ALUM ROCK FISH PASSAGE PROJECT MITIGATION MONITORING REPORT YEAR FOUR, 2016

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Tables and Figures

Acronyms and Abbreviations

FAC	Facultative
FACW	Facultative Wetland
HMMP	Habitat Mitigation and Monitoring Plan
HTH	H. T. Harvey & Associates
OBL	Obligate
Plan	Fisheries Monitoring Plan
Project	VTA’s Alum Rock Fish Passage Project
VTA	Valley Transportation Authority
YSI	Youth Science Institute

Alum Rock Fish Passage Project
Mitigation Monitoring Report

This Mitigation Monitoring Report represents a full accounting of the required vegetation monitoring in accordance with the *Habitat Mitigation and Monitoring Plan – Alum Rock Park Bank Repair and Stream Restoration Projects* (Winzler & Kelly 2012 (HMMP) associated with VTA's Alum Rock Fish Passage Project (Project), which consists of several project elements contained in the City of San Jose's larger Alum Rock Park Bank Repair and Stream Restoration Project. This report also provides a summary of the Geomorphic/Physical Site Monitoring and Fish Passage Improvement Monitoring required under permit conditions for the Project. The full Geomorphic and Fish Passage Improvement Monitoring reports are attached to this report and; in full represent a complete accounting of the required monitoring for 2016, and the status of the Project as related to achievement of performance objectives.

The Alum Rock Fish Passage Project is located in Alum Rock Park (Figure 1) and consists of five separate sites. Site 10 is a newly constructed floodplain approximately 120 feet long by 30 to 40 feet wide that begins just south of the Alum Rock Park Bridge L (Figure 2). Site 13 is a newly constructed fish passage located directly downstream of the Youth Science Institute (YSI, Figure 3). Site 2, a reinforced, concrete curved retaining wall, was installed on the left bank next to the YSI Bridge to protect a mature deodar cedar whose roots were becoming scoured out (Figure 1). Site 3, consisting of removal of a rock wall downstream of Bridge L, and Site 5, consisting of repair of an eroded rill, are included in the Project (Figure 1); however, there are no monitoring requirements assigned specifically to Sites 2, 3 or 5.

Year Four, 2016

Executive Summary

Geomorphic Monitoring

Geomorphic monitoring of Sites 10 and 13 for the Project began in September 2013, and will occur from years 1-5, 7, 9 and 10. Monitoring is being conducted by Balance Hydrologics, Inc.

Site 10 Floodplain

Monitoring at Site 10 includes installation of level loggers that record water surface elevation depths every 15 minutes. Two loggers were installed on September 26, 2013 directly adjacent to Site 10. Two sedimentation plates were installed to provide a means to directly measure sedimentation on the floodplain. In addition to these passive methods of floodplain inundation measurements, two cross-sections and one floodplain 'longitudinal profile' were initially surveyed on October 17, 2013. These will be re-surveyed on a yearly basis to measure any changes to floodplain geometry at these locations. Photo point locations were established, with an initial set of photos taken to record existing conditions.

