ATTACHMENT C

Redwood Glen Water Diversion Operation

Biological Resources Evaluation

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1 Introduction

This report presents the results of a biological resources evaluation and impact analysis of the Redwood Glen Water Diversion Project (project) located at Redwood Glen Camp and Conference Center in Loma Mar, California (Appendix A: Figures 1 and 2). The project includes existing water diversion sites in Hoffman and Piney creeks, existing gravity fed diversion pipes, and a water treatment plant. The biological resources evaluation and impact analysis identifies sensitive biological resources within and near the project as well as the potential impacts to those resources resulting from continued, but modified, operation of the water diversion. Specifically, this report provides the following:

- A general description of the project.
- A list of the federal, state, and local regulations that may pertain to project activities.
- A description of the environmental conditions in the project area, including vegetation communities and associated wildlife habitats present at the water diversion sites, diversion pipes, and water treatment plant (the project area).
- A discussion of special-status plant and animal species, as well as sensitive communities that are known to occur or that could potentially occur in the project area.
- An evaluation of the potential impacts to biological resources that may occur during project construction and/or operation.
- Responses to the California Environmental Quality Act (CEQA) Guidelines Appendix G questions related to biological resources.

This report will be used by San Mateo County when it considers the potential environmental impacts of issuing a permit for the project. Specifically, San Mateo County requested that Redwood Glen provide a report that:

- Provides an overview of the habitat that surrounds the creeks
- Identifies all creeks, sensitive habitats and riparian habitats that will be affected by the project
- Identifies any sensitive, threatened, or endangered species that are present on site and might be affected by the proposed project
- Report existing conditions
- Identify what types of creeks Hoffman and Piney are and if they flow into Pescadero Creek
- Assess the impact of the proposed water usage on the creeks, habitat, and Pescadero Creek
- Address how the water usage will affect spawning grounds for steelhead
- Provide mitigation measures and recommendations
- Explain project impacts in terms of both the dry and wet season, and during consecutive years of drought.

This report may also be used by State resource agencies, including the Water Resources Control Board, and the California Department of Fish and Wildlife, during project review.

2 Location

Redwood Glen is a non-profit camp, located at 100 Wright Drive Road in Loma Mar, San Mateo County, California. Redwood Glen is located on 165 acres in the Santa Cruz Mountains approximately ten miles from the Pacific Ocean, and is adjacent to San Mateo County Memorial Park and Pescadero Creek County Park. The camp has lodging, a large kitchen, and bathroom facilities, and can serve a maximum capacity of approximately 300 people.

3 Project Background

From 1958 to 1995, Redwood Glen had multiple sources of water that supplied both the potable water system, as well as irrigation and/or other, non-potable uses. During this time, Redwood Glen diverted up to 8-acre-feet of water/year or 2,606,808 gallons/year in accordance with their pre-1914 appropriate riparian water right. There are two existing on-site surface water diversion locations – Hoffman Creek and Piney Creek – and four existing wells (Appendix A: Figure 2). The Hoffman Creek source has been utilized since 1958, while the Piney Creek source was utilized beginning in the 1970s. Therefore, from 1958 to 1995, Redwood Glen used three existing surface water diversions to feed its potable water system, including Hoffman Creek, Piney Creek, and Pescadero Creek. Wells were drilled later in the 1990s. A description of each surface water supply source follows:

- **Hoffman Creek**: Hoffman Creek was used as the primary potable water source for Redwood Glen prior to 1995, and since 1995, Redwood Glen has continued diverting water from Hoffman Creek for irrigation purposes only. Redwood Glen has both pre-1914 appropriative and riparian rights to Hoffman Creek. There is a diversion structure located at an elevation of 526 feet, which diverts a portion of the water flow from Hoffman Creek water near the spring that feeds the creek. The diversion structure consists of a stainless-steel sink attached to a redwood log across the creek. Sediment and wood debris impounded behind the log has raised the channel bed to allow flow over the log and into the sink. Underflow beneath the log bypasses the diversion structure, as does overflow when the sink is spilling.
- **Piney Creek**: Appropriative rights License No. 11116 allows Redwood Glen to divert water from Piney Creek at a rate not to exceed 0.042 cubic feet per second from January 1 to December 31, and not to exceed 24 acre-feet per year. The point of diversion (POD) is located near the headwaters of Piney Creek. The diversion structure on Piney Creek was rehabilitated during 2017 to remove sediment and debris and restore its full functionality. It now includes a functioning bypass port and diversion port with the same diameter and set at the same elevation. If both ports are completely open,

then the flow is passively split in half. However, a significant proportion of baseflow still bypasses this diversion structure.

- **Four groundwater wells:** Well #1 was drilled in July 1992; it has a yield of 2.5 gallons per minute, and is acceptable as potable water with treatment for iron and manganese. It could potentially be used for irrigation instead of the current irrigation source (Hoffman Creek). Well #2 was drilled in January 1992. It is a substandard well for potable use, but can be used as a monitoring well or an irrigation well. Well #3 was drilled in July 1995. Its construction is substandard and it cannot be permitted as a potable water source, and the water quality is not acceptable for potable or irrigation use. Well #4 was drilled in July 2015. The water quality is unacceptable due to high total dissolved solids and other constituent. The wells were not pursued as a supply source due to low pumping yields, poor water quality, and additional treatment expenses.

Potable water was provided to Redwood Glen by San Mateo County Memorial Park from 1998 through March 2016; therefore, the Hoffman and Piney Creek sources were only used for irrigation purposes during this time. Based on the San Mateo County Statements of Diversion and Use, water diverted at Redwood Glen for irrigation purposes has ranged from 180,000 to 250,000 gallons/year.

In 2014, the State Water Resource Control Board (SWRCB) issued notice to the San Mateo County Parks Department that Memorial Park would lose its classification as a transient non-community water system and be re-classified as a community water system should the system continue to serve Redwood Glen. Redwood Glen attempted negotiations with the Parks Department to remain a customer of the water system, however, Memorial Park discontinued serving Redwood Glen water on March 1, 2016.

Since late 2014, Redwood Glen has explored alternatives for rehabilitating the existing water infrastructure to incorporate on-site water sources and additional facilities with the objective of designing and constructing an independent, permitted public water system to meet the projected annual average potable water demand for the camp, which is estimated to be 1,305,953 gallons per year (i.e., 4-acre-feet/year). After studying the alternatives, the selected option was to use the existing water diversion systems at Hoffman Creek and Piney Creek, to add piping to the end of the existing Hoffman Creek diversion line to extend it to a storage tank, and to replace the existing 2-inch raw water transmission line from Piney Creek and extend it to a water storage tank. A new surface water treatment plant, housed in a cargo container in a developed portion of the camp will provide the primary form of treatment. It does not involve new or increased diversions above historic use. A more detailed description of each project component follows.

Redwood Glen is currently installing a new surface water treatment plant and associated infrastructure (hereafter called the “water infrastructure site”). As part of the project, raw water from the Hoffman and Piney Creek water diversion sites will be delivered to the water

infrastructure site and a 70,000-gallon raw water storage tank via existing gravity-fed diversion pipes, which generally follow existing foot paths and hiking trails (Appendix B, Photos 1 to 5)

The water infrastructure site consists of an iron and manganese filtration unit, a surface water treatment plant located in a converted Conex shipping container, two 5,000-gallon raw water storage tanks, a 5,000-gallon treatment tank, and a 2,000-gallon backwash recycling settling tank. Additionally, there is an existing 70,000-gallon raw water storage tank and 20,000-gallon potable water storage tank located nearby. Water from the raw water storage tanks will be treated and then pumped to the 20,000-gallon potable water storage tank. These facilities are in already developed areas of the camp.

Throughout the wet season, the two 5,000-gallon tanks will be gravity fed by Hoffman Creek while the water from Piney Creek will fill the 70,000-gallon tank. Whenever Hoffman Creek is not able to supply Redwood Glen's full demand, an automated valve will allow Piney Creek to feed into the tanks. This set-up will also ensure that the total volume of stored water from Hoffman Creek is equal to or less than 10,000 gallons, a limit established through Redwood Glen's riparian rights to the creek (SWRCB 2017).

The project area discussed in this report includes the existing water diversion sites in Hoffman and Piney creeks, existing on-site gravity-fed diversion pipes, and the new surface water treatment plant and associated infrastructure (water diversion infrastructure site).

4 Regulatory Setting

Biological and water resources in California are protected under federal, state, and local laws. The laws that may pertain to the biological and water resources within the project area include the following:

4.1 Federal

4.1.1 Endangered Species Act

The federal Endangered Species Act (FESA) of 1973, as amended, provides the regulatory framework for the protection of plant and animal species (and their associated critical habitats), which are formally listed, proposed for listing, or candidates for listing as endangered or threatened under FESA. FESA has the following four major components: (1) provisions for listing species, (2) requirements for consultation with the United States (U.S.) Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries Service), (3) prohibitions against "taking" (i.e., harassing, harming, hunting, shooting, wounding, killing, trapping, capturing, or collecting, or attempting to engage in any such conduct) of listed species, and (4) provisions for permits that allow incidental "take". Specifically, Section 9 of the FESA prohibits the "taking" of a federally listed species.

Both the USFWS and the NOAA Fisheries share the responsibility for administration of the FESA. Section 7 requires federal agencies, in consultation with, and with the assistance of the

USFWS or NOAA Fisheries, as appropriate, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat for these species. Non-federal agencies and private entities can seek authorization for take of federally listed species under Section 10 of FESA, which requires the preparation of a Habitat Conservation Plan.

The FESA also discusses recovery plans and the designation of critical habitat for listed species. A critical habitat designation generally has no effect on situations that do not involve a federal agency. A critical habitat designation does not necessarily restrict further development or trigger the need for non-federal agencies to consult with the USFWS.

4.1.2 Migratory Bird Treaty Act

Under the Migratory Bird Treaty Act (MBTA), it is unlawful to "pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not." Under the MBTA it is also illegal to disturb a nest that is in active use, since this could result in killing a bird or destroying an egg. The USFWS oversees implementation of the MBTA. With a few exceptions (e.g., European starling [*Sturnus vulgaris*] and rock pigeon [*Columba livia*]), most birds are considered migratory under the MBTA.

4.1.3 Clean Water Act

The Clean Water Act (CWA) is the primary federal law regulating water quality. The implementation of the CWA is the responsibility of the U.S. Environmental Protection Agency (EPA). However, the EPA depends on other agencies, such as the individual states and the U.S. Army Corps of Engineers (USACE), to assist in implementing the CWA. The objective of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Section 404 and 401 of the CWA apply to activities that would impact waters of the U.S. The USACE enforces Section 404 of the CWA and the California SWRCB enforces Section 401.

Section 404

As part of its mandate under Section 404 of the CWA, the EPA regulates the discharge of dredged or fill material into "waters of the U.S.". "Waters of the U.S." include territorial seas, tidal waters, and non-tidal waters in addition to wetlands and drainages that support wetland vegetation, exhibit ponding or scouring, show obvious signs of channeling, or have discernible banks and high-water marks. Wetlands are defined as those areas "that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3(b)). The discharge of dredged or fill material into waters of the U.S. is prohibited under the CWA except when it follows Section 404 of the CWA. Enforcement authority for Section 404 was given to the USACE, which it accomplishes under its

regulatory branch. The EPA has veto authority over the USACE's administration of the Section 404 program and may override a USACE decision with respect to permitting.

Substantial impacts to waters of the U.S. may require an Individual Permit. Projects that only minimally affect waters of the U.S. may meet the conditions of one of the existing Nationwide Permits, if other conditions of the permit are satisfied. A Water Quality Certification or waiver pursuant to Section 401 of the CWA is required for Section 404 permit actions.

Section 401

Any applicant for a federal permit to impact waters of the U.S. under Section 404 of the CWA, including Nationwide Permits where pre-construction notification is required, must also provide to the USACE a certification or waiver from the State of California. The "401 Certification" is provided by the SWRCB through the local Regional Water Quality Control Board (RWQCB).

The RWQCB issues and enforces permits for discharge of treated water, landfills, storm-water runoff, filling of any surface waters or wetlands, dredging, agricultural activities and wastewater recycling. The RWQCB recommends that the application for a Certification under Section 401 of the CWA be made at the same time as other applications are provided to other agencies, such as the USACE. It must include a description of the habitat that is being impacted, a description of how the impact is to be minimized, and proposed mitigation measures with goals, schedules, and performance standards. Mitigation must include a replacement of functions and values, and replacement of wetland, generally at a minimum ratio of 2:1, or twice as many acres of wetlands provided as are removed. The RWQCB prefers that mitigation be on site and in-kind, with functions and values as good as or better than the water-based habitat that is being removed or impacted. A higher mitigation ratio may be required, depending on site conditions and project impacts.

4.2 State

4.2.1 California Fish and Game Code

California Endangered Species Act

The California Endangered Species Act (CESA; Fish and Game Code 2050 et seq.) generally parallels the FESA. It establishes the policy of the State to conserve, protect, restore, and enhance threatened or endangered species and their habitats. Section 2080 of the California Fish and Game Code prohibits the take, possession, purchase, sale, and import or export of endangered, threatened, or candidate species, unless otherwise authorized by permit or by the regulations. "Take" is defined in Section 86 of the California Fish and Game Code as to "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." This definition differs from the definition of "take" under FESA, in that it is specific to take of an individual, whereas FESA considers harassment and modification of habitat as potentially resulting in take. CESA is administered by California Department of Fish and Wildlife (CDFW). CESA allows for take incidental to otherwise lawful projects, but mandates that State lead agencies consult with

the CDFW to ensure that a project will not jeopardize the continued existence of threatened or endangered species.

California Fish and Game Code Sections 4150-4155

Sections 4150-4155 of the California Fish and Game Code protects non-game mammals, including bats. Section 4150 states “A mammal occurring naturally in California that is not a game mammal, fully protected mammal, or fur-bearing mammal is a nongame mammal. A non-game mammal may not be taken or possessed except as provided in this code or in accordance with regulations adopted by the commission”. The non-game mammals for which “take” is typically authorized are primarily those that cause crop or property damage. All bats are classified as a non-game mammal and are protected under California Fish and Game Code.

California Fish and Game Code Sections 3503 and 3513

According to Section 3503 of the California Fish and Game Code, it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird. Section 3503.5 specifically protects birds in the orders Falconiformes and Strigiformes (birds-of-prey). Section 3513 essentially overlaps with the MBTA, prohibiting the take or possession of any migratory non-game bird. Disturbance that causes nest abandonment and/or loss of reproductive effort is considered “take” by the CDFW.

California Fish and Game Code Sections 1600-1607

Sections 1600-1607 of the California Fish and Game Code require that a Notification of Lake or Streambed Alteration Agreement (LSAA) application be submitted to CDFW for “any activity that may substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake.” CDFW reviews the proposed actions in the application and, if necessary, prepares a LSAA that includes measures to protect affected fish and wildlife resources.

The notification requirement applies to any work undertaken in or near a river, stream, or lake that flows at least intermittently through a bed or channel. This includes ephemeral streams, desert washes, and watercourses with a subsurface flow. The CDFW typically considers a river, stream, or lake to include its riparian vegetation, but it may also extend to its floodplain. The term “stream”, which includes creeks and rivers, is defined in the California Code of Regulations (CCR) as follows: “a body of water that flows at least periodically or intermittently through a bed or channel having banks and supports fish or other aquatic life”. This includes watercourses having a surface or subsurface flow that supports or has supported riparian vegetation (14 CCR 1.72). In addition, the term stream can include ephemeral streams, dry washes, watercourses with subsurface flows, canals, aqueducts, irrigation ditches, and other means of water conveyance if they support aquatic life, riparian vegetation, or stream-dependent terrestrial wildlife (CDFW 1994). Riparian is defined as “on, or pertaining to, the banks of a stream”; therefore, riparian vegetation is defined as, “vegetation which occurs in and/or adjacent to a stream and is dependent on, and occurs because of, the stream itself” (CDFW 1994).

Native Plant Protection Act

The Native Plant Protection Act (NPPA) was created in 1977 with the intent to preserve, protect, and enhance rare and endangered plants in California (California Fish and Game Code sections 1900 to 1913). The NPPA is administered by CDFW, which has the authority to designate native plants as endangered or rare and to protect them from "take." CDFW maintains a list of plant species that have been officially classified as endangered, threatened or rare. These special-status plants have special protection under California law.

Fully Protected Species and Species of Special Concern

The classification of California fully protected (CFP) species was the CDFW's initial effort to identify and provide additional protection to those animals that were rare or faced possible extinction. Lists were created for fish, amphibians and reptiles, birds, and mammals. Most of the species on these lists have subsequently been listed under CESA and/or FESA. The Fish and Game Code sections (§5515 for fish, §5050 for amphibian and reptiles, §3511 for birds, §4700 for mammals) deal with CFP species and state that these species "…may not be taken or possessed at any time and no provision of this code or any other law shall be construed to authorize the issuance of permits or licenses to take any fully protected species". "Take" of these species may be authorized for necessary scientific research. This language makes the CFP designation the strongest and most restrictive regarding the "take" of these species. In 2003, the code sections dealing with CFP species were amended to allow the CDFW to authorize take resulting from recovery activities for state-listed species.

California species of special concern (CSSC) are broadly defined as animals not currently listed under the FESA or CESA, but which are nonetheless of concern to the CDFW because they are declining at a rate that could result in listing, or historically occurred in low numbers and known threats to their persistence currently exist. This designation is intended to result in special consideration for these animals by the CDFW, land managers, consulting biologists, and others, and is intended to focus attention on the species to help avert the need for costly listing under FESA and CESA and cumbersome recovery efforts that might ultimately be required. This designation also is intended to stimulate collection of additional information on the biology, distribution, and status of poorly known at-risk species, and focus research and management attention on them. Although these species generally have no special legal status, they are given special consideration under CEQA during project review.

Sensitive Vegetation Communities

Sensitive vegetation communities are natural communities and habitats that are either unique in constituent components, of relatively limited distribution in the region, or of particularly high wildlife value. These communities may or may not necessarily contain special-status species. Sensitive natural communities are usually identified in local or regional plans, policies or regulations, or by the CDFW or the USFWS. The California Natural Diversity Database (CNDDB), which is maintained by the CDFW, identifies several natural communities as rare, which are given the highest inventory priority (Sawyer et. al. 2009; CDFW 2010). Impacts to sensitive natural communities and habitats must be considered and evaluated during CEQA review.

4.2.2 Porter-Cologne Water Quality Control Act

The intent of the Porter-Cologne Water Quality Control Act (Porter-Cologne) is to protect water quality and the beneficial uses of waters of the State, and it applies to both surface and ground water. Under this law, the SWRCB develops statewide water quality plans, and the RWQCBs develop basin plans, which identify beneficial uses, water quality objectives, and implementation plans. The RWQCBs have the primary responsibility to implement the provisions of both statewide and basin plans. Waters regulated under Porter-Cologne, referred to as “waters of the State,” include isolated waters that are not regulated by the USACE. Projects that require a USACE permit, or fall under other federal jurisdiction, and have the potential to impact waters of the State are required to comply with the terms of the Water Quality Certification Program. If a proposed project does not require a federal license or permit, any person discharging, or proposing to discharge, waste (e.g. dirt) to waters of the State must file a Report of Waste Discharge and receive either waste discharge requirements (WDRs) or a waiver to WDRs before beginning the discharge.

4.3 Local

4.3.1 San Mateo County Tree Ordinances

The San Mateo County Ordinance Code (Ordinance No. 2427) requires a permit from the San Mateo County Planning Department to cut down, destroy, move or trim any heritage tree growing on any public or private property within the unincorporated area of San Mateo County. Class 1 heritage trees are those trees designated by the County Board of Supervisors as heritage trees. Class 2 heritage trees are healthy trees of a certain species and size designated in the ordinance. There are currently 17 species of heritage trees described in the ordinance.

The Significant Tree Ordinance of San Mateo County (Part Three of Division VIII of the San Mateo County Ordinance Code) requires a permit for the cutting down, removing, poisoning or otherwise killing or destroying or causing to be removed any significant tree or community of trees, whether indigenous or exotic, on any private property (Section 12,020). A “Significant Tree” is any live woody plant rising above the ground with a single stem or trunk of a circumference of thirty-eight inches (38") (a 38-inch circumference is equivalent to a 12-inch

diameter), or more measured at four and one-half feet (4 1/2') vertically above the ground or immediately below the lowest branch, whichever is lower, and having the inherent capacity of naturally producing one main axis continuing to grow more vigorously than the lateral axes (Section 12,012). Additionally, a criterion for permit approval requires that significant trees that are removed be replaced by plantings approved by the Planning Director or Design Review Administrator, unless special conditions indicate otherwise (Section 12,023).

5 Methods

This section describes the methods used to complete the biological resources evaluation. Methods include a database and literature review, field survey, an assessment of plant communities and wildlife habitats, an assessment of sensitive habitats and aquatic features, a habitat evaluation for special-status species, and an assessment of wildlife corridors.

5.1 Database and Literature Review

MIG reviewed the following sources for information relevant to this biological resources evaluation:

- CDFW CNDDB record search (CDFW 2017).
- CNPS Rare Plant Program Inventory of Rare and Endangered Plants of California record search within a five-mile radius of parcel (CNPS 2017).
- USFWS Information for Planning and Consultation (IPaC) search for a list of endangered and threatened species and Critical Habitat for the property (USFWS 2017a).
- The Jepson Manual: Vascular Plants of California, Second Edition (Baldwin et al. 2012).
- U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) (USFWS 2017b).
- Aerial photographs of the property (Google Earth Pro 2017).

5.2 Field Survey

On September 14, 2017, MIG biologists Megan Kalyankar and David Gallagher conducted a reconnaissance-level biological survey of the project area. Redwood Glen staff showed the MIG biologists the existing water diversion infrastructure on the site, including the location of the proposed water treatment system, water storage tanks, sediment filters, diversion pipes, as well as the water diversion structures in Hoffman and Piney creeks. During the field visit, plant species, wildlife species, and habitats (including sensitive habitats) present in the project area were documented. The biologists also assessed habitat at the sites for the potential to support special-status species.

The botanical study for this assessment was not floristic in nature. A complete determination of the presence or absence of potentially occurring botanical resources would require focused surveys to be conducted during all appropriate blooming periods (CNPS 2001). Additionally, certain plant species, especially annuals, may not be present every year due to varying

flowering phenologies and life forms, such as bulbs, biennials, annuals as well as annual variations in temperature and rainfall, which influence plant phenology. Colonization of new populations within an area may also occur from year to year. Specific plant species identifications in this report are tentative due to the absence of morphological characters, resulting from immature reproductive structures or seasonal desiccation, which are required to make species level determinations.

5.3 Plant Communities and Wildlife Habitats

Plant communities were classified based on existing descriptions in “A Manual of California Vegetation, Second Edition” (Sawyer et. al. 2009).

5.4 Sensitive Habitats and Aquatic Features

The areas within and adjacent to the project area were inspected for the presence of wetlands, drainages, streams, and other aquatic features, including those that support stream-dependent (i.e., riparian) plant species that could be subject to jurisdiction by the USACE, RWQCB, or CDFW. Wetlands are defined for regulatory purposes in the 33 CFR 328.3 and 40 CFR 230.3 as areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.” To be considered subject to federal jurisdiction, a wetland must normally exhibit positive indicators for hydrophytic vegetation, hydric soil, and wetland hydrology. A formal jurisdictional delineation, including wetland delineation, was not conducted.

All plant communities observed within and adjacent to the project area were evaluated to determine if they have been defined as sensitive communities. Sensitive natural communities are communities that are especially diverse; regionally uncommon; or of special concern for local, state, and federal agencies.

