County of Santa Cruz

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CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)
INITIAL STUDY/ENVIRONMENTAL CHECKLIST

Date:	September 11, 2017	**Application Number:**	171089
Project Name:	San Vicente Creek Watershed Clematis Vitalba Control Project	**Staff Planner:**	John Cairns

I. OVERVIEW AND ENVIRONMENTAL DETERMINATION

APPLICANT:	Peninsula Open Space Trust (POST)	**APN(s):**	058-011-10; 063-071-01
OWNER:	Peninsula Open Space Trust (POST) & Sempervirens Fund (SVF)	**SUPERVISORAL DISTRICT:**	3

PROJECT LOCATION: The proposed project is located within the San Vicente Creek riparian corridor, on the east side of Highway 1, adjacent to the communities of Davenport and Bonny Doon, in the unincorporated County of Santa Cruz (Figure 1, Project location, attached). The County of Santa Cruz is bounded on the north by San Mateo County, on the south by Monterey and San Benito counties, on the east by Santa Clara County, and on the south and west by the Monterey Bay and the Pacific Ocean.

SUMMARY PROJECT DESCRIPTION: The project proposes to treat and control the invasive plant *Clematis vitalba* (Clematis) on approximately 30 acres within Santa Cruz County's San Vicente Creek watershed. Clematis, a non-native invasive plant, has infested approximately 70 acres within the San Vicente Creek watershed (30 acres on the San Vicente Redwoods property owned by Peninsula Open Space Trust (POST) and Sempervirens Fund (SVF) and 40 acres on the Bureau of Land Management's (BLM) Coast Dairies property). The infestation poses a threat to anadromous fish and other wildlife habitat, water quality, and ecosystem health (including coast redwood habitat) throughout the lower watershed. The population has been identified as a "Red Alert" by the California Invasive Plant Council, as one of only two documented occurrences in the state. Additionally, this invasive vegetation management project was identified as a priority in the in the San Vicente Creek Watershed Plan for Salmonid Recovery, published in 2014 by the Resource Conservation District of Santa Cruz County. The proposed project would entail the removal of the 30 acres of Clematis by a variety of methods (discussed further below) over a period of three years. Figure 2 depicts the project site and management units. Within 2 years' time, POST and SVF will be working with BLM to construct a plan to eradicate the remaining 40 acres of Clematis downstream from the project. This plan will be predicated upon the treatment methods proven most effective in this project.

DETERMINATION:

On the basis of this initial evaluation:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☒ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Todd Sexauer, Environmental Coordinator　　　　Date

Figure 1

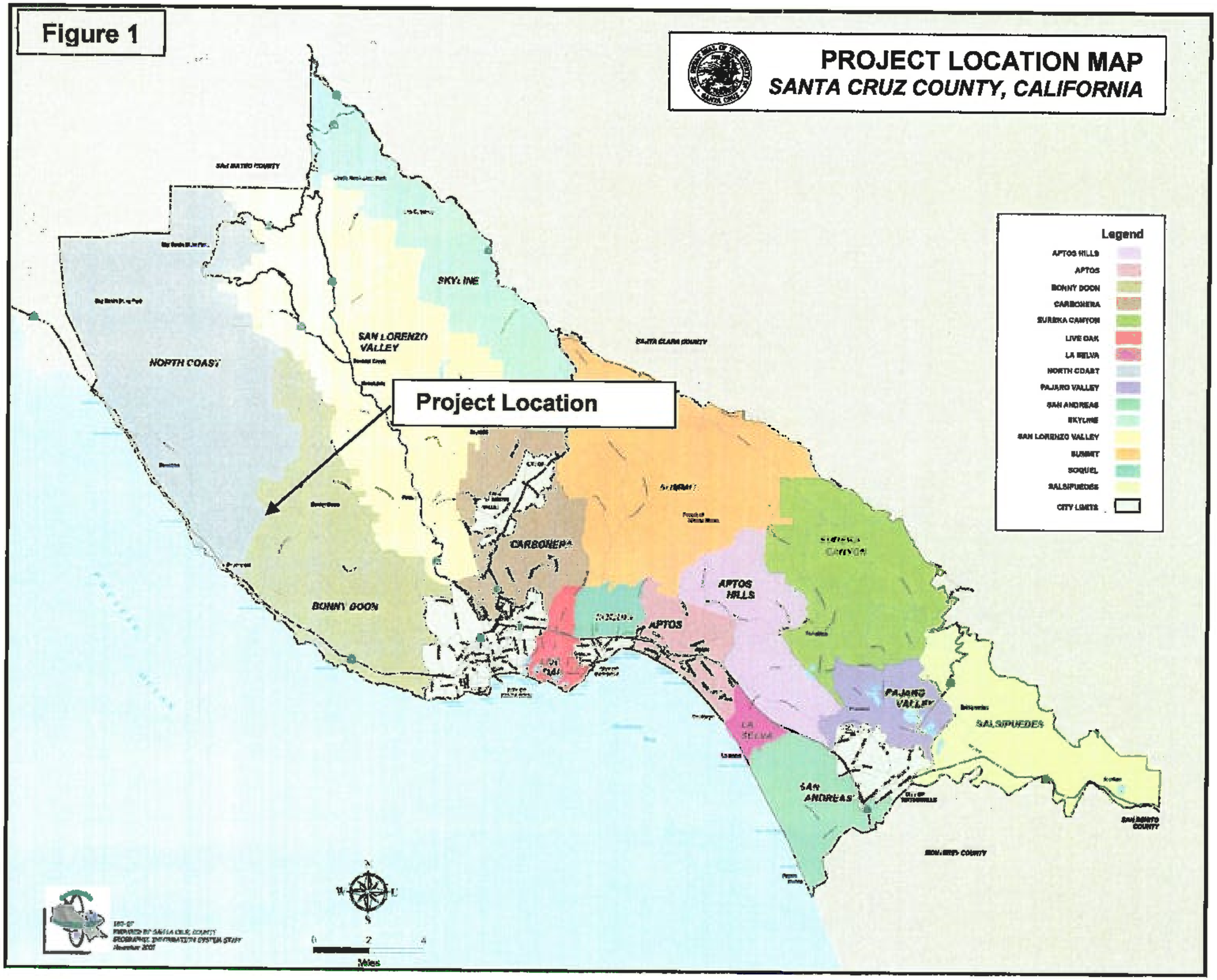
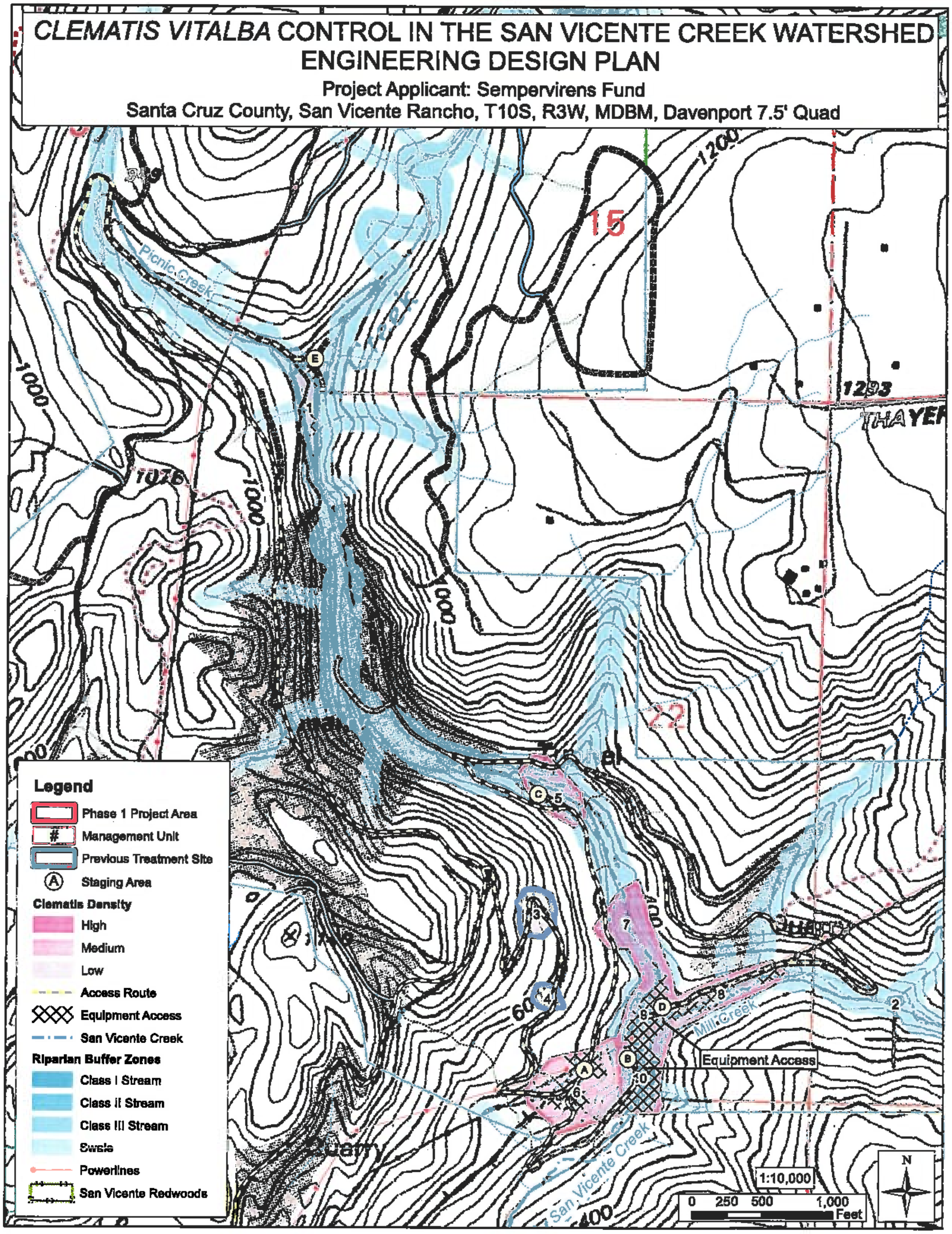

PROJECT LOCATION MAP
SANTA CRUZ COUNTY, CALIFORNIA
Project Location
Legend
APTOS HILLS
APTOS
BONNY DOON
CARBONERA
EUREKA CANYON
LIVE OAK
LA SELVA
NORTH COAST
PAJARO VALLEY
SAN ANDREAS
SKYLINE
SAN LORENZO VALLEY
SUMMIT
SOQUEL
SALSIPUEDES
CITY LIMITS
NORTH COAST
SAN LORENZO VALLEY
SKYLINE
BONNY DOON
CARBONERA
SUMMIT
APTOS HILLS
APTOS
PAJARO VALLEY
SALSIPUEDES
SAN ANDREAS
SANTA CLARA COUNTY
SAN MATEO COUNTY
SAN BENITO COUNTY
MONTEREY COUNTY
Miles

Figure 2


CLEMATIS VITALBA CONTROL IN THE SAN VICENTE CREEK WATERSHED
ENGINEERING DESIGN PLAN
Project Applicant: Sempervirens Fund
Santa Cruz County, San Vicente Rancho, T10S, R3W, MDBM, Davenport 7.5' Quad
Legend
Phase 1 Project Area
Management Unit
Previous Treatment Site
Staging Area
Clematis Density
High
Medium
Low
Access Route
Equipment Access
San Vicente Creek
Riparian Buffer Zones
Class I Stream
Class II Stream
Class III Stream
Swale
Powerlines
San Vicente Redwoods
Picnic Creek
Mill Creek
San Vicente Creek
Equipment Access
1:10,000
0 250 500 1,000
Feet
N

II. BACKGROUND INFORMATION

EXISTING SITE CONDITIONS:

Parcel Size (acres):	837 acres (project area 30 acres)
Existing Land Use:	Open Space
Vegetation:	Native Riparian & Nonnative Invasive
Slope in area affected by project:	☒ 0 - 30% ☐ 31 – 100% ☐ N/A
Nearby Watercourse:	San Vicente Creek; Mill Creek
Distance To:	Site is located directly within the riparian corridor.

ENVIRONMENTAL RESOURCES AND CONSTRAINTS:

Water Supply Watershed:	Yes	Fault Zone:	No
Groundwater Recharge:	Yes	Scenic Corridor:	No
Timber or Mineral:	Yes/Partial	Historic:	No
Agricultural Resource:	No	Archaeology:	Yes/Partial
Biologically Sensitive Habitat:	Yes	Noise Constraint:	No
Fire Hazard:	Yes/Partial	Electric Power Lines:	Yes
Floodplain:	No	Solar Access:	No
Erosion:	Yes/Partial	Solar Orientation:	No
Landslide:	Yes	Hazardous Materials:	No
Liquefaction:	No	Other:	

SERVICES:

Fire Protection:	CRZ-FSA48	Drainage District:	Zone 7
School District:	Pacific Elementary SD, Bonny Doon Union SD	Project Access:	Yes
Sewage Disposal:	CSA-12	Water Supply:	N/A

PLANNING POLICIES:

Zone District:	CA	Special Designation:
General Plan:	R-M	
Urban Services Line:	☐ Inside	☒ Outside
Coastal Zone:	☒ Inside	☐ Outside

ENVIRONMENTAL SETTING AND SURROUNDING LAND USES:

Natural Environment

Santa Cruz County is uniquely situated along the northern end of Monterey Bay approximately 55 miles south of the City of San Francisco along the Central Coast. The Pacific Ocean and Monterey

Vicente Creek, 500 feet below the original pulling zone. The seedlings were pulled, but the stretch of creek above the San Vicente Quarry shall continue to be monitored.

A third soil type underlies Management Unit 5, which is below the outlet of the tunnel (karst) that goes below the San Vicente Quarry. This mapped soil is Pits - Dumps complex. Pits indicate the open excavations from which soil material has been removed. Dumps are uneven areas of accumulated waste material. Included with this complex are small areas of rock outcrop. This soil type makes up the old quarry and waste disposal sites. Management Unit 5 is located along steep side slopes adjacent to San Vicente Creek, intermingled with English ivy in the northern part of the Unit. There are many native species also present, and percent cover of Clematis varies from 5% to 80%. Access in this Management Unit would be difficult as terrain is generally steep and rocky along this portion of San Vicente Creek.

Management Units 7 and 8 on the north side have Pits - Dumps complex along their northern margins. This is due to the steep limestone overburden area that consists of old quarry fill. Much of the nearby overburden is colonized by jubata grass. Management Unit 7 is along the rocky banks of San Vicente Creek and up the steep slope on the edge of the riparian area. Percent cover in this zone ranges from <10% on the northern fringe, to near 100% at the south boundary of this Unit.

Management Units 9 and 10 are the most heavily invaded parts of the project area, along the broader floodplain sections of San Vicente Creek, above and below the Mill Creek confluence. There is much aerial climbing in these Units and therefore numerous seedlings. The ground also has a think mat of Clematis near the center of Units 9 & 10. The percent cover of Clematis is near 100% on the floodplain and near the water and tapers off on the on the edge of the riparian area. Some clearing of dense Clematis occurred in 2015 and 2016 in a two-acre patch adjacent to San Vicente Creek. This site was subsequently planted and is a trial area for testing methods to date.

Management Unit 8 is upstream along Mill Creek, adjacent to dense Clematis growth. Some of this area is difficult to access due to willows and other intertwined riparian vegetation. A small stand of Acacia was cut in the lower part of Unit 8 in 2014, and it is now thick Acacia sprouts, Clematis, and poison oak.

Management Unit 2 is a very small outlier in Mill Creek. Ten single-stem plants were found in 2016 and were pulled. This area has a rocky streambed with an adjacent trail. There is an aggressive population of *Tradescantia* in the vicinity.

All of the Clematis population is in the riparian corridor of San Vicente Creek or Mill Creek, except for Management Units 3 & 4 and the upper portion of Management Unit 6. Management Unit 6 is mostly small patches of Clematis with coverage <50%. Management Unit 6, under the PG&E transmission lines from where the source population may have originated. It is located in the upland site of the previous Quarry Camp, a hub with approximately 10 homes and a hostel during the quarry period of around 1904-1955 (when the town was wiped out by a landslide). The Clematis present at this upland site is relatively sparse and intertwined with native vegetation and weeds.

DPS and Central California Coast Steelhead DPS (NOAA, 2015). The Project directly addresses the present or threatened destruction, modification, or curtailment of coho habitat or range, and carries out Recovery Action Step 14.1.1.1 to remove invasive exotic vegetation from riparian zones (NMFS, 2012).

The project supports natural resource management actions underway and recommendations set forth within the California Natural Resources Agency's Safeguarding California: Reducing Climate Risk plan, including developing management practices to help safeguard species and ecosystems from climate risk (Biodiversity and Habitat Sector Plan) and implementing forest management for the overall health and protection of watersheds (Forestry Sector Plan) (Resources Agency, 2014).

In December 2016, the project was selected as the recipient of $1.14M in Proposition 1 funding administered by the California Department of Fish & Wildlife (CDFW). The proposed project would build upon previous work on *Cape Ivy* in the watershed, which was conducted by the RCDSCC on the Bureau of Land Management's Coast Dairies property. In addition, the proposed project site is also the location of a planned large wood project that the RCDSCC is planning to implement to further improve habitat for salmonids.

In addition to the support of the project partners, POST and SVF, the project has received written support by Save the Redwoods League, the Bureau of Land Management, the Resource Conservation District of Santa Cruz County, and the University of California at Santa Cruz.

The goal of the project is to treat and control the invasive Clematis on approximately 30 acres of the San Vicente Redwoods property, within the San Vicente Creek watershed. The infestation threatens anadromous fish and other wildlife habitat, water quality, and ecosystem health (including coast redwood habitat) throughout the lower watershed. The project would address the Clematis infestation in the watershed by controlling the invasive on the San Vicente Redwoods property, monitoring and documenting the success or failure of treatment methods used, and identifying opportunities for follow up work on the Clematis population on BLM's Coast Dairies property (previously treated by BLM and the RCDSCC starting in 2014). A plan to collaborate with BLM and implement the removal of the remaining 40 acres of Clematis on the adjacent parcel would begin within 2 years' time. The ultimate goal is to eradicate the plant from the watershed and share the results of the project as a case study to inform land management and invasive plant management efforts more broadly.

The project would enhance riparian and instream habitat to protect important spawning and rearing grounds and aid the recovery of Central California Coast (CCC) Evolutionary Significant Unit of coho salmon (Oncorhynchus kisutch) and CCC steelhead (*Oncorhynchus mykiss*). In addition, the upper watershed of San Vicente Creek contains outstanding redwood stands, some of which provide structural characteristics, potentially suitable for marbled murrelet and other old-growth forest-dependent species. San Vicente Creek and its main tributary, Mill Creek, supply water to the town of Davenport. Treating Clematis in the lower watershed would help prevent its spread upstream where the invasive would further impact forest health and water quality in the headwaters.

DETAILED PROJECT DESCRIPTION:

A Background on Clematis

botanists and ecologists, and pilot treatments. As more is learned about this species and its behavior in the San Vicente Creek watershed, knowledge of the species and approach may change.

What is certain is that the effects of Clematis on the riparian forest habitat in the San Vicente Creek watershed, if left unmanaged, would have profound impacts on the anadromous fish populations (and other aquatic and terrestrial wildlife) in the watershed. As Clematis quickly takes over riparian areas, killing native vegetation and trees along the way, the degradation of riparian habitat manifests in changes to leaf litter inputs into the waterways, nutrient cycling, stream bank stability, light availability, and interception of solar radiation, resulting in impacts to water quality (e.g., increased turbidity), stream dynamics, water temperature, and food systems in the watershed (RCDSCC, 2014).

Both CDFW and National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) have made substantial investments in maintaining and restoring coho salmon in this watershed. The agencies have conducted surveys and released juvenile coho through the captive breeding program (discussed in more detail below). In addition to funding the Recovery Plan, CDFW has recently awarded a grant to the RCDSCC to implement a large woody debris restoration project in the watershed. Habitat for anadromous fish is present below mile 3.4 on the creek's mainstem (restricted upstream by an old quarry) and in roughly the first half-mile of Mill Creek below a sizeable non-functional dam. Surveys by NOAA and CDFW from 2006 to 2013 have found coho in San Vicente Creek even when coho were not found in most of the other surveyed local creeks (CDFW 2015 and RCDSCC 2014). Although less surveying has been done for steelhead, the creek also appears to support a relatively robust steelhead run (RCDSCC 2014).

At the downstream end of San Vicente Creek, a 245-foot tunnel dug through bedrock in 1906 to construct the railroad and a 142-foot long concrete box culvert under Highway 1 confine the creek and prevent a sand bar from forming and blocking the creek's exit to the ocean. Thus, there is a year round connection between the creek and the ocean, offering coho, steelhead, and other aquatic species year-round access to San Vicente Creek. While there are some benefits to the year-round connection, this infrastructure reduces the quality of downstream habitat and makes the lower creek channel more susceptible to the influence of stormwater flooding and sea level rise.

When this challenge is combined with the impassible obstacles upstream, the reaches of San Vicente Creek that are infested with Clematis are critically important for anadromous fish habitat restoration. If the Clematis now present in San Vicente Creek migrates to other watersheds within the Santa Cruz Mountains it would become not a localized problem but a regionally significant problem that further jeopardizes anadromous fish recovery efforts on California's central coast. Furthermore, in the San Vicente Creek watershed and in the Santa Cruz Mountains generally, Clematis is an extreme threat to coast redwood (*Sequoia sempervirens*) forests because the weed creates a monoculture and is not height limited in growth. In fact, Clematis has climbed upwards of 100 feet on redwoods and other trees in the watershed (Hamey 2016). As noted in NOAA's CCC Coho Salmon Recovery Plan, California's redwood forests are some of the last areas where coho salmon persist. Because of California's strict regulations for forest harvest, many redwood forests retain ecosystem processes that provide for salmon spawning, rearing, and sheltering. This emphasizes the importance of healthy redwood forests in salmonid

Treatment methods would consist of work crews using hand tools to cut and pull Clematis from native vegetation where it is entangled in thick mats. Work crews would also cut and pull Clematis from trees, where it climbs, covers, and chokes out water and sunlight. Clematis stumps would be removed by hand methods as much as possible. In cases where hand methods are not viable (e.g. in areas where access is restricted due to topography) or not recommended because hand digging and root pulling would cause too much soil disturbance, a licensed contractor would apply herbicide judiciously, subject to Best Management Practices and Pest Control Adviser recommendations. The use of mechanical methods (i.e. small equipment with grapple or excavator buckets or scrapers) may be considered if determined to be ecologically safe and preferable to ensure efficient, successful removal. In areas where removal of Clematis leaves the ground bare and particularly exposed to re-invasion, treatment will also include planting of native seedlings to supplement native species regrowth from the seed bank. Treated areas will be monitored to detect new Clematis infestations, evaluate treatment effectiveness, and guide adaptive management.

Process

Finalization of Treatment Plan: POST and SVF would work with consultant biologist(s) and habitat restoration professionals (with engineer as needed) to develop a baseline assessment of the project site to confirm the mapped boundaries of the infestation, specific treatment approach, and the order of initial treatment in each Management Unit. Site conditions and specific treatment approaches would be used to define Treatment Units. Treatment Unit data would be recorded in the field using the Calflora Observer Pro Weed Manager tool and following data collection methods described in the Monitoring Plan to record information about site status, treatment methods, timing and efficacy.

Year One -- Initial Clematis Treatment: POST and SVF would contract with habitat restoration professionals and the Conservation Corp of Monterey Bay to conduct initial treatments of the Clematis infestation. The work would be a combination of manual methods and chemical treatment of the vines. Control work would start upstream and with outlier populations (Management Units 1,3,5, see Management Unit Map) and work down toward the heart of the invasion (Management Units 6,10,9). Proposed treatment methods would build on the success of control work done to date on the property, and consist of work crews using hand tools to cut and pull Clematis from native vegetation, where it is entangled in thick mats. Plants would be removed by following vines to the roots and digging them up. Any remaining vines in trees would be cut far enough up so they do not touch the ground (cut stems would re-root if they reach the soil). Care would be taken not to leave holes in the soil when removing the plants. Holes would be backfilled with removed soil material or as needed with mulch. This will reduce germination of weed seeds exposed through soil disturbance and minimize erosion. In some locations, native vegetation would need to be removed in conjunction with Clematis because it is completely intertwined. Mechanical methods (i.e. small equipment with grapple or excavator buckets or scrapers) would be employed as deemed acceptable (see list of Best Management Practices (BMPs) that are followed by operators on San Vicente Redwoods below). When digging is not feasible or would create problems on unstable slopes or other difficult sites, spot spraying may take place with an appropriate herbicide. Herbicide would only be applied by a licensed contractor, subject to Pest Control Adviser recommendations. Areas designated for herbicide treatment would be identified in baseline assessment and data records of treatment would be collected in the Weed Manager tool. Project Partners would work with interns from the

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

III. ENVIRONMENTAL REVIEW CHECKLIST

A. AESTHETICS AND VISUAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒

Discussion: The project site is located across two parcels of the 8,532-acre San Vicente Redwoods Property. The site is not located within a designated scenic corridor as designated in the County's General Plan (1994). The site is not visible from any public roads. The site is located directly within the riparian corridor of San Vicente and Mill Creeks, and the proposed project would result in the removal of nonnative invasive vegetation. In areas of lower density infestation, native vegetation would be left intact. In some cases, complete removal of vegetation would be required, but the project is designed to reestablish and recruit native vegetation. Visual changes would be temporary in nature. Project implementation would not alter the scenic conditions or substantially change the visual quality of the project site as post-construction conditions would be similar to or improved from existing conditions. As a result, no impact would occur from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒

Discussion: The proposed project site is not visible from Highway 1; and therefore, project construction activities would not impact views from this scenic highway. The site is not visible from any public roads. There would be no views of the project site from a designated or eligible State Scenic Highway. Therefore, no impact to scenic resources associated with a State scenic highway would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☐	☒

Discussion: Visual character of the existing site would change very little after project construction. Restoration activities may improve visual quality of the project site as the site would be restored to native habitat conditions. Therefore, the proposed project would have no adverse impact on visual character or quality of the site.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
Public Resources Code Section 4526), or timberland zoned Timberland Production (as defined by Government Code Section 51104(g))?				

Discussion: The project is located on land designated as Timber Resource. However, the project does not involve the removal of timber. The proposed project would be classified as watershed management and fish and wildlife habitat management (Santa Cruz County LCP, principal permitted uses within the Coastal Zone, Chapter 13.10.372, Uses in the Timber Production TP District). The project would not negatively affect the resource or access to harvest the resource in the future. The removal of Clematis would improve the recruitment and viability of redwood and other trees. The timber resource may only be harvested in accordance with California Department of Forestry timber harvest rules and regulations. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Result in the loss of forest land or conversion of forest land to non-forest use?*	☐	☐	☐	☒

Discussion: The project would not result in the loss of forest land or conversion of forest land to non-forest use. See discussion under B-3 above. No impact is anticipated.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
5. *Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?*	☐	☐	☐	☒

Discussion: The proposed project would not result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use. Some of the areas selected for ecological restoration are subject to routine flooding, which prevents economically viable agricultural production (Dobler pers. comm.).

C. AIR QUALITY

The significance criteria established by the Monterey Bay Unified Air Pollution Control District (MBUAPCD) has been relied upon to make the following determinations. Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Conflict with or obstruct implementation of the applicable air quality plan?*	☐	☐	☐	☒

Discussion: The project would not conflict with or obstruct any long-range air quality plans of the Monterey Bay Air Resources District (MBARD). The North Central Coast Air Basin does not meet state standards for ozone and particulate matter (PM10). Therefore, the regional pollutants of concern that would be emitted by the project are ozone precursors

Discussion: The project treatment would not result in substantial pollutant concentrations or create objectionable odors affecting a substantial number of people. Impacts would be less than significant.

D. BIOLOGICAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *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 California Department of Fish and Wildlife, or U.S. Fish and Wildlife Service?*	☐	☒	☐	☐

Discussion: The Clematis project area is located in the lower San Vicente Creek watershed, which supports listed anadromous salmonids (steelhead and coho), below the San Vicente Quarry. The majority of the invasive population is located on the broad, rocky floodplain adjacent to San Vicente Creek and Mill Creek. Several small outlier segments of the population are located on the hillside west of San Vicente Creek, with another small outlier on lower Picnic Creek near the confluence with San Vicente Creek. The vegetation communities are largely a factor of surface water conditions, ground water conditions, historic seed bank and distribution of seed from surrounding seed sources. Dominant native species include redwood, Douglas-fir, moisture-dependent species such as lady fern (*Athyrium filix-femina* var. *cyclosorum*), western chain fern (*Woodwardia fimbriata*), giant horsetail (*Equisetum telmateia* subsp. *braunii*), Pacific oenanthe (*Oenanthe sarmentosa*), Douglas's water hemlock (*Cicuta douglasii*), wild ginger (*Asarum caudatum*), redwood clover (*Oxalis oregana*), giant trillium (*Trillium chloropetalum*), sedge (*Carex* spp.), nutsedge (*Cyperus* spp.), and rush (*Juncus* spp.), among others. Dominant invasive species include Clematis (*Clematis vitalba)*, French broom (*Genista monspessulana*), jubata grass (*Cortaderia jubata*), forget-me-not (*Myosotis latifolia*), English ivy (*Hedera helix*), geranium, poison hemlock and spiderwort, among others.

Based on the field investigation done by Nadia Hamey (Hamey, pers. comm. 2017), review of available databases and literature, familiarity with local fauna, and on-site habitat suitability, a total of 34 special-status animal species were considered in this evaluation. A total of 22 special-status plant species were considered possibly present in the vicinity, but were not identified. The remaining species that turned up in scoping are not expected to occur on site based on the lack of suitable habitat (e.g., tidal, serpentine, vernal pool, vernal swale and dune habitats), local extirpations, lack of connectivity between areas of suitable and occupied habitat, etc.

Attachment 4 provides status and habitat requirements for each of the special-status animal species with potential to occur in the Clematis removal project area. The California Natural Diversity Data Base (CNDDB), maintained by the California Department of Fish and Wildlife indicates that several special status species have been observed in proximity to the project site. Avoidance/recovery measures for these species are described below.

and the lower reaches of Mill Creek. By removing invasive exotic vegetation from riparian zones, the project would enhance riparian and instream habitat to protect important spawning and rearing grounds and aid the recovery of Central California Coast (CCC) Evolutionary Significant Unit of coho salmon (Oncorhynchus kisutch) and CCC steelhead (Oncorhynchus mykiss). ~~To protect the beneficial uses of water mitigations for avoidance and minimization~~Mitigations of water quality impacts for steelhead are outlined below in BIO-1-~~5.~~3, HYD-1 and Herbicide Best Management Practices (Section H). With mitigation incorporated, project impacts would be less than significant.

AMPHIBIANS

California Red-Legged Frog (*Rana draytonii*)

The San Vicente watershed has been known to support the California red-legged frog, a federally threatened and state species of concern. CNDDB records documented the species within the project area in 2011, although the species was noted as recently as 2015 (Hamey, Registered Professional Forester, pers. comm.). Per discussions with the US Fish & Wildlife Service (USFWS) (Mitcham, pers. comm.), protocol level surveys to determine presence/absence would not be appropriate in this habitat given the mobility of the species and prolific breeding that can occur, especially during wet years such as 2016/2017. Assuming the species are likely present within the project area, the project includes implementation of take avoidance/recovery measures in consultation with the Resource Conservation District of Santa Cruz County (RCDSCC) Technical Program Director Kelli Camara's existing 10(a)(1)(A) recovery permits for clematis removal activities.

To avoid impacts to California red-legged frog, the project will proceed in accordance with the avoidance measures outlined in BIO-1. These measures are based on guidelines developed by the U.S. Fish and Wildlife Service (USFWS, 2008) in consultation with USFWS staff Chad Mitcham and RCDSCC staff Kelli Camara. With mitigation incorporated, project impacts would be less than significant.

REPTILE

Western Pond Turtle (*Emys marmorata*)

The western pond turtle is a CDFW Species of Special Concern. Western pond turtles occur in a variety of permanent and intermittent aquatic habitats, but most frequently inhabit lowland streams, rivers, and sloughs. In streams they avoid fast-moving and shallow water, and tend to be concentrated in pools, backwater areas, and estuaries. Occupied habitats often contain aquatic vegetation, deep water cover, as well as good basking sites. Pond turtles are usually absent from heavily shaded streams. Nests may be excavated more than 0.25 miles from water, and are generally located in exposed (unshaded) upland locations in friable soils. The nesting season extends from April through August.

The nearest CNDDB records are from Highland Springs near Highway 9 at Ben Lomond, approximately 5.3 miles northeast of the project area, and the lagoon at Waddell Creek, 6 miles Northwest. It is unlikely that suitable western pond turtle habitat is present in the project area and the species has not been recorded anywhere in the San Vicente watershed. Because this species openings or edges. Nests are built in trees. Olive-sided flycatchers occur as a breeding species in the Scotts Creek watershed and are absent (migrants) in winter. Suitable nesting and foraging habitat is present in the project area. Project activities are not anticipated to impact this species. , as the project scope does not include manipulation or impacts to trees. In addition, the project activities shall proceed in accordance with the mitigation measures outlined in BIO-7.

Yellow Warbler (*Dendroica petechia brewsteri*)
The yellow warbler is a CDFW Species of Special Concern (nesting only). Yellow warblers are found primarily in riparian habitats dominated by deciduous trees such as alders, willows, maples, sycamores, and cottonwoods. The species has been recorded from adjacent Scotts Creek watershed and suitable nesting and foraging habitat for yellow warblers is present in the project area. Project activities are not anticipated to impact this species. — as they shall proceed in accordance with the mitigation measures outlined in BIO-7.

Purple Martin (*Progne subis*)
The purple martin is a CDFW Species of Special Concern (nesting only). It is a very rare and localized breeder in in upper elevation knobcone pine and redwood forests in Santa Cruz County. Tall, old snags with woodpecker holes are required for nesting. Martins often forage over water. Project activities are not expected to impact snags nor anticipated to impact this species. – as they shall proceed in accordance with the mitigation measures outlined in BIO-7.

Red-breasted Sapsucker (*Sphryapicus ruber*)

The red-breasted sapsucker is a federal Species of Concern (nesting only). It is a cavity nester that potentially occurs in most forest and woodland habitats. This species is expanding its breeding range in Santa Cruz County, but is more common during fall and winter. Suitable nesting and foraging habitat may be present in the project area. Project activities are not anticipated to impact this species.

BIRDS OF PREY (OWLS and LISTED RAPTOR SPECIES)

Golden Eagle (*Aquila chrysaetos*)

The golden eagle is a CDFW Fully Protected Species. Golden eagles require wide-open country for foraging, and prey predominantly on jackrabbits and ground squirrels. Nests typically are built on cliffs throughout the range of this species, although in the oak/grass savannas of the inner California coast ranges most nests are built in trees, principally secluded oaks, cottonwoods, and sycamores. This species is not known to nest within or near the project area, although there are potentially suitable cliffs nearby. Potentially suitable foraging habitat is present on open grassland habitat within the San Vicente Creek watershed. Project activities are not anticipated to impact this species.

Long-eared Owl (*Asio otus*)
The long-eared owl is a CDFW Species of Special Concern (nesting only). In California long-eared owls typically inhabit dense tree or shrub thickets within or adjacent to open habitat areas, which are favored for hunting. In the Santa Cruz Mountains they have been associated with conifer forests and mixed conifer/broadleaf forests. Rodents comprise the bulk of the diet. Long-eared owls use abandoned nests of corvids, hawks, and squirrels for nesting. Nests tend

small mammals, reptiles, and amphibians are also taken. Potentially suitable Cooper's hawk nesting habitat and foraging habitat may be present within the project area. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Great Horned Owl (*Bubo virginianus*)
This is a common widespread species, found in virtually all habitat types in North America, including conifer forests. Great horned owls nest in trees and on cliffs. In trees it uses abandoned stick nests of other raptors, corvids, squirrels and woodrats. This species was detected in 2008 and 2009 adjacent to the project area during a marbled murrelet survey on Redwood Meadows Ranch. Great horned owls may nest within or adjacent to the project area. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Western Screech Owl (*Otus kennicottii*), Northern Pygmy Owl (*Glaucidium gnoma*), and Northern Saw-whet Owl (*Aegolius acadicus*)
These three species of small owls inhabit forested areas and nest in woodpecker holes and natural cavities in snags. Nests typically are difficult to find. Any of these three species may nest in the project area. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Red-shouldered Hawk (*Buteo lineatus*)
The red-shouldered hawk most frequently occurs in association with streams and riparian woodlands, but may nest in any forest type except very dense second-growth. Stick nests are constructed in either broadleaf or coniferous trees, generally quite high up and against the bole. Unlike most other buteos, red-shouldered hawks forage both in wooded and open areas. Red-shouldered hawks may nest within or adjacent to the project area, particularly along watercourses. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Red-tailed Hawk (*Buteo jamaicensis*)
This very common and widespread hawk occurs throughout North America. It requires open areas for foraging, where it preys chiefly on small mammals. Red-tailed hawks build large stick nests either on cliffs or in trees. Nests rarely are built in the forest interior because this species is not adept at flying through forest cover and also tends to select nesting sites that allow a commanding view of the landscape. Thus, suitable nest trees usually are prominent specimens that are situated in the open, on ridgetops, or at the forest edge. Red-tailed hawks may nest in the vicinity or the project area. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Turkey Vulture (*Cathartes aura*)
The turkey vulture is a common, widespread scavenger that occurs in a variety of habitats throughout North America. The species generally forages over relatively open country, scanning the ground for carrion. Turkey vultures usually nest in large fissures or cavities on sheer cliffs, but may also occasionally use hollow snags or large empty stick nests of other species in dead or live trees. Due to the infrequency with which tree nests are used, the likelihood is low that turkey vultures nest within or adjacent to the project area, thus, project activities are not anticipated to impact this species.

PLANTS

The project area has been assessed for the potential presence of several rare plant species, described in Attachment 4. Special-Status Vascular Plant Species with Potential to Occur within project area. No special status plant species were detected. Botanical reconnaissance will continue during site visits and monitoring through spring 2017. If any listed plant species are discovered, they will be flagged for avoidance during treatment activities. Active or passive regeneration of native plants shall follow eradication. See mitigation measure BIO-~~5~~3 for more native vegetation avoidance and minimization measures. With mitigation incorporated, project impacts would be less than significant.

Restoration species, often collected nearby from seed and cuttings, include but are not limited to:

Elk Clover (*Aralia californica)*
Wild Strawberry (*Fragaria vesca)*
Thimbleberry (*Rubus parviflorus)*
California Blackberry (*Rubus ursinus)*
Yerba Buena (*Clinopodium douglasii)*
California sagebrush (*Artemisia californica)*
California figwort (*Scrophularia californica)*
Willow (*Salix sp.)*
Rush (*Juncus sp.)*
Redwood sorrel (*Oxalis oregana)*
Coast redwood (*Sequoia sempervirens)*
Sticky Monkey-flower (*Mimulus aurantiacus)*

Exotic Species

In addition to Clematis, the project area has other weedy species such as French broom, (*Genista monspessulana*), jubata grass (*Cortaderia jubata*), forget-me-not (*Myosotis latifolia*), acacia (*Acacia* sp.), Himalaya berry (*Rubus armeniacus*), poison hemlock (*Conium maculatum*), tall sock-destroyer (*Torilis arvensis*), cut-leaved geranium (*Geranium dissectum*), and spiderwort (*Tradescantia* sp.). Most of these species do not threaten tree cover in the watershed, and do not pose the same threat to anadromous fish recovery as Clematis; however, in order to be successful at restoring the habitat value of the site, these invasive species would also have to be controlled. Invasive plant species monitoring and control efforts according to a proactive and adaptive Management Plan for the property are planned to continue.

TERRESTRIAL NATURAL PLANT COMMUNITIES

habitats via runoff or drift, only ~~aquatic-safe formulations of~~ herbicides ~~would~~that pose low fish toxicity risks should be used ~~(~~such as aminopyralid (i.e.~~g.,~~ Milestone~~,~~) or triclophyr amine (i.e. Garlon 3A), and they ~~would~~should be applied only by brushing directly onto stumps~~. The more toxic~~ or via the basal bark or frill cut methods. Herbicides with high fish toxicity risks, such as Garlon 4 ~~Ultra would~~, should not be used.

2. No herbicide shall be applied within 15 feet of aquatic features.

3. Herbicide use ~~would~~should strive to minimize ~~toxicity~~risk to non-target aquatic organisms while providing the most effective control ~~to minimize applications for herbicides approved for use~~ in and near aquatic environments, including restriction for use within buffer zones. ~~Herbicides are planned to include — Milestone (Active ingredient: aminopyralid), and Rodeo (Active ingredient: glyphosate). If these herbicides are not available, a suitable alternative would be utilized of an herbicide approved for over-water use~~

~~4. Herbicides would be judiciously applied directly to stumps, and foliar application would not be used in any areas subject to potential drift to surface water bodies. Stump application of all herbicides would~~4. Herbicide applications should be conducted by a State of California Qualified Applicator or by staff under their supervision. ~~Experimentation with ways to limit the dripping of any herbicide around the target cut stump would be experimented with. Ideas include incorporating a rubber gasket that slides around the cut vine surface prior to application.~~

~~4.~~ Herbicides ~~would~~should not be applied within 24 hours of predicted rain events (40 percent chance or greater for rainfall) to reduce the potential for runoff of herbicides into surface water bodies.

5. Foliar application of herbicides or other spray application methods ~~would~~should not be applied when wind speeds exceed 10 miles per hour to reduce likelihood of drift into surface water bodies.

6. ~~Chemical treatment would~~Herbicide applications should be conducted in accordance with the requirements of the herbicide product label, any property ~~Management Plan, Best Management Practices, Pest Control Adviser Recommendations and an~~management plan, approved treatment ~~plan~~plant, applicable best management practices, and any recommendation from a Department of Pesticide Regulation (DPR)-licensed pest control advisor.

~~7. Contractors must have all necessary licensing by CDPR for herbicide application. Use of herbicides would be consistent with label instructions and Material Safety Data Sheets documents would be maintained.~~

7. Contractors should be DPR-licensed commercial applicators who have registered with the appropriate county agricultural commissioner's office.

8. Integrated Pest Management Approaches: Applicants would also use non-chemical methods such as hand pulling or chip deposition on seed stock to prevent seedling germination~~, thus reducing the need for herbicides.~~.

~~9. A liquid herbicide would be applied to each cut vine within 60 minutes of felling; a typical vine requires ¼ to ½ an ounce of diluted solution, which must be applied to the cambium layer, directly beneath the bark. The cut stump formulation may be diluted or adjusted at the judgment of the~~

43. Native plants characteristic of the local habitat type will be the preferred alternative for revegetation. However non-invasive non-native species, such as common barley, may be used for temporary erosion control.

54. The spread or introduction of invasive plant species will be avoided to the maximum extent possible by avoiding areas with established native vegetation during treatment wherever possible, restoring disturbed areas of native communities with native species where appropriate, and post-project monitoring and control of invasive species being treated as part of the project.

65. The spread of exotic plant pathogens such as SOD shall be limited by following the guidelines set by the California Oak Mortality Task Force, which monitors distribution of sudden oak death and disseminates current information. All equipment entering or leaving the project area will be inspected to assure that it is free of any foliar materials (leaves, twigs, branches) and soil. If need be, equipment will be washed to remove accumulations of soil and organic debris, according to the guidelines provided by the California Oak Mortality Task Force, www.suddenoakdeath.org. Restoration planting stock will be from a facility free of SOD. No host foliage will be brought to or removed from the project area.

Mitigation Measure BIO-4: California red-legged frog Mitigations:

1. Prior to operations occurring in the wet season, a qualified biologist will conduct a biological resources education program for workers, and will remain on-site as a biological monitor for the duration of the project. The educational program will include a description of the California red-legged frog and its habitat, and the guidelines that must be followed by all project personnel to avoid take of the species. Educational programs will be conducted for new personnel before they join project activities. Color photographs will be used in the training session, and a qualified person will be on hand to answer questions. For purposes of protection of red-legged frogs, the wet season begins with the first frontal rain system depositing a minimum of 0.25 inches of rain after October 15 and ending on April 15. In the absence of rain events that total at least 0.25 inches as measured at the Ben Lomond rain gauge, wet season restrictions would nevertheless apply on November 30.

2. For wet-season operations, before project activities begin each day, a biological monitor will inspect under any equipment left overnight to look for California red-legged frogs. If a red-legged frog is found, the red-legged frog will not be relocated or captured, and all activities that could result in take will cease and the sighting will be reported to CDFW, USFWS, and the County of Santa Cruz, along with measures being implemented to avoid take of the individual. Activities related to the observation shall not commence until approved by the agencies.

3. A biological monitor will be on-site during all project activities, to ensure that there is no take of this species. If red-legged frogs are observed, work will immediately stop and the biological monitor will consult with CDFW, the U.S Fish and Wildlife Service and the County of Santa Cruz to determine when work can continue.

Mitigation Measure BIO-5: Western Pond Turtle Mitigations:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

even if the nest continues to be active beyond the typical nesting season for the species, until the young have fully fledged and will no longer be adversely affected by the project.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Have a substantial adverse effect on any riparian habitat or sensitive natural community identified in local or regional plans, policies, regulations (e.g., wetland, native grassland, special forests, intertidal zone, etc.) or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?*	☐	☒	☐	☐

***Discussion*:** The project site includes approximately 11 acres of riparian corridor, along San Vicente Creek, Mill Creek and Picnic Creek. This project is intended to enhance and restore the native riparian vegetation within the project site. While short-term disturbance of the riparian corridor may occur as a consequence of project implementation, the protections for riparian habitat already included as part of the project, and any additional measures incorporated into the project pursuant to agency consultation, would ensure that the project does not have a substantial adverse effect on any riparian habitat or sensitive natural community. The impact would therefore be less than significant. See mitigation measures BIO-1 through BIO-7.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?*	☐	☒	☐	☐

***Discussion*:** Restoration activities would not result in hydrological interruptions since the project activities would not interfere with the stream channel, bed and bank to a significant degree.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4 *Interfere substantially with the movement of any native resident or migratory fish or wildlife species or migratory wildlife corridors, or impede the use of native wildlife nursery sites?*	☐	☐	☒	☐

***Discussion*:** The enhancement and restoration of wetland and upland habitat would have no effect on fish passage through San Vicente Creek and Mill ecosystem, nor would project activities interfere with movement of wildlife through the riparian corridor or upland areas. The proposed project would enhance riparian habitat for more likely future riparian tree recruitment.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

Vista, or Quarry Camp. Bella Vista is gone, having been destroyed by a massive landslide March 7, 1962[1]. However, some ornamental plantings, a concrete staircase, and sheet metal are present on the site.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Guidelines Section 15064.5?*	☐	☒	☐	☐

Discussion: A property-wide records check for documented cultural resources and prior archaeological surveys throughout the property was completed by the Northwest Information Center, Information Center File No. 12-0751. No archaeological sites were recorded in the vicinity of proposed invasive species control project. The historic town of Bella Vista/ Quarry Camp is located near to upper extent of one of the main areas of concentrated Clematis. No cultural resources have subsequently been discovered or recorded in proximity to the proposed project. Surveys of the area encompassed by the project was conducted by the project Forester, Nadia Hamey, who has a current archaeological certificate from Cal Fire.

Mitigation Measure CUL-1:

Surveys for cultural resources shall continue during future fieldwork and monitoring activities. In order to protect any undiscovered cultural resources that may be located within the project area, the Forester or a designee with archaeological training will inspect the project area regularly during project implementation to determine if any artifacts are revealed. If a potentially significant archaeological site is discovered during project implementation, the following procedures apply:

1) The person who made the discovery shall immediately notify the Forester.

2) No treatment shall occur within 100 feet of the identified boundaries of the new site until the protection measures are proposed and agreed to.

4) A report shall be filed with a State Archaeologist. The minimum information provided shall include:

(a) A statement that the information is confidential.

(b) The mapped location of the site.

(c) A description of the site.

