TECHNICAL MEMORANDUM

FINAL CONCEPTUAL RESTORATION PLAN

CALAVERAS DAM REPLACEMENT PROJECT

Prepared for

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List of Acronyms

CDFG	California Department of Fish and Game
CDRP	Calaveras Dam Replacement Project
cfs	cubic feet per second
DSOD	California Department of Water Resources Division of Safety of Dams
NPDES	National Pollutant Discharge Elimination System
RWQCB	Regional Water Quality Control Board
SFPUC	San Francisco Public Utilities Commission
SWPPP	Stormwater Pollution Prevention Plan
USACE	U.S. Army Corps of Engineers

1 INTRODUCTION

The San Francisco Public Utilities Commission (SFPUC) proposes to replace the Calaveras Dam, which is seismically unsafe, and restore water in the Calaveras Reservoir to its historic pool elevation (a normal elevation of 756 feet). Construction of the Calaveras Dam Replacement Project (CDRP), located in Alameda and Santa Clara counties (Figure 1), would require the use of several borrow areas, disposal sites, staging areas, and haul roads in the vicinity of the Calaveras Reservoir. Construction of the CDRP would result in temporary and permanent impacts to wetlands and other waters of the U.S. and habitats identified as sensitive by the California Department of Fish and Game (CDFG).

The SFPUC will implement this Conceptual Restoration Plan to minimize potential impacts to existing wetlands and other habitats in the project area. This plan describes specific actions that would restore natural vegetation and aquatic resource functions in the project area that would be temporarily or permanently affected by construction activities. Temporary and permanent impacts are defined in this document as follows:

- Temporary impacts - alteration of habitat that will be restored to pre-project conditions or enhanced following the completion of the CDRP. Temporary impacts specifically addressed in this document include the Calaveras Creek low-flow channel below the replacement dam, Staging Areas 1, 5, and 11, and Observation Hill.
- Permanent impacts - substantial modifications to habitats where restoration to pre-project conditions would not be feasible. Areas of permanent impacts that are addressed in this plan include Borrow Area B, Borrow Area E, and Disposal Site 3. Off-site compensation for permanent impacts to habitat is described in the *Sunol Region Mitigation and Monitoring Plan* (URS 2010). However, only a small portion of the area permanently impacted by construction of the CDRP would be precluded from establishment of vegetation following construction. Several permanent impact areas would provide a unique opportunity for targeted reestablishment of habitat. Habitat reestablishment in the project area would minimize erosion and establishment of invasive species and would provide additional habitat for plants and wildlife that will supplement proposed off-site compensation.

Areas of temporary and permanent impacts are described in more detail in the remainder of this document.

1.1 OBJECTIVES OF THIS PLAN

The objectives of this Conceptual Restoration Plan are to minimize habitat impacts associated with the CDRP by restoring some habitat functions after completion of construction. Two categories of restoration are proposed in this plan:

1. **Rehabilitation** of jurisdictional wetlands and other waters temporarily affected by the CDRP, proposed as mitigation for the U.S. Army Corps of Engineers and Regional Water Quality Control Board (RWQCB) permits for compliance with Sections 404 and 401 of the Clean Water Act. Sites that fall into this category would be restored or enhanced following construction to pre-project conditions and, thus, qualify as temporarily affected wetlands and other waters. Two sites are proposed for rehabilitation: Staging Area 1 and the Calaveras Creek low-flow channel (Table 1 and Figure 2).

2. **Reestablishment** of riparian, wetland, scrub, oak savannah, and oak woodland habitats to minimize the project impacts to wetlands, waters, upland vegetation, and wildlife habitats.

The hydrology and topography of several areas will be permanently altered, preventing restoration to pre-project conditions. Compensation for permanent impacts to these habitats will be provided off-site, as described in the *Sunol Region Mitigation and Monitoring Plan* (URS 2010). In addition to the off-site compensation, this Conceptual Restoration Plan proposes to reestablish habitat at Lower Disposal Site 3, Borrow Area B, Borrow Area E, Observation Hill, and Staging Area 5 and 11 (Table 1 and Figure 2).

The SFPUC will reestablish herbaceous vegetation on the remaining project areas as described in Appendix A and consistent with the Storm Water Pollution Prevention Plan (SWPPP). The revegetation effort in these areas would be primarily focused on erosion control. Revegetation for erosion control is not intended to replicate or replace specific habitat affected by the project; however, establishing vegetation in these areas would provide habitat benefits that would minimize impacts to biological resources.

Table 1 outlines the construction action, type of disturbance, and proposed revegetation or restoration for each project component described in this document. Figure 2 shows the work limit area for the CDRP, and highlights the category of action (as described above) proposed in this plan. The SFPUC proposes to implement off-site mitigation for permanent impacts to wetlands, waters, upland vegetation, and wildlife habitats. Proposed off-site mitigation is described in the *Sunol Region Mitigation and Monitoring Plan*, which was submitted separately to the resource agencies in June 2010 (URS 2010).

Table 1
Construction Activities and Proposed Restoration and Revegetation

Restoration Type	Revegetation Area	CDRP Construction Action	Disturbance	Restoration Objective
Rehabilitation: Rehabilitation of temporarily impacted jurisdictional waters and wetlands (USACE and RWQCB)	Staging Area 1 (wetland)	Staging of construction equipment and stockpiling of materials	Temporary disturbance to a small seasonal wetland	Restore wetland functions after construction
	Calaveras Creek low-flow channel	Installation of new low-flow ring-jet valves	Temporary disturbance to stream bed, bank, and riparian vegetation	
Reestablishment: Focused reestablishment of riparian, wetland, scrub, and oak savannah habitats to provide additional habitat benefits to minimize impacts.	Lower Disposal Site 3 (base of fill)	Placement of fill in and adjacent to 400 linear feet of drainage	Permanent impact to perennial drainage	Grading and revegetation implemented to enhance post-project functions for wetland, riparian, and upland habitats
	Borrow Area B	Excavation of approximately 845,000 cubic yards of material	Change in topography, permanent loss of habitat	
	Borrow Area E	Excavation of 75 acres to a depth of 10 to 20 feet	Change in topography, permanent loss of habitat	
	Observation Hill	Removal of vegetation adjacent to excavation for replacement dam and spillway.	Temporary disturbance to oak woodland habitat	
	Staging Area 5 and 11	Staging of construction equipment and stockpiling of materials	Temporary impact to upland habitat	
Additional Revegetation for Erosion Control (See Appendix A): Proposed for NPDES compliance and impact minimization	Staging Areas not addressed by rehabilitation or reestablishment	Staging of construction equipment and stockpiling of materials	Temporary disturbance to upland habitats	Post-construction erosion control and minimize upland habitat loss
	Upper Disposal Site 3 (above base of fill)	Disposal of 2.48 million cubic yards of fill	Permanent impact to upland and wetland habitats	
	Calaveras Creek low-flow channel (top of bank)	Installation of low-flow valves and construction access and staging	Temporary disturbance along the upland margins of the west bank	
	Disposal Site 7	Placement of fill up to 100 feet thick in 21-acre area filled to elevation 860 feet	Permanent impact to wetlands and waters	
	Access Roads and Haul Routes	Haul road construction necessary for site access and transport of materials during construction	Permanent disturbance to upland habitat. Temporary disturbance of stream and wetland habitats	Post-construction erosion control and minimize upland habitat loss; stabilize channel and banks at stream crossings
	Downstream face of the replacement dam	Replacement dam will be an earthen dam, requiring revegetation for erosion control	Permanent impact to wetlands and waters	Post-construction erosion control of the downstream face of the dam

1.2 ORGANIZATION OF DOCUMENT

This document describes the conceptual restoration and revegetation proposed for the CDRP construction area. Section 2 presents the specific rehabilitation and reestablishment of habitat for each project component; a detailed outline of the restoration design, goals, and methods for areas affected by the CDRP (Section 3); and the plan for the monitoring and maintenance of the restoration and revegetation areas (Section 4).

1.3 RESPONSIBLE PARTIES

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2 PROJECT DESIGN

2.1 LOCATION

The CDRP is located within and adjacent to the Calaveras Reservoir, which is in the Diablo Mountain Range in Alameda and Santa Clara Counties, California, about 12 miles south of the city of Pleasanton and 7.5 miles east of the city of Fremont (Figure 1). Calaveras Dam impounds flows from Calaveras Creek and Arroyo Hondo as well as diversions from upper Alameda Creek via the Alameda Creek Diversion Tunnel. Calaveras Dam is on Calaveras Creek at the northern end of Calaveras Reservoir, about 1 mile upstream from the confluence of Calaveras and Alameda Creeks (Figure 1). The locations of the major components of the CDRP, including the dam and spillway, Borrow Areas, Staging Areas, disposal sites, access areas, and the West Haul Road, are shown on Figure 2.

The dam, reservoir, and much of the surrounding watersheds of Calaveras Creek, Arroyo Hondo, and upper Alameda Creek (herein called the Alameda Creek Watershed Lands) are owned and managed by the SFPUC.

2.2 PROJECT SUMMARY

The CDRP would replace the existing Calaveras Dam, which is seismically unsafe, and restore reservoir storage operations to provide water supply to SFPUC's customers. Because the existing dam is vulnerable to failure during a large earthquake, the California Department of Water Resources Division of Safety of Dams (DSOD) has restricted the water level of Calaveras Reservoir since 2001. The purpose of the CDRP is to replace the existing Calaveras Dam on Calaveras Creek and restore operations to approximately the levels that existed before the DSOD restrictions. The proposed project would restore Calaveras Reservoir to its historical pool elevations (a normal elevation of 756 feet), resume consistent flow diversions at the Alameda Creek Diversion Dam, and implement flow releases and/or bypasses for environmental purposes (specifically, fisheries habitat and steelhead restoration).

Construction of the replacement dam would require materials that will primarily be provided from the required excavations and two borrow areas (Borrow Areas B and E). Unsuitable or excess materials will be disposed of at four disposal sites (Disposal Sites 2, 3, 5[1] and 7). After excavation and disposal of materials and construction of the dam, the two borrow areas and two of the disposal sites (Disposal Sites 3 and 7[2]) will be contoured and revegetated.

2.3 PROJECT PURPOSE

The overall purpose of the CDRP is to replace the existing dam with a new earth and rockfill dam that meets current seismic safety design requirements and that will accommodate a public water supply reservoir of the same size (96,850 acre-feet) as the one that has been in operation since the 1920s. When the proposed replacement dam is completed, DSOD restrictions will be lifted and the original reservoir pool will be restored to the historical inundation area defined by a reservoir water surface elevation of 756 feet. The objective of the CDRP is to restore the reservoir to its historical capacity

[1] Disposal Site 5, which is within the limits of Borrow Area E, is a reserve disposal site, which may or may not be used for the CDRP.

[2] The remaining disposal sites, Disposal Sites 2 and 5 (if used), will be below the 756ft normal surface water elevation of the reservoir following construction, and will not be targeted for restoration.

and thereby restore the water supply and improve water delivery reliability in the event of an interruption of supply or drought.

2.4 PROJECT COMPONENTS

This section briefly describes the CDRP components that are proposed for on-site restoration and revegetation in this plan. A detailed description of the proposed project is provided in the *Draft Environmental Impact Report* (SFPUC 2009) and in the permit applications submitted to the resource agencies.

The project components and their respective revegetation and restoration categories are shown in Figure 2. The temporarily impacted areas that would be rehabilitated after completion of construction include a seasonal wetland at Staging Area 1 and the Calaveras Creek channel immediately below the new stream maintenance valves, hereafter referred to as the Calaveras Creek low-flow channel (See Table 1 – "Rehabilitation"). Oak savannah and oak woodland would be reestablished at two staging areas (Staging Areas 5 and 11) and a narrow work area on the north side of Observation Hill that would be temporarily impacted during construction (See Table 1 – "Reestablishment")

In several areas, habitat will be permanently altered during construction and impacts will be mitigated for off-site as described in Section 1.1. Some of these areas provide opportunities to restore some additional habitat value or improve aesthetics. Areas that present opportunities for reestablishment include the two borrow areas and Disposal Site 3 (See Table 1 – "Reestablishment").

The remainder of the project component areas will be revegetated for erosion control only. Areas of disturbance that fall below the 756 normal maximum surface elevation will be revegetated using the mesic grassland hydroseed mix (see Appendix A) for erosion control while the reservoir fills. Details of revegetation for erosion control are presented in Appendix A.

The following project components are described in more detail below:

- Replacement dam and spillway
- Staging areas
- Access roads and haul routes
- Borrow areas
- Disposal sites

Figure 2 shows the limits of work associated with these project components. Proposed revegetation and restoration for the project components is described in Section 3 and Appendix A.

2.4.1 REPLACEMENT DAM AND SPILLWAY

The replacement dam would be constructed on Calaveras Creek, immediately downstream of the existing dam. The completed dam and spillway would restore the maximum normal reservoir storage to 96,850 acre-feet, which was the storage capacity of the reservoir when it was completed in 1925 and the storage capacity to which it was operated until the DSOD restrictions were enacted in 2001.

The new spillway would be constructed at the western abutment of the dam. The spillway chute would discharge into a new stilling basin. The stilling basin would be 80 feet wide by 155 feet in length and 14 feet deep. Water from the stilling basin would flow through a discharge channel that would be about 50 feet wide by 400 feet long. The spillway discharge channel would flow into Calaveras Creek downstream of the stream channel reach described below. The overall length of the

spillway, including the approach channel, crest structure, chute, stilling basin, and discharge channel, would be about 1,950 feet. Observation Hill, located to the west of the spillway for the replacement dam, may need to be cleared of vegetation in order to facilitate excavation necessary for construction of the replacement dam and spillway.

CALAVERAS CREEK (LOW-FLOW) CHANNEL

Two new 8-inch low-flow ring-jet valves (one for service and one for backup) would be installed at the downstream toe of the new dam. These valves would discharge water to the valve vault before release to Calaveras Creek. The new low-flow valves would increase operational flexibility for water releases and help maintain fisheries and aquatic habitat. Seepage from the dam (about 0.5 cubic feet per second [cfs]) would also be released into Calaveras Creek at this location.

The CDRP would provide a minimum flow of 5 cfs in Calaveras Creek, which is about ten times the current base flow of 0.5 cfs. Additional flows, up to a maximum of 12 cfs, would be released from the low-flow release valves according to the schedule submitted to National Marine Fisheries Service in July 2010 (SFPUC 2010).

The portion of Calaveras Creek downstream of the valves but upstream of the confluence of the spillway discharge channel and Calaveras Creek would be avoided during construction except as follows:

- Temporary disturbance along the tops of the west bank
- The placement of riprap at the south terminus of the channel to protect the bank from erosion when flows are released from the low-flow valves

The extent of disturbance to riparian vegetation along Calaveras Creek that would result from the installation of the new valves will be minimized to the greatest extent possible. Approximately 0.08 acre of riparian vegetation adjacent to Calaveras Creek would be disturbed during construction.

2.4.2 STAGING AREAS

Eleven construction staging areas would be required for the construction office trailers, an on-site soils testing laboratory, equipment and maintenance yards, construction materials storage, and an area for stockpiling imported filter, drain, and aggregate materials. Staging Areas 1, 5, and 11 are identified on Figure 2. The total extent of the 11 staging areas for the project would be about 35 acres.

Staging Areas 1, 2, 3, and 4 would be on relatively flat terrain where the dam access road joins Calaveras Road to minimize grading. Staging Areas 5 through 8 and Staging Area 10 would be near the dam and spillway construction areas. Staging Area 9 would be on the top of the existing dam. Staging Area 11 would be at the south end of the reservoir adjacent to the south side of Borrow Area E.

2.4.3 ACCESS ROADS AND HAUL ROADS

The construction of the CDRP would use public roads and SFPUC roads in their watershed lands. Some of the SFPUC roads would require improvements, and temporary roads would be constructed at the project site. The contractor would design haul roads within the North and South Observation Hill Access Areas, Borrow Area B Access Areas, and the Disposal Site 3 Access Area.

Access from the dam site to Borrow Area E would be either by a haul road constructed along the western shore of the reservoir or by barging. If used, the West Haul Road would be constructed so

that it would lie mostly below the restored reservoir pool water line at the 756-foot elevation of the filled reservoir. This haul road would be about 3.4 miles long and would cross several minor drainages, requiring culverts at drainage crossing locations. The southern half of the road would be a 40-foot-wide road that would allow two-way traffic. Due to topographic conditions, the northern half of the road would be either a single-lane, 20-foot-wide road with turnouts or two single-lane 20-foot-wide roads built at different elevations to allow two-way traffic.

Construction of the West Haul Road would temporarily affect 0.04 acre of seasonal wetland, 78 linear feet of perennial stream, and 665 linear feet of ephemeral drainage. However, all temporary impacts would occur below the 756-foot reservoir elevation.

2.4.4 BORROW AREAS

Construction material would be obtained from two borrow areas, Borrow Area B and Borrow Area E, and from excavation of the spillway for the new dam.

BORROW AREA B

Borrow Area B is north of the dam site and above the west bank of Calaveras Creek. This area is about 9 acres and would be excavated by blasting to a depth of about 200 to 280 feet. About 845,000 cubic yards of material would be removed from Borrow Area B. Current vegetation at the site consists primarily of low-growing shrubs, grasses, and forbs with significant exposures of bare rock, with some oak woodland present as well. The borrow area would be excavated such that the cuts have an overall slope of 2 horizontal to 1 vertical (2H:1V) with minimum 10-foot-wide benches for every 50 feet in elevation. The benches would be sloped toward the hill to maximize the capture of water and facilitate infiltration.

