SECTION 2
PHYSICAL/BIOLOGICAL SETTING, INCLUDING COVERED SPECIES

2.0 PHYSICAL / BIOLOGICAL SETTING, INCLUDING COVERED SPECIES

2.1 SIGNIFICANT HYDROLOGIC FEATURES

2.1.1 San Francisquito Creek Watershed

The San Francisquito Creek watershed encompasses an area of approximately 45 square miles and is located on the eastern flank of the Santa Cruz Mountains, at the base of the San Francisco Peninsula (Fig. 2-1). This watershed is located in two counties, San Mateo and Santa Clara, and two of its constituent creeks (Los Trancos and San Francisquito) form part of the boundary between the two counties. The San Francisquito Creek watershed has four major sub-watersheds located at least partially on Stanford lands: Bear Creek (Bear Gulch Creek), Los Trancos Creek, San Francisquito Creek, and streams that flow into Searsville Reservoir (including Corte Madera, Dennis Martin, Sausal, and Alambique creeks).

A USGS gauging station (11164500) is located on San Francisquito Creek near the Stanford golf course, approximately 500 meters south (upstream) of the Junipero Serra Boulevard/Alpine Road intersection. This station has been in operation since the early 1930s.

The Stanford-owned mid-section of this watershed, including San Francisquito Creek between Searsville Reservoir and Junipero Serra Boulevard, Los Trancos Creek from Arastradero Road to its confluence with San Francisquito Creek at Piers Lane, and Bear Creek from Sand Hill Road to its confluence with San Francisquito Creek, are characterized by a mix of open space and development. This portion of the watershed includes low-density residential, commercial, recreational (Stanford golf course and equestrian facilities), scientific (Stanford Linear Accelerator and Jasper Ridge Biological Reserve), and agricultural (Webb Ranch and Boething Treeland) land uses. Downstream from Junipero Serra Boulevard, the watershed is dominated by high-density residential and commercial land uses. Upstream from the Stanford-owned reaches, the watershed is mainly low-density residential and open space. Most of the creeks in the Stanford portion of the watershed support riparian vegetation, generally a 25- to 75-meter-wide band of dense willows, bay laurels, redwoods, alders, cottonwoods, dogwoods, valley oaks, and coast live oaks. This riparian zone is currently limited in extent by land use and topography.

The San Francisquito Creek watershed is a major source of water for Stanford. Flows within the creek are highly variable. In 1931, the USGS started recording flows within San Francisquito Creek. The mean annual flows have ranged from less that 0.05 cfs (recorded in 1961) to 89.1 cfs (recorded in 1933). During all but the wettest years, significant portions of San Francisquito Creek and its tributaries dry up by mid-summer.

When this HCP was prepared, Stanford had the following functioning water diversion facilities in the San Francisquito Creek system: Searsville Dam and Reservoir, located downstream from the confluence of Corte Madera Creek and Sausal Creek; Los Trancos diversion on Los Trancos Creek, near the intersection of Arastradero and Alpine roads; and an in-channel pumping station, located in San Francisquito Creek near the Stanford golf course, south of the Junipero Serra Boulevard/Alpine Road intersection. Another diversion facility called the Lagunita diversion dam facility, located on San Francisquito Creek approximately 4,300 feet south of Junipero Serra Boulevard, is currently not in service but has historically also served as a diversion facility to the campus. The diverted water is stored in Searsville Reservoir, Felt Reservoir, and Lagunita, or sometimes it is directly diverted for agricultural, University landscaping, and other uses.

Skippers Pond is the largest natural pond located on Stanford lands. It is situated in the riparian thicket adjacent to Family Farm Road, upstream from Jasper Ridge Biological Preserve, in San Mateo County. This pond fills naturally with groundwater and runoff, with comparatively little surface flow connection to the nearby creeks (Sausal and Corte Madera). Skippers Pond holds water year-round in some years, but generally dries up by the end of summer in years of average or below average rainfall.

A portion of the San Francisquito Creek watershed was listed in 1998 by the U.S. Environmental Protection Agency (EPA) as sediment and pesticide (diazinon) impaired. The EPA also listed Corte Madera Creek and the main stem of San Francisquito Creek as impaired. However, the water quality data from the Long Term Monitoring Program (a cooperative program sponsored by the San Francisquito Creek Watershed Council) in the San Francisquito Watershed consistently indicate absence of diazinon.

Hydrogeologic investigations of the groundwater in this area show the presence of thick coarse- and fine-grained alluvial deposits on the San Francisquito Creek alluvial fan where four of Stanford's groundwater wells are located (Sokol 1963;

Geomatrix 1992). Geologic cross sections, based on the correlation of electrical resistivity logs, show that sand and gravel layers range between 50 and 200 feet in thickness, defining the most important groundwater zones. Several clay layers, interpreted to be mostly laterally continuous, range between 20 and 80 feet thick and form aquitards above and between the coarse water-bearing units. Stanford's wells are screened below the upper clays, starting at 100 feet below the surface.

2.1.2 Matadero Creek Watershed

The Matadero Creek watershed is entirely within Santa Clara County (Fig. 2-1). Matadero Creek begins in Palo Alto's hills. The creek flows under Highway 280, through Stanford agricultural lands south of Foothill Expressway, and through the developed commercial and residential areas of the Stanford Research Park and Palo Alto. One major tributary, Deer Creek, joins Matadero Creek just upstream from Foothill Expressway.

Upstream from Foothill Expressway, Matadero and Deer creeks are generally low gradient, with broad riffle-run zones and pebble- to cobble-sized substrate. Both of the creeks in this area have reaches that dry out during drought conditions, but Deer Creek is much more ephemeral and susceptible to drying than the generally perennial Matadero Creek. The riparian zone is similar to that of San Francisquito Creek, consisting primarily of willow, bay, and oak trees, but is generally not as extensive (less wide) or mature.

Downstream of El Camino Real the creek has been channelized and concrete-lined for flood control by Santa Clara Valley Water District.

A mix of open space, low-density residential housing, and undeveloped private property covers the upland areas of the watershed. The downstream areas of the watershed have been highly modified and are either commercial or high-density residential.

A portion of the Matadero Creek watershed was listed in 1998 by the U.S. Environmental Protection Agency as being pesticide (diazinon) impaired (http://oaspub.epa.gov).

2.2 SIGNIFICANT LAND FORMS

2.2.1 Santa Cruz Mountains (Jasper Ridge)

A portion of the University is located on the lower, eastern flank of the Santa Cruz Mountains. The majority of this land form at Stanford is located in the Jasper Ridge Biological Preserve. The 1,200-acre Preserve is an academic research and teaching facility that is extensively used by students and researchers. The Preserve does provide significant conservation benefit to the region, but it is not operated as a refuge for native plants and animals. The Jasper Ridge Biological Preserve was designated as a research facility by the trustees of Stanford University, and no public access is allowed, but docent-led tours are available.

Other land uses in this region include residential development, a vineyard, and equestrian facilities. Searsville Reservoir is located in the Jasper Ridge Biological Preserve and is managed by the University's Facilities and Operations department in coordination with the Preserve.

2.2.2 Foothills

A wide-band of low, rolling foothills (generally 200 to 400 feet in elevation) are present from the edge of the main campus to the base of the Santa Cruz Mountains. The foothills are located south of Junipero Serra Boulevard and extend across Interstate 280, to Jasper Ridge. They consist of a mix of grassland, woodland, and riparian areas. The foothills are generally undeveloped, but do support a number of existing uses, primarily livestock grazing. A number of academic facilities are scattered across the foothills. These include radio telescopes, including the landmark Dish, a linear accelerator,[1] solar observatory, student observatory complex, several academic think tanks, artist studio, and part of the Stanford golf course. Commercial communications facilities and four water supply-related facilities, including two covered reservoirs, are located in the Stanford foothills. Residential and commercial facilities also are located in the Stanford foothills.

Stanford allows public access to a limited portion of the foothills, but this recreational use is restricted to designated service roads. Formal public access points are located along Junipero Serra Boulevard and Alpine Road. Public use is monitored by Stanford University security, and dogs and bicycles are not allowed.