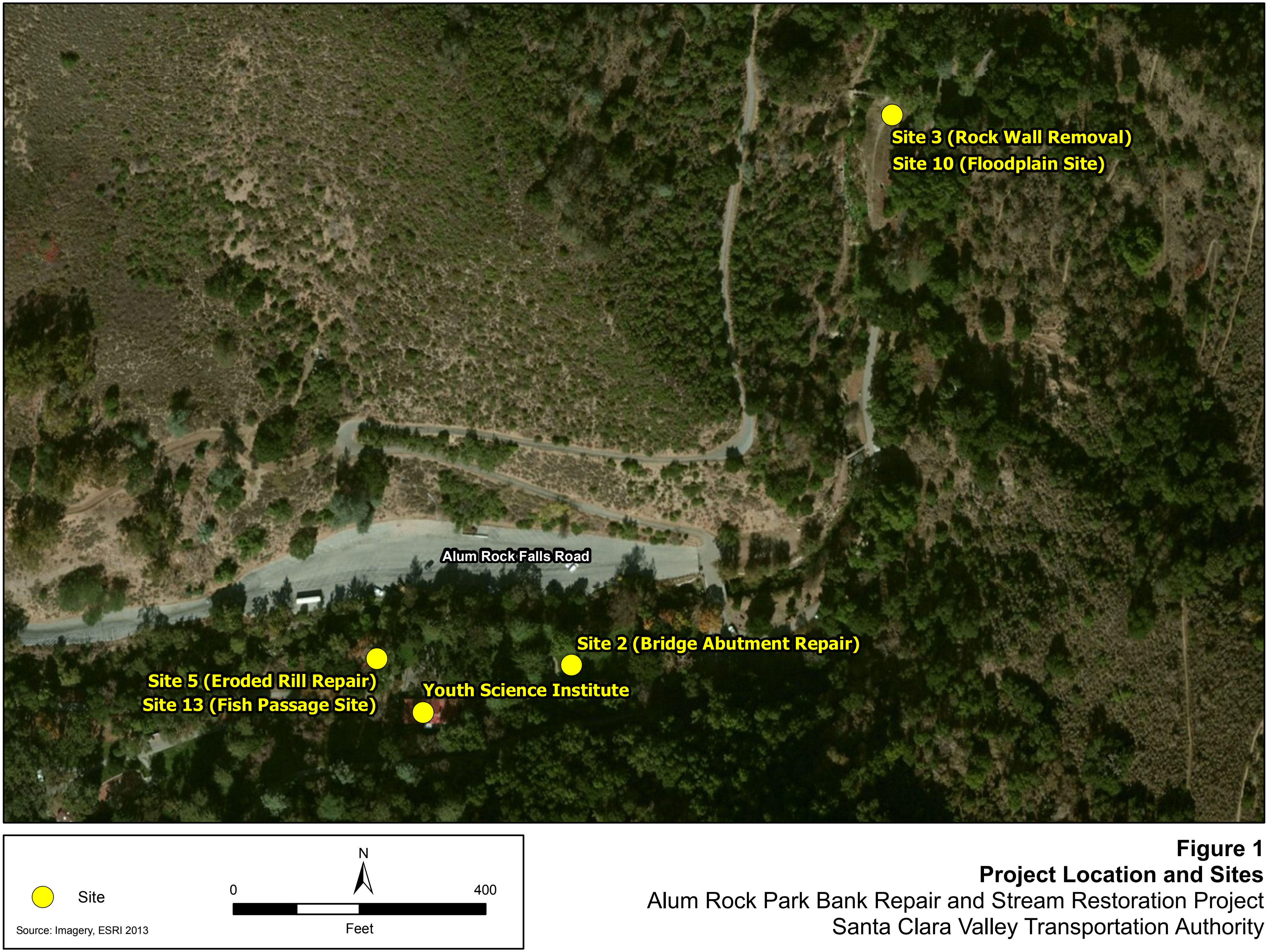
Visual assessment of geomorphic change at Project Site 10 in September 2016 was marked by fine sediment deposition on the floodplain, coarse sediment deposition in the channel, and continued growth of alders and willows. Aggradation was observed on the floodplain; evidence included organic debris wrack lines from high water, movement of large and small wood onto the floodplain, and fresh sediment deposits. This is consistent with the stage record of inundation. The connections from the main channel to the constructed floodplain have not changed significantly; however, a substantial amount of coarse sediment was transported into the channel bed below the elevation of the floodplain, presumably during one or more of the high-flow events occurring from December 2015 to March 2016. Coarse sand to cobble–sized particles filled in the pool that contained the in-channel gage, burying the gage in 1-2 feet of sediment and transforming the channel adjacent to the floodplain into a coarse riffle. The increased bed elevation through this reach will likely increase the likelihood of flows reaching the floodplain. The depth of sediment accumulated on the floodplain sedimentation plates was measured on September 15, 2016. Both plates had been inundated during flood flows, and were covered in fine sediment and organic debris. Both plates had accumulated approximately 0.25 feet (7.5 centimeters) of sediment.

Comparison of September 2016 data to previous surveys generally confirm the results of the visual observations: a small amount of deposition is occurring on the floodplain, especially on downstream portions, and coarse sediment deposition took place in the channel. There is no evidence of major erosion on the floodplain, toe wall, nor evidence of channel widening or downcutting over Water Year 2016 (WY2016). The elevation of the floodplain generally appears to be consistent with or slightly elevated from the baseline survey by a few inches. In some upstream portions there is evidence of a few inches of scour, which is possible due to the inundations that took place over the course of the water year. The magnitude of elevational changes is minor, however, and does not hinder the habitat function of the floodplain. The surveyed profile suggests geomorphic stability within Project Site 10.

Site 13 Fish Passage

At Site 13, the uppermost step in the original channel design failed in the first year's set of storms (i.e. two large storms in December, 2012). The step was rebuilt in mid-September, 2013. All monitoring work commenced after the step was rebuilt. To monitor channel evolution, seven cross-sections and one longitudinal profile were initially surveyed on October 17, 2013. These sections will be re-surveyed on a yearly basis to measure any changes to channel geometry at these locations. Photo point locations were established, with an initial set of photos taken to record existing conditions.

Visual inspections and photo point comparisons from Year 1 to Year 4 of Project Site 13 show that despite the increased volume of flow passing through the project site in WY2016, the fish passage seems to be functioning as intended and the rock band structures and pools were in good condition. This year some larger rocks (~2 feet in diameter) moved slightly, and there was continued reworking of finer bed sediment, but in general these changes were localized and did not appear to be degrading the constructed elements. Like last year, some mobilization of the bed and reworking of gravel to cobble-size sediments was also observed. These reworked sediments provide an additional increase in habitat complexity and are not expected to interfere with the structural integrity of the channel. Vegetation that had largely been scoured out at the time of last years' survey (WY2015) has grown back vigorously, and the site remains largely free of thick algal mats.



Source: Imagery, ESRI 2013

Figure 1
Project Location and Sites
Alum Rock Park Bank Repair and Stream Restoration Project
Santa Clara Valley Transportation Authority