BORROW AREA E

Borrow Area E is located on the gently sloping alluvial fan at the south end of the reservoir. The majority of the borrow area (approximately 75 acres) would be excavated to a depth of 10 to 20 feet. Situated on the reservoir shoreline, Borrow Area E would include construction of a drainage channel with check dams to allow for drainage of surface water and to minimize the discharge of sediment to the reservoir. As previously discussed, access for hauling materials from the borrow area to the dam site would require either construction of a haul road along the west side of the reservoir or the use of barges. Use of barges would require construction of loading docks and materials-handling equipment at the north and south ends of the reservoir. Either the West Haul Road or the barging facilities would likely be constructed during the year of construction before the use of the borrow area. The final grade of the southern edge of the excavated portion of the borrow area would be no steeper than a slope of 20H:1V slope to provide a transitional habitat between uplands and the open water of the reservoir. The majority of the borrow area would be below the restored normal maximum water surface elevation of 756 feet.

2.4.5 DISPOSAL SITES

Disposal sites would be required for unsuitable and excess material generated from the excavation associated with the dam foundation, spillway, borrow areas, haul roads, and staging areas, and the partial removal of the existing dam fill material. Four disposal sites have been identified (Disposal Sites 2, 3, 5, and 7). Disposal Site 2 would be between the new dam and the existing dam and would be inundated after construction is complete. Therefore, this site is not discussed further in this section.

DISPOSAL SITE 3

Disposal Site 3 would be located to the west of the existing dam. Surplus material excavated from the dam site would be placed on the west-facing hillside below the existing dam access road. The toe of the disposal site would be located in the northwestern corner of the reservoir. The approximately 30-acre site would be filled with up to 2.48 million cubic yards of fill and would slope toward the northeast to a maximum elevation of 960 feet. Erosion protection measures and benching and surface water ditches would be constructed at this disposal site to prevent erosion and promote restoration of the slopes. Drainage from springs and seeps within the footprint of the disposal site would be collected and conveyed under the disposal site to the reservoir through sand and gravel finger drains. A rockfill dike would be constructed at the base of the disposal site to a crest elevation of 730 feet. The final grade of the site would be configured to allow for restoration of natural vegetation communities. The western base of the disposal site would be graded and planted to re-establish approximately 450 linear feet of perennial drainage and the associated hydrologic functions and riparian habitat.

DISPOSAL SITE 5

Disposal Site 5 would be used if the amount of surplus rock and soil exceeds the capacity of Disposal Sites 2, 3, and 7 or if local disposal is needed for materials associated with the barge option. Disposal Site 5 would be within the Borrow Area E excavation and would have an area of about 55 acres. When the reservoir level is restored to elevation 756 feet, this site would be under water.

DISPOSAL SITE 7

Disposal Site 7 is on the northeastern shore of Calaveras Reservoir. The approximately 21-acre area would be filled to elevation 860 feet, with a layer of fill up to 100 feet thick. This disposal site would slope upward to the east to a maximum elevation of 870 feet. An existing alkali seep and the upper reach of a drainage swale outside the disposal site would not be graded; however, the water would be directed into a seepage collection trench through the fill. A dike would be constructed at a crest elevation of 756 feet and would consist of hard-rock blueschist. The disposal site would be constructed in a manner similar to that described for Disposal Site 3 to simulate the natural topography and to encourage native vegetation communities. Erosion protection measures and benching and surface water ditches would be constructed at this disposal site to prevent erosion and promote restoration of the slopes.

2.5 PROJECT AREA CONDITIONS

The project area is entirely within the Calaveras Creek and Arroyo Hondo watersheds. Existing conditions that would affect the restoration options for the project area are described below.

2.5.1 LAND USE

The Calaveras and Arroyo Hondo watersheds are primarily undeveloped range lands that are managed for cattle grazing and watershed protection. Scattered residential development occurs along the periphery of the watershed. Public access is limited to East Bay Regional Park District lands and wilderness areas. All of the land owned by the SFPUC in the project area is inaccessible to the public.

2.5.2 SOILS AND TOPOGRAPHY

The Calaveras Creek and Arroyo Hondo watersheds, with a total area of about 98 square miles, drain to the Calaveras Reservoir. The topography, including the area surrounding Calaveras Reservoir, is

steep and thus is highly susceptible to erosion. The average overland slope for the Calaveras sub-basin is 42 percent. Soil types within the study area range from deep, permeable loams on flat to moderate slopes to rocky, shallow soils with low permeability on steeper slopes (SCS 1966, 1974). Soils in the study area are formed from alluvium, weathered sandstone, mudstone, and shale and Franciscan formation rocks, including serpentine formations.

2.5.3 EXISTING VEGETATION COMMUNITIES

The project area includes developed areas and undeveloped areas that support natural vegetation communities. Developed areas include access roads, bridges, spoils areas, and existing SFPUC facilities and utilities.

The existing vegetation communities within the project area include California annual grassland, oak savannah, oak woodland, Diablan sage scrub, riparian forest, and seasonal wetland.

CALIFORNIA ANNUAL GRASSLAND

California annual grassland is the most common vegetation type in the project area and occurs to some extent in every revegetation area. California annual grassland is an herbaceous vegetation community dominated by non-native annual grasses (Holland 1986; Sawyer and Keeler-Wolf 1995). In the CDRP, the dominant grasses include wild oat (*Avena fatua*), soft chess (*Bromus hordeaceous),* ripgut brome (*Bromus diandrus*), wild barley (*Hordeum* spp.), and Italian ryegrass (*Lolium multiflorum*). The species composition of the non-native grassland is highly diverse and includes many other native and non-native forbs. Common forb species include clover (*Trifolium* spp.), filaree (*Erodium* spp.), cut-leaved geranium (*Geranium dissectum*), miniature lupine (*Lupinus bicolor)*, four-spot (*Clarkia purpurea* ssp*. quadrivulnera*), California poppy (*Eschscholzia californica*), purple owl's-clover (*Castilleja exerta*) and Ithuriel's spear (*Triteleia laxa*). Numerous scattered patches of native purple needlegrass (*Nassella pulchra*), California melic grass (*Melica californica*) and squirreltail (*Elymus elymoides*) appear in the native and non-native grassland.

Non-native invasive plants observed in this vegetation community include yellow star thistle *(Centaurea solstisialis*), Italian thistle (*Carduus pycnocephalus*), milk thistle (*Silybum marianum*), false brome (*Brachypodium distachyon*), bellardia (*Bellardia trixago*), wild radish (*Raphanus sativus*), stinkweed (*Dittrichia graveolens*), wild mustard (*Brassica* spp.), and poison hemlock (*Conium maculatum*).

OAK SAVANNAH

Oak savannah occurs in the uplands of Borrow Area B and Disposal Site 3. Oak savannahs typically have relatively open canopies with a predominantly grassy understory (Holland 1986). In the project area, oak savannah consists of scattered blue oak (*Quercus douglasii*) and coast live oak (*Quercus agrifolia*). Shrubs are scarce but include coyote brush (*Baccharis pilularis*), blue elderberry (*Sambucus mexicana*), sagebrush (*Artemisia californica*), and nude buckwheat (*Eriogonum nudum).* Many of the same non-native grasses and forbs described above are common in the oak savannah as well as natives such as pine bluegrass (*Poa secunda*), purple sanicle (*Sanicula bipinnatifida*), blue wildrye (*Elymus glaucus*), California melic grass, and small-flowered melic grass (*Melica imperfecta*).

Non-native invasive plants observed in oak savannah include tobacco tree (*Nicotiana glauca*), false brome, annual grass species, and Italian thistle.

OAK WOODLAND

The oak woodland vegetation community occurs throughout the CDRP, including the potential excavation area of Borrow Area B and at Observation Hill. Similar to oak savannah, this vegetation community is composed of an overstory dominated by oak species. It contains a mix of co-dominant oaks such as coast live oak, blue oak, and valley oak (*Quercus lobata*). Oak woodlands tend to have denser tree canopies than oak savannah and a greater prevalence of shrub species in the understory (Holland 1986). Non-native invasive plants observed in this habitat include milk thistle and poison hemlock.

DIABLAN SAGE SCRUB

The existing terraces and slopes within the proposed Borrow Area B support Diablan sage scrub vegetation. SFPUC will reestablish this vegetation community at Borrow Area B after completion of construction to the extent feasible. Diablan sage scrub is a subunit of coastal sage scrub (one of two major scrub formations in the California floristic province). Diablan sage scrub occurs in the inner Coast Ranges from Mount Diablo south to San Luis Obispo County (Holland 1986). In the CDRP area, Diablan sage scrub consists of a diverse shrub community of elderberry, sagebrush, coyote brush, poison oak (*Toxicodendron diversilobum*), nude buckwheat, and sticky monkeyflower (*Mimulus aurantiacus)*, with a mixed grass/forb understory consisting of non-native annual grasses, filaree, and native grasses and herbs such as blue wildrye, California melic grass, and small-flowered melic grass. Non-native invasive plants observed in Diablan sage scrub include a number of annual grass species, tobacco tree, Italian thistle, and false brome.

RIPARIAN FOREST

Riparian forest occurs adjacent to Calaveras Creek at the base of the existing spillway and in other drainages with seasonal or perennial streams in the project vicinity. Riparian forest will be reestablished below the dam adjacent to Calaveras Creek and along the base of Disposal Site 3. In the CDRP, riparian forest overstory is dominated by arroyo willow (*Salix lasiolepis*), red willow (*Salix laevigata*), and sandbar willow (*Salix exigua*). The understory between willows is often dominated by freshwater marsh species, including common rush (*Juncus patens*), seep monkey flower (*Mimulus guttatus*), water parsley (*Oenanthe sarmentosa*), mulefat (*Baccharis salicifolius*), and horsetail (*Equisetum arvense*). The most common species in the riparian forest of Disposal Site 3 is poison hemlock, which forms dense stands throughout the area. Non-native invasive plants identified in and adjacent to riparian forest are poison hemlock, orchard grass (*Dactylis glomerata*), fennel (*Foeniculum vulgare*), and Harding grass (*Phalaris aquatica*).

SEASONAL WETLAND

Seasonal wetland vegetation is present in Staging Area 1, adjacent to Calaveras Creek within the excavation area of the replacement dam, and adjacent to Calaveras Creek below the proposed low-flow valves. This vegetation community is dominated by annual plants that are marginally hydrophytic (occasionally present in wetlands). The most common plants are Italian ryegrass (*Lolium mulitflorum*), Mediterranean barley (*Hordeum marinum*), fiddle dock (*Rumex pulcher*), and sour clover (*Trifolium fucatum*). Other dominant hydrophytic plants include iris-leaved rush (*Juncus xiphioides*), Baltic rush (*Juncus balticus*), common rush (*Juncus patens*), spikerush (*Eleocharis* sp.), curly dock (*Rumex crispus*), and rabbit's-foot grass (*Polypogon monspelliensis*). Plant species composition is variable between seasonal wetlands in the CDRP area.

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3 RESTORATION DESIGN

This section presents the conceptual goals, design, and implementation of revegetation and habitat restoration for the CDRP project area. Specific restoration design details are provided for the following locations:

- Staging Areas 1, 5 and 11
- Borrow Area B
- Borrow Area E
- Disposal Site 3 (base of fill)
- Observation Hill
- Calaveras Creek channel below the stream maintenance valves (Calaveras Creek low-flow channel)

Appendix A describes the design details for revegetation of the following locations for erosion control:

- Staging areas
- Access roads and access areas
- Disposal Site 3 (above base of fill)
- Uplands adjacent to the Calaveras Creek channel
- Disposal Site 7
- Replacement Dam

Restoration design details presented in this section include site preparation, planting, irrigation, and monitoring. Vegetation reestablishment is primarily intended to facilitate establishment of native vegetation cover and habitat values. Rehabilitation of temporarily impacted areas (Section 1.2) is intended to restore wetlands and other waters of the U.S. to approximately pre-project conditions.

3.1 CONSTRUCTION CONTRACT

Restoration of the construction area would be implemented in two phases under two separate contracts:

- General Contract for the CDRP
- Specialty Restoration Contract for the CDRP

The general contractor for the CDRP will be responsible for general site grading and preparation and will also implement the erosion control measures described in Appendix A. The remaining restoration efforts will be implemented by a specialty restoration contractor. The specialty restoration contractor will be selected by the SFPUC independent from the general CDRP construction contract. The details of the construction contract design and specifications will be developed concurrent with final project design based on the concepts presented in this plan.

3.2 RESTORATION AND REVEGETATION GOALS

As described in Section 1, three categories of restoration and revegetation are proposed for the CDRP disturbance areas:

- Rehabilitation of jurisdictional wetlands and other waters temporarily affected by the CDRP;
- Reestablishment of riparian, wetland, scrub, oak savannah, and oak woodland habitats to minimize permanent and temporary impacts to wetlands, waters, upland vegetation, and wildlife habitats; and
- Revegetation for erosion control proposed for NPDES compliance and impact minimization

Table 1 and Figure 2 summarize the locations where each of these categories of restoration and revegetation would be implemented. Where feasible, the SFPUC has proposed to rehabilitate or reestablish vegetation communities to further minimize the biological impacts of the proposed project:

1. **Rehabilitation of jurisdictional wetlands and other waters temporarily affected by the CDRP, for compliance with RWQCB and USACE permits:** The SFPUC will rehabilitate wetlands and other waters of the United States within the CDRP area that are temporarily impacted during construction. Rehabilitation of temporary impacts to wetlands and other waters is specifically proposed at Staging Area 1 and the Calaveras Creek low-flow channel where jurisdictional wetlands and other waters would be temporarily disturbed by the CDRP and where rehabilitation for compliance is proposed.

2. **Reestablishment of vegetation communities to provide additional habitat benefits not required by federal, state, or local permits:** Staging Areas 5 and 11, Borrow Areas B and E, the lower portion of Disposal Site 3, and Observation Hill provide opportunities for reestablishment of habitats after construction of the CDRP is completed. Impacts to these areas are planned to be mitigated for off-site, as described in the *Sunol Region Mitigation and Monitoring Plan* (URS 2010). The hydrology and topography of these areas will be altered to a state preventing restoration to pre-project conditions. However, reestablishment of some habitat values in these areas is feasible and is included as part of the impact minimization for the proposed project.

The goals of the proposed restoration and revegetation are to (1) achieve soil stability, (2) improve water quality by reducing erosion, (3) establish native plant communities for habitat and aesthetics, and (4) minimize establishment of non-native invasive species. Although these goals apply to most areas disturbed by the CDRP, the strategies to achieve the goals vary and are discussed in detail in Section 3.3.

3.3 TARGET VEGETATION COMMUNITIES

It will not be possible to restore vegetation communities to match existing vegetation in certain cases. Target vegetation communities are proposed to match existing vegetation communities to the extent practicable; however, the establishment of these target vegetation communities would be constrained by the final topography and availability of plant propagule material.

Target vegetation communities to be restored, created, or enhanced in areas where disturbance will occur are upland and mesic grassland, oak savannah, oak woodland, Diablan sage scrub, riparian forest, and wetland. The existing vegetation communities and target vegetation communities to be restored at each site are provided in Table 2 and Figures 3 through 7, which depict target vegetation planting zones for Borrow Areas B and E, Disposal Site 3, Staging Area 5 and 11, the Calaveras Creek low-flow channel, and Observation Hill. Mesic grassland does not currently occur within the CDRP specialty restoration sites; therefore, this vegetation community is described below. A description of all other target vegetation communities is provided in Section 2.5.3.

3.3.1 MESIC AND UPLAND GRASSLANDS

Although the mesic grassland vegetation community does not currently exist on-site, it is found in the immediate vicinity of the restoration and revegetation sites. Mesic grassland is a target vegetation community that is intended to resemble a transitional community between upland, xeric vegetation communities, such as upland grasslands (i.e., native and California annual grasslands), and wetland vegetation communities, such as freshwater marsh, which exist on-site. The mesic grassland vegetation community will lend itself to a variety of conditions, allowing it to be planted broadly over much of the restoration area. Typical plant species in the mesic grassland community are tolerant of seasonal inundation or saturation, but can also survive during periods of drought. As a result, species composition in mesic grasslands varies depending on environmental conditions and may include hydrophytic, water tolerant, and water intolerant plant species. Mesic grassland plant species in the project vicinity include native grasses such as meadow barley (*Hordeum brachyantherum*), tufted hairgrass (*Deschampsia cespitosa*), and creeping wildrye (*Leymus triticoides*). Mesic grasslands occur along the reservoir edge in a limited number of locations, including Cherry Knoll. Non-native plants identified in mesic grassland in the CDRP include poison hemlock, Harding grass, cocklebur (*Xanthium strumarium*), orchard grass, and sheep sorrel (*Rumex* spp.).

There may be a substantial period following completion of project components before the reservoir water levels reach the normal maximum water surface elevation. In areas below the 756 normal maximum water surface elevation, hydroseeding with a mesic grassland seed mix will allow sites to meet desired revegetation goals while the reservoir fills. Because mesic grassland is a versatile plant community, it is anticipated that it will respond to varying hydrologic conditions throughout the project area, characterized by changes in the water surface elevation of the dam.

Upland grasslands will consist of native grass and forb species adapted to drier conditions. Native species to be established include yarrow (*Achillea millefolium*), purple needlegrass, California brome (*Bromus carinatus*) and blue wildrye.

