

Chapter 3

Physical and Biological Resources Biological Inventory Report

3.1 Introduction

This chapter presents the physical and biological setting for the Alameda Watershed HCP. The methods used to collect data to define the baseline conditions are described in this chapter, and the baseline conditions are presented in detail. The impact analysis (Chapter 4) and conservation strategy (Chapter 5) are derived from these baseline conditions. The baseline conditions were evaluated by examining the resource categories listed below.

- Physical Resources
 - Topography
 - Soils
 - Geology
 - Climate
 - Hydrology
- Biological Resources
 - Flora
 - Fauna
 - Land Cover Types
 - Covered Species

3.2 Study Area

The HCP study area encompasses 36,816 acres of the Alameda watershed lands owned by SFPUC, plus approximately 9,900 acres immediately adjacent to the SFPUC lands (Figure 3-1). The additional 9,900 acres include all privately owned 1-square-mile (640-acre) sections adjacent to SFPUC lands on Poverty Ridge and Oak Ridge and all private land on Apperson Ridge between the San Antonio Reservoir and lands owned by the EBRPD.

The majority of the additional 9,900 acres are within the primary watersheds of the San Antonio and Calaveras Reservoirs, which SFPUC considers important parcels for maintaining water quality. This area also includes headwater streams of subwatersheds that drain into the reservoirs. This area contains potential mitigation sites for impacts of HCP-covered projects and activities.

In the north and west, the study area includes Alameda Creek downstream to the SFPUC property line in Niles Canyon and an approximately 2.5-mile reach of Arroyo de la Laguna just upstream of its confluence with Alameda Creek. In the south, the study area is defined by the SFPUC ownership boundary in the northern part of Santa Clara County (Figure 3-1).

3.3 Data Collection

3.3.1 Physical Resources

Data Sources

Sources used to map and describe the physical resources of the study area include U.S. Geological Survey (USGS) data on topography and hydrology (U.S. Geological Survey 1999); geologic maps of the area (California Department of Conservation 1990); soil survey information (Welch 1981; Welch et al. 1966); the *Alameda Watershed Management Plan* (EDAW 2001) and *Alameda Watershed Management Plan Draft Environmental Impact Report* (plan DEIR) (San Francisco Planning Department 2000); and other published information (Hickman 1993; Alt and Hyndman 2000). (Additional data sources for hydrologic resources are described in Section 3.3.2, *Biological Resources*).

Field Data Collection

Field data for physical resources were collected specifically to address habitat suitability for covered species. (The term *covered species* is explained in detail in Section 3.4.2, *Covered Species*.) Field data collection focused on mapping of serpentine soils, ponds (natural and stock), and streams. Because collection of physical resource data is directly linked to covered species, a detailed description of this effort is provided in the Section 3.3.2, *Biological Resource*.

3.3.2 Biological Resources

Data Sources

The following resources were consulted regarding the occurrence of special-status species in and around the HCP study area.

- California Natural Diversity Database (CNDDDB) Rarefind Version 2.1.2 (2003) and Version 3.0.5 (2006).
- Personal communication with SFPUC staff and other local experts.
- Relevant literature, including the *Alameda Watershed Management Plan* (EDAW 2001) and the *Alameda Watershed Management Plan Draft Environmental Impact Report* (San Francisco Planning Department 2000).
- Previous studies of species distribution in the area.
- Occurrence records provided by SFPUC.

These data were used to develop the list of covered species, species profiles, species range maps, and model parameters for distribution models. Specific species profiles provide a full listing of appropriate citations (Appendix D).

Field Surveys

Habitat models were developed for most covered species in the HCP study area to describe suitable habitat and likely distribution, estimate impacts, and develop conservation measures. These models were initially developed on the basis of existing vegetation data, physical features, and existing species occurrence information. Field surveys were conducted to supplement existing data and to validate and refine preliminary models.

Ponds

Habitat assessment of ponds was conducted in 2003 by Jones & Stokes and SFPUC staff to refine the habitat models for those covered species strongly associated with ponds: California red-legged frog (*Rana aurora draytonii*), California tiger salamander (*Ambystoma californiense*), western pond turtle (*Emys marmorata*), and tricolored blackbird (*Agelaius tricolor*). Jones & Stokes and SFPUC staff conducted site assessments of a sample of ponds on lands owned by SFPUC; these assessments were used to characterize pond habitats throughout the study area. Surveys were conducted on September 22–25, 2003.

Jones & Stokes identified 175 ponds (stock ponds, natural ponds, irrigation ponds, and golf course ponds) within the study area based on air photo interpretation; 128 of these ponds occur on SFPUC land. The field team collected data on 68 ponds distributed across the study area (Figure 3-2). The surveyed ponds represent 53% of ponds on SFPUC land, 39% of the ponds within the study area, and 70% of the total area of pond habitat in the study area. Before conducting the site assessments, a habitat quality classification system was developed to characterize aquatic and upland habitats associated with individual ponds (see Appendix A for sample survey sheet). Data collected included variables known to affect habitat suitability for the covered species associated with ponds that were easily measurable in the field (e.g., presence and abundance of vegetation in ponds, presence of nonnative predators, and upland habitat characteristics). Characterization of ponds that were mapped using air photo interpretation were refined on the basis of field observations.

Butterfly Habitat

Dr. Richard Arnold of Entomological Consulting Services, Ltd., reviewed background material and aerial photos and conducted a preliminary reconnaissance-level survey of the Alameda watershed on October 29, 2003. The purpose of the survey was to determine presence or absence of habitats that might support special-status invertebrates.

During this survey, Dr. Arnold identified potentially suitable habitat for bay checkerspot butterfly (*Euphydryas editha bayensis*) and Callippe silverspot butterfly (*Speyeria callippe callippe*). Bay checkerspot is usually associated with serpentine grassland vegetation, particularly in areas that are characterized by native bunch grasses. Callippe silverspot butterfly occurs in grasslands that support its larval food plant, California golden violet (*Viola pedunculata*). It has been observed in grazed and ungrazed grasslands.

During spring 2004, Dr. Arnold conducted focused presence/absence surveys for both butterflies in the Alameda watershed. These surveys targeted areas with the highest likelihood of butterfly presence. Maps that illustrate the occurrence of serpentine formations, prepared by the California Department of Mines and Geology, were consulted to identify locations within the watershed that support serpentine formations and grassland vegetation. Similarly, soil maps prepared by the Natural Resources Conservation Service were consulted (Arnold 2004).

Survey locations were selected using information from the reconnaissance-level field surveys, analysis of aerial photos, and additional research on vegetation type as described above. Specifically, bay checkerspot survey locations were selected on the basis of presence of serpentine grassland areas in close proximity to a variety of plants necessary for all stages of the butterfly's life cycle. Callippe silverspot survey locations were selected on the basis of suitable habitat (perennial or annual grassland) in close proximity to nectar plants that grow in riparian corridors or along the edges of oak woodlands.

Surveys were conducted one or two times per week on 30 days between March 26 and June 30, 2004. Survey areas were mapped and the food plants present were noted. To ensure that a comprehensive presence-absence survey was conducted for an entire flight season, Dr. Arnold surveyed for bay checkerspot during its entire 2005 flight season. Approximately two surveys per week were conducted between March 1 and May 9, 2005. These survey reports can be found in Appendix M. – Survey Reports for bay checkerspot and Callippe silverspot butterflies.

Alameda Whipsnake Habitat

Swaim Biological Consulting developed the Alameda whipsnake (*Masticophis lateralis euryxanthus*) habitat assessment of the study area. The first stage of this assessment involved identifying habitat using the Jones & Stokes land cover map. At this level of analysis, all Diablan sage scrub habitat and willow forest/scrub shown on the land cover map (i.e., patches larger than the minimum mapping unit of 1 acre) were delineated as habitat for this species.

Swaim Biological Consulting then used digital aerial photographs to further define and refine the potential distribution of Alameda whipsnake habitat in the study area. During this stage of the assessment, Swaim Biological Consulting identified patches of Diablan sage scrub less than 1 acre in size as well as other scrub or brush patches of various sizes that could serve as suitable habitat for Alameda whipsnake. Accordingly, suitable habitat in the HCP study area was broadly defined to include patches of vegetation dominated by either Diablan sage scrub, California sagebrush (*Artemisia californica*), mule fat (*Baccharis salicifolia*), lupine (*Lupinus* sp.), willows (*Salix* spp.), or vegetation that appeared structurally similar to a shrub community.

Analysis of aerial photographs and the land cover map allowed Swaim Biological Consulting to map all of the suitable core habitat for this species and to conclude that most of the non-scrub habitat within the study area could be used as movement habitat for this species (Swaim pers. comm.). Whipsnakes use grassland, woodland, riparian, and the fringes of developed or disturbed land cover types to move from one core area of scrub habitat to another. The most likely movement corridors in the study area are creeks and drainages and rocky areas. Ground verification was not conducted during this analysis.

Covered Plants

Focused surveys were conducted between May 20 and 27 and June 25 and 26, 2003, to identify locations of covered plants on SFPUC-owned lands. This effort focused on habitats with the highest probability of finding and identifying special-status species, primarily areas supporting serpentine soils. Survey efforts also emphasized areas potentially subject to covered activities. Seven survey plots were selected, ranging in size from approximately 50 to approximately 550 acres. Each plot consisted of areas previously identified as having serpentine

grassland or mapped with serpentine soils. The land cover type map (Figure 3-3) illustrates the extent of the serpentine land cover types, including serpentine bunchgrass grassland and serpentine foothill pine–chaparral woodland, mapped in the study area.

During the surveys, Jones & Stokes botanists traversed each survey plot by foot along meandering transects. Steep topography limited the survey area in many locations. The surveyors determined the location and direction of transects by visually assessing the terrain ahead for microhabitats with higher potential for the occurrence of special-status species, as indicated by the plant community, topography, slope aspect, and presence of features such as rock outcrops or wetlands. All plants encountered along these transects were identified to the extent possible¹; at a minimum, every plant was thoroughly examined to determine whether it was a special-status taxon. Additional incidental observations were made while traveling between plots. A checklist of plant species observed was accumulated for each sample plot. The seven plots were sampled over a period of approximately 76 person hours. Jones & Stokes personnel surveyed approximately 1,340 acres, or approximately 4% of lands owned by SFPUC.

Special-status plant populations were mapped onto a 1:30,000 photographic base map by visually estimating the extent of the population. Point locations were recorded for each population using a hand-held global positioning system (GPS) recorder. A standard California native species field survey form was filled out for each occurrence.

3.3.3 Land Cover Mapping

Data Sources

The primary data source used for the land cover mapping was ortho-rectified color aerial photographs (May 2001) provided by SFPUC. The land cover classification system applied to this mapping effort was based on the vegetation type classification system used in the *Alameda Watershed Management Plan* (EDAW 2001).

Methods

Jones & Stokes staff mapped land cover types within the entire study area. Except for ground-verification, all mapping were data attribution carried out on screen using ArcView 3.2 or 8.2 on the air photo base map. All digitizing was performed at a scale of 1 inch = 300 feet (1:3600). The minimum mapping unit

¹ Although the surveys were floristic (i.e., all plants species encountered were recorded), they did not result in a comprehensive list of all plants that occur on SFPUC lands because of their limited geographic scope and limited duration.

applied to all land cover types was 1 acre, except for ponds, which were mapped to the nearest 0.1 acre.

Jones & Stokes biologists consulted SFPUC staff and spent 1 day in the field prior to aerial photograph mapping to familiarize themselves with the landscape, land cover classification, and correspondence between aerial photograph signatures and land cover types.

The land cover data were supplemented with field mapping of serpentine-based land cover types (serpentine grassland and serpentine foothill pine–chaparral woodland) and existing GIS data on aquatic land cover types (i.e., stock ponds) provided by SFPUC. Jones & Stokes biologists conducted ground-verification of the maps in the field during September 21–25, 2003. Ground-verification within the study area was limited to lands owned by SFPUC. Ground-verification was particularly important to ensure accurate mapping of the following land cover types.

- Oak-dominated woodlands (mixed evergreen forest/oak woodland versus valley oak woodland versus blue oak woodland).
- Riparian forest (willow riparian forest/scrub versus coast live oak riparian versus white alder versus sycamore alluvial woodland).
- Ponds (location of stock ponds and natural ponds).

Land Cover Classification System

Jones & Stokes biologists and GIS specialists mapped land cover types using a modified version of the classification system developed for the *Alameda Watershed Management Plan* and plan DEIR (Table 3-1). The original type descriptions and names were updated to better reflect current field conditions in the watershed. Notable changes to the nomenclature used in the *Alameda Watershed Management Plan* are listed below.

- The *Pond or Reservoir* category was split into the following three distinct categories to improve characterization.
 - Pond (this category includes actively maintained stock ponds, relic stock ponds, and irrigation ponds).
 - Reservoir (Calaveras Reservoir and San Antonio Reservoir).
 - Quarry Pond (defined as a pond created to support an active mining quarry).
- The names of land cover types were modified or combined as follows to better represent current conditions in the watershed.
 - Mixed Evergreen Forest/Coast Live Oak Woodland was changed to Mixed Evergreen Forest/Oak Woodland.
 - Northern Coastal Scrub was changed to Diablan Sage Scrub.

- ❑ Central Coast Arroyo Willow Riparian Forest and Willow Riparian Forest were combined into Willow Riparian Forest/Scrub.
- New land cover types were added as shown below to represent types not covered by the definitions used in the watershed management plan.
 - ❑ Serpentine Foothill Pine–Chaparral Forest (single occurrence).
 - ❑ Oak Savannah (to clearly indicate areas with scattered oak trees where canopy cover is between 5% and 30%).
 - ❑ Developed (this category has four sub-categories—developed/disturbed, cultivated agricultural, turf, and nursery).
 - ❑ Rock Outcrop.

3.4 Setting

3.4.1 Physical Resources

This section presents an overview of the physical resources in the Alameda watershed. The following key physical resources are discussed in this section.

- Topography.
- Soils.
- Geology.
- Climate.
- Hydrology.

While physical and biological resources are discussed independently in this chapter, it is important to recognize the link between them. The processes that control and shape the distribution and abundance of local biota are both physical and biological. The physical resources selected for discussion in this chapter are relevant to this HCP because management of covered species is shaped by local physical resources.

Topography

The study area is in a single northwest-trending valley along Calaveras Creek and Sunol Valley and major east-west valleys such as La Costa Valley and San Antonio Creek Valley that branch from Sunol Valley. Elevations in the watershed range from 3,380 feet along Apperson Ridge to 125 feet in Sunol Valley. In general, the southwest portion of the watershed is characterized by rolling to moderately steep hills; the northeast portion is characterized by moderately steep to very steep hills and deep canyons. Figure 3-3 illustrates the topography of the study area and adjacent lands.

Soils

Two soil associations are present in the HCP study area: the Millsholm–Los Gatos–Los Osos association and the Vallecitos-Parrish association (Welch et al. 1961). A majority of the northwest portion of the study area is within the Millsholm–Los Gatos–Los Osos association. These soils are broadly described as “moderately steep to very steep, well-drained clay loams and loams that formed in material weathered from interbedded sedimentary rock on uplands” (Welch 1977). The higher moisture retention of these clay loams supports heavier and more diverse vegetation, which in turn promotes soil development. On steep slopes, these soils pose a severe erosion hazard. When cut banks composed of these soils approach vertical, they collapse and contribute major volumes of loose material to water flow (East Bay Regional Park District 1991). The Vallecitos-Parrish association is located in the southeast portion of the watershed east of Calaveras Reservoir. This association is also generally characterized by moderately steep and very steep slopes, but unlike the Millsholm–Los Gatos–Los Osos association, it develops on meta-sedimentary and basic igneous rocks.

Perhaps the most important physical feature of these soil associations and the soil series they contain is their susceptibility to erosion. Numerous types of soils throughout the study area have erosion ratings of severe or very severe. Because of the highly erodible nature of many of the upland soils, they tend to be highly sensitive to disturbance such as cultivation and livestock grazing (EDAW 2001). The type, texture, and chemical makeup of the soil can greatly influence the suite of plant species and plant communities that occur in a particular area. Thus, the soil type is directly relevant to the habitats present in the watershed and, therefore, to the covered species associated with particular habitats in this HCP.

Geology

The geology of the Alameda watershed is dominated by the Calaveras fault zone. The fault zone created the Sunol Valley, bisecting the study area into zones with markedly different geologic formations and structures. To the west of the fault zone, the substrate is mostly marine sedimentary rocks such as sandstone or shale. East of the fault zone, the geology includes marine sedimentary rocks mostly characterized by the Franciscan Complex, a highly complex assortment of sedimentary rocks deposited in seawater at various depths and mixed with slices of basalt sea floor.

Several areas near Calaveras Reservoir are also characterized by serpentinized ultramafic rock (i.e., serpentine outcrops). These serpentine areas are limited in size and distribution, but they contain a disproportionate number of rare and endemic plant species because of their distinctive chemical and physical properties. Soils derived from serpentine rocks are generally low in available calcium and high in magnesium, and they have low water-holding capacity. Four of the seven covered plant species in this HCP potentially occur in serpentine grasslands and/or serpentine foothill pine–chaparral forests of the study area.

Climate

Climatically, the study area is intermediate between the moderate, marine Mediterranean conditions of the Bay Area and the more marked seasonality of the interior Central Valley. Unlike most of western Alameda County, the SFPUC Alameda watershed lands do not experience regular fog in the summer. Consequently, the summers are substantially hotter and drier than in areas nearer San Francisco Bay. Temperatures vary widely based on elevation and topography, but can range from more than 100°F (38+°C) in the summer to below freezing in the winter.

Precipitation in the watershed occurs seasonally, with the bulk of rain falling between October and April. Although the annual total precipitation in the watershed varies widely from year to year, average annual precipitation ranges from approximately 10 to 20 inches, depending on elevation and aspect. Accordingly, the study area is dominated by xeric species that have adapted to relatively low rainfall and prolonged periods of drought.

Hydrology

Like other watersheds on the central and southern California coast, the Alameda watershed is characterized by marked seasonal variation in precipitation and is subject to periodic droughts. Alameda Creek is typically a perennial stream in the upper watershed, but in the Sunol Valley, where principal stream channels are broad and the substrate is characterized by deep, coarse alluvium, a high rate of infiltration results in dry reaches during the summer months. Many of the tributaries that supply flows to Alameda Creek are historically intermittent and can be isolated from the mainstem beginning in early to mid-summer (Welch et al. 1961). This is especially true of streams, both natural and channelized, that drain the Livermore Valley. In addition to fluctuations in streamflows caused by varying levels of surface water runoff, flows in Alameda Creek tributaries also vary greatly with rising and falling water tables in the area (Gunther et al. 2000).

Groundwater

Available information on groundwater hydrology indicates that there is significant groundwater inflow in the near-surface alluvial deposits along Alameda Creek and that the direction of groundwater flow is parallel to the creek and follows the ground surface contours of the valley floor. Research in the Sunol Valley indicates that depth to groundwater varied from 16 feet to 80 feet below ground surface when measured in 1986 and 1992/1993, respectively (Bookman-Edmonston 1995).