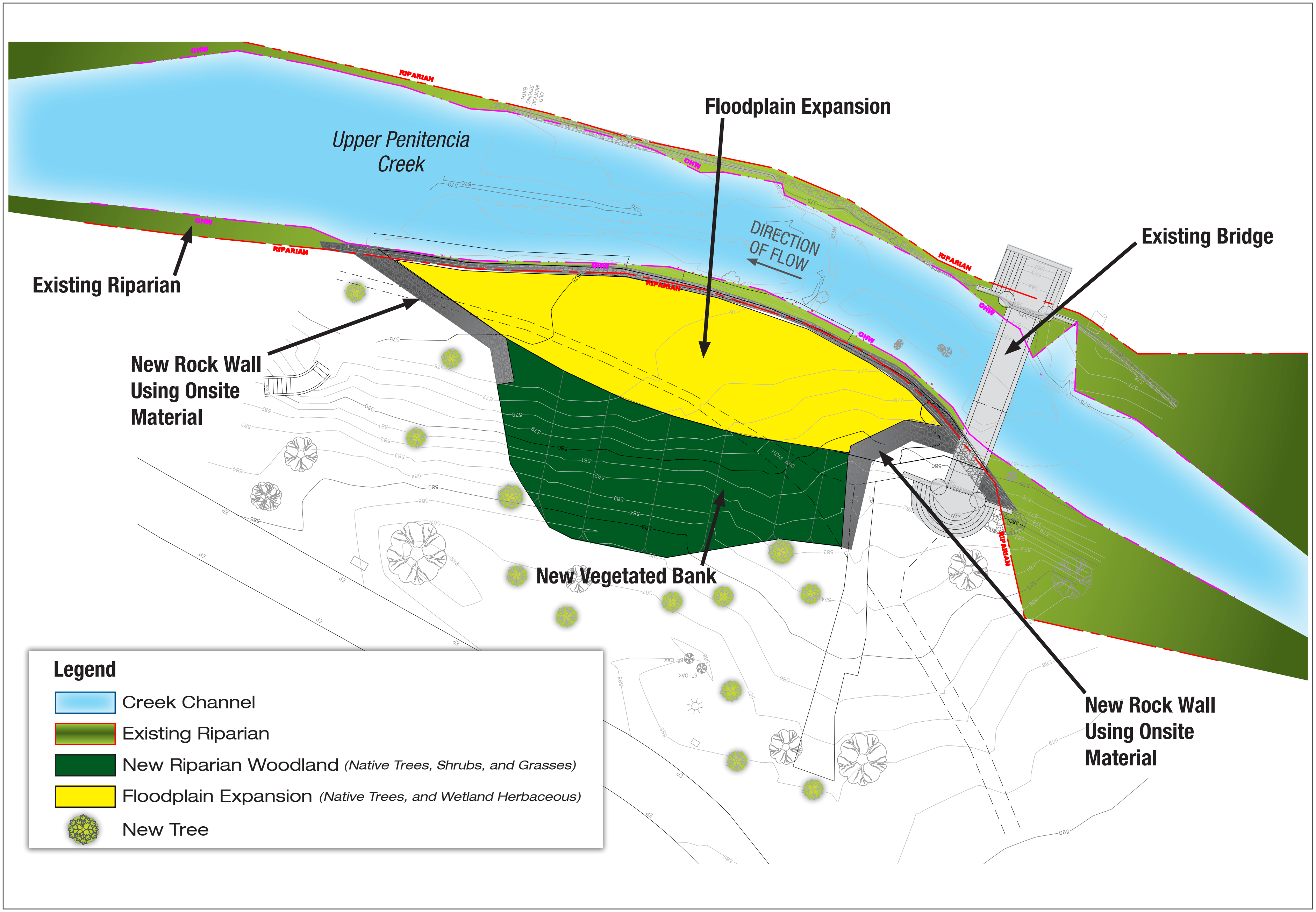


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Figure 2
Site 10 Floodplain Restoration
Alum Rock Park Bank Repair and Stream Restoration Project
Santa Clara Valley Transportation Authority