5.5 Special-Status Species Habitat Evaluation

During the field survey, the biologist evaluated the suitability of the habitat to support special-status species documented to occur in and within the vicinity project area. For the purposes of this assessment, special-status species include:

- Species listed or proposed for listing as threatened or endangered under the FESA (50 CFR 17.12 [listed plants], 50 CFR 17.11 [listed animals], and various notices in the Federal Register [proposed species]).
- Species that are candidates for possible future listing as threatened or endangered under the FESA (73 Federal Register [FR] 75176, November 9, 2009).
- Species listed or proposed for listing by the state of California as threatened or endangered under the CESA (14 CCR 670.5).

- Species that meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380).
- Plants listed as rare under the California NPPA (California Fish and Game Code, Section 1900 et seq.).
- Plants considered by CNPS to be "rare, threatened, or endangered in California" (California Rare Plant Rank [CRPR] 1B and 2).
- Animal species listed as CSSC by the CDFW.
- Animals listed as CFP by the CDFW (California Fish and Game Code, Section 3511 [birds], 4700 [mammals], 5050 [amphibians and reptiles], and 5515 [fish]).

The potential occurrence of special-status plant and animal species within and adjacent to the project area was evaluated by developing a list of special-status species that are known to occur, or have the potential to occur, near the area based on a search of the CNDDB, CNPS, and USFWS databases. The potential for occurrence of those species included on the list were then evaluated based on the habitat requirements of each species relative to the conditions observed during the field survey. Each species was evaluated for its potential to occur on or in the immediate vicinity of the sites according to the following criteria:

No Potential: There is no suitable habitat present (i.e., habitats are clearly unsuitable for the species requirements [e.g., foraging, breeding, cover, substrate, elevation, hydrology, plant community, disturbance regime]). Additionally, there are no or few historical records known records of occurrence near of the site. The species has no potential of being found.

Low Potential: Limited suitable habitat is present (i.e., few of the habitat components meeting the species requirements are present and/or the majority of habitat is unsuitable or of very low quality). Additionally, there are no or few historical records of occurrence in the vicinity of the site. The species has a low probability of being found.

Moderate Potential. Suitable habitat is present (i.e., some of the habitat components meeting the species requirements are present and/or most of the habitat is suitable or of marginal quality). Additionally, there are few to many modern records of occurrences near the site. The species has a moderate probability of being found.

High Potential: Highly suitable habitat is present (i.e., all habitat components meeting the species requirements are present and/or the habitat is highly suitable or of high quality). Additionally, there are few to many records of occurrences within the last ten years near the site. This species has a high probability of being found.

Present or Assumed Present. Species was observed at the site or has a recent (within five years) recorded observation in the CNDDB or literature at the site.

The list of special-status animals and plants that have potential to occur near the project area, their habitat requirements, and the ranking of potential for occurrence in the project area is included in Appendix C.

6 Environmental Setting

6.1 Climate and Topography

The climate at Redwood Glen is Mediterranean, with most rain falling in the winter and spring. Mild cool temperatures are common in the winter. The summer is characterized by mild to hot temperatures. The average annual rainfall near the property (Skyline Ridge Open Space Preserve) from 1981 to 2010 was 45.2 inches (WRCS 2017). Topography within the property is hilly and slopes down towards Pescadero Creek. Elevations range from approximately 200 feet to 1,000 feet above mean sea level.

6.2 Hydrology

Hoffman and Piney creeks are perennial streams that flow down the north side of Butano Ridge toward Pescadero Creek (Appendix B: Photo 6). The water diversion sites on Hoffman Creek and Piney creeks are approximately 0.5 miles and 0.4 miles upstream of Pescadero Creek, respectively. Pescadero Creek is a perennial stream that is approximately 27 miles long. Its headwaters are located on the western edge of Castle Rock State Park and Portola Redwoods State Park. Pescadero Creek is one of the two principal streams that form the Pescadero-Butano watershed, which is the largest coastal watershed between the Golden Gate in San Francisco County and the San Lorenzo River in Santa Cruz County. Pescadero Creek joins Butano Creek at Pescadero Marsh, which is at the mouth of both creeks at the Pacific Ocean.

6.3 Plant Communities Observed in the Project Area

Vegetative communities are assemblages of plant species that occur together in the same area, which are defined by species composition and relative abundance. Only three vegetation communities and/or other habitats are present in the project area—developed habitat, redwood forest alliance, and perennial creek habitat. Vegetation communities and other habitats within the project area are described in more detail below. Photographs of the project area are provided in Appendix B.

6.3.1 Developed Habitat

Developed habitat includes areas where permanent structures and/or pavement have been placed, which prevents the growth of vegetation. The property contains a main area that has several buildings, paved roads and parking areas, and a swimming pool. The water diversion infrastructure site, including the surface water treatment plant and raw water holding tanks, is located within developed habitat.

6.3.2 Redwood Forest Alliance

This alliance contains forest stands where redwood is the dominant tree but other tree species often share the canopy. This alliance occurs on raised stream terraces and benches as well as upland areas in moist coastal areas with heavy summer fog, generally below 600 m in elevation from southern Oregon to Santa Lucia Mountains in central California.

The existing water diversion sites and existing on-site gravity-fed diversion pipes occur within the redwood forest alliance vegetation that forms the riparian area around the creeks. The water diversion infrastructure is surrounded by upland redwood forest alliance. Trees observed in the redwood forest alliance riparian and upland habitat include coast redwood (*Sequoia sempervirens*), Douglas fir, (*Pseudotsuga menziesii* var. *menziesii*), beaked hazelnut (*Corylus cornuta* var. *californica*), California bay (*Umbellularia californica*), and tanbark oak (*Lithocarpus densiflorus*). Shrubs observed include California huckleberry (*Vaccinium ovatum*), thimbleberry (*Rubus parviflorus*) and common snowberry (*Symphoricarpos albus*). Herbs observed include redwood sorrel (*Oxalis oregana*), Pacific trillium (*Trillium ovatum*), American trailplant (*Adenocaulon bicolor*), feathery false lily of the valley (*Maianthemum racemosum*), starry false lily of the valley (*Maianthemum stellatum*), and fringe cups (*Tellima grandiflora*).

6.3.3 Perennial Creek Habitat

Perennial creek habitat occurs in both Piney and Hoffman creeks, and consists of flowing water, rocky pools, and stream dependent vegetation (see above Section 6.3.2: Redwood Forest Alliance). It is part of the understory of the Redwood Forest Alliance.

6.4 Wildlife Observed in the Project Area

One invertebrate species was observed during the field survey: Pacific banana slug *(Ariolimax columbianus*).

Bird species observed during the field survey included acorn woodpecker (*Melanerpes formicivorus*), American crow (*Corvus brachyrhynchos),* dark-eyed junco (*Junco hyemalis*), Pacific wren (*Troglodytes pacificus*), red-shouldered hawk (*Buteo lineatus*), and Steller's jay (*Cyanocitta stelleri*).

No reptiles, fish, amphibians, or mammals were observed during the field survey.

6.5 Sensitive Habitats

The Redwood Forest Alliance within the project area is classified as a highly imperiled, sensitive natural community by CDFW (S3 – At moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors).

The water diversion sites in Hoffman and Piney creeks, and their associated riparian habitat, which is formed by the Redwood Forest Alliance, are subject to jurisdiction by CDFW (see section 5.8). Additionally, the USFWS NWI map data were reviewed for the project area as part of the evaluation for the presence of Waters of the U.S., including wetlands. NWI maps are based on interpretation of aerial photography, limited verification of mapped units, and/or

classification of wetland types using the classification system developed by Cowardin et al. 1979. Both Hoffman and Piney creeks are mapped in the NWI as Waters of the U.S., and both diversion sites are within the ordinary high-water mark (OHWM) of these creeks, based on field observation. The NWI documents both Hoffman and Piney creeks flowing into Pescadero Creek, which is also mapped as a Water of the U.S. (Appendix A: Figure 2).

Pescadero Creek[2] is designated as critical habitat for the federally listed Threatened Central California Coast steelhead (*Oncorhynchus mykiss irideus*) Distinct Population Segment (DPS). Critical habitat for the Central California Coast steelhead DPS was designated on September 2, 2005 and includes all river reaches and estuarine areas accessible to listed steelhead in coastal river basins from the Russian River in Sonoma County to Aptos Creek in Santa Cruz County. The San Mateo Hydrologic Unit includes the coastal streams in San Mateo County from San Pedro Creek near Pacifica to Butano Creek near Año Nuevo and the Santa Clara Hydrologic Unit includes South Bay creeks from San Francisquito Creek in Palo Alto eastward to Coyote Creek (NOAA 2005).

The entire property of Redwood Glen is within designated critical habitat (SNM-2) for the California red-legged frog (CRLF; *Rani draytonii*). Critical habitat for CRLF was designated in 2001 and expanded in 2010 to include over 1.6 million acres. The designation seeks to protect abundant, healthy frog populations and to provide connectivity between populations. It generally avoids areas that are not favorable for the species, which typically is land on the fringe of developed areas, fragmented habitat and intensively farmed areas. The new designation identifies upland habitat that generally protects watershed habitat up to a mile from water. The SNM-2 unit includes most of San Mateo County west of Highway 35 (Skyline Blvd.) and south of Highway 84 extending to the coast and to the Santa Cruz County line.

The water diversion site on Piney Creek is located within designated critical habitat for marbled murrelet. Critical habitat designations identify areas considered essential for the conservation of a species listed as threatened or endangered by the USFWS, and to develop a recovery plan for the species. The designation provides notice of the importance of these areas to the conservation of the species. Critical habitat for marbled murrelet was designated in 1996 and revised in 2011. The current designation consists of approximately 3,698,100 acres in Washington, Oregon, and California.

There are no other sensitive natural community types present within the project area.

6.6 Wildlife Migration and Movement Corridors

Habitat loss, fragmentation, and degradation resulting from land use changes or habitat conversion can alter the use and viability of wildlife movement corridors (i.e. linear habitats that naturally connect and provide passage between two or more otherwise disjunct larger habitats

[2] As stated previously, both Hoffman Creek and Piney Creek are tributaries to Pescadero Creek.

or habitat fragments). In general, studies suggest that habitat corridors provide connectivity for and are used by wildlife, and as such are an important conservation tool (Beier and Noss 1998). Wildlife habitat corridors should fulfill several functions. They should maintain connectivity for daily movement, travel, mate-seeking, and migration; plant propagation; genetic interchange; population movement in response to environmental change or natural disaster; and recolonization of habitats subject to local extirpation (Beier and Loe 1992)

Redwood Glen is surrounded by open space and rural-residential development. Much of Redwood Glen is undeveloped and features hiking trails. Several open space areas surround Redwood Glen, including the 8,000-acre Pescadero Creek Park to the south and 673-acre Memorial County Park Redwood to the north. The undeveloped open space within the Redwood Glen property is likely used by wildlife to travel between the two county parks by providing natural woodland, riparian, and aquatic (creek) habitat. Hoffman and Piney creeks flow to Pescadero Creek, and provide a connection to Pescadero Creek.

6.7 Special-Status Species

Based on a review of the CNDDB and CNPS databases, the biologist's knowledge of special-status species, and an assessment of the types of habitats in the project area, it was determined that eight special-status animal species and four special-status plant species are expected to occur in the project area (i.e., all special-status species ranked as "Moderate Potential" or "High Potential"). This determination was made due to the presence of essential habitat requirements, known occurrences close to the existing water diversion sites, known ranges, and connectivity with areas of suitable or occupied habitat. A list of special-status animal and plant species that have moderate or high potential to occur in the project area follows.

Animals

- CRLF, high potential;
- Foothill yellow-legged frog (*Rana boylii*), moderate potential;
- Santa Cruz black salamander (*Aneides niger*), high potential;
- California giant salamander (*Dicamptodon ensatus*), high potential;
- Marbled murrelet (*Brachyramphus marmoratus*), high potential;
- Townsend's big-eared bat (*Corynorhinus townsendii*), high potential; and
- Western red bat (*Lasiurus blossevillii*), high potential.

Plants

- Dudley's lousewort (*Pedicularis dudleyi*), high potential;
- Minute pocket moss (*Fissidens pauperculus*), high potential;
- Western leatherwood (*Dirca occidentalis*), moderate potential; and
- White-flowered rein orchid (*Piperia candida*), moderate potential.

Additionally, since the existing water diversion sites are located on Hoffman and Piney creeks, which are tributaries of Pescadero Creek, a habitat analysis is included in this report for species known to occur in Pescadero Creek, but are not expected to occur in the project area. These species are included in the event that operation of the diversions on Hoffman and Piney Creek could result in impacts to water flow and habitat downstream of the project area, including in Pescadero Creek. Special-status species that occur downstream of the Redwood Glen property in Pescadero Creek include steelhead, western pond turtle (WPT, *Emys marmorata*), and San Francisco garter snake (SFGS; *Thamophis sirtalis tetrataenia*).

Other special-status plant or animal species were determined to have low potential or no potential to occur in the project area due to the lack of essential habitat requirements for the species, the lack of known occurrences close to Redwood Glen, lack of connectivity with areas of suitable or occupied habitat, and/or because the project area is not within the species known range of distribution.

A complete list of all special-status species considered as part of this assessment, their regulatory status, habitat requirements, local distribution, and potential for occurrence are provided in Appendix C (Tables 1 and 2). Additional details on the special-status species with a moderate or high potential to occur in the project area, as well as for steelhead, Western pond turtle, and San Francisco garter snake, follow.

6.7.1 Special-Status Animals

California red-legged frog. CRLF is listed as a threatened species under the FESA and is designated a CSSC. CRLF is distributed throughout 26 counties in California, but is most abundant in the San Francisco Bay Area. CRLF 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 1,500 meters in elevation (Jennings and Hayes 1994, Bulger et al. 2003, Stebbins 2003). CRLF breed between November and April in standing or slow-moving water at least 0.7 meters (2½ feet) in depth with emergent vegetation, such as cattails (*Typha* spp.), tules (*Schoenoplectus* spp.) or overhanging willows (*Salix* spp.) (Hayes and Jennings 1988). Egg masses containing 2,000 to 5,000 eggs are attached to vegetation below the surface and hatch after 6 to 14 days. Larvae undergo metamorphosis 3½ to 7 months following hatching and reach sexual maturity 2 to 3 years of age (Jennings and Hayes 1994). CRLF breed in a variety of aquatic habitats. Larvae and meta-morphs use streams, deep pools, backwaters of streams and creeks, ponds, marshes, sag ponds, dune ponds, and lagoons.

Breeding adults are commonly found in deep (more than 2 feet), still or slow-moving water with dense, shrubby riparian or emergent vegetation. Adult frogs have also been observed in shallow sections of streams that are not shrouded by riparian vegetation. Generally, streams with high flows and cold temperatures in spring are unsuitable for eggs and tadpoles. Stock ponds are frequently used by this species for breeding if they are managed to provide suitable hydro-period, pond structure, vegetative cover, and control of nonnative predators such as bullfrogs (*Rana catesbeiana*) and exotic fish. Most frogs move away from breeding ponds to non-

breeding 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. In this Marin County study, the furthest distance traveled was 2.25 miles and most dispersing frogs moved through grazed pastures to reach the nearest riparian habitat (Fellers and Kleeman 2007). Bulger et al. (2003) did not observe habitat preferences among frogs moving between ponds. They did note that when breeding ponds dry, CRLF use moist microhabitats of dense shrubs and herbaceous vegetation within 350 feet of ponds.

CRLF is known to occur within the upper reaches of Pescadero Creek within Memorial, Sam McDonald, and Pescadero Creek County Parks. There is suitable breeding habitat within Pescadero Creek near Redwood Glen. In addition, designated critical habitat is present within the project area. However, based on a field assessment of site conditions and the lack of suitable wetlands in the area, it was determined the project area does not support breeding habitat for CRLF. There is a high potential for CRLF to move through, as well as to occupy both Hoffman and Piney creeks, including the associated Redwood Forest Alliance riparian habitat at or near the water diversion sites, since this area provides suitable upland refugia, dispersal, and foraging habitat. CRLF were not observed during the field survey, although this species can be cryptic and may not have been detected.

Foothill yellow-legged frog. Foothill yellow-legged frog is proposed to be listed as threatened under the CESA, and is a CSSC. The largest remaining populations in California are in the north coast range, particularly in the Smith River, tributaries of the Klamath River, the South Fork Trinity River, the South Fork Eel River, Redwood Creek, coastal tributaries in Mendocino County and Russian River tributaries. Foothill, yellow-legged frog is also known from Marin and Santa Clara counties. This species frequents rocky streams and rivers with rocky substrate and open, sunny banks, in forests, chaparral, and woodlands. It's sometimes found in isolated pools, vegetated backwaters, and deep, shaded, spring-fed pools. It needs at least some cobble-sized substrate for egg-laying, and at least 15 weeks to attain metamorphosis.

Foothill yellow legged frog is known from Pescadero Creek County Park. Both Hoffman and Piney creeks provide suitable breeding and foraging habitat for this species. There is a moderate potential for foothill yellow-legged frog to occupy both Hoffman and Piney creeks at or near the water diversion sites. Foothill yellow-legged frog were not observed during the field survey, although this species can be cryptic and may not have been detected.

Santa Cruz black salamander. Santa Cruz black salamander is designated as a CSSC. It is endemic to California with a limited range west of the San Francisco Bay and south of the San Francisco Peninsula from Santa Cruz County and western Santa Clara County, north to southern San Mateo County. It was formerly considered a subspecies of the black salamander (*Aneides flavipunctatus*). It is a medium-sized salamander measuring up to 5.5 inches long that is solid black with fine white specks. It is a member of the Plethodontidae or lungless salamanders. Plethodontid salamanders do not breathe through lungs but instead respire through their skin and mouth tissues. They are found in damp environments on land and move

only during periods of high humidity (e.g. rain events). The Santa Cruz black salamander is a terrestrial salamander; therefore, it does not live directly in bodies of water but is generally found in moist areas near streams and creeks in deciduous woodland, coniferous forest, and coastal grasslands. They are also adapted for climbing with long toes and a rounded prehensile tail. They may be active year-round along streams but will stay in moist underground burrows or under rocks, logs or other objects near streams during dry periods.

The Redwood Forest Alliance habitat near both Hoffman and Piney creeks provides suitable habitat for Santa Cruz black salamander. Santa Cruz black salamanders are known to occur within nearby areas of Redwood Glen. Based on the habitat requirements and nearby occurrences of Santa Cruz black salamander, there is a high potential for this salamander to occur in the project area. Santa Cruz black salamander was not observed during the field survey, although this species can be cryptic and may not have been detected.

California giant salamander. California giant salamander is designated as a CSSC. It is one of the largest terrestrial salamanders in North America and can grow up to one-foot in length. It is endemic to California, found in two or three isolated regions from Mendocino County to southern Santa Cruz County, and does not occur east of the San Francisco Bay. It occurs in wet coastal forests in or near clear, cold permanent or semi-permanent streams and seepages. The California giant salamander is light reddish brown with copper-colored marbling on the upper body. Larvae are born in the water where they swim using an enlarged tail fin and breathe with filamentous external gills. The aquatic larvae transform into terrestrial four-legged salamanders that breathe air with lungs. They are active on rainy nights and during daylight in wet periods during winter. They will eat other salamanders, small rodents, slugs, and lizards.

Both Hoffman and Piney creeks provide suitable habitat for California giant salamander. California giant salamanders are known to occur within nearby areas of Redwood Glen. Based on the habitat requirements and nearby occurrences of California giant salamander, there is a high potential for this salamander to occur at or near the water diversion sites. California giant salamander was not observed during the field survey, although this species can be cryptic and may not have been detected.

Marbled murrelet. Marbled murrelet is federally listed as threatened and state-listed as endangered. It feeds near-shore and nests inland along coast from Eureka to Oregon border and from Half Moon Bay to Santa Cruz. Marbled murrelet nests in old-growth redwood-dominated forests, up to six miles inland, often in Douglas-fir.

Marbled murrelet is known to nest in nearby Memorial and Pescadero Creek County Parks, including a recent nest record on Piney Creek within Pescadero County Park. Both County Parks are within federally-designated critical habitat for marbled murrelet. Based on the habitat requirements and nearby occurrences of marbled murrelet, there is a high potential for this species to occur in the project area. The Piney Creek water diversion site is also within critical habitat for marbeled murrelet.

Townsend's big-eared bat. Townsend's big-eared bat is designated as a CSSC. It is a medium-sized bat with extremely long, flexible ears, and small yet noticeable lumps on each side of the snout. They are found in a variety of habitats from forests to desert scrub. They prefer to roost in open caves. However, they will use a variety of other roost types, particularly abandoned buildings, mines, and tunnels. When roosting they do not tuck themselves into cracks and crevices like many bat species do, but prefer large open areas. This species is sensitive to disturbance and it has been documented that they will abandon roost sites after human interference.

Townsend's big-eared bat hibernates throughout its range during winter months when temperatures are between 0°C and 11.5 degrees Celsius (32-53 degrees Fahrenheit). While hibernating, it hangs alone or in small groups in the open, with fur erect to provide maximum insulation and with ears coiled back. These bats emerge late in the evening to forage and are swift, highly maneuverable fliers. Prey items include small moths, flies, lacewings, dung beetles, and sawflies.

Townsend's big-eared bat is known to occur in the Pescadero-Butano watershed and has been documented on the nearby La Honda Creek Open Space Preserve (MROSD 2012). This species may roost within large tree cavities present in the Redwood Forest Alliance in the project area. Based on the habitat requirements of the Townsend's big-eared bat and nearby occurrences, there is a high potential for this species to occur in the project area.

Western red bat. Western red bat is designated as a CSSC. The western red bat roosts primarily in tree foliage, especially in cottonwood, sycamore, and other riparian trees or orchards. The bat prefers habitat edges and mosaics with trees that are protected from above and open below with open areas for foraging, including grasslands, shrublands, and open woodlands. They are solitary by nature, but will gather in larger nursery roosts during the summer.

Western red bat is known to occur in the Pescadero-Butano watershed and has been documented on the nearby La Honda Creek Open Space Preserve (MROSD 2012). This species may roost in the trees associated with the Redwood Forest Alliance around Hoffman and Piney creeks. Based on the habitat requirements of the Western red bat and nearby occurrences, there is a high potential for western red bat to occur in the project area.

Steelhead. Central California Coast Steelhead DPS is designated Federal Threatened. Steelhead are anadromous forms of rainbow trout, spending some time in both fresh and salt water. The older juvenile and adult life stages occur in the ocean, until the adults ascend freshwater streams to spawn. Eggs (laid in gravel nests), alevins (gravel dwelling hatchlings), fry (juveniles newly emerged from stream gravels) and young juveniles all rear in freshwater until they become large enough to migrate to the ocean to finish rearing and maturing to adults. Coastal California steelhead usually live in freshwater for 2 years, then spend 1 or 2 years in the ocean before returning to their natal stream to spawn. Steelhead may spawn one to four times over their life.

Steelhead are known to occur in Pescadero Creek and its tributaries within the Pescadero-Butano watershed. The reach of Pescadero Creek near the confluence of Hoffman and Piney creeks likely functions as an important migratory connection to suitable upstream spawning and rearing habitat. Hoffman Creek was evaluated as part of a 2004 fish passage study (Ross Taylor and Associates 2004 as cited in Becker and Reining 2008) and was determined to be "Steep…Deemed not fish bearing." During the site visit of the project area on September 14, 2017, the biologists noted that both the water diversion sites on Hoffman and Piney creeks are located close to their respective headwaters where the creeks are shallow and lack deep water pools. Therefore, no suitable habitat was observed to be present for steelhead at these locations. However, steelhead are present in Pescadero Creek and could occur in the lower reaches of Hoffman and Piney Creek where they flow into Pescadero Creek. No steelhead or other fish species were observed in Hoffman or Piney creeks within or near the project area during the field visit.