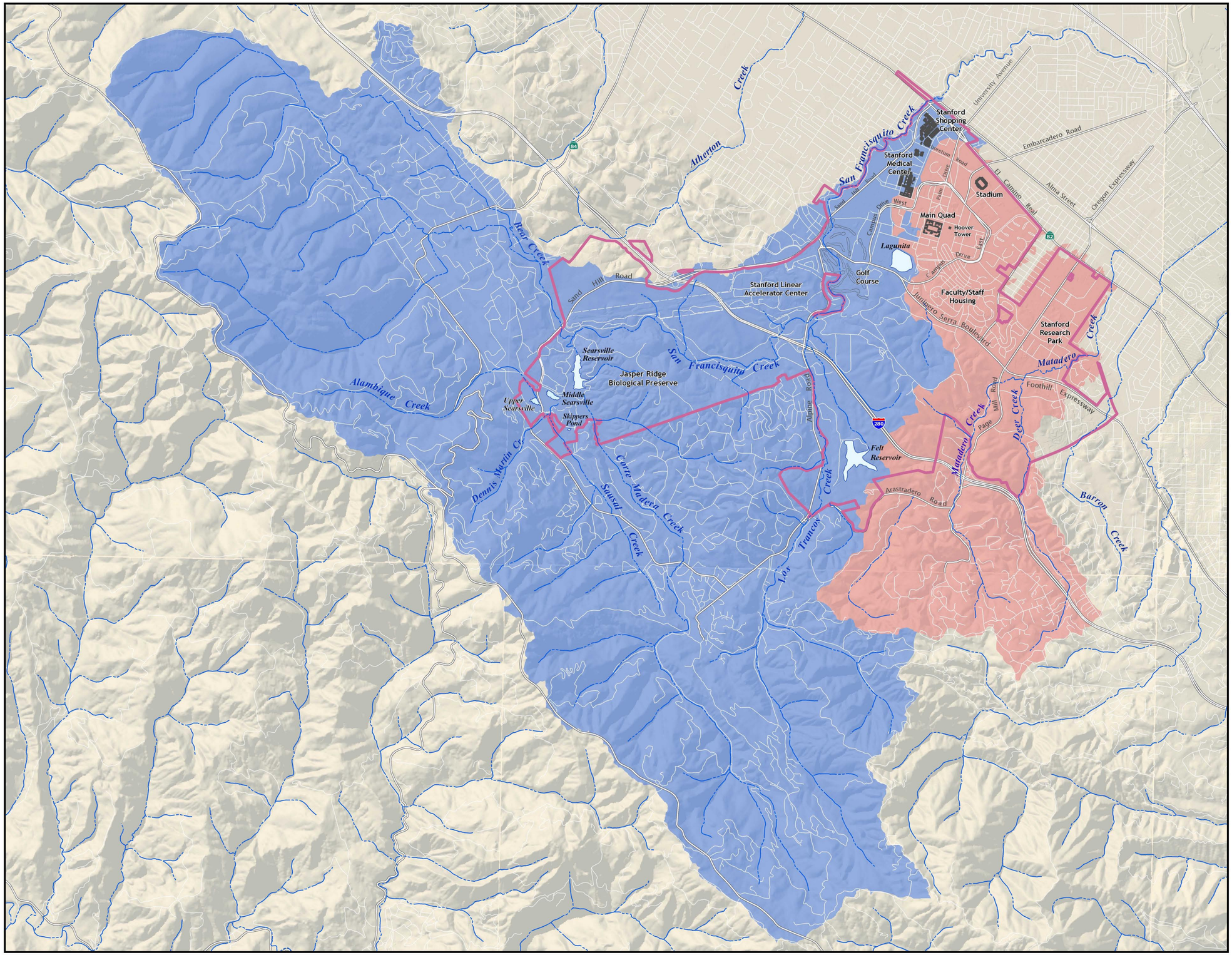
2.2.3 Alluvial Plain

Virtually all of the main campus is located on the comparatively flat areas located between the foothills and San Francisco Bay. Most of the alluvial plain area located north of Junipero Serra Boulevard (Foothill Expressway) is developed with a relatively high density of housing, academic buildings, and commercial development. The alluvial plain areas south of Junipero Serra Boulevard are primarily agricultural, with crop plants farmed in areas near San Francisquito Creek, a commercial (wholesale) nursery that operates in several areas, and livestock (equestrian) uses scattered across most of the remaining areas. A few aca-

[1] The Stanford Linear Accelerator Center (SLAC) is a federal facility, though Stanford maintains some control over the use of the SLAC site. The SLAC site has been included in the HCP, however, only those activities for which Stanford is directly responsible for, such as routine landscape maintenance will be governed by this HCP. Strictly federal activities at the SLAC site, including the modification or expansion of any SLAC facilities, are not covered by this HCP. In the event all or part of the SLAC site is returned to Stanford during the life of the HCP, those portions of the SLAC site returned to Stanford will be subject to the provisions of the HCP.

Stanford University Habitat Conservation Plan

Primary Watershed Basins



Matadero Creek
San Francisquito Creek
Stanford Boundary

Note:
Complete stream basins not shown. Depicted are those primary basin areas that are adjacent to, within or upstream of Stanford University lands.

Sources:
Watershed: USGS, 1991, Nolte, 1999, SU/PO, 2004
Additional S.F. Creek drainage: Nolte, 1999
Creeks: US Geological Survey, 1991

Disclaimer:
This map was produced by the SU Planning Office. While generally accurate, this map may not be completely free of error. The information is derived from a variety of sources deemed reliable, but subject to recurrent change and Stanford does not warrant the accuracy and completeness of these data.

Graphic Scale
1 Inch = 1 Mile
0 0.5 1
Miles

N

Stanford University Planning Office
Date Printed: August 24, 2006

Figure 2-1

demic facilities are in these southern alluvial plain areas (a plant genetics laboratory and a plant growth facility).

2.3 BIOLOGICAL SETTING

2.3.1 Annual Grassland

This community/habitat type consists primarily of non-native annual grasses and forbs forming a continuous cover of herbaceous vegetation. Annual grasslands are present in the alluvial plain and lower foothills portions of Stanford. Non-native species dominating these areas include ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), Italian rye (*Lolium multiflorum*), wild oat (*Avena fatua and A. barbata*), wall barley (*Hordeum murinum*), Italian thistle (*Carduus pycnocephalus*), storksbill (*Erodium* species), bristly ox-tongue (*Picris echioides*), purple star thistle (*Centaurea calcitrapa*), yellow star thistle (*Centaurea solstitialis*), common groundsel (*Senecio vulgaris*), geranium (*Geranium* species), and milk thistle (*Silybum marianum*). Several native grasses, most notably purple needlegrass (*Nassella pulchra*), are not uncommon in some areas of the grasslands at Stanford. Native forbs that commonly occur within this community include: California man-root (*Marah fabaceus*), California buttercup (*Ranunculus californicus*), blue-eyed grass (*Sisyrinchium bellum*), terrestrial brodiaea (*Brodiaea terrestris*), blue dicks (*Dichelostemma capitatum*), Ithuriel's spear (*Tritelia laxa*), suncup (*Oenothera ovata*), and mule's ear (*Wyethia* species). Occasional individual oak trees or small, open-canopied groupings of oaks occur within this community type.

Annual grasslands at Stanford provide habitat for a diversity of terrestrial wildlife. Amphibians include western toad (*Bufo boreas*), Pacific treefrog (*Hyla regilla*), and California tiger salamander (*Ambystoma californiense*). Reptiles include the western fence lizard (*Sceloporus occidentalis*), gopher snake (*Pituophis melanoleuca*), and western racer (*Coluber constrictor*).

A variety of bird species are at least seasonally present in the grasslands at Stanford. Avian seedeaters, including western meadowlark (*Sturnella neglecta*), nest in grazed annual grasslands, while other grassland species, such as red-winged blackbirds (*Agelaius phoeniceus*), are more likely to nest in taller, ungrazed vegetation. A variety of other species, including American goldfinch (*Carduelis tristis*), California towhee (*Pipilo crissalis*), loggerhead shrike (*Lanius ludovicianus*), and northern mockingbird (*Mimulus polyglottos*), nest in scattered shrubs throughout annual grasslands. Raptors, including white-tailed kite (*Elanus caeruleus*), red-tailed hawk (*Buteo jamaicensis*), barn owl (*Tyto alba*), and American kestrel (*Falco sparvarius*), nest in nearby trees and forage in grasslands. Burrowing owls (*Athene cunicularia*) have not been observed nesting at Stanford for nearly a century, but overwinter at several locations at Stanford. Aerial foragers, including northern rough-winged swallow (*Stelgidopteryx serripennis*), tree swallow (*Tachycineta bicolor*), violet-green swallow (*Tachycineta thalassina*), cliff swallow (*Petrochelidon pyrrhonota*), barn swallow (*Hirundo rustica*),

and white-throated swift (*Aeronautes saxatilis*), also may frequent annual grasslands. Great blue herons (*Ardea herodias*) and great egrets (*Ardea alba*) frequently are observed foraging in the grasslands of Stanford.

Small mammals that forage on the plants found in this habitat type include deer mice (*Peromyscus* species), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), California ground squirrel (*Spermophilus beecheyi*), and Botta's pocket gopher (*Thomomys bottae*). Larger mammals, such as bobcat (*Lynx rufus*), coyote (*Canis latrans*), opossum (*Didelphis virginiana*), raccoon, striped skunk (*Mephitis mephitis*), black-tailed jackrabbit (*Lepus californicus*), and black-tailed deer (*Odocoileus hemionus*), also use the annual grasslands at Stanford, though other habitats are generally required for cover. Badgers (*Taxidea taxus*) are apparently absent from Stanford and rarely sighted in the southern San Francisco Peninsula. Mountain lions (*Felis concolor*) are occasionally reported from the grasslands, riparian zones, and woodlands of the lower foothills region.

2.3.2 Oak Woodland/Savanna

This plant community occurs in a number of locations at Stanford. This community is dominated by a mix of coast live oaks (*Quercus agrifolia*), blue oaks (*Quercus douglasii*), valley oaks (*Quercus lobata*), and California buckeye (*Aesculus californica*). Understory species include shrubs such as poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), common snowberry (*Symphoricarpos albus*), blue elderberry (*Sambucus mexicana*), western leatherwood (*Dirca occidentalis*), and occasional dense patches of coyote brush (*Baccharis pilularis*) along the edges of the woodland. Common grass species and herbs found beneath the oak woodland canopy include ripgut brome, bedstraw (*Galium californicum*), wide-leaf filaree (*Erodium botrys*), soft chess, Italian rye, soft geranium (*Geranium dissectum*), Indian lettuce (*Claytonia parviflora*), and goldenback fern (*Pentagramma triangularis*).

The wildlife typically associated with oak woodland at Stanford include: bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), western gray squirrel (*Sciurus griseus*), California ground squirrel, black-tailed deer, deer mice, San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*), broad-footed mole (*Scapanus latimanus*), acorn woodpecker (*Melanerpes formicivorus*), band-tailed pigeon (*Columba fasciata*), northern flicker (*Colaptes aurantus*), and western scrub jay (*Aphelocoma californica*). Oak trees and other hardwoods in this community provide shelter, shade, and breeding habitat for mammal species such as raccoon, striped skunk, and cottontail rabbits (*Sylvilagus audubonii*).

The abundant insect and plant life present in the oak woodlands provides food for bird species such as white-breasted nuthatch (*Sitta carolinensis*), California thrasher (*Toxostoma redivivum*), bushtit (*Psaltriparus minimus*), oak titmouse (*Baeolophus inornatus*), dark-eyed junco (*Junco hyemalis*), blue-grey gnatcatcher (*Polioptila caeurlea*), Bewick's wren (*Thryomanes bewickii*), spotted towhee (*Pipilo maculatus*), California quail (*Callipepla californica*), mourning dove (*Zenaida macroura*), Anna's hummingbird (*Calypte anna*), and ash-throated flycatcher (*Myiarchus cinerascens*). A wide variety of woodpecker species are primary-cavity nesters in oak trees, while house wren (*Troglodytes aedon*), western bluebird (*Sialia mexicana*), and American kestrel are secondary-cavity nesters (i.e., utilizing abandoned woodpecker cavities). Coastal oak woodland also is important to neotropical migrant songbirds (i.e., warblers, vireos, grosbeaks) providing feeding, resting, and nesting habitats. Raptors that nest and forage in the oak woodland habitat include great horned owl (*Bubo virginianus*), barn owl, western screech-owl (*Otus kennicotti*), red-tailed hawk, and red-shouldered hawk (*Buteo lineatus*). Cooper's hawk (*Accipiter cooperi*), white-tailed kite, and golden eagle (*Aquila chrysaetos*) are additional special-status bird species that have been recorded in woodlands and grasslands of the Stanford foothills.

