Holland and Keil 1995). The boundary between open water and emergent wetlands is generally at a depth of about 7 ft (Kramer 1988). Open water areas are often artificial and naturally relatively rare on the River. Open water areas include standing/slow flowing water found in ponds, lakes and reservoirs. The oxygen content of ponded water is usually relatively low due to the small proportion of water that is in contact with the air and because decomposition of organic materials is occurring on the substrates below (Grenfell 1988).

Riparian Ecosystems

Riparian ecosystems border or straddle water bodies including streams, rivers, ponds, lakes, and seeps or springs. As a result, these areas support plants and animals adapted to (at least periodically) wet environments. Riparian vegetation communities grow in strips along rivers in damp soil. These riparian zones link terrestrial and aquatic systems, and play important ecological roles in the landscape for water and nutrient cycling as well as providing habitats for native flora and fauna. Transfers of nutrients, sediment, and coarse organic matter occur between aquatic and riparian zones, affecting both systems. Riparian areas filter out sediments and nutrients, and they usually store water in alluvial soils that may prolong or sustain stream flows later in the summer (Yarnell et al. 2010).

Stream riparian natural communities are formed by the interacting effects of flood frequency and intensity, soil saturation and depth of groundwater table, proximity to the channel, height above low-flow water level, climate (e.g., temperature, humidity, etc.), slope angle, and fluvial processes (e.g., sediment erosion/transport/deposition). In turn, these factors are controlled by low and high water flow levels, sediment availability, channel geomorphology, channel erosion, and channel meandering, which normally produces backwaters, old channels, different flow

gradients and areas of deposition. Where unconstrained, southern California river floodplain riparian zones are resilient, changing shape and extent naturally in response to episodic larger flood flows, as well as in response to natural variations in groundwater levels and surface water flows. However, human modifications of the watershed, floodplain, and/or channel often severely limit this flexibility.

Local factors determining the dominant plant species (and their size and stem density) on a riparian site include duration of soil saturation, soil depth, soil texture, flood frequency/season/duration, water table depth, soil oxygen availability, and fire (Knight 1994; Weixelman et al. 2011). Changes in plant community composition are mostly driven by successional processes in response to disturbance (e.g., natural denudation) and simultaneously by changes in flooding regime and water table, all of which can change the site type and the potential plant communities that can form. Changes in stream gradient, sinuosity, channel width-to-depth ratios, topography and floodplain landform, or soil type (Knight 1994) (as potentially driven by stream narrowing or channelization) produce various riparian landforms and resulting vegetation communities (Friedman et al. 1997). For instance, riparian vegetation composition is altered below dams due to changes in magnitude, duration, and/or frequency of low and high water flow levels below these structures.

Riparian ecosystems are an extremely small component of the landscape (Sands and Howe 1977). Riparian corridors occupy a small proportion of California, but are biologically important far beyond the land area they occupy. As resource-rich ‘‘islands’’ in semi-arid, human-dominated landscapes, they provide ecosystem functions and services related to water quality, microclimate, structural habitats for wildlife and fish, an energy base for the food web, and typically bank stability (Stella et al. 2013). Riparian zones in California naturally show high levels of plant biodiversity, structural complexity, and strong physical controls on plant demographics and community structure (Stella et al. 2013). In the Los Angeles Basin riparian zones historically supported a distinct riparian flora that was adapted to multiple abiotic stressors, including dynamic flooding and sediment regimes, seasonal water shortage, and fire. The most severe human impacts to riparian areas in the Project region are from watershed and floodplain land-use conversion to urban and industrial uses, flood management, streamflow modification and diversion, and exotic species introductions.

More than 225 species of birds, mammals, reptiles, and amphibians depend on California’s riparian natural communities (RHJV 2004). Riparian ecosystems harbor the most diverse bird communities in the arid and semiarid portions of the western United States (Knopf et al. 1988, Dobkin 1994, Saab et al. 1995). Riparian vegetation is critical to the natural function of in-stream ecosystems and aids significantly in maintaining aquatic life by providing shade, food, and nutrients that form the basis of the food chain (Jensen et al. 1993). Riparian vegetation also modifies in-stream communities when downed trees form scour pools[7] and debris-jams important for fish, amphibians, and aquatic insects (RHJV 2004). The National Research

[7] Pools: the deepest locations of a stream reach. The water surface slope of pools at below bankfull flows is near zero. Pools are often located at the outside of meander bends.

Council (2002) concluded that riparian areas perform a disproportionate number of biological and physical functions on a unit area basis and that the restoration of riparian ecosystem functions along America's waterbodies should be a national goal.

Riparian natural communities in California make up less than 0.5 percent of the total land area, an estimated 360,000 ac of the state (CDF 2002). Yet, studies of riparian natural communities indicate that these communities are very important or essential to ecosystem integrity and function across landscapes (Sands 1977; Johnson and McCormick 1979; Katibah 1984; Johnson et al. 1985; Faber 2003). Consequently, riparian communities are one of the most important natural communities for wildlife in California, such as land birds (Manley and Davidson 1993). Nevertheless, riparian natural communities in California have been drastically reduced over the past 150 years. Today, depending on region, riparian natural communities only cover 2 to 15 percent of their historical acreages in those regions of California (Katibah 1984; Dawdy 1989).

Due to their biological wealth and severe degradation, riparian areas are extremely important natural communities for wildlife conservation and restoration, including migrant and resident birds in the West (Miller 1951, Gaines 1974, Manley and Davidson 1993, Rich 1998, Donovan et al. 2002). California's riparian communities provide important feeding, breeding, and sheltering areas, as well as over-wintering grounds, migration stopover areas, and corridors for dispersal for many native species. The loss of riparian communities is one of the most important causes of population declines among land bird species in western North America (DeSante and George 1994).

Valley Foothill Riparian

The planning objectives for the Project include restoring an undetermined acreage of the Study Area to what is described as valley foothill riparian strand natural community (CDFG 1988; USACE 2013a). For this Project, valley foothill riparian strand is noted by the Corps as equivalent to (USACE 2013b): southern cottonwood-willow riparian forest and southern willow scrub (pursuant to Holland 1986); and *Salix gooddingii* woodland alliance (black willow thickets), *Salix laevigata* woodland alliance (red willow thickets), and *Populous fremontii* forest alliance (Fremont cottonwood forest) (pursuant to Sawyer and Keeler-Wolf 2009).

Valley foothill riparian is a tree-dominated natural community primarily vegetated by cottonwood (*Populus fremontii*), western sycamore (*Platanus racemosa*), and willows (*Salix* sp.). Forest understory may consist of shrubby willows and mule fat (*Baccharis salicifolia*) with herbaceous species including sedges, rushes, and mugwort (*Artemisia douglasiana*) (USACE 2013b). Scrub community areas have less vertical structure, with shorter willows dominant (USACE 2013b). The structure of this natural community has a canopy height of up to approximately 100 ft in a mature riparian forest, with a canopy cover of 20 to 80 percent (CDFG 1988). Most trees are winter deciduous. Lianas (often wild grape [*Vitis californica*]) frequently provide 30 to 50 percent of the ground cover (CDFG 1988). Herbaceous vegetation constitutes about 1 percent of the cover, except in openings where tall forbs and shade-tolerant grasses occur (Conard et al. 1977). Generally, the understory is impenetrable and includes fallen limbs and other debris (CDFG 1988).

Cottonwood trees in this community usually grow rapidly and can reach large age class sizes in about 20 to 25 years (typically measured since the last large flood denudation event). Shrubby riparian willow thickets may last 15-20 years before being overtopped and shaded out by cottonwoods and other trees. Valley-foothill riparian natural communities typically provide food, water, migration and dispersal corridors, and escape, nesting, and thermal cover for an abundance of wildlife. Many amphibians and reptiles occur in valley foothill riparian systems; some are permanent residents, while others are transient or temporal visitors (Brode and Bury 1985).

Fish and Wildlife

Historic Fish

The River historically had at least seven species of native fish that were relatively common in the inland portions of the River: Pacific brook lamprey (*Lampetra pacifica*), Pacific lamprey (*Entosphenus tridentata*), unarmored three-spine stickleback (*Gasterosteus aculeatus williamsoni*), southern steelhead trout (*Oncorhynchus mykiss irideus*), arroyo chub (*Gila orcuttii*), Santa Ana sucker, and Santa Ana speckled dace (*Rhinichthys osculus*) (Swift and Seigel 1993; Gumprecht 1999). Two of these species, southern steelhead and Pacific lamprey formerly migrated from the sea in mid-winter to spawn in the main River and in its larger tributaries of Big Tujunga Creek and Arroyo Seco; these species spawned both in the lowlands and the mountains, their young spending one to two years in the streams or coastal lagoons before returning to the sea (Swift and Seigel 1993). Five of these native fish species were permanent residents. Four of the resident taxa were endemic to the larger Los Angeles Basin (this includes the Los Angeles, San Gabriel, and Santa Ana River systems combined) and nearby areas (Swift and Seigel 1993). All seven species originally lived the Study Area or within a few miles (Swift and Seigel 1993). Other native fish species possibly included Chinook salmon (*Oncorhynchus tshawytscha*) and Sacramento pikeminnow (*Ptychocheilus grandis*) (Hall and Litton 2008).

Fish habitats in southern California are naturally challenging, including highly variable water flow regimes and high water temperatures (Bell et al. 2011). The Los Angeles Basin has a small but highly endemic native freshwater fish fauna (Swift and Seigal 1993). In comparison, southern California streams to the north and south of the Basin typically have two to four native freshwater fish species (Swift and Seigel 1993). Pacific brook lamprey, arroyo chub, and unarmored three-spine stickleback were common in the lowlands of the Basin in the original streams, springs, and marshes that were present in the Basin; these species did not penetrate far, if at all, into the mountainous tributaries of the Santa Monica and San Gabriel mountains (Swift and Seigel 1993). Santa Ana sucker and Santa Ana speckled dace occurred most widely in the mountainous portions of the drainage; however speckled dace also occurred in a few spring-fed localities and Santa Ana suckers also occurred in the large main river channels (Swift and Seigel 1993).

As urban development expanded across much of the lower elevations of the River's watershed, populations of native fish declined. For example, steelhead spawning grounds were directly reduced or cut off by dams and road crossings that made fish passage difficult, if not impossible.

Water that is/was diverted or pumped (e.g., groundwater from wells) for agricultural, residential, or commercial use reduces/reduced stream low-flows in the River. In addition, poor water quality from urban runoff likely adversely affects/affected the streams and lagoons necessary for native fish.

All of the native fish species are apparently extirpated from the mainstem (including the Study Area) of River today, although a couple of these native fish species reportedly persist in some of the River's tributaries (noted below). Native fishes were widespread across the lowlands of the Los Angeles Basin before completion of many flood damage reduction projects in the 1940s (Van Wormer 1991; Swift and Seigel 1993). No native fish species of the River apparently remained extant for more than several years following the channelization of the River that occurred in 1938 (Hall and Litton 2008).

Historically, the River supported a seasonal recreational fishery, mainly comprised of an annual winter run of steelhead trout. As noted, following channelization of the River, steelhead trout and other native species of the fishery disappeared, and were eventually replaced by common carp (*Cyprinus carpio*), tilapia (*Oreochromis* sp.), and other non-native species.

Survival, competition, and effective growth and reproduction of fish is highly dependent on metabolic rates as affected by water temperatures, food availability, available cover, and other factors. Water temperature in turn is affected by several key environmental parameters, including instream flows, riparian vegetation condition, groundwater influence, and channel morphology (Bell et al. 2011). As such, the information below, in part, is provided pursuant to the Project general objective of restoring some native fish habitat to the River and to inform restoration and enhancement designs and decisions for the proposed and other future projects, and to assist in the subsequent management of stream characteristics and parameters within and along the River.

Pacific Brook Lamprey

By the time Pacific brook lamprey was a recognized as district from the Pacific lamprey, the former was extirpated and very few specimens had been saved (Swift et al. 1993). Restoration of Pacific brook lamprey to the Study Area is not likely practicable.

Presumably the biology of the Pacific brook lamprey was much like other small species of western nonparasitic lampreys (Swift and Seigel 1993). The Pacific brook lamprey likely lived their entire lives in silty but well-oxygenated sediments, and transformed to adults in the early spring only long enough to spawn (Swift and Seigel 1993). The spawning period in the River probably occurred in late April through early May(Swift and Seigel 1993). It probably was a short lived and possibly an annual species, particularly in southern California (Swift and Seigel 1993). It is also possible that the local form was a distinct species (Hubbs and Porter 1971). It lived primarily, if not exclusively in the lowlands of the Los Angeles Basin and undoubtedly was common in the River (Swift and Seigel 1993).

In the synonymous or likely similar western brook lamprey, spawning adults build nests slightly smaller in diameter than their body lengths in gravel riffles at a water depth of about 5 to 6 in, in

slow (0.7 ft/second) moving water. Median substrate size in western brook lamprey nests is 0.9 in, and most nests are associated with cover (boulder, wood, or vegetation) and found in either pool tail outs or low gradient areas. Upon completion of the nest, adhesive eggs are deposited and covered with sand and gravel. Speckled dace and salmonids (*Oncorhynchus* spp.) feed on the eggs in western brook lamprey nests where they co-occur (Brumo 2006). Once juveniles reach about 10 in in length, they leave the nest and move downstream, usually at night, to burrow into deposits of fine sediments, their mouths towards the substrate surface so that they can filter feed. Ammocoetes (larvae) move further downstream into deeper areas as they grow (Kostow 2002). While they grow they feed on algae (especially diatoms) and organic matter (Wydoski and Whitney 1979).

Pacific brook lamprey in the River probably had similar habitat requirements to that of southern steelhead with which they co-occurred. They likely needed clear, cool water in little disturbed watersheds as well as clean gravel near cover (boulders, riparian vegetation, woody debris, etc.) for spawning. Additionally, they likely needed habitats with slow moving water and fine sediments for rearing. The adults likely avoided areas with deep, fast water and large substrates.

Pacific Lamprey

Shortly after hatching in freshwater streams, Pacific lamprey ammocoetes drift downstream into areas of low velocity and fine substrates where they burrow, and live as filter feeders for up to 7 years. Metamorphosis to macropthalmia (juvenile phase) occurs gradually over several months from July to November before their migration to the ocean in the winter and early spring. During this transformation they develop eyes and teeth. As adults in the ocean, Pacific lamprey are parasitic and feed on the body fluids and blood of marine fishes. After spending 1 to 3 years in the marine environment, Pacific lamprey stop feeding and migrate back to freshwater between February and June. They overwinter in fresh water until they spawn the following year between March and July. After spawning, Pacific lamprey die within days. Restoration of Pacific lamprey to the Study Area and environs would be quite challenging and require substantial riverine, riparian, and watershed restoration along the much of the River inside and outside of the Study Area, including fish passage and water quality parameters similar to those needed for restoration of steelhead trout.

Unarmored Threespine Stickleback

The unarmored threespine stickleback ("stickleback") is a small, scaleless, freshwater fish of up to 2 in standard length inhabiting slow-moving reaches or quiet-water microhabitats in streams and rivers (USFWS 2009). Restoration of stickleback to the Study Area would be challenging and require substantial riverine, riparian, and watershed restoration along the much of the River.

Favorable habitats are usually shaded by dense and abundant vegetation. In more open reaches, algal mats or barriers (e.g., sand bars, floating vegetation) may provide refuge for the species. Stickleback feed primarily on benthic insects, small crustaceans, and snails, and to a lesser degree on flatworms, nematodes, and terrestrial insects. Stickleback reproduce throughout the year, with less breeding activity occurring from October to January. Reproduction occurs in areas with adequate aquatic vegetation and slow-moving water where males can establish and vigorously defend territories. The male builds a nest of fine plant debris and algal strands and

courts all females that enter his territory; a single nest may contain the eggs of several females. Following spawning, the male defends the nest including newly hatched fry. Stickleback are thought to live for only 1 year.

Stickleback are currently restricted to three areas: the upper Santa Clara River and its tributaries in Los Angeles County, San Antonio Creek on Vandenberg Air Force Base in Santa Barbara County, and the Shay Creek vicinity (which includes Shay Pond, Sugarloaf Pond, Juniper Springs, Motorcycle Pond, Shay Creek, Wiebe Pond, and Baldwin Lake) in San Bernardino County. San Felipe Creek in San Diego County is another area that may support the stickleback; however, its current status there is unknown. They were historically found in low-gradient portions of the Los Angeles, San Gabriel, and Santa Ana Rivers, and from a few localities in Santa Barbara County, but have been extirpated from these areas. In 1917, the stickleback was reported to be abundant throughout the Los Angeles Basin (Miller and Hubbs 1969) but by 1942, they were no longer found there and were thought to be extirpated. Stickleback were likely extirpated from River as a result of the effects of urbanization, including flood risk management, channelization, dewatering of streams, habitat alteration, introduction of exotic predators, and pollution.

Santa Ana Sucker

The Santa Ana sucker is federally listed as threatened and occupied the Study Area historically, but is very likely extirpated from the Study Area and along the whole mainstem of the River. The Santa Ana sucker is potentially restorable to the Study Area with considerable riverine and riparian modifications to the River, including substrates and water quality parameters as noted below.

The Santa Ana sucker inhabits streams that are generally shallow, with currents ranging from swift (in canyons) to slow (in the bottomlands). All of these streams are subject to periodic severe flooding (Moyle 1976, Moyle 2002). Santa Ana suckers feed mostly on algae, which they scrape off of rocks and other hard substrates, with aquatic insects making up a small component of their diet. Larger Santa Ana suckers generally feed more on insects than do smaller fish (Greenfield et al. 1970; Moyle 1976).

Santa Ana suckers generally live no more than 3 years (Greenfield et al. 1970). Spawning typically occurs from early April to early July (Moyle 2002). Fecundity appears to be exceptionally high for a small sucker species (Moyle 1976). The combination of early sexual maturity, protracted spawning period, and high fecundity likely allows the Santa Ana sucker to quickly repopulate streams following periodic flood events that temporarily decimate populations (Moyle 1976).

Santa Ana suckers historically occurred in low-elevation streams in the Los Angeles, San Gabriel, and Santa Ana River systems (Swift et al. 1993). They also historically occurred in the upper Santa Ana River (Moyle et al. 1995). Introduced populations are present in the Santa Clara River, Sespe Creek, Piru Creek, and San Francisquito Creek. Although historic records are scarce, Santa Ana suckers presumably ranged from near the Pacific Ocean to the uplands of these river systems (Swift et al. 1993). The species has experienced significant declines throughout

most of its range (Moyle et al. 1995; Swift et al. 1993) and is currently restricted to three noncontiguous populations: (1) lower and middle Santa Ana River; (2) East, West, and North Forks of the San Gabriel River; and (3) lower Big Tujunga Creek (a tributary to the Los Angeles River).

Santa Ana suckers were found in the River and larger tributaries usually in rocky and gravelly areas where they grazed algae and diatoms from rocks. They probably spawned in the River in March or April in runs and the lower ends of pools (Swift and Seigel 1993). They historically were known to occur in the Study Area near Griffith Park (Swift and Seigel 1993). A single fish was taken about 2 mi downstream of the Sepulveda Flood Basin in 1949 (Swift and Seigel 1993). Since that time all records for the River drainage are from upstream of Hansen Dam on Big Tujunga Creek (Swift and Seigel 1993).

Nonnative fish such as green sunfish (*Lepomis cyanellus*) are potential competitors and egg predators that have a deleterious effect on Santa Ana sucker populations. Santa Ana sucker has been extirpated from the upper Santa Ana River drainage, largely because of inadequate flow, poor water quality, and in the lower Santa Ana River likely due to introduced brown trout (*Salmo trutta*) below Prado Dam (USFWS 2000). The San Gabriel River generally contains a higher abundance of Santa Ana suckers and larger individuals than the Santa Ana River, which could be attributed to more suitable habitat characteristics (as compared to the Santa Ana River) such as cooler water temperatures, intermediate water velocities, and commonality of pools and riffles with coarser bottom substrates, all of which may contribute to a better functioning system and a greater abundance of suitable habitat for Santa Ana suckers (Saiki et al. 2007). Santa Ana suckers prefer cool water temperatures but have been found in some life stages in waters between 59 and 82 deg. F in the Santa Ana River (Swift 2001); they typically inhabit small, shallow streams and rivers less than 23 ft wide where water temperature is generally below 72 deg. F, and where currents range from swift to sluggish (USFWS 2000).

Santa Ana suckers appear to be most abundant where the water is cool, unpolluted, and clear, although they can tolerate and survive for a period in seasonally turbid water (Moyle 1976, Moyle and Yoshiyama 1992, Saiki 2000). Santa Ana suckers are often found in pools; juvenile and adult Santa Ana suckers require deeper pools of water for foraging, shelter during storms, and protective cover. The presence of coarse substrates, including gravel, cobble, and a mixture of gravel or cobble with sand, and a combination of shallow riffle[8] areas and deeper runs[9] and pools provide optimal stream conditions (USFWS 2010). Adults show a strong preference for run habitat and a water depth of 16 in and greater. Juveniles prefer riffle and run habitat, depths greater than 12 in and gravel substrate (Haglund and Baskin 2002). In a study conducted in

[8] Riffles: the sections of the streambed with the steepest slopes and shallowest water depths at flows below bankfull. Riffles typically occur at cross over locations and have a poorly-defined thalweg (deepest part of the channel).

[9] Runs: the sections of streambed that often follow riffles and are usually followed by pools. Runs differ from riffles in that the depth of flow is typically greater and slope of the bed is less than that of riffles. Runs will often have a well-defined thalweg.

2002, fry were found exclusively in edgewater habitat over silt at depths of less than 7 in where there was no measurable flow (Haglund and Baskin 2002). Areas of shifting sandy substrates are less suitable for development of algae, an important food source for suckers (Saiki et al. 2007). Gravel beds in shallow, but clear, flowing stream reaches are needed for spawning; Santa Ana suckers spawn over gravel riffles where fertilized eggs adhere to the substrate. As such, an integrated stream system that contains the appropriate quantity of coarse substrates such as gravel, larger cobbles, or boulders that provide the space for reproductive development and growth of algae as a primary food source is important for a viable population of Santa Ana suckers (USFWS 2010).

The systems occupied by these fish undergo flashy, high stream flows that can periodically reduce population abundance and distribution. Natural upstream and downstream movement depends on habitat conditions; flood events often contribute to dispersal of the species (Riverside County Integrated Project 2000).

Native riparian vegetation over water provides cover and shelter from predators, which is normally essential for juvenile and adult Santa Ana suckers (USFWS 2010). Shallow areas with sandy substrates and overhanging vegetation are needed to support larvae and fry. Cooler water temperatures are only maintained in some areas by the upwelling of cooler groundwater, tributary flows, and shade from overhanging vegetation, which reduces water temperature during summer and fall months. Overhanging and instream vegetation are also needed for the development of an aquatic invertebrate community to supply food for adult suckers.

Therefore, in order to support Santa Ana sucker a complex and integrated stream system is needed or restored that:

1. encompasses sand, gravel, cobble, and rock substrates;
2. harbors diverse bed morphologies normally found in canyons and alluvial floodplains;
3. provides cool, clear water of varying depths and velocities, and native riparian vegetation cover;
4. contains tributaries that provide fish with areas of refuge (refugia) from predators and during floods and that can also provide suitable breeding habitat; and
5. harbors sources of coarse sediment for renewal of substrates in occupied areas.

Southern Steelhead Trout

Southern steelhead trout, otherwise known as southern steelhead or steelhead, are a cold water fish and unique form of rainbow trout; southern steelhead are the southernmost native anadromous rainbow trout in North America. Steelhead are federally listed as endangered in Los Angeles, Orange, and San Diego counties (the range of the Southern California Steelhead Distinct Population Segment [Southern California Steelhead DPS] extends to the U.S.-Mexico Border) (NOAA 2012). It is estimated that this Southern California DPS once numbered over 45,000 but has since declined to less than 500 individuals. Steelhead occupied the Study Area historically and are now extirpated from the River and tributaries. Restoration of steelhead trout to the Study Area and environs would be quite challenging and require substantial riverine, riparian, and watershed restoration along the much of the River inside and outside of the Study Area.

Steelhead are one of six Pacific salmon species that are native to the west coast of North America, and are currently the only species of this group that naturally reproduces within the coastal watersheds of southern California. Because steelhead employ several different life-history strategies that exploit all portions of a river system, they serve as a good indicator of the health of southern California watersheds and streams. Southern California Steelhead DPS populations have declined precipitously, largely due to extensive watershed development (NOAA 2012).

Differences between the southern steelhead and those steelhead to the north relate mainly to life history, reflecting the highly variable environment in which these fish evolved (California Trout 2011). Southern steelhead exhibit three basic life-history strategies: fluvial-anadromous (migration between freshwater and saltwater), lagoon-anadromous (migration to and from a brackish lagoon), and freshwater residency (remain in fresh water; resident inland rainbow trout) (NOAA 2012). These three life-history strategies have allowed southern steelhead to take advantage of different habitats and to persist in the highly variable and naturally challenging southern California environment (NOAA 2012). Southern steelhead are dependent on short-duration winter rains to provide passage through estuaries and rivers to the upstream freshwater spawning and rearing habitats of their birth. This results in a restricted and rapid spawning period, so fish are generally mature when they ascend the rivers (California Trout 2011). Because of frequent droughts in southern California, streams may be inaccessible from the ocean during some years, forcing adult steelhead to spend additional years in the ocean (California Trout 2011). During drought years the steelhead in freshwater endure long, hot summers by remaining in pools of deep, cool water (NOAA 2012).

While all steelhead hatch in gravel-bottomed, fast-flowing, well-oxygenated rivers and streams, some individuals (rainbow trout, as indicated above) stay in fresh water all their lives. The steelhead that migrate to the ocean develop a slimmer profile, become more silvery in color, and typically grow much larger than the rainbow trout that remain in fresh water. Some inland trout do migrate for the purpose of spawning or food foraging.

Southern steelhead occasionally attain weights of over 20 pounds (but are usually lighter) (California Trout 2011). They have lifespans up to 11 years and are sexually mature at 2-3 years.

Steelhead eat zooplankton while young; adults feed on aquatic and terrestrial insects, mollusks, crustaceans, fish eggs, minnows, and other small fishes (including other trout). Optimal growth for steelhead occurs at 59 to 64 deg. F, and mortality typically results at 75 to 81 deg. F. Steelhead require near saturation levels of dissolved oxygen to grow, though these fish can survive at levels as low as 1.5-2.0 parts per million (ppm). They do best where dissolved oxygen concentration is at least 7 ppm. In streams, deep, low-velocity pools are important wintering habitats. Steelhead require suitable gravel within stream riffle sections or pool tails, free of excessive silt, to dig nests for spawning. Times spent in freshwater and in the ocean vary according to geography, life history patterns, and effects of natural phenomena.

The female fish digs a redd (nest) and deposits 200 to 12,000 eggs depending upon her body size. After breeding, steelhead rest before moving back out to sea. In 3 to 4 weeks the eggs hatch, and the young trout spend another 2 to 3 weeks under the cover of the gravel before emerging as fry. In some instances the fry of anadromous steelhead will emerge soon after hatching and swim straight to the ocean to avoid dry summer periods. Typically the young steelhead reside in freshwater for 1 to 3 years before smoltification (transition to being able live in salt water). When the smolts finally reach the ocean they begin feeding on invertebrates, krill, and then focus on fish. Steelhead may stay in saltwater for 1 to 2 years before returning to their native streams to spawn. Most anadromous salmonids (e.g., salmon) die after spawning, but steelhead may make numerous trips back and forth between fresh and salt water to breed. Steelhead may spawn up to four times per life span, though the mortality rate between successive cycles is high. Within a stream's freshwater reaches, steelhead have in-stream habitat preferences generally determined by size. The smallest fish are mostly found in riffles, medium sized fish in runs, and larger fish predominantly in pools.

The primary factors impacting southern steelhead populations in southern California region include: (1) alteration of stream flow patterns, (2) physical impediments to fish passage, (3) alteration of floodplains and stream channels, (4) sedimentation, (5) waste discharges, (6) exotic species, (7) loss of estuarine habitat, and (8) stocking of hatchery reared salmonids (California Trout 2011). Southern steelhead have survived in the region despite the extensive modification of much of their habitat.

Many streams of the region have portions of their watersheds that are currently inaccessible to southern steelhead due to man-made barriers, but were historically used by steelhead. Major southern steelhead watersheds include the Santa Maria, Santa Ynez, Ventura, and Santa Clara Rivers, and Malibu and Topanga Creeks to the north of the River, and the San Gabriel, Santa Margarita, San Luis Rey, San Dieguito, and Sweetwater Rivers, and San Juan and San Mateo Creeks to the south.

Arroyo Chub

The arroyo chub is a California Species of Special Concern and has no Federal status. They are found only in the coastal streams of southern California. They probably occupied the Study Area historically, but are likely extirpated. The arroyo chub is likely restorable to the Study Area with considerable riverine and riparian modifications along the River.

Arroyo chub are normally restricted to pools and glides[10] in low gradient stream reaches (2 percent slope maximum), and they are usually associated with emergent vegetation. Arroyo chub are adapted to survive in streams that fluctuate between large winter storm flows and low summer flows, including the low dissolved oxygen and relatively wide temperature fluctuations (50 to 75 deg. F) associated with this flow regime. They are most common in slow flowing or

[10] Glides: the section of streambed located immediately downstream of pools. A glide ends at the upstream end of a riffle or run. The slope of the channel bed through a glide is negative while the slope of the water surface is positive.

backwater stream areas with sand or mud substrate, but may also inhabit areas with velocities in excess of 2.6 ft/second over coarse substrate (University of California 2013). They feed on plants such as algae and water ferns (*Azolla* spp.), and on invertebrates such as insects and mollusks. In a trial study the arroyo chub was found to be a viable alternative to the exotic mosquito fish (*Gambusia affinis*) for integrated mosquito management programs in riverine wetlands and sensitive watersheds of southern California within its former range (Van Dam and Walton 2007).

Arroyo chubs reach a size of 3.1 to 3.5 in by their fourth year and rarely live longer than this. Females can reproduce at age 1. Spawning takes place in pools and edge habitat from February to August with a peak in June and July. Fertilized eggs stick to plants or bottom substrate and hatch in about 4 days. Fry stay on the substrate for a few days, then rise to the surface and stay among plants or other cover for 3 to 4 months.

Like the Santa Ana sucker, the arroyo chub is endemic to the streams and rivers of the Los Angeles plain in southern California, including the Los Angeles, San Gabriel, Santa Ana, San Luis Rey, and Santa Margarita rivers, and Malibu and San Juan creeks. They have been extirpated from much of their native range but have been introduced to streams along the coast as far north as Chorro Creek in San Luis Obispo County, California. They have also been introduced to the Mojave River system where they may have eliminated the Mojave tui chub.

Arroyo chub are still found in Big Tujunga Canyon (tributary to the River), the Santa Ana River, Trabuco Creek, San Juan Creek, and Malibu Creek, and are reportedly now common only in Trabuco Creek, San Juan Creek, and Malibu Creek (Swift et al. 1993; WR Biological Monitoring Program 2011; Wilcox 2012). Re-establishment of the arroyo chub was the focus of a recent habitat restoration effort in the City of Pasadena on a remaining soft-bottom stretch of the Arroyo Seco (tributary to the River).

Speckled Dace

The speckled dace is a California Species of Special Concern. They probably occupied the Study Area historically, but are likely extirpated. The speckled dace is possibly restorable to the Study Area with substantial measures within the Study Area.

Speckled dace are capable of living in an array of habitat types from small springs or streams to large rivers and deep lakes. Speckled dace prefer habitat that includes clear, well oxygenated water, with movement due to a current or waves. In addition, the fish do well in areas with deep cover or overhead protection provided by vegetation or woody debris. Speckled dace predominantly occupy small streams of the second to third order where they feed and forage for aquatic insects. The species is very adaptable and is found in cold alpine lakes such as Lake Tahoe, but it has also been able to survive adversity in temperatures at or above 88 deg. F with a dissolved oxygen concentration of 2 ppm. In streams speckled dace swim along the bottom looking for small invertebrates while in lakes they are opportunistic feeders that may feed on zooplankton, algae, nymphs, or the resulting flying insects. Speckled dace typically have a life span of three years but may live 6 or more years, during which time females typically grow more rapidly than males. The fish become sexually mature in their second year, and during the summer months the dace spawn. Stream dwellers spawn in riffles or gravely areas, while the

lake inhabitants spawn in tributaries or in shallow shoreline regions. The embryos hatch in 6 days, and the larvae remain in the safety of the gravel for 7-8 days. The young fry then spend the early part of their lives in the shallow warm areas of the stream or lake where they hatched.