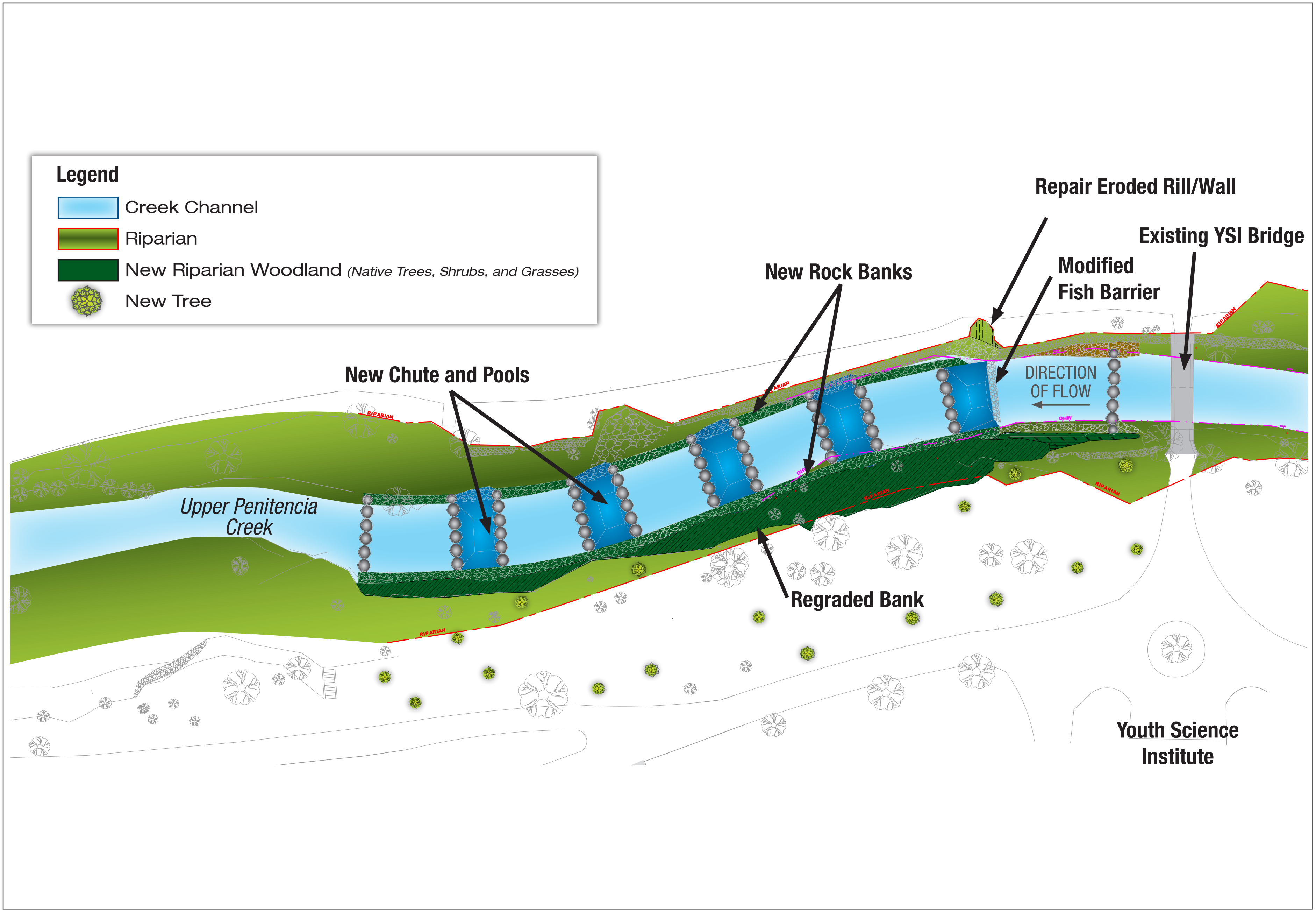

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Figure 3
Site 13 Fish Passage Improvement Restoration
Alum Rock Park Bank Repair and Stream Restoration Project
Santa Clara Valley Transportation Authority

The flows of WY2016 continued to move large wood in the channel. A large log that shifted a few feet up the bank in WY2015 has now accumulated several more pieces of small to large-sized wood, and a similar debris pile has formed on the right bank, potentially improving habitat structure and function. Additionally there is a sizeable log on the south bank, downstream of the YSI Bridge, which was transported during one of the season's more significant flows.

Comparisons of September 2016 cross section survey data to September 2014 survey data generally confirm the results of the visual observations – major geomorphic change, such as significant bank widening, mobilization or deposition, did not take place in the fish passage structure over WY2016, but movement of individual boulders and localized variations in bed elevations were detected.

The longitudinal profile shows that despite the wet year, the profile remains largely unchanged from the previous year. Pools which deepened in the December 2014 flood, such as through a segment approximately 20 to 60 feet downstream of the YSI Bridge and downstream of cross section (XS) 4, have deepened, but by half a foot or less. Through this upper reach, pools are approximately 1 foot deeper than when constructed. Sediment, which accumulated in pools from Station 175 to 200 and below Station 300 during WY2015, has been mobilized again, with pool bed elevations dropping by about half a foot. As expected from the cross section surveys, there is some change in the profile around XS 5, where large boulder movements were observed, but the overall bed elevation has not changed appreciably. The tops of rock band structures and weirs are at the same elevations as last year. The surveyed profiles suggest geomorphic stability, but active channel dynamics at Project Site 13, which are likely due to post-drought, episodic conditions upstream of the site. (For details of the geomorphic site monitoring, refer to Appendix C.)

Fisheries Monitoring

H. T. Harvey & Associates (HTH) developed and implemented a Fisheries Monitoring Plan (Plan) to meet the requirements of the Project's Biological Opinion prepared by the National Marine Fisheries Service (May 31, 2012 (NMFS). Plan goals were to: 1) document the fish species occupying Site 13, and 2) document habitat associations in the Project and reference reaches upstream. Special attention was given to the occurrence of Central California Coast steelhead (*Oncorhynchus mykiss*) due to their special status.

Spring electrofishing surveys were not conducted in 2016 to avoid stressing fish already impacted by prolonged drought conditions (per instructions from NMFS). Therefore, H. T. Harvey quantitatively surveyed 10 contiguous habitat units in the Project reach and seven contiguous habitat units in the Upstream reach. Fall electrofishing surveys were conducted on October 24, 2016. The fish community documented during Year 4 surveys was composed of four native species: California roach (*Lavinia symetricus*), riffle sculpin (*Cottus gulosus*), Sacramento sucker (*Catostomus occidentalis*), Central California Coast steelhead *(Oncorhyncus mykiss)*, and one introduced species, golden shiner (*Notemigonus crysoleucas*). The fall survey observed one *O. mykiss* in the Project reach but was not captured. In total, 715 fish were captured during fall.

The results of the 2016 Year 4 surveys indicate that a stable community of native fishes inhabit the Project reach and the Upstream reach. *O. mykiss* maintain a presence in these reaches, albeit at low levels. The density (i.e., number of fish per 100 feet) of *O. mykiss* in Upper Penitencia Creek has been low since 2011, likely attributable to drought conditions during this timeframe, and the single *O. mykiss* observed was probably resident (see also Leicester and Smith 2016). Year 4 survey results are consistent with previous monitoring results indicating that Project goals regarding fish passage improvements continue to be met. (For details of the Alum Rock Park Fish Passage Improvement Project: Year 3 Fisheries Monitoring refer to Appendix D).

Vegetation Monitoring

The HMMP was completed for the Project to aid in mitigating the vegetation effects of the restoration activities. The HMMP states that once during the growing season herbaceous species will be monitored for five years and woody species for ten years to determine the success of the re-vegetation. ICF International biologists conducted the vegetation monitoring for Year-4 on September 1, 2016.

