# Existing Information for Vernal Pool Branchiopods

## Conservancy Fairy Shrimp

#### Endangered Species Act Listing Status

Conservancy fairy shrimp was listed as endangered throughout its range on September 19, 1994 (59 FR 48136–48153). In its 5-year review of the species issued in June 2012, USFWS recommended that the species remain listed as endangered (USFWS 2012:28).

#### General Life History and Habitat Requirements

Conservancy fairy shrimp primarily occurs in large turbid vernal pools (playa pools) that remain inundated much longer than do typical vernal pools, often into summer (Eriksen and Belk 1999:88; USFWS 2012:3). Conservancy fairy shrimp has been found in vernal pools on a variety of landforms, geologic formations, and soil types (USFWS 2005:II-183) and within a wide elevation range (16 to 5,577 feet) (Eriksen and Belk 1999:88). Conservancy fairy shrimp rarely co-occurs with vernal pool fairy shrimp and California fairy shrimp (*Linderiella occidentalis*) and generally greatly outnumbers these species when they do co-occur (Eriksen and Belk 1999:89).

Similar to other vernal pool branchiopods, Conservancy fairy shrimp is adapted to the environmental conditions of its ephemeral vernal pool habitats. These adaptations include the ability of fairy shrimp cysts to remain dormant in the soil when vernal pool habitats are dry. Fairy shrimp are also able to complete their lifecycle (from cyst hatching to reproducing) within the relatively short time period when vernal pools are inundated with water (USFWS 2005:II-195). Differences in the rate of maturation and reproduction of vernal pool branchiopods are thought to be the result of variations in water temperature (Helm 1998:134).

For the purpose of assessing the distribution of habitat for Conservancy fairy shrimp in the action area, the species model included seasonal wetlands mapped using remote imagery and a 250-foot upland buffer. Features were removed from the model if they did not show obvious signs of pooling in the winter and spring or if they did show signs of pooling and saturation year round or into late summer, which would not be conducive to the species life history.

#### Historical and Current Distribution and Abundance

USFWS’s *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* recognizes that, although the historical distribution vernal pool fairy shrimp is unknown, Conservancy fairy shrimp was probably found in suitable vernal pool habitats throughout much of the Central Valley and southern coastal regions of California (USFWS 2005:II-181). Except for one population along the Central Coast in Ventura County, all current locations of Conservancy fairy shrimp are in the Central Valley. USFWS has identified 10 Conservancy fairy shrimp populations: (1) Vina Plains, Butte and Tehama Counties; (2) Sacramento NWR, Glenn County; (3) Mariner Ranch, Placer County; (4) Yolo Bypass Wildlife Area, Yolo County; (5) Jepson Prairie, Solano County; (6) Mapes Ranch, Stanislaus County; (7) University of California, Merced area, Merced County; (8) the State Route 165 area, Merced County; (9) Sandy Mush Road, Merced County; and (10) Los Padres National Forest, Ventura County (USFWS 2012:3).

#### Occurrence in the Action Area

Modeled habitat for Conservancy fairy shrimp, seasonal wetlands, is present in the grasslands around and to the west of Funks Reservoir, in the action area (Figures 4.2-5, 4.2-6). The likelihood of Conservancy fairy shrimp occurring in the action area is low because there are no large, deep pools characteristic of habitat for this species. There are no known occurrences in the action area. There are no protocol-level survey reports documenting whether or not this species is present, however. Of the 43 known occurrences of Conservancy fairy shrimp range-wide, one is within 5 miles of the action area (Figure 4.2-6, CDFW 2019).

#### Limiting Factors, Threats, and Stressors

The loss and modification of vernal pool habitat have been and continue to be the primary threats to the Conservancy fairy shrimp (USFWS 2012:14). Historically, the primary causes of vernal pool habitat loss were conversion to agriculture and water conveyance and storage projects. More recently, vernal pool habitat loss has resulted from widespread urbanization (USFWS 2005:I-18). Vernal pool habitat also has been altered and degraded as a result of changes in natural hydrology, invasive species, incompatible grazing regimes, infrastructure projects, recreational activities, erosion, climatic and environmental change, and contamination (USFWS 2005:I-16–17).

Human disturbances and changes in land use practices can alter the hydrology of vernal pools and result in changes in the timing, frequency, and duration of inundation, which can create conditions that make vernal pools unsuitable for vernal pool species (USFWS 2005:I-20).

#### Recovery

Conservancy fairy shrimp are included in USFWS’s *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005).