Speckled dace in the watersheds of the River were found in small to large, often spring-fed, moderate to high gradient rocky to gravelly streams, mostly in the mountainous tributaries farther upstream (Swift and Seigel 1993). The closest recorded population to the Study Area occurred in a small spring-fed stream in North Hollywood last collected in 1939; it was probably never common in the Study Area (Swift and Seigel 1993). It occurred further upstream in Big Tujunga Creek below Tujunga Reservoir until about the mid-1980's and had not been collected since. It is possibly extirpated in the River drainage, but populations still exist in the San Gabriel and Santa Ana drainages (Swift and Seigel 1993).

The native range of the speckled dace is the drainages of the western U.S. and Canada from the Columbia River (British Columbia) to the Colorado River (Arizona and New Mexico) and south into Sonora (Mexico) (Page and Burr 1991).

Current Fish

Fish species currently in the River consist of a variety of non-native species. Of the 1,200 fish caught in a 2008 fish study within the Project area, mosquitofish (*Gambusia affinis*) and tilapia were the most abundant, and common carp, fathead minnow (*Pimephales promelas*), and green sunfish were also common (Friends of the Los Angeles River 2008). The fish caught in this study and one from 1991/1992 (Swift and Seigel 1993) in the Project area were:

- fathead minnow
- common carp
- black bullhead (*Ameiurus melas*)
- Amazon sailfin catfish (*Pteroplichthys pardalis*)
- mosquitofish
- green sunfish
- largemouth bass (*Micropterus salmoides*)
- goldfish (*Carasius auratus*)
- tilapia

Flathead minnow, goldfish, and mosquitofish have been present since the 1950s in southern California drainages, and tilapia have been found in California coastal drainages since the 1990s (Swift and Seigel 1993). Species also known to occur in the River include: bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), and channel catfish (*Ictalurus punctatus*) (Friends of the Los Angeles River 2008).

The only currently approved place to fish on or near the River is at Lake Balboa, within the Sepulveda Basin, which is stocked with rainbow trout, largemouth bass, and other fish species (Los Angeles River Revitalization Corporation 2013). People are reported to fish in the Study Area in accessible River stretches with flowing or standing water.

Black bullheads, green sunfish, and largemouth bass are all currently common in most southern California freshwater streams on the coastal slope, including the Big Tujunga Wash, an upstream tributary of the Project site (Friends of the Los Angeles River 2008). Bullhead catfish (brown and black) are nocturnal predators that prey to some extent on native fish species in other areas of the Project region (Friends of the Los Angeles River 2008). Notably, green sunfish also prey on native fishes and amphibians in places such as Malibu Creek and Big Tujunga Wash (Friends of the Los Angeles River 2008). Green sunfish are probably continually washed down into the Project area from Tujunga Wash and other upstream locations (Friends of the Los Angeles River 2008). During a 2008 fish study a largemouth bass was detected only a single time in the Glendale Narrows portion of the Project area, possibly coming from one of the lakes upstream where they are more common (Friends of the Los Angeles River 2008). Largemouth bass apparently do not do well in strongly flowing streams; they are typically restricted to backwaters and slow moving pools (Friends of the Los Angeles River 2008). Backwaters and slow moving pools are currently quite uncommon in the Project area due to channelization, and this likely restricts largemouth bass and other species with similar life history restrictions in this portion of the River. Notably, largemouth bass also strongly prey on many native fish species in the region (Friends of the Los Angeles River 2008). Many of the exotic fish species detected in the 2008 study are likely better adapted to slower waters than the storm flows that are seasonally present in the Project area, but are nevertheless effectively extant and competitive under current conditions (Friends of the Los Angeles River 2008).

Amphibians & Reptiles

The upper watershed of the River continues to support substantial and intact reptile and amphibian populations. The arroyo toad (*Anaxyrus californicus*) and California red-legged frog (*Rana draytonii*) persist on the upper Tujunga Wash and the upper Arroyo Seco tributaries to the River upstream of the Study area.

A total of 12 species of amphibians and 21 species of reptiles are considered to occur now or have occurred in the 20th century within 1 mi of the present channel of the River from Sepulveda Basin to the River mouth (hereafter considered "the channel area"); these consist of 5 salamanders, 7 frogs, 1 turtle, 7 lizards, and 13 snakes. Only one of these, the bullfrog (*Rana* [*Lithobates*] *catesbeiana*), is exotic; the balance of 32 species are herein considered the native reptile and amphibian fauna of the River (Bezy et al. 1993).

Of the native amphibians of the River, four salamanders are considered as occurring or probably occurring within 1 mi of the channel area: Pacific slender salamander (*Batrachoseps pacificus*) in flatland situations; arboreal salamander (*Aneides lugubris*), black-bellied salamander (*Batrechoseps nigriventris*), and ensatina (*Ensatina escholtzii*) in the foothill area of Griffith Park. Of the 6 frogs/toads of the original native River fauna, only California toad (*Anaxyrus boreas halophilus*) and Baja California treefrog (*Pseudacris hypochondriaca*) (and the exotic bullfrog) persist in the channel area. The California treefrog (*Pseudacris cadaverina*), western spadefoot (*Scaphiopus hammondii*), arroyo toad (federally listed endangered), and red-legged frog (federally listed threatened) formerly occurred but are no longer found in the channel area; none of these are likely to be restored to Study Area.

Only one native turtle occurred in the River, the southwestern pond turtle (*Actinemys marmorata pallida*); it is now extirpated from the River basin and is not likely to be restored to the Study Area. Of the 7 lizards of the original native fauna, 6 are considered to still be present in the channel area. These six are: southern California legless lizard (*Anniella stebbinsi*), coastal whiptail (*Aspidoscellis tigris stejnegeri*), Skilton's skink (*Plestiodon skiltonianus skiltonianus*), western side-blotched lizard (*Uta stansburiana elegans*), San Diego alligator lizard (*Elgaria multicarinata webbii*), and western fence lizard (*Scleroporus occidentalis*). The coast horned lizard (*Phrynosoma coronatum*) is likely extirpated from the channel area and is not likely to be restored to the Study Area. Of the 13 snakes in the original native fauna, six snakes are considered to persist in the channel area. These six are: two-striped garter snake (*Thamnophis hammondii*),ringneck snake (*Diadophis punctatus*), southern Pacific rattlesnake (*Crotalus oreganus helleri*), California kingsnake (*Lampropeltis californiae*), California striped racer (*Coluber lateralis lateralis*), and San Diego gopher snake (*Pituophis catenifer annectens*) (Bezy et al. 1993).

California toad, Baja California treefrog, bullfrog, and two striped garter snake are the only reptiles and amphibians currently expected within the aquatic zone of the River in the Study Area (Bezy et al. 1993). The following are the only reptiles and amphibians currently expected in the riparian zone of the River in the Study Area: Pacific slender salamander, California legless lizard, coastal whiptail, San Diego alligator lizard , western fence lizard , western side-blotched lizard , southern Pacific rattlesnake , ringneck snake, California kingsnake, San Diego gopher snake, and south coast gartersnake (*Thamnophis sirtalis*) (Bezy et al 1993). These aquatic and riparian zone species of the Study Area would likely benefit from the proposed Project restoration measures, based on current occupation of the River degraded channel ecocsystem combined with general increases in carrying capacity for these species expected from the Project. Crayfish (*Procambarus* sp.) and mosquito fish, both exotic species reported from the River, are noted to feed on the larvae of some native amphibians in the River and are thought to contribute to their local decline (The River Project 2001).

Birds

The loss of lowland riparian and riverine ecosystems in coastal southern California has been severe, with a large percentage of dependent natural communities either destroyed or greatly modified over the past century (Garrett 1993). From an avian ecology perspective, even apparently intact riparian and riverine systems typically suffer from the effects of exotic plants, introduced predators, and/or parasitism from artificially high populations of brown-headed cowbirds (Garrett 1993). Comparisons of lowland riparian and riverine bird populations in the River system with those of more natural riparian reaches in other drainages in the region suggest a substantial overall reduction in native breeding species diversity and numbers, and demonstrate a considerable loss of sensitive breeding species in the River (Garrett 1993).

Channelization of the River and its major lowland tributaries was particularly devastating to four natural community types: coastal estuaries, seasonal and permanent freshwater and brackish wetlands, lowland riparian forests and woodlands, and alluvial scrub (Garrett 1993). A number of bird species associated with these communities have either completely disappeared from the Los Angeles River Basin or have suffered considerable population declines. Channelization also

eliminated nearly all the earthen stream bank communities, formerly favored for nesting by such declining species such as the bank swallow. The avifauna of the River drainage has been supplemented with a number of exotic species. All of these exotic species reach peak abundances in urban and suburban habitats, and only a few (e.g., European starling [*Sturnus vulgaris*]) maintain significant populations in native riparian or riverine communities of the River.

Natural community modifications and livestock and agricultural practices in California have allowed for major expansion in range and population sizes of the brown-headed cowbird, an avian brood parasite (Garrett 1993). These inflated cowbird populations have very likely adversely affected several open-nesting passerine bird species in the River drainage over the last century, including willow flycatchers, vireos (*Vireo* sp.), gnatcatchers (*Polioptila* sp.), and warblers (e.g., *Vermiform sp., Oreothlypis* sp. sp., *Setophaga* sp.) (Garrett 1993). Apart from modifications and loss of habitats, the increase in brown-headed cowbirds may have been the greatest factor in the decline of other native passerines in the River basin; the cowbirds increase is, in turn, related to habitat modification (Garrett 1933). The establishment of feral populations of predatory mammals, such as domestic cats (*Felis silvestris* [=*F. catus*]) and red foxes (*Vulpes vulpes*), has reduced ground-nesting throughout much of the lowland and suburban portions of the River drainage (Garrett 1993).

The following were likely breeding species in the Study Area historically that are now extirpated as breeders from the River drainage (Garrett 1993): yellow-billed cuckoo (*Coccyzus americanus*), long-eared owl (*Asio otus*), willow flycatcher, tree swallow (*Tachycineta bicolor*), bank swallow, and Wilson's warbler (*Cardellina pusilla*). Tree swallow could likely be re-established to the Study Area with restoration of nest cavities (such as placed snags and appropriate nest boxes); the other noted species are not expected to be restorable to the Study Area.

The following were likely breeding species in the Study Area historically before substantial modifications to the River, but are now greatly reduced in numbers or extirpated as breeders in the River drainage (Garrett 1993): common gallinule (*Gallinula galeata*), burrowing owl (*Athene cunicularia*), hairy woodpecker (*Picoides villosus*), purple martin (*Progne subis*), Swainson's thrush (*Catharus ustulatus*), loggerhead shrike (*Lanius ludovicianus*), yellow-breasted chat (*Icteria virens*; "chat"), and blue grosbeak (*Passerina caerulea*). Swainson's thrush, chat, and blue grosbeak could likely be re-established in the Study Area with considerable restoration measures, such as any restoration of substantial areas of dense closed-canopy riparian forests, open-canopy riparian thickets adjacent to forest areas, and riparian scrub with low tangled vines/woody shrubs, combined with cowbird control. The other noted species are not expected to be practicably restorable to the Study Area.

A total of 102 native bird species were recorded from the Study Area in 1991/1992 (Garrett 1993).[11] Several native riparian and wetland bird species have been able to maintain current populations in the soft-bottomed channelized portions of the River in the Study Area in the last few decades. These include pied-billed grebe (*Podilymbus podiceps*), cinnamon teal (*Anas cyanoptera*), American coot (*Fulica Americana*), killdeer *(Charadrius vociferous*), black phoebe (*Sayornis nigricans*), northern rough-winged swallow (*Stelgidopteryx serripennis*), common yellowthroat (*Geothlypis trichas*), song sparrow (*Melospiza melodia*), and red-winged blackbird (*Agelaius phoeniceus*) (Garrett 1993). Many other wetland birds are relatively common non-breeding visitors to the Study Area, including great-blue heron (*Ardea herodias*), green heron (*Butorides virescens*), black-crowned night heron (*Nycticorax nycticorax*), great egret (*Ardea alba*), bufflehead (*Bucephala albeola*), spotted sandpiper (*Actitis macularius*), least sandpiper (*Calidris minutilla*), Wilson's snipe (*Gallinago delicata*), and marsh wren (*Cistothorus palustris*) (Garrett 1993). Almost all of these species would likely increase in number and possibly distribution within the Study Area with implementation of the proposed Project. This would most likely occur associated with any restoration of open shallow water areas, larger open stream areas surrounded by dense riparian cover with minimal human disturbance, large forked canopy trees near water, stream edges with thick vegetation at the margins, and freshwater marsh areas with dense cattails, reeds and/or bulrushes.

An additional select group of relatively uncommon to somewhat common native birds could be substantially re-established or increased in the Study Area with directed restoration or artificial enhancement measures, based on recorded past or currently limited use of the Study Area and environs. These include (Garrett 1993): wood duck (*Aix sponsa*), common merganser (*Mergus merganser*), osprey (*Pandion haliaetus*), sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk (*Buteo lineatus*), peregrine falcon (*Falco peregrinus*), barn owl (*Tyto alba*), great-horned owl (*Bubo virginianus*), chimney swift (*Chaetura pelagica*), Vaux's swift (*Chaetura vauxi*), white-throated swift (*Aeronautes saxatalis*), belted kingfisher (*Ceryle alcyon*), cliff swallow (*Hirundo pyrrhonota*), barn swallow (*Hirundo rustica*), Bewick's wren (*Thryomanes bewickii*), ruby-crowned kinglet (*Regulus calendula*), western bluebird (*Sialia mexicana*), vireo, orange-crowned warbler (*Vermivora celata*), Nashville warbler (*Vermivora ruficapilla*), yellow warbler (*Setophaga petechia*), Lincoln's sparrow (*Melospiza lincolnii*), lesser goldfinch (*Carduelis psaltria*), and American goldfinch (*Carduelis tristis*). Potential effective restoration and control measures would overlap for many of these species, such as any development of extensive acreages of dense multi-story riparian scrub, woodland, and forest; restoration of wooded stream areas, larger native nest trees, and open woodlands; expansion of mud flats; and cowbird control. Artificial enhancement measures would have less overlap between species, but could practicably be developed in otherwise heavily constrained channel areas, including provision and maintenance of a wide variety of nest cavities (including

[11] Comprehensive bird surveys of the Study Area have apparently not been performed since 1992. A large percentage of the noted 102 species were rarely reported in the surveys of 1991/1992, and were represented by only a few individuals. For these species the River currently represents marginal or poor habitat, or the species are uncommon migrants or vagrants in the region (Garrett 1993).

nest boxes), platforms, and placed large hollow snags; and creation and maintenance of artificial sandy cut banks with openings

Mammals

The Los Angeles River basin historically consisted of a variety of natural community types which supported a diverse mammal fauna. Today, coastal sage scrub, alluvial scrub, riparian, and chaparral communities can still be found along the River's tributaries, but are fragmented and in poor or altered (disturbed) conditions. In these fragmented areas, mammal species composition is fairly consistent with similar communities outside the basin. The mammal fauna that now exists in the channelized portion of the River, such as the Study Area, has changed considerably. The lowland portions of the River have little remaining habitats suitable for native mammal species (Barkley 1993).

Changes compared to the historic diversity and numbers on the River (including the Study Area) are most evident in the paucity of native carnivores (e.g., foxes, weasels, bear, mountain lion); large predators and those requiring relatively pristine or undisturbed habitats (e.g., weasels, grey fox) are particularly reduced (Barkley 1993). The California grizzly and pronghorn that historically utilized the River are now respectively extinct and extirpated, and it is quite unlikely that mountain lion, badger, or long tailed weasels still maintain ranges in the lower River drainage including the Study Area (Barkley 1993). Grassland dwellers (e.g., voles, gophers, moles, shrews) also have apparently declined substantially along the River. Southern grasshopper mouse (*Onychomys torridus ramona*) and California vole (*Microtus californicus*), known from the River drainage previously, are probably rare or nonexistent in most of the basin today (Barkley 1993).

Major resources for all mammal species presently living in or visiting the River basin are water and cover; cover is generally sparse or unavailable in the Study Area (Barkley 1993). Corridors or linkages for many of the original native mammal fauna are also currently not functional to or through the Study Area. The open water occurring in the Project area is a major resource for all mammals, as all mammal species that potentially occur in the area need free water to drink (Barkley 1993). Those areas that also have native vegetation nearby are especially attractive to mammals as this provides cover and possible feeding grounds. Fully channelized portions of the River (concrete bottom and slopes) offer little or no cover (thus little food and high susceptibility to predation) and reportedly are inhabited mainly by exotic rats (*Rattus* sp.), house mice (*Mus musculus*) feral cats, and dogs (*Canis familiaris*). Feral dogs and cats often prey on small rodents and these feral populations are reportedly significant enough in some portions of the River that even where habitats appear suitable such animals likely inhibit native rodent recolonization (Barkely 1993).

Six bat species have detected along the Los Angeles River - Yuma myotis (*Myotis yumanensis*), Mexican freetailed bat (*Tadarida brasiliensis*), hoary bat (*Lasiurus cinereus*), western red bat (*Lasiurus blossevillii*), big brown bat (*Eptesicus fuscus*), western pipistrelle (*Pipistrellus hesperus*) (Barkley 1993; Remington and Cooper 2009). Yuma myotis and Mexican freetailed bat are the two most commonly-observed species in urban southern California (Remington and Cooper 2009). Both are often detected near water sources, where the Yuma myotis specializes in

the capture of emergent aquatic insects, and Mexican free-tailed bat forages opportunistically (Remington and Cooper 2009). The Los Angeles River is likely a feature that funnels activity of both species. Riparian growth in the River and local streams attracts insects and provides the best source of food for insectivorous bats which typically forage above riparian tree tops (Barkely 1993). The major factor affecting influencing bat occurrence and abundance in the Study Area is likely roost availability (Barkley 1993).

The western red bat is a California Species of Special Concern. The hoary bat is a migratory species in southern California that relies on woodland and riparian natural communities, similar to those of the western red bat (Barbour and Davis 1969). Both the hoary bat and western red bat are foliage-roosting species and tend to move the location of their day roost daily from tree to tree; therefore a range of tree options is important for this group of bats (Remington and Cooper 2009). The distribution of Yuma myotis is highly correlated with the presence of permanent water sources such as the River. Yuma myotis, western red bat, big brown bat, and Mexican free-tailed bat appear to be currently roosting within Griffith Park or nearby (Remington and Cooper 2009).

Raccoons (*Procyon lotor*) and coyotes (*Canis latrans*) likely make steady use of the Study Area. Other native mammals that rely on riparian or riverine growth are likely not currently present or are rare in the Study Area. Major restoration efforts in the Study Area would be needed to in order encourage species such as bobcat (*Lynx rufus californicus*), long-tailed weasel (*Mustela frenata*), Merriam's chipmunk (*Eutamias merriami merriami*), desert woodrat (*Neotoma lepida intermedia*), and mastiff bat (*Eumops perotis californicus*) to recolonize and reside in the River portion ofStudy Area (Barkley 1993). Nevertheless, we consider the bobcat to be good umbrella planning species for evaluating potential vertebrate movement and corridors through the the Study Area.

Vertebrate Use of Aquatic and Riparian Zones

Riparian and riverine zones of southern California (such as the Study Area historically) are typically resource-rich ecosystems within water-limited, larger landscapes (Stella et al. 2013). Riparian ecosystems normally serve as movement and dispersal corridors for wildlife, particularly for larger vertebrates. Higher riparian plant richness, diversity, and structure provide important resources used by most larger vertebrates, notably resting sites, cover, and food. Additionally, riverine and riparian areas normally have higher water availability, allowing many species to withstand water loss and thermal gradients in the high summer temperatures of the region. Riparian ecosystems also generally have diverse and heterogeneous plant communities. Most carnivore species respond to water channel type and standing water availability in all seasons; use of riparian and riverine ecosystems by carnivores is typically linked to water availability that provides for hydration, foraging, and external temperature regulation (Santos et al. 2010).

Umbrella Planning Species for Riparian Areas

Vireo, chat, and yellow warbler are uncommon sensitive birds that currently make some limited use of the riparian zones within the Study Area. All of these species were likely much more common and made extensive use of the former riparian scrub/woodland/forest areas of the Study

Area historically (Garrett 1993). Birds are generally valuable indicators of ecological integrity (Carignan and Villard 2002). These three species are typically good umbrella planning or surrogate[12] species for southern California riparian restoration projects on the coastal slope, including the Study Area, due to the range of riparian types and classes used by these species.

Least Bell's Vireo

In response to a substantial decline of the vireo population and widespread loss of its riparian habitat, the vireo was listed as endangered in 1986 (51 ***FR*** 16474). Critical habitat was designated in 1994 (59 ***FR*** 4845). A draft recovery plan was published in March 1998 (Service 1998); a final plan has not been issued.

Vireos are an obligate riparian species during the breeding season, and prefer diverse early and mid-successional (e.g., woody riparian vegetation about 3 to 15 years old since the last flood denudation event) riparian thickets. Vireos use a number of riparian natural community types, including cottonwood-willow woodlands/forests, and mule fat scrub. Occupied breeding habitats include dense cover within 3 to 6 ft of the ground, where nests are typically placed, and a dense, stratified canopy for foraging. Plant species composition does not appear as important a determinant in nesting site selection as habitat structure. For more information on habitat requirements during breeding and migration, see the draft recovery plan for the species (Service 1998).

The vireo historically occupied willow riparian habitats from Tehama County in northern California, southward to northwestern Baja California, Mexico (Grinnell and Miller 1944, Service 1998). About 99 percent of the vireos currently occur in southern California south of the Tehachapi Mountains (Service 2006). Thus, despite a significant increase in overall population numbers, and a slight shift northward in the species overall distribution, the population remains restricted to the southern portion of its historic range (Service 2006). Abundance of vireos rangewide has been relatively constant in the last decade (Lynn and Kus 2010, Pike et al. 2010, Jorgensen 2010, McDonald et al. in litt. 2011).

From 1977 to 2005 Los Angeles County supported 2 percent or less of the overall rangewide vireo population (Service 2006). The vireo was formerly a regular breeding summer resident on the River "in the willow lowlands, and along streams up to the foothills" (Grinnel 1898). Grinnel and Miller (1944) alluded to the vireo's decline beginning in the late 1920s as caused by

[12] The surrogate/umbrella species approach is typically used where conservation actions targeted for one or a small group of species should benefit a broader community of target species and are expected to provide an effective framework to guide ecological restoration efforts. Surrogate or umbrella species are often used as proxies for broader sets of species when the number of species of concern is practicably too great to allow each to be considered individually. We expect that these species would be generally representative of a much larger set of target species and provide a reasonable surrogate for the other species in each group. The logistical constraints of available data and resources often necessitate this approach. Our suggested approach would use multiple species as surrogates for community types/classes instead of the typical single species approach. See Seavy et al. 2012.

cowbird brood parasitism. Little successful nesting by vireos has been documented recently in the River drainage, outside of the area behind Hansen Dam and the Sepulveda Basin; cowbirds are reportedly common at all potential nesting sites along the River and their abundance would make successful nesting by vireos unlikely in most areas (Garrett 1993). The vireo was nearly eliminated as a breeding species in the River (Garrett 1993). An undetermined (but likely small) number of vireos was reported in 2009 and 2013 from within the Study Area near Taylor Yard (USACE 2013a).

Additional information on the vireo can be found in the Service's 5-year review (Service 2006) and draft recovery plan (Service 1998) for the species.

Yellow-Breasted Chat

The chat is a California Species of Special Concern that breeds from British Columbia, Ontario, and (rarely) Massachusetts south to California, the Gulf Coast, and Florida. They winter in the tropics.

Chats are foliage gleaners and consume insects and berries about equally (Ehrlich et al. 1988). Nestlings are typically fed a diet of soft-bodied orthopterans (e.g., grasshoppers) and larval lepidopterans (Petrides 1938).

In California, chats require dense riparian vegetation associated with streams, swampy ground and the borders of small ponds (Small 1994). Some taller trees (i.e., cottonwoods and alders) are required for song perches (Dunn and Garrett 1997). Blackberry (*Rubus* spp.), wild grape (*Vitis* spp.), willow, and other plants that form dense thickets and tangles are frequently selected as nesting strata (Grinnell and Miller 1944). The nest is a bulky cup that is normally a well-hidden structure, commonly placed about 3 ft above ground (Petrides 1938, Dunn and Garrett 1997). Nesting chats occupy riparian habitats with a well-developed shrub layer and an open canopy. Vegetation structure, however, more than age appears to be the important factor in nest-site selection (Eckerle and Thompson 2001). Nesting habitat is usually restricted to the narrow border of streams, creeks, sloughs, and rivers. Garrett and Dunn (1981) described the chat as having "greatly declined as a breeder in recent years" in southern California.

Chats are relatively rare and localized in Los Angeles County (Shufurd and Gardali 2008). Chats were formerly a "common summer resident in the willow regions of the lowlands" (Grinnel 1898) of the River, but are now rare breeding summer residents or scarce transients (Garrett 1993). Two territorial chats were reported from the Study Area near the Taylor Yard in 2010 (Hall 2010).

Yellow Warbler

The yellow warbler is a California Species of Special Concern. Yellow warblers breed across central and northern North America and spend winters in Central America and northern South America. They occur principally in California as a migrant and summer resident from late March through early October, breeding from April to late July (Dunn and Garrett 1997). Grinnell and Miller (1944) formerly described the yellow warbler as a "common" to "locally abundant" breeder throughout California, except for most of the Mojave Desert.

Yellow warblers were nearly extirpated from the coastal lowlands of Orange County by 1990 (Garrett and Dunn 1981, Gallagher 1997, Unitt 2004). Yellow warblers have increased greatly on the coastal slope in San Diego County since the late 1980s, apparently in response to habitat restoration and cowbird trapping to aid vireos (Unitt 2004).

Yellow warblers generally occupy structurally diverse riparian vegetation in close proximity to water along streams and in wet meadows (Lowther et al. 1999; Strusis-Timmer 2009). In California they are found in willows and cottonwoods and other species of riparian shrubs or trees, varying by biogeographic region. Yellow warblers are a shrub nesting species in California, often utilizing early successional patches (Strusis-Timmer 2009). Coastal California yellow warblers often utilize areas with a short, sparse riparian deciduous canopy and extensive willow shrub cover (Strusis-Timmer 2009).

Yellow warblers were formerly common breeders along the River, and were "particularly numerous and well distributed over the mesas and lowlands" along the River (Grinnel 1898). The decline of this species on the River can probably be attributed to loss of riparian habitat and, in part, to cowbird parasitism (Garrett 1993). It is currently a common spring and fall transient throughout the River drainage and an uncommon breeding summer resident in cottonwoods and other riparian habitats of foothill canyons, including along the Arroyo Seco, Santa Anita Canyon, and the Rio Hondo. (Garrett 1993). As of 2005, 6 to 10 pairs of yellow warblers were reported nesting along the River in the Study Area just northwest of downtown Los Angeles (Shufurd and Gardali 2008). Nine territorial yellow warblers and evidence of young were reported from the Study Area near Taylor Yard in 2010 (Hall 2010).

Environmental Heterogeneity

Natural ecosystems have long been thought of as complex systems, wherein the conditions for sustaining biodiversity are optimized (Nicolis and Prigogine 1977; Fath et al. 2004). Generally complex structures and dynamics are distinct attributes of natural ecosystems, which can be empirically tested and measured (Parrott 2010). Complexity has been defined as a balance between the two extremes of order and disorder (Langton 1992; Levin 1992; Parrott 2010). Environmental heterogeneity is the spatial or temporal variation of a given resource, structure, or biota in a given area. The Study Area has low environmental heterogeneity: it is ecologically extensively homogenous and modified compared to its natural state. The pattern of resources, biota, and natural structures in the River ecosystem has been modified over the last century to become rather uniform, and native biodiversity has largely collapsed.

Ecological Connectivity of Channels

An important design component and strategy of conservation planning is the retention or restoration of ecological networks. An ecological network is a nature conservation system where large reserves are connected to each other via ecological linkages or corridors across broad landscapes to facilitate recolonization and persistence of wildlife populations, particularly those threatened with extinction or local extirpation (Jongman, 2004; Noss, O'Connell and Murphey 1997). Some European countries have used rivers as an organizing principle for national ecological networks (Jongman 1998). Hydrologic networks are inherently a hierarchically connected system and logically meet the need for connectivity of many species in nature reserve

systems. However, hydrological networks alone are insufficient to meet the functional connectivity needs of all important organisms (Huber, Shilling, Thorne, and Greco 2012; Jongman 1998). Nonetheless, where river and stream systems can contribute to ecological conservation and connectivity, conventionally designed flood control channels often offer limited or no value because they commonly lack many of the important ecological attributes, such as contiguous vegetated cover, functional ingress/egress routes, or appropriate substrates. It is vitally important to the integrity and viability of river and stream systems that ecological conservation functions be incorporated into the planning and design process of multifunctional open channel flood control structures, to the extent practicable.

EFFECTS OF THE PROPOSED PROJECT ON BIOLOGICAL RESOURCES

Implementation of the proposed Project would likely result in direct and indirect effects to biological resources during demolition, clearing, grading, structure construction, operations, and maintenance. Most of these impacts would likely be temporary and relatively minor to moderate in extent. Proposed restoration measures would likely more than offset these impacts, and would improve riverine and riparian ecological functions of the Project following Project construction activities.

Potential construction-related impacts include increased stream turbidity, clearing of extant riparian or riverine natural communities, noise, night-time lighting, and contaminant introduction or release into stream waters, wetland, or upland areas. Most of these impacts would occur during the relatively short construction period of the Project and would likely be temporary. The resources that would be affected, notably riparian and riverine natural community remnants along the River, are already heavily degraded by past actions (particularly channelization and development) within and along the River channel and former floodplain.

While the proposed Project would provide substantial ecological enhancement and partial restoration to the portions of the highly degraded River, the designs currently proposed would nevertheless still provide largely unnatural biological conditions as compared historic conditions and to other southern California coastal streams in urban areas (Mazor et al. 2011). For example, the proposed Project would likely provide/retain mostly rock and concrete substrates, low natural community/habitat complexity within riverine and riparian systems, relatively high ongoing human disturbance near or in most restoration areas , high levels of open water and exotic species, simple channel geomorphology with many hard structures, high water temperatures, and low levels of riparian vegetation acreage and age/cover/species diversity.

Habitats for vireo, chat, and yellow warbler would likely be temporarily disturbed by Project construction and then subsequently restored and expanded, with an undetermined acreage of created riparian habitats, and an associated undetermined level of likely increase in use by these species. Native fish are currently extirpated within the Study Area; some potential exists for re-establishment of habitats for Santa Ana sucker and arroyo chub as part of Project restoration, depending on how riverine and riparian restoration would be designed and performed.

The ecological functions of riverine and riparian areas/fragments normally depend not only on their size and internal features, but also on their configuration relative to one another and the characteristics of the surrounding landscape (Andren 1992 & 1994; Sisk et al. 1997; Saab 1999; Tewksbury et al. 2002). As such, additional projects would need to be implemented outside of the Project area in order to partially restore many important basic riparian and riverine ecosystem functions within the Project footprint. For instance, substantial modifications to the watershed and River upstream would be needed in order to restore natural stream sediment supplies that are key to the River's natural fluvial processes in the Study Area and areas downstream. Similarly, downstream channel modifications and enhancement would likely be needed to restore effective fish passage and conditions/linkages in order for some native fish to become established and make considerable use of the Project reach proposed to be restored. Nevertheless, substantial restoration potential exists within the Study Area, and the Project would have individual and incremental biological benefits.

Ecological Benefits of the Proposed Project[13]

From an environmental heterogeneity standpoint, the proposed Project would substantially improve portions of the Study Area (particularly Taylor Yard and Piggyback Yard) from a highly modified/uniform ecosystem to semi-natural/disordered ecosystem (Seiferling et al. 2014). The environmental heterogeneity/biodiversity relationships in the currently homogenized ecosystem would be increased, since the Project would add naturalistic heterogeneity and complexity through increases in habitats, channel/floodplain forms, vegetation structures, and resource opportunities, which should promote niche partitioning and some improved native species coexistence.