(d) Protection measures, and

[1] The Wildest Ride in Town – Davenport's Cement Plant Railroad System, by Alverda Orlando

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
B. *Strong seismic ground shaking?*	☐	☐	☐	☒
C. *Seismic-related ground failure, including liquefaction?*	☐	☐	☐	☒
D. *Landslides?*	☐	☐	☐	☒

Discussion (A through D): The proposed project would not expose people or structures to potential substantial adverse effects due to rupture of a known earthquake fault, seismic ground shaking, or liquefaction, and the potential exposure to landslides is low given the nature of the proposed work. No known landslides are within the project area. No structures are located within the proposed project area.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?*	☐	☐	☐	☒

Discussion: Project activities would not result in potential for landslide, lateral spreading subsidence, liquefaction or collapse. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Develop land with a slope exceeding 30%?*	☐	☐	☐	☒

Discussion: The project would not involve any development. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Result in substantial soil erosion or the loss of topsoil?*	☐	☐	☒	☐

Discussion: Some potential for erosion or the loss of topsoil exists during the implementation phase of the project, particularly in cases where Clematis has formed thick groundcover and may need to be removed by mechanical methods. (i.e. small equipment with grapple or excavator buckets or scrapers). However, this potential is minimal due to erosion control measures that will be in place. Any bare soil exceeding 100 contiguous square feet resulting from project activities will be treated with standard erosion control measures. Bare areas will be seeded, covered in jute netting or natural straw wattles will be placed depending on the slope and distance from waterways. Disturbed areas would also be planted and/or to be maintained to minimize surface erosion. In addition, a component of the project is to

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

with grapple or excavator buckets or scrapers) of vegetation. All project construction equipment would be required to comply with the Regional Air Quality Control Board emissions requirements for construction equipment. Following construction, the direct and indirect GHG emissions associated with other sources within the county or state would be unchanged by the project. Project construction emissions would be relatively small, if not negligible, and would cease upon project completion. As a result, GHG emissions from project construction activities would not substantially contribute to the global GHG emissions burden and their impact would be less than significant.

For the construction phase of projects, the MBUAPCD has established a significance threshold of 82 pounds per day of PM10 emissions, and states that this threshold would not be expected to be exceeded by projects involving minimal earthmoving or grading on up to 8.1 acres per day. PM10 emissions from construction activities are mostly from earth moving and movement of vehicles and equipment over bare earth surfaces. Since the project involves neither significant earthmoving nor significant use of mobile equipment, the MBUAPCD's PM10 threshold for construction activities would not be expected to be exceeded.

The MBUAPCD states that construction-related emissions of ozone precursors, including volatile organic compounds (VOC) and oxides of nitrogen (NOx), are typically associated with use of diesel-powered equipment. Minimal diesel-powered equipment is proposed to be used in the project.

Small amounts of pollutants would be emitted by gasoline-powered equipment used in the project, including chainsaws/mowers, and by vehicles used by crew and personnel to access the site. Vehicle emissions would include tailpipe emissions and dust emissions from travel over unpaved roads on the San Vicente Redwoods property. Given the modest amount of new traffic that would be generated by the project, the short-term nature of project implementation, and the use of only light gasoline-powered equipment, there is no indication that new emissions of VOCs or NOx would exceed MBUAPCD thresholds for these pollutants and therefore there would not be a significant contribution.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?*	☐	☐	☐	☒

Discussion: The proposed project would restore native species and riparian habitat at the site. After completion, the project would not affect the operational GHG emissions of any source locally or elsewhere in the state, nor would it conflict with any local or state plan, policy or regulation to reduce GHG emissions. No impact is expected to occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

BMP 10 -- Daily: Check wind speed/weather.

BMP 11 -- Daily: Check mixing and loading tanks, herbicide application equipment and other equipment for wear/tear, leaks.

BMP 12 -- Selective application techniques shall be used whenever practicable so that desirable vegetation is not adversely affected.

BMP 13 -- For directed foliar spray, provide selective control of vegetation by directing the application toward target species. The nozzle tip, pressure and sprayer configuration shall be such to produce a coarser droplet to minimize drift.

BMP 14 -- For cut stem treatments, apply the herbicide judiciously to the stump immediately after cutting.

BMP 15 -- Applications will not be performed when the National Weather Service forecasts a >70% probability of measurable precipitation (>0.25") within the next 24 hour period.

BMP 16 Applications will cease when wind speed measured on site exceeds 7 mph sustained.

BMP 17 -- The following special precautions must be observed during periods of inclement weather:

BMP 18 -- Applications must not be made in, immediately prior to, or immediately following rain when runoff could be expected.

BMP 19 -- Applications must not be made when wind and/or fog conditions have the potential to cause drift.

BMP 20 -- Basal bark applications must not be made when stems are wet.

BMP 21 -- The following minimum buffer widths from streams, wetlands and other sensitive habitat must be maintained: No buffer requirement for herbicides approved for aquatic use without surfactant; 100 foot buffer requirement for herbicides not approved for aquatic use.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?*	☐	☐	☒	☐

Discussion: Please see discussion under H-1 above. Project impacts would be considered less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
response plan or emergency evacuation plan?				

Discussion: The proposed project would not conflict with implementation of the County of Santa Cruz Local Hazard Mitigation Plan 2010-2015 (County of Santa Cruz, 2010). Therefore, no impacts to an adopted emergency response plan or evacuation Plan would occur from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
8. *Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?*	☐	☐	☐	☒

Discussion: The project would be located several miles upstream on/around San Vicente and Mill Creeks, surrounded by thousands of acres of open space land, with the closest residences being located on San Vicente St. (Davenport) and off of Via Venado and Bonny Doon/Thayer Roads (Bonny Doon). Project activities would not expose people or structures to risks involving wildland fires.

I. HYDROLOGY, WATER SUPPLY, AND WATER QUALITY

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Violate any water quality standards or waste discharge requirements?*	☐	☐	☐	☒

Discussion: The proposed project would not result in a significant change to post-construction stormwater runoff or impact how stormwater is handled. The project would not violate any water quality standards or wastewater discharge requirement, and with the following mitigation measure in place, no impact on water quality would occur.

Mitigation Measure HYD-1: Water Quality Avoidance and Minimization:

a) Ground based equipment will not operate during the winter period, which is October 15 to April 15.

b) Equipment will not operate within the channel zone.

c) All erosion control measures shall be installed as soon as practical following treatment and prior to the start of any rain which causes overland flow across or along the disturbed surface. All inactive areas (defined as a five-day period) will have all necessary soil stabilization practices in place two days after identification of inactivity and/or before a rain event, whichever comes first.

d) Any bare soil exceeding 100 contiguous square feet resulting from project activities will be treated with standard erosion control measures. Bare areas will be seeded, covered in jute netting or natural straw wattles will be placed depending on the slope and distance from waterways. Bare areas will also be replanted with local native species as necessary.

mats. No long-term effects would result. An erosion control plan would also be required per Section 16.22.060 of the County Code.

Mitigation Measure HYD-2: Minimizing Contaminants and Sediment Movement:

The following water quality protection and erosion and sediment control mitigation measures would be implemented, based on standard County requirements, to minimize construction-related contaminants and mobilization of sediment to San Vicente Creek in the project area.

The mitigation measures will be selected to achieve maximum sediment removal and represent the best available technology that is economically achievable and are subject to review and approval by the County. The County will perform routine inspections of the construction area to verify the mitigation measures are properly implemented and maintained. The County will notify contractors immediately if there is a noncompliance issue and will require compliance.

The mitigation measures will include, but are not limited to, the following.

- All mechanical earthwork involving rivers, ephemeral drainages, and culverts, will occur in the dry season (generally between June 1 and October 15).
- Equipment used in and around drainages and wetlands will be in good working order and free of dripping or leaking engine fluids. All vehicle maintenance will be performed at least 300 feet from all drainages and wetlands. Any necessary equipment washing will be carried out where the water cannot flow into drainages or wetlands.
- Exposed bare soil shall be treated to minimize soil erosion by planting and/or packing with mulch. In areas where, due to steepness of slope or lack of slash and debris, planting or mulching is not feasible, another method of effective erosion control will be implemented, such as applying erosion control blankets or installing wattles. For areas disturbed from May 1 to October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface that could deliver sediment into a watercourse or lake in quantities deleterious to the beneficial uses of water.
- An herbicide spill prevention plan is in-use on the property per the Property Management Plan – Herbicide Application Best Management Practices Table 7-1 (~~attached~~Attachment 7), and shall be followed during project activities.
- During initial treatments, research will involve understanding the biology of the pests, chemical and non-chemical options for controlling them, and any secondary effects of the control techniques. Non-chemical techniques to control invasive plants (cutting, digging, mowing) will be considered along with chemical methods (herbicides).

could release sediment and other pollutants that could migrate to surface waters. The grading and other activities would be required to perform under a SWPPP prepared in conformance with requirements of SWRCB's "General Permit for Discharges of Stormwater Associated with Construction Activities (General Permit)." The General Permit presents a very specific process for construction projects to comply with the CWA's provisions that relate to the control of pollutant discharge from "nonpoint" sources. The General Permit provides for compliance with the regulations through submittal of a Notice of Intent to comply with the format and content of the process developed for the General Permit, which includes development and implementation of a SWPPP.

Construction impacts on water quality would be minimized through implementation of a SWPPP. Also see discussion under I-3 above.

The town of Davenport uses San Vicente Creek and a stream diversion on Mill Creek as water sources for drinking water. Although the project will include light applications of herbicide and the clearing of areas that ~~will~~may require erosion control measures, all water supply intakes are located upstream of all project activities and will not affect water supply.

Impacts to water quality would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
7. *Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?*	☐	☐	☐	☒

Discussion: Although the project site is located within a 100-year flood hazard area as mapped on Flood Insurance Rate Map (FEMA 2013), implementation of the project would not involve placement of any new housing or structures within a 100-year flood hazard area. Therefore the project would have no impact on flood hazards associated with housing.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
8. *Place within a 100-year flood hazard area structures which would impede or redirect flood flows?*	☐	☐	☐	☒

Discussion: Although the project site is located within the 100-year floodplain, wetland restoration activities would not substantially impede or redirect flood flows as the culverts that carry flows west from the site would not be altered. Restoration and protection of wetland habitat within the project site would provide a beneficial impact on surrounding residences and agricultural fields by providing a designated wetland available to capture and store flood waters. Construction and operation of the proposed project would have no adverse impact on flood flows.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?				

Discussion: The proposed project would conform to the applicable land use plans, policies and regulations either through project design or with the implementation of mitigation measures. The project would be consistent with the applicable policies and objectives in the General Plan and would comply with all applicable zoning and land use ordinances in the SCCC. The project would not conflict with any regulations or policies adopted for the purpose of avoiding or mitigating an environmental effect. Impacts would be considered less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Conflict with any applicable habitat conservation plan or natural community conservation plan?*	☐	☐	☐	☒

Discussion: The project does not conflict with any applicable habitat conservation plans or natural community conservation plans. No impact would occur.

K. MINERAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?*	☐	☐	☐	☒

Discussion: The project does not entail the extraction of any mineral resources or the removal of any material other than nonnative invasive vegetation. Therefore, no impact is anticipated from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?*	☐	☐	☐	☒

Discussion: The project site is zoned.

L. NOISE

Would the project result in:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				

Discussion: The project area is not located within 2 miles of a public airport or in an area with an airport land use plan. Project activities would not expose people residing or working in the project area to excessive noise levels. No impact would occur.

6. *For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?*	☐	☐	☐	☒

Discussion: The proposed project is not within two miles of a private airstrip. Therefore, the proposed project would not expose people residing or working in the project area.

M. POPULATION AND HOUSING

Would the project:

1. *Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?*	☐	☐	☐	☒

Discussion: The proposed project would not induce substantial population growth in an area because the project does not propose any physical or regulatory change that would remove a restriction to or encourage population growth in an area. The project proposes only to restore wetland and riparian habitat and would not induce population growth. No impact would occur.

2. *Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?*	☐	☐	☐	☒

Discussion: The proposed project would not displace any existing housing. No impact would occur.

3. *Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?*	☐	☐	☐	☒

Discussion: The proposed project would not displace a substantial number of people since the project is intended to restore wetland and riparian habitat. No impact would occur.

Creek Clematis patch. Recreational use is not planned to occur in this part of the property in the future, therefore, the proposed project would not result in an increase in the use of this area, or any other existing neighborhood and regional parks.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?*	☐	☐	☐	☒

Discussion: The project as proposed does not include construction or expansion of recreational facilities, therefore, the project would have no impact on the environment as a result of constructing or expanding recreational facilities.

P. TRANSPORTATION/TRAFFIC

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?*	☐	☐	☐	☒

Discussion: The proposed project would not conflict with an applicable plan, ordinance or policy guiding transportation systems. The project requires daily access for work crews and intermittent access for groups of volunteers. Restoration ecologists and practitioners would access the site from Highway 1 to Old Cement Plant Road to Warrenella Road, then down to San Vicente Creek. Temporary traffic trips to the project site would be limited to a few trips a day at the peak. Therefore, project traffic would not impact traffic on Highway 1 or other roads in the vicinity of the project.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
sacred place, or object with cultural value to a California Native American tribe, and that is:				
A. Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources Code section 5020.1(k), or	☐	☐	☐	☒
B. A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.	☐	☐	☐	☒

Discussion: The project proposes to establish eradication of the invasive plant species *Clematis vitalba*. Section 21080.3.1(b) of the California Public Resources Code (AB 52) requires a lead agency formally notify a California Native American tribe that is traditionally and culturally affiliated within the geographic area of the discretionary project when formally requested. As of this writing, no California Native American tribes traditionally and culturally affiliated with the Santa Cruz County region have formally requested a consultation with the County of Santa Cruz (as Lead Agency under CEQA) regarding Tribal Cultural Resources. As a result, no Tribal Cultural Resources are known to occur in or near the project area. Therefore, no impact to the significance of a Tribal Cultural Resource is anticipated from project implementation.

R. UTILITIES AND SERVICE SYSTEMS

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒

Discussion: The proposed project would not generate wastewater. Therefore, wastewater treatment requirements would not be exceeded. No impacts would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
7. *Comply with federal, state, and local statutes and regulations related to solid waste?*	☐	☐	☐	☒

Discussion: The project would comply with all federal, state, and local statutes and regulations related to solid waste disposal. No impact would occur.

S. MANDATORY FINDINGS OF SIGNIFICANCE

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?*	☐	☒	☐	☐

Discussion: The potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory were considered in the response to each question in Section III (A through Q) of this Initial Study. Resources that have been evaluated as significant would be potentially impacted by the project, particularly Air Quality, Biological Resources, and Cultural Resources. However, mitigation has been included that clearly reduces these effects to a level below significance. These mitigation measures include best management practices to avoid air quality and water quality impacts, measures to avoid impacts to anadromous fish, California red-legged frogs, and nesting birds and measures to protect cultural resources in the event of a discovery. As a result of this evaluation, there is no substantial evidence that, after mitigation, significant effects associated with this project would result. Therefore, this project has been determined not to meet this Mandatory Finding of Significance.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Does the project have impacts that are individually limited, but cumulatively considerable? ("cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of*	☐	☐	☒	☐

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MITIGATION MONITORING AND REPORTING PROGRAM for San Vicente Creek Watershed Clematis Control Project Application Nos. 171089 September 11, 2017

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
Biological Resources					
BIO-1	*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 California Department of Fish and Wildlife, or U.S. Fish and Wildlife Service?*	**Herbicide Avoidance and Minimization Measures** 1. A 60-foot buffer zone adjacent to standing or flowing water would be established within which there would be no foliar application of herbicides. Within the 60-foot buffer, as well as areas greater than 60 feet from surface waters but where there is potential for herbicides to reach aquatic habitats via runoff or drift, only herbicides that pose low fish toxicity risks should be used such as aminopyralid (i.e. Milestone) or triclophyr amine (i.e. Garlon 3A), and they should be applied only by brushing directly onto stumps or via the basal bark or frill cut methods. Herbicides with high fish toxicity risks, such as Garlon 4, should not be used. 2. No herbicide shall be applied within 15 feet of aquatic features. 3. Herbicide use should strive to minimize risk to non-target aquatic organisms while providing the most effective control in and near aquatic environments, including restriction for use within buffer zones. 4. Herbicide applications should be conducted by a State of California Qualified Applicator or by staff under their supervision. Herbicides should not be applied within 24 hours of predicted rain events (40 percent chance or greater for rainfall) to reduce the potential for runoff of herbicides into surface water bodies. 5. Foliar application of herbicides or other spray application methods should not be applied when wind speeds exceed 10 miles per hour to reduce likelihood of drift into surface water bodies. 6. Herbicide applications should be conducted in accordance with the requirements of the herbicide product label, any property management plan, approved treatment plant, applicable best management practices, and any recommendation from a Department of Pesticide Regulation (DPR)-licensed pest control advisor. 7. Contractors should be DPR-licensed commercial applicators who have registered with the appropriate county agricultural commissioner's office. 8. Integrated Pest Management Approaches: Applicants would also use non-chemical methods such as hand pulling or chip deposition on seed stock to prevent seedling germination. 9. Drift from foliar application should be avoided by implementing measures, such as avoiding windy days (e.g., avoid spraying when wind speeds are more than 10 miles per hour) and using proper spraying techniques, and following all DPR regulations and product label prohibitions.	Applicant	Compliance monitored by the County Planning Department and approved Pest Control Adviser.	To be implemented prior to and during project construction.

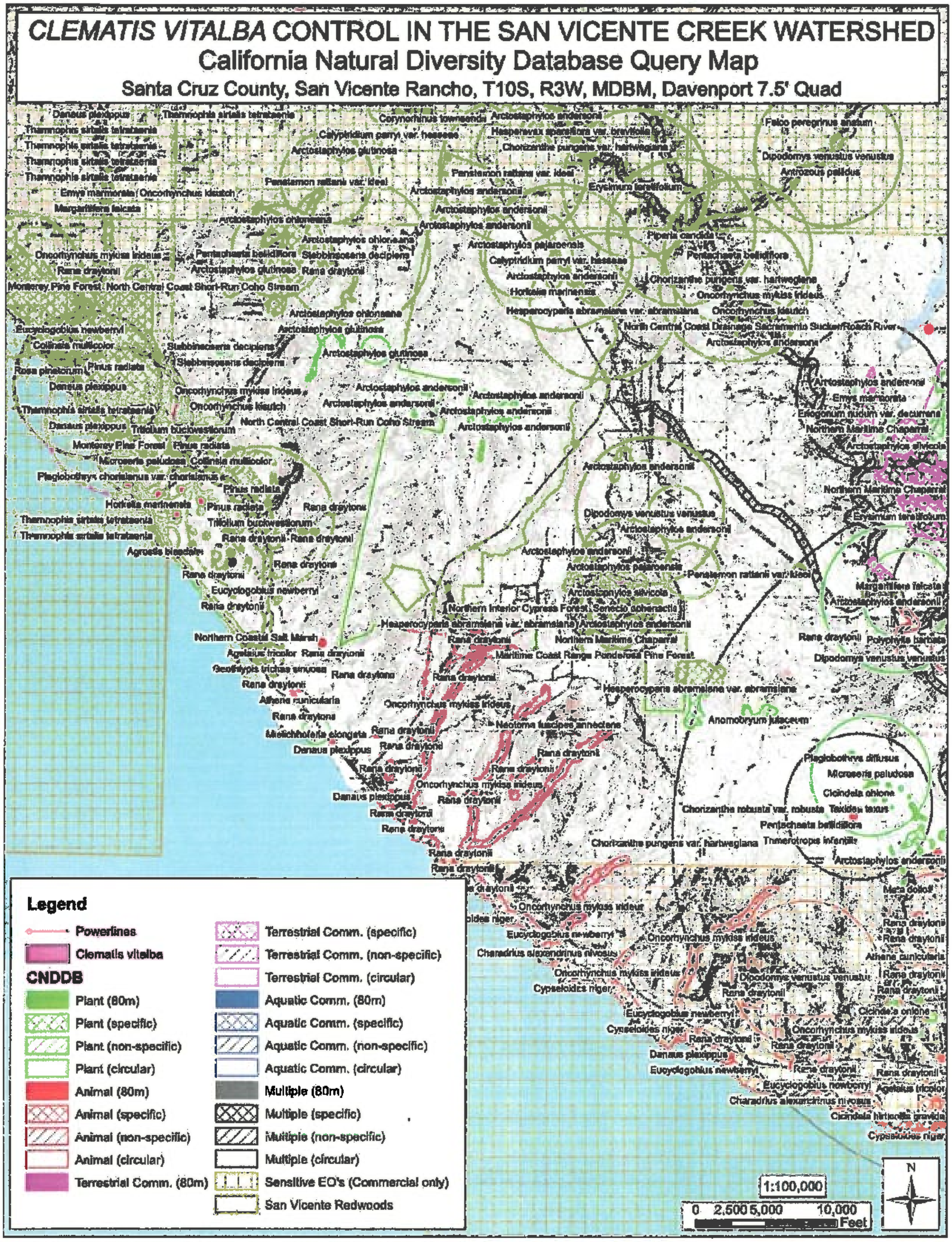
No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		www.suddenoakdeath.org. Restoration planting stock will be from a facility free of SOD. No host foliage will be brought to or removed from the project area.			
BIO-4		**California red-legged frog Mitigations:** 1. Prior to operations occurring in the wet season, a qualified biologist will conduct a biological resources education program for workers, and will remain on-site as a biological monitor for the duration of the project. The educational program will include a description of the California red-legged frog and its habitat, and the guidelines that must be followed by all project personnel to avoid take of the species. Educational programs will be conducted for new personnel before they join project activities. Color photographs will be used in the training session, and a qualified person will be on hand to answer questions. For purposes of protection of red-legged frogs, the wet season begins with the first frontal rain system depositing a minimum of 0.25 inches of rain after October 15 and ending on April 15. In the absence of rain events that total at least 0.25 inches as measured at the Ben Lomond rain gauge, wet season restrictions would nevertheless apply on November 30. 2. For wet-season operations, before project activities begin each day, a biological monitor will inspect under any equipment left overnight to look for California red-legged frogs. If a red-legged frog is found, the red-legged frog will not be relocated or captured, and all activities that could result in take will cease and the sighting will be reported to CDFW, USFWS, and the County of Santa Cruz, along with measures being implemented to avoid take of the individual. Activities related to the observation shall not commence until approved by the agencies. 3. A biological monitor will be on-site during all project activities, to ensure that there is no take of this species. If red-legged frogs are observed, work will immediately stop and the biological monitor will consult with CDFW, the U.S Fish and Wildlife Service and the County of Santa Cruz to determine when work can continue.	Applicant	Compliance monitored by the County Planning Department, USFWS and approved biologist.	To be implemented prior to and during project construction
BIO-5		**Western Pond Turtle Mitigations:** To avoid potential impacts to western pond turtles, at the beginning of each day before any equipment work a biological monitor will inspect under equipment to look for turtles. If a turtle is found, the turtle will not be relocated or captured, all activities that could result in take will cease and the sighting will be reported to CDFW and the County along with measures being implemented to avoid take of the individual.	Applicant	Compliance monitored by the County Planning Department and CDFW approved biologist.	To be implemented prior to and during project construction
BIO-6		**San Francisco Dusky-Footed Woodrat:** 1. In the event that a Woodrat nests are found in the project area, they will be flagged for avoidance with special treatment flagging.	Applicant	Compliance monitored by the County Planning Department and CDFW approved biologist.	To be implemented prior to and during project construction.
BIO-7		**Protection of Nesting Birds:**	Applicant	Compliance	To be implemented

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
	local or regional plans, policies, regulations (e.g., wetland, native grassland, special forests, intertidal zone, etc.) or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service			approved biologist.	
Cultural Resources					
CUL-1	*Cause a substantial adverse change in the significance of a historical resource as defined in CEQA Guidelines Section 15064.5?*	In order to avoid potential adverse impacts to the remains of the historic town of Bella Vista, the following mitigation shall be conducted. 1. Onsite training shall be conducted by a historian with expertise in the history of the town of Bella Vista and the associated quarry to educate the Clematis removal team on the history of the town. Education will also focus on the importance of preservation of the site in its current condition. The training shall inform the Clematis removal team that any artifacts discovered on the site shall not be disturbed and left as discovered. Care shall be taken no to impact any potential artifacts associated with the town of Bella vista during soil disturbance associated with Clematis removal. 2. Photo documentation of substantial artifacts discovered shall be submitted to the County Planning Department following the discovery. County Planning shall determine if any further action is required in order to avoid impacts to the resource during Clematis removal. 3. No staging for Clematis removal shall occur within the boundaries of the historic town of Bella Vista.	Applicant	Compliance monitored by the County Planning Department.	To be implemented prior to and during project construction
CUL-2	*Cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Guidelines Section 15064.5?*	Surveys for cultural resources shall continue during future fieldwork and monitoring activities. In order to protect any undiscovered cultural resources that may be located within the project area, the Forester or a designee with archaeological training will inspect the project area regularly during project implementation to determine if any artifacts are revealed. If a potentially significant archaeological site is discovered during project implementation, the following procedures apply: 1. The person who made the discovery shall immediately notify the Forester. 2. No treatment shall occur within 100 feet of the identified boundaries of the new site until the protection measures are proposed and agreed to. 4. A report shall be filed with a State Archaeologist. The minimum information provided shall include: a. A statement that the information is confidential. b. The mapped location of the site. c. A description of the site. d. Protection measures, and	Applicant	Compliance monitored by the County Planning Department and qualified archeologist.	To be implemented prior to and during project construction.

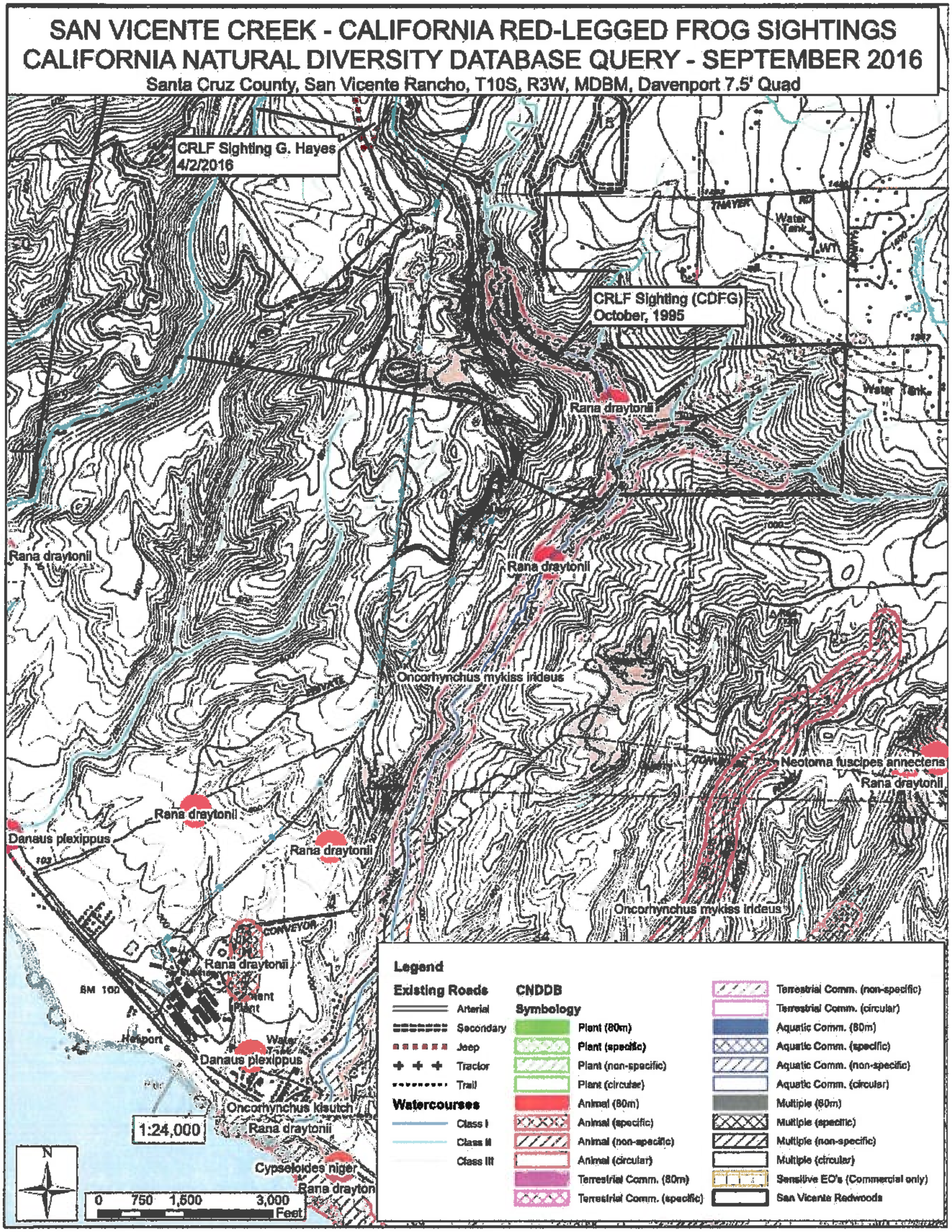
No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		water by accidental spills. 7. An Emergency Response Preparedness Plan, including a First Aid Kit will be on site. 8. Anyone who handles herbicides must participate in a training program that describe the materials used and the measures to follow, including Herbicide Spill Prevention and Emergency Response Preparedness, as well as site-specific considerations. 9. Identify the closest area of cell phone reception and familiarize all volunteers with that location. 10. Daily: Check wind speed/weather. 11. Daily: Check mixing and loading tanks, herbicide application equipment and other equipment for wear/tear, leaks. 12. Selective application techniques shall be used whenever practicable so that desirable vegetation is not adversely affected. 13. For directed foliar spray, provide selective control of vegetation by directing the application toward target species. The nozzle tip, pressure and sprayer configuration shall be such to produce a coarser droplet to minimize drift. 14. For cut stem treatments, apply the herbicide judiciously to the stump immediately after cutting. 15. Applications will not be performed when the National Weather Service forecasts a >70% probability of measurable precipitation (>0.25") within the next 24 hour period. 16. Applications will cease when wind speed measured on site exceeds 7 mph sustained. 17. The following special precautions must be observed during periods of inclement weather: 18. Applications must not be made in, immediately prior to, or immediately following rain when runoff could be expected. 19. Applications must not be made when wind and/or fog conditions have the potential to cause drift. 20. Basal bark applications must not be made when stems are wet. 21. The following minimum buffer widths from streams, wetlands and other sensitive habitat must be maintained: No buffer requirement for herbicides approved for aquatic use without surfactant; 100 foot buffer requirement for herbicides not approved for aquatic use.			
Hydrology, Water Supply, and Water Quality					
HYD-1	*Violate any water quality standards or waste discharge requirements?*	**Water Quality Avoidance and Minimization:** a. Ground based equipment will not operate during the winter period, which is October 15 to April 15. b. Equipment will not operate within the channel zone. c. All erosion control measures shall be installed as soon as practical following treatment and prior to the start of any rain which causes	Applicant	Compliance monitored by the County Planning Department, CDFW, NMFS, and applicant.	To be implemented prior to and during project construction.

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		wetlands. Any necessary equipment washing will be carried out where the water cannot flow into drainages or wetlands. • Exposed bare soil shall be treated to minimize soil erosion by planting and/or packing with mulch. In areas where, due to steepness of slope or lack of slash and debris, planting or mulching is not feasible, another method of effective erosion control will be implemented, such as applying erosion control blankets or installing wattles. For areas disturbed from May 1 to October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface that could deliver sediment into a watercourse or lake in quantities deleterious to the beneficial uses of water. • An herbicide spill prevention plan is in-use on the property per the Property Management Plan – Herbicide Application Best Management Practices Table 7-1 (attached), and shall be followed during project activities. • During initial treatments, research will involve understanding the biology of the pests, chemical and non-chemical options for controlling them, and any secondary effects of the control techniques. Non-chemical techniques to control invasive plants (cutting, digging, mowing, etc.) will be considered along with chemical methods (herbicides). • The landowners, stewardship volunteers, Property Manager, and/or Conservation Easement Holder will monitor sites to ascertain results of the management actions. • The effectiveness of the methods will be evaluated in light of the site goals, and this information will be used to modify and improve control priorities, methods and plans. Follow-up monitoring will be necessary to contain the spread of the invasive plant and then eradicate it completely from the site.			

Attachment 2



Attachment 3



Attachment 4

California Natural Diversity Database Query Results

Query Criteria: Imported file selection

Clematis Control in the San Vicente Creek Watershed

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Accipiter cooperii Cooper's hawk	ABNKC12040	None	None	G5	S4	WL
Adela oplerella Opler's longhorn moth	IILEE0G040	None	None	G2	S2	
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	Candidate Endangered	G2G3	S1S2	SSC
Agrostis blasdalei Blasdale's bent grass	PMPOA04060	None	None	G2	S2	1B.2
Amsinckia lunaris bent-flowered fiddleneck	PDBOR01070	None	None	G2G3	S2S3	1B.2
Anomobryum julaceum slender silver moss	NBMUS80010	None	None	G5?	S2	4.2
Antrozous pallidus pallid bat	AMACC10010	None	None	G5	S3	SSC
Arctostaphylos andersonii Anderson's manzanita	PDERI04030	None	None	G2	S2	1B.2
Arctostaphylos glutinosa Schreiber's manzanita	PDERI040G0	None	None	G1	S1	1B.2
Arctostaphylos ohloneana Ohlone manzanita	PDERI042Y0	None	None	G1	S1	1B.1
Arctostaphylos regismontana Kings Mountain manzanita	PDERI041C0	None	None	G2	S2	1B.2
Arctostaphylos silvicola Bonny Doon manzanita	PDERI041F0	None	None	G1	S1	1B.2
Ardea herodias great blue heron	ABNGA04010	None	None	G5	S4	
Arenaria paludicola marsh sandwort	PDCAR040L0	Endangered	Endangered	G1	S1	1B.1
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S3	SSC
Brachyramphus marmoratus marbled murrelet	ABNNN06010	Threatened	Endangered	G3G4	S1	
Calasellus californicus An isopod	ICMAL34010	None	None	G2	S2	
California macrophylla round-leaved filaree	PDGER01070	None	None	G3?	S3?	1B.2
Calyptridium parryi var. hesseae Santa Cruz Mountains pussypaws	PDPOR09052	None	None	G3G4T2	S2	1B.1
Campanula californica swamp harebell	PDCAM02060	None	None	G3	S3	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Erysimum teretifolium Santa Cruz wallflower	PDBRA160N0	Endangered	Endangered	G1	S1	1B.1
Eucyclogobius newberryi tidewater goby	AFCQN04010	Endangered	None	G3	S3	SSC
Eumetopias jubatus Steller (=northern) sea-lion	AMAJC03010	Delisted	None	G3	S2	
Euphilotes enoptes smithi Smith's blue butterfly	IILEPG2026	Endangered	None	G5T1T2	S1S2	
Falco peregrinus anatum American peregrine falcon	ABNKD06071	Delisted	Delisted	G4T4	S3S4	FP
Fissilicreagris imperialis Empire Cave pseudoscorpion	ILARAE5010	None	None	G1	S1	
Fritillaria agrestis stinkbells	PMLIL0V010	None	None	G3	S3	4.2
Geothlypis trichas sinuosa saltmarsh common yellowthroat	ABPBX1201A	None	None	G5T3	S3	SSC
Hesperevax sparsiflora var. brevifolia short-leaved evax	PDASTE5011	None	None	G4T3	S2	1B.2
Hesperocyparis abramsiana var. abramsiana Santa Cruz cypress	PGCUP04081	Threatened	Endangered	G1T1	S1	1B.2
Hesperocyparis abramsiana var. butanoensis Butano Ridge cypress	PGCUP04082	Threatened	Endangered	G1T1	S1	1B.2
Hoita strobilina Loma Prieta hoita	PDFAB5Z030	None	None	G2	S2	1B.1
Holocarpha macradenia Santa Cruz tarplant	PDAST4X020	Threatened	Endangered	G1	S1	1B.1
Horkelia cuneata var. sericea Kellogg's horkelia	PDROS0W043	None	None	G4T1?	S1?	1B.1
Horkelia marinensis Point Reyes horkelia	PDROS0W0B0	None	None	G2	S2	1B.2
Lasiurus cinereus hoary bat	AMACC05030	None	None	G5	S4	
Laterallus jamaicensis coturniculus California black rail	ABNME03041	None	Threatened	G3G4T1	S1	FP
Limnanthes douglasii ssp. sulphurea Point Reyes meadowfoam	PDLIM02038	None	Endangered	G4T1	S1	1B.2
Lytta moesta moestan blister beetle	IICOL4C020	None	None	G2	S2	
Malacothamnus arcuatus arcuate bush-mallow	PDMAL0Q0E0	None	None	G2Q	S2	1B.2
Margaritifera falcata western pearlshell	IMBIV27020	None	None	G4G5	S1S2	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Pentachaeta bellidiflora white-rayed pentachaeta	PDAST6X030	Endangered	Endangered	G1	S1	1B.1
Philanthus nasalis Antioch specid wasp	IIHYM20010	None	None	G1	S1	
Pinus radiata Monterey pine	PGPIN040V0	None	None	G1	S1	1B.1
Piperia candida white-flowered rein orchid	PMORC1X050	None	None	G3	S3	1B.2
Plagiobothrys chorisianus var. chorisianus Choris' popcornflower	PDBOR0V061	None	None	G3T2Q	S2	1B.2
Plagiobothrys diffusus San Francisco popcornflower	PDBOR0V080	None	Endangered	G1Q	S1	1B.1
Polygonum hickmanii Scotts Valley polygonum	PDPGN0L310	Endangered	Endangered	G1	S1	1B.1
Polyphylla barbata Mount Hermon (=barbate) June beetle	IICOL68030	Endangered	None	G1	S1	
Rana draytonii California red-legged frog	AAABH01022	Threatened	None	G2G3	S2S3	SSC
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S2	
Rosa pinetorum pine rose	PDROS1J0W0	None	None	G2	S2	1B.2
Senecio aphanactis chaparral ragwort	PDAST8H060	None	None	G3	S2	2B.2
Sidalcea malachroides maple-leaved checkerbloom	PDMAL110E0	None	None	G3	S3	4.2
Silene verecunda ssp. verecunda San Francisco campion	PDCAR0U213	None	None	G5T2	S2	1B.2
Speyeria adiaste adiaste unsilvered fritillary	IILEPJ6143	None	None	G1G2T1	S1	
Stebbinsoseris decipiens Santa Cruz microseris	PDAST6E050	None	None	G2	S2	1B.2
Stuckenia filiformis ssp. alpina slender-leaved pondweed	PMPOT03091	None	None	G5T5	S3	2B.2
Stygobromus mackenziei Mackenzie's Cave amphipod	ICMAL05530	None	None	G1	S1	
Taxidea taxus American badger	AMAJF04010	None	None	G5	S3	SSC
Thamnophis sirtalis tetrataenia San Francisco gartersnake	ARADB3613B	Endangered	Endangered	G5T2Q	S2	FP
Trifolium buckwestiorum Santa Cruz clover	PDFAB402W0	None	None	G2	S2	1B.1

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Table 2: Special-status Vascular Plant Species with Potential to Occur in San Vicente Creek Watershed Clematis Control Project

Species Name, Common Name	Federal/State-listing, CA Rare Plant Rank	Habitat Preferences, Elevation	Phenology, Life Form	Local Distribution	Potential for Occurrence, Presence
Amsinckia lunaris bent-flowered fiddleneck	None/None 1B.2	Steep slopes, openings in coastal scrub, oak woodland, grassland. 50-800 m.	Mar-June Annual herb	Occurs in Scott Creek watershed and Swanton area (coastal slope) on Cal Poly land.	Not likely. Not observed.
Arabis blepharophylla coast rockcress	None/None 4.3	Rocky outcrops, slides. 3-1100 m.	Feb-May Perennial herb	Occurs at Eagle Rock.	Not likely. Not observed.
Arctostaphylos andersonii Anderson's manzanita	None/None 1B.2	Openings and edges of redwood or mixed-evergreen forest, chaparral. 60-792 m.	Nov-May Evergreen shrub	Santa Cruz Mtns. endemic. Suitable habitat present.	Possible. Not observed.
Arctostaphylos silvicola Bonny Doon manzanita	None/None 1B.2	Inland marine sands (Zayante series) in conifer forest, maritime chaparral. 120-600 m.	Feb-Mar Evergreen shrub	Large population at Bonny Doon Ecological Reserve.	Not likely. Not observed.
Calandrinia breweri Brewer's calandrinia	None/None 4.2	Disturbed sites, burned areas, grassy slopes, chaparral, Monterey pine forest. < 1200 m.	Feb-May Annual herb.	Occurs at Big Basin Redwoods State Park and probably elsewhere.	Possible. Not observed.
Calyptridium parryi* var. *hesseae Santa Cruz Mountains pussypaws	None/None 1B.1	Sandy or gravelly openings in chaparral, woodland, forest. Fire-follower. 305-1530 m.	May-Aug Annual herb	Documented near Eagle Rock, though not documented since the 1950s.	Not likely. Not observed.
Carex saliniformis deceiving sedge	None/None 1B.2	Wet openings in coastal prairie, coastal scrub, in redwood/mixed-evergreen forest or oak woodland. 3-230 m.	June-July Perennial rhizomatous herb	Laurel and Felton quad occurrences extirpated; rediscovered in a seep under redwood and live-oak in UCSC upper campus (Felton quad). Suitable habitat present.	Possible. Not observed.

Table 2: Special-status Vascular Plant Species with Potential to Occur in San Vicente Creek Watershed Clematis Control Project

Species Name, Common Name	Federal/State-listing, CA Rare Plant Rank	Habitat Preferences, Elevation	Phenology, Life Form	Local Distribution	Potential for Occurrence, Presence
Erysimum teretifolium Santa Cruz wallflower	Federally and State-Endangered 1B.1	Sandy openings (Zayante series) in maritime chaparral, understory of ponderosa pine forest. 120-610 m.	Mar-July Perennial herb	Occurs at Bonny Doon Ecological Reserve.	Not likely. Not observed.
Hesperocyparis abramsiana* var. *abramsiana Santa Cruz cypress	Federally and State-Endangered 1B.2	Sandstone or granitic-derived soils in maritime chaparral, knobcone-pine forest. 280-800 m.	Evergreen tree	Stands at Bonny Doon Ecological Reserve and Eagle Rock and individual trees along Empire Grade.	Possible. Not observed.
Horkelia marinensis Point Reyes horkelia	None/None 1B.2	Coastal prairie or openings in oak woodland/mixed evergreen forest. 5-755 m.	May-Sep Perennial herb	Suitable habitat present.	Possible. Not observed.
Hosackia gracilis harlequin lotus	None/None 4.2	Ditches, wet areas in meadows. < 700 m.	Mar-July Perennial herb	Occurs at Bonny Doon Ecological Reserve.	Possible. Not observed.
Leptosiphon grandiflorus large-flowered leptosiphon	None/None 4.2	Sandy soil, open grassy flats. < 1200 m.	Apr-July Annual herb	Occurs off of Smith Grade in Bonny Doon area. Local plants appear to belong to unnamed subspecies.	Possible. Not observed.
Micropus amphibolus Mt. Diablo cottonweed	None/None 3.2	Openings on slopes, ridges, shallow soils. 40-900 m.	Mar-June Annual herb	Occurs in Swanton area (coastal slope). Suitable habitat present.	Possible. Not observed.

Table 2: Special-status Vascular Plant Species with Potential to Occur in San Vicente Creek Watershed Clematis Control Project

Species Name, Common Name	Federal/State-listing, CA Rare Plant Rank	Habitat Preferences, Elevation	Phenology, Life Form	Local Distribution	Potential for Occurrence, Presence
Pentachaeta bellidiflora white-rayed pentachaeta	Federally and State Endangered 1B.1	Dry, rocky slopes, grassy areas. < 620 m.	Mar-May Annual herb	Occurs at Eagle Rock. Last documented in 1955. At southern edge of range.	Possible. Not observed.
Pinus radiata Monterey pine	None/None 1B.1	Closed-cone coniferous forest, woodland. 25-185 m.	Evergreen tree	Native stands occur at Swanton and Ano Nuevo.	Only planted Monterey pine observed.
Piperia candida white-flowered rein orchid	None/None 1B.2	Open or shaded sites in mixed-evergreen/ redwood forest. < 1500 m.	Mar-Sep Perennial herb	Occurs near Pine Mtn. at Big Basin Redwoods S.P.	Possible. Not observed.
Plagiobothrys chorisianus* var. *chorisianus Choris's popcorn-flower	None/None 1B.2	Moist depressions, coastal prairie, cha-parral, coastal scrub. < 200 m.	Mar-June Annual herb	Occurs in Scott Creek watershed/Swanton (coastal slope) area.	Possible. Not observed.
Plagiobothrys chorisianus* var. *hickmanii Hickman's popcorn-flower	None/None 4.2	Moist depressions, sandy deposits over clay pans. < 200 m.	Apr-July Annual herb	Not likely.	Possible. Not observed.
Plagiobothrys diffusus San Francisco popcorn-flower	None/State-listed Endangered 1B.1	Moist depressions, seeps in coastal prairie/annual grassland. 30-150 m.	Apr-June	Occurs in Scott Creek watershed.	Not likely. Not observed.

Attachment 6:

Protection of California Red-legged Frog from Pesticides

Back to Endangered Species Project

Stipulated Injunction and Order

Background

On October 20, 2006, the U.S. District Court for the Northern District of California imposed no-use buffer zones around California red-legged frog upland and aquatic habitats for certain pesticides. This injunction and order are part of a settlement reached between U.S. EPA, CropLife America, American Forest and Paper Association, Western Plant Health Association, Oregonians for Food and Shelter, and Syngenta Corporation as co-defendants, and the Center for Biological Diversity as the plaintiff.

The suit by the Center for Biological Diversity alleged that U.S. EPA failed to solicit U.S. Fish & Wildlife Service (FWS) formal consultation on the risks of 66 pesticides to California red-legged frog (CRLF).

This injunction and order will remain in effect for each pesticide listed below until EPA goes through formal 7(A)(2) consultation with FWS on each of the 66 active ingredients, and FWS issues a Biological Opinion including a "not likely to adversely affect" statement for the pesticides. Each pesticide in turn will be removed from the list, as this occurs.

Pesticide Use Restrictions Now Required
Under the injunction and order, no-use buffer zones of 60 feet for ground applications and 200 feet for aerial applications apply from the edge of the following California red-legged frog habitats as defined by the U.S. Fish & Wildlife Service and the Center for Biological Diversity: Aquatic Feature, Aquatic Breeding Habitat, Non- Breeding Aquatic Habitat, and Upland Habitat (details on these habitats are given in a Powerpoint Presentation following the list of prohibited active ingredients). These CRLF habitats are found in 33 counties of California link to map, PDF (455 kb).
The active ingredients for which the no-use buffer zones apply are the following:

2,4-D	Endosulfan	Myclobutanil	Thiobencarb
Acephate	EPTC	Naled	Tribufos (DEF)
Alachlor	Esfenvalerate	Norflurazon	Triclopyr
Aldicarb	Fenamiphos	Oryzalin	Trifluralin
Atrazine	Glyphosate	Oxamyl	Vinclozolin
Azinphos-methyl	Hexazinone	Oxydemeton-methyl	Ziram
Bensulide	Imazapyr	Oxyfluorfen	
Bromacil	Iprodione	Paraquat dichloride	
Captan	Linuron	Pendimethalin	
Carbaryl	Malathion	Permethrin	

Attachment 7: Herbicide Application Best Management Practices

TABLE 7-1
HERBICIDE APPLICATION BEST MANAGEMENT PRACTICES

BMP 1	Conduct a review of the CNDDB and identify sensitive natural resources within the project including but not limited sensitive plants, habitats, animals or riparian areas.
BMP 2	Conduct on-site field evaluations. Review riparian areas and appropriateness of various herbicide treatments.
BMP 3	Identify avoidance areas such as sensitive species locale(s), buffer zones and other potential constraints using flagging or some other field identification method.
BMP 4	Determine best timing of treatments and schedule based on site-specific locale.
BMP 5	Develop an Herbicide Spill Prevention Plan.
BMP 6	Designate routes of travel, water sources and mixing sites. A Spill Kit must be on-site. These actions will reduce the risk of contamination of water by accidental spills.
BMP 7	An Emergency Response Preparedness Plan, including a First Aid Kit will be on site.
BMP 8	Anyone who handles herbicides must participate in a training program that describe the materials used and the Best Management Practices to follow, including Herbicide Spill Prevention and Emergency Response Preparedness, as well as site-specific considerations.
BMP 9	Identify the closest area of cell phone reception and familiarize all volunteers with that location.
BMP 10	Daily: Check wind speed/weather.
BMP 11	Daily: Check mixing and loading tanks, herbicide application equipment and other equipment for wear/tear, leaks.
BMP 12	Selective application techniques shall be used whenever practicable so that desirable vegetation is not adversely affected.
BMP 13	For directed foliar spray, provide selective control of vegetation by directing the application toward target species. The nozzle tip, pressure and sprayer configuration shall be such to produce a coarser droplet to minimize drift.
BMP 14	For cut stem treatments, apply the herbicide judiciously to the stump immediately after cutting.
BMP 15	Applications will not be performed when the National Weather Service forecasts a >70% probability of measurable precipitation (>0.25") within the next 24 hour period.
BMP 16	Applications will cease when wind speed measured on site exceeds 7 mph sustained.
BMP 17	The following special precautions must be observed during periods of inclement weather:
BMP 18	Applications must not be made in, immediately prior to, or immediately following rain when runoff could be expected.
BMP 19	Applications must not be made when wind and/or fog conditions have the potential to cause drift.
BMP 20	Basal bark applications must not be made when stems are wet.
BMP 21	The following minimum buffer widths from streams, wetlands and other sensitive habitat must be maintained: No buffer requirement for herbicides approved for aquatic use without surfactant 100 foot buffer requirement for herbicides not approved for aquatic use

Source: San Vicente Redwoods Management Plan, Chapter 7 (ESA, 2015).