The Project met all performance objectives for Year-4 monitoring. Wetland species averaged a total of 71% aerial cover; the required aerial cover in the HMMP was 45%. Aerial cover of native plants averaged a total of 75% of the Project area; the required aerial cover in the HMMP was 35%. Survival of trees and woody plants averaged 115%; the required survival in the HMMP was 75%. Lastly, invasive species were not widespread during Year-4 monitoring and did not prevent the achievement of any performance objectives.

Management Recommendations

Fisheries Monitoring

There are no management recommendations for Fisheries Monitoring. Year 4 survey results are consistent with previous monitoring results indicating that Project goals regarding fish passage improvements continue to be met.

Geomorphic Monitoring

The quantitative surveys of the floodplain (Site 10) were a challenge this year due to the vigorous willow and alder growth. This proved to be a major obstacle in surveying XS 101 – only the upstream portion of the survey could be completed in a timely manner. The ability to capture accurate survey data in a cost-effective manner is diminishing each year. As such, it is recommended that starting next year (2018), there is a shift to qualitative descriptions, sediment plate measurements, and photo points to assess the condition of the floodplain, and eliminate the total station surveys. There is an established baseline survey dataset that can be re-occupied, should issues arise with the site that would require measurements along the profiles.

Vegetation Monitoring

To continue the high plant survival trend in following monitoring years, it is recommended that invasive species are assessed monthly and controlled, as described in the HMMP. Although these species did not prevent the achievement of the performance objectives in Year-4, with neglect, invasive species could spread quickly and become more difficult to control. During the Year-4 survey no stinkwort was observed in the Project area. However, if stinkwort is detected during Year 5, continued management by spraying or pulling by hand prior to seeding (this species blooms from September to November) is important in control. No other invasive species were observed in any of the zones.

Natural recruitment is occurring in the Project area, so great care should be taken during invasive species management to retain the maximum amount of native recruitments possible. Naturally erodible soil is present in Zone 1 of Site 13. Crews should be careful during weeding of this site and keep walking on the bank to a minimum.

It was apparent that the floodplain (Zone 4) became inundated with surface flow during 2015/2016. Many of the cages are damaged and thick sediment and organic debris has covered most of the floodplain (see Appendix B Miscellaneous Photos, Photo 6 and Appendix C Geomorphic and Hydrologic Monitoring Annual Report). This caused a loss of herbaceous species but has not compromised the site. Planted trees (willows, alders) are thriving. We suggest that the damaged cages and rebar be removed. There are no plants in the cages and the cages and rebar may get swept downstream into the creek when the floodplain becomes inundated again.

Introduction

The Mission-Warren/Truck Rail project was completed by the Santa Clara Valley Transportation Authority (VTA) in 2012 and as mitigation, VTA constructed five mitigation projects along Upper Penitencia Creek known collectively as the Alum Rock Fish Passage Project (Project). These projects included removal of a rock wall downstream of Bridge L (Site 3) (Figure 1), floodplain expansion downstream of Bridge L (Site 10) (Figure 2), fish passage improvement (Site 13) (Figure 3), Youth Science Institute (YSI) Bridge abutment repair project (Site 2) (Figure 1), and repair of eroded rill (Site 5) (Figure 1). These projects served as compensatory mitigation for permanent, unavoidable impacts due to the Mission-Warren/Truck Rail project. Project Sites 3 and 10 excavated and graded the right bank (from the perspective of looking downstream), creating a 0.06 acre floodplain area (Figure 2). In Project Site 13, a stable roughened channel was created below an undercut weir in order to allow salmonids to migrate over the weir and access the upper part of Upper Penitencia Creek (Figure 3). For Project Site 2, a reinforced, concrete curved retaining wall was installed on the left bank to protect a mature deodar cedar whose roots were becoming scoured out. The repair of the eroded rill (Project Site 5) connected the existing walls using rock and grout, with the bottom of grouted sack wall keyed into the channel and the wall was backfilled with compacted engineer fill. The Project resulted in impacts to jurisdictional waters; mitigation for these impacts comprises revegetation of temporarily disturbed areas with native riparian, wetland, and herbaceous plant species.

Several monitoring activities associated with Sites 10 and 13 are required to ensure success of the Project. These include geomorphic (physical) and biological (fisheries) monitoring, which are required by the Project permits and Biological Opinion. Vegetation is in accordance with the *Habitat Mitigation and Monitoring Plan Alum Rock Park Bank Repair and Stream Restoration Projects* (Winzler & Kelly 2012) (HMMP). There are no monitoring requirements assigned specifically to Sites 2 (City of San Jose project), 3 and 5.

Project Location

The Project is located on Upper Penitencia Creek within Alum Rock Park in the County of Santa Clara, California; Latitude 37°23'301' N, Longitude 121°47'30' W; Assessor's Parcel Numbers: 595-07-01 5, 599-25-001, 612-46-001 (Figure 1). Alum Rock Park is a 720-acre municipal park run by the City of San Jose, Department of Parks, Recreation, and Neighborhood Services. The five projects, as described above, are grouped at two locations, the YSI Bridge and Bridge L along Upper Penitencia Creek. The YSI Bridge is located near a facility operated by the Youth Sciences Institute and Bridge L is located 1400 feet upstream. Sites 13, 5, and 2 surround the YSI Bridge and Sites 10 and 3 are located immediately downstream of Bridge L.