The overall goals of the recovery plan are to achieve and protect in perpetuity self-sustaining populations of each species in the recovery plan, delist the 20 federally listed plant and animal species, and ensure the long-term conservation of the 13 species of special concern. The actions needed to meet the goals of the recovery plan are as follows:

* Protect habitat within core areas, vernal pool regions, and all other areas that contribute to recovery, as appropriate.
* Refine areas for vernal pool conservation by conducting GIS, remote sensing, and other analyses.
* Restore habitat where needed and adaptively manage vernal pool conservation areas.
* Develop and implement standardized survey and monitoring protocols to determine success in meeting recovery criteria.
* Conduct research necessary to refine management techniques and recovery criteria.
* Develop and implement cooperative programs and partnerships by establishing regional recovery implementation working groups.
* Develop and implement participation programs in the form of outreach and education.

The action area overlaps the San Joaquin Valley Vernal Pool Region but is not located within any core areas.

#### Critical Habitat

Critical habitat for Conservancy fairy shrimp was designated on August 6, 2003 (68 FR 46684 46867) and consists of a total of eight disjunct units that constitute approximately 250,000 acres. The critical habitat units are located in Tehama and Butte Counties, Solano County, Glenn County, Stanislaus County, Merced County, and Ventura County. The action area overlaps critical habitat for conservancy fairy shrimp south of the Travis Air Force Base in the city of Fairfield.

## Vernal Pool Tadpole Shrimp

#### Endangered Species Act Listing Status

Vernal pool tadpole shrimp was listed as endangered throughout its range on September 19, 1994 (59 FR 48136–48153). In its 5-year review of the species, USFWS recommended that the species remain listed as endangered (USFWS 2007b:37). On May 25, 2011, USFWS announced that it was initiating a new 5-year review to determine if the species should remain listed as endangered. The 5-year review has not yet been published.

#### General Life History and Habitat Requirements

Vernal pool tadpole shrimp occurs in a variety of seasonal habitats, including vernal pools and other seasonal pools, ponded clay flats, roadside ditches, and stock ponds (Helm 1998:132; Rogers 2001:1002). Habitats where vernal pool tadpole shrimp have been observed range in size from clear, vegetated vernal pools of less than 25 square feet to winter lakes of more than 80 acres (Helm 1998:133). Vernal pool tadpole shrimp produces cysts (eggs) that lie in the soil until the next winter rains trigger the eggs to hatch (USFWS 2007b:3).

In the laboratory, vernal pool tadpole shrimp eggs collected from dry pond sediments at the end of summer hatched in 17 days (Ahl 1991:137). In a study using large plastic pools to simulate natural vernal pools, Helm found that vernal pool tadpole shrimp reached maturity in an average of 38 days following hatching, and reproduced an average of 54 days after hatching (Helm 1998:133). Differences in water temperature, which strongly effects the growth rates of aquatic invertebrates, may cause variation in rates of growth and maturation (USFWS 2005:II-206). During the wet season, vernal pool tadpole shrimp can produce additional eggs that hatch without going through a dormant period (Ahl 1991:137).

Although vernal pool tadpole shrimp is adapted to seasonal habitats, it has a relatively long lifespan compared with other large branchiopods (USFWS 2005:II-206). In Helm’s study, vernal pool tadpole shrimp lived an average of 143 days. The long lifespan of vernal pool tadpole shrimp is attributed to its ability to tolerate drying pool conditions and warm water (Helm 1998:133, 135). Vernal pool tadpole shrimp feeds on both living organisms, such as fairy shrimp and other invertebrates, and on detritus (USFWS 2007c).

To assess the distribution of habitat for vernal pool tadpole shrimp in the action area, the species model included seasonal wetlands mapped using remote imagery and a 250-foot upland buffer. Features were removed from the model if they did not show obvious signs of pooling in the winter and spring or if they did show signs of pooling and saturation year round or into late summer, which would not be conducive to the species life history.

#### Historical and Current Distribution and Abundance

The historical range of vernal pool tadpole shrimp likely consisted of the Central Valley and Central Coast regions of California (USFWS 2005:II-204). Currently, vernal pool tadpole shrimp occurs sporadically in the Central Valley from Shasta County to northwestern Tulare County and the San Francisco Bay Area (USFWS 2007b:II-204–205, 2005:4). The greatest number of vernal pool tadpole shrimp occurrences is in Sacramento County (USFWS 2007b:4).