Western pond turtle. WPT is designated as a CSSC. WPT is often seen basking above the water, but will quickly slide into the water when it feels threatened. The species is active from around February to November and may be active during warm periods in winter. Western pond turtle hibernates underwater, often in the muddy bottom of a pool and may estivate during summer droughts by burying itself in soft bottom mud. When creeks and ponds dry up in summer, some turtles that inhabit creeks will travel along the creek until they find an isolated deep pool, others stay within moist mats of algae in shallow pools while many turtles move to woodlands above the creek or pond and bury themselves in loose soil where they will overwinter.

Pond turtles are normally found in and along riparian areas, although gravid females have been reported up to a mile away from water in search of appropriate nest sites. The preferred habitat for these turtles includes ponds or slow-moving water with numerous basking sites (logs, rocks, etc.), food sources (plants, aquatic invertebrates, and carrion), and few predators (raccoons, introduced fishes, and bullfrogs). Typically, the female excavates a nest in hard-packed clay soil in open habitats (usually on south-facing slopes) within a few hundred yards of a watercourse.

WPT are known from Pescadero Marsh. The species is also known to occur in the San Gregorio and Waddell Creek watersheds, to the north and south of Pescadero Creek, respectively (MROSD 2012). This species has not been documented within the upper reaches of Pescadero Creek. Based on a field assessment, Pescadero Creek as well as Hoffman and Piney creeks could provide suitable high-quality aquatic habitat for WPT. However, based on the lack of nearby occurrences of WPT and the lack of suitable upland grassland habitat, there is a low potential for WPT to occur in the project area. WPT was not observed during the field survey.

San Francisco garter snake. SFGS is federal and state-listed as endangered and is a fully protected species under §5050 of the California Fish and Game Code. A highly aquatic subspecies of the common garter snake endemic to the San Francisco Bay Area, SFGS are distributed along the western San Francisco Peninsula from the southern San Francisco County

border south to Waddell Lagoon south of Año Nuevo and as far east as US 101 near the San Francisco Airport. It occurs sympatrically with its primary prey species, the California red-legged frog; however, it will opportunistically prey on a variety of species including frogs, tadpoles, egg masses, newts, small fish, salamanders, reptiles, small mammals, birds and their eggs and several small invertebrates (Stebbins 2003).

San Francisco garter snakes prefer dense habitats close to water and will retreat to it when disturbed (Stebbins 2003). The species often occurs near ponds, marshes, streams and other wetlands associated with cattails (*Typha* spp.), bulrushes (*Scirpus* spp.) and rushes (*Juncus* and *Eleocharis* spp.). Mating occurs shortly after they leave their winter retreats in May and females give birth to live young between June and September. Species may hibernate near the coastal areas in fossorial mammal burrows and other refuges, or remain active year-round, weather permitting.

SFGS are known to occur within Pescadero Marsh. Based on a field assessment, Pescadero Creek could provide suitable habitat for SFGS. However, SFGS has not been documented within the upper reaches of Pescadero Creek near Redwood Glen.

Based on the field assessment of site conditions and the lack of suitable wetlands and upland habitat at or near the project area, the project area does not support breeding or upland habitat for SFGS. Additionally, SFGS is not expected to use the creek habitat as a movement corridor within the project area due to the lack of connectivity of Hoffman and Piney creeks to suitable wetland habitat. Based on the habitat requirements and lack of nearby occurrences of SFGS, this species has a low potential to be present in the project area. SFGS were not observed during the field survey.

6.7.2 Special-Status Plants

Dudley's lousewort. Dudley's lousewort a CRPR 1B.2 plant, is a perennial herb in the broom rape family (Orobanchaceae). It is endemic to central coastal California from San Mateo county south to San Luis Obispo county. It grows in chaparral, valley and foothill grassland and North coast coniferous forest, particularly in deep shady woods and steep cut banks in older coast redwood forests and maritime chaparral. It blooms from April through June. Dudley's lousewort is threatened by foot traffic, trail maintenance, erosion, and potentially by development (CNPS 2017). Based on suitable habitat and nearby occurrences, Dudley's lousewort has a high potential to occur in the project area.

Minute pocket moss. Minute pocket moss, a CRPR 1B.2 plant, is found in Alameda, Butte, Del Norte, Humboldt, Mendocino, Marin, Santa Cruz, San Mateo, Sonoma, and Yuba counties. Minute pocket moss grows in damp, coastal soil in North Coast coniferous forest. Minute pocket moss is known from along Pescadero Creek near Redwood Glen. Based on suitable habitat and nearby occurrences, this species has a high potential to occur in the project area.

Western leatherwood. Western leatherwood, a CRPR 1B.2 plant, is a perennial deciduous shrub in the Daphne family (Thymelaeaceae). It is endemic to California and is found in

Alameda, Contra Costa, Marin, Santa Clara, San Mateo, and Sonoma counties. Western leatherwood is found in mesic habitats including broad-leafed upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, north coast coniferous forest, and riparian forest and woodland. It blooms from January through April. It is possibly threatened by road and trail maintenance (CNPS 2017). Based on suitable habitat and nearby occurrences, western leatherwood has a moderate potential to occur in the project area. Western leatherwood was not observed during the field survey and the shrub would have been visible at the time the survey was conducted.

White-flowered rein orchid. White-flowered rein orchid, a CRPR 1B.2 plant, is a perennial herb in the Orchid family (Orchidaceae). It is found along the coast and coast ranges in California from the northern border of the state to the Santa Cruz mountains. White-flowered rein orchid grows in broad-leafed upland forest, lower montane coniferous forest, and North Coast coniferous forest, sometimes in serpentine soils. It blooms from May through September. It is threatened by logging, and populations often have small numbers (CNPS 2017).

Based on suitable habitat and nearby occurrences, white-flowered rein orchid has a moderate potential to occur in the project area. White-flowered rein orchid was not observed during the field survey, although the survey was conducted at the end of this species blooming period and may not have been easy to detect.

6.8 Migratory Birds and Raptors

The trees and dense vegetation found at and nearby the project area support potential nesting habitat for birds including raptors. Most bird species are protected under the MBTA and all bird species are protected under California Fish and Game Code.

6.9 Bats

The trees found at and nearby the project area could provide roosting habitat for common bat species. Bats tend to forage near water sources; therefore, trees over or near water bodies are even more likely to serve as roosting sites. As a result, bat species have potential to occur in the project area and use the trees for roosting. Bats are protected under California Fish and Game Code as non-game mammals.

6.10 Potential Jurisdictional Aquatic Features

The existing water diversion sites on Hoffman and Piney creeks are located within potential jurisdictional waters of the U.S. and State as defined by Sections 401 and 404 of the CWA and the Porter Cologne Act. Construction or modifications below the OHWM of these creeks may require authorization from the USACE and/or RWQCB. In addition, Redwood Forest Alliance riparian vegetation and drainage and pond features with bed and bank topography are regulated by Sections 1600-1616 of the California Fish and Game Code. The existing water diversion

sites are regulated by sections 1600-1603 of California Fish and Game Code and may be subject to an LSAA from CDFW.

7 Biological Impact Assessment

7.1 Significance Criteria

Potential impacts to biological resources were determined in accordance with Appendix G of the CEQA Guidelines. Impacts would be considered potentially significant if the proposed project will:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW or USFWS.
- Have a substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the CDFW or USFWS.
- Have a substantial adverse effect on federally protected wetlands, as defined by Section 404 of the CWA (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrologic interruption, or other means.
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.
- Conflict with the provisions of an adopted Habitat Conservation Plan (HCP), Natural Community Conservation Plant (NCCP), or other approved local, regional, or state HCP.

7.2 Overall Impacts from Water Diversion Activities

Redwood Glen is primarily surrounded by open space with natural habitats, but also by rural residential development. The Redwood Glen property is mostly undeveloped with natural habitats. The development and construction of the current water diversion system is complete, including the water infrastructure site, water diversion sites in Hoffman and Piney creeks, and the gravity-fed diversion pipes. Water for Redwood Glen has been provided from the Pescadero Creek watershed since it opened in 1958, and the Hoffman and Piney Creek diversions have been in operation since that time, although the amount of water diverted has varied. From 1958 to 1995, Redwood Glen had multiple sources of water that supplied both the potable water system, as well as irrigation and/or other, non-potable uses. During this time, Redwood Glen diverted up to 8-acre-feet of water/year or 2,606,808 gallons/year in accordance with their pre-1914 appropriate riparian water right at Hoffman Creek. From 1998 through March 2016, potable water was provided to Redwood Glen by San Mateo County Memorial Park; therefore, the Hoffman and Piney creek sources were only used for irrigation purposes during this time. Based on the San Mateo County Statements of Diversion and Use, water diverted at Redwood

Glen for irrigation purposes has ranged from 180,000 to 250,000 gallons/year. The proposed project would need to increase the amount of water diverted and/or stored to meet the projected annual average potable water demand for the camp, which is estimated to be 1,305,953 gallons per year (i.e., 4-acre-feet/year).

Although the project would need to meet the project annual average demand, the project will not have significant impacts on special-status species, habitat, or baseflows in Hoffman and Piney creeks. Additionally, there are no current conflicts with local policies or conservation plans. The proposed project is also not expected to have cumulative biological impacts. The impact assessment is based on a site assessment by MIG and the findings of Balance Hydrologics (Balance; Appendix D), including the following conclusions:

- The current diversion system on Hoffman and Piney creeks are inefficient and baseflow will continue to passively bypass the diversions. Storm-related streamflows and early dry-season baseflows also flow over the diversion structures. Therefore, the existing/historic effect of the diversions on baseflows in Hoffman, Piney, and Pescadero creeks is not significant.
    - Balance provided an example of existing late dry-season baseflow bypass at the Hoffman Creek diversion where they measured flow at the diversion on September 9, 2017. At that time, they measured 4.6 gallons per minute flowing below the diversion while 0.73 gallons per minute were being diverted.
    - Although higher rates of diversion are possible at the diversions when the diversions are fully submerged, such as during storm events, even some of this water still bypasses the diversion structures.
- The drainage areas of Hoffman and Piney creeks are significantly small compared to Pescadero Creek, and as a result, wet-season runoff at water diversion sites on Hoffman and Piney creeks are much less than one percent of flow in Pescadero Creek.
- The water diversion sites on Hoffman and Piney creeks are situated at headwater springs that, therefore, can only divert a portion of total baseflow at the mouth of the creeks. Springflow to the creeks downstream of the water diversion sites are not diverted by the Redwood Glen diversions.
- In extreme dry years, most of the water in the creeks would likely passively bypass the diversion structures and an existing 70,000 gallon raw water storage and other water use conservation measures would be used to ensure the potable water demand was met.

Future development of infrastructure associated with water diversion, including rebuilding equipment at the existing water diversion sites could result in direct and indirect effects on biological resources. Potential impacts could include the loss of natural redwood forest, aquatic, and riparian habitat through grading and removal of vegetation, all of which provide valuable

habitat and migratory paths for native plants and wildlife. Other impacts include the degradation of water quality from discharge of sediment into Hoffman and Piney creeks.

Future development of infrastructure associated with water diversion, including maintenance of the existing water diversion sites, should include avoidance and mitigation measures (AMMs) and best management practices (BMPs) to avoid or mitigate for significant impacts to biological resources, including special-status animals and plants. Possible measures include conducting pre-construction surveys to comply with state and federal laws protecting bird, special-status plant and animal species; conducting pre-construction surveys to protect bat species that may roost in trees; and implementing a Stormwater Pollution Prevention Plan (SWPP) to minimize disturbance and protect water quality. Resource agency permits may be required, depending on what activities are planned.

Future development of infrastructure associated with the water diversion could also allow for a more efficient diversion system that would capture more water and allow less passive bypass flow. This would allow for a future increase in the volume of water diverted that could possibly result in indirect or direct impacts to biological resources in Hoffman and Piney creeks, as well as Pescadero Creek, and would require a new assessment as it could adversely impact biological resources. At this time, there is no plan to construct a new diversion on Hoffman or Piney creeks.

7.3 Sensitive Species – *Less-Than-Significant Impact*

7.3.1 Special-Status Animals

Amphibians. Operation of the existing water diversion is not expected to affect special-status amphibian species. No wetlands were observed in the project area during the site visit conducted in September 2017. In addition, as stated above, baseflow will continue to bypass the diversion system, including in dry years, and; therefore, the diversion will not have a significant effect on the baseflows or habitat in Hoffman, Piney, or Pescadero Creek. The proposed project will also not result in changes to the existing Redwood Forest Alliance habitat surrounding the creeks because baseflows will continue to bypass the diversions for stream dependent vegetation and no new construction will occur at the diversions.

Future construction activities at the water diversion sites could result in direct impacts to special-status amphibian species, including CRLF, foothill yellow-legged frog, Santa Cruz black salamander, and California giant salamander, and would need to be evaluated for potential impacts to special-status amphibians. In addition, if the diversion structures were modified to capture more water and minimize bypass flows, impacts to special-status species would need to be re-evaluated.

Steelhead. Hoffman and Piney creeks do not provide suitable habitat for steelhead. Therefore, direct impacts to steelhead at the water diversion sites are not expected to occur.

Steelhead are known to occur downstream in Pescadero Creek. The concern is that impacts to steelhead habitat in Pescadero Creek could occur from operation of the water diversion if the water diversion significantly affects Pescadero Creek during certain periods of the year. Very low flows can pose a risk to developing eggs and can strand fish. Decreased flows could also result in temperature changes that could make the habitat unsuitable for steelhead.

Balance prepared a hydrologic analysis to determine how the operation of the water diversion associated with the project affects the stream flow regime in Pescadero Creek (Appendix D). The hydrologic analysis concluded that the drainage areas of Hoffman and Piney creeks were significantly small compared to Pescadero Creek, and that wet season runoff at the water diversion sites on Hoffman and Piney Creek is much less than one percent of the flow in Pescadero Creek. In addition, baseflow estimates for Hoffman and Piney creeks during consecutive dry years were much less than one percent of the flow in Pescadero Creek. Only the base flow estimate for 2014, which was an extreme dry year, exceeded one percent of the flow in Pescadero Creek. However, Piney Creek can provide raw water that can be stored through the summer months and used during an extreme dry year scenario to ensure that flows in Pescadero Creek are not altered. Based on this assessment, operation of the water diversions on Hoffman and Piney creeks is not expected to impact steelhead in Pescadero Creek.

If future construction activities are necessary at the water diversion sites, these will need to be evaluated for potential impacts to steelhead from stormwater pollution, and AMMs would need to be proposed to avoid or significantly reduce these impacts. In addition, if there is a future proposal to modify the diversion structures so that the volume of water diverted in Hoffman and Piney creeks could be increased and bypass flows minimized, impacts to steelhead would need to be re-evaluated.

Roosting Bats. The project area provides suitable roosting (i.e., trees with large cavities) and foraging (i.e., perennial creek) habitat for western red bat and Townsend's big-eared bat as well as other common bat species protected under California Fish and Game Code. As stated above, baseflow will continue to bypass the diversion system, including in dry years, and; therefore, the diversion will not have a significant effect on the baseflows or foraging/creek habitat in Hoffman, Piney, or Pescadero Creek. In addition, the project will not impact any of the trees in the project area. Therefore, the operation of the water diversions is not expected to impact roosting bats.

Future construction activities in the project area could result in direct and indirect impacts to roosting bats, and would need to be re-evaluated. In addition, if there is a future proposal to modify the diversion structures so that the volume of water diverted in Hoffman and Piney creeks could be increased and bypass flows minimized, impacts to bat foraging habitat would need to be re-evaluated.

Nesting Birds. Operation of the water diversions will have no impacts on nesting birds, including marbled murrelet, because no trees in the project area will be impacted and the Redwood Forest Alliance habitat will remain unchanged. Future construction activities in the project area, if proposed, could result in direct and indirect impacts to nesting birds, and will need to be assessed. Nesting birds, including raptors, protected under the MBTA and California Fish and Game Code are potentially present in the trees within the project area. Marbled murrelet has additional protection under FESA and CESA.

Special-Status Plants. The current water diversion infrastructure, including the water diversion sites and associated activities are not expected to impact special-status plants. As stated above, baseflow will continue to bypass the diversion system, including in dry years, and; therefore, the diversion will not have a significant effect on the baseflows or habitat in Hoffman, Piney, or Pescadero Creek. In addition, the operation of the water diversions will not impact the Redwood Forest Alliance habitat.

There is suitable habitat for Dudley's lousewort, minute pocket moss, and white-flowered rein orchid throughout the project area. There is also suitable habitat for western leatherwood in the Hoffman and Piney Creek riparian areas. If construction projects are proposed in the project area the impacts to rare plant species will need to be re-evaluated. In addition, if there is a future proposal to modify the diversion structures so that the volume of water diverted in Hoffman and Piney creeks could be increased and bypass flows minimized, impacts to rare plant species would need to be re-evaluated.

7.4 Sensitive Natural Vegetation Communities, Including Wetlands – *Less-Than-Significant Impact*

Sensitive vegetation communities include riparian habitat or other sensitive natural communities identified in local or regional plans, policies, or regulations, or designated by the USFWS and CDFW. The operation of the diversions will not have significant impacts on sensitive vegetation communities, including riparian and the Redwood Forest Alliance because of the reasons stated above, including that water will continue to passively bypass the diversions and baseflow will not be significantly altered.

Future construction activities at the water diversion sites could result in impacts that will need to be addressed at that time. In addition, if there is a future proposal to modify the diversion structures so that the volume of water diverted in Hoffman and Piney creeks could be increased and bypass flows minimized, impacts to sensitive vegetation communities would need to be re-evaluated. Any future construction or maintenance activities at the water diversion sites could require a USACE Nationwide Permit pursuant to Section 404 of the CWA, a Water Quality Certification by the RWQCB pursuant to Section 401 of the CWA, and an LSAA from CDFW.

7.5 Interfere with Native Wildlife Movement – *No Impact*

Operation of the water diversions will not impede or alter, native wildlife movement. Any future construction activities and/or maintenance activities at Hoffman and Piney creeks would need to be evaluated to determine potential impacts to movement of wildlife. In addition, if there is a future proposal to modify the diversion structures so that the volume of water diverted in Hoffman and Piney creeks could be increased and bypass flows minimized, impacts to wildlife movement would need to be re-evaluated.

7.6 Conflict with Local Policies – *No Impact*

No trees will be removed as part of the proposed project. Therefore, operation of the project will not conflict with any local policies.

If construction or maintenance activities involve the removal of trees classified as heritage or significant by the County of San Mateo, a permit from the County will need to be obtained. The permit will likely require requirements to replace any significant trees removed with other native plantings.

7.7 Conflict with Conservation Plan – *No Impact*

The project area is not within an area covered by an HCP or NCCP. As a result, the continued diversion of water from Hoffman and Piney creeks will have no impact related to a conservation plan.

8 References

Baldwin, B.G., D.H. Goldman, D. J. Keil, R. Patterson, T.J. Rosatti, and D.H. Wilken, editors. 2012. The Jepson Manual: Vascular Plants of California, second edition. University of California Press, Berkeley.

Becker, G.S. and I.J. Reining. 2008. Steelhead/Rainbow Trout (*Oncorhynchus mykiss*) Resources South of the Golden Gate, California. Center for Ecosystem Management and Restoration, Oakland, CA.

Beier, P. and S. Loe. 1992. A Checklist for Evaluating Impacts to Wildlife Movement Corridors. Wildlife Society Bulletin 20(4):434-440.

Beier, P. and R.F. Noss. 1998. Do Habitat Corridors Provide Connectivity? Conservation Biology 12(6):1241-1252.

Bulger, J.B., N.J. Scott Jr. and R. Seymour. 2003. Terrestrial Activity and Conservation of adult California red-legged frogs *Rana aurora draytonii* in coastal forests and grasslands. Biological Conservation. Vol. 110: 85-95.

CDFW. 2017. California Department of Fish and Wildlife. California Natural Diversity Database. RareFind 5 (version 5.1.1). Accessed September 2017.

CNPS. 2001. California Native Plant Society (CNPS) Botanical Survey Guidelines. California Native Plant Society, Sacramento, CA. http://www.cnps.org/cnps/rareplants/pdf/cnps_survey_guidelines.pdf [accessed September 2017]

CNPS 2017. California Native Plant Society (CNPS), Rare Plant Program. Inventory of Rare and Endangered Plants of California (online edition, v8-03.39). http://www.rareplants.cnps.org [accessed September 2017].

Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U. S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. (Version 04DEC98).

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report Y- 87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. January. 100 pp. plus appendices.

Fellers, G. M., and P. M. Kleeman. 2007. California Red-Legged Frog (*Rana draytonii*) Movement and Habitat Use: Implications for Conservation. Journal of Herpetology 41: 276–286.

Flower, S. S. 1931. Contributions to our knowledge of the duration of life in vertebrate animals. V. Mammals. Procs. Zool. Soc. London. 1931:145-234.

Jennings, M.R. and M.P. Hayes 1984. Pre-1900 overharvest of the California red-legged frog (*Rana aurora draytonii*): the inducement for bullfrog (*Rana catesbeiana*) introduction. Herpetologica 41(1): 94-103.

MROSD. 2012. Midpeninsula Regional Open Space District. La Honda Creek Open Space Preserve Master Plan. Draft Initial Study/Mitigated Negative Declaration.

NOAA 2005. National Oceanic and Atmospheric Administration Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead; Final Rule. 50 CFR Part 17 Vol. 70 (170): 52488- 52627. September 2.

Ross Taylor and Associates. 2004. San Mateo county Stream Crossing Inventory and Fish Passage Evaluation. Final Report.

Sawyer, J.O., T. Keeler-Wolf, and J. Evans. 2009. A Manual of California Vegetation 2nd edition. California Native Plant Society. Sacramento, CA.

SWRCB. 2017. State Water Resources Control Board. Redwood Glen Camp & Conference Center. State Water Resources Control Board Division of Drinking Water Technical Report, March 2017.

Stebbins, R. C. 2003. A Field Guide to Western Reptiles and Amphibians. 3rd Edition. Houghton Mifflin Company. New York, New York. 533 pp.