More than 10 species of bats are common in the Stanford area, and individuals of some species roost in tree cavities. Townsend's big-eared bats (*Corynorhinus townsendii*) are occasionally recorded at Stanford and probably utilize local woodlands and riparian areas on a regular basis, at least for foraging.

Amphibian and reptile species that are found in the oak woodlands at Stanford include: California tiger salamander, western toad, Pacific treefrog, California slender salamander (*Batrachoseps attenuatus*), arboreal salamander (*Aneides lugubris*), sharp-tailed snake (*Contia tenuis*), ringneck snake (*Diadophis punctatus*), California kingsnake (*Lampropeltis getulus*), gopher snake, western terrestrial gartersnake (*Thamnophis elegans*), western skink (*Eumeces skiltonianus*), western fence lizard, southern alligator lizard (*Elgaria multicarinata*) and northern alligator lizard (*Elgaria coeruleus*). It is likely that California red-legged frogs (*Rana aurora draytonii*) regularly traverse many of the oak woodlands at Stanford.

2.3.3 Riparian Woodland and Creeks

Riparian woodland is well established along Matadero Creek and Deer Creek and along the creeks in the San Francisquito watershed. There also is a substantial riparian forest associated with the Searsville Reservoir. Vegetation along the creeks consists primarily of a moderately closed canopy of valley oak and coast live oak that ranges from approximately 20 to 40 feet in height. Associated species within this community include California buckeye, bay (*Umbellularia californica*), redwood (*Sequoia sempervirens*), willow (*Salix* species), and white alder (*Alnus rhombifolia*). An understory shrub layer occurs beneath much of the riparian canopy, particularly in areas where gaps in the overstory allow direct sunlight. Shrub species present include poison oak, California rose (*Rosa californica*), blackberry (*Rubus ursinus*), common snowberry, blue elderberry, bee plant, and coyote bush. The riparian forest associated with the Searsville Reservoir is dominated by willows, maples (*Acer* species), and dogwoods (*Cornus* species).

Small clumps of native and non-native grasses and forbs are present in the understory of the riparian woodland, including ripgut brome, wild oat, horehound (*Marrubium vulgare*), poison hemlock (*Conium maculatum*), wild radish (*Raphanus sativus*), field mustard (*Brassica rapa*), milk thistle, and California mugwort (*Artemesia douglasiana*). Aquatic vegetation found intermittently along the creek channels includes water cress (*Rorippa nasturtium-aquaticum*), iris-leaved juncus (*Juncus xiphioides*), broad-leaved cattail (*Typha latifolia*), and curly dock (*Rumex crispus*).

Riparian woodland provides abundant food, cover, and breeding habitat for wildlife. These factors and the structural diversity of riparian woodland are largely responsible for the high productivity of this habitat type. Bird species that are characteristic of this habitat at Stanford include California quail, mourning dove, orange-crowned warbler (*Vermivora celata*), Nuttall's woodpecker (*Picoides nuttallii*), black phoebe (*Sayornis nigricans*), black-crowned night heron (*Nycticorax nycticorax*), belted kingfisher (*Ceryle alcyon*), western wood-pewee (*Contopus sordidulus*), California towhee, and song sparrow (*Melospiza melodia*). Many of these species nest or roost in riparian woodlands and feed in adjacent habitat areas, such as annual grasslands. Stellar's jay (*Cyanocitta stelleri*) and western scrub jays are found in abundance in the riparian woodlands at Stanford, as are California thrasher, red-tailed hawk, Cooper's hawk, red-shouldered hawk, and sharp-shinned hawk (*Accipiter striatus*). Riparian woodlands also provide important feeding, resting, and nesting for neotropical songbirds such as warblers, vireos, grosbeaks, and flycatchers. Salt marsh common yellowthroat (*Geothlypis trichas sinuosa*) is relatively common at the margin of the riparian forest upstream of the Searsville Reservoir.

Common mammals found within this riparian woodland include: deer, opossum, raccoon, deer mice (including, *Peromyscus*

truei and *P. maniculatus*), Botta's pocket gopher, tree squirrels (*Scirus* species), San Francisco dusky-footed wood rat, California vole, coyote, gray fox, bobcat, striped skunk, and the non-native red fox (*Vulpes vulpes*). Merriam's chipmunk (*Eutamias merriami*) are also occasionally encountered in the riparian woodlands at Stanford, particularly in the large woodland track upstream from Searsville Reservoir. Recent work by a Stanford graduate student (Evelyn et al. 2004) indicates that the riparian areas at Stanford are used extensively by foraging bats. A number of bat species have been recorded including: Townsend's big-eared bat, red bat (*Lasiurus blossevillii*), hoary bat (*Lasiurus cinereus*); California myotis (*Myotis californicus*), Yuma myotis (*Myotis yumanensis*), long-ear myotis (*Myotis evotis*), fringed myotis (*Myotis thysanodes*), long-legged myotis (*Myotis volans*), big brown bat (*Eptesicus fuscus*), and western pipistrelle (*Pipistrellus hesperus*).

Amphibians and reptiles known to occur in this biotic community at Stanford include western toad, Pacific treefrog, California red-legged frog, arboreal salamander, black salamander (*Aneides flavipunctatus*), slender salamander, California newt (*Taricha torosa*), rough-skinned newt (*Taricha granulosa*), Santa Cruz ensatina (*Ensatina eschscholtzi*), California kingsnake, gopher snake, western night snake (*Hypsoglena torquata*), western fence lizard, southern alligator lizard, and western skink.

California tiger salamanders have not been recorded from Stanford's riparian zones. However, because of their ability to disperse from Lagunita, low numbers of salamanders could occur in riparian zones north of I-280.

Western pond turtles (*Clemmys marmorata*) are found scattered throughout San Francisquito Creek. They have been reported from Matadero Creek by local residents, but have not been observed during recent surveys. Newts (*T. torosa* and *T. granulosa*) are common in the San Francisquito system, but they have not been observed in Stanford's portion of the Matadero drainage during the recent surveys.

Native fish recorded from the Matadero and San Francisquito systems include three-spined stickleback (*Gasterosteus aculeatus*), roach (*Lavinia symmetricus*), Sacramento blackfish (*Orthodon microlepidotus*), Sacramento suckers (*Catostomus occidentalis*), and sculpin (*Cottus asper* and *C. gulosus*). Steelhead/rainbow trout (*Oncorhynchus mykiss*) are abundant in the San Francisquito system, but have not been recorded in the Matadero system in recent surveys conducted by Stanford (but have been reported as being historically present by numerous long-term local residents). Hitch (*Lavinia exilicauda*) are also present in the San Francisquito system.

San Francisquito Creek contains one of the few remaining steelhead runs in the San Francisco Bay drainage. Steelhead spawn throughout the San Francisquito Creek system, including those portions that flow through Stanford. Searsville Dam is a barrier to fish migration in the system, and isolates about 6 to 8 kilometers of suitable spawning habitat from migrating adults. Resident rainbow trout are present in the creeks above Searsville Dam (notably Corte Madera Creek and Sausal Creek), and are scattered throughout the system.

Native mussels (*Anodonta* species) are found scattered across the San Francisquito Creek system.

Non-native aquatic animals that have been recorded from the creeks at Stanford include bullfrog (*Rana catesbienna*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), mosquito fish (*Gambusia affinis*), largemouth bass (*Micropterus salmoides*), Louisiana red swamp crayfish (*Procambarus clarki*), and signal crayfish (*Pascifasticus leniusculus*). Bullfrogs are occasionally observed in the Stanford portions of Matadero Creek and Deer Creek; generally no more than three or four individuals are observed each year (and fewer than 10 bullfrog tadpoles have been encountered in Matadero and Deer creeks since the mid-1990s). Green sunfish are relatively common throughout the unincorporated Santa Clara County portion of Matadero Creek, but are limited in Deer Creek to reaches immediately upstream from its confluence with Matadero Creek (reaches that do not typically dry out). No young-of-the-year green sunfish have been observed in the Stanford portions of Matadero Creek and Deer Creek during annual surveys since 1997, suggesting that juvenile or adult sunfish may be dispersing into either downstream or upstream reaches. During recent annual surveys, only one largemouth bass was observed in the Stanford portion of the Matadero watershed and Louisiana red swamp crayfish are rarely encountered.

Mitten crabs (*Eriocheir sinensis*) have been observed in the San Francisquito system since at least 1996. The number of these invasive non-native crabs in the Stanford portions of the creeks varies each year. From 1996 to 1998, there were very few observations of crabs upstream of El Camino Real. In 1999 and 2000, hundreds of crabs were seen in San Francisquito Creek. Some individuals reach the confluence with Bear Creek. During 2001 through 2005, very few crabs were observed in the system. At the present time, the extent and impacts of this recent invasion are unclear.

In 2000, a mitten crab was observed in Matadero Creek, just downstream of the Foothill Expressway bridge (there were mid-1990s reports of mitten crabs at Matadero Creek's outflow into San Francisco Bay). Mitten crabs have not been observed in the areas of the creek that support red-legged frogs, but they could colonize the area in the future.