#### Occurrence in the Action Area

Potentially suitable habitat for vernal pool fairy shrimp, seasonal wetlands, is present in the grasslands around and to the west of Funks Reservoir, in the action area. There is one occurrence of vernal pool tadpole shrimp in the action area where the Delevan Pipeline intersects the Delevan NWR. This occurrence is attributed to a specific pool that was discovered as occupied by vernal pool tadpole shrimp in 1994. There are another four vernal pool tadpole shrimp occurrence within 5 miles of the Delevan Pipeline, in the Sacramento NWR north of the action area (CDFW 2019) Figures 4.2-5 and 4.2-6 show the distribution of occurrences around the action area and modeled habitat in the construction and inundation area.

#### Limiting Factors, Threats, and Stressors

Conversion of vernal pool habitat to agricultural uses and urban development was identified as the primary threat to vernal pool tadpole shrimp in 1994 (59 FR 48136−48153). The largest continuing threats to vernal pool tadpole shrimp are habitat loss and modification as a result of urban development, agricultural conversion, altered hydrology, and inappropriate land management (USFWS 2007b:16). Vernal pool habitat has also been altered and degraded as a result of invasive species, incompatible grazing regimes, infrastructure projects, recreational activities, erosion, climatic and environmental change, and contamination (USFWS 2005:I-16–17). Modification of surrounding uplands that alter vernal pool hydrology may also result in habitat loss (59 FR 48136−48153).

Human disturbances and changes in land use practices can alter the hydrology of vernal pools and result in changes in the timing, frequency, and duration of inundation, which can create conditions that make vernal pools unsuitable for vernal pool species (USFWS 2005:I-20).

Climate change is anticipated to contribute to extended drought conditions, which could change the length of inundation of vernal pool tadpole shrimp habitats. The larger, deeper pools that provide habitat for vernal pool tadpole shrimp should hold water during dry years; however, these types of pools, especially on protected lands, are limited. Drought conditions can cause pools to fail to inundate or dry up before reproduction is complete, resulting in limited or no reproductive success. Climate change could also result in conditions in which increased winter precipitation and runoff result in longer periods and greater frequency of inundation. The additional inundation can convert seasonal habitat into more permanently flooded habitat that is more suitable for invasive species such as bullfrogs and mosquitofish (USFWS 2007b:35).

#### Recovery

Vernal pool tadpole shrimp are included in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005). The overall goals of the recovery plan are to achieve and protect in perpetuity self-sustaining populations of each species in the recovery plan, delist the 20 federally listed plant and animal species, and ensure the long-term conservation of the 13 species of special concern. The actions needed to meet the goals of the recovery plan are as follows:

* Protect habitat within core areas, vernal pool regions, and all other areas that contribute to recovery, as appropriate.
* Refine areas for vernal pool conservation by conducting GIS, remote sensing, and other analyses.
* Restore habitat where needed and adaptively manage vernal pool conservation areas.
* Develop and implement standardized survey and monitoring protocols to determine success in meeting recovery criteria.
* Conduct research necessary to refine management techniques and recovery criteria.
* Develop and implement cooperative programs and partnerships by establishing regional recovery implementation working groups.
* Develop and implement participation programs in the form of outreach and education.

The action area overlaps the San Joaquin Valley Vernal Pool Region, but is not located within any core areas.

#### Critical Habitat

Critical habitat for vernal pool tadpole shrimp was designated on February 10, 2006 (71 FR 7118–7316). The action area overlaps critical habitat for vernal pool tadpole fairy shrimp south of the Travis Air Force Base in the city of Fairfield.

## Vernal Pool Fairy Shrimp

#### Endangered Species Act Listing Status

Vernal pool fairy shrimp was listed as threatened throughout its range on September 19, 1994 (59 FR 48136-48153). In its 5-year review of the species, USFWS recommended that the species remain listed as threatened (USFWS 2007a:47). On May 25, 2011, USFWS announced that it was initiating a new 5-year review to determine if the species should remain listed as threatened. The 5-year review has not yet been published.

#### General Life History and Habitat Requirements

Similar to other vernal pool branchiopods, vernal pool fairy shrimp are adapted to the environmental conditions of its ephemeral vernal pool habitats. These adaptations include the ability of fairy shrimp cysts to remain dormant in the soil when vernal pool habitats are dry. Fairy shrimp are also able to complete their lifecycle (from cyst hatching to reproducing) within the relatively short time period when vernal pools are inundated with water (USFWS 2005:II-195).