San Vicente Creek Watershed

Plan for Salmonid Recovery

Prepared February 2014

Contents

Fisheries Service (NMFS), California Department of Fish and Wildlife (DFW) and both the Trust for Public and the U.S. Bureau of Land Management since 2005 on a variety of projects and efforts to increase habitat complexity in San Vicente Creek with the goal of improving survival rates of coho salmon and steelhead at all life stages. Efforts to date have included enhancement and restoration of two backwater ponds that were built on footprints of historic agricultural ponds within San Vicente's floodplain for the purpose of creating winter high-flow refugia and installation of eight large woody debris structures to increase instream habitat complexity and encourage floodplain connectivity. In addition, limited cape ivy (*Delairea odorata)* removal has occurred to encourage the presence of more robust and diverse floral communities and to facilitate natural scour and deposition in floodplains.

While significant traction, action and interest in San Vicente Creek clearly exists, much of the past fisheries restoration and recovery work has happened in an ad-hoc fashion without the support of a larger guiding plan that brings together all of the existing data on the physical and biologic process at play, provides new data to fill known information gaps, and provides a scientifically defensible plan for future recovery actions.

To address this need, the RCD, with funding from the DFW's Fisheries Restoration Grants Program, have partnered with local technical experts to develop a watershed assessment that will culminate in a single regional repository of existing data on priority resources (biological, physical, and socio-economic) and a Restoration Action Plan for Salmonid Recovery for the watershed. The technical focus of this effort is on the fresh-water habitats that support the critical life history stages from spawning adults to outmigrant smolts. This planning effort includes the following components: a summary of historic data on watershed conditions related to salmonid recovery; 4 new assessments focused on known data gaps and potential limiting factors; and a final Restoration Action Plan with specific recommendations based synthesis of the existing data and new assessments. The following document represents the first and second of these efforts and synthesizes the historic and existing, available information on key resources that influence the opportunities and constraints to salmonid recovery in this watershed. The Final Restoration Action Plan will be informed by the historic data, findings from the new assessments (including a geomorphic assessment, a fisheries assessment and a large woody debris and invasive species assessment) and public review and input on by two stakeholder groups: our Local Watershed Steering Committee (a group of interested local stakeholders, large land-holders and local technical experts) and the IWRP Technical Advisory Committee (composed of techincal specialists from our state, federal and local resource agencies). In addition to providing peer review, these two stakeholder groups have provided significant support on identifying and gathering existing reports and data as well as outreach and liaison with the larger community. Please reference the Acknowledgements section for a list of participants from our Local Watershed Steering Committee and the Technical Advisory Committee.

Note that the bulk of this effort will focus on the areas of the watershed with direct influence on the anadromous stream reaches and floodplain as well as the factors directly and indirectly affecting salmon recovery and restoration of natural stream processes. This effort does not aim to evaluate the watershed in its entirety and review resources and issues that are not relevant to salmonid recovery.

Chapter 1: Primer for San Vicente Creek Watershed

REPORT OVERVIEW

The first chapter of this report is meant to provide the reader with a basic primer on the geography, climate, biological resources, and past and present land-uses within the watershed. Subsequent chapters build on this primer and provide more detailed assessments of key physical and biological data. The focus and scope of these assessments was developed collaboratively between the project team and staff from California Department of Fish and Wildlife (DFW) and National Marine Fisheries Service (NMFS). As such, they specifically address a subset of known data gaps (e.g. peak and baseflow hydrology data) and a list of potential limiting factors developed over years of local observation (e.g. floodplain connectivity and gravel availability). These assessments not only reflect a comprehensive analysis of existing data, but synthesize extensive new data collected through this effort on the hydrology, geomorphology, fisheries resources, large woody debris loading and recruitment potential, and mapping of invasive flora. Collectively, chapters 1–6 provide the scientific basis and foundation upon which specific recommendations for recovery actions are based (see chapter 7) and provide a new baseline dataset of existing conditions upon which a host of future analyses can and should be founded.

GEOGRAPHY

Located in the Santa Cruz Mountains, 9 miles north of the City of Santa Cruz, San Vicente Creek watershed drains an 11.1 square mile area (NMFS, 2008). Its headwaters are located at an elevation of approximately 2,600 feet at Camp Ben Lomond and its main stem flows for about 9.3 miles under Highway 1 and the railroad tunnel before entering the Monterey Bay National Marine Sanctuary and Pacific Ocean just south of the town of Davenport. The 11.1 square mile watershed also includes 11.3 miles of tributary streams (DFG, 1996), the most significant of which is Mill Creek (Weppner, et al., 2009). Approximately 2.5 miles of the main stem channel (San Vicente Creek) and 0.25 miles of tributaries (see Figure 1-1 and 1-2) are thought to be potentially usable coho rearing habitat (CDFG, 1998).

CLIMATE

Mean annual rainfall in the watershed ranges from about 24 inches at the mouth to upwards of 60 inches in the headwaters along Empire Grade (CDFG, 1988). The geology and precipitation are such that San Vicente Creek sustains summer minimum baseflows of about 1 cubic feet per second (cfs) in nearly all years—a large flow by regional standards and a critically-impor-

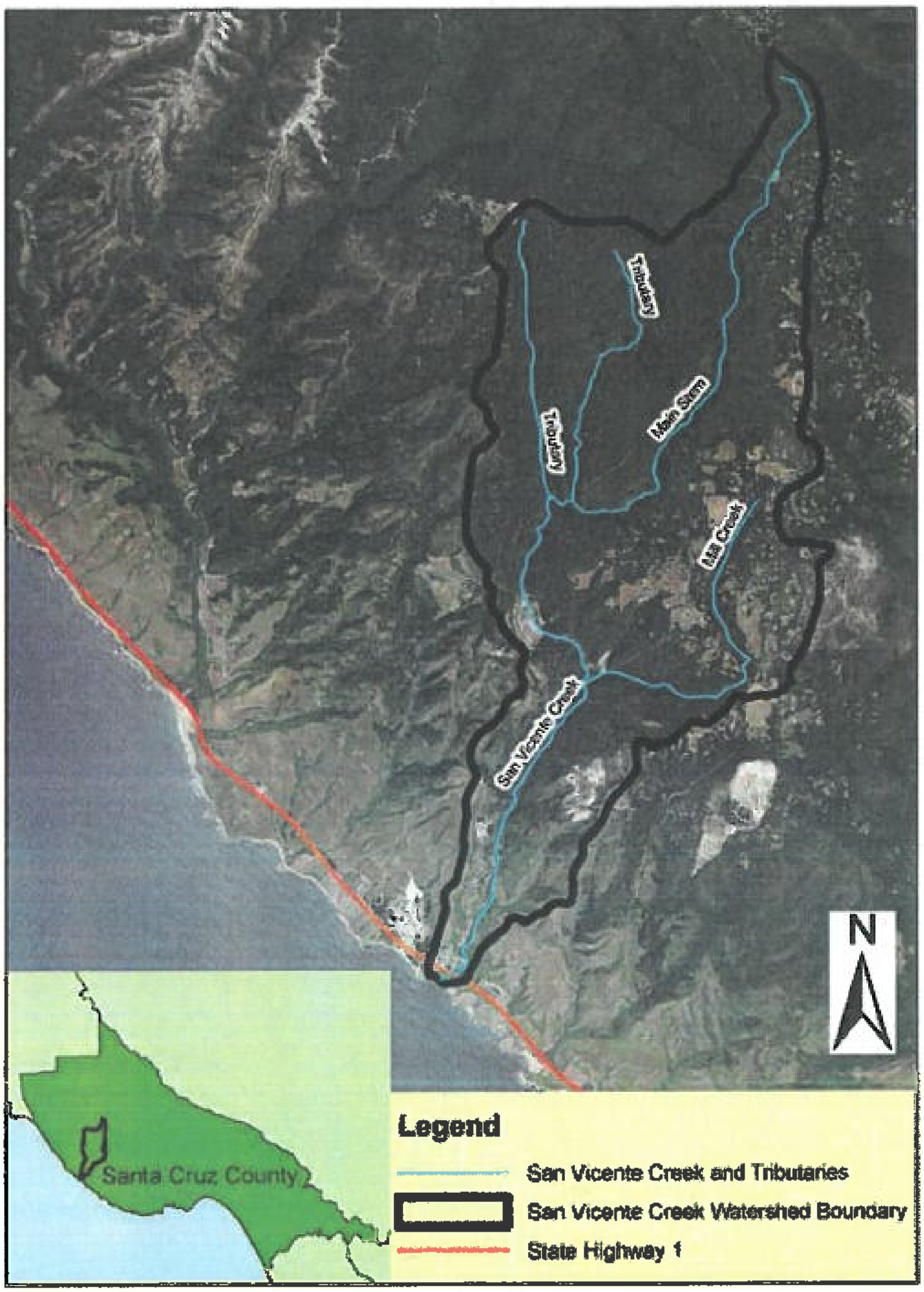


Figure 1-1.SanVicente

tant attribute in restoring coho salmon and steelhead populations (Balance Hydrologics, 2008).

Extreme weather events throughout the region have had significant effects on the vegetative makeup, stream flow and morphology of San Vicente Creek (Smith, pers. comm.). In the late 1970s, persistent drought conditions resulted in high willow mortality within San Vicente Creek's riparian corridor (Heady, pers. comm.). In the winter of 1982-83, Santa Cruz County received 25 inches of precipitation in a single storm (Griggs and Haddad, 2011). The storm, noted as a 100-year storm event, downed the majority of alders located in the lower watershed (Smith, pers. comm.). Additionally, a landslide caused by the storm forced a portion of the San Vicente Creek channel to migrate to the west, creating both a new channel and a long-term source of sediment deposited within the natural floodplain. While riparian and floodplain disturbance is common and a critical component of most healthy stream systems, disturbance that creates open ground, whether through natural or anthropogenic activities, tend to reduce native vegetative diversity by facilitating the spread of invasive non-native species such as cape ivy (ESA, 2001). This problem is pronounced in the lower reaches of San Vicente Creek. Chapter 6 provides an assessment of the current extent of cape ivy and other invasive species in the watershed.

GEOLOGY

San Vicente Creek is characterized by steep bedrock uplands leading to sequences of elevated marine terraces (Weppner et al., 2009). The bedrock is primarily a mix of granite and limestone, creating karst geology (formed from the dissolution of soluble rocks in limestone, dolomite and gypsum) unique within the region. Karst geomorphic features found in the watershed impact groundwater recharge as karst processes develop zones of enhanced porosity creating an aquifer system with rapid rates of recharge (Tihansky and Knochenmus, 2003). The karst geology significantly regulates water quantity and temperature in the middle and lower reaches of San Vicente Creek through processes of deep percolation into limestone and upwelling of cold groundwater through multiple springs that feed the stream with a perennial source of cool water. Chapter 3 provides a detailed description of the watershed geology and builds on this information with new data and analysis to better understand the role of natural geologic formations on sediment inputs, stream substrate, and the volume, seasonality and temperature of instream flow.

VEGETATION COMMUNITIES

Although redwood forest dominates the watershed, the lower reaches of the creek support a narrow riparian zone that is predominantly alders *(Alnus spp.)* and willows *(Salix spp.)*. The upper reaches are home to some of the most valuable timber stands in all of Santa Cruz County (ESA, 2001). Seventeen native vegetative communities and three communities dominated by introduced non-native species have been documented throughout the Coast Dairies Property, which extends three miles inland from the coast and comprises nearly 7,000 acres within San Vicente Creek watershed (ESA, 2001). Non-native plant species have established a presence in every vegetative community throughout the watershed including but not limited to iceplant *(Carpobrotus edulis)*, Italian rygrass *(Lolium multiflorum)*, French broom *(Genista monspessulana)*, Pampass grass *(Cortaderia selloana)* and Cape ivy *(Delairea odorata)* (ESA, 2001). Neighbors living on San Vicente Street have noted removal of cape ivy as a key action for watershed recovery in the area due to the species highly invasive nature and long-term threats to salmonid habitat (Heady, pers. comm.). Chapter 6 of this report provides a comprehensive assessment of invasive plant species with a particular emphasis on distribution and impacts from cape ivy and Chapter 5 provides a comprehensive assessment of riparian conditions as they relate to current and future recruitment of large woody debris into the system.

FISH AND WILDLIFE

Salmonids

As anadramous fish species, both steelhead and coho utilize freshwater for mating/spawning, egg development and early maturation and move to the ocean for a period of rapid growth and weight gain prior to returning to freshwater to spawn. The life cycle begins with the development of eggs into young fish in freshwater streams. Once the eggs hatch, young fish develop in the watercourse and gradually make their way to the ocean. Steelhead trout in this area typically spend two years in fresh water although a few may spend additional years inland before migrating out to sea. The length of time spent in streams depends on environmental and genetic factors, and some individuals never migrate (Barnhart, 1986). Research by Smith (2005) suggests that one of the key environmental factors may be food supply and growth. According to these data, size is a critical factor in determining when a juvenile steelhead will leave freshwater, and once juveniles reach approximately 3.5 inches in forklength by the fall, they tend to outmigrate the following spring. In order to acclimate to saltwater, both steelhead and coho go through a process of smoltification prior to entering the ocean and juvenile fish leaving freshwater are referred to as smolts. Steelhead and coho along the California coast usually spend two years in salt water, attaining sexual maturity and storing fat for their journey back up their natal streams to spawn and restart the life cycle process. While females of both species and most males usually spend two years in the ocean, a portion of male coho, called jacks, are known to return to freshwater after 1 year in the ocean. Due to the abundance of food, anadromous fish species experience most of their growth once they have reached the ocean. Therefore, jacks are generally identified due to their smaller size and weight. While there are many similarities in the life cycle for these species, there are some key differences that should be highlighted. These include:

» **Timing of adult return to freshwater and spawning:** Coho are known to return to their natal streams in the southern portion of the ESU between November

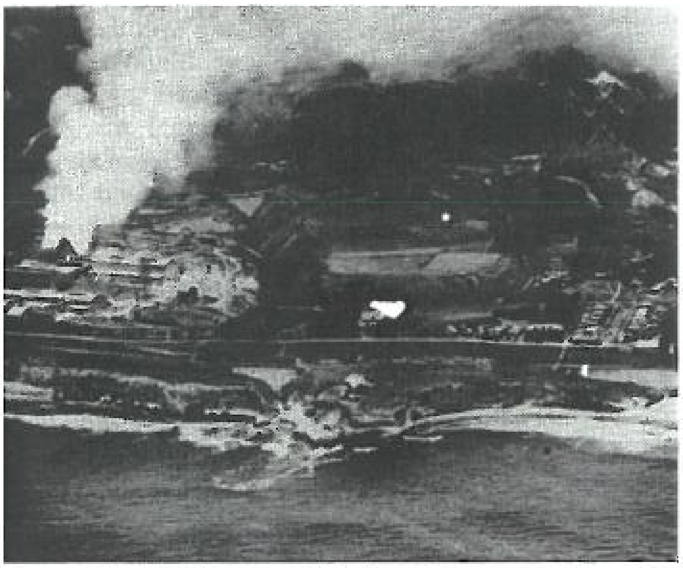


Figure 1-3. Ariel view of Davenport and the Santa Cruz Portland Cement Company.

LAND USE—PAST AND PRESENT

San Vicente Creek watershed has seen a variety of high and low impact land-use over the past 150 years including logging, selective timber harvesting, quarrying, mining, irrigated agriculture, ranching and urbanization. All of these land uses have had direct and indirect impacts on stream habitat and the forces that create and sustain habitat diversity and complexity.

Evidence of historic logging activities has been documented in San Vicente Creek watershed (ESA, 2001) and associated impacts (reduced large woody debris recruitment, road construction and increased sediment loading) have been identified as a threat to multiple life stages of salmonids (Santa Cruz County, 2009). Previously uncut stands of redwood forest were almost completely clear-cut in the watershed between 1870 and 1923. While the robust logging economy provided economic advantages of employment and revenue for the region, clear-cutting of the watershed resulted in significant changes to run-off, debris loading, sediment dynamics, and a host of other natural processes necessary for supporting a self-sustaining salmonid fishery in San Vicente Creek as well as neighboring creeks.

In the early 1900s the arrival of the Santa Cruz Portland Cement Company (see aerial view of cement plant in the left of Figure 1-3) ushered in a new era of land use throughout San Vicente Creek watershed. Rich deposits of limestone buried beneath the earth fueled a thriving cement industry that fueled the local economy for nearly 100 years. In the early 1900s a dam, 90 foot vertical shaft, and tunnel were installed in the upper reach of San Vicente Creek to force surface water down into the tunnel, away from quarry operations. In the early 1920s, the tunnel was expanded to allow a train to stop under the quarry floor so that limestone could be loaded into railcars. While the train was in operation, San Vicente Creek flowed on one side of the tunnel with train tracks on the other (Hamey, pers. comm.). The tunnel (and its associated vertical shaft), located at stream mile 3.4, is still present today and creates an impassable barrier to fish that has completely eliminated fish passage to approximately 50% of the upper San Vicente Creek watershed (Santa Cruz County, 2009).


Figure 1-4. San Vicente Creek tunnel under Highway 1.

In 1906 consistent access for people and goods to San Vicente Creek watershed was established through the construction of the Southern portion of the Ocean Shore Railroad which linked Davenport with Santa Cruz. While the rail system in Santa Cruz proper was built in 1876, the connection to the North Coast was not completed until 1906 (Hamman, 1996). As part of construction of the railroad, the lower reach of San Vicente Creek was redirected through a tunnel dug through bedrock (see Figure 1-4), bypassing a historic lagoon and sending the stream directly into the Pacific Ocean. While the tunnel allows year-round access to San Vicente Creek for migrating salmon, the loss of the lagoon eliminated an important element for both salmon and other estuarine dependent species (Becker, 2010). After 1906, salmonids in San Vicente Creek that had previously migrated freely up and down the streams were channeled through tunnels and in some places confronted with new obstructions that they could not pass (ESA, 2001). As such, the combination of intensive upland land uses and lower watershed infrastructure set in motion a number of human induced factors that appear to have impacted salmonid habitat quality and quantity in the watershed.

Timber harvesting, water diversions, and rural residential development occur in the upper watershed. Open pit mining historically occurred in the upper watershed, but was recently terminated. Cattle grazing and agricultural water diversions historically occurred in the lower watershed but were gradually phased out over the past decade. Currently, dominant land-use within the watershed includes residential (more densely populated directly adjacent to the town of Davenport), two quarries located on Mill Creek and one of the unnamed tributaries to San Vicente Creek (County of Santa Cruz County, 2012), logging, agriculture along the coast, grazing and open space, with the dominant land-use being timber. The cement plant, and associated quarry lands, changed ownership a number of times (most recently CEMEX) before

Chapter 2: Hydrology

OBJECTIVES

When thinking about recovery of salmonids, water is the fundamental resource that needs to be understood and evaluated. While summer baseflow deficit is considered a critical limiting factor in nearly every salmonid watershed south of the Golden Gate, National Oceanic and Atmospheric Association's (NOAA) 2012 Recovery Plan (NOAA, 2012) does not highlight instream flow impacts as a major threat to recovery in San Vicente Creek based on the number and magnitude of diversions and the high levels of cool baseflows observed throughout the summer in most years. Based on this context, the primary objective of the hydrologic assessment was to verify and quantify the existing hydrologic characteristics and restoration opportunities which currently or could in the future have a positive impact to coho salmon (*Oncorhynchus kisutch*) or steelhead trout (*Oncorhynchus mykiss*) habitat in San Vicente Creek. To address this objective, Balance Hydrologics (Balance) designed the hydrologic assessment with five key questions in mind:

1. What are the sources and rates of low-flows to the mainstem San Vicente Creek? What is the quality of the sources?
2. What are rates and the sources of low flows to San Vicente Creek? How do the flows compare to those in other Santa Cruz Mountains streams? How much more slowly do they recede both seasonally and during dry sequences of years?
3. What are the very large peak flows? How do these compare to those in other streams in the region? How large were the 1982, 1998, 2005 and/or 2011 peak flows, both as recurrences and relative to peaks in other streams?
4. What are the dominant discharges, or channel-forming flows?
5. How does San Vicente Creek compare to other regional salmonid streams in both a hydrologic and water quality sense?

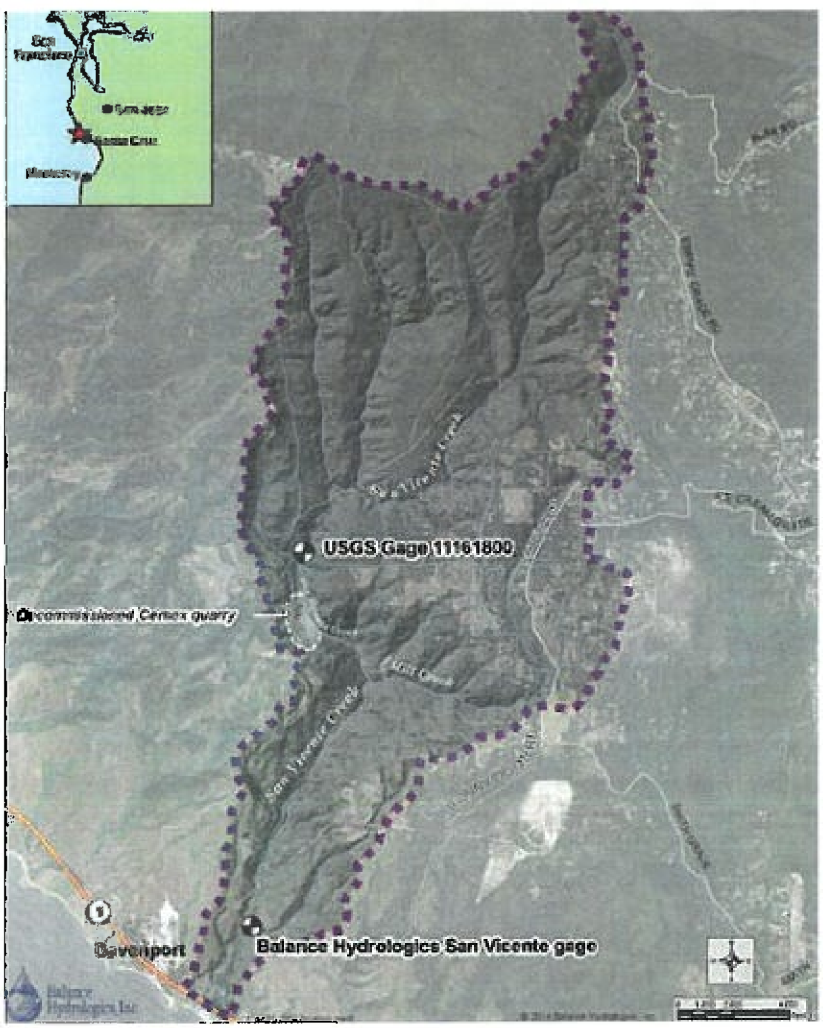


Figure 2-1. San Vicente Creek watershed.

To answer these questions, we carried out several hydrologic subtasks, consistent with the general guidance offered within California Salmonid Stream Habitat Restoration Manual. The specific subtasks included:

» Stream gaging and basic water quality measurement and sampling;

» Synoptic low-flow measurements;

» Peak discharge and dominant or channel-forming flows analysis;

» Region-wide hydrologic and basic water quality comparison;

» Climate change hydrologic analysis.

We will now review work completed in each of these subtasks.

INTRODUCTION

San Vicente Creek drains a watershed area of 11.1 square miles, originating on the western slope of Ben Lomond Mountain and discharging to the Pacific Ocean (Figure 2-1). The Mediterranean climate of the region provides for warm, dry summers and wet, cool winters. Mean annual rainfall in the watershed ranges from 24 inches near the ocean to upward of 60 inches at the headwaters near Empire Grade (County of Santa Cruz, 2000). The large rainfall gradient characteristic of San Vicente Creek is evidence that Ben Lomond Mountain plays a significant role in driving the local precipitation regime. Rainfall is the only source of meteoric water in the watershed as there is no measurable snowfall, and fog does not measurably contribute to stream runoff.

The alluvial groundwater basin is recharged during late fall and winter storm periods, providing the water which re-emerges during the spring and summer dry season months (Creegan and D'Angelo, 1984). The local karst system in the adjoining Liddell Creek basin is known to include trans-watershed divide groundwater transfers (PELA, 2005) to the Liddell system, from the Upper Laguna basin to a lesser extent, and from Reggiardo Creek to a greater extent. Additionally the Santa Margarita Sandstone (Figure 2-2: Tsm) which occurs just south of Bonny Doon, and just east of the now closed Bonny Doon Quarry is known to be an important recharge or supply source to the Liddell marble aquifer (PELA, 2005; Nolan Associates and Johnson, 2007). Given the prevalence of Santa Margarita Sandstone within the headwaters of Mill Creek (Figure 2-2) and just to the east of the decommissioned quarry (Figure 2-1) along upper San Vicente Creek, it is likely that the Santa Margarita is an important recharge zone for the San Vicente basin, possibly providing a large percentage of the flows which sustain the regionally high summer baseflows. Karst geology (Figure 2-2: m) undoubtedly plays an equally important role in San Vicente Creek (Figure 2-2) in terms of groundwater hydrology, and notably the decommissioned marble (locally called limestone) quarry in San Vicente Creek has been identified as being within a groundwater recharge zone (ESA, 2001). Presently the City of Santa Cruz Water Resources Department, the County of Santa Cruz Environmental Health Services Agency, and the Santa Cruz County Water Advisory Commission are pursuing development of a karst-specific protection zone ordinance (KPZ). The purpose of the KPZ would be in general to protect karst features, and specifically protect zones of groundwater recharge in the County that are related to karst, noting that these geologic attributes are regionally rare, yet vitally important to the hydrology of affected basins (see August 21, 2012 County of Santa Cruz Board of Supervisors Agenda item 24, available online at the County's website).

The USGS operated gage number 11161800 in the upper watershed from Water Year[1] 1970 through Water Year 1985, upstream of the decommissioned quarry (See Figures 2-1 and 2-4[2]) and upstream of the primary surface water diversion in the SVC basin (discussed below)[3]. The drainage area at the former USGS gage is 6.07 square miles. The period of record for the former USGS gage provides a useful snapshot of watershed hydrology for diverse climatic conditions (Figure 2-4). Specifically, the record includes the WY1776–77 drought, regionally one of the most severe in the last 50 years, as well as WY1982 which was considered very wet, and resulted in significant local flooding (USGS, 1989). The record also includes several years of average or normal precipitation conditions, as well as less severe dry and wet conditions. Of note in September of WY1977 the USGS reported flows of 0.01 cfs, or for all intents and purposes close to zero. The lowest reported flows for WY1976 were 0.60 cfs. These records indicate that upper San Vicente Creek is characterized by a groundwater basin which is resilient in the face of a one year drought, but which can be challenged by more sustained droughts. The role of how in-basin surface water diversions might have affected flows downstream of the former USGS gage during the WY76–77 drought is unclear. Unfortunately data for the lower watershed during the 1970s drought is lacking, short of observations by watershed residents.

Figure 2-3: Synoptic low flow measurement made in July 2013 as a part of the watershed assessment project.

From our brief introduction above, it is not surprising that surface flow in upper San Vicente Creek is interrupted by karst features as it travels downstream past the former USGS gage location: (1) surface flow is captured upstream of the decommissioned quarry via an Instream inlet and 80 foot vertical shaft connected to a tunnel under the quarry; and (2) surface flow capture occurs via a sinkhole feature located in the decommissioned quarry floor. Captured streamflow re-emerges downstream from a tunnel located at the end of the abandoned rail alignment, formerly used for quarry activities[4]. Captured streamflow re-emerges downstream from a cave located at the end of the abandoned rail alignment, formerly used for quarry activities. The percent of flow that is captured and which re-emerges at the downstream cave has not been quantified to the best of our knowledge. It is also not known if the hydrologic character of re-emergence varies from storm to storm, or wet season to dry season, etc. Further downstream stream

1 A water year extends from October 1st of the previous year through September 30th of the following year. For example, water year 1970 covers the period October 1, 1969 through September 30, 1970. Water year is abbreviated as WY. For example water year 1970 is abbreviated as WY1970, or WY70.

2 The record of rainfall illustrated in Figure 1.2 includes rainfall data for the now defunct NOAA Santa Cruz rainfall station for the period 1878-1996 (http://iridl.ldeo.columbia.edu, station 47916), coupled with rainfall data for the CIMIS DeLaveaga (104) rainfall station for the period 1997-2013. Rainfall data was summed over the rain year: June through May of the subsequent year, and represents a long-term estimation of precipitation conditions in Santa Cruz given the slightly different geographic locations of the precipitation stations.

3 USGS data reports published when the gage was active indicate that there were no known surface water diversions upstream of the gaging station.

4 The tunnel emerges just past the southern tip of the decommissioned quarry on upper San Vicente Creek (see Figure 2-1), which is also the upstream end of Reach 5, as described in the Geomorphology Chapter. At the tunnel exit there is an abandoned rail station that was used for mining activities.

the San Vicente right presently divert surface flows on a regular basis: 0.2 cfs for the town of Davenport water supply and 0.1 cfs for dust control at the decommissioned processing plant. The Davenport water supply is managed by the County of Santa Cruz[7] and includes a water treatment facility, located on the cement plant property. Six-inch pipelines convey diverted surface water to the cement plant property, and water is taken from the pipes to the water treatment plant from where it is ultimately distributed (Reppert, 2002). Staff from the National Oceanic and Atmospheric Administration (2014) have noted that they have observed significant leakage from the water supply pipelines during previous visits to the watershed. Barton (2012) further indicates that the Mill Creek surface diversion is presently inactive, but is left open at a minimal flow by the County of Santa Cruz to keep the line flushed and the water fresh within the line. The County uses the Mill Creek flow as backup if the San Vicente line becomes clogged.

Annual filings of water usage for right S008351 from San Vicente Creek from 2003 – 2008 indicate diversion totals of 300 to 585 acre-feet per year. Annual filings of water usage for right S008350 from Mill Creek, from 2003–2008 indicate diversion totals of 60–299 acre-feet per year. There have been no water usage fillings for rights S008350 or S008351 since 2010. Barton (2012) is the only indication of estimated present use of either water right. However, since it is known that the water supply pipelines leak, the indicated diversion rate of 0.3 cfs for right S008351 is likely an under-estimate of actual rate of diversion. Furthermore, it is thought that the Mill Creek right is presently exercised to some degree, in order to maintain the pipeline free of debris which could otherwise block the pipeline (Ricker, pers. comm.).

There is one known well located within the San Vicente stream corridor (within 50 feet of the active stream), located approximately where the conveyor belt crosses San Vicente Creek, and operated as part of the Coast Dairies (Coast Dairies, 2013). According to field observations, the well is connected to a 6-inch pipeline that runs about 0.3 miles downstream (location of Balance temporary stream gage) and then south about 0.5 miles up a hill to a pond on the ridge. Depending on the depth(s) at which the well is screened, typical pumping rates and durations, etc., it is possible that well operation results in transitory impacts to surface flows along San Vicente Creek. We were however unsuccessful in acquiring well construction and pumping records from the Trust for Public Land, and therefore cannot rationally evaluate this possibility. Some smaller diversions and wells are known to be sited in upper Mill Creek in the vicinity of Bonny Doon. Diversion and pumping rates for these facilities was also not acquired, and therefore relative or direct surface flow impacts is not known. The potential impacts of these diversion on salmonids is currently not quantified and was outside of the scope of this effort.

7 The water supply pipeline is still, however, maintained by CEMEX, not the County of Santa Cruz (Ricker, pers. comm.).

Prior to the present effort and those of the USGS, at least two additional efforts in the last 15 years to characterize surface water hydrology of San Vicente Creek at various locations are known. These efforts include a 2003 project by ESA to collect hydrologic data for CEMEX, and a subsequent initiative completed by Balance Hydrologics in 2008 as a part of the lower off-channel pond design project (Stamm et. al., 2008). In sum these two projects provide one key piece of hydrologic information. During the high flows of WY1998, the lowermost reach of San Vicente Creek within 1,500–2,000 feet of the Highway 1 tunnel was characterized by significant alder mortality and deposition of significant volumes of sediment. From this we surmise that the Highway 1 tunnel acts as a hydraulic bottleneck, promoting a dynamic channel environment along the upstream affected reach, and capable of driving a shifting stream course, and associated re-setting of the riparian corridor.

The remainder of this chapter will be spent reviewing data collected as a part of the stream gaging program, the two sets of synoptic flow measurements, a review of channel-forming flow estimates, a limited regional hydrologic comparison, and results stemming from completion of a first-order estimate of possible effects to watershed hydrology due to climate change.

METHODOLOGY

Stream Gaging

Assessment and Methods

In September 2012, Balance Hydrologics installed a stream gage on San Vicente Creek adjacent to the CEMEX gate at the end of San Vicente Creek Road (SVCG) (Figure 2-1). The drainage area at SVCG is estimated to be 10.5 sq. miles and the site was selected for relatively uniform channel cross section conditions, as well as a lack of nearby streamwood structures, or other physical barriers. The gage was equipped with two pressure transducers (depth sensors), a temperature sensor, and a specific electrical conductance probe. The pressure transducers measure water depth according to an internal calibration which converts a pressure measured across a thin plate to a small voltage which is relayed to the datalogger. Specific electrical conductance (SC) is a measure of the electrical conducting properties of natural waters, and therefore provides a measure of the magnitude or concentration of dissolved salts (salinity), or solids present in the water. The major cations and anions comprising the dissolved load typically include Calcium, Magnesium, Potassium, Sodium, Bicarbonate, Sulfate and Chloride. Because conductance is the reciprocal of resistance, the conductivity probe works by measuring the voltage drop (resistance) across a known length of fluid, from electrodes of known area for a given field temperature. All probes were programmed to record data to memory at 15-minute intervals from the hour. The sensor array was connected to a data logger housed in a weather proof box on the south bank of the creek. The gage was operational for the duration of W20Y13 which included the wet winter, and dry summer seasons. Manual measurements of stage, streamflow and basic water quality conditions (water temperature, specific conductance, and dissolved oxygen) were

Water Quality Observations			High-Water Marks		Remarks
Specific Conductance at 25C	Dissolved oxygen	Additional sampling?	Estimated stage at staff plate	Inferred dates?	
(at 25 oC)	mg/L	(Qbed, etc.)	(feet)	(mm/dd/yr)	
-	-	-	-	-	INSTALLED GAGE TODAY. Did not have staff plate on hand will install at next visit - water level marked on 2x4 for reference.
400	6.35	-	3.0 to 3.4 WY12	3/16/12	Installed staff plate. Measured high water mark cross section from WY12 likely from 3/16/12. There has been a couple days of fog after a heat wave a for a few days prior to this.
358		-	none visible	-	Some light rain today however probably not enough to create much flow response.
-	-	Qss, Qbed	-	-	High flow conditions. Sampled Qss with DH48 single vertical at 11:57, 12:30, Tried to sample Qbed with a single vertical at 12:38, 11:27 however did not seem like a good sample.
289	8.65	-	3.10	12/2/12	Sand had buried the bottom part of the staff plate and had to dig out. Sand has heavy muscovite content. Water is clear. Measured cross section from 12-2-12 float test.
220	10.00	-	3.94	12/23/12	Light turbidity conditions. Measured cross section from 12-23-12 flow event.
-	-	-	-	-	Measured high water mark cross section
-	-	-	-	-	Pulled up and a resident came out to warn me of several mountain lions seen at the gage today.
384		-	-	-	Had trouble downloading - will have to return.
		-	-	-	Flow also measured at the old USGS gage in the upper watershed today.
		-	-	-	Replaced datalogger cpu and sent original program. Left wiring the same.
294		-	-	-	Unable to see recent high water mark.

Water Quality Observations			High-Water Marks		Remarks
Specific Conductance at 25C	Dissolved oxygen	Additional sampling?	Estimated stage at staff plate	Inferred dates?	
(at 25 oC)	mg/L	(Qbed, etc.)	(feet)	(mm/dd/yr)	
		-	-	-	Stage observation only.
326	6.98	-	-	-	Changed battery but unable to download - software not functioning.
		-	-	-	Returned to download.
252	8.19	-	-	-	Tree has fallen down stream of the gage in the channel and will directly affect the gage with back water. Had to go about 75 ft. downstream to find a decent cross section for a flow measurement.
		-	-	-	Stage observation when passing by gage during channel surveys. Flow measured upstream of the gage and named site #5.
385		-	-	-	Synoptic measurements through the watershed were collected on 7-22-13 and 7-23-13. Download and stage reading only.
434		-	-	-	Back-water at the gage has gotten deeper with increasing debris in the fallen tree constriction downstream. Debris is to large to remove manually. It has been warm for the last week in Santa Cruz.
468	10.20	-	-	-	Good cross section about 40 ft DS of NOAA#15 marker. Note that there is a tree in the channel downstream that has created back water conditions at the gage.
452	6.67	Alkalinity see notes	-	-	Collect alkalinity samples at gage at 13:30; above Mill Cr at 14:15; and on San Vicente above San Vicente at 14:17
-	-	-	- -		No staff plate available at the old USGS gage however there was a brass monument - measure relative to water surface next time. Flow also measured at the Davenport gage today.

made once monthly and during select winter storms (Table 2-1). Manual measurements of alkalinity and total suspended solids were also made a few times during the course of the monitoring (Table 2-1). Station details and the annual record including basic statistics are provided in Table 2-2.

Creating a Record of Streamflow

Manual observations of stage and streamflow were used to develop a gage-specific stage-to-discharge relationship ("stage-discharge rating curve"). The stage-discharge rating curve coupled with datalogger records of water depth, converted to a record of stage using the manual observations as calibration points, permits the development of a record of streamflow. Corresponding records of stage and streamflow detail conditions at 15-minute intervals throughout WY13. A period of data loss for the stage data occurred from January 9–11, January 14–February 12, and March 11–15 due to equipment malfunction. When field conditions permitted safe entry to the channel, standard streamflow equipment appropriate for the conditions encountered in the field were used and included hand-held, low-flow (Price Pygmy) and high-flow (Price Type-AA, or "Standard") bucket-wheel current meters (c.f., Rantz, 1982). When hydrologic conditions were unsafe to permit entry to the stream, stream velocity-float measurements were conducted and a subsequent channel survey performed to measure the cross-sectional area of flow conditions at the time of the float measurement. Given that conditions at the temporary gage were generally unsafe during peak flows, bedload samples were not collected, as originally envisioned. Nonetheless two suspended sediment samples were collected using a DH-48, dipped into the water column from the streambank (Table 2-1).

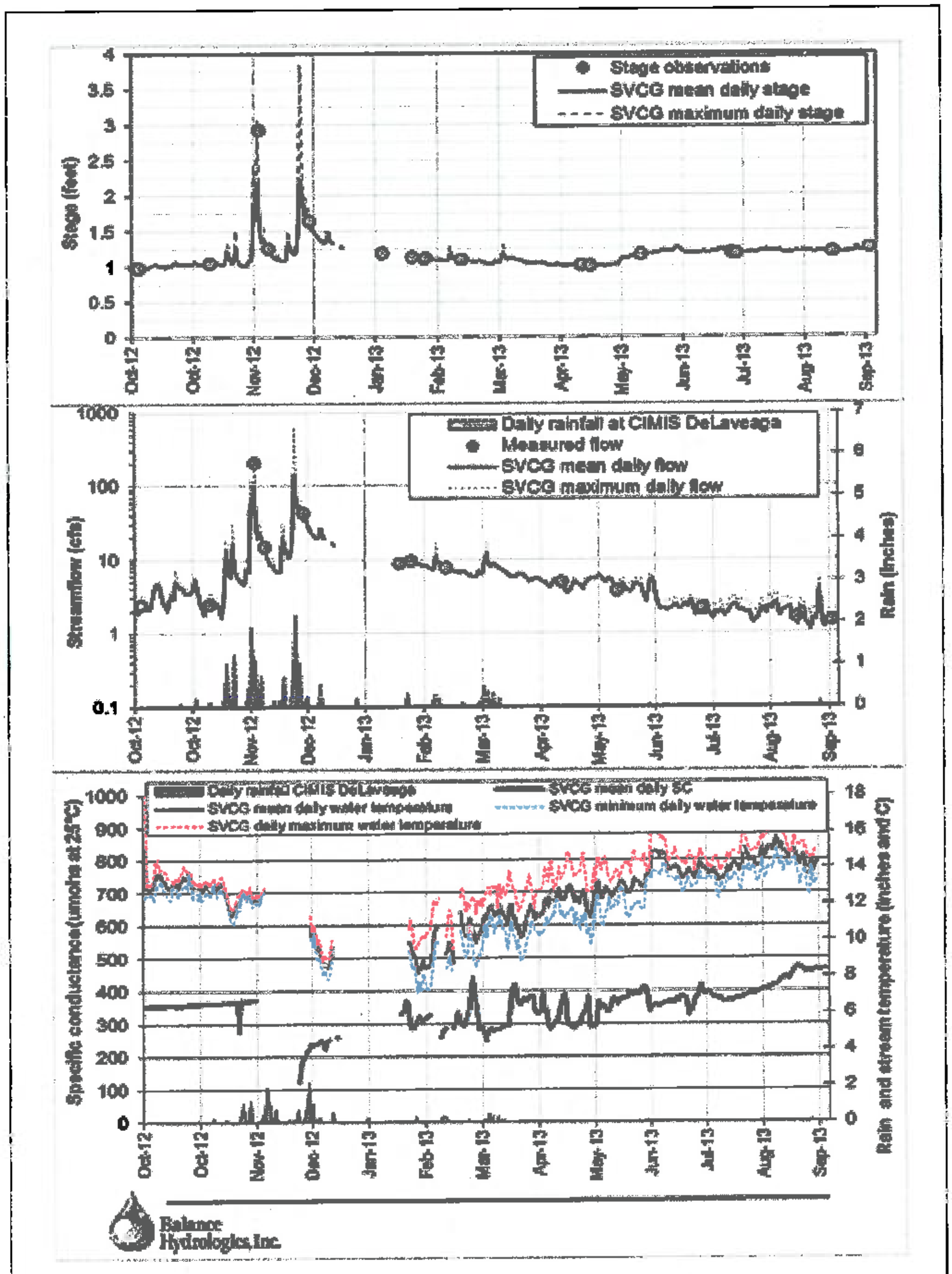


Figure 2-5. Record of mean daily stage (top), mean daily streamflow and local daily predipitation (middle) and water temperature and specific electrical conductance (bottom) for SVCG.

Findings and Results

Figure 2-5 illustrates the WY2013 record of stage, streamflow and water temperature and specific electrical conductance for SVCG. Also provided in Figure 2-5 are manual measurements of the relevant parameters made during the monitoring period, and corresponding precipitation data for the CIMIS DeLaveaga station (same station used in Figure 2-4 in order to remain consistent) along with the streamflow record.

Mean daily baseflows at the beginning of the water year ranged from 1.5 to 6 cfs, largely consistent with baseflows recorded toward the end of the water year (Figure 2-5). Given the very low rainfall totals recorded after the New Year, these results generally reflect what the historic USGS data suggest, namely that San Vicente Creek appears to be hydrologically resilient during dry spells that last one year or less. This seems to be a reliable finding for planning purposes given that similar

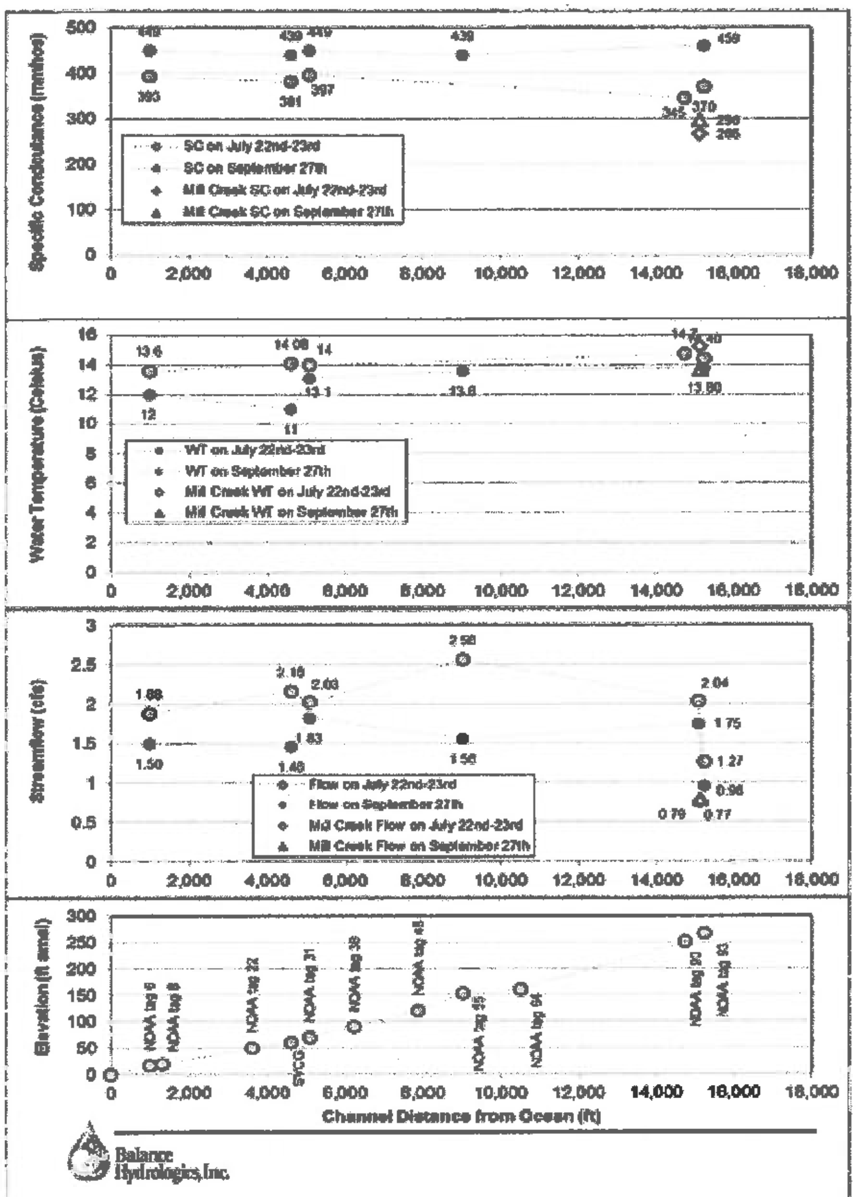


Figure 2-7. Plots of synoptic specific electrical conductance (top), water temperature (middle top), streamflow (middle bottom), and longitudinal stream station (bottom) for San Vicente Creek.

hydrologic trends emerge for data collected at two different locations in the watershed, separated in time by some 37 years. Two clear peak events were recorded during WY2013, the first on December 2 and the second on December 23 (Figure 2-5). The estimated instantaneous peak flow for December 2 was 251 cfs, or 23.9 cfs per sq. mile and the estimate peak for December 23 was 657 cfs, or about 62 cfs per sq. mile. Following the New Year a few smaller precipitation events occurred, but the water year ended relatively dry. Despite the distance down the coast to the CIMIS DeLaveaga precipitation station, it is instructive to note that the annual rainfall totals for WY2013 at DeLaveaga registered about 66% of the long-term average (19.2 inches vs. 28.9 inches) (Figure 2-4), supporting the conclusion that regionally WY2013 was a dry year.

Over the monitoring period, mean daily specific conductivity varied from just over 100 to more than 450 µmohs, normalized to 25 degrees Celsius. Because data was lost during the two December storm events it is possible that SC dipped below 100 µmohs during the actual storm events, as is commonly observed by Balance staff throughout the Santa Cruz north coast. The transition into the dry season brought a general rising trend in SC from July to September, from roughly 350 to 470 µmohs. As shown in the synoptic measurements discussed in the next Section, the trend of higher SC into the summer months is consistent with the geochemical signature of flows contributed by the karst influenced mainstem of San Vicente Creek. This observation is interesting because Mill Creek was measured to provide upwards of 45% of the surface flow component in September (see next Section), and with a lower SC signature (296 µmohs). This suggests that during the summer months, surface flows downstream of the Mill Creek confluence acquired additional salts along the 2+ mile trip to the SVCG gaging station, and attained SC levels pretty consistent with those measured upstream of Mill Creek. The values of SC observed at SVCG are consistent with those measured in the adjacent East Brach Liddell Creek immediately downstream of the discharge point of Liddell Spring, a regional karst drainage feature. From Mill Creek to SVCG however, it is more likely that the Santa Cruz Mudstone (Figure 2-2) provided the salts which elevated the mainstem SC to the measured values. Mean daily water temperature was measured to fluctuate between 8 to 13 degrees Celsius. As with SC, the lower temperatures were measured around the December storm events, whereas the higher temperatures define the beginning and ending conditions to the water year. During late summer and fall 2013 daily maximum water temperatures rose to as high as about 16.5 degrees Celsius. The envelope of daily minimum to maximum water temperatures ranged from less than 0.5 to 3 degrees Celsius. All in all the SC and water temperature conditions measured at SVCG are consistent with the ranges of conditions observed regionally, and are within acceptable ranges for both coho and steelhead.