2.3.4 Serpentine Grasslands

There are two main areas of serpentine grassland at Stanford, both located in the Jasper Ridge Biological Preserve. These two areas are of limited extent, and the total acreage of serpentine grassland at Stanford is less than 25 acres. These grasslands

have not been managed specifically to promote native biodiversity; indeed a hands off management policy has been in effect at the Preserve for more than 25 years. This policy was implemented in order to ensure that the inevitable vagaries of multi-year management activities did not unnecessarily affect the long-term research activities at the site. The grasslands do, however, still support an array of native plant and animal species, including California plantain (*Plantago erecta*), goldfields (*Lasthenia chrysostoma*), serpentine linanthus (*Linanthus ambiguus*), common linanthus (*Linanthus androsaceus*), red maids (*Calandrinia ciliata*), purple needlegrass, California man-root, California buttercup, poison oak, blue-eyed grass, terrestrial brodiaea, blue dicks, Ithuriel's spear, yarrow (*Achillia millifolium*), and common muilla (*Muilla maritima*).

Native insects are common in the serpentine grasslands at Stanford and the Lepidoptera in particular have been the focus of research efforts. The Bay checkerspot butterfly (*Euphydryas editha bayensis*) has been studied annually by Professor Paul Ehrlich's group at Stanford since 1960. This threatened butterfly subspecies formerly had two relatively robust populations at Stanford (a third population has been recorded in the literature [population "G"], but never supported butterflies for more than a few years). The Bay checkerspot butterfly has not been observed at Stanford since 1997 (despite hundreds of hours spent annually looking for them). Opler's longhorn moth (*Adela oplerella*) has not been recorded from Stanford, and is not expected since its obligatory host plant, California creamcups (*Platystemon californicus*) is rarely observed at Stanford. Several other species of *Adela* moths are common in the serpentine grasslands (*A. trigrapha* and *A. flammeusella*). Approximately 330 acres of serpentine grasslands at Stanford are designated as critical habitat for the Bay checkerspot butterfly.

A wide range of reptiles, mammals and birds can be found in the serpentine grasslands at Stanford. However, these are, by and large, the same species found in the annual grasslands and oak woodlands in the area. Botta's pocket gophers are typically found in very high densities in the serpentine grasslands at Stanford.

2.3.5 Chaparral and scrub

Chaparral and scrub are present at Stanford in several locations. There is a several-hundred-acre patch of chaparral located in the Jasper Ridge Biological Preserve. This chaparral includes dense stands of chamise (*Adenostoma fasciculatum*), buckbrush (*Ceanothus cuneatus*), yerba-santa (*Eriodictyon californicum*), toyon (*Heteromeles arbutifolia*), scrub oak (*Quercus berberidifolia*), poison oak, and black sage (*Salvia mellifera*). Scrub also is found on Coyote Hill and at Jasper Ridge. These areas are dominated by California sagebrush (*Artemisia californica*), coyotebrush, scrub oak, toyon, sticky monkeyflower, and California bee plant (*Scrophularia californica*).

Chaparral and scrub at Stanford provide habitat for a diversity of terrestrial wildlife. Amphibians include western toad and Pacific treefrog. Reptiles include western fence lizard, gopher snake, western racer, northern Pacific rattlesnake (*Crotalus viridus*), and western whiptails (*Cnemidophorus tigrus mundus*). Coast horned lizards (*Phrynosoma coronatum frontale*) have not been recorded at Stanford for several decades, but are present in chaparral located about 6 miles south of the University.

A wide range of mammals and birds can be found in the chaparral and scrub at Stanford. These are, however, primarily the same species found in the annual grasslands and oak woodlands in the area.

2.3.6 Seasonal Wetlands

The primary seasonal wetlands at Stanford are Lagunita and Skippers Pond. Both of these bodies of water support large numbers of aquatic invertebrates and vegetation. Pacific treefrogs are found in abundance in both bodies of water, and western toads frequently reproduce in large numbers in Lagunita. California newts do not typically use either of these waters. California tiger salamanders have been documented to reproduce in Lagunita since the early part of the 1900s. Bullfrogs are abundant in Skippers Pond in some years, and particularly when periods of above average rainfall allow the pond to retain water through the summer. A few bullfrogs are encountered in Lagunita every year, but no bullfrog tadpoles have been encountered there in at least three decades. Fish are generally not present in either Lagunita or Skippers Pond, but occasionally low densities of mosquito fish and goldfish are encountered. Crayfish also are found with some regularity in Lagunita. The timing of the crayfish's annual appearance always coincides with the annual crayfish cookout by one of the local dorms, so it has been assumed that the crayfish in Lagunita are the result of intentional releases. Pocket gophers are also abundant in the Lagunita area (so much so that the University Facilities department must constantly take active measures to control the numbers of gophers residing in the earthen dam that forms two-thirds of Lagunita's edge, as required by the California Division of Dam Safety). Skunks and raccoons also are commonly encountered in the seasonal wetlands. Waterfowl are

fairly abundant in Lagunita during the wet season. A number of reptile species occupy the Lagunita lakebed and surrounding grasslands, including western racer, kingsnake, gopher snake, and common gartersnake (*Thamnophis sirtalis*).[2]

2.3.7 Perennial Standing Water

Searsville Reservoir and Felt Reservoir support populations of fishes, most of which are non-native game species such as largemouth bass, black crappie, sunfish, and catfish. Neither Searsville Reservoir nor Felt Reservoir provide habitat for native aquatic species of conservation concern due to the presence of bullfrogs and abundance of non-native fishes. There are some roach, sculpin, hitch, and trout in the reservoirs, but the vast majority of fish in each are non-natives. However, prickly sculpins are common in Felt Reservoir, western toads reproduce exceedingly well in Felt Reservoir, and both Searsville Reservoir and Felt Reservoir provide a habitat for water fowl and foraging areas for bats. Felt Reservoir and Searsville Reservoir are also used by both migratory and resident birds. Freshwater mussels (likely *Anodonta californiensis* and *A. oregonensis*) are present in Felt Reservoir. Non-native Chinese mystery snails (*Cipangopaludina chinensis*) and Lousiana red swamp crayfish are abundant in Felt Reservoir.

2.3.8 Urban/Suburban

Urban landscape includes both native and non-native vegetation growing within the main campus and around residential areas of Stanford lands. Vegetation consists of remnant native species, such as oaks, as well as non-native trees (primarily *Eucalyptus*), ruderal annual grasslands, and ornamental landscape plants.

In rare instances the urban/suburban areas can provide habitat elements for wildlife, including cover for nesting and roosting, and foraging sites. Except for the occasional tiger salamander that wanders into the main campus from Lagunita, the central campus and other developed areas do not support individuals of the Covered Species (described following). It should be noted that the tiger salamanders which do find themselves in the main campus have an exceedingly low chance of getting back to either Lagunita or the ponds in the foothills; in addition to the large numbers of buildings, roads, drains, and simple curbs on the main campus, there many retaining walls and stairs located in the main campus. Since Lagunita is uphill from most of the main campus, these retaining walls and stairs form a unidirectional barrier to California tiger salamander dispersal; individuals dispersing from Lagunita can essentially fall down steps or over a retaining wall and reach the main campus, but the reverse trip is virtually impossible because the tiger salamanders have limited climbing abilities.

Native and introduced animals that are tolerant of human activities can thrive in urban landscapes. These species include: western fence lizard, southern alligator lizard, northern mockingbird, barn swallow, raccoon, striped skunk, European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), house finch (*Carpodacus mexicanus*), eastern grey squirrel (*Sciurus caralinensis*), fox squirrel (*Sciurus niger*), house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), black rat (*Rabus rattus*), and opossum. Highly urbanized areas such as the Stanford Shopping Center, Medical Center, and the Research Park consist of very intensely developed landscapes that have little value to native wildlife (Blair 1996, Blair and Launer 1997).

2.3.9 Plant Species

More than 650 species of native vascular plants have been recorded from Stanford and vicinity. There are a number of these plant species that are considered by the California Native Plant Society as being of conservation concern. These include: Franciscan onion (*Allium peninsulare franciscanum*, CNPS 1b), western leatherwood (*Dirca occidentalis*, CNPS 1b), woolly-headed lessingia (*Lessingia hololeuca*, CNPS 3), serpentine linanthus (*Linanthus ambiguous*, CNPS 4), chaparal bush mallow (*Malocothamnus fasciculatus*, CNPS 1b [as M. arcuatus), Gairdner's yampah (*Perideridia gairdneri gairdneri*, CNPS 4), Michael's piperia (*Piperia michaelii*, CNPS 4), Mt. Diablo cottonseed (*Stylocline amphibola*, CNPS 3), Hickman's popcornflower (*Plagiobothrys chorisianus var. hickmanii*, CNPS 4), coast rock cress (*Arabis blepharophylla*, CNPS 4), fragrant fritillary (*Fritillaria liliacea*, CNPS 1b), mountain lady's slipper (*Cypripedium montanum*, CNPS 4), spring lessingia (*Lessingia tenuis*, CNPS 4), bristly linanthus (*Linanthus acicularis*, CNPS 4), California rockjasmine (*Androsace elongate acuta*, CNPS 4), showy Indian clover (*Trifolium amoenum*, CNPS 1b), and San Francisco blue-eyed marry (*Collinsia multicolor*, CNPS 1b). Most of the species have not been recorded at Stanford for many decades. If present, these species are found predominately on Jasper Ridge, although the western leatherwood is also found scattered through the oak and riparian woodlands of campus. While conservation measures enacted by Stanford during the course of this HCP will undoubtedly benefit several of these species, no plant species are explicitly covered by this HCP.

[2] The endangered San Francisco gartersnake is not found at Stanford. Studies have shown that the common gartersnake found at Stanford is an intergrade form between *T. s. tetrataenia* found to the north and west, and *T. s. infernalis* to the south and east (Barry 1994). Specimens from Stanford (mainly Lagunita) were classified by herpetologists as intergrades, with the population more phenotypically aligned with *T. sirtalis infernalis* than with *T. sirtalis tetrataenia*. An analysis of 47 gartersnakes from Palo Alto, including Lagunita and parts of San Franciquito Creek, found that 80% were intergrades and 20% were red-sided gartersnakes (Barry 1994). Additionally, museum records indicate that of 35 gartersnakes collected from Stanford and the vicinity, 18 were *T. sirtalis infernalis*, 16 were intermediates between *T. sirtalis infernalis* and *T. s. tetrataenia*, and 1 was a *T. sirtalis tetrataenia* (Seib and Papenfuss 1981). These studies show that the vast majority of gartersnakes in the Stanford area were either pure red-sided gartersnakes or individuals with some level of intergradation between the two subspecies. These results and conclusions are consistent with recent observations of the snakes found at or near Lagunita.