Human Influence

The hydrology of the Alameda watershed has been greatly altered by water supply activities as well as by development and flood control. Creek channels are frequently used to move water from one facility to another; consequently, a given creek reach can have significant flow due to water releases from various facilities. For example, the Alameda Creek Water District (ACWD) purchases water from the State Water Project (SWP). This water is released into Vallecitos Creek in the summer and allowed to flow through Niles Canyon into Fremont, where it is diverted and stored in offstream ponds for groundwater recharge (Gunther et al. 2000). The Zone 7 Water Agency also receives SWP deliveries through Arroyo Mocho for use in the Livermore Valley. These supplies, together with local runoff, are delivered to water contractors or used for groundwater recharge. Although these operations occur outside the HCP study area, they influence the hydrology of Alameda Creek from Niles Canyon downstream. In addition, discharges from quarries in the Pleasanton area provide year-round flow in Arroyo de la Laguna, which joins Alameda Creek just upstream of Niles Canyon (Gunther et al. 2000).

Three major reservoirs have a significant impact on present hydrologic conditions in Alameda Creek. Del Valle Reservoir was completed in 1968 and is operated as a component of the Department of Water Resources' (DWR's) SWP. Del Valle Reservoir is managed as regulatory storage for the South Bay Aqueduct and for flood control and recreation. Del Valle Reservoir captures the entire flow of the Arroyo Valle watershed. ACWD and Zone 7 each have storage rights in Del Valle Reservoir of 7,500 af. The Del Valle watershed connects to Arroyo de la Laguna in the Livermore Plain. Part of the ACWD storage may be released to Arroyo Del Valle Creek, where it flows to Arroyo de la Laguna and Alameda Creek for recharge in the Niles Cone area.

SFPUC completed San Antonio Reservoir in 1965 on San Antonio Creek, 1.5 miles upstream of its confluence with Alameda Creek. San Antonio Reservoir stores water from the Hetch Hetchy aqueduct and the SWP. It also captures all flows from the headwater streams of San Antonio Creek.

SFPUC completed Calaveras Reservoir in 1925, but hydrologic conditions may have been altered as early as 1913 when construction of the dam began. Calaveras Dam is located about 0.8 mile upstream of the Alameda Creek confluence. Calaveras Reservoir captures the flow from Calaveras Creek and the large Arroyo Hondo tributary watershed. In addition, flows from upper Alameda Creek are diverted about 3 miles upstream of the Calaveras Creek confluence through the Alameda Creek Diversion Dam tunnel into Calaveras Reservoir. Calaveras Reservoir spills relatively infrequently, about once in 5 years on average, and spills are relatively small, averaging 275 cfs (Hagar et al. 1993).

Alameda Creek Reaches

The portion of the Alameda Creek Watershed covered by this HCP can be roughly divided into six distinct reaches based on drainage patterns, water project facilities, and geomorphology.

- Niles Canyon.
- Sunol Valley: Arroyo de la Laguna to Calaveras Road Crossing.
- Sunol Park: Calaveras Road Crossing upstream to confluence with Calaveras Creek.
- San Antonio Reservoir and tributaries.
- Calaveras Reservoir and tributaries.
- Upper Alameda Creek above the confluence of Calaveras Creek.

Figure 3-4 shows the boundaries of each of the six reaches and indicates which tributaries of Alameda Creek maintain perennial surface water and which maintain intermittent or ephemeral flow.

Niles Canyon Reach

USGS has maintained an active gauging station in Niles Canyon continuously since 1891. Comparisons of monthly averages over a 30-year period from the earliest records (1891–1921) and the most recent available records (1968–1998) indicate increased summer flows (June–October) and decreased winter flows (December–March). Average flows for April and May show little difference between the two periods (Figure 3-5). Because the Niles gauge location is upstream of the ACWD diversions, outflow of Alameda Creek to San Francisco Bay is not well represented. The USGS Union City gauge indicated that between 1972 and 2002, flows to the Bay were somewhat reduced during most months of the year. This reduction was most significant in terms of total percent reduced during the summer months (June–October).

Sunol Valley and Sunol Park Reaches

The Sunol Valley reach is a low-gradient alluvial valley reach. Streamflow is subsurface in a majority of the Sunol Valley reach during the dry season (June–October). The Sunol Park reach has a slightly higher gradient and the valley is considerably narrower than in the Sunol Valley reach. In addition, unlike the Sunol Valley reach, surface flow in Alameda Creek is generally perennial throughout much of this reach.

San Antonio and Calaveras Reservoir Reaches

The watersheds contributing to San Antonio and Calaveras Reservoirs are relatively undeveloped and, though ungauged, are expected to have natural hydrologic conditions. As mentioned previously, all inflows are stored except for infrequent spills during extreme wet periods.

Upper Alameda Creek Reach

The Upper Alameda Creek Watershed is relatively undeveloped open space managed by EBRPD and SFPUC. Major land use activities include cattle grazing and recreation. Hydrologic conditions are relatively pristine upstream of the Alameda Creek Diversion Dam and are only influenced by local pumping for livestock and domestic use (if any) and by potential impacts related to cattle grazing. The Alameda Creek Diversion Dam is capable of taking a significant portion of the flow of Alameda Creek (approximately 60% on an annual basis), and downstream hydrology is affected accordingly (Gunther et al. 2000). USGS maintains two gauging stations of potential relevance in this reach: one above the Alameda Creek Diversion Dam and the other below the confluence with Calaveras Creek. Unfortunately, neither gives a very good indication of potential anadromous fish migration flows within the overall reach. A majority of flows measured by the upper station are diverted into Calaveras Reservoir, while the second station has an incomplete record of flows for 1995–1998 (Gunther et al. 2000).

3.4.2 Biological Resources

The HCP study area lies within the Central California Coast Ranges ecological section, including parts of the Fremont-Livermore Hills and Valleys subsection (west of Calaveras Boulevard) and the Western Diablo Range subsection (east of Calaveras Boulevard) (Miles and Goudey 1997). Floristically, this corresponds to the San Francisco Bay Area subregion of the Central Western California region of the California Floristic Province (Hickman 1993).

Differences in physical resources such as geology, topography, and soils can have a strong effect on the distribution and abundance of biological resources. For example, shallow soils on steep, southwest-facing slopes are likely to support scrub or chaparral, whereas moderately steep, northeast-facing slopes are likely to support dense oak woodlands. Although the characteristic vegetation community types (grasslands, oak woodland/forest, and chaparral) in the study area are similar to those observed in other parts of the Bay Area, the specific species assemblages and spatial distributions are uniquely suited to the onsite physical resources. Table 3-2 lists the acreage and percent of coverage of each land cover type in the study area. The areal extent of specific land cover types is based on data derived from the land cover mapping effort described in Section 3.3.3, *Land Cover Mapping*.

Flora

The checklist of plants observed in the HCP study area during the limited botanical surveys comprises 337 plant taxa (species, subspecies, varieties) in 60 plant families (Appendix C). This inventory represents approximately 64% of the flora identified in this part of the East Bay (Erter 1997). Comparable survey information from areas similar to the HCP study area is not readily available, although data were obtained from two sites in eastern Alameda County: Site 300

and the Carnegie State Vehicle Recreation Area. The checklist of plants at Site 300, Lawrence Livermore National Laboratory's 7,000-acre research facility in Corral Hollow in eastern Alameda County, comprises 406 taxa (Jones & Stokes 2002). At the Carnegie State Vehicle Recreation Area, on the south side of Corral Hollow, 353 taxa were found on a 3,260-acre site (Jones & Stokes 2000). These data suggest that a substantial number of species that occur in the HCP study area have not yet been documented.

During focused botanical surveys conducted in spring and summer 2003, Jones & Stokes botanists observed populations of two of the seven covered plant species. One population of Diablo helianthella (*Helianthella castanea*) was observed in the HCP study area. This observation was limited to a small population of about 25 plants found at the north end of Wauhab Ridge. This is the first occurrence of this species observed within the HCP study area. The CNDDDB (2003) lists two records of most-beautiful jewelflower (*Streptanthus albidus* subsp. *peramoenus*) in the HCP study area: one along Alameda Creek near its confluence with Calaveras Creek, and one along Leyden Creek near its confluence with Alameda Creek. The database lists two other occurrences in Sunol Regional Wilderness adjacent to the HCP study area. During surveys, Jones & Stokes botanists located the Leyden Creek occurrence and five additional occurrences of most-beautiful jewelflower in the HCP study area. Development of a local flora database necessitates gathering data from all habitat types during the full course of the growing season and over several different years. Jones & Stokes' 2003 survey was conducted during a narrow survey window (late May and late June) and focused on serpentine habitats. Species less common or present only in other habitat types were not likely to have been encountered. Moreover, year-to-year variation in environmental parameters, such as the amount and timing of rainfall or the abundance of herbivores, may have a substantial effect on whether species are evident. Therefore, additional surveys are necessary before the flora can be considered well documented and before the distribution of special-status plants can be considered adequately known.

Fauna

Field surveys of wildlife in the HCP study area have focused on special-status species. Common wildlife species associated with each land cover type are noted in the detailed description of land cover types below.

Four species of special-status amphibians and three species of special-status reptiles are known or believed to occur in the study area (Appendix E). California tiger salamander (*Ambystoma californiense*), foothill yellow-legged frog (*Rana boylei*), California red-legged frog (*Rana aurora draytonii*), California horned lizard (*Phrynosoma coronatum frontale*), western pond turtle (*Emys marmorata*), and Alameda whipsnake (*Masticophis lateralis euryxanthus*) all have either been documented (California Natural Diversity Database 2006) or are thought to occur.

A comprehensive survey of bird species has not been conducted within the HCP study area. However, the abundance of water in the study area likely supports a large variety of birds, including shorebirds, waterfowl, and wading birds. The study area's grasslands provide suitable breeding habitat for grassland obligate species like grasshopper sparrow (*Ammodramus savannarum*), Lazuli bunting (*Passerina amoena*), western meadowlark (*Sturnella neglecta*) as well as valuable foraging habitat for raptors that prey on small mammals. Special-status birds recorded in the study area include golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*), and western burrowing owl (*Athene cunicularia hypugea*) (California Natural Diversity Database 2006).

A comprehensive survey of mammal species has not been conducted in the study area. However, the productive and diverse grasslands in the study area likely support an abundance of common rodents and mammalian predators. Berkeley kangaroo rat (*Dipodomys heermanni berkeleyensis*) was last recorded near Calaveras Dam in 1940 (California Natural Diversity Database 2006). This subspecies historically occurred in Alameda and Contra Costa Counties but is believed to be extinct. The CNDDDB incorrectly states that this subspecies was found in 2000 near Del Valle Dam in the northeastern portion of the San Antonio Reservoir watershed, which is just outside the SFPUC property. In actuality, experts were not able to determine whether or not this specimen was a Berkeley kangaroo rat or the closely related subspecies *D. h. tularensis* (Didonato pers. comm.). To date, there have been no definitive opinions as to whether Berkeley kangaroo rat still occurs in the Alameda watershed, and it is likely extirpated from the SFPUC study area (Appendix L. Berkeley Kangaroo Rat Memo).

Townsend's western big-eared bat (*Plecotus townsendii townsendii*) has been observed in the study area (California Natural Diversity Database 2006).

Comparable survey information from areas similar to the study area is not readily available, although data obtained from one site in eastern Alameda County—Site 300—indicate that a substantial number of species occur in the study area that have not yet been documented there. At the Lawrence Livermore National Laboratory Site 300, a total of 20 species of amphibians and reptiles, 75 species of birds, and 26 species of mammals were observed in 1986 (Orloff 1986) and 1991 (U.S. Department of Energy 1992) collectively.

A total of 13 native fish species have been recorded in the Alameda watershed since 1905. Since 1953, an additional 14 introduced fish species have been documented in the watershed.

A comprehensive survey of invertebrate species has not been conducted in the study area. However, the diverse habitats and microclimates likely support an diverse assemblage of invertebrates. The CNDDDB lists no occurrences of special-status invertebrates in the study area, but there has been one occurrence of California linderiella (*Linderiella occidentalis*) outside the HCP study area (California Natural Diversity Database 2003). Field surveys are currently underway to document presence or absence of special-status invertebrates.

To understand the potential impact of activities covered in the HCP and to develop conservation strategies, it is imperative to have accurate information on biological resources at both the habitat and species levels. The following discussion of land cover type provides baseline information on potential habitats occurring in the HCP study area.

Land Cover Types

This section describes the current conditions, vegetation community profile, wildlife use, key ecological characteristics, and regional distribution trends for each of the land cover types delineated on the land cover type map (Figure 3-6). In total, 21 land cover types were mapped in the HCP study area (Tables 3-1 and 3-2). In addition to these 21 types, streams and freshwater seeps are described in this section, but were not mapped during the land cover mapping. The freshwater seeps and streams, added to the land cover type map from existing SFPUC and USGS GIS data layers, were not mapped because their size (generally less than 0.1 acre) was smaller than the minimum mapping unit.

Grasslands

Nonnative Grassland

Current Conditions

Nonnative Grassland is by far the most common land cover in the HCP study area, occupying more than 21,032 acres (45%) of the total land area in the watershed. It commonly occurs throughout the HCP study area in large contiguous patches on flat to gently rolling hills.

Vegetation Community Profile

Nonnative Grassland, also known as California annual grassland, is an herbaceous plant community dominated by nonnative annual grasses (Holland 1986; Sawyer and Keeler-Wolf 1995). In the HCP study area, the dominant grasses include wild oat (*Avena*) species, brome (*Bromus*) grasses, wild barley (*Hordeum*) species, Italian ryegrass (*Lolium multiflorum*), and annual fescue (*Vulpia*) species. Species composition of the Nonnative Grassland is highly diverse and includes many other native and nonnative forbs. Common species in the HCP study area include many clover (*Trifolium*) species, filaree (*Erodium*) species, miniature lupine (*Lupinus bicolor*), four-spot (*Clarkia purpurea* ssp. *quadrivulnera*), California poppy (*Eschscholzia californica*), purple owl's-clover (*Castilleja exerta*), smooth cat's-ear (*Hypochaeris glabra*), and Ithuriel's spear (*Triteleia laxa*).

Many special-status plants occur in Nonnative Grasslands. Thirty-eight special-status plants are reported to occur in grassland habitats in the East Bay Area (California Natural Diversity Database 2006). Many of these species occur on specific substrates that are not found in the HCP study area (e.g., alkaline soils) or are covered elsewhere in this document (e.g., serpentine grasslands). No

special-status plants are presently known to occur in Nonnative Grassland in the HCP study area. However, the HCP study area lies within the ranges of several special-status plants that have been reported to occur in grasslands. Maple-leaved checkerbloom (*Sidalcea malachroides*) can be found in the coastal prairie, generally not in annual grasslands. It has a low probability of occurring in Nonnative Grassland in the HCP study area; one historic occurrence is reported from Alum Rock Park, south of the HCP study area, in an unknown habitat type. Big scale balsamroot (*Balsamorhiza macrolepis*) occurs in both annual and perennial grasslands on various substrates, including serpentinite and sandstone. It has a reasonable potential to occur in Nonnative Grassland in the HCP study area; nearby populations are in the Oakland Hills and in the hills southeast of Livermore. Only one species covered under this HCP potentially occurs in Nonnative Grassland in the study area: round-leaved filaree (*Erodium macrophyllum*). Round-leaved filaree occurs in annual grasslands on clay soils (see species profile, Appendix D). Nearby populations occur in the Oakland Hills and in the Diablo Range foothills east of Livermore.

Wildlife Species Use

A variety of reptiles, including western fence lizard (*Sceloporus occidentalis*), common garter snake (*Thamnophis sirtalis*), and western rattlesnake (*Crotalus oreganus*), are characteristic of annual grassland. Mammals typically found in this land cover type include black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), American badger (*Taxidea taxus*), and coyote (*Canis latrans*). Common birds that breed in annual grassland habitats include western burrowing owl, short-eared owl (*Asio flammeus*), horned lark (*Eremophila alpestris*), and western meadowlark. Annual grassland also provides important foraging habitat for turkey vulture (*Cathartes aura*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), red-shouldered hawk (*Buteo lineatus*) and red-tailed hawk (*Buteo jamaicensis*).

Grassland-associated wildlife species covered under this HCP that are known to occur in the study area include western burrowing owl, California red-legged frog, and California tiger salamander. California red-legged frogs and California tiger salamanders breed in aquatic habitats (e.g., ponds) within grassland complexes and use uplands within grasslands as movement habitat. In addition, California tiger salamanders use burrows within grasslands as aestivation (summer hibernation) habitat. The HCP study area is within the range of Callippe silverspot butterfly, a covered species associated with grasslands that support its host plant, California golden violet (*Viola pedunculata*).

Key Ecosystem Characteristics

The annual flora of Nonnative Grassland follows a cycle of germination after the first fall rains, growth in winter, flowering and fruit set in spring, and survival as seeds buried in the soil during the summer drought (Heady 1988). In general, the species composition varies according to annual rainfall, slope, exposure, soil type, and the presence of disturbance (Pitt and Heady 1978; Heady 1988).

Nonnative Grassland appears to be relatively stable, recovering rapidly following cessation of disturbance (White 1966). The primary sources of disturbance are trails, access roads, and fire breaks. Disturbance does, however, create opportunity for invasion by exotic species, and these travel routes provide a corridor by which seeds from these species can travel, either on wind of passing vehicles or as “hitchhikers” on vehicles, animals, or clothing. Burning appears to have little long-term effect on nonnative grassland (Heady 1988; Kyser and Di Tomaso 2002). Grazing also appears to have little effect on nonnative grasslands, although overgrazing may affect the species composition (Heady 1988).

The primary ecosystem functions of Nonnative Grassland in the HCP study area are to maintain water quality through soil retention and to provide surface runoff area, wildlife habitat, fodder for grazing livestock, and area for recreation. The key characteristics of Nonnative Grassland habitat that contribute to these functions are high-cover herbaceous vegetation, low-cover woody vegetation, and low levels of disturbance.

Nonnative Grassland in the study area provides abundant forage for insect and mammal grazers, which in turn provides a food base for predators.

Local Distribution and Trends

Nonnative Grassland has been present in California since about the mid-1800s, when nonnative grasses and forbs introduced from Europe largely replaced the native grassland vegetation (Heady 1988).

Valley Needlegrass Grassland

Current Conditions

No field surveys of native grassland have been conducted in the HCP study area. However, incidental field observations and interviews with SFPUC staff suggest that Valley Needlegrass Grassland is common in very small patches throughout the HCP study area. It is not possible to distinguish Valley Needlegrass Grassland from the surrounding annual grassland on aerial photographs because of its limited extent, small patch size, and similar air photo signature. Therefore, this land cover type was mapped as annual grassland.