Synoptic Low-Flow Measurements

Assessment and Methods

Balance conducted two rounds of synoptic low-flow streamflow

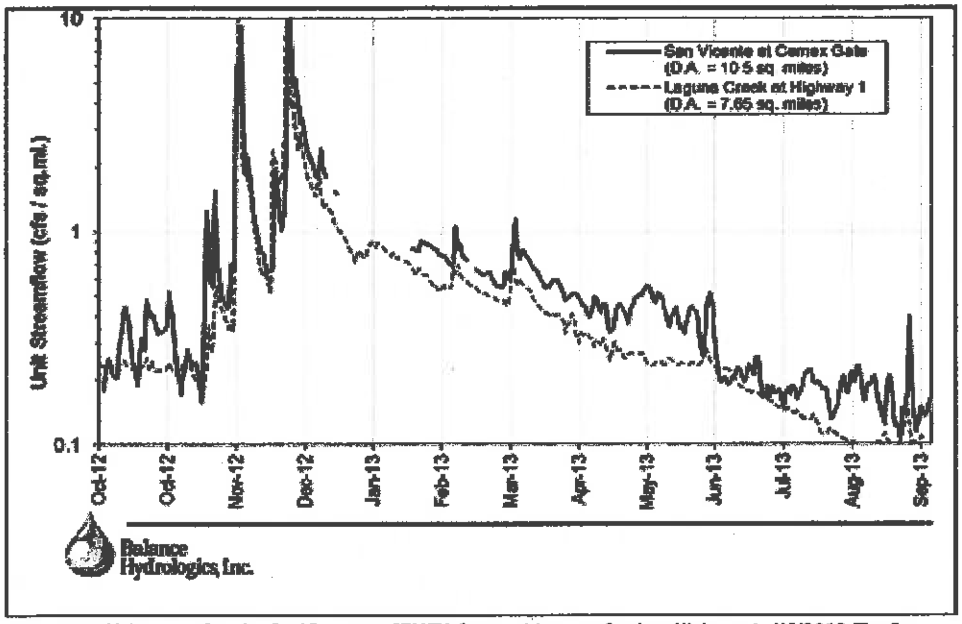


Figure 2-8. Unit streamflow for San Vicente at CEMEX Gate and Laguna Creek at Highway 1, WY2013.The flow record for Laguna Creek has been corrected for City of Santa Cruz water supply diversion.The San Vicente record however has not been corrected for upstream diversions, therefore in WY2013 San Vicente produced even more runoff per unit drainage area as measured at SVCG than what is depicted in Figure 2-8.

Observations made by Balance staff in association with the lower and upper San Vicente off-channel ponds projects suggests that the value is likely closer to 300 cfs+, as large rates of bedload movement were inferred from floods in this general range, and floodplain activation was also observed at the pond locations. This point will be revisited within the geomorphic assessment. The peak flow at SVCG during WY2013 was estimated at 657 cfs. Results provided in Table 2-3 suggest this flow rate is roughly equivalent to a bit more than a 3-year flood. This finding takes on more relevance within the floodplain connectivity discussion of the Geomorphic Assessment.

Table 2-3: Estimated flood frequency statistics for San Vicente Creek.

Return Period (years)	USGS gage (cfs)	SVCG (cfs)
50	2787	4821
20	1681	2909
10	1054	1823
5	584	1011
3	329	569
2	175	304
1.5	91	159

Region-wide Hydrologic and Basic Water Quality

Assessment and Methods

A regional comparison of hydrology and basic water quality between San Vicente several different nearby streams was completed with use of available records, data and reports available to Balance. Comparison of rates of streamflow was made with Laguna Creek because Laguna also shares significant influence from karst within its upper watershed. Basic water or geochemistry comparisons were made with several additional karst water bodies including the adjacent Liddell Spring, as well as Neary Lagoon within the City of Santa Cruz, which drains portions of the UCSC campus. Finally, peak flow comparisons were made with Pilarcitos, Pescadero, and Soquel Creeks, and the San Lorenzo River.

Streamflow comparison with Laguna Creek was accomplished by computing records of mean daily unit streamflow for the SVCG and the Laguna Creek at Highway 1 (Parke and others, 2013) stream gages. The Laguna Creek gage is operated by Balance Hydrologics for the City of Santa Cruz Water Department. The City provided access to the data for this report. Mean daily unit streamflow is computed as the quotient of mean daily flow and drainage area at each gage location. Scaling by drainage area is useful because it makes hydrologic comparisons between differing watersheds, or watershed locations straightforward and possible. The mean daily record of streamflow for Laguna Creek represents the estimated unimpaired flow for that system.

Findings and Results

Figure 2-8 presents WY2013 records of unit streamflow for SVCG and Laguna Creek at Highway 1. A semi-log scale is used to accentuate differences between the two gage locations at lower streamflows. The results indicate pretty definitively that during WY2013, the San Vicente Creek watershed produced more water per unit area than Laguna. These differences are generally more pronounced at lower rates of streamflow, than at higher ones where unit area flow production tends to converge, or swap with Laguna producing higher unit flows. The data also show that flows in San Vicente appear more dynamic than those in Laguna Creek, with reasonably large daily fluctuations evident into the dry season (on both sides of the winter months). Locally, Laguna Creek is known as a stream with a reasonably strong baseflow hydrology. The consistently larger unit baseflow values for San Vicente mainstem vs. Laguna Creek reinforces something that has been acknowledged for a while, but perhaps not quantified, that San Vicente is a prized local stream in terms of baseflow hydrology.

Figure 2-9 illustrates the WY2013 record of 15-minute mean, maximum and minimum water temperature for SVCG along with spot measurements of water temperature on Laguna Creek at Highway 1. Three of the four spot measurements made from

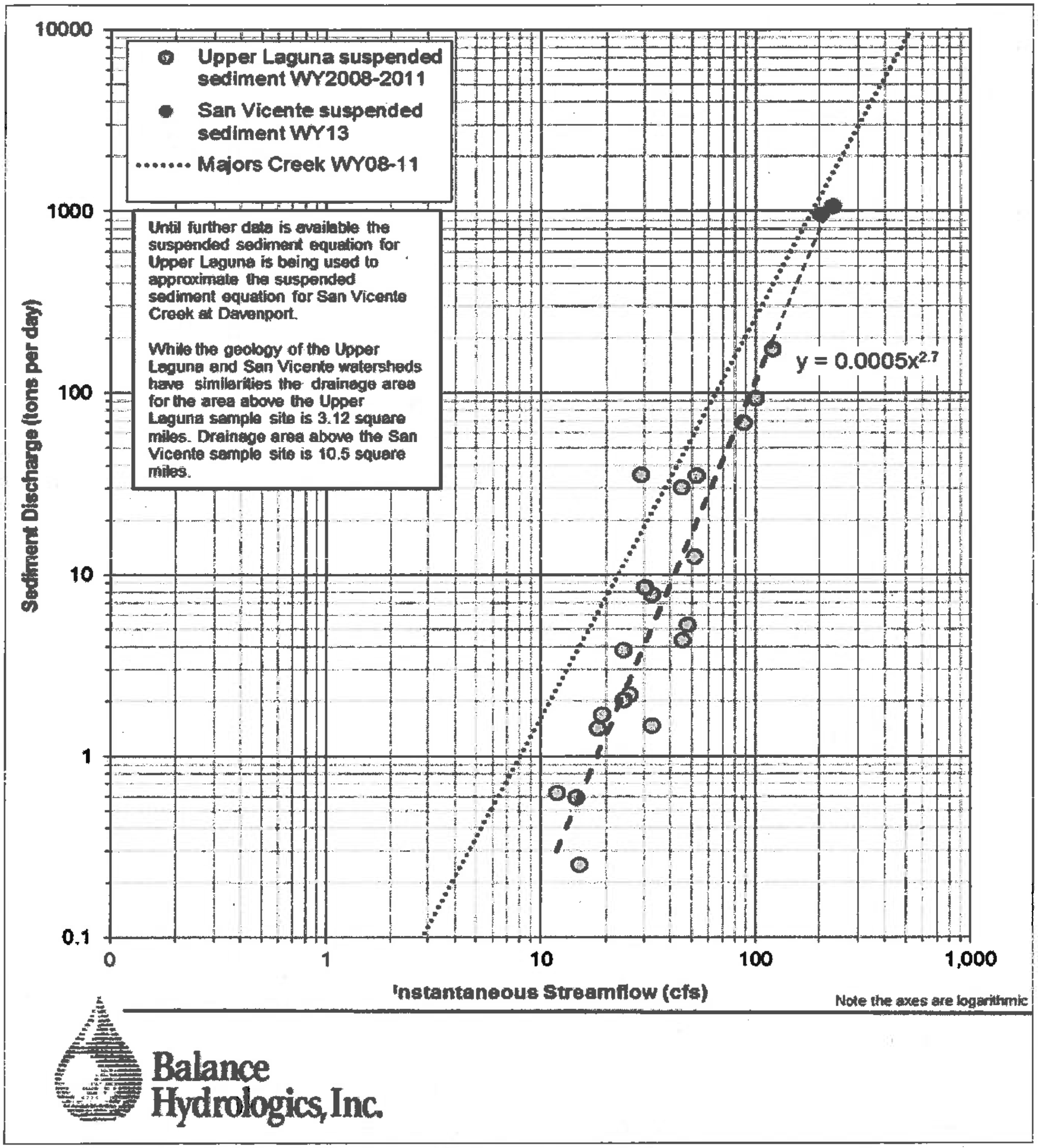


Figure 2-10. Suspended sediment data and rating curves for Santa Cruz County northcoast streams.

west lead to rainfall intensities and total depths which factor more significantly than the sandy soils, and as a result San Vicente produces relatively large peak flows. Practically speaking this raises the probability that the mainstem riparian corridor could experience severe mortality and a general 're-setting' of channel geometries during large magnitude floods. The likelihood of this scenario playing out is accentuated by the confined nature of the lower mainstem, as well as the hydraulic bottleneck effect created by the Highway 1 tunnel. As a result substantial channel shifting and general change should be anticipated within the lower reach, within several thousand feet or so of the Highway 1 tunnel (see Stamm and others, 2008, for further discussion).

Climate Change Hydrologic Analysis

Assessment and Methods

An analysis of potential impacts to streamflow using six different climate change projections, from three different Global Climate Models (GCMs) has been completed. This work is intended to help inform decisions regarding future restoration actions, notably if GCMs predict a significant change in

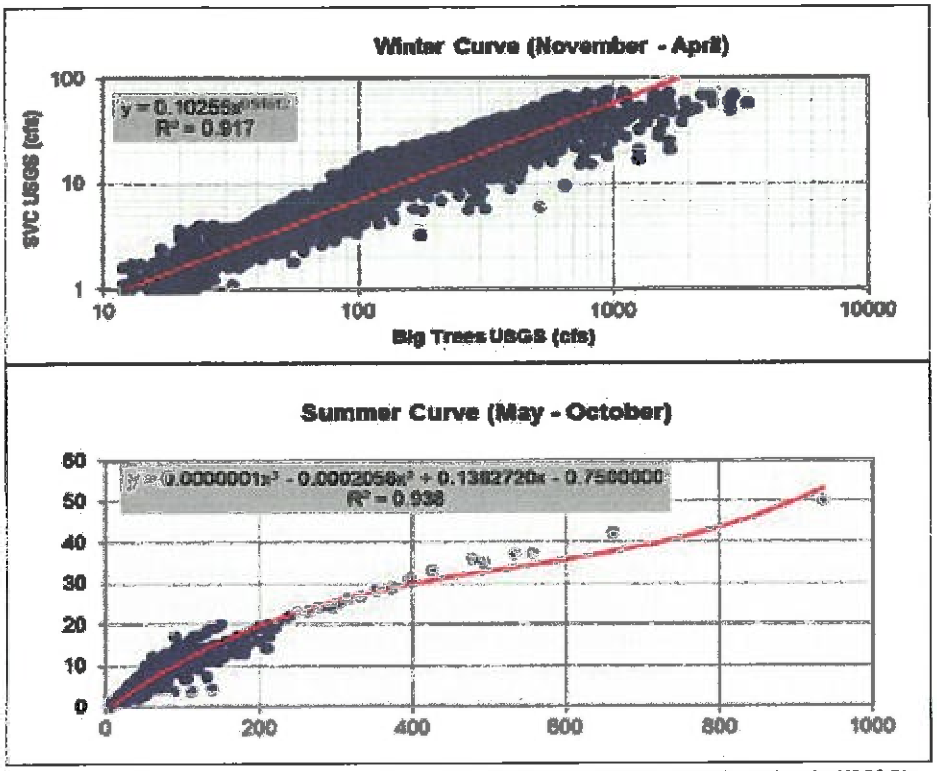


Figure 2-13. Regression models used to extend the USGS San Vicente record of streamflow using the USGS Big Trees gage on the San Lorenzo River.

For each of the three GCMs, monthly mean precipitation (mm) and air temperature (degrees Celsius) computed from the A2 (medium-high) and B1 (low) emission scenarios was used (Figure 2-12). These two emissions scenarios provide all the output desired for the analysis. Specifically, the A2 scenario provides that global (including California) CO_2 emissions exhibit a continual rise throughout the 21st century and by century's end achieve CO_2 concentrations that will be more than triple their pre-industrial levels (Cayan and others, 2008). The B1 scenario on the other hand assumes that global CO2 emissions peak by mid-century at concentrations which are roughly double the pre-industrial level, before dropping below current levels by 2100 (Cayan and others., 2008).

The climate projection data was downloaded from cal-adpat (www.cal-adapt.org) using their tabular downloads option. Data was specified for a 1/8 by 1/8 degree grid (~140 km2) centered just east of Davenport. Cal-adapt is an organization whose aim is to provide access to the vast information and data sources regarding climate change produced by California scientists and researchers. Specifically, the air temperature and precipitation data is sourced from *Scripps Institution of Oceanography: California Nevada Applications Program (CNAP)*. The Cal-adapt organization is an outgrowth from a key recommendation of the 2009 California Climate Adaptation Strategy, and includes collaboration between UC Berkeley's Geospatial Innovation Facility (GIF) with funding and advisory oversight by the California Energy Commission's Public Interest Energy Research (PIER) Program, and advisory support from Google.org. The 1/8 degree air temperature and precipitation data are bias corrected using a gridded observed data set (NRA2) with the same grid that is used for the downscaled GCMs.

The gridded observation data set (NRA2) was used to develop the water balance model. The NRA2 data set includes monthly precipitation and surface air temperature observations converted from point measurements (stations) to average values for grid spaces, for the time period 1950-1999. The NRA2 grid is the same as the grid used to downscale the GCM model output and allows the statistical model developed with the historic data to be driven with the downscaled GCM data. The water balance model is stated as:

$$P = ET + Q + R \quad (1)$$

The term P is precipitation (m/day), ET is the evapotranspiration (m/day), Q is streamflow discharge (m^3/day) and R is groundwater recharge (m/day). The equation lacks a change in storage term (ΔS) because we have no idea how storage may change in the watershed over the time period of interest. We also do not have measurements of recharge, as a result the recharge term will be the knob we turn to optimize a fit between the NRA2 data set and our extended and correlated record of flow for San Vicente Creek. Precipitation is a measured or projected parameter, ET is measured and computed with projected average air temperature, and streamflow discharge is a computed parameter given values for the other three terms.

The USGS San Vicente record of streamflow (WY1970–WY1985) was extended based on development of two regression models with the overlapping record of flow for the USGS Big Trees streamflow gage (1160500) (Figure 2-13). Application of the regression models to the Big Trees record results in a record of streamflow for San Vicente Creek for the period WY1936–WY2000. Extension of the flow record to 2000 was done in order to be consistent with the NRA2 data. Despite the differences in geology, the predictive capabilities of the models are quite good (Figure 2-13), and certainly so for the present application. Based on comparison to the gaged record of flow for San Vicente Creek, the skill of the regression models is challenged by conditions of the lowest flows, when the models over predict flow. We note that the correlated record of streamflow for San Vicente Creek is not intended to be used as a model of expected streamflow, but rather to be used as a device for comparing historic conditions with projected conditions.

To supplement the hydrologic climate change analysis we also reviewed the National Academies report on projected sea level rise off the California, Oregon and Washington coasts (National Academies Press, 2012). The report specifically projects sea level

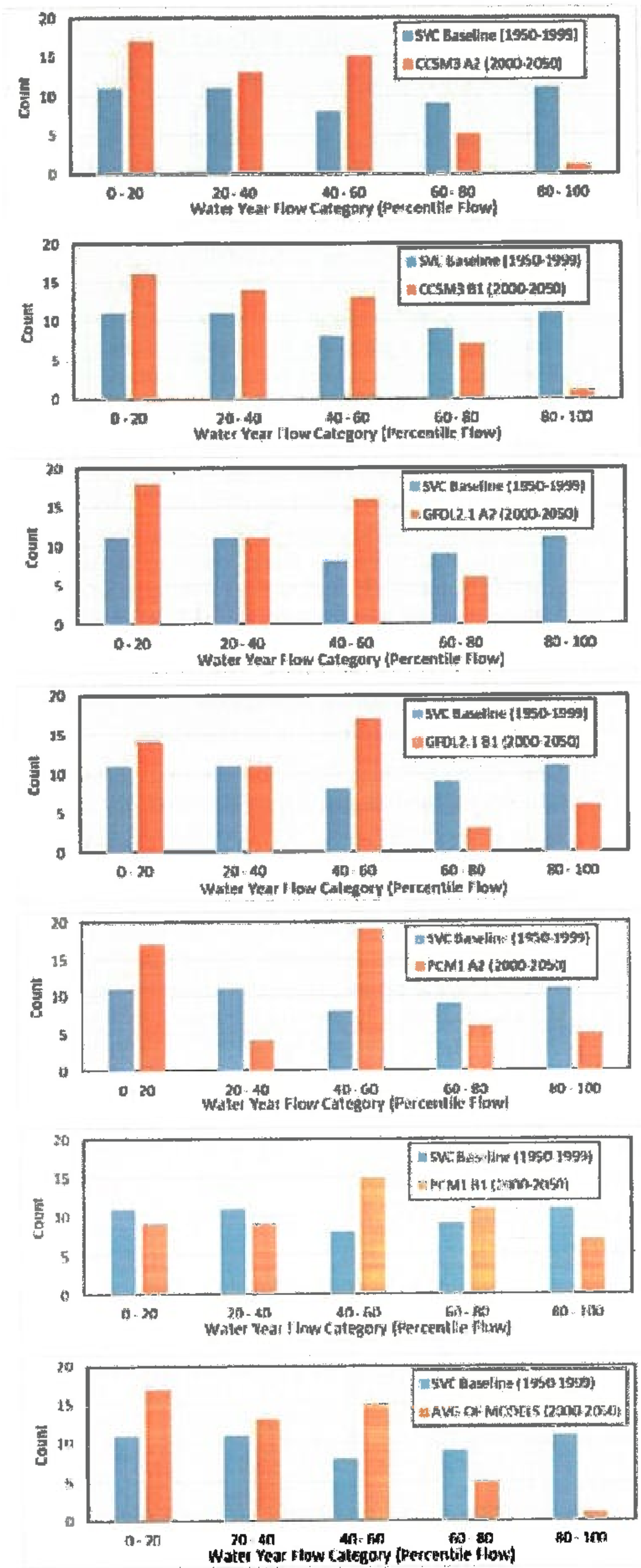


Figure 2-14. Summary of water balance model estimates of future hydrologic conditions within San Vicente Creek through 2050.

justified to anticipate such outcomes, and to provide flexibility within pertinent recommendations to facilitate adaptation to such conditions.

Potential Impacts of Low-Flow Surface Diversions to Salmonids

National Oceanic and Atmospheric Administration (2012) has indicated that surface water diversions are a limiting factor to coho during the summer months within the Santa Cruz County Diversity Stratum. The USGS records for the former SVC gage indicate that flow conditions during the 1976-77 drought were very poor during the late summer months, with 10 days of zero cfs recorded from September 9–18, 1977 (Figure 2-15). The USGS records further indicate that the second year of a 2-year drought (the most severe recorded by the USGS at the SVC gage) was a particularly vulnerable period for salmonids. During consecutive drought years, any impairment to natural surface flows will be more pronounced due to reduced groundwater contributions and overall reduced baseflows. As such, while SCV generally maintains high leves of surface flow due to natural processes and limited divesion, during consecutive drought years, impacts to surface flows via diversion (legal or otherwise) could have a critical impact on salmonids. Furthermore, any additional flows that can be introduced to the system could mean the difference between saving or losing a coho year class during drought.

Synoptic measurements made as a part of this study suggest that during the summer months, Upper San Vicente Creek and Mill Creek contribute most if not all surface flows to the mainstem San Vicente Creek (see Figure 2.7). If Upper San Vicente went dry in September 1977, it is likely that Mill Creek did as well. Under such conditions the mainstem likely had intermittent surface flows, with isolated pools, or perhaps longer stretches of zero surface flow. Climate conditions during WY2014 are setting records across the State of California for low rainfall totals. Given that WY2013 was dry, the WY2013-14 period is shaping up to as dry if not drier than WY1976-77. As such we can anticipate that surface flows in San Vicente Creek could reach very low levels,with possible loss of surface flows along some reaches from the headwaters to the mouth at the Pacific Ocean. The climate change results just presented above suggest a potential for more frequent occurrences of severe dry conditions through 2050, and beyond. With a drier forecast at hand and climate change predictions indicating that these conditions are likely to become more regular, watershed management for salmonid recovery should focus on protecting and increasing instream flows into the anadromous reaches of San Vicente to protect all year classes of coho and steelhead to be greatest extent practicable, especially through times of drought.

Leaking water supply pipelines represent an obvious target of improvement, and a practical means to keep as much water in SVC as possible. Upgrading the diversion facility on Upper SVC and Mill Creek for the Davenport water supply, and replacing aging pipeline infrastructure is likely to represent

F. San Vicente appears to transport a relatively moderate amount of fine sediment during flood stages. An additional physical attribute conducive to salmonid success in the basin.

G. Large floods on San Vicente are likely regionally and relatively large for the size of the basin. This has practical habitat implications for salmonids such that the stream corridor will likely experience complete re-set during floods of significant magnitude. The lower reach of the mainstem is at more risk to substantial change during significant floods due to the contributing deleterious effects of the Highway 1 tunnel. These potentialities clearly point to the notion that habitat protection and enhancement efforts should focus on locations out of the Highway 1 effect zone (within ~2,000 feet), and downstream of Mill Creek.

H. Estimates of hydrologic conditions through 2050 using downscaled climate change projection data for three different GCMs suggests drier conditions than those observed from 1950-1999. Potentially drier conditions in the basin accentuate the importance of developing a water resources protection plan for salmonids, and other Instream resources.

I. Sea level projections for coastal California by 2050 fall within the range of 1-foot above historical mean sea level. This potential outcome coupled with the elevation of the lowermost mainstem of San Vicente suggests an increase in durations and incidences of sea water intrusion upstream of the Highway 1 tunnel. Because we do not understand how this outcome would precisely affect the objectives of the present effort, the recommendation to focus habitat enhancement efforts upstream of the Highway 1 backwater zone seems even more prudent.

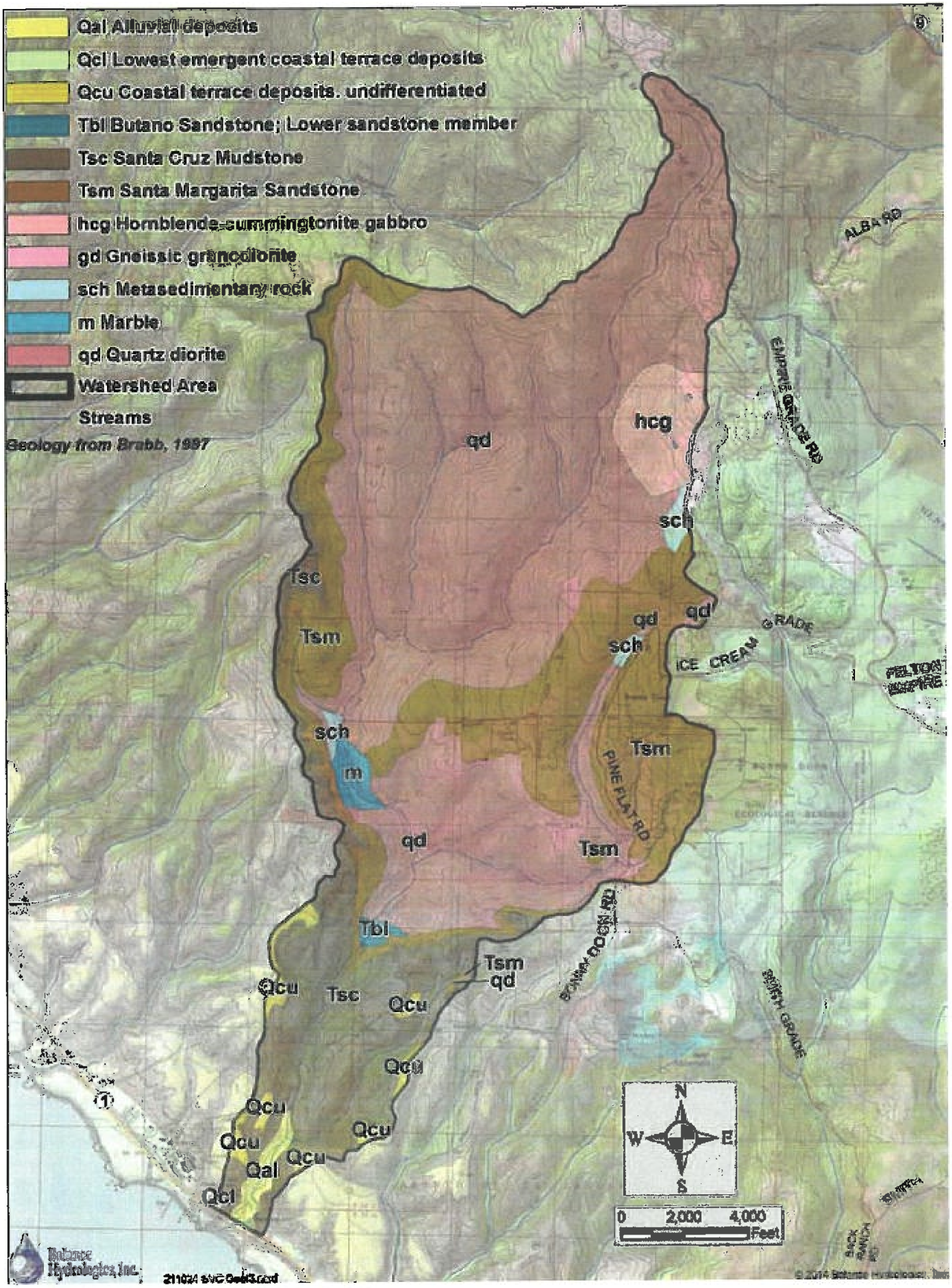


Figure 3-1. Geologic map of the San Vicente Creek watershed.

ation of karst terrain--cave and conduit features in the bedrock that greatly influences water storage and movement. P.E. LaMoreaux & Associates (2005) conducted dye tracer studies in an adjacent watershed, and found that cross-basin conveyance is likely occurring in San Vicente, a process by which groundwater is exported from one watershed to an adjacent watershed. At this time, geologic controls on surface water and groundwater movement into or out of the San Vicente Watershed have not been examined extensively, but some data suggests these processes are at play (P.E. LaMoreaux & Associates, 2005).

The upper portion of the watershed is primarily composed of fractured crystalline rocks (e.g., granite, quartz diorite) and may provide sources of baseflow to the lower watershed via fractured flow. In contrast, the lower watershed is underlain by marine-sedimentary rocks, including the Santa Margarita sandstone and Santa Cruz mudstone, both highly erosive and subject to mass wasting (e.g. landsliding) as the result of watershed disturbances (e.g., road building), flooding or tectonic activity. The mudstone or sandstone is part of a sequence of Tertiary sediment rocks that increase in thickness as the stream flows downstream toward the coastline (Creegan and D'Angelo, 1984). In the middle and upper reaches of the San Vicente Creek, the mudstone or sandstone comes into contact with the Mesozoic or Paleozoic marble unit. The marble unit has been quarried for over 100 years, creating a canyon within the main stem of San Vicente Creek and exposing the basement rocks of old schist, marble and granitics (Weppner and others, 2009). Engineered tunnels at the entrance and the bottom of the abandoned marble quarry has caused San Vicente Creek to flow subsurface at this location which resurfaces immediately downstream of the marble unit.

METHODOLOGY

Stream Morphology and Stream Reach Classification

Assessment and Methods

Using information collected from LiDAR-based topography, stream reconnaissance, and channel morphology, we classified five distinct channel reaches[2] which can be used to characterize geomorphic processes and communicate our observations and measurements (Figure 3-2, Table 3-1). Each reach was classified based on several characteristics including: a) channel slope, b) channel morphology, c) dominant bed material size, and, d) influence of land-uses or modification of channels or hydrology.

2 The choice of reach definitions is not a hard-and-fast rule, but is subjective based on the purpose(s) of a study; in this case the reaches were defined from a geomorphology perspective with an eye toward potential for salmonid-habitat restoration projects. Other scientists would likely come up with different reach definitions which would be equally valid. For a different type of study, we would likely use a different set of reach classifications.

Table 3-1. Reach-scale classification and descriptions: San Vicente Creek, Santa Cruz County, California

Reach	Reach length		Distance from Pacific Ocean	Reach elevation		Slope	Morphology	Description
	Begin (ft)	End (ft)	(End) (mi)	Begin (ft)	End (ft)	(overall) (%)		
Reach 1	0	1,345	0.25	0	22	1.2	pool-riffle	Heavily modified reach, contriction at HWY 1 has potential for inundation during large floods; bimodal substrate: cobble in sand
Reach 2	1,345	5,840	1.11	22	90	1.4	pool-riffle	Reach includes greatest opportunity for aquatic habitat enhancement
Reach 3	5,840	6,590	1.25	90	104	<2	bedrock-controlled	Short reach the begins immediately downstream of the CEMEX conveyor belt and extends upstream to a weir and road-crossing, channel express bedrock chutes and deep pools
Reach 4	6,590	14,145	2.68	104	260	2.1	plane-bed	Steeper channel that expresses muted pool-riffle morphology. Pools are shallow with abundant fines
Reach 5	14,145	16,420	3.11	206	410	6.9	step-pool, pool-riffle	Reach expresses both pool-riffle and step-pool morphology, many steps are natural barriers to fish passage; reach terminates at Quarry tunnel
Mill Creek tributary							step-pool	Reach expresses few pool-riffles and mostly step-pool morphology; natural barriers to fish passage; abundant sediment sources in reach

sands, with only small amounts of fine gravel. Mean particle size of riffles has been estimated to 73 mm (cobble). Substrate lithology is mixed with larger material derived from crystalline rock (i.e., diorite) and finer material derived from Santa Cruz mudstone, Santa Margarita sandstone, and to a lesser extent, diorite and limestone. Based on observations, Reach 1 has moderate volumes of instream wood and has recruited older alders into log jams, due to dynamic channel conditions.

Reach 1 has been heavily modified over the years for agricultural use (instream and offstream ponds), floodplain encroachment, former and existing road crossings, channel realignment and filling of the lagoon from construction of Highway 1. We have defined the upstream extent of Reach 1 as a zone of potential backwatering due to the tunnel under Highway 1 which imposes constraints on passage of moderate to extreme flood flows. Anecdotal and field evidence suggests the flood of February 3, 1998 (estimated 80- to 100-year recurrence submerged the tunnel and backwatered the channel to about 22-foot elevation (Stamm et al, 2008). This elevation corresponds to the upper limit of Reach 1. Submergence and backwatering of this reach has the potential to increase sedimentation, bank erosion, and shifts in channel position. As a result, this reach may not be a good candidate for additional enhancement and restoration due to dynamic and uncertain conditions created by such floods.

Reach 2

Reach 2 extends 4,500 feet upstream from the 22-foot elevation contour to approximately 90-feet elevation. Reach 2 exhibits a 1.4 percent slope overall and expresses pool-riffle morphology. Substrate is mostly cobble sourced from crystalline rock (i.e., diorite), however, abundant sand-sized sediment fills pools and backwater. This reach has moderate volumes of instream wood and opportunities for recruitment during floods.

Reach 3

Reach 3 extends roughly 750 feet upstream of Reach 2, and is defined by a bedrock-controlled channel bed between the CEMEX conveyor belt upstream to a weir/road crossing; the overall reach slope is approximately 2 percent. Bedrock is mostly Santa Cruz mudstone which is easily weathered and forms bedrock chutes and occasional deep pools. Cobble and boulder sized material are common in this reach

Reach 4

Reach 4 extends upstream 7,500 feet from Reach 3 to the confluence of Mill Creek. Channel slope through Reach 4 is generally steeper (2.1 percent) than downstream reaches. Channel morphology predicted by Montgomery and Buffington (1997) is "plane bed"—characterized by relatively straight channel (confined or unconfined), lacks discrete bars, comprised of dominantly cobble- and boulder-sized substrate, and lacks rhythmic bedforms (i.e., pool-riffle, step-pool). Although Reach 4 doesn't exhibit all these characteristics, its bedforms are muted, with shallow pools and long riffles. In some areas, the channel does appear confined by topography (valley walls), or in some cases, current and former logging roads.

Reach 5

Reach 5 extends roughly 2,300 feet upstream from the confluence with Mill Creek to the outlet of the old quarry (also referred to as the "tunnel"). This reach exhibits increasingly steeper characteristics defined by boulder step-pool and boulder-cascade morphology. Abundant fines (fine to coarse sand) were observed in pools and may be associated with discharges from the quarry; however, hydrology and sediment transport through the quarry is poorly understood.

Mill Creek

Mill Creek is a perennial tributary to San Vicente Creek and extends roughly 3 miles upstream. The first 500 feet of channel, upstream from its confluence with San Vicente Creek, exhibits some pool-riffle morphology and provides ample fish passage. Above this segment, Mill Creek is a steep channel (greater than 5 percent) and mostly exhibits step-pool and cascade morphology. The uppermost segment of Mill Creek (above Boony Doon Road crossing) exhibits a lower slope and likely pool-riffle morphology. Mill Creek appears highly altered with evidence of two former dams, creek-side skid roads and narrow-gauge railroad beds which have confined the channel. Based on our field reconnaissance, these human confinements have led to bank failures and landslides into the channel from deeply weathered diorite. These conditions provide a source of abundant sediment to downstream reaches as evidenced by pools filled with medium and coarse sand throughout this tributary.

Sediment-Source Inventory and Evaluation

Sediment-Source Background

Our assessment of sediment sources in San Vicente Creek Watershed should be considered within the context of large or infrequent events or recent variations in climate, land-use, geology, and hydrologic conditions. Landslides and debris flows are prevalent in the Santa Cruz Mountains and are well-recognized as sources of sediment to coastal reaches of anadromy. Ellen and others (1988) have mapped landslides in the Santa Cruz Mountains generated by the January 1-3, 1982 rainfall and floods, while Spittler and others (1989) mapped landslide features triggered by the Loma Prieta earthquake. Neither of these studies identified major landslides in the San Vicente Watershed as a result of these historic events. Erosion after wildfires is another potential large source of sediment. The last major wildfire in the San Vicente Creek watershed was in 1948 (15,000 acres; RCD, 2013); however, there are no known studies that document if this fire was a major source of sediment. Finally, notable storms and associated floods are also common sources of landslides and bank failures. 2013 was a year characterized with below average rainfall and after a decade or more absent of large rainfall or flooding events. Water year 1998 was the last year noted for substantial channel changes, debris flows, and landslides. Locally, a flood on March 26, 2011 was moderately large, but not relative to historical floods.

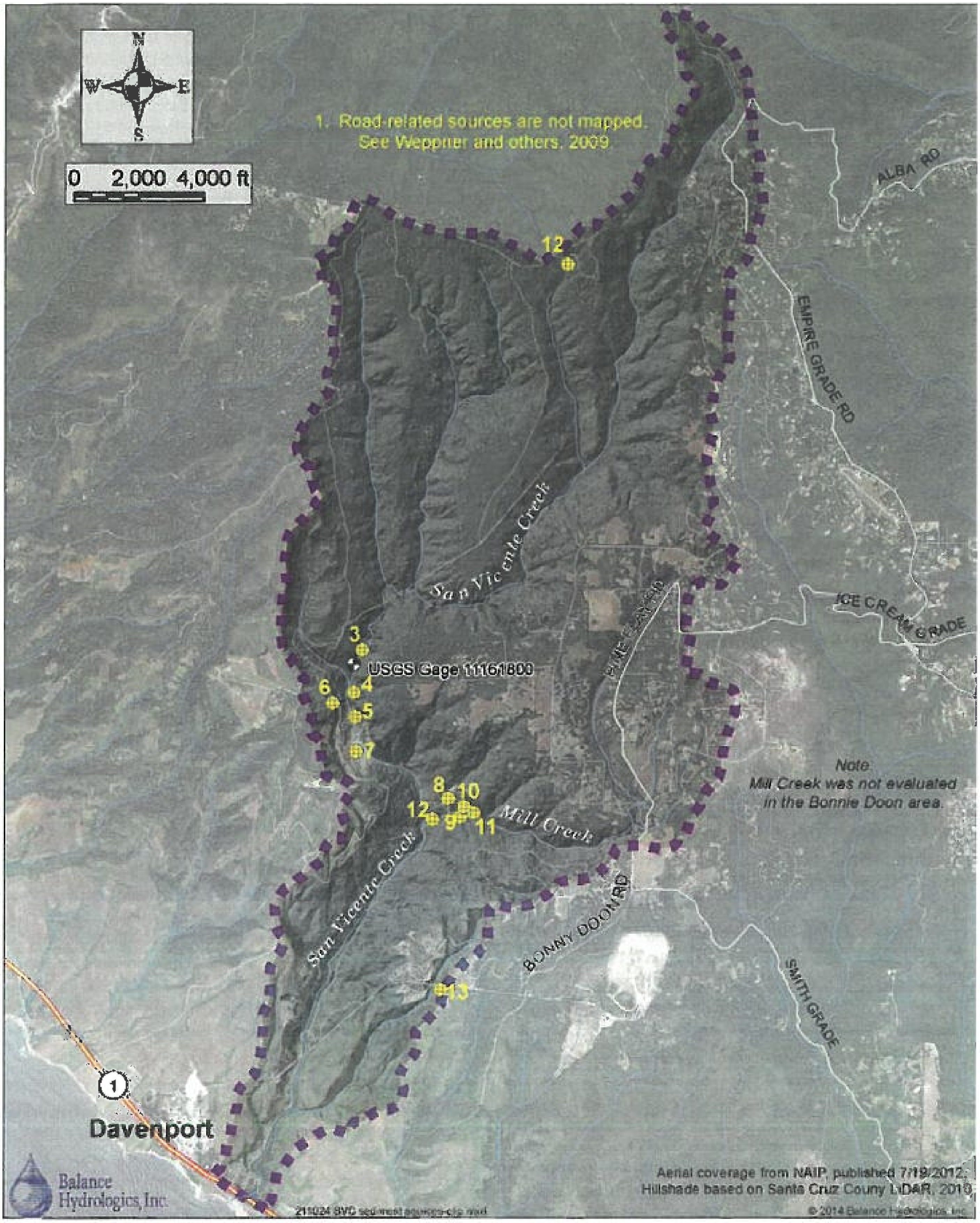


Figure 3-4. Map of recorded sediment-source areas.

bances. For instance, remains of former skid-roads and railroad grades were observed along the channel and likely confined the former channel to its existing condition today. As the channel attempts to reclaim its former channel width and form (meanders), the resulting hydraulic forces create sediment sources that include on-going bank failures and near-channel landslides into Mill Creek.

While bedrock exposures at bank failures and landslide scarps suggest diorite as the source, upstream portions of the watershed are mapped as Santa Margarita sandstone. This lithology has been described by others as very friable (Clark, 1981) and has been the source of other sediment issues in the Santa Cruz Mountains (Hecht, B., pers. comm.). Creegan and D'Angelo (1984) described the majority of the fine sediment originating from further upstream, specifically the Bonny Doon area. A field assessment of the Bonny Doon area was limited because of private property. However, a review of recent and historical aerials did not suggest any major and current sediment sources from private lands in the Bonny Doon area (that are visible from the air), but we do not conclude that sources do not exist.

Between Bonny Doon and the reach we walked, Mill Creek includes two diversion dams located 0.45 and 0.7 miles above the confluence (Creegan and D'Angelo, 1984). While our reconnaissance did not include observations of these dams, previous assessments suggest that they are silted in with the potential to release stored sediment in the event of dam failure (Creegan and D'Angelo, 1984). Previous assessments by the NRCS discounted dam and sediment removal due to limited access and uncertainty with channel stability once removed.

Measureable overbank storage of fine sediment observed at the confluence with San Vicente Creek may have originated from upstream bank failures, landslides and sediment releases from the upstream dams. While these deposits are located above the active channel, they are likely mobile in large events. Removal of these deposits may be difficult given their location and limited access; however, stabilization of these deposits using vegetation may be a more feasible option.

Lower San Vicente Creek

Our assessment of lower watershed included a reconnaissance of the entire channel from the Highway 1 tunnel upstream to the confluence with Mill Creek (Reaches 1-4). In the context of limited or lack of large events over the past 15 years, we did not identify measurable (>10 CY) sources of sediment to the channel, although we note that much of San Vicente Creek appears to have exhibited an historical period of incision, likely as the result of logging and road building 100 years ago. Today, the channel exhibits general dynamic equilibrium with only occasional evidence of continued incision, or widening of meander magnitude.

A reconnaissance of an unnamed tributary in the eastern portion of the watershed was made impossible by thick vegetation, although a review of current and historical aerial photographs reveals that this tributary drains a former quarry area, also known as the 'Shale Quarry'. Santa Cruz County (2009) identified 'Shale Quarry' as a major sediment source. Reportedly, holding ponds, constructed in the Shale Quarry, frequently were blown out by storms and released large volumes of sediment to San Vicente Creek (Santa Cruz County, 2009). In 2011, a large deposit of fine sand was observed in a recently restored backwater habitat, located at the receiving end of this unnamed tributary. The sediment resulted in approximately 50 percent reduction in backwater habitat at this location.

Other sources of sediment may exist in the near channel environment. Reach 1, for example, has been characterized as a reach subject to backwatering from extreme floods (e.g., 1998). In moderate-to-large floods, former deposits from backwatering can be mined by the creek. These processes may be currently active today based on the percent fines we see in some of the Reach 1 riffles.

In an effort to identify the source rock of fine sediment found in the lower watershed, we qualitatively investigated lithology of fine sediment deposited in pools and riffles. We note that determining the lithology for grains less than 2 mm becomes increasingly difficult. Nevertheless, we observed an abundance of coarse sand composed of mafic minerals (i.e., dark, ferromagnesian) which may suggest that a good portion of the fines are derived from diorite.

Previous assessments have identified sediment sources associated with old quarry overburden or operations and suggest that marble may be a dominant source of fines. Creegan and D'Angelo (1984) observed an increased percentage of marble in the channel after the 1982 flood. Today, very little marble is observed in the channel and suggests that these sources may have become less significant and the formerly observed marble has been transported through the system or buried by new sources of sediment that originate from other lithologies.

Similarly, while Santa Cruz mudstone is mapped throughout much of the lower watershed (Brabb, 1989), we did not identify it as the source rock for many of the fines found in pools and riffles within Reaches 1 through 4. Its absence is likely because this unit is weakly cemented, highly friable and quickly degrades through both physical and chemical weathering. Similarly, density of Santa Cruz mudstone is significantly less than the diorites and marbles and is therefore sediment originating from this unit is more subject to transport as bedload or suspended load during periods of high flow.

Conclusions of Sediment-Source Findings and Results

In conclusion, our sediment-source assessment identified few active sediment sources relative to other watersheds in the Santa Cruz Mountains identified by others. Many of the sediment sources that exist appear to be in the upper watershed. Along the mainstem of San Vicente Creek, in the upper watershed, sediment may be effectively stored (temporarily or long-term) within the decommissioned Quarry; however, sediment trans-

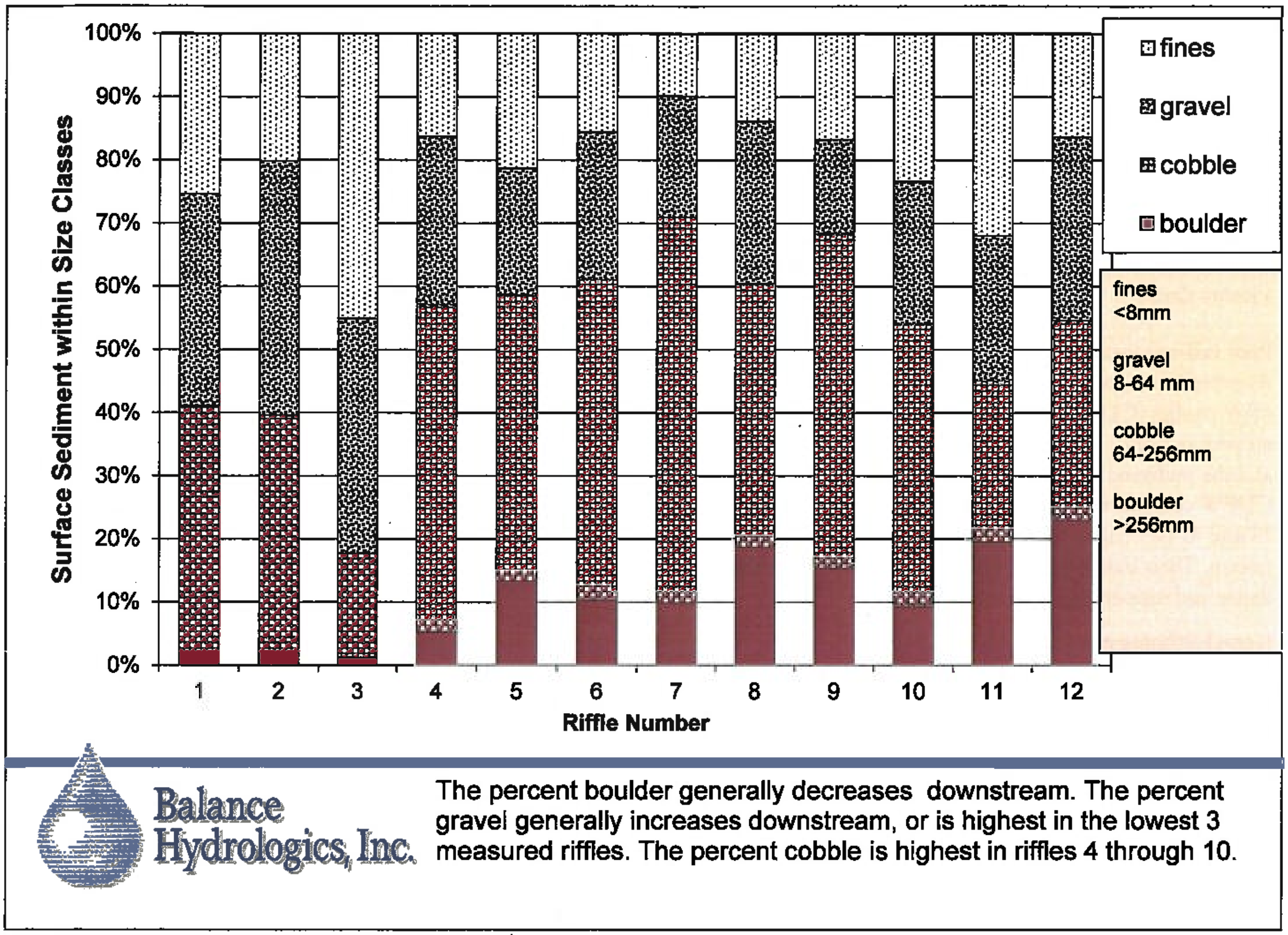


Figure 3-6. Riffle-surface texture measurements, San Vicente Creek July 2013.

We note that water year 2013 (WY2013) was a below-average rainfall year despite having an above-average peak flow. WY2013 also follows several average to below-average years in terms of precipitation and runoff. Riffle conditions may not reflect "typical" conditions and could be changed in a peak flood such as those conditions observed by Creegan and D'Angelo (1984) after the big-flood years of 1981 and 1982. The last significant flood in San Vicente may have been WY2008 or WY1998. Interpretation of our results and observations should be placed in the context of the historical hydrology.

Findings and Results

Riffles selected for evaluation are located in Figure 3-2. Particle size distributions for all 12 riffles are presented in Figure 3-5.

For each riffle, the percent of samples falling into four sediment size classes (i.e., fines, gravels, cobbles, boulders) are presented in Figure 3-6.

Riffle-surface size results

We characterized riffles within the lower and middle San Vicente Creek watershed as a coarse system, but with a near normal distribution, whereas our median and mean for each riffle were approximately the same with few exceptions (Figure 3-6). Overall, riffles expressed a median diameter (D50) of 67.

Percent gravel results

More importantly, we note that gravels comprised a range between 15 percent and 46 percent of riffles in San Vicente Creek (Figure 3-6). Moreover, riffles in the lower reaches of San Vicente Creek (Reaches 1 and 2) exhibited the highest within this range. For instance, riffles 1-3 exhibited more than 30 percent gravels. Alternatively, Reach 4 (riffles 7 and 9 in particular) expressed the lowest abundance of gravels, 19 and 15 percent, respectively. We recognize that range of size and abundance of gravels may not be an indicator of usable habitat given that our sampling was limited to riffles and did not include pool-tail outs—a more common location for spawning. Gravel requirements also differ with life stage, thus the appropriate gravel size and abundance may vary with the functions of each life stage (Kondolf, 2000). With that said, our data may suggest Reach 2 may be the highest priority for planning efforts to protect and enhance general salmonid spawning habitat solely on the fact that riffles in this reach may provide the best opportunities. Although one riffle in Reach 1 exhibits an abundance of years, we still observe coho presence in San Vicente Creek and a moderate level of gravel abundance in downstream reaches. In the absence of knowing the dynamics of sediment and streamflow through the quarry, and if we are to assume that sources above the decommissioned quarry are captured, Reach 6 and Mill Creek may be the more obvious sources of gravels. Patterns or trends in gravel abundance among riffles sampled may not relate to the source of gravels, but instead, be attributed to sorting and storage as the result of a particular flood—which, at this time, we do not have a full understanding. Nevertheless, we do know Mill Creek is largely underlain by diorite and therefore, should be protected as a source of gravels.

Understanding gravel abundance may provide a good proxy for material used by salmonids; however, additional information is needed to evaluate whether those gravels can be modified or moved by salmonids (i.e., spawning) and to better understand salmonid abundance to determine whether spawning gravels (as a proxy for redd formation) could be a limiting factor for salmonid populations in San Vicente.

Percent of fine sediment in riffles results

Studies of spawning gravels have related the percentage of fines as the most significant effect on salmonid embryo survival (Kondolf, 1988, Kondolf and Wolman, 1993, Tappel and Bjornn, 1983). Coho were found to have lower rates of survivability when riffles include 30 percent or more of fines measuring 6.4 mm or smaller. We evaluated our riffle textures in the context of these findings. However, because we used standard phi sizes for our analysis we characterized fines as sediment grains less than 8mm for the purpose of this analysis. Riffles were grouped in bins including:

» Fines < 8mm;

» Gravel;

» Cobble;

» Boulder.

Sediment less than 8mm comprised between 10 and 45 percent of riffles, while only two riffles (Riffle 3, Riffle 11: Mill Creek) exhibited greater than 30 percent of sediment 8mm or less. We note that riffles with more than 30 percent fines were located downstream of recent or on-going disturbances or channel modifications. For instance, Riffle 3 (Reach 2) is located below recent introduction of instream wood to the creek for habitat restoration objectives. These structures may be inducing new hydraulics to the reach segment as both bed and bar materials are noticeably reorganized. Similarly, riffle 11 is located in Mill Creek and downstream of numerous and active sediment sources identified as part of this study and discussed in detail in subsequent sections of this report. When we compare the percent fines from riffles evaluated in the mainstem of San Vicente Creek (upstream of the confluence) and Mill Creek, we observe more than twice the percent of fines in Mill Creek. This result, although based on a single riffle in each reach, may further support the contention that the major sources of fine sediment originate from the Mill Creek tributary. While Mill Creek is also a potential source of gravel-sized material, it is also a known source of finer material that is not advantageous for salmonids.

Embeddedness results

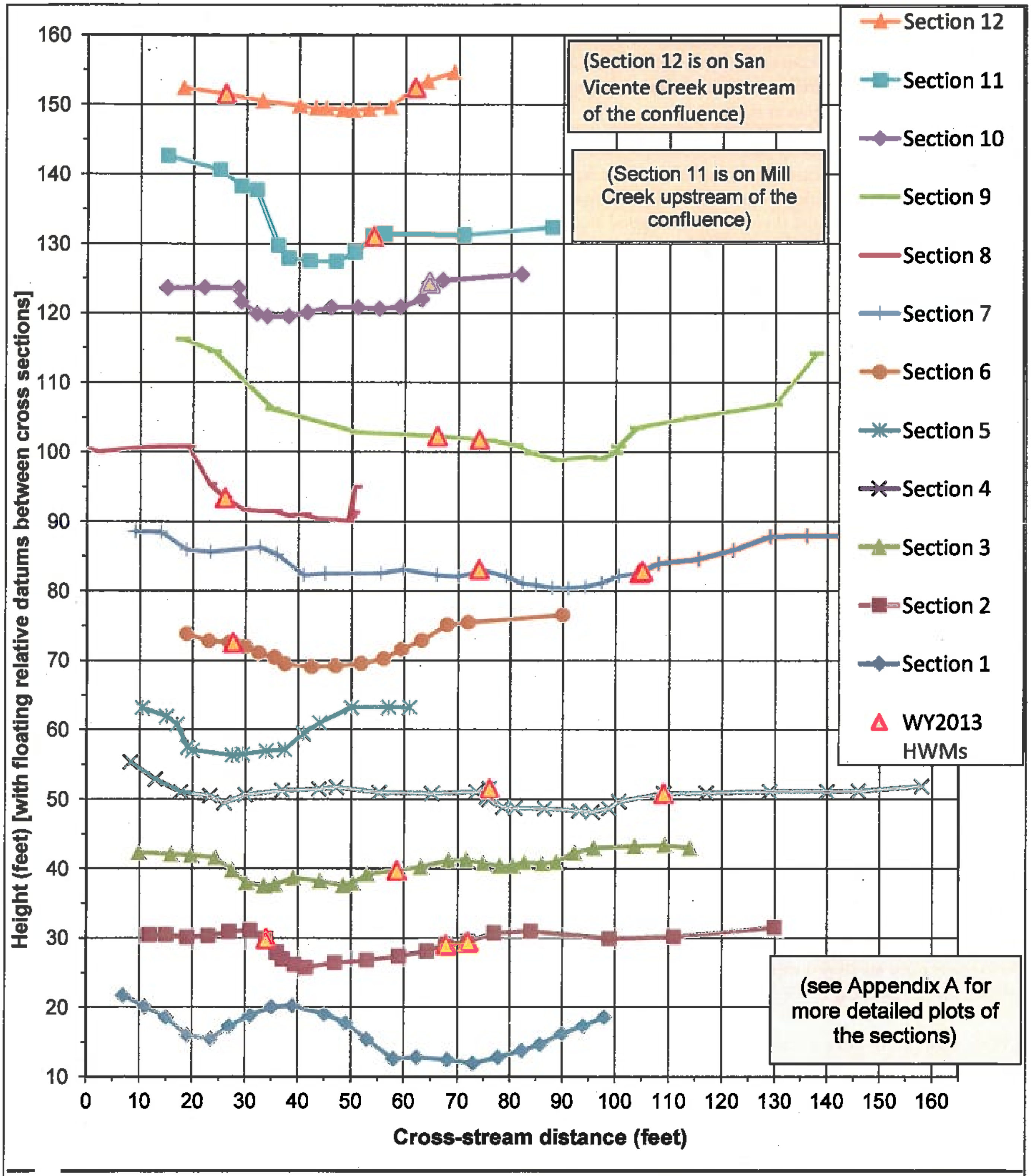
Percent embeddedness for sampled riffles is shown in Figure 3.7.

While the percent of fines is one metric used to evaluate spawning habitat suitability, embeddedness is another metric that provides additional information. The literature describes multiple definitions for embeddedness and methods of measurement (Sylte and Fishchenich, 2002). Therefore, comparison between studies should be used with caution. For the purposes of this study, embeddedness is defined as the degree that spawning-sized substrate is held tightly into the channel bottom by other finer sediment, making the construction of redds by spawning salmonids difficult. Absence or presence of embeddedness was recorded for each sample collected by difficulty of removal of gravel or cobble sized particles from the bed and the observation of algae or sediment staining. CDFW (1998) has characterized good spawning substrate as less than 25 percent embedded.

We observed varying conditions of embeddedness in the riffles in San Vicente Creek, ranging between 4.5 and 35 percent with a mean of 22 percent across all riffles. Percent embeddedness for sampled riffles is shown in Figure 3.7. Please note that "percent" embeddedness is not the extent to which an average clast is embedded, but the percent of clasts that are embedded either a small amount or a large amount. Creegan and D'Angelo (1984) reported the presence of embeddedness throughout San Vicente Creek, while McGinnis (1991) reported between values 25 and 50 percent embeddedness and more recently CDFW (2013) reported similar results for pool-tail outs. Combined, these studies suggest San Vicente Creek experiences a moderate level of embeddedness that has not measurably changed over the years and suggests fine sediment continues to have an impact on salmonid habitat.

Mineralogy of sediment results

Based on our assessment of riffle texture, salmonid spawning-sized substrate is largely sourced from diorite. Diorite is mapped throughout the upper watershed, specifically in areas above the old quarry and USGS gaging station (Brabb, 1989). It also exists in lower portions of Mill Creek and along the mainstem, a short distance downstream of the Mill Creek confluence. Our qualitative assessment of the upper watershed found an abundance of gravel-sized substrate stored along instream bars, behind large woody debris and old dams previously used for diversion of flow for quarrying operations. Additional storage of gravel was observed along a wide floodplain on the quarry floor; however, hydrology and sediment transport from the quarry to downstream reaches is poorly understood. A tunnel exists between the quarry and downstream reaches of San Vicente Creek and was observed blocked by abundant wood and sediment. Observations of the reach below the tunnel outlet (Reach 5) did not suggest that sediment observed in the quarry is currently reaching downstream reaches. As noted earlier with sediment sources in



The cross-section surveys show varying degrees of floodplain connectivity. Well connected floodplains would ideally be inundated one or more times per year during most years. This frequency of inundation generally corresponds to a floodplain that is 2 to 2.5 feet above the channel bottom.

Figure 3-8. Cross-section survey measurements: San Vicente Creek, July 2013.

Table 3-3. Floodplain-to-creek connectivity parameters: San Vicente Creek near Davenport

Based on the level of WY 2013 high-water marks compared to the floodplains, only a few localized sites along San Vicente Creek have good floodplain connectivity. Because the water year 2013 high flow was a 3 to 4 year peak flow, well connected floodplains should have been moderately inundated. Sites that were just barely inundated during water year 2013 would likely not have been inundated during a year with a 1.5 to 2 year peak flow.

Cross Section Location	Reach Location	Closest NOAA tag #	Height from WSE to WY 2013 HWMs (feet)	Height from WSE to flood-plain/ terrace (feet)	Inundation depth on floodplain based on WY 2013 HWMs (feet)	Width of Inundation at HWM elevation (feet)	Degree of floodplain connectivity	Width of primary floodplain or terrace (feet)
Section 1	1	6	no HWM	6	not inundated	no HWM	poor	34
Section 2	1	8	2 to 3	4	not inundated	36	poor	30
Section 3	2	15	1.7	2.5 to 3.2	not inundated	31 or more	marginal	30
Section 4	2	22	2 to 2.5	2 to 2.5	0.5	74	good	50
Section 5	2	31	no HWM	5 to 6	not inundated	na	poor	11
Section 6	3	38	3	3 and 6	not inundated	35	poor	4 and 30
Section 7	4	48	1.5 to 2	1.5 and 5	0.5 and not	63	good	39 and 14
Section 8	4	55	2.6	9.5	not inundated	24	poor	17
Section 9	4	64	2 to 2.5	2 to 3	just barely	30	marginal	25
Section 10	4	90	4.5	3.6	0.9	50	good	13
Section 11	4	Mill Cr.	3.3	3.6	not inundated	18	poor	34
Section 12	5	93	2 to 2.7	no floodplain	no floodplain	36	poor	none

Notes:

WY 2013 = water year 2013, which started October 1, 2012, and finished September 30, 2013.

WSE = water surface elevation (when surveyed, July 22 and 23, 2013).

HWM = high-water mark (evidence found of water levels from previous high-water)

HWMs are by their nature approximate, and sometimes can be difficult to assign an accurate date to, so some HWMs that we surveyed may have been from previous larger floods than the December 2012 dates that we assigned to the HWMs in the field.

HWMs were found over a range of elevations at many sites, so often a height range is given in the Table above. For sites where HWMs were not surveyed, we have assummed similar relative heights from the other sites.

» "poor" floodplain connectivity is based on floodplains not inundated by the WY 2013 high flows

» "marginal" floodplain connectivity is based on floodplains barely inundated by the WY 2013 high flows

» "good" floodplain connectivity is based on floodplains moderately inundated by the WY 2013 high flows

Vicente Creek, low floodplain areas fill in relatively quickly, so if it is desired to keep complex features at a low elevation, flood hydraulics need to be considered and perhaps used to site the features where high velocity will maintain or scour them during storms. Large wood or log structures can be used to focus high flows to improve or maintain complex habitat features.

Duration of inundation

For fisheries, the *duration* of inundation of the floodplain or backwater areas is also important. Figure 3.9 shows the hydrograph of the December 23, 2012 storm which was a typical duration for a large storm, and was slightly above average in terms of peak flow (657 cfs). The duration of floodplain inundation varies site by site, but if 300 cfs causes inundation at a site, then the duration of inundation would have been approximately three hours. The inundation duration for sites with lower habitat areas, like backwater channels that provide high-flow refuge, that might have been inundated by 100 cfs would have been approximately 15 hours.

For the purpose of categorizing the degree of vertical floodplain connectivity, we defined the "floodplain" as the broad flat area next to the creek that appeared to an alluvial surface. For restoration or enhancement projects a broader and more useful definition of "floodplain" could be the wide flat area, plus lower areas of relic channels, high-flow over-flow channels, oxbows, and connected or disconnected back-water channels; these lower areas would get inundated more often and for a longer duration and therefore might be more useful for fish refuge and habitat.

In larger, low-gradient or snow-melt river systems long periods of floodplain inundation create conditions that are favorable for fish to interact with floodplains and complex habitat features.

FINDINGS

A. Although the degree of sediment sources in San Vicente Creek are low relative to other Santa Cruz Mountain streams, on-going and planned road-drainage improvements should provide additional reductions of fine sediment to salmonid habitats.

B. Because the quarry appears to function as a sink for upper watershed coarse sediment, and because dynamics of sediment moving through bedrock tunnels in and near the quarry is poorly understood, additional study may be required to better understand sediment dynamics through the quarry, such as repeat surveys of sediment deposits in the quarry, or paired bedload measurements above and below the quarry tunnel over a range of events. However, access to these locations is difficult and may be infeasible during wet conditions.

C. There is potential to reduce fine sediment in the creek system by repairing, stabilizing, and revegetating some of fine sediment sources identified in this study. Steep and remote terrain in may be the most limiting factor for implementing channel restoration or mitigation measures. Alternatively, fine sediment can be address through more passive approaches. This may include restoration elements in downstream reaches that encourage overbank deposition.

D. Introduction of instream wood in Reach 2 seems to be trapping and storing gravel-sized sediment, but the cumulative and long-term effects of introduced wood on reducing fines to downstream reaches is unknown. This approach of adding large wood could be expanded to a larger-scale pilot study to evaluate its effect on reducing fine sediment to the stream.

E. Gravels comprised a range between 15 percent and 46 percent of riffles in San Vicente Creek, which may be considered low-to-moderate abundance for salmonids. Gravel augmentation has been suggested as a possibility for enhancing gravel abundance in San Vicente Creek; however, our assessment cannot conclude whether such efforts are feasible or needed. We suggest that a separate study be undertaken to review the feasibility of gravel augmentation for the lower reaches of San Vicente Creek.

F. Fines less than 8mm comprised between ten and 45 percent of 12 riffles examined at part of this assessment. Coho typically have lower rates of survivability when riffles include 30 percent or more of fines. While only two riffles exceeded 30 percent fines, the average percent of fines approached 25 percent and suggests that fines may be a limiting factor in salmonid spawning habitat. We suggest that a combined effort of fine sediment source reductions and/or floodplain enhancement are undertaken to minimize additional fines.

G. Measurements for embeddedness suggest San Vicente Creek exhibits a moderate level of embeddedness (22 percent across all riffles), but only slightly less than value considered as detrimental by the CDFW (25 percent). We recommend that efforts to reduce fine sediment to San Vicente Creek should be sought to maintain or improve substrate conditions.

H. Floodplain re-activation projects have potential in the four reaches downstream of the Mill Creek confluence. Within those reaches, locations need to be evaluated on a site-specific basis because there is frequent variability over short distance. Avoiding reach 1 may be desired due to the potential for backwatering and resulting sedimentation due to potential clogging of the Highway 1 tunnel during high flows (as occurred during 1998).

I. Because we did not find long stretches of well-connected floodplains, restoration efforts could focus on connecting short sections of well-connected floodplain that are close to each other. This could be designed by creating low-elevation backwater channels instead of- or in addition to- lowering large swathes of floodplain.

J. Improving floodplain connectivity can be performed by lowering the floodplain (such as by mechanical removal of vegetation and soil), or by raising the channel bed of the creek (such as by adding large wood that fully spans the channel). Locations where the floodplain has marginal connectivity should be considered as candidates for raising the bed of the channel with large wood (probably limited to half the diameter of available wood). Projects that use large wood that fully crosses the creek channel will also likely help retain gravel-sized sediment.

K. Because there are limited locations with good creek-to-floodplain connectivity, natural areas of good floodplain-to-creek connectivity (sites 3 and 7) should be used as analogs for designing complex floodplain re-activation projects. These sites have examples of complex habitat features such as low floodplains, backwater channels, undercut banks, and creek wood.

important attribute in restoring coho salmon and steelhead populations (Stamm et al., 2008). The hydrology and geology of the watershed are discussed in detail in chapters one and two, respectively, of this report.

Although redwood forest dominates the watershed, the lower reaches of the creek support a narrow riparian zone dominated by alders (*Alnus spp.*) and willows (*Salix spp.*). Timber harvesting, water diversions, and rural residential development occur in the upper watershed. Open pit mining historically occurred in the upper watershed, but was recently terminated. Cattle grazing and agricultural water diversions historically occurred in the lower watershed but were gradually phased out over the past decade.

History, Previous Studies or Projects

Salmonid Populations

The historic presence and abundance of salmonid populations in San Vicente Creek are fairly well documented. A newspaper article dating back to 1866 placed San Vicente Creek at the top of the county's fisheries streams:

> *"The best [trout fishing] stream probably, is the San Beicente [San Vicente], ten miles up the coast, a large creek emptying into the sea. In this stream, trout bite as rapid and as strong as in Eastern streams, and [are] even more abundant and delicious. The largest trout caught (by Mr. Begelow, the insurance agent), being over 22 inches long and weighing about four pounds. In this stream the largest average from ten to fifteen inches."* (Sentinel 1/13/1866)

In addition to steelhead trout, museum specimens of coho salmon from San Vicente Creek dating back to 1895, prior to the first known stocking of coho salmon south of San Francisco Bay, provide strong evidence that the species historically occurred in the watershed (Spence et al., 2011). However, recreational and industrial pressures on these populations were already significant at the time, as indicated by the following reports:

> *"Messrs. Tom Dakan and Rob Dudley whipped the San Vicente for trout Sunday with immense results. Eight hundred and fifty is the record they are willing to make their affidavit on, and all caught with a hook."* (Surf 6/2/1891)

> *"The San Vicente Creek, beloved of the angler and the artist, has its mouth stopped by a vast dyke, and its throat choked into a tunnel, a saloon on its border, and its bed for miles denuded of the granite cobbles and sand beds. A sawmill is swiftly cutting out the timber and dirt and debris defile the pools and clog the riffles where lurked the gamey trout."* (Surf 2/02/1906)

In 1934, CDFW staff surveyed San Vicente Creek and noted both the presence of steelhead and past steelhead stocking. Natural propagation was said to be "good in normal years" (DFG, 1953). A CDFW (DFG, 1953) report states, "...the upper portion of this creek is a beautiful trout creek."

Coho salmon occurrences in San Vicente Creek have been documented a number of times over the past three decades, including in 1981 by Harvey & Stanley Associates (1982), in 1991 by McGinnis (1991), and in 1996 by CDFW (DFG, 1998). Steelhead have consistently been documented in San Vicente Creek throughout these and more recent survey efforts. By the late 1990's, CDFW considered the San Vicente Creek coho salmon population to be near extinction (DFG, 1998). However, a smolt outmigrant study conducted for NMFS and the Coast Dairies Land Company in the spring of 2003 captured over 1,000 coho salmon smolts and over 2,000 juvenile steelhead (ESA, 2003).

Subsequent randomized snorkel surveys, performed by SWFSC staff in 2008, observed a total of 188 juvenile coho salmon in the watershed. While this is a relatively small number from a population viability perspective, it represented the highest coho salmon abundance of any sampled watershed south of San Francisco Bay at that time (NMFS, 2012). San Vicente Creek has been identified by NMFS biologists as one of the highest priority anadromous fishery creeks south of the Golden Gate (Best, pers. comm.).

CDFW staff conducted spawning surveys in San Vicente Creek (excluding Mill Creek) and other drainages in Santa Cruz and San Mateo counties during the 2011-2012 spawning season1 to estimate regional escapement and general run timing (Jankovitz, 2012). The surveys were conducted at 10 to 14 day recurrence intervals and generally followed a protocol designed for monitoring salmonids along the north coast of California outlined by Gallagher and Knechtle (2005). However, while the protocol calls for surveys of randomly selected stream reaches, mainstem San Vicente Creek was surveyed in its entirety due to ease of access, short extent of anadromy, and the importance of the system to coho salmon recovery efforts. CDFW staff observed a total of 22 live broodstock coho salmon (see discussion of the broodstock program below), four broodstock carcasses, two ocean return coho salmon of unknown hatchery origin2, and 14 coho salmon redds between January 24 to March 1, 2012 (Jankovitz, 2012). All observations were made between the mouth of San Vicente Creek and the confluence of Mill Creek. The two ocean return coho of unknown hatchery origin were observed spawning in lower San Vicente Creek on February 17, 2012 and the resulting redd was observed and measured on February 28. This was the only pair of coho known to have returned from sea and successfully spawned in the entire Santa Cruz/San Mateo survey area3 during the

1 Spawning surveys were again conducted during the 2012-2013 spawning season, but results were not available at the time of report preparation.

2 The two adult coho salmon had clipped adipose fins, indicating they were hatchery releases, but did not contain any tags identifying the hatchery from which they were released (Jankovitz, 2012).

3 The survey area consisted of 21 randomly selected sampling reaches within

occurrence were low gradient riffle units (19%), run units (19%), and mid-channel pool units (15%). Based on percent total length, there were 21% run units, 18% low gradient riffle units, 16% high gradient riffle units. These results again suggest an overall reduction in pool habitat units, both in terms of frequency of occurrence and percent total stream length, between 1996 and 2010.

A total of 70 individual pool units were identified in 1996 under a random subsampling protocol (i.e., not all pools were quantified), with main channel pools being the most abundant (64%) pool habitat unit type, comprising 69% of the total length of pools. The 2010 assessment included quantification of all pool units and identified a total of 123 individual pools, with scour pools as the most frequently encountered at 53%, comprising 51% of the total length of all pools. Due to the different sampling intensities used for the two assessments, these numbers are not directly comparable.

Pool quality for salmonids increases with depth, particularly if instream shelter is present within the pool. Twenty-one of the 70 pools (30%) identified in 1996 had a residual depth of three feet or greater, while only 13 of the 123 pools (11%) had a residual depth of three feet or greater in 2010. Residual pool depth is a measure that is independent of streamflow or stage, and therefore provides a useful comparison tool. The residual pool depth data for 1996 and 2010 appear to indicate that pool depths have decreased considerably over 14 years. Coho salmon are known to prefer deep pools and relatively slow water velocities while steelhead generally reside in the more shallow and fast-flowing areas of a channel (e.g., Roni, 2002). As such, the apparent loss of deep pool habitat availability in San Vicente Creek has likely affected coho salmon disproportionately.

The depth of cobble embeddedness was estimated at pool tail-outs. This habitat parameter is rated on a scale of 1 to 5, with a value of 1 indicative of the best spawning conditions and a value of 4 representing the worst. A value of 5 is assigned to tail-outs that are deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other such features. Of the 70 pool tail-outs measured in 1996, one had a value of 1 (1%), 12 had a value of 2 (17%), 51 had a value of 3 (73%), one had a value of 4 (1%), and five had a value of 5 (7%). Of the 123 pool tail-outs measured in 2010, 13 had a value of 1 (11%), 78 had a value of 2 (63%), 8 had a value of 3 (7%), none had a value of 4, and 24 had a value of 5 (20%). As such, a total of 74% of measured pool tail-outs had embeddedness ratings (1 or 2) generally considered suitable for salmonid spawning in 2010, while only 18% of tail-outs contained embeddedness levels suitable for spawning in 1996. Based on this analysis alone, fine sediment levels in San Vicente Creek may have decreased over time. This observation is consistent with the results of a sediment source inventory conducted for this report (chapter 2) that "identified very few active sediment sources that currently may impair spawning/rearing habitat."

Available instream cover was evaluated using a standard shelter rating for each habitat unit. The proportion of each habitat unit that is influenced by some type of shelter is estimated as a percentage of the total surface area of the unit, and a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) is assigned according to the complexity of the cover. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream. A pool shelter rating of approximately 100 is desirable for salmonids. For San Vicente Creek, the mean shelter ratings for riffle and flatwater habitat types were very low (ratings of 10 or less) and similar to each other in 1996 and 2010. However, the mean shelter rating value for pools increased from 12 in 1996 to 35 in 2010. The dominant overall cover type was boulders during both assessment years. Within pools, the dominant cover types were root masses and boulders in 1996, but terrestrial vegetation and small woody debris in 2010. More importantly, large woody debris (LWD) accounted for only 7% of measured pool cover in 1996, but for 16% in 2010. These values may be indicative of marginal increases in large woody debris (LWD) loading in San Vicente Creek over the past 14 years. A detailed discussion of current LWD loading and recruitment potential is provided in chapter 5 of this report.

Channel substrate size suitability for salmonid spawning was evaluated differently in 1996 (sampled in low gradient riffles) and 2010 (sampled in pool tail-outs). During the former assessment, 100% of low gradient riffles contained large cobble as the dominant substrate size, which is generally considered unsuitable for spawning. In 2010, gravel substrate was dominant in 34% of pool tail-outs and small cobble substrate was dominant in 31% of pool tail-outs in 2010. Gravel and small cobble substrates are generally considered to provide suitable spawning conditions. No comparative conclusions can be drawn from the data presented for the two assessments, other than a potential indication that low gradient riffles in San Vicente Creek may not provide suitable spawning conditions (at least in 1996) while the majority of pool tail-outs appear to provide spawning opportunities (at least in 2010).

The mean percent canopy density for the surveyed length of San Vicente Creek was 87% in 1996 and 92% in 2010. In 1996, 75% of canopy cover was provided by hardwood trees, 12% by conifers, and 13% of the survey reach was classified as open (i.e., no canopy cover). In 2010, 78% of canopy cover was provided by hardwood trees, 14% by conifers, and only 8% of the survey reach was classified as open. Similar trends were observed in the percentage of vegetated streambanks, with 73% and 76% of the right and left banks, respectively, vegetated in 1996; and 77% and 80% of the right and left banks, respectively, vegetated in 2010. Although individual canopy cover and bank vegetation values for 1996 and 2010 are very similar, the data suggest that a gradual trend toward increased canopy cover has occurred since 1996.

Figure 4-2. Processing of juvenile salmonids captured in San Vicente Creek, Spring 2013

Marked fish were released approximately 200 feet upstream of the outmigrant trap. PIT tag codes were used to identify and quantify marked and subsequently recaptured fish.

Outmigrant traps typically need to be removed from the stream during high flow events. However, water year 2013 proved to be a drought year along the central coast of California and no significant storm events occurred during the trapping period. As such, the trap remained in place and operational during the entire outmigrant study.

Juvenile Distribution

In July 2012, SWFSC staff conducted snorkel surveys in mainstem San Vicente Creek to document the distribution and abundance of juvenile coho salmon. The snorkel survey extended approximately 3.4 miles from the confluence with the Pacific Ocean to the quarry tunnel representing the upstream limit of anadromy. Procedurally, two snorkelers equipped with dive lights worked side-by-side to cover the width of the stream and slowly proceeded in an upstream direction. The survey was limited to pool habitat units and every pool encountered was sampled via a single pass. Based on methodologies previously employed by SWFSC staff (Spence, unpublished data), pools were defined as habitat units of at least 2.0 m^2 (21.5 ft^2) in surface area, widths at least one-half the wetted-width of the channel, and maximum depths exceeding 0.3 m (1 ft). For each pool, only the number of juvenile coho salmon was recorded; steelhead were not enumerated. Physical habitat information including location, total pool length, pool width, maximum pool depth, and pool tail depth were also recorded for each unit surveyed.

FINDINGS

Smolt Outmigration

Coho Salmon

A total of 329 juvenile coho salmon were captured in the outmigrant trap between March 2 and June 15, 2013. Of this total, 196 fish were marked with CWT, indicating that they were broodstock smolts released into the system on April 23, 2012. Of these totals, one non-CWT and three CWT coho were recaptures (see below). Furthermore, two of juvenile coho salmon captured toward the end of the trapping period were age 0+ fish (based on forklength). One of these was marked with a red visible implant elastomer (VIE) tag, indicating it was broodstock fish previously released as a fry; the other fish had no visible mark, suggesting it may have been the offspring of instream spawning. As such, the total tally of individual captured juvenile coho salmon was 130 non-CWT smolts, 193 CWT smolts, one VIE fry, and one non-VIE fry. In comparison, the 2003 trapping study (ESA, 2003) captured 703 smolts in mainstem San Vicente Creek and 319 smolts migrating from the Lower San Vicente Pond off-channel habitat feature[4], for a total of 1,022 smolts.

A total of five juvenile coho salmon were found dead upon arrival at the traps. Two of these mortalities were CWT-marked broodstock smolts and external fungus was observed on two others. Fungus infections were noted on a total of thirteen juvenile coho salmon, but twelve of these were CWT-marked broodstock smolts. Minor to moderately severe black spot (*Neascus sp.*) infestations were observed on only six captured coho salmon, none of which were broodstock CWT-marked broodstock smolts. One additional juvenile coho salmon mortality occurred during PIT-tagging.

Trap efficiency tests were inconclusive. On one hand, we felt that the positioning of the trap assured that essentially 100% of the channel width and depth were blocked by the trap and wing seines, and the absence of significant storm events enable us to operate the trap continuously without the trap being bypassed, over-topped, or removed. On the other hand, however, recapture success was low. A total of 26 coho salmon smolts (22 CWT broodstock smolts, 4 non-CWT smolts) captured in the trap were marked and released upstream. Of these, only four (three CWT broodstock smolts, one non-CWT smolt) were subsequently recaptured in the trap. These results suggest a low trap efficiency of approximately 15%. However, the recapture rate for non-broodstock smolts

4 The Lower San Vicente Pond site became hydrologically disconnected from San Vicente Creek in 2012. Therefore, no fish occupied this habitat in 2013.

likely to reattempt outmigration (with subsequent recapture) after being marked than non-smolts that may have initially been captured during redistribution, but did not down-migrate again after being marked. However, as discussed above, trapping efficiency qualitatively appeared to be close to 100% and the reasons for the relatively low recapture rates are not known. It is interesting to note that even though the majority (n = 27, 52.9%) of marked fish were recaptured within one day of being marked and released, the average time to recapture was 7.2 days and the maximum time was 68 days. Given the considerable delay in recapture observed in many marked fish, trap recognition and avoidance, particularly in light of the high underwater visibility (due to a lack of runoff-induced turbidity) that prevailed during most of the study period, may have been an important factor in the low number of recaptures. Predation may have also affected recapture rates.

The average forklength of steelhead smolts was 164 mm (standard deviation, SD, ± 22 mm), and the average wet weight of steelhead smolts was 42.2 g (SD ± 20.4 g) (Table 4-2). The average condition factors for steelhead smolts was 0.92 (SD ± 0.07).

By comparison, average forklengths of steelhead smolts captured in San Vicente Creek and Lower San Vicente Pond in 2003 were 152 mm (SD ± 21 mm) and 163 mm (SD ± 24 mm), respectively, and average wet weights were 34.3 g (SD ± 15.2 g) and 42.5 g (SD ± 21.8 g), respectively (Table 4-2). As such, average sizes of steelhead smolts in 2013 were larger than those trapped in the mainstem in 2003, and similar in size to those captured exiting the off-channel habitat in 2003. Condition factors in 2003 were similar at 0.93 (creek) and 0.92 (pond).

Outmigration timing

Coho smolt migration timing along the central California coast has been studied in some detail. The results of a 9-year coho salmon and steelhead study on Waddell Creek show that the great majority of coho smolts enter the ocean during the months of April and May, with over 95% of the migration occurring during the 9-week period of April 8 through June 9 (Shapovalov and Taft, 1954). In 2013, 99% of all coho salmon smolts were captured in the outmigrant trap during that period, and the peak of the outmigration occurred during a 3-week period extending from May 3 through May 23 (Figure 4-3) during which 57% of the migration occurred. The peak of the steelhead smolt downstream migration occurred approximately one month earlier during the 3-week period of April 5 through April 25 (Figure 4-3), during which 63% of the migration occurred.

The timing of the peak smolt outmigration in San Vicente Creek was very similar during 2013 and 2003 for coho salmon (Figure 4-4). For steelhead, the migration timing as depicted in Figure 4-5 suggests that the 2013 migration peaked approximately one week earlier than in 2003, but as described in ESA (2003), the trap was non-operational for a total of three days during the week of April 12 through April 18, 2003. This weekly period had the highest number of steelhead smolt captures in 2013, and may have also had the highest number of outmigrants in 2003 if the trap could have been operated during the entire period.

Juvenile Distribution

Of the 131 pool habitat units surveyed by SWFSC staff, 66 (50%) contained one or more juvenile coho salmon (Figure 4-6). Notably, only 5 individuals were observed above stream mile 1.9 where a large debris jam restricted passage by adult salmon the previous winter. No redds or live adults were observed upstream of this point during the 2011-2012 spawner surveys (Jankovitz, 2012). Consequently, coho salmon were absent from nearly 1.5 miles (45 suitable pool habitat units; Figure 4-7) of potential rearing habitat in the mainstem during the summer of 2012.

Many factors determine juvenile salmonid rearing habitat site selection, but the 2012 distribution data suggest that coho salmon rearing in San Vicente Creek is concentrated within reaches containing abundant and large pools. Furthermore, juvenile coho salmon in San Vicente Creek appear to remain relatively close to spawning sites. Juvenile coho salmon have been shown to migrate considerable distances from their natal reaches, but this tendency is typically thought to be a response to rising summer water temperatures forcing juveniles to seek out cooler rearing habitat elsewhere in the watershed. Relatively cool and stable summer water temperatures in San Vicente Creek likely reduce or eliminate the need for significant juvenile redistribution. It should be noted, however, that the lowermost reaches of the stream also show a concentration of coho salmon rearing, even though no redds were observed in this area during spawner surveys. A certain amount of downstream redistribution of juveniles occurs in most drainages.

Conclusions

As described above, the fisheries portion of this Existing Conditions assessment was initially envisioned to provide an evaluation of the current status of salmonids in general, and coho salmon in particular, within the watershed. The overall goal was to determine whether coho salmon were still utilizing San Vicente Creek. However, the focus of the assessment shifted after NOAA's SWFSC, in collaboration with MBSTP, embarked on a concerted coho salmon broodstock reintroduction and research effort. As such, the coho salmon population within the watershed is currently being artificially supplemented. Available data from a 2011-2012 spawner surveys, a July 2012 juvenile distribution survey, and a spring 2013 smolt outmigration study indicate that limited spawning is occurring, and at least a portion of the offspring and/or broodstock juveniles are successfully rearing and subsequently migrating to the ocean. The proportion of the wild versus broodstock coho salmon in San Vicente Creek is currently unknown, but this information will become available once the genetic samples that have been collected over the past two years are analyzed.

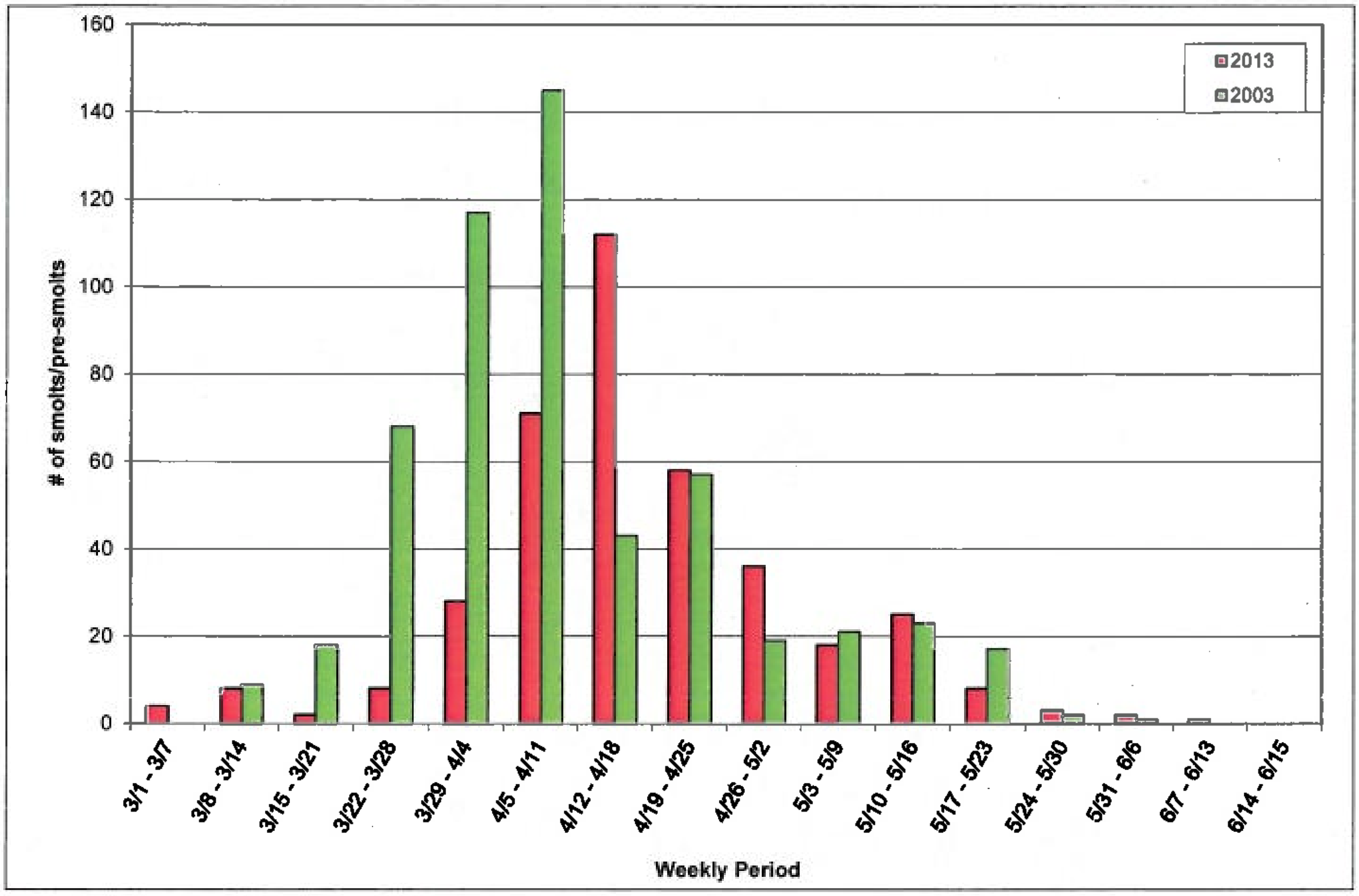


Figure 4-5. Steelhead smolt migration timing, San Vicente Creek, March 1–June 15, 2013 and 2003.

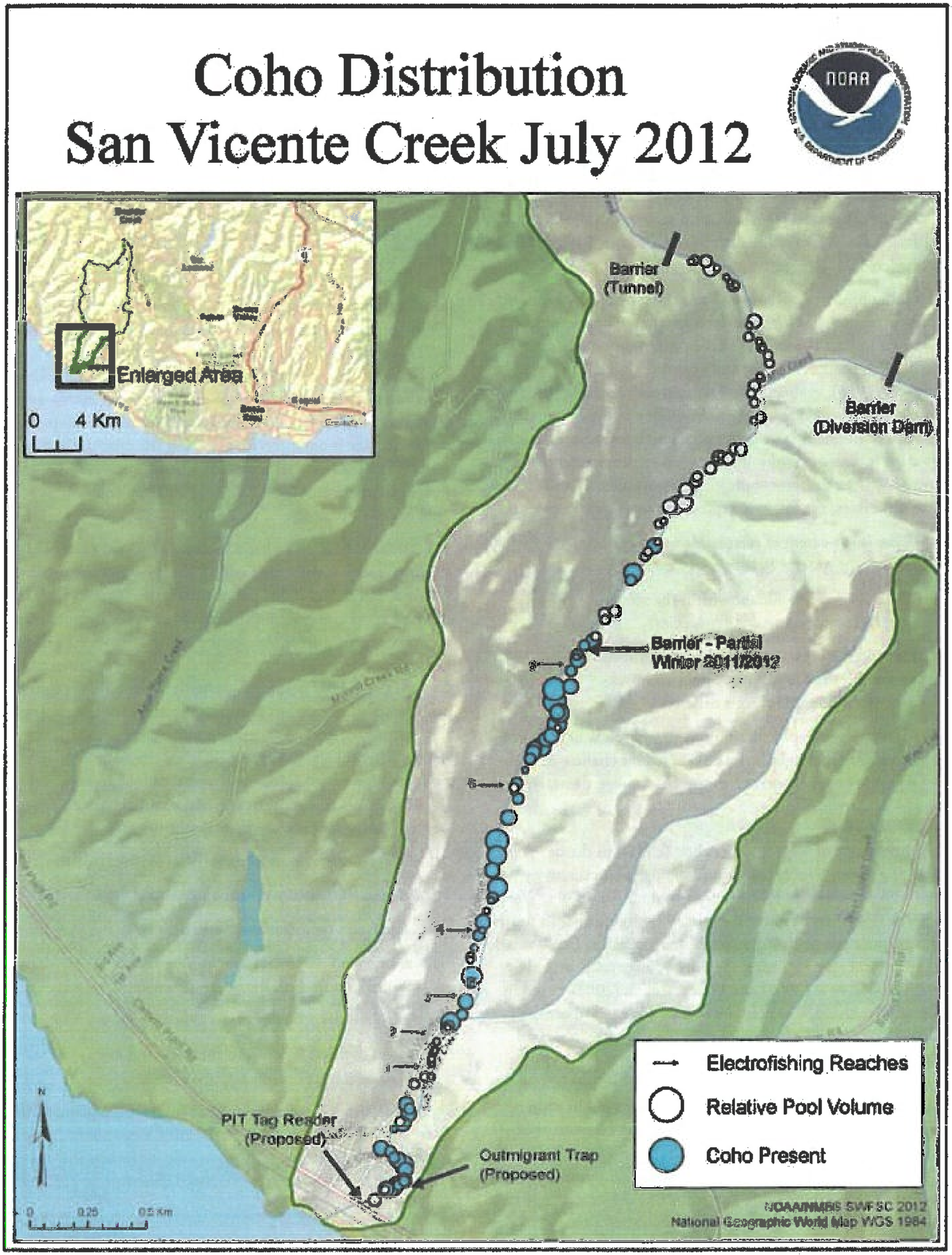


Figure 4-7. Spatial distribution of pool habitat units identified, relative pool volume, and juvenile coho salmon presence within pool habitat units.

residents, increased rates of sedimentation, and loss, alteration, and simplification of riparian forests which leads to a lack of significant large wood recruitment. In San Vicente Creek, specifically, contributing factors are likely historical grazing adjacent to and within the riparian corridor and flood control methods in the community of Davenport (RCD, 2010). The deficiency of pools is indicative of the current and past land use practices and associated removal of LWD from riparian areas and streams within the channel.

Lack of recruitment is due in large part to the much younger age of current riparian forests which generally lack older, larger trees that fall into the stream as they age and die. The absence of large wood in the stream, in particular, has major impacts on coho salmon because of its role in physical habitat formation, in sediment and organic-matter storage, and in maintaining a high degree of spatial heterogeneity (habitat complexity) in stream channels. Instream pools provide an increase in the volume of rearing habitat and, as such, data indicates that stream reaches with a high density of deep cool pools allow for a greater density of juvenile coho than an equivalent length of stream with limited pool habitats (NMFS, 2012). Decreases in coho abundances following LWD removal or loss have been widely documented and are often linked to loss of pool habitat for summer rearing and for winter refuge. Maintaining pool habitats, reversing the mechanisms leading to their loss, and adding wood will be critical to ensuring adequate summer and winter rearing habitat in streams designated by the California Department of Fish and Wildlife (CDFW) and/or the NMFS for recovery of endangered central California coast coho salmon (NMFS, 2012).

While the NMFS Recovery Plan (2012) notes that water quality, fish passage and migration, stream temperature and water quality as being "good" or "very good", habitat complexity for San Vicente Creek is listed as "poor" for LWD and the shelter rating. To address these, NMFS priorities actions include:

1. Improve over-winter survival by increasing the frequency and functionality of off-channel habitat (Recovery Action 2),
2. Increase shelter ratings to optimal conditions (>80 pool shelter value) in mainstem San Vicente Creek (Recovery Action 3),
3. Increase large wood frequency (Recovery Action 4), and
4. Increase pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order streams; >3 feet in third order or larger streams) (Recovery Action 3).

Past Actions: A severe paucity of large woody debris and subsequent lack of pool habitat within San Vicente Creek Watershed has been noted by many biologists, ecologists, and planners over the past few decades, including the County of Santa Cruz (County of Santa Cruz, 2000) and RCD (2010). In response to this lack of pool frequency, abundance and depth, the County of Santa Cruz installed 18 complex large wood habitat structures in 1999 within a reach extending from approximately one mile above the mouth of San Vicente Creek to the confluence of San Vicente and Mill Creek at stream mile 2.5. A total of 106 pieces of large wood and root balls were installed. Natural stream meander has since rendered a number of these structures nonfunctional, but some remain in or along the channel and continue to provide refugia for anadramous fish through maintenance of pools and slack water and increased instream cover (RCD, 2010).

While reconnaissance level stream surveys conducted by the RCD and its partners for the Bureau of Land Management (BLM) in 2010 revealed greater frequency and complexity of LWD features (compared to observations in 2008) in a small reach below the lower pond outlet (RCD, 2010), this study noted that a quantitative assessment of current LWD loading was needed for the entire watershed. The RCD's work for this assessment focused on identifying near-future opportunities for LWD augmentation projects within an approximately 1-mile reach of lower San Vicente Creek extending from the inlet to the Lower San Vicente Pond upstream to the first bridge across the creek. This particular focus area was chosen based on the following criteria;

- The channel slope, substrate and proximal floodplains create natural conditions for LWD structure to develop, persist, and have maximum benefit for pool creation, sediment sorting, and reconnection of high flows with floodplains,
- Historic and current NMFS snorkeling surveys noting that juvenile coho salmon in San Vicente Creek have generally been observed using small pockets of habitat in the lower most 1 mile of the creek,
- LWD augmentation projects had previously been installed upstream of the bridge by the County, and
- The channel downstream of the Lower San Vicente Creek Pond outlet is geomorphically unstable (due to periodic backwatering effects of the Highway 1 culvert), in close proximity to residential development, and currently contains a number of smaller, naturally occurring LWD structures composed of a mix of live and dead alders, willows, and other material.

Based on the findings of the reconnaissance surveys, the RCD, with funding and support from CDFW, NMFS, and the Natural Resources Conservation Service (NRCS), installed eight LWD structures in 2011 in the focus area reach of in an effort to improve rearing and sheltering habitat for salmonids (RCD, 2010). Seventeen redwood and Douglas fir trees were sourced from the Santa Cruz Mountains, keeping the majority of their rootballs intact. These logs were buried into the banks of San Vicente Creek with the root wads placed directly into the creek itself. Each structure was designed with a different configuration to encourage recruitment of additional smaller woody debris, increase Instream habitat complexity, activate the adja-

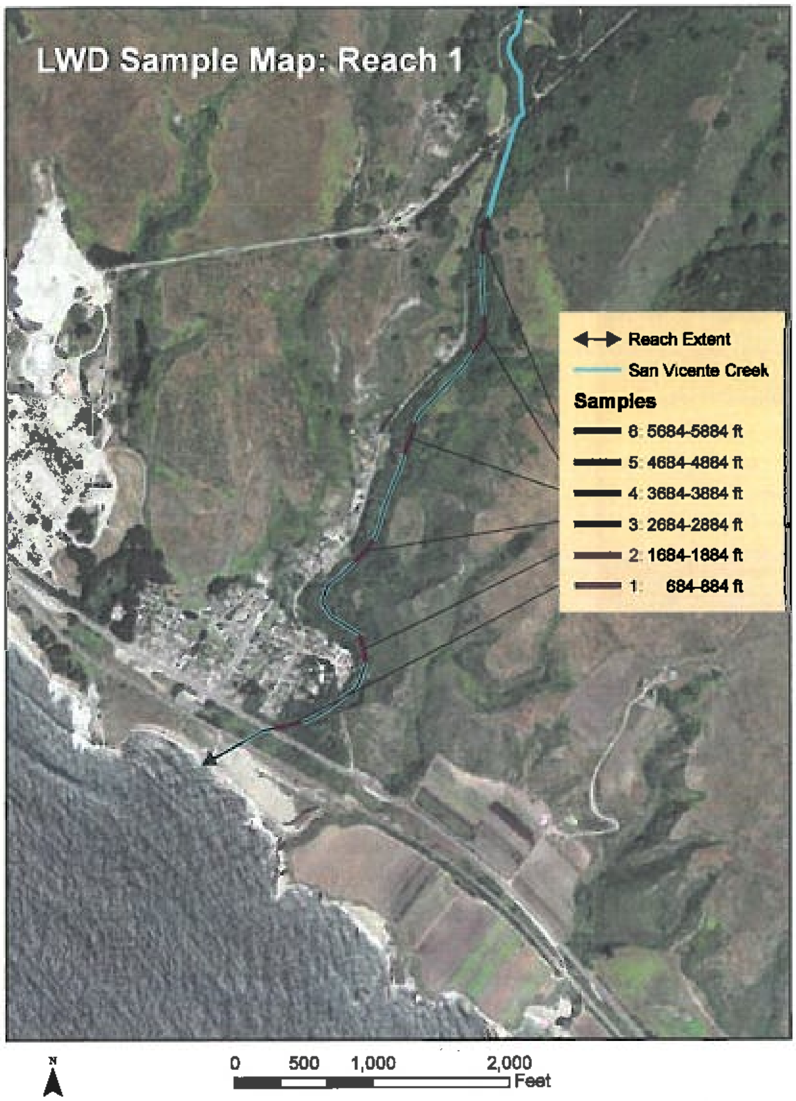


Figure 5-1a. Reach 1 LWD sample map

upslope side of the tree. Diameter of downed logs was the largest diameter anywhere along the log. During the survey in each 200-foot sample area, the surveyors periodically confirmed size, dimensions, and distances for accuracy and calibration. This ongoing calibration effort kept the surveyors' estimates more accurate.

Leicester's (2005) protocol requires identifying trees and LWD to the species level, as coniferous LWD is more decay resistant then hardwood and likely to persist in the channel longer. Secondly, as the probability of a tree falling into the stream decreases from the channel upslope, Leicester separates habitats into perched, riparian, and upslope zones to further evaluate recruitment potential. Perched applies to standing live or dead trees within the stream channel or to trees or downed wood at the edge of bankfull (active) channel, which are likely to be recruited at high flows. Riparian designates an area beginning at the edge of the bankfull channel and dominated by deciduous riparian trees. Upslope designates an area beyond the riparian zone that still falls within 75 ft of the bankfull channel. However, downed wood that cannot be observed has little chance of making it to the stream and thus, is not tallied. Slopes were measured for the riparian and upslope zones separately. Thirdly, four categories are used within the bankfull channel to indicate the effects of LWD on habitat features: a) lowflow/pool for LWD pieces in the lowflow channel which are creating or enhancing a pool, b) lowflow/extra for pieces in the low flow channel present but not creating pool habitat, c) bankfull/backwater for pieces in the remainder of the stream channel which were creating or enhancing backwater or high water refugium, and d) bankfull/extra for pieces in the bankfull channel which were present but not contributing to the creation or enhancement of backwater or refuge habitat. Bankfull width and depth were also measured.

For this assessment, Leicester's protocol was further refined to address specific conditions associated with the San Vicente Creek watershed. Wood recruitment potential was documented as less than 75 feet, if the edge of an access road was located within the 75 feet. This is because past observations show that when trees fall across the road, they are cut up with a chain saw for road access and are removed from the system as possible LWD.

In addition, Leicester (2005) noted a deficiency in the survey method of LWD debris jams as they often occurred outside sample boundaries and were not tallied. As the location of LWD structures vary in distribution they may not be included in the 200 foot sample sections and a significant portion of the total in channel LWD present in the stream may not be recorded. As this underrepresentation of wood accumulation could affect not only the documented health of the stream system, but also influence future recommendations, all LWD structures were noted during stream surveys and the findings are discussed separately in the following section.

All LWD and trees located within the sample areas and which measured greater than 6 feet (1.8 m) in length and 1 foot (30 cm) in diameter were identified to species and recorded with their sizes, locations, positions in the channel and association with any habitat structures (pool or backwater). The form categorizes trees, logs, and stumps in the bankfull channel or adjacent to the channel by length [6-20 feet (2-6 m), >20 feet (>6 m), diameter [in I-foot (30 cm) increments from 1 foot (30 cm) to >4 feet (120 cm)], and location (bankfull channel, "perched" at the edge of the bankfull channel, or upslope; on the left or right bank). All trees within the channel and/or 75 feet (23 m) up the bank on either side were recorded by diameter as live or dead. Out-of-channel trees and logs are also recorded as conifer or deciduous. Root wads and stumps are also differentiated. Stumps are fully rooted in the ground and are at distances far enough from the stream that there is

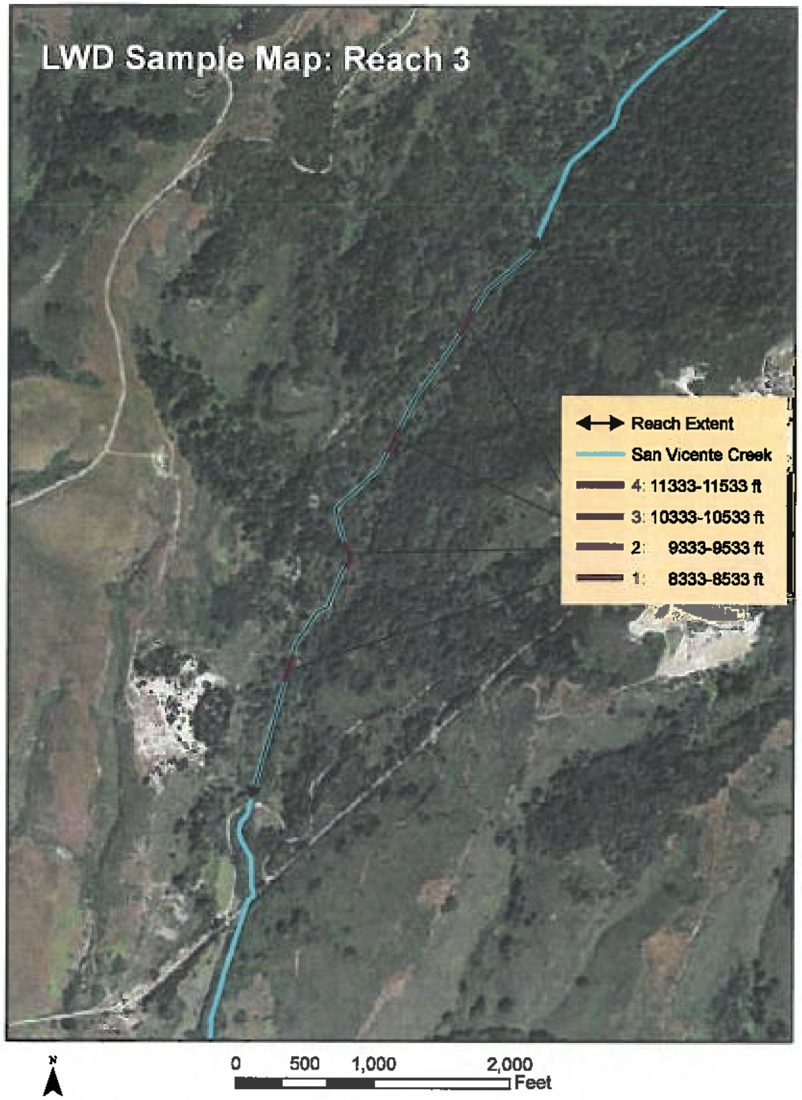


Figure 5-1c. Reach 3 LWD sample map

remains visible on the right bank. Doug Fir is the dominant species within this reach (87%).

Reach 6 has a bankfull width of approximately 11 feet. This is the steepest (>7%), most incised reach and is dominated by Redwood (65%), followed by Doug fir (34%). A private access road is visible for a portion of the reach on the right bank.

Wood Distribution

Recruitment of large pieces of wood to streams is a dynamic process consisting of episodic disturbances, chronic riparian forest mortality, and stream erosion processes (Lienkaemper and Swanson, 1987; Benda et al., 2003). Wood recruitment into streams occurs either as a result of individual tree mortality or as a consequence of fine to coarse scale disturbances affecting multiple trees in the riparian forest (Benda et al., 2002). While individual tree mortality, caused by forces such as windthrow, contributes wood to the stream system, larger disturbance are responsible for the majority of wood recruitment. As streams meander onto broad floodplains, they create scour and cause shallow rooted trees (e.g., Alder) to fall into the stream, as well as remobilize stored wood. Likewise, during larger storm events as the water levels rise, streambank erosion can occur, undercutting trees in perched and riparian areas. These trees may fall directly into the stream or be deposited onto the streambank and recruited during future high flow events.

The width of floodplains and riparian areas influences the amount of wood readily available for recruitment. McDade et al. (1990) looked at LWD recruitability as a function of distance from the stream and found that 70% of wood originates from within 65 feet of the stream channel. To determine the recruitment potential from the perched and riparian areas in San Vicente Creek, the width of the riparian area was considered. Overall, the riparian area was widest in the downstream reaches where a broad, inactive floodplain has been noted for the left bank and gentle slopes allowed the stream to historically meander (see Table 5-2 and Figure 5-2). The widest riparian (mean) width was recorded for Reach 1 (61.7 feet), where the stream would have historically meandered (prior to construction of Highway 1) in this lower, flatter area before emptying into the Pacific Ocean. In Reach 4, the stream channel widens and flattens out (discussed as plane-bed in chapter 3) before steepening and becoming higher gradient and narrowing in the upper reaches, particularly for Reach 6 (Mill Creek), which had the lowest mean width (<17.5 feet). The riparian area is further confined in the upper reaches by the private access road, which was constructed adjacent to the stream channel. If wood recruitment occurs within 65 feet of the stream, most of the wood recruitment in the lower reaches of San Vicente Creek will be from the riparian area, whereas in Mill Creek, most of wood recruitment will occur in the upslope areas.

While McDade et al. (1990) considered proximity to the stream channel as a function of wood recruitment, it could also be hypothesized that a wider riparian corridor would have a greater tree density and thus a higher recruitment potential. Reaches 1, 3, and 4, which had the widest riparian areas when left and bank mean widths were averaged (56, 38, and 48 feet respectively), had the highest density of trees and logs within the riparian area per reach (490, 623, and 589 respectively) (see Figure 5-3). Reach 2, which had the same riparian width as Reach 3 (38.8 feet) had the lowest density of trees (90). Reaches 5 and 6, which had narrower riparian widths (35 and 16.3 feet respectively), had the lowest density of trees and logs within the riparian area per reach (148 and 217 respectively). When the values were standardized to eliminate the skew created by

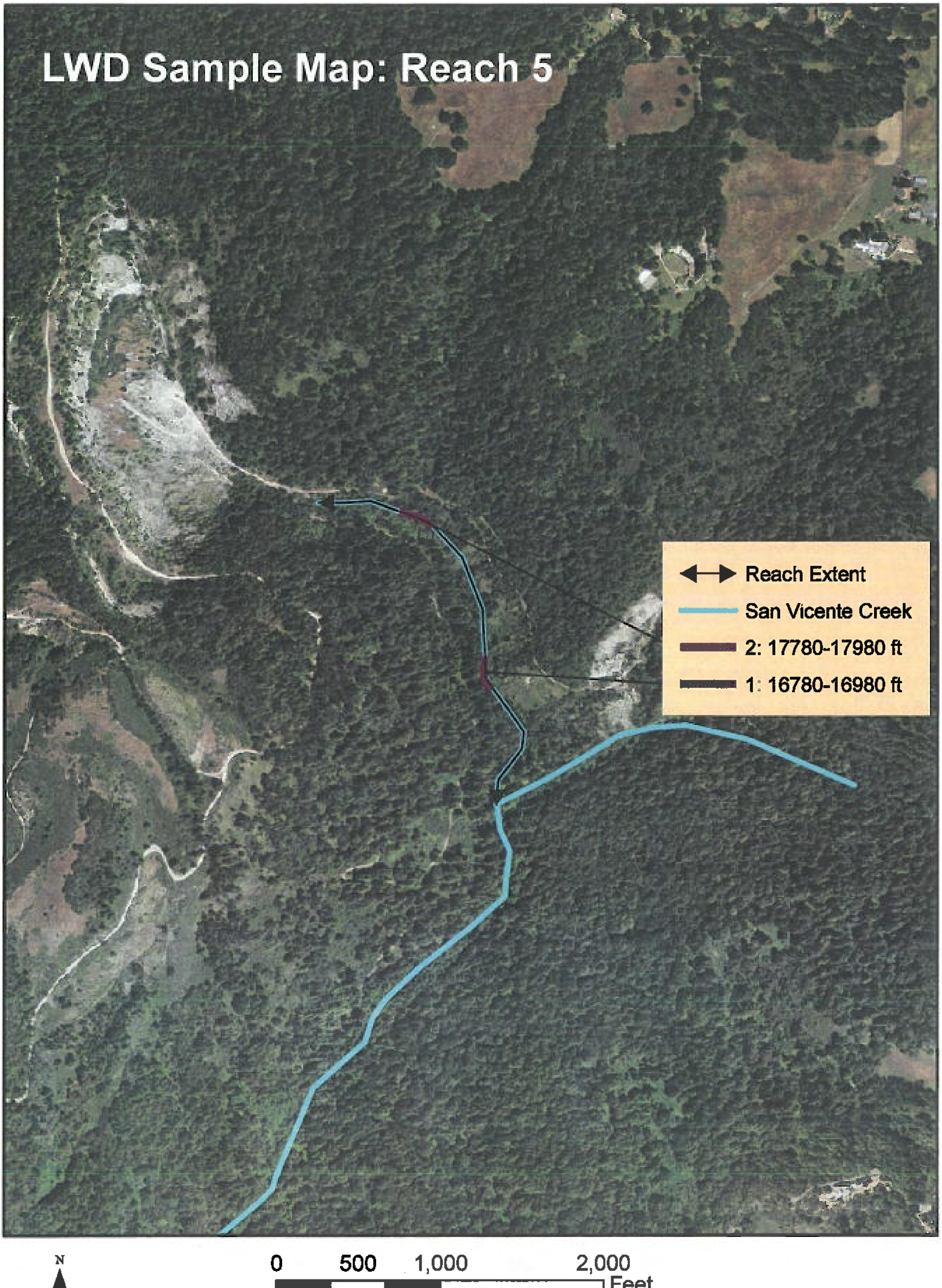


Figure 5-1e. Reach 5 LWD sample map.

Table 2. Reach lengths (feet), number of samples per reach, and Rosgen channel classification types.

	Riparian Width (ft)				Slope (%)							
	Left Bank		Right Bank		Left Bank Upslope		Left Bank Riparian		Right Bank Riparian		Right Bank Upslope	
Reach	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
1	61.7	20-75	50.8	25-75	32.5	29-37	28.7	13-45	22.8	11-42	21.3	9-30
2	50.0	50.0	27.5	25-30	43.5	36-51	16.5	15-18	26.0	23-29	35.0	35.0
3	45.0	40-60	32.5	20-40	30.0	30.0	19.5	9-29	18.0	8-34	65.0	25-90
4	48.3	40-60	48.3	45-50	51.7	35-64	24.3	13-43	19.7	19-20	53.0	53.0
5	42.5	35-50	27.5	25-30	65.0	65	27.5	20-35	40.0	35-45	56.0	47-65
6	17.5	ID	15.0	ID	40.0	35-45	19.5	14-25	47.5	40-50	42.5	15-70

varying reach lengths, reaches with the widest riparian area (Reaches 1, 3, and 4) were still found to support the highest amount of riparian trees (see Figure 5-4). While, Reach 2, which had the shortest reach length (1,628 feet), shows a higher density of trees with standardization (0.06 trees per linear foot), this is still substantially lower in terms of potential wood recruitment than the other reaches. Reach 6, which had the narrowest riparian area (17.5 feet), also shows a higher density of trees with standardization (0.09 trees per linear foot), which is slightly higher than Reach 1.

As floodplain re-activation will be critical to restoring stream function and wood recruitment processes in San Vicente Creek, wide riparian areas will be a plentiful source of wood in the future, particularly in those areas with gentle slopes. Reaches 1, 3 and 4 have both the widest riparian areas and the gentlest slopes when looking at the ranges for both the left and right banks (see Table 5-2). While Reach 6 may have adequate wood recruitment potential, the narrow channel will likely limit the transport of this wood material downstream to valuable coho habitat.

As the stream exerts erosive forces on the bank over time, a wider riparian area with a corresponding increase in tree density has a greater potential to have perched trees. Similar to the riparian areas, there was a pattern of an increase in

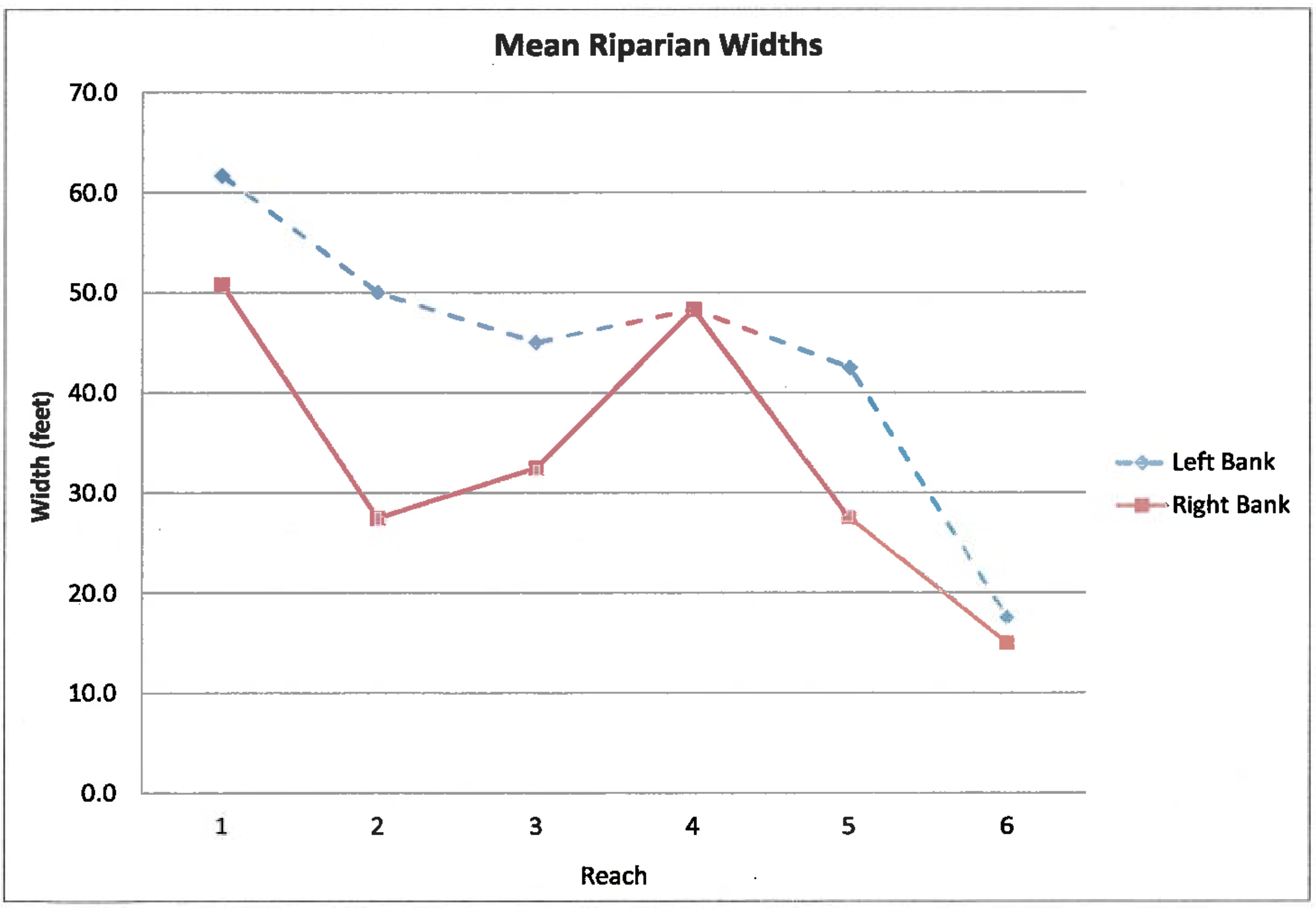


Figure 5-2.

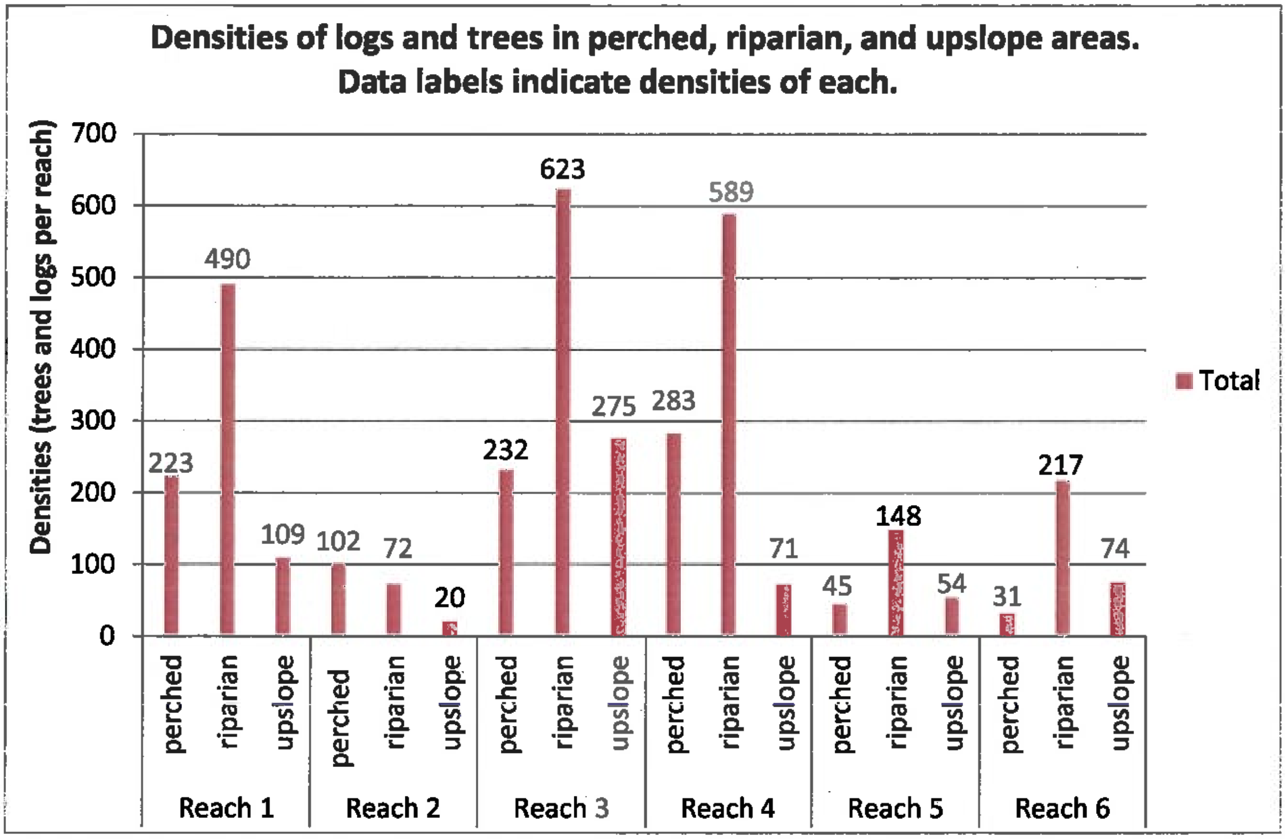


Figure 5-5.

as this assessment showed that the majority of recruitable wood along the floodplain is hardwood.

Riparian vegetation type was roughly linked to riparian width, with the wider, downstream reaches dominated by hardwood riparian forests and the narrower upstream riparian areas having more abundant conifers (see Figure 5-6). Reach 1 had almost 500 hardwood trees compared to less than 55 hardwoods in Reaches 5 and 6. Likewise Reaches 1 and 2 had fewer than 10 conifers, while Reaches 5 and 6 had greater than 125. When the values were standardized to eliminate the skew created by varying reach lengths, the wider downstream reaches were still dominated by hardwood riparian forests (4 to 9 trees per linear foot), while the upper reaches had a higher proportion of conifers (5 to 7 trees per linear foot) (see Figure 5-7). Reach 4 has the highest density of conifers (0.03 trees per linear foot) and second highest density of hardwoods (0.05 trees per linear foot).

Similar to the riparian zones, the perched area was dominated by hardwoods (see Figure 5-8 and Figure 5-12). As the "perched" category is defined as a hardwood-dominated transition area, it makes sense that it is dominated by hardwood species. As perched trees are the result of bank undercutting and erosion, these hardwood species are more likely to be recruited to the stream channel during flood events and thus contribute to the high proportion of hardwood within San Vicente Creek. While Reaches 1, 2, and 3 were still dominated by hardwoods, when the values were standardized to eliminate the skew created by varying reach lengths, there is an inverse relationship

Table 5-3. Correlation between riparian width and density of vegetation. The percent given represent the number of trees within the perched, riparian, or uplsope areas based on the total number of trees per reach.

Reach	Riparian Width*	Percent of Total , Riparian	Upslope Width*	Percent of Total, Upslope
1	56	69	19	15
2	39	42	36	10
3	39	55	36	24
4	48	63	27	27
5	35	52	40	24
6	16	41	59	42

*width has been rounded to a whole number.

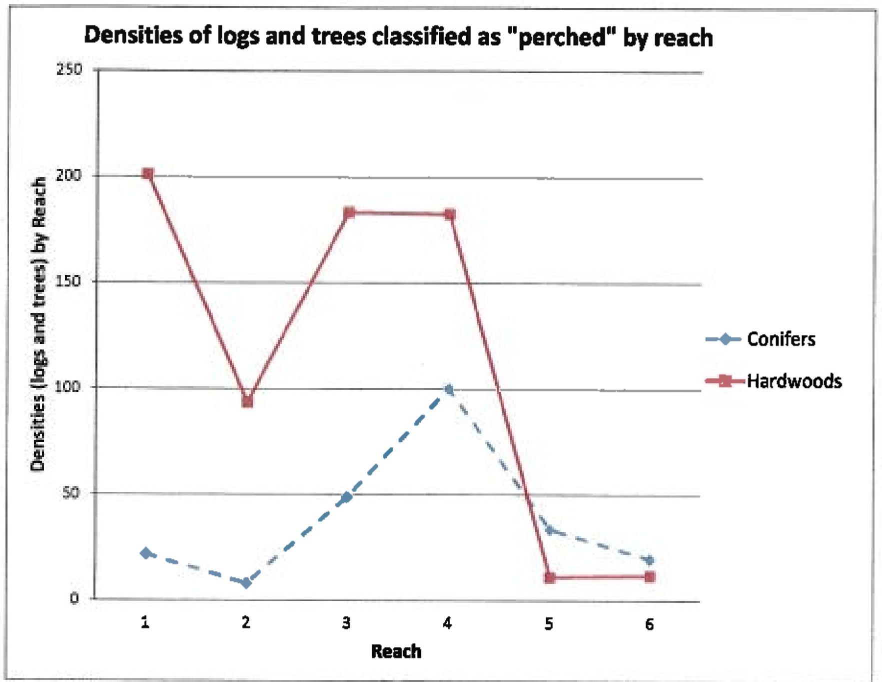


Figure 5-8.

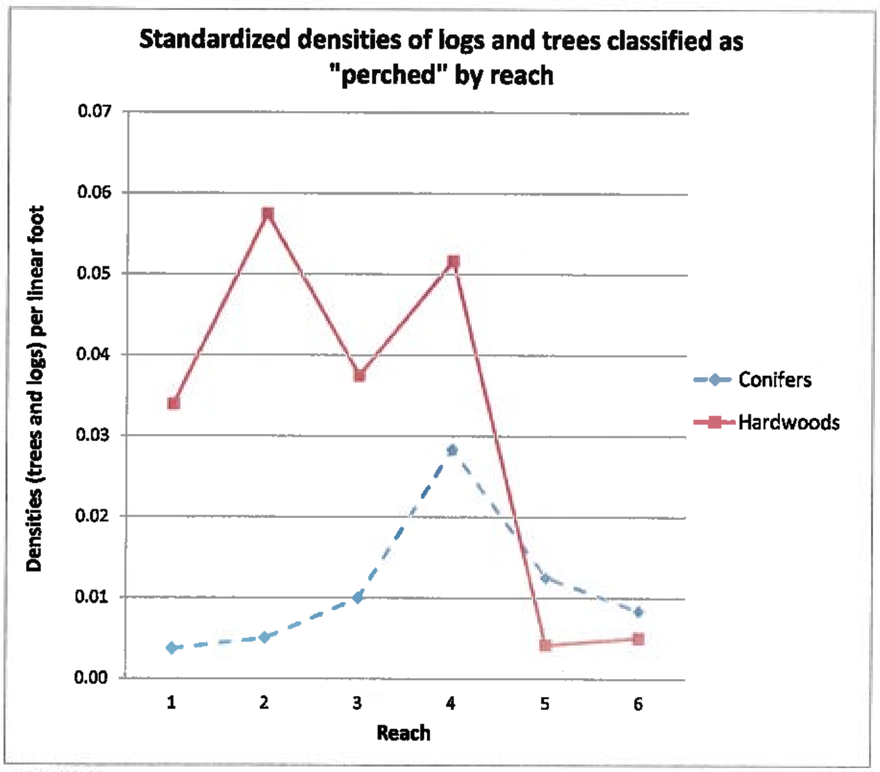


Figure 5-9.

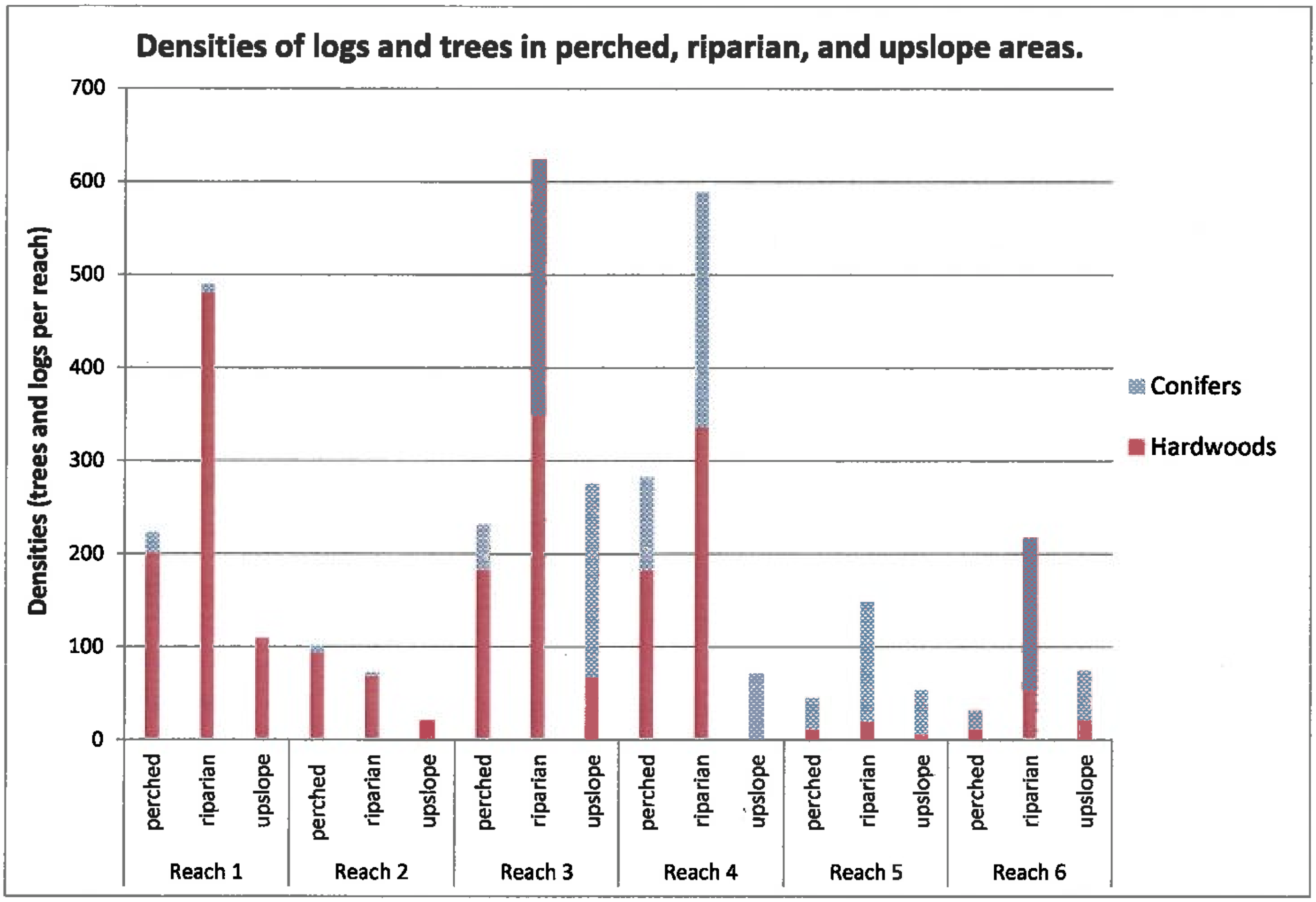
the previous section on potential wood recruitment, noting the current LWD distribution and abundance will guide recommendations for future wood recruitment projects.

Overall, there were only 102 pieces of in-channel LWD documented within the sample reaches (see Figure 5-14). Reach 1 had the highest overall in-channel density (62 pieces) . Reach 4 had the second highest density (19 pieces), followed by Reach 3 (15 pieces). The same pattern is seen when the values were standardized to account for the number of samples per reach. The high density in Reach 1 is likely due to the position in the watershed and lower gradient of the channel and that 4 of the 8 LWD structures implemented in 2011 by the RCD and NRCS occurred within Reach 1. The higher density of in-channel wood in Reach 3 was attributed to the LWD structures installed by the County of Santa Cruz as the area surveyed was less than 75 feet due to the presence of an access road. As previously mentioned, downed trees that had fallen across the road are often cut to restore vehicle access and as such, this wood does not make its way to the stream. Such activities were evident for Reach 3 during field surveys. As such, much of the wood which would have been accounted for in the upslope area was not tallied. The larger quantity of wood in Reach 4 may be attributed to its position (at the confluence of Mill Creek) or the low gradient of the stream in this area. All other reaches had less than 10 pieces.

The Conservation Action Planning (CAP) Viability Results noted in NMFS' Coho Recovery Plan (2012), rated San Vicente Creek as "poor" for habitat complexity for adult, summer rearing juveniles and winter rearing juvenile coho with <4 key pieces per 100 meters biologically function wood (BFW) 0-10 meters) and < 1 key piece per 100 meters (BFW 10-100 meters). The desired criteria in NMFS' Coho Recovery Plan is listed as 6 to 11 key pieces per 100 meters, and 1.3 to 4 key pieces per 100 meters for the above listed indicators. This assessment confirmed that San Vicente severely deficient in meeting the desired criteria. Reach 1 had 4 pieces per 100 meters, Reach 4 had 2 pieces per 100 meters, and Reaches 2 and 3 had 1 piece per 100 meters.

However, Leicester (2005) noted a deficiency in the survey method in that debris jams outside the sample boundaries were not tallied. As jams are spotty in distribution, they are likely to occur outside of the 200-foot sample sections. This could result in a significant portion of the total in channel LWD present in the stream not being recorded. To achieve a more accurate estimation, all in-channel LWD was documented and analyzed in this assessment.

When LWD outside of the sample areas was considered, the density of in-channel LWD



5-12.

Creek, all in-channel LWD was considered. Overall, LWD formed in-channel 56% of the time. It's important to note that while pools and backwater habitat was noted with conifer LWD 45% of the time, 69% of the time that hardwood was observed, it was associated with a pool or backwater structure (see Figure 5-16). This small, high decaying wood seems to have a large impact on the creation of pools and aquatic habitat within the stream system. Whether the LWD resulted in the creation of pool or backwater habitat varied depending on the reach. In Reach 1, the presence of wood resulted in pool or backwater habitats 75% of the time and the predominance of this was from hardwood species. In Reach 2, the presence of wood resulted in pool or backwater habitat 100% of the time, but the sample size was small (5 pieces). In Reach 3, the presence of LWD resulted in an Instream structure (pool or backwater) 44% of the time. In Reach 4, LWD resulted in an Instream structure only 34% of the time. The formation of pools was closely observed within the first year for all 8 structures installed by the RCD in Reach 1. All LWD structures formed pools and most were recorded between 2 and 3 feet in depth. It is important to note that while LWD tallied and classified as "extra" is not currently contributing to habitat structures or their formation, it has the potential to become mobile during storm events and become associated with debris jams. Bilby (1984) and Swanson et al. (1984) found that, while the largest pieces of LWD were more stable and likely to create habitat, smaller pieces associated with debris jams could also contribute to habitat formation, since they become mobile during floods. If more large-diameter logs were added to the stream to serve as "catcher" logs, much of the smaller "extra" LWD may have a chance to be incorporated in a debris jam and begin to form habitat, rather than being rinsed out of the system,.Larger "extra" LWD also provides opportunities for habitat enhancement if it can be moved within the channel to more productive configurations or locations (Leicester, 2005).

Keim and Skaugset (2002) found that a piece of LWD with a rootwad attached was far more likely to form a pool or be a key piece in a log jam than a piece without a rootwad. For the in-channel LWD noted in San Vicente Creek watershed, 26 trees had rootwads. Of these, 88% were redwood. The remaining 12% were alder. However, 50% of these were associated with past project implemented by the County of Santa Cruz or RCD. Approximately 60% of the time, trees with rootwads occurred on the left bank; 70% of the in-channel wood was noted to be located on the left bank.

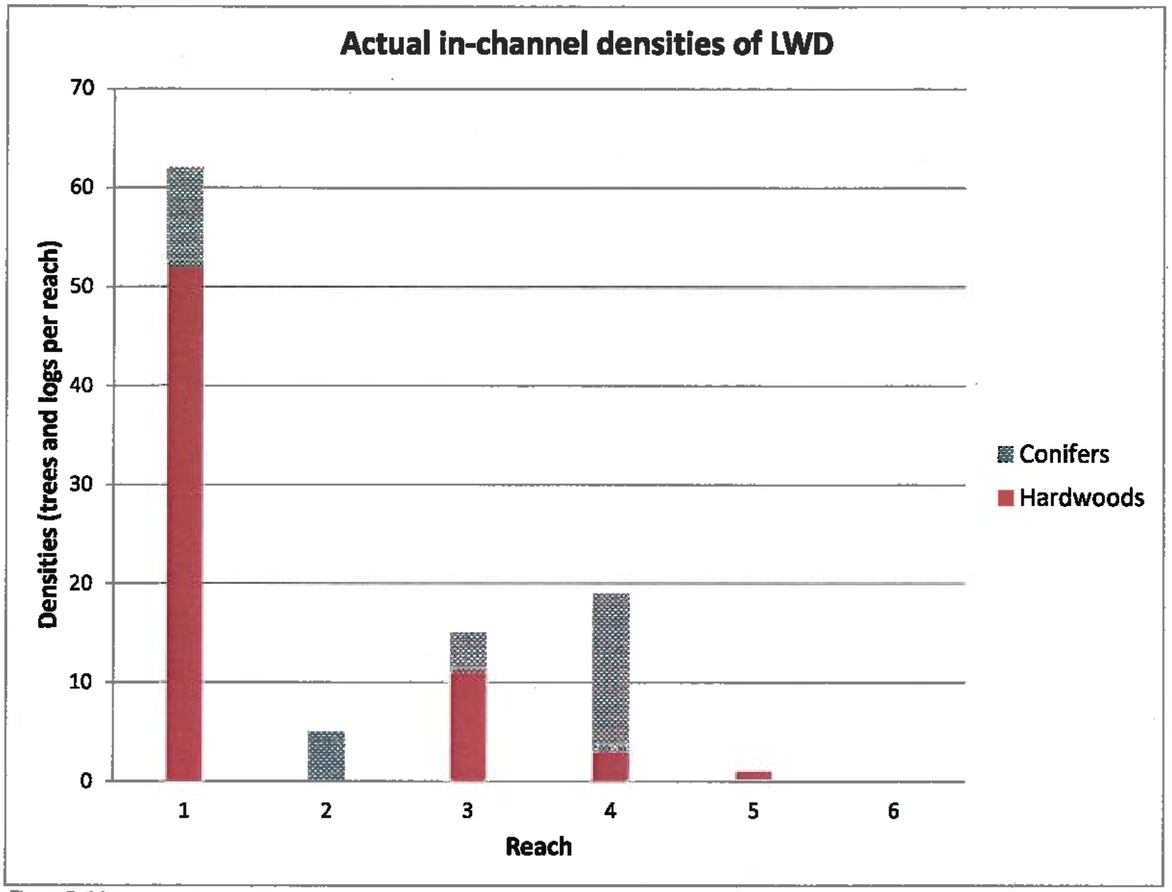


Figure 5-14.

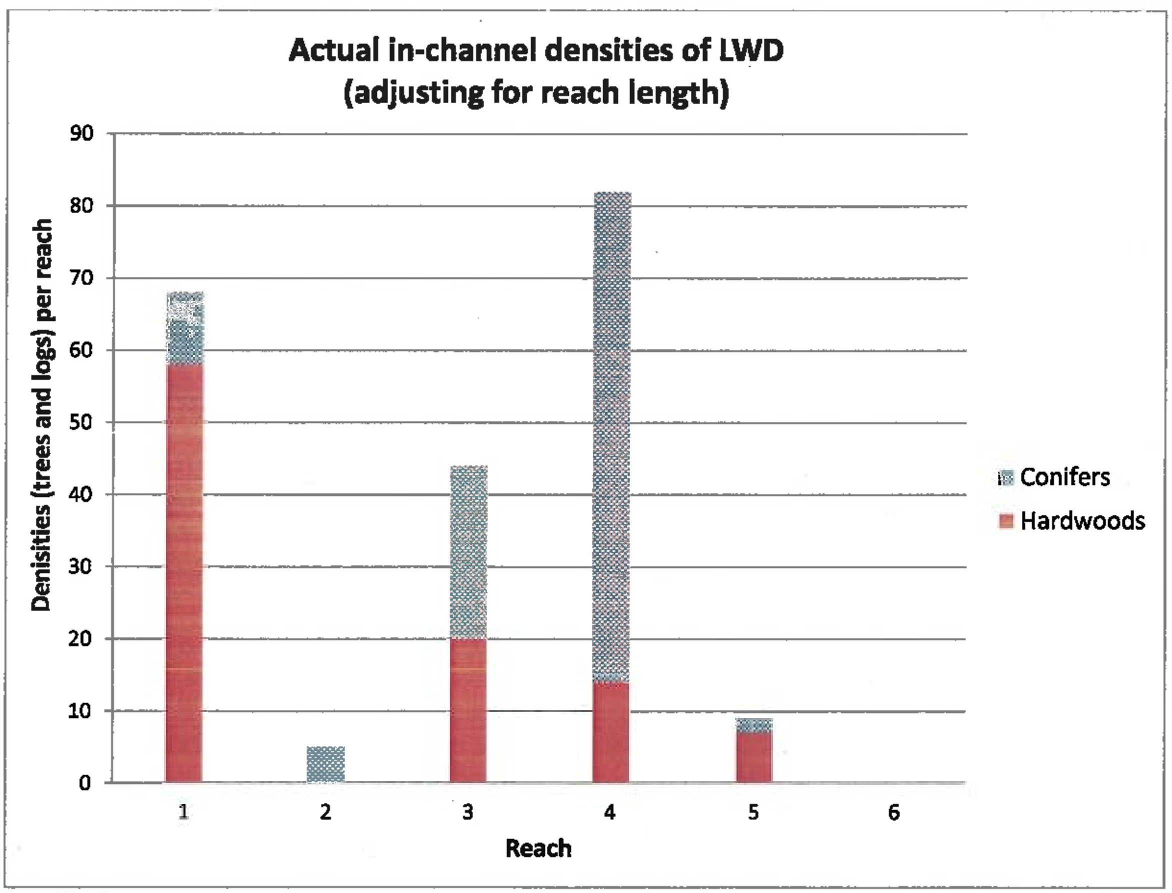


Figure 5-15.

(2002) found that large pieces of wood exceeding the width of the bankfull channel are more likely to remain stable and act as a trap for smaller pieces of wood, resulting in reduced large wood export. In San Vicente Creek, which had a mean bankfull width of 25 feet, shorter wood (<20 feet) was more plentiful in all reaches and was the largest contributor to the creation of in-channel structure (see Figure 5-18). LWD (less < 20 feet in length), was structure forming 95% and 84% of the time for LWD 1-2 foot and > 4-foot diameter, respectively. Longer LWD (> 20 feet in length) was structure forming 45% and 63% of the time for LWD 1-2 foot and > 4-foot diameter, respectively. Note: Because wood length was not documented for all LWD outside of the sample reaches, the data was not included in Figure 5-18. However, for the data that was collected, 61% of the in-channel wood was < 20 feet and a pool was noted in association with this wood 69% of the time, compared to 31% of the time for wood > 20 feet.

Various characteristics, including the shape and density of individual wood pieces, affect their potential to be mobilized and transported or to be retained as can the quantity, position and orientation of the wood pieces within the stream channel (Gurnell, et al., 2002). As only size and length has been considered as part of this assessment, it is challenging to determine the movement of recruited wood in San Vicente Creek. It is equally challenging to determine the effect of a predominance of hardwood species within the system on long-term pool and backwater development. However, the results suggest that the presence of both hardwood and conifer species greater than 1 foot in diameter will result in a pool and backwater habitat at least for a short time. Long term LWD debris jam formation and wood accumulation will be annually monitored.

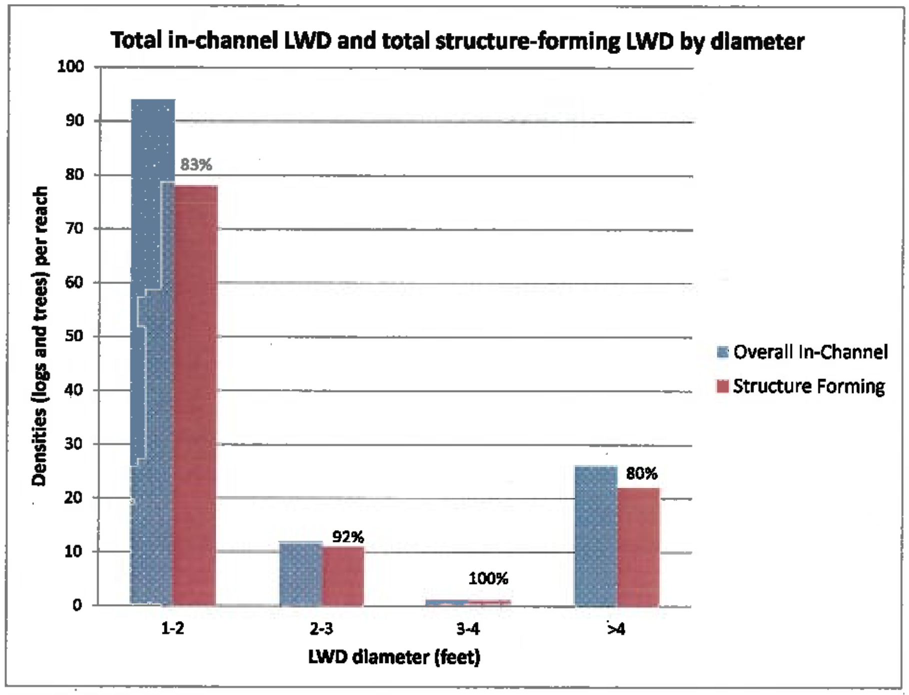


Figure 5-17.

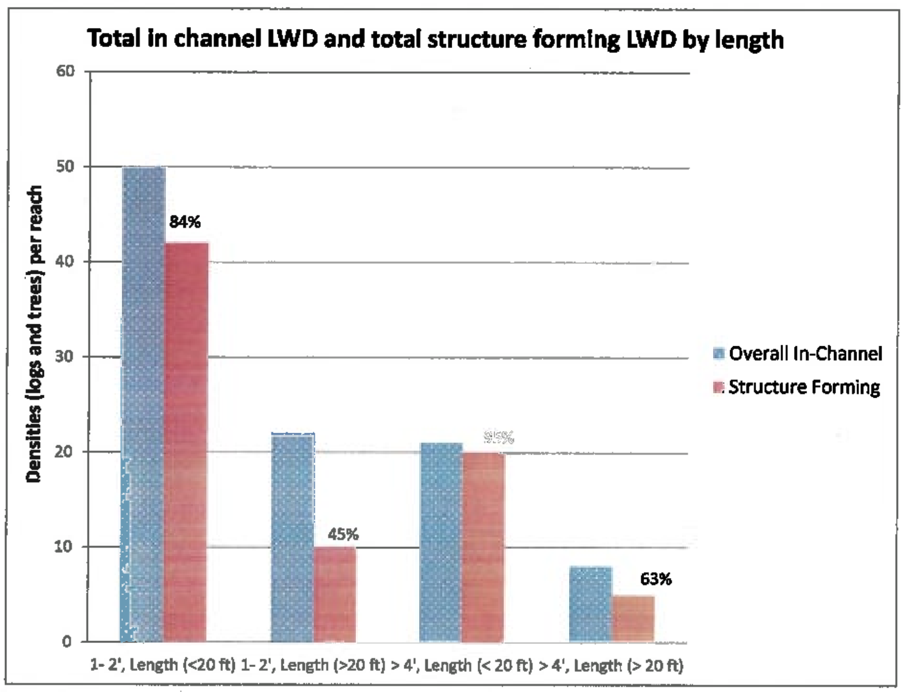


Figure 5-18.

Chapter 6: Invasive Species

OBJECTIVES

The goal of this project was to evaluate riparian health related to the Cape ivy infestation, and other non-native species to a lesser extent, in San Vicente Creek. This goal builds directly off of Priority 1: Threat Abatement Action articulated in NOAA's 2012 CCC Coho Recovery Plan which focuses on removal of exotic vegetation from riparian zones in lower San Vicente Creek.

The main objectives of the invasive species assessment was to conduct reconnaissance to determine the extent of cape ivy within the watershed, consider how cape ivy is impacting salmonid habitat, and develop recommendations on methods and schedule of activities for control.

To address these objectives, the following questions were kept in mind:

» Is the presence of cape ivy impairing salmonid habitat directly or through modification of vegetative or morphologic structure?

» How will the presence of other non-native species influence control/eradication methodology recommendations?

» Will the presence of cape ivy influence the prioritization of restoration activities?

INTRODUCTION

After decades of neglect and abuse, riparian zones are now recognized as critical components of aquatic and terrestrial ecosystems (Bragg et al., 2000). Riparian ecosystems, defined as the transitional zone between terrestrial and aquatic ecosystems, provide many beneficial functions including flood attenuation, groundwater recharge, stream temperature regulation, improved water quality, wildlife cover and food, and large woody debris production. Riparian communities are characterized by highly diverse, disturbance dependent, early seral vegetation that reflect environmental heterogeneity. However, riparian zones are susceptible to invasive by non-indigenous plant species (Masters and Sheley, 2001) and can become a homogeneous blanket, degrading riparian habitat by out competing native plants and reducing biodiversity.

Aquatic systems depend on the riparian ecosystems for recruitment of leaves, woody debris, and other detrital matter for habitat and food resources. Changes in leaf litter inputs due to the presence of non-native vegetation may result in substantial impacts on aquatic communities and food-web dynamics. Changes in terrestrial leaf inputs may further influence stream organic matter processing, nutrient cycling, and light availability within streams (Benbow et al., 2013).

Changes in light availability can impact drifting macroinvertebrates, which comprise the vast majority of the food resources for juvenile salmonids (Chapman and Bjornn, 1969; Elliot, 1973). Canopy cover can have a strong influence on invertebrate production and salmonid growth (Behmer and Hawkins, 1986; Hill et al., 1995; Quinn et al., 1997; Poole and Berman, 2001). In addition, riparian canopy intercepts solar radiation, buffering salmonids from changing stream temperatures. Juveniles, in particularly cannot persist in streams with high summer temperatures or highly fluctutating temperatures. Increasing stream temperatures can influence salmonid survival directly and habitat by changing the structure of plant and invertebrate communities (Bisson and Davis, 1976).

Changing plant communities can also result in less bank stability and an increase in turbidity level. Sediment can directly reduce salmonid breeding by covering spawning gravels and reducing light available for primary production (Kirk, 1985; Davies-Colley and Smith, 2001). An increase in turbidity also has been shown to affect salmonid behavior, as well as density and growth (NMFS, 2012).

The riparian ecosystem plays an important function in stream and salmonid health. However, like many of the coastal stream systems in California, San Vicente Creek hosts a number of invasive, non-native species that can prevent the growth and establishment of other plant species. For the past five years, Cape ivy has been noted in the lower watershed and recognized as by far the largest invasive infestation responsible for degrading riparian habitat due to its expansive coverage and known ecological impacts. Thus, a large part of this assessment was focused specifically on Cape ivy.

However, field reconnaissance in 2012-2013 identified the presence of a non-native species, which had previously escaped notice by field researchers. Identified as *Clematis vitalba* (Moore, pers. comm., West, pers. comm.), this plant has not been previously found in Santa Cruz County and is known from only one other occurrence in California, San Francisco County. While the original intent of this assessment was to discuss management recommendations for Cape ivy, this newly identified Clematis has the potential to be of even greater threat to the health and function of San Vicente Creek and thus will also be discussed.

Cape ivy

Cape ivy (*Delairea odorata*) is an aggressive, invasive, non-native plant. Cape ivy can form dense vegetative groundcover that smothers other vegetation and can prevent seeding of native plants. Cape ivy forms stands of close to 100% cover and competes with other plants for water and nutrients. Native plant species richness can be reduced up to 90% (McMenamin, pers. comm.) with greater short-term impacts on annual than on woody perennial species. In the long-term, impacts on woody species can be significant.

Cape ivy readily climbs to the top of mature trees, depriving them of light, increasing limb loss and causing them to fall due to weakened conditions, including added weight and the increased effects of wind forces. The loss of tree canopy results in changes in stream temperature and modification of instream structure and the aquatic food chain (Cal IPC, 2013). The sup-

2012. Additional reconnaissance was done between April 1 and October 31, 2013. The intent was to determine the spatial extent and infestation of Cape ivy and to a lesser extent other specific invasive species within the riparian corridor and then develop specific recommendations on methods, priorities, timing and schedule of related activities for invasive control and management.

For field reconnaissance observations, San Vicente Creek was divided into three reaches for discussion and recommendations for control and eradication within riparian habitat. Reach 1 extends from the Highway 1 crossing (684 ft upstream from the confluence of San Vicente Creek and the Pacific Ocean) to the 1st gate, which is located 3,670 ft upstream of Highway 1. Reach 2 extends north of the 1st gate to the conveyor below (5,260 ft upstream from the Highway 1). Reach 3 extends north from the conveyor belt to the tunnel on San Vicente Creek (15,470 ft upstream of Highway 1) and from the confluence of San Vicente Creek and up Mill Creek to the 1st dam (15,240 ft upstream from Highway 1)(see Figure 6-2).

To systematically collect data, a one-page Occurrence Sheet was developed (see Figure 6-3). The sheet included a description of location (GPS was unreliable due to canopy cover), a description of specific invasive species present and percent cover, limited documentation of specific native species presence, and also information on access and priority based on potential for spreading, ease of control, and presence of native species. Photos were also collected at each occurrence location (see Appendix E) Invasive Mapping Reconnaissance for completed documents and map).

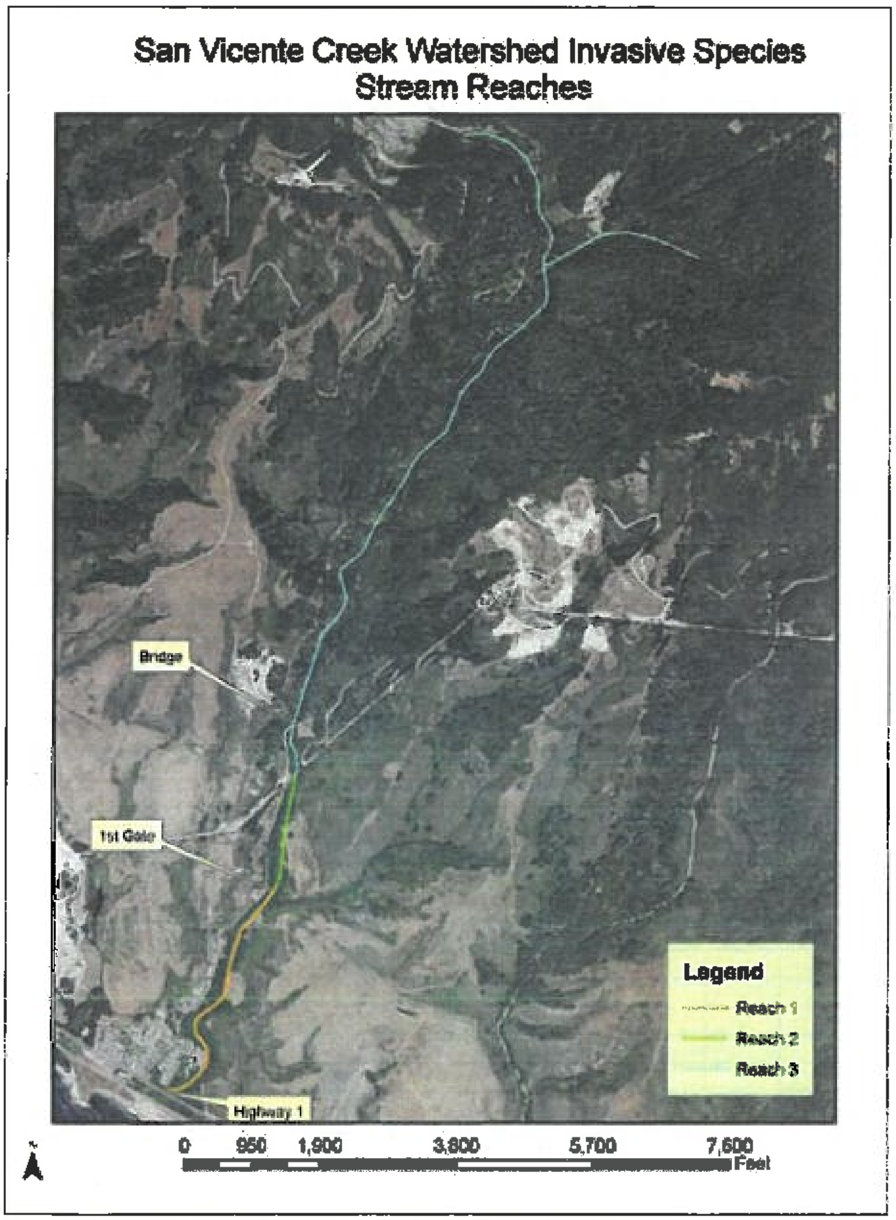


Figure 6-2. San Vicente Creek Watershed Invasive Species Stream Reaches Map

While the Occurrence Sheets provided basic information on the location of invasive species, infestation severity, and impact to habitat quality, a more in-depth procedure was developed for Reach 2, which was found to consist of five well defined patches of Cape ivy. As it is important to treat these patches before they spread and become a larger patch, which will result in the loss of native species, and greater time and expense for eradication, additional focus was given in this area. In Reach 2, assessments were conducted in fall/winter, 2012, when Cape ivy is easiest to identify and in April, July and October of 2013. The assessments included walking along San Vicente Street to identify Cape ivy on the west side of the stream and then walking the stream to identify Cape ivy on both the west and east sides of San Vicente Creek. Once Cape ivy was identified, the boundaries of each infestation were walked and recorded with an accuracy of approximately 1 meter. Information was recorded for each infestation Area, including an approximation of percent invasive and native cover, predominant native and non-native trees, shrub and herbaceous species, the distance from the road and stream, approximate size and density of the infestation, and predominance of Cape ivy in tree canopy (see Appendix E and Figure 6-4). This data was then hand drawn onto aerial photos. The hand drawn data was used to develop a GIS data layer (see Figure 6-5).

FINDINGS

The following invasive plants, with critical ecosystem impacts, were identified within the project area and are considered to be of management concern for San Vicente Creek and Mill Creek.

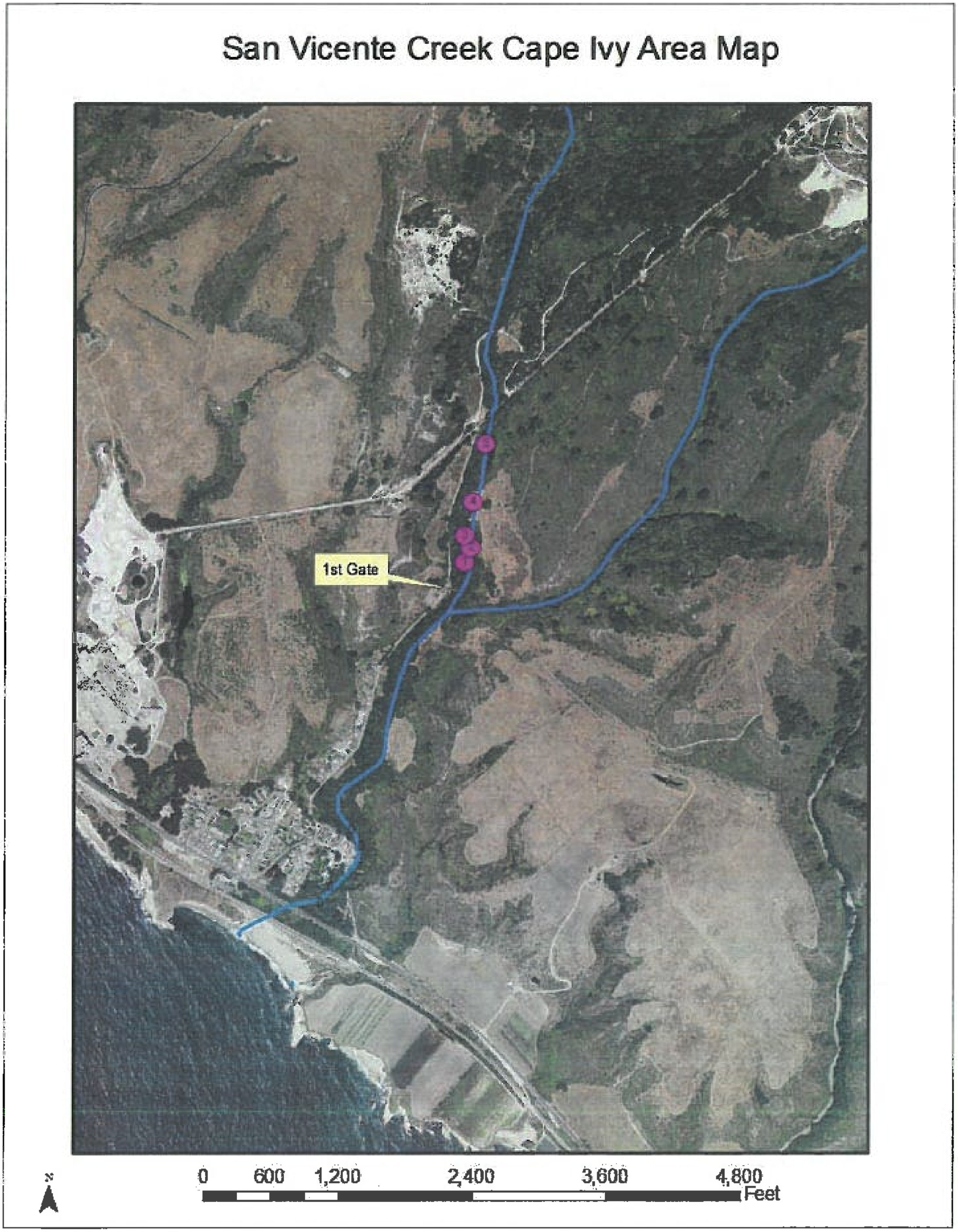


Figure 6-4 4. Cape Ivy Area Map

ment, but coordination with the adjacent landowners will be needed.

Reach 2

Reach 2 appears to have been less modified historically. Interestingly, the infestation of invasive species is less severe and occurs in isolated patches in Reach 2 rather than as a homogenous community. Whether this is directly linked to the lack of disturbance could not be confirmed through field observation or analysis of historic aerial images. The Cape ivy patches have established within approximately a 1,450 ft linear stretch of the riparian zone and appear to be located only on the western side of San Vicente Creek. With the exception of the upper most area (Area 5), all areas appear to have spread from the streambank towards the road. Area 5 is also the largest patch of Cape ivy. This suggests that Area 5 may have been the initial infestation site and that Cape ivy has since been spreading downstream during winter rain events.

As previously mentioned, within Reach 2, five Cape ivy areas were intensively mapped, documenting current boundaries, distance between patches, and the presence of specific herbaceous natives that may need to be protected.

Note: The information listed below, describing the five Cape ivy areas in Reach 2 is accurate prior to any treatments that occurred in July, August and September, 2013. After treatment, some changes will have occurred.

Area 1 is located 340 feet north of Gate 1 (measured on the road). The stream distance is approximately 250'. The area is between 400 and 600 sq. ft. in size with an overall density of Cape ivy less than 50%. Cape ivy can be found in 5 to 10 trees up to heights of 30'. A low density of Cape ivy is found on the northeastern streambank.

Area 2 is located 75 feet north of Area 1, along the stream. The stream distance is approximately 340'. The area is between 450 and 550 sq. ft. The Cape ivy density is greater than 50%. Cape ivy can be found in 5 to 10 trees up to heights of 30'. While there is not usable access for this area from the road at this time, due to a Yellow Jacket nest, access will be created through Area 3, in the future. The distance between area 2 and area 3 along the stream is approximately 20'.

Area 3 is located 459 north of Gate 1(measured on the road) and 410' north (stream distance). This area is approximately 4000 to 5000 sq. ft. in size with an overall density of Cape ivy of 70% to 80%. Cape ivy can be found in 10 to 30 trees up to heights of 30'. There are significant patches of desirable native plant species within the area.

Area 4 is located 993 ft north of Gate 1. This area is 225 to 300 sq. ft. with a density of 40% to 60%. The Cape ivy is in a few trees to a height of 15'. This is the only patch of Cape ivy within a 325 linear foot section of habitat between Area 3 and Area 5. There is also an isolated 500 to 600 sq. ft. patch of Vinca (*Vinca major*) directly adjacent to the Cape ivy, along the stream. Also, there is a tiny (15 sq. ft.) patch of Wandering Jew (*Tradescantia fluminensis*) approximately 70 ft upstream. As of July 2013, there is access for this area from the road.

Area 5 has to road access points. The southern access is located 1179 ft north of Gate 1. The northern access is located 1425 ft. north of Gate 1. This is the largest patch of Cape ivy (15,000 to 17,000 sq. ft.). It runs north to south for 246 linear feet of the road. This area represents the furthest known upstream, northern extent of the Cape ivy. This is also the only patch in Reach 2 that stretches from San Vicente Creek to the road. The height in the trees ranges from 15 to 30 ft. The width of this patch is 75 ft at the upstream edge and 78 ft at the downstream edge. As the creek bends in this stretch there is a narrowed section running east to west, with a width of approximately 45 ft. This was likely the initial point of infestation in Reach 2.

Other non-native species occur in small patches, including a few single jubata grass plants, a few French broom and Clematis within the stream channel and along both sides of the stream, although more dominantly established on the left bank. Italian thistle (*Carduus pycnocephalus*) has been observed along San Vicente Road (McMenamin, pers. comm.).

Noted native species include California blackberry (*Rubus ursinus*), California Bee Plant (*Scrophularia californica*), Stachys, Coffeeberry, Red elderberry (*Sambucus racemosa*), Dogwood (*Cornus sp.*), *Ribes sp.*, Bracken fern (*Pteridium aquilinum*), Five finger fern, Horsetail, Scirpus (*Scirpus sp.*) and Stinging nettle.

Reach 3

While Reach 3 is devoid of Cape ivy, the riparian habitat is dominated by Clematis, particularly in areas where the canopy is less dense and more sunlight is available. In the upper extent of this reach, Clematis blankets the ground (>70%) and is present in California Redwood (*Sequoia sempervirens*) and Alder trees up to heights of 30 feet. Clematis forms a solid wall in some areas and native herbaceous plants are limited in these areas (see Figure 6-6).

Two large patches of jubata grass exist on the right bank (facing upstream) in the upper extent of Reach 3, near the tunnel on San Vicente Creek. They are fairly close together and appear to have colonized on old landslides/scarps (see Figure 6-7).

In addition, English ivy appears to have been planted near a historic building on to the left of San Vicente Creek (facing upstream). The ivy now occurs on covers both stream banks near the tunnel (Figure 6-8).

Acacia (*Acacia sp.*) trees were observed near the lower dam on Mill Creek (Moore, pers. comm.). There were removed in November, 2013.

A small amount of English ivy and individual jubata plants also exists in most of this reach, although a large patch of jubata is present near the tunnel. French broom has colonized small, sunny disturbed areas, although expansion is minimal due to heavy canopy and groundcover.

The Cape ivy appears to be desiccating and will likely be dead prior to winter. More than half of the upstream edge of Cape ivy was cleared from native trees and shrubs and a limited amount was pulled adjacent to the stream bank to limit downstream transport and establishment. Due to the presence of native herbaceous plants, care was taken to limit damage to the desirable plant species. The yellow jacket nest limits work in the area.

An access path was cleared to reach Area 4 and Cape ivy was carefully hand pulled to 99%+. No further ivy has been observed on the ground and the little Cape ivy which remained high in the trees has desiccated further and is highly likely to be dead by the first rains. A small patch of *Vinca major* was removed to 97%+, with only a few roots remaining on the stream bank. The *Tradescantia* was not removed yet, as a path will be required to access this small infestation. The two Clematis seedlings found in Area 4 were left undisturbed for further observation and will be hand pulled this fall or winter. A small San Francisco dusky-footed Woodrat nest is found in Area 4 and was left undisturbed during removal activities.

Area 5 was too large to attempt large scale eradication in 2013 due to limited resources, but a permanent north and south border was established by carefully hand pulling the ivy to create an easily monitored and defensible border and prevent future infestation upstream and downstream. Desiccation for Cape ivy in the few remaining trees is not as high as elsewhere, likely due to shade and greater mass.

The small patch of purple starthistle was hand removed in 2012 prior to seed set.

Most of the plant species found within the project area are listed by the CDFA and Cal-IPC, as noxious weeds and invasive species. Table 6-1 lists these species and the invasive threat ranking based on the CDFA ranking, Cal-IPC ranking, and field observations.

Methods of Control

There are various management techniques used to treat/eradicate the non-native species identified as resource concerns in the San Vicente watershed, including heavy equipment, the use of specific hand power equipment, hand tools, hand removal, grazing, and herbicide application. Specific bio-control agents are presently going through the field testing process for approved use in California for use with Cape ivy and may be available a few years down the line. The most effective control techniques consider species' growth patterns, reproduction characteristics, the species location within the project area, weather, type of and proximity of desirable species, and the level of infestation. Below provides a summary of those methods, as well as their growth patterns (see Table 6-1). Also taken into account are the species' flowering and seed production periods (see Table 6-2). The selected method of control may vary from location to location within the habitat for a given species based on extent, presence of natives, distance from stream, soil and moisture conditions, time of year, amount of solar radiation, etc.

Italian thistle (*Carduus pycnocephalus*) readily colonizes any area removed of dense groundcover and recently disturbed (Harradine, 1985). However, it does not readily establish in shaded moist environments and so is a limited threat to riparian restoration. Potential removal techniques include:

1. Hand pull.
2. Carefully timed weed whacking
3. Graze with sheep or goats.

Purple starthistle (*Centaurea calcitrapa*) readily colonizes recently disturbed areas and roadsides (Bossard et al., 2000). However, unlike Italian thistle which can be dispersed long distances by wind, purple starthistle seeds are primarily deposited below or near the parent plant. Thus, it will be most important to continue to remove new plants prior to seed set to eventually deplete the seed bank. Potential removal techniques include:

1. Hand pulling, digging, or grubbing prior to seed set.

Clematis (*Clematis vitalba*) growth patterns and rate of reproduction in San Vicente Creek is currently unknown. As previously mentioned, the potential removal techniques are based on experience in English ivy removal (Moore, pers. comm.) and include:

1. For climbing vines, cut a 4-5 ft swath around the trees with loppers and/or hedge trimmers to kill the Clematis in the tree canopy. Larger stems are common and will require hand saws. Minimize damage to the bark of the host tree.
2. For groundcover:
   - Re-cut tree root in spring and apply an herbicide approved for use in riparian areas.
   - Apply foliar application of herbicide approved for use in riparian areas with backpack sprayers in areas with high density Clematis and limited native species.
   - Use a small skidster/loader to remove surface mass and follow up with spot treatment of herbicide in areas with large infestations. Requires a skilled operator.

Poison hemlock (*Conium maculatum*) can spread quickly after the rainy season to areas that have been cleared or disturbed. The combination of a long seed dispersal period, seed dormancy, and non-specific germination requirements enable poison hemlock seedlings to emerge almost every month of the year (Roberts, 1979). Given its broad infestation and prolific nature, only low level management of this non-native will be possible. Potential removal techniques include:

1. Hand pull or grub plants before seeds set. Removing the entire root mass is not necessary, but repeating this procedures for multiple years will be required.
2. Apply a post emergent herbicide, like glyphosate with a surfactant.
3. Flame in wet season, late winter.

Jubata grass (*Cortedaria jubata*) is a very invasive weed in the coastal area of Santa Cruz County. It readily colonizes disturbed soils and produces an abundance of seed that can disperse widely. It persists under dense canopy, but does not readily produce seed under shaded conditions. Potential removal techniques include:

1. Hand removal with the use of pulaski, prior to seeding.
2. Apply a post emergency herbicide, such as glyposate at a 2% solution.
3. Removal with heavy equipment or pull out with a truck and chain

Cape ivy (*Delaireia odorata*) is one of the priority species for removal in the watershed and methods for removal will vary greatly based on site conditions and financial resources available. Success will always require specific methodologies following carefully prioritized steps and long term monitoring. Potential removal techniques include:

1. Hand Grubbing:

» Break ground contact for all Cape ivy in trees for 3-6 feet. If practical remove all the Cape ivy from the trees. If removal is not practical, ground contact should be broken as soon as possible after the rainy season.

» Establish easy maintained borders/ buffer zones around the edge of each patch if it is not going to be treated to 95%+ eradication level in any given year. Monitor and remove any Cape ivy growing into the border areas/buffer zones.

» Hand pull, follow up with second pass to remove all above ground Cape ivy to 90+ % and third pass to remove all Cape ivy rhizomes and roots to 95+%.

2. Grazing is an option for large areas and minimal native species.
3. Mechanical removal with heavy equipment.
4. Herbicide treatment with an herbicide approved for use in riparian areas.

Fennel (*Foeniculum vulgare*) thrives on disturbance (including control techniques). Control techniques include either minimizing disturbance or increasing disturbance to promote fennel seed germination. Because the species readily colonizes disturbed sites and can have dormant seeds for several years, fennel control will be crucial to control seed dispersal on recently disturbed sites. Potential removal techniques include:

1. With small stands, dig out the whole plant. Do not cut plant as this disperses seeds.

French broom (*Genista monspessulana*) is an aggressive shrub that readily colonizes disturbed sites and roadsides, particularly sunny locations. It produces long-lived seeds (over 30 years) and requires a long term commitment to be removed. Control of this plant will also be critical to ensure that it does not colonize sites after another invasives are removed. Potential removal techniques include:

1. Hand pull and pull with weed wrenches, removing entire mature plant; repeat yearly for 5-6 years. Apply multiple treatments each year to speed up depletion of the seed bank.
2. Apply foliar herbicide spray to mature plants during active growth and after flower formation.
3. Use a flaming method on young seedlings and seeds in winter months.

Table 6-2. Typical Flowering Period of Invasive Weeds

Common Name	Scientific Name	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Italian thistle	*Carduus pycnocephalus*					■	■	■	■				
Purple starthistle	*Centaurea calcitrapa*							■	■	■	■		
Clematis	*Clematis vitalba*					■							
Poison hemlock	*Conium maculatum*				■	■	■	■					
Jubata grass	*Cortaderia jubat*					■	■						
Cape ivy	*Delairea odorata*	■	■										■
Fennel	*Foeniculum vulgare*				■	■	■	■					
French broom	*Genista monspessulana*			■	■	■	■						
English ivy	*Hedera helix*	■	■										■
Forget-me-nots	*Myosotis sylvatica*				■	■	■	■					
Wild radish	*Raphanus sativus*		■	■	■	■	■						
Wandering Jew	*Tradescantia fluminensis*				■	■	■	■					
Vinca	*Vinca major*	■	■	■	■	■							

Chapter 7: Plan for Salmonid Recovery

INTRODUCTION

Over the past two years, the RCD team has completed a number of key technical assessments with the collective goals of enabling development of a comprehensive and multidisciplinary set of recommendations to support recovery of listed salmonids in the San Vicente Watershed. The previous 6 chapters of this Plan both set the context for the intrinsic value and uniqueness of this particular watershed, and articulate the objectives and findings from these assessments. While these assessments contain invaluable data and insights, there are two external factors which make this document and the technical information it presents so valuable. First, the technical team and the review committee have been working collaboratively in this watershed for over a decade (and some folks for upwards of half of century). During this time, we have walked, talked, observed, discussed, and experimented in this watershed; learning all the time and shaping the assessment conducted as part of this effort. Second, our landowner partners (particularly the Trust for Public Land/Coast Dairies, US Bureau of Land Management, CEMEX, and Living Landscape Initiative) have provided us with unprecedented access to nearly 90% of the watershed and to their internal archives and data. This level of cooperation and access has significantly enriched and informed both the objectives and methods for the assessments as well as interpretation and ground-truthing of the findings.

This effort was explicitly funded in order to develop specific recommendations to promote recovery of listed salmonids in the San Vicente Creek Watershed and this section aims to accomplish that stated goal. That said, through a process of critical review, robust discussion and a long history of observation, the RCD technical team has developed a list of recommended actions that we believe are at their core ecological, interconnected, synergistic, and holistic. As such, the recommendations not only specifically address listed salmonids but address ecological uplift and resilience across the watershed, amongst different habitat types and niches, and through both short and long term time scales. For a purely ecological perspective, the recommendations contained in this section address the foundational ecological concepts of:

Food: via enhancing and protecting the ability of the system to create allochthonous productivity (insects and food sources from outside of the stream such as leaf litter fall from riparian trees and material washed in from floodplains) and autochthonous productivity (insects and food sources produced in the stream such as benthic macroinvertebrates that rely on clean gravels and cobbles);

Shelter: via enhancing and restoring the processes that create a mosaic of shelter for both adult and juvenile salmonids such as large wood to provide refuge, force scour pools, and promote channel aggradation and flow redirection to enable floodplain activation and recreate slack water habitat; and

Successful Reproduction and Rearing: via reestablishment of natural geomorphic processes that would recruit and sort spawning sized gravels, removal of barriers to sediment transport, remediation of areas contributing fine sediments, and protection of instream flows to allow fish to access high quality spawning habitat, migrate through and feed in shallow riffles, and hide in deep, cool pools.

In addition to framing and developing recommendations that support the overt goal of salmonid recovery, we also emphasize the more subtle and foundational goal of enhancing and restoring the key ecological processes that maintain the watershed. All of the recommendations discussed in this chapter also address one or more of the following watershed objectives:

1. Improve conditions that facilitate natural geomorphic function;
2. Improve riparian health;
3. Floodplain connectivity;
4. Improve instream habitat suitability and quality for salmonids; and
5. Consider all actions within the context of adaptive management.

Finally, it should be noted that the recommendations articulated below are also intertwined with the on-going efforts of the local captive broodstock coho recovery program and are focused on increasing carrying capacity and improving the ecological health of the watershed to increase the value and effectiveness of this broodstock program. These recommendations have been developed in a collaborative fashion, have been reviewed by the Steering Team and modified based on substantive feedback.

Please note, for the purpose of this report, the implementation timeline provided for all recommended practices is defined in the following manner: Short-term (0-5 years), medium-term (4-10 years), and long-term (10+ years).

CONCLUSION

As mentioned above, this plan is the culmination of decades of experience, familiarity and commitment by this team and watershed partners. This plan is a living document that will not collect dust by sitting on the shelf, but rather guide our actions over the next decade to improve riparian health and restore ecosystem function.

While ambitious, the recommendations in the plan are implementable. They build on previous efforts in the watershed under the auspices of IWRP and by partners and the RCD, and can be permitted through the Santa Cruz Countywide Partners in Restoration (PIR) Permit Coordination Program. The PIR program facilitates the implementation of small-scale, environmentally beneficial projects through the issuance of programmatic permits rather than permitting projects on an individual basis. Projects are designed based on criteria set forth by the Natural Resources Conservation Service (NRCS) and environmental guidelines and protection measures set forth by the program partners, including the County of Santa Cruz, Regional Water Quality Control Board (RWQCB), Army Corps of Engineers (ACOE), National Marine Fisheries Service (NMFS), US Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW).

Implementation			
*Timeline: Short term = 0-5, Medium Term = 4-10, Long Term = 9+			
Timeline*	Priority	Estimated Budget	Identified Partners
Short-term and Ongoing (recommend 10 year data set)	Medium	$5,000/year	RCDSCC, BLM and Technical Consultant, FRGP, IWRP, Sanitation District
Ongoing	High	$15,000/year	FRGP, Sanitation District, NOAA, and/or BLM.
Short-term	Medium	Unknown	RCDSCC, Bonny Doon Fire Safe Council, Rural Bonny Doon Association and NRCS
Short-term	High	None	County Sanitation Department, Davenport residents, IRWM, CEMEX
Medium and long-term	Medium	Unknown	County Sanitation Department, Davenport residents, IRWM, CEMEX, Resource Agencies, many others
Medium-term	Medium	Unknown	RCDSCC, BLM, Bonny Doon Fire Safe Council, Rural Bonny Doon Association and NRCS
Short-term	High	Unknown	BLM, Sanitation Department, private landowners, RCDSCC, NRCS
Short-term	Medium	Unknown	County
Medium-term	Medium	Unknown	County

Implementation			

*Timeline: Short term = 0-5, Medium Term = 4-10, Long Term = 9+

Timeline*	Priority	Estimated Budget	Identified Partners
Immediate	High	$5,000-$10,000 for eviction, clean-up and fencing/signage	BLM
Short-term and ongoing	High	Unknown	BLM, Living Landscapes Initiative, County Sheriff
Short-term	High	Unknown	IWRP, RCDSCC, BLM, IWRP TAC
Short-term	High	Unknown	IWRP, RCDSCC, BLM, IWRP TAC
Short-term	Highest	Unknown	IWRP, RCDSCC, BLM, IWRP TAC
Short-term	Highest	Unknown	IWRP, RCDSCC, BLM, IWRP TAC

Implementation

*Timeline: Short term = 0-5, Medium Term = 4-10, Long Term = 9+

Timeline*	Priority	Estimated Budget	Identified Partners
Short-term	High	Unknown	IWRP, RCDSCC, BLM, IWRP TAC
Short-term	Medium	Unknown	IWRP, RCDSCC, BLM, IWRP TAC
Medium-term and ongoing	High	Unknown	RCDSCC, George McMenamin, BLM and NRCS
Short-term	Medium	Unknown	IWRP, RCDSCC, BLM, IWRP TAC
Short-term	Medium	$30,000-$40,000 (for designs and studies)	IWRP, RCDSCC, BLM Caltrans, CEMEX (possible use of sediment for reclamation)
Medium-term	Medium	$50-200,000	IWRP, RCDSCC, BLM, IWRP TAC

Implementation			

*Timeline: Short term = 0-5, Medium Term = 4-10, Long Term = 9+

Timeline*	Priority	Estimated Budget	Identified Partners
Short-term	Medium	$2,000-$4,000	RCDSCC, IWRP, BLM, Techincal Consultant
Short-term	High	$10,000-30,000	RCDSCC, IWRP, BLM
Ongoing	High	Unknown	NOAA Fisheries SWFSC, DFW, FRGP, RCDSCC, BLM
Ongoing	High	Unknown	IWRP, RCDSCC, BLM, IWRP TAC, NOAA Fisheries SWFSC
Medium -term	Medium	Unknown	USFWS, DFW, RCDSCC, BLM, Living Landscapes Initiative

Implementation

*Timeline: Short term = 0-5, Medium Term = 4-10, Long Term = 9+.

Timeline*	Priority	Estimated Budget	Identified Partners
Short-term and ongoing	High	$40,000-$60,00	RCDSCC, George McMenamin, BLM and NRCS
Medium-term and ongoing	Medium	$200,000-$300,000	RCDSCC, George McMenamin, BLM and NRCS
Short-term and ongoing	High	$150,000-$200,000	RCDSCC, Living Land-scape Initiative Partners, BLM, NRCS
Short-term and ongoing	Low	$50,000	Watershed Stewards Project members, RCDSCC Interns, BLM, Living Landscape Initia-tive Partners, private landowners
Short-term	Medium	$2500-$5,000	Living Landscapes Initiative Partners, RCDSCC, IWRP, Technical consultant
Medium -term	Medium	Unknown	Living Landscapes Initiative Parners, RCDSCC, IWRP, Technical consultant

Implementation

*Timeline: Short term = 0-5, Medium Term = 4-10, Long Term = 9+

Timeline*	Priority	Estimated Budget	Identified Partners
Short-term	Medium	$500	RCDSCC, County Sanitation Department and/or Public Works.
Medium-term	Medium	Unknown	RCDSCC and County Department of Sanitation and/or Public Works.
Medium-term	Medium	Unknown	Technical consultant, County, IWRP, RCDSCC, BLM, Living Landscape Initiative Partners
Long-term	Low	Millions	Caltrans, RTC, NMFS, NOAA Science Center, DFW, RWQCB, ACOE, USFWS, BLM.

Implementation

*Timeline: Short term = 0-5, Medium Term = 4-10, Long Term = 9+

Timeline*	Priority	Estimated Budget	Identified Partners
Long-term	Low	Millions	Living Landscapes Initiative Parners, RCDSCC, IWRP, NMFS, DFW, etc

APPENDIX A

San Vicente Resource Library Documents

Author	Year	Title
Abbe, T.B. and D.R Montgomery	1996	Large Woody Debris Jams, Channel Hydraulics and Habitat Formation in Large Rivers
Alvarez, M. E.	1997	Management of Cape-ivy (*Delairea odorata*) in the Golden Gate National Recreation Area
Andrus, C., B. Bilby, T. Nichelson, A. McKee and J. Boechler	1993	Modeling woody debris inputs and outputs
Archbald, G.	1995	Biology and control of German ivy
Becker, G.S., K.M. Smetak, and D.A. Asbury	2010	Southern Steelhead Resources Evaluation: Identifying Promising Locations for Steelhead Restoration in Watersheds South of the Golden Gate
Behmer, J. D. and C.P Hawkins	1986	Effects of overhead canopy on macroinvertebrate production in a Utah stream

Bilby, R.E. and J.W.Ward	1991	Characteristics and Function of Large Woody Debris in Streams Draining Old-Growth, C ear-Cut, and Second-Growth Forests in Southwestern Washington
Bisson, P. and G. Davis	1976	Production of juvenile chinook salmon (*Oncorhynchus tshawytscha*) in a heated model stream
Blodgett, C. J. and E.H Chin	1989	Flood of January 1982 in the San Francisco Bay Area, California.
Bossard, C.	1998	Effects of floating Cape ivy (Senecio mikanioides) foliage on golden shiners and crayfish
Bossard, C.C., M.J. Randall and C.M. Hoshovsky	2000	Invasive plants of California's wildlands
Bragg, D. C., J. L. Kershner and D. W. Roberts	2000	Modeling large woody debris recruitment for small streams of the central Rocky Mountains
Bryant, M. D. and D.N. Swanston	1998	Coho Salmon Populations in the Karst Landscape of North Prince of Wales Island, Southeast Alaska
Burnham, K.	2008	~285 km Since Before 11 Ma Vs. ~30 km Since ~3 Ma: The Hayward-Calaveras Faulat Outranks a part of the San Andreas Fault in Both Age and Offset Distance

California Department of Forestry and Fire Protection (CalFire)	2003	Timber Harvesting Plan
California Department of Forestry and Fire Protection (CalFire)	2009	Lockheed Fire: Post Fire Risk Assessment
California Regional Water Quality Control Board (CRWQCB)	2005	Fact Sheets Supporting Revision of the Section 303(d) List
Carter, K.	2005	The Effects of Temperature on Steelhead Trout, Coho Salmon, and Chinook Trout Biology and Function by Life Stage
Cartier, R.	1991	The Santa's Village Site Excerpt: *An Overview of Ohlone Culture*
Catalano, S., S. Luschi, G. Flamini, P. L. Cioni, E. M. Nieri, and I. Morelli	1996	A xanthone from Senecio mikanioides leaves
CEMEX	2006	Davenport Cement Centennial: Honoring Our Past, Building the Future
Chapman, D.W. and T.C. Bjornn	1969	Distribution of salmonids in streams, with special reference to food and feeding

County of Santa Cruz	1998	San Vicente Creek Enhancement Project Proposal
County of Santa Cruz	2000	San Vicente Creek Enahncement Project
County of Santa Cruz	1998	San Vicente Creek Habitat Enhancement Project Drawings
County of Santa Cruz	2004	Davenport Water & Surface Water Treatment Plant Monthly Report
County of Santa Cruz	2006	Winter Raw Water Supply
Creegan and D'Angelo	1984	Watershed Analysis, San Vicente Creek, Mill Creek, Liddel Creek
Crispin, V., R. House and D. Roberts	1993	Changes in instream habitat, large woody debris, and salmon habitat after restructuring of a coastal Oregon stream
Davies-Colley, R. J. and D. G. Smith	2001	TURBIDITY, SUSPENDED SEDIMENT, AND WATER CLARITY: A REVIEW

Gilchrist, J. et al.	1982	Fish Habitat Assessment for Santa Cruz County Streams
Gregory, S. V. et al.	2003	The ecology and management of wood in world rivers.
Gurnell, A. M., H. Piegay, F. J. Swanson and S.V. Gregorys	2002	Large Wood and Fluvial Processes.
Hagans, D.	2010	Testimony read into the record at the 04.04.2010 SWRCB hearing
Hamey, N.	2009	Support of delist San Vicente Creek from the RWQB 303(d) TMDL List
Hamman, R.	1996	140 Years of Railroadings in Santa Cruz County
Harradine, A.R.	1985	Dispersal and establishment of slender thistle, Carduus pycnocephalus, as effected by ground cover.
Hildebrand, R.H., A.D. Lemly, C.A. Dolloff, and K.L. Harpster	1998	Design Considerations for Large Woody Debris Placement in Stream Enhancement Projects

Lassettre, N.S.	2001	Large woody debris in channels for aquatic habitat: developing strategies for watershed scale management, Soquel Demonstration Forest.
Lehane, B.M., P.S. Giller, J. O'Halloran, C. Smith, and J. Murphy	2002	Experimental provision of large woody debris in streams as a trout management technique.
Leicester, M. A	2005	Recruitment and Function of Large Woody Debrs in Four California Coastal Streams
Lienkaemper, G. W. and F.J. Swanson.	1987	Dynamics of large woody debris in streams in old-growth Douglas-fir forests
Lonestar	1983	Fisheries Resouce
Masters, R. A. and R. L. Sheley	2001	Principles and practices for managing rangeland invasive plants
McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. VanSickle	1990	Source distance for coarse woody debris entering small streams in western Oregon and Washington
McGinnis, M.S.	1991	An Evaluation of the Anadromous Fish Spawning San Vicente Creek Systems

National Oceanic and Atmospheric Association (NOAA)	2012	Stream Reach Data
North Coast Regional Water Quality Control Board (NCRWQCB)	2006	Desired Salmonid Freshwater Habitat Conditions for Sediment-Related
Opperman, J.J. and A.M Merenlender	2007	Living trees provide stable large wood in streams
Paul, G.	2007	California 2004-2006 Section 303(d) list-San Vicente Creek, Santa Cruz County
Poole, G.C. and C. H. Berman	2001	An Ecological Perspective on In-Stream Temperature: Natural Heat Dynamics and Mechanisms of Human-Caused Thermal Degradation
Quinn, J. M, A.B Cooper, M.J Stroud, and G.P Burrell	2007	Shade effects on stream periphyton and invertebrates: an experiment in streamside channels.
Rainville R.P., S.C. Rainville, and E.L. Lider	1985	Riparian silviculture strategies for fish habitat emphasis
Regional Water Quality Control Board (RWQCB)	2010	California 2010 Integrated Report (303(d) List 305(b) Report - FINAL and DRAFT

Santa Cruz County	2009	San Vicente Recovery Issues
Santa Cruz County Environmental Health Service	2003, 2004, 2005, 2006, 2007	Surface Water Treatment Plant Monthly Report
Schmid, E.	1997	Resource Management Planning for Coast Dairies Property
Shirvell, C. S.	1990	Role of Instream Rootwads as Juvenile Coho Salmon (Oncorhynchus kisutch) and Steelhead Trout (O. myskiss) Cover Habitat Under Varying Streamflows.
Sierra Club	2004	Supplement to San Vicente 303d Listing
Sierra Club	2008	Support of not delisting
Sierra Club	2004	Inclusion of San Vicente Creeek Watershed on 2004 Clean Water Act Section 303(d) List
Spence, B. W.G. Duffy, J.C. Garza, B.C. Harvey, S.M. Sogard, L.A. Weitkamp, T.H.	2011	Historical occurrence of Coho salmon *(O, kisutch)* in streams of the Santa Cruz Mountain Region of California: Response to an endangered species act petition to delist Coho salmon south of the San Francisco Bay

UC:ANR: Hopland Research Extension and Center GIS Lab	2008	Description of Attributes in Tables produced in the Stream Summary Application
University of California Santa Cruz (UCSC)	2012	San Vicente Creek Coho reintroduction and monitoring program.FRGP Proposal Application Form
Watson, J., J. Casgrande and F. Watson.	2008	Central Coast Region South District Basin Planning & Habitat Mapping Project
Weppner, E.M., E. Richards and D. Hagans.	2009	Cemex THP 1-06-080SCR 2008 Phase 1 Road Assessment Project, San Vicente Creek Santa Cruz County, California
West, C.J.	1991	Literature review of the biology of Clematis vitalba (old man's beard)
West, J.A.	2012	A Journey through Scott's Creek Watershed
West, J.A.	2012	Traversing Swanton Road
Wohl E. and K. Jaeger.	2009	A conceptual model for the longitudinal distribution of wood in mountain streams

Appendix B

Balance Hydrologics, Inc. (Santa Cruz)
224 Walnut Ave., Suite E
Santa Cruz, CA 95060
Attn: Denis Ruttenberg

Work Order #: 3100329
Reporting Date: October 17, 2013

SAMPLE SUMMARY

Laboratory ID	Client ID	Station ID	Matrix	Sampled	Received
3100329-01	SVC at Gage		Water	10/09/13 13:30	10/10/13 09:20
3100329-02	Mill Cr. At SVC		Water	10/09/13 14:15	10/10/13 09:20
3100329-03	SVC above Miller		Water	10/09/13 14:17	10/10/13 09:20

RL - are levels down to which we can quantify with reliability, a result below this level is reported as "ND" for Not Detected.

Balance Hydrologics, Inc. (Santa Cruz)
224 Walnut Ave., Suite E
Santa Cruz, CA 95060
Attn: Denis Ruttenberg

Work Order #: 3100329
Reporting Date: October 17, 2013

Date Received:	October 10, 2013
Project # / Name:	211024 / San Vincente Water Shed
Sample Identification:	Mill Cr. At SVC
Matrix:	Water
Laboratory #:	3100329-02

	Results	Units	RL	Dilution Factor	Analysis Method	Date Analyzed	Flags
Carbonate as CO3	ND	mg/L	4.5	4.55	SM 2320B	10/10/13	
Bicarbonate as HCO3	120	mg/L	4.5	4.55	SM 2320B	10/10/13	
Total Alkalinity as CaCO3	97	mg/L	4.5	4.55	SM 2320B	10/10/13	
Hydroxide as OH	ND	mg/L	4.5	4.55	SM 2320B	10/10/13	

RL - are levels down to which we can quantify with reliability, a result below this level is reported as "ND" for Not Detected.

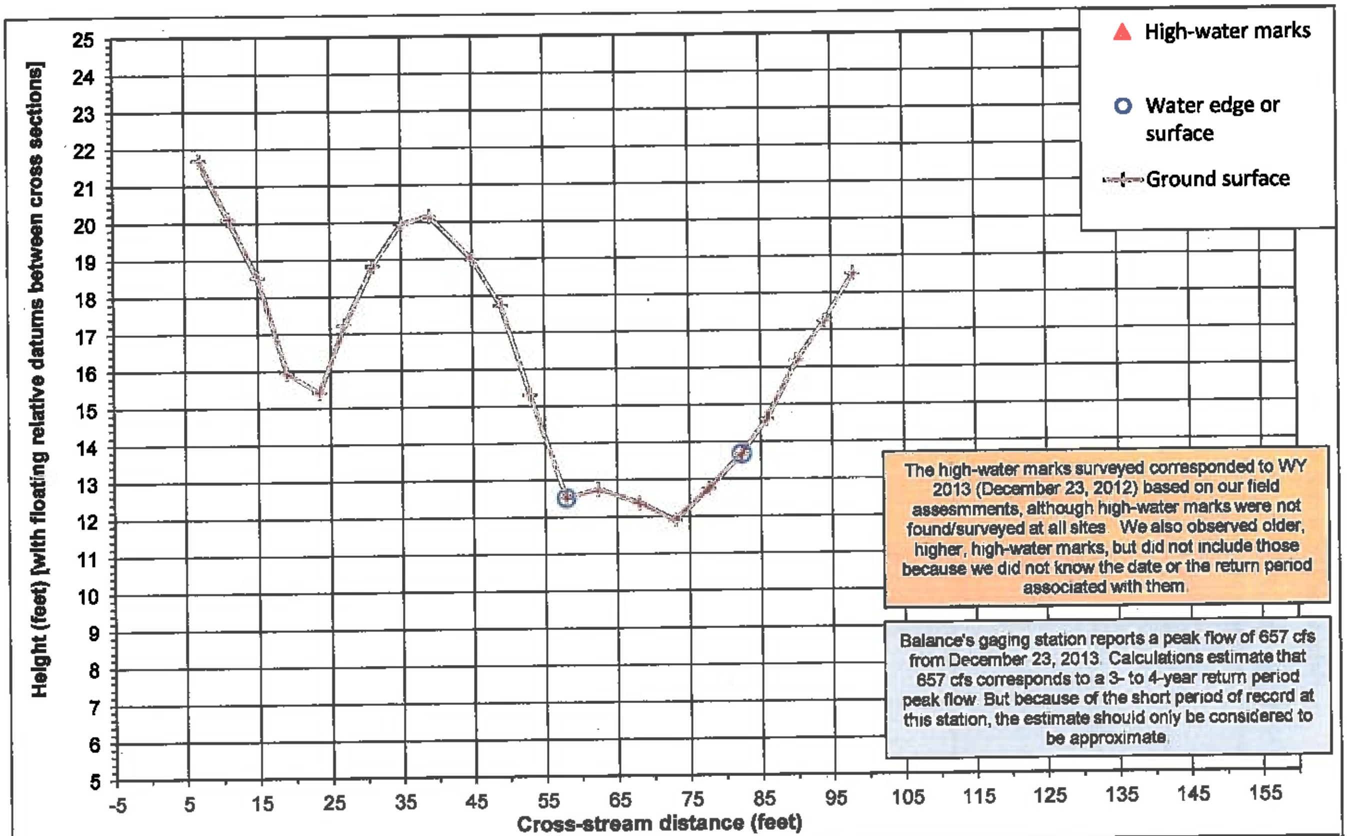
Balance Hydrologics, Inc. (Santa Cruz)
224 Walnut Ave., Suite E
Santa Cruz, CA 95060
Attn: Denis Ruttenberg

Work Order #: 3100329
Reporting Date: October 17, 2013

Classical Chemistry Parameters - Quality Control
Soil Control Lab

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch PJ30109 - Default Prep GenChem											
Blank (PJ30109-BLK1)					Prepared & Analyzed: 10-Oct-13						
Total Alkalinity as CaCO3	2.120		1.0	mg/L							
Duplicate (PJ30109-Dup1)		**Source: 3100349-01**			Prepared & Analyzed: 10-Oct-13						
Total Alkalinity as CaCO3	276.2		2.0	mg/L		277.4			0.414	20	

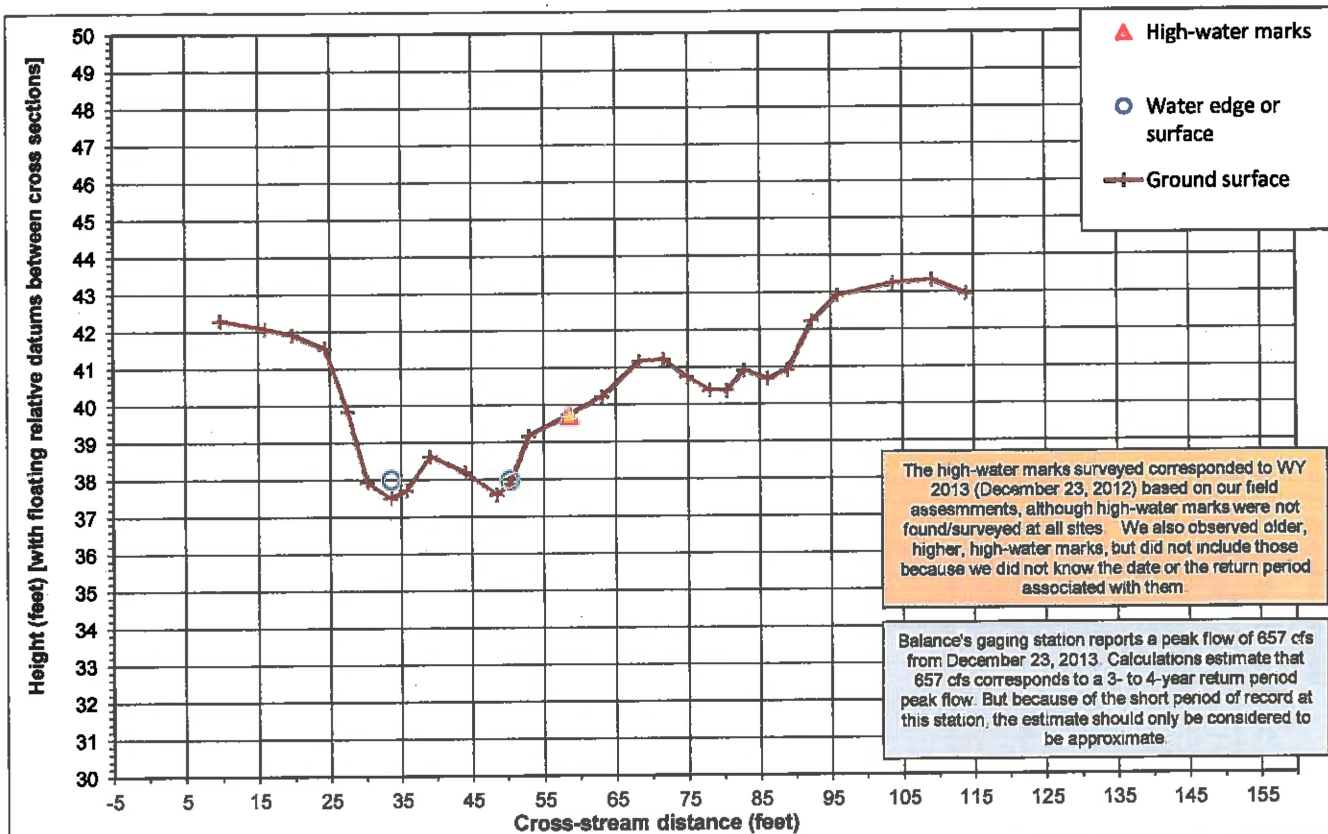
RL - are levels down to which we can quantify with reliability, a result below this level is reported as "ND" for Not Detected.



Balance Hydrologics, Inc.

Figure B.1. **Cross-section 1 survey data: San Vicente Creek, July 2013.** The cross-section surveys show varying degrees of floodplain connectivity. Well-connected floodplains would ideally be moderately inundated by the water year 2013 peak flow (indicated by high-water marks).

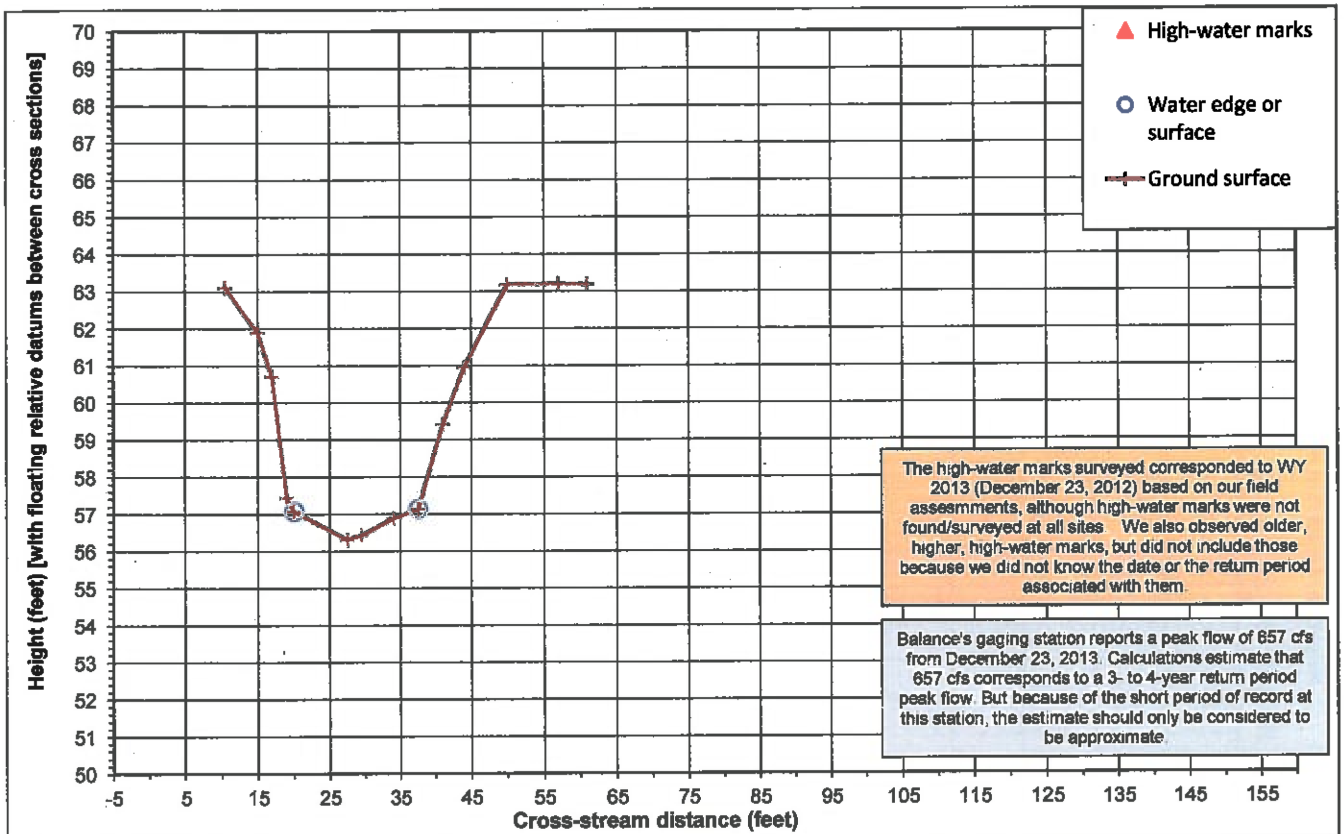
211024 SVC_Floodplain July 2013 JO.xlsx, Fig B1



Balance Hydrologics, Inc.

Figure B.3. Cross-section 3 survey data: San Vicente Creek, July 2013. The cross-section surveys show varying degrees of floodplain connectivity. Well-connected floodplains would ideally be moderately inundated by the water year 2013 peak flow (indicated by high-water marks).

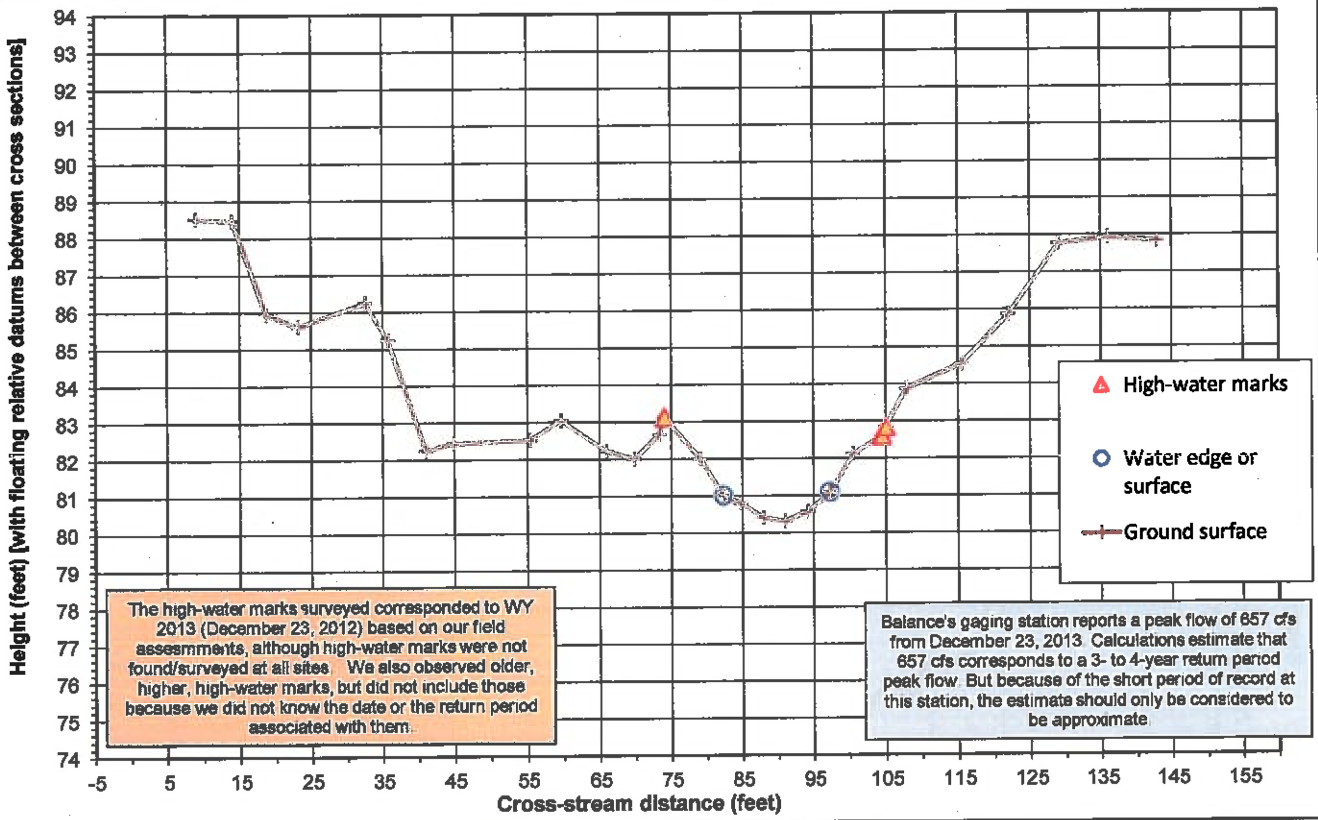
211024 SVC_Floodplain July 2013 JO.xlsx, Fig B3



Balance Hydrologics, Inc.

Figure B.5. Cross-section 5 survey data: San Vicente Creek, July 2013. The cross-section surveys show varying degrees of floodplain connectivity. Well-connected floodplains would ideally be moderately inundated by the water year 2013 peak flow (indicated by high-water marks).

211024 SVC_Floodplain July 2013 JO.xlsx, Fig B5



Balance Hydrologics, Inc.

Figure B.7. Cross-section 7 survey data: San Vicente Creek, July 2013. The cross-section surveys show varying degrees of floodplain connectivity. Well-connected floodplains would ideally be moderately inundated by the water year 2013 peak flow (indicated by high-water marks).

211024 SVC_Floodplain July 2013 JO.xlsx, Fig B7

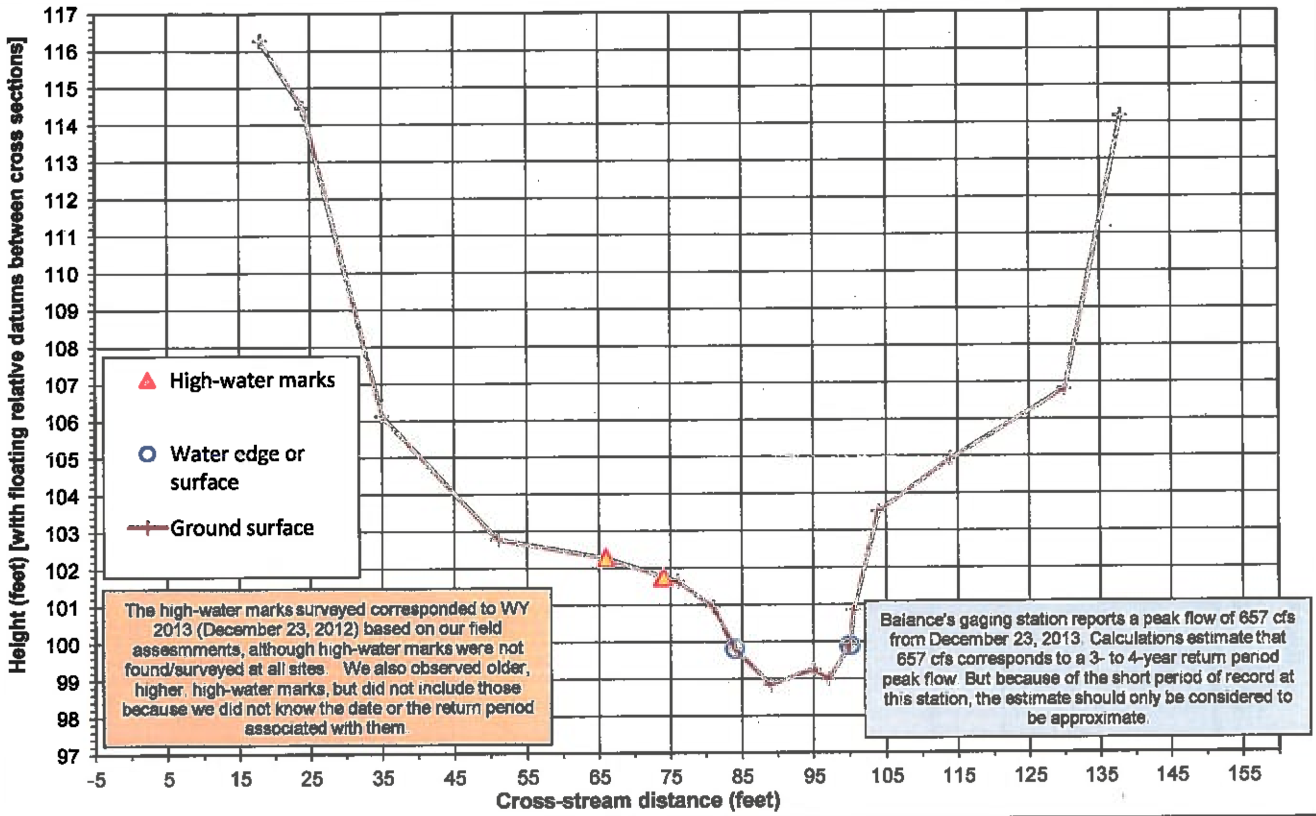
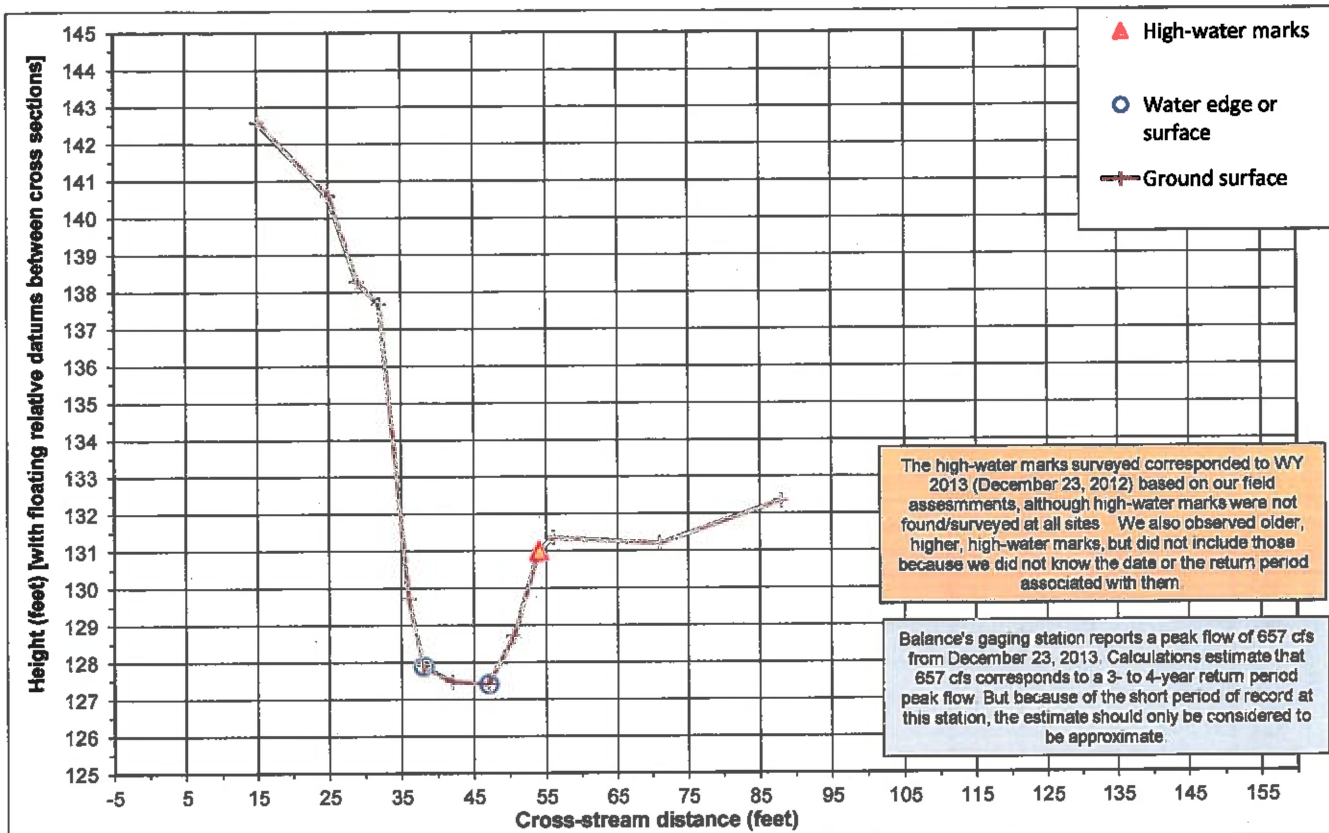


Figure B.9. Cross-section 9 survey data: San Vicente Creek, July 2013. The cross-section surveys show varying degrees of floodplain connectivity. Well-connected floodplains would ideally be moderately inundated by the water year 2013 peak flow (indicated by high-water marks).

Balance Hydrologics, Inc.

211024 SVC_Floodplain July 2013 JO.xlsx, Fig B9



Balance Hydrologics, Inc.

Figure B.11. Cross-section 11 survey data: Mill Creek, July 2013. The cross-section surveys show varying degrees of floodplain connectivity. Well-connected floodplains would ideally be moderately inundated by the water year 2013 peak flow (indicated by high-water marks).

211024 SVC_Floodplain July 2013 JO.xlsx, Fig B11

Appendix D

LARGE WOODY DEBRIS SURVEY DATA SHEETS

02

Large Woody Debris Inventory Form

Date: 7-15-13	Surveyors: JM+GW	Stream: San Vicente Creek – Main Stem	Drainage: San Vicente Creek	Sample 2 of 6	Reach No: 1
Channel Type: F5	Ref pt: Confluence with Pacific Ocean		Sample Location (ft. from ref pt.): 1,050 to 1,385	Reach Location (ft. from ref pt.): 0 to 5,950	

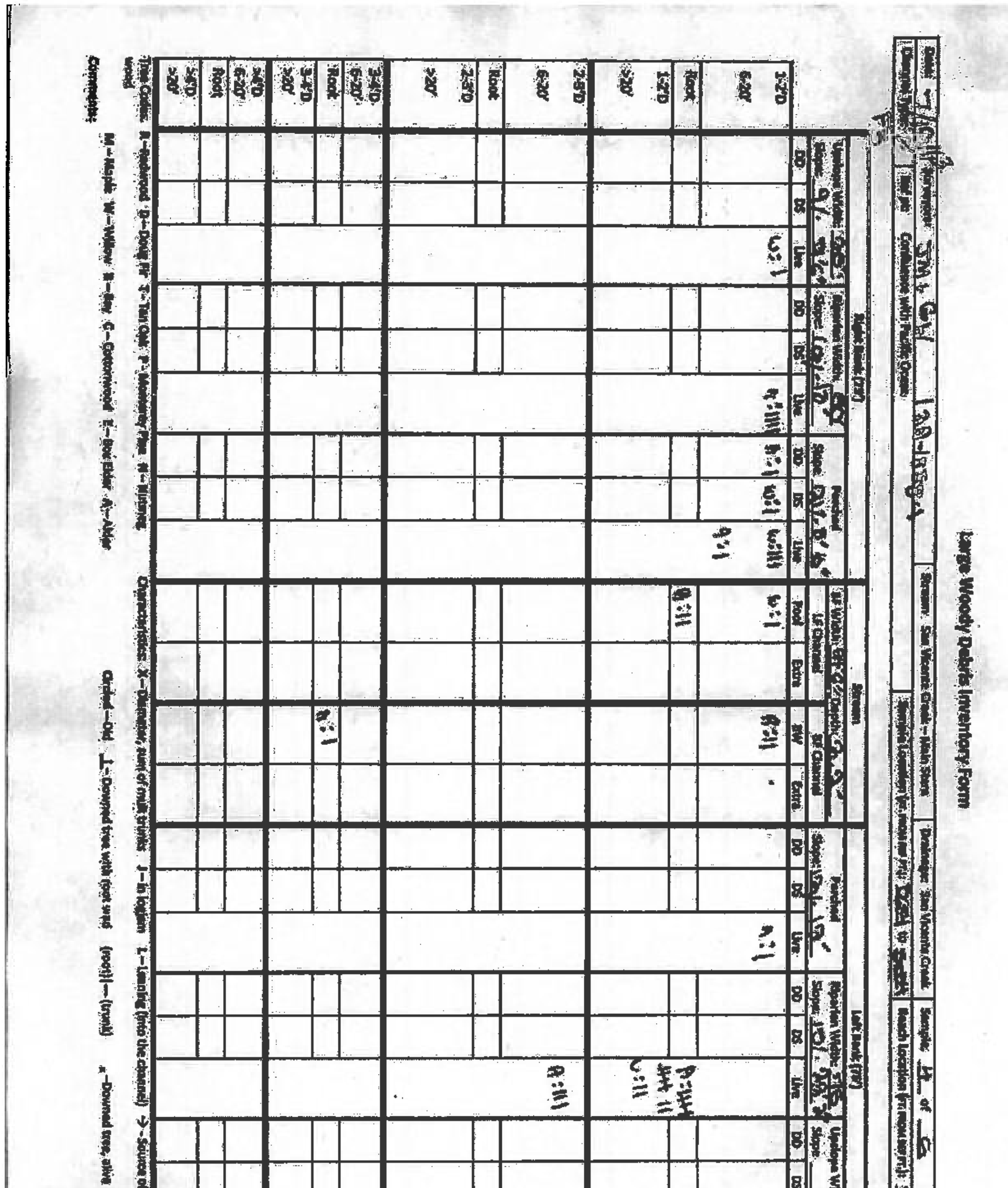
	Right Bank (75')									Stream				Left Bank (75')								
	Upslope Width: 30' Slope: 90%			Riparian Width: 75' Slope: 45% / 15%			Perched Slope: 15% / 10%			BF Width: 35' Depth: 2.5'				Perched Slope: 24% / 11%			Riparian Width: 35' Slope: 45% / 50%			Upslope Width: X Slope: X		
										LF Channel		BF Channel										
	DD	DS	Live	DD	DS	Live	DD	DS	Live	Pool	Extra	SW	Extra	DD	DS	Live	DD	DS	Live	DD	DS	Live
1-2'D 6-20'			W:IIII			R:HHT HHT II W:III		A:II	W:III R:I	W:I	A:II				W:I	W:I A:I		W:I	W:HHT A:II			
Root																						
1-2'D >20'								A:I														
2-3'D 6-20'			W:II			A:II O:II			A:L-II							W:I A:I			A:HHT W:I			
Root																						
2-3'D >20'																						
3-4'D 6-20'																						
Root																						
3-4'D >20'																						
>4'D 6-20'																						
Root																						
>4'D >20'																						

Tree Codes: R–Redwood D–Doug Fir T–Tan Oak P–Monterey Pine N–Nutmeg M–Maple W–Willow B–Bay C–Cottonwood E–Box Elder A–Alder

Characteristics: X–Diameter, sum of multi trunks J–In logjam L–Leaning (into the channel) → - Source of recruited wood

Circled – Old ⊥– Downed tree with root wad (root)|—(trunk) – Downed tree, alive

Comments:



Large Woody Debris Inventory Form

Date: 7/10/13 | Surveyors: JM + GW | 120-18?? | Stream: San Vicente Creek – Main Stem | Drainage: San Vicente Creek | Sample: 4 of 6 | Reach No: 1
Channel Type: F3 | Std pt: Confluence with Pacific Ocean | Sample Location (ft. from std pt.): [illegible] to [illegible] | Reach Location (ft. from std pt.): 0 to 5935

	Right Bank (79')									Stream				Left Bank (79')								
	Upslope Width: [illegible] Slope: 9% [illegible]			Riparian Width: 50' Slope: [illegible]			Perched Slope: [illegible]			BF Width: [illegible] Depth: [illegible]				Perched Slope: [illegible]			Riparian Width: [illegible] Slope: [illegible]			Upslope Width: X Slope:		
										LF Channel		SF Channel										
	DD	DS	Live	DD	DS	Live	DD	DS	Live	Pool	Extra	BW	Extra	DD	DS	Live	DD	DS	Live	DD	DS	Live
1-2'D 6-20'			W:1			R:1111	R:1	W:1	W:111 R:1	W:1		R:11	•			R:1						
Root										R:11									R:1111 1111 11 W:11			
1-2'D >20'																						
2-3'D 6-20'																			R:111			
Root																						
2-3'D >20'																						
3-4'D 6-20'																						
Root												R:1										
3-4'D >20'																						
>4'D 6-20'																						
Root																						
>4'D >20'																						

Tree Codes: R–Redwood D–Doug Fir T–Tan Oak P–Monterey Pine N–Nutmeg M–Maple W–Willow B–Bay C–Cottonwood E–Box Elder A–Alder

Characteristics: X–Diameter, sum of mult trunks J–In logjam L–Leaning (into the channel) →–Source of recruited wood Circled–Old ⊥–Downed tree with root wad (root)|—(trunk) *–Downed tree, alive

Comments:

Large Woody Debris Inventory Form

Date: 7-19-11 Surveyors: JM & GW	Stream: San Vicente Creek – Main Stem	Drainage: San Vicente Creek	Sample: 6 of 6 — Reach No: 1
Channel Type: B2 — Ref pt: Confluence with Pacific Ocean		Sample Location (ft. from ref pt.): [illegible] to [illegible]	Reach Location (ft. from ref pt.): 0 to 5853

	Right Bank (75') Upslope Width: X Slope: – DD	DS	Live	Riparian Width: 25 Slope: 10% DD	DS	Live	Perched Slope: [illegible] DD	DS	Live	Stream BF Width: [illegible] LF Channel Pool	Extra	Depth: [illegible] BF Channel RW	Extra	Left Bank (75') Perched Slope: [illegible] DD	DS	Live	Riparian Width: 50 Slope: [illegible] DD	DS	Live	Upslope Width: X Slope: DD	DS	Live
1-2'D 6-20'						B:HHT I				W:1		W:11				A:1			W:1111 A:1			
Root																						
1-2'D >20'												A:11										
2-3'D 6-20'						A:11			B:111 A:1													
Root																						
2-3'D >20'																						
3-4'D 6-20'																						
Root																						
3-4'D >20'																						
>4'D 6-20'																						
Root																						
>4'D >20'																						

Tree Codes: R – Redwood D – Doug Fir T – Tan Oak P – Monterey Pine N – Nutmeg M – Maple W – Willow B – Bay C – Cottonwood E – Box Elder A – Alder

Characteristics: X – Diameter; sum of mult trunks J – in logjam L – Leaning (into the channel) → – Source of recruited wood Circled – Old ⊥ – Downed tree with root wad (root)|—(trunk) – Downed tree, alive

Comments:

Large Woody Debris Inventory Form

Date: 7-1-[illegible]	Surveyors: [illegible]	Stream: San Vicente Creek – Main Stem	Drainage: San Vicente Creek	Sample: 5 of 6	Reach No: 2
Channel Type: [illegible]	Ref pt: Confluence with Pacific Ocean		Sample Location (ft. from ref pt.): [illegible] to [illegible]	Reach Location (ft. from ref pt.): [illegible] to [illegible]	

	Right Bank (75')									Stream				Left Bank (75')								
	Upslope Width: [illegible] Slope: [illegible]			Riparian Width: [illegible] Slope: [illegible]			Perched Slope: [illegible]			BF Width: [illegible] Depth: [illegible]				Perched Slope: [illegible]			Riparian Width: [illegible] Slope: 17			Upslope Width: X Slope:		
										LF Channel		BF Channel										
	DD	DS	Live	DD	DS	Live	DD	DS	Live	Pool	Extra	BW	Extra	DD	DS	Live	DD	DS	Live	DD	DS	Live
1-2'D 6-20'			A: IIII			A: IIII			A: IIII			A: III A: II		A: I		A: II		A: I	A: I			
Root																						
1-2'D >20'																			A: I			
2-3'D 6-20'						A: I		A: I	A: II							A: III			A: I			
Root																						
2-3'D >20'																						
3-4'D 6-20'									A: II													
Root																						
3-4'D >20'																						
>4'D 6-20'																						
Root																						
>4'D >20'																						

Tree Codes: R – Redwood D – Doug Fir T – Tan Oak P – Monterey Pine N – Nutmeg M – Maple W – Willow B – Bay C – Cottonwood E – Box Elder A – Alder

Characteristics: X – Diameter, sum of multi trunks J – In logjam L – Leaning (into the channel) → – Source of recruited wood

Circled – Old ⊥ – Downed tree with root wad (root)|— (trunk) ⊥ – Downed tree, alive

Comments:

Large Woody Debris Inventory Form

Date: 7/7/13	Surveyors: GW + JM	Stream: San Vicente Creek – Main Stem	Drainage: San Vicente Creek	Sample: 2 of 4	Reach No: 3
Channel Type: B3	Ref pt: Confluence with Pacific Ocean	Sample Location (ft. from ref pt.): 1312 to 1515	Reach Location (ft. from ref pt.): 760 to 1514		

	Right Bank (75')									Stream				Left Bank (75')								
	Upslope Width: 20 Slope: vertical			Riparian Width: 20 Slope: 8%			Perched Slope: 8% 12 ft			BF Width: 12 Depth: 1 ft				Perched Slope: 9% 15 ft			Riparian Width: 40 Slope: 25%			Upslope Width: # Slope: #		
										LF Channel		BF Channel										
	DD	DS	Live	DD	DS	Live	DD	DS	Live	Pool	Extra	BW	Extra	DD	DS	Live	DD	DS	Live	DD	DS	Live
1-2'D 6-20'			R: III A: II			A: IIII I										A: II	A: I R: #			R: IIII I A: IIII IIII		
Root																						
1-2'D >20'																						
2-3'D 6-20'			R: II											A: II			A: I		R: I	A: I		
Root																						
2-3'D >20'																						
3-4'D 6-20'			A: I																			
Root																						
3-4'D >20'																						
>4'D 6-20'																						
Root																						
>4'D >20'																						

Tree Codes: R – Redwood D – Doug Fir T – Tan Oak P – Monterey Pine N – Nutmeg M – Maple W – Willow B – Bay C – Cottonwood E – Box Elder A – Alder

Characteristics: X – Diameter, sum of mult trunks J – In logjam L – Leaning (into the channel) → - Source of recruited wood Circled – Old ⊥ – Downed tree with root wad (root) ⊥— (trunk) ⊥ – Downed tree, alive

Comments:

Large Woody Debris Inventory Form

Date: 9/3/13	Surveyors: JAN + [illegible]	Stream: San Vicente Creek – Main Stem	Drainage: San Vicente Creek	Sample: 4 of 4	Reach No: 3
Channel Type: B3	Ref pt: Confluence with Pacific Ocean	Sample Location (ft. from ref pt.): 11334 to 11533		Reach Location (ft. from ref pt.): 7520 to 15443	

	Right Bank (75')									Stream				Left Bank (75')								
	Upslope Width: 35' Slope: Vertical			Riparian Width: 40' Slope: 16%			Perched Slope: 15%			BF Width: 36' Depth: 2.5'				Perched Slope: 21%			Riparian Width: 40' Slope: 4%			Upslope Width: Slope:		
										LF Channel		BF Channel										
	DD	DS	Live	DD	DS	Live	DD	DS	Live	Pool	Extra	BW	Extra	DD	DS	Live	DD	DS	Live	DD	DS	Live
1-2'D 6-20'			A:lll A:ll			A:l										[illegible] A:l			A:[illegible]		ROAD	
Root																						
1-2'D >20'																						
2-3'D 6-20'			D:[illegible] R:l			D:l													R:ll			
Root																						
2-3'D >20'																						
3-4'D 6-20'																						
Root																						
3-4'D >20'																						
>4'D 6-20'																						
Root																						
>4'D >20'																						

Tree Codes: R—Redwood D—Doug Fir T—Tan Oak P—Monterey Pine N—Nutmeg M—Maple W—Willow B—Bay C—Cottonwood E—Box Elder A—Alder

Characteristics: X—Diameter, sum of mult trunks J—In logjam L—Leaning (into the channel) → - Source of recruited wood Circled—Old ⊥—Downed tree with root wad (root)|—(trunk) ⌙—Downed tree, alive

Comments:

Large Woody Debris Inventory Form

Date: 8/2/13	Surveyors: G.W. + J.M.	Stream: San Vicente Creek – Main Stem	Drainage: San Vicente Creek	Sample 2 of 3	Reach No: 4
Channel Type: [illegible]	Ref pt: Confluence with Pacific Ocean		Sample Location (ft. from ref pt): [illegible] to [illegible]	Reach Location (ft. from ref pt): [illegible] to [illegible]	

	Right Bank (75')									Stream				Left Bank (75')								
	Upslope Width: ___ Slope: ___			Riparian Width: 50' Slope: 14%			Perched Slope: 17%			BF Width: 23'6" Depth: 2.4'				Perched Slope: 40%			Riparian Width: 48' Slope: 13%			Upslope Width: ___ Slope: ___		
										1F Channel		BF Channel										
	DD	DS	Live	DD	DS	Live	DD	DS	Live	Pool	Extra	BW	Extra	DD	DS	Live	DD	DS	Live	DD	DS	Live
1-2'D 6-20'						A: [illegible]			A: [illegible]	A: ||	R: |					A: [illegible] A: [illegible]			R: [illegible] A: [illegible]			
Root									A: [illegible]													
1-2'D >20'												A: |	A: |									
2-3'D 6-20'						A: |||			A: |													
Root																						
2-3'D >20'																						
3-4'D 6-20'																						
Root										R: |												
3-4'D >20'																						
>4'D 6-20'																						
Root										R: |												
>4'D >20'																						

Tree Codes: R—Redwood D—Doug Fir T—Tan Oak P—Monterey Pine N—Nutmeg M—Maple W—Willow B—Bay C—Cottonwood E—Box Elder A—Alder

Characteristics: X—Diameter, sum of multi trunks J—In logjam L—Leaning (into the channel) →—Source of recruited wood
Circled—Old ⊥—Downed tree with root wad (root)|—(trunk) ⌞—Downed tree, alive

Comments:

Large Woody Debris Inventory Form

Date: 1/6/15	Surveyors: Chris Loomis & John Drups	Stream: San Vicente Creek – Main Stem	Drainage: San Vicente Creek	Sample: 1 of 2	Reach No: 5
Channel Type: B1/5	Ref pt: Confluence with Pacific Ocean		Sample Location (ft. from ref pt.): 16120 to 16430	Reach Location (ft. from ref pt.): 15930 to 18423	

	Right Bank (75')									Stream				Left Bank (75')								
	Upslope Width: 50' Slope: 65%			Riparian Width: 25' Slope: 65%			Perched Slope: 22%			BF Width: 21' Depth: 6"				Perched Slope: 5%			Riparian Width: 35 Slope: 20%			Upslope Width: Slope:		
										LF Channel		BF Channel										
	DD	DS	Live	DD	DS	Live	DD	DS	Live	Pool	Extra	BW	Extra	DD	DS	Live	DD	DS	Live	DD	DS	Live
1-2'D 6-20'																						
Root																						
1-2'D >20'			R: lll T: ll Ma: l			D: Ull		R: l	R: l J		R: l →					R: l			Ma: l D: M			
2-3'D 6-20'																						
Root																						
2-3'D >20'																D: l			D: ll			
3-4'D 6-20'																						
Root																		R: lll				
3-4'D >20'																						
>4'D 6-20'																						
Root																						
>4'D >20'																						

Tree Codes: R – Redwood D – Doug Fir T – Tan Oak P – Monterey Pine N – Nutmeg M – Maple W – Willow B – Bay C – Cottonwood E – Box Elder A – Alder

Characteristics: X – Diameter, sum of mult trunks J – In logjam L – Leaning (into the channel) → - Source of recruited wood Circled – Old ⊥ - Downed tree with root wad (root)|— (trunk) ⌞ – Downed tree, alive

Comments: Ma = Madrone

Large Woody Debris Inventory Form

Mill Ck

Date: 12/16/13	Surveyors: CL + JD	Stream: San Vicente Creek – Main Stem	Drainage: San Vicente Creek	Sample: 1 of 2	Reach No: 6
Channel Type: B3	Ref pt: Confluence with Pacific Ocean w/ San Vicente Ck		Sample Location (ft. from ref pt.): 400 to 600	Reach Location (ft. from ref pt.): 0 to 2347	

	Right Bank (75')									Stream				Left Bank (75')								
	Upslope Width: 45' Slope: 15%			Riparian Width: 30' Slope: 45%			Perched Slope: 85%			BF Width: 15' Depth: 6"				Perched Slope: 5%			Riparian Width: 35' Slope: 85%			Upslope Width: 40' Slope: 45%		
										LF Channel		BF Channel										
	DD	DS	Live	DD	DS	Live	DD	DS	Live	Pool	Extra	BW	Extra	DD	DS	Live	DD	DS	Live	DD	DS	Live
1-2'D 6-20'																W: ll						
Root																						
1-2'D >20'						T: llll A: l			A: lll A: l							A: lll A: ll		T: l	T: ll A: llll l			
2-3'D 6-20'																						
Root																						
2-3'D >20'																			A: llll			
3-4'D 6-20'																		A: lll				
Root																						
3-4'D >20'																						
>4'D 6-20'																						
Root																						
>4'D >20'																						

Tree Codes: R – Redwood D – Doug Fir T – Tan Oak P – Monterey Pine N – Nutmeg M – Maple W – Willow B – Bay C – Cottonwood E – Box Elder A – Alder

Characteristics: X – Diameter, sum of mult trunks J – In logjam L – Leaning (into the channel) → – Source of recruited wood Circled – Old ⊥ – Downed tree with root wad (root) |— (trunk) ₐ – Downed tree, alive

Comments:

Appendix E

LARGE WOODY DEBRIS SURVEY DATA SHEETS

Occurrence 1

Date: 12/13/12 **Time:** 10:11AM **Observers:** Graham/Jessica
Description: This point is for the lower SVC pond to the road. Cape Ivy is present in the trees. There appears to be flooding as indicated by the vegetation. There are several large trees and a white alder (ALRH) forest. Hemlock is present.
Access: Hand Crew
Adjacent to floodplain: Yes

Invasive Species	Cover	In Trees	Mixed w/Natives	Isolated
DEOD (Cape Ivy)	> 50%	Yes	Yes	
FOVU (Fennel)	< 50%			

Dominant Natives
SCCA
STBU

Photos:

Picture 42: North

Picture 45: West

Picture 46: Channel

Picture 48: Downstream

Picture 49: Left Bank

Occurrence 3:

Date: 12/13/12 **Time:** **Observers:** Graham/Jessica

Description: At the rock weir. Cape ivy is in the trees and across the stream, running up the cliff. Cape Ivy is surrounding the flow control structure. Large alders are present.

Access: Hand Crew, Herbicide

Adjacent to floodplain: Yes

Slope: Greater than 1:1

Invasive Species	Cover	In Trees	Mixed w/Natives	Isolated
DEOD	>50%	Yes		
COJU	< 50?			
GEMO	< 50%			
FOVU	<50%			

Photos:

Picture 51: Upstream

Picture 54: Right Bank

Picture 55: Right Bank, upstream


Picture 57: Downstream


Picture 58: Left Bank

Occurrence 5:

Date: 12/13/12 **Time:** 12:45PM **Observers:** Graham/Jessica
Lat: 37 01' 07.772" N **Long:** 122 11' 15.008" W
Description: High priority area, adjacent to a large redwood tree. Fennel is present 15ft past this point.
Access: Hand Crew
Adjacent to floodplain: Yes
Slope: Innerbank 3:1

Invasive Species	Cover	In Trees	Mixed w/Natives	Isolated
DEOD	> 50%	Yes	Yes	Yes

Dominant Natives
STBU
RUUR

Photos:

Picture 61: Upstream

Picture 62: Right Bank

The following points were taken from San Vicente Road, using the gate as a point of reference.

Occurrence 9:

Date: 12/13/12 **Time:** **Observers:** Graham/Jessica
Description: Large patch of ivy, extending 238 feet along the road and all the way to the stream. Only covers trees up to 15ft. 8 – 10 mature white alder and 1 large redwood 3-4 ft in diameter.
Distance from gate: 1361ft

Invasive Species	Cover	In Trees	Mixed w/Natives	Isolated
DEOD	> 50%	Yes	Yes	Yes

Dominant Natives
ALRH
SESE

Photos:
The following photographs document the cape ivy as seen along the road:

The following points were taken from San Vicente Road, using the gate as a point of reference.

The following points were taken from San Vicente Road, using the gate as a point of reference.

Occurrence 10:

Date: 12/13/12 **Time:** **Observers:** Graham/Jessica
Description: Underneath conveyor belt. Large and very tall patch of French broom, continues upstream.
Distance from gate: 1690ft

Invasive Species	Cover	In Trees	Mixed w/Natives	Isolated
GEMO	> 50%			Yes

Photos:

Invasive Mapping Reconnaissance

Project Key

DEOD	Cape Ivy
FOVU	Fennel
SCCA	Bee Plant
STBU	Hedge Nettle
RHCA	Coffeeberry
SARA	Red Elderberry
COJU	Jubata Grass
GEMO	French Broom
HEHE	English Ivy
RUUR	California Blackberry
RUPA	Rubus Parviflorus
ALRH	White Alder
SESE	Coast Redwood

Description for Cape Ivy - Area 3						
						# of
Plant name	Dist.	Dist.	Area (sq ft)	Density	Hgt in	Trees
	RD	Strm		> %	Trees	
	Access					
	455	410	82 x 85 - 20%	40-80	20-30	10-30+
			Approx. 5600 sq. ft.			
Notes						
Yellow Jacket nest- downstream path near Redwoods						
Herbicide use:						
CI pull down from Alder and spray downstream wall of CI near YJ nest						
Spray 6' wide path along upstream section of path				~ 800 - 1000 sq. ft.		
No CI along the road. It begins around the large Alder 35' toward the stream						
There is a lot of Urtica in here and nice patches of Scrophularia and Stachys						

Description for Cape Ivy - Area 4						
						# of
Plant name	Dist.	Dist.	Area (sq ft)	Density	Hgt in	Trees
	RD	Strm		> %	Trees	
	Access					
	855		20 x 20= 400		15	a few
Notes						
Smaller Clematis at the stream near the building						
Access point 6' upstream from 3 transformer pole; walk upstream to within 45' of patch						
Cross stream for access road, 130' pass the power pole with 3 transformers						
There is a 1000 sq ft patch of Vinca along the stream & directly upstream from the CI patch						
There is a 15 sq foot patch of Tradescantia sp.(Wandering Jew) 70' upstream from the Vinca						

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