Geomorphic Monitoring

The 5-year geomorphic monitoring program (Appendix C) is intended to evaluate the restoration and enhancement of Sites 10 and 13 (Figures 2 and 3). Data collected is used to assess, on an annual basis, whether the sites meet the criteria for success set forth in the Biological Opinion, RWQCB 401 certification document, and HMMP, and to inform the response to any physical conditions that need immediate attention. The program includes monitoring the creek for bank stability and channel stability, as well as the new floodplain for inundation. Please refer to Appendix C for the complete geomorphic monitoring report.

Fisheries Monitoring

Fisheries monitoring at Sites 10 and 13 utilizes the electrofishing protocol specified in Appendix D. The purpose of this monitoring is to document the fish community at the project sites, with particular emphasis on the presence of Central California Coast steelhead (*Oncorhynchus mykiss*). Please refer to Appendix D for the complete fisheries monitoring report.

Vegetation Monitoring

The HMMP completed for the Project states that once during the growing season herbaceous species will be monitored for five years and woody species for ten years to determine the success of the re-vegetation.

In December 2012, native vegetation was planted to coincide with the onset of the rainy season. Construction and planting of the Project was fully completed February 5, 2013. Ecological Concerns Inc. is currently performing landscape maintenance twice a week and has been continuous since March 2013. The monitoring for Year-4 was conducted on September 1, 2016 by Donna Maniscalco and Amy May, ICF biologists.

Methods

The methods for the Geomorphic and Fisheries monitoring are discussed in Appendices C and D.

The vegetation monitoring protocol was designed to evaluate the performance of native vegetation as described in the HMMP. A description of the study design and monitoring protocol follows.

Study Design

The study design for the Geomorphic and Fisheries monitoring is discussed in Appendices C and D.

Vegetation was counted and assessed in four zones: Zone 1, 2, 4, and 5 (Figure 4), which follow the zones in the Planting Site Plans for the Project (Appendix A) and the HMMP. Zones 1 and 2 comprise riparian woodland species planted along the mid to top of the left bank of Upper Penitencia Creek at Site 13 downstream of the YSI Bridge. Zones 4 and 5 comprise floodplain species at Site 10 immediately downstream of Bridge L. Note that Zone 3 comprises herbaceous species planted at Site 13. Zone 3 was planted with hydroseed, so plants were not counted. In each of the four zones, all living and dead trees, shrubs, and herbaceous species were counted individually and tallied in a notebook. Total aerial percent cover and percent cover of native species in each zone were estimated and invasive species were noted.

Trees and woody shrubs in the Project area were not tagged or numbered; rather the total number of individuals from each monitoring year will be compared to the total number originally planted to determine survival.

One or two permanent photo-documentation stations were established to document each zone, and monitoring photographs were taken at each location (Figure 5 and Appendix B). These locations were marked with a Trimble GeoXT GPS Unit and, in most cases, demarcated on-site with a wooden stake or rebar. Photos were taken from these locations in years two and three. For Year-4, photos were taken from the middle of the creek channel due to the thick willows blocking the view of the restoration areas. Additional photos were taken to present a better picture of the project site. Bankside erosion was also documented in the vicinity of each zone.

Performance Objectives

The performance objectives for the geomorphic and fisheries monitoring are discussed in Appendices D and E. The objectives for the vegetation monitoring are discussed below.

Wetland Species

The HMMP requires a minimum of 45% aerial cover of native facultative and wetter species within both sites during Year-4 monitoring. Percent aerial cover was calculated individually for each zone and totaled for the entire Project area.

Native Species

The HMMP requires a minimum of 35% aerial cover of native species within the riparian and restored upland areas during Year-4 monitoring. Percent aerial cover was calculated individually for each zone and totaled for the entire Project area.

Trees and Woody Plants

The HMMP requires that at each annual monitoring event, the Project area will exhibit a 75% survival rate of trees and woody plants. Survival was calculated for each zone and totaled for the entire Project area.

Invasive Species

The HMMP requires that at each annual monitoring event, invasive species will be assessed and managed as appropriate to ensure the performance objectives described above are met.