Vegetation Community Profile

Valley Needlegrass Grassland, also known as purple needlegrass grassland, is an herbaceous grassland community in which purple needlegrass (*Nassella pulchra*) is a dominant or co-dominant species (Holland 1986; Sawyer and Keeler-Wolf 1995). In the HCP study area, valley needlegrass grassland generally occurs as patches within the larger annual grassland complex. Accordingly, Valley Needlegrass Grassland contains an abundance of nonnative annual grasses mixed with perennial grasses and forbs. In the HCP study area, species commonly found associated with Valley Needlegrass Grassland include slender wild oats (*Avena barbata*), one-sided bluegrass (*Poa secunda*), big squirreltail (*Elymus multisetus*), prairie junegrass (*Koeleria macrantha*), California golden violet (*Viola pedunculata*), common lomatium (*Lomatium utriculatum*), California poppy, and arroyo lupine (*Lupinus succulentus*).

Five of the 38 special-status grassland plant species are reported to occur in Valley Needlegrass Grassland. The HCP study area is within the range of three of these species: big scale balsamroot, fragrant fritillary (*Fritillaria liliacea*), and Diablo helianthella. Big scale balsamroot occurs on various substrates, including serpentine and sandstone. Nearby populations occur in the Oakland Hills and southeast of Livermore. Two species covered under this HCP potentially occur in Valley Needlegrass Grassland in the study area: fragrant fritillary occurs in Valley Needlegrass Grassland, often on clay soils, including clay soils derived from serpentinite (see species profile, Appendix D); Diablo helianthella occasionally occurs in Valley Needlegrass Grassland, although it is more commonly found in oak woodland or chaparral habitats.

Wildlife Species Use

Wildlife species use of Valley Needlegrass Grassland is similar to that of nonnative grassland, as described above.

Key Ecosystem Characteristics

Valley Needlegrass Grassland in the HCP study area provides ecosystem functions similar to those of nonnative grassland. Perennial grasses develop extensive, long-lived root networks. These root networks are important for a number of reasons, including protecting soil from erosion and providing habitat for a wide variety of soil microorganisms that create the backbone of the grassland food web. In addition, because of their long-lived root networks, many native perennial grasses green-up later in the season than annual grasses and stay green through the early summer, providing a more consistent food source for grazers.

Various types of disturbance have different effects on Valley Needlegrass Grassland. Ground-disturbing activities such as plowing may eliminate perennial grasses, and burrowing by rodents can cause disturbance that favors annual grasses (Stromberg and Griffin 1996; Dyer and Rice 1997). Annual grasses adversely affect purple needlegrass, apparently because of competition for moisture (Hamilton et al. 1999). Grazing appears to have mixed effects. It reduces the size of individual purple needlegrass clumps (Fehmi and Bartolome 2003). Also, although some reports suggest that bunchgrasses may be eliminated by grazing (Muller and Muller 1964) or may increase when grazing is discontinued (Hull and Muller 1977), many other reports suggest that appropriately timed grazing is beneficial (Biswell 1956; Bartolome and Gemmill 1981; Heady 1988; Edwards 1992; Stromberg and Griffin 1996; Dyer and Rice 1997). White (1967) found no significant differences between grazed and ungrazed stands of purple needlegrass. Burning may have a positive effect on Valley Needlegrass Grassland. Burning results in greater seedling establishment, increased clump size, and increased cover of purple needlegrass (Biswell 1956; Menke 1992; Dyer and Rice 1997; Fehmi and Bartolome 2003). However, burns volatilize the nutrients contained in the vegetation, and too frequent burning could deplete the soil (Menke 1992).

Local Distribution and Trends

Native grasslands dominated by perennial grasses, such as purple needlegrass and Sandberg bluegrass (*Poa secunda*), likely occurred through most of the HCP study area in areas currently occupied by annual grassland (Heady 1988; Wester 1981). These native grasslands supported a high diversity of native annual and perennial herbs and grasses. Although once extensive in the greater Bay Area and Central Valley, invasion by exotic annual grasses, drought, and improper livestock grazing has led to the decline of this land cover. Historical records do not provide definitive data on the distribution of these native perennial grasslands, but research indicates human use of fire may have had a profound impact on the distribution and areal extent of historic grasslands. Prior to European settlement, native perennial grasslands in the HCP study area were likely subject to regular burning by Native American people. Keeley (2002) surmises that because dense shrubland or chaparral had little value to Native Americans, they used periodic burning to clear shrubs and provide habitat for fire-tolerant native grasses. Keeley (2002) also implies that the current mosaic of annual grassland that we see today is likely a result of historic vegetation management that favored open grasslands over chaparral.

Starting in 1769, another human-made change to the landscape occurred with the introduction and spread of many nonnative plants throughout California. These plants include Mediterranean annual grasses and herbs such as wild oats, bromes, barleys, ryegrass, and thistles (*Centaurea*, *Cirsium*) (Bartolome and Gemmill 1981). European settlers grazing livestock in the study area likely became more widespread after the gold rush of the 1850s. The combination of livestock grazing, drought, and spread of exotic grasses and herbs dramatically altered the native grasslands that occurred in the study area prior to the 1850s (Heady 1988). Grazing by livestock and wildlife continues today on almost all the grasslands in the HCP study area, although probably less intensively than in the past.

Serpentine Bunchgrass Grassland

Current Conditions

Serpentine Bunchgrass Grassland is uncommon in the HCP study area, occurring on only 242 acres (0.5%). Serpentine Bunchgrass Grassland is limited to a few small areas near Calaveras Reservoir and in Sunol-Ohlone Regional Park. Patches range in size from 14 to 93 acres.

Vegetation Community Profile

Serpentine Bunchgrass Grassland is similar to Valley Needlegrass Grassland in that purple needlegrass is a dominant species in both. Serpentine Bunchgrass Grassland occurs on soils derived from serpentinite and generally has lower overall vegetation cover and lower cover of nonnative species than Valley Needlegrass Grassland (McNaughton 1968; Holland 1986). The native bunchgrasses typically occur in patches, both single-species patches or patches with multiple species (McCarten 1987). As with other grasslands in the HCP study area, the dominant grasses are nonnative annual grasses, primarily slender wild oats, Italian ryegrass, soft chess (*Bromus hordeaceus*), and foxtail barley (*Hordeum murinum* ssp. *leporinum*). Patches of native perennial grasses, including purple needlegrass, prairie junegrass, one-sided bluegrass, and big

squirreltail, are scattered throughout. Herbaceous species characteristic of Serpentine Bunchgrass Grassland in the HCP study area include weakstem cryptantha (*Cryptantha flaccida*), Douglas' sandwort (*Minuartia douglasii*), chia (*Salvia columbariae*), slender buckwheat (*Eriogonum gracile*), and resin weed (*Calycadenia truncata*).

Serpentine Bunchgrass Grassland has a high proportion of special-status plants, compared to chaparral or woodland communities (McCarten 1987). Twelve special-status plant species are reported to occur in Serpentine Bunchgrass Grassland habitats in the East Bay Area. The HCP study area occurs within the ranges of five of these species: big scale balsamroot, fragrant fritillary, Tiburon Indian paintbrush (*Castilleja affinis* ssp. *neglecta*), Presidio clarkia (*Clarkia franciscana*), and most-beautiful jewelflower. Big scale balsamroot occasionally occurs in Serpentine Bunchgrass Grassland. It has a reasonable potential to occur in Serpentine Bunchgrass Grassland in the HCP study area. Nearby populations occur in the Oakland Hills and in the hills southeast of Livermore. Four species potentially occur in serpentine grassland in the HCP study area: fragrant fritillary often occurs in Serpentine Bunchgrass Grassland; Tiburon Indian paintbrush, Presidio clarkia, and most-beautiful jewelflower typically occur in Serpentine Bunchgrass Grassland (see species profiles, Appendix D). Most-beautiful jewelflower occurs in Serpentine Bunchgrass Grassland at five locations in the HCP study area.

Wildlife Species Use

Wildlife species use of Serpentine Bunchgrass Grassland is similar to that of Nonnative Grassland, as described above.

Key Ecosystem Characteristics

Ecosystem characteristics of native bunchgrasses in serpentine habitat are generally similar to those in non-serpentine habitats, although serpentine populations may have specific responses that differ from those of non-serpentine populations (Huntsinger et al. 1996). Herbaceous cover is generally lower in Serpentine Bunchgrass Grassland than in either Nonnative Grassland or Valley Needlegrass Grassland, and the amount of forage provided is subsequently lower. Grazing may have little effect on species diversity in serpentine grasslands (Harrison 1999) or it may alter the species composition, favoring species that are more tolerant of grazing (McCarten 1987). Because invasive nonnatives generally are not tolerant of serpentine soils, the potential for exotic nonnatives to invade serpentine bunchgrass grasslands currently appears to be low (Harrison 1999). However, disturbance may allow the establishment of nonnative species when the soil chemistry or hydrology is altered (McCarten 1987), and invasive exotics have been reported in some Serpentine Bunchgrass Grassland (California Natural Diversity Database 2006). Serpentine substrates in the HCP study area appear to be more prone to slumping than non-serpentine areas, and several large slumps with accompanying erosion are present in the Serpentine Bunchgrass Grasslands.

In addition to the ecological functions provided by serpentine Bunchgrass Grassland, this land cover type habitat has been the focus of many scientific

investigations on plant ecology and evolution because of the unusual effects of serpentine soil on plant growth and the degree of species endemism found in serpentine habitats.

Local Distribution and Trends

Serpentine Bunchgrass Grassland has always been a rare plant community (McCarten 1987). Housing development and construction of roads, landfills, and golf courses, particularly in the last 35 years, has further reduced serpentine habitat in the East Bay Area (McCarten 1987; California Natural Diversity Database 2006).

Scrub/Chaparral

The only scrub/chaparral land cover type observed in the HCP study area was Diablan Sage Scrub, a subunit of coastal sage scrub.

Diablan Sage Scrub

Current Conditions

Diablan Sage Scrub is relatively common, occupying 2,438 acres (5.2%) of the total land area in the study area. It is most common in the upper portions of the HCP study area on south-facing slopes, although it is also found in small patches throughout the watershed. Because Diablan Sage Scrub is often found in very small patches, the vegetation mapping likely slightly underestimates the true coverage of this type in the study area.

Vegetation Community Profile

Coastal sage scrub is one of two major scrub formations in the California Floristic Province. It is characterized by low to medium-high shrubs with semi-woody, flexible stems and soft leaves that are facultatively drought-deciduous. Characteristic species include California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), and several sage (*Salvia*) species (Mooney 1988). It co-occurs with chaparral but typically grows where there is less available soil moisture because of low rainfall, slope aspect, or edaphic factors (specific soil characteristics) (Harrison et al. 1971). Coastal sage scrub is a vegetation formation that is composed of many different subunits rather than a uniform plant community. The plant species composition has been shown to be associated with habitat variables such as altitude, slope aspect, and substrate (Cole 1980; Kirkpatrick and Hutchinson 1980; O'Leary 1988; DeSimone and Burk 1992). The species composition does not appear to be determined by a direct response to these habitat variables, but instead appears to be dependent on individual species responses to factors such as soil moisture availability, disturbance, and fire (Wells 1962; Freudenberger et al. 1987; O'Leary 1988; Gill and Hanlon 1998).

The coastal sage scrub subunit that occurs in the inner Coast Ranges from Mount Diablo south to San Luis Obispo County is classified as Diablan Sage Scrub (Axelrod 1978; Holland 1986). In the East Bay Area, it is a characteristic vegetation type of the East Bay Hills/Mount Diablo ecological subsection (Miles

and Goudey 1997). In the HCP study area, other shrub or semi-shrub species associated with this habitat include bush monkeyflower (*Mimulus auranticus*), coyote brush (*Baccharis pilularis*), California matchweed (*Gutierrezia californica*), poison-oak (*Toxicodendron diversilobum*), California broom (*Lotus scoparius*), and bush lupine (*Lupinus albifrons*).

Twelve special-status plant species are reported to occur in Diablan Sage Scrub habitat in the East Bay Area (California Natural Diversity Database 2006). The HCP study area is within the ranges of five of these species: maple-leaved checkerbloom, Presidio clarkia, fragrant fritillary, Diablo helianthella, and most-beautiful jewelflower. Maple-leaved checkerbloom generally occurs in Diablan Sage Scrub along coastal terraces. It has a low probability of occurring in Diablan Sage Scrub in the HCP study area; one historic occurrence is reported from Alum Rock Park, south of the HCP study area, in unknown habitat. The other three species potentially occurring in Diablan Sage Scrub are covered under this HCP. Presidio clarkia and fragrant fritillary occur on serpentine outcrops in Diablan Sage Scrub (see species profiles, Appendix D). These two species have a reasonable potential to occur in the HCP study area. Diablo helianthella is typically found in oak woodland and chaparral habitats but has also been found in coastal scrub. Diablo helianthella has been observed at the ecotone between oak woodland and Diablan Sage Scrub at one location in the HCP study area, and other populations potentially occur there. Most-beautiful jewelflower, which normally occurs in serpentine habitats, was found on outcrops within Diablan Sage Scrub habitat along the north slope of the canyon of Arroyo Hondo.

Wildlife Species Use

Common wildlife that use Diablan Sage Scrub land cover include gopher snake (*Pituophis melanoleucus*), western rattlesnake (*Crotalus viridis helleri*), western fence lizard (*Sceloporus occidentalis*), brush rabbit (*Sylvilagus bachmani*), California pocket mouse (*Perognathus californicus*), Botta's pocket gopher (*Thomomys bottae*), California ground squirrel (*Spermophilus beecheyi*), mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), and bobcat (*Lynx rufus*). Common bird species that occur in this land cover type include but are not limited to the mourning dove (*Zenaida macroura*), California quail (*Callipepla californica*), Anna's hummingbird (*Calypte anna*), western scrub-jay (*Aphelocoma californica*), Bewick's wren (*Thryomanes bewickii*), and California towhee (*Pipilo crissalis*). Lesser goldfinch (*Carduelis psaltria*) is an important seed-eating bird in this cover type, and wintering species include fox sparrow (*Passerella iliaca*), white-crowned sparrow (*Zonotrichia leucophrys*), dark-eyed junco (*Junco hyemalis*), and hermit thrush (*Catharus guttatus*). Alameda whipsnake (*Masticophis lateralis euryxanthus*) is the only covered wildlife species that potentially uses Diablan Sage Scrub in the HCP study area for primary habitat (see species profiles in Appendix D).

Key Ecosystem Characteristics

Most authorities currently regard Diablan Sage Scrub as a self-replacing vegetation type that exists in a dynamic relationship with other vegetation types. Disturbance is believed to affect both the composition of the Diablan Sage Scrub community and the interaction between Diablan Sage Scrub, chaparral,

grassland, and other plant communities (Westman 1979; Callaway and Davis 1993; Gray 1983; Freudenberger et al. 1987; O'Leary and Westman 1988; DeSimone and Zedler 1999). Fire plays a major role in the Diablan Sage Scrub community. Coastal sage scrub has been characterized as a seral community that needs disturbance to become established and, in the absence of disturbance such as fire, would be replaced by chaparral (Epling and Lewis 1942; Axelrod 1978).

The role of fire in the Diablan Sage Scrub ecosystem is still poorly understood. Diablan Sage Scrub has always been subject to periodic fires. Fire has both short- and long-term effects on the structure and composition of Diablan Sage Scrub. In the short term, aboveground woody cover is greatly reduced and mortality is high, although the ability to withstand fire varies among species. Following removal of the woody canopy, many seedlings are able to become established, and herbaceous cover is highest following fire (Westman 1981). Alteration of the vegetation structure and composition also alters the composition of the fauna (Price and Waser 1984; Schwilk and Keeley 1998). Burning reduces the amount and diversity of foraging habitat for both resident and nonresident species and reduces cover for nesting (Stanton 1986). The fundamental long-term effect of fire on this land cover type is the maintenance of stand complexity via thinning of brush, creation of openings for early seral species, and reduction of even-age stands.

Diablan Sage Scrub responds quickly after fire; the vegetation structure and composition reestablishes within a few years. Wildlife use also resumes its prefire pattern within a short time. However, the plant associations present following fire may not be the same as before the fire. Postfire recovery patterns vary among sites, and identifying the factors that influence the vegetation response is difficult because of the many variables involved (White 1995). Fire characteristics such as intensity and fire interval may affect both the structure and composition of the Diablan Sage Scrub community. Following burns, shrubs on sites with lower intensity fires were larger than those on sites with higher intensity fires (Malanson and O'Leary 1982). Frequent fires can alter the composition of the vegetation by favoring sprouters over seeders (Zedler et al. 1983). With shorter fire intervals, growth of herbaceous species may inhibit establishment of shrubs by seed (Malanson and O'Leary 1982). Short fire intervals may reduce or eliminate some species, and greater diversity is expected with longer fire intervals (Malanson 1985; Haidinger and Keeley 1993). Disturbance may accentuate these postfire successional patterns (O'Leary and Westman 1988).

The primary ecosystem functions of Diablan Sage Scrub in the HCP study area are to provide surface runoff area, to maintain water quality through soil retention, and to provide wildlife habitat. Because Diablan Sage Scrub occurs primarily on slopes with thin soils, most of the precipitation that falls on this habitat runs off, and little is retained as groundwater. The root systems of the shrub species occurring in sage scrub are well developed and play an important role in soil stability. Even following fire, which may destroy most of the aboveground biomass, the roots remain intact and serve to hold the soil in place until regrowth or revegetation occurs. Because of the dense woody vegetation, this habitat provides scant fodder for livestock and provides habitat primarily for

browsers, seed eaters, and insectivores. The tall shrub cover also limits the use of this habitat for recreation, and the few travel routes that traverse this habitat are primarily access roads.

Local Distribution and Trends

A substantial amount of Diablan Sage Scrub habitat in Alameda and Contra Costa Counties has been lost to urban development, improper grazing management, and fire suppression (62 FR 64306–64320).

Woodland

Mixed Evergreen Forest/Oak Woodland

Current Conditions

Mixed Evergreen Forest/Oak Woodland is the most common woodland community in the HCP study area, occupying 13,077 acres (28% of the study area). It is present in scattered locations throughout the HCP study area, with the largest continuous patches on north-facing slopes in the upper portions of the watershed.

Vegetation Community Profile

Mixed Evergreen Forest/Oak Woodland is characterized by a diverse overstory often dominated by coast live oak. The nomenclature for this land cover type has been changed since publication of the *Alameda Watershed Management Plan* from Mixed Evergreen Forest/Coast Live Oak Woodland to Mixed Evergreen Forest/Oak Woodland to better reflect conditions observed in the HCP study area. Unlike the coast live oak woodland commonly occurring on north-facing slopes and in canyons and dominated by coast live oak, the most ubiquitous woodland cover type in the study area contains a mix of co-dominant oaks such as coast live oak (*Quercus agrifolia*), blue oak (*Q. douglasii*), and valley oak (*Q. lobata*). In interior foothills like those of the HCP study area, the canopy of this land cover type is generally more open and includes some deciduous species (Griffin 1988). In addition to the array of dominant oaks in this land cover type, a number of both broad-leafed evergreen and deciduous trees are present, including California bay (*Umbellularia californica*), madrone (*Arbutus menziesii*), California buckeye (*Aesculus californica*), and black oak (*Q. kelloggii*) (Holland 1986; Sawyer and Keeler-Wolf 1995). Where shrubby, the understory consists of patches of toyon (*Heteromeles arbutifolia*), poison oak (*Toxicodendron diversilobum*), and scrub oak (*Q. berberidifolia*). Where more open, the understory consists of annual grasses and shade-tolerant perennials, such as yerba santa (*Satureja douglasii*) and common snowberry (*Symphoricarpos albus*).