Vernal pool fairy shrimp commonly inhabit vernal pools or vernal pool-like habitats, typically in grassland landscapes. Most commonly, vernal pool fairy shrimp are found in vernal pools or vernal swales in unplowed grasslands (Eng et al. 1990:257). The chemical composition of the habitat and temperature variations resulting from pools filling at different times, and the distribution of pools along altitudinal and longitudinal gradients, are the most important factors in determining the distribution of different species of fairy shrimp (including vernal pool fairy shrimp) and their appearance from year to year (Eng et al. 1990:273; USFWS 2007a:5). Vernal pool fairy shrimp sometimes occur in other wetlands that provide habitat characteristics similar to those of vernal pools; these other wetlands include alkaline rain pools, rock outcrop pools, and some disturbed and constructed sites, including tire ruts, ditches, and puddles (59 FR 48136–48153, September 16, 1994; Eriksen and Belk 1999:93; Helm 1998:129–130; USFWS 2007a:24, 58). Occupied habitats range in size from 6-square-foot puddles to pools exceeding 24 acres (Eriksen and Belk 1999:93). Vernal pool fairy shrimp are not found in riverine, marine, or other permanent waters (USFWS 2007a:4). Suitable pools must stay inundated long enough for the shrimp to complete their life cycle.

Vernal pool fairy shrimp matures very quickly and is able to have multiple clutches of eggs per lifespan (Eriksen and Belk 1999:93). In a study using large plastic pools to simulate natural vernal pools, Helm found that vernal pool fairy shrimp reached maturity in an average of 18 days following hatching, and reproduced an average of 40 days after hatching. Differences in the rate of maturation and reproduction of vernal pool branchiopods are thought to be the result of variations in water temperature (Helm 1998:133–134).

For the determining presence or absence of vernal pool fairy shrimp, the species model included seasonal wetlands mapped using remote imagery and 250 feet of upland habitat surrounding vernal pools (250 feet is a standard default measure used in vernal pool branchiopod habitat models to capture surrounding uplands and address potential indirect effects). Seasonal wetlands were removed from the model if they did not did not show obvious signs of pooling in the winter and spring or if they did show signs of pooling and saturation year round or into late summer, which would not be conducive to the species life history.

#### Historical and Current Distribution and Abundance

Vernal pool fairy shrimp is known to occur in a wide range of vernal pool habitats in the southern and Central Valley areas of California, and in two vernal pool habitats in Jackson County, Oregon (USFWS 2005:II-192). The species is currently found in fragmented habitats across the Central Valley of California from Shasta County to Tulare and Kings Counties, in the central and southern Coast Ranges from Napa County to Los Angeles County, and inland in western Riverside County (USFWS 2005:II-193, 2007a:17). The historical distribution of vernal pool fairy shrimp likely matched the historical distribution of vernal pools in California’s Central Valley and southern Oregon. Although the current range is similar to the historic range, remaining populations are much more fragmented and isolated than prior to widespread agricultural land conversion (USFWS 2005:II-192).

#### Occurrence in the Action Area

Modeled habitat for vernal pool fairy shrimp, seasonal wetlands, is present in the grasslands around and to the west of Funks Reservoir, in the action area. There are no California Natural Diversity Database (CNDDB) element occurrences for vernal pool fairy shrimp in the action area. There is one CNDDB element occurrence for vernal pool fairy shrimp within 5 miles of the action area (CDFW 2019). Figures 4.2-5 and 4.2-6 show the distribution of occurrences around the action area and modeled habitat in the construction and inundation area.

#### Limiting Factors, Threats, and Stressors

Conversion of vernal pool habitat to agricultural uses and urban development was identified as the primary threat to vernal pool fairy shrimp in 1994 (59 FR 48136−48153). The largest continuing threats to vernal pool fairy shrimp are habitat loss and modification of habitat as a result of urban development, agricultural conversion, and infrastructure construction, especially along the edge of urban areas (USFWS 2007a:27). Vernal pool habitat has also been altered and degraded as a result of changes in natural hydrology, invasive species, incompatible grazing regimes, infrastructure projects, recreational activities, erosion, climatic and environmental change, and contamination (USFWS 2005:I-16–17). Modification of surrounding uplands that alter vernal pool hydrology may also result in habitat loss (59 FR 48136−48153).

Human disturbances and changes in land use practices can alter the hydrology of vernal pools and result in changes in the timing, frequency, and duration of inundation, which can create conditions that make vernal pools unsuitable for vernal pool species (USFWS 2005:I-20).

Drought and climate change have the potential to affect vernal pool fairy shrimp populations. Drought conditions can cause pools to fail to inundate or dry up before reproduction is complete, resulting in limited or no reproductive success (USFWS 2007a:44). Climate change is anticipated to result in changes in vernal pool inundation patterns and temperature regimes that could negatively affect vernal pool fairy shrimp. Increased variability in precipitation and loss of soil moisture from evaporation and transpiration could result in reduced water depth and inundation or changes in pool temperatures that affect cyst hatching or the ability of vernal pool fairy shrimp to complete its lifecycle (USFWS 2007a:45).