Within the Study Area the riverine and riparian natural communities are currently greatly reduced, degraded, and isolated remnants of their former extents. Following implementation of any of the Project alternatives, both riverine and riparian natural communities would be enhanced and expanded. Considerable creation of wetlands would occur. Nevertheless, with Project implementation these areas would remain relatively fragmented and isolated; this is to be expected considering the many constraints to restoration of ecological connectivity due to the heavy urban context of the Study Area. Some improvements in ecological connectivity, such as enhanced movement corridors for some small vertebrates, would occur due to Project restoration/enhancement measures, with the level of improvement varying by Project alternative. The Project would provide moderate long-term benefits to the same native biological resources that would be temporarily adversely affected by construction through creation (re-establishment) or enhancement of many stream and riparian natural community features in portions of the Project footprint, particularly through channel widening and re-establishment of some areas of

[13] In a comment letter to us dated May 14, 2014, the Corps commented that proposed Project "[b]enefits may include potential re-introduction of fish (Santa Ana sucker (SAS), arroyo chub), benefits to least Bell's vireo (LBVI) and other threatened and endangered (T&E) species, contributions to restored connectivity for wildlife movement, and contributions to potential future connectivity to significant regional habitat areas."

former floodplain and associated riverine and riparian natural communities, such as semi-natural aquatic soft-bottom channel and valley foothill riparian areas. Actual enhancement and partial restoration levels that would likely be attained by the Project are difficult to ascertain, due to the general or vague descriptions in the 2013 EIS/EIR, such as "Approximately 60 acres of riparian habitat corridors would be restored along the overbanks of both sides of the river. Overbanks are those areas adjacent to the river where overland flow in flood events could occur in a natural river environment" (Section 7.1.1).

The Project as proposed would provide ecological enhancement and partial riverine and riparian restoration to a highly degraded stretch of the River. The Project would likely provide modest ecological net gains, particularly for native species that are somewhat tolerant of urban or degraded environments, such as certain migratory and resident birds that currently utilize riverine and riparian natural communities (as noted above). Increased function and occupation by native small mammals, reptiles, and amphibians would likely be low to moderate. Pursuant to the objective of restoring biological diversity to the Study Area, we do not expect re-establishment of any extirpated reptiles, amphibians, or large mammals with implementation of the proposed Project. Increased or restored function and occupation by large mammals would likely be quite low, outside of coyotes.

The Project would provide considerable riparian corridor management; this one of five key high priority action items identified for the River for re-establishment of Southern California Steelhead DPS (NOAA 2009). The proposed Project would provide general ecological improvement of aquatic natural communities in the Study Area. The Project objectives include "Restore…native fish habitats…throughout the Project period of analysis…" On the other hand, the 2013 Draft EIS/EIR does not specify which of the seven potential native fish species formerly found in the River would be the subject of the restoration objectives of Project, nor did the document provide basic design parameters or concepts that would lead us expect restoration of functional habitats for native fish. In our opinion, the current Project description and designs do not appear sufficient to provide restoration that would support any of the native fish outside of the short-term. For example, the proposed Project design drawings show substantial areas of unnatural open water (unshaded, relatively still areas of surface water mostly free of emergent vegetation, etc.) that, if implemented, would likely give substantial competitive advantage to the exotic fish and invertebrates in the Study Area over potential native fish such as Santa Ana sucker or arroyo chub. With modifications to the proposed Project designs and implementation, the Study Area could likely support some native fish, as noted in our Recommendations below.

The carrying capacities of the Study Area would likely be improved and enhanced for a few sensitive species, such as vireo; it is difficult to estimate the acreage or numbers of pairs of vireo that would likely be restored and enhanced by the Project, based on the relatively vague information provided. Native riparian and riverine plant diversity and function would substantially increase, but remain relatively low compared to some reaches of similar rivers, such as the Santa Ana River or San Luis Rey River, in an urban context. The Proposed Project would

provide considerable areas of native landscaping[14] along the River, with some benefits to connectivity and function along the River, mostly for non-sensitive native birds. Overall numbers of native wildlife, particularly birds, is expected to substantially increase. Local opportunities for observing native birds and invertebrates, aquatic and riparian natural communities, and native plants would be drastically improved.

Alternative 13 would provide approximately 588 ac of partial general restoration, including (with undefined proportions of) valley foothill riparian, freshwater marsh, and open water natural communities, and other wetland areas. Alternative 20 would boost this same basic acreage, and provide an overall total about 719 ac of partial restoration, with undefined portions of those same natural community types.

Additional information on potential Project effects is described in the 2013 Draft EIS/EIR.

CUMULATIVE EFFECTS

Compared to the subject proposed Project, a smaller scale recreation and "greening" open space project on the River is proposed approximately 6 mi upstream, along a reach of the River between Coldwater Canyon Ave. and Whitsett Ave. This proposed project is named the "Los Angeles River Greenway Trail, Coldwater Canyon Ave to Whitsett Ave, San Fernando Valley." This project would create an access trail and native landscaping along about a 0.5 mi stretch of the existing River concrete flood channel (Community Conservation Solutions 2014). While stating that it would "Restore a native ecosystem of oak woodland, chaparral and mixed scrub," this project would only provide minor ecological enhancement on an existing strip of exotic landscaping in this same area along the flood channel; the River itself would remain a concrete flood channel facility.

A proposed project named The Los Angeles River Natural Park is envisioned as a "Green Solution" river-oriented park on a 16-ac project site in Studio City, also about 6 mi upstream of the subject proposed Project. The proposed L.A. River Natural Park would create a wetlands complex to capture and improve runoff water quality from a 200-ac surrounding area, and provide human access to the L.A. River Trail. The Park would create a public access hub for pedestrians and bicyclists and include a public parking garage, pedestrian bridges, and improvements to the L.A. River Trail (Community Conservation Solutions 2013).

Please see the 2013 Draft EIS/EIR for additional cumulative effects information regarding biological resources in the Study Area.

[14] Landscaping: using living, natural, and human elements in the art and craft of growing plants with a goal of creating a beautiful and naturalistic environment within the landscape.

RECOMMENDATIONS

The FWCA states that "…wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs through the effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation." With the following recommendations we are suggesting "…measures that should be adopted to prevent the loss of or damage to …wildlife resources, as well as to provide concurrently for the development and improvement of such resources."

Available funding for fish and wildlife conservation is sparse and usually competitive, normally limiting related actions. Expending conservation resources in areas of high human density is quite costly and often considered less likely to succeed. Yet, coastal southern California contains a large fraction of endemic at-risk species and (now) rare ecosystems, as well as the state's three largest metropolitan regions. As such, understanding the context and capacity to enhance, restore, conserve, and access ecosystems and native fish and wildlife species within this highly urbanized coastal region is a conservation/societal priority. The values of partially restoring and enhancing the ecosystems of the River are greater than the potential biological conservation benefits alone.

As outlined below, we generally suggest that the designs for proposed Project be developed with a stronger focus on principles of restoration of stream natural communities and processes. We understand that the Study Area is within a heavily populated urban area, and we acknowledge that the varied constraints to ecological restoration of the River are tremendous; we are also well aware that the Project design selected can not increase flood risks.

Based on our Project discussions, the Corps appears to define partial ecological restoration as improvements in habitats or ecological functions. As we have noted above, we expect that full or partial restoration also includes a self-sustaining component as essential to the definition of restoration, even in highly constrained project areas. This is more than semantics, due to the considerable number of restoration projects continuing to be developed and reviewed by our agencies; it is important that we understand each of our respective definitions. While ecological improvements and benefits such as artificial enhancements are highly important and valuable in many areas, we continue to stress the essential long-term importance of at least partial recovery of self-sustaining ecological functions for restoration projects. For example, this would mean evaluating whether proposed native vegetation in some plating areas would not only survive in the long-term without permanent irrigation, but would it also effectively reproduce and replace itself (or naturally succeed) both over time and following expected disturbances such as periodic flooding events.

In part, the current proposed Project designs (all alternatives) appearsubstantially compromised by proposed recreational, and aesthetic features, often at the expense of otherwise practicable ecological restoration potential (e.g., restoration of relatively natural complexities of processes, substrates, channel/floodplain forms, and natural communities/habitats in some areas). The current designs in many locations are also heavily compromised by the lack of channel widening; this is understandable given the consistent need to maintain channel flood flow capacity and the

surrounding constraints. It is understood that widening the channel and floodplain cannot be practicably accomplished throughout the whole Study Area with the subject Project. The resultant potential for partial restoration of ecological functions in these areas of unwidened channel is quite low. Our specific recommendations below reflect these combined issues.

1. We promote the restoration and enhancement of fully functioning and self-sustaining ecosystems, where and to the extent practicable. As we have noted otherwise herein, the River is not restorable to a self-sustaining, full function stream system, even within the proposed widened floodplain areas of the Project, due to the constraints of the Study Area and watershed (e.g., reduced fluvial sediment supply from upstream, modified hydrograph, water quality and temperature, etc.). On the other hand, substantial enhancement and partial restoration of the River is practicable in respective portions of the Study Area. The proposed Project has good basic goals and objectives in relation to general fish and wildlife resources, though they (combined with the Project description and figures) are currently too vague for us to assess the fundamental ecological functions and values of restoration and enhancement that would be implemented. Pursuant to the current Project goals and objectives (to the extent practicable), we suggest the Project designs be modified to more clearly focus on restoration of substantially more natural function of riverine and riparian natural communities in the Project. . The proposed channel/streamside ecological structures and natural communities within the River reaches to be partially restored/widened (e.g., former rail yards) should be designed to be more like similarly situated southern California River reference sites (e.g., less open/slow moving water areas), including designing in greater channel/aquatic and riparian area complexity and utilizing natural community compositions and substrates that support higher sensitive taxa richness. The current proposed designs and descriptions for restoration areas read more like landscaping plans than restoration plans. The objectives, designs, and Project description should indicate enough specificity to allow evaluation of the rough elemental ecological gains that would be made (for example, specify the individual minimum acreage of valley foothill riparian strand, freshwater marsh, etc., that would be created or enhanced in each reach, instead of consistently lumping this information); these data are currently lacking. We commend the integrated multi-project, step-wise approach planned for partial restoration and enhancement of the River that would be hopefully continued with future projects.

2. Of the Project alternatives currently proposed, we recommend Alternative 20, with modifications (as noted below). Alternative 20 has the highest potential of the proposed alternatives to restore considerable ecological functions of the River. In order to perform any substantial riverine and riparian restoration or enhancement on the River (and maintain current flood flow capacities for flood risk management), the right-of-way (ROW) and floodplain currently utilized by the River will need to be re-widened in considerable River reaches (as noted in the 2013 EIS/EIR). This is because effective restoration cannot be performed within the confines of the existing channelized River without reducing flood carrying capacity of that same channelized reach (e.g., due to channel “roughness” associated with mature woody vegetation) unless a wider/larger area

to carry the same flood flows is provided. As such, truly effective ecological restoration of the River (partial restoration) can only occur in areas of widened River ROW.

We recommend substantive modification of any approved Project alternative to increase the focus of proposed Project resources on practicable levels of restoration of River hydrology and geomorphology.We expect that the current proposed designs (all proposed alternatives), if implemented, would result in improvements, but relatively small native fish and wildlife resource net gains and overall low ecological integrity and function for these species within Project restoration and enhancement areas, due to very important remaining stressors such as: a) resultant low complexities of substrates/geomorphology/hydrology/natural communities; b) large areas of artificial (slow moving low flow) open water and channel; c) high human disturbance near stream banks; d) low cover levels, structure, and diversity (e.g., age classes) of native riparian and riverine vegetation; and e) substantial use of proposed hard structures. These stressors can be reduced with potential Project designs, such as maintenance of relatively natural lotic (flowing water; we suggest less area of still, open water) conditions over the length of the Study Area, but some of these stressor would remain with all practicable designs. Considering the constraints involved, we nevertheless suggest that it is practicable for the designs for Project restoration areas (areas of widened floodplain) to be more "wild" and less "naturalistic"[15]/ordered (such as by hard structures and slope protection) than as shown within Project concept drawings and designs.[16]

We suggest that riverine and riparian ecological (partial) restoration be more clearly the primary goal within the specific River reaches to be widened. For instance, most widened floodplain areas should be designed for riparian scrub-woodland-forest communities relatively similar to those that existed historically in the Project reaches, including providing for cyclical and episodic succession of riparian natural community age classes over time following denudation events (floods). Proposed Project designs shouldrely on utilization of existing groundwater (e.g., less than 6 to 8 ft from the ground surface for riparian natural communities) and natural surface water flows for native vegetation needs (e.g., see Stromberg et al. 1996; Stromberg 1998). Restoration of

[15] Naturalistic: looking similar to what appears in nature; not looking artificial or man-made. Not necessarily retaining the functional characteristics of natural ecosystems, such as self-sustainability, functional food webs/native species interactions, etc.

[16] In email attachment to us dated 25 November 2014, the Corp noted: "The Corps' intent is that the stressors described will be addressed in widened areas, where increased flood capacity will allow for varied substrates and natural hydrology, high vegetative cover and structural diversity, and very limited and well-buried hard structures. Open water areas will be designed to support native fish such as Santa Ana sucker and Arroyo chub, including riffle/pool/glide sequences. Human disturbance is expected to be minimal in widened areas, where recreational dirt trails will be designated. In widened areas, it is expected that the active channel will migrate and change form and that sediments will be redistributed with storm events. Vegetation is expected to be denuded with natural higher flows and velocities, and be re-established naturally. Any grade stabilizers in these areas will be well buried, and not visible from the surface."

widened floodplain areas should also be designed with the expectation of some channel form changes over time: large flood events should be allowed to provide some channel re-setting (geomorphic change) action within the necessary outside flood risk management sideboards of widened River reaches.

3. Project recreation/access features involving hard structures should be limited to the outside periphery of widened/restored River stretches (such as Taylor Yard and Piggyback Yard). Many of the design drawings show substantial "hard-scaped" recreational features well within widened-reach restoration areas. Limiting recreational structures within the interior of restoration areas would both reduce potential for flood damage/maintenance of expensive structures, and would likely increase the biological function in these widened reaches for native species. The proposed construction of instream and floodplain hard structures that are out of context with naturally functioning systems (e.g., retaining walls, curbs, formal paved or heavily compacted or surfaced paths, boardwalks, grade control structures, etc.) should be minimized within restored areas in widened reaches (Kauffman et al. 1993). Also, such hard structures typically reduce the actual and perceived "wild" nature of areas, reducing the effective nature experience for people (Louv 2012, Cookson 2013).[17] We recognize that recreation enhancement projects within the River should inspire new River "stewards," who would be fundamental in the protection of these natural systems in the future. As such, we suggest designing "organic" recreation enhancement features that instill "adventure" and "challenge," in part through subtle engineering solutions that accommodate River recreation without degrading development of natural River ecosystem features and functions (e.g., see Borgman 1995). Pursuant to our Connecting People with Nature policies, we suggest that Project designs be modified with a greater emphasis on restoration of (and access to) the "wildness" of the River within these widened reaches, to the fullest extent practicable. Compared to current designs, such restoration would likely result in higher abundance of native fish and wildlife and greater levels of native biodiversity, with resultant enhanced opportunities for uncommon wildlife observation and nature experiences.[18]

4. Similar to our suggestions regarding Project recreation structures above, we suggest that the potential ecological interactions between the riparian and aquatic ecosystems be

[17] In email attachment to us dated 25 November 2014, the Corp noted: "As required, the Recreation Plan was developed after restoration features were planned. Recreation features include passive activities such as hiking, walking, and wildlife viewing. Widened areas supporting restoration of more natural hydrology such as Taylor Yard and LATC (a.k.a. Piggyback Yard) will support a limited length of dirt/gravel trails that will not impede hydrologic and ecologic functioning. Recreation structures such as restrooms and parking lots will be limited to the outside edges of widened areas and along overbank recreation trails. New trails throughout the project area will be unpaved, and certain currently paved access roads will be converted to dirt/gravel."

[18] Please see additional information at: http://www.fws.gov/home/fwn/pdf/NewsSuFall07.pdf, https://www.facebook.com/USFWSPacificCPWN, and http://www.fws.gov/letsgooutside/families.html

reflected more fully in the Project restoration and flood damage reduction features proposed. We suggest minimization of instream flow-control hard structures and unburied hard streambank slope protection in widened reaches, particularly along the riverine-riparian interface. These features often result in severed linkages between aquatic and riparian ecosystems (Kauffman et al. 1997). Any new essential instream and riparian hard-structure features (e.g., flow control and retaining walls, culverts, etc.) should be naturally complex (e.g., buried rock instead of surface concrete where practicable), accelerate riparian recovery, and imitate natural processes and functions (Kauffman et al. 1997). While acknowledging the context of the Study Area, the hydrology designs for widened River reaches to be restored (such as Taylor Yard and Piggyback Yard) should accommodate, to the maximum extent practicable, the dynamic and episodic nature of surface low and high River flows and the fluvial processes that were natural to the River, including water inlet and outlet structures that provide for a relatively natural high-flow hydrograph to newly created riparian areas. Restoration designs for low-flow channel paths and water inlet/outlet structures for widened reaches should emulate the full range of natural flow events and groundwater levels that original riverine and riparian terrace natural communities were subjected to before development. Restoration designs should reflect and emulate the fact that the natural River channel and riparian zones were (historically) dynamic both spatially and temporally, and that episodic denudation flood flows are natural and necessary to riparian integrity (e.g., cycling of seral stages) in the Study Area.

While we understand the major design constraints of the Project area, we suggest that the current proposed Project designs (even though an improvement over existing conditions) would retain many of the existing rather simplified ("naturalistic") features of the River in widened/restored areas. These reaches of low natural heterogeneity, as designed, would have continuing negative influences on local channel hydrodynamics, channel morphology, and native streambank surface cover and function for native species. As such, these features would likely have long-term detrimental influences on important riparian/aquatic interactions by reducing shade over water, stream nutrient inputs, and woody debris inputs, and ecosystem productivity would not meet its full potential.

The riverine and riparian ecosystems that are expected to be at least partially restored by the proposed Project are episodic disturbance oriented/dependent ecosystems. As such, in areas where the River would be substantially widened, we suggest that Project designs should not intend to fully "lock" the low-flow channel in one place, but instead should allow for some limited amount of channel migration over time between the "sideboards" otherwise necessary for flood damage reduction capacities (in the heavily constrained context of the Project area). Almost all restored floodplain terrace ground surfaces should be well within the distances to groundwater that can be utilized naturally by the expected native riparian vegetation and designed for appropriate episodic succession-setting flooding events necessary to sustain the target natural communities (e.g., willow-

cottonwood woodland) and habitats (e.g., vireo habitat) in the long-term, with no reliance on periodic replanting for replacement recruitment.[19]

5. Within the Project portions of the River that would not be widened by the proposed Project, we suggest that ecological enhancement, native landscaping, recreation, buffer, and/or stream water shading be the stated goals for and focus of Project activities in most of these areas.. While providing some ecological improvement , we suggest that these features be treated as ecological enhancement because the substantial constraints in these reaches preclude self-sustaining full or partial restoration of most of the important riverine or riparian ecological functions of the River. Expectations of substantial occupation or connectivity use by typical target native species in portions of the River that would not be widened should be low, with the exceptions of any implementation of specific artificial enhancements (such as developed artificial snags, nesting cavities and shelves, and riverine hardscape pools and riffles). . Establishment of native trees on the south side of the River where water shading can be accomplished would enhance stream water temperature reductions thatmay help provide for limited use of other Project areas by native fish. . We find this distinction between restoration and enhancement to be important due to the precedent this could set for ecological restoration within other projects.[20]

6. We suggest that the Project ecological guidelines and designs for restoration be based on typical restoration ecology[21] science and terminology, and less on landscape

[19] In email attachment to us dated 25 November 2014, the Corp noted: "…the Corps' intent is that that widened areas will support high levels of heterogeneity. The active channel will migrate and change form and terraces and sediments will be redistributed with storm events. Initial grading during construction of widened areas will be heterogeneous and diverse topography will be created. The dynamic and episodic nature of the River flows will be accommodated in these areas, allowing the River to carve new channel configurations over time. Vegetation is expected to be denuded with natural higher flows and velocities, and be re-established naturally. Any grade stabilizers in these areas will be well buried perpendicular to flows, and not visible from the surface. Once initially planted and a seed bank established, passive recovery will be the method for re-vegetation after flood events. Such natural hydrologic functions would support riparian/aquatic interactions by providing habitat elements including shade over water, and stream nutrient and woody debris inputs."

[20] In email attachment to us dated 25 November 2014, the Corp noted: "The Corps disagrees that individual project features should be parsed out as "restoration" vs. "landscaping" vs. "greening". While the definition of "restoration" as provided by USFWS is not achievable in every portion of the project area, the project as a whole meets the Corps' criteria for ecosystem restoration, in that all features collectively contribute to habitat and connectivity creation and improvement throughout the project area. In this way, wildlife is provided new large areas (e.g. 35+ acre sites such as Verdugo Wash, Taylor Yard, and LATC (a.k.a. Piggyback Yard)) of restored habitat with a means to move between them, as well as into other surrounding natural areas."

[21] Restoration ecology: the scientific study of repairing disturbed ecosystems through human intervention. Ecological restoration implementation aims to recreate, initiate, or accelerate the recovery of an ecosystem that has been disturbed.

architecture[22] science and terminology. Baseline and post-Project implementation surveys/assessments for fish, amphibians, reptiles, and the associated parameters of potential habitats for target species should be performed in the Study Area. Non-native species with considerable potential to adversely affect Project restoration success should also be assessed, including potential source populations in the watershed.

The following water quality parameters of specific Project reaches should be evaluated and mapped as part of Project planning and implementation: water temperature, dissolved oxygen, pH, conductivity, turbidity, substrates, water velocities, channel forms (e.g., deep or exotic predator-free pools), flood refugia and back-channel areas, woody debris and leaf litter. These parameters and natural community mapping should be analyzed relative to current non-native fish, amphibian, and reptile occupation of the Study Area. These parameters should then be compared to known ideal (and minimum) necessary natural parameters and conditions of habitats normally utilized by species such as Santa Ana sucker, arroyo chub, two-striped garter snake, California toad, Baja California treefrog, and other appropriate restoration indicator and surrogate/umbrella species. This survey information should be used to inform basic Project design development (e.g., to provide functional habitats for specific native fish and aquatic wildlife species), as well as post-construction adaptive management decisions, and future restoration projects in the watershed.[23]

7. In relation to the needs of any of the seven native fish that could potentially be re-established in the River (such as arroyo chub), the proposed Project as currently designed would appear to: a) lack necessary complexity of habitats; b) lack necessary substrates and channel forms, including refugia; c) provide low food availability; d) be subject to excessive water temperatures; e) have an overabundance of large areas of open water; and f) provide/retain competitive advantage for exotic fish species over native species. The Project ecological restoration designs should provide higher priority to creating the natural parameters and conditions needed for the restoration of at least one specific native

[22] Landscape architecture: the art and practice of designing the outdoor environment, especially designing parks or gardens together with buildings and roads.

[23] In email attachment to us dated 25 November 2014, the Corp commented: "The Monitoring and Adaptive Management Plan (MAMP) to be included in the Final IFR document includes pre- and post-restoration monitoring to evaluate the performance of restoration actions. Habitat evaluations will be performed as restoration progresses to assess habitat values of restored features and inform adaptive management decisions. These evaluations require an inventory of wildlife species based on observations of wildlife and signs of usage, mapping of habitat, as well as inventory of habitat elements present within the project footprint. Monitoring of riparian, marsh, and fish habitat is outlined in the MAMP, which evaluates various habitat parameters including, but not limited to, invasive plants, hydrology, soils, sedimentation, water quality, in-stream structure, and also includes bird, fish, and amphibian species surveys. These habitat parameters can be compared to ideal reference conditions to inform adaptive management decisions and direct restoration actions. The MAMP will be revised to include a list of target species in order to direct restoration of habitat elements in ways that would benefit the life history requirements of those species."

fish species, to the extent practicable, so as to both support their basic survival and to give them competitive advantages over exotic species that would likely continue to occupy the Study Area following Project implementation (e.g., see Moyle and Light 1996). Assessments of whether proposed Project designs would likely provide these specific natural conditions for target species, including expectations of associated non-native species competition, should be provided before Project designs are developed further.[24]

8. In our opinion, the various alternatives proposed would provide limited restored functions for typical stream restoration target species. Considering the heavy constraints of the Study Area, some excellent opportunities exist for artificial enhancement measures, particularly where restoration is not practicable. Additionally, these types of features (e.g., large hollow snags, tall steep river banks) are not likely to otherwise develop in the short-term or over time in significant number/area within the Study Area due to the limited floodplain widths and modified hydrology in even the widest proposed restoration sites of the Project. The directed artificial measures suggested below would likely be substantially and quickly utilized by some uncommon or sensitive bird and bat species and could provide very attractive and important watchable wildlife opportunities along the River for residents and visitors. These features could be effectively incorporated into many otherwise heavily constrained channel reaches and off-channel adjacent areas that otherwise lack the space to support aquatic or riparian restoration features (such as artificial features added to walls, bridges, and other hard structures). These include: provision of various nest cavities and structures (e.g., for wood duck, barn owl, osprey, tree swallow, white throated swifts, and western bluebird) such as nest holes/crevices created in/on new and existing hard structures, and nest platforms/shelves/boxes; placed/erected large hollow snags and suitable vertical shafts with heavy inside texture (e.g., swifts); and creation of artificial large steep sandy/earth banks (e.g., northern rough-winged swallow and belted kingfisher; note that these supported banks could functionally occur along channel tops in some areas, without affecting flood conveyance). Directed artificial enhancement measures for some local bat species (e.g., Yuma myotis, western pipistrelle, Mexican free-tailed bat, and big brown bat) should include increasing availability of roosts in the Project area by providing large hollow vertical snags and shafts, rock outcrops, bat boxes, and artificial roost cavities designed

[24] In email attachment to us dated 25 November 2014, the Corp commented: "The design drawings at the feasibility level are conceptual, and will be revised and refined during the detailed design stage to include the necessary parameters that would support native fish habitat in widened areas and in overbank areas during the detailed design phase. In concrete reaches, where features are more limited by maintenance of flood capacity, designs will focus on providing refugia and passage. As discussed with USFWS, designs will focus on providing the hydrology, substrates, and habitat elements required by Arroyo chub and Santa Ana sucker. In the Draft IFR, in Section 4.2.2, Santa Ana sucker are identified as a target for restoration of native fish habitat. Other target fish species for restoration as well as their general requirements will be clarified in the Final IFR document."

into new hard structures.. Almost all of these artificial features would require some limited periodic maintenance or replacement.

9. Brown-headed cowbird occupation of the Study Area should be assessed during Project planning, including potential source populations in the region within several miles. Cowbird feeding areas (e.g., outdoor human feeding areas, stables and other equestrian facilities, and some turf zones) should be reduced or modified in the Project general region, to the extent practicable. If brown-headed cowbird parasitism levels are still likely to be problematic for sensitive birds potentially occurring within the Project area, then management of cowbird numbers should be performed by the Project for the life of the Project, such as through trapping at local horse stables and other cowbird source or breeding areas, with standard cowbird traps. We recommend a long-term management strategy for cowbirds be developed by the City and Corps for the lowland region of the River.

10. Restoration of basic natural stream features is a highly important first design step in the re-establishment of any of the native fish to the River (e.g., channel substrates, water quality/flow, channel configuration/complexity). Nevertheless, many of the factors affecting the current extirpation of most native fish in the River extend well beyond the riparian/stream ecotone. We suggest that riparian and riverine native fish restoration designs within the Project's widened reaches include specific measures (where practicable) for development of: a) water shaded by riparian woody vegetation; b) sediment and leaf-fall inputs to aquatic areas; c) channels with steep native-soil streambanks and in-channel woody debris; d) substantial channel diversity including riffle-run-pool-glide sequences, point bars; e) back channel refugia that utilizes upwelling groundwater (low temperature water of higher quality) and provides protected waters during larger flood flow events; f) appropriate channel substrates, including sand, gravel and cobble; g) potential for some channel movement/meander over time in widened channel areas; h) minimal areas of wide ponded or open water; i) riparian hiding cover for native fish (e.g., herbaceous plants and woody shrubs providing overhanging vegetation on stream banks for hiding cover); and j) target fish species passage and appropriate water temperatures and oxygenation levels, including shading of water surfaces through native tree landscaping on the south side of non-widened channel reaches, where practicable and appropriate. Periodic artificial substrate import (e.g., sand and gravel) into the upper end of the Study Area during the Project life will likely be necessary to maintain some important fluvial processes and conditions for native fish through the Study Area, considering the artificial fluvial conditions of the watershed and upstream channel. The Project should initiate an aquatic exotic species control program for the Study Area: complementary to the level of competitive advantages to native target species provided by the Project (e.g., through channel morphology, riparian cover, etc., as outlined above), periodic direct control of the problematic exotic aquatic species should be implemented in the Study Area, including mosquitofish, tilapia, common carp, green sunfish, fathead minnow, bullfrog, red swamp crayfish (*Procambarus clarkii*), and other species, as appropriate. The closer the River is restored to natural conditions, the greater the competitive advantage for native species over exotic species, with

concomitantly less control of exotic species needed. Considering the conditions of the watershed and the constraints of the Study Area, it is very likely that periodic control of some exotic aquatic species would be needed in perpetuity in order to maintain native fish and their habitats in the Study Area.

11. Feral mammal populations should be controlled in Project restoration areas, as practicable and appropriate. As part of restoration designs, competitive advantage over exotic mammals should be provided to native species to the extent practicable.

12. Project designs and objectives should include greater specificity regarding minimum levels of ecological functions and values to be created or enhanced. As currently written, the designs, objectives, and criteria are difficult to assess as to the basic or minimum ecological functions that would be gained. We suggest the use of appropriate umbrella species to help briefly outline/translate minimum ecological functions to be restored in meaningful ways, and for planning, design, and implementation purposes.

    As such, we suggest that the Project include restoration of specified minimum acreages of functional habitats in the long-term for typical restoration planning species for southern California riparian areas, including vireo, chat, and yellow warbler.[25] These species are excellent umbrella planning species that guide restoration for a variety of currently uncommon or extirpated native riparian wildlife species in the Project area by targeting the necessary components of relatively high-function riparian natural communities with a variety of vegetation structures, densities, and seral stages. For example, vireo, yellow warbler, and chat typically utilize different forms, configurations, and seral stages of riparian scrub/woodland/forests.

13. Any federally listed species occupying the Project footprint should be the subject of consultation under the Endangered Species Act, as appropriate. An unknown number of vireo likely occupy the Project direct activity footprint and would likely be positively affected by the beneficial aspects of the Project and temporarily adversely affected (through loss of habitat and function) by the action's construction activity of riparian vegetation clearing within seasonally occupied habitat in the River. As such, the action would likely warrant consultation. Appropriate surveys should be performed to determine occupation and usage areas (protocol surveys of the Study Area for vireo have apparently not been performed in the last decade; recent surveys of all appropriate vireo habitat should have been performed and reported during development of the 2013 EIS/EIR). Any listed species expected to be attracted to the Project area that would subsequently be potentially adversely affected by Project operations or maintenance

[25] The 2013 EIS/EIR provides a proposed target objective to restore a "minimum of one habitat node with a minimum width of 250 meters (820 feet) to support high frequencies" of vireo. In our opinion this and the other related objectives remain too vague to effectively evaluate the minimum that would be accomplished for target species from an ecological restoration perspective.

should also be monitored and addressed through consultation (for instance, potential translocation and establishment of Santa Ana sucker).[26]

14. A table describing the various acreages of all of the existing conditions in the Project alternatives' direct activity footprints should be developed. Only portions of this information were available in the 2013 EIS/EIR in any form. This table (and related map) should describe land uses, wetlands, and natural communities acreages (pre- and post-Project alternative), and should clearly demonstrate the specific biological impacts and gains that would be provided by the proposed Project alternatives, by acreage and natural community/land use type. In this way the Project can be evaluated for what resources would be lost and gained with implementation. We suggest that this be standard practice for most Corps projects.