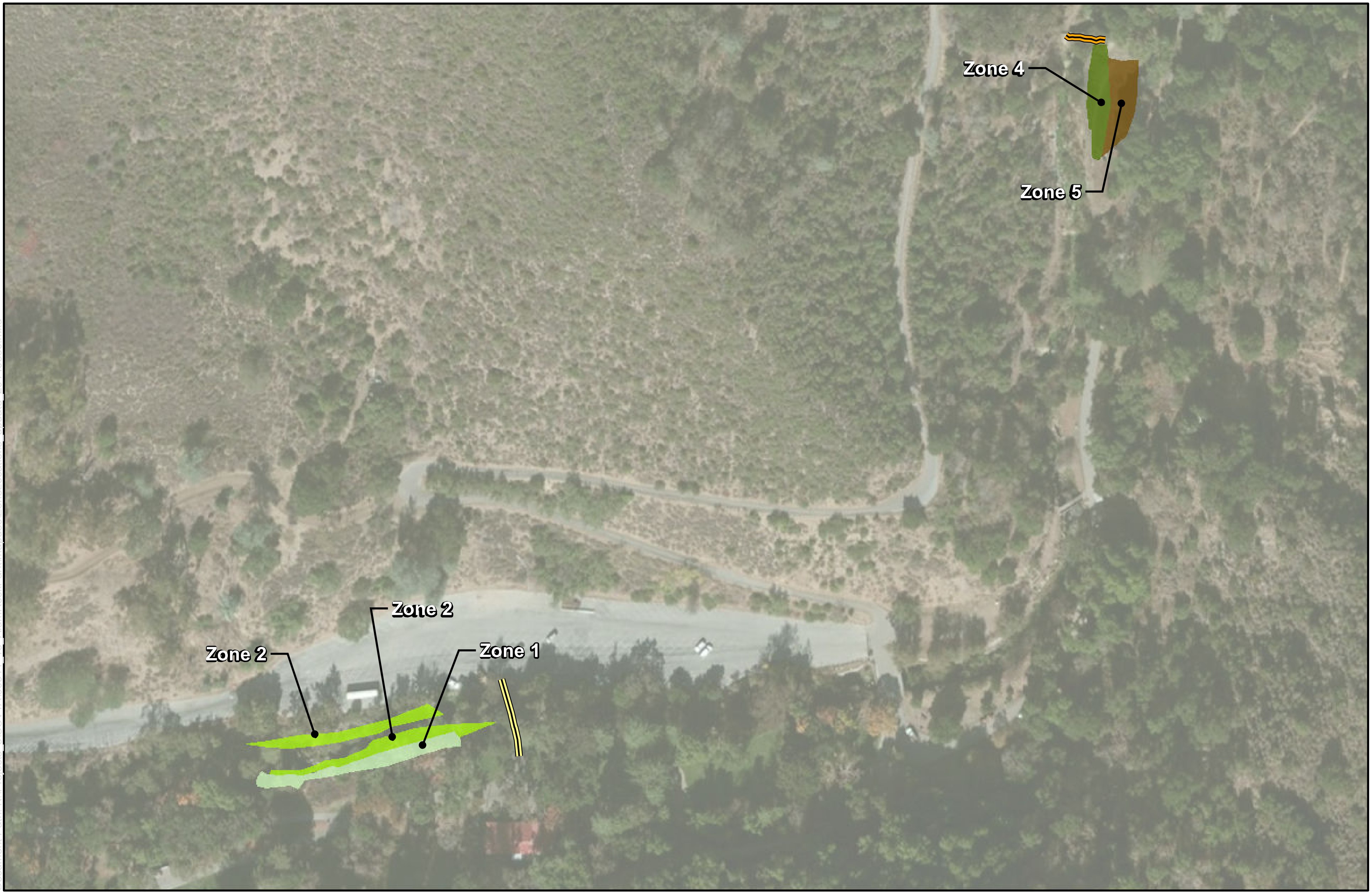
Results

The results from this year’s geomorphic and fisheries monitoring are discussed in Appendices C and D.

The results from this year’s vegetation monitoring indicates that survival is high for both trees, woody plants, and herbaceous species, and restoration is exceeding the required performance objectives for Year-4. Specific results for each objective are summarized below.

Wetland Species - Objective One

Per the performance objectives in the HMMP, plants with a Facultative (FAC), Facultative Wetland (FACW), or Obligate (OBL) wetland indicator status must be present to determine site success of the floodplain and shrub/scrub and emergent floodplain areas. Species in the planting palette that meet



Zone 1
Zone 2
Zone 4
Zone 5
Bridge L
YSI Bridge

N
0 200
Feet

Source: Imagery, ESRI 2013

Figure 4
Planting Zones
Alum Rock Park Bank Repair and Stream Restoration Project
Santa Clara Valley Transportation Authority