Table 2
Existing and Target Vegetation Communities in Areas Proposed for Rehabilitation and Reestablishment[1]

Restoration Type	Revegetation Area	Existing Vegetation Communities	Target Vegetation Communities
Rehabilitation: Rehabilitation of temporarily impacted riparian forests and jurisdictional waters and wetlands (USACE and RWQCB)	Staging Area 1	Seasonal wetland and California annual grassland	Seasonal wetland and upland grassland
	Calaveras Creek low-flow channel	Riparian forest and seasonal wetland	Riparian forest and seasonal wetland bordered by mesic grassland
Reestablishment: Focused reestablishment of riparian, scrub, grassland, and oak savannah habitats to provide additional habitat benefits to minimize impacts	Disposal Site 3 (base of fill)	Riparian forest and oak savannah	Riparian forest
	Borrow Area B	Diablan sage scrub, California annual grassland, oak woodland (potential borrow zone)	Diablan sage scrub
	Borrow Area E	California annual grassland	Mesic grassland and upland grassland
	Staging Area 5 and 11	California annual grassland	Oak savannah
	Observation Hill	Oak woodland	Oak woodland

[1] Existing and Target Vegetation Communities in areas planted for erosion control only are summarized in Appendix A

3.4 RESTORATION AND REVEGETATION DESIGN DETAILS

This section describes specific restoration and revegetation activities that will be implemented according to the goals outlined in Section 1.

3.4.1 SITE PREPARATION

Areas disturbed during construction would be revegetated and stabilized to the extent practicable. The following actions are proposed to reestablish or rehabilitate vegetation in the project area.

STAGING AREA 1 AND WEST HAUL ROAD

Geotextile filter fabric will be placed over the existing ground surface in areas designated as wetlands and other waters of the United States within Staging Area 1 and the West Haul Road before their construction to facilitate reestablishment of the affected wetlands and other waters of the United States.

STAGING AREAS 5, BORROW AREA B, DISPOSAL SITE 3, AND CALAVERAS CREEK LOW-FLOW CHANNEL

The topsoil[3] will be stockpiled separately from subsoil, where appropriate (in heavily invaded areas, topsoil may be buried to avoid germination of non-native, invasive species). Any additional soil layers that are excavated will be replaced in the same order they were removed, where appropriate, and aerated as necessary.

ALL REVEGETATION AND RESTORATION AREAS

Temporary disturbance areas (e.g., staging areas) will be returned to pre-disturbance grades. Temporary roads outside the inundation area (for elevation 756 feet) will be regraded where feasible and the natural topography restored after construction is completed. In some areas, grading will not be possible due to slope or surrounding topography and hydrology. Specific grading plans for borrow and fill areas are described below.

3.4.2 STAGING AREAS

After the completion of construction, staging areas will be re-graded to match pre-project conditions. Staging Areas 1 and 5 will receive additional treatment and grading to provide additional habitat values.

Staging Area 1: A seasonal wetland in Staging Area 1 will be rehabilitated after completion of construction consistent with USACE and RWQCB requirements for temporary impacts. Additional revegetation activities in this area are not required by permit conditions, but will be included to prevent erosion and provide upland habitat functions. Staging Area 1 is in the northernmost part of the CDRP area (Figure 2). Most of the area is California annual grassland; however, a small seasonal wetland (0.1 acre) would be temporarily disturbed during construction. Before the start of construction, a geotextile filter fabric will be placed on the surface of the seasonal wetland and covered with rock and soil to protect the ground surface, existing vegetation, and seed bank. Fill and filter fabric will be removed on project completion to restore the original ground surface. The area will then be hydroseeded to provide soil stability, decrease the establishment of invasive plant

[3] The topsoil is defined as the A-horizon, or top 6 inches of soil, not to exceed 12 inches below the ground surface.

species, and establish native vegetation. The final target community would be expected to match the plant communities in the seasonal wetlands in the vicinity.

Staging Area 5 and 11: Targeted reestablishment of oak savannah habitat at Staging Area 5 and Staging Area 11 is proposed to minimize project impacts to oak savannah and provide additional habitat benefits in addition to the off-site compensation proposed in the *Sunol Region Mitigation and Monitoring Plan*. Existing vegetation at Staging Area 5 (Figure 2) and Staging Area 11 (Figure 4) is primarily California annual grassland. After completion of construction, the staging areas will be hydroseeded to provide soil stability and decrease the potential for establishment of invasive plant species. Container plants and acorns will be installed (as described Section 3.3) to diversify habitat and improve aesthetics.

3.4.3 CALAVERAS CREEK LOW-FLOW CHANNEL

Riparian and wetland vegetation adjacent to Calaveras Creek below the existing dam would be removed during construction. The segment between the new stream maintenance valves and the confluence of the new spillway discharge channel would be rehabilitated following completion of construction. Restoration of this area will increase the habitat values and functions of the riparian habitats as required by federal and state permits.

After the completion of construction activities, this area will be contoured and revegetated to match the remainder of the stream reach to every extent practicable. In some areas the rocky nature of the low-flow channel may inhibit the establishment of vegetation. For example, a large rocky hill in the middle of this area that will not be graded during construction as the primary substrate is exposed rock that would be difficult to revegetate. Appendix A describes revegetation of areas outside the riparian corridor in this area.

After the completion of construction, riparian vegetation would be reestablished where the substrate permits establishment of vegetation. Proposed planting zones for the site are shown on Figure 6. Restoration at this site is limited to the area downstream of the riprap below the low-flow valves. Revegetation of the riprap area will not be possible because of maintenance requirements to ensure the structural stability of the new dam and variability in substrate.

3.4.4 DISPOSAL SITES

DISPOSAL SITE 3

Impacts for Disposal Site 3 are being mitigated offsite. However, focused reestablishment of riparian forest habitat is being proposed in addition to offsite mitigation to provide habitat benefits at this location. In addition, grassland hydroseeding of the slopes is being proposed to prevent erosion and provide some habitat benefits. Revegetation of the slopes for erosion control purposes is described in Appendix A.

Disposal Site 3 would consist primarily of upland fill on a southwesterly facing slope. At the toe of the fill slope, a 1,250-linear-foot drainage would be constructed in the transition zone at the margins of the reservoir (Figure 5). After placement of the fill material the upper 240 linear feet of the drainage between elevation 750 and 756 feet will be graded and planted to enhance hydrologic function and habitat. Selection and placement of appropriate native vegetation and grading would create a self-sustaining riparian corridor and enhance ecological niches for wildlife species, while improving hydrologic conditions of the site.

The drainage channel and banks would be graded to recreate a natural shaped channel bed and banks (see Appendix B). By appropriately sizing the channel to a bank full flow capacity (bank full discharge typically with a recurrence interval between 1.1 to 1.8 years), competence and stream channel integrity would be maintained and would prevent excessive erosion of bank and fill material (Rosgen 1998). Allowing the banks to flood would reduce erosive boundary shear stress and would redistribute fine sediment alluvium onto a small floodplain.

Where the stream enters the reservoir, a relatively short distance of the channel will be affected by the water elevation of the reservoir. At this point, water flows will decrease and sediment capacity will decrease to zero. Due to the moderate slope of the valley and channel, the length of stream affected by a "back-water" effect should be minimal. As the level of the reservoir fluctuates, different portions of the channel, and accumulated sediments, will be exposed to streamflow processes. Any accumulation of sediment at the reservoir level will be subject to erosion. Depending on the extent of the sediment fan, shifts in channel alignment and shape may occur (a similar process that occurs in alluvial fans) until the reservoir fills above the sediment fan. Bank full flows will likely be the dominant driver in the formation and maintenance of channel dimensions until an area becomes inundated.

The existing topsoil in the disposal site area, including the channel, would be stripped and stockpiled. Existing vegetation or seed stock, including rushes, sedges, and willows would be salvaged to the extent possible. Salvaged plant material could potentially be used for other mitigation sites in the CDRP, such as the SFPUC Habitat Reserve Program. The relocated channel bed would be either lined at least a foot deep with stockpiled stream gravel excavated from the existing site or native soil and gravel mixed on site from existing sources or purchased quarry gravel. The banks and bank full bench would be capped with at least six inches of stockpiled topsoil. The upstream end of the channel slope would be graded to match the upstream slope of the existing channel. The channel bed and bank construction would extend to an elevation of 730 feet so that the stream would function as the reservoir level fluctuates between 756 and 730 feet.

The remaining portion of the disposal area, above 756 feet and outside of the riprap covered area, would be hydroseeded with a native upland grasslands erosion control seed mixture (described further in Appendix A). The proposed vegetation planting zones for the site are shown in Figure 5.

Table 3
Plant Quantities, Plant Sizes, and Plant Spacing for Revegetation Areas

Site	Vegetation Community	Acres (approx)	Application/ Planting Method	Hydroseed Mixture and Seeding Rate	Rooted Container Plantings, Acorns or Willow Staking	
					Estimated Number of Plants, Species	Plant Spacing
Staging Area 1	Seasonal wetland	0.1	Hydroseed	30 lb/acre meadow barley 18 lb/acre, tall flatsedge (*Cyperus eragrostis*) 8 lb/acre, common rush (*Juncus patens*) 2 lb/acre, Baltic rush (*Juncus balticus)* 2 lb/acre plus hydro-mulch	Not Applicable	Not Applicable
Calaveras Creek low-flow channel	Riparian forest and wetland; mesic grassland	0.09	Hydroseed; live willow staking, divisions and/or plugs for herbaceous species	30 lb/acre meadow barley 18 lb/acre, tall flatsedge (*Cyperus eragrostis*) 8 lb/acre, common rush (*Juncus patens*) 2 lb/acre, Baltic rush (*Juncus balticus)* 2 lb/acre plus hydro-mulch	**160 PLANTS TOTAL** **Riparian forest and wetland** **6 each of the following (live willow staking)**: red willow (*Salix laevigata*), arroyo willow (*Salix lasiolepis),* sandbar willow (*Salix exigua*) **11 each of the following (divisions/plugs):** tall flatsedge, meadow barley, creeping spikerush (*Eleocharis macrostachya*), Baltic rush, spreading common rush **Mesic grassland** **30 each of the following (divisions/plugs)**: tufted hairgrass, meadow barley, creeping wildrye	Willows spaced 10 ft on center Herbaceous species spaced 5 ft on center

Table 3
Plant Quantities, Plant Sizes, and Plant Spacing for Revegetation Areas

Site	Vegetation Community	Acres (approx)	Application/ Planting Method	Hydroseed Mixture and Seeding Rate	Rooted Container Plantings, Acorns or Willow Staking	
					Estimated Number of Plants, Species	Plant Spacing
Staging Area 5 (Adjacent to Borrow Area B)	Oak Savannah	1	Hydroseed; acorns with tubes, D-pots and plugs for herbs and grasses	30 lbs / acre blue wildrye (*Elymus glaucus*), 18 lb/acre, California melic grass 6 lb/acre, pine bluegrass (*Poa secunda*) 6 lb/acre plus hydro-mulch.	**1,295 PLANTS TOTAL; 1,151 containers and plugs + 144 acorns** **230 of the following (D-16 containers):** purple sanicle (*Sanicula bipinnatifida*) **460 each of the following (plugs):** blue wildrye, California melic grass **acorns:** 79 valley oak, 65 blue oak	Herbaceous species spaced 6 ft on center. Spacing of acorns will vary, some will be clustered, average 18 ft on center
Staging Area 11 (Adjacent to Borrow Area E)	Oak Savannah	4	Hydroseed; acorns with tubes, D-pots and plugs for herbs and grasses	30 lbs / acre blue wildrye 18 lb/acre, California melic grass 6 lb/acre, pine bluegrass 6 lb/acre plus hydro-mulch.	**5,366 PLANTS TOTAL; 4,770 containers and plugs + 596 acorns** **954 of the following (D-16 containers):** purple sanicle **1,908 each of the following (plugs):** blue wildrye, California melic grass **acorns:** 328 valley oak, 268 blue oak	Herbaceous species spaced 6 ft on center. Spacing of acorns will vary, some will be clustered, average 18 ft on center

Table 3
Plant Quantities, Plant Sizes, and Plant Spacing for Revegetation Areas

Site	Vegetation Community	Acres (approx)	Application/ Planting Method	Hydroseed Mixture and Seeding Rate	Rooted Container Plantings, Acorns or Willow Staking	
					Estimated Number of Plants, Species	Plant Spacing
Borrow Area B Quarry Terraces	Diablan Sage Scrub	8	Hydroseed; plugs for grasses and blue-eyed grass, D-pots for small shrubs and herbs.	37 lbs / acre blue wildrye 18 lb/acre, California melic grass 6 lb/acre, pine bluegrass 4 lb/acre, yarrow 0.75 lb/acre, common deerweed (*Lotus scoparius*) 6 lb/acre, California poppy (*Eschscholzia californica*), 2.25 lb/acre plus hydro-mulch.	**15,239 PLANTS TOTAL** **2,286 each of the following (plugs and D-16 containers):** blue wildrye, purple needlegrass, blue-eyed grass (*Sisyrinchium bellum*), purple sanicle, California beeplant **1,905 each of the following (D-16 containers):** sticky monkey flower (*Mimulus aurantiacus)*, California sagebrush (*Artemisia californica*)	Herbaceous species spaced 5 ft on center; Shrubs spaced10 ft on center.
Borrow Area E	Mesic Grassland Upland Grassland	5 3	Hydroseed; plugs for grasses and herbs	32 lb/acre Meadow barley 18 lb/acre, creeping wildrye 8 lb/acre, tufted hairgrass 6 lb/acre plus hydro-mulch.	**19,549 PLANTS TOTAL** **Mesic grassland** **2,904 each of the following (divisions/plugs)**: tufted hairgrass, meadow barley, creeping wildrye **Upland grassland** **547 each of the following (plugs)**: yarrow, purple needlegrass **1,368 each of the following (divisions/plugs)**: California brome (*Bromus carinatus)*, blue wildrye, junegrass (*Koeleria micrantha*) **274 each of the following (plugs)**: purple sanicle	Herbaceous species spaced 5 ft on center

Table 3
Plant Quantities, Plant Sizes, and Plant Spacing for Revegetation Areas

Site	Vegetation Community	Acres (approx)	Application/ Planting Method	Hydroseed Mixture and Seeding Rate	Rooted Container Plantings, Acorns or Willow Staking	
					Estimated Number of Plants, Species	Plant Spacing
Disposal Site 3	Riparian Forest	0.41	Hydroseed; live willow staking, plugs for grass and herbs	30 lb/acre meadow barley 18 lb/acre, tall flatsedge 8 lb/acre, spreading rush 2 lb/acre, Baltic rush 2 lb/acre plus hydro-mulch	**705 PLANTS TOTAL** **59 each of the following (live willow staking):** arroyo willow, sandbar willow, red willow **106 each of the following (divisions/plugs):** spreading rush, creeping spikerush, Baltic rush **70 each of the following (divisions/plugs and D-pots):** seep monkey flower (*Mimulus guttatus),* tall flatsedge, meadow barley	Willows spaced 10 ft on center Herbaceous species spaced 5 ft on center
Observation Hill	Oak Woodland	0.34	Hydroseed; acorns with tubes, D-pots and plugs for herbs and grasses	30 lbs / acre blue wildrye 18 lb/acre, California melic grass 6 lb/acre, pine bluegrass 6 lb/acre plus hydro-mulch.	**599 PLANTS TOTAL; 1151 containers and plugs + 67 acorns and buckeye seeds** **112 each of the following (plugs):** blue wildrye, pacific sanicle **90 each of the following (plugs):** yarrow **45 each of the following (supercells and plugs):** soap plant (*Chlorogalum pomeridianum*), purple needlegrass **acorns and buckeyes:** 30 valley oak, 27 blue oak, 10 California buckeye	Herbaceous species spaced 5 ft on center Spacing of acorns and buckeye seeds will vary, some will be clustered, average, 18 ft on center

3.4.5 BORROW AREAS

Restoration and revegetation activities at the borrow areas are proposed to reestablish habitat and provide additional habitat benefits to further minimize project impacts. Additional compensation is provided by the mitigation proposed in the *Sunol Region Mitigation and Monitoring Plan*. The borrow areas will be graded to prevent erosion and on-site pooling of water and protect water quality and aesthetics. Specific revegetation activities at each borrow area are described below.

BORROW AREA B

Revegetation zones in Borrow Area B include the ten-foot-wide quarry terraces, the quarry bottom, and the haul road. A conceptual design of how the quarry might be graded is shown in Figure 3. The final condition of Borrow Area B will depend on the actual volume of material excavated for dam construction and the contractor's design of the slopes and benches.

The target vegetation community on the quarry terraces would be Diablan sage scrub. A 2-foot-thick lift (layer) of soil and rock debris, salvaged from the excavated portions of the borrow area, would be placed on the back 8 feet of each terrace. Materials on the terraces would be sloped toward the hill to minimize run-off and soil loss. The soil would increase the ability of the quarry terraces to support vegetation and provide cover and refuge for wildlife such as the Alameda whipsnake. Placement of material would be at the direction of an on-site restoration specialist who would be part of SFPUC's construction management team.

The terraced benches would be revegetated with native shrubs and perennial grasses typical of the Diablan sage scrub community. If determined necessary, biodegradable erosion control fabric or rock-slope protection would be placed over the soil fill to reduce erosion.

BORROW AREA E

The southern margins of Borrow Area E would be graded as shown on Figure 4. The slope will not exceed a 50:1 slope, and is intended to provide a gradual transition zone from uplands to the open water of the reservoir similar to the current margins at the south end of Calaveras Reservoir. Site grading would provide a broad zone of transitional vegetation (mesic grassland and upland grassland) associated with the margins of the reservoir. All areas above the existing water surface elevation after completion of construction will be hydroseeded with a native mesic grassland seed mix to prevent erosion until the reservoir level is restored to the normal maximum water surface elevation of 756 feet. When the reservoir level is restored to the normal maximum water surface elevation of 756 feet, the majority of Borrow Area E will be under water.

3.5 PLANTING MATERIALS REQUIRED

Proposed restoration and revegetation includes site preparation, grading, grass and forb hydroseeding, rooted material installation and installation of erosion control measures. The planting elements are described below. Collection, propagation, and planting of plant material would be carried out by either a specialty restoration contractor selected by the CDRP construction contractor, or by a specialty restoration contractor under a separate contract with SFPUC.

3.5.1 SOURCES AND STORAGE

Plant materials will be collected locally wherever possible (i.e., from Alameda Creek watershed), or will otherwise be obtained commercially from local sources as close to the project site as possible. Cuttings that are grown in a nursery will be from source materials collected on or near the project site.

Plants will be propagated by a native plant nursery and/or specialist knowledgeable about native plant cultivation. A list of the number of plants (by species) and plant sizes recommended for CDRP is provided in Table 3. Rooted plantings would be delivered to the site in good health (i.e., they should not be root-bound, should show no visible diseases, and would not have chlorotic leaves).

3.5.2 HYDROSEEDING

Hydroseeding would be used at almost every site disturbed by CDRP construction. Multiple hydroseed mixes are proposed. Hydroseed mix selection will depend on the goals and conditions at each site. Five grass and forb hydroseed mixes are recommended for this project:

- Upland grassland hydroseed mix
- Diablan sage scrub hydroseed mix
- Riparian forest and wetland hydroseed mix
- Oak woodland and oak savannah hydroseed mix
- Mesic grassland hydroseed mix

Hydroseeding is most appropriate for areas that are not steep areas, areas prone to erosion, and fill-slopes.

After soil preparation is complete, grassland seed mixes would be applied to the site as per contract specifications.

Grassland seeding would be accomplished during the first fall after construction, and before installation of other rooted materials on-site. Information on the recommended seeding mixtures and seeding rates is provided in Table 3.

3.5.3 ROOTED MATERIAL

Plant material should be grown for at least several months, but no more than 2 years, in the containers in which they are to be delivered and planted at the project site. These container plants should be inoculated with mycorrhizal fungi at the plant nursery. Plants must be free of insects and disease, disfiguring knots, sun-salt injuries, abrasions, or other objectionable defects.

Vegetation will be planted in the late fall through (mid-November through March) after the first rains of the season have begun and the soil is saturated, to minimize stress and irrigation needs. Where feasible, watering basins will be constructed about 36 inches in diameter and with rims at least three inches high around each installed tree and shrub. These basins will encourage deep watering and prevent water from running down slope. All other plants will be thoroughly water immediately after planting.

3.5.4 ACORN INSTALLATION

Acorns will be planted, if available, to establish oak species within oak savannah and oak woodland vegetation communities at Staging Area 5 and 11 and Observation Hill. If acorns are unavailable, container-grown oaks will be planted in their place.

Acorns will be planted so that adult trees will be spaced with similar densities and arrangements as those found before disturbance of the site. Information on the additional species that will be planted in conjunction with acorns and further information regarding planting palettes, planting sizes and

numbers, and recommended planting densities is provided in Table 3. Additional guidelines are as follows:

- Acorns shall be sown in the fall and early winter, as soon as the soil has been moistened several inches down, and no later than the end of January.
- Acorns shall be pre-germinated in shallow dishes with moist vermiculite, sand, or peat. Germination will be evidenced by a white tip, or radicle, protruding ¼ inch to ½ inch from the pointed end of the acorn.
- Pre-germinated acorns, with developed radicles ¼- to ½-inch-long, shall be installed using a pointed object to make a hole in the soil. Acorns will be positioned in the hole with the radicle pointing downward. Acorns will then be covered with ½ to 1 inch of soil. If radicles become too long, tangled, and unwieldy, to permit planting, they can be clipped back to ½ inch before planting.

Buckeyes will be planted in a shallow depression where the top half of the buckeye is not covered by soil. Pre-germinated acorns and buckeyes shall be placed in clusters, spaced approximately 18 feet on center. A 3-foot radius shall be cleared of vegetation surrounding each planting and covered with bark chips, straw, compost, mulching paper, or black plastic sheeting. "Tree shelters" consisting of a rigid translucent tube 1 foot high, shall be placed around each individual planting and secured with a metal fence post to protect seedlings from herbivory.

3.5.5 WILLOW STAKING

Willow staking will be used for restoration at Disposal Site 3 and the Calaveras Creek low-flow channel. Guidelines for willow staking include such parameters as planting density, plant source, moisture requirements, and maintenance. The following guidelines shall be implemented for willow staking:

- Cutting and planting shall occur when willows are dormant (generally January to March).
- Cuttings shall be a minimum of 1 inches in diameter to prevent breaking poles when placing stakes in holes. The basal end shall be cut at an angle.
- Stakes shall be 3 to 5 feet long, cleared of side branches.
- Cuttings shall be soaked in water, such as Calaveras Creek, overnight before planting.
- If cuttings must be stored, they shall be placed in a container with water, covered with black trash bags and stored in a cool, dark place.
- Pilot holes shall be probed with a steel rod such as rebar, or probed with an attachment on a backhoe or excavator, augered, or probed with a water jet stinger. Pounding willow stakes into the ground is not allowed. Holes shall be placed perpendicular to the slope.
- Stakes shall be placed basal end (the angled end) first in the hole and protrude far enough from the soil such that at least two bud scales are visible. In general, more than ½ of the pole must be underground.
- Stakes shall be placed deep enough into the bank such that the basal ends of the willows are in contact with the ground water table during the summer months. At a minimum, stakes shall be buried two feet below ground surface.
- A soil water slurry shall be poured into the hole to achieve good soil contact around the stake. The soil around the stake shall then be tamped at the surface.

3.5.6 EROSION CONTROL

Erosion control materials will be installed, as necessary to stabilize the restoration area during plant establishment. Disturbed areas that are not to be planted with rooted material will be hydroseeded

with a mixture that contains both mulch and a tackifier to help stabilize slopes, ensure good adhesion to sloped areas, and help prevent run-off while seeds are establishing.

Other areas that are prone to erosion, e.g. slopes, will be evaluated for erosion potential, and straw wattles or erosion control blankets will be installed as necessary to stabilize slopes during plant establishment. Additional erosion control Best Management Practices will be included in the project's Storm Water Pollution Prevention Plan. All erosion control materials, including straw wattles and erosion control blanket material used on-site will be biodegradable. Use of erosion control containing plastic monofilament will not be allowed as wildlife may become entrapped in this material. The erosion control materials (wattles, blankets) will be secured to the ground with wooden stakes or earth staples, per the recommendations of the manufacturer and the specifications of the Storm Water Pollution Prevention Plan. Erosion control materials will remain in place for the duration of the monitoring period and allowed to decompose naturally over time.

3.5.7 INVASIVE PLANT MANAGEMENT

In coordination with the planting effort, non-native, invasive plants shall be managed for eradication or control within the revegetation areas. The goal is that non-native, invasive plant species shall not become dominant at any site. Many non-native species now naturalized in California plant communities; however, do not pose a threat to the value or function of the community; therefore not all non-native plant species will be controlled. Non-native, invasive plant species, with a California Invasive Plant Council (Cal-IPC) Central West Region invasiveness rating of "high" and select Cal-IPC species with a "low" or "moderate" rating that may impede native vegetation establishment (as determined by the restoration specialist and approved by the agencies will be controlled. Non-native annual grasses included on the Cal-IPC list, with the exception of medusahead, are not targeted for control in the revegetation areas. Cover of selected non-native invasive species will not be allowed to equal more than 5 percent cover of the restored area during the first two years of establishment. Species known to occur within or adjacent to the CDRP area are the most likely species that will require removal during the first few years of site maintenance (partial list included in Table 4). All of the species listed in Table 4 will be targeted for management and removal. Additional species to be targeted will be recommended by the restoration specialist, and submitted for approval by the agencies, during regular monitoring and maintenance of the site. The list in Table 4 has been reviewed and tentatively approved by the RWQCB.

Non-native, invasive plant control will be conducted in the spring and fall throughout the monitoring period to facilitate native species establishment and avoid weed infestations in the revegetated areas. Non-native, invasive plant control would be carried out by a specialty restoration contractor either selected by the CDRP construction contractor or a specialty restoration contractor, as described in Section 3.1.

Table 4
Partial List of Non-Native Invasive Plants Observed in the CDRP[1] Area

Common Name	Scientific Name	Cal-IPC [2] Central West Region Listing	Where Observed in the CDRP
Fennel	*Foeniculum vulgare*	High	California annual grasslands throughout the CDRP
Harding grass	*Phalaris aquatica*	Moderate	Mesic grasslands
Himalayan blackberry	*Rubus discolor*	High	Riparian areas
Italian thistle	*Carduus pycnocephalus*	Moderate	Throughout the CDRP
Poison hemlock	*Conium maculatum*	Moderate	Mesic grasslands
Purple star thistle	*Centaurea calcitrapa*	Moderate	California annual grasslands throughout the CDRP
Stinkweed	*Dittrichia graveolens*	Moderate	California annual grasslands throughout the CDRP; high cover along reservoir edges
Tobacco tree	*Nicotiana glauca*	Moderate	Quarry slopes (Borrow Area B)
Yellow star thistle	*Centaurea solsititialis*	High	California annual grasslands throughout the CDRP

[1]CDRP = Calaveras Dam Replacement Project

[2]Cal-IPC = California Invasive Plant Council

3.5.8 IRRIGATION

Irrigation and watering applications will be performed in a manner to establish healthy and vigorous plants that are not irrigation-dependent at the end of the monitoring period. Irrigation will be provided to woody plants for a 2 year period to increase plant survival and vigor. For wetland and grassland plantings, it is not anticipated that long-term irrigation will be needed except during installation; plantings may be "watered in" during installation.

Water will be applied during the first one to 2 years after plant installation, not to exceed 24 months. If plants continue to lack vigor after 2 years of irrigation, plants will be replaced with species more tolerant of hydrologic conditions at the site.

If plant survivorship is low or water/drought stress is evident in the plantings during the monitoring period, supplemental irrigation will be applied as a remedial action or adaptive management decision at a frequency recommended by the project restoration specialist or biologist. Supplemental irrigation will be installed and maintained by a specialty restoration contractor.

If vegetation monitoring recommends further watering beyond Year 2, than the monitoring period will be extended by the equivalent number of years watering was extended regardless of when irrigation was reinitiated.

3.5.9 PLANTING IMPLEMENTATION SCHEDULE

Various construction activities will be completed at different times during the course of the CDRP. The following general schedule will be followed for each area described in this revegetation plan as construction is completed:

- Seeds for vegetative propagation will be collected in the summer of the year before construction activities are complete. Seeds will be propagated in a nursery.
- Plant seeds for hydroseed mixes (potentially collected over multiple years) will be collected and/or the remaining nursery stock will be secured.
- Willow cuttings will be collected just prior to installation.
- Immediately after construction, the planting site will be graded, invasive species removed, contouring completed, and erosion control measures installed.
- After completion of construction, restoration and revegetation areas will be hydroseeded, and rooted plantings installed (in late fall after first heavy rains). Planting would be completed in the late fall through winter (November – March) in order to maximize planting survival. Willow cuttings will be installed in the winter (January – March).
- Plant maintenance, monitoring, reporting, and remedial actions will be implemented in the winter after construction through the performance period, as specified in Section 4.

3.5.10 GRAZING

Livestock grazing of the revegetation sites during the performance period will be determined by a restoration specialist, in coordination with the SFPUC watershed manager.

4 MONITORING AND MAINTENANCE

This section defines monitoring protocols that will be used to evaluate site conditions, performance criteria that will be used to assess progress toward, and achievement of, restoration and revegetation success, and maintenance actions that will support vegetation establishment at the site. Performance standards and monitoring periods differ by habitat type and by the goal for a given site (defined in Section 3).

4.1 PERFORMANCE CRITERIA

Performance criteria are benchmarks against which project achievement will be assessed. Restoration and revegetation efforts serve three purposes: (1) to eliminate or minimize erosion; (2) to protect water quality; and (3) to ensure native or naturalized plants become established and non-native invasive plants do not become established. Progress will be tracked to determine if restoration and revegetation efforts are meeting these purposes. Erosion prevention and water quality will be addressed via a vegetation cover criteria, rill mapping, hydrologic function criteria, and by performance of maintenance activities. Native plant establishment will be evaluated using vegetation cover criterion and an invasive species cover criterion. If performance criteria are not met, replacement plantings or other remedial actions are necessary until the site meets the performance criteria.

4.1.1 GENERAL PERFORMANCE CRITERIA

The following general performance criteria apply to the revegetation areas in the CDRP:

- Restoration and revegetation implementation must be completed in the same calendar year that construction is completed in that area.
- Vegetation within restoration areas will be fully established, and self-sustaining (as evidenced by successive years of healthy vegetative growth; observed increase in vegetative cover, canopy cover, and/or plant height; successful flowering, seed set, and/or vegetative reproduction over the monitoring period defined in Section 4.2).
- Restoration areas shall be monitored after replanting for presence of invasive plants during the monitoring periods defined in Section 4.2 (from 3 to 10 years). If invasive plants (as defined in Section 3.5.7) are found during the monitoring period, they shall be removed as necessary to meet the cover and vegetation composition performance criteria.
- No excessive erosion of disturbed surfaces. Vegetative cover must be sufficient to prevent erosion, defined as rills more than two inches deep.
- Stream channel morphology (Disposal Site 3 and the Calaveras Creek low-flow channel) will be evaluated over 10 years to monitor channel adjustment for signs of aggradation, degradation, or lateral migration that could negatively affect the goals and objectives of the site restoration.

4.1.2 VEGETATION PERFORMANCE CRITERIA

The vegetation standards for the CDRP are outlined by vegetation community in Table 5.

Table 5
Performance Criteria for Vegetation Cover and Survivorship

Project Standard	Field Indicator/Measurement
Vegetation Cover and Survivorship	**Upland and Mesic Grassland (most sites)**: a minimum of 40% relative cover in hydroseeded and/or broadcast seeded areas by Year 1, and 50% cover of typical native and naturalized grassland species known from the region by Year 3. **Oak Savannah and Oak Woodland (Staging Areas 5 and 11 and Observation Hill):** a minimum of 50% survivorship of planted buckeyes and oaks by the end of Monitoring Year 2 and 30% by Year 10. Greater than or equal to 45% relative cover of native herbaceous understory vegetation by Year 10 **Diablan Sage Scrub (Borrow Area B):** a minimum of 5% relative vegetative cover of target scrub vegetation at the end of Monitoring Year 5. **Riparian Forest (Calaveras Creek low-flow channel and Disposal Site 3):** a minimum of 75% survivorship of planted tree species at the end of Monitoring Year 2; a minimum of 60% relative cover of native species by Monitoring Year 5. **Seasonal Wetland (Calaveras Creek low-flow channel, Staging Area 1):** a minimum of 70% relative cover of native herbaceous vegetation by Year 5 and the dominant vegetation shall be hydrophytic (defined as FAC, FACW, or OBL).
Invasive Plants	No more than 5% relative cover of target noxious non-native plants present in CDRP restoration and revegetation sites at all monitoring events. Non-native species targeted for control are those as defined in Section 3.5.7 and include those in Table 4.

4.1.3 HYDROLOGY PERFORMANCE CRITERIA

Performance criteria for channel restoration will focus on establishing native riparian vegetation and increasing channel stability. Monitoring results should meet the success criteria for a stable channel stated in Table 6. If success criteria are not attained in any one-year for the criteria stated, then a fluvial geomorphologist will assess the successional stage shift of stream types to determine if the stream system is shifting towards a more suitable stable condition or unstable condition. If the successional shift is to a more unstable condition then remedial actions may be prescribed.

Table 6
Acceptable geomorphic design variations for streams.

Metric	Acceptable Value Range
Bank-Height Ratio	1.0 – 1.3
Width/Depth (W/D) Ratio State (Existing W/D Ratio to Design W/D Ratio)	0.6 – 1.4
Revised Pfankuch Channel Stability Rating for C4 Stream Type	70-90 (Good - Stable)
Bank Erosion Hazard Index (BEHI) Rating	5 – 19.5 (Very Low – Low)
Longitudinal profile analysis	Neither aggrading or degrading

4.2 MONITORING PLAN AND RATIONALE

Monitoring will measure overall success using the indicated performance criteria, while the site assessments are intended to monitor plant establishment and maintenance needs.

Monitoring assessments should be conducted by qualified personnel (e.g., a professional biologist, botanist, ecologist, and/or hydrologist/geomorphologist). It is recommended that the same person or team conducts the monitoring throughout the life of the project so that the evaluation and data are consistent and have continuity through time.

4.2.1 VEGETATION MONITORING

Point-line intercept surveys using a systematic random sampling method will be used to estimate total vegetative cover, native cover, hydrophytic cover, and non-native invasive species cover. This design uses non-permanent transects that are evenly spaced from one another and perpendicular along a "main line." An example method for random selection of the placement of transects is described below:

- Prior to establishing the first transect, two numbers are selected at random for each survey area. R1, the first random number, is used to offset the starting position of the first transect location. R2 is the second random number and is used to offset the first sample point along the first transect.

After the first transect and the first sample point have been established, sample points and transects are designated at evenly spaced intervals so that the end result is a sampling grid with randomly chosen but evenly spaced points (Figure 7). The interval distance between points and transects is constant within a survey area and is based upon the survey area size. Sample points taken using the point-intercept method record species, height strata, wetland indicator, and nativity.

To take data from a point, a 2-meter metal rod will be placed vertically (perpendicular to the ground) at the location of the sampling point. All plant species touching the rod within each height category (low, medium, and high) will be recorded. Plant species that touch the rod in more than one height category will be recorded in each height category. The two smallest vegetation height categories, Low (0.0 meter to 0.5 meter) and Medium (0.5 meter to 2 meters), are captured by the height of the rod (2 `meters tall). The High category (over 2 meters) will be estimated.

Cover estimates will be calculated using relative cover analysis. The values of relative percent cover measurement will fall between 0 and 100 percent. In addition to vegetative cover, each point where there is no vegetation, bare ground should be noted. Dead vegetation will not be counted towards relative or absolute cover.

The primary objective of sampling is to compare a percentage (a proportion of values) to a threshold percentage in order to determine if a given goal percent cover has achieved. In other words, we define the specific question to be addressed as follows:

"Is the true value of the percent cover less than or equal to the percent cover requirement?"

An a *priori* power analysis will be used to determine the sample size requirement. The number of sampling points required to evaluate percent cover will be calculated taking into account the confidence level (1-α), the power of detection (1-β), width of the gray region (i.e., minimum effect of concern, or also referred to as margin of error) (Δ), and the goal (or threshold/action level) of percent cover. A nonparametric random sampling approach is used to determine the number of samples. The formula used here is the most recognized formula for calculating the number of samples for testing a proportion (see USEPA's *Guidance for the Data Quality Objectives Process*, EPA/600/R-96/084, for details), and is shown below:

$$n = \left(\frac{z_{1-\alpha}\sqrt{P_0(1-P_0)} + z_{1-\alpha}\sqrt{P_1(1-P_1)}}{\Delta} \right)$$

where

n is the number of samples,
P_0 is the threshold,
P_1 is the outer bound of the gray region (note that $| P_1 - P_0 |$ is Δ),
α is the acceptable probability of incorrectly concluding the proportion is less than the threshold,
β is the acceptable probability of incorrectly concluding the proportion exceeds the threshold,
$z_{1-\alpha}$ is the value of the standard normal distribution such that the proportion of the distribution less than $z_{1-\alpha}$ is $1-\alpha$,
$z_{1-\beta}$ is the value of the standard normal distribution such that the proportion of the distribution less than $z_{1-\beta}$ is $1-\beta$.

Given a target of 95% confidence level ($\alpha = 5\%$), 80% power of detection ($\beta = 20\%$), a Δ of 15%, and a goal of 50 percent cover (the most conservative assumption in terms of sample size calculation for a test for proportion), the number of samples required is calculated to be 67.

Once the samples have been collected, statistical evaluation will be performed based on the one-sample proportion test, as described in USEPA's *Data Quality Assessment: Statistical Methods for Practitioners*, EPA QA/G-9S, to determine if the assessed percent cover has achieved the performance criteria.

4.2.2 GEOMORPHIC MONITORING

A qualified hydrologist/geomorphologist selected by the SFPUC will perform geomorphic monitoring for the stream channel at the base of Disposal Site 3 and the Calaveras Creek low-flow channel below the replacement dam. The monitoring effort is intended to provide adequate information to monitor change and channel stability without being too onerous for the size and scope of the restoration.

The goal of the monitoring is to document changes in channel, bank, or floodplain stability that could jeopardize riparian plantings or cause significant erosion or sedimentation of nearby habitat. Monitoring will include photo monitoring, longitudinal, and cross sectional, bank erosion hazard index rating, and revised Pfankuch surveys. The cross sectional and longitudinal surveys provide adequate detail to monitor channel adjustment over time as well as provide data necessary for calculating the bank height ratio and width/depth ratio state and background information for the bank erosion hazard index rating and revised Pfankuch surveys. In order to have an accurate and representative comparison, surveys need to be setup and documented carefully by installing a permanent benchmark, profile, and cross section pins and identifying where measuring tapes and instruments where placed with detailed notes and a site map. Subsequent surveys need to be conducted in the exact methodology and placement as the baseline survey - taking measurements at the same stationing as the baseline survey as well as surveying additional locations where changes have occurred. For instance, the stations at which the cross sections cross the longitudinal profile need to be the same for every survey year. Without this level of detail, surveys cannot be adequately compared to previous year's surveys. In addition to the aforementioned recommendations, survey practices should follow the procedures described in *Stream Channel Reference Sites: An Illustrated Guide to Field Technique* (Harrelson et al. 1994) and monitoring procedures described below and

detailed in *River Stability Field Guide* (Rosgen 2008) and *Watershed Assessment of River Stability and Sediment Supply* (Rosgen 2006).

Photo-documentation points will be established along the channel upstream, downstream, and within the revegetation area at Disposal Site 3. Documentation of changes below the 756-foot reservoir fill elevation will proceed until the reservoir is filled or as the reservoir level drops over the course of the 10 year monitoring period. Photo monitoring points at Calaveras low-flow channel will be placed to monitor the channel adjacent to the revegetation area and an area within 300 feet downstream of the revegetation area. Representative cross-section locations will be photo-documented using a digital camera by taking a panoramic photo looking upstream through the feature, a panoramic photo looking downstream through the feature, and one photo each of the left and right banks at the cross-section location. Other permanent photo points will be established to capture unique views of the meander bends, in-stream structures, and other features to provide a view of areas where channel adjustment typically occurs.

Longitudinal surveys will be conducted from 300 feet upstream of the Disposal Site 3 restoration area to the end of the graded channel or to the reservoir edge (as the reservoir level fluctuates in the 10-year monitoring period). A longitudinal survey at the Calaveras Creek low-flow channel will cover the area from the outlet of the discharge basin to 300 feet downstream of the extent of restoration area.

Longitudinal surveys will be conducted along the thalweg of the stream to capture vertical changes in the bed slope. The longitudinal survey would also capture the water surface (when present), bank full elevation and the low bank height where it departs from the bank full elevation. The longitudinal profile provides an assessment of changes to bed slope, bank full slope, and the position and change of bed features (riffle, run, pool, and glide). Low banks are topographic features indicating a previous bank full elevation. The presence of a low bank diverging from the existing bank full elevation in a downstream direction is an indication of channel incision occurring within the reach and moving upstream (Rosgen 2006). With such a condition, a detailed bed and water surface profile should capture a nick point or sudden change in channel slope near the point of interception of low bank and bank full. The reverse condition may be observed where a low bank is observed converging with the existing bank full elevation, an indication of aggradation within the reach.

Each monitoring period the channel bed and water surface profile will be overlaid with the previous year or baseline bed profile to be analyzed for changes that may indicate shifts towards stability or instability. Evidence of aggradation or degradation may be identified with abrupt changes in channel bed/water surface slope or identification of low banks and subsequent shifts in the bank height ratio (see below). The profile will show shifts in the riffle, run, pool, and glide facet slopes that can explain channel morphological changes such as pool filling, areas of excess scour, or relocation of bed features. Such changes are acceptable to a degree that the channel is neither aggrading nor degrading and the system as a whole remains stable (as measured with the Pfankuch channel stability rating).

Cross-sectional surveys will monitor lateral and vertical adjustments in the channel/floodplain. Two permanent cross sections will be measured at the Calaveras Creek low-flow channel (one within the restoration area, one downstream – both located in a riffle feature, if possible). Five permanent cross sections will be measured at Disposal Site 3. Where possible, one cross section should be located within 300 feet upstream of the restoration area in a riffle, two within the restoration planting area at a riffle and a pool, and two downstream of the restoration planting area in a riffle and a pool. All cross-sections will lie within the bounds of the longitudinal survey at the same stationing established in the baseline survey, as described above. If streambed morphological features are not present then cross sections will be evenly spaced or located at locations where features are expected to develop (e.g. on

a meander bend where pools would typically develop or between meander bends where riffles would develop).

Permanent cross-sections are used to monitor any lateral or vertical adjustment influenced by the restoration/construction grading. Like the longitudinal profile, the cross section provides a visual documentation of change and provides valuable data for assessing morphology. From the riffle cross section shifts in the width to depth and entrenchment ratio can be measured. Since the channel design is based on an empirical approach to channel dimensioning, it is expected that cross sections will adjust in response to the effective discharge and sediment supply unique to the watershed. For instance, the channel should begin to form an inner berm that will be visible in the pool and riffle cross sections. The inner berm area increases channel velocities (and boundary shear) and maintains secondary circulation. This feature is critical for maintaining channel competence (Rosgen 2010). The cross sections, particularly at the bends (pools) will provide information as to lateral migration of the channel. As the channel adjusts to a new equilibrium and vegetation becomes established the channel cross section, particularly the banks where near bank shear stress is highest, should stabilize.

In addition to photo documentation, longitudinal, and cross sectional surveys the following metrics will be calculated to determine the relative stability of the channels and departure from the baseline or as-built measurements. These metrics will rate the severity of change and provide means for determining a need for corrective measures. The quantitative metrics that will be utilized to rate channel stability include:

Bank height ratio (BHR): BHR measures the degree of channel incision and is calculated as the ratio of the lowest bank height to the maximum bank full depth measured at the toe of the study slope. BHR is determined from data collected from measuring the bank full depth and lowest bank height during the longitudinal survey. From these measurements the beginning and ending BHR can be determined for the reach. Ideally the BHR should be 1.0 indicating no channel incision. A ratio above 1.3 is an indication that channel incision is impacting the stability of the reach.

Width/depth ratio state: This ratio measures the amount of departure in the channel cross-sectional shape from the design. It is calculated by dividing the existing width to depth ratio by the as-built or baseline width to depth ratio. Width/depth ratios are measured at the cross section locations. Typically, the width/depth ratio state is compared to the variability in the reference reach width/depth ratio. Because the project channel dimensions are relative to empirical relationships the comparison will be made with the design width/depth ratio. This will provide a measure of relative departure from the design parameters, but may not necessarily mean a departure from stability. Other metrics (described in this document) will be necessary to confirm whether the measured trend is towards or away from a stable channel width/depth ratio. It is assumed that the methods used to describe the channel dimensions are suitable for the conditions of the project site, therefore any adjustment outside the 0.6 – 1.4 range should suggest a trend towards instability generally associated with streambank erosion, aggradation, or degradation that should also be identified through other prescribed metrics and surveys.

Bank Erosion Hazard Index (BEHI) rating: BEHI is an adjective rating for bank erosion hazard that combines various input variables to determine the overall hazard rating. These variables include bank height (toe of slope to top of bank), bank full height (toe of slope to bank full elevation), bank angle, percent bank surface protection (vegetation), root depth, and percent root density. Each of the variables can be measured (e.g. bank height, bank full height, bank angle, root depth) or visually estimated (bank surface protection, root density). Numeric BEHI ratings (0 – 10, Very Low - Extreme) are chosen from separate graphs of the ratio of study bank height/bank full height, root depth/study bank height, weighted root density, bank angle, and surface protection (see Rosgen 2006,

2008). Each of the assigned adjective ratings are summed up with additional adjustments made to the total score if the bank materials (bedrock, cobble, sand, silt/clay) and stratification of bank materials in relation to the bank full stage influence the stability of the bank.

BEHI should be conducted along the entire reach of stream. Separate ratings should be given for differing areas of bank erosion. These areas should be mapped and identified by right bank/left bank and stationing (from the longitudinal profile) as they occur throughout the reach. As the channel dimensions adjust shape to the watershed conditions a short term decreasing trend may occur from baseline conditions, however as vegetation becomes established the trend should become more stable as bank surface protection, rooting depth, and root densities increase.

Revised Pfankuch channel stability rating: This rating ranks the overall channel bank and bed stability. Fifteen unique stream indicators of stability are evaluated along the upper banks, lower banks, and bottom. A numerical score is assigned in each category according to whether the reach is found to be in excellent, good, fair, or poor condition with respect to that category. The scores are summed, and the total score is used to identify the overall condition (good, fair, or poor) of the reach. Scores range from a minimum of 38 to a maximum of 152. A modified version of the Pfankuch stability rating, in which the overall condition varies by stream type, will be utilized. The Pfankuch survey should be conducted for the area outside the restoration area and for the representative area within the restoration area where the stream type is the same. If a portion of the stream channel morphs into a different stream type than a separate evaluation should be conducted for that particular reach. The Pfankuch rating should increase slightly in the early years following construction as vegetation becomes established and channel adjusts to a more suitable dimension. Should the rating decrease outside the range of a "Good - Stable" rating (70-90 for a C4 channel type) than the other metrics should also indicate a decreasing trend in channel/bank stability.

4.2.3 PERIODIC SITE ASSESSMENTS

In addition to cover data collected using point-line intercept methodology, quantitative and qualitative data will be collected for each CDRP revegetation area through a periodic site assessment. The following data will be collected during the site assessment:

- Mortality (presence/absence) of planted tree and shrubs. Mortality data for planted trees and shrubs is intended for determining future maintenance needs, and is not intended for use in establishing whether or not the site has met performance standards.
- A vegetation monitor will walk CDRP revegetation sites and record all plant species present that can be identified during the monitoring visit, and will record relative cover for the dominant species (dominant species are defined as any species with greater than 20 percent relative cover) and for any invasive plants encountered.
- Conduct a health and vigor assessment of planted materials, using the scale provided in Table 7.
- Species richness (i.e., the total number of species present). This general site data will be used for calibrating similar data taken at transects, and is not intended for use in establishing whether or not the site has met performance standards.
- Canopy cover estimates (by vegetation community type) using standard field estimation methods for small habitats (areas of less than 5 acres). Canopy cover estimates are primarily intended for use in calibrating similar data collected along sampling transects.
- Other site characteristics (e.g., observed patterns of plant die-offs, erosion, hydrological issues, trespass, herbivory and grazing pressure, and/or other land use issues).

Table 7
Qualitative Score for Assessing the Health and Vigor of Planted Stock

Score	Description of Score
Excellent	No evidence of stress; minor pest or pathogen damage may be present but no chlorotic leaves, and no or very minor herbivory (browse)
Good	Some evidence of stress; pest or pathogen damage present; few chlorotic leaves (>5%); minor evidence of herbivory (browse)
Fair	Moderate level of stress; high levels of pest or pathogen damage; some chlorotic leaves (>10%); some herbivory damage (a few snapped leaves, stems, wear marks, etc.)
Poor	High level of stress; high levels of pest or pathogen damage; many chlorotic leaves (>30%); severe herbivory damage (massive forage damage, main stems/leaves stripped, etc.)

4.3 MONITORING AND MAINTENANCE SCHEDULE

Monitoring frequency and duration vary according to habitat type and vary according to a site's revegetation goal, as follows:

- Seven times (Years 1 through 5, 7, and 10) over 10 years for oak savannah and oak woodland (Staging Area 5 and 11 and Observation Hill), Diablan sage scrub (Borrow Area B), riparian forest (Calaveras low-flow channel and Disposal Site 3)
- Three times (Years 1, 2, and 3) over 3 years for upland and mesic grassland (most sites)
- Five times (Years 1 through 5) over 5 years for seasonal wetland (Calaveras Creek low-flow channel, Staging Area 1)
- Six times (Baseline, Years 1, 3, 5, 7, and 10) over 10 years for streams (monitoring hydrogeomorphic changes at Calaveras low-flow channel and Disposal Site 3)

Data will be collected at about the same time each year during the monitoring periods outlined in Section 4.2 to standardize results (i.e., within a 2-week period to account for seasonal variations in weather, precipitation, and temperature).

In general, grasslands and wetlands will be sampled in spring (March or April), and shrub and woodland/forested habitats sampled in late summer/early fall (late August - early September) when planted trees and shrubs are most likely to exhibit stress.

The stream channel and floodplain should be maintenance free; however, the results from the geomorphic monitoring will be used to determine if any major channel adjustments warrant some level of channel maintenance/alteration.

Periodic site assessments will occur every month during the first growing season, then every six months in Years 2 through 5, 7, and 10, or as recommended by the restoration specialist. It is anticipated that all target vegetation communities will not respond to environmental conditions the same, and may need to be monitored on varying schedules to accurately measure progress and successfully maintain the sites. As a result, the intervals for the periodic site progress assessment and reporting are subject to change by the restoration specialist, particularly if performance criteria are not met.

As described in Section 3.1, the maintenance contractor will report to the site at the same time that the periodic monitoring is scheduled. The maintenance contractor will be required to summarize their activities to the SFPUC immediately after their visit. Maintenance activities include but are not limited to these:

- Watering, clean up, litter removal, and all other operations necessary to assure good plant growth
- Replacement and/or repair of erosion control devices
- Removal of non-native, invasive species through hand-pulling
- Inspection of the irrigation system and adjustment and/or replacement of parts as necessary
- Replacement of dead container plants with the same species and size, or with other species approved by the SFPUC during the installation warranty period
- As-needed plant replacement after the first installation warranty period if performance criteria are not met

4.4 REPORTING

Seven annual monitoring reports (Years 1 through 5, 7, and 10) will be prepared and submitted to the appropriate permitting agencies in November of each year. The results of periodic site assessments (see Section 4.3 for site assessment schedule) will be compiled in technical memorandums after each assessment event. The SFPUC will forward these to the resources agency representatives as requested.

4.5 FINANCIAL ASSURANCES

The San Francisco Public Utilities Commission is financially responsible for the attainment of the success criteria required in this plan.

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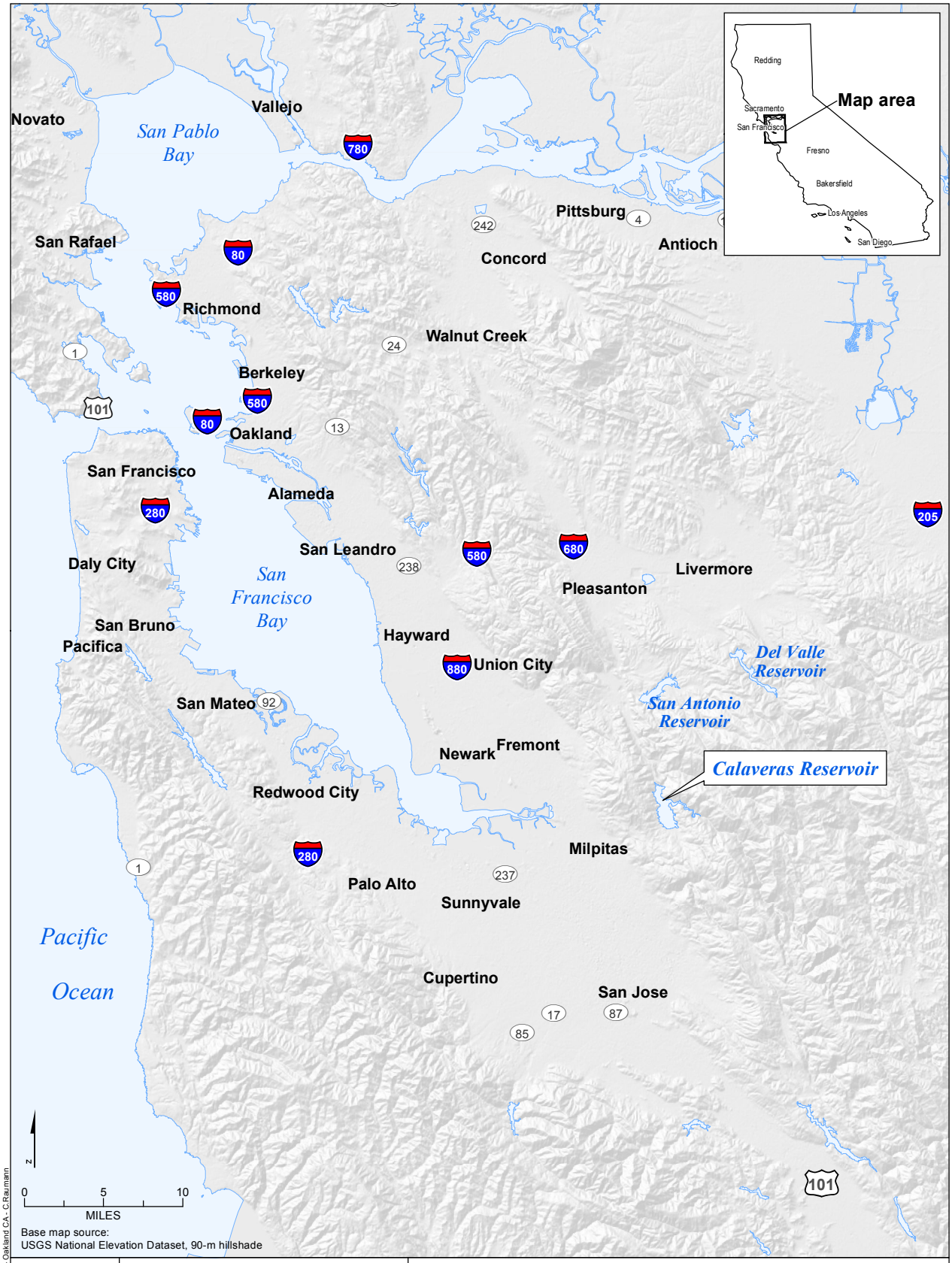
SFPUC (San Francisco Public Utilities Commission). 2009. *Calaveras Dam Replacement Project Draft Environmental Impact Report.* City and County of San Francisco, San Francisco Planning Department. State Clearinghouse No. 2005102102.

URS (URS Corporation). 2010. *Final Sunol Region Mitigation and Monitoring Plan*. Prepared for the San Francisco Public Utilities Commission, September.

Figures



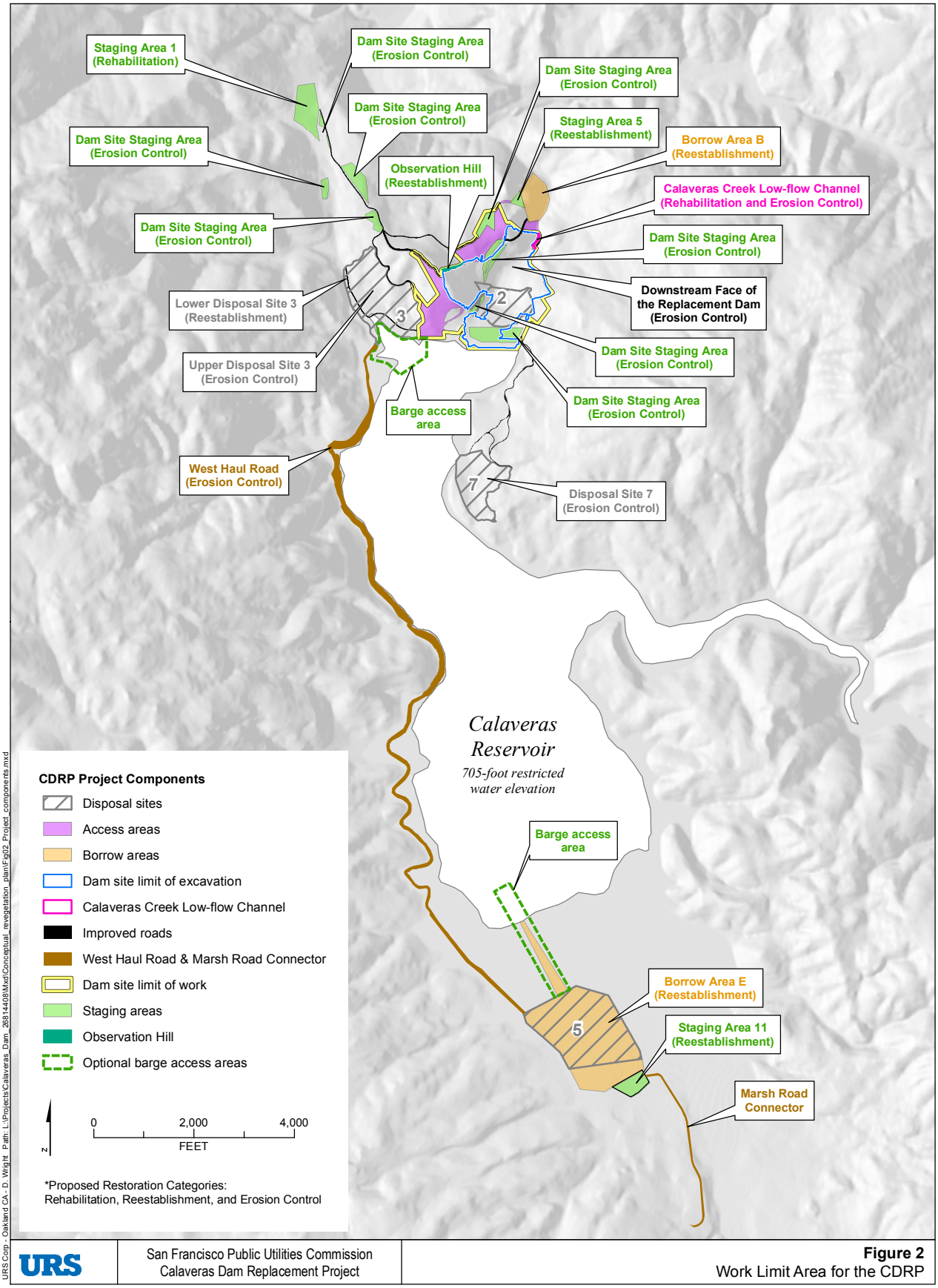
Base map source:
USGS National Elevation Dataset, 90-m hillshade

URS Corp - Oakland, CA - C.Raumann

URS

San Francisco Public Utilities Commission
Calaveras Dam Replacement Project

Figure 1
CDRP Project Location

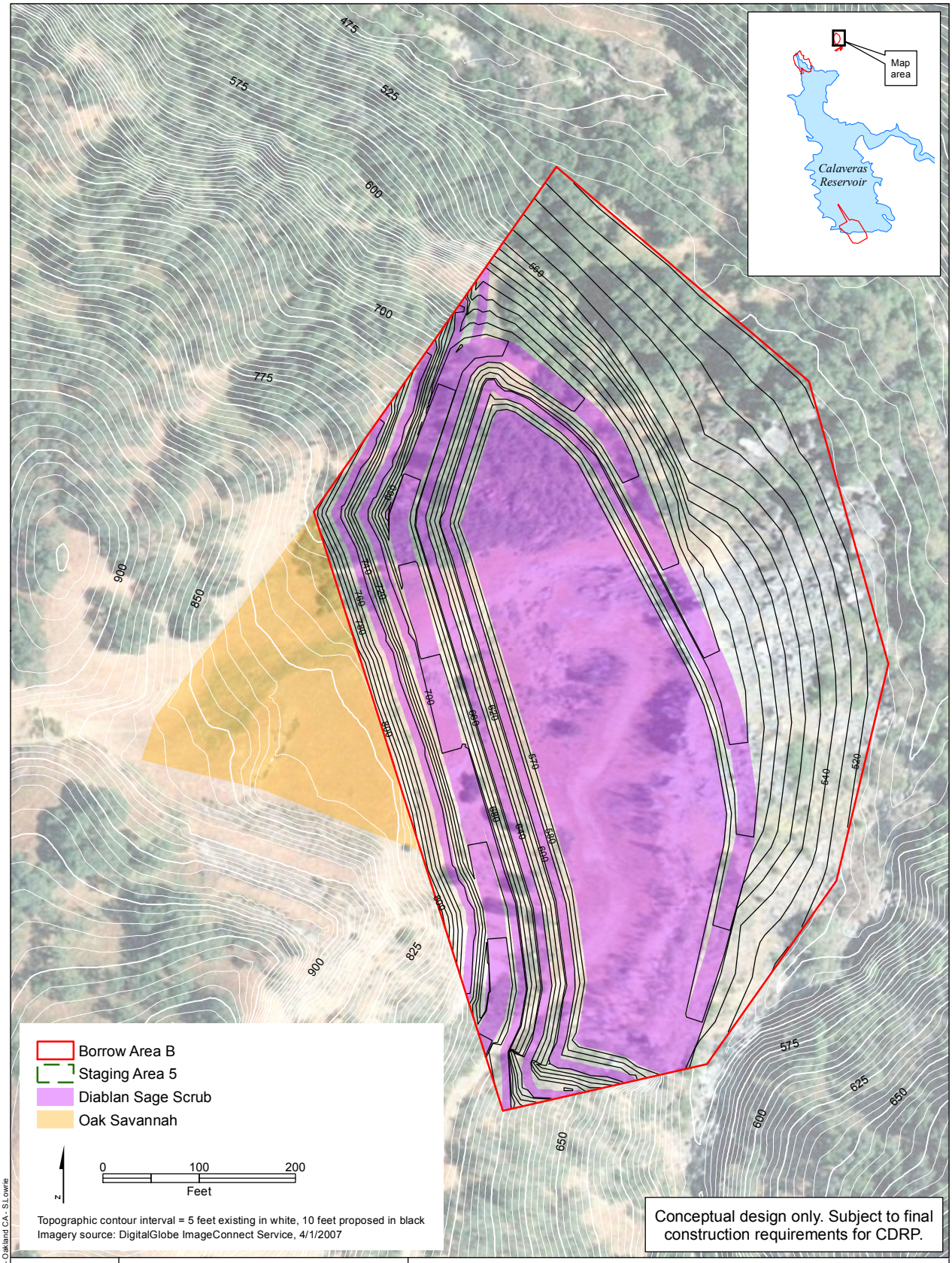


URS Corp - Oakland CA - D. Wright Path: I:\Projects\Calaveras_Dam_26814408\Mxd\Conceptual_revegetation_plan\Fig02_Project_components.mxd

URS

San Francisco Public Utilities Commission
Calaveras Dam Replacement Project

Figure 2
Work Limit Area for the CDRP

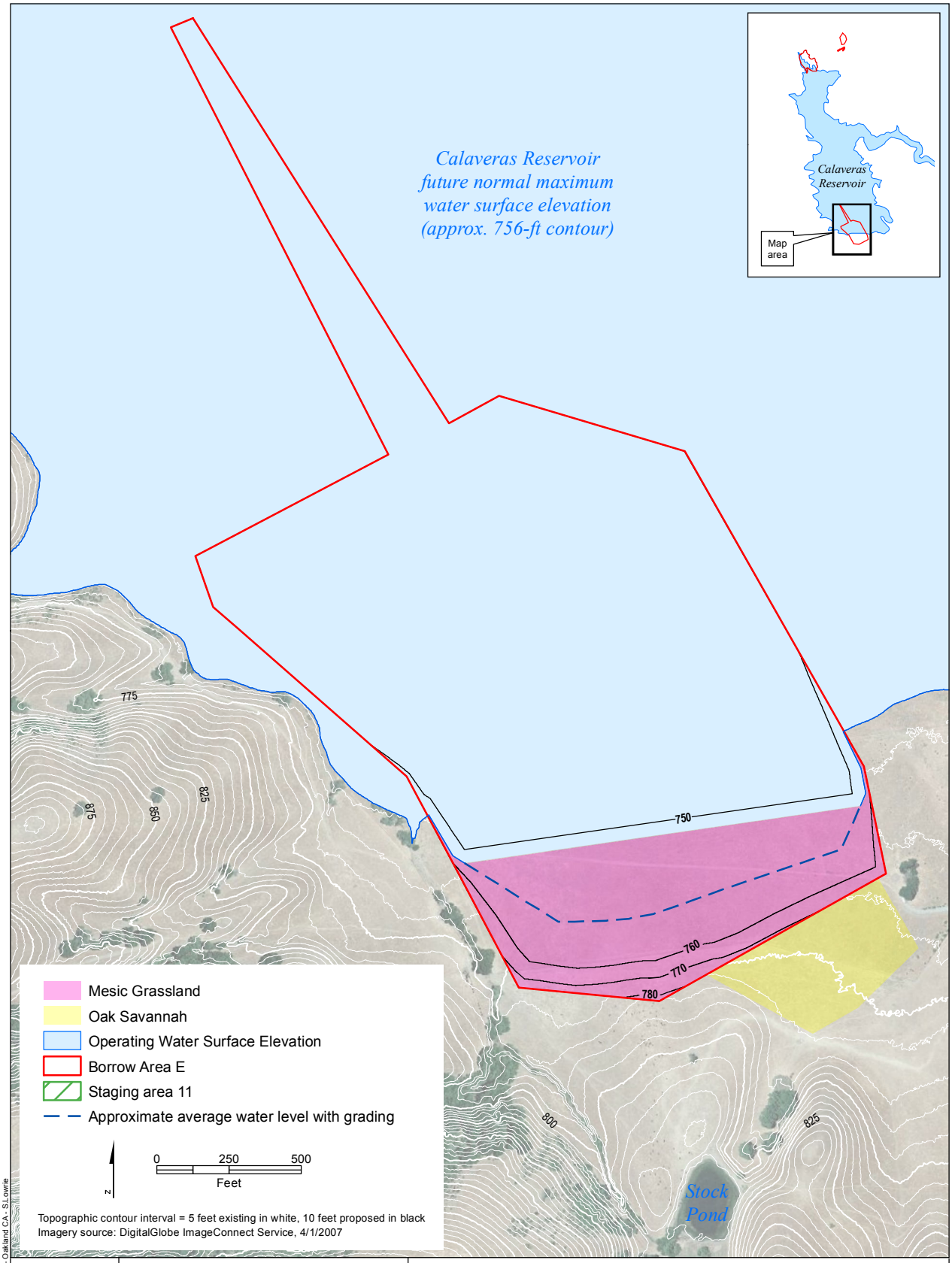


URS Corp - Oakland CA - S.Lowrie

URS

San Francisco Public Utilities Commission
Calaveras Dam Replacement Project

Figure 3
Proposed Vegetation Planting Zones for Borrow Area B and Staging Area 5



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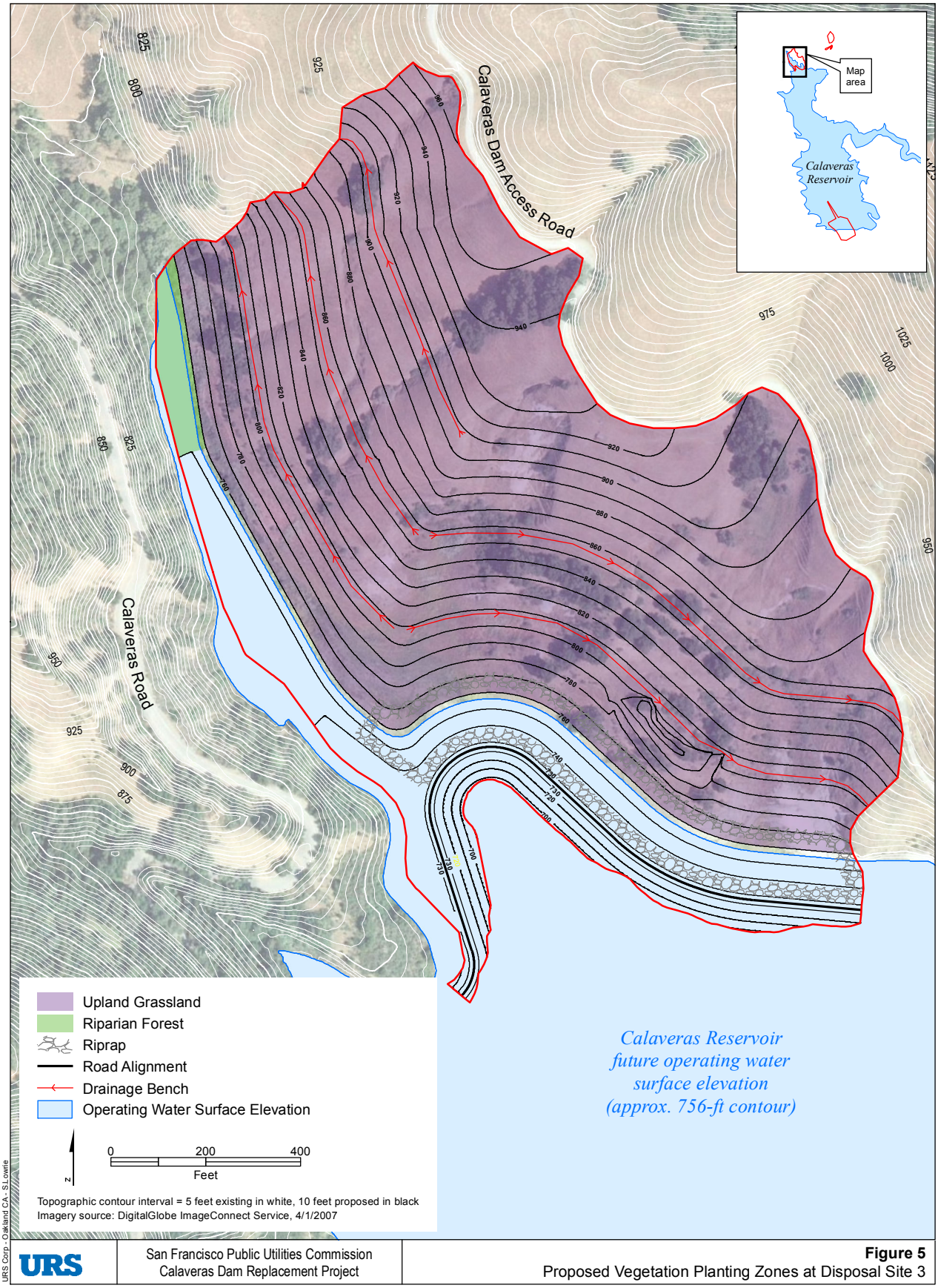
San Francisco Public Utilities Commission
Calaveras Dam Replacement Project

Figure 4
Proposed Vegetation Planting Zones for Borrow Area E



Topographic contour interval = 5 feet existing in white, 10 feet proposed in black
Imagery source: DigitalGlobe ImageConnect Service, 4/1/2007

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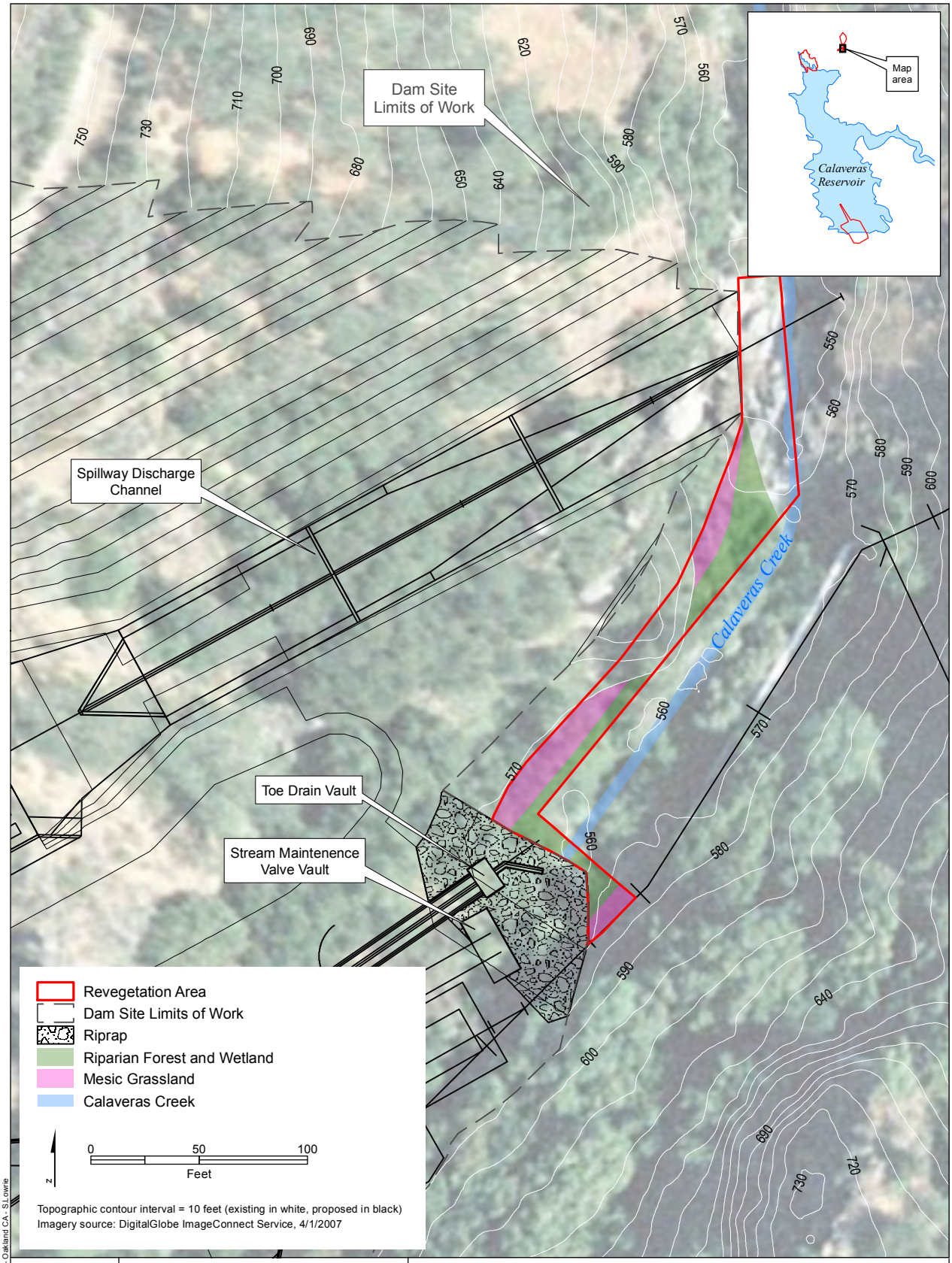
URS

San Francisco Public Utilities Commission
Calaveras Dam Replacement Project

Figure 5
Proposed Vegetation Planting Zones at Disposal Site 3



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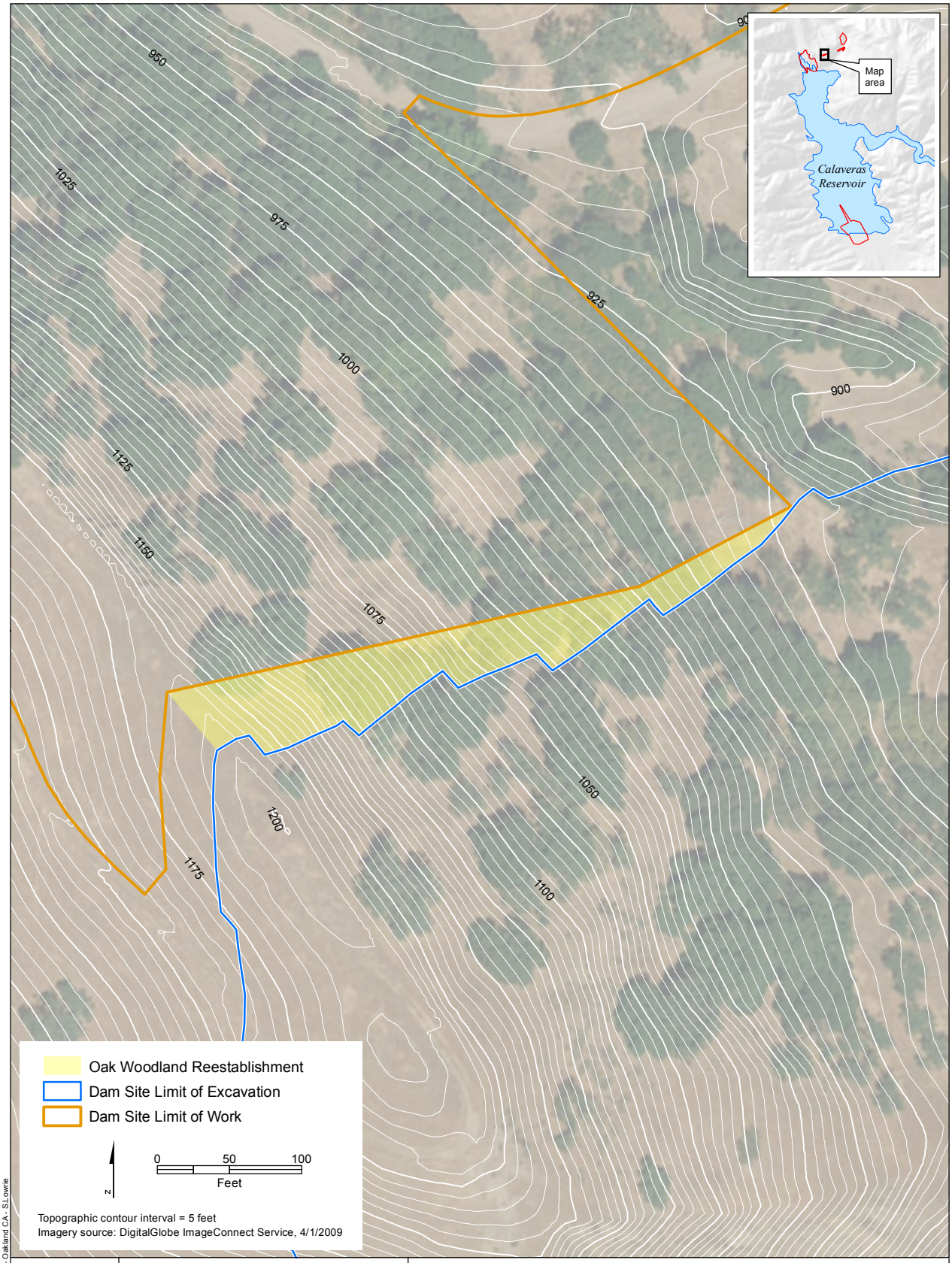
URS

San Francisco Public Utilities Commission
Calaveras Dam Replacement Project

Figure 6
Proposed Vegetation Planting Zones for the Calaveras Creek Low-flow Channel



URS Corp - Oakland CA - S.Lowrie

URS

San Francisco Public Utilities Commission
Calaveras Dam Replacement Project

Figure 7
Proposed Vegetation Planting Zones for Observation Hill Site

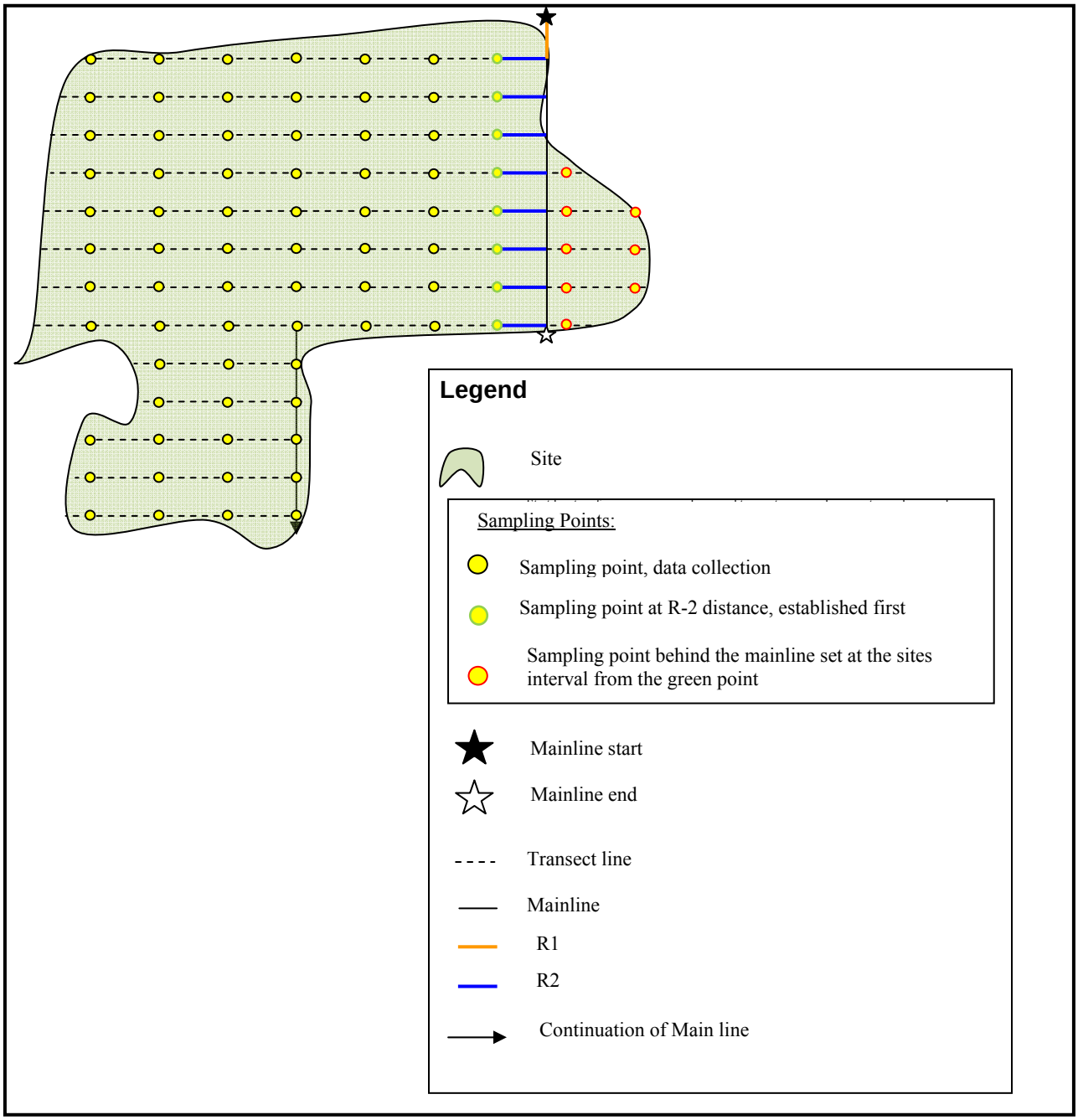


Figure 8. Transect Design Diagram

Appendices

Appendix A

General Erosion Control Revegetation

Appendix A describes the proposed revegetation of areas that are not proposed for specialized habitat rehabilitation or reestablishment in the conceptual restoration plan. The general erosion control revegetation proposed for the remainder of the project construction areas would be completed by the general contractor prior to completion of the CDRP, rather than a specialty contractor, who would complete revegetation activities described in the conceptual restoration plan.

All areas disturbed by the CDRP will be revegetated for long-term erosion control to the extent practicable. Areas that cannot be revegetated would be treated with other permanent erosion control measures as described in the SWPPP. Long-term erosion control measures would be implemented as required for compliance with Section 402 of the Clean Water Act, and would be consistent with the conditions of the individual NPDES permit issued by the San Francisco Regional Water Quality Control Board.

General revegetation for erosion control would be implemented by hydroseeding on all disturbed soil of slopes between 1:1 and 2:1 (horizontal:vertical). Disturbed areas would be hydroseeded immediately following completion of final grading unless otherwise specified in the SWPPP or the construction specifications.

Hydroseed species mixes were selected for erosion control characteristics and also to improve aesthetics, resist invasion of exotic species, and provide habitat benefits. Table A-1 shows existing and target vegetation communities proposed in areas to be revegetated for erosion control. Table A-2 below is a brief description of the general erosion control revegetation proposed for each project component area.

Table A-1
Existing and Target Vegetation Communities

Restoration Type	Revegetation Area	Existing Vegetation Communities	Target Vegetation Communities
Erosion Control: Revegetation of permanent and temporary disturbance areas to prevent erosion and provide some habitat benefits (NPDES)	Staging Areas	California annual grassland; wetland (Staging Area 1)	Upland grassland; wetland and mesic grassland (Staging Area 1)
	Access Roads; Borrow Area E	Predominantly California annual grassland	Upland grassland / Mesic grassland
	Downstream face of replacement dam	Stream channel, California annual grassland, oak woodland, Diablan sage scrub, seasonal wetlands, and riparian forest	Upland grassland
	Upper Disposal Site 3	Oak savannah	Upland grassland
	Calaveras Creek low-flow channel	Riparian forest and seasonal wetland	Mesic grassland / Riparian forest and seasonal wetland
	Disposal Site 7	California annual grassland (serpentine)	Upland grassland

STAGING AREAS

After completion of construction, staging areas will be graded to pre-project conditions. Compacted soil will be ripped and disced with a ring roller to break up large clods. The upland grassland hydroseed mix (Table A-2) will be applied to all staging areas except for the wetland portion of Staging Area 1.The riparian forest and wetland hydroseed mix will be applied to the wetland portion of Staging Area 1.

ACCESS AND ROADS

All temporary roads, except portions of the West Haul Road and roads within the access areas will be re-graded and the natural topography restored when construction is complete. All fill and filter fabric placed in drainage features to construct the West Haul Road would be removed. Compacted soil will be ripped and disced with a ring roller to break up large clods. The entire West Haul Road would then be hydroseeded to provide soil stability, improve aesthetics, protect water quality, and reduce invasive plant establishment.

Portions of the West Haul Road that would be constructed in wetlands or other waters are below the normal maximum water surface elevation of 756 feet. These areas would be revegetated with the mesic grassland hydroseed mix after completion of the CDRP to prevent erosion until the reservoir level increases to the normal maximum water surface elevation.

REPLACEMENT DAM

The downstream face and toe of the replacement dam would be covered with topsoil and hydroseeded. Revegetation of the dam face will minimize long-term erosion and provide grassland habitat benefits. The upstream face will be lined with riprap and is not available for revegetation.

DISPOSAL SITE 3

Habitat impacts associated with Disposal Site 3 will be compensated by implementing the off-site mitigation proposed in the *Sunol Region Mitigation and Monitoring Plan* (Sunol Region MMP). In addition, establishment of riparian forest at the base of Disposal Site 3 is proposed in the Conceptual Restoration Plan. The upland slopes of Disposal Site 3 would be hydroseeded with the upland grassland mix (Table A-2) to minimize erosion and re-establish grassland habitat.

The approximately 30-acre area above the normal maximum water surface elevation (756 feet) would be covered by up to 2.48 million cubic yards of fill that would slope toward the northeast to a maximum elevation of 960 feet. Erosion protection measures, including benching and surface water ditches, would be constructed at this disposal site to reduce the length of the slope susceptible to surface erosion and redirect runoff to engineered drains. Drainage from springs and seeps within the footprint of the disposal site would be collected and conveyed under the disposal site to the reservoir through sand and gravel finger drains.

CALAVERAS CREEK LOW-FLOW CHANNEL

The banks of Calaveras Creek below the proposed stream maintenance valves (low-flow channel) would be temporarily impacted during construction. Riparian and wetland vegetation would be re-established in this area after completion of construction as described in the Conceptual Restoration Plan. Areas within the riparian corridor will be hydroseeded with the riparian forest and wetland mix; areas outside of the riparian corridor will be hydroseeded with the mesic grassland mix (See Table A-2).

DISPOSAL SITE 7

Impacts associated with Disposal Site 7 will be mitigated by offsite compensation as proposed in the Sunol Region MMP. General revegetation of this area will be implemented to prevent erosion and provide grassland habitat benefits. The target vegetation community on the finished fill surface of Disposal Site 7 is upland grassland. The existing topsoil from Disposal Site 7 will be stockpiled and replaced following completion of construction. The disposal site would be hydroseeded with an upland grassland erosion control seed mix (Table A-2).

BORROW AREA E

The southern margins of Borrow Area E would be graded so that the slope will not exceed a 50:1. Site grading would provide a broad zone of transitional vegetation (mesic grassland and upland grassland) associated with the margins of the reservoir. All areas above the existing water surface elevation after completion of construction will be hydroseeded with a native mesic grassland seed mix to prevent erosion until the reservoir level is restored to the normal maximum water surface elevation of 756 feet. When the reservoir level is restored to the normal maximum water surface elevation of 756 feet, the majority of Borrow Area E will be under water.

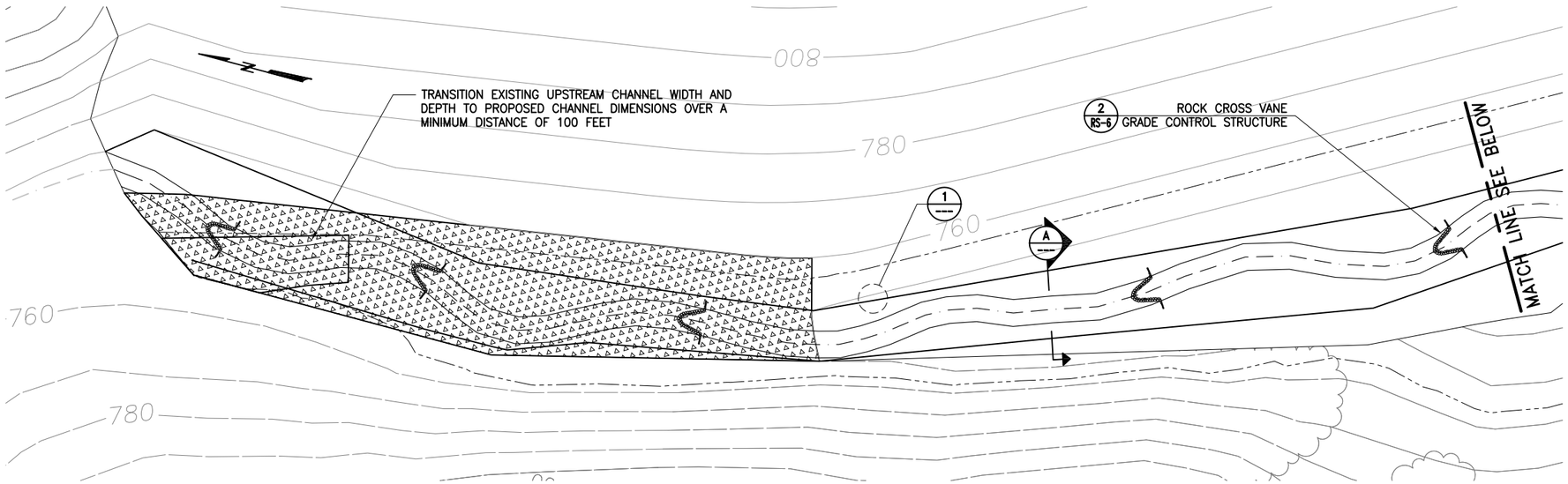
Table A-2
Erosion Control Hydroseed Mixes and Seeding Rates[1]

Project Area	Hydroseed Mix	Acres (approx)	Application/ Planting Method	Hydroseed Mixture and Seeding Rate
Upper portion of Disposal Site 3 and Disposal Site 7; all staging areas; access roads; access areas and downstream face of new dam	Upland Grassland	164 acres	Hydroseed	purple needlegrass (*Nassella pulchra*) 8 lb/acre, California brome (*Bromus carinatus*) 16 lb/acre, California melic grass (*Melica californica*) 4 lb/acre, California poppy (*Eschscholzia californica*) 1.75 lb/acre, buckwheat (*Eriogonum nudum)* 0.5 lb/acre, yarrow (*Achillea millefolium*) 0.75 lb/acre, plus hydro-mulch.
West Haul Road; Borrow Area E	Mesic Grassland	0.08 acre	Hydroseed	meadow barley 18 lb/acre,creeping wildrye (*Leymus triticoides*) 8 lb/acre, tufted hairgrass (*Deschampsia cespitosa*) 6 lb/acre, plus hydro-mulch.
Calaveras Creek low-flow channel	Mesic Grassland	0.05	Hydroseed	meadow barley 18 lb/acre,creeping wildrye (*Leymus triticoides*) 8 lb/acre, tufted hairgrass (*Deschampsia cespitosa*) 6 lb/acre, plus hydro-mulch.
Staging Area 1; Calaveras Creek low-flow channel (Seasonal wetlands and other waters)	Riparian Forest and Wetland	0.6	Hydroseed	meadow barley 18 lb/acre, tall flatsedge (*Cyperus eragrostis*) 8 lb/acre, common rush (*Juncus patens*) 2 lb/acre, Baltic rush (*Juncus balticus*) 2 lb/acre

Note:
1. Detailed specifications for hydroseed application are provided in the 100 percent design materials for the Calaveras Dam Replacement Project.

Appendix B

Disposal Site 3 Stream Channel Design Details



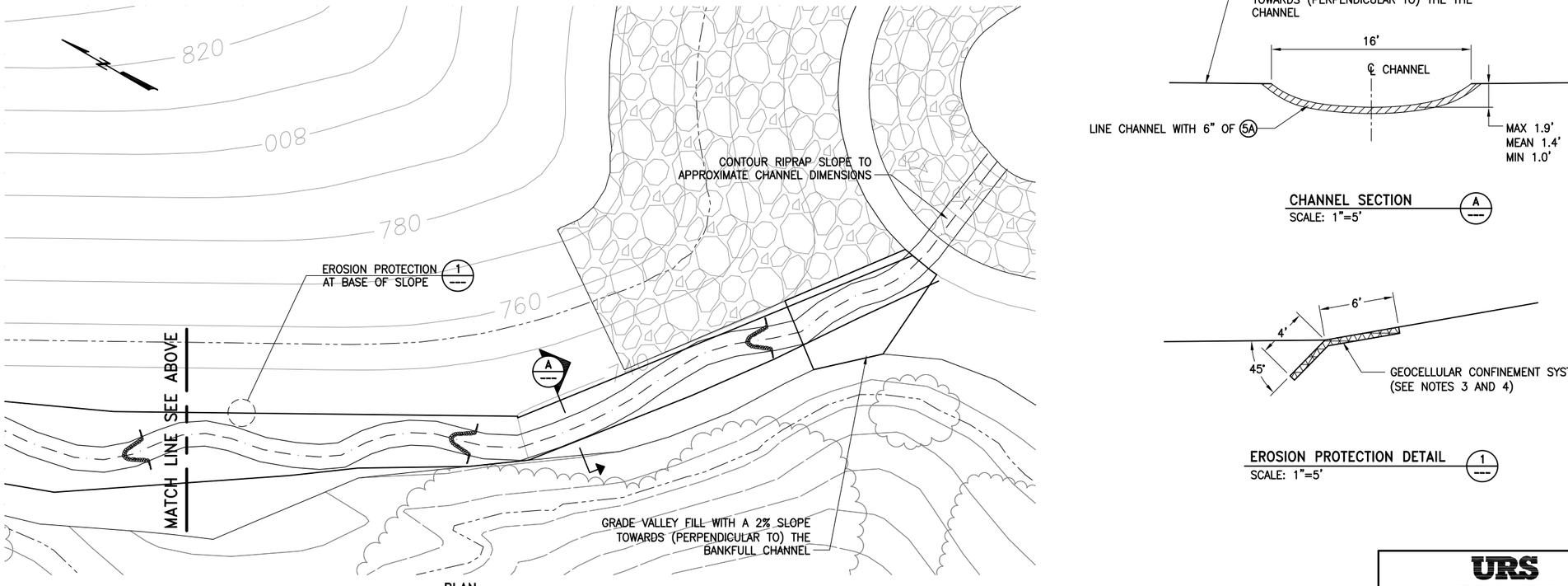
PLAN
SCALE: 1"=40'

NOTES:

1. GRADING FOR THE LOW FLOW CHANNEL SHALL BE ADJUSTED AS DIRECTED BY THE CITY REPRESENTATIVE.
2. COORDINATE WITH CONTRACTOR PERFOMING SPECIAL PLANTING FOR RIPARIAN FORESTNAD WETLAND TIMING OF RESTORATION OF THE CHANNEL ALONG THE BASE OF DISPOSAL SITE 3. PLANTING OF RIPARIAN FOREST AND WETLAND SHALL BE PERFORMED BY SPECIAL PLANTINGS CONTRACTOR AFTER DISCONTINUATION OF DIVERSION OF STREAM FLOWS AND PRIOR TO HYDROSEEDING.
3. GEOCELLULAR SYSTEM SHALL BE _____ OR EQUAL.
4. FILL CELLS WITH TOPSOIL AND SEEDED WITH NATIVE GRASS.

LEGEND:

- – – – FUTURE NORMAL MAXIMUM WATER SURFACE (ELEV 756)
- RIPARIAN FOREST AND WETLAND



PLAN
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CHANNEL SECTION A
SCALE: 1"=5'

EROSION PROTECTION DETAIL 1
SCALE: 1"=5'

5' 0 5' 10'
SCALE 1"=5'

40' 0 40' 80'
SCALE 1"=40'

ELEVATION DATUM
USGS

100% DRAFT SUBMITTAL

CONTRACT NO. WD-2551

URS
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612
PHONE: (510) 893-3600

XXXXX			DRAWN E. HULBERT		
XXX			DESIGNED D. ROBERTSON		
XXX XXXX			CHECKED J. ROADIFER/M. FORREST		
CIVIL	ELECT.	MECH.	PIPING	GEOTECH.	

NO.	DATE	DESCRIPTION	BY	APPR'D
		REVISIONS		

CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION
INFRASTRUCTURE DIVISION
ENGINEERING MANAGEMENT BUREAU

CALAVERAS DAM REPLACEMENT PROJECT

DISPOSAL SITE 3
RESTORATION

CHECKED / APPROVED	DRAWN ---	SCALE AS SHOWN
SECTION MANAGER	DESIGNED	DATE 7/26/10
APPROVED	APPROVED	
MANAGER, ENGINEERING MANAGEMENT BUREAU	MANAGER, WATER SUPPLY AND TREATMENT DIVISION	

SHEET	PLAN NO.	DRAWING NO.	REVISION NO.
– OF	RS-5	E-	

ARCH.	CIVIL	ELECT.	MECH	PIPING	STRUC.	OTHERS

PLOT: EXTEND
SCALE: 1:1
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YELLOW 0.20MM
GREEN 0.25MM
CYAN 0.40MM
BLUE 0.50MM
MAGENTA 0.20MM
WHITE 0.35MM
GRAY 0.15MM
9 0.15MM
10 1.00MM
11 0.70MM
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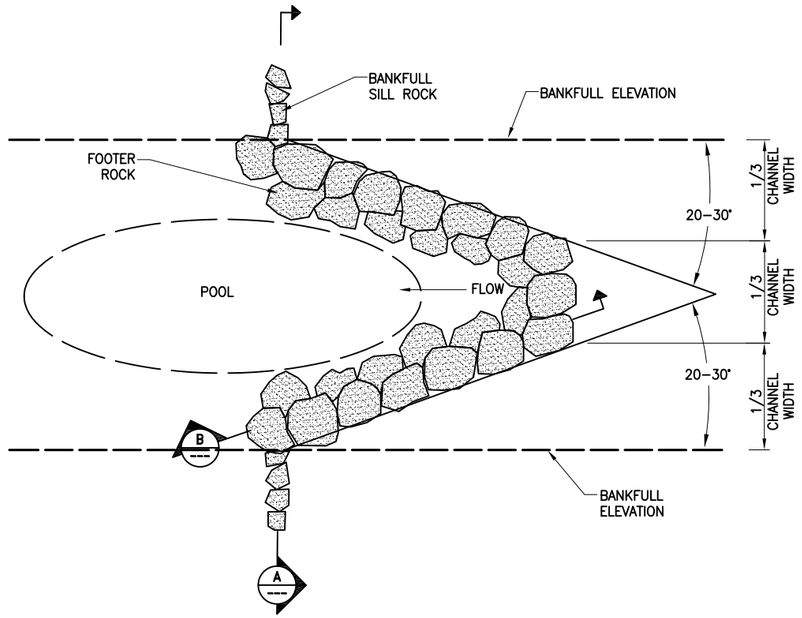
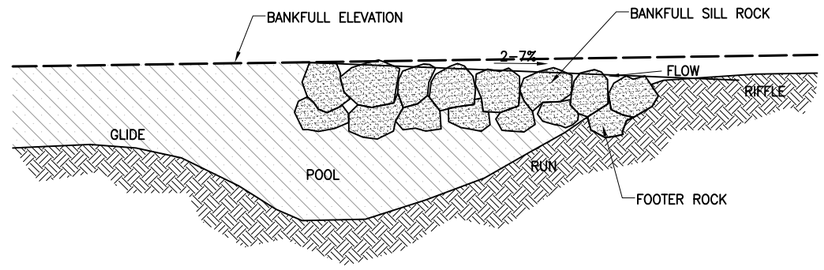
100 0.70MM
210 0.60MM FILE: P:\CADD\Sheet\RS-5.dwg

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 4



TYPICAL CROSS VANE PLAN VIEW (2 / RS-5)
SCALE: N.T.S.

NOTE: FOR CROSS VANES ALONG THE TRIBUTARIES, THE HEADER AND FOOTER ROCKS SHALL BE 12" DIAMETER WITH FLAT LONG EDGE



TYPICAL CROSS VANE LONGITUDINAL VIEW (B / –)
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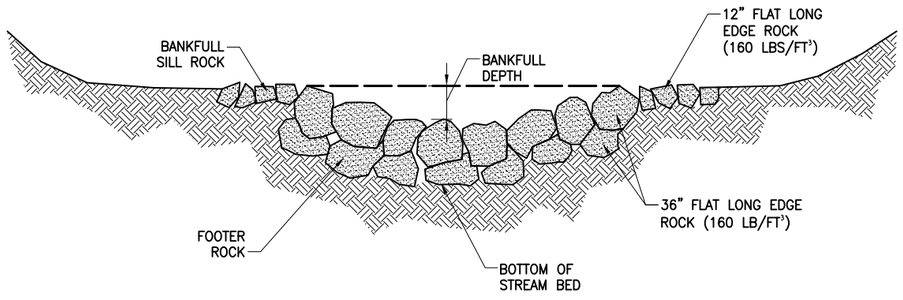

TYPICAL CROSS VANE CROSS SECTION (A / –)
SCALE: N.T.S.

100% DRAFT SUBMITTAL

CONTRACT NO. WD–2551

CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION
INFRASTRUCTURE DIVISION
ENGINEERING MANAGEMENT BUREAU

CALAVERAS DAM REPLACEMENT PROJECT

CROSSVANE GRADE CONTROL STRUCTURE DETAILS

URS
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612
PHONE: (510) 893-3600

XXXXXX	DRAWN E. HULBERT
XXX	DESIGNED J. PEARSON
XXX XXXX	CHECKED J. ROADIFER/M. FORREST

CIVIL | ELECT. | MECH. | PIPING | GEOTECH.

NO.	DATE	DESCRIPTION	BY	APPR'D

REVISIONS

CHECKED / APPROVED		DRAWN — — —	SCALE AS SHOWN
SECTION MANAGER		DESIGNED	DATE 7/26/10
APPROVED		APPROVED	
MANAGER, ENGINEERING MANAGEMENT BUREAU		MANAGER, WATER SUPPLY AND TREATMENT DIVISION	
SHEET — OF	PLAN NO. RS–6	DRAWING NO. E–	REVISION NO.

ARCH. | CIVIL | ELECT. | MECH | PIPING | STRUC. | OTHERS

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SCALE 1"=10'

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SCALE: 1:1
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22,34
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RED 0.70MM
YELLOW 0.20MM
GREEN 0.25MM
CYAN 0.40MM
BLUE 0.50MM
MAGENTA 0.20MM
WHITE 0.35MM
GRAY 0.15MM
9 0.15MM
10 1.00MM
11 0.70MM
12 0.60MM
100 0.70MM
210 0.60MM

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FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 4