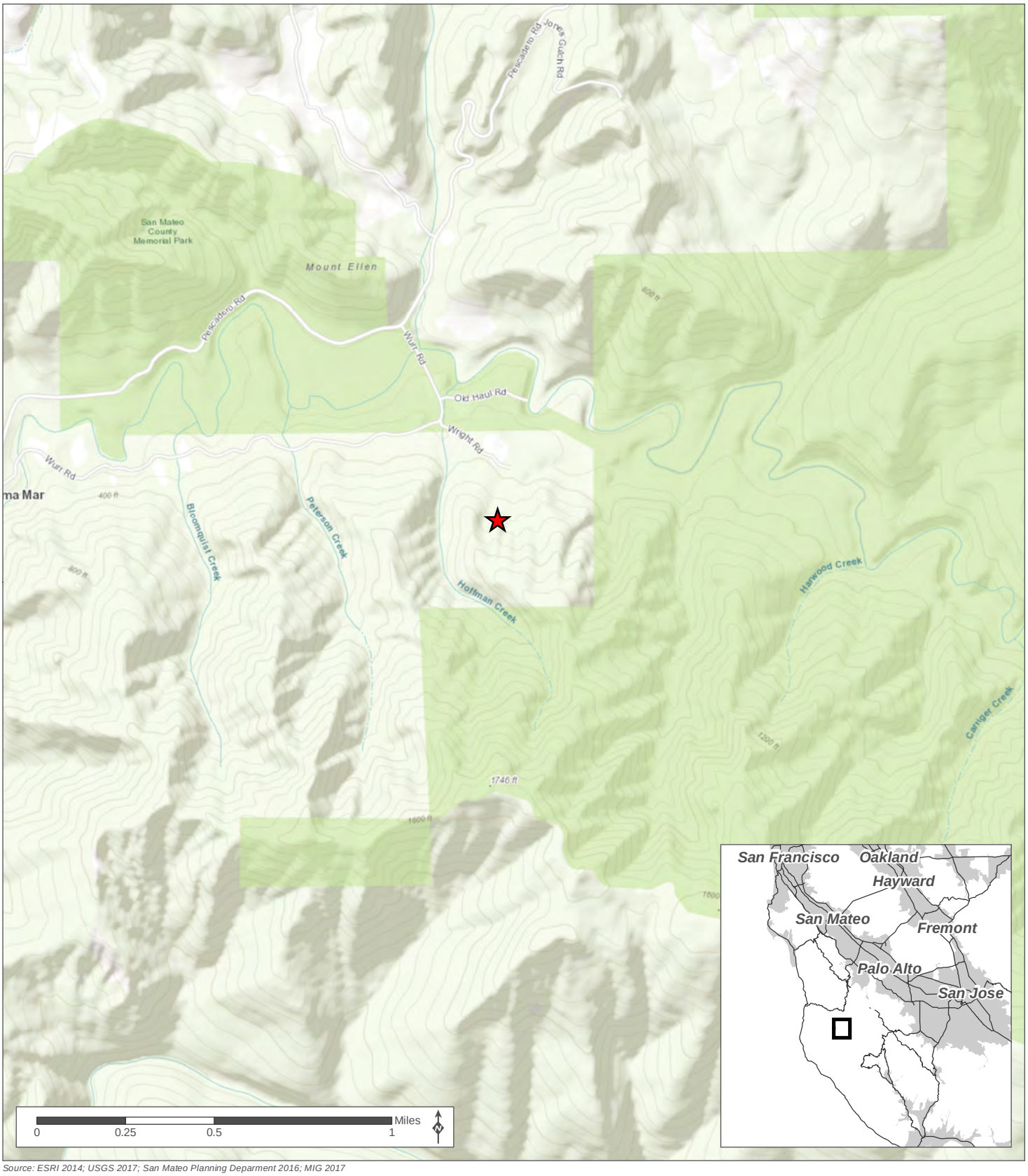
Sequoia Audubon Society. 2001. San Mateo County Breeding Bird Atlas. SAS, Redwood City.

USFWS. 2017a. United States Fish and Wildlife Service (USFWS) Environmental Online Conservation System, Information and Planning for Conservation (IPac). https://ecos.fws.gov/ipac/ [accessed September 2017].

USFWS. 2017b. United States Fish and Wildlife Service (USFWS) National Wetlands Inventory. Wetland Mapper. https://www.fws.gov/wetlands/Data/Mapper.html [accessed September 2017].

WRCS. 2017. Western Regional Climate Center. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca8273 [accessed September 2017].

Appendix A Report Figures



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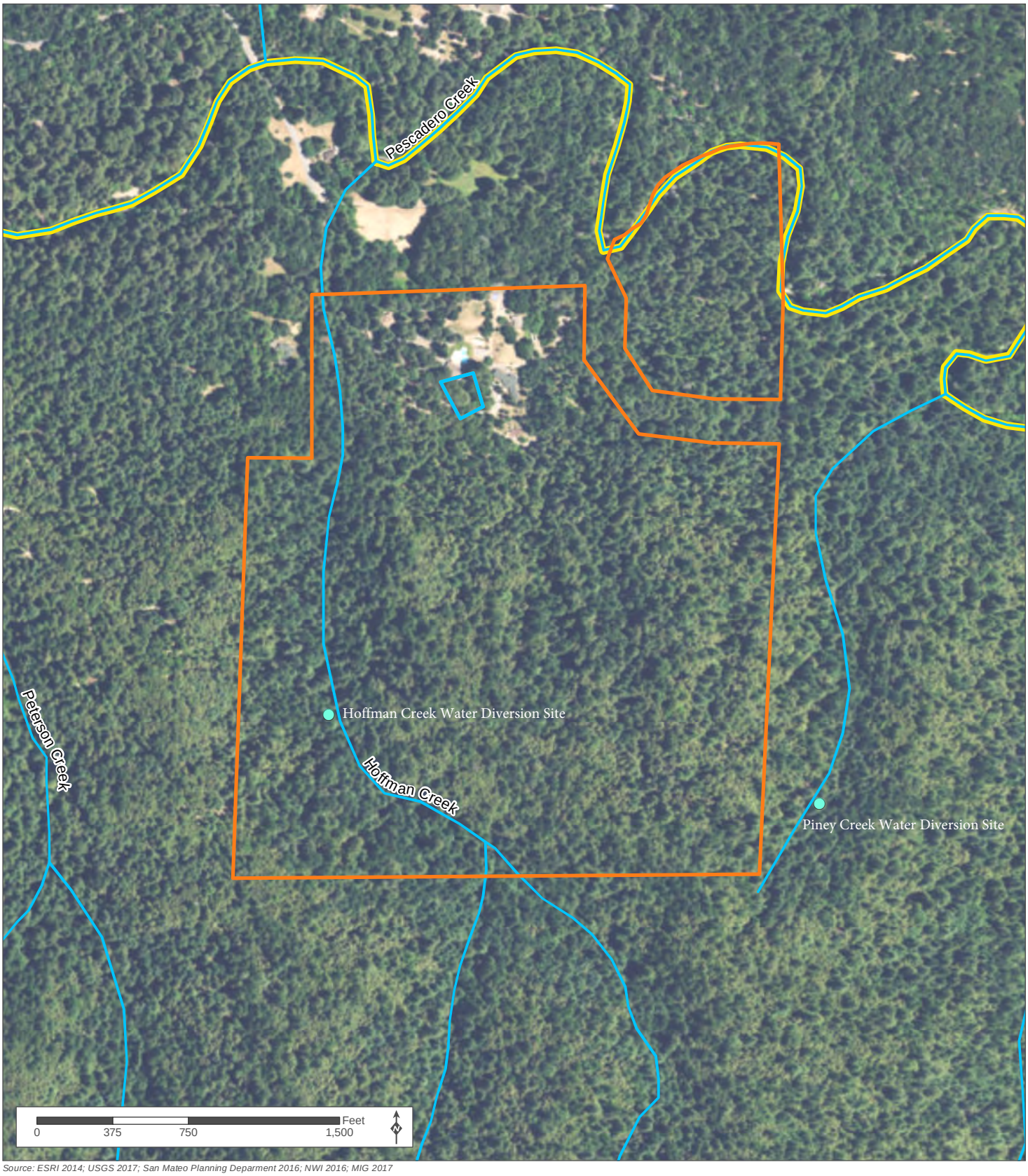
Source: ESRI 2014; USGS 2017; San Mateo Planning Deparment 2016; MIG 2017

Project Location

Figure 1 Site Location

Redwood Glen Water Diversion Project Biology Resources Evaluation



Source: ESRI 2014; USGS 2017; San Mateo Planning Deparment 2016; NWI 2016; MIG 2017

Redwood Glen Camp and Conference Center Property Boundary

Water Infrastructure Site

Water Diversion Site

Critical Habitat

Steelhead

California Red-Legged Frog (all areas of map)

Aquatic Features

NWI Waters of the US

Figure 2 Critical Habitat and Waters of the U.S. in the Project Area

Redwood Glen Water Diversion Project Biology Resources Evaluation

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Appendix B Photographs

Photo 1. Converted Conex shipping container where the surface water treatment plant is located.

Photo 2. Existing raw water storage tanks at the water infrastructure site.

Photo 3. The 70,000-gallon raw water storage tank.

Photo 4. Water Diversion site on Hoffman Creek.

Photo 5. Water Diversion site on Piney Creek.

Photo 6. Pescadero Creek near confluence with Hoffman Creek. The water diversion sites on Hoffman Creek and Piney creeks are approximately 0.5 miles and 0.4 miles upstream of Pescadero Creek, respectively.

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Appendix C Special-Status Plant and Animal Species Evaluated for Potential to Occur in the Project Area

Table 1. Special-Status Plant Species Evaluated for Potential to Occur in the Project Area

Species Name	Federal, State, and CNPS Listing Status[1]	Geographic Distribution	Habitat Preferences and Elevation Range	Blooming Period	Potential to Occur[2]
Anderson's manzanita (*Arctostaphylos andersonii*)	1B.2	Endemic to California. Found in Santa Clara, Santa Cruz, and San Mateo counties.	Anderson's manzanita is found in the openings and edges of broad-leafed upland forest, chaparral, and north coast coniferous forest. It occurs at elevations from approximately 200 to 2,500 feet.	November – May	**None.** Eight CNDDB occurrences for Anderson's manzanita have been documented within 5 miles of Redwood Glen. However, there is no suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.
Arcuate bush-mallow (*Malacothamnus arcuatus*)	1B.2	Endemic to California. Found in Santa Clara, Santa Cruz, and San Mateo counties.	Arcuate bush-mallow is found growing in gravelly alluvium substrates in chaparral and cismontane woodland habitats. It occurs at elevations between 50 and 1,160 feet.	April – September	**None.** One CNDDB occurrence for arcuate bush mallow has been documented within 5 miles of Redwood Glen However, there is no suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.
Butano Ridge cypress (*Hesperocyparis abramsiana var. butanoensis*)	FT CE 1B.2	Endemic to California. Found only in San Mateo County.	Butano Ridge cypress is found in closed-cone coniferous forest, chaparral, and lower montane coniferous forest on sandstone. It occurs at elevations between 1,312 and 1,607 feet.	October	**None.** Known only from Butano Ridge in the Santa Cruz Mountains. However, there is no suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.

Species Name	Federal, State, and CNPS Listing Status[1]	Geographic Distribution	Habitat Preferences and Elevation Range	Blooming Period	Potential to Occur[2]
Choris' popcorn-flower (*Plagiobothrys chorisianus var. chorisianus*)	1B.2	Endemic to California. Found in Alameda, Monterey, Santa Clara, Santa Cruz, San Francisco, and San Mateo counties.	Choris' popcorn-flower grows in mesic chaparral, coastal prairie, and coastal scrub habitats. It occurs at elevations between 50 and 520 feet.	March – June	**None.** Three CNDDB occurrences for Choris' popcorn-flower have been documented within 5 miles of Redwood Glen. There is no suitable habitat for this species on the project site.
Dudley's lousewort (*Pedicularis dudleyi*)	CR 1B.2	Endemic to central coastal California from San Mateo county south to San Luis Obispo county.	Chaparral, valley and foothill grassland and North coast coniferous forest, particularly deep shady woods and steep cut banks in older coast redwood forests and maritime chaparral.	April – June	**High.** One CNDDB occurrence for Dudley's lousewort has been documented within 5 miles of Redwood Glen. There is suitable habitat at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.
Kellman's bristle moss (*Orthotrichum kellmanii*)	1B.2	Endemic to California. Found in Monterey, Santa Cruz, and San Mateo counties.	Kellman's bristle moss grows in chaparral, and cismontane woodland on sandstone, carbonate soils. It occurs at elevations from approximately 1,125-2,247 feet.	January-February	**None.** One CNDDB occurrence for Kellman's bristle moss has been documented within 5 miles of Redwood Glen. However, there is no suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.
Minute pocket moss (*Fissidens pauperculus*)	1B.2	In California, found in Alameda, Butte, Del Norte, Humboldt, Mendocino, Marin, Santa Cruz, San Mateo, Sonoma, and Yuba counties.	Minute pocket moss grows in damp, coastal soil in North Coast coniferous forest. It occurs at elevations from approximately 33-3,360 feet.	N/A	**High.** Three CNDDB occurrences for minute pocket moss have been documented within 5 miles of Redwood Glen, including one from 2011 along Pescadero Creek near Redwood Glen. There is suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.

Species Name	Federal, State, and CNPS Listing Status[1]	Geographic Distribution	Habitat Preferences and Elevation Range	Blooming Period	Potential to Occur[2]
Point Reyes meadowfoam (*Limnanthes douglasii ssp. sulphurea*)	CE 1B.2	Endemic to California. Found in Marin, and San Mateo counties.	Point Reyes meadowfoam grows in coastal prairie, meadows and seeps (mesic), marshes and swamps (fresh water), and vernal pools. It occurs at elevations from 0-459 feet.	March - May	**None.** One CNDDB occurrence for Point Reyes meadowfoam has been documented within 5 miles of Redwood Glen. However, there is no suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.
Round-leaved filaree (*California macrophylla*)	1B.2	Occurs in central and coastal California from near Chico to near San Diego.	Round-leaved filaree grows in cismontane woodland, and valley and foothill grassland in clay soils. It occurs at elevations from approximately 49 to 3,937 feet.	March - May	**None.** One CNDDB occurrence for round-leaved filaree has been documented within 5 miles of Redwood Glen. However, there is no suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.
San Mateo woolly sunflower (*Eriophyllum latilobum*)	FE CE 1B.1	Endemic to San Mateo County.	San Mateo woolly sunflower is found growing in cismontane woodland habitats often on serpentinite soils and on roadcuts. It is known from two extant occurrences. It occurs at elevations between 150 and 500 feet.	May – June	**None.** One CNDDB occurrence for San Mateo thorn-mint has been documented within 5 miles of Redwood Glen. However, there is no suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.
Toren's grimmia (*Grimmia torenii*)	1B.3	Endemic to California. Found in Contra Costa, Colusa, Lake, Mendocino, Monterey, Santa Cruz, and San Mateo counties.	Toren's grimmia grows in chaparral, cismontane woodland, and lower montane coniferous forest in openings, rocky, boulder and rock walls in carbonate, volcanic soils. It occurs at elevations from approximately 1,066 to 3,806 feet.	N/A	**None.** One CNDDB occurrence for Toren's grimmia has been documented within 5 miles of Redwood Glen. However, there is no suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.

Species Name	Federal, State, and CNPS Listing Status[1]	Geographic Distribution	Habitat Preferences and Elevation Range	Blooming Period	Potential to Occur[2]
Western leatherwood (*Dirca occidentalis*)	1B.2	Endemic to California. Found in Alameda, Contra Costa, Marin, Santa Clara, San Mateo, and Sonoma counties.	Western leatherwood is found in mesic habitats including broad-leafed upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, north coast coniferous forest, and riparian forest and woodland. It occurs at elevations from approximately 80 to 1,400 feet.	January – April	**Moderate.** Five CNDDB occurrences for western leatherwood have been documented within 5 miles of Redwood Glen. There is suitable habitat for this species at the water diversion sites, but it was not observed during the September 2017 site visit.
White-flowered rein orchid (*Piperia candida*)	1B.2	Found along the coast and coast ranges in California from the northern border of the state to the Santa Cruz mountains.	White-flowered rein orchid grows in broad-leafed upland forest, lower montane coniferous forest, and North Coast coniferous forest, sometimes in serpentine soils. It occurs at elevations from approximately 98 to 4,298 feet.	May - September	**Moderate.** One CNDDB occurrence for white-flowered rein orchid has been documented within 5 miles of Redwood Glen. There is suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.
Woodland monolopia (*Monolopia gracilens*)	1B.2	Endemic to California. Found in Alameda, Contra Costa, Monterey, San Benito, Santa Clara, Santa Cruz, San Luis Obispo, and San Mateo counties.	Woodland monolopia grows in serpentine soils in openings in broad-leafed upland forests, openings in chaparral, cismontane woodlands, North Coast coniferous forests, and valley foothill grassland habitats. It occurs at elevations between 330 and 4,000 feet.	February – July	**None.** One CNDDB occurrence for woodland monolopia has been documented within 5 miles of Redwood Glen. However, there is no suitable habitat for this species at the water diversion sites, water infrastructure site, and at the existing gravity-fed diversion pipes.

Species Name	Federal, State, and CNPS Listing Status[1]	Geographic Distribution	Habitat Preferences and Elevation Range	Blooming Period	Potential to Occur[2]

[1] Status explanations:

Federal:

FE = Listed as endangered under the Federal Endangered Species Act.

FT = Listed as threatened under the Federal Endangered Species Act.

State:

CE = Listed as endangered under the California Endangered Species Act.

CT = Listed as threatened under the California Endangered Species Act.

CR = Listed as rare in California.

California Rare Plant Rank:

Rank 1B = Rare, threatened, or endangered in California and elsewhere;

.1 = Seriously endangered in California

.2 = Fairly endangered in California

.3 = Not very endangered in California

[2] Potential Occurrence explanations:

Present: Species was observed at the site or has a recent (within five years) recorded observation in the CNDDB or literature at the site.

High: Highly suitable habitat is present (i.e., all habitat components meeting the species requirements are present and/or the habitat is highly suitable or of high quality). Additionally, there are few to many records of occurrences within the last ten years in the vicinity of the site. This species has a high probability of being found.

Moderate: Suitable habitat is present (i.e., some of the habitat components meeting the species requirements are present and/or the majority of the habitat is suitable or of marginal quality). Additionally, there are few to many modern records of occurrences in the vicinity of the site. The species has a moderate probability of being found.

Low: Limited suitable habitat is present (i.e., few of the habitat components meeting the species requirements are present and/or the majority of habitat is unsuitable or of very low quality). Additionally, there are no or few historical records of occurrence in the vicinity of the site. The species has a low probability of being found.

None: There is no suitable habitat present (i.e., habitats are clearly unsuitable for the species requirements [e.g., foraging, breeding, cover, substrate, elevation, hydrology, plant community, disturbance regime]). Additionally, there are no or few historical records of occurrence in the vicinity of the site. The species has no potential of being found.

Plant species that do not meet the definition for special-status species:

California bottle-brush grass (*Elymus californicus*; CRPR 4.2)

Mountain lady's-slipper (*Cypripedium montanum*; CRPR 4.2)

Table 2. Special-Status Animal Species Evaluated for Potential to Occur in the Project Area

Species Name	Federal and State Listing Status[1]	Geographic Distribution	Habitat Requirements	Potential to Occur[2]
Fish				
Longfin smelt (*Spirinchus thaleichthys*)	FC CT CSSC	Found in nearshore coastal environments from San Francisco Bay north to Lake Earl, near the Oregon Border. Specifically, found in the Sacramento-San Joaquin Delta, San Pablo Bay, San Francisco Bay, the Gulf of Farallones, the Humboldt Bay, and the Eel River estuary.	Longfin smelt is found in open waters of estuaries, mostly in the middle or bottom of the water column. It prefers salinities of 15 to 30 parts per thousand, but it can be found in completely freshwater to almost pure saltwater.	**None.** One CNDDB occurrence for longfin smelt has been documented within 5 miles of the project site. There is no suitable habitat for this species on the project site.
Coho salmon (*Oncorhynchus kisutch*)	FE CE	The species was historically distributed throughout the North Pacific Ocean from central California to Point Hope, Alaska, through the Aleutian Islands. Coho probably inhabited most coastal streams in Washington, Oregon, and central and northern California. Some populations, now considered extinct, are believed to have migrated hundreds of miles inland to spawn in tributaries of the upper Columbia River in Washington, and the Snake River in Idaho.	Coho salmon is an anadromous fish, meaning it spends approximately the first half of its life cycle rearing and feeding in streams and small freshwater tributaries, and the second half of its life foraging in estuarine and marine waters of the Pacific Ocean. Streams with stable gravel substrates provide spawning habitat for this species. Adults return to their stream of origin to spawn and die, usually at around three years old. Young coho spend one to two years in their freshwater natal streams. Smolts migrate to the ocean in late March through July. Coho salmon live in the salt water for one to three years before returning to spawn.	**None.** Coho were reported in the lower reaches of Pescadero Creek in 2015, but are thought to be nearly extirpated from the Pescadero-Butano Watershed. Coho salmon are known to occur in the San Gregorio Watershed north of the project area.

Species Name	Federal and State Listing Status[1]	Geographic Distribution	Habitat Requirements	Potential to Occur[2]
Steelhead- central California coast DPS (*Oncorhynchus mykiss irideus*)	FT	This DPS includes all populations of steelhead from the Russian River south to Aptos Creek. Steelhead in drainages of San Francisco, San Pablo, and Suisun Bays are also part of this DPS.	Adult steelhead migrate from the ocean into streams in the late fall, winter, or early spring seeking out deep pools within fast moving water to rest prior to spawning. Steelhead spawn in shallow-water gravel beds.	**Low.** There are four CNDDB occurrences for steelhead within 5 miles of the project site; it is known from Pescadero Creek and tributaries. Pescadero Creek is within NOAA Fisheries designated critical habitat for this species. It has not been documented in Hoffman or Piney creeks and Hoffman Creek was determined not to be suitable habitat for steelhead during a fish passage study conducted in 2004.
Amphibians				
California giant salamander (*Dicamptodon ensatus*)	CSSC	Known from wet coastal forests near streams and seeps from Mendocino County south to Monterey County and east to Napa County.	Aquatic larvae found in cold, clear streams, occasionally in lakes and ponds. Adults known from wet forests under rocks and logs near streams and lakes.	**High.** There are nine CNDDB occurrences for California giant salamander within 5 miles of the project site. There is suitable habitat for this species on site in Hoffman and Piney creeks.
California red-legged frog (*Rana draytonii*)	FT CSSC	Found from Riverside County to Mendocino County along the Coast Range, from Calaveras County to Butte County in the Sierra Nevada, and in Baja California.	California red-legged frog is found in lowlands and foothills in or near permanent sources of deep water. It prefers shorelines with extensive vegetation since it disperses far during and after rain. Larvae require 11-12 weeks of permanent water for development.	**High.** There are 11 CNDDB occurrences for California red-legged frog within 5 miles of the project site. The site is within USFWS-designated habitat for this species. There is some suitable habitat for this species on the project site.

Species Name	Federal and State Listing Status[1]	Geographic Distribution	Habitat Requirements	Potential to Occur[2]
Foothill yellow-legged frog (*Rana boylii*)	CPT CSSC	Largest remaining populations in California are in the north coast range, particularly in the Smith River, tributaries of the Klamath River, the South Fork Trinity River, the South Fork Eel River, Redwood Creek, coastal tributaries in Mendocino County and Russian River tributaries.	Foothill yellow-legged frog is found in partly-shaded, shallow streams and riffles with a rocky substrate in a variety of habitats. It needs at least some cobble-sized substrate for egg-laying, and at least 15 weeks to attain metamorphosis.	**Moderate.** One CNDDB occurrence for foothill yellow-legged frog has been documented within 5 miles of the project site in Pescadero Creek in 1999. There is some suitable habitat for this species on the site.
Santa Cruz black salamander (*Aneides niger*)	CSSC	Found in mixed deciduous and coniferous woodlands and coastal grasslands in San Mateo, Santa Cruz, and Santa Clara counties.	Adults found under rocks, talus, and damp woody debris.	**High.** Three CNDDB occurrences for Santa Cruz black salamander have been documented within 5 miles of the project site. There is some suitable habitat for this species on the project site.

Species Name	Federal and State Listing Status[1]	Geographic Distribution	Habitat Requirements	Potential to Occur[2]
Reptiles				
San Francisco garter snake (*Thamnophlis sirtalis tetrataenia*)	FE CE	Historically, occurred in scattered wetland areas on the San Francisco Peninsula from approximately the San Francisco County line south along the eastern and western bases of the Santa Cruz Mountains. Found at least from the Upper Crystal Springs Reservoir in San Mateo County south to Año Nuevo State Reserve in Santa Cruz County. Currently, although the geographical distribution may remain the same, reliable information regarding specific locations and population status is not available. Much of the remaining suitable habitat is located on private property that has not been surveyed for the presence of the snake.	San Francisco garter snake is a highly aquatic species that is found in or near densely vegetated freshwater ponds with adjacent open hillsides where they can bask, feed, and find cover in rodent burrows.	**Low.** There are 24 CNDDB occurrences for San Francisco garter snake within 5 miles of the project site. There is no suitable habitat for this species on the project site.
Western pond turtle (*Emys marmorata*)	CSSC	From Oregon border of Del Norte and Siskiyou Counties south along the coast to San Francisco Bay, inland through the Sacramento Valley and on western slope of Sierra Nevada.	Ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation in woodlands, grasslands, and open forests.	**Low.** Although there are no CNDDB records for western pond turtle within 5 miles of the project area, Hoffman and Piney Creek could provide suitable habitat for this species.

Species Name	Federal and State Listing Status[1]	Geographic Distribution	Habitat Requirements	Potential to Occur[2]
Birds				
American peregrine falcon (*Falco peregrinus anatum*)	CFP	Occurs throughout the Central Valley, coastal areas, and northern mountains of California.	American peregrine falcon uses steep cliffs and buildings for nesting. It forages over a variety of habitats, especially wetlands.	**None.** Two CNDDB occurrences for American peregrine falcon have been documented within 5 miles of the project area. There is no suitable nesting habitat for this species in the project area.
Marbled murrelet (*Brachyramphus marmoratus*)	FT CE	Feeds near-shore; nests inland along coast from Eureka to Oregon border and from Half Moon Bay to Santa Cruz.	Marbled murrelet nests in old-growth redwood-dominated forests, up to six miles inland, often in Douglas-fir.	**High.** There are 24 CNDDB occurrences for marbled murrelet within 5 miles of the project area, including within San Mateo County Memorial Park and Pescadero Creek Park. Suitable habitat for this species is present in the project area.
Mammals				
Pallid bat (*Antrozous pallidus*)	CSSC	Common throughout low elevations of California. Not found in the high Sierra from Shasta to Kern counties and the northwestern corner of the State from Del Norte and western Siskiyou counties to northern Mendocino County.	Pallid bat is uncommon, especially in urban areas. This species roosts in caves and large cavities within trees. It forages in grasslands and oak savannah. It is most common in open, dry habitats with rocky areas for roosting.	**Low.** One CNDDB occurrence from 1945 for pallid bat has been documented within 5 miles of the project area. Trees are present in the project area that could provide roosting habitat for pallid bat; however, the site is not in its preferred habitat.

Species Name	Federal and State Listing Status[1]	Geographic Distribution	Habitat Requirements	Potential to Occur[2]
Townsend's big-eared bat (*Corynorhinus townsendii*)	CPT CSSC	Found throughout California, but details of its distribution are not well known. Found in all but subalpine and alpine habitats.	Townsend's big-eared bat roosts in caves, mines, and large cavities within trees. It forages within woodlands and along stream edges. This species is extremely sensitive to human disturbance.	**High.** Four CNDDB occurrences for Townsend's big-eared bat have been documented within 5 miles of the project site. The large trees and streams at the site could provide suitable habitat for this species.
Western red bat (*Lasiurus blossevillii*)	CSSC	Found throughout California. Additionally, these bats can be found in western Canada, the western United States, western Mexico and Central America.	The western red bat roosts primarily in tree foliage, especially in cottonwood, sycamore, and other riparian trees or orchards. The bat prefers habitat edges and mosaics with trees that are protected from above and open below with open areas for foraging, including grasslands, shrublands, and open woodlands. They are solitary by nature, but will gather in larger nursery roosts during the summer.	**High.** Western red bat is known to occur in the Pescadero-Butano watershed and has been documented on the nearby La Honda Creek Open Space Preserve. This species may roost in the riparian vegetation within Hoffman and Piney creeks.

Species Name	Federal and State Listing Status[1]	Geographic Distribution	Habitat Requirements	Potential to Occur[2]
San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*)	CSSC	The San Francisco dusky-footed woodrat is one of eleven historically described subspecies of the dusky-footed woodrat (packrats) found in forest and shrubland communities throughout much of California and Oregon. The San Francisco dusky-footed woodrat can be found throughout the SF Bay area.	San Francisco Dusky-footed woodrat is a nocturnal species that is known for constructing large terrestrial stick houses, some of which can last for twenty or more years. Houses typically are placed on the ground against or straddling a log or exposed roots of a standing tree, and, are often located in dense brush. Nests are also placed in the crotches and cavities of trees and in hollow logs. Sometimes arboreal nests are constructed in habitat with evergreen trees such as live oak.	**Low.** San Francisco dusky-footed woodrat is widely distributed in San Mateo County. There is suitable high-quality habitat at Redwood Glen. However, the open understory of the Redwood forest provides marginal habitat.

Species Name	Federal and State Listing Status[1]	Geographic Distribution	Habitat Requirements	Potential to Occur[2]

[1] Status explanations:

Federal:

FE = Listed as endangered under the Federal Endangered Species Act.

FT = Listed as threatened under the Federal Endangered Species Act.

FC = Candidate species to be listed under the Federal Endangered Species Act.

State:

CE = Listed as endangered under the California Endangered Species Act.

CT = Listed as threatened under the California Endangered Species Act.

CPT = Proposed as threatened under the California Endangered Species Act.

CSSC = Species of Special Concern designated by California Department of Fish and Wildlife.

CFP = Fully Protected Species under California Fish and Game Code.

[2] Potential Occurrence explanations:

Present: Species was observed at the site or has a recent (within five years) recorded observation in the CNDDB or literature at the site.

High: Highly suitable habitat is present (i.e., all habitat components meeting the species requirements are present and/or the habitat is highly suitable or of high quality). Additionally, there are few to many records of occurrences within the last ten years in the vicinity of the site. This species has a high probability of being found.

Moderate: Suitable habitat is present (i.e., some of the habitat components meeting the species requirements are present and/or the majority of the habitat is suitable or of marginal quality). Additionally, there are few to many modern records of occurrences in the vicinity of the site. The species has a moderate probability of being found.

Low: Limited suitable habitat is present (i.e., few of the habitat components meeting the species requirements are present and/or the majority of habitat is unsuitable or of very low quality). Additionally, there are no or few historical records of occurrence in the vicinity of the site. The species has a low probability of being found.

None: There is no suitable habitat present (i.e., habitats are clearly unsuitable for the species requirements [e.g., foraging, breeding, cover, substrate, elevation, hydrology, plant community, disturbance regime]). Additionally, there are no or few historical records of occurrence in the vicinity of the site. The species has no potential of being found.

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Appendix D Hydrologic Analysis

Memorandum

To: Lauren Huff, Senior Biologist, MIG, Inc.

From: Mark Woyshner and Jonathan Owens

Date: October 27, 2017

Subject: CEQA-level hydrologic analysis for an evaluation of the biological effects of surface-water diversions at Redwood Glen, San Mateo County, CA.

Introduction

Redwood Glen, located at 100 Wright Way, Loma Mar, CA 94021, is a non-profit camp and conference center situated on 165 acres with lodging, a kitchen, and bathroom facilities, and can serve a maximum capacity of approximately 300 people. Redwood Glen holds riparian water rights to Hoffman Creek and appropriative rights to Piney Creek (also known as Pioneer Creek in some documents).[1] Hoffman and Piney Creeks are first-order tributaries to Pescadero Creek.

Prior to 1995, water was supplied to the camp solely by diversion from Hoffman and Piney Creeks. From 1995 through March 2016, potable water was provided to Redwood Glen by San Mateo County Memorial Park, by diversion from Pescadero Creek. In addition, Redwood Glen utilized 8 acre-feet per year of flow from Hoffman Creek (~5 gallons per minute, or gpm, continuous), as per their Statement of Diversion and Use filings with the State. Potable water service from Memorial Park was discontinued in March 2016, and as a result, Redwood Glen has since been in the process of permitting a new public water system. The State Water Resources Control

[1] Redwood Glen holds riparian rights to Hoffman Creek, allowing the camp to utilize water available in Hoffman Creek instantaneously, as well as store up to 10,000 gallons of water. Redwood Glen holds appropriative rights License No. 11116 to divert water from Piney Creek at a rate not to exceed 0.042 cubic feet per second (19 gpm or 27,000 gpd) from January 1 to December 31, and not to exceed 24 acre-feet per year (Permit No. 16745, Application No. 24192). Appropriative rights also allow Redwood Glen to store an unlimited amount of raw water from Piney Creek. Two point of diversions (PODs) are identified: (a) POD #1 (aka upper POD) is south 2,500 feet and east 200 feet from NW corner of Section 2, T8S, R4W, being within SW1/4 of NW1/4 of said section 2; and (b) POD #2 (aka lower POD) is south 2,000 feet and east 350 feet from NW corner of Section 2, T8S, R4W, being within SW1/4 of NW1/4 of said section 2. During August 2017, Redwood Glen improved the diversion structure at the lower POD.

Board (SWRCB) has approved the use of the two creeks as source water for their new public water system at Redwood Glen.

Triggered by the Resource Management Permit and update to the Use Permit, San Mateo County Planning Department requested an evaluation of the biological effects of the diversions, including the potential cumulative effect to anadromous salmon, including steelhead (*Oncorhynchus mykiss*), downstream in Pescadero Creek.[2] To support the biological evaluation, this memo presents a hydrologic analysis at the point of diversions (PODs) on Hoffman Creek and Piney Creek relative to flow in Pescadero Creek.

Background

Physical setting

The Pescadero Creek watershed is the largest coastal watershed between the Golden Gate in San Francisco County and the San Lorenzo River in Santa Cruz County, measuring 59.7 square miles (sq. mi.) above Pescadero Marsh (**Figure 1**). Ranging in elevation from sea level to roughly 2,700 feet above sea level, the watershed is dominated by the rugged topography of the Santa Cruz Mountains, sloping westward into uplifted marine terraces at the coast. Pescadero Creek joins Butano Creek at Pescadero Marsh, which opens to the Pacific Ocean. The watersheds of these two principal streams feeding Pescadero Marsh are generally divided by Butano Ridge -- a prominent regional bedrock feature -- with Pescadero Creek flowing north of Butano Ridge, and Butano Creek south of the ridge. The two watersheds have a combined drainage area of 81 sq. mi. at Pescadero Marsh. Hoffman and Piney Creeks are each one of many small sub-watersheds draining the northerly slopes of Butano Ridge into Pescadero Creek. Relative drainage areas are shown in **Table 1**.

The U. S. Geological Survey (USGS) operates a stream gage (No. 11162500) about 3.5 miles upstream of the Town of Pescadero and west of Butano Ridge.[3] Data from this

[2] The County requested more information about the biological impacts to the creeks, which they felt was not covered by the Notice of Exemption that Redwood Gelen initially received for the project.

[3] U.S. Geological Survey gaging station no. 11162500, Pescadero Creek near Pescadero, CA. LOCATION - Lat 37°15'39", long 122°19'40" referenced to North American Datum of 1927, in SW 1/4 sec.05, T.8 S., R.4 W., San Mateo County, CA, Hydrologic Unit 18050006, on left bank, at

gage is used in our hydrologic analysis. Hoffman Creek is located about four miles upstream from the USGS gage, and Piney Creek another mile upstream from Hoffman Creek. Hoffman Creek has a drainage area 0.4 sq. mi., which is one percent of the 39.1 sq. mi. Pescadero Creek drainage area (at their confluence), while the drainage area above Redwood Glen's POD on Hoffman Creek is 0.5 percent of Pescadero Creek.[4] Piney Creek has a drainage area one-quarter size of Hoffman Creek. The drainage area above Redwood Glen's POD on Piney Creek is 0.03 sq. mi. (or 19 acres), which is 0.08 percent of the 38.4 sq. mi. Pescadero Creek drainage area (at their confluence). The drainage areas of Hoffman and Piney Creeks are significantly small compared to Pescadero Creek.

Geology and soils

Pescadero Creek watershed has been mapped generally as an assemblage of large, fault-bounded blocks that contain unique stratigraphic sequences (Brabb and others, 2000). The region is transected by two major faults, the north-south trending San Gregorio fault to the west, and the WNW trending reverse Butano fault to the east, separating the watershed into lithologically and structurally distinct regions. The San Andreas fault is a few miles to the northeast. Lithologically, the watershed is complex, consisting mainly of a thick sequence of folded Tertiary marine sedimentary rocks overlying a crystalline basement, with minor carbonates and volcanics interspersed amongst predominant marine sandstones, mudstones, shales, and various Quaternary deposits. Three prominent folds cross the watershed with northwest trending axes: the Big Basin Syncline on the south, the Butano Anticline along Butano Ridge, and the Pescadero syncline north of Pescadero Creek.

Butano Ridge is a large northwest trending block of consolidated Butano Sandstone (Tb) – Tertiary marine deposits potentially thousands of feet thick – drained by steeply sloped single-order and second-order streams (**Figure 1**). Large northerly-trending vertical fracture zones are found in the Butano ridge block, which lead to springs at the sources of Hoffman Creek, Piney Creek, and other creeks which head in the bedrock.

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downstream side of highway bridge, 3.0 mi east of Pescadero, and 5.3 mi upstream from mouth. DRAINAGE AREA - 45.9 mi^2. PERIOD OF RECORD - April 1951 to current year.

[4] Drainage areas of Hoffman and Piney Creeks are expressed relative to the Pescadero Creek drainage area below their respective confluences, so as to exclude the drainage area downstream of the confluences.

Overlying the Butano Sandstone, Santa Cruz Mudstone (Tsc) is mapped at the foot of Butano Ridge, along Pescadero Creek and the Butano fault at the northern most portion of Redwood Glen. Quaternary terrace deposits (Qt), found along Pescadero Creek, overlay the Santa Cruz Mudstone (**Figure 2**).

The Hoffman Creek and Piney Creek watersheds drain north-facing slopes of Butano Ridge with Hugo and Josephine sandy loam soils (HyF). In general, both soils are 36 to 60 inches deep over bedrock, with generally slopes 40 percent or steeper. Runoff is very rapid, and the erosion hazard is very high. The effective depth of root penetration is deep. The water-holding capacity of the Hugo soil is low, and that of the Josephine soil is moderate ('good'). Permeability is moderately rapid in the Hugo soil and in the surface soil of the Josephine; the Josephine subsoil has moderately slow permeability. The underlying fractured sandstone and mudstone provide a limited potential for well yields. Based on well pumping tests at Redwood Glen (Woyshner and others, 2017), the hydraulic conductivity of the underlying bedrock is on the order of 0.02 to 0.04 gallons per day per square foot (or 1 to 2 x 10^{-6} centimeters per second). These soils are good for growing timber, particularly redwood and Douglas fir.

Land use

Intensive logging in the Pescadero Creek watershed began during the second half of the 1800s and then resumed in the 1950s and 1960s (Barbic and others, 2004). Forests of the area have since regenerated. There is evidence of old landslides within the watersheds and broader area, potentially related to the logging activities. The watersheds of Hoffman Creek and Piney Creek are currently not managed for timber harvesting. 90 percent of the 117-acre Hoffman Creek watershed (**Figure 3**) and 98 percent of the 19-acre Piney Creek watershed (**Figure 4**) are owned by San Mateo County as an open-space park land and are managed mainly for stream water quality for downstream anadromous fishery habitat (see Decision-Making Guidelines for Vegetation Management, San Mateo County Parks, June 30, 2006).

Diversion structures

The diversion structure on Hoffman Creek consists of a stainless-steel sink attached to a redwood log across this creek (**Figure 5**). Sediment and wood debris impounded behind the log has raised the channel bed to allow flow over the log and into the sink. Underflow beneath the log bypasses the 'sink' diversion, as does overflow when the sink is spilling. As an example of existing late dry-season baseflow bypass, on September 9,

2017, we measured 4.6 gpm below the sink diversion while 0.73 gpm was being diverted. At that time, the diversion port was only partially submerged. Higher rates of diversion are possible when the diversion port is fully submerged with higher rates of inflow to the sink.

The diversion structure on Piney Creek was rehabilitated during 2017 to remove sediment and debris, and to restore its full functionality. It now includes a functioning bypass port and diversion port with the same diameter and set at the same elevation (**Figure 6**). If both ports are completely open, then the flow is passively split in half.

Both diversion structures bypass a significant proportion of baseflow.

Proposed water demand

Redwood Glen has not proposed to increase water demand for their new water system permit (the project conditions) beyond their historic use (the existing conditions), therefore, there is ***no additional impact by the proposed project***. Redwood Glen reported following water demand calculations for their new public water system permit (SRT, 2017):

- Average demand
  - Average Annual Demand = 1,305,953 gallons per year (gal/year)
  - Average Daily Demand (ADD) = 3,578 gallons per day (gpd)
  - Average Daily Rate of Production (24-HR) = 2.5 gallons per minute (gpm)
- Maximum demand
  - Maximum Month Demand (MMD) = 230,010 gal/month
  - Average Daily Usage During Maximum Month = 7,420 gal/day or 5.2 gpm
  - Maximum Daily Demand (MDD) = MMD * 1.5 = 11,130 gal/day
  - Maximum Daily Rate of Production (24-HR) = 7.7 gpm
  - Peaking Factor (MDD/ADD) = 3.1
- Maximum demand with Factor of Safety (using omitted data for elevated-years)
  - MMD with Factor of Safety = 259,107 gal/month
  - Average Daily Usage During Maximum Month = 8,358 gal/day or 5.8 gpm
  - Maximum Daily Demand (MDD) = MMD * 1.5 = 12,537 gal/day
  - Maximum Daily Rate of Production (24-HR) = 8.7 gpm
  - Peaking Factor (MDD/ADD) = 3.5

The SWRCB issued a letter on January 6, 2017, which recognizes that Redwood Glen's two surface water sources "would provide sufficient supply to meet demand for the Center." The State nonetheless expressed concerns that Hoffman Creek and Piney Creek may only provide marginal supply during the dry season. The estimated supply deficit during an extreme dry-year scenario (such as during 2014), though, can be bridged with the use of the existing 70,000-gallon raw water tank supply (SRT 2017). With additional conservation, for example, 70,000 gallons storage can provide 40 days of supply at half the ADD.

Hydrologic Analysis

Pescadero Creek annual hydrology (by water year)[5]

The USGS Pescadero Creek gaging station has a 65-year period of record (1951-2016). To evaluate baseflow conditions during dry-year conditions, we looked at the recent five consecutive dry years from 2012 through 2016, which ranked 4th driest of the 5-year-average periods, exceeded only by dry years during late 1980s through 1992 (**Table 2**). The dry period 2012 through 2016 is appropriate for this analysis given the following conditions: a) water year 2014 ranked second driest water year (preceded by 1977); b) the effects of logging during the '50s and '60s have further recovered, providing slightly higher evapotranspiration rates and lower baseflows than during initial years/decades following logging; and c) the somewhat improved gaging methods at the Pescadero Creek gage. The annual runoff at the Pescadero Creek station during water years 2012, 2013, and 2014 was 47 percent, 57 percent, and 6 percent of normal, for those respective years. The extreme dry year of 2014 was then followed by an annual runoff of 41 percent of normal during 2015 and 92 percent of normal during 2016. Baseflow hydrographs (**Figure 7**) illustrate the deepening multi-year drought into the 2014 extreme dry year, when flows were below the 5th percentile of the 65-year record during nearly all of the dry season (rivaling baseflow during 1977, the driest year of record). Bracketing the multiyear drought, baseflows tracked the 50th percentile during 2012 and 2016, receding to the 25th percentile by season end. Baseflows during

[5] Most hydrologic and geomorphic monitoring occurs for a period defined as a water year, which begins on October 1 and ends on September 30 of the named year. For example, water year 2016 (WY 2016) began on October 1, 2015, and concluded on September 30, 2016.

intervening water years 2013 and 2015 receded to a level within the 10th and 25th percentiles.

Hoffman Creek and Piney Creek monthly and baseflow hydrology

We estimated monthly mean flow at the PODs on Hoffman Creek and Piney Creek for the recent consecutive dry years 2012 through 2016 by correlating flow measurements taken during dry seasons 2015, 2016 and 2017 to the corresponding daily mean flow at the USGS Pescadero Creek gaging station.[6] Redwood Glen staff frequently measured flow in Hoffman Creek at Wright Way and in Piney Creek at Old Haul Road using a bucket-and-stopwatch method (**Table 3**). Periodic measurements of flow at were measured by Balance Hydrologics' hydrologists at the upstream PODs, using USGS bucket-wheel current-meter methods (c.f., Rantz and others, 1982), a portable cutthroat flume, and/or the bucket-and-stopwatch method; Balance also measured flows at the road culverts. The measurement locations are identified in **Figure 8**, and the flow measurements are shown in **Table 3**. We also measured the specific conductance and temperature of the water in the creeks at these sites (**Table 4**).[7] The higher specific conductance measurements downstream of the PODs generally support observations of flow accretion, potentially by groundwater with deeper or longer flow paths and/or groundwater emanating from fractures in the Santa Cruz Mudstone, located lower in the watersheds.

The baseflow correlations were based on the more frequent measurements at the road crossings and then shifted slightly to match fewer measurements at the PODs. Higher flows were proportioned to drainage area, and low-flow extrapolation beyond the lowest measurement was based on the proportion of Pescadero Creek flow of that lowest measurement. Correlations are shown in **Table 5** and **Figures 9**. Based on these correlations, we developed monthly estimates of mean daily flow for water years 2012 through 2016 (**Table 6 and Figure 10**). We also calculated the monthly mean daily flows

[6] Correlations to daily mean flows were appropriate primarily because no rain occurred during the dry-season baseflow measurement period.

[7] Specific conductance (SC) measures the ability of the water to conduct electricity and is a widely used index for salinity or total dissolved solids (TDS). Rainwater has very low specific conductance (nearly zero), and as water passes over and through the ground, salts are dissolved, thereby increasing the specific conductance. Higher specific conductance indicates transmittal through salt-bearing geologic formations or longer residence times in the ground.

for Hoffman Creek and Piney Creek from the monthly mean daily flows for the period of record at the USGS Pescadero Creek station.

Winter storm flow

Given that annual rainfall and runoff totals during water years 2012 through 2016 were below normal, the estimated dry-season baseflows are shown to be lower than the monthly means for the period of record. Runoff related to the December 11, 2014 storm and the March 6th and 13th, 2016 storms, however, were significantly large, and the related mean daily flow for December 2014 and March 2016 were above normal. Similarly, rainfall during November and December of 2012 generated above normal runoff. The runoff estimates for March and April of 2012 and January 2016 were near normal, while other months were below normal.

Monthly flow as percent of Pescadero Creek

The Pescadero Creek USGS gaging record includes the effect of Redwood Glen's historic water use from Hoffman Creek and Piney Creek diversions, as well as raw-water supplies from San Mateo County's Memorial Park diversion, located on the right bank just downstream from Wurr Road bridge, which is also downstream of both Hoffman and Piney Creeks (**Figure 1**). However, to give an idea of the relative magnitude of potential diversions at the Hoffman Creek and Piney Creek PODs, we calculated mean monthly flow at the PODs as a percent of flow at USGS Pescadero Creek gaging station for mean daily flow conditions and for the consecutive dry year period 2012 through 2016 (**Table 6**). Mean daily flow conditions are significantly less than one percent of the flow in Pescadero Creek. During the consecutive dry years, flows were also estimated at less than one percent of flow in Pescadero Creek, with the exception of dry-season 2014, the extreme dry year. Baseflows in Hoffman and Piney Creeks during July, August, and September of 2014 exceeded one percent of the flow in Pescadero Creek, with the baseflow in Piney Creek during August the highest at 1.7 percent of the flow in Pescadero Creek.[8]

[8] Flow extrapolations for an extreme dry year has a higher uncertainty than dry-year correlations within the range of flow measurements taken at Hoffman and Piney Creeks.