In addition to the native species of plants, more than 325 species of non-native plants have been found growing outside of landscaped areas at and near Stanford, and new species of non-native plants invade the area on a regular basis. Many of these exotic species are highly invasive and destructive weeds. Control of these species is often extremely difficult, and management efforts are ongoing. Some of the more problematic exotic plant species at Stanford are mustard (*Brassica* species), ripgut brome, stinkword (*Dittrichia graveolens*), Italian thistle, yellow star-thistle, purple star-thistle, pampas grass (*Cortaderia selloana*), storkbill (*Erodium* species), fennel (*Foeniculum vulgare*), broom (*Genista maderensis* and G. *monspessulana*), Italian ryegrass, Harding and canary grass (*Phalaris* species), wild radish, and medusa-head (*Taeniatherum caput-medusae*). Ivy (*Hedera helix*) and greater periwinkle (*Vinca major*) are found in high densities in a number of locations scattered along the creeks and in moist forested areas. Giant reed (*Arundo donax*) is present in a few locations at Stanford and has been the target of focused eradication efforts. Parrot's feather (*Myriophyllum aquaticum*) occasionally reaches potentially problematic densities at Searsville Reservoir.

2.3.10 Animal Species

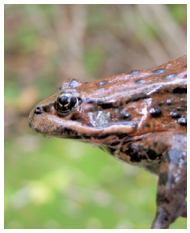
Nearly 240 species of vertebrates, including 150 species of native birds, are found at and near Stanford. In addition to the native bird species, more than 45 species of mammals, 19 species of reptiles, 11 species of amphibians, and 8 species of fishes native to the area have been recorded. In addition, subfossil remains of a host of other vertebrate species have been found at Stanford. Grizzly bear (*Ursus arctos*), pronghorn (*Antilocapra americana*), tule elk (*Cervus elaphus*), and roadrunner (*Geococcyx californianus*) are among the species recently extirpated from the area.

Approximately 30 non-native vertebrate species are present in the area and some pose problems for conservation efforts. The non-native centrarchids (sunfish and largemouth bass), bullfrog, starling, and red fox potentially cause the most difficulties for native wildlife.

In addition to the vertebrate species, a large number of species of invertebrates are found at Stanford, including more than 30 species of butterflies and skippers, and 55 species of odonates.

2.4 COVERED SPECIES

2.4.1 California red-legged frog



Description. California red-legged frogs are the largest frogs native to California, reaching sizes upwards of 4.5 inches in body length. Adult frogs are variable in color but are often characterized by the rich red coloration of the lower sides of their bodies and the under-surfaces of their hind limbs. Upper portions of red-legged frogs are red-pink to green-brown, with irregular black mottling on dorsal surfaces of the back and thighs. There are dorsolateral folds extending from the hips to eyes on both sides of the body.

Red-legged frog tadpoles are brown, often with a pinkish sheen on their undersides, and commonly reach 3 inches in total length. Tadpoles may be mottled with irregular dark spots, but they do not have the pencil-point black dots typical of bullfrog tadpoles. Juveniles are generally less than an inch in body length at metamorphosis, and more brown-green than red.

Eggs are laid in loose clusters, generally in shallow water. These rough egg masses are clear to yellow brown or grey in color, with a dark developing embryo in each individual egg.

Natural History. Red-legged frogs typically live in still freshwater such as ponds, lakes, and marshes, or in slow flowing sections of creeks and streams. Local reproduction generally begins in late January and lasts through March. Minimum breeding age appears to be 2 years in males and 3 years in females (Jennings and Hayes 1985). Females lay 750-4,000 eggs in clusters attached to aquatic vegetation, 2 to 6 inches below the water surface. Eggs hatch in 2 to 3 weeks. Once hatched, the tadpoles generally take between 11-20 weeks to metamorphose, doing so between May and August. Tadpoles can reach 3 inches total length just prior to metamorphosis. Individual frogs average 1 ¼ inches in snout-vent length at metamorphosis.

Adults feed on a wide range of invertebrates and small vertebrates including aquatic and terrestrial insects, snails, crustaceans, fish, worms, tadpoles, small mammals, and smaller frogs (including members of their own species). The aquatic larvae (tadpoles) are primarily herbivorous. When threatened, adult and juvenile California red-legged frogs generally seek refuge in water; they will dive rapidly to the bottom of deeper pools and seek refuge under cover. *R. a. draytonii* is prey for a number of species, including bullfrogs, largemouth bass, snakes, raccoons, dogs, foxes, coyotes, cats, herons, and egrets. Crayfish are also thought to prey upon red-legged frog eggs and tadpoles. Newts may eat red-legged frog eggs. Late season heavy rains also wash away egg masses and young tadpoles.

The maximum longevity of red-legged frogs is not known, but an individual of a closely related subspecies (*Rana aurora aurora*) was known to live in captivity for 13-15 years (Cowan 1941).

Some scientists believe that California red-legged frogs are relatively inactive during dry periods of the year or during droughts. California red-legged frogs are known to occasionally disperse widely during autumn, winter, and spring rains. Juveniles use the wet periods to disperse outward from their pond or stream of origin, and some adults have been found to move considerable distances, often well away from aquatic resources. Frogs disperse through many types of upland vegetation and use a broader range of habitats outside of breeding season.

Stanford University Habitat Conservation Plan

California Red-Legged Frog at Stanford

- Occupied Creek (Creek widths exaggerated)
- Associated Uplands
- Outliers / Historical Records

hectare

100
25
4
acres

Sources:
CRLF habitat: Stanford Unv. Campus Biologist, 2006
Aerial photos: Aerotopia, 1999
Creeks: US Geological Survey, 1991

Disclaimer:
This map was produced by the SU Planning Office. While generally accurate, this map may not be completely free of error. The information is derived from a variety of sources deemed reliable, but subject to recurrent change and Stanford does not warrant the accuracy and completeness of these data.

Graphic Scale
1 Inch = 0.5 Miles

0 0.25 0.5 0.75 1
Miles

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Date Printed: August 24, 2006

Figure 2-2

Habitat and Range. Populations of California red-legged frogs are thought to require permanent or nearly permanent bodies of water for persistence. Red-legged frogs are known to occur, at least temporarily, in grassland, riparian woodland, oak woodland, and coniferous forest, but prefer quiet pools, slow-flowing streams, and marshes with heavily vegetated shores for reproduction. California red-legged frogs are frequently encountered in areas of relatively unfiltered sunlight. Seasonal bodies of water are frequently occupied by red-legged frogs, and in some areas these water bodies may be critical for persistence.

While typically associated with bodies of water, an individual California red-legged frog occasionally traverse many miles of non-wetlands during rainy periods. It is also thought that members of some California red-legged frog populations spend most of their lives well away from the wetlands where they reproduce, either in other wetlands or simply in moist, vegetation-covered areas. Historically, California red-legged frogs were found throughout California from Mendocino County in the north to Baja California in the south. The range is considerably reduced, particularly in southern and eastern areas of California, where the California red-legged frog has all but disappeared. A related subspecies (*Rana aurora aurora*) persists in northern California, and ranges north into British Columbia.

Threats. Natural threats to the California red-legged frog include predation by fishes, snakes, birds, mammals, and other frogs. However, loss of habitat and the introduction of non-native species that compete with or prey upon both adult and larval red-legged frogs are much more significant to the fate of the red-legged frog. Disruption or destruction of suitable habitat has been a major cause of the decline in California red-legged frogs over much of their former range (Davidson et al. 2001). Development of land for agricultural or urban uses has significantly reduced frog populations. Introduced species, such as bullfrogs, crayfish, sunfishes (*Lepomis* species), and largemouth bass, also pose challenges to red-legged frogs, competing for resources and often preying directly upon larval and adult frogs (Alvarez et al. 2003, Doubledee et al. 2003). The introduction of non-native species is also thought to play a role in the spread of disease, particularly chytridiomycosis. A chytrid fungus,very likely *Batrachochytrium dendrobatidis*, is the cause of chytridiomycosis and has been linked to numerous amphibian declines across the world. Given the vulnerability of the remaining populations of California red-legged frogs, this pathogen is considered a major threat.

California red-legged frogs at Stanford. California red-legged frogs have been monitored annually on Stanford lands since 1997. These surveys have documented two distinct frog populations, one along Matadero and Deer creeks, and one along San Francisquito Creek (Fig. 2-2). Prior to the construction of Highway 280 and the general suburban buildup of the area, it is likely that these two populations were part of a single, more widespread population.

Annual surveys conducted since 1997 have documented red-legged frog reproduction in Deer Creek and Matadero Creek and in a pool associated with the "Upper Quarry." California red-legged frog reproduction in Matadero Creek appears to be very limited, with only a few tadpoles surviving to metamorphosis each year. In some years, Deer Creek is more productive, with large numbers of mature tadpoles (hundreds) and metamorphs (tens) observed in comparatively wet years. However, it appears that no successful red-legged frog reproduction occurs in Deer Creek during conditions of moderate to severe drought. Reproduction in the quarry pool is fairly consistent, but the pool is somewhat unusual because California red-legged frog tadpoles are present in the pool year-round. (Fellers et al. 2001).

California red-legged frogs also are found along the Stanford portions of San Francisquito Creek. Recent observation of red-legged frogs in San Francisquito Creek have been limited to the reaches located downstream from the confluence with Bear Creek (in the Jasper Ridge Biological Preserve) to within 1.5 kilometers (along the creek) upstream from the Interstate 280 bridge. Red-legged frog reproduction in this area has been variable, with few tadpoles (~20) seen most years since 1997, but with 50+ seen in some years (particularly when weather conditions have caused side-pools to form).