#### Recovery

Vernal pool fairy shrimp are included in USFWS’s *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005).

The overall goals of the recovery plan are to achieve and protect in perpetuity self-sustaining populations of each species in the recovery plan, delist the 20 federally listed plant and animal species, and ensure the long-term conservation of the 13 species of special concern. The actions needed to meet the goals of the recovery plan are as follows:

* Protect habitat within core areas, vernal pool regions, and all other areas that contribute to recovery, as appropriate.
* Refine areas for vernal pool conservation by conducting GIS, remote sensing, and other analyses.
* Restore habitat where needed and adaptively manage vernal pool conservation areas.
* Develop and implement standardized survey and monitoring protocols to determine success in meeting recovery criteria.
* Conduct research necessary to refine management techniques and recovery criteria.
* Develop and implement cooperative programs and partnerships by establishing regional recovery implementation working groups.
* Develop and implement participation programs in the form of outreach and education.

The action area overlaps the San Joaquin Valley Vernal Pool Region but is not located within any core areas.

#### Critical Habitat

Critical habitat for vernal pool fairy was designated on February 10, 2006 (71 FR 7118–7316). The action area overlaps critical habitat for vernal pool fairy shrimp south of the Travis Air Force Base in the city of Fairfield.

# Effects on Vernal Pool Branchiopods

## Geotechnical Investigations

This section describes the effects of geotechnical activities associated with the Proposed Action on federally listed vernal pool branchiopods (Conservancy fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp).

The vernal pool branchiopods may be present in seasonal wetlands that occur in the action area. Geotechnical investigations would completely avoid any effects on vernal pool branchiopods or their habitat with the implementation of the *Avoidance of Occupied Habitat for Geotechnical and Geophysical Work* conservation measure described in Chapter 2, Section 2.5.3.4, *Vernal Pool Branchiopods Conservation Measures*, which would require that no geotechnical boring or excavation work be conducted within 250 feet of any vernal pool branchiopod habitat identified during pre-activity surveys and mapping. Implementation of *Avoidance and Minimization Specific to Geotechnical Exploration* described in Section 2.5.3.1, *General Conservation Measures*, would ensure that water from aquifer and well testing would be placed into tankers and 55-gallon drums, respectively, and would not be discharged in uplands or wetlands within the action area. Implementation of the *Conduct Biological Resources Awareness Training* conservation measure, described in Section 2.5.3.1, would ensure that the proposed activities do not affect these species by making workers aware of the species habitat requirements and the need to avoid the species habitat.

## Construction

This section describes the effects of construction of the Proposed Action on federally listed vernal pool branchiopods (Conservancy fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp).

### Direct Effects

#### Potential Injury or Mortality

Vehicles and heavy equipment used at the construction sites could injure or kill vernal pool brachiopods or their eggs or cysts, particularly as a result of heavy machinery driving through vernal pools, if individuals are present within the construction footprint. Implementation of *Avoidance of Occupied Habitat* in Section 2.5.3.4 would require that temporary work, staging, and access areas for construction activities be located at least 250 feet from vernal pool branchiopod habitat; therefore, no injury or mortality of these species would result in areas that are temporarily affected.

There are no conservation measures to avoid or minimize these effects where habitat would be removed permanently in the construction and inundation area.

#### Permanent Habitat Loss

Modeled habitat for vernal pool branchiopods, seasonal wetlands, is present in the grasslands around and to the west of Funks Reservoir, in the action area. An estimated 57 acres of federally listed vernal pool branchiopod modeled habitat overlaps with the construction and inundation area, and construction of the Proposed Action would permanently remove this habitat. As described under *Minimization of Habitat Disturbance* in Section 2.5.3.1, *General Conservation Measures*, workers would confine ground disturbance and habitat removal to the smallest area necessary to facilitate construction activities.

As described in Chapter 4, Conservancy fairy shrimp has a very low likelihood of being present in the action area. Thus, the likelihood of the Proposed Action affecting the species is low. Although vernal pool fairy shrimp and vernal pool tadpole shrimp have a greater likelihood of being present and affected by the Proposed Action, surveys in the action area have not resulted in observations of this species. There are no critical habitat or important recovery areas for these three listed species in the action area.

As described under *Avoidance of Occupied Habitat* in Section 2.5.3.4, *Vernal Pool Branchiopods Conservation Measures*, activities with flexible locations would avoid occupied habitat.1 The Authority would offset unavoidable loss of occupied habitat complexes, including indirect effects within 250 feet of pools, through habitat restoration, protection, and management as described in under *Compensation for Unavoidable Loss of Habitat* in Section 2.5.3.4.