Conclusions

- Given that Redwood Glen is not proposing to increase water demand for project conditions described for their new water system permit beyond their historic use and water rights, there is no additional impact by the proposed project.

- The drainage areas of Hoffman and Piney Creeks are significantly small compared to Pescadero Creek, and as a result, wet-season runoff at Redwood Glen's PODs on Hoffman and Piney Creeks are much less than one percent of flow in Pescadero Creek.

- Hoffman and Piney Creeks are small sub-watersheds on Butano Ridge, formed at large fracture zones that lead to spring sources supporting perennial baseflows that accrete (gain flow) downstream. The point of diversions on Hoffman and Piney Creeks are situated at headwater springs that, therefore, can only divert a portion of total baseflow found at the mouth of the creeks. Springflow to the creeks downstream of the PODs are obviously not diverted by the diversions. In addition, the diversion structures allow for a significant portion of baseflow to passively bypass the diversions. Storm-related streamflows and early dry-season baseflows also flow over the diversion structures. Therefore, the existing/historic effect of the diversions on baseflows in Pescadero Creek is not significant.

- Baseflow estimates for Hoffman and Piney Creeks during consecutive dry years were much less than one percent of flow in Pescadero Creek. As a worst case scenario, baseflow estimates in each creek during the 2014 extreme dry year exceeded one percent of the flow in Pescadero Creek during July, August and September. Considering passive bypass flows at the diversions, the estimated combined diverted quantity from both creeks could be as much as 1.5 percent of the baseflow in Pescadero Creek during this period. The existing 70,000 gallon raw water tank storage can provide supply to help bridge the baseflow supply deficit during an extreme dry-year scenario by providing roughly 0.5 gpm during this period three-month period, which would have been diverted at higher flows during the Spring months. 0.5 gpm is roughly 0.5 percent of the average flow in Pescadero Creek during July, August and September of 2014. Additional water use conservation would also benefit.

- The Hoffman Creek and Piney Creek watersheds are currently not managed for timber harvesting, as they were many decades ago; but rather, they are managed by the County for stream water-quality for downstream anadromous fishery habitat and for water supply. However given the high runoff potential of the soils, if a fire were to significantly burn the watersheds, then the streams would be vulnerable to sedimentation and higher levels of turbidity. Similarly, if the County were to change their land-use plan sediment production may increase. Redwood Glen manages only the lower 10 percent of Hoffman Creek and 2 percent of Piney Creek for water quality.

Limitations

Balance Hydrologics prepared this memo for the client's exclusive use on this particular project. It was prepared in general accordance with the accepted standard of practice existing in Northern California at the time the investigation was performed. No other warranties, expressed or implied, are made. It is based in part on information obtained from property plans and well drillers reports, including a level survey of portions of the property and personal communication with the client regarding subsurface conditions below the property. The methods used relied upon flow measurements performed by the client and reference values commonly used in the area or developed by sources generally held to be reliable. Hydrologic results are considered provisional and subject to revision. Findings and recommendations in this memo are based on the assumption that an appropriate and adequate follow-up program will be conducted, and that Balance will be retained at key stages in the project to revise the findings described in this memo as warranted.

References Cited

Barbic, N., Sicular, D., Hagans, D., O'Connor, M., Blount, C., and Jackson, D., 2004, Pescadero-Butano watershed assessment: Environmental Science Associates. Available online from: montereybay.noaa.gov/resourcepro/reports/sedrep/pescadero.pdf

Brabb, E.E, Graymer, R.W., and Jones, D.L., 2000, Geologic map and map database of the Palo Alto 30' X 60' quadrangle, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-2332

Donaldson, E., 2011, Geomorphic controls on spatial distributions of cobbles and boulders in stream-channel network: Master of Science in Geoscience, San Francisco State University, August 2011, 57 p. + tables, figures and appendix.

Rantz, S.E., and others, 1982, Measurement and computation of streamflow: U. S. Geological Survey Water-Supply Paper 2175, volume 1, p. 1-284, volume 2, p. 285-631.

County of San Mateo Environmental Services Agency Parks and Recreation Department, 2006, Decision-making guidelines for vegetation management, San Mateo County Parks, June 30, 2006, 156 p. + appendices.

SRT Consultants, 2017, Water system design technical report, Redwood Glen Camp and Conference Center: State Water Resources Control Board Division of Drinking Water, PWS No. 4100522, March 2017, 52 p.

Woyshner, M., Porras, G., and Hecht, B., 2017, Well drilling and testing results, Redwood Glen, San Mateo County, CA: Balance Hydrologics technical memo to SRT Consultants and Redwood Glen, March 29, 2017, 127 p.

Attachments

Table 1. Drainage areas, Redwood Glen, San Mateo County, CA

Location	Latitude *(WGS84)*	Longitude *(WGS84)*	Drainage area *(sq.mi.)*	*(acres)*	*(% of Pescadero Cr)*
Pescadero Cr at Highway 1 [1]	37.26621	-122.41156	81	--	--
Pescadero Cr at Butano Cr (at Pescadero Marsh)	37.26623	-122.41149	59.7	--	--
Butano Cr at Pescadero Cr (at Pescadero Marsh)	37.25988	-122.40602	21.1	--	--
USGS Pescadero Cr gage near Pescadero, CA (No. 11162500)	37.26078	-122.32886	45.9	--	--
Pescadero Cr below Hoffman Cr	37.27518	-122.28440	39.1	--	--
Hoffman Cr at Pescadero Cr	37.27421	-122.28455	0.40	256	1.0%
Hoffman Cr at Wright Way (flow measurement site)	37.27063	-121.72418	0.29	182	0.73%
Hoffman Cr "sink" POD (flow measurement site)	37.26585	-122.28427	0.18	117	0.47%
Pescadero Cr below Piney Cr	37.27176	-122.27397	38.4	--	--
Piney Cr at Pescadero Cr (flow measurement site)	37.27101	-122.27483	0.10	64	0.26%
Piney Cr at lower POD (flow measurement site)	37.26750	-122.27643	0.03	19	0.08%

Notes:

[1] Pescadero Creek and its major tributary Butano Creek both terminate at Pescadero Marsh above Hwy 1.

Table 2. Monthly mean flow in Pescadero Creek near Pescadero, San Mateo County, CA.

We analyzed flows for the recent dry-year period 2012 through 2016 (highlighted) and ranked the annual mean flow and five-year mean annual flow from driest to wettest. The years analyzed are appropriate for baseflow analysis given the following conditions: a) the five-year period included water year 2014, which ranked second driest year for the 65-year period of record; b) the effects of logging during the '50s and '60s have recovered; c) the likely fewer diversions in general than during earlier years; and d) somewhat improved gaging methods.

Water	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Mean			5-yr Mean Annual	
Year	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(% of normal)	(rank, dry to wet)	(cfs)	(rank, dry to wet)
1952	3.84	7.8	158	418.3	134.2	268.3	54.5	23.8	13.8	8.82	5.32	3.14	92.2	227%	59	--	--
1953	2.55	7.01	158.6	184.2	34.7	53	34	23.6	10.7	6.58	5.53	3.2	44.1	109%	40	--	--
1954	4.08	9.25	5.31	35.7	58.9	82.6	46.9	14.9	8.35	3.63	3.56	3.24	22.8	56%	25	--	--
1955	3.99	11.6	64.3	72.5	34.9	23.9	19.3	14.8	6.15	3.56	2.91	1.46	21.6	53%	23	--	--
1956	1.97	3.7	469.4	338	134.9	72	32.2	19.6	11.3	7.33	5.17	4.04	92.3	227%	60	54.6	52
1957	5.28	4.59	5.86	13.6	45.2	54.6	18.6	47.8	12.2	4.73	3.71	2.23	18.1	45%	19	39.8	33
1958	8.37	7.26	27	75.3	429.2	255.8	398.4	33.4	16.1	10	6.64	3.97	103.3	254%	63	51.6	49
1959	2.8	3.89	6.83	48.6	98.3	19.5	7.96	5.46	3.3	1.65	1.16	5.53	16.5	41%	16	50.4	47
1960	2.38	2.95	3.67	19.6	67.2	11.1	8.86	4.3	2.33	1.29	0.71	0.807	10.2	25%	9	48.1	44
1961	0.971	5.6	8.3	5.44	12.2	17.3	7.99	5.03	2.25	0.494	0.219	0.223	5.47	13%	4	30.7	18
1962	0.377	2.62	8.6	8.13	153.3	82.9	14.5	7.54	3.74	1.75	1.63	0.33	22.9	56%	26	31.7	21
1963	92.8	9.98	19.8	127.1	259.3	68.7	151.5	41.6	17.8	9.8	5.56	3.99	66.0	162%	54	24.2	10
1964	5.47	21.8	7.64	45.6	13	10.7	6.68	5.09	3.66	2	1.14	0.983	10.3	25%	10	23.0	8
1965	1.34	11.1	158.5	229.5	39.2	21.1	109.1	24.7	13.1	6.9	3.79	2.95	52.1	128%	45	31.4	19
1966	2.55	18.6	35.4	57.6	60.1	20.5	9.69	5.76	3.69	2.37	1.12	1.06	18.0	44%	18	33.9	23
1967	1.12	10.4	54.6	253.7	80.5	147.3	199.2	47.5	21	10.1	5.86	3.34	69.6	171%	55	43.2	38
1968	3.95	4.69	11.5	71.6	60.8	67.5	21.3	8.91	5.09	2.85	3.06	1.7	21.9	54%	24	34.4	26
1969	1.89	4.21	24.4	372	389.9	145.4	55.8	20.5	9.59	9.8	10.5	5.16	85.7	211%	58	49.5	46
1970	5.19	4.8	33.7	256	77.5	80.6	20.9	10.3	6.3	4.03	2.18	1.68	42.0	103%	39	47.4	42
1971	1.76	28.1	124.8	52.8	17.8	36.7	19.9	9.76	5.63	3.55	2.29	1.9	25.6	63%	31	49.0	45
1972	1.76	3.34	23.1	10.8	18	6.52	6.69	3.01	1.79	1.03	0.649	0.799	6.43	16%	6	36.3	28
1973	9.32	71.4	23.2	244.8	301.7	148.2	40.9	16.3	8.53	5.44	3.48	2.79	71.6	176%	56	46.3	41
1974	4.73	49.4	137	130.7	37.4	179.5	172.1	32.9	19	8.58	5.11	4.24	65.3	161%	53	42.2	36
1975	4.65	8.34	28.3	41.3	117.6	138.7	50.3	18.1	10.1	7.13	4.93	3.53	35.6	88%	36	40.9	34
1976	5.64	4.75	4.38	4.29	4.73	9.71	8.48	2.76	1.91	0.921	1.12	0.674	4.11	10%	3	36.6	29
1977	0.921	1.78	2.3	3.22	2.92	4.58	1.93	2	0.78	0.205	0.012	0.083	1.72	4%	1	35.7	27
1978	0.488	3.9	25.8	299.2	166.8	124	86.1	30.4	12.3	6.4	3.25	2.8	63.0	155%	51	33.9	24
1979	2.25	3.43	3.75	34.2	104.9	68.9	36.4	13.8	5.47	3.85	2.75	2.08	22.9	56%	27	25.5	11
1980	4.62	6.14	34.6	150.4	281.9	115.9	51.1	24.9	12.1	6.14	4.17	4.03	57.2	141%	49	29.8	15
1981	2.13	2.4	5.2	31.9	18.9	65.3	19.6	6.49	3.46	1.75	1.78	0.64	13.3	33%	14	31.6	20
1982	3.01	27.6	56.5	292.6	178.6	205.6	351.9	43.5	16.3	9.34	6.95	5.74	99.2	244%	62	51.1	48
1983	7.39	51.2	317.6	311.5	475.7	540.1	129.9	93.8	28.1	14.8	8.71	7.79	164.2	404%	65	71.4	58
1984	10.4	85.9	308.9	72	38	28.2	17.6	12.3	10.7	4.09	3.2	2.34	49.8	123%	43	76.7	60
1985	5.83	35.1	30.5	11.1	55.7	56.5	21.3	9.38	5.2	2.55	2.24	3.32	19.6	48%	21	69.2	57
1986	3.16	8.05	15.1	28	434.3	231.6	35.9	15.5	8	5	3.67	4.57	63.6	157%	52	79.3	61
1987	3.27	3.48	5.41	8.24	27.5	27.6	7.45	3.76	2.14	1.29	0.786	0.787	7.53	19%	7	60.9	53
1988	1.16	2.49	18	27.5	6.93	4.25	5.98	3.61	2.23	0.949	0.391	0.229	6.18	15%	5	29.3	14
1989	0.514	6.21	12.3	13.2	6.87	57.4	11.3	3.47	1.87	1.1	1.27	1.42	9.81	24%	8	21.3	5
1990	11.7	21.2	12.7	17.3	23.4	10.4	7.03	8.72	5.47	3.17	2.48	2.04	10.4	26%	11	19.5	3
1991	1.73	2.12	3.61	2.75	3.64	121.5	13.1	4.56	2.61	1.76	1.35	0.753	13.5	33%	15	9.5	1
1992	1.93	1.61	7.57	10.8	212.9	63.8	14.8	6.46	3.39	2.26	1.09	0.829	26.5	65%	32	13.3	2
1993	1.45	1.9	24.6	288.9	168.8	78.5	36.9	13	9.08	5.02	3.11	2.84	52.3	129%	46	22.5	7
1994	2.93	4.79	16.1	12.1	85	14.1	8.45	7.63	3.02	1.29	0.952	0.645	12.6	31%	13	23.1	9
1995	0.831	8.72	9.62	362.7	54.5	367.5	66.4	62.2	21.9	13.4	7.9	5.28	82.6	203%	57	37.5	31
1996	4.21	4.14	31.9	87.9	310.7	120.7	41.5	25.4	13.8	8.05	5.25	4.08	53.8	132%	47	45.6	40
1997	4.12	14	133.1	435.3	77.9	28.5	16	10.1	6.28	4.27	3.31	2.88	61.7	152%	50	52.6	50
1998	2.91	16.2	28.5	233.5	865.3	132	98.2	51.4	32.5	17.5	11.6	8.64	119.7	295%	64	66.1	55
1999	8.26	9.58	16	79.5	247.1	92.4	81.7	24.5	14.1	9	6.01	5.88	48.1	118%	42	73.2	59
2000	4.98	6.62	5.95	96.7	361.5	133.1	38.3	20.2	11.5	7.91	4.8	4.64	56.8	140%	48	68.0	56
2001	8.19	5.9	6.85	26.5	94.8	66.2	18.3	8.45	4.88	3.56	2.47	1.88	20.2	50%	22	61.3	54
2002	1.69	11.4	118.7	67.1	35.6	39.8	19	10.2	6.57	3.83	2.22	1.77	26.6	65%	33	54.3	51
2003	1.81	5.25	175.1	46	22.6	20.9	72.6	39.7	12	6.89	3.98	2.69	34.4	85%	35	37.2	30
2004	2.33	4.39	66.1	84.3	159.2	49.2	14.9	7.93	4.84	2.86	2.08	1.55	32.9	81%	34	34.2	25
2005	4.74	4.75	69.5	144	96.6	153.2	76.1	32.5	16.8	9.35	5.19	3.88	51.3	126%	44	33.1	22
2006	3.57	5	133.7	154.8	62	329	333.7	43.8	18.4	10.5	7.04	5.09	92.5	228%	61	47.5	43
2007	5.13	7.41	13.8	8.69	64.4	24.1	8.35	5.42	3.66	2.34	1.87	1.48	11.9	29%	12	44.6	39
2008	2.71	2.29	4.27	149	87	22.5	9.59	6.23	3.41	1.98	1.42	0.954	24.2	60%	29	42.6	37
2009	1.3	3.76	6.66	4.55	172.4	100.5	11.5	7.13	4.35	2.47	1.45	1.26	25.5	63%	30	41.1	35
2010	10.9	2.71	6.83	101.2	91	90.4	95	22	9.66	5.26	3.94	2.69	36.5	90%	37	38.1	32
2011	2.97	5.69	62.7	28.7	92.4	255.9	54.4	17.9	15.4	8.38	5.71	3.65	46.1	113%	41	28.8	13
2012	5.54	6.02	4.73	11.3	6.25	105.1	61.3	12.2	6.18	3.65	2.16	1.75	18.9	47%	20	30.2	17
2013	2.21	15.2	186.2	32.8	12.1	9.89	8.15	4	2.72	1.56	0.984	0.935	23.3	57%	28	30.1	16
2014	0.891	2	2.03	1.06	6.02	9.49	6.21	1.51	0.823	0.365	0.102	0.266	2.54	6%	2	25.5	12
2015	0.395	1.64	110	9.52	53.8	8.67	6.39	4.08	2.73	1.74	0.966	0.799	16.6	41%	17	21.5	6
2016	0.658	2.84	21.8	112.6	22.8	233.5	25.6	12	6.06	3.44	2.26	1.56	37.5	92%	38	19.8	4
Mean	4.98	11.3	57.2	108	123	95.9	54.4	18.1	8.74	4.98	3.36	2.61	40.6	--	--	--	--

Data source: USGS gaging station 11162500; latitude 37°15'39", longitude 122°19'40" NAD27; drainage area 45.9 square miles; gage datum 62.30 feet above NGVD29.

Table 3. Streamflow measurements in Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA.

Date	Hoffman Cr at ("sink") POD		Hoffman Cr at Wright Way		Piney Cr at POD (improved 2017)		Piney Cr at Haul Rd	
	gpm	cfs	gpm	cfs	gpm	cfs	gpm	cfs
10/12/2015	--	--	3.0	0.0067	--	--	4.0	0.0089
4/14/2016	29	0.065	36	0.080	--	--	22	0.049
5/2/2016	--	--	41	0.091	--	--	12	0.027
5/15/2016	--	--	26	0.058	--	--	14	0.031
5/31/2016	--	--	25	0.056	--	--	10	0.022
6/2/2016	--	--	--	--	5.8	0.013	9.6	0.021
6/11/2016	--	--	14	0.031	--	--	8.0	0.018
7/1/2016	6.8	0.015	6.8	0.015	--	--	7.4	0.016
7/7/2016	--	--	7.4	0.016	--	--	7.2	0.016
7/14/2016	--	--	6.4	0.014	--	--	6.9	0.015
7/21/2016	--	--	6.7	0.015	--	--	7.4	0.016
8/5/2016	--	--	5.5	0.012	--	--	6.9	0.015
8/11/2016	--	--	3.9	0.0087	--	--	6.1	0.013
8/22/2016	--	--	4.2	0.0093	--	--	6.2	0.014
8/29/2016	--	--	4.4	0.0098	--	--	6.2	0.014
9/8/2016	--	--	2.9	0.0065	--	--	5.1	0.011
9/29/2016	--	--	2.9	0.0065	--	--	5.0	0.011
10/11/2016	--	--	--	--	4.1	0.0091	5.1	0.011
10/13/2016	3.5	0.0078	2.9	0.0065	--	--	--	--
10/17/2016	--	--	22	0.050	--	--	13	0.028
11/8/2016	--	--	8.6	0.019	--	--	8.0	0.018
11/19/2016	--	--	--	--	4.0	0.0088	--	--
12/5/2016	--	--	15.9	0.035	--	--	9.4	0.021
7/20/2017			14.7	0.033			12.2	0.027
7/27/2017			13.4	0.030			10.6	0.024
8/4/2017			13.3	0.030			11.2	0.025
8/21/2017			14.4	0.032			9.4	0.021
9/4/2017			12.2	0.027			6.0	0.013
9/9/2017	5.3	0.012	8.5	0.019	4.6	0.0102	10.9	0.024

Notes:

1. Flow measurements were more frequently made at the easily accessible culvert outflow sites of Hoffman Cr at Wright Way and of Piney Cr at Haul Rd using a calibrated bucket and stopwatch, mainly by Redwood Glen water-system staff. At the PODs, flows were measured by a Balance Hydrologics hydrologist using either a current meter and open-channel flow method, portable cutthroat flume, or a bucket and stopwatch where applicable. On these site visits by Balance, flows were also measured at the culvert sites.

Table 4. Specific conductance and temperature measurements in Hoffman, Piney, and Pescadero Creeks, Redwood Glen, San Mateo County, CA.

Data generally support the observation of flow accretion downstream of the point of diversions.

Date	Hoffman Cr at ("sink") POD		Hoffman Cr at Wright Way		Piney Cr upper bowl of lower POD		Piney Cr lower bowl of lower POD		Piney Cr lower POD (composite) [2]		Piney Cr at Haul Rd		Pescadero Creek at park diversion	
	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C
4/14/2016	245	11.6	508	11.5	--	--	--	--	--	--	624	12	599	11.5
6/2/2016	500	14	785	14.5	--	--	--	--	--	--	809	14.5	778	18
7/1/2016	493	13.6	762	14.2	--	--	--	--	--	--	616	13.5	--	--
10/11/2016	--	--	--	--	710	12.8	676	13.2	--	--	695	13.2	--	--
10/13/2016	693	12.1	907	12.1	--	--	--	--	--	--	--	--	--	--
11/14/2016	--	--	--	--	681	12.2	789	12.3	743	12.6	--	--	--	--
11/18/2016	--	--	--	--	--	--	--	--	--	--	--	--	709	8
11/19/2016	--	--	--	--	684	10.2	778	12	--	--	--	--	--	--
9/9/2017	546	14.6	711	15.2	--	--	--	--	707	14.2	--	--	706	18.9

Notes:

1. Measurements made with a YSI Pro30 specific conductance and temperature field meter.

2. During August 2017, the diversion structure on Piney Creek was improved at the composite site located just downstream of the upper and lower bowls to include a diversion port, bypass port and sediment sluicing port.

Data provisional and subject to revision.

Table 5. Flow correlation equations for Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA.

Dependent variable (y)	Independent variable (x)	Polynomial coefficients			
		ax^3	bx^2	cx	d
Piney Cr @ lower POD (gpm)	Pescadero Cr near Pescadero, CA (cfs)	-5.40139161583832E-09	2.24592175335179E-05	2.8068149420691E-01	3.33867879637544
	Pescadero Cr near Pescadero, CA (below 0.45035 cfs)	0	0	7.69402166460992	0
Hoffman Cr @ "sink" POD (gpm)	Pescadero Cr near Pescadero, CA (above 2.393 cfs)	0	0	1.85026750816993	0
	Pescadero Cr near Pescadero, CA (2.393 to 0.53125 cfs)	0	0.014519934	0.68912955	2.695403074
	Pescadero Cr near Pescadero, CA (below 0.53125 cfs)	0	0	5.77051624845744	0

Notes:

1. Correlations of baseflow measurements and of drainage areas were developed using daily mean flows at Pescadero Creek near Pescadero, CA (USGS station no. 11162500). The baseflow correlations were based on more frequent measurements at the easily accessible road-crossing culvert sites and then shifted slight to match fewer measurements at the PODs. Higher flows were proportioned to drainage area. Correlations to daily mean flows were appropriate primarily because no rain occurred during the dry-season baseflow measurement period.
2. Values shown are coefficients "a", "b", "c", and "d" of a polynomial equation $y = ax^3 + bx^2 + cx + d$ where "x" is the flow in Pescadero Creek and "y" if the flow in Hoffman or Piney Creeks.
3. Correlations shown in Figure 10.

Data provisional and subject to revision.

Table 6. Monthly mean flow estimates for Hoffman and Piney Creeks during recent consecutive dry years 2012 through 2016 and statistically mean conditions, Redwood Glen, San Mateo County, CA.

	Pescadero Cr USGS station near Pescadero	Hoffman Cr at POD "sink" diversion		Piney Cr at POD (improved 2017) 2,000 ft south and 350 ft east from NW corner of Section 2, T8S, R4W	
Drarinage area					
Square miles	45.9		0.183		0.030
% of Pescadero Cr			0.4%		0.06%
	(cfs)	*(gpm)*	*(% of Pescadero Cr)*	*(gpm)*	*(% of Pescadero Cr)*
Water Year 2012 *(dry year)*					
October	5.55	10	0.4%	5	0.2%
November	6.00	11	0.4%	5	0.2%
December	4.72	9	0.4%	5	0.2%
January	11.4	21	0.4%	7	0.1%
February	6.27	12	0.4%	5	0.2%
March	105	194	0.4%	33	0.1%
April	61.1	113	0.4%	21	0.1%
May	12.2	23	0.4%	7	0.1%
June	6.17	11	0.4%	5	0.2%
July	3.66	7	0.4%	4	0.3%
August	2.17	4	0.4%	4	0.4%
September	1.76	4	0.5%	4	0.5%
Annual	18.9	35	0.4%	9	0.1%
	(cfs)	*(gpm)*	*(% of Pescadero Cr)*	*(gpm)*	*(% of Pescadero Cr)*
Water Year 2013 *(dry year)*					
October	2.21	5	0.5%	4	0.4%
November	15.2	28	0.4%	8	0.1%
December	186	345	0.4%	58	0.1%
January	32.9	61	0.4%	13	0.1%
February	12.1	22	0.4%	7	0.1%
March	9.91	18	0.4%	6	0.1%
April	8.16	15	0.4%	6	0.2%
May	4.00	7	0.4%	4	0.2%
June	2.72	5	0.4%	4	0.3%
July	1.57	4	0.5%	4	0.5%
August	0.985	3	0.8%	4	0.8%
September	0.936	3	0.8%	4	0.9%
Annual	23.3	44	0.4%	10	0.1%
	(cfs)	*(gpm)*	*(% of Pescadero Cr)*	*(gpm)*	*(% of Pescadero Cr)*
Water Year 2014 *(extreme dry year)*					
October	0.889	3	0.8%	4	0.9%
November	2.00	4	0.5%	4	0.4%
December	2.03	4	0.5%	4	0.4%
January	1.07	3	0.7%	4	0.8%
February	6.03	12	0.4%	5	0.2%
March	9.50	18	0.4%	6	0.1%
April	6.21	12	0.4%	5	0.2%
May	1.51	4	0.6%	4	0.6%
June	0.826	3	0.9%	4	1.0%
July	0.365	2	1.2%	3	1.5%
August	0.102	1	1.3%	1	1.7%
September	0.266	1	1.1%	2	1.4%
Annual	2.54	6	0.5%	4	0.3%

	Pescadero Cr USGS station near Pescadero	**Hoffman Cr at POD** "sink" diversion		**Piney Cr at POD (improved 2017)** 2,000 ft south and 350 ft east from NW corner of Section 2, T8S, R4W	
	(cfs)	*(gpm)*	*(% of Pescadero Cr)*	*(gpm)*	*(% of Pescadero Cr)*
Water Year 2015 *(dry year)*					
October	0.395	2	1.1%	2	1.4%
November	1.64	4	0.6%	4	0.5%
December	110	204	0.4%	35	0.1%
January	9.56	18	0.4%	6	0.1%
February	53.9	100	0.4%	19	0.1%
March	8.66	16	0.4%	6	0.1%
April	6.38	12	0.4%	5	0.2%
May	4.07	8	0.4%	4	0.2%
June	2.73	5	0.4%	4	0.3%
July	1.74	4	0.5%	4	0.5%
August	0.975	3	0.8%	4	0.8%
September	0.8	3	0.9%	4	1.0%
Annual	16.6	31	0.4%	8	0.1%
	(cfs)	*(gpm)*	*(% of Pescadero Cr)*	*(gpm)*	*(% of Pescadero Cr)*
Water Year 2016 *(below normal)*					
October	0.659	3	1.0%	4	1.2%
November	2.83	5	0.4%	4	0.3%
December	21.8	40	0.4%	10	0.1%
January	113	208	0.4%	36	0.1%
February	22.8	42	0.4%	10	0.1%
March	234	432	0.4%	71	0.1%
April	25.6	47	0.4%	11	0.1%
May	12.0	22	0.4%	7	0.1%
June	6.07	11	0.4%	5	0.2%
July	3.44	6	0.4%	4	0.3%
August	2.27	4	0.4%	4	0.4%
September	1.56	4	0.5%	4	0.5%
Annual	37.5	70	0.4%	14	0.1%
	(cfs)	*(gpm)*	*(% of Pescadero Cr)*	*(gpm)*	*(% of Pescadero Cr)*
Mean Daily Flow *(65-yr period of record)*					
October	4.98	9	0.4%	5	0.2%
November	11.3	21	0.4%	6	0.1%
December	57.2	106	0.4%	19	0.1%
January	108	200	0.4%	34	0.1%
February	123	225	0.4%	38	0.1%
March	95.9	178	0.4%	30	0.1%
April	54.4	100	0.4%	19	0.1%
May	18.1	34	0.4%	8	0.1%
June	8.76	16	0.4%	6	0.1%
July	5.00	9	0.4%	5	0.2%
August	3.38	6	0.4%	4	0.3%
September	2.62	5	0.4%	4	0.3%
Annual	40.6	75	0.4%	15	0.1%

Notes:

1. Estimates were based on correlations of baseflow measurements (for low flow) and of drainage areas (for high flow) to Pescadero Creek near Pescadero, CA (USGS station no. 11162500), period of record for water years

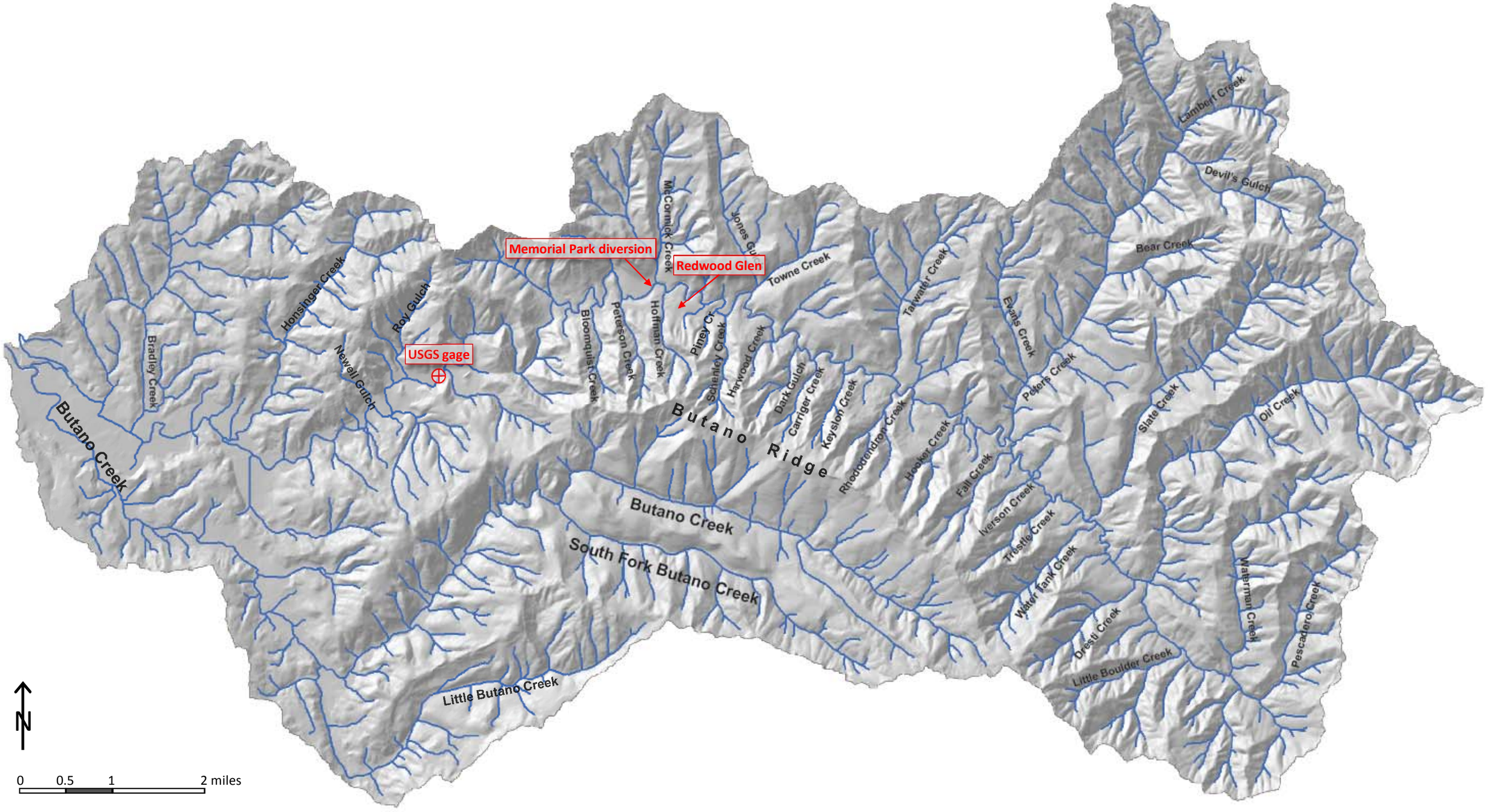

Figure 1. Location of Redwood Glen and USGS gaging station in Pescadero Creek watershed, San Mateo County, CA.
Base map source: Donaldson, E., 2011, Geomorphic controls on spatial distributaions of cobbles and boulders in stream-channel network: Master of Science in Geoscience, San Francisco State University, August 2011, 57 p. + tables, figures and appendix.

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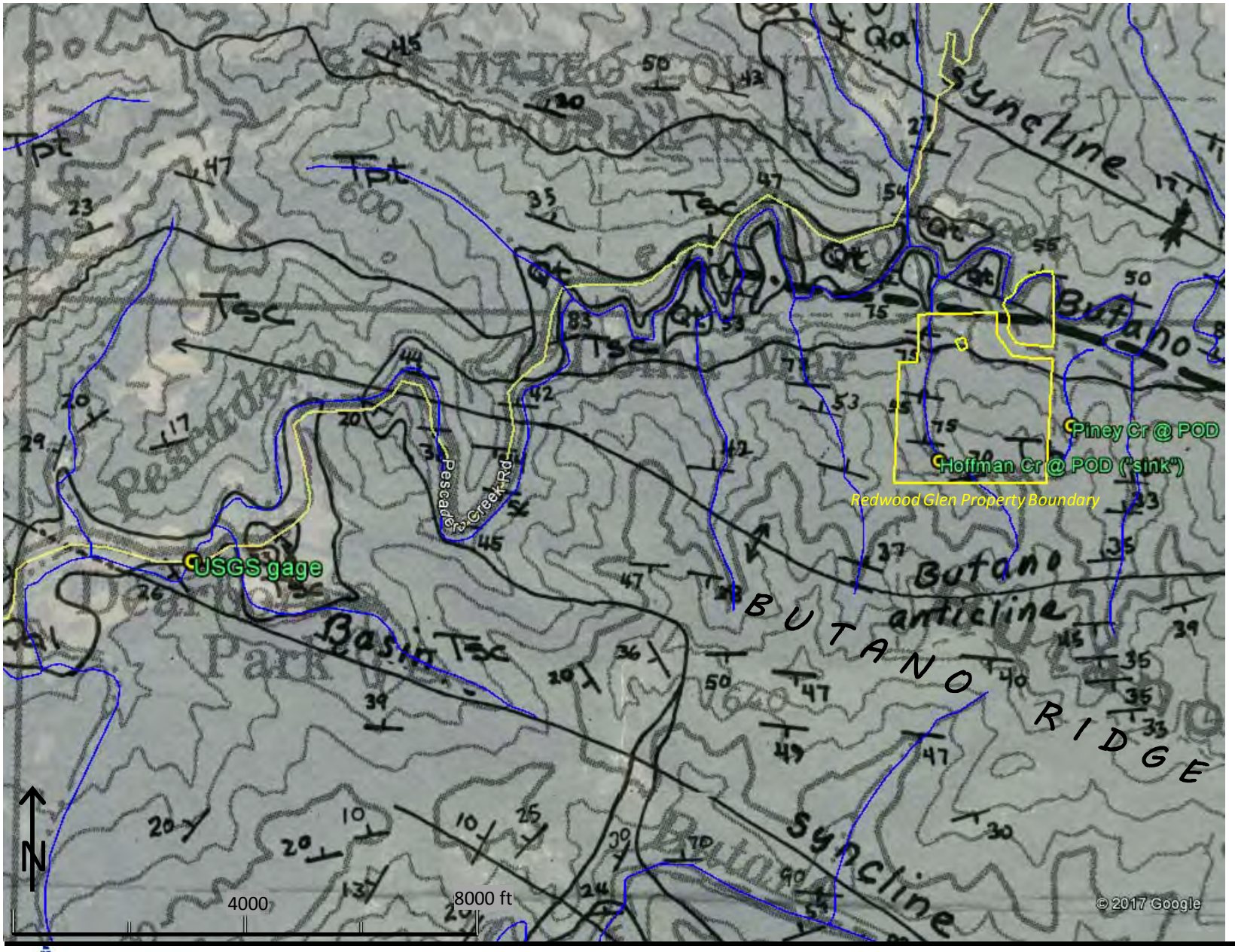

Description of Map Units

(Brabb and others, 2000)

Santa Cruz Mudstone, Tsc (upper Miocene) -- Brown and gray to light-gray, buff, and light-yellow siliceous mudstone with nonsiliceous mudstone and siltstone and minor amounts of sandstone. Santa Cruz Mudstone is more than 1,000 m thick

Butano Sandstone, Tb (middle and lower Eocene) -- Light-gray to buff, very fine to very coarse grained arkosic sandstone in thin to very thick beds interbedded with dark-gray to brown mudstone and shale. Conglomerate, containing boulders of granitic and metamorphic rocks and well-rounded cobbles and pebbles of quartzite and porphyry, is present locally in lower part of section. Amount of mudstone and shale varies from 10 to 40 percent of volume of formation. About 3,000 m thick

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Figure 2. Surface geology mapped in the vicinity of Redwood Glen, San Mateo County, CA. Large vertical-trending fracture zones are found in the Butano Ridge block, which lead to springs at the sources of Hoffman Creek, Piney Creek, and other creeks that head in the Butano Sandstone (Tb). Overlying Santa Cruz Mudstone (Tsc) is mapped along Pescadero Creek and the Butano fault at the northern most portion of Redwood Glen, overlain by Quaternary terrace deposits (Qt).

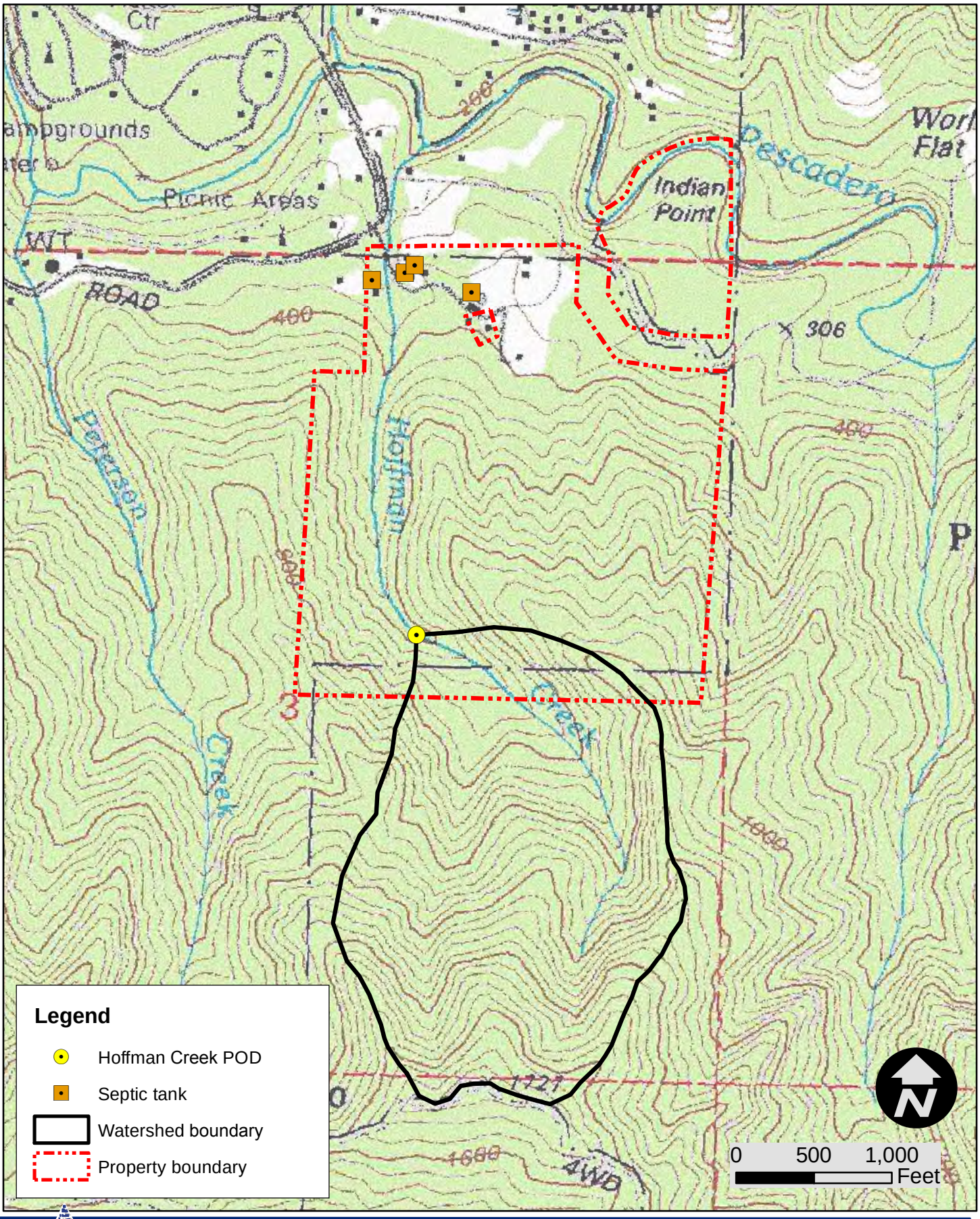

Figure 3. Source-water assessment map for existing point of diversion on Hoffman Creek (the 'sink' diversion), Redwood Glen, San Mateo County, CA.

Area of the watershed is 117 acres.

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Base map: USGS La Honda 7.5' Quadrangle

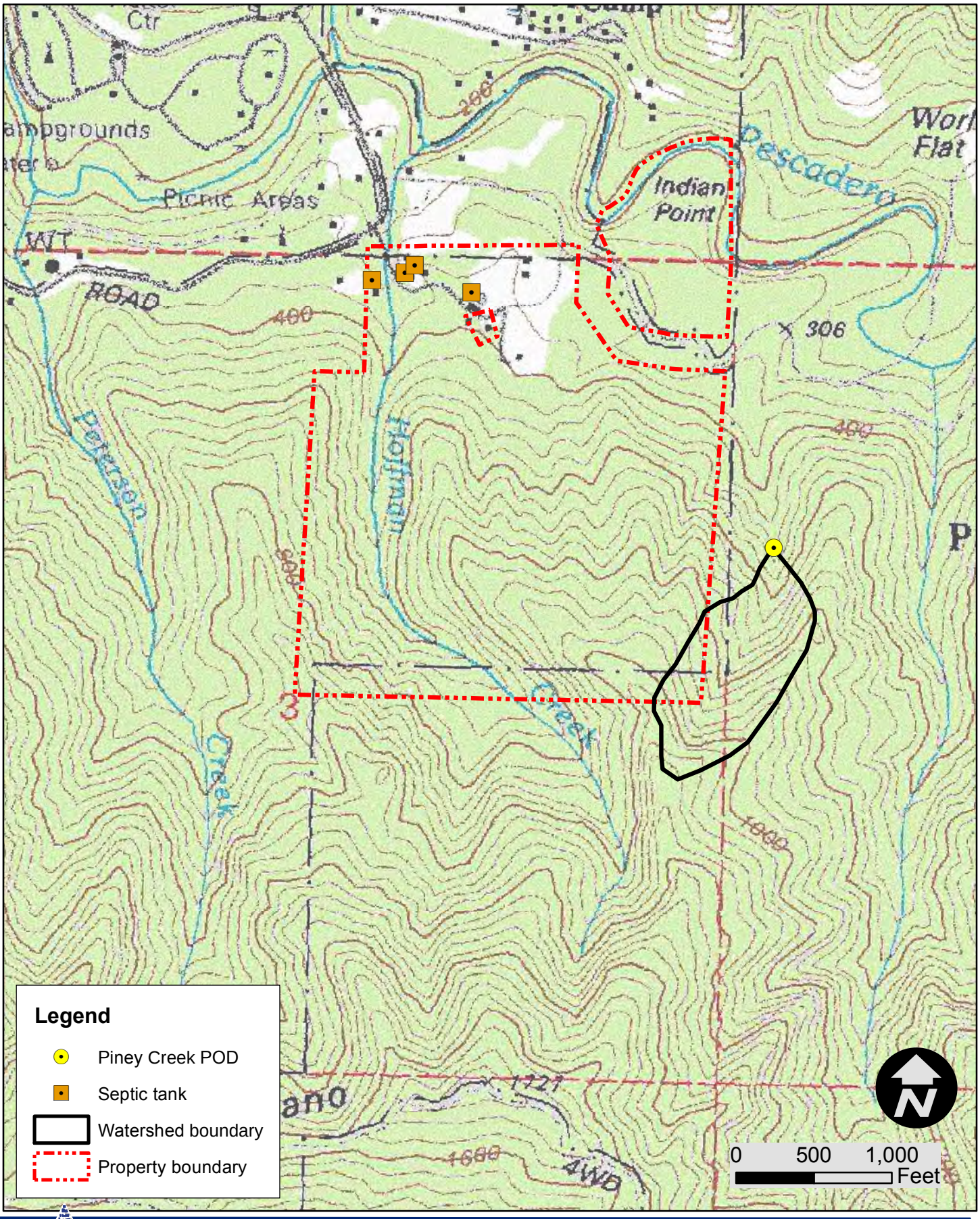

Figure 4. Source-water assessment map for point of diversion on Piney Creek, Redwood Glen, San Mateo County, CA

Area of the watershed is 19 acres.

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Base map: USGS La Honda 7.5' Quadrangle

On 9/9/17 0.73 gpm diverted and 4.6 gpm basefow downstream of the diversion

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Figure 5. Existing diversion structure on Hoffman Creek, Redwood Glen, San Mateo County, CA. The diversion structure consists of a stainless-steel sink attached to a redwood log across this creek. Sediment and wood debris impounded behind the log has raised the channel bed to allow flow over the log and into the sink. Underflow beneath the log bypasses the diversion, as does overflow when the sink spills.

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Figure 6. Improved diversion structure on Piney Creek, Redwood Glen, San Mateo County, CA.
The diversion structure was rehabilitated during 2017 to remove sediment and debris, and to restore its full functionality. It now includes a functioning bypass port and diversion port with the same diameter and set at the same elevation. If both ports are completely open, then the flow is passively split in half.

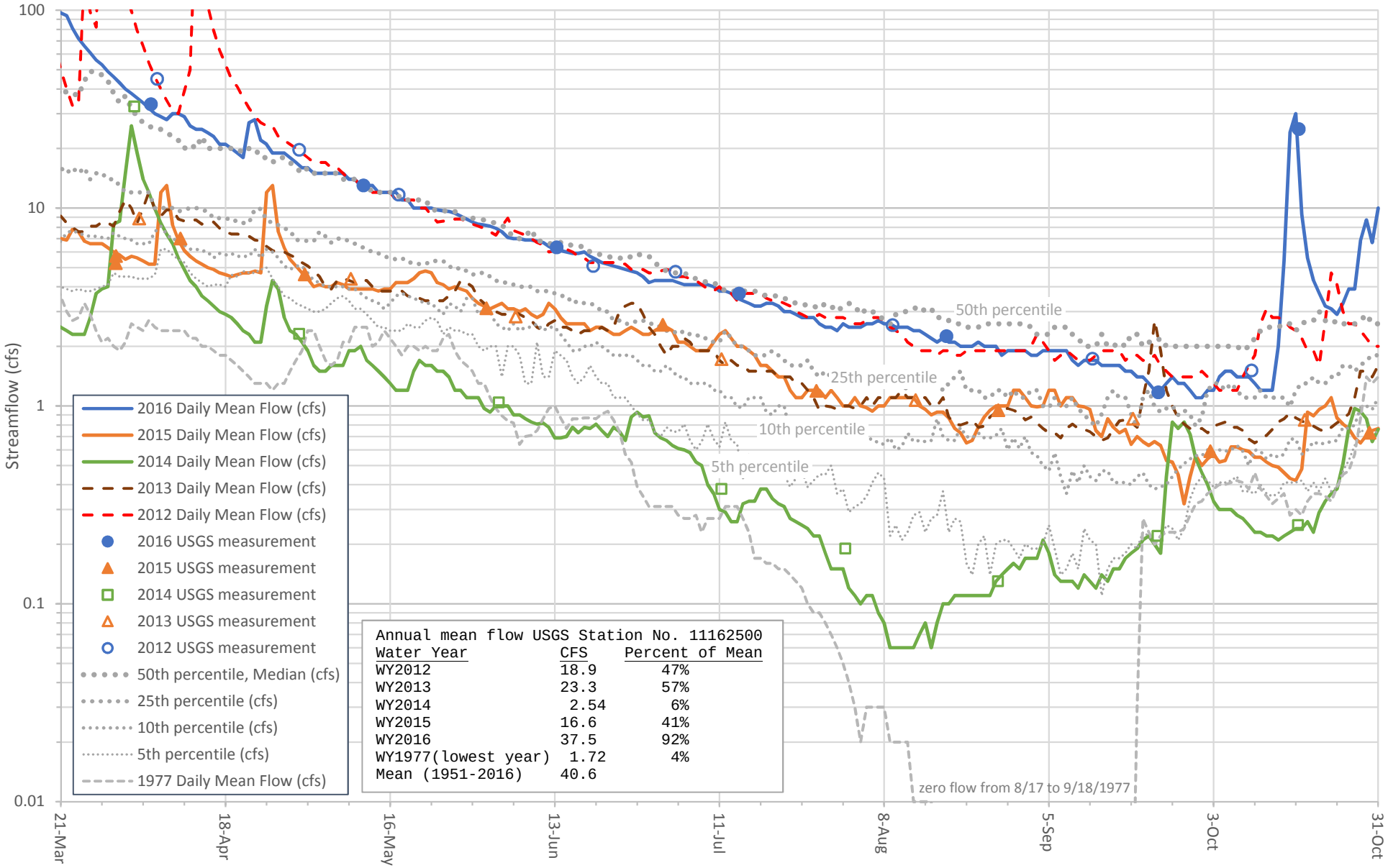


Figure 7. Streamflow recession at the USGS gage on Pescadero Creek near Pescadero during consecutive dry years 2012 through 2016, San Mateo County, CA. Baseflow hydrographs illustrate a deepening multi-year drought into the 2014 extreme dry year, when flows were below the 5th percentile of the 65-year record during nearly all of the dry season; flows during 2013 and 2015 receded to a level within the 10th and 25th percentiles; and bracketing the multi-year drought, baseflows tracked the 50th percentile during 2012 and 2016, receding to the 25th percentile by season end.

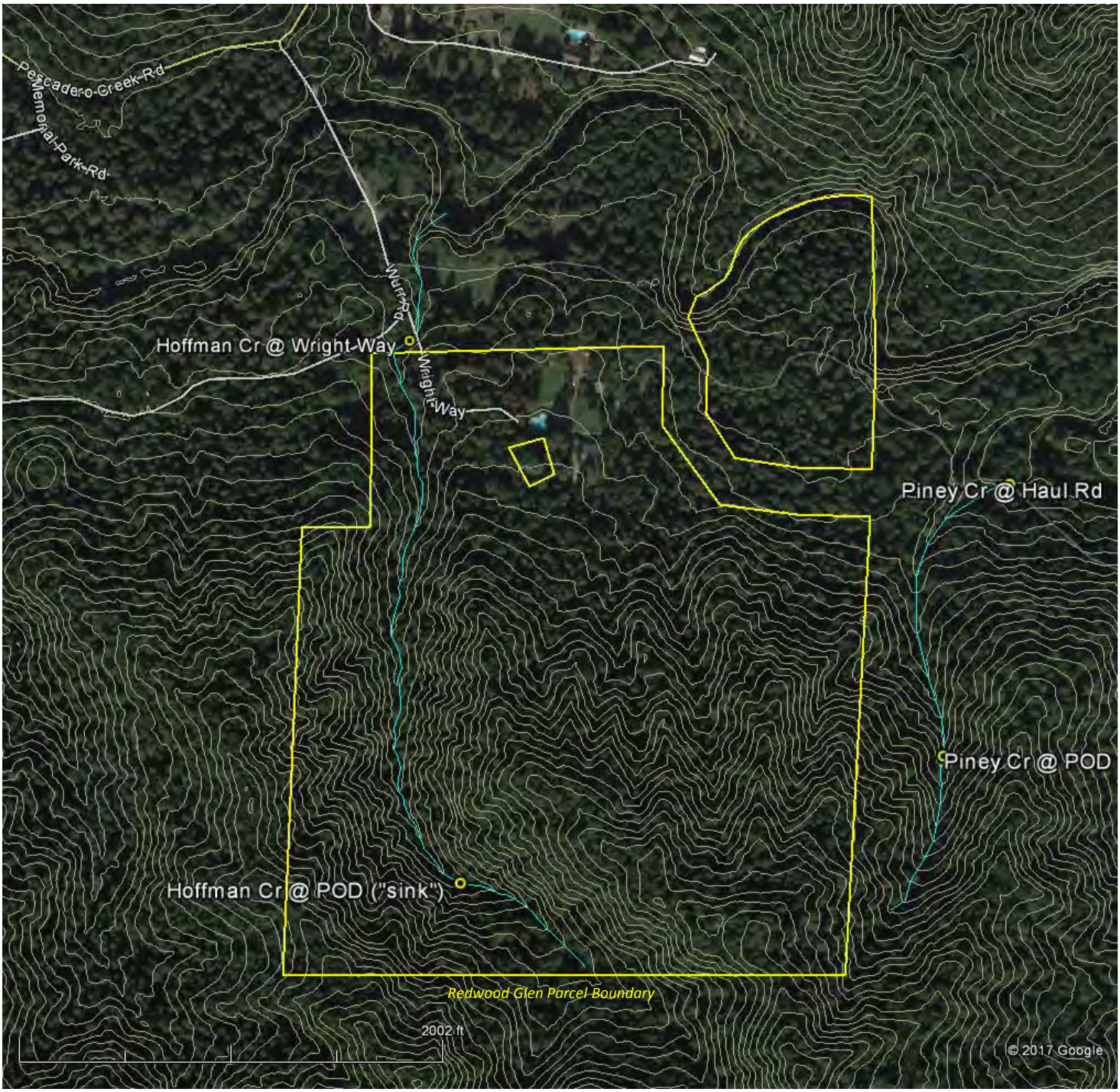
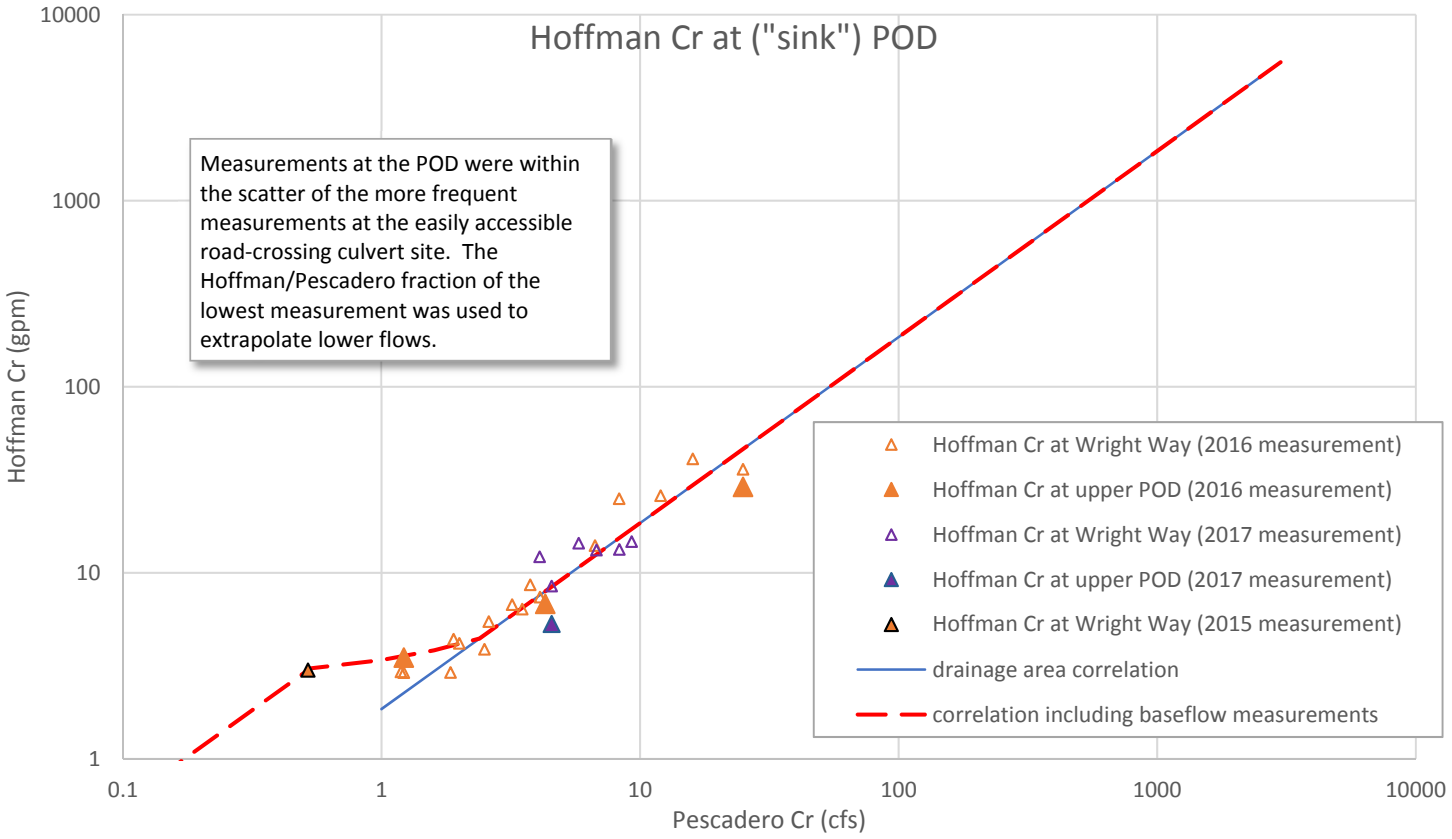


Figure 8. Streamflow measurement locations at Redwood Glen, San Mateo County, CA.
Photo source: Google Earth.
Contour interval: 5 ft



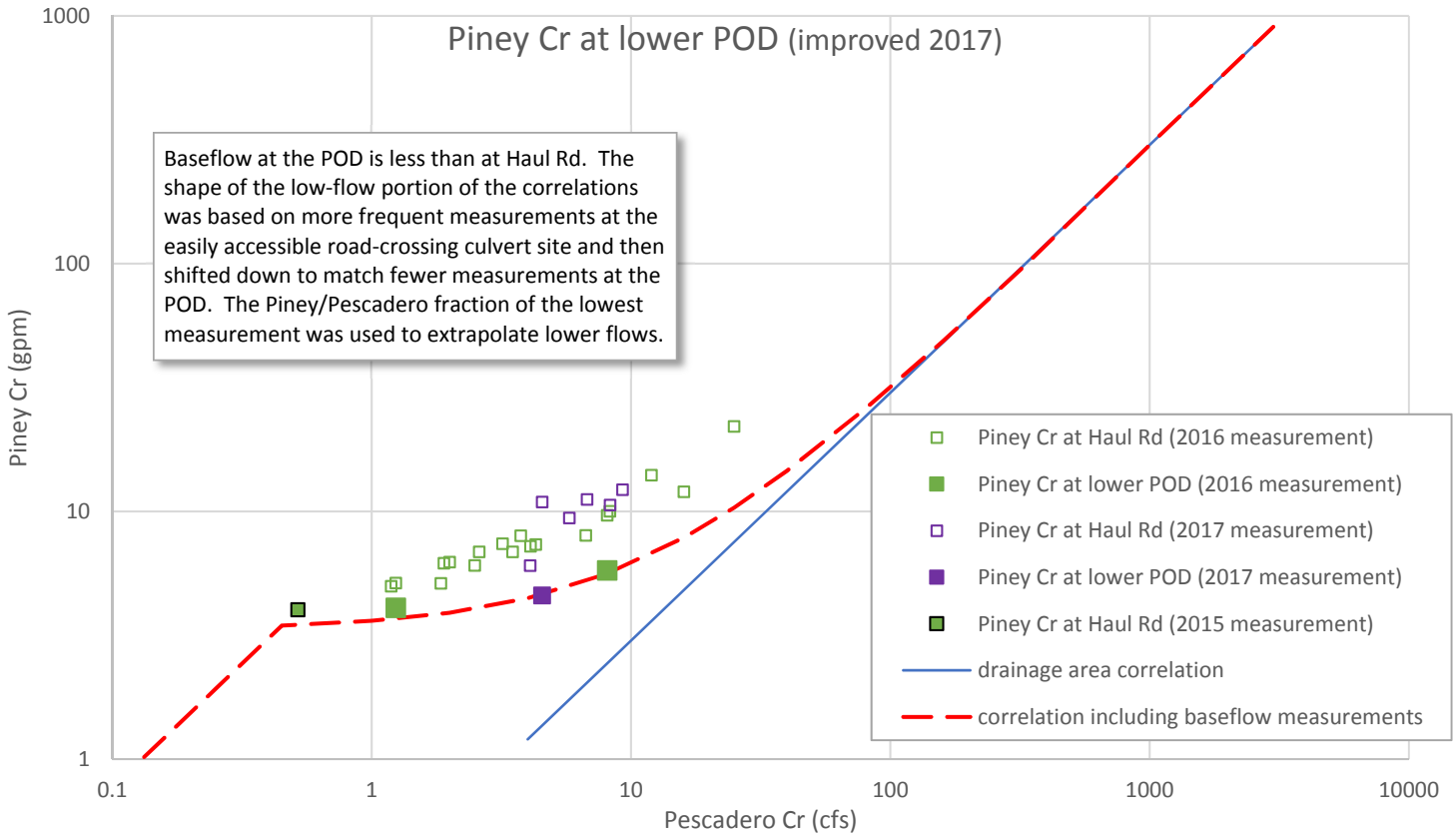
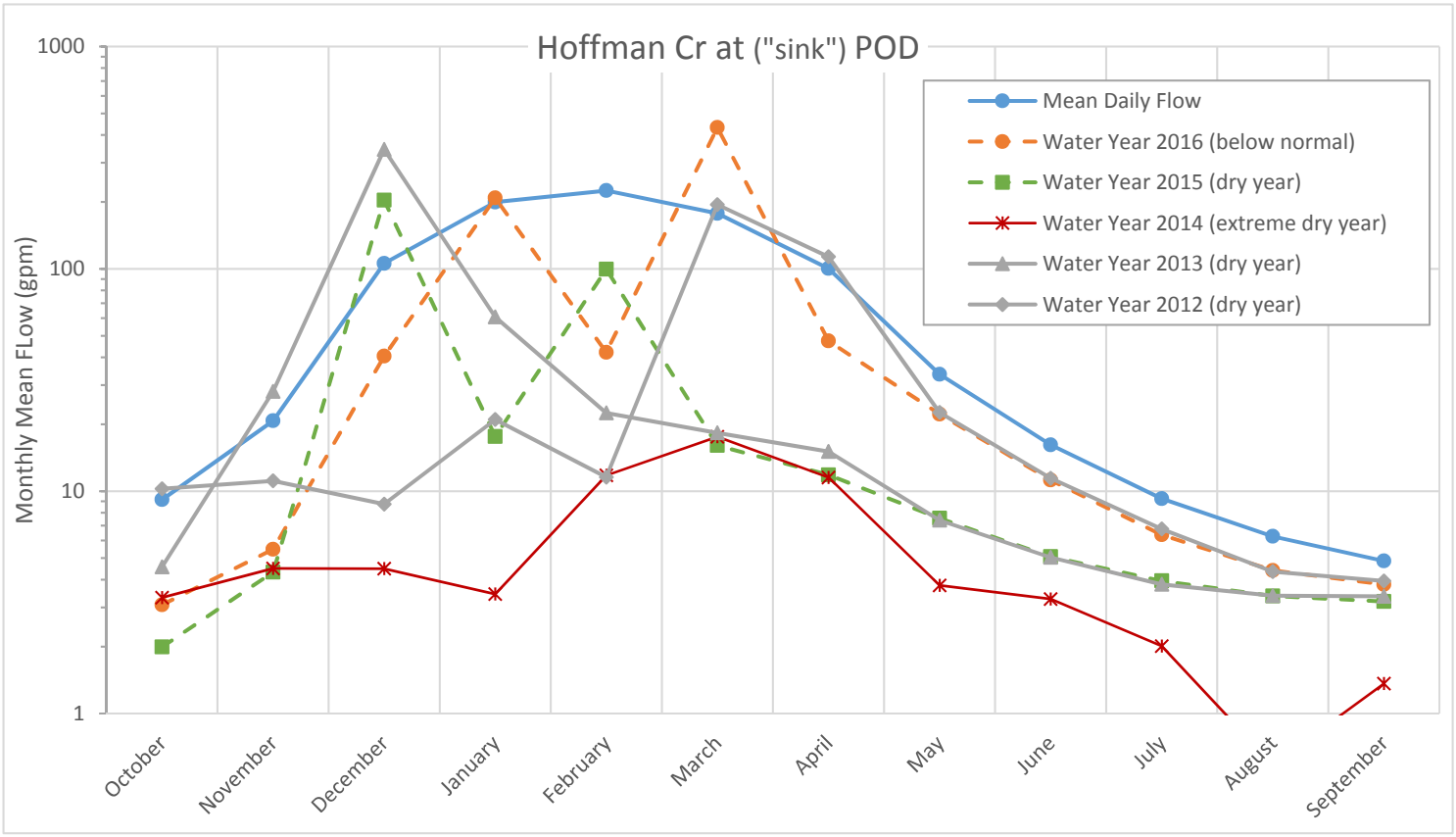


Figure 9. Flow correlations for Piney and Hoffman Creeks, Redwood Glen, San Mateo County, CA. Baseflow measurements were correlated to corresponding flows in Pescadero Cr near Pescadero, CA (USGS station no. 11162500). Higher flows were proportioned to drainage area. Correlation equations are listed in Table 5.



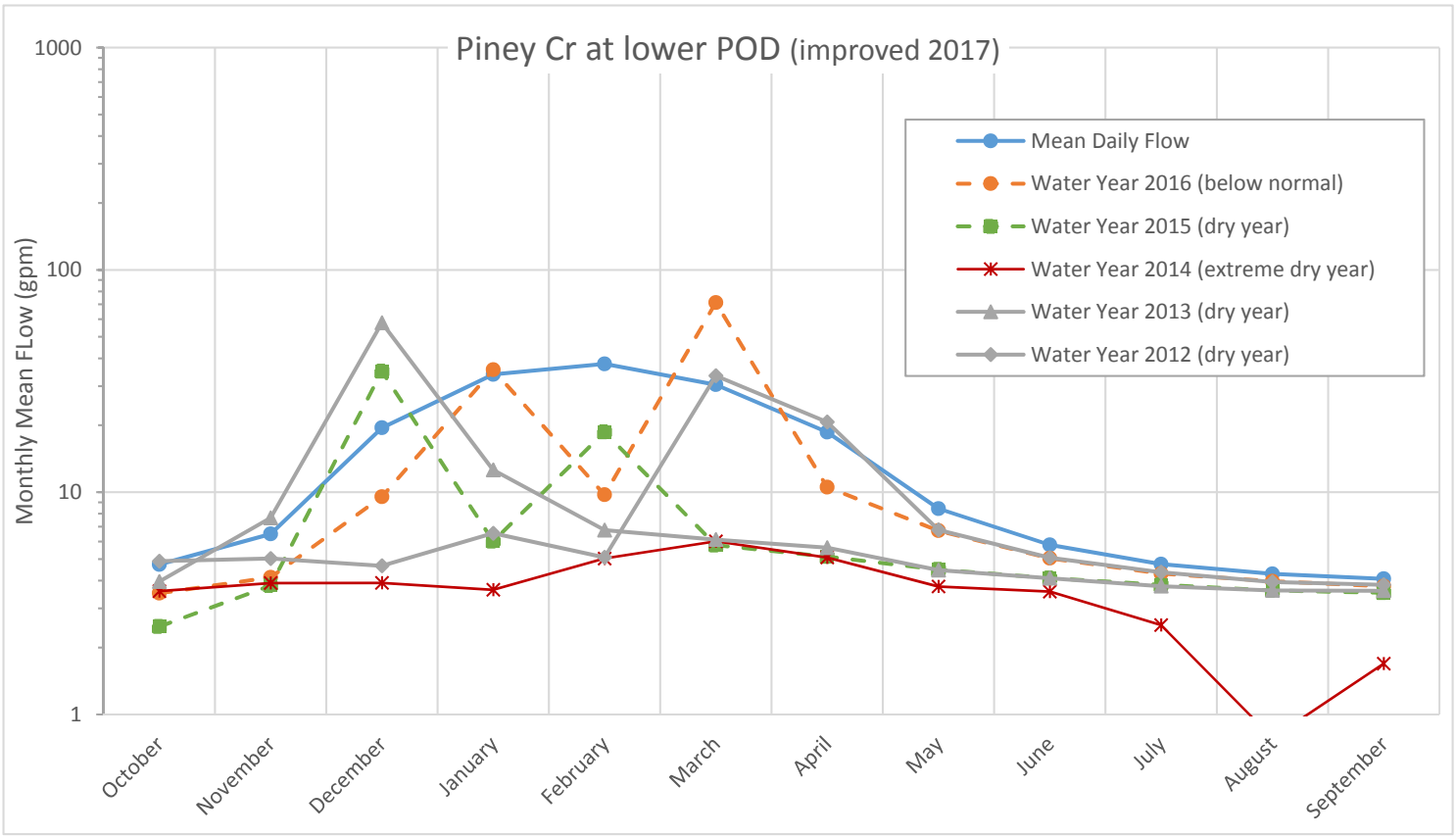


Figure 10. Monthly mean flow estimates for Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA. Estimates were based on correlations of baseflow measurements (for low flow) and of drainage area (for high flow) to Pescadero Creek near Pescadero, CA (USGS station no. 11162500).

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