California red-legged frogs also are known to occur along Los Trancos Creek. However, most of the recently observed frogs were found well upstream of Stanford, and there is only a single recent record of a California red-legged frog from Stanford's portion of Los Trancos Creek. In 1995, a single frog was repeatedly observed in the roots of a large bay tree located just downstream of the Los Trancos Diversion facility.

There have been other sporadic records of California red-legged frogs in the San Francisquito watershed. There are unsubstantiated records from the 1970s of red-legged frogs in San Francisquito Creek immediately south of the golf course, near the non-Stanford residences along Bishop Lane (a reach some 3 to 4 kilometers downstream from the frog's current distribution). Recent verified observations have been lacking.

While recent observations of red-legged frogs away from the creeks have been few, it is apparent that some individuals disperse far from the riparian zone. A large red-legged frog was found in January 2000 as a road-kill along Junipero Serra Boulevard, opposite Frenchman's Road (approximately 1.5 kilometers from the nearest creek site known to support frogs). In 2006, two red-legged frogs were reported from an area between SLAC and Sand Hill Road. Multiple subsequent surveys at the site failed to observe any California red-legged frogs, but, given the location, transient individuals are not unexpected. Other historic records of California red-legged frogs at Stanford indicate that in the early- and mid-part of the last century, they were occasionally found in Lagunita and in the goldfish pond of a campus apartment building (Kingscote).

No California red-legged frogs have been observed at these central campus locations for many decades.

At Stanford, several factors threaten California red-legged frogs, including loss of habitat, predation and competition by non-native species, disruption of dispersal routes, and direct interaction with people and domestic animals. Historic reductions of riparian forests, loss of side pools and degradation of seasonal tributaries, have undoubtedly also impacted local frog populations.

The local populations of red-legged frogs have probably declined considerably during the last 50 years. Anecdotal accounts and specimen locations indicate that red-legged frogs were more widespread and probably abundant in many locations where the frog is now absent. Most likely, no single major reason for this decline exists, but rather the decline is the result in long-term changes to the area that have occurred with increased urbanization.

Notes. There is a sizable concentration of red-legged frogs located on the Lawler Ranch, which is adjacent to Stanford, west of Sand Hill Road. It is presumed that frogs reproducing in the ponds and creeks present in the Lawler Ranch occasionally occupy adjacent upland areas owned by Stanford. The Lawler Ranch population is separated from the red-legged frogs present in San Francisquito Creek by Sand Hill Road and the Stanford Linear Accelerator Center (SLAC).

Rana aurora draytonii was first listed as a threatened species by the Service in 1996.

The California red-legged frog, *R. a. draytonii*, is different from the northern red-legged frog, *R. a. aurora*, having larger size, rugose skin, distinct spots with light centers along its dorsal line, and prominent dorsolateral folds. Behavioral and genetic differences are discussed by Hayes and Miyamoto (1984). Recent genetic analyses (Shaffer et al. 2004) have further documented these differences, and many consider the California red-legged frog and the northern red-legged frog to be two distinct species (*Rana draytonii* and *Rana aurora* respectively)

2.4.2 Steelhead

Description. Steelhead are the anadromous form of *Oncorhynchus mykiss*; non-anadromous forms are referred to as rainbow trout. The coloration of adults is highly variable and may range from silvery with faint dark spotting to dark dorsal coloration with a faded lateral red band and heavy spotting; individuals that are in marine environments or have recently returned to freshwater from marine environments are usually quite silvery white-blue in color, with some dorsal spotting. Young steelhead, or parr, are similarly colored with the exception that they have between 8 and 13 widely spaced marks (parr marks) along the lateral line. During smoltification, the dark parr marks will usually fade, and the smolts become lighter and more silvery as they descend the streams and enter salt water. During the time that they are in freshwater, parr and smolt are generally less than 10 inches in total length; returning adults can be 15 to 25 inches in total length.

Natural History. Steelhead spawn in fresh water streams and rivers, and typically spend the first to second years of their lives as residents of their natal stream. After obtaining sufficient size, parr begin a transformation called smoltification, a physical and behavioral transition from freshwater form to a form that is able to survive in marine environments. In freshwater, steelhead feed on drift organisms, benthic invertebrates, and small fish. As with other salmon of the Pacific Basin (all members of the genus *Oncorhynchus*), steelhead return to the same stream in which they were hatched. Steelhead generally spend several years living in coastal marine environments prior to initial spawning or between repeated spawning events. Unlike other Pacific Basin salmon, not all steelhead die after spawning, and many individuals are able to complete the migration cycle multiple times in their lives (but only once per year). Spawning and the migration it requires are, however, quite difficult, and most individuals are unable to survive multiple spawning migrations. In most southern watersheds, including those on the Stanford campus, steelhead are late winter/early spring spawners, but in some systems there are fall or summer runs (Fukushima and Lesh 1998, McGinnis 1984, Shapovalov and Taft 1954). Maximum fish age is usually 7 or 8 years.

Habitat and Range. Steelhead are native to coastal streams from Baja California to Alaska (and parts of Asia). During their time as stream residents, steelhead require water that is generally cool, 10-21° C, and saturated with oxygen (Moyle 1976). These requirements are best satisfied in sections of stream that have cool and clear water input, and are relatively fast-moving. Breeding steelhead have similar temperature and oxygen requirements for creating their nests (redds), and typically spawn in shallow-water gravel beds with rapid flow. Water flow within the gravel beds promotes egg and alevin survival. Adult steelhead that are waiting to spawn also are restricted to relatively cool water and tend to hold in deep pools. Reaches of stream used for rearing by fry and parr benefit from cover, in the form of woody debris, large boulders, and undercut banks. Shade-providing riparian vegetation is often very beneficial for steelhead because it keeps water temperatures low and the associated insects are a source of food. Surface turbulence, areas of white water, also provides cover for steelhead and saturates the water with oxygen.

Threats. There has been a long-term decline of steelhead populations in the last century leading to the listing of Central California Coast (CCC) steelhead as threatened under the ESA in 1997. Degradation of spawning streams has been cited as a main factor in their decline (Moyle 1976). Dams and other water migration barriers, water diversions, removal of riparian vegetation, decreased water quantity and quality, and the

Stanford University Habitat Conservation Plan

Steelhead at Stanford

Occupied Creek
(Creek width exaggerated)

hectare
100
25
4
acres

Sources:
SH habitat: Stanford Unv. Campus Biologist, 2006
Aerial photos: Aerotopia, 1999
Creeks: US Geological Survey, 1991

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Graphic Scale
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0 0.25 0.5 0.75 1
Miles

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Figure 2-3

presence of non-native fish all affect the quality of habitat in steelhead spawning streams. Pollution is also a threat to salmonids, including steelhead. The presence of non-native species, including non-local forms of rainbow trout, can also threaten steelhead populations.

Steelhead at Stanford. Steelhead have long been documented to be present in the San Francisquito watershed (Fig. 2-3), but as with the vast majority of salmonid runs, few specifics are known about the mean number of individuals annually spawning in the system. Estimates range from zero in drought years to several hundred adult fish during wet years. At Stanford, relatively large numbers of parr are typically found in Los Trancos Creek and in a few portions of San Francisquito Creek and Bear Creek. Given the flashy nature of the system and physical limitations of the creek beds, redd surveys have not yielded results that are quantitatively valid. Following a working definition from NOAA Fisheries, all *O. mykiss* from within a zone of anadromy, an area where at least some of the individuals are migratory, are considered steelhead. At Stanford, all *O. mykiss* downstream of Searsville Dam, including Los Trancos and Bear creeks, are the classified as steelhead. All *O. mykiss* upstream of Searsville Dam are considered rainbow trout, because they never migrate to marine environments.

There are non-migratory adults in the downstream reaches of San Francisquito, Los Trancos, and Bear creeks and would be called rainbow trout if they were not found in the zone of anadromy. These individuals exhibit color patterns typical of rainbow trout; silvery green-white base color with many spots, a wide pinkish band along the lateral line, and generally a pinkish red gill cover.

At Stanford, spawning typically occurs from February to April. Parr generally rear in the creeks for one to two summers, but are commonly land-locked for additional years if drought conditions are present. Searsville Dam is a barrier to fish migration on Stanford lands. Resident rainbow trout also are found in the San Francisquito Creek watershed.

Pollutants, including those that originate upstream, can negatively affect steelhead at Stanford. Throughout the system, eutrophic runs and pools are not uncommon by the end of summer. In portions of the creek immediately downstream from Searsville Dam, the water becomes tainted with a naturally occurring heavy load of decaying plant material (coffee-colored water by the end of summer). Non-native fishes and invertebrates also present a threat to steelhead in the San Francisquito watershed. However, most of the non-native fishes are concentrated in the portion of the system immediately downstream from the Searsville Dam, and very few non-native fishes are encountered farther than one kilometer downriver from the dam. Since the mid-1990s, non-native fishes have only spawned downstream of the reservoir on a few occasions, and it is therefore assumed that Searsville Reservoir is the primary source of non-native fishes in the system. The live bearing non-native mosquito fish, *Gambusia affinis*, is an exception and is found in low abundance throughout the system. Stanford annually performs efforts to monitor and control infestations of non-native fishes. These efforts were initiated in 1997 and appear to have been successful at reducing the presence of non-native fishes in areas immediately downstream from Searsville Dam.

Perhaps the primary limiting factor for steelhead in this portion of their range is the low amount of water present in the system during the annual dry season and during periods of drought. San Francisquito Creek frequently experiences drought and low water conditions. During most years, fairly extensive portions of the system dry out. During drought years, particularly during the summer months, creek drying is much more extensive and portions of the creek become dry as early as late April. The impacts of creek drying on steelhead are manifold: even short-distance dispersal through the natural channels is prevented, water quality can be rendered unsuitable, and steelhead become overly concentrated in small areas. Concentrating individuals in areas of declining water quality can increase mortality due to physiological stress and increased predation. Other potentially limiting factors include relatively low channel/stream complexity (low levels of large woody debris and other structure-providing features), the general paucity of suitable spawning sites, and the variable quantities of prey.

Non-native crayfish are widespread in the system, but are uncommon in Los Trancos Creek. Mitten crabs have recently been observed in the San Francisquito watershed, but their numbers present at Stanford vary considerably from year to year. There is no direct evidence that the steelhead population reproducing in the San Francisquito watershed has declined in the last 100 years or is declining at the present time.

2.4.3 California tiger salamander

Description. California tiger salamanders are large salamanders, with adults frequently reaching 7.5 inches or more in total length. These are thick-bodied salamanders with broad heads and blunt snouts. Adults are black or dark grey, with oval to bar-shaped spots ranging in color from white to yellow. Juveniles are dark olive green in color and do not generally have any lighter markings.

Larval tiger salamanders have external gills and are olive green in color, generally with very fine dark markings (stippling).

Eggs are laid underwater singularly or in small groups, on subsurface portions of emergent vegetation or other debris. Each egg is approximately 0.5 to 0.75 centimeters in diameter, including a thick gelatinous layer.

Natural History. Adult tiger salamanders are rarely seen, even during the breeding season when they are most active above ground. For most of the year, they live in the burrows of ground squirrels, gophers, and other rodents in open wooded or grassy areas. Occasionally, tiger salamanders are found in various man-made structures including buildings and drainage pipes. They are found on the surface during periods of damp weather, almost exclusively at night.

Breeding occurs during the winter rainy season. The breeding season begins with a migration of adults to the seasonal wetlands where breeding occurs. This migration typically begins with the second or third heavy rain of the season, and may consist of moves in excess of a kilometer, though most movements are less than 500 meters (Loredo et al. 1996, Trenham et al. 2001, Trenham et al. 2000). Movement occurs on the surface, and possibly underground through rodent burrows as well. Most male tiger salamanders at Stanford are ready to start breeding when they are 3 years old; most females require an additional year to reach sexual maturity.

Eggs are laid underwater singularly or in small groups, on subsurface portions of emergent vegetation or other debris. Young are aquatic and prefer the cover of vegetation to open water. Larvae feed on anuran tadpoles and various aquatic invertebrates such as crustaceans, zooplankton, snails, and insect larvae. These salamanders metamorphose into land-dwelling juveniles by May or June. After metamorphosis, the juvenile salamanders eat a wide variety of insects, and other invertebrates. Juveniles generally remain near the breeding site until autumn rains, at which time they disperse to upland areas.

Habitat and Range. California tiger salamanders require a complex mixture of habitats, consisting of seasonally filled pools located in or near grasslands or oak woodlands (Trenham 2001, Trenham and Shaffer 2005). Semi-permanent ponds and reservoirs, and portions of slow-moving, seasonal creeks, also may be used. Safe and easy access between these habitats is vital, as migration between them is a vulnerable part of the salamanders' life cycle. Seasonal water is important because it usually has fewer predators than permanent bodies of water. Fish in particular are known to have a "significant negative impact on the survival of [salamander] eggs and larvae" (Shaffer et al. 2004).

The California tiger salamander ranges from west of the Sierra Nevada crest, from Sonoma and Yolo Counties in the north to Santa Barbara County in the south, and west to the outer coast range. It is believed that the salamander population on the Stanford University campus represents the only population remaining on the San Francisco Peninsula. These salamanders apparently live in the grassland and foothills surrounding Lagunita and migrate to Lagunita to breed.

Threats. California tiger salamander populations have declined significantly in California. The main cause is fragmentation and destruction of habitat by agricultural and urban development. Introduced species, such as other species of salamanders that hybridize with native tiger salamanders, may be a problem in some locations (Fitzpatrick and Shaffer 2004, Riley et al. 2003). Natural predators of tiger salamanders include herons, waterfowl, raccoons, snakes, and small mammals such as skunks. Weather is a very important determinant of salamander reproductive success. In seasons with heavy early rain, which will trigger migration and reproduction, but little or no mid- to late-season rain, many salamander larvae will not grow enough for successful metamorphosis and survival. Likewise, un-seasonally heavy rains can trigger salamander migrations that result in high levels of mortality (Holland et al. 1990).

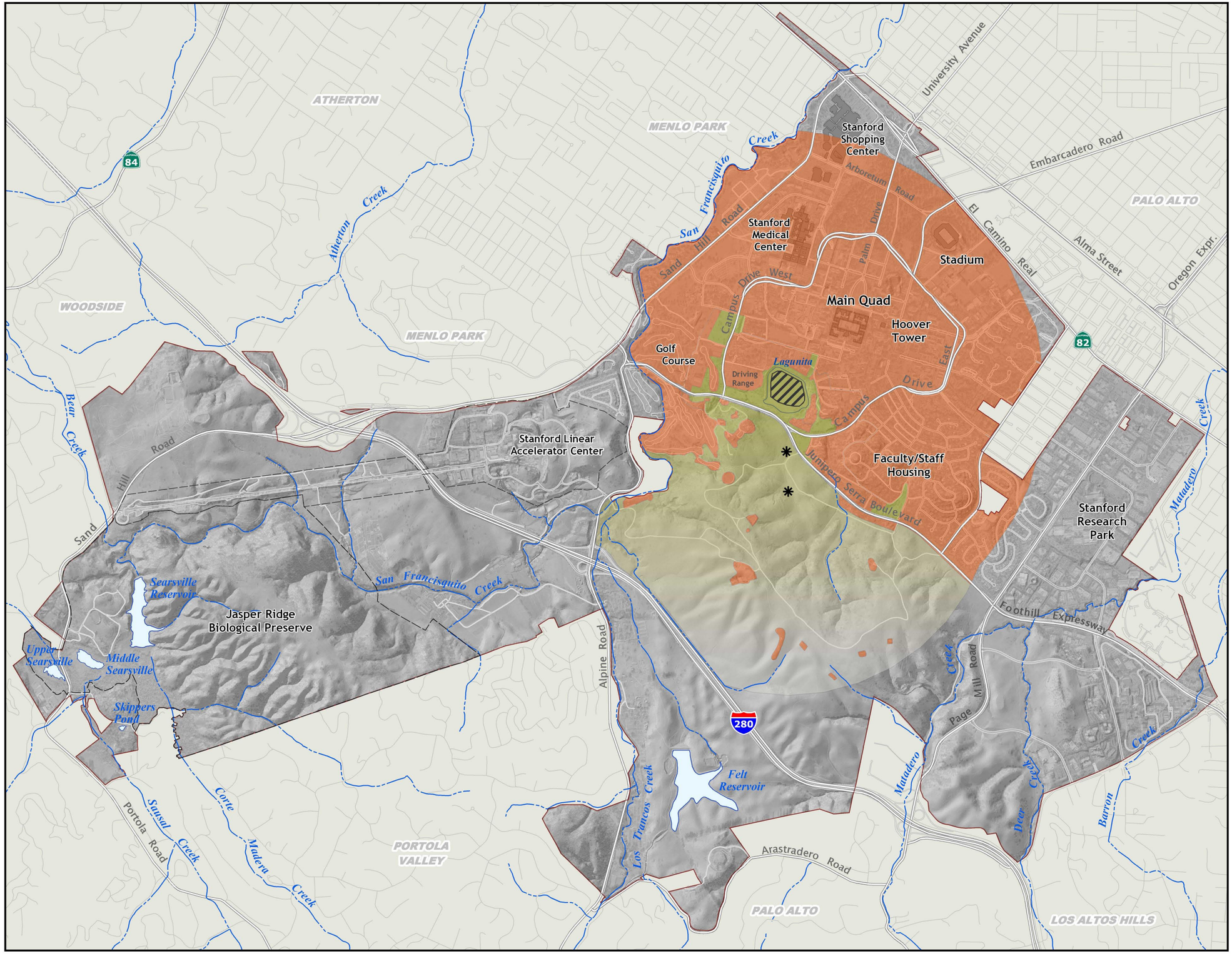
California tiger salamanders at Stanford. At the present time, California tiger salamanders are concentrated around Lagunita, with the density of salamanders decreasing significantly as the distance from Lagunita exceeds 0.75 miles (Fig. 2-4). The distribution of salamanders is not random, and in the heavily developed area of campus very close to Lagunita, few, if any salamanders are present. Much of the main campus is a population sink for salamanders, which means that any individual unlucky enough to get into the main campus will find it virtually impossible to migrate back to Lagunita. Most of the main campus is downhill from Lagunita, and a myriad of curbs, steps, buildings, drains, and retaining walls block migrating salamanders from reaching Lagunita. Therefore, salamanders found in the main campus are essentially lost from the breeding population, because they have virtually no chance of reproducing successfully.

Scientists have studied the California tiger salamander at Stanford and its vicinity for more than 60 years (Twitty 1941). Early work focused on local distribution and factors associated with migrations. Recent work has been centered on conservation planning for the salamanders. This work, which started in the early 1990s, has involved many Stanford-affiliated workers and researchers, including undergraduates (two of whom conducted honors work on the local salamanders), graduate students, post-doctoral fellows, research associates, and hired consultants and experts. Work by non-Stanford scientists on the Lagunita population has also been conducted on a sporadic basis (Barry and Shaffer 1994).

Much of the recent work was conducted to implement the California Tiger Salamander Management Agreement. This agreement is between Stanford, Santa Clara County, California Department of Fish and Game, and the Service and was signed in June 1998. One of its key elements was the designation of a California Tiger Salamander Management Zone. Another important element of the California Tiger Salamander Management Agreement was the construction in the late 1990s of five small seasonal wetlands (ponds) south of Junipero Serra Boulevard. These ponds were classified as experimental and were expected to be modified as their performance was evaluated. The goal of these wetlands is to provide supplemental

Stanford University Habitat Conservation Plan

California Tiger Salamander at Stanford



Breeding locations

Occupied Undeveloped Lands

Population Sinks

Stanford Lands

hectare

100

25

4

acres

Sources:
CTS habitat: Stanford Unv. Campus Biologist, 2006
Aerial photos: Aerotopia, 1999
Creeks: US Geological Survey, 1991

Disclaimer:
This map was produced by the SU Planning Office. While generally accurate, this map may not be completely free of error. The information is derived from a variety of sources deemed reliable, but subject to recurrent change and Stanford does not warrant the accuracy and completeness of these data.

Graphic Scale
1 Inch = 0.5 Miles

0 0.25 0.5 0.75 1

Miles

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Date Printed: August 24, 2006

Figure 2-4

breeding locations for California tiger salamanders, reduce the reliance of the local population on Lagunita and extend their effective range farther into the foothills. By 2001, Stanford determined that two of the ponds were essentially non-functional and a third lost capacity during the floods of 1998. The two remaining ponds worked as designed, but were considered too small to contribute significantly to the persistence of the local California tiger salamander population. The constructed wetlands, however, supported large numbers of Pacific treefrogs and western toads, an array of invertebrates, and were used by a wide variety of mammal and bird species. In Fall 2003, following two years of consultation and permitting by the Service, California Department of Fish and Game, California Regional Water Quality Control Board, U.S. Army Corps of Engineers, and Santa Clara County, the two remaining ponds were reconstructed and enlarged, and six additional ponds were built. In 2006, California tiger salamanders reproduced in two of the ponds. In addition, Stanford installed three amphibian tunnels under Junipero Serra Boulevard, to allow migration between Lagunita and the lower foothills.

Non-native tiger salamanders are occasionally found at Stanford. During the last decade, intensive annual fieldwork has turned up three individuals that were clearly not California tiger salamanders (out of more than 1,000 observations of adult and juvenile tiger salamanders). Researchers at U.C. Davis found that the tiger salamanders at Stanford are native salamanders, of distinct genetic stock, and have not been compromised by introgression with non-native species (Shaffer et al. 2004). At the present time, non-native tiger salamanders are not considered a huge threat to the local salamander population. But, the threats from non-native salamanders remains a concern because virtually every pet store in the vicinity regularly sells a number of non-native tiger salamander species, and hybridization is a big problem elsewhere in the state.

Mortality due to traffic is quite high, a finding first noted by Victor Twitty at Stanford more than 50 years ago (Twitty 1941). This finding has been confirmed by more recent data from ongoing work by Stanford and by a study by the Coyote Creek Riparian Station (Rigney et al. 1993).

Old records indicate that California tiger salamanders were more widespread in northern Santa Clara and southern San Mateo counties. At Stanford, it is unclear whether the population is declining or remaining steady. It is quite possible, however, that the local California tiger salamander population increased dramatically 100 years ago with the construction of Lagunita.

The Service listed the California tiger salamander as threatened in 2004.

Notes. For a period during the late 1970s and 1980s, the population of tiger salamanders at Stanford was believed by some to be extinct. This was apparently due to a conspicuous lack of suitable observers. The salamanders "publicly" appeared during the winter of 1991-1992 and have been monitored annually since their reappearance.

At least two other "populations" of tiger salamanders once existed in the Stanford area, and there were reports of California tiger salamanders at the Jasper Ridge Biological Preserve in the early 1980s. All attempts to locate these populations (indicated in Twitty 1941) indicate that these populations are no longer in existence.

2.4.4 Western pond turtle

Description. Western pond turtles are freshwater turtles with carapaces measuring 9-18 cm in length when fully grown. Generally, they are olive, dark brown, or blackish in color, with a network of dashes of brown or black that radiate outwards from the centers of their shells. However, shell coloration is highly variable. The ventral color of adults is yellow with patches of brown or black. Seeliger (1945) found juveniles and smaller specimens to be much more irregularly colored. Western pond turtles show little sexual dimorphism, although the male has a more depressed shell than the female.

Natural History. These turtles are wary and secretive. When disturbed, they seek cover in water, diving beneath the surface and hiding in vegetation or beneath submerged rocks and debris. They prefer calm waters with vegetated banks, and typically avoid rapidly running waters. In many locations, western pond turtles move away from creeks during the rainy season, presumably in an effort to avoid being swept away during seasonal flooding. Western pond turtles are omnivorous with a preference for animal matter, although plant material is occasionally eaten. Food includes aquatic plants, fishes, aquatic invertebrates, and carrion. This species is a scavenger and an opportunistic predator with a preference for live prey. The diets of males, females, and juveniles differ in prey size and proportions of food items (Bury 1986). Juveniles in particular appear to be principally carnivorous, shifting to a more omnivorous diet as they mature.

Five to 11 eggs are laid between May and August, in buried nests in sunny areas near water. Hatching time is roughly 73-80 days, after which the 1-inch-long young remain in nests through the winter. Eggs and young are extremely vulnerable to predation (see Threats below). Sexual maturity is believed to be attained after 8 years.

Western pond turtles have been found to feed and reproduce in limited geographic regions of suitable habitat. Daily movements tracked among four turtles near San Simeon averaged between 50 and 60 meters along a stream drainage (Rathbun et al. 1992). Such areas are often inhabited year after year by the same turtles. Juveniles are comparatively sedentary (Bury 1972).

Habitat and Range. Preferred habitat for the pond turtle consists of calm waters such as streams or pools with vegetated banks and basking sites such as logs or rocks, and they may utilize habitat extending as far as 0.25 miles away from water (Rathbun et al. 1992). It has been suggested that two types of nesting sites may be utilized (Storer 1930). Most commonly, eggs are laid in sandy banks adjacent to water. Occasionally, eggs may be laid considerable distances away from water. Nests located out of the flood plain may confer some reproductive advantage in regions that are prone to periodic flooding. Upland habitats are quite important for western pond turtles for wet season refugia and nesting sites (Reese and Welsh 1997).

Records indicate that western pond turtles were historically found from British Columbia to San Diego. The turtles' known range is now considerably decreased. The northwestern subspecies ranges from southern British Columbia south to central California, while the southwestern subspecies ranges northward from extreme southern California to the central portion of the state. The two subspecies intergrade from south of the San Francisco Peninsula region to Kern County (Seeliger 1945).

Threats. Habitat loss and fragmentation are the main threats to western pond turtles. Development in the riparian zone is a significant problem for western pond turtles because of their strong tendency to leave the waterways during periods of high water. Buildings, roads, trails and other human altered landscapes in areas within several hundred meters of a creek occupied by pond turtles will likely adversely affect turtle survival. Other threats to the turtle include a large number of natural and introduced predators that prey on eggs, hatchlings, and juveniles. Predators include largemouth bass, snakes, wading birds, bald eagles, bullfrogs, black bears, coyotes, otters, and dogs. Raccoons (*Procyon lotor*) have been cited as a major predator on turtle eggs (Temple 1987). Adult pond turtles are relatively free from predation, and have a long life span. This belief is supported to some degree by findings that the population structure of most turtle populations includes a high percentage of adults (Bury 1972). Dessication of young hatchlings is also believed to be a major mortality factor under hot and dry conditions. Alteration of hydrologic regimes by dams may also threaten western pond turtles (Reese and Welsh 1998). While it is unlikely that people continue to harvest pond turtles for food, it is not uncommon to hear of turtles being picked up during their rainy season wanderings by well meaning people.

Suitable habitat for the pond turtle has been disappearing rapidly as development and construction alters or eliminates the streams and ponds upon which the turtles depend. Direct hunting of turtles for sport or consumption has also played a role in the turtles' decline. Two accounts of turtle trapping for human consumption were included in Storer's 1930 article, which detailed methods used to trap pond turtles and also noted that the turtles commanded "$3 to $6 per dozen and were most in demand about April" (Storer 1930). Trapping or hunting is a particular problem for turtle populations because very few turtles manage to survive long enough to reach sexual maturity.

Western Pond Turtles at Stanford. Western pond turtles are the only native turtles found at Stanford. They are found scattered throughout San Francisquito Creek, from Searsville Dam to the downstream edge of Stanford's boundary (Fig. 2-5). In the Jasper Ridge Biological Preserve, they have been historically found along marshier areas of Searsville Reservoir. Western pond turtles were found in Searsville Reservoir through the mid-1990s, but there have been no recent records from the reservoir. Likewise, surveys in creeks and ponded areas upstream from Searsville Reservoir have not documented the presence of western pond turtles in the last 5 years. Western pond turtles were also present in Felt Reservoir but have not been observed there for two decades.

While no pond turtles have been observed by recent surveys in Matadero and Deer creeks, local residents report that turtles were present in the area, at least through the 1980s.

Western pond turtles are occasionally found well away from waterways; along paths and roads at Jasper Ridge, near the Stanford golf course, along Palm Drive, and the Stanford Shopping Center. These specimens are probably either individuals leaving the creek-bed during the beginning of the rainy period (when many turtles apparently take cover in upland areas), or are females looking for places to lay eggs.

Perhaps the greatest threat to western pond turtles at Stanford is human interference, primarily due to habitat loss and human presence near creeks. Female turtles searching for places to lay eggs, in particular, are quite sensitive to interactions with humans and human-built environments, and will retreat to the creek if sufficiently disturbed without laying eggs. The abundance of raccoons, dogs, cats, rats, and other animals associated with suburban development also may be taking a large toll on pond turtles.

There are no historic quantitative records of turtle abundance or distribution. Therefore, it is unclear whether the local population is stable. The paucity of sightings of adult turtles and nearly complete absence of juvenile turtles strongly implies, however, that the local turtle population is in danger of extinction.

The Western pond turtle is not currently protected under the ESA.

Notes. Two subspecies are found in California, the northwestern (*Clemmys marmorata marmorata*) and the southwestern (*Clemmys marmorata pallida*). Distinguishing between the two subspecies is difficult. The northern subspecies has inguinal scutes and a more lightly colored throat than the sides of its head (Pritchard 1979). Seeliger notes that *Clemmys marmorata marmorata* also has a pair of triangular inguinal plates that are larger than the small or even absent inguinal plates of the southern variety. The two subspecies of western pond turtle transition just south of the San Francisco Bay Area. Seeliger lists localities from which intergrades have been examined, including Alameda County, Contra Costa County, and Palo Alto.

Stanford University Habitat Conservation Plan

Western Pond Turtle at Stanford

- Recently Occupied Creek (Creek width exaggerated)
- Recently Occupied Reservoir
- Stanford Lands

hectare
100
25
4
acres

Sources:
WPT habitat: Stanford Unv. Campus Biologist, 2006
Aerial photos: Aerotopia, 1999
Creeks: US Geological Survey, 1991

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Figure 2-5