The steep topography has a strong influence on the vegetation communities in the study area. This is particularly apparent in oak woodlands. In the southern portions of the watershed, the canopies of valley oak, blue oak, coast live oak and, to a lesser degree, canyon oak (*Q. chrysolepis*) and black oak overlap. This situation is unique because these oaks generally occupy different ecological niches based on slope, aspect, and soil type.

Seven special-status plant species are reported to occur in Mixed Evergreen Forest/Oak Woodland in the East Bay Area (California Natural Diversity Database 2006). The HCP study area is within the ranges of three of these species: maple-leaved checkerbloom (*Sidalcea malachroides*), robust monardella (*Monardella villosa* ssp. *globosa*), and Diablo helianthella (*Helianthella castanea*). Maple-leaved checkerbloom occurs in Mixed Evergreen Forest/Oak Woodland along the margins of coastal terraces. One historic occurrence is reported from Alum Rock Park, south of the HCP study area, in unknown habitat. It could potentially occur in Mixed Evergreen Forest/Oak Woodland in the HCP study area, but the probability is low. Two of the species are covered under this HCP. Robust monardella occurs on rock outcrops and road banks in Mixed Evergreen Forest/Oak Woodland (see species profile, Appendix D). It could potentially occur in that habitat in the HCP study area, but the probability is low. All populations of *Monardella villosa* located in the HCP study area are ssp. *villosa*; the nearest populations of robust monardella are in the Berkeley/Oakland Hills. Diablo helianthella has been located at the transition zone between Mixed Evergreen Forest/Oak Woodland and Diablan Sage Scrub at one location in the HCP study area, and other populations are likely to occur elsewhere in the area (see species profile, Appendix D).

Wildlife Species Use

Mixed Evergreen Forest/Oak Woodland provides food and cover for many species of wildlife. Common reptiles include gopher snake and western fence lizard. Common mammals include deer mouse (*Peromyscus maniculatus*), western gray squirrel (*Sciurus griseus*), mule deer, and coyote. Representative raptors in this cover type include red-tailed hawk, American kestrel, barn owl, and great horned owl. Representative bird species include acorn woodpecker (*Melanerpes formicivorus*), Nuttall's woodpecker (*Picoides nuttallii*), northern flicker (*Colaptes auratus*), and white-breasted nuthatch (*Sitta carolinensis*). Other common birds include California quail, spotted towhee (*Pipilo maculatus*), Bewick's wren, and bushtit (*Psaltriparus minimus*).

Key Ecosystem Characteristics

Mixed Evergreen Forest/Oak Woodland lacks drought adaptations and generally grows in more mesic habitats, typically on north-facing slopes (Griffin 1971, 1973). Survival of coast live oak appears to be higher for seedlings growing under a shrub canopy, apparently as a result of more mesic soil conditions under the shade of shrubs (Callaway and D'Antonio 1991; Muick 1991; Plumb and Hannah 1991; Parikh and Gale 1998). Coast live oak, the dominant species in this land cover type, has acorns that germinate relatively slowly and have a low rate of root elongation, which limits the ability of seedlings to survive under more xeric conditions (Matsuda and McBride 1986). The root system of coast live oaks consists mostly of lateral roots, a configuration that does not favor survival under xeric conditions (Callaway 1990).

Unlike valley oak or blue oak woodlands, which are dominated by deciduous species, the understory vegetation in Mixed Evergreen Forest/Oak Woodland is quite different from the adjacent grasslands. Because many of the trees are evergreen, light levels beneath the canopy are low, and the understory vegetation

cover consists of primarily shade-tolerant species (Parker and Muller 1982; Marañón and Bartolome 1994).

A recently identified canker disease, Sudden Oak Death (SOD), which is epidemic in populations of coast live oak in central coastal California, has the potential to cause widespread mortality in the species (Rizzo et al. 2002). SOD has not been observed in the HCP study area. As of January 2004, the nearest confirmed infection was in Castro Valley on a California bay laurel, approximately 20 miles northwest of the study area (U.C. Berkeley 2003).

The primary ecosystem functions of Mixed Evergreen Forest/Oak Woodland in the HCP study area are to provide surface runoff area, to maintain water quality through soil retention, and to provide wildlife habitat. Mixed Evergreen Forest/Oak Woodland shares many of the same functions as the adjacent grasslands and scrub communities. However, the dominance of oak trees and other evergreen trees within this community makes it unique because of the structure and food that forest and woodlands provide. Oaks provide shade under the leaf canopy and within trunk cavities, offering shelter to a variety of wildlife in an otherwise open, dry landscape. Evergreen oaks such as coast live oak, as well as California bay, madrone, and gray pine, provide this shelter year-round, unlike the largely deciduous vegetation of riparian forest and scrub. The often deep leaf litter or duff under oaks provides a deep cover of organic matter and protection from desiccation for soil invertebrates and amphibians. Oaks, in particular, support a diverse wildlife community dependent on their acorns. For example, scrub-jay, acorn woodpecker, and black-tailed deer consume this high-quality food in abundance. The diverse insect fauna found on oaks also provides food for mammals and birds. Like grasslands, the oak woodland community provides important upland habitat for aquatic species such as frogs and salamanders that are dependent on ephemeral ponds and wetlands in oak woodland.

Like other natural communities, oak woodlands adjacent to or surrounded by urban land uses provide significantly reduced habitat value. Wildlife habitat under these conditions is degraded by human disturbance such as noise, light, pests, irrigation, and/or frequent disking for fire protection. Habitat in these oak woodlands can also be degraded by invasion of exotic plant species in the understory. Because of the absence of adjacent urban land use, mixed evergreen forest/oak woodland in the HCP study area has very high functional values.

Local Distribution and Trends

Like all oak-dominated land cover types in the Bay Area, the Mixed Evergreen Forest/Oak Woodland land cover type has been heavily affected by urban development and agricultural conversion. Although land conversion has reduced the distribution of these land cover types, other threats are potentially even more troublesome. Several oak species are not regenerating in portions of their range. In essence, young trees are not replacing older trees that are removed or die of natural causes. Valley oak, blue oak, coast live oak and, in some areas, California black oak are particularly affected by the lack of regeneration. Research on the causes of this decline has yet to identify a particular causal

mechanism, but potential interacting mechanisms include overgrazing, fire suppression, noxious weed invasion, and the dominance of annual grasses over native perennial grasses (California Department of Fish and Game and University of California Division of Agriculture and Natural Resources 1996).

In addition to threats posed by development and lack of regeneration, SOD poses a threat to the oak land cover types. The disease, first identified in 1995, has since spread to 12 counties and killed tens of thousands of oaks. Research indicates that coast live oaks and black oaks appear to be the most susceptible (Rizzo et al. 2002). The list of known host plants includes two common sub-dominants in the land cover type: madrone and California bay laurel (Rizzo et al. 2002). Although no cases of SOD have been confirmed on SFPUC lands in the Alameda watershed (Koopmann pers. comm.), SOD has been confirmed in Alameda, Contra Costa, and Santa Clara Counties.

Valley Oak Woodland

Current Conditions

Valley Oak Woodland occupies 1,328 acres (2.8%) of the total land area in the HCP study area. It is most common near San Antonio and Calaveras Reservoirs on deep, well-drained alluvial soils. Although valley oaks are often associated with these soils, observations in the HCP study area suggest that stands of valley oak occur across a wide variety of conditions ranging from wide valley floodplains to steep, rocky, dry slopes and narrow canyons. Accordingly, Valley Oak Woodlands are found intergrading with mixed evergreen forest/oak woodland, blue oak woodland, and a number of riparian land cover types.

Vegetation Community Profile

Valley Oak Woodland is characterized by a fairly open canopy of mature valley oaks with a grassy understory, generally on valley bottoms and north-facing slopes (Griffin 1971; Holland 1986; Sawyer and Keeler-Wolf 1995). Valley Oak Woodland is generally denser on valley bottoms where the tree roots can penetrate to the groundwater, and less dense on hillsides where trees need wider spacing to develop larger root systems (Griffin 1973). The understory is composed primarily of grassland species, with a composition similar to that of the adjacent Nonnative Grassland (Parker and Muller 1982).

Very few special-status plants are found in Valley Oak Woodland, and only two special-status plants, Santa Clara Valley dudleya (*Dudleya setchellii*) and Diablo fairy lantern (*Calochortus pulchellus*), are found in Valley Oak Woodlands in the East Bay Area (California Natural Diversity Database 2006). The HCP study area is not within the range of either of these species, and there is only very low potential for any special-status plants to occur in Valley Oak Woodland in the HCP study area.

Wildlife Species Use

Wildlife species use of Valley Oak Woodland in the study area is similar to that of coast live oak forest. Additionally, where the tree canopy is relatively open and aquatic habitat (e.g., ponds) occurs, California red-legged frog and California tiger salamander could occur.

Key Ecosystem Characteristics

Valley Oak Woodland provides ecosystem functions similar to those of both grasslands and Mixed Evergreen Forest/Oak Woodland. Because the understory is composed primarily of grassland species, Valley Oak Woodland provides forage for livestock as well as wildlife.

Local Distribution and Trends

The trends for Valley Oak Woodland are similar to those discussed for Mixed Evergreen Forest/Oak Woodland. A major difference is that valley oaks do not appear to be susceptible to SOD.

Blue Oak Woodland

Current Conditions

Blue Oak Woodland is somewhat common in the HCP study area, occupying 2,111 acres (4.5%) of the total land area in the watershed. It is present in scattered locations mostly in the central or eastern portions of the watershed on dry or well-drained north- or northeast-facing slopes.

Vegetation Community Profile

A canopy ranging from dense to open, generally in canyons and on north-facing slopes, characterizes Blue Oak Woodland (Holland 1986; Sawyer and Keeler-Wolf 1995). The understory varies from shrubby to open, with a composition similar to that of the adjacent nonnative grassland. Blue oaks generally occur on sites that are drier and have lower levels of nitrogen, phosphorus, and organic matter than those where valley oak or coast live oak are found (Griffin 1973; Baker et al. 1981). Although blue oaks can become established on south-facing slopes during wetter years or where mesic conditions are present, they are generally found on north-facing slopes (Griffin 1971). However, in the Central California Coast Ranges ecological section, Blue Oak Woodland is more common on south-facing slopes (Miles and Goudey 1997).

Four special-status plants have been reported in Blue Oak Woodland in the East Bay Area (California Natural Diversity Database 2003): large-flowered fiddleneck (*Amsinckia grandiflora*), Mount Diablo fairy lantern, Brewer's dwarf flax (*Hesperolinon breweri*), and Diablo helianthella. The HCP study area is not within the range of the three former species, and there is very low potential for them to occur in the HCP study area. However, Diablo helianthella occurs in Blue Oak Woodland and has been located at the ecotone between Mixed Evergreen Forest/Oak Woodland and Diablan Sage Scrub at one location in the HCP study area. Other populations are likely to occur elsewhere in this habitat (see species profile, Appendix D).

Wildlife Species Use

Wildlife species use of Blue Oak Woodland in the study area is similar to that of Valley Oak Woodland and Mixed Evergreen Forest/Oak Woodland. Additionally, where the tree canopy is relatively open and aquatic habitat (e.g., ponds) is present, California red-legged frog and California tiger salamander could occur in Blue Oak Woodland.

Key Ecosystem Characteristics

Blue Oak Woodland provides ecosystem functions similar to those of both grasslands and Mixed Evergreen Forest/Oak Woodland. Because the understory is composed primarily of grassland species, Blue Oak Woodland also provides forage for livestock as well as wildlife.

Local Distribution and Trends

The trends for Blue Oak Woodland are similar to those discussed for Mixed Evergreen Forest/Oak Woodland. A major difference is that, unlike live and black oaks, blue oaks do not appear to function as a host for SOD or to be susceptible to it.

Oak Savannah

Current Conditions

Oak Savannah is uncommon, occupying 1,599 acres (3.4%) of the total land area in the study area. It is present throughout the HCP study area in small patches and in the grassland/oak woodland transition zone, but it is most common in the lower portions of the watershed near San Antonio Reservoir.

Vegetation Community Profile

Oak Savannah is defined as grassland with a tree canopy cover of 10–30%. Because the body of scientific literature does not provide a universal definition of *savannah*, this definition was developed on the basis of locally important ecological functions (Huntley and Walker 1982; Saramiento 1983; Archibold 1995; Allen-Diaz et al 1999). The majority of oak woodlands in the HCP study area have a canopy cover of nearly 100%; accordingly, in this document, the definition focuses on distinguishing between savannah and grassland. In the HCP study area, Oak Savannah consists of grassland with a low canopy cover of trees, primarily blue oak, valley oak, and scattered coast live oak. Shrubs are generally scarce and may include scattered individuals or occasional aggregations. Herbaceous species commonly found include many of the species mentioned above in the description of nonnative grassland.

Special-status plant species that potentially occur in Oak Savannah in the HCP study area are the same as those described above for Nonnative Grassland and Valley Oak Woodland. Of these species, only round-leaved filaree is a covered species in this HCP.

Wildlife Species Use

Wildlife species use of Oak Savannah in the study area is similar to that of Valley Oak Woodland described above.

Key Ecosystem Characteristics

The ecosystem functions of oak savannah are similar to both those of Nonnative Grassland and Valley Needlegrass Grassland and the oak woodland land cover types. Although oak woodlands and Oak Savannahs are functionally similar in many ways, they play somewhat different ecological roles in the landscape. For example, unlike dense oak woodlands, Oak Savannahs are less likely to provide

cool, shady refugia for wildlife during the hot dry summer. On the other hand, Oak Savannahs function as a transition zone between dense oak woodlands and open grasslands. This transition zone is ecologically important for a number of covered species for roosting, migration, and/or aestivation. Additionally, whereas dense oak woodlands may provide better summer refugia habitat for mammals and amphibians, sparse Oak Savannahs may offer raptors ideal hunting perches.

Local Distribution and Trends

Trends for oak savannah are similar to trends for valley oak woodland, blue oak woodland, and annual grassland.

Serpentine Foothill Pine–Chaparral Woodland

Current Conditions

Serpentine Foothill Pine–Chaparral Woodland is very uncommon in the HCP study area, occupying a single 72-acre patch along the west side of Alameda Creek between Alameda Creek and Calaveras Boulevard.

Vegetation Community Profile

Serpentine Foothill Pine–Chaparral Woodland is an open woodland of foothill pine (*Pinus sabiniana*) with a shrubby understory that occurs on serpentine substrates (Holland 1986). This land cover type was not identified in the *Alameda Watershed Management Plan* (EDAW 2001). In the HCP study area, both foothill pine and California bay are present in the canopy. The understory shrubs include big-berry manzanita (*Arctostaphylos glauca*), toyon, shrubby interior live oak (*Quercus wislizenii* var. *frutescens*), and leather oak (*Quercus durata*).

Only a few special-status plants in the East Bay Area occur in serpentine habitats in association with foothill pine (California Natural Diversity Database 2006), and the HCP study area is not within the range of these species. However, most-beautiful jewelflower is known to occur in serpentine chaparral in at least one location, and one of the populations in the HCP study area occurs along Leyden Creek at the transition from serpentine grassland to Serpentine Foothill Pine–Chaparral Woodland, in association with coastal sage scrub species. Therefore, the Serpentine Foothill Pine–Chaparral Woodland in the HCP study area should be considered potential habitat for this species.

Wildlife Species Use

Wildlife species use of serpentine Foothill Pine–Chaparral Woodland is similar to that of the chaparral and woodland types described above.

Key Ecosystem Characteristics

Ecosystem functions of Serpentine Foothill Pine–Chaparral Woodland are similar to those of mixed evergreen forest/oak woodland. However, Serpentine Foothill Pine–Chaparral Woodland may be more prone to erosion following slumping, such as is present along Leyden Creek.

Local Distribution and Trends

This land cover type is naturally limited in distribution due to its dependence on serpentine soils for development. Although serpentine soil exists throughout the Coast Ranges, it generally occurs as small isolated patches; consequently, serpentine-dependent land cover types are distributed in small patches across the landscape.

Riparian

Central Coast Live Oak Riparian Forest and Coast Live Oak Riparian Forest

Current Conditions

Central Coast Live Oak Riparian and Coast Live Oak Riparian Forests are the most common riparian habitat type in the HCP study area. They are present throughout the watershed in canyon bottoms and floodplains. The *Alameda Watershed Management Plan* (EDAW 2001) draws a distinction between Central Coast Live Oak Riparian Forest and Coast Live Oak Riparian Forest based on moisture regime. According to the vegetation community description provided in the plan, Central Coast Live Oak Riparian Forest occurs on floodplains and in canyons along perennial or intermittent streams, while Coast Live Oak Riparian Forest is found along ephemeral streams. Although both communities can be difficult to distinguish from adjacent Mixed Evergreen Forest/Oak Woodland communities because they often possess a similar overstory species composition, Central Coast Live Oak Riparian Forest generally intergrades with the Mixed Evergreen Forest/Oak Woodland, while the Coast Live Oak Riparian Forest is found in dry, isolated drainages surrounded by scrub or grassland. Because these types are difficult to distinguish on aerial photographs from the various land cover types dominated by coast live oak, it is likely that the 420 acres (0.9% of the study area) calculated for these riparian types is an underestimation of the total cover of these communities.

Vegetation Community Profile

Central Coast Live Oak Riparian Forest is an evergreen riparian forest occurring in canyon bottoms and along floodplains along the western slope of the Coast Ranges from Sonoma County to Santa Barbara County (Holland 1986). Coast Live Oak Riparian Forest occurs in drier, steep canyons of ephemeral drainages through the Coast Ranges. The dominant canopy tree in both types is coast live oak. In the HCP study area, associated canopy species of the Central Coast Live Oak Riparian Forest include big-leaf maple (*Acer macrophyllum*), California buckeye, white alder (*Alnus rhombifolia*), western sycamore (*Platanus racemosa*), and Fremont cottonwood (*Populus fremontii*). Canopy cover of these associated species is substantially more limited within the Coast Live Oak Riparian Forest. A shrubby understory is present in both, most commonly including coyote brush, coffeeberry, ceanothus, California wild rose (*Rosa californica*), California blackberry (*Rubus ursinus*), poison-oak, lemonade berry (*Rhus trilobata*), and blue elderberry (*Sambucus mexicanus*).

Three special-status plant species are reported to occur in Central Coast Live Oak Riparian Forest (California Natural Diversity Database 2006); of these, western leatherwood (*Dirca occidentalis*) could potentially occur in the HCP study area. However, because the nearest documented populations of western leatherwood are in the Berkeley/Oakland Hills, the probability that it occurs in the study area is low. No species covered under this HCP are reported to occur in Central Coast Live Oak Riparian Forest.