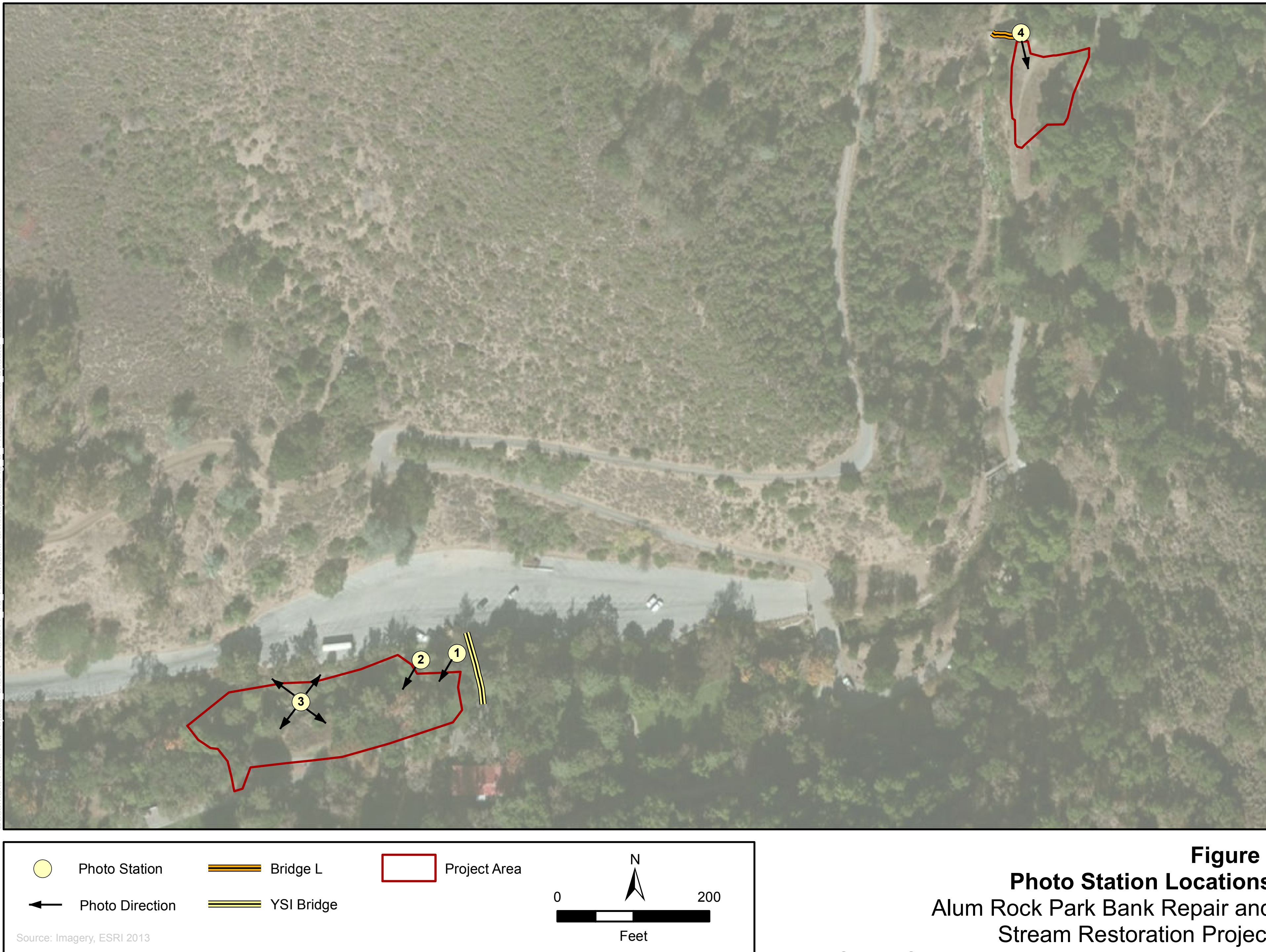


Figure 5
Photo Station Locations
Alum Rock Park Bank Repair and
Stream Restoration Project
Santa Clara Valley Transportation Authority

this criterion include: California blackberry (*Rubus ursinus*), mugwort (*Artemisia douglasiana*), white alder (*Alnus rhombifolia*), arroyo willow (*Salix lasiolepis*), snowberry (*Symphoricarpos alba* var. *laevigatus*), common bulrush (*Scirpus robustus*) [now called seacoast bulrush (*Bolboschoenus robustus)*], common monkeyflower (*Mimulus guttatus*), nut-sedge (C*yperus eragrostis*), slough sedge (*Carex obnupta*[1]), hedge nettle (*Stachys ajugoides*), California rose (*Rosa californica*), big leaf maple (*Acer macrophyllum*), and blue elderberry (*Sambucus mexicana*). The combined aerial percent cover of the above species is listed in Table 1 for each zone.

Table 1. Aerial Percent Cover of Wetland Species

	Year 1		Year 2		Year 3		Year 4	
Zone	Aerial % Cover	Criterion of 20% Met?	Aerial % Cover	Criterion of 35% Met?	Aerial % Cover	Criterion of 40% Met?	Aerial % Cover	Criterion of 45% Met?
Zone 1	30%	Yes	50%	Yes	75%	Yes	75%	Yes
Zone 2	75%	Yes	80%	Yes	80%	Yes	80%	Yes
Zone 4	80%	Yes	100%	Yes	95%	Yes	95%	Yes
Zone 5	15%	No	20%	No	20%	No	35%	No
Average	50%	Yes	63%	Yes	68%	Yes	71%	Yes

Note: For Year 4, the success criterion for Objective 1 is a minimum of 45% aerial cover of native facultative and wetter species within the re-established scrub/shrub and emergent floodplain area.

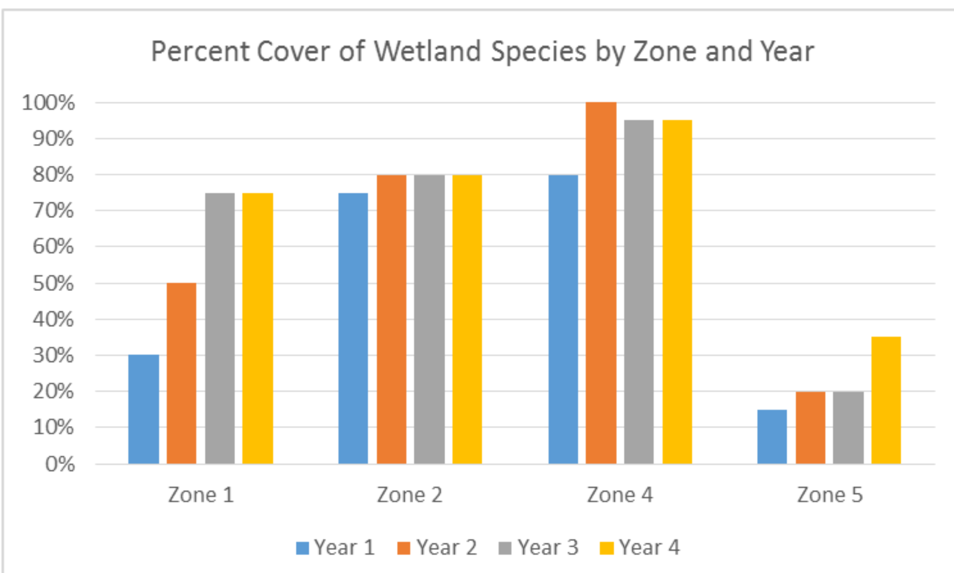


Figure 6. Percent Cover of Wetland Species by Zone and Year

[1] *Carex obnupta* was substituted for *Carex nudata* for the following reasons*:* the *Carex obnupta* delivered was collected for propagation in Alum Rock Park for riