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Arroyo Mocho Habitat Suitability Assessment for Sensitive Reptiles, Amphibians, and Fish

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Disclaimer

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

SEQUOIA
Ecological Consulting, Inc.

LLNL-SR-826592

Lawrence Livermore National Laboratory Support for the Sitewide Environmental Impact Statement (SWEIS)

Arroyo Mocho Habitat Suitability Assessment for Sensitive Reptiles, Amphibians, and Fish

September 2021

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CONTENTS

FIGURES

APPENDICES (Back of Report)

1.0 INTRODUCTION

Sequoia Ecological Consulting, Inc. (Sequoia) has prepared this habitat suitability assessment for the purpose of assessing current habitat suitability and evaluating the potential presence of special-status species at and near the Arroyo Mocho Pumping Station (Arroyo Mocho). The Study Area is located 7.5 miles southeast of the City of Livermore in Alameda County, California (Figures 1 and 2). Our analysis provides a description of presence and habitat suitability for special-status reptiles, amphibians, and fish within the Study Area and identifies potential conservation measures. Special-status animals are designated by the US Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW). This analysis focuses on California tiger salamander (*Ambystoma californiense*), California red-legged frog (*Rana draytonii*), foothill yellow-legged frog (*Rana boylii*), western pond turtle (*Emys marmorata*), Alameda whipsnake (*Masticophis lateralis euryxanthus*), Coast horned lizard (*Phrynosoma blainvilli),* and central California coast distinct population segment (DPS) steelhead (*Oncorhynchus mykiss*), per the request of Lawrence Livermore National Laboratory.

2.0 LOCATION DESCRIPTION

The Arroyo Mocho is an important tributary within the Alameda Creek watershed, and a historically anadromous fish-bearing stream. The Study Area is located 7.5 miles southeast of the City of Livermore, in southeastern Alameda County, California in the Diablo Range. According to the Public Land Survey System, it is located within Sections 8 and 9 of Township 4 South Range 3 East of the Mount Diablo Baseline and Meridian. The Study Area lies within the Arroyo Mocho Creek watershed, which drains south of Livermore and runs between Crane Ridge and Cedar Mountain, entering the City of Livermore east of Robertson Park. The entirety of Arroyo Mocho is approximately 10 miles long and drains into Arroyo de la Laguna at river mile 7, southeast of the Interstate 580-680 interchange. Arroyo Mocho is divided into two sub-watersheds, Upper Arroyo Mocho (United States Geological Survey [USGS] Hydrologic Unit Code [HUC] 180500040301) and Lower Arroyo Mocho (USGS HUC 180500040302). Lower Arroyo Mocho runs through the Livermore Valley floor while Upper Arroyo Mocho is confined by steep canyon walls from its headwaters on the north slope of Mount Mocho (elev. 3,671 feet), running north-northwest into the broad Livermore Valley at approximately elevation 623 feet.

LLNL has conducted two restoration projects within Arroyo Mocho in the study area —a boulder removal project and a new stream crossing in 2004. The boulder project removed two large upstream rock formations in the Arroyo Mocho that were threatening the gabion-style retaining wall supporting the pump housing. The new stream crossing is a steel structure, erected higher than the 100-year flood mark. This replaced the existing 160-foot-long by 80-foot-wide low-flow concrete crossing. The concrete crossing was past its useful life and in danger of failure and obstructed fish passage.

The Study Area is located just off Mines Road between miles 5 and 6 within the Upper Arroyo Mocho sub-watershed (Figure 2). The City of Livermore lies to the north, Del Valle Regional Park lies to the

southwest, and privately owned undeveloped land surrounds the rest of the site. A paved and gravel road leads from Mines Road to the pumping station and adjacent private land, crossing Arroyo Mocho approximately 0.5 miles from the turnoff of Mines Road. The Study Area encompasses approximately 52 acres surrounding the access road, pumping station, and associated water tanks. The land surrounding the pumping station and water tanks is owned by the San Francisco Public Utilities Council (SFPUC) and the access road is adjacent to privately owned land. Land uses at the Arroyo Mocho pumping station are primarily water delivery and associated facilities and open space. Land use designations surrounding Arroyo Mocho are primarily rural residential and private open space, including grazing lands (Nomad Ecology 2020).

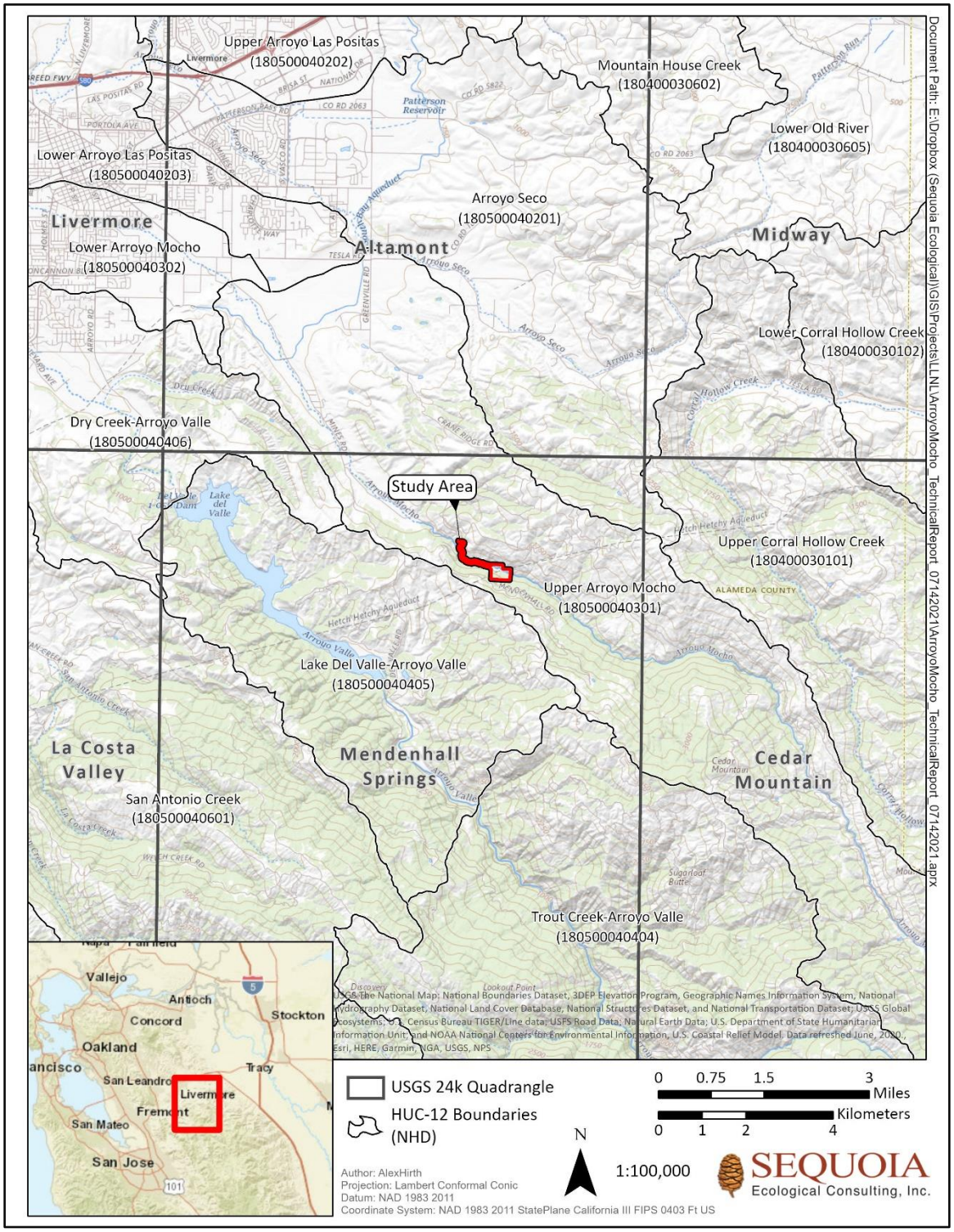

Figure 1. Regional Map of the Study Area.

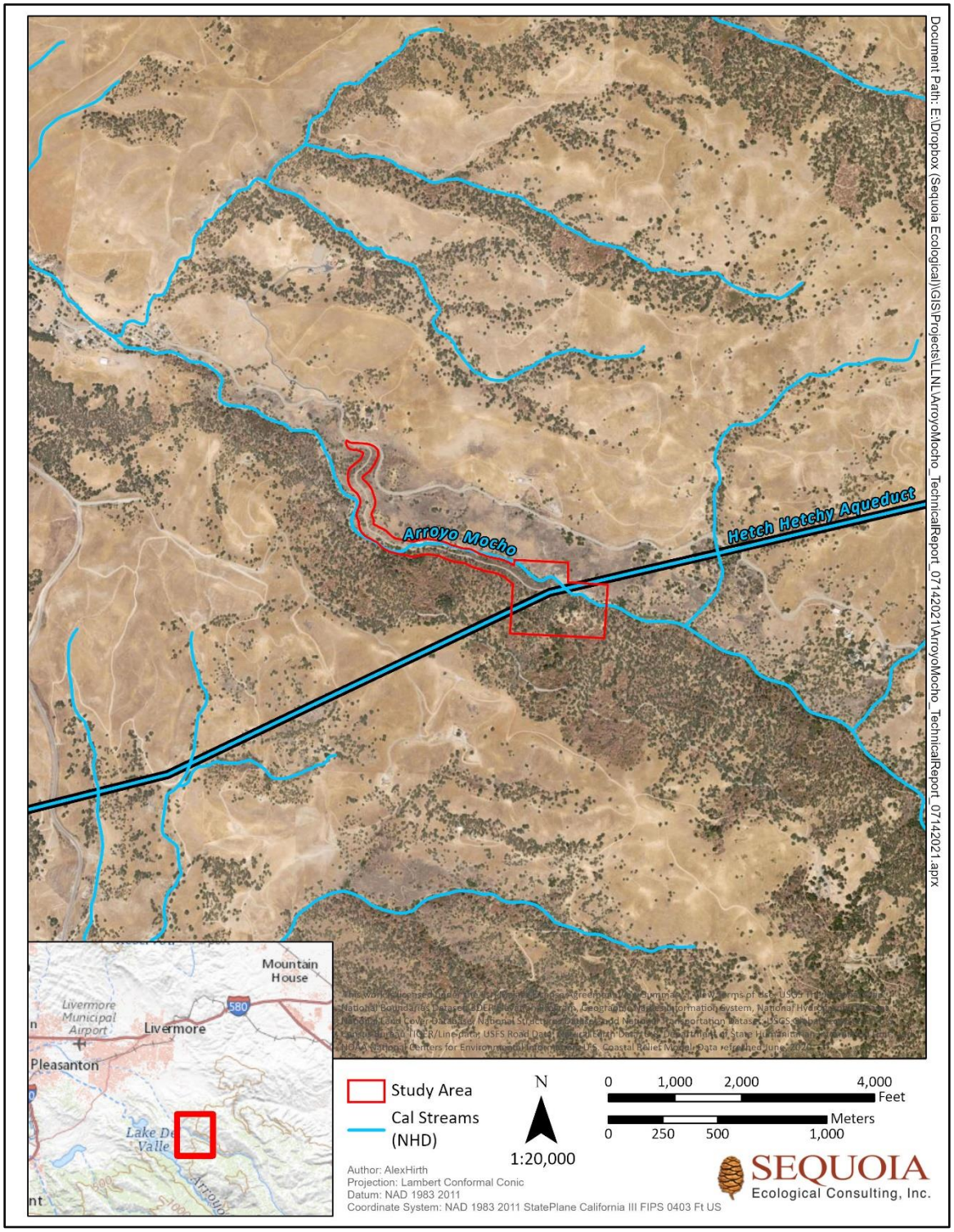

Figure 2. Location Map of the Study Area.

3.0 METHODS

Sequoia performed a desktop review to determine potential special-status species that may occur within the Study Area and adjacent lands. Only special-status amphibians, reptiles, and fish were included in this study; all other species and sensitive resources were not evaluated. After determining which special-status species may occur, Sequoia conducted a site visit of the Study Area. Using those results, Sequoia evaluated the extent of presence and/or likelihood of occurrence of identified special-status species in the Study Area. Sequoia also evaluated habitat suitability for these special-status species within the Study Area.

3.1 Definitions

3.1.1 Special-Status Species

For the purposes of this document, special-status species include:

- Plant, fish, and wildlife species listed as Threatened or Endangered under Federal Endangered Species Act (FESA), (50 CFR 17), and candidates for listing under the statute;
- Species protected by the California Fish and Game Code (CFGC), including nesting birds and Fully Protected species;
- Plant, fish, and wildlife species listed as Threatened or Endangered under California Endangered Species Act (CESA); and the laws and regulations for implementing CESA as defined in CFGC §2050 et seq. and the California Code of Regulations (CCR) 14 CCR §670.1 et seq., and candidates for listing under the statute (CFGC §2068);
- Species meeting the definition of 'Rare' or 'Endangered' under CEQA Guidelines 14 CCR §15125 (c) and/or 14 CCR §15380, including plants listed on CNPS Lists 1A, 1B, 2A, and 2B, 3, and 4. Plants occurring on CNPS Ranks 3 and 4 are "plants about which more information is necessary," and "plants of limited distribution" (CNPS 2001). These plants may be included as special-status species on a case-by-case basis due to local significance or recent biological information (see additional definition information below);
- USFWS Birds of Conservation Concern;
- Fully Protected species, as designated by the California Department of Fish and Wildlife (CDFW), (CFGC 3511, 4700, 5050, and 5515);
- Species of Special Concern, as designated by the CDFW and required by 14 CCR §15380; and/or
- Avian species protected under the MBTA of 1918.

3.2 Desktop Review

Sequoia reviewed relevant databases, literature, and known observations for baseline information regarding biological resources occurring and potentially occurring in the Study Area and the immediate vicinity. The review included the following sources:

- USFWS Information for Planning and Consultation (IPaC) search (USFWS 2021a), and Critical Habitat Portal (USFWS 2021b)
- CDFW California Fish Passage Assessment Database (CalFish 2021)
- PISCES database, UC Davis (2021)
- CalFish, UC Davis (2021)
- USFWS National Wetlands Inventory (USFWS 2021c)
- CDFW California Natural Diversity Database (CNDDB) for the project polygon and a 3-mile buffer (CNDDB 2021)
- Lawrence Livermore National Laboratory field observations and personal communications
- Aerial photographs (Google Earth 2021)

3.3 Site Visit

Sequoia biologists Brett Hanshew and Aurelie Muckenhirn conducted a survey at the Arroyo Mocho Study Area on July 27, 2021, to record biological resources and identify the presence and suitability of habitats for target special status species. Surveys involved observing all habitats within the Study Area. Sequoia cross-referenced the habitats occurring on the project site with the habitat requirements of identified special-status species. Due to the steep and rugged terrain, direct access to much of the Study Area was not feasible. Biologists surveyed representative portions of each habitat type present within the Study Area and were able to visually observe the locations of different habitat types, ecotones, and prominent macrohabitat features. During the surveys, the biologists scanned for special-status species or suitable habitat for these species, including California tiger salamander, California red-legged frog, and steelhead, among others. Any special-status species or suitable habitat was documented.

4.0 RESULTS

4.1 Topography and Hydrology

Topography and hydrology within the Study Area was previously analyzed by Nomad Ecology in their report entitled “Wetland/Aquatic Resources Delineation, for the 2021 Sitewide Environmental Impact Statement, Lawrence Livermore National Laboratory Facilities, Alameda and San Joaquin Counties” (2020). The topography of the area consists of the Arroyo Mocho creek canyon with steep slopes rising on either side. This section of Arroyo Mocho lies between Crane Ridge and Cedar Ridge, within the Upper Arroyo Mocho sub-watershed. At the northern end of the site, the creek flows approximately north to south, and the slopes on either side of the road are predominantly west-facing. Farther south,

the river turns to flow east-west, and slopes rising on either side are north- or south-facing. Elevation ranges from approximately 1,280 feet just south of the water storage tanks, to 1,440 feet in the southwest corner of the Study Area, to approximately 960 feet at the bottom of the canyon.

Hydrology at Arroyo Mocho is characterized by steep slopes that drain into Arroyo Mocho Creek, an intermittent waterway. Arroyo Mocho Creek is located in HUC 12 and characterized as a 2nd order stream consisting of primarily gravel-and-cobble dominant streambed, with larger diameter sediment (e.g., boulders) present sporadically throughout. Arroyo Mocho drains the Arroyo Mocho watershed, which ultimately flows into the Alameda Creek Watershed. Arroyo Mocho has its headwaters at Mount Mocho, approximately 13 miles south of the Study Area. It is fed by multiple small tributaries as it follows Mines Road from Mount Mocho and through Arroyo Mocho Canyon. Arroyo Mocho flows seasonally, largely as a response to precipitation events and resultant contributions from groundwater. The USGS maintained a stream gage (USGS No. 11176000, Latitude 37°37'35", Longitude 121°42'13" NAD27) downstream of the Study Area until January 16, 2002, however review of the annual hydrograph for the preceding 12 years (Figure 3) shows consistent patterns of flashy, precipitation-driven flows during the winter (November-April/May) with retreat to base, or no, flow between June and October. Daily discharge statistics. Base flow during winter conditions is approximately 1-5 cubic feet per second (cfs), and storm events can increase flow several orders of magnitude to 200-800+ cfs, indicating a very flashy system.

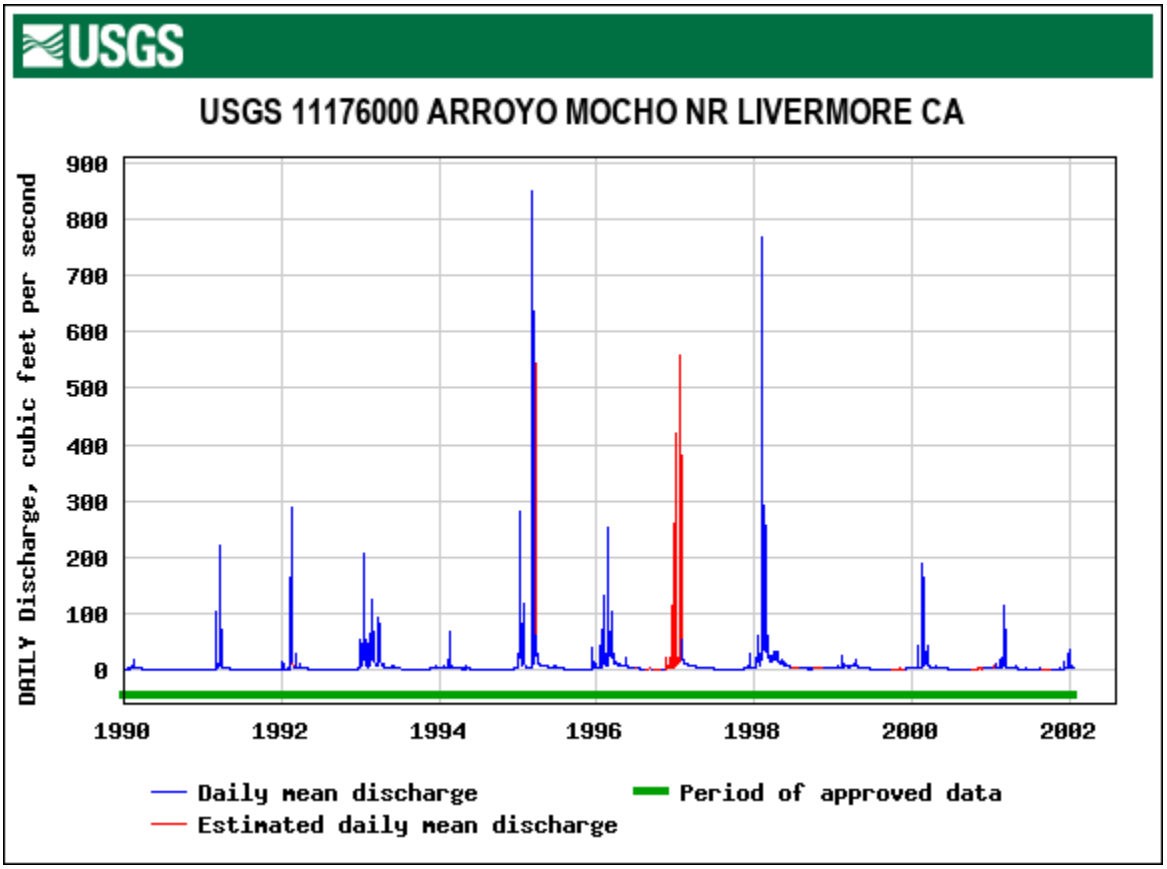

Figure 3. Hydrograph of Upper Arroyo Mocho sub-watershed, 1990-2002, measured downstream of Study Area.

From the Study Area, Arroyo Mocho Creek flows approximately 6 miles northwest to the City of Livermore where it enters the Lower Arroyo Mocho sub-watershed. It then flows approximately 10 miles west, crossing Highway 84 and multiple surface streets before joining Arroyo de la Laguna just east of the city of Pleasanton. Arroyo de la Laguna flows 3 miles south to Sunol, where it joins Alameda Creek and cuts west through Niles Canyon, where it parallels Highway 84 for 15 miles before emptying into San Francisco Bay, approximately 4 miles south of the Highway 92 bridge.

Locally, the climate of the Study Area is characterized as Mediterranean, with cool wet, winters and warm to hot, dry summers. Annual average rainfall is approximately 23 inches (PRISM 2020).

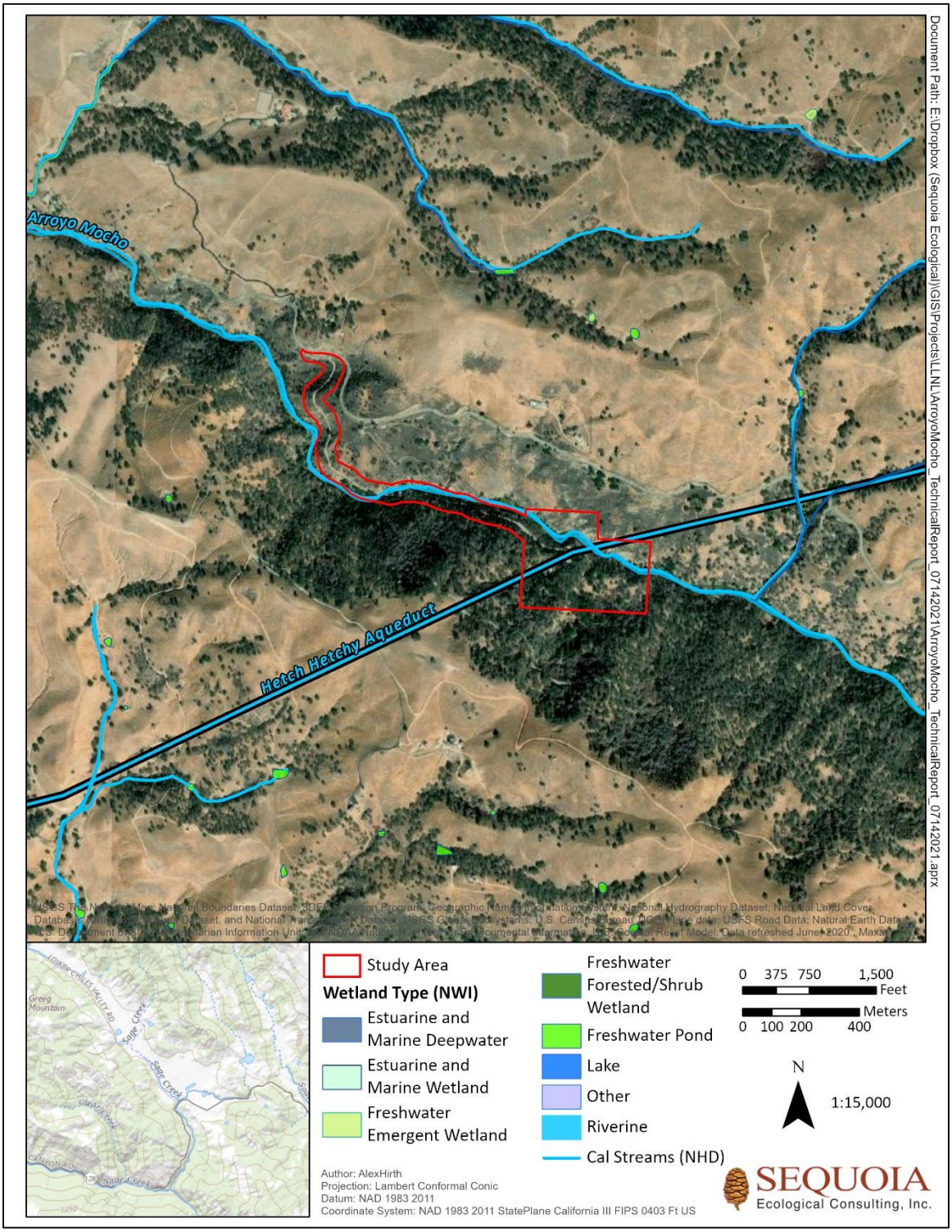

Figure 4. USFWS National Wetlands Inventory and National Hydrography Dataset features in the Study Area and surrounding vicinity.

4.2 Vegetation Communities and Wildlife Habitats

Vegetation communities within the Study Area were previously identified by Nomad Ecology in "Wetland/Aquatic Resources Delineation, for the 2021 Sitewide Environmental Impact Statement, Lawrence Livermore National Laboratory Facilities, Alameda and San Joaquin Counties" (2020). Vegetation communities present at the Arroyo Mocho Study Area consist primarily of blue oak woodland, California buckeye groves, and Diablan sage scrub. White alder riparian forest and central coast riparian scrub are present along Arroyo Mocho Creek. Small amounts of coast live oak woodland and non-native annual grassland are present in the upland communities. Brief descriptions of these vegetation communities are provided below.

4.2.1 Blue Oak Woodland

Blue oak woodland is a highly variable climax woodland dominated by blue oak, but usually including individuals of other oak species as well as gray pine (*Pinus sabiniana*) (Holland 1986). Stands vary from open savannas with grassy understories to fairly dense woodlands with shrubby understories (Holland 1986). At the Arroyo Mocho Study Area, this vegetation type is present on the north-facing slopes above the creek. Characteristic species include blue oak in the canopy, with a sparse shrub layer of sticky monkeyflower (*Diplacus aurantiacus*), poison oak (*Toxicodendron diversilobum*), California sagebrush, and coyote mint *(Monardella villosa* subsp. *villosa*). Herbaceous cover consists of slender wild oats, brome fescue, soft chess, wild sweetpea (*Lathyrus vestitus* var. *vestitus*), wild parsley (*Torilis nodosa*), wall bedstraw (*Galium parisiense*), and yarrow (*Achillea millefolium*).

4.2.2 Coast Live Oak

Coast live oak woodland is typically dominated by one tree species, coast live oak, but can vary from pure stands to mixtures with conifers and broadleaf trees to open savannas (Holland 1986). The shrub layer is poorly developed, and the herb component is continuous and dominated by non-native grasses and other introduced taxa (Holland 1986). In the Study Area, coast live oak woodland is located in a stand on a north-facing slope above the creek. Coast live oak woodland at Arroyo Mocho is dominated by coast live oak in the canopy, with scattered California buckeye (*Aesculus californica*). Poison oak is dominant in the shrub layer with interspersed toyon (*Heteromeles arbutifolia*) and hollyleaf cherry (*Prunus ilicifolia* subsp*. ilicifolia).* Herbaceous cover consists of slender oats, soft chess, Pacific sanicle (*Sanicula crassicaulis*), California lomatium (*Lomatium californicum),* and California maidenhair fern (*Adiantum jordanii*).

4.2.3 California Buckeye Groves

Holland (1986) does not describe California buckeye groves, although Sawyer et al. (2009) describe it as a community with California buckeye dominant or co-dominant in the tree canopy, shrubs common in the understory, and a sparse to grassy herbaceous layer. This vegetation type is present in the southeast

corner of the Study Area on a gradual north-facing slope. California buckeye is dominant in the canopy, and the shrubby understory consists mostly of poison oak. Herbaceous cover consists of Italian thistle (*Carduus pycnocephalus* subsp*. pycnocephalus*), dove's foot geranium (*Geranium molle*), slender oats, miner's lettuce (*Claytonia perfoliata* subsp*. perfoliata*), and blue wildrye.

4.2.4 White Alder Riparian Forest

White alder riparian forest is a medium-tall, broad-leafed community dominated by white alder (*Alnus rhombifolia*), with a shrubby, deciduous understory (Holland 1986). It is common in steep-sided canyons with narrow riparian corridors (Holland 1986). In the Study Area, this community is restricted to the riparian corridor immediately along Arroyo Mocho Creek. White alder dominates in the canopy with red willow scattered throughout and co-dominate in some places. Herbaceous cover consists of torrent sedge (*Carex nudata*), California hemp (*Hoita macrostachya*), mugwort (*Artemisia douglasiana*), Indian hemp (*Apocynum cannabinum*), California brickelbush (*Brickellia californica*), and sneezeweed *(Helenium puberulum*).

4.2.5 Central Coast Riparian Scrub

Central coast riparian scrub is a scrubby streamside thicket, varying from open to impenetrable, dominated by any of several willow species (Holland 1986). This early seral community may succeed to any of several riparian woodland or forest types absent severe flooding disturbance (Holland 1986). At Arroyo Mocho, this community is dominated by red willow and is restricted to the narrow riparian corridor immediately on Arroyo Mocho Creek. Scattered elderberry and coyote brush are present. White alder dominates in the canopy with red willow scattered throughout. Herbaceous cover consists of torrent sedge, California hemp, mugwort, Indian hemp, and sneezeweed.

4.2.6 Diablan Sage Scrub

Diablan sage scrub is a relatively dry vegetation community with sparse shrub flora and high diversity of perennial herbs, and is typically on shallow, rocky soils (Holland 1986). This vegetation type occurs on the slopes above the Arroyo Mocho streambed. The dense shrub layer is dominated by California sagebrush, poison oak, golden yarrow (*Eriophyllum confertiflora* var*. confertiflora*), sticky monkeyflower, and California buckwheat. Herbaceous species include Pacific sanicle, goldenback fern (*Pentagramma triangularis*), coyote mint, slender oats, ripgut brome, and red brome.

4.2.7 Non-native Annual Grassland

Non-native grassland is dominated by a sparse to dense cover of non-native annual grasses and weedy annual and perennial forbs, primarily of Mediterranean origin, that have replaced native perennial grasslands as a result of human disturbance (Holland 1986). Where not completely outcompeted by weedy non-native plant species, scattered native wildflower species and native perennial grass species considered remnants of the original vegetation may also be common (Holland 1986). At Arroyo Mocho,

this community is present in upland areas and is dominated by non-native annual grasses including slenderoats, ripgut brome, soft chess, red brome, and brome fescue, among others, as well as various native and non-native forbs.

4.2.8 Riverine

Riverine habitats can occur in association with many terrestrial habitats. Riparian habitats are found adjacent to many rivers and streams as is the case in Arroyo Mocho Study Area. Riverine habitats are also found contiguous to lacustrine and fresh emergent wetland habitats.

Intermittent or continually running water distinguishes rivers and streams. Streams begin as outlets of ponds or lakes (lacustrine) or rise from spring or seepage areas. All streams at some time experience very low flow and nearly dry up. Some streams, except for occasional pools, dry up seasonally every year. The temperature of the riverine habitat is not constant. In general, small, shallow streams tend to follow, but lag behind air temperatures, warming and cooling with the seasons. Rivers and streams with large areas exposed to direct sunlight are warmer than those shaded by trees, shrubs and high, steep banks. The constant swirling and churning of high-velocity water over riffles and falls result in greater contact with the atmosphere-and thus have a high oxygen content. In polluted waters, deep holes or low velocity flows, dissolved oxygen is lower (Smith 1974).

Within the Arroyo Mocho, this habitat type supports adjacent riparian habitat. The Arroyo Mocho consists of open and mixed canopy cover. The Arroyo Mocho stream generally has continuous flow during winter and into spring, containing pools and riffles over gravel-and-cobble dominant streambed, with larger diameter sediment (e.g., boulders) present sporadically throughout.

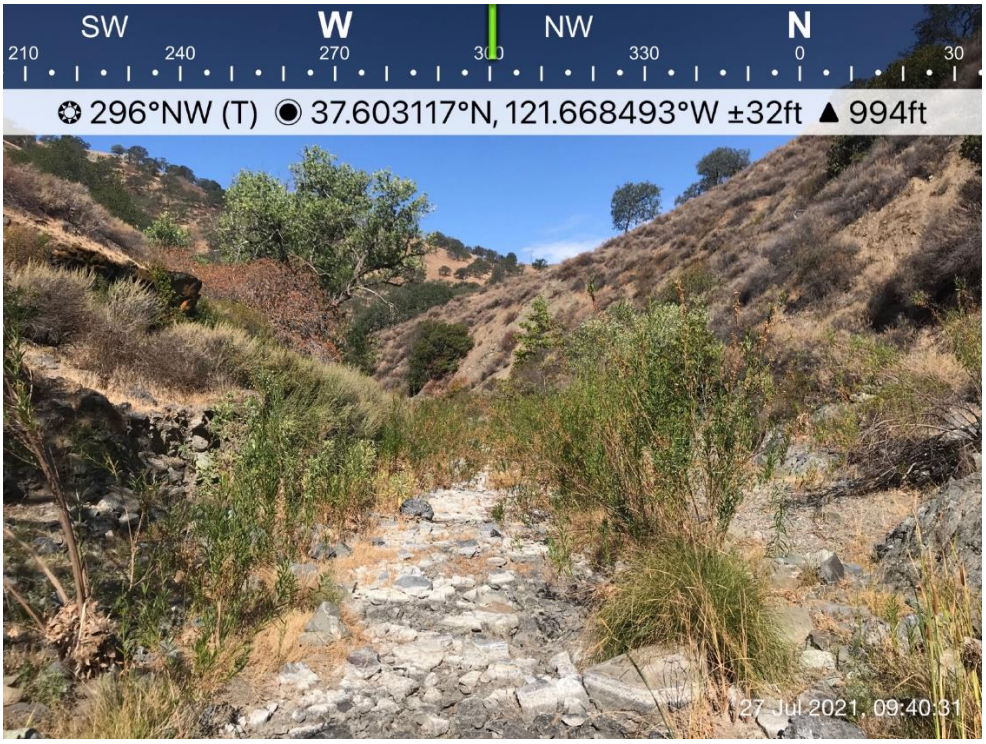

Figure 5. Representative photo of Arroyo Mocho stream within the Study Area (1).

Figure 6. Representative photo of Arroyo Mocho stream within the Study Area (2).

4.3 Special-Status Wildlife

The following species were identified during the desktop review process: California tiger salamander, California red-legged frog, foothill yellow-legged frog, steelhead, western pond turtle, Alameda whipsnake, and coast horned lizard (Figure 4). The following subsections discuss the potential for occurrence of each special-status species, along with their habitat requirements, occurrence classification, and basis for occurrence classification.

The potential to occur for each special-status species was evaluated according to the following criteria:

- *No Potential.* Habitat on and adjacent to the site is clearly unsuitable for the species' requirements (foraging, breeding, cover, substrate, elevation, hydrology, plant community, site history, disturbance regime).
- *Unlikely.* Few of the habitat components meeting the species' requirements are present, and/or the majority of habitat on and adjacent to the site is unsuitable or of very poor quality. The species is not likely to be found on the site.
- *Moderate Potential.* Some of the habitat components meeting the species' requirements are present, and/or only some of the habitat on or adjacent to the site is unsuitable. The species has a moderate probability of being found on the site.
- *High Potential.* All of the habitat components meeting the species' requirements are present and/or most of the habitat on or adjacent to the site is highly suitable. The species has a high probability of being found on the site.
- *Present.* Species is observed on the site or has been recorded (i.e., CNDDB, other reports) on the site recently.

A summary of this information can also be found in Appendix A.

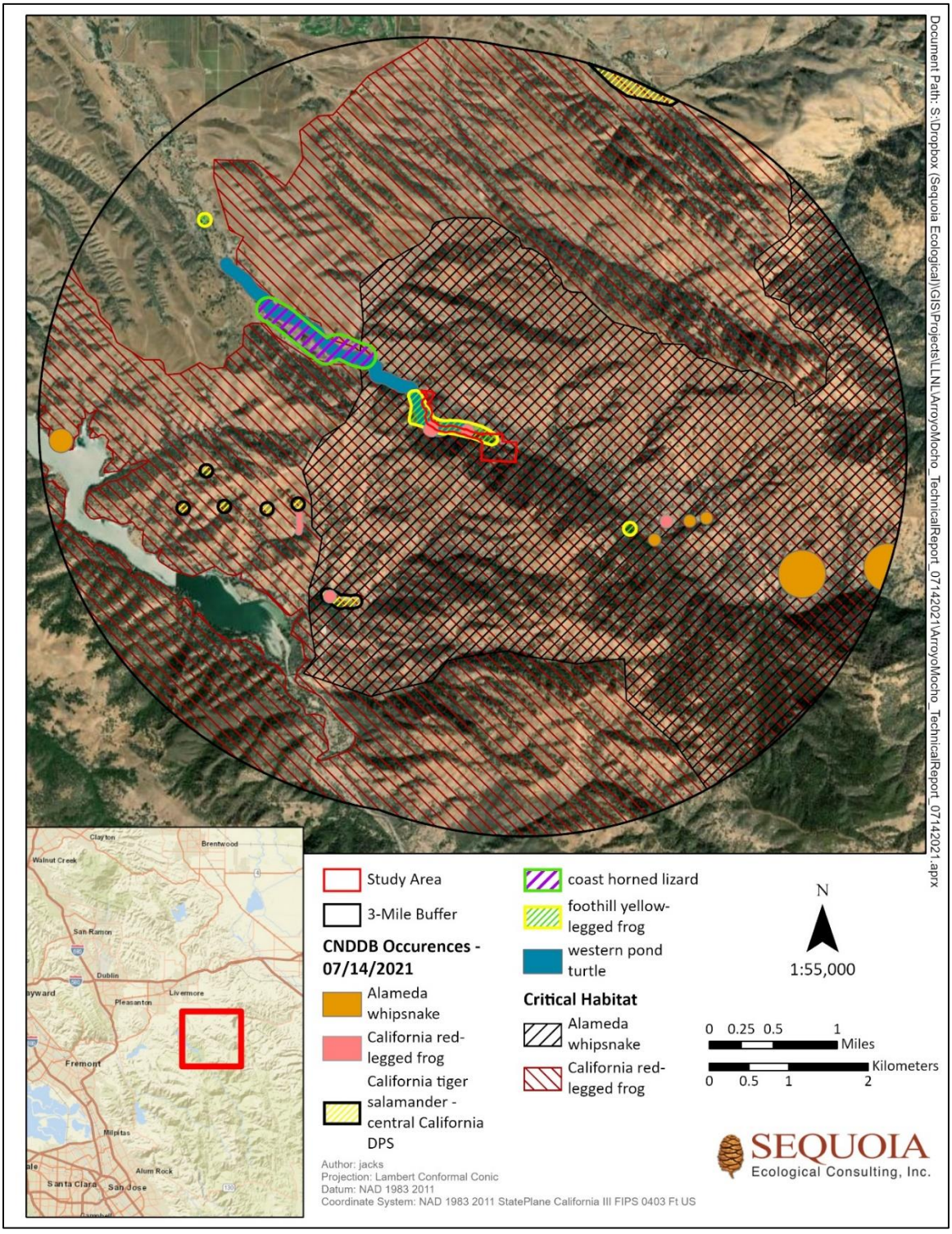

Figure 7. Closest Known Records for Special-Status Wildlife Species Within 3 Miles of the Study Area.

4.3.1 California Tiger Salamander

The Central California Distinct Population Segment (DPS) of the California tiger salamander was federally listed as a threatened species on August 4, 2004 (69 FR 47212), and was listed as a threatened species by the State of California effective August 19, 2010 (Section 670.5, Title 14, CCR, as amended). Critical habitat for the Central Valley, Sonoma, and Santa Barbara populations were designated for this species on August 23, 2005, August 31, 2011, and November 24, 2004, respectively. Recovery plans for the Central Valley, Sonoma, and Santa Barbara populations were published for this species on June 6, 2017, May 31, 2016, and December 12, 2016, respectively (USFWS 2017). The closest occurrence of critical habitat is located approximately 3 miles east of the project site (Figure 3).

The California tiger salamander is a large, terrestrial salamander distributed throughout the Central Valley and Central Coast ranges, from Colusa County south to San Luis Obispo and Kern counties, from sea level to 3,500 feet in elevation. Two disjunct populations are located within Sonoma County and Santa Barbara County, which are geographically isolated from the Central Valley population. Shaffer et al. (2004) identified six distinct populations based on mitochondrial DNA and allozymes analysis: the Santa Rosa area of Sonoma County; the Bay Area (central and southern Alameda, Santa Clara, western Stanislaus, western Merced, and the majority of San Benito counties); the Central Valley (Yolo, Sacramento, Solano, eastern Contra Costa, northeast Alameda, San Joaquin, Stanislaus, Merced, and northwestern Madera counties); southern San Joaquin Valley (portions of Madera, central Fresno, and northern Tulare and Kings counties); the Central Coast Range (southern Santa Cruz, Monterey, northern San Luis Obispo, and portions of western San Benito, Fresno, and Kern counties); and Santa Barbara County.

California tiger salamanders inhabit lowland grasslands, oak savannah, and mixed woodland habitats, and require vernal pools, seasonal ponds, or semi-permanent calm waters that pond water for a minimum of 3 to 4 months in duration for breeding and larval maturation, and adjacent upland refugia and foraging habitat with small mammal burrows (Storer 1925, Stebbins 2003). Migration to breeding sites begins with the onset of autumn rains, typically in November. California tiger salamanders have been reported to migrate up to 1.3 miles (2.2 kilometers) between breeding ponds and upland habitat (Orloff 2007). Searcy and Shaffer (2011) estimated average migration distance to be 1,844 feet (562 meters), and they estimated that Central California tiger salamanders are physiologically capable of migrating up to 1.5 miles (2.4 kilometers) each breeding season. In addition, Searcy and Shaffer (2011) estimated that 95 percent of the population occurred within 1.16 miles (1.86 kilometers) of the breeding pond. Eggs are laid singly or in small clusters on the pond bottom or attached to individual strands of vegetation (Storer 1925, Barry and Shaffer 1994, Jennings and Hayes 1994). Metamorphosis requires a minimum of 10 weeks following hatching, and young migrate en masse when temporary pools begin to dry in late spring or early summer (Jennings and Hayes 1994, Stebbins 2003). Outside of the breeding season, juveniles and adults remain in subterranean habitat, typically in small mammal burrows provided by California ground squirrels and pocket gophers (Barry and Shaffer 1994, Jennings and Hayes 1994, Stebbins 2003).

The California tiger salamander is the most vulnerable of the group of amphibians that breed in vernal pools because its long developmental interval to metamorphosis restricts it to pools that are the longest lasting, and therefore often the largest in size. Loss and degradation of complexes of vernal pools pose a significant threat, as many of these areas are essential breeding habitat. California tiger salamanders are at risk due to loss of habitat from development of agriculture and grazing lands, habitat fragmentation, loss and degradation of complexes of vernal pools, and introduction of predatory exotic species such as mosquitofish (*Gambusia affinis*), American bullfrog (*Lithobates catesbeiana*), and Louisiana red swamp crayfish (*Procambarus clarkii*), and poisoning of ground squirrels (Zeiner et al. 1988, Shaffer et al. 1993, Jennings and Hayes 1994). High mortality of California tiger salamanders while crossing roads travelling to and from breeding sites also adversely affects both individuals and at-risk populations (Barry and Shaffer 1994).

The closest known record for California tiger salamander is located 1.1 miles southwest of the Study Area (CNDDB Occurrence No. 187; Figure 4). This breeding occurrence was present in a nearby stock pond. Although pools are found within the stream, the Study Area does not contain any suitable breeding habitat due to water flow. Crevices under rocks and other underground refugia can provide suitable over-wintering habitat for this species. There is low potential for California tiger salamander to occur within the Study Area. Although the study area is close to known breeding populations, and there is a lack of existing dispersal barriers (i.e., roadways, residential neighborhoods, water treatment facilities, etc.), the site has only very marginal quality as upland habitat for the California tiger salamander.

4.3.2 Foothill Yellow-Legged Frog

The foothill yellow-legged frog is divided into five distinct clades in California based on genetic divergence and conservation concern (CDFW 2019). The northwest/north coast clade is the most intact population and is designated as a California Species of Special Concern. Historically, foothill yellow-legged frog occurred from west of the crest of the Cascade Mountains in Oregon south to the Transverse Ranges in Los Angeles County, and in the Sierra Nevada foothills south to Kern County (Zweifel 1955; Stebbins and McGinnis 2012). The current range now excludes coastal areas south of northern San Luis Obispo County and foothill areas south of Fresno County, where the species is considered extirpated (Jennings and Hayes 1994). In a 1994 report (Fellers 1994), healthy reproducing populations were reported in suitable habitat throughout the Diablo Range in Alameda, western Stanislaus, Santa Clara, San Benito, and western Fresno counties. Foothill yellow-legged frogs are found in or near rocky streams in a variety of habitats, including valley foothill hardwood, valley-foothill riparian, coastal scrub, mixed conifer, mixed chaparral, and wet meadows (Zeiner et al. 1988). Foothill yellow-legged frogs rarely migrate far from perennial or intermittent streams (Stebbins and McGinnis 2012). The foothill yellow-legged frog requires shallow, flowing water in small to moderate-sized streams containing some cobble-sized substrate and portions of open canopy important for basking (Hayes and Jennings 1988; Jennings 1988; Bourque 2008). It deposits its egg masses on the downstream side of cobbles and boulders over which a relatively thin, gentle flow of water exists (Storer 1925; Fitch

1936; Zweifel 1955; Kupferberg 1996).

The closest occurrence of this species is located within the Study Area (CNDDB Occurrence No.474; Figure 4). Additionally, foothill yellow-legged frogs of various life stages (larvae, metamorph, adult) are documented in CNDDB within the 3-mile radius of the Study Area.

During the removal of the lower water crossing and construction of a clear span bridge in 2004, LLNL monitored construction daily for approximately one month during the summer. During daily monitoring conducted in 2004, foothill yellow-legged frogs were abundant within the study area (L. Paterson pers. comm).

Lawrence Livermore National Laboratory biologists conducted foothill yellow-legged frog egg mass surveys prior to and following the 2004 bridge project. During these surveys, multiple egg masses were observed on-site in 2003 and 2007, LLNL has not conducted systematic monitoring for protected amphibians within the study area since 2007, although and one adult was observed in 2017 (C. Murphy pers. comm.). Highly suitable breeding habitat exists on site within isolated pools, as well as non-breeding aquatic habitat in rocky streams with higher exposure to scour, and dispersal habitat including riparian woodlands and stream edges containing boulders occur within the Study Area. Due to the occurrences nearby and within the Study Area and suitable habitat, this species is expected to occur within the Study Area.

4.3.3 California Red-Legged Frog

The California red-legged frog was listed as a federally threatened species on May 23, 1996 (USFWS 1996; 61 FR 25813) and is designated as a California Species of Special Concern (CDFW 2021). A recovery plan was published for the California red-legged frog on September 12, 2002 (USFWS 2002). Critical habitat was designated for this species on April 13, 2006, and revisions to the critical habitat designation were published on March 17, 2010. The project site is not located within critical habitat for this species.

The California red-legged frog is distributed throughout 26 counties in California but is most abundant in the San Francisco Bay Area (USFWS 2017b). Populations have become isolated in the Sierra Nevada, northern coast, and northern Transverse Ranges (Jennings and Hayes 1994, Stebbins and McGinnis 2012). The species is believed to be extinct from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico (USFWS 2017c). California red-legged frogs predominantly inhabit permanent water sources such as streams, lakes, marshes, natural and man-made ponds, and ephemeral drainages in valley bottoms and foothills up to 4,900 feet in elevation (Jennings and Hayes 1994, Bulger et al. 2003, Stebbins and McGinnis 2012). Adults breed in a variety of aquatic habitats, while larvae and metamorphs use streams, deep pools, backwaters of streams and creeks, ponds, marshes, sag ponds, dune ponds, and lagoons. Stock ponds are frequently used for breeding when they provide a suitable hydroperiod, pond structure, and vegetative cover, and are managed to control non-native predators such as bullfrogs and exotic fish. Breeding occurs between November and April within still or slow-moving water with light to dense, riparian or emergent vegetation, such as cattails (*Typha*

spp.), tules (*Scirpus* spp.), or overhanging willows (*Salix* spp.) (Hayes and Jennings 1988). Egg masses are attached to vegetation below the surface and hatch after 6 to 14 days (Storer 1925, Jennings and Hayes 1994). Larvae undergo metamorphosis 3.5 to 7 months following hatching and reach sexual maturity at 2 to 3 years of age (Jennings and Hayes 1984, 1994). During the dry season, California red-legged frogs may use refugia in upland habitat, such as small mammal burrows or adjacent moist vegetation (USFWS 2002).

Tatarian (2008) noted that 57 percent of frogs fitted with radio transmitters in the Round Valley of eastern Contra Costa County stayed at their breeding pools, whereas 43 percent moved into adjacent upland habitat or to other aquatic sites. This study reported a peak of seasonal terrestrial movement in the fall months corresponding to 0.2 inches of precipitation that tapered off into spring. Upland movement activities ranged from 3 to 233 feet, averaging 80 feet, and were associated with a variety of refugia, including ground squirrel burrows at the bases of trees or rocks, logs, grass thatch, crevices, cow hoof prints, and a downed barn door; others were associated with upland sites lacking refugia (Tatarian 2008). The majority of terrestrial movements lasted from 1 to 4 days; however, one female was reported to remain in upland habitat for 50 days (Tatarian 2008). Uplands closer to aquatic sites were more often used and were more commonly associated with areas exhibiting higher object cover (e.g., small woody debris, rocks, and vegetative cover).

Most frogs move away from breeding ponds to upland areas. The distance moved is site dependent, though one recent study shows that only a few frogs move farther than the nearest suitable non-breeding habitat (Fellers and Kleeman 2007). In this Marin County study, the farthest distance traveled was 0.87 miles and most dispersing frogs moved through grazed pastures to reach the nearest riparian habitat (Fellers and Kleeman 2007). The manner in which California red-legged frogs use upland habitats is not well understood; studies are currently examining the amount of time California red-legged frogs spend in upland habitats, patterns of use, and whether there is differential use of uplands by juveniles, subadults, and adults. Dispersal distances are considered to be dependent on habitat availability and environmental conditions (Rathbun 1998). Upland habitat is defined as areas within 200 ft of the edge of riparian vegetation or dripline surrounding aquatic and riparian habitat and comprised of vegetation such as grasslands, woodlands and/or wetland/riparian plant species that provides shelter, forage, predator avoidance for the frog. Upland habitat can include natural features such as boulders, rocks, organic debris, small mammal burrow, and moist leaf litter or manmade features such as industrial debris and agricultural features (USWFS 2011).

There are five known California red-legged frog occurrences in the CNDDB within 3 miles of the Study Area, including one within the Study Area (CNDDB Occurrence No. 824; Figure 4). Three of the five occurrences are adult observations. During the removal of the lower water crossing and construction of a clear span bridge in 2004, LLNL monitored construction daily for approximately one month during the summer. During daily monitoring conducted in 2004, foothill yellow-legged frogs were abundant within the study area. Although foothill yellow-legged frogs were abundant, less than five California red-legged frogs were observed. (L. Paterson, pers. comm.)

The Study Area is within California red-legged frog critical habitat (Unit ALA-2). It provides low suitability as potential breeding habitat within pools in the Arroyo Mocho stream due to flashy water flows during winter storm events, and lack of in-water vegetation for oviposition. High quality non-breeding aquatic habitat can be found throughout and adjacent to Arroyo Mocho. In addition, adjacent oak woodland and grassland provide highly suitable upland and dispersal habitat. Due to the occurrences nearby and within the Study Area and presence of suitable habitat, California red-legged frogs have a high potential of occurring within the Study Area.

One American bullfrog was observed within the study area during rare plant surveys conducted on April 20, 2020 (L. Paterson pers. comm.).

4.3.4 Western Pond Turtle

The western pond turtle, a California Species of Special Concern (CDFW 2021), is the only freshwater turtle native to greater California and is distributed along much of the western coast, from the Puget Sound in Washington south to the Baja Peninsula, Mexico (Storer 1930). Overall, western pond turtles are habitat generalists, and have been observed in slow-moving rivers and streams (e.g., oxbows), lakes, reservoirs, permanent and ephemeral wetlands, stock ponds, and sewage treatment plants. They prefer aquatic habitat with refugia, such as undercut banks and submerged vegetation (Holland 1994), and require emergent basking sites, such as mud banks, rocks, logs, and root wads to thermoregulate their body temperature (Holland 1994, Bash 1999). Pond turtles are omnivorous and feed on a variety of aquatic and terrestrial invertebrates, fish, amphibians and aquatic plants.

Western pond turtles regularly utilize upland terrestrial habitats, most often during the summer and winter, especially for oviposition (females), overwintering, seasonal terrestrial habitat use, and overland dispersal (Reese 1996, Holland 1994). Females have been reported ranging as far as 1,640 feet from a watercourse to find suitable nesting habitat (Reese and Welsh 1997). Nest sites are most often situated on south- or west-facing slopes, are sparsely vegetated with short grasses or forbs, and are scraped in sands or hard-packed, dry silt or clay soils (Holland 1994, Rathbun et al. 1992, Holte 1998, Reese and Welsh 1997). Western pond turtles exhibit high site fidelity, returning in sequential years to the same terrestrial site to nest or overwinter (Reese 1996).

Females in southern and central California lay their clutch as early as late April to late July, although they predominantly lay in June and July. In the early morning or late afternoon, gravid females leave the water and move upland to nest (Holland 1994). Natural incubation times vary, ranging from 80 to 100+ days in California. In northern California and Oregon, hatchlings remain in the nest after hatching and overwinter, emerging in the spring. In southern and central California, those that do not overwinter emerge from the nest in the early fall (Holland 1994).

The western pond turtle is known from one CNDDB occurrence within the Study Area (CNDDB Occurrence No. 58; Figure 4). Western pond turtles were observed during surveys conducted in preparation for the 2004 bridge project (L. Paterson pers. comm.) Moderately suitable basking habitat

including rocks and logs, breeding habitat including open woodlands, foraging, and migration/dispersal habitat is present within the Study Area. One adult western pond turtle was observed within the project site during rare plant surveys conducted on April 20, 2020 (L. Paterson pers. comm.). This species has high potential to occur within the Study Area, as it contains suitable habitat and there are known recent observations within or nearby the Study Area.

4.3.5 Alameda Whipsnake

The Alameda whipsnake was listed as a federally threatened species on December 5, 1997 (USFWS 1997) and is state listed as threatened (CDFW 2021). Critical habitat was designated for this species on October 2, 2006, and a recovery plan was published in 2003 (USFWS 2003).

The Alameda whipsnake is a subspecies of the California whipsnake (*Masticophis lateralis*), which inhabits the foothills and mixed deciduous and pine forests of the Sierra Nevada and Coast Range mountains from Siskiyou County in northern California to the flatland desert in Cañon de Los Reyes in southern Baja California (Stebbins 2012). The Alameda whipsnake inhabits the inner Coast Ranges in western and central Contra Costa and Alameda counties (Jennings 1983, Swaim 1994). Habitat fragmentation has restricted its range to five recognized subpopulations: Tilden-Briones population, Oakland-Las Trampas population, Hayward-Pleasanton Ridge population, Mount Diablo-Black Hills population, and Sunol-Cedar Mountain population.

Suitable habitat for this species includes mixed chaparral, coastal scrub, and annual grassland and oak woodlands adjacent to scrub habitats. Grassland areas linked to scrub by rock outcrops or river corridors are also considered primary habitat constituent elements (USFWS 2003). This habitat provides cover for snakes during dispersal, shelter from predators, and a variety of microhabitats where whipsnakes can move to regulate their body temperature (Swaim 1994). Important features include small mammal burrows, rock outcrops, talus, and other forms of shelter that provide snakes with alternative habitats for temperature regulation, protection from predators, sites for egg-laying, and winter hibernaculum. Whipsnakes will use grasslands, woodlands, riparian areas, and the fringes of developed or disturbed land cover types to move to and from core habitat areas.

The closest known record for this species is located 1.18 miles east-southeast of the Study Area (CNDDB) Occurrence No. 184, Figure 4); however, the species may be present where suitable habitat exists in the Study Area. In addition, the Study Area is within Alameda whipsnake critical habitat (Unit 5A). Alameda whipsnakes have high potential to occur within the Study Area, as high-quality suitable habitat is present. The Study Area is comprised of core scrub habitat such as Diablan scrub, adjacent oak woodlands, riparian habitat, and annual grasslands that provide dispersal and foraging habitat. In addition, although there are no known occurrences within or directly nearby the Study Area, there is highly suitable habitat adjacent to the Study Area and the Study Area lies within critical habitat for the species.

4.3.6 Coast Horned Lizard

Coast horned lizard is a California Species of Special Concern. It has no federal listing status. This lizard occurs in a variety of habitats, such as valley-foothill hardwood, conifer and riparian habitats, as well as in pine-cypress, juniper, and annual grass habitats; however, it is most common in sandy washes with scattered shrubs. Open areas are required for basking. This species forages on the ground in open areas, usually between shrubs and often near ant nests. Beetles, grasshoppers, flies, and wasps are also included in its diet (Stebbins 2003). Populations of California horned lizard have been reduced throughout the lowlands of California due to urbanization and agricultural expansion, particularly due to deep disking practices that routinely occur in these areas.

The closest known record for this species is located .43 miles northwest of the Study Area (CNDDB Occurrence No. 595, Figure 4). The Study Area has moderate habitat suitability, although it is primarily lacking in friable, fine grained, sandy soils commonly used by this species. Isolated deposits of sandy soils along the streambed would provide suitable habitat if, or where, they occur. Due to the nearby known occurrences, coast horned lizards have moderate potential to occur.

4.3.7 Steelhead

Steelhead occupy various habitats and distinct locations throughout California and may exhibit varying life histories and seasonal running. The following is a summary of the steelhead DPS that may be present within the Study Area:

Central California Coast DPS (Federally Threatened): This DPS listing includes all runs in coastal basins from the Russian River in Sonoma County, south to Soquel Creek in Santa Cruz County. It includes the San Francisco and San Pablo Bay basins, but excludes the Sacramento-San Joaquin River basins.

Steelhead exhibit a flexible life history pattern (i.e., migratory and resident), entering freshwater streams to spawn and rear young (Moyle 2002). Steelhead are not genetically distinct from rainbow trout; they are differentiated based on life history because they (steelhead) are anadromous, while rainbow trout remain freshwater residents during their entire lives. Both are born in freshwater rivers, but like other anadromous fish, steelhead migrate to the ocean to grow and only return to freshwater to spawn (CalFish 2017a). Steelhead require a minimum water depth of 7 inches for adult migration from ocean to spawning habitat. They have been observed to be unable to traverse water at velocities exceeding 10 feet per second. Ideal water temperatures for migration range between 7.7 and 11.1 ˚C. The preferred spawning habitat for steelhead is cool oxygenated water in small- to medium-sized rivers and their medium-sized perennial tributaries. Steelhead build redds (nests dug into stream gravel) at the head of riffles where water is well oxygenated, with nearby pools and deepwater runs that provide safe refuge. Cool water temperatures are required for optimal growth, and the species requires well-oxygenated waters. Fry and parr stay in waters less than 20 inches in depth, ranging in temperature from 7.2 to 15.6 ˚C. Juvenile rearing habitat is composed of larger cobble substrate at a depth of 10 to 20 inches, typically in estuaries or at edges of streams (CalFish 2017b). Unlike all other pacific salmonids,

steelhead can be iteroparous (able to breed multiples times) and return to the ocean after spawning.

The desktop review showed no known CNDDB occurrences of this species within 3 miles of the Study Area. The UC Davis PISCES database considers Arroyo Mocho (including the Study Area) to be outside of the historic, current, and observed range of the species (Santos et al. 2014). Additionally, review of CDFW's CPAD shows that Alameda Creek has a downstream blockage at the BART weir site that prevents steelhead from accessing upstream reaches and tributaries, including Arroyo Mocho (CDFW, 2021). The concrete apron of the BART weir is considered impassable due to its steep slope and the high sheeting velocities that occur over its surface. Therefore, steelhead is not expected to occur within the Study Area when flowing water is present as the waters are considered non-anadromous. Resident rainbow trout (*Oncorhyncus mykiss irrideus*) located in perennial reaches downstream of the Study Area would not be considered steelhead on this basis.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 Discussion of Results

The Study Area is a relatively undisturbed portion of the Upper Arroyo Mocho sub-watershed and contains a wide variety of habitats. The lack of human presence in these areas likely promotes species diversity and inhabitance. Due to the diversity of moderate-high quality, undisturbed habitats present, the following species have a moderate to high potential occur within the Study Area: California tiger salamander, California red-legged frog, foothill yellow-legged frog, western pond turtle, coast horned lizard, and Alameda whipsnake.

Maintaining existing habitat and wildlife corridors between adjacent areas is crucial. Wildlife corridors are habitats that provide connectivity between natural communities otherwise separated by urbanization and other development. These areas allow animals to travel between communities for seasonal migration, provide access to overwintering/summering habitat, and facilitate breeding. In addition, the wildlife corridors allow animals the opportunity to migrate from natural disasters and other forms of habitat loss, as well as a chance to recolonize habitats previously extirpated.

Wildlife corridors around the Study Area specifically provide access and dispersal to adjacent ponds, thus allowing breeding opportunities and communication between populations for several of these aquatic species including California tiger salamander and California red-legged frog. Maintaining open corridors along the Arroyo Mocho itself is important for access to other breeding and non-breeding locations, especially when aquatic conditions during drought years can be highly variable. Additionally, the Study Area may be a potential dispersal corridor for Alameda whipsnake, which have been sighted in nearby scrub habitats.

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Appendix A

Special-Status Wildlife Species with Potential to Occur on the Arroyo Mocho Site.

Table 1. Special-Status Wildlife Species with Potential to Occur on the Arroyo Mocho Site.

Scientific Name	Common Name	Listed Status	Habitat Requirements	Potential for Occurrences
Amphibians/Reptiles				
Ambystoma californiense	California tiger salamander	FT, CT, SSC	Occurs in vernal and seasonal pools and associated grasslands, oak savanna, woodland, and coastal scrub. Needs underground refuges (e.g., small mammal burrows, pipes) in upland areas such as grassland and scrub habitats.	Low Potential. Low suitable breeding habitat on-site, known CNDDB closest breeding occurrence 1.1. miles away. Low to moderate upland and dispersal habitat, no ground squirrel burrows observed.
Rana boylii	Foothill yellow-legged frog	West/Central Coast Clade: CE	Found in rocky streams and rivers with rocky substrate and open, sunny banks in forests, woodlands, and chaparral. May also occur in isolated pools and vegetated backwaters.	High Potential. Highly suitable breeding, upland, and dispersal habitat occurs on-site. CNDDB occurrence listed within Study Area.
Rana draytonii	California red-legged frog	FT, SSC	Occurs in semi-permanent or permanent water at least 2 feet deep, bordered by emergent or riparian vegetation, and upland grassland, forest, or scrub habitats for aestivation and dispersal.	Moderate Potential. Low suitable breeding habitat. High quality upland, and dispersal habitat occurs on-site. CNDDB occurrence listed within Study Area.
Emys marmorata	Western pond turtle	SSC	Occurs in rivers, ponds, and freshwater marshes, and nests in upland areas (sandy banks or grassy open fields) up to 1,640 feet from water.	High Potential. Moderate suitable breeding, upland, and dispersal habitat occurs on-site. One CNDDB occurrence listed within Study Area and one recent observation from LLNL in 2020.
Masticophis lateralis euryxanthus	Alameda whipsnake	FT, CT	A fast-moving, diurnal predator; actively hunts with head held high. Limited range, mostly in Alameda and Contra Costa counties, utilizing chaparral, scrub, and rocky outcrops as core habitat. Also uses surrounding woodlands and grassland for foraging and dispersal.	High Potential. High suitable habitat onsite including Diablan scrub, oak-woodland, etc.
Phrynosoma blainvillii	Coast horned lizard	SSC	Occurs in variety of habitats, such as valley-foothill hardwood, conifer and riparian habitats, as well as in pine-cypress, juniper, and annual grass habitats; however, it is most common in sandy washes with scattered shrubs. Open areas are required for basking and foraging. This	Moderate Potential. Low suitable habitat on-site, however CNDDB occurrence only .43 miles away. Lacking friable, sandy soil and ant nests.

Scientific Name	Common Name	Listed Status	Habitat Requirements	Potential for Occurrences
			species is often found near ant nests.	
Fishes				
Oncorhynchus mykiss	Steelhead – Central California Coast DPS	FT, SSC	Occurs in fresh water, fast-flowing, highly oxygenated, clear, cool streams where riffles tend to dominate pools; small streams with high elevation headwaters close to the ocean that have no impassible barriers; spawning and high elevation headwaters.	Not likely. No CNDDB occurrences within 3 miles, Study Area is considered outside of historic and current range, and significant barriers limit upstream dispersal.

Key to status:
FE=Federally listed as endangered species
FT=Federally listed as threatened species
FC=Federally listed as a candidate species for listing
CE=California listed as endangered species
CT=California listed as threatened species
FP=California listed as fully protected
SSC=California species of special concern