The Service offers the following related suggestion that is much larger in scope than (and not specific to) the proposed Project:

With the goal of partially restoring greater ecological functions and nature access to the River, the Corps, City of Los Angeles, other local cities, County of Los Angeles, and resource agencies should continue to develop and implement restoration projects along the lengths of the River and its major tributaries. The focus of these projects should be on:

- Re-establishing some substantial areas of former floodplain with partial restoration of riparian natural communities;
- Channel widening and partial restoration of riverine natural communities and natural channel geomorphology and substrates;
- Partial restoration of fluvial and hydrological processes;
- Partial restoration and enhancement of target native species (e.g., arroyo chub) and their various habitats, including linkages and corridors for appropriate indicator/umbrella species (e.g., bobcat);
- Improving water quality, water temperatures, and native fish passage/linkages;
- Improving watershed processes related to contaminants and the natural "spreading out" of stream flow peaks during storm events; and
- Providing unstructured recreation opportunities for people in nature (e.g., see Louv 2011).

[26] In email attachment to us dated 25 November 2014, the Corp commented: "Section 5.5.1 of the Draft IFR outlines that Section 7 of the ESA requires consultation with USFWS if adverse impacts to listed species are anticipated. Under Section 10.1 of the Draft IFR, the Corps determined that the proposed project would have no effect on federally listed threatened or endangered species. The Corps will continue to review conditions to determine if endangered species may be present, and coordinate or consult with USFWS as necessary through the design and construction of each project phase/feature. Endangered species surveys will be conducted during the detailed design phase and in the nesting season(s) immediately prior to construction within any potentially suitable areas to confirm presence or absence of federally and state listed threatened and endangered species. The Corps will continue to coordinate with the USFWS throughout the design and construction period, and consult under ESA if necessary."

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Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX O
Cultural Resources

Part 1 – Programmatic Agreement

Part 2 – Consultation Letters

September 2015

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Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX O
Cultural Resources Part 1
Programmatic Agreement

September 2015

STATE OF CALIFORNIA – THE NATURAL RESOURCES AGENCY

EDMUND G. BROWN, JR., *Governor*

OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
1725 23rd Street, Suite 100
SACRAMENTO, CA 95816-7100
(916) 445-7000 Fax: (916) 445-7053
calshpo@parks.ca.gov
www.ohp.parks.ca.gov

July 3, 2015

In reply refer to: COE_2014_0912_001

Eduardo T. De Mesa
Acting Chief, Planning Division
Department of the Army
Los Angeles District, Army Corps of Engineers
915 Wilshire Boulevard, Suite 930
Los Angeles, CA 90017

RE: Executed Programmatic Agreement, Los Angeles River Ecosystem Restoration

Dear Mr. De Mesa:

Please find enclosed two copies of the executed *Programmatic Agreement Between the U.S Army Corps of Engineers and the California State Historic Preservation Officer Regarding the Los Angeles River Ecosystem Restoration Project, Los Angeles County, California* (PA).

Thank you for seeking my comments and considering historic properties as part of your project planning. If you have any questions, please contact Jessica Tudor, Associate Archaeologist, of my staff at 916-445-7016 or jessica.tudor@parks.ca.gov, or Kathleen Forrest, Historian, at 916-445-7022 or kathleen.forrest@parks.ca.gov.

Sincerely,

Jenan Saunders
Deputy State Historic Preservation Officer

PROGRAMMATIC AGREEMENT
BETWEEN
THE U.S. ARMY CORPS OF ENGINEERS
AND
THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER
REGARDING THE
LOS ANGELES RIVER ECOSYSTEM RESTORATION PROJECT
LOS ANGELES COUNTY, CALIFORNIA

WHEREAS, the U. S. Army Corps of Engineers, Los Angeles District (Corps), in cooperation with the City of Los Angeles (City), is currently conducting the Los Angeles River Ecosystem Restoration feasibility study to evaluate opportunities for ecosystem restoration within the Los Angeles River Basin under the Corps' General Investigation Program; and

WHEREAS, the feasibility study includes an Environmental Impact Statement/Environmental Impact Report prepared jointly by the Corps and City; and

WHEREAS, the Corps has identified Alternative 20 as the preferred alternative, and determined that Alternative 20 constitutes an undertaking as defined in the regulations implementing the National Historic Preservation Act (NHPA) found at 36 C.F.R. § 800.16(y) (hereinafter, the "Undertaking"); and

WHEREAS, the Undertaking involves the restoration of approximately 11 miles in and along the Los Angeles River (River) from Griffith Park to Downtown Los Angeles and generally includes excavation and planting of enclosed drainages, creation of side channels, installation of pre-seeded turf reinforcement mats, planting riparian habitat along channel overbanks, modifying trapezoidal channels, restructuring the confluence at Verdugo Wash, terracing and restructuring banks, widening the River into the historic floodplain at the Taylor Yard and Los Angeles Trailer and Container intermodal yard with softening of some beds and banks stabilized with bank protection, softening the bed and bank of the lower Arroyo Seco, and establishing riparian, wetland and marsh habitat. The Undertaking is described in greater detail in Appendix A, attached hereto and incorporated by reference; and

WHEREAS, the Corps has determined that the Undertaking has the potential to cause effects to properties that are either included on or are eligible for inclusion on the National Register of Historic Places (NRHP); and

WHEREAS, under the Corps' General Investigation Program, the Undertaking would be authorized by Congress at the end of the feasibility stage but prior to the development of project level designs or acquisition of project lands and this authorization would constitute an approval of the Undertaking under Section 106 of the NHPA (54 U.S.C. § 306108; hereafter, "Section 106"); and

WHEREAS, the Undertaking, if approved, may be constructed in phases that correspond to the eight (8) reaches described in Appendix A and consequently Section 106 responsibilities may be conducted and concluded at different times for each phase of the Undertaking; and

WHEREAS, the Corps has consulted with the California State Historic Preservation Officer (SHPO), pursuant to Section 106 and its implementing regulations at 36 C.F.R. § 800.14(b)(3) about this Undertaking, and the signatories have determined that a phased approach for compliance with Section 106 is reasonable for this Undertaking because not all of the potential effects of the Undertaking on historic properties within the Area of Potential Effects (APE) can be known prior to the approval of the Undertaking (36 C.F.R. § 800.14(b)(1)(ii)); and

WHEREAS, the Corps has notified and invited the Advisory Council on Historic Preservation (ACHP) per 36 C.F.R. § 800.6(a)(1)(i)(C) to consult on this Undertaking and this Programmatic Agreement (PA), and as per their letter to the Corps dated October 7, 2014, the ACHP has elected not to participate in this PA; and

WHEREAS, pursuant to the special relationship between the Federal government and Indian tribes, and Section 101(d)(6)(B) of the NHPA, 36 C.F.R. § 800.2(c)(2)(ii), the Corps is responsible for government-to-government consultation with federally-recognized Indian tribes; and

WHEREAS, no federally recognized Indian tribes have been identified as Consulting Parties (defined in Stipulation I.C hereof) to this PA; and

WHEREAS, the non-federally recognized Indian tribes of the Gabrieleno Band of Mission Indians, Fernandeño Tataviam Band of Mission Indians, Gabrielino Tongva Indians of California, Gabrielino –Tongva Tribe, Gabrielino Tongva Nation, Los Angeles City and County Native American Indian Commission, Ti'At Society/Inter-Tribal Council of Pima, and San Gabriel Band of Mission Indians (collectively, "Tribal Organizations") have been invited to consult on this Undertaking and this PA, have been afforded Consulting Party status pursuant to 36 C.F.R. § 800.3(f)(2), and have been invited to be Concurring Parties to this PA; and

WHEREAS, the Corps shall continue to consult with the Tribal Organizations throughout the implementation of this PA regarding effects to historic properties to which they may attach religious and cultural significance, notwithstanding any decision by these Tribal Organizations to decline to be a Concurring Party; and

WHEREAS, the City and California Department of Parks and Recreation (Department) have been invited to consult on this Undertaking and this PA, have been afforded Consulting Party status pursuant to 36 C.F.R. § 800.3(f)(1), and have been invited to be Concurring Parties to this PA; and

WHEREAS, the Corps will continue to consult with any Consulting Party throughout the implementation of this PA regarding effects to historic properties, notwithstanding any decision by a Consulting Party to decline to be Concurring Party.

NOW, THEREFORE, the Corps and the SHPO (individually a "Signatory" and collectively "Signatories") agree that the proposed Undertaking shall be implemented in accordance with the following Stipulations in order to take into account the effects of the Undertaking on historic properties and to satisfy the Corps' Section 106 responsibilities for all individual aspects of the Undertaking.

STIPULATIONS

To the extent of its legal authority and in cooperation with SHPO and other Consulting Parties to this PA, the Corps shall ensure that the following Stipulations are carried out, as indicated:

I. DEFINITIONS

A. The definitions provided in 36 C.F.R. § 800.16 are applicable throughout this PA.

B. ***Concurring Parties***. For purposes of this PA, the Concurring Parties are the City, Department, and Tribal Organizations that have decided to concur by signing this PA.

C. ***Consulting Parties***. Parties that have a consulting role in the Section 106 process. For this PA, Consulting Parties are the Signatories, Concurring Parties, Tribal Organizations and any additional individuals and organizations with a demonstrated interest in the Undertaking.

II. AREA OF POTENTIAL EFFECTS

A. The Corps has determined and documented the APE for the Undertaking in consultation with SHPO. A map of the APE is attached in Appendix B. Modifications of the APE will be made in accordance with Stipulations II.B, II.C, and XI.B.

B. The APE encompasses an area sufficient to accommodate all of the proposed components under consideration as of the date of execution of this PA. If it is determined in the future that the Undertaking may directly or indirectly affect historic properties located outside the currently defined APE, then the Corps, in coordination with SHPO and Concurring Parties, shall modify the APE using the following process:

i) The Corps shall notify the SHPO and Concurring Parties of any change in the APE with a map and description of the change. The SHPO and Concurring Parties shall then have fifteen (15) calendar days or as extended by the Signatories to comment on the modified APE.

ii) If the Signatories agree to the proposal, or if no comments are received within the allotted review time, then the Corps will notify all Concurring Parties of the modification to the APE. The Corps will keep copies of the description and the map on file for its administrative record and distribute copies of each to SHPO and Concurring Parties within thirty (30) days of the day upon which agreement to the modification was reached or as extended by the Signatories.

iii) If the Signatories cannot agree to a proposal for the modification of the APE, then they will resolve the dispute in accordance with Stipulation XII below.

C. Any Concurring Party to this PA may propose that the APE established herein be modified at any time. Any Concurring Party wishing to modify the APE must provide the Corps a map of the proposed modification and a reason for the modification. The Corps will then notify the SHPO and the Concurring Parties that it has received a request for modification within seven (7) days. If the Corps and SHPO agree with the proposal they will follow the steps outlined in Stipulation II.B.ii. hereof. If the SHPO and Corps cannot come to agreement on the modification they will resolve the dispute in accordance with Stipulation XII below.

D. Upon agreeing to a modification to the APE that alters the geographic area, the Corps shall follow the processes set forth in Stipulation III (below) to identify and evaluate historic properties in the revised APE, assess the effects of the Undertaking on any historic properties in the revised APE, and provide for resolution of any adverse effects to such properties, known or subsequently discovered, per Stipulations IV and V below.

III. IDENTIFICATION AND EVALUATION

A. Identification

i) During subsequent planning stages for construction of the Undertaking but prior to any ground disturbing activity, the Corps shall re-evaluate the APE to ensure that it includes all refined elements including access routes, staging areas, and visual and auditory effects to historic properties. If needed, the Corps shall follow the process in Stipulation II (above) to amend the APE of the Undertaking.

ii) The Corps shall seek to identify any additional interested persons pursuant to 36 C.F.R § 800.4(a)(3) and involve them, as appropriate, in consultation and coordination associated with the Undertaking.

iii) The Corps shall continue to consult with interested Tribal Organizations or tribal individuals that attach religious or cultural significance to potential historic properties within the APE and shall respond to any additional request to consult with Tribal Organizations or tribal individuals.

iv) If the Undertaking has the potential to affect historic properties on lands that have not been inventoried for historic properties in excess of five (5) years to date, the Corps will ensure that a cultural resources assessment is conducted within the APE. This will typically consist of a cultural resources inventory by a professional meeting the Secretary of the Interior's Professional Qualifications Standards in the appropriate discipline, as defined in Stipulation VIII. The cultural resource assessment is the Corps' "good faith" effort to identify historic properties in the APE and as such should take into account geomorphological processes that would influence site location and depositional rates; historical and ethnographic sources; and previous archaeological or historical work in the APE.

(1) Field inventory strategies shall be tailored to each of the eight (8) reaches of the Undertaking, as described in Appendix A of this PA. The level of effort and field methods used will be appropriate for the number and kinds of cultural resources known or expected to occur in such reaches, and should be suited to the area's environmental conditions.

(a) If the Corps proposes to deviate from a traditional pedestrian cultural resources survey of the entire APE in order to identify potential historic properties, then the Corps will notify SHPO in writing not less than thirty (30) days prior to commencing fieldwork of its intention to deviate from a standard survey. SHPO shall have 30 calendar days from the date of receipt to respond to this intention with comments. The Corps shall consider and incorporate the comments received by SHPO into their identification plan, or continue to consult in order to resolve any objections pursuant to Stipulation XII below.

(2) A data review/records search is required for all inventories. The record search shall include the General Land Office (GLO) cadastral survey plats, local historic maps, a records search request at the appropriate California Historical Resources Information Center (CHRIS), and any other relevant archive. Historic structures such as roads, flood control features and railroad grades must be identified. Furthermore, a review of previous inventories and sites recorded within a half mile of the APE will be completed.

(3) An attempt to relocate any previously recorded sites within the APE will be performed, and the respective site form shall be updated for those that are relocated if more than five (5) years has passed since the site form was prepared or updated or if the site has been visibly altered. If a site cannot be found, a discussion of the relocation efforts will be included in the cultural resources assessment.

(4) Linear resources (railroad, road, trail, ditch, etc) that appear on historic maps or are known from other archival data to be historic or which have associated features or dateable artifacts will be recorded on the appropriate California Department of Parks and Recreation (DPR) 523 series form or successor form. Linear resources that cannot be verified as historic either through archival research or associated artifacts will be treated as isolated road segments and will be recorded in tabular form and included in the cultural resources assessment.

(5) Non-linear sites that extend outside of the APE will be recorded in their entirety unless access to the land outside the APE is prohibited.

(a) In the event that access cannot be gained, the Corps shall notify SHPO in writing of its proposed means of evaluating the site. SHPO shall have thirty (30) calendar days from the date of receipt to respond to this proposal with comments. The Corps shall consider and incorporate the comments received by SHPO into its identification plan, or continue to consult in order to resolve any objections pursuant to Stipulation XII below.

(6) The Corps shall report the results of the identification efforts in a cultural resource assessment that is consistent with the Secretary of Interior's Standards and Guidelines for Identification (48 FR 44720-23). The Corps shall distribute any draft cultural resource assessments to all Consulting Parties for a thirty (30)-day review and comment period. A

Consulting Party may provide its comments directly to the SHPO with a copy to the Corps within the thirty (30) day comment period. The Corps will forward to the SHPO all comments received during the thirty (30) day comment period. The Corps will consider and attempt to resolve all comments when finalizing its cultural resource assessments. After the thirty (30) day comment period, the Corps will distribute its final cultural resources assessments to Consulting Parties concurrently with the evaluation in Stipulation II.B.i.

B. Evaluation

i) The Corps, in consultation with SHPO, shall evaluate resources identified through the cultural resource assessment pursuant to 36 C.F.R. § 800.4(c) and in accordance with the criteria set forth in 36 C.F.R. Part 60 early in the planning phase and prior to the initiation of activities that may affect historic properties. The SHPO shall have thirty (30) days from the date of receipt to review and comment on evaluations.

(1) The Corps shall seek the views and comments of Tribal Organizations and individual tribal members regarding the eligibility of cultural resources to which they may attach religious or cultural significance in order to accurately apply the NRHP eligibility criteria. The Corps will consider this information when making its determinations of eligibility.

(2) Resources that intersect with any part of the APE shall be incorporated into the APE as a whole and evaluated in their entirety. Linear resources shall only be recorded to the edge of the APE; however, evaluation of eligibility for linear resources will be based on the significance of the whole resource.

ii) Concurring and other Consulting Parties may provide comments directly to the SHPO with a copy to the Corps within the thirty (30) day comment period. The Corps will forward to the SHPO all comments received during the thirty (30) day comment period. If a Concurring Party objects to the determination, the Corps will notify the SHPO of the objection and will seek to resolve the objection pursuant to Stipulation XII.E below.

iii) If the Corps determines any of the National Register criteria are met and SHPO concurs, the property shall be considered eligible for the National Register for Section 106 purposes. If the Corps and SHPO do not agree, the Corps shall consult to resolve objections pursuant to Stipulation XII below, and if that is not successful they will obtain a determination from the Secretary of the Interior in accordance with 36 C.F.R. § 800.4(c)(2).

iv) If adverse effects to a historic property can and shall be avoided, the Corps may propose to assume eligibility of that resource.

IV. ASSESSMENT OF EFFECTS

A. The Corps shall make determinations of effect consistent with 36 C.F.R. § 800.4(d) and identify the type of adverse effect for each affected property in accordance with the criteria established in 36 C.F.R. § 800.5(a)(1) and (2)(i)-(vii) early in the design phase and prior to the initiation of activities that may affect historic properties within the APE.

B. The Corps shall issue its assessment of effects, and make the assessment available to the SHPO and the other Consulting Parties for a thirty (30) day review and comment period, from the date of receipt.

C. The Corps will forward to the SHPO all comments received during the thirty (30) day comment period regarding its assessment of effects.

D. The Corps will consider all comments when making its findings of effect. The Corps shall attempt to make its findings to the extent possible in a single consolidated decision and may submit findings of effect to the SHPO concurrently with its determinations of eligibility.

E. After the comment period, the Corps may request SHPO concurrence on its findings of effect.

i) SHPO will have thirty (30) days from the date of receipt in which to comment.

ii) Should SHPO not comment, the Corps may document that SHPO has elected not to comment and may proceed in accordance with its proposed finding.

iii) Should SHPO disagree with Corps' finding, they shall resolve the dispute in accordance with Stipulation XII below.

F. Where a Concurring Party or other Consulting Party objects to the Corps' findings, the Corps shall consult with the objecting party and the SHPO regarding the nature of the objection and reconsider its findings.

i) If the objection is not resolved, the Corps shall further consult with the SHPO and follow the processes provided at Stipulation XII.E below.

G. The Corps may prepare the analysis required above in phases that correspond to the proposed sequence of construction for the Undertaking, provided that analyses are ultimately prepared for the entirety of the APE.

H. If adverse effects to such cultural resources will not be avoided, the Corps must resolve the adverse effect through the development and implementation of a Historic Properties Treatment Plan (HPTP).

V. TREATMENT AND MANAGEMENT OF HISTORIC PROPERTIES

When historic properties cannot be avoided, the Corps will ensure that one or more HPTPs are prepared, executed, and field work associated with the HPTPs completed prior to the issuance of a notice to proceed for construction. All finalized HPTPs will be included in Appendix C hereof.

A. The Corps may authorize the phased implementation of the HPTPs, or if appropriate, the development of HPTPs for individual historic properties, or HPTPs that are related to specific issues or geography.

B. In developing the HPTPs, treatment efforts will be tailored to the types and degree of anticipated project effects. Treatments shall address the loss of location, design, setting, materials, feeling, association and workmanship. Example treatments may include, but are not limited to: public outreach and interpretation, exhibits, publications, educational materials, oral histories, and off-site investigations.

C. Where an HPTP specifically addresses treatment for adverse effects to historic properties to which Tribal Organizations attach religious or cultural significance, the Corps shall submit the HPTP to the Tribal Organization(s) and seek their views and comments through consultation, regardless of the absence of a Tribal Organization as a Concurring Party to this PA. The Corps shall consult with involved Tribal Organization(s) on the distribution to other Consulting Parties of any HPTPs that specifically addresses treatment for adverse effects to historic properties to which the Tribal Organizations attach religious or cultural significance.

D. The Corps shall distribute the draft HPTPs to the SHPO and other Consulting Parties for a thirty (30)-day review period or as extended by the Signatories. The Corps will consider timely comments when finalizing the HPTPs. A Consulting Party may provide its comments directly to the SHPO with a copy to the Corps within thirty (30) days of receipt, or as extended by the Signatories, of the draft HPTP. The Corps will forward to the SHPO all comments regarding the HPTPs received during the comment period.

E. The Corps shall have sixty (60) days to address comments received from the Consulting Parties and shall revise the HPTPs as appropriate. The Corps shall note proposed changes that it does not believe should be included in the HPTPs and shall discuss these changes in a written reply to the Consulting Parties.

F. The Corps shall resubmit the revised HPTPs to the SHPO and other Consulting Parties for a fifteen (15)-day review period, or as extended by the Signatories. The Corps will consider any comments sent within fifteen (15) days of receipt in finalizing the HPTPs.

G. The Corps will submit the finalized HPTPs to the SHPO for concurrence. If the SHPO does not concur, the Corps will consult directly with the SHPO to address issues or concerns with the HPTPs. When the Signatories agree on the final HPTPs, a copy of the final HPTPs will be submitted to the other Consulting Parties. If the Signatories cannot come to agreement, they will resolve the dispute in accordance with Stipulation XII below.

H. Modifications of HPTPs will be made in accordance with this paragraph and Stipulation XI.B. If it is determined an HPTP should be modified, the Corps, in coordination with SHPO and Concurring Parties, shall use the following process:

i) The Corps shall notify the SHPO and Concurring Parties of any proposed change in the HPTP with a description of the proposed change. The SHPO and Concurring Parties shall

then have fifteen (15) calendar days from receipt, or as extended by the Signatories, to comment on the modified HPTP.

ii) If the Signatories agree to the proposal, or if no comments are received within the allotted review time, then the Corps will notify all Concurring Parties of the modification to the HPTP. The Corps will keep copies of the description on file for its administrative record and distribute copies of each to SHPO and Concurring Parties within thirty (30) days of the day upon which agreement to the modification was reached or as extended by the Signatories.

iii) If the Signatories cannot agree to a proposal for the modification of the HPTP, then they will resolve the dispute in accordance with Stipulation XII below.

VI. DISCOVERIES AND UNANTICIPATED EFFECTS

A. The Corps, in consultation with the Consulting Parties, will seek to develop a monitoring and discovery plan for the Undertaking pursuant to 36 C.F.R. § 800.13(a)(1). A finalized monitoring and discovery plan will be included as part of the HPTPs found in Appendix C hereof.

B. If the Corps determines that implementation of the Undertaking will affect a previously unidentified property that may be eligible for the NRHP, or affect a known historic property in an unanticipated manner, and a monitoring and discovery plan has not been finalized, the Corps will address the discovery or unanticipated effect by following the procedures at 36 C.F.R. § 800.13(b)(3), where a process has not been yet been agreed to pursuant to 36 C.F.R. § 800.13(a)(1).

C. The Corps at its discretion may assume any post-review discovery to be eligible for inclusion in the NRHP and treat it accordingly. The Corps' compliance with this Stipulation shall satisfy the requirements of 36 C.F.R. § 800.13(a)(1).

VII. TREATMENT OF HUMAN REMAINS OF NATIVE AMERICAN ORIGIN AND RELATED CULTURAL ITEMS

To the extent not inconsistent with Federal law, the Corps shall ensure that Native American burials and related cultural items are treated in accordance with the applicable requirements of the California Public Resources Code at Sections 5097.98 and 5097.991, and of the California Health and Human Safety Code at Section 7050.5(c).

VIII. STANDARDS AND QUALIFICATIONS

A. PROFESSIONAL QUALIFICATIONS. All actions prescribed by this PA that involve the identification, evaluation, analysis, recordation, treatment, monitoring, and disposition of historic properties and that involve the reporting and documentation of such actions in the form of reports, forms or other records, shall be carried out by or under the direct supervision of a person or persons meeting, at a minimum, the Secretary of the Interior's Professional Qualifications Standards (PQS), for the appropriate discipline (48 Fed. Reg. 44739 dated September 29, 1983). However, nothing in this Stipulation may be interpreted to preclude any party qualified under the terms of this Section from using the services of persons who do not

meet the PQS, so long as the work of such persons is supervised by someone who meets the PQS. Tribal consultants who are available to perform monitoring duties are assigned and approved of by each Tribe.

B. DOCUMENTATION STANDARDS. Reporting on and documenting the actions cited in this PA shall conform to every reasonable extent with the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (48 Fed Reg. 44716-40 dated September 29, 1983), as well as, the Archaeological Resource Management Reports (ARMR): Recommended Contents and Format (ARMR Guidelines) for the Preparation and Review of Archaeological Reports.

C. CURATION STANDARDS. The Corps shall ensure that cultural materials and records resulting from excavations or surface collections on non-federal land are curated in accordance with the Secretary of the Interior's Standards for Archaeological Documentation. The permanent disposition of Native American human remains and associated items shall be addressed in consultation with the most likely descendent(s) designated by California's Native American Heritage Commission pursuant to California Public Resources Code section 5097.98.

IX. REPORTING REQUIREMENTS

A. Within twelve (12) months after the Corps has determined that all fieldwork required by Stipulations III through V has been completed, the Corps will ensure preparation and concurrent distribution to the Consulting Parties of a draft report that documents the results of implementing the requirements of each Stipulation. The Consulting Parties will be afforded thirty (30) days, or as extended by the Signatories, after receipt to review and to submit any written comments to the Corps. The Corps will consider all timely comments when making revisions to the draft report. A revised draft will be provided for review within fifteen (15) days of receipt or as extended by the Signatories. The Corps will consider all timely comments in making final changes to the report. Thereafter, the Corps may issue the reports in final form and distribute these documents in accordance with Stipulation IX.B. hereof.

B. Unless otherwise requested, the Corps will distribute one copy of final reports documenting the results of implementing the requirements of Stipulations III through V to each Consulting Party, and to the appropriate CHRIS Regional Information Center.

C. The Corps shall ensure that any draft document that communicates, in lay terms, the results of implementing Stipulations III through V to members of the interested public is distributed for review and comment concurrently with and in the same manner as that prescribed for the draft technical report prescribed by Stipulation IX.A. If the draft document prescribed is a publication, such as a report or brochure, the Corps shall distribute the publication upon completion to the Consulting Parties and to other entities that said parties may deem appropriate. Archaeological and sensitive Native American site locations and maps and the nature of sensitive historic properties shall not be included in copies of reports for general distribution.

X. IMPLEMENTATION OF THE UNDERTAKING

The Corps may authorize construction activities to proceed in specific geographic areas of the APE where there are no historic properties; where there will be no adverse effect to historic properties; or where an HPTP has been approved, initiated, and fieldwork completed.

XI. AMENDMENTS TO THE PROGRAMMATIC AGREEMENT

A. This PA may be amended only upon written agreement of the Signatories.

i) Upon receipt of a written request to amend this PA, the Corps will immediately notify the other Consulting Parties and initiate a thirty (30) day period from the date of receipt to consult on the proposed amendment, or as extended by the Signatories, whereupon all Signatories and Consulting Parties shall consult to consider such amendments.

ii) If agreement to the amendment cannot be reached by the Signatories within the thirty (30) day period, or as extended by the Signatories, resolution of the issue may proceed by following the dispute resolution process in Stipulation XII below.

B. Each Appendix to this PA may be individually revised or updated through consultation and agreement in writing of the Signatories without requiring amendment of the PA, unless the Signatories through such consultation decide otherwise. Upon revising any Appendix, the Corps shall append any revised document to this PA and share the final revised document with SHPO and other Consulting Parties.

XII. DISPUTE RESOLUTION

A. Should SHPO object in writing at any time to the manner in which the terms of this PA are implemented, the Corps will consult with SHPO to resolve the objection for a period of thirty (30) days upon receipt of the notification.

B. If the objection is resolved and agreed to by the Signatories within the thirty (30) day period, the Corps may authorize the disputed action to proceed in accordance with the terms of such resolution.

C. If the objection cannot be resolved through such consultation, the Corps will forward all documentation relevant to the objection to the ACHP and follow the process outlined at 36 C.F.R. § 800.7(c). Any comments provided by the ACHP within forty-five (45) days after its receipt of all relevant documentation will be taken into account by the Corps in reaching a final decision regarding the objection. The Corps will notify SHPO and Concurring Parties in writing of its final decision within fourteen (14) days after it is rendered or as extended by the Signatories.

D. The Corps' responsibility to carry out all other actions under this PA that are not the subject of the objection will remain unchanged.

E. At any time during implementation of the terms of this PA, should an objection pertaining to the PA be raised by a Concurring Party or a member of the interested public, the

Corps shall notify the SHPO and other Concurring Parties within forty-eight (48) hours, consult with the SHPO about the objection, and take the objection into account. The other Consulting Parties may comment on the objection to the Corps. The Corps shall consult with the objecting party/parties for no more than thirty (30) days following receipt of the objection. Within fourteen (14) days following closure of consultation, the Corps will render a final decision regarding the objection and proceed accordingly after notifying all Consulting Parties of its decision in writing. In reaching its final decision, the Corps will take into account all comments from the Consulting Parties regarding the objection.

XIII. CONFIDENTIALITY

All parties to this PA acknowledge that information about historic properties, prospective historic properties, or properties considered historic for purposes of this PA are or may be subject to the provisions of NHPA Section 304, 36 C.F.R. § 800.11(c), relating to the disclosure of sensitive information, and having so acknowledged, will ensure that all actions and documentation prescribed by this PA are, where necessary, consistent with the requirements of NHPA Section 304, 36 C.F.R. § 800.11(c).

XIV. TERMINATION

A. If any Signatory to this PA determines that its terms will not or cannot be carried out, that party shall immediately notify the other Signatory in writing and consult with the other Signatory to attempt to develop an amendment per Stipulation XI above. If within sixty (60) days of receipt of the notification, or as extended by the Signatories, an amendment cannot be reached, a Signatory may terminate the PA upon written notification to the other Signatory.

B. If the PA is terminated, and prior to work continuing on the Undertaking, the Corps shall continue to follow the process provided at 36 C.F.R. § 800.4 – 6 until (a) a new agreement is executed pursuant to 36 C.F.R. § 800.6 or (b) the agency requests, takes into account, and responds to the comments of the ACHP under 36 C.F.R. § 800.7. The Corps shall notify SHPO as to the course of action it will pursue.

XV. DURATION OF THIS PROGRAMMATIC AGREEMENT

A. Unless amended or modified pursuant to Stipulation XI.A, this PA shall remain in force until whichever of these events occurs first: 1) ten (10) years after the effective date; or 2) the PA is terminated pursuant to Stipulation XIV.

B. Sixty (60) days prior to expiration of the PA, the Signatories will consult to determine whether the terms of the PA have been met, whether revisions are needed, and whether the duration of the PA should be extended.

XVI. EFFECTIVE DATE OF THIS PROGRAMMATIC AGREEMENT AND AMENDMENTS

This PA and any amendments shall take effect on the date that it has been fully executed by the Signatories.

[Remainder Left Intentionally Blank]

EXECUTION of this PA by the Corps and SHPO, and its transmittal to the ACHP, and subsequent implementation of its terms evidence that the Corps has afforded the ACHP an opportunity to comment on the Undertaking and its effects on historic properties, that the Corps has taken into account the effects of the Undertaking on historic properties, and that the Corps has satisfied its responsibilities under Section 106 of the NHPA and applicable implementing regulations for all aspects of the Undertaking.