Wildlife Species Use

Wildlife species use of central Coast Live Oak Riparian Forest in the study area is similar to that of Willow Riparian Forest/Scrub. Due to the drier condition associated with Coast Live Oak Riparian Forest, wildlife use of this type is more similar to that of Mixed Evergreen Forest/Oak Woodland. Additionally, three covered wildlife species, western pond turtle, foothill yellow-legged frog and California red-legged frog, are associated with the Central Coast Live Oak Riparian Forest land cover type.

Key Ecosystem Characteristics

Ecosystem functions of Central Coast Live Oak Riparian Forest and Coast Live Oak Riparian Forest are similar to those of Mixed Evergreen Forest/Oak Woodland and riparian forest. Because of the dense canopy cover, this cover type provides the most moderate, mesic habitat.

Local Distribution and Trends

Local trends in Central Coast Live Oak Riparian Forest and Coast Live Oak Riparian Forest land cover types mirror the trends described above for other oak-dominated land cover types and for riparian land cover types described below (Sycamore Alluvial Woodland, Willow Riparian Forest/Scrub, and White Alder Riparian Forest).

Sycamore Alluvial Woodland

Current Conditions

Sycamore Alluvial Woodland is uncommon in the HCP study area, occupying 342 acres (0.73%) of the study area along Alameda Creek, San Antonio Creek, and Arroyo Hondo. This land cover type is generally present on floodplains and terraces along low-gradient streams with deep alluvium. Areas mapped as Sycamore Alluvial Woodland may contain a mix of western sycamore, white alder, and willows (*Salix* spp.), with sycamores forming either the dominant or co-dominant canopy cover.

Vegetation Community Profile

Sycamore Alluvial Woodland is an open woodland in which the dominant canopy tree is western sycamore (Holland 1986). This habitat occurs along broad, meandering channels of intermittent streams, often with deposits of alluvium (Holstein 1984; Shanfield 1984). The understory is disturbed by winter flows, and herbaceous vegetation is typically sparse or patchy. Mule fat may be present along stream channels and on stream banks.

No special-status plant species are known to be associated with Sycamore Alluvial Woodland in the East Bay Area (California Natural Diversity Database 2006).

Wildlife Species Use

Wildlife species use of Sycamore Alluvial Woodland is similar to that of the woodland types described above. Because this land cover type occurs along streams, it can also support some aquatic and riparian-associated species, depending on the understory vegetation structure. The presence of flowing water associated with this land cover type attracts numerous mammals, amphibians, and reptiles. Riparian corridors are also important for deer movement. Common mammals, in addition to deer, found in this cover type include raccoon (*Procyon lotor*), gray fox (*Urocyon cinereoargenteus*), striped skunk (*Mephitis mephitis*), deer mouse, western harvest mouse, broad-handed mole (*Scapanus latimanus*), and dusky-footed woodrat (*Neotoma fuscipes*). Numerous birds are also found in this cover type. representative examples include Wilson's warbler (*Wilsonia pusilla*), yellow warbler (*Dendroica petechia*), northern flicker, Bewick's wren, white-tailed kite (*Sceloporus occidentalis*), Cooper's hawk, red-shouldered hawk (*Buteo lineatus*), song sparrow (*Melospiza melodia*), and black-headed grosbeak (*Pheucticus melanocephalus*). Three covered wildlife species could occur in Sycamore Alluvial Woodland: western pond turtle, foothill yellow-legged frog and California red-legged frog.

Key Ecosystem Characteristics

Although it occurs along streams, Sycamore Alluvial Woodland undergoes extreme variation in water availability. During the rainy season, the stream channel and adjacent terraces are subject to flooding. During the summer drought, the streams are generally dry, and little moisture is available in the stony substrate. The alluvial substrate contains little soil and is nutrient poor. Flooding also subjects sycamore alluvial forest to frequent disturbance. However, this disturbance appears to benefit regeneration of western sycamores. Regeneration from seed appears to occur in pulses correlated with large flood events (Shanfield 1984). Trees that are damaged by flooding can also resprout from the roots and trunk (Shanfield 1984). Anthracnose, a fungal disease, can defoliate the trees in springtime (Holstein 1984). Heavy cattle grazing may inhibit recruitment of sycamore seedlings, although recruitment may occur under light grazing in favorable (wet) years (Smith 1989).

Like other riparian woodland land cover types, Sycamore Alluvial Woodland is disproportionately important in the landscape because of its function as an interface between aquatic and terrestrial communities. The value of this interface is evidenced by the role riparian zones play for both terrestrial and aquatic species. These roles include providing movement corridors and both nesting and foraging habitat across the landscape; supporting high levels of invertebrate production; creating moist, cool refugia during the hot dry summer; supporting the aquatic food chain by litterfall; armoring stream banks; and modifying channel form. The impact of sycamores on channel form is clearly evidenced in Alameda Creek upstream from Little Yosemite Falls, by the presence of channel braids around the large mature sycamores occupying the active channel.

Sycamore Alluvial Woodlands also play a role in moderating stream temperatures. However, because the tree canopy cover in this type is relatively open, the total shade effect provided is less than in other riparian forest types.

Local Distribution and Trends

Historical data from photo archives suggest that these habitats are substantially reduced from their historic coverage in the Bay Area. Although the Sycamore Alluvial Woodland was likely never a prolific land cover type in this region, its distribution in wide alluvial floodplains has made it particularly susceptible to the impacts of human development. The same flat, alluvial terraces that support Sycamore Alluvial Woodland are also ideal for a variety of human uses such as cultivated agriculture, nurseries, aggregate mining, and housing. Much of the historic floodplain in the study area that supported this land cover type has been converted to these uses. In addition, historical research on Alameda Creek suggests that major changes in hydrology resulting from development, flood control, and upstream dams currently limit the ability of this land cover type to establish and regenerate.

Willow Riparian Forest/Scrub

Current Conditions

This land cover type is uncommon, occupying 158 acres (0.3%) of the HCP study area. Willow Riparian Forest/Scrub occurs in and along the margins of the active channel on intermittent and perennial streams. In the HCP study area, most of the areas mapped as Willow Riparian Forest/Scrub are associated with intermittent reaches of perennial streams, including areas along and within Alameda Creek throughout the Sunol Valley reach and the upper reaches of Arroyo Hondo. Perennial stream reaches supporting Willow Riparian Forest/Scrub include the pools along lower Vallecitos Creek and lower San Antonio Creek.

Vegetation Community Profile

In the East Bay Area, streamside habitat dominated by shrubby willows is classified as Central Coast Riparian Scrub (Holland 1986). Although red willow (*Salix laevigata*) and arroyo willow (*Salix lasiolepis*) remain the most common dominant canopy species in this habitat, the name of this land cover type has been changed to Willow Riparian Forest/Scrub to better represent the range of conditions occurring in the HCP study area. This range includes three gradations of willow community: (1) dense mature willows intergrading with Central Coast Live Oak Riparian Forest and White Alder Riparian Forest on well established stream terraces; (2) dense willow riparian scrub dominated by young trees and shrubs on young and dynamic alluvial deposits; and (3) scattered willows and mule fat occurring in and along the margins of the active stream channel and generally found in open sandy washes. Understory development in willow scrub or forest land cover types is dictated by canopy density. Where the canopy is more open and dominated by trees or scattered willow scrub, an understory of shrubs and herbs is present.

No special-status plant species are known to be associated with Willow Riparian Forest/Scrub in the East Bay Area (California Natural Diversity Database 2006).

Wildlife Species Use

Riparian land cover provides habitat for a wide diversity of wildlife. Flowing water associated with this land cover type attracts numerous mammals, amphibians, and reptiles. Riparian corridors are also important for deer migration. In addition to deer, common mammals found in this cover type include raccoon, gray fox, striped skunk, deer mouse, harvest mouse, broad-handed mole, and dusky-footed woodrat. In addition, because of their proximity to rangelands, many riparian areas in the study area are grazed by livestock. Numerous birds are also typical of this cover type, including yellow warbler, northern flicker, Bewick's wren, white-tailed kite, Cooper's hawk, red-shouldered hawk, song sparrow, and black-headed grosbeak. Riparian habitat is especially important for neotropical migratory birds such as Pacific-slope flycatcher (*Empidonax difficilis*) and Wilson's warbler. Willow habitats can be important breeding habitat for amphibians such as California red-legged frog.

Key Ecosystem Characteristics

Willow Riparian Forest/Scrub provides ecosystem functions similar to those of Sycamore Alluvial Woodland. Where it occurs, riparian forest/scrub serves to greatly reduce and moderate stream temperatures (i.e., reduce their variability), increasing the value of these aquatic habitats for native fish, invertebrates, and amphibians. Differences in vegetative structure between riparian woodland and riparian scrub lead to varying effectiveness in providing these ecosystem functions. For example, because of the reduced canopy cover and overhang of riparian scrub, it is often not as effective in moderating stream temperatures as riparian woodland. On the other hand, riparian scrub may provide better nesting and foraging habitat for migratory passerine birds that prefer the dense thicket habitat provided by scrub.

Local Distribution and Trends

Local trends in distribution of the Willow Riparian Forest/Scrub land cover type are similar to those of the Sycamore Alluvial Woodland and other riparian land cover types. In the greater Bay Area, flood control activities and agricultural and urban development have significantly reduced the distribution of this land cover type. Willow forest and willow scrub can also be severely affected by improper grazing management. Consequently, it is possible that this cover type was much more abundant in the HCP study area prior to the onset of intensive livestock grazing. In the HCP study area, SFPUC is in the process of fencing a number of stream corridors to control livestock grazing in riparian areas and in the stream channel (Koopmann pers. comm.). It is likely that these management actions will result in an increase in abundance and distribution of the land cover type. Finally, seedling success and development of willows is heavily dependent on access to surface water or shallow groundwater during the majority of the year (Sacchi and Price 1992). Accordingly, water operations and land alterations that result in reduced stream baseflows and/or increased depth to water table have a notable adverse effect on this land cover type.

White Alder Riparian Forest

Current Conditions

White Alder Riparian Forest is a riparian community in the HCP study area, occurring on at least 137 acres (0.29%) of the total land area in the watershed. White Alder Riparian Forest is well developed in the southeastern portion of the watershed along Alameda Creek and Arroyo Hondo. Because white alder stands generally occur in thin bands along the active stream channel, this land cover type was difficult to map from aerial photos. In many areas of Alameda Creek and Arroyo Hondo, small White Alder Riparian Forest stands (>1 acre) are scattered throughout the riparian corridor surrounded by dominant canopy cover of either sycamore alluvial woodland or central coast live oak riparian forest. In these situations, White Alder Riparian Forest stands were mapped as part of the larger riparian forest type. Accordingly, the true extent and coverage of this land cover type is likely underestimated.

Vegetation Community Profile

Streamside forest dominated by white alder is classified as White Alder Riparian Forest (Holland 1986). White alder is a riparian obligate species and is restricted to reaches with perennial flow (Holstein 1984). Because it is restricted to stream courses with permanent water, this species is considered a reliable indicator of the presence of water. The understory is shrubby and includes willow species, mule fat, poison-oak, and California wild rose.

No special-status plant species are reported to occur in White Alder Riparian Forest in the East Bay Area (California Natural Diversity Database 2006).

Wildlife Species Use

White Alder Riparian Forest provides high-quality foraging habitat, breeding habitat, and cover for many wildlife species. The diversity of plant species and multistoried canopy in riparian forests provides food and favorable microhabitat conditions for wildlife. The presence of moisture associated with this cover type attracts numerous fish, mammals, amphibians, and reptiles.

California red-legged frog, foothill yellow-legged frog, and western pond turtle are examples of covered wildlife species found in riparian habitats. Riparian corridors are also considered important movement habitat for large vertebrates such as deer. Other common mammals found in this habitat include raccoon, gray fox, striped skunk, deer mouse, harvest mouse, and dusky-footed woodrat. Birds typical of this habitat include Wilson's warbler, yellow warbler, northern flicker, Bewick's wren, white-tailed kite, Cooper's hawk, red-shouldered hawk, song sparrow, and black-headed grosbeak.

Key Ecosystem Characteristics

In addition to the ecosystem characteristics common to all woody riparian communities, White Alder Riparian Forest is ecologically distinctive in that it facilitates nitrogen fixation through a symbiotic association with bacteria of the genus *Frankia*. These nitrogen-fixing bacteria live in the tissues of white alder root nodules. The bacteria obtain carbohydrates from the alder, while the alder obtains nitrates from the bacteria. There are about 21 genera of non-legumes that

fix nitrogen, and very few of these are found in riparian areas. Because alders are the only woody riparian species in the study area that support nitrogen-fixing bacteria, they play a critical role in biogeochemical cycling by increasing bio-available forms of nitrogen for understory development and establishment of later successional riparian forests. In addition, research indicates that white alders are more resilient to flood flows than other woody riparian species and consequently play a critical role in armoring streambanks, reducing bank erosion, and jump-starting reestablishment of dense riparian forest after major flood events (Bendix 1994 and 1999).

White alder is considered poorly adapted to water stress and, hence, ceases to exist in reaches without permanent water. Although this species needs a permanent water source for establishment, once mature it can survive away from the active channel and sends roots down as deep as 20 feet to access the water table.

Local Distribution and Trends

White alder forests are often the dominant vegetation type in southern California's Transverse Range riparian systems. White Alder Riparian Forest is much less common in northern California, where red alder (*Alnus rubra*) is often associated with low-gradient riparian systems. Because alders are particularly sensitive to drought and rely on oxygenated perennial water sources, changes in stream hydrology that result in losses of summertime flow have a profound impact on the distribution and success of this land cover type.

Freshwater Wetland

Freshwater Marsh

Current Conditions

Freshwater Marsh is currently limited in distribution in the HCP study area to four small areas totaling 21 acres (0.04%) of the study area. Within the study area, patches of Freshwater Marsh are found near the outlets of tributary creeks of San Antonio Reservoir and in isolated patches in the north and northwestern portion of the study area.

Vegetation Community Profile

Freshwater Marsh generally occurs near river mouths or adjacent to lakes and springs (Holland 1986). Freshwater Marsh is typically dominated by erect, rooted, herbaceous hydrophytic plant species adapted to growing in conditions of prolonged inundation. Common plant species present in this land cover type include perennial wetland species such as cattails (*Typha* spp.) and tules (*Scirpus californicus*). Freshwater Marsh is characterized by a year-round water source.

Seven special-status plants are reported from Freshwater Marsh in the East Bay Area (California Natural Diversity Database 2006). However, none of these species are known to occur in the HCP study area. The HCP study area does not overlap the known range of any of these species, and it is highly unlikely that any of them would occur in the HCP study area.

Wildlife Species Use

Areas with year-round surface water provide important habitat for a number of wildlife species. Perennial Freshwater Marsh areas provide habitat for breeding and larval development of amphibians, including California red legged frog, a species covered by this HCP. Freshwater marsh also provides breeding habitat for waterbirds. Species likely to occur in freshwater marsh habitat in the Alameda watershed include marsh wrens (*Cistothorus palustris*) and song sparrows, breeding and roosting red-winged blackbird (*Agelaius phoeniceus*), and possibly tricolored blackbird, a species covered by this HCP.

Feral pigs (*Sus scrofa*) are abundant in the study area. This nonnative species affects wetland habitat by rooting in wet soil. Rooting destroys native vegetation and causes erosion, thereby reducing wetland habitat value for native wildlife.

Key Ecosystem Characteristics

Freshwater Marsh provides a set of functions unique to wetlands. Marsh often occurs in basins or low areas adjacent to stream channels, and so serves a water storage and groundwater recharge function. Aquatic vegetation removes nutrients and toxins from surface water, providing nutrient cycling and water quality functions. Permanent and seasonal wetlands function as breeding habitat for frogs, salamanders, and other amphibians that depend on aquatic environments for reproduction and juvenile development. These wetlands also function as habitat for high levels of insect production, which in turn provides a major food sources for birds, amphibians, and other insectivores. Perennial wetlands are permanent water sources during the dry season in an otherwise arid landscape and thus function as essential habitat for a wide variety of terrestrial as well as water-dependant wildlife species.

Local Distribution and Trends

Prior to lowering the surface elevation of Calaveras Reservoir, there was a large (approximately 50-acre) Freshwater Marsh at the southern end of the alluvial fan of Calaveras Creek. Due to changes in water surface elevation, current reservoir levels do not appear to support Freshwater Marsh. For a regional perspective, large Freshwater Marsh systems were probably rare in central and eastern Alameda, Contra Costa, and Santa Clara Counties. On the other hand, numerous small patches (0.25–10 acres) of Freshwater Marsh were likely associated with the floodplains of most of the perennial streams in the region. Cultivation, flood control, and urbanization along the floodplains of the Bay Area's major streams has led to draining of these marshes and the complete hydrologic disconnection between the marshes and the streams that support them.

Freshwater Seep

Current Conditions

Seeps generally occur at grade breaks or intersections of different subsurface strata where groundwater tends to rise to the surface. In the HCP study area, seeps were observed in grasslands on grassy slopes and at the toes of rolling hills. These features are small and isolated and therefore could not be distinguished from grassland habitat on the aerial photographs. Accordingly, this land cover type was included within nonnative grassland and serpentine bunchgrass

grassland. Freshwater seeps are uncommon in the HCP study area but do occur in small, scattered locations throughout the watershed.

Vegetation Community Profile

Freshwater seeps generally occur in grasslands or meadows where water is permanently near the soil surface, supporting perennial grasses, rushes, sedges, and other wetland species (Holland 1986). Freshwater seeps are associated with serpentine grassland at several locations in the HCP study area and are likely to be present along drainages and other locations. Common species associated with freshwater seeps in the HCP study area include Baltic rush (*Juncus balticus*), toad rush (*Juncus bufonius*), creeping spikerush (*Eleocharis macrostachya*), annual rabbit's-foot grass (*Polypogon monspeliensis*), seep-spring monkeyflower (*Mimulus guttatus*), and bull clover (*Trifolium fucatum*).

In the East Bay Area, 8 special-status plants are recorded in seep habitats, six of which are associated with alkali seeps, and two with freshwater seeps (California Natural Diversity Database 2006). Neither of the two species that occur in freshwater seeps is covered under this HCP. Hospital Canyon larkspur (*Delphinium californicum* ssp. *interius*) occurs in seeps in chaparral along the east slope of the Diablo Range and would not be expected to occur in the HCP study area. Mount Hamilton thistle (*Cirsium fontinale* var. *campylon*) occurs in seeps in serpentine habitats. This species would be highly unlikely to occur in the HCP study area because the study area is outside the species' range.

Wildlife Species Use

Like other aquatic habitats, Freshwater Seep communities provide wildlife species with a source of water for drinking, foraging, and breeding. As they do in other wetland types, feral pigs occupy and degrade freshwater seeps, often diminishing the habitat's utility for other wildlife. Freshwater seeps in the study area that have not been affected by pigs may support reptiles and amphibians such as common garter snake and slender salamander (*Batrachoseps attenuatus*). California red-legged frog and California tiger salamander, species covered by this HCP, could also be supported by freshwater seeps.

Key Ecosystem Characteristics

Ecosystem functions of Freshwater Seep habitats are similar to those of freshwater marsh, except that seeps have a unidirectional water flow and little or no water storage or groundwater recharge function. Because water in seeps is at or near the surface but does not pond, except in small depressions (such as hoofprints), it provides less breeding habitat for amphibians and other aquatic organisms than marsh. In addition, groundwater levels may fluctuate during the year, so that seeps may be wet only seasonally.

Local Distribution and Trends

No data are available on the historic distribution and trends of freshwater seeps in the region. It is likely that many seeps in the region have been lost as a result of extensive conversion of grassland and woodland to cultivated agriculture and urban development.

Aquatic

Streams (Perennial, Intermittent, and Ephemeral)

Streams were not mapped as part of the land cover type mapping conducted during summer 2003. All stream coverages come from USGS datasets and/or datasets developed by SFPUC. For ease of discussion, streams within the HCP study area have been broken down into the following six units (see Figure 3-4).

- Alameda Creek and tributaries in Niles Canyon.
- Alameda Creek and tributaries in Sunol Valley.
- Alameda Creek and tributaries in Sunol Park.
- Upper Alameda Creek above the confluence of Calaveras Creek.
- Above San Antonio Reservoir.
- Above Calaveras Reservoir.

Current Conditions

The HCP study area contains 22 miles of stream containing perennial surface water and 130 miles of stream with intermittent or ephemeral flow (Figure 3-4). The major watersheds that feed San Antonio Reservoir are La Costa, Indian, and San Antonio creeks. La Costa Creek and Indian Creek have intermittent surface flow but may contain isolated pools year-round. San Antonio Creek dries out completely during the summer except in exceptionally wet years (Entrix 2003a).

The major watersheds that feed Calaveras Reservoir (Calaveras Creek, Arroyo Hondo, and Alameda Creek) contain a mixture of intermittent, ephemeral, and perennial drainages. Alameda Creek only feeds Calaveras Reservoir due to the diversion dam; its natural course would not contribute water to the reservoir. Arroyo Hondo appears to maintain perennial surface flow in most years. Calaveras Creek above the reservoir and Alameda Creek above the diversion dam maintain only intermittent surface flow, with much of the stream drying by early summer. In addition to these major drainages, a number of smaller, unnamed, perennial drainages flow into the reservoir from the west.

Community Profile and Key Ecological Characteristics

Unlike the preceding community profiles, this profile focuses on hydrologic conditions and the potential for occurrence of covered species in the six distinct stream units. The key ecological characteristics of each stream unit are presented in the community profile section.

Niles Canyon. The Niles Canyon reach of Alameda Creek extends downstream from the confluence of Alameda Creek and Arroyo de la Laguna to the boundary of the HCP study area (Figure 3-4). Much of this reach is confined by steep upland habitat to the north and south of the channel. The channel form is dominated by a gently sinuous main channel with limited backwaters or oxbows. There are multiple road crossings, including State Route (SR) 84 and active railroad tracks. Large pools, long runs, and relatively short riffles are

characteristic of this predominantly low-gradient reach (Buchan et al. 1999). Substrates range from silt-, sand-, and boulder-dominated pools to gravel and cobble riffles and runs (San Francisco Public Utilities Commission 2003). Dense riparian vegetation dominated by willows is found on both sides of the channel downstream of Sunol Dam. Throughout much of the reach, the edge of the creek is lined with cattails, bulrush (*Scirpus* spp.), bunchgrasses, and extensive beds of water primrose (*Ludwigia hexapetala*) (San Francisco Public Utilities Commission 2003).

The Niles Canyon reach of Alameda Creek supports known populations of California red-legged frog (San Francisco Public Utilities Commission 2003).

Sunol Valley. This reach of Alameda Creek extends upstream from the upstream boundary of the Niles Canyon reach (the confluence with Arroyo de la Laguna) to the Calaveras Road Bridge (Figure 3-4). This reach of Alameda Creek is much less confined than the Niles Canyon reach and flows through a wide alluvial valley. The channel is characterized by a wide and braided form dominated by sand, gravels, and cobbles. A major stretch of this reach, as it flows through the quarries, is confined by high artificial banks and appears to be disconnected from its floodplain during all but the highest flood flows. The Sunol Valley reach supports the largest intact stand of Sycamore Alluvial Woodland in the HCP study area (and perhaps the region). Riparian vegetation in this reach generally consists of scattered sycamores, willows, and mule fat, with regions of dense canopy in more confined areas and relic floodplains.

The wide, braided form of the channel results in long sections with very shallow flow, presenting passage problems at lower flows. Because of the characteristics of the riparian canopy and the width of the channel, this reach experiences more solar exposure and ambient warming than other reaches. Water temperatures in the upstream portion of this reach average approximately 63.5°F (17.5°C), with average daily fluctuations of 4.5°F (2.5°C) (San Francisco Public Utilities Commission 2002). This section of Alameda Creek is largely without water during the dry season (Trihey & Associates 2001b).

Calaveras Dam and the Alameda Creek Diversion Dam both limit sediment transport from the steep, erodible, upstream portions of the watershed to the Sunol Valley. These structures represent major traps to coarse sediment but allow passage of fines such as silt and clay. Consequently, any coarse sediments deposited in this reach are derived from Alameda Creek downstream of the diversion or from lower Calaveras Creek. This lack of natural sediment appears to be causing channel incision and bank erosion.

The Sunol Valley reach plays a potentially important role in hydrologic and geomorphic processes in adjacent reaches. Early photographs indicate that the channel of Alameda Creek in Sunol Valley was characterized by a braided, alluvial channel; however, the braids were relatively stable and lined with sycamore trees. The low banks provided a large flood-prone area that enhanced both sediment storage and groundwater recharge (Collins pers. comm.). Present-day land uses have influenced these processes by isolating the stream in a narrow

leveed channel and lowering groundwater levels through reduced recharge or direct pumping. Large amounts of sediment generated in the upper Alameda watershed, particularly fine sediments, are more easily transported through the Sunol Valley and contribute to deposition in downstream reaches (Collins pers. comm.). Reduction of groundwater levels in the Sunol Valley has the potential to influence subsurface flows downstream into Niles Canyon with potential impacts on both flow and water temperature during the summer dry season. California red-legged frogs have been observed directly below the dam adit tower in San Antonio Creek, which has its confluence with Alameda Creek in Sunol Valley (Koopmann pers. comm.). California red-legged frogs have also been observed downstream of the dam spillway, just before the confluence with San Antonio Creek (Sak pers. comm.).

Sunol Park. This small reach extends upstream from the Calaveras Road Bridge to Alameda Creek's confluence with Calaveras Creek (Figure 3-4). This reach is more confined than the Sunol Valley reach. Most of this reach has dense riparian cover and a deep, single channel. An intergrading mosaic of Sycamore Alluvial Woodland, White Alder Riparian Forest, Willow Riparian Forest/Scrub, and Coast Live Oak Riparian Forest dominates the riparian vegetation in this reach. Hydrology is strongly influenced by operations of Calaveras Reservoir and the Alameda Creek Diversion Dam. SFPUC is planning a streamflow augmentation project to enhance conditions for native trout and native warm-water fish populations by reducing water temperature (Trihey & Associates 1998). Releases from Calaveras Reservoir would provide cool-water high summer baseflow habitat in the upper part of the reach, transitioning to warm-water high baseflow conditions farther downstream. Releases would be recaptured by an inflatable diversion structure near the existing water treatment facility. Average daily water temperatures in this reach range from 64°F to 67.3°F (17.8°C to 19.6°C), with average daily fluctuations of 3.2°F to 15.5°F (1.8°C to 8.6°C) (San Francisco Public Utilities Commission 2002).

Although a substantial body of information regarding water quality and aquatic habitat has been developed for this reach over the past decade, there appears to be a dearth of information regarding historic conditions. Nonetheless, because the hydrology and biology of this reach are controlled by the steep bedrock canyon it flows through, it can be inferred from the geology that this reach likely supported perennial surface flow and deep, cold-water pools. Perhaps the key difference in this reach between current and historical conditions would be a major shift in the composition, distribution, and density of riparian vegetation. Today, peak flow events are generally contained behind Calaveras Dam and Alameda Creek Diversion Dam, resulting in a diminished capacity for scour and mechanical vegetation removal. The current conditions in this reach reflect this controlled hydrology by supporting a dense riparian corridor that borders the low-flow channel throughout much of its length. Pre-dam hydrology with regular high flow events and the related scour would have likely resulted in a more dynamic and patchy assemblage of riparian vegetation.

Upper Alameda Creek above the Confluence of Calaveras Creek. This reach extends from the Calaveras Creek confluence to the headwaters of Alameda

Creek (Figure 3-4). The creek is confined to a single channel through the deep canyon between Calaveras Creek and Little Yosemite Falls. Upstream of the falls, the canyon becomes wider and the creek flows through multiple channels across its cobble- and gravel-dominated floodplain. Sections of creek in this reach include long gravel and sand-bedded runs, steep boulder step pools and falls, and wide cobble-bedded floodplains.

The Upper Ohlone reach (upstream of the Alameda Diversion) has relatively pristine hydrology with no influence of water supply projects. Grazing and private wells are the only potential source of alterations to hydrologic conditions. The Alameda Creek Diversion Dam prevents upstream fish migration past this point and on into the headwaters and significantly influences the flow regime downstream. Water temperature in pools in this reach during mid-day in late September 1999 ranged from 59°F to 71°F (15°C to 21.5°C). Daily water temperature about 500 feet upstream of the confluence with Calaveras Creek averaged 51.6°F (10.9°C) in 2001, with an average daily fluctuation of 7.6°F (4.2°C) (San Francisco Public Utilities Commission 2002). Thermal stratification of 4°F to 5°F (2°C to 3°C) was present in deeper pools (1.5 feet or more) and may be indicative of the influence of subsurface flows. In early October 1999, there was no flow and few if any residual pools upstream of Valpe Creek. Abundant foothill yellow-legged frogs are found in this reach of Alameda Creek (Sak pers. comm.).

Above San Antonio Reservoir. This unit comprises three main creeks: San Antonio Creek, La Costa Creek, and Indian Creek. Much of the stream length of these creeks is dominated by seasonal flow and narrow riparian corridors. Riparian vegetation includes limited stands of Sycamore Alluvial Woodland and Willow Riparian Forest/Scrub. The channels all appear to be incised and contain coarse substrates dominated by gravels and cobbles. Because there are no major upstream impediments to sediment delivery, these systems experience generally natural regimes of sediment conveyance and deposition. All three subwatersheds are grazed by domestic livestock, but riparian fencing has recently been installed on portions of Indian and La Costa Creeks to reduce the potential impact of livestock on the stream and its associated riparian cover (Koopmann pers. comm.).

Above Calaveras Reservoir. This unit includes Calaveras Creek, Arroyo Hondo, and a few smaller tributaries such as Smith Creek and Isabel Creek. Arroyo Hondo is the largest tributary of Calaveras Reservoir and maintains perennial flows throughout much of its length. The channel runs through a steep canyon and is confined by bedrock in many places. The channel bed is dominated by coarse sediments such as gravels, cobbles, and boulders. This creek experiences substantial shading because of the steep slopes and dense riparian cover. Riparian cover includes large stands of White Alder Riparian Forest along the stream banks intergrading with Central Coast Live Oak Riparian Forest upslope. Near its headwaters, Arroyo Hondo experiences some dry-back conditions during the summer, but it supports isolated cold-water pools throughout the year. Calaveras Creek is an intermittent stream along much of its length. The narrow creek canyon opens into a wide alluvial fan as it drains into Calaveras Reservoir. The stream substrate is similar to that in Arroyo Hondo.

Both streams experience natural sediment conditions because neither contains major upstream impediments.

Pond

Current Conditions

This category includes stock ponds, natural ponds, irrigation ponds, and golf course ponds. This category does not include ponds associated with mining operations (see quarry ponds). During the aerial photograph land cover mapping, Jones & Stokes biologists identified 175 ponds totaling almost 44 acres in the HCP study area; of these 175 ponds, 130 are on SFPUC lands. These ponds ranged from small (0.01–0.1 acre) seasonal ponds with limited emergent vegetation to large (up to 3.3 acres) perennial ponds with varying degrees of emergent and submergent vegetation. Jones & Stokes surveyed 68 of the 174 ponds in the study area (64 of which were on SFPUC lands) to determine their suitability to support covered species (Figure 3-2). A description of the methods and results for the pond survey is provided in *Habitat Assessment of Ponds* later in this chapter.

Vegetation Community Profile

The pond community is composed of emergent and margin vegetation dominated by cattails, tules, rushes (*Juncus* spp.), and other sedges (*Scirpus* spp.). These plants are generally found along the margins of ponds as emergent vegetation. Willows and giant cane (*Arundo donax*) are often found on the margins of perennial ponds with limited grazing pressure. The pond community may also contain a submergent vegetation component. The most common submergent plant observed in pond in the HCP study area was Eurasian milfoil (*Myriophyllum spicatum*).

Wildlife Species Use

Like other aquatic land cover types, ponds are important because they provide drinking water, foraging habitat, breeding habitat, and resting habitat for a variety of wildlife. Both stock and natural ponds provide essential habitat for four covered species: California tiger salamander, red-legged frog, western pond turtle, and tricolored blackbird. Western pond turtle is found in perennial ponds year-round and occurs in adjacent upland habitat during nesting. Tricolored blackbird relies on vegetation associated with this land cover type (cattails and bulrush) for nesting.

Common wildlife associated with this land cover type include garter snake, a variety of ducks, both wading and shore birds, and large mammals that use ponds for drinking water. Water sources such as ponds attract many birds that are normally found in the adjacent grasslands; for example, California quail, mourning dove, and barn and cliff swallows (*Hirundo rustica* and *H. pyrrhonota*) all require daily water and are known to use ponds as water sources.

In addition to these species, nonnative bass (*Micropterus* spp.) and bullfrog (*Rana catesbeiana*) are common and often prevalent wildlife species in perennial ponds. Bass (*Morone* spp.) and bullfrog (*Rana catesbeiana*) are known to deplete special status California red-legged frog and California tiger

salamander; consequently the presence of bullfrogs and bass limits the opportunity for success of these covered species.

Key Ecosystem Characteristics

Because most ponds are located in valley bottoms or on streams, they play an important role in sediment storage until they become full and can hold no more sediment. Fine sediments eroded from upstream sources are suspended in flowing water and deposited in slow-moving lentic environments common to ponds. These fine sediments form an ideal substrate for colonization by emergent vegetation such as cattails and tules.

Perennial and seasonal ponds often represent the only available standing water source for livestock during the summer drought. Heavy livestock use can degrade ponds quickly, leading to loss of emergent vegetation and eutrophication from increased nitrogen contributed by cattle urine.

Local Distribution and Trends

The natural topography, geology, and hydrology of the Bay Area are not conducive to the creation of numerous natural ponds. The vast majority of ponds have been developed as water sources for livestock. As development pressure results in conversion of active rangelands to urban land cover, ponds may disappear from the landscape or be lost because of lack of maintenance (i.e., silt removal).

Reservoir

Current Conditions

The reservoir land cover type covers 2,216 acres (4.75%) of the HCP study area. The two major reservoirs in the HCP study area, San Antonio and Calaveras, comprise the entirety of this land cover type. San Antonio Reservoir, impounded by the James H. Turner Dam, was constructed in 1964 and is located 1.5 miles upstream of San Antonio Creek's confluence with Alameda Creek. San Antonio Reservoir can store approximately 50,500 af of water from a number of sources, including the upper watershed, the Hetch Hetchy aqueduct, and the SWP. Calaveras Reservoir was completed in 1925 and is located on Calaveras Creek, 0.8 mile upstream of its confluence with Alameda Creek. This reservoir is currently maintained at 30% of capacity because of seismic concerns. At full capacity, this reservoir can store approximately 96,900 af of water.

Vegetation Community Profile

Vegetation within the reservoir is limited by reservoir fluctuations and steep, rock-lined banks. It is not uncommon for algal growth to increase in reservoirs during the warm summer months. Algal growth is generally controlled with treatments of a copper-sulfate-based algaecide. The high-water line of the reservoirs is generally characterized by an abrupt change from unvegetated banks to the natural vegetation community that existed before the reservoir was built. The southern end of Calaveras Reservoir has historically supported a wide freshwater marsh on the gently sloping fan of Calaveras Creek. Due to the current (approximately 30% capacity) reservoir level, the appropriate gradient to support freshwater marsh has been virtually eliminated, resulting in a grassland

dominated by ruderal species. Reservoirs in the HCP study area support dense stands of riparian vegetation near the mouths of the tributaries that spill into them. Examples of this include lower San Antonio Creek and Indian Creek.

Wildlife Species Use

Reservoirs can be important habitat for various ducks, including mallard (*Anas platyrhynchos*), green-winged teal (*Anas crecca*), cinnamon teal (*Anas cyanoptera*), gadwall (*Anas strepera*), American widgeon (*Anas americana*), and American coot (*Fulica americana*). Birds of prey, such as bald eagle, and osprey (*Pandion haliaetus*) depend on reservoirs and other large bodies of water (e.g., Lake De Valle) for foraging habitat. Where the fringes of reservoirs are vegetated, they can also function as habitat for amphibians such as California red-legged frog and reptiles such as western pond turtle. Large mammals also use Reservoir habitat for a permanent source of drinking water.

Key Ecosystem Characteristics

The dams of both the San Antonio and Calaveras Reservoirs present complete migration barriers for fish and therefore play a key role in fragmenting fish habitat in the HCP study area. The reservoirs are also enormous sediment sinks. Because the vast majority of all coarse sediments transported from the upper reaches of the watershed are trapped in the reservoirs, downstream reaches tend to be sediment starved and may have a tendency to downcut or erode and deepen. Another important characteristic of these reservoirs is that they have the potential to release water during the summer and fall to augment dry season base flows currently depleted by downstream groundwater extraction and water table disruption.

Local Distribution and Trends

There are no current plans to build large (>25,000 af) new reservoirs in the greater Bay Area. However, SFPUC is currently developing plans to either replace Calaveras Reservoir at its current as-built capacity (approx 96,000 af) or expand it to a capacity of more than 400,000 af. In addition, Contra Costa Water District plans to enlarge Los Vaqueros Reservoir in Contra Costa County.

Quarry Pond

Current Conditions

Land cover mapping from 2001 aerial photographs indicate that there are 10 quarry ponds totaling 96 acres in the HCP study area. Although the precise number and acreage of quarry ponds mapped depends heavily on which depressions contain water during the aerial photo fly-over, it is clear that some of these ponds do in fact function as permanent aquatic features. All the quarry ponds in the study area are located in the Sunol Valley.

Vegetation Community Profile

The majority of quarry ponds lack vegetation because of a number of factors, including frequent fluctuations in water level, high levels of turbidity, and steep slopes. Quarry ponds that maintain constant water levels or that have been removed from active use (i.e., are fallow) have vegetation associations similar to

those of other ponds. They may have a dense cover of tules, cattails, or willows along the pond margins, with limited emergent vegetation in the deeper interior sections.

Wildlife Species Use

The age and size of a quarry pond influences its biological productivity and potential to support wildlife. Like other aquatic resources, reclaimed or late-stage quarry ponds may provide foraging and resting habitat for a variety of wildlife species. These late-stage quarry ponds can support fish, waterfowl, and invertebrates. However, because the quarry ponds in the HCP study area are in use and are subject to high levels of turbidity and extreme fluctuations in water level, they do not support habitat for wildlife.

Key Ecosystem Characteristics

Quarrying operations for sand, aggregate, and gravel in the study area are located on wide alluvial floodplain terraces. Accordingly, development of quarry ponds can have a profound effect on the local hydrologic cycle and associated stream habitat and biota. The quarry ponds in the Sunol Valley tend to be deep and appear to be dug well below the depth of the local water table. Thus, these ponds may lower the local water table, reducing groundwater inputs into the stream and reducing available soil moisture for riparian plants. The effects of this hydrologic alteration may be compounded by groundwater intercepting and collecting in the quarry pond before it reaches the stream channel. Lowered local groundwater levels would also affect the stream by increasing surface water losses to groundwater during the dry season.

Local Distribution and Trends

Quarry ponds are the result of mining operations and are used to store water pumped from active mines. Although Alameda County's Measure D prohibits new mining on County lands, there are two potential plans to develop new mines in the HCP study area. These plans include development of a mine on private property on Apperson Ridge and SFPUC granting a lease for new mining operations in Sunol near the junction of Interstate 680 (I-680) and SR 84. In addition, many of the mines and associated ponds currently in operation in the HCP study area are nearing the end of production and will be reclaimed for other uses during a 50-year transition. This reclamation will generally result in redevelopment of quarry ponds to other land cover types.

Developed and Cultivated

Disturbed/Developed

Current Conditions

Urban developed land cover types occupy approximately 536 acres (1.1%) of the study area. These areas consist mostly of quarries (excluding ponds discussed above), rural residences, SFPUC facilities, highways, and associated farming facilities.

Vegetation Community Profile

Most of the developed areas are not extensively landscaped and support predominantly ruderal (weedy) vegetation. Dominant plant species include nonnative annual grasses such as ripgut brome (*Bromus diandrus*) and other invasive weedy species such as cheeseweed (*Malva parviflora*), Mediterranean mustard (*Hirschfeldia incana*), and thistle (*Cirsium* spp.). Golf courses are an exception because they are extensively landscaped with nonnative turf grasses and ornamental trees and shrubs.

Wildlife Species Use

Wildlife in urban developed areas consists mostly of birds and rodents that are adapted to disturbed habitats. Typical bird species found in the urban landscape include the American robin (*Turdus migratorius*), Northern mockingbird (*Mimus polyglottos*), American crow (*Corvus brachyrhynchos*), and house sparrow (*Passer domesticus*). These species are typically opportunistic foragers that are highly tolerant of human activity. Some wildlife species are abundant in the ruderal areas where there is no disturbance from tilling and pest control measures. This is especially true for burrowing mammals such as California ground squirrels. Western fence lizards and gopher snakes, which often use mammal burrows for cover, are also more common in these urban areas.

Key Ecosystem Characteristics

Ecosystems in the urban disturbed land cover type provide limited wildlife and water quality functions. In fact, urban disturbed areas generally contain a large amount of impervious surfaces, which reduce groundwater recharge and increase surface runoff rates, peak flows, and inputs of contaminants into surface water sources.

Local Distribution and Trends

As population pressure increases, the amount of urban developed lands increases. Potential CIPs on SFPUC lands will nominally increase the future acreage of this land cover type in the HCP study area. Moreover, expansion of mining operations in Sunol and on Apperson Ridge would also increase the acreage of this land cover type in the HCP study area.

Cultivated Agriculture

Current Conditions

The cultivated land cover type occupies approximately 379 acres (0.81%) of the HCP study area. The most common type of cultivated agriculture in the HCP study area is dry farming of hay. Typical farming practices involve seed drilling in rows, which produces up to 100% canopy cover in productive stands (Mayer and Laudenslayer 1988). Irrigated agriculture in the HCP study area is currently limited in scope. This land cover type does not include nursery production.

Vegetation Community Profile

Because of high (approaching 100%) canopy cover of cultivated crops, the profile of this land cover type is generally monotypical, or represented by a single crop species in any given area.

Wildlife Species Use

Dryland crops are usually established on fertile soils that have historically supported a variety of wildlife (Mayer and Laudenslayer 1988). Although grain cropland cover supports reduced wildlife habitat richness and diversity for native species, it does support a greater variety of wildlife species than traditional irrigated agricultural land cover (e.g., vineyards, orchards). Short-grass habitat associated with dryland grain production is compatible with foraging by raptors such as western burrowing owl, a species covered in this HCP. During winter, this type of agricultural land also provides important foraging and roosting habitat for wintering waterfowl.

Key Ecosystem Characteristics

Because the majority of cultivated lands in the HCP study area are currently under dryland production, the ecosystem characteristics are similar to those of annual grassland. The major exception is that nutrient-rich seeds and dry thatch are removed from the system after harvest. Removal of all the biomass reduces post-harvest wildlife value and often leaves fallow land susceptible to erosion during early rains before seedlings have become established.

Local Distribution and Trends

Current production figures cite 3,520 harvested acres of dryland crops in Alameda County, down from nearly 25,000 acres in the 1950s (Alameda County Community Development Agency 2002; Banke pers. comm.). Although dryland crops are generally planted in the fall and harvested in the spring, inter-annual production varies significantly depending on the market value of specific crops. In the rolling hills of Alameda and Santa Clara Counties, common cropping techniques consist of an alternation between crop production and fallow grazed rangeland, depending on market conditions (Huff pers. comm.). Additional future trends in cultivated agriculture include the potential for expansion of irrigated agriculture. Efforts are currently underway to assess the feasibility of bringing reclaimed water into the Sunol Valley for development of irrigated agriculture.

Turf

Current Conditions

The Turf land cover type includes developed parks and golf courses that support irrigated lawns and horticultural plantings. In the HCP study area, the only Turf is found on the Sunol Valley Golf Course (215 acres).

Vegetation Community Profile

Turf is dominated by nonnative and planted turf grasses. In general these grasses have a short stature and spread by means of rhizomes (aboveground roots). Turf is irrigated during the dry season and thus stays green year-round. Maintenance of turf generally requires the use of chemical fertilizers and herbicides.

Wildlife Species Use

The Sunol Valley Golf Course has a high concentration of golf course ponds that could be used by amphibians and waterfowl for both breeding and resting. Turf

surrounding these ponds may provide limited foraging habitat for waterfowl and dispersal habitat for amphibians.

Turf provides limited habitat for special-status wildlife. Both California red-legged frog and California tiger salamander could enter turf areas during wet season dispersal but the combination of rodent control and regularly mowed grass reduces the likelihood that they will succeed in this land cover type.

Key Ecosystem Characteristics

The key ecological characteristics of Turf are related to the regular mowing of the grass, year-round irrigation, and regular use of chemicals. Because mowed clippings are removed from the site, there is a net loss of nutrients from the site that must be replenished through artificial fertilizer. Regular watering leaches these fertilizers, as well as any pesticides or herbicides, into the groundwater, creating the potential for contamination of local water sources. The Sunol Valley Golf Course is situated on the banks of Alameda Creek, which increases the potential for chemicals applied to the turf to enter the stream.

Local Distribution and Trends

The Turf land cover type has seen rapid expansion in the region over the past 50 years as golf courses, parks, and residential lawns expand. As of January 2004, there are at least 75 golf courses in Contra Costa, Alameda, and Santa Clara Counties (Bay Area Golf Map 2001).

Nursery

Current Conditions

The Nursery land cover type occupies approximately 177 acres (0.38%) of the HCP study area. Acreage estimates include lands currently in production and lands with existing nursery infrastructure that are not currently in operation. Nursery production in the study area is limited to the Sunol Valley.

Vegetation Community Profile

Nurseries in the HCP study area are generally devoid of non-commodity vegetation. In-soil nursery production involves application of herbicides to eliminate competition for resources, while greenhouse and container nurseries are developed on bare ground or pavement.

Wildlife Species Use

Because the plants in a nursery are potted and placed on paved surfaces, grown in greenhouses, or grown in sterile beds, vegetation in a nursery is generally not directly connected with soil or water resources, and therefore is not integrated into the local ecosystem. Moreover, nursery systems are often heavily managed and may be treated with pesticides, herbicides, and chemical fertilizers, further reducing ecological value of this cover type. Therefore, this land cover type does not provide valuable wildlife habitat, other than temporary refuge for birds.

Key Ecosystem Characteristics

Container plants, greenhouse plants, and plants in sterile beds do not function as an integrated component of an ecosystem. Without contact with local soil and water resources there is little opportunity for ecosystem processes such as cycling of nutrients or providing habitat for soil invertebrates. This land cover type functions similarly to the urban developed land cover type in that both are associated with impermeable surfaces and can have a substantial impact on local hydrology. In the HCP study area, nurseries are located on the Alameda Creek floodplain, often within 50 or 100 feet of the active stream channel. Thus, if not managed properly, the potential effect of increased impervious surfaces and runoff contaminated with pesticides and chemical fertilizers could have profound impacts on the ecological health of the creek.

Local Distribution and Trends

Alameda and Santa Clara Counties once supported a thriving nursery industry. Today, the nurseries in the Sunol Valley and Fremont are the last remnants of this economy.

Covered Species

Introduction

To determine the species covered by the Alameda Watershed HCP, a comprehensive list of 152 special-status species (Appendix E) that occur or may occur in the study area was compiled on the basis of information available from the sources listed below.

- Search of the CNDDDB Rarefind Version 3.0.5 for the Niles, La Costa Valley, Mendenhall Springs, Milpitas, Mountain View, Calaveras Reservoir, Mt. Day, San Jose West, San Jose East, Newark, Altamont, and Livermore USGS 7.5-minute quadrangles (2006).
- *Inventory of Rare and Endangered Vascular Plants of California* 6th edition (California Native Plant Society 2001).
- DFG Special Animals and Special Plants lists (California Department of Fish and Game 2003);
- Informal consultation with USFWS (letter request found in Appendix K).
- Personal communication with local experts.
- A review of relevant literature, including the *Alameda Watershed Management Plan* (EDAW 2001) and the plan DEIR (San Francisco Planning Commission 2000).

Definition of Special-Status Species

Special-status species are plants and animals that are legally protected under the federal ESA, the California ESA (CESA), or other regulations, and species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status plants are species in one or more of the following categories.

- Listed or proposed for listing as threatened or endangered under the federal ESA (50 Code of Federal Regulations [CFR] 17.12 [listed plants] and various notices in the Federal Register [FR] [proposed species]).
- Candidates for possible future listing as threatened or endangered under the federal ESA (66 FR 54808, October 30, 2001).
- Listed or candidates for listing by the State of California as threatened or endangered under CESA (14 CCR 670.5).
- Listed as rare under the California Native Plant Protection Act (California Fish and Game Code, Section 1900 et seq.).
- Determined to meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380).
- Considered by the California Native Plant Society (CNPS) to be rare, threatened, or endangered in California (Lists 1B and 2 in California Native Plant Society 2001).
- Considered by CNPS to be plants about which more information is needed to determine their status and plants of limited distribution (Lists 3 and 4 in California Native Plant Society 2001), which may be included as special-status species on the basis of local significance or recent biological information.

Special-status animals are species in one or more of the categories listed below.

- Listed or proposed for listing as threatened or endangered under the federal ESA (50 CFR 17.11 [listed animals] and various notices in the FR [proposed species]).
- Candidates for possible future listing as threatened or endangered under the federal ESA (66 FR 54808, October 30, 2001).
- Determined to meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380).
- Listed or candidates for listing by the State of California as threatened or endangered under the CESA (14 CCR 670.5).
- Species of special concern (SSC) to California Department of Fish and Game 2003 (CDFG) and the Point Reyes Bird Observatory 2001 (birds) and Special Animals list CDFG (amphibians, reptiles, and mammals).

- Fully protected under California Fish and Game Code Section 3511 (birds), Section 4700 (mammals), Section 5515 (fish), and Section 5050 (reptiles and amphibians).

Covered Species Criteria

Information was compiled on the status, population trends, distribution, threats, and conservation and management efforts for each special-status species with potential to occur in the study area. The following criteria were then applied to each species to determine whether SFPUC should seek coverage (i.e., inclusion in the final permits) under the HCP. In order for SFPUC to seek coverage, a species had to meet all four of the following criteria.

1. **Occurrence:** The species is known to occur or likely to occur based on the extent, quality, and distribution of suitable habitat within the HCP study area, based on credible evidence.
2. **Status:** The species is currently listed under ESA or CESA or is expected to be listed within the permit term (assumed to be 30 years). Species that are expected to be listed within the permit term include species that are:
 - a. proposed for listing under ESA,
 - b. candidates under CESA,
 - c. candidates under ESA, or
 - d. California fully protected species or specified birds listed in the California Fish and Game Code; as well as some species that are:
 - California species of special concern (CSC);
 - CNPS List 1A, List 1B, or List 2;
 - unlisted and known by experts to be very rare (e.g., newly discovered species) or declining rapidly; or
 - unlisted and not rare but the covered activities may affect a substantial portion of the species' range or important habitat.
3. **Impact:** The species will likely be adversely affected by covered activities or projects. *Affected* includes activities considered *take* under ESA, which is defined as “an action or attempt to hunt, harm, harass, pursue, shoot, wound, capture, kill, trap, or collect a species.”²
4. **Data:** Sufficient data exist on the species' life history and habitat requirements to adequately evaluate impacts on the species and to develop conservation measures to mitigate these impacts to regulatory standards.

² Because CESA has a weaker definition of take than ESA, only the ESA definition is applied as a criterion.

Species Evaluation

Tables 1-2a and 1-2b summarize the criteria that were met by each of the 152 species. Using these criteria, seven plant and nine wildlife species were selected for potential coverage under the Alameda Watershed HCP. Seven of these species are currently listed; the others are unlisted but have the potential to be listed within the assumed 30-year permit term. Table 3-3 presents the list of the 16 species proposed for coverage in the HCP.

Fish were initially considered for coverage under this HCP but were subsequently excluded when it was determined that endangered species compliance would be better achieved in a regional HCP process focused on fish.

Species Profiles

Detailed species profiles are provided in Appendix D for the 16 covered species. The species profiles summarize basic ecological information, distribution, status, threats, population trends, and known occurrences in and near the study area. In addition, distribution maps displaying the known range of covered species accompany the profiles. Representative profiles also include descriptions and results of any field surveys and of species habitat distribution models that were developed for selected species (described below). Each profile is designed for easy reference, and literature cited is provided at the end of each profile. The basic biological data in these profiles form the basis for the impact analysis (Chapter 4) and conservation strategy (Chapter 5) in this HCP.

Land cover types are the basic unit of evaluation for modeling habitat, analyzing potential impacts, and developing conservation strategies for covered species. Each covered species is associated with one or more land cover types (Table 3-4). These land cover type associations and other habitat features were used to develop species habitat distribution models for all of the covered species.

Species Habitat Distribution Model Maps

Descriptions of species habitat models are included in the profiles for selected species (Appendix D). The purpose of the species-habitat models is to identify areas within the study area where covered species occur or could occur based on known habitat requirements. These models are used to quantify impacts from covered activities on covered species. The models are also used to develop conservation measures for each covered species. Alternative restoration designs are evaluated against each covered species model to ensure that regulatory standards and biological goals for each species are met and that conservation for each is maximized. A summary of the modeling results for suitable habitat for all modeled species is presented in Table 3-5.

Model Structure and Methodology

The species habitat models described in the species profiles were designed to estimate the location of key habitat characteristics of each species, as well as to be repeatable and scientifically defensible, while remaining as simple as possible.

The models are based on identification of land cover types that provide important habitat for these species (Table 3-4). For each species, land cover types were identified as suitable habitat on the basis of known or presumed habitat requirements and use patterns. When supported by data, the models were refined by physical parameters such as elevation limits. In some cases, perimeter zones were used to designate habitat use a certain distance from a land cover type. For example, California red-legged frog uses upland habitat for aestivation and dispersal, but the probability of use decreases with increasing distance from suitable breeding sites (i.e., ponds and streams). For wildlife, land cover types considered suitable habitat were classified by habitat use. Where appropriate, land cover types used for breeding were designated as core use areas. Other important habitats that may or may not include the core areas are foraging and aestivation areas and migration, movement, or dispersal corridors.

Determinations of suitable land cover types and additional physical parameters were based on available data from survey reports, environmental documents, consultation with scientific experts, and peer-reviewed scientific literature. When data were inconclusive or contradictory, conservative values were assumed to estimate suitable habitat. Data sources used for plant model development included the CNDDDB (2003), *The Jepson Manual* (Hickman 1993), and CNPS (2001). See the wildlife profiles for a complete accounting of all data sources by species.

Habitat Assessment of Ponds

Understanding how pond habitat suitability for covered species varies over the HCP study area is important for identifying key conservation areas, developing restoration priorities, and estimating the level of take that is likely to result from covered activities. The field team collected data on 68 of the 175 ponds distributed across the HCP study area (64 of the 130 ponds on SFPUC land) (Figure 3-2). The surveyed ponds represent 39% of the ponds within the study area and 53% of ponds on SFPUC land. Approximately 70% of the total area of pond habitat in the HCP study area was covered in this assessment. Table 3-6 summarizes the statistical analysis for this assessment.

Methods

This section describes the methodology used to determine habitat suitability for all ponds surveyed within the Alameda watershed. Ponds were assessed for their suitability to support California red-legged frog, California tiger salamander, western pond turtle, and tricolored blackbird. Biologists ranked each pond for suitability on the basis of key discriminators specific to the four species (Table 3-7). The results indicate if a pond is considered suitable or not suitable for population persistence. Ponds that are suitable for population persistence are considered primary habitat for the subject species; those ponds that are not suitable for population persistence are considered secondary habitat.

Hall et al. (1997) suggest that habitat quality or suitability is a continuous variable that ranges from low to high, where low suitability describes habitat with resources available only for survival of individuals, median suitability describes habitat with resources available to support reproduction, and high

suitability describes habitat capable of supporting population persistence. This definition of habitat suitability provides a conceptual framework for ranking ponds within the HCP study area; however, its practical use is limited here because the collection of demographic data (e.g., survival, reproductive success) for covered species is beyond the scope of the HCP. In this analysis, habitat suitability is expressed as the relative likelihood of presence or persistence of a species based on the presence and quality of habitat characteristics known or hypothesized to affect presence or persistence. For California red-legged frog, California tiger salamander, western pond turtle, and tricolored blackbird, each pond was assigned one of three rankings.

- 0 = not suitable. The pond is not likely to support the species due to a lack of habitat elements required by the species.
- 1 = low to moderate suitability. The pond habitat includes elements that could support individuals; however, successful reproduction and/or population persistence is less likely due to suboptimal habitat and/or the confirmed presence of predators.
- 2 = high suitability. The pond habitat includes a combination of characteristics that are typically suitable for supporting breeding populations.

A stepwise procedure was used to assign a suitability ranking to each pond. First, each pond was assigned *a priori* a ranking of 2 for each species. Survey data from each pond was then examined and used to determine whether this initial ranking was appropriate or whether the rank should be lowered.

Although several variables were measured or estimated at each pond during the field survey, only a subset of these variables was used to discriminate habitat suitability among ponds across species. Each ranking is a hypothesis of habitat suitability based on professional opinion and the known life history requirements of each target species. Rankings were not developed or supported using species presence/absence or demographic data (i.e., criteria used to rank the suitability of each pond were not based on frequency distributions of microhabitat attributes measured at locations used by the target species). The ranking variables are summarized in Table 3-8. After each pond was ranked on the basis of survey data, representative photographs of each pond taken during the field survey were examined to confirm or refine these rankings and provide a qualitative validation.

Results

All surveyed ponds were considered suitable habitat for California red-legged frog and California tiger salamander, 72% were considered suitable for western pond turtle, and 26% were considered suitable for tricolored blackbird. Habitat suitability may be overestimated, particularly for California red-legged frog and California tiger salamander. Each of these species is sensitive to the presence of predators (e.g., bullfrogs, fish), and the presence of predators may be the single most important variable that determines their presence and persistence in otherwise suitable conditions. Although the presence of predators was noted incidentally during the pond surveys, and this information was used to assign suitability rankings to each pond, comprehensive surveys for predators were not

conducted. Therefore, it is likely that more ponds support predators than were identified in this analysis. Results of pond suitability ranking across species are summarized in Table 3-8 and are indicated in the species habitat distribution models. A detailed analysis of the pond suitability data and the methodology used to link these data with the habitat distribution models is provided in each species' profile (Appendix D).

Covered Species Locations

Documented occurrences of covered species within the study area were used to validate and refine the models. The following sources of occurrence data were used.

- California Natural Diversity Database.
- Data from previous studies of species distribution in the area.
- Occurrence records provided by SFPUC.

Individual occurrences that fell outside a model's predicted habitat distribution were evaluated separately to determine whether they indicated flaws in the model or were anomalous points. The original aerial photos were examined to try to explain serious outlier points.

The majority of the records come from the CNDDDB. These records represent the best available statewide data but are limited in their use for conservation planning. CNDDDB records rely on field biologists to voluntarily submit information on the results of surveys and monitoring. As a result, the database is biased geographically toward areas where surveys have occurred or survey effort is greater, and many areas have not been surveyed at all. The database may also be biased taxonomically toward species that receive more survey effort. For example, there have been more surveys for California red-legged frog than other special-status wildlife because it is a listed species. Conspicuous diurnal species such as raptors likely receive greater survey effort than nocturnal species such as bats. Plants typically receive less survey effort than wildlife.

Model Limitations

The precision of the species distribution models is limited by the mapping unit of the coarsest data used for the modeling. For certain species, the land cover types map (1-acre minimum) will represent the coarsest data, and for other species the resolution of the digital elevation model (10-meter grids) will be a limiting factor for precision. Areas of suitable habitat smaller than the mapping thresholds were not mapped and therefore could not be incorporated into the models. This constraint limited the degree of resolution of some habitat features potentially important to some species.

The species distribution models distinguished habitat by key life history requirements, such as breeding, foraging, or dispersal, that are tied to land cover types. For species associated with ponds—California red-legged frog, California tiger salamander, tricolored blackbird, and western pond turtle—the models were refined on the basis of field surveys of a large sample of ponds (see discussion of these methods above). Similarly, the model for Alameda whipsnake was refined

on the basis of field reconnaissance of the species' habitat and specialized knowledge of the species' habitat requirements. For all other covered species, the data did not allow for further distinctions of habitat quality. For example, California red-legged frogs disperse from breeding sites as their ponds or streams dry out during the summer. The movement corridors used by individuals may follow moisture gradients and associated wetland and/or swale vegetation. Including these features in the models was not possible. Accordingly, conservative estimates of movement/dispersal habitat requirements were used. This procedure will overestimate the actual extent of suitable or required habitat for this species, but is consistent with current conservation planning practices when data are limited (Noss et al. 1997).

Because of these limitations, models could not be developed for all covered species. For some species, available location data and the resolution capacity of the modeling procedure were insufficient to precisely identify potential habitat (e.g., Townsend's western big-eared bat).

3.5 References

3.5.1 Printed References

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3.5.2 Personal Communications

Banke. Personal Communication

Collins, Laurel. 2003. Fluvial geomorphologist, Watershed Sciences, Berkeley, California. September 2003—Personal communication.

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Huff. Personal Communication

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Sak, Brian. 2003. Biologist. SFPUC. December 10, 2003—Email.

Swaim, Karen. Wildlife Biologist, Swaim Biological Consulting, Livermore, CA. January 9, 2003—Telephone conversation. April 21, 2004—E-mail correspondence.

Table 3-1. Crosswalk of land-cover types in the Alameda Watershed Management Plan and the HCP

Category	Alameda Watershed Management Plan Land-Cover Types	HCP Land-Cover Type
Grasslands		
	Non Native Grassland	Non Native Grassland
	Valley Needlegrass Grassland	Valley Needlegrass Grassland*
	Serpentine Bunchgrass Grassland	Serpentine Bunchgrass Grassland
Scrub/ Chaparral		
	Northern Coastal Scrub	Diablan Sage Scrub
	Chamise Chaparral	--
	Northern Mixed Chaparral	--
Woodland		
	Mixed Evergreen Forest/ Coast Live Oak Woodland	Mixed Evergreen Forest/Oak Woodland
	Valley Oak Woodland	Valley Oak Woodland
	Blue Oak Woodland	Blue Oak Woodland
	--	Oak Savanna
	--	Serpentine Foothill Pine-Chaparral Woodland
Riparian		
	Central Coast Live Oak Riparian Forest	Central Coast Live Oak Riparian Forest
	Coast Live Oak Riparian Forest	Coast Live Oak Riparian Forest
	Sycamore Alluvial Woodland	Sycamore Alluvial Woodland
	Central Coast Arroyo Willow Forest/ Willow Riparian Forest	Willow Riparian Forest/Scrub
	White Alder Riparian Forest	White Alder Riparian Forest
Freshwater Wetland		
	Freshwater Marsh	Freshwater Marsh
	--	Freshwater Seep*
Aquatic		
	Pond or Reservoir	Streams
	Pond or Reservoir	Pond
	Pond or Reservoir	Reservoir
	--	Quarry Pond
Developed and Cultivated		
	Urban and Cultivated	Disturbed/Developed
	Urban and Cultivated	Cultivated Agriculture
	Urban and Cultivated	Turf
	Urban and Cultivated	Nursery
	--	Rock Outcrop

*Land cover type could not be mapped; see text for explanation.

Table 3-2. Summary of Acres (or Stream Miles) for each Land-Cover Type in the HCP Study Area.

Note: Stream miles not included in total area.

Land-Cover Type	Area within SFPUC ownership (acres)	Area outside SFPUC ownership (acres)	Total HCP Study Area (acres)	Percent of Total HCP Study Area
Non native Grassland	17,086	3,946	21,032	45
Serpentine Bunchgrass Grassland	242	0	242	1
Diablan Sage Scrub	1,693	745	2,438	5
Mixed Evergreen Forest/Oak Woodland	9,620	3,458	13,077	28
Valley Oak Woodland	1,025	303	1,328	3
Blue Oak Woodland	1,350	761	2,111	5
Oak Savannah	1,194	405	1,599	3
Serpentine Foothill Pine-Chaparral Woodland	72	0	72	<1
Central Coast Live Oak Riparian Forest	177	155	332	1
Coast Live Oak Riparian Forest	55	33	88	<1
Sycamore Alluvial Woodland	276	66	342	1
Willow Riparian Forest/Scrub	157	1	158	<1
White Alder Riparian Forest	136	1	137	<1
Freshwater Marsh	21	0	21	<1
Streams (Perennial, Intermittent and Ephemeral)	125	130.1	255.1	NA
Pond	36	7	43	<1
Reservoir	2,216	0	2,216	5
Quarry Pond	96	0	96	0
Disturbed/ Developed	523	13	536	1
Cultivated Agriculture	379	0	379	1
Turf	215	0	215	<1
Nursery	177	0	177	<1
Rock Outcrop	16	2	18	<1
Totals	36,761	9,894	46,656	100.00

Table 3-3. Species for which the SFPUC is seeking coverage under the Alameda Watershed HCP

Common Name	Scientific Name	Status		
		Federal	State	CNPS
WILDLIFE				
<i>Amphibians</i>				
California tiger salamander	<i>Ambystoma californiense</i>	Threatened	SSC	
California red-legged frog	<i>Rana aurora draytoni</i>	Threatened	SSC	
Foothill yellow-legged frog	<i>Rana boylei</i>		SSC ¹	
<i>Birds</i>				
Tricolored blackbird	<i>Agelaius tricolor</i>		SSC	
Western burrowing owl	<i>Athene cunicularia hypugea</i>		SSC	
<i>Invertebrates</i>				
Callipe silverspot butterfly	<i>Speyeria callipe callipe</i>	Endangered		
<i>Mammals</i>				
Townsend's western big-eared bat	<i>Corynorhinus townsendii townsendii</i>		SSC	
<i>Reptiles</i>				
Western pond turtle	<i>Clemmys marmorata marmorata</i> and <i>C. m. pallida</i>		SSC	
Alameda whipsnake	<i>Masticophis lateralis euryxanthus</i>	Threatened	Threatened	
PLANTS				
Tiburon Indian paintbrush	<i>Castilleja affinis</i> subsp. <i>neglecta</i>	Endangered	Threatened	List 1B
Presidio clarkia	<i>Clarkia franciscana</i>	Endangered	Endangered	List 1B
Round-leaved filaree	<i>Erodium macrophyllum</i>			List 2
Fragrant fritillary	<i>Fritillaria liliacea</i>			List 1B
Diablo helianthella	<i>Helianthella castanea</i>			List 1B
Robust monardella	<i>Monardella villosa</i> ssp. <i>globosa</i>			List 1B
Most beautiful jewel-flower	<i>Streptanthus albidus</i> subsp. <i>peramoenus</i>			List 1B

¹ SSC=Species of Special Concern

Table 3-4. HCP-Covered Wildlife Species and Land-Cover Associations

HCP-Covered Wildlife	Non Native Grassland	Valley Needlegrass Grassland	Serpentine Bunchgrass Grassland	Diablan Sage Scrub	Mixed Evergreen Forest/Oak Woodland	Oak Woodland ¹	Oak Savannah	Serpentine Foothill Pine-Chaparral Woodland	Riparian	Freshwater/Wetland/Pond ³	Stream	Reservoir	Quarry Pond	Disturbed/Developed	Cultivated Agriculture	Turf	Nursery	Rock Outcrop
<i>Amphibians</i>																		
California tiger salamander	A/M	A/M	A/M		M	A/M	A/M	A/M	A/M	B/F						M		
California red-legged frog	A/M	A/M	A/M		A/M	A/M	A/M	A/M	A/M	B/F	B/F					M		
Foothill yellow-legged frog										M/F	B/M/F							
<i>Birds</i>																		
Tricolored blackbird	F	F	F						B/F	B/F		B*		B*/F*	B*/F*			
Western burrowing owl	B/F	B/F	B/F											B*/F*	B*/F*			
<i>Invertebrates</i>																		
Callippe silverspot butterfly	Y/F/B	Y/B/F	M/F	F/M		F/M			F/M									F
<i>Mammals</i>																		
Townsend's western big-eared bat				F	F	F		F	F					A/B				A/B
<i>Reptiles</i>																		
Western pond turtle	B/A	B/A	B/A	B/A	B/A	B/A	B/A	B/A	B/A	M/F/A	M/F/A	M/F			B/A			
Alameda whipsnake	M/F	M/F	M/F	B/F	M/F	M/F	M/F	M/F	M/F		M							B/F

HCP-Covered Wildlife	Non Native Grassland	Valley Needlegrass Grassland	Serpentine Bunchgrass Grassland	Diablan Sage Scrub	Mixed Evergreen Forest/Oak Woodland	Oak Woodland ¹	Oak Savannah	Serpentine Foothill Pine-Chaparral Woodland	Riparian	Freshwater Wetland/Pond ³	Stream	Reservoir	Quarry Pond	Disturbed/ Developed	Cultivated Agriculture	Turf	Nursery	Rock Outcrop
Notes:																		
*Occasional use																		
KEY																		
F = Foraging																		
Habitat																		
B = Breeding																		
Habitat																		
A = Aestivation																		
Habitat																		
M = Movement																		
Habitat																		
Y = Year-round																		
Habitat																		

Table 3-5. Summary of Species Habitat Distribution Model Results¹

Species	Modeled Habitat ²	Area within SFPUC ownership (acres)		Area outside SFPUC ownership (acres)		Percent of Total HCP Study Area
		Area within SFPUC ownership (acres)	Area outside SFPUC ownership (acres)	Total HCP Study Area (acres)	Total HCP Study Area	
WILDLIFE						
<i>Amphibians</i>						
California tiger salamander	Core Habitat	41.0	10.7	51.7	0.1	
	Migration and Aestivation Habitat	31,600.1	7,325.0	38,925.1	83.4	
California red-legged frog ³	Core Habitat	747.9	166.5	914.4	2.0	
	Migration and Aestivation Habitat	32,007.5	9,128.8	41,136.2	88.2	
Foothill yellow-legged frog ³	Core Habitat	142.5	17.9	160.5	0.3	
	Low-use Habitat	540.4	145.2	685.5	1.5	
<i>Birds</i>						
Tricolored blackbird	Breeding Habitat	21.8	2.9	24.7	< 0.1	
	Foraging Habitat	18,437.3	3,215.2	21,652.5	46.4	
Western burrowing owl	Core Habitat	17,327.8	4,021.8	21,349.6	45.8	
	Low-Use Habitat	378.7	0	378.7	0.8	
<i>Invertebrates</i>						
Callippe silverspot butterfly		922.7	NA	--	--	
<i>Reptiles</i>						
Western pond turtle	Core Habitat (includes nesting)	1,351.6	153.4	1,505.0	3.2	
	Movement and Overwintering Habitat	6,766.6	2,149.4	8,916.0	19.1	
Alameda whipsnake	Core Habitat	15,288.1	4,630.1	19,918.2	42.7	

Table 3-5. Summary of Species Habitat Model Results*

Species	Modeled Habitat ²	Area within SFPUC ownership (acres)		Area outside SFPUC ownership (acres)		Percent of Total HCP Study Area
		Area within SFPUC ownership (acres)	Area outside SFPUC ownership (acres)	Total HCP Study Area (acres)	Percent of Total HCP Study Area	
PLANTS						
Tiburon Indian paintbrush	Primary Habitat	95.0	0	95.0	0.2	
	Secondary Habitat	147.0	0	147.0	0.3	
Presidio clarkia	Suitable Habitat	185.7	0	185.7	0.4	
	Primary Habitat	3,133.9	32.2	3,166.1	6.8	
Round-leaved filaree	Secondary Habitat	21,41.9	1,140.4	32,82.2	7.0	
	Primary Habitat	129.8	0	129.8	0.3	
Fragrant fritillary	Secondary Habitat	112.1	0	112.1	0.2	
	Primary Habitat	14,465.7	3,516.9	17,982.6	38.5	
Diablo helianthella	Secondary Habitat	817.0	924.2	1,741.2	3.7	
	Suitable Habitat	11,544.4	3,671.9	15,216.3	32.6	
Most beautiful jewel-flower	Primary Habitat	28.3	0	28.3	< 0.1	
	Secondary Habitat	1,997.0	816.7	2,813.7	6.0	

¹ Pacific Townsend's big-eared bat and Callippe silverspot butterfly do not have modeled habitat. However, a survey-based study of butterfly habitat in the study area provided an estimate of total habitat in the study area.

² Habitat types vary depending on the species. Specific definitions of habitat types for each species can be found in the species profiles in Appendix D

³ Area calculations include habitat in stream miles. Area was estimated from stream miles by applying a conservative estimate of 50 ft stream corridor width for all stream habitats

Table 3-6. Statistical Analysis of Surveyed Ponds on SFPUC-owned Land*

	Pond Size (acres)		Pond Elevation (ft)		Pond Aspect (degrees)	
	unsurveyed	surveyed	unsurveyed	surveyed	unsurveyed	surveyed
total acreage	36.8	30.5	36.8	30.5	36.8	30.5
mean	0.29	0.46	896.6	1053.1	162.4	171.7
median	0.11	0.22	712.0	785.0	161.0	169.0
min	0.01	0.02	231.0	306.0	-1.0	-1.0
max	3.31	3.31	2,994.0	2994.0	357.0	357.0
**p value	< 0.001		< 0.125		< 0.388	

* Total ponds mapped on SFPUC lands = 128 and total ponds surveyed on SFPUC lands = 68.

** P value is two-way and was derived by a bootstrap test (Sokal and Rolf 19XX) with 1000 replicates. For pond size, our analysis indicates that our sample was skewed toward larger ponds and is considered significantly different from the universe of all ponds on SFPUC land. For elevation and aspect our sample is not considered significantly different from all ponds on SFPUC lands.

Table 3-7. Suitability Ranking Methods for Pond Data

Target Species	Primary Discriminators	Primary Discriminators Resulting in a Lower Ranking	Relative Ranking of Habitat Suitability
California Red-legged Frog	Predators present Y/N	Predators present	Presence of predators reduces habitat suitability from 2 to 1.
	Emergent vegetation present Y/N	No emergent vegetation	No emergent vegetation reduces habitat suitability from 2 to 1.
California Tiger Salamander	Predator Information	Predators present	Presence of predators reduces habitat suitability from 2 to 1
Western Pond Turtle	Water perennial or seasonal?	Water not present during dry season	Absence of water reduces habitat suitability from 2 to 0
	Basking sites present Y/N	Absence of basing sites	Absence of basking sites reduces habitat suitability from 2 to 1
	Vegetation density	Emergent vegetation too dense in pond interior	Open water 20-25%, emergent vegetation >50% and 100% interior vegetation reduces habitat suitability from 2 to 1
Tricolored Blackbird	Vegetation density	Absence or low density of tall emergent vegetation around pond margins	Absence of tall emergent vegetation (cattail and bulrush) reduces suitability from 2 to 0 Tall emergent vegetation >0% to >25% reduces habitat suitability from 2 to 1

Table 3-8. Summary of Pond Suitability Ranking Across Species

Species	Pond Suitability Ranking		
	0 Number of Unsuitable Ponds (%)	1 Number of Moderately Suitable Ponds (%)	2 Number of Highly Suitable Ponds (%)
California Red-legged Frog	0 (0%)	56 (82%)	12 (18%)
California Tiger Salamander	0 (0%)	43 (63%)	25 (37%)
Western Pond Turtle	19 (28%)	29 (43%)	20 (29%)
Tricolored Blackbird	50 (74%)	13 (19%)	5 (7%)