##### Temporary Habitat Loss

Habitat loss could result from development and use of temporary access roads, work areas, and staging areas that would be restored to pre-construction conditions when construction is complete. For the purpose of this effects assessment, all habitat loss is quantified as permanent and described in the preceding section because: (a) not all work areas have been identified (the permanent impact footprint was extended by 100 feet to ensure temporary habitat loss is subsumed within the permanent impact calculations); and (b) the temporary disturbance would typically last multiple years, in which case USFWS would normally treat these effects as permanent.

Even though this assessment treats temporary habitat loss as permanent loss for the purpose of quantifying impacts, measures would be in place to minimize temporary habitat loss. As described under *Avoidance of Occupied Habitat* in Section 2.5.3.4, temporary disturbance areas would be located within the permanent disturbance footprint, such as the reservoir inundation area, where possible. Where temporary work, staging, and access areas for construction activities are located outside the permanent footprint, they would be at least 250 feet from occupied vernal pool branchiopod habitat, thus avoiding temporary habitat loss for the species.[[1]](#footnote-1)

### Indirect Effects

Indirect effects are effects that are reasonably certain to result from the Proposed Action but would occur later in time*.*

#### Disturbance from Recreation

The proposed recreation areas have a footprint that represents the total project area within which land-based recreation could occur. Although the entire recreation area footprints are included within the permanent habitat loss areas analyzed under *Direct Effects*, only approximately 15 percent of each footprint would experience a permanent loss of habitat as a result of the construction of facilities such as boat ramps, picnic areas, roads, restroom facilities, and campgrounds. The remainder of the acreage could experience indirect impacts of constructing the recreation facilities from activities such as hiking, camping in undesignated areas, firewood collection, fuelbreak and vegetation maintenance, and off-road vehicle or mountain bike use. These activities could result in additional loss or degradation of vernal pool branchiopod habitat and injury or mortality of individuals through crushing by humans, pets, or recreational vehicles. Including the entire recreation areas in the permanent disturbance footprint accounts for these ongoing impacts.

### Operation

Reclamation does not anticipate any operational effects of the Proposed Action on the federally listed vernal pool branchiopods (Conservancy fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp).

# General Conservation Measures and Avoidance and Minimization Measures

## General Terrestrial Conservation Measures

##### G-CM1: Conduct Biological Resources Awareness Training

Prior to the start of ground-disturbing work (including vegetation clearing, grading, and equipment staging), a USFWS-approved biologist will conduct a mandatory biological resources awareness training for all project personnel. This training will cover sensitive biological resources. The training will cover the natural history, appearance (using representative photographs), legal status of species, regulatory protections, penalties for noncompliance, benefits of compliance, as well as the avoidance and minimization measures to be implemented. Participants will be required to sign a form that states they have received and understand the training. The Sites Authority will maintain the record of training and make it available to agencies, upon request. If new construction personnel are hired for the Project, the contractor will ensure that the new personnel receive the mandatory training before starting work.

##### G-CM2: Treatment of Vehicles, Equipment, Hazardous Materials, and Dust

Construction vehicles will observe the posted speed limit on hard-surfaced roads and a 10 mile-per­hour speed limit on unpaved roads during travel within habitat for federally listed species. Construction vehicles and equipment will restrict off-road travel to the designated construction areas. Construction vehicles and equipment left on-site overnight will be thoroughly inspected each day for snakes and frogs before they are moved. All construction equipment will be maintained to prevent leaks of fuels, lubricants, or other fluids. To prevent possible resource damage from hazardous materials such as motor oil or gasoline, construction personnel will not service or refuel vehicles, construction equipment, or motorized tools within 300 feet of potentially suitable frog or snake aquatic habitat. Gravel roadways, staging areas, and other applicable areas will be sprayed with water as needed to minimize dust during construction activities,

##### G-CM4: Notification

The Sites Authority will notify USFWS within 24 hours in the event that a federally listed species becomes injured or killed at a construction site.

##### G-CM6: Decontamination

The Sites Authority will follow USFWS-approved decontamination protocols prior to any staff (biologists, surveyors, construction workers), equipment, tools, or vehicles entering action area waters or moist soils associated with waters in order to minimize the spread of pathogens. At a minimum, these measures will include the following:

* All organic matter should be removed from boots and vehicle tires and all other surfaces that have come into contact with water or potentially contaminated sediments. Cleaned items should be rinsed with clean water before leaving each study site.
* Boots and hands, etc. should be scrubbed with either a 75% ethanol solution, a bleach solution (0.5 to 1.0 cup per 1.0 gallon of water), Quat-128™ (1:60), or a 6% sodium hypochlorite 3 solution. Equipment should be rinsed clean with water between work areas. Cleaning equipment in the immediate vicinity of a pond or wetland should be avoided (e.g., clean in an area at least 100 feet from aquatic features). Care should be taken so that all traces of the disinfectant are removed before entering the next aquatic habitat.
* Used cleaning materials (liquids, etc.) should be disposed of safely, and if necessary, taken back to a facility proper disposal. Used disposable gloves should be retained for safe disposal in sealed bags.

##### G-CM7: Minimization of Habitat Disturbance

The Sites Authority will limit habitat disturbance to the minimal area necessary to facilitate construction. The boundaries of the disturbance areas (including staging, access, and construction areas), will be clearly marked and construction personnel and equipment will be confined within the delineated boundaries.

##### G-CM8: Avoidance and Minimization Specific to Geotechnical Exploration

General restrictions and guidelines that will be followed by personnel are listed below. The project foreman will be responsible for ensuring that crew members adhere to these guidelines and restrictions.

* No less than 1 week prior to mobilization, the Project geologist, drilling foreman, and agency-approved biologist will conduct a joint pre-geotechnical explorations survey. This team will review the site location and drilling plan and coordinate in the field the final locations of the borehole and geophysics lines, and the extent of the ground surface preparations (if any) at each bore location. The team will also confirm means of access by geotechnical studies personnel, and coordinate in the field the final means of transportation and route of transportation for accessing the locations.
* Qualified Biologists will conduct pre-construction surveys prior to the initiation of activities and will monitor these activities. Details are provided in Conservation Measures 4, 6, 7, and 8.
* Helicopter flights will follow designated routes to avoid potential and known nest locations for raptors, such as Swainson’s hawk, bald eagle, and golden eagles, and other special-status avian species, such as yellow-billed cuckoo. The timing of helicopter use (i.e., landing/take off and equipment delivery) will be adjusted based on the results of special-status/nesting bird surveys. Restrictions would be developed based on site specific conditions (e.g., proximity and status of the nest, baseline noise conditions, topography) and would include limiting flight times outside of periods of high activity (e.g., morning and dusk) and outside of sensitive nesting periods, such as egg incubation.
* All food-related trash will be disposed of in closed containers and removed from the work area daily during the work period. Personnel will not feed or otherwise attract fish or wildlife to the work site.
* No pets or firearms will be allowed in the work areas.
* Sites will follow USFWS-approved decontamination protocols prior to any staff (biologists,
* Temporary signs, staking, or flagging will be used to identify sensitive biological resources and project personnel will be advised to avoid disturbance of these areas. These areas will be identified during pre-activity surveys. Signs, staking, and flagging will be inspected by the biological monitor on a daily basis.
* Any worker who inadvertently injures or kills a sensitive species or finds one dead, injured, or entrapped will immediately report the incident to the project foreman, who will immediately report the incident to the Authority. The Authority will provide oral notification to the USFWS Sacramento Endangered Species Office and the local CDFW warden or biologist within 1 working day. The Authority will follow up with written notification to USFWS and CDFW (if necessary) within 5 working days.
* Maintain equipment and materials necessary for cleanup of accidental spills onsite. Clean up accidental spills and leaks immediately and dispose of properly.
* If no suitable upland disposal location is located nearby (i.e., one that would not result in discharges to sensitive biological resources including habitat of listed aquatic or semi-aquatic species) investigation-derived groundwater generated during field activities will be placed into water tanks and/or 55-gallon drums and disposed of offsite in an area without sensitive biological resources. Disposal of this water in either uplands near the investigation site or in offsite locations will be completed in accordance with Order R5-2016-0076-01 for Limited Threat Discharges to Surface Water or *General Waste Discharge Requirements for Discharges to Land with a Low Threat to Water Quality* 2003-003-DWQ, as applicable.
* If water drafting (pumping from the Sacramento River or other waterways in the action area) is needed, then and all intakes used to draft water will be screened to protect special-status fish and special-status amphibians, including eggs, larvae, and adults, from being entrained with water being pumped from the waterway. Screens will be installed, operated, and maintained according to applicable CDFW and NMFS fish screening criteria for salmonid fry (California Department of Fish and Game 2002a; National Marine Fisheries Service 1997). Fish screens meeting CDFW and NMFS criteria to protect salmonid fry have the following specifications:
* A minimum effective screen area[[2]](#footnote-2) of 3.0 square feet per cubic feet per second, and a nominal maximum approach velocity[[3]](#footnote-3) of 0.33 feet per second.
* Screen face material consisting of the following dimensions:
* Perforated plate: screen openings shall not exceed 3/32 inch (2.38 millimeters), measured in diameter.
* Profile bar: screen openings shall not exceed 0.0689 inch (1.75 millimeters) in width.
* Woven wire: screen openings shall not exceed 3/32 inch (2.38 millimeters), measured diagonally (e.g., 6 to 14 mesh).
* Screen material with a minimum of 27 percent open area.

##### G-CM9: Miscellaneous Measures

1. .

##### G-CM10: Restoration of Temporarily Disturbed Area

The Authority will restore temporarily disturbed areas to pre-project conditions within a year after the activity causing habitat disturbance is completed. When restoring temporarily-impacted habitat, the Sites Authority must utilize native plant species appropriate to the area and will control the spread of invasive plant species.

## Vernal Pool Branchiopods Avoidance and Minimization Measures

The following measures will be implemented to avoid and minimize impacts on federally listed vernal pool branchiopods including vernal pool fairy shrimp, Conservancy fairy shrimp, and vernal pool tadpole shrimp.

##### VPB-CM1: Avoidance of Occupied Habitat for Geotechnical and Geophysical Work

* At least two weeks prior to any ground disturbing activities a USFWS approved biologist will ground truth the land cover mapping within geotechnical and geophysical work areas and staging areas, including areas within 250 feet, to confirm the presence or absence of habitat suitable for vernal pool branchiopods. All suitable branchiopod habitat will be mapped in the field using a GPS with submeter accuracy and will be used to update the land cover mapping. Surveys will be conducted in accordance with “Survey Guidelines for the Listed Large Branchiopods”, from May 2015, or current survey protocols.
* Unless otherwise approved by the USFWS, geotechnical boring activities will fully avoid effects on vernal pool branchiopods and their habitat. Full avoidance requires a minimum 250-foot no-disturbance buffer around all suitable habitat potentially supporting vernal pool branchiopods.
* Geophysical activities will not take place in suitable vernal pool branchiopod habitat. All geophysical lines will avoid going through pools that represent potential suitable habitat for these species. Unless otherwise approved by the USFWS, a biological monitor will be present when geophysical work occurs within 250 feet of suitable vernal pool branchiopod habitat. The monitor will ensure that the contractor complies with these avoidance buffers.

##### VPB-CM2: Surveying of Suitable Habitat

A qualified biologist with a Federal permit to conduct sampling for listed vernal pools branchiopods will complete surveys of the seasonal wetlands in the construction and inundation area prior to project construction to determine whether the species are present. The qualified biologist will record the locations of any seasonal wetlands supporting listed branchiopods found using a GPS unit. Following the surveys, the qualified biologist will identify which of the seasonal wetland features are occupied by each species: an entire complex of seasonal wetland features is considered occupied if the species is found in one or more of those features.

##### VPB-CM3: Avoidance of Occupied Habitat

Design temporary work areas and any other activities with flexible locations to avoid occupied habitat of the listed branchiopods by at least 250 feet if located outside the permanent disturbance footprint.

# Compensatory Mitigation

##### VPB-CM4: Compensation for Unavoidable Loss of Habitat

Directly affected occupied vernal pool branchiopod habitat will be offset by either purchasing restoration/creation credits at conservation bank (at 1:1) or by restoring/creating habitat at non-bank site approved by the USFWS (at 2:1), and by protecting habitat at either a conservation bank (at 2:1) or at a non-bank site approved by the USFWS (at 3:1). Indirectly affected occupied vernal pool branchiopod habitat will be offset by protecting habitat at either a conservation bank (at 2:1) or at a non-bank site approved by the USFWS (at 3:1).

1. If one season wetland feature in a complex is found to be occupied by a listed branchiopod species, the entire complex of seasonal wetlands would be deemed occupied by that species. [↑](#footnote-ref-1)
2. *Effective screen area* - the total submerged screen area, excluding major structural members, but including the screen face material. The minimum *effective screen area* is calculated by dividing the maximum screened flow by the allowable approach velocity. [↑](#footnote-ref-2)
3. *Approach velocity* - the vector component of velocity that is perpendicular to the vertical projection of the screen face, calculated by dividing the maximum screened flow by the effective screen area. An exception to this definition is for end-of-pipe cylindrical screens, where the *approach velocity* is calculated using the entire effective screen area. [↑](#footnote-ref-3)