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT

BY: _____ DATE: 7/2/15

Kimberly M. Colloton, PMP
Colonel, U.S. Army
Commander and District Engineer

CALIFORNIA STATE HISTORIC PRESERVATION OFFICE

BY: _____ DATE: 7/2/15

Jenan Saunders
Deputy State Historic Preservation Officer

CONCURRING PARTIES

CITY OF LOS ANGELES, a Municipal Corporation

BY: _____ DATE: _____
NAME:
TITLE:

CALIFORNIA DEPARTMENT OF PARKS AND RECREATION

BY: _____ DATE: _____
NAME:
TITLE:

GABRIELENO BAND OF MISSION INDIANS

BY:_____ DATE:_____
NAME:
TITLE:

FERNANDEÑO TATAVIAM BAND OF MISSION INDIANS

BY:_____ DATE:_____
NAME:
TITLE:

GABRIELINO TONGVA INDIANS OF CALIFORNIA

BY:_____ DATE:_____
NAME:
TITLE:

GABRIELINO- TONGVA TRIBE

BY:_____ DATE:_____
NAME:
TITLE:

GABRIELINO TONGVA NATION

BY:_____ DATE:_____
NAME:
TITLE:

LOS ANGELES CITY AND COUNTY NATTIVE AMERICA INDIAN COMMISSION

BY:_____ DATE:_____
NAME:
TITLE:

TI'AT SOCIETY/ INTER-TRIBAL COUNCIL OF PIMA

BY:_____ DATE:_____
NAME:
TITLE:

SAN GABRIEL BAND OF MISSION INDIANS

BY:_____ DATE:_____
NAME:
TITLE:

APPENDIX A: PROJECT DESCRIPTION FOR ALTERNATIVE 20

Alternative 20 Project Description

The plan consists of the following major restoration features within the eight reaches of the study area, in addition to removal of invasive vegetation throughout the project area:

- Reach 1 (Pollywog Park to Bette Davis Park, 1.5 miles) – Restoration of riparian habitat corridors along overbanks on both sides of the river, along the Burbank Western Channel tributary, and in the Pollywog Park area of Griffith Park.
- Reach 2 (Bette Davis Park to Ferraro Fields, 0.75 miles) – Restoration of riparian and soft bottom habitat through establishment of riparian corridors along the left and right overbanks of the river and modification of the right river bank from trapezoidal to a vertical wall with overhanging vines, increasing the channel bottom width by 80 feet.
- Reach 3 (Ferraro Fields to Upstream Glendale Narrows, 1 mile) – Restoration of riparian and wetland habitat in and along the channel, including restoration of wetland and riparian habitat at the confluence of the river and the Verdugo Wash tributary, where concrete in the tributary channel's bottom and sides would be removed and the confluence area expanded; restoration of a riparian corridor on the right river overbank; daylighting of a small stream currently encased in a culvert; and creation of a side channel around Ferraro Fields that reenters the river through the daylighted stream.
- Reach 4 (Upstream Glendale Narrows to Los Feliz, 1.75 miles) – Restoration of riparian and wetland habitat through establishment of a riparian corridor on the left river overbank, creation of a side channel diverting river flows through the Griffith Park (Harding) Golf Course on the right side of the river, lowering of the Los Feliz Golf Course on the left side of the river to allow seasonal flooding through existing culverts, and daylighting of eight streams currently encased in culverts.
- Reach 5 (Los Feliz to Bowtie Parcel, 1.55 miles) – Restoration of riparian and wetland habitat through modification of the right river bank from a trapezoidal bank to a vertical wall with overhanging vines, widening the soft-bottom riverbed by over 100 feet; terracing of the left river bank to support riparian planting; widening of the left bank at the downstream end of the reach; and daylighting of one stream currently confined in a culvert.
- Reach 6 (Bowtie Parcel to Downstream Glendale Narrows/Arroyo Seco, 2.34 miles) – Restoration of riparian corridor and freshwater marsh through creation of a backwater wetland in the channel at the upstream end of the reach, terracing the left river bank to transition to a softened channel bank for widening of the channel by 300 feet at Taylor Yard, and modifying the right bank to support implanted vegetation.
- Reach 7 (Downstream Glendale Narrows/Arroyo Seco to Main Street, 1 mile) – Restoration of riparian and wetland habitat including restoration of 0.5 miles of the Arroyo Seco tributary upstream from the river, softening its banks and bed and establishing a backwater wetland at its confluence with the river; restoration of wetlands at the Los Angeles State Historic Park with a connection to the river through terracing and planting of the right river bank, accommodated with trestling of a railroad line; and daylighting three streams currently encased in culverts.
- Reach 8 (Main Street to 1st Street, 1 mile) – Restoration of riparian and wetland habitat, including removal of the concrete lining and naturalization of approximately 0.75 miles of the river to support open channel, and freshwater marsh; reconnection of the river to the historic floodplain at the LATC site, accommodated with trestling of a railroad line, with restoration of riparian and wetland habitat including a meandering historic wash and small channels; and terracing of river banks upstream and downstream of the LATC site.

APPENDIX B: MAP OF THE AREA OF POTENTIAL EFFECTS

Equestrian Center

Ferraro Soccer Field

Forest Lawn Memorial

Golf Courses

Griffith Park

Forest Lawn Memorial

Rio de Los Angeles State Park

Silver Lake

Elysian Park

Downtown Los Angeles

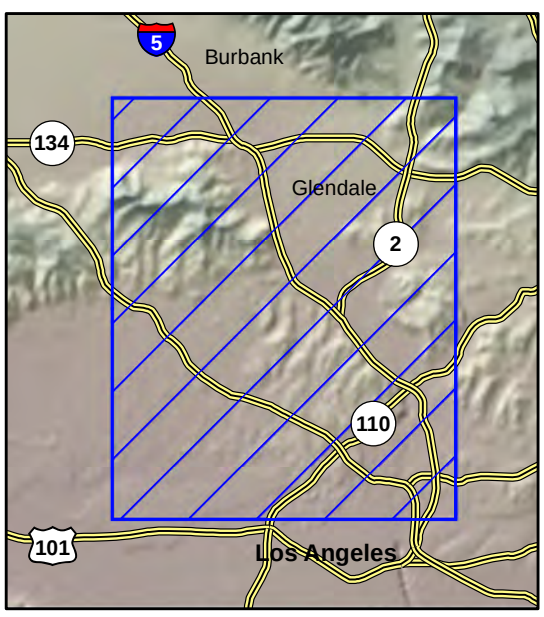
5

134

2

101

110



Legend

Reach

- 1 - Pollywog / Headworks to Betty Davis Park
- 2 - Betty Davis Park to Ferraro Fields
- 3 - Ferraro Fields to Brazil St
- 4 - Brazil St to Los Feliz Blvd
- 5 - Los Feliz to S-2
- 6 - S-2 to I-5
- 7 - I-5 to Main
- 8 - Main to First

Cultural Feature

- Park
- Ferraro Field
- Golf Courses
- Equestrian Center

1 in = 3,500 ft

0 1,750 3,500 7,000 Feet

N

LOS ANGELES RIVER

AREAS OF POTENTIAL EFFECT

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

APPENDIX C: HISTORIC PROPERTIES TREATMENT PLAN(S)

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX O
Cultural Resources Part 2
Consultation Letters

April 2015

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
915 Wilshire Boulevard, Suite 930
LOS ANGELES, CALIFORNIA 90017-3401

REPLY TO
ATTENTION OF

September 5, 2014

Office of the Chief
Planning Division

Carol Roland-Nawi, PhD
State Historic Preservation Officer
Office of Historic Preservation
1725 23rd Street, Suite 100
Sacramento, California 95816

Dear Dr. Roland-Nawi:

The U.S. Army Corps of Engineers (Corps), Los Angeles District, is preparing environmental and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project (LARER), along and within the Los Angeles River, Los Angeles County, California. The LARER is an ecosystem restoration project that would create ground and visual disturbance along the River near downtown Los Angeles (enclosure 1).

Prior to publishing the Draft Integrated Feasibility Report (IFR) for the proposed project, we discussed the project with Ms. Susan Stratton and Mr. Brendon Greenaway of your office in June 2013. Ms. Stratton indicated that your office might review the Draft IFR (which also served as the Environmental Impact Statement/Environmental Impact Report), although we understand that review is not always possible because of workload constraints. We did not receive any comments on the Draft IFR, which was available for public review from September 13, 2013 through November 18, 2013. However, we will proceed to obtain your comments and guidance as we move through the Section 106 process in accordance with 36 CFR 800. A CD containing the Draft IFR is enclosed for reference (enclosure 2).

The Draft IFR identified Alternative 13 as the Tentatively Selected Plan. Subsequently, the Corps and the non-federal sponsor (City of Los Angeles) have identified a more comprehensive restoration plan, Alternative 20, as the Locally Preferred Plan. Alternative 20 will be the Recommended Plan in the Final IFR.

The proposed project is to restore approximately 11 miles of the Los Angeles River from Griffith Park to downtown Los Angeles by reestablishing riparian strand, freshwater marsh, and aquatic habitat communities while maintaining existing levels of flood risk management. A secondary purpose is to provide recreational opportunities consistent with the restored ecosystem within this 11-mile reach of the river. A more detailed project description is included as enclosure 6.

Based on the current proposed project description, we have delineated an Area of Potential Effects (APE). The APE includes both direct and indirect effects that may occur from implementation of the undertaking. The enclosed APE map designates the portions of the project that would experience direct ground-disturbing activities. In addition, the APE includes a reasonable and good-faith effort to capture the potential for visual, auditory, and other non-direct effects. Ground disturbance will occur mostly in areas that were previously disturbed by construction of the original concrete lined flood control channel. There are virtually no undisturbed ground surfaces in this highly urbanized environment through the

entire reach of the project. Some undisturbed and intact subsurface deposits are still present. As construction would disturb these areas we would include the possibility for encountering buried cultural remains within the vertical APE. The vertical APE varies greatly from a few inches to several feet. Horizontally we are proposing a one-eighth mile buffer around each depicted feature for noise and visual impacts. For clarity we have depicted the APE (without the one-eighth mile buffer) on both the USGS topographic map, and an aerial view (enclosures 4 and 5). Each measure and project feature is detailed in the legend.

The Corps requested a Sacred Lands File search and a Native American contact list from the Native American Heritage Commission (NAHC) dated July 16, 2012. The NAHC responded by indicating that there are cultural resources within the general area of the proposed APE. (Enclosure 4). In addition to this information, we corresponded with the Gabrielino/Tongva prior to publishing the Draft IFR, and they were also sent copies of the document to obtain their concerns during the public review period. No responses were received. We will send this proposed APE map to the list of organizations and individuals provided by the NAHC for their review and comment. Communication with the Gabrielino/Tongva Tribal contacts will continue throughout the life of the project.

By this letter the Corps requests your comments on the appropriateness of the APE for the proposed undertaking (pursuant to §800.4[a][1]).

Please review the enclosed information, and respond within thirty days of your receipt of this letter. If you have any further questions on this project please call Mr. Stephen Dibble, Senior Archeologist, at (213) 452-3849. He may also be reached by e-mail at David.S.Dibble@usace.army.mil.

Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

N
W
E
S
CALIFORNIA
Sacramento
San Francisco
PACIFIC OCEAN
Los Angeles
Study Area
San Diego
Data Source: ESRI 2008, Census 2012
Miles
0
50
100

ENCLOSURE #1

Enclosure #3

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

This alternative provides the most extensive restoration and includes measures in all eight reaches with channel widening at Verdugo Wash, Arroyo Seco, Cornfield/LA State Historic Park, and Piggyback Yard. Features of Alterative 20 are similar to those included in Alternative 13, but are more extensive in scope. Sub-measures under this alternative would be implemented in all reaches (1-8) throughout the study area and include:

- Riparian planting of habitat corridors (reaches 1,2,3,4,5,6,7,8)
- Bioengineer channel walls (reach 5)
- Trapezoidal to vertical walls (reaches 2,5)
- Create/rebuild channel geomorphology (reaches 3,4,5,7,8)
- Divert flow into channels (reaches 3,4,7,8)
- Widen channel (reach 3,8)
- Widen tributaries (reach 3)
- Expose/daylight stormdrain outlets (reaches 4,5,7)
- Channel bed deepening (reach 5)
- Terrace banks (reaches 5,6,7, 8)
- Elevate railroad (reaches 7,8)

Reach 1 – Reach 1 for all alternatives in the final array would implement the habitat corridor with riparian planting on the overbanks. This would restore approximately 60 acres of riparian habitat corridors along the overbanks of both sides of the river. 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 Pollywog Park, the bank between Headworks and the River with a connection under SR-134 to Headworks, the open area directly downstream of Headworks with a connection under Forest Lawn Drive on the same side of SR-134 with Headworks, and on the left bank of Burbank Western Channel (tributary from the north/west).

This 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, creating a hydrologic connection. Soil amendments would be required. 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. There would be no 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* –** Like Alternatives 10, 13, and 16, implementation of the habitat corridors/riparian planting measure would result in restoration of approximately 26 acres of riparian habitat corridors along the overbanks of both sides of the river as described for Reach 1. 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. This reach is soft bottom and would include invasives management in the existing vegetation in the channel and on the overbank. Unlike the other alternatives, Alternative 20 would add additional modification in Reach 2. The right bank would be modified from trapezoidal to a vertical bank creating 80 feet of additional soft bottom width in the channel with overhanging vines.

Reach 3 – In this reach a side channel would divert water from the river into a side channel flowing on the west side of Ferraro Fields and would daylight a stream currently confined in a large culvert just downstream of Ferraro Fields on the right bank in the Zoo Drive area. The side channel would support a riparian fringe, and open water and freshwater marsh will be located in the daylighted area outside of the mainstem of the River channel. Two additional smaller streams would be daylighted on the left bank. These would include a riparian fringe with freshwater marsh at the confluence. Riparian areas are located on the right or west bank along Zoo Drive, on the River's edge of Ferraro Fields, and between the daylighted streams on the left or east bank. There would be no modifications to the channel itself. In the Verdugo Wash confluence, the channel mouth will be widened and the south slope 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. Levee protection would be tied-in to the bank, and other levee protection will remain. Levee vegetation policy will be followed. Modifications at the Verdugo Wash confluence are not expected to impact the tracks along San Fernando Road under the 134 Freeway or affect ongoing railroad operations. Modifications at the confluence may affect grade separation proposals for Doran Street. Details for the confluence area will be determined during the detailed design phase of the study. Acquisition of several parcels at the confluence area is anticipated if this feature is included.

***Reach 4* –** Restoration in Reach 4 (via implementation of measures to daylight and restore stream geomorphology and habitat in seven areas, a side channel through both the Griffith Park Golf Course on the west and the Los Feliz Golf Course on the east bank, and a riparian habitat corridor) would include approximately 30 acres of restored riparian and wetland habitat. This would be accomplished through a diversion of river flow into a side channel up to 10 feet deep with a riparian fringe through Griffith Park on the right bank, lining the left river bank with a riparian corridor within levee regulation requirements, and daylighting approximately seven small streams.

The riparian corridor measure would involve planting a riparian strip of mugwort and scarlet monkeyflower with a buffer of 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, creating a hydrologic connection. Soil amendments would be required. Establishment and drought management for this vegetation would utilize irrigation, which would be either through flood irrigation (simulating a natural riparian regime) or drip irrigation, dependent upon the availability of water. This would be implemented as continuously as possible within the requirements of levee regulations. There would be no channel modifications within this reach.

The storm drains 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. 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.

Reach 5 – 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 river bed by over 100 feet. The top of the bank would be notched and planted with overhanging vines. The left bank would be modified with terraces planted with herbaceous vegetation and necessary erosion measures, which would consist of concrete-lined beds. The inland bank would be planted with riparian 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. All of these measures would comply with levee vegetation regulations.

Reach 6 – Reach 6 in this alternative includes riparian corridors and widening of the soft bottom river bed by over 300 feet with additional slope back to the overbank elevation along the reach length approximately 1,000 feet. At the upstream end of the reach, a back water wetland would be developed on a setback bench and there would be a small terraced area at the downstream end of the Bowtie parcel. Freshwater marsh would dominate the new river bed. The banks of the river would be restructured to support overhanging vines and other vegetation. Restructuring the banks may impact the existing roadway used for maintenance access along the east bank of the River. A new road would be provided for SCRRA maintenance crews to allow access to the facilities.

Reach 7 – In Reach 7, the Arroyo Seco tributary would be restored with riparian habitat. This ephemeral stream would have the banks and bed softened for approximately one half mile upstream and would be stabilized with erosion control elements to maintain the existing protection. At the confluence on the upstream edge of the Los Angeles River, a backwater riparian wetland and marsh would be established. Within the River channel itself, the banks would be restructured to support vegetation on the banks. Downstream, freshwater marsh would be restored and connected under a railroad trestle with the right bank of the river channel terraced.

Reach 8 – Reach 8 would be modified with terracing on the right bank upstream of Piggyback Yard and on the left bank downstream of Piggyback Yard. This terracing would be planted with riparian vegetation. The channel would be changed from concrete to soft bottom to support freshwater marsh, and the reach would be widened. The marsh would extend into the Piggyback Yard 500 feet, with riparian area extending another 1,000 feet into Piggyback Yard, gradually sloping up to existing bank elevations. The historical wash would be restored through the property with a riparian fringe as well as other side channels, and river flows would be diverted out of the River into Piggyback Yard creating a large wetland area. A railroad trestle would be included with this alternative to allow the described restoration to occur and allowing for the connection of the river channel and the adjacent restored areas

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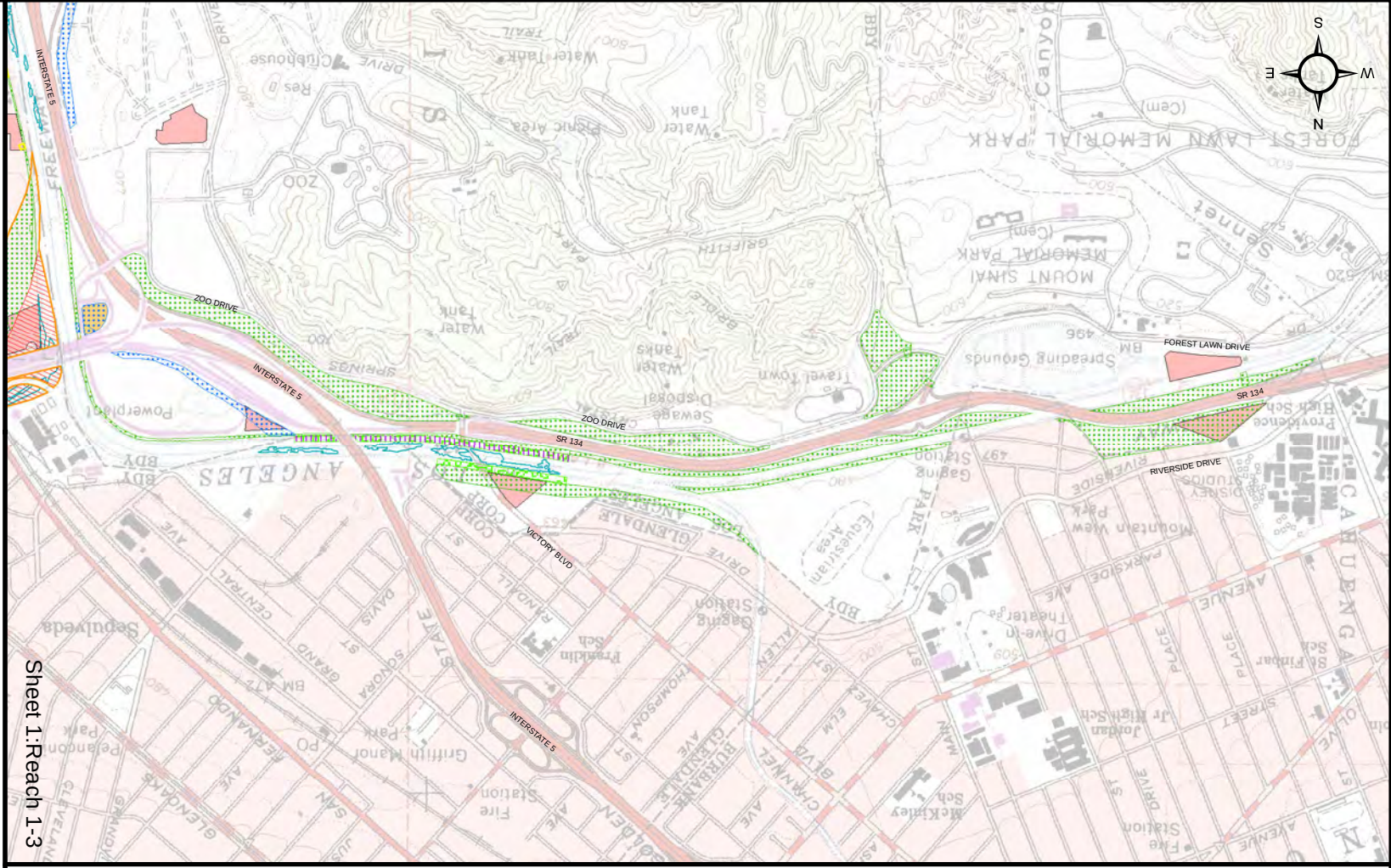
Data Source: USACE, 2011
City of Los Angeles, 2011
Aerial Source: LARIC 2008

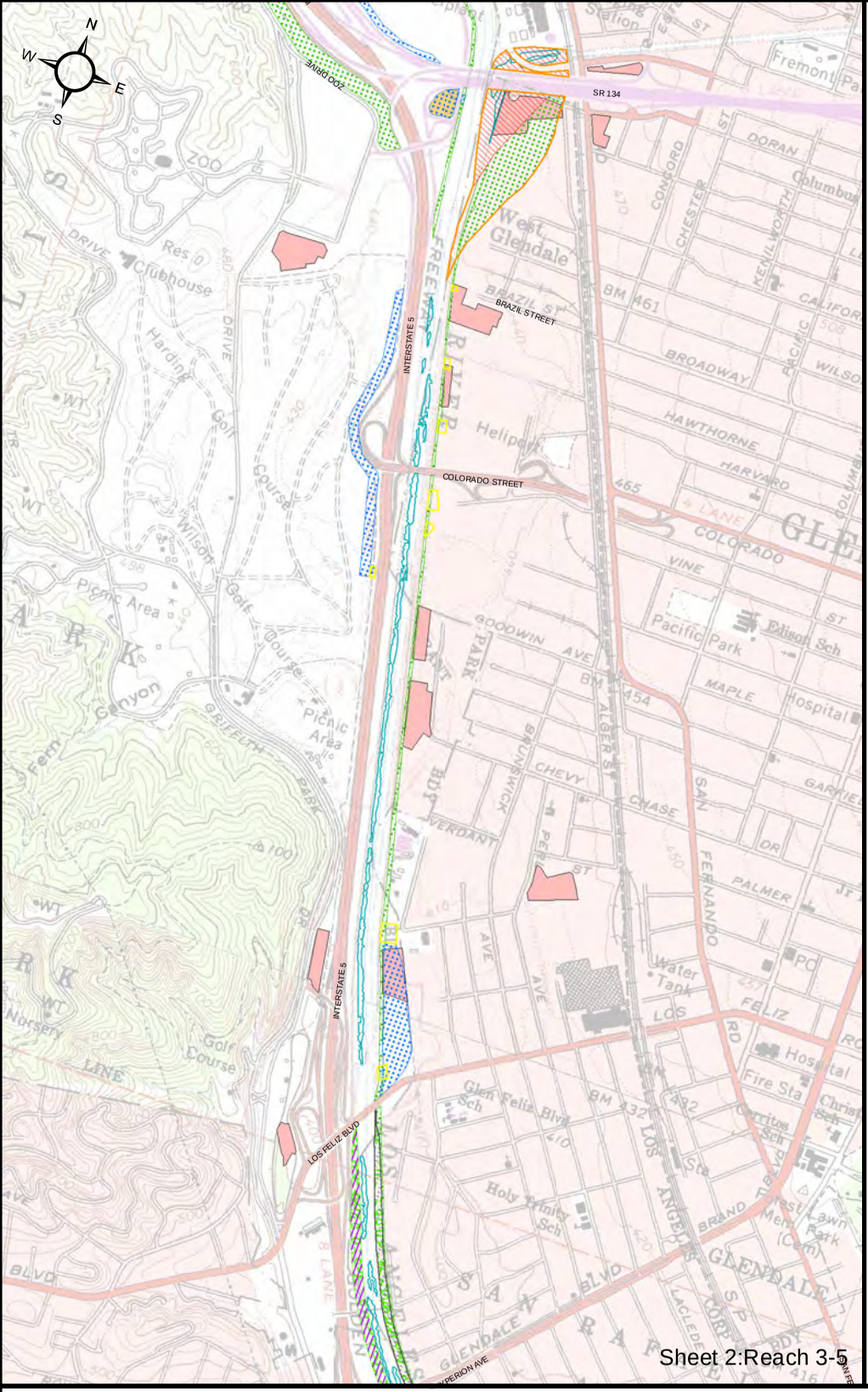
Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)



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



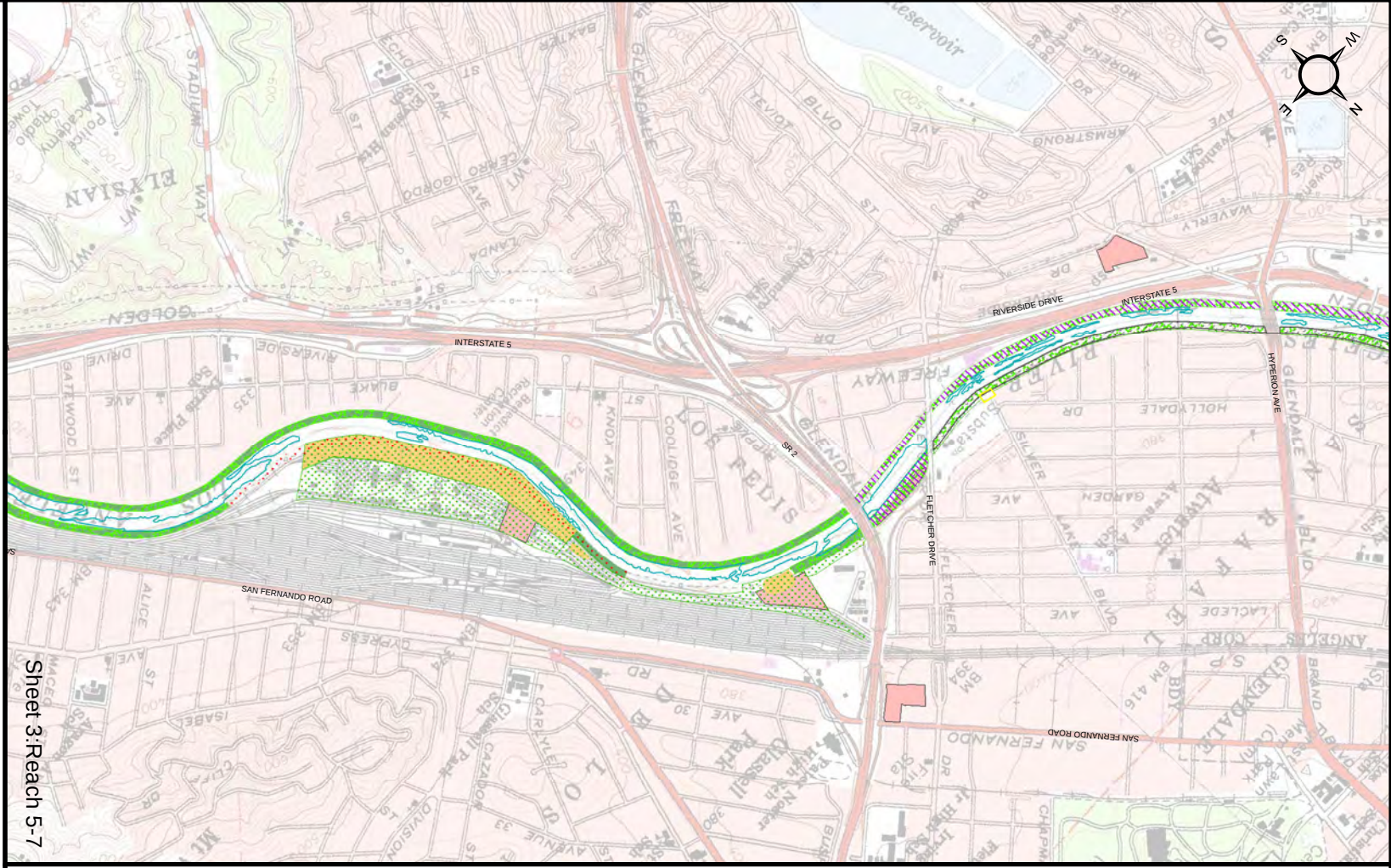
LEGEND
Sub-Measures

- 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

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

0 0.2 0.4 Miles



Sheet 3:Reach 5-7

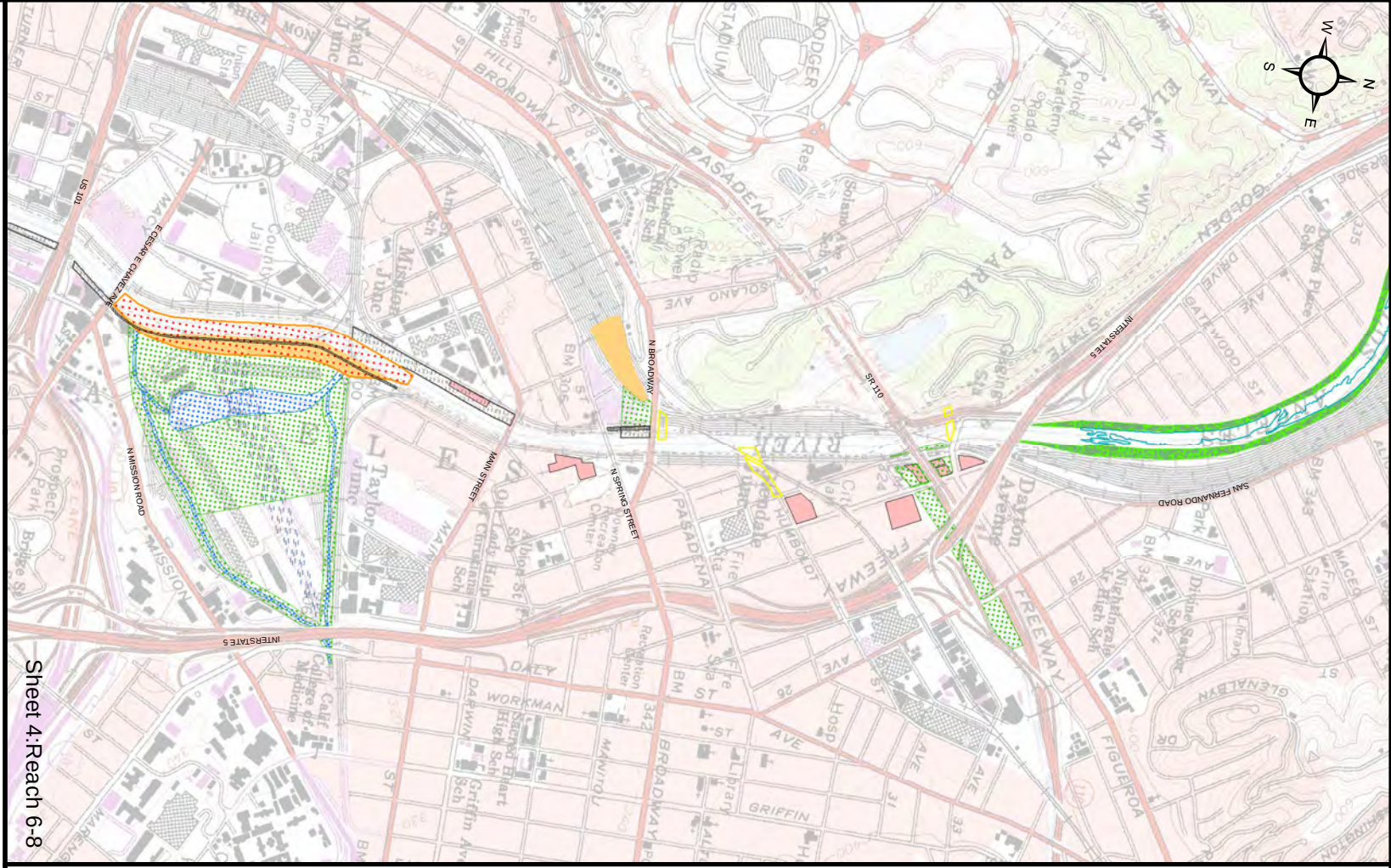
LEGEND
Sub-Measures

- 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

0 0.2 0.4 Miles

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

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

0 0.2 0.4 Miles

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

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

0 0.2 0.4 Miles

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Sheet 2:Reach 3-5

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

0 0.2 0.4 Miles

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Sheet 3:Reach 5-7

LEGEND
Sub-Measures

- 2. Expose stormdrain outlets; convert to natural stream confluence
- 3/5. Create geomorphology and plant for freshwater marsh
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- 26. Terrace banks
- 27. Modify trap channel to vertical sides
- 29. Invasive management
- Potential Temporary Construction Staging Areas

0 0.2 0.4 Miles

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

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

0 0.2 0.4 Miles

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
Web Site www.nahc.ca.gov
e-mail: ds_nahc@pacbell.net

July 16, 2012

Mr. Stephen Dibble, Archaeologist
United States Army Corps of Engineers
Los Angeles District Office
915 Wilshire Boulevard
Los Angeles, CA 90017

Sent by FAX to: (213) 452-4204 and (213) 452-4219
No. of Pages: 4

Re: Request of Sacred Lands File & Native American Contacts List , pursuant to 36 CFR Part 800, Protection of Historic Properties (NHPA Section 106; 16 U.S.C. 470 *et* seq) for the **"Los Angeles River Ecosystem Restoration Project;"** located on the Los Angeles River near Downtown Los Angeles; Los Angeles County, California.

Dear Mr. Dibble:

The Native American Heritage Commission (NAHC) is the California State 'Trustee Agency' pursuant to Public Resources Code §21070 for the protection of California's Native American Cultural Resources. The NAHC is also a 'reviewing agency' for environmental documents prepared under the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq*), 36 CFR Part 800.3, .5 and are subject to the Tribal and interested Native American consultation as required by the National Historic Preservation Act, as amended (Section 106) (16 U.S.C. 470; Section 106, [4f], 110 [f] [k], 304). The provisions of the Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. 3001-3013) and its implementation (43 CFR Part 10.2), and California Government Code §27491 may apply to this project if Native American human remains are inadvertently discovered.

The NAHC is of the opinion that the federal standards, pursuant to the above-referenced Acts and the Council on Environmental Quality (CSQ; 42 U.S.C. 4371 *et seq*) are similar to and in many cases more stringent with regard to the 'significance' of historic, including Native American items, and archaeological, including Native American items at least equal to the California Environmental Quality Act (CEQA.). In most cases, federal environmental policy require that any project that causes a substantial adverse change in the significance of an historical resource, that includes archaeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Statement (EIS).

The NAHC did conduct a Sacred Lands File (SLF) search of its Inventory and Native American cultural resources **were identified** in the area you specified. Early and quality consultation with the Native American representatives on the attached list may provide detailed information of sites with which they are aware. Also note that the absence of archaeological resources does not preclude their existence, particularly at the subsurface level.

The NAHC Sacred Lands File Inventory of the Native American Heritage Commission is established by the California Legislature pursuant to California Public Resources Code §§5097.94(a) and 5097.96. The NAHC Sacred Lands Inventory is populated by submission to

the data by Native American tribes and Native American elders. In this way it differs from the California and National Register of Historic Places under the jurisdiction of the U.S. Secretary of the Interior.

The NAHC, pursuant to Appendix B of the Guidelines to the California Environmental Quality Act (CEQA) is designated as the agency with expertise in the areas of issues of cultural significance to California Native American communities. Also, in the 1985 California Appellate Court decision (170 Cal App 3rd 604), the court held that the NAHC has jurisdiction and special expertise, as a state agency, over affected Native American resources, impacted by proposed projects including archaeological, places of religious significance to Native Americans and burial sites

Culturally affiliated tribes are to be consulted to determine possible project impacts pursuant to the National Historic Preservation Act, as amended. Early consultation with Native American tribes in your area is the best way to avoid unanticipated discoveries once a project is underway. The NAHC recommends as part of 'due diligence', that you also contact the nearest Information Center of the California Historical Resources Information System (CHRIS) of the State Historic Preservation Office (SHPO) for other possible recorded sites in or near the APE (contact the Office of Historic Preservation at 916-445-7000).

Attached is a list of Native American contacts is attached to assist you pursuanat to Section 800.2(c)(1)(i) and Section 800.2(c)(2); they may have knowledge of cultural resources in the project area. It is advisable to contact the persons listed and seek to establish a 'trust' relationship with them; if they cannot supply you with specific information about the impact on cultural resources, they may be able to refer you to another tribe or person knowledgeable of the cultural resources in or near the affected project area.

Lead agencies should consider avoidance, in the case of cultural resources that are discovered. A tribe or Native American individual may be the only source of information about a cultural resource; this is consistent with the NHPA (16 U.S.C. 470 *et seq* Sections. 106, 110, and 304) Section 106 Guidelines amended in 2009. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful

NEPA regulations provide for provisions for accidentally discovered archeological resources during construction and mandate the processes to be followed in the event of an accidental discovery of any human remains in a project location other than a 'dedicated cemetery. Even though a discovery may be in federal property, California Government Code §27460 should be followed in the event of an accidental discovery of human remains during any groundbreaking activity; in such cases California Government Code §27491 and California Health & Safety Code §7050.5 will apply and construction cease in the affected area.

If you have any questions about this response to your request, please do not hesitate to contact me at (916) 653-6251.

Sincerely,

Dave Singleton

Cc: State Clearinghouse

Native American Contact
Los Angeles County
July 16, 2012

Fernandeno Tataviam Band of Mission Indians
Ronnie Salas, Cultural Preservation Department
1019 - 2nd Street, Suite #1
San Fernando CA 91340
rsalas@tataviam-nsn.gov
(818) 837-0794 Office

(818) 837-0796 Fax

Fernandeno Tataviam

LA City/County Native American Indian Comm
Ron Andrade, Director
3175 West 6th St, Rm. 403
Los Angeles , CA 90020
randrade@css.lacounty.gov
(213) 351-5324
(213) 386-3995 FAX

Ti'At Society/Inter-Tribal Council of Pimu
Cindi M. Alvitre, Chairwoman-Manisar
3094 Mace Avenue, Apt. B
Costa Mesa, , CA 92626
calvitre@yahoo.com
(714) 504-2468 Cell

Gabrielino

Tongva Ancestral Territorial Tribal Nation
John Tommy Rosas, Tribal Admin.
Private Address
,
tattnlaw@gmail.com
310-570-6567

Gabrielino Tongva

Gabrieleno/Tongva San Gabriel Band of Mission
Anthony Morales, Chairperson
PO Box 693
San Gabriel , CA 91778
GTTribalcouncil@aol.com
(626) 286-1632
(626) 286-1758 - Home
(626) 286-1262 -FAX

Gabrielino Tongva

Gabrielino Tongva Nation
Sam Dunlap, Chairperson
P.O. Box 86908
Los Angeles , CA 90086
samdunlap@earthlink.net

(909) 262-9351 - cell

Gabrielino Tongva

Gabrielino Tongva Indians of California Tribal Council
Robert F. Dorame, Tribal Chair/Cultural Resources
P.O. Box 490
Bellflower , CA 90707
gtongva@verizon.net
562-761-6417 - voice
562-761-6417- fax

Gabrielino Tongva

Gabrielino-Tongva Tribe
Bernie Acuna
1875 Century Pk East #1500
Los Angeles , CA 90067
(619) 294-6660-work
(310) 428-5690 - cell
(310) 587-0170 - FAX
bacuna1@gabrieinotribe.org

Gabrielino

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed Los Angeles River Ecosystem Restoration Project; located near Downtown Los Angeles; Los Angeles County, California for which a Sacred Lands File search and Native American Contacts list were requested.

Native American Contact
Los Angeles County
July 16, 2012

Gabrielino-Tongva Tribe
Linda Candelaria, Chairwoman
1875 Century Pk East #1500 Gabrielino
Los Angeles , CA 90067
lcandelaria1@gabrielinoTribe.org
626-676-1184- cell
(310) 587-0170 - FAX

Gabrieleno Band of Mission Indians
Andrew Salas, Chairperson
P.O. Box 393 Gabrielino
Covina , CA 91723
(626) 926-4131
gabrielenoindians@yahoo.
com

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed Los Angeles River Ecosystem Restoration Project; located near Downtown Los Angeles; Los Angeles County, California for which a Sacred Lands File search and Native American Contacts list were requested.

OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
1725 23rd Street, Suite 100
SACRAMENTO, CA 95816-7100
(916) 445-7000 Fax: (916) 445-7053
calshpo@parks.ca.gov
www.ohp.parks.ca.gov

October 3, 2014

In reply refer to: COE_2014_0912_001

Dr. Josephine R. Axt, Ph.D.
Chief, Planning Division
Department of the Army
Los Angeles District Corps of Engineers
915 Wilshire Blvd., Suite 930
Los Angeles, CA 900017-3401

Re: Section 106 Consultation for the Los Angeles River Ecosystem Restoration Project in Los Angeles County, California.

Dear Dr. Axt:

Thank you for your letter dated September 5, 2014, requesting my review and comment with regard to the proposed Los Angeles River Ecosystem Restoration (LARER) Project. The Army Corps of Engineers (COE) is consulting with me Pursuant to 36 CFR Part 800 (as amended 8-05-04) regulations implementing Section 106 of the National Historic Preservation Act. Along with your consultation letter, you also provided the following document:

- *Los Angeles River Ecosystem Restoration Integrated Feasibility Report, Los Angeles County, California (U.S. Army Corps of Engineers 2013)*

The COE is proposing to restore approximately 11 miles of the Los Angeles River from Griffith Park to downtown Los Angeles by reestablishing riparian strand, freshwater marsh, and aquatic habitat communities while maintaining existing levels of flood risk management. A secondary purpose of this project is to provide recreational opportunities consistent with the restored ecosystem within this 11-mile stretch of the river.

Based upon the current proposed project description, the COE has delineated an Area of Potential Effects (APE) that intends to be inclusive of both direct and indirect effects that may result from implementation of the proposed undertaking. The APE identified by the COE is inclusive of the proposed project footprint and physical disturbance areas for river channel and bank alterations, storm drain outlet conversions to natural stream confluences, creation of freshwater marshes, diversions of river flow into side channels, riparian planting, invasive management, re-vegetation, construction of elevated railroad trestles, and all potential temporary construction staging areas. Additionally, to consider potential indirect effects the COE is proposing a 1/8-mile (660-foot) buffer around all identified project features subject to direct ground-disturbing activities.

The COE requested a Sacred Lands File search and a Native American contact list from the Native American Heritage Commission (NAHC) dated July 16, 2012. The NAHC responded by indicating that there are cultural resources within the general area of the proposed APE and the

COE has indicated that they will consult with the organizations and individuals identified on the contact list provided by the NAHC with regard to the proposed APE for this undertaking. Furthermore, the COE has stated that they corresponded with Gabrielino/Tongva representatives prior to publishing the Draft Integrated Feasibility Report and have expressed their commitment to continuing communication with the tribal representatives throughout the life of the LARER Project.

The COE is requesting my comments on the appropriateness of the APE for the proposed undertaking.

- Pursuant to 36 CFR 800.4(a)(1) I have no objection to your definition of the APE for the proposed undertaking as it includes a reasonable and good-faith effort to capture the potential for both direct physical and indirect effects. Please note that the APE should be revised, as necessary, to reflect changes to the project design, should they occur.

Thank you for seeking my comments and considering historic properties as part of your project planning. I look forward to our continued consultation regarding the LARER Project. Be advised that under certain circumstances, such as a change in project description, the COE may have additional future responsibilities for this undertaking under 36 CFR Part 800. If you have any questions, please contact Patrick Riordan of my staff at (916) 445-7017 or Patrick.Riordan@parks.ca.gov.

Sincerely,

Carol Roland-Nawi, PhD
State Historic Preservation Officer

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
915 Wilshire Boulevard, Suite 930
LOS ANGELES, CALIFORNIA 90017-3401

REPLY TO
ATTENTION OF

September 15, 2014

Office of the Chief
Planning Division

Mr. John M. Fowler
Executive Director
Advisory Council on Historic Preservation
401 F Street NW, Suite 308
Washington, DC 20001-2637

Dear Mr. Fowler:

The U.S. Army Corps of Engineers (Corps), Los Angeles District, is preparing environmental and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project (LARER), along and within the Los Angeles River, Los Angeles County, California. The LARER is an ecosystem restoration project that would create ground and visual disturbance along the River near downtown Los Angeles (enclosure 1).

The Draft Integrated Feasibility Report (IFR) for the proposed project, (which also serves as the Environmental Impact Statement/Environmental Impact Report), was available for public review from September 13, 2013 through November 18, 2013. A CD containing the Draft IFR is enclosed for reference (enclosure 2).

The Draft IFR identified Alternative 13 as the Tentatively Selected Plan. Subsequently, the Corps and the non-federal sponsor (City of Los Angeles) have identified a more comprehensive restoration plan, Alternative 20, as the Locally Preferred Plan. Alternative 20 will be the Recommended Plan in the Final IFR.

The proposed project is to restore approximately 11 miles of the Los Angeles River from Griffith Park to downtown Los Angeles by reestablishing riparian strand, freshwater marsh, and aquatic habitat communities while maintaining existing levels of flood risk management. A secondary purpose is to provide recreational opportunities consistent with the restored ecosystem within this 11-mile reach of the river. A more detailed project description is included as enclosure (enclosure 3)

Based on the current proposed project description, we have delineated an Area of Potential Effects (APE). The APE includes both direct and indirect effects that may occur from implementation of the undertaking. The enclosed APE map designates the portions of the project that would experience direct ground-disturbing activities. In addition, the APE includes a reasonable and good-faith effort to capture the potential for visual, auditory, and other non-direct effects. Ground disturbance will occur mostly in areas that were previously disturbed by construction of the original concrete lined flood control channel. There are virtually no undisturbed ground surfaces in this highly urbanized environment through the entire reach of the project. Some undisturbed and intact subsurface deposits are still present. As construction would disturb these areas we would include the possibility for encountering buried cultural remains within the vertical APE. The vertical APE varies greatly from a few inches to several feet.

Horizontally we are proposing a one-eighth mile buffer around each depicted feature for noise and visual impacts. For clarity we have depicted the APE (without the one-eighth mile buffer) on both the USGS topographic map, and an aerial view (enclosures 4 and 5). Each measure and project feature is detailed in the legend. In a letter dater September 5, 2014 we initiated the Section 106 process with the California State Historic Preservation Officer (SHPO) by requesting their comments on the appropriateness of the APE for the proposed undertaking (pursuant to §800.4[a][1]). We are awaiting a response.

The Corps requested a Sacred Lands File search and a Native American contact list from the Native American Heritage Commission (NAHC) dated July 16, 2012. The NAHC responded by indicating that there are cultural resources within the general area of the proposed APE (enclosure 6). In addition to this information, we corresponded with the Gabrielino/Tongva prior to publishing the Draft IFR, and they were also sent copies of the document to obtain their concerns during the public review period. No responses were received. Although not Federally Recognized, communication with the Gabrielino/Tongva Tribal contacts will continue throughout the life of the project.

We have decided to pursue a Programmatic Agreement (PA) as the path to Section 106 compliance in accordance with 36 CFR 800.14(b)(ii). This project will be constructed over a number of years, and at this time the information we have is based on a records and literature search. Based on the information we do have, we do not anticipate there will be any Tribal or public controversy. The draft NEPA document that the public reviewed did not generate any significant concerns.

By this letter we are making the notification to ACHP required under 36 CFR 800.6 (a)(1), and giving your office the opportunity to participate. After reviewing Appendix A the 36 CFR 800 we believe that the Council's participation is not necessary at this time.

Please review the enclosed information, and respond within fifteen days of your receipt of this letter. If we do not hear from you within that period we will assume you do not choose to participate in the PA. If you have any further questions on this project please call Mr. Stephen Dibble, Senior Archeologist, at (213) 452-3849. He may also be reached by e-mail at David.S.Dibble@usace.army.mil.

Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

Preserving America's Heritage

October 7, 2014

Josephine R. Axt, Ph.D.
Chief, Planning Division
Los Angeles District, Corps of Engineers
915 Wilshire Boulevard, Suite 930
Los Angeles, CA 90017-3401

Ref: Proposed Los Angeles River Ecosystem Restoration Project
Los Angeles County, California

Dear Dr. Axt:

On September 22, 2014, the Advisory Council on Historic Preservation (ACHP) received your notification and supporting documentation regarding the adverse effects of the referenced undertaking on properties listed on and eligible for listing in the National Register of Historic Places. Based upon the information you provided, we have concluded that Appendix A, *Criteria for Council Involvement in Reviewing Individual Section 106 Cases,* of our regulations, "Protection of Historic Properties" (36 CFR Part 800) does not apply to this undertaking. Accordingly, we do not believe that our participation in the consultation to resolve adverse effects is needed. However, if we receive a request for participation from the State Historic Preservation Officer, Tribal Historic Preservation Officer, or another party, we may reconsider this decision. Additionally, should circumstances change, and you determine that our participation is needed to conclude the consultation process, please notify us.

Pursuant to 36 CFR 800.6(b)(1)(iv), you will need to file the final Programmatic Agreement (PA), developed in consultation with the California State Historic Preservation Officer (SHPO) and any other consulting parties, and related documentation with the ACHP at the conclusion of the consultation process. The filing of the Agreement and supporting documentation with the ACHP is required in order to complete the requirements of Section 106 of the National Historic Preservation Act.

Thank you for providing us with your notification of adverse effect. If you have any questions or require further assistance, please contact Brian Lusher at 202-517-0221, or via email at blusher@achp.gov.

Sincerely,

Raymond V. Wallace

Raymond V. Wallace
Historic Preservation Technician
Office of Federal Agency Programs

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, U.S. ARMY CORPS OF ENGINEERS
915 WILSHIRE BOULEVARD, SUITE 930
LOS ANGELES, CALIFORNIA 90017

September 26, 2014

Office of the Chief
Planning Division

Carol Roland-Nawi, Ph.D.
State Historic Preservation Officer
Office of Historic Preservation
1725 23rd Street, Suite 100
Sacramento, California 95816

Dear Dr. Roland-Nawi:

The United States Army Corps of Engineers (Corps), Los Angeles District, is preparing environmental and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project (LARER), along and within the Los Angeles River, Los Angeles County, California. The LARER is an ecosystem restoration project that would create ground and visual disturbance along the Los Angeles River near downtown Los Angeles (COE_2014_0912_001).

In a letter dated September 5, 2014 we initiated consultation on this project by submitting our proposed area of potential effects for your review and comment. Subsequent to that submittal we decided to pursue a programmatic agreement (PA) as our compliance instrument. The draft PA was submitted to Ms. Jessica Tudor by e-mail on September 17, 2014. Ms. Tudor also requested that we formally submit a hard copy by mail. The draft PA is attached for your review and comment. This particular project is a very high priority undertaking for the Corps and we appreciate your assistance.

Please review the draft PA, and respond at your earliest convenience. If you have any further questions on this project please call Mr. Stephen Dibble, Senior Archeologist, at (213) 452-3849. He may also be reached by e-mail at David.S.Dibble@usace.army.mil.

Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure

State of California • Natural Resources Agency
Edmund G. Brown Jr., *Governor*
DEPARTMENT OF PARKS AND RECREATION
Major General Anthony L. Jackson, USMC (Ret), *Director*
Angeles District
1925 Las Virgenes
Calabasas, Ca. 91302

November 18, 2013

Josephine R. Axt, Ph.D.
Chief, Planning Division
U.S. Army Cory of Engineers, Los Angeles District
PO Box 532711
ATTN: Ms. Erin Jones, CES-PD-RN
Los Angeles, CA 90053-2325

RE: Draft Los Angeles Ecosystem Restoration Integrated Feasibility Report (DIFR) for the Los Angeles River Ecosystem Restoration Feasibility Study, Los Angeles County, California

Dear Dr. Axt:

The California Department of Parks and Recreation (California State Parks) has reviewed the above-referenced "Los Angeles River Project" DIFR and appreciates the opportunity to comment.

California State Parks stands with our partner park agencies, the National Park Service and the Santa Monica Mountains Conservancy, in its strong support for Alternative 20. The Los Angeles River Project presents a historic opportunity to reconnect the City of Los Angeles with its natural heritage by linking existing public open spaces, by providing habitat connectivity between the mountains and the river floodplain, and by promoting opportunities for passive outdoor recreation in the most park-poor metropolis in the United States. The community consensus-building and momentum that have resulted from the feasibility study and from other planning efforts over many years call for a bold vision to begin the restoration of what was once a vibrant ecosystem of mountains, rivers and coastal lowlands of almost unequalled biodiversity.

Over the past 12 years, California State Parks has invested over $150 million dollars to bring nature to the city by acquiring and developing three parks in urban Los Angeles: Rio de Los Angeles State Park, Los Angeles State Historic Park and the Baldwin Hills Scenic Overlook. Los Angeles State Historic Park and Rio de Los Angeles State Park were designated by Proposition 12 as Los Angeles River parkway projects.

In partnership with local communities, we have succeeded in preserving over one hundred acres of open space in the most park-poor region of the most park-poor city in the nation. These parks have not only attracted thousands of visitors every year, but have contributed to the economic revitalization of the surrounding communities. California State Parks' investment in these properties indicates that they rise to the level of statewide significance. We further recognize the Los Angeles River as a resource of statewide and national significance due to its cultural and historic role in the

transformation of Los Angeles from a frontier town to the second largest metropolis in the United States. We believe in the river's potential to transform the city once more through positive economic and environmental impacts that would benefit the entire Los Angeles region.

Los Angeles State Historic Park and Rio de Los Angeles State Park are innovative urban parks that serve low-income, park-poor communities that fought for equal access to parks and green space that are more available to more affluent Los Angeles neighborhoods. As reported by the City Project in *Dreams of Fields: Soccer, Community, and Equal Justice,* the community within a five mile radius of Los Angeles State Historic Park is 68% Latino, 14% Asian, 11% non-Hispanic white, and 4% African American. The population surrounding the park is disproportionally low income, with 30% of the residents living in poverty compared to 14% for the State of California as a whole. The community within a five mile radius of Rio de Los Angeles State Park reflects a similar socio-economic demographic with a 56% Latino, 17% Asian, 20% non-Hispanic white, and 4% African American population. Twenty seven percent of that population lives in poverty, with a median annual household income at just 69% of that for the State.

Los Angeles State Historic Park revives the forgotten history of Los Angeles from Native American times to the present, providing passive and active recreational opportunities in this rare swath of open space in the heart of the city. Rio de Los Angeles State Park features cutting edge wetlands restoration, much-needed athletic fields and community activities. Both of these parks are included as part of the National Park Service Rim of the Valley (ROTV) Corridor Special Resource Study, along with significant acreage in the Verdugo Mountains, also under the stewardship of California State Parks. During the public scoping process for the study, the national significance of the Los Angeles River and adjoining parklands, as well as the wildlife and habitat linkages they provide, was highlighted as a top concern by participants. Public comments received on the preliminary alternative concepts for the ROTV study strongly supported Alternative C (Connecting Urban Parks – SMNRA Boundary Adjustment), particularly in regard to the inclusion of the Los Angeles River and Arroyo Seco Corridors.

Alternative C of the ROTV Study complements existing Los Angeles River revitalization efforts and river parkway projects, of which Los Angeles State Historic Park and Rio De Los Angeles State Park are primary examples. National Park Service technical assistance and leadership in cooperative conservation efforts, coupled with acquisition and management capabilities, would be beneficial as a variety of city, county, state, joint powers, and local non-profit agencies currently work to leverage resources and connect open space along the river. The parcel G-2, currently held by Union Pacific, has long been considered the "crown jewel" in the emerald necklace of Los Angeles River parkway projects. Federal assistance could prove invaluable in the acquisition

and protection of this critical Los Angeles River connection. Alternative 20 is fully consistent with the concerns demonstrated by a large portion of the public in the ROTV study, and there is a tremendous opportunity for the Corps to build on this momentum and offer leadership in this comprehensive restoration effort.

After 12 years of extensive planning and public participation, California State Parks is ready to deliver on its commitment to the community and construct the full 32 acres at Los Angeles State Historic Park, beginning in early 2014. The park construction will happen in tandem with the development of the La Noria Water Wheel project, funded by the Annenberg Foundation, adjacent to the park. Echoing the historic waterwheel once located on North Broadway Street, the La Noria project will pump water from the Los Angeles River to the seasonal wetland portion of Los Angeles State Historic Park. The project will re-establish the site's physical connection to the historic Los Angeles River flood plain, and this hydrological connection to the river fulfills the vision laid out in the park's general plan, as stated in the *Declaration of Purpose*:

> *"The purpose of Los Angeles State Historic Park is to provide the public with a place to learn and to celebrate the ethnically diverse history and cultural heritage of Los Angeles, with an emphasis on its evolution to an economic and industrial metropolis of the 21st Century with extraordinary influence throughout the world. The park will contribute to the emerging Los Angeles River Greenway, stretching from the San Gabriel Mountains to the Pacific Ocean. The park will bring a wide range of visitors together to examine and experience the complete story of Los Angeles. It will be a sanctuary from the dense, urban environment that surrounds it. The park will connect abstract historical and social patterns to the personal experiences of Angelenos and visitors from the city, the state, the nation, and the world."*

California State Parks is working in partnership with the City of Los Angeles and the Department of Toxic Substances Control on clean-up of the Bowtie parcel of Rio de Los Angeles State Park to park standard, which has already been identified by the Army Corps through the Los Angeles River Ecosystem Restoration Feasibility Study as the primary location for a demonstration project. The 18.5 acre parcel is large enough to achieve substantial restoration benefits and offers the potential to incorporate riparian bank-to-bank hydrological and habitat connections. The parcel's use for naturalized open space is consistent with the general plan for Rio de Los Angeles and consistent with the Los Angeles River Revitalization Master Plan's designation of the parcel as habitat/open space within the "Taylor Yard Opportunity Area." These projects present a tremendous opportunity for leveraging resources through extended partnerships with the Army Corps and project components offered in Alternative 20. Accordingly, we fully support the funding and implementation of Alternative 20, specifically the direct connection of Los Angeles State Historic Park and a portion of Rio de Los Angeles to the Los Angeles River.

Biological Resources

Riparian and wetland habitats are among those most impacted, due to damage and conversion associated with transportation, agriculture, water infrastructure and other development. Water quality degradation is also typical as the pollution from upgradient areas collects in these habitats. Yet, riparian and wetlands habitats are vital for the health of local fish and wildlife populations, and provide important resources for feeding, breeding, and resting. They also provide key corridors to local and large-scale animal movement that are necessary to avoid inbreeding depression and local extinctions.

Many unique special status species are associated with riparian and wetland habitats and would benefit from restoration of the Los Angeles River. Alternative 20 is preferable because it provides an additional 131 acres of restored and higher quality habitat compared to Alternative 13.

The long-term health of many fish and wildlife populations is dependent upon their ability to access both local and regional resources for food, mates, and sanctuary. Equally important is access to refuges where animal subpopulations can replenish their numbers and genetic diversity after bouts of disease, extreme weather, and decreased resource availability. These resources are even more crucial in intensely developed areas like Los Angeles, where the isolated patch of open space has even more value due to its relative rarity and the convoluted path to reach it. Adjacent development impacts, also known as edge effects, put greater pressures on native species through increased disturbance, disease, exposure to toxins, invasive species impacts and general habitat degradation. Restoration of the Los Angeles River would restore a key artery to the historic system of animal movement in the region and would not only provide increased options for existing wildlife, but vastly improve the future health and expansion of these populations.

The importance of the Los Angeles River for animal movement is supported by National Park Service's ongoing research tracking carnivores through the Santa Monica Mountains. The Park Service has identified the Los Angeles River as an important corridor for animal movement. Mountain Lion P22, among others, would benefit by having access to the Verdugo Hills via the restoration of the Verdugo Wash proposed only by Alternative 20. We believe that Alternative 20 is clearly the preferred alternative for maximizing animal movement and habitat connectivity. Alternative 20 adds 205% connectedness in the Study Area over Alternative 13. It provides the greatest range of connectivity by providing links to the Verdugo Mountains and associated property managed by California State Parks, Santa Monica Mountains Conservancy and the City of Glendale. It also ensures that the Elysian Hills would be connected to the Los Angeles River via Los Angeles State Historic Park. These benefits are not provided by other project alternatives. Alternative 20 therefore provides the best opportunity to protect and enhance existing animal populations at a regional level in both the short and long term.

The DIFR clearly underlines the importance of maximizing habitat linkages (Appendix G, Section 7.1.2):

> *"In order to benefit the biological integrity of a landscape, corridors should be restored to allow for dispersal between habitat areas. More corridors equal more routes to suitable habitat, creating more opportunities for dispersal. A complex network of nodes and corridors is therefore critical to restoration in an urban environment, as suitable habitat often remains unused if isolated (Hanski & Thomas 1994)."*

In *Sections 3.5.4* and *5*, the DIFR does not adequately discuss plant and animal species and unique habitats considered sensitive by the State of California, as required by the California Environmental Quality Act (CEQA). These include California Species of Special Concern, California Fully Protected, and species considered local endemics, among other designations. Just one example of this oversight is the silvery legless lizard (*Anniella pulchra pulchra*). This species is identified as potentially present, and it is a California Species of Concern, yet there is no discussion of how potential impacts to this species could occur during ground disturbing activities, nor is there discussion of how potential impacts be avoided.

We recommend inclusion of the following measures in the section on Best Managment Practies for Biological Resources:

- Conduct standard preconstruction surveys for special-status plants at the time of year when they are most likely to be in bloom or most visible to determine presence
- Conduct special-status animal clearance surveys just prior to construction to relocate animals out of harm's way.

The CHAP scoring and CE/ICA does not capture the regional importance of the project. We are concerned that it appears that total cost is the primary reason Alternative 20 has not been selected. This appears to be in part due to consideration of the relationship of cost to total acres restored or Habitat Units created, rather than the ecological *value* of the restored acres or resource areas made accessible. Alternative 20 not only significantly increases the *quantity* of habitat restored compared to Alternative 13, 719 vs. 588 acres, respectively, but creates *and* provides greater access to more higher *quality* habitat. We would like to reference and reiterate Santa Monica Mountains Conservancy's November 5, 2013 comment letter which clearly outlines these concerns. (See the *Importance of Biodiversity, Cost Effectiveness* and *Plan Selection* sections).

Specifically:

- Alternative 13 and 20 give the same credit for 113 acres of restoration associated with the Piggyback Yard, yet the restoration and associated ecological benefits are significantly greater under Alternative 20.
- At the Los Angeles State Historic Park ("Cornfield") location, Alternative 20 has significant ecological improvements over Alternative 13.
- Alternative 20 is identified as a "Best-Buy" in the CE/ICA, and is the only alternative that provides linkages to the Verdugo Mountains and Elysian Hills.
- Alternative 20 is efficient, the most complete, the most effective, and the best alternative at recreating natural processes that are needed to facilitate a self-sustaining system within the project area and throughout the region over the *long term*.
- Alternative 20 best complies with the goal of the Water Resources Development Act of 2007 to develop a plan *"consistent with the goals of the Los Angeles River Revitalization Master Plan published by the city of Los Angeles..."*
- As discussed in *Appendix G, Section 7*, three key project benefits have been excluded from the CHAP analysis: habitat connectivity, hydrologic and hydraulic connectivity of the Los Angeles River to its floodplain and human benefit.

Since the basis for the tentative selection of Alternative 13 is the relation of the total Habitat Units resulting from each alternative divided by the total cost, it is unacceptable to exclude habitat and hydraulic and hydrological connectivity from the equation. Incorporation of these factors must occur to provide clarity on the true cost/benefit relationship of the four project alternatives. Potential approaches to modifying the calculation of HUs could include:

- Differentiation of the relative ecological benefits of the restored habitat via modifiers to determine the value of the final restored area.
- Quantification of acres of significant habitat made available via corridor connections.
- Quantification of cumulative length of corridors connected or created or percent increase of corridors provided as an HU input.
- Weighting of HU outputs to consider direct human benefits. Specifically, building upon past investments in the project area, better connecting existing open space areas to the project area, quantified by acres or annual visitors, and direct economic benefits as calculated in the DIFR.

Cultural Resources

Los Angeles State Historic Park is designated as Los Angeles Historical Cultural Landmark (HCM) No. 82 River Station Area/Southern Pacific Railroad. Throughout the DIFR document, the property is referred to as the "Cornfields." Although we understand

that this was a previous nickname for the property, the origins of the name can only be traced back to the 1980's definitively, and thus does not represent the true historical designation. Instead, the study should refer to this area by the current name, Los Angeles State Historic Park, or the historical name, River Station. We believe that these are more appropriate terms and better connect the property to the origins of Los Angeles and the association with the Los Angeles River.

The site is historically significant with known significant archaeological resources. Archaeological features in the park, along with adjacent historical properties, are indicative of the importance of this site with regard to the industrial development and the rapid urban expansion of Los Angeles. Cultural resource identification efforts are preliminary at this point, and it is unclear in the DIFR document at what point additional background research, field survey and evaluation are to be undertaken. As a result, it is nearly impossible to provide comment on resource identification level of effort and potential for adverse effects. There should be additional opportunities made available for public comment through the Section 106 process to ensure that project effects on historic properties are being accounted for.

We recommend that additional background research efforts include analysis of ethnographic village locations in order to access the potential for encountering buried archaeological deposits within a region that experienced development early in time. This was an issue encountered during construction of the nearby Metropolitan Water District building where both Native American and historic-period archaeological materials were both anticipated and found based on previous research. As well, more detailed sources of historic map data, such as Sanborn fire insurance maps readily available at the City of LA Public Library, should be consulted, in addition to the historic topographic maps thus far consulted. Geomorphic studies of the historic configuration of the riverbed would also assist in determining the potential for encountering subsurface archaeological resources.

Additional archaeological testing has been conducted at Los Angeles State Historic Park in recent years in association with planning efforts for the next phase of park development. All of these data can be made available to the cultural resources consultant conducting additional identification efforts for the Los Angeles River restoration project. Additionally, geophysical survey methods, including ground-penetrating radar, magnetometer, gradiometer and resistivity, have proven to be quite successful in identifying subsurface historic-period features at the park, and we encourage the use of these methods in resource identification efforts throughout the developed Los Angeles River project restoration area where historic map data suggest the possibility for encountering features.

We believe it is preliminary to make any determinations on the level of potential for encountering cultural resources within all of the analyzed study reaches based on the limited background research conducted to date. As noted in the comments above, and

acknowledged in Section 5.6.4 in the DIFR, substantial additional research, testing, and evaluation will have to be conducted prior to any determination of effects from the proposed alternatives on historic properties with the study Area of Potential Effect (APE). We concur that development of a Programmatic Agreement will help to address some of our concerns noted above.

Thank you for the opportunity to comment on this project. Please contact Jamie King, Environmental Scientist at Jamie.King@parks.ca.gov or 818.880.0373, if clarifications are required.

Sincerely,

Craig Sap
State Parks
Angeles District Superintendent

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

September 21, 2012

Office of the Chief
Planning Division

Mr. Ronnie Salas
Fernandeno Tataviam Band of Mission Indians
Cultural Preservation Department
1019 2nd Street, Suite #1
San Fernando, California 91340

Dear Mr. Salas:

The Los Angeles District, Corps of Engineers (Corps) is preparing an Environmental Impact Statement (EIS) and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project located within the City of Los Angeles, in Los Angeles County (enclosure 1). The proposed project would provide restoration of riparian and aquatic habitat along portions of the Los Angeles River.

The purpose of this letter is to request your initial input by providing us with information on traditional cultural properties or other resources of concern that might be present within or near the project area. Any other comments or concerns are appreciated. This will not be your only opportunity to comment on the proposed project. A draft EIS detailing all considered alternatives is being prepared and a copy will be sent to you for further comment. This request is being sent to all names provided by the Native American Heritage Commission (enclosure 2).

Please review the enclosed map, and respond with comments at your earliest convenience. If you have any further questions on this project please call Mr. Stephen Dibble, Senior Archeologist, at (213) 452-3849. He may also be reached by e-mail at david.s.dibble@usace.army.mil.

Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

September 21, 2012

Office of the Chief
Planning Division

Mr. Ron Andrade, Director
LA City/County Native American Indian Commission
3175 West 6th Street, Room, 403
Los Angeles, California 90020

Dear Mr. Andrade:

The Los Angeles District, Corps of Engineers (Corps) is preparing an Environmental Impact Statement (EIS) and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project located within the City of Los Angeles, in Los Angeles County (enclosure 1). The proposed project would provide restoration of riparian and aquatic habitat along portions of the Los Angeles River.

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Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

September 21, 2012

Office of the Chief
Planning Division

Mr. Robert Dorame, Tribal Chair
Gabrielino Tongva Indians of California
P.O.Box 490
Bellflower, California 90707

Dear Mr. Dorame:

The Los Angeles District, Corps of Engineers (Corps) is preparing an Environmental Impact Statement (EIS) and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project located within the City of Los Angeles, in Los Angeles County (enclosure 1). The proposed project would provide restoration of riparian and aquatic habitat along portions of the Los Angeles River.

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Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

September 21, 2012

Office of the Chief
Planning Division

Mr. Bernie Acuna
Gabrielino-Tongva Tribe
1875 Century Park East, #1500
Los Angeles, California 90067

Dear Mr. Acuna:

The Los Angeles District, Corps of Engineers (Corps) is preparing an Environmental Impact Statement (EIS) and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project located within the City of Los Angeles, in Los Angeles County (enclosure 1). The proposed project would provide restoration of riparian and aquatic habitat along portions of the Los Angeles River.

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Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

September 21, 2012

Office of the Chief
Planning Division

Mr. Sam Dunlap, Chairperson
Gabrielino Tongva Nation
P.O. Box 86908
Los Angeles, California 90086

Dear Mr. Dunlap:

The Los Angeles District, Corps of Engineers (Corps) is preparing an Environmental Impact Statement (EIS) and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project located within the City of Los Angeles, in Los Angeles County (enclosure 1). The proposed project would provide restoration of riparian and aquatic habitat along portions of the Los Angeles River.

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Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

September 21, 2012

Office of the Chief
Planning Division

Ms. Cindi M. Alvitre, Chairwoman
Ti'At Society/Inter-Tribal Council of Pimu
3094 Mace Avenue, Apt. B
Costa Mesa, California 92626

Dear Ms. Alvitre:

The Los Angeles District, Corps of Engineers (Corps) is preparing an Environmental Impact Statement (EIS) and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project located within the City of Los Angeles, in Los Angeles County (enclosure 1). The proposed project would provide restoration of riparian and aquatic habitat along portions of the Los Angeles River.

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Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

September 21, 2012

Office of the Chief
Planning Division

Mr. Anthony Morales, Chairperson
San Gabriel Band of Mission Indians
P.O. Box 693
San Gabriel, California 91778

Dear Mr. Morales:

The Los Angeles District, Corps of Engineers (Corps) is preparing an Environmental Impact Statement (EIS) and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project located within the City of Los Angeles, in Los Angeles County (enclosure 1). The proposed project would provide restoration of riparian and aquatic habitat along portions of the Los Angeles River.

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Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

N
W
E
S
CALIFORNIA
Sacramento
San Francisco
PACIFIC OCEAN
Los Angeles
Study Area
San Diego
Data Source: ESRI 2008, Census 2012
Miles
0
50
100

ENCLOSURE #1

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
Web Site www.nahc.ca.gov
e-mail: ds_nahc@pacbell.net

July 16, 2012

Mr. Stephen Dibble, Archaeologist
United States Army Corps of Engineers
Los Angeles District Office
915 Wilshire Boulevard
Los Angeles, CA 90017

Sent by FAX to: (213) 452-4204 and (213) 452-4219
No. of Pages: 4

Re: Request of Sacred Lands File & Native American Contacts List , pursuant to 36 CFR Part 800, Protection of Historic Properties (NHPA Section 106; 16 U.S.C. 470 *et* seq) for the **"Los Angeles River Ecosystem Restoration Project;"** located on the Los Angeles River near Downtown Los Angeles; Los Angeles County, California.

Dear Mr. Dibble:

The Native American Heritage Commission (NAHC) is the California State 'Trustee Agency' pursuant to Public Resources Code §21070 for the protection of California's Native American Cultural Resources. The NAHC is also a 'reviewing agency' for environmental documents prepared under the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq*), 36 CFR Part 800.3, .5 and are subject to the Tribal and interested Native American consultation as required by the National Historic Preservation Act, as amended (Section 106) (16 U.S.C. 470; Section 106, [4f], 110 [f] [k], 304). The provisions of the Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. 3001-3013) and its implementation (43 CFR Part 10.2), and California Government Code §27491 may apply to this project if Native American human remains are inadvertently discovered.

The NAHC is of the opinion that the federal standards, pursuant to the above-referenced Acts and the Council on Environmental Quality (CSQ; 42 U.S.C. 4371 *et seq*) are similar to and in many cases more stringent with regard to the 'significance' of historic, including Native American items, and archaeological, including Native American items at least equal to the California Environmental Quality Act (CEQA.). In most cases, federal environmental policy require that any project that causes a substantial adverse change in the significance of an historical resource, that includes archaeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Statement (EIS).

The NAHC did conduct a Sacred Lands File (SLF) search of its Inventory and Native American cultural resources **were identified** in the area you specified. Early and quality consultation with the Native American representatives on the attached list may provide detailed information of sites with which they are aware. Also note that the absence of archaeological resources does not preclude their existence, particularly at the subsurface level.

The NAHC Sacred Lands File Inventory of the Native American Heritage Commission is established by the California Legislature pursuant to California Public Resources Code §§5097.94(a) and 5097.96. The NAHC Sacred Lands Inventory is populated by submission to

the data by Native American tribes and Native American elders. In this way it differs from the California and National Register of Historic Places under the jurisdiction of the U.S. Secretary of the Interior.

The NAHC, pursuant to Appendix B of the Guidelines to the California Environmental Quality Act (CEQA) is designated as the agency with expertise in the areas of issues of cultural significance to California Native American communities. Also, in the 1985 California Appellate Court decision (170 Cal App 3rd 604), the court held that the NAHC has jurisdiction and special expertise, as a state agency, over affected Native American resources, impacted by proposed projects including archaeological, places of religious significance to Native Americans and burial sites

Culturally affiliated tribes are to be consulted to determine possible project impacts pursuant to the National Historic Preservation Act, as amended. Early consultation with Native American tribes in your area is the best way to avoid unanticipated discoveries once a project is underway. The NAHC recommends as part of 'due diligence', that you also contact the nearest Information Center of the California Historical Resources Information System (CHRIS) of the State Historic Preservation Office (SHPO) for other possible recorded sites in or near the APE (contact the Office of Historic Preservation at 916-445-7000).

Attached is a list of Native American contacts is attached to assist you pursuanat to Section 800.2(c)(1)(i) and Section 800.2(c)(2); they may have knowledge of cultural resources in the project area. It is advisable to contact the persons listed and seek to establish a 'trust' relationship with them; if they cannot supply you with specific information about the impact on cultural resources, they may be able to refer you to another tribe or person knowledgeable of the cultural resources in or near the affected project area.

Lead agencies should consider avoidance, in the case of cultural resources that are discovered. A tribe or Native American individual may be the only source of information about a cultural resource; this is consistent with the NHPA (16 U.S.C. 470 *et seq* Sections. 106, 110, and 304) Section 106 Guidelines amended in 2009. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful

NEPA regulations provide for provisions for accidentally discovered archeological resources during construction and mandate the processes to be followed in the event of an accidental discovery of any human remains in a project location other than a 'dedicated cemetery. Even though a discovery may be in federal property, California Government Code §27460 should be followed in the event of an accidental discovery of human remains during any groundbreaking activity; in such cases California Government Code §27491 and California Health & Safety Code §7050.5 will apply and construction cease in the affected area.

If you have any questions about this response to your request, please do not hesitate to contact me at (916) 653-6251.

Sincerely,

Dave Singleton

Cc: State Clearinghouse

Native American Contact
Los Angeles County
July 16, 2012

Fernandeno Tataviam Band of Mission Indians
Ronnie Salas, Cultural Preservation Department
1019 - 2nd Street, Suite #1
San Fernando CA 91340
rsalas@tataviam-nsn.gov
(818) 837-0794 Office

(818) 837-0796 Fax

Fernandeno Tataviam

LA City/County Native American Indian Comm
Ron Andrade, Director
3175 West 6th St, Rm. 403
Los Angeles , CA 90020
randrade@css.lacounty.gov
(213) 351-5324
(213) 386-3995 FAX

Ti'At Society/Inter-Tribal Council of Pimu
Cindi M. Alvitre, Chairwoman-Manisar
3094 Mace Avenue, Apt. B
Costa Mesa, , CA 92626
calvitre@yahoo.com
(714) 504-2468 Cell

Gabrielino

Tongva Ancestral Territorial Tribal Nation
John Tommy Rosas, Tribal Admin.
Private Address
,
tattnlaw@gmail.com
310-570-6567

Gabrielino Tongva

Gabrieleno/Tongva San Gabriel Band of Mission
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Gabrielino Tongva

Gabrielino Tongva Nation
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(909) 262-9351 - cell

Gabrielino Tongva

Gabrielino Tongva Indians of California Tribal Council
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Gabrielino Tongva

Gabrielino-Tongva Tribe
Bernie Acuna
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Gabrielino

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed Los Angeles River Ecosystem Restoration Project; located near Downtown Los Angeles; Los Angeles County, California for which a Sacred Lands File search and Native American Contacts list were requested.

Native American Contact
Los Angeles County
July 16, 2012

Gabrielino-Tongva Tribe
Linda Candelaria, Chairwoman
1875 Century Pk East #1500 Gabrielino
Los Angeles , CA 90067
lcandelaria1@gabrielinoTribe.org
626-676-1184- cell
(310) 587-0170 - FAX

Gabrieleno Band of Mission Indians
Andrew Salas, Chairperson
P.O. Box 393 Gabrielino
Covina , CA 91723
(626) 926-4131
gabrielenoindians@yahoo.
com

This list is current only as of the date of this document.

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DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
915 Wilshire Boulevard, Suite 930
LOS ANGELES, CALIFORNIA 90017-3401

REPLY TO
ATTENTION OF

December 12, 2014

Office of the Chief
Planning Division

Mr. Andrew Salas
Chairperson
Gabrieleno Band of Mission Indians
P.O. Box 393
Covina, California 91723

Dear Mr. Salas:

The U.S. Army Corps of Engineers (Corps), Los Angeles District, is preparing environmental and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project (LARER), along and within the Los Angeles River, Los Angeles County, California. The LARER is an ecosystem restoration project that would create ground and visual disturbance along the River near downtown Los Angeles (enclosure 1).

The Draft Integrated Feasibility Report (IFR) for the proposed project, (which also serves as the Environmental Impact Statement/Environmental Impact Report), was available for public review from September 13, 2013 through November 18, 2013. A CD containing the Draft IFR is enclosed for reference (enclosure 2).

The Draft IFR identified Alternative 13 as the Tentatively Selected Plan. Subsequently, the Corps and the non-federal sponsor (City of Los Angeles) have identified a more comprehensive restoration plan, Alternative 20, as the Locally Preferred Plan. Alternative 20 will be the Recommended Plan in the Final IFR.

The proposed project is to restore approximately 11 miles of the Los Angeles River from Griffith Park to downtown Los Angeles by reestablishing riparian strand, freshwater marsh, and aquatic habitat communities while maintaining existing levels of flood risk management. A secondary purpose is to provide recreational opportunities consistent with the restored ecosystem within this 11-mile reach of the river. A more detailed project description is included in enclosure 3.

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project. Some undisturbed and intact subsurface deposits may still be present. As construction may disturb these areas we would include the possibility for encountering buried cultural remains within the vertical APE. The vertical APE varies greatly from a few inches to several feet. Horizontally we are proposing a one-eighth mile buffer around each depicted feature for noise and visual impacts. For clarity we have depicted the APE (without the one-eighth mile buffer) on both the USGS topographic map, and an aerial view (enclosures 4 and 5). Each measure and project feature is detailed in the legend. In a letter dater September 5, 2014 we initiated the Section 106 process with the California State Historic Preservation Officer (SHPO) by requesting their comments on the appropriateness of the APE for the proposed undertaking (pursuant to §800.4[a][1]). SHPO has not responded as of the date of this letter.

The Corps requested a Sacred Lands File search and a Native American contact list from the Native American Heritage Commission (NAHC) dated July 16, 2012. The NAHC responded by indicating that there are cultural resources within the general area of the proposed APE (Enclosure 6). In addition to this information, we corresponded with the Gabrielino/Tongva prior to publishing the Draft IFR, and they were also sent copies of the document to obtain their concerns during the public review period. No responses were received. Although not Federally Recognized, communication with the Gabrielino/Tongva Tribal contacts will continue throughout the life of the project.

We have decided to pursue a Programmatic Agreement as the path to Section 106 compliance in accordance with 36 CFR 800.14(b)(ii). This project will be constructed over a number of years, and at this time the information we have is based on a records and literature search.

With this letter we are requesting your comments on the APE and draft PA (enclosure 7).

Please review the enclosed information, and respond at your earliest convenience. Preferably we would appreciate a response within thirty days. However, we will consider and respond to your comments throughout the life of the project. If you have any further questions on this project please call John J. Killeen, R.P.A. at (213) 452-3861. He may also be reached by e-mail at john.j.killeen@usace.army.mil.

Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
915 Wilshire Boulevard, Suite 930
LOS ANGELES, CALIFORNIA 90017-3401

REPLY TO
ATTENTION OF

December 12, 2014

Office of the Chief
Planning Division

Mr. Ronnie Salas
Cultural Preservation Department
Fernadeno Taraviam Band of Mission Indians
1019 - 2nd Street

Dear Mr. Salas:

The U.S. Army Corps of Engineers (Corps), Los Angeles District, is preparing environmental and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project (LARER), along and within the Los Angeles River, Los Angeles County, California. The LARER is an ecosystem restoration project that would create ground and visual disturbance along the River near downtown Los Angeles (enclosure 1).

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The proposed project is to restore approximately 11 miles of the Los Angeles River from Griffith Park to downtown Los Angeles by reestablishing riparian strand, freshwater marsh, and aquatic habitat communities while maintaining existing levels of flood risk management. A secondary purpose is to provide recreational opportunities consistent with the restored ecosystem within this 11-mile reach of the river. A more detailed project description is included in enclosure 3.

Based on the current proposed project description, we have delineated an Area of Potential Effects (APE). The APE includes both direct and indirect effects that may occur from implementation of the undertaking. The enclosed APE map designates the portions of the project that would experience direct ground-disturbing activities. In addition, the APE includes a reasonable and good-faith effort to capture the potential for visual, auditory, and other non-direct effects. Ground disturbance will occur mostly in areas that were previously disturbed by construction of the original concrete lined flood control channel. There are virtually no undisturbed ground surfaces in this highly urbanized environment through the entire reach of the

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Please review the enclosed information, and respond at your earliest convenience. Preferably we would appreciate a response within thirty days. However, we will consider and respond to your comments throughout the life of the project. If you have any further questions on this project please call John J. Killeen, R.P.A. at (213) 452-3861. He may also be reached by e-mail at john.j.killeen@usace.army.mil.

Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
915 Wilshire Boulevard, Suite 930
LOS ANGELES, CALIFORNIA 90017-3401

REPLY TO
ATTENTION OF

December 12, 2014

Office of the Chief
Planning Division

Mr. Ron Andrade
Director
Los Angeles City
and County Native American Indian Commission
3175 West 6th Street, Room 403
Los Angeles, California 90020

Dear Mr. Andrade:

The U.S. Army Corps of Engineers (Corps), Los Angeles District, is preparing environmental and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project (LARER), along and within the Los Angeles River, Los Angeles County, California. The LARER is an ecosystem restoration project that would create ground and visual disturbance along the River near downtown Los Angeles (enclosure 1).

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The proposed project is to restore approximately 11 miles of the Los Angeles River from Griffith Park to downtown Los Angeles by reestablishing riparian strand, freshwater marsh, and aquatic habitat communities while maintaining existing levels of flood risk management. A secondary purpose is to provide recreational opportunities consistent with the restored ecosystem within this 11-mile reach of the river. A more detailed project description is included in enclosure 3.

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Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
915 Wilshire Boulevard, Suite 930
LOS ANGELES, CALIFORNIA 90017-3401

REPLY TO
ATTENTION OF

December 12, 2014

Office of the Chief
Planning Division

Mr. Craig Sap
District Superintendent
Angeles and Channel Coast Districts
California State Parks
1925 Las Virgenes Road
Calabasas, California 91302

Dear Mr. Sap:

The U.S. Army Corps of Engineers (Corps), Los Angeles District, is preparing environmental and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project (LARER), along and within the Los Angeles River, Los Angeles County, California. The LARER is an ecosystem restoration project that would create ground and visual disturbance along the River near downtown Los Angeles (enclosure 1).

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Sincerely,

Josephine R. Axt

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
915 Wilshire Boulevard, Suite 930
LOS ANGELES, CALIFORNIA 90017-3401

REPLY TO
ATTENTION OF

December 12, 2014

Office of the Chief
Planning Division

Ms. Cindi M. Alvitre
Chairwoman-Manisar
Ti'At Society/Inter-Tribal Council of Pimu
3094 Mace Avenue, Apartment B
Costa Mesa, California 92626

Dear Ms. Alvitre:

The U.S. Army Corps of Engineers (Corps), Los Angeles District, is preparing environmental and cultural resources documentation for the proposed Los Angeles River Ecosystem Restoration Project (LARER), along and within the Los Angeles River, Los Angeles County, California. The LARER is an ecosystem restoration project that would create ground and visual disturbance along the River near downtown Los Angeles (enclosure 1).

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Sincerely,

Josephine R. Axt, Ph.D.
Chief, Planning Division

Enclosure(s)

N
W
E
S
CALIFORNIA
Sacramento
San Francisco
PACIFIC OCEAN
Los Angeles
Study Area
San Diego
Data Source: ESRI 2008, Census 2012
Miles
0
50
100

ENCLOSURE #1

Enclosure #3

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

This alternative provides the most extensive restoration and includes measures in all eight reaches with channel widening at Verdugo Wash, Arroyo Seco, Cornfield/LA State Historic Park, and Piggyback Yard. Features of Alterative 20 are similar to those included in Alternative 13, but are more extensive in scope. Sub-measures under this alternative would be implemented in all reaches (1-8) throughout the study area and include:

- Riparian planting of habitat corridors (reaches 1,2,3,4,5,6,7,8)
- Bioengineer channel walls (reach 5)
- Trapezoidal to vertical walls (reaches 2,5)
- Create/rebuild channel geomorphology (reaches 3,4,5,7,8)
- Divert flow into channels (reaches 3,4,7,8)
- Widen channel (reach 3,8)
- Widen tributaries (reach 3)
- Expose/daylight stormdrain outlets (reaches 4,5,7)
- Channel bed deepening (reach 5)
- Terrace banks (reaches 5,6,7, 8)
- Elevate railroad (reaches 7,8)

Reach 1 – Reach 1 for all alternatives in the final array would implement the habitat corridor with riparian planting on the overbanks. This would restore approximately 60 acres of riparian habitat corridors along the overbanks of both sides of the river. 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 Pollywog Park, the bank between Headworks and the River with a connection under SR-134 to Headworks, the open area directly downstream of Headworks with a connection under Forest Lawn Drive on the same side of SR-134 with Headworks, and on the left bank of Burbank Western Channel (tributary from the north/west).

This 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, creating a hydrologic connection. Soil amendments would be required. 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. There would be no 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* –** Like Alternatives 10, 13, and 16, implementation of the habitat corridors/riparian planting measure would result in restoration of approximately 26 acres of riparian habitat corridors along the overbanks of both sides of the river as described for Reach 1. 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. This reach is soft bottom and would include invasives management in the existing vegetation in the channel and on the overbank. Unlike the other alternatives, Alternative 20 would add additional modification in Reach 2. The right bank would be modified from trapezoidal to a vertical bank creating 80 feet of additional soft bottom width in the channel with overhanging vines.

Reach 3 – In this reach a side channel would divert water from the river into a side channel flowing on the west side of Ferraro Fields and would daylight a stream currently confined in a large culvert just downstream of Ferraro Fields on the right bank in the Zoo Drive area. The side channel would support a riparian fringe, and open water and freshwater marsh will be located in the daylighted area outside of the mainstem of the River channel. Two additional smaller streams would be daylighted on the left bank. These would include a riparian fringe with freshwater marsh at the confluence. Riparian areas are located on the right or west bank along Zoo Drive, on the River's edge of Ferraro Fields, and between the daylighted streams on the left or east bank. There would be no modifications to the channel itself. In the Verdugo Wash confluence, the channel mouth will be widened and the south slope 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. Levee protection would be tied-in to the bank, and other levee protection will remain. Levee vegetation policy will be followed. Modifications at the Verdugo Wash confluence are not expected to impact the tracks along San Fernando Road under the 134 Freeway or affect ongoing railroad operations. Modifications at the confluence may affect grade separation proposals for Doran Street. Details for the confluence area will be determined during the detailed design phase of the study. Acquisition of several parcels at the confluence area is anticipated if this feature is included.

***Reach 4* –** Restoration in Reach 4 (via implementation of measures to daylight and restore stream geomorphology and habitat in seven areas, a side channel through both the Griffith Park Golf Course on the west and the Los Feliz Golf Course on the east bank, and a riparian habitat corridor) would include approximately 30 acres of restored riparian and wetland habitat. This would be accomplished through a diversion of river flow into a side channel up to 10 feet deep with a riparian fringe through Griffith Park on the right bank, lining the left river bank with a riparian corridor within levee regulation requirements, and daylighting approximately seven small streams.

The riparian corridor measure would involve planting a riparian strip of mugwort and scarlet monkeyflower with a buffer of 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, creating a hydrologic connection. Soil amendments would be required. Establishment and drought management for this vegetation would utilize irrigation, which would be either through flood irrigation (simulating a natural riparian regime) or drip irrigation, dependent upon the availability of water. This would be implemented as continuously as possible within the requirements of levee regulations. There would be no channel modifications within this reach.

The storm drains 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. 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.

Reach 5 – 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 river bed by over 100 feet. The top of the bank would be notched and planted with overhanging vines. The left bank would be modified with terraces planted with herbaceous vegetation and necessary erosion measures, which would consist of concrete-lined beds. The inland bank would be planted with riparian 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. All of these measures would comply with levee vegetation regulations.

Reach 6 – Reach 6 in this alternative includes riparian corridors and widening of the soft bottom river bed by over 300 feet with additional slope back to the overbank elevation along the reach length approximately 1,000 feet. At the upstream end of the reach, a back water wetland would be developed on a setback bench and there would be a small terraced area at the downstream end of the Bowtie parcel. Freshwater marsh would dominate the new river bed. The banks of the river would be restructured to support overhanging vines and other vegetation. Restructuring the banks may impact the existing roadway used for maintenance access along the east bank of the River. A new road would be provided for SCRRA maintenance crews to allow access to the facilities.

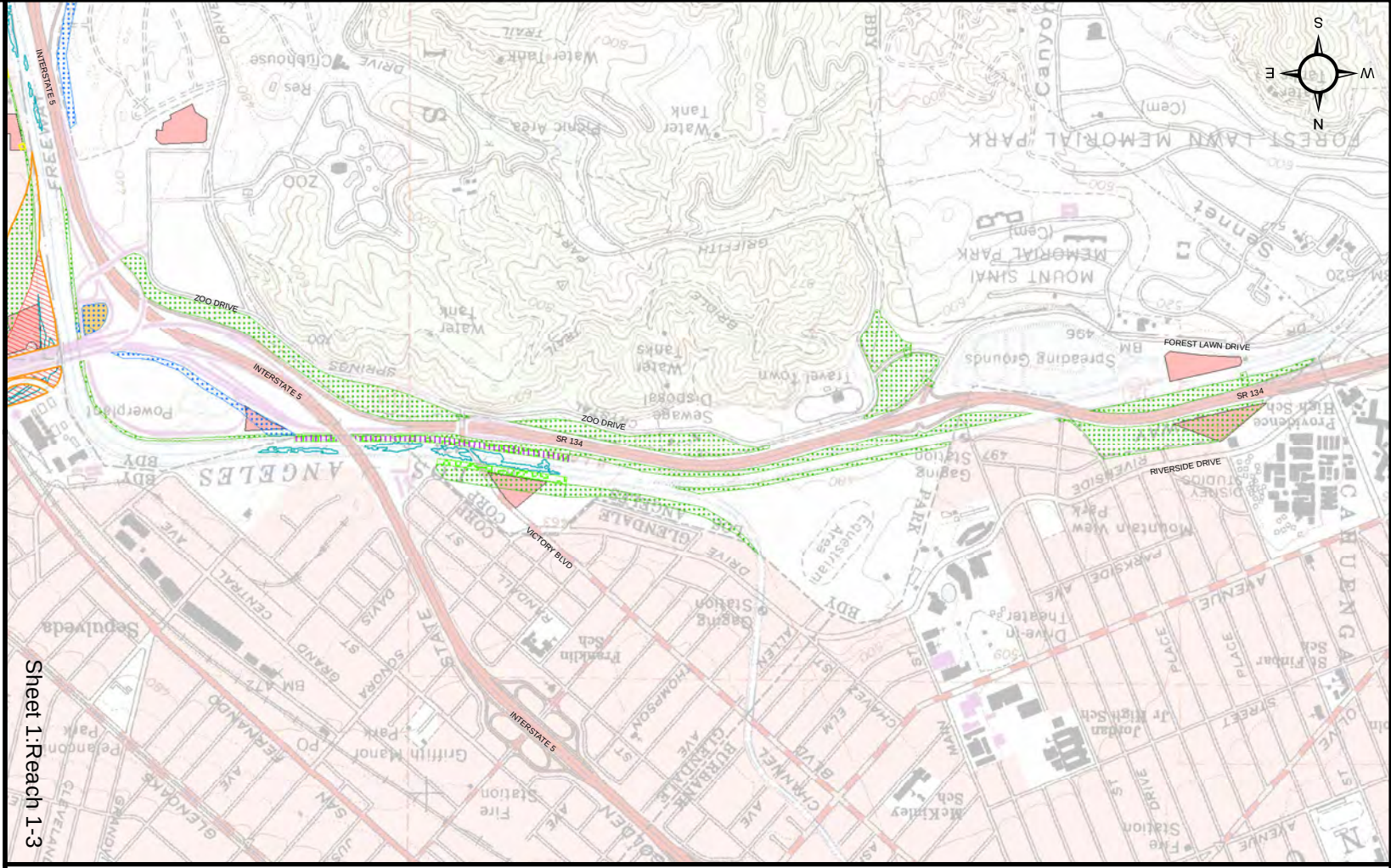
Reach 7 – In Reach 7, the Arroyo Seco tributary would be restored with riparian habitat. This ephemeral stream would have the banks and bed softened for approximately one half mile upstream and would be stabilized with erosion control elements to maintain the existing protection. At the confluence on the upstream edge of the Los Angeles River, a backwater riparian wetland and marsh would be established. Within the River channel itself, the banks would be restructured to support vegetation on the banks. Downstream, freshwater marsh would be restored and connected under a railroad trestle with the right bank of the river channel terraced.

Reach 8 – Reach 8 would be modified with terracing on the right bank upstream of Piggyback Yard and on the left bank downstream of Piggyback Yard. This terracing would be planted with riparian vegetation. The channel would be changed from concrete to soft bottom to support freshwater marsh, and the reach would be widened. The marsh would extend into the Piggyback Yard 500 feet, with riparian area extending another 1,000 feet into Piggyback Yard, gradually sloping up to existing bank elevations. The historical wash would be restored through the property with a riparian fringe as well as other side channels, and river flows would be diverted out of the River into Piggyback Yard creating a large wetland area. A railroad trestle would be included with this alternative to allow the described restoration to occur and allowing for the connection of the river channel and the adjacent restored areas

.

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

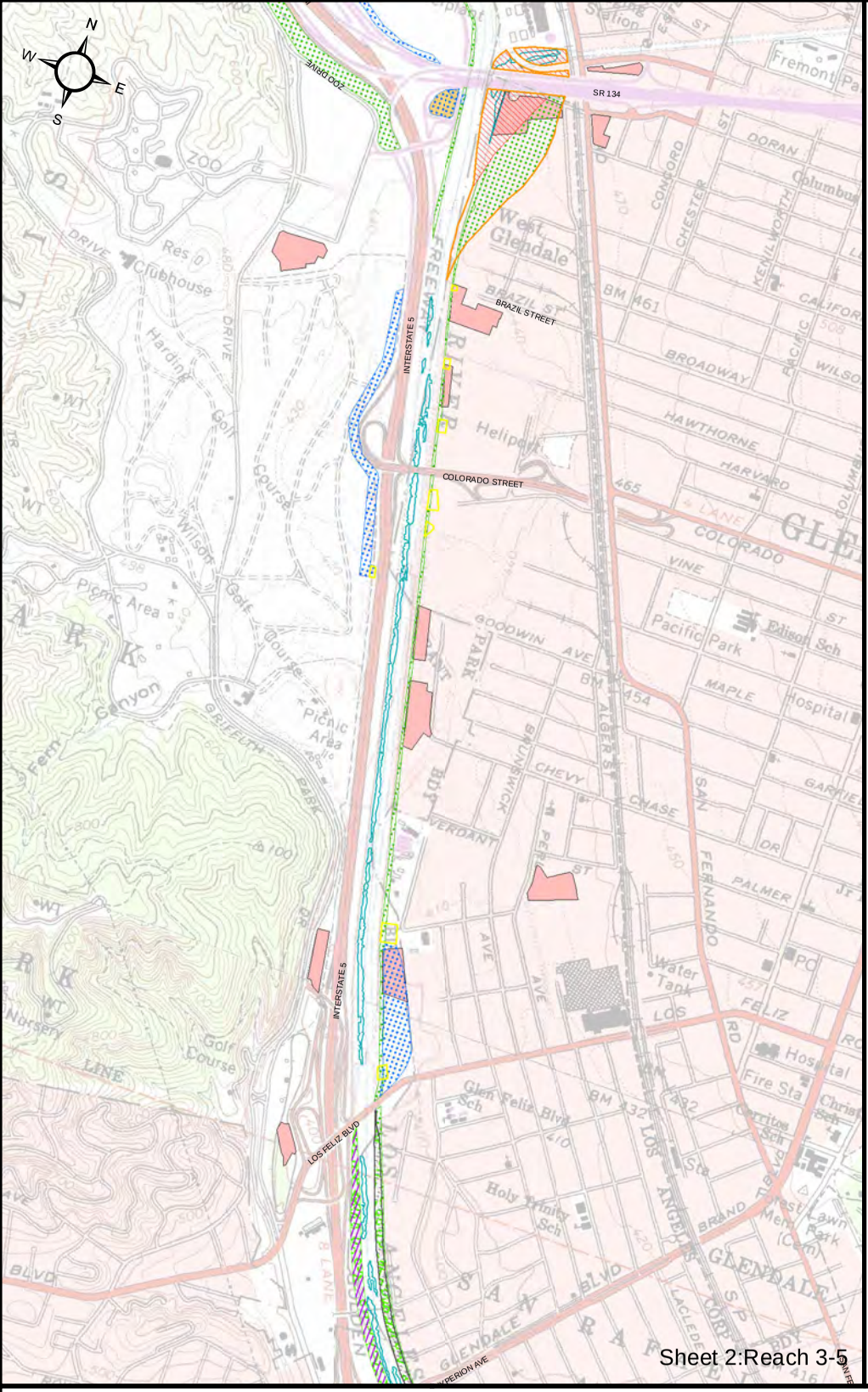
Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)



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



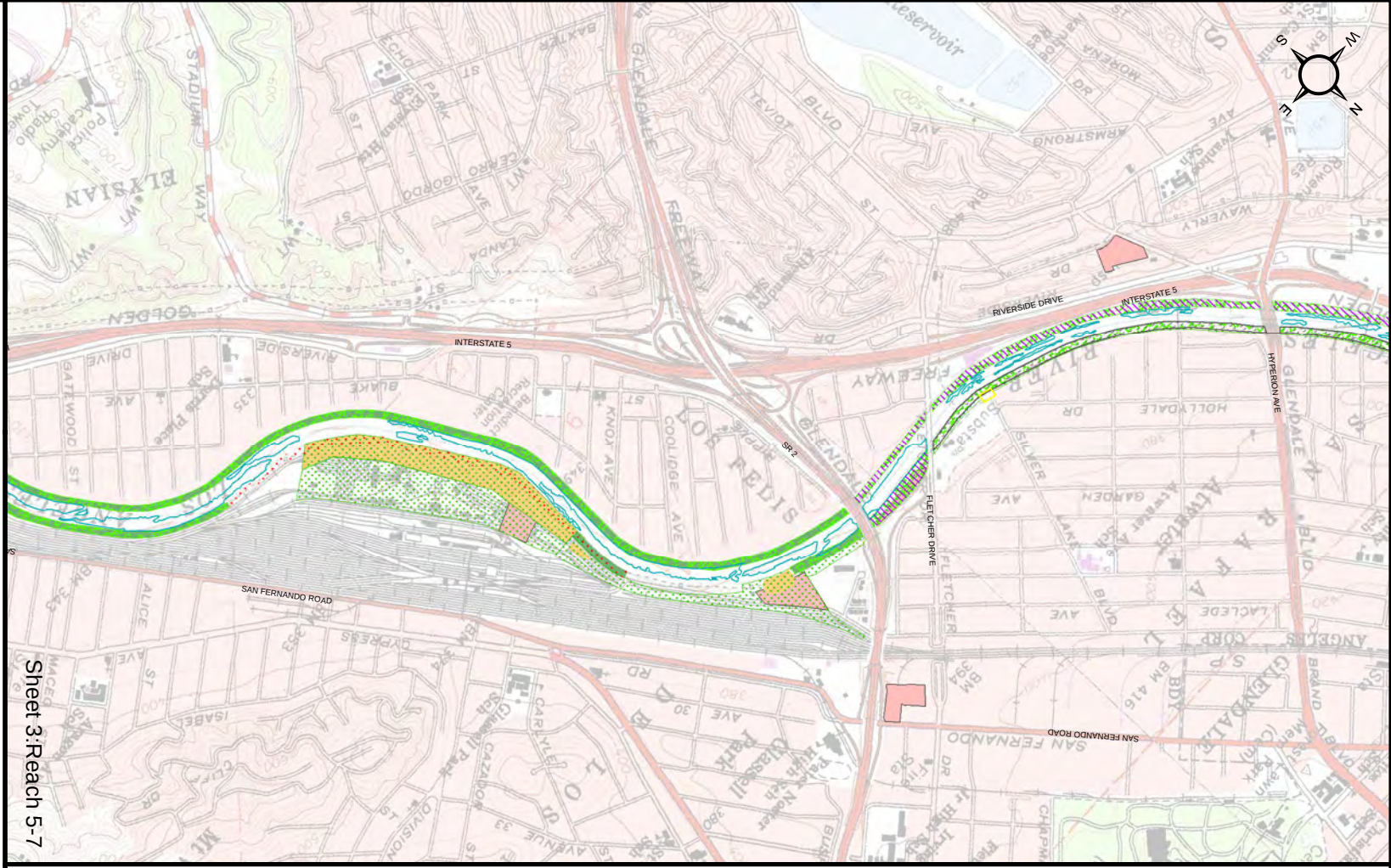
LEGEND
Sub-Measures

- 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

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

0 0.2 0.4 Miles



Sheet 3:Reach 5-7

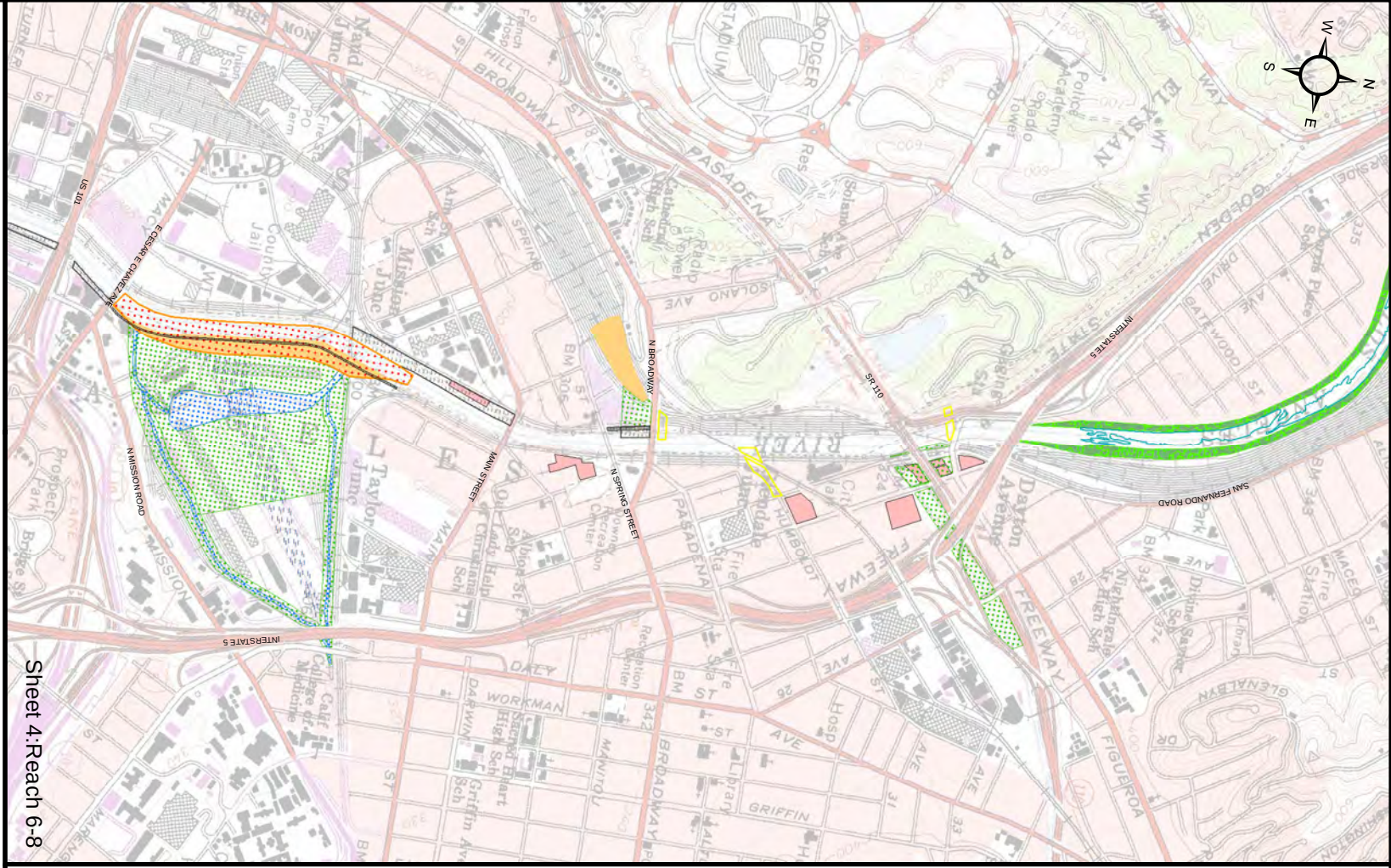
LEGEND
Sub-Measures

- 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

0 0.2 0.4 Miles

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

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

0 0.2 0.4 Miles

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

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

0 0.2 0.4 Miles

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Sheet 2:Reach 3-5

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

0 0.2 0.4 Miles

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

Sheet 3:Reach 5-7

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

0 0.2 0.4 Miles

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

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

0 0.2 0.4 Miles

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

Alternative 20, ARBOR, Riparian Integration via Varied Ecological Restoration (RIVER)
Los Angeles River Ecosystem Restoration (Feb, 2013)

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
Web Site www.nahc.ca.gov
e-mail: ds_nahc@pacbell.net

July 16, 2012

Mr. Stephen Dibble, Archaeologist
United States Army Corps of Engineers
Los Angeles District Office
915 Wilshire Boulevard
Los Angeles, CA 90017

Sent by FAX to: (213) 452-4204 and (213) 452-4219
No. of Pages: 4

Re: Request of Sacred Lands File & Native American Contacts List , pursuant to 36 CFR Part 800, Protection of Historic Properties (NHPA Section 106; 16 U.S.C. 470 *et* seq) for the **"Los Angeles River Ecosystem Restoration Project;"** located on the Los Angeles River near Downtown Los Angeles; Los Angeles County, California.

Dear Mr. Dibble:

The Native American Heritage Commission (NAHC) is the California State 'Trustee Agency' pursuant to Public Resources Code §21070 for the protection of California's Native American Cultural Resources. The NAHC is also a 'reviewing agency' for environmental documents prepared under the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq*), 36 CFR Part 800.3, .5 and are subject to the Tribal and interested Native American consultation as required by the National Historic Preservation Act, as amended (Section 106) (16 U.S.C. 470; Section 106, [4f], 110 [f] [k], 304). The provisions of the Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. 3001-3013) and its implementation (43 CFR Part 10.2), and California Government Code §27491 may apply to this project if Native American human remains are inadvertently discovered.

The NAHC is of the opinion that the federal standards, pursuant to the above-referenced Acts and the Council on Environmental Quality (CSQ; 42 U.S.C. 4371 *et seq*) are similar to and in many cases more stringent with regard to the 'significance' of historic, including Native American items, and archaeological, including Native American items at least equal to the California Environmental Quality Act (CEQA.). In most cases, federal environmental policy require that any project that causes a substantial adverse change in the significance of an historical resource, that includes archaeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Statement (EIS).

The NAHC did conduct a Sacred Lands File (SLF) search of its Inventory and Native American cultural resources **were identified** in the area you specified. Early and quality consultation with the Native American representatives on the attached list may provide detailed information of sites with which they are aware. Also note that the absence of archaeological resources does not preclude their existence, particularly at the subsurface level.

The NAHC Sacred Lands File Inventory of the Native American Heritage Commission is established by the California Legislature pursuant to California Public Resources Code §§5097.94(a) and 5097.96. The NAHC Sacred Lands Inventory is populated by submission to

the data by Native American tribes and Native American elders. In this way it differs from the California and National Register of Historic Places under the jurisdiction of the U.S. Secretary of the Interior.

The NAHC, pursuant to Appendix B of the Guidelines to the California Environmental Quality Act (CEQA) is designated as the agency with expertise in the areas of issues of cultural significance to California Native American communities. Also, in the 1985 California Appellate Court decision (170 Cal App 3rd 604), the court held that the NAHC has jurisdiction and special expertise, as a state agency, over affected Native American resources, impacted by proposed projects including archaeological, places of religious significance to Native Americans and burial sites

Culturally affiliated tribes are to be consulted to determine possible project impacts pursuant to the National Historic Preservation Act, as amended. Early consultation with Native American tribes in your area is the best way to avoid unanticipated discoveries once a project is underway. The NAHC recommends as part of 'due diligence', that you also contact the nearest Information Center of the California Historical Resources Information System (CHRIS) of the State Historic Preservation Office (SHPO) for other possible recorded sites in or near the APE (contact the Office of Historic Preservation at 916-445-7000).

Attached is a list of Native American contacts is attached to assist you pursuanat to Section 800.2(c)(1)(i) and Section 800.2(c)(2); they may have knowledge of cultural resources in the project area. It is advisable to contact the persons listed and seek to establish a 'trust' relationship with them; if they cannot supply you with specific information about the impact on cultural resources, they may be able to refer you to another tribe or person knowledgeable of the cultural resources in or near the affected project area.

Lead agencies should consider avoidance, in the case of cultural resources that are discovered. A tribe or Native American individual may be the only source of information about a cultural resource; this is consistent with the NHPA (16 U.S.C. 470 *et seq* Sections. 106, 110, and 304) Section 106 Guidelines amended in 2009. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful

NEPA regulations provide for provisions for accidentally discovered archeological resources during construction and mandate the processes to be followed in the event of an accidental discovery of any human remains in a project location other than a 'dedicated cemetery. Even though a discovery may be in federal property, California Government Code §27460 should be followed in the event of an accidental discovery of human remains during any groundbreaking activity; in such cases California Government Code §27491 and California Health & Safety Code §7050.5 will apply and construction cease in the affected area.

If you have any questions about this response to your request, please do not hesitate to contact me at (916) 653-6251.

Sincerely,

Dave Singleton

Cc: State Clearinghouse

Native American Contact
Los Angeles County
July 16, 2012

Fernandeno Tataviam Band of Mission Indians
Ronnie Salas, Cultural Preservation Department
1019 - 2nd Street, Suite #1
San Fernando CA 91340
rsalas@tataviam-nsn.gov
(818) 837-0794 Office

(818) 837-0796 Fax

Fernandeno Tataviam

Gabrieleno/Tongva San Gabriel Band of Mission
Anthony Morales, Chairperson
PO Box 693
San Gabriel , CA 91778
GTTribalcouncil@aol.com
(626) 286-1632
(626) 286-1758 - Home
(626) 286-1262 -FAX

Gabrielino Tongva

LA City/County Native American Indian Comm
Ron Andrade, Director
3175 West 6th St, Rm. 403
Los Angeles , CA 90020
randrade@css.lacounty.gov
(213) 351-5324
(213) 386-3995 FAX

Gabrielino Tongva Nation
Sam Dunlap, Chairperson
P.O. Box 86908
Los Angeles , CA 90086
samdunlap@earthlink.net

(909) 262-9351 - cell

Gabrielino Tongva

Ti'At Society/Inter-Tribal Council of Pimu
Cindi M. Alvitre, Chairwoman-Manisar
3094 Mace Avenue, Apt. B
Costa Mesa, , CA 92626
calvitre@yahoo.com
(714) 504-2468 Cell

Gabrielino

Gabrielino Tongva Indians of California Tribal Council
Robert F. Dorame, Tribal Chair/Cultural Resources
P.O. Box 490
Bellflower , CA 90707
gtongva@verizon.net
562-761-6417 - voice
562-761-6417- fax

Gabrielino Tongva

Tongva Ancestral Territorial Tribal Nation
John Tommy Rosas, Tribal Admin.
Private Address
,
tattnlaw@gmail.com
310-570-6567

Gabrielino Tongva

Gabrielino-Tongva Tribe
Bernie Acuna
1875 Century Pk East #1500
Los Angeles , CA 90067
(619) 294-6660-work
(310) 428-5690 - cell
(310) 587-0170 - FAX
bacuna1@gabrieinotribe.org

Gabrielino

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed Los Angeles River Ecosystem Restoration Project; located near Downtown Los Angeles; Los Angeles County, California for which a Sacred Lands File search and Native American Contacts list were requested.

Native American Contact
Los Angeles County
July 16, 2012

Gabrielino-Tongva Tribe
Linda Candelaria, Chairwoman
1875 Century Pk East #1500 Gabrielino
Los Angeles , CA 90067
lcandelaria1@gabrielinoTribe.org
626-676-1184- cell
(310) 587-0170 - FAX

Gabrieleno Band of Mission Indians
Andrew Salas, Chairperson
P.O. Box 393 Gabrielino
Covina , CA 91723
(626) 926-4131
gabrielenoindians@yahoo.
com

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed Los Angeles River Ecosystem Restoration Project; located near Downtown Los Angeles; Los Angeles County, California for which a Sacred Lands File search and Native American Contacts list were requested.

US Army Corps
of Engineers®
Los Angeles District

Los Angeles River Ecosystem Restoration Feasibility Study

APPENDIX P
Letters and Guidance Memoranda

September 2015

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3. City of Los Angeles, Mayor's Office to District Commander Colonel Kimberly M. Colloton, Memorandum Subject: Seeking Approval to Proceed with Alternative 20, 10 April 2014

4. ASA(CW) to USACE Headquarters, Deputy Commanding General for Civil and Emergency Operations, Memorandum Subject: Cost Sharing and the Locally Preferred Plan (LPP), 27 May 2014

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ANTONIO R. VILLARAIGOSA
MAYOR

March 22, 2013

Colonel R. Mark Toy
Los Angeles District Commander
United States Army Corps of Engineers
915 Wilshire Boulevard, Suite 1100
Los Angeles, CA 90017

Dear Colonel Toy:

I write to inform you that the City of Los Angeles, as local sponsor of the Corps' Los Angeles River Ecosystem Restoration Feasibility Study (River Study), is supportive of the Los Angeles District's request for a real estate policy waiver for the River Study. The waiver will enable the recommended project to be built and the City of Los Angeles will forego the reimbursement for real estate-related costs above the thirty-five percent to support the project.

As you know, the River Study has advanced to a stage that has identified a set of viable alternatives. Cost estimates for the alternatives are indicative of the challenges we face in urban areas. Large cities such as Los Angeles with high land value may be stretched to meet the corps criteria for local match. In this particular case the City of Los Angeles believes that our best approach is to mirror the approach that Chicago took in 2011(Upper Des Plaines River and Tributaries, Illinois and Wisconsin Feasibility Study). In that case the City of Chicago whose land value was also high was willing to forego reimbursement above the 35%. The City of Los Angeles is prepared to do the same.

Although prevailing Corps policy indicates that projects with land costs exceeding 25% of the total project cost are not likely to be given a high priority for budgetary purposes, we are hopeful that our demonstrated commitment to the Los Angeles River and our productive partnership with the Corps will enable us to transform urban rivers like the LA River into a valuable economic, environmental and recreational asset for the region.

Very truly yours,

ANTONIO R. VILLARAIGOSA
Mayor

200 NORTH SPRING STREET • LOS ANGELES, CALIFORNIA 90012
PHONE: (213) 978-0600 • FAX: (213) 978-0750
EMAIL: MAYOR@LACITY.ORG

ARV:dg

cc: Nancy Sutley Chair, Council on Environmental Quality, Executive Office of the President
Jeffrey Zients, Acting Director, Office of Management and Budget, Executive Office of the President
Jo-Ellen Darcy, Assistant Secretary of the Army for Civil Works
Ed P. Reyes, Los Angeles City Councilmember, District One
Sally Ericsson, Associate Director, Natural Resources Programs, Office of Management and Budget
Gary Lee Moore, P.E., City Engineer

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

AUG - 8 2013

MEMORANDUM FOR DIRECTOR OF CIVIL WORKS

SUBJECT: Los Angeles River Ecosystem Restoration Feasibility Study, California – Real Estate Waiver

In response to a July 11, 2013 memorandum from the Chief, Planning and Policy Division, I have evaluated the Corps request for me to grant an exemption to the Army policy in order to allow the city of Los Angeles to forego reimbursement for real estate acquisition which may exceed the legislated 35 percent non-federal share of a Los Angeles River ecosystem restoration project. In a March 22, 2013 letter to the District Engineer, the Mayor of Los Angeles stated that the city would forego reimbursement for real estate costs in excess of the 35 percent non-federal share. The city indicated that they believe that their action would enable a project to be built to restore fish and wildlife habitat in the Los Angeles River corridor.

According to the Corps, the final array of alternatives includes four plans with total costs that range between about $350 million, to over $1 billion. Real Estate costs could range from 45 percent to as much as 85 percent of the project costs. Additionally, the city would be responsible for providing clean lands for the project that are consistent with guidance for hazardous, toxic, and radiological waste.

While I cannot support the city's conclusion that foregoing reimbursement would automatically enable the project to be built, I am granting this requested exception. The feasibility report should clearly state that the city of Los Angeles has voluntarily agreed to waive reimbursement for the value of real estate above the 35 percent share and explicitly document the estimated real estate costs as well as an estimate of the reimbursement waived. I am withholding my evaluation of whatever plan the Chief of Engineers may ultimately recommend until he provides his report for my review.

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

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ERIC GARCETTI
MAYOR

April 10, 2014

Colonel Kimberly M. Colloton, PMP
Commander and District Engineer
United States Army Corps of Engineers
Los Angeles District
915 Wilshire Boulevard
Los Angeles, CA 90053

Dear Colonel Colloton:

I am writing to continue our discussion that started at the White House on October 28, 2013. I was encouraged by your acknowledgment of the importance of our Los Angeles River Ecosystem Restoration Feasibility Study (Study) and understanding that its completion requires an unprecedented kind of collaboration to explore options that will successfully reflect the Administration's *America's Great Outdoors* and *Urban Waters Federal Partnership* initiatives, which have already prioritized the Los Angeles River.

The City of Los Angeles has been a fully-engaged local sponsor of the Study for 8 years, has committed to its 50% share of the more than $10 million cost, and has attracted funding from a long-standing community partner—Friends of the Los Angeles River—of almost $1 million. The City has also expressed a willingness to assume more than the traditional 35% of the cost of the Study's recommended project.

Although I was informed by representatives from the U.S. Army Corps of Engineers (Corps) South Pacific Division (SPD) and Los Angeles District (SPL) that the Corps has thus far sustained its recommendation for Alternative 13 as the National Ecosystem Restoration (NER) and Tentatively Selected Plan (TSP), the overwhelming response from the public was for the more ambitious Alternative 20. During the Study's public review (from September to November 2013), at a public rally on September 28, and at the official hearing on October 17, the clear majority of comments were in favor of Alternative 20. Among these, the Los Angeles and Glendale City Councils, Los Angeles County Board of Supervisors, Los Angeles Unified School District, State legislators, U.S. Environmental Protection Agency, U.S. Department of the Interior, U.S. Congressional delegation representing the Los Angeles region, every major environmental organization, and more than 8,000 petitioners all endorsed Alternative 20.

Given this, I believe that the Corps' "public acceptability" criterion cannot be met with Alternative 13. The public responses also underscored that our Study is the only large urban project of its

kind in the nation's only Mediterranean-type climate, which is a globally-scarce resource. While habitat connectivity was repeatedly referenced as undervalued in the Study analysis, I believe that other factors that were emphasized, including an opportunity to redress historic environmental injustices, are as critical. Moreover, while I understand that the Study cost may be considerable when compared to other ecosystem restoration efforts, the national ecosystem investment is more than worthwhile when understood as a dollar-per-person investment, not just a dollar-per-acre investment.

Specifically, we must include restoration at the Verdugo Wash confluence because it is the only connection between our largest open space, Griffith Park, and the Verdugo Hills and because it is the only major restoration area that would also benefit our neighboring cities of Burbank and Glendale. We must also make connections between the large restoration areas at the Los Angeles State Historic Park and in the river channel between the William Mead public housing complex and César Chávez Avenue. These benefits are only in Alternative 20 and, without Corps leadership, are unlikely to happen.

On August 23, 2013, the elected representatives of the Los Angeles City Council adopted a resolution supporting the most comprehensive Study alternative—with elements that are only included in Alternative 20—as the NER/TSP. As outlined in the Study, Alternative 20 would require a Federal cost-share of 54% to a Non-Federal cost-share of 46%. Consistent with your August 8, 2013 approval of the City's request to waive Federal reimbursement above the typical 35% cost-share commitment of local sponsors, I am now offering to advance Alternative 20 at a more equitable 50% to 50% cost-share whereby the City will provide approximately $44 million more for its match. This results in more than $160 million in savings to the Federal government beyond the traditional cost-share relationship.

I am hereby seeking your approval to proceed with this plan. The City acknowledges its commitment to acquire the necessary real estate interests and its responsibility for the costs of 50% of the project's planning, engineering, design, and construction. Upon your approval, I therefore request that this plan be identified in the Final Integrated Feasibility Report/Environmental Impact Statement/Report as the recommended plan and, because this path forward may extend our completion date beyond December 2014, I am also hereby requesting your assistance in obtaining an exemption from the "3x3x3 Rule" as per CECW-P PB No. 2012-04, reissued January 11, 2013. Given the time-sensitive nature of our case, your swift response would be much appreciated.

I am grateful for your and the Corps' championing of our Study and am eager to work with you in crafting this new kind of project in the Federal interest that will reflect long-standing local priorities and the principles of your new planning paradigm while honoring our Nation's urban future.

Sincerely,

ERIC GARCETTI
Mayor

Cc:
Hon. Jo-Ellen Darcy, Assistant Secretary of the Army (Civil Works)

Attachment:
Combined file including real estate waiver, Los Angeles City Council resolution and key support letters

DEPARTMENT OF THE ARMY
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MAY 27 2014

MEMORANDUM FOR DEPUTY COMMANDING GENERAL FOR CIVIL AND EMERGENCY OPERATIONS

SUBJECT: Los Angeles River Aquatic Ecosystem Restoration Feasibility Study, California – Request for Policy Exceptions

I am responding to the May 12, 2014 memorandum from the Director of Civil Works (DCW) which requested an exception to Army policy requiring decision documents to recommend the national environmental restoration (NER) plan. The exception would allow the Chief of Engineers to recommend Alternative 20 as the locally preferred plan (LPP) for the Los Angeles River Aquatic Ecosystem Restoration project. The DCW indicated that the City of Los Angeles, as the non-Federal sponsor, supports the LPP in lieu of the NER plan in order to provide additional restoration that is vital to local interests. The DCW also provided a copy of an April 14, 2014 letter from the City of Los Angeles which requested that the LPP be cost shared equally between the Federal government and City of Los Angeles.

Based on the information from the Corps, the LPP would include additional restoration benefits above that identified for the NER plan at Verdugo Wash, the Los Angeles State Historic Park (Cornfields), and at the Los Angeles Trailer and Container Intermodal Facility (LATC) site. These additional restoration benefits include direct restoration of an additional 131 acres, nearly twice the acreage of local and hydrologic connectivity (298 acres total), and provision of a direct connection to the significant habitat areas of the Verdugo Mountains. Nearly unanimous support for the LPP was expressed by the public through review of the Draft Feasibility report and public meetings. Further, the LPP is consistent with the goals of the Los Angeles River Revitalization Master Plan published in 2007 by the City of Los Angeles. After reviewing the materials provided, I believe implementation of the LPP best addresses the public's expressed desire for increased habitat and hydrologic connectivity, regional economic development and recreation, as well as restored community cohesion. I therefore have decided to grant the requested LPP exception and permit the Corps to recommend the LPP in the final feasibility report and the report of the Chief of Engineers. The LPP estimated cost would be $1.08 billion.

Over the last 150 years, the Los Angeles River has been degraded by development, flooding and channelization, including the Corps construction of the Los Angeles County Drainage Area flood risk management project that modified most of the Los Angeles River, with concrete banks and a mostly concrete bed to protect the city and surrounding areas from catastrophic flooding. The Flood Control Act of 1944

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(Public Law 78-534) directed the Corps to construct the Los Angeles County Drainage Area project which ultimately involved construction of 5 dams and over 240 miles of channels to protect communities from significant and recurring flood damages. Restoration of 11 miles of the Los Angeles River that was the focus of the Corps' Los Angeles River Aquatic Ecosystem Restoration Feasibility Study of September, 2013, is within the footprint of the existing flood risk management project. The ecosystem project would in part, reverse a portion of the degradation associated with the existing Los Angeles County Drainage Area project, and concurrently advance a number of important Administration efforts, including the Climate Action Plan, America's Great Outdoors initiative, and the Urban Waters Federal Partnership. The Climate Action Plan would be advanced through improved drought resilience as a consequence of restoration activities and the America's Great Outdoors initiative would be advanced through the provision of increased access to lands and waters for recreation, as well as providing linkages among a variety of recreational facilities including urban parks and habitat corridors. Finally, the Los Angeles River is one of 7 original pilot locations for the Urban Waters Federal Partnership and the proposed restoration activities would advance the goals of restoring the ecosystem and balancing revitalization with flood avoidance to ensure public safety for 11 miles of 51 miles of the Los Angeles River that is the focus of the partnership work.

Quantifications of the connections among restored areas demonstrate the significant benefits to be realized through implementation of the LPP in lieu of the NER plan. Restoration of such connections will involve modifications to the urban river channel by removing concrete and reconfiguring channel walls and widening the channel to restore hydrologic connectivity and additional wetland habitat. The LPP would also provide significantly greater regional economic benefits, including nearly 13,000 more jobs and nearly $3.5 billion in labor income, as well as substantive opportunities for redevelopment in both the Verdugo Wash confluence and Chinatown/Confields areas. Environmental justice benefits would also be realized through restored community cohesion for communities previously separated by the existing Los Angeles County Drainage Area flood risk management project through provision of new public access to restored natural areas with associated recreational amenities. I appreciate the complexities of restoration within the nation's second largest urban region while also continuing to provide important flood risk reduction to an economically challenged community and that such complex projects represent a significant financial investment on the part of both the Federal government and the non-Federal sponsor.

Having fully reviewed and taken into consideration the unique aspects of the project as detailed by the Los Angeles District, the concurrence by other Federal agencies in the plan, the city's willingness to limit the Federal government's exposure to real estate costs beyond 35 percent of project cost as approved in my August 8, 2013 memorandum, and the non-Federal Sponsor's offer to share equally in the costs of the LPP, I have concluded there is substantial Federal interest in the LPP. Equal cost sharing of the LPP between the Federal government and the non-Federal sponsor, as

requested by the City of Los Angeles, would total $540 million each. I have decided to permit the Corps to recommend equal cost sharing of the LPP plan.

These decisions are subject to the Corps incorporating the information discussed above into the final decision documents and subject to the non-Federal sponsor's continued agreement to forgo reimbursement or credit for real estate which may exceed 35 percent of the LPP cost. All other requirements of local cooperation remain the same, including the non-Federal sponsor's requirement to operate, maintain, repair, replace, and rehabilitate (OMRR&R) the project after construction in accordance with Section 103(j) of the WRDA of 1986.

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Los Angeles River Ecosystem Restoration Feasibility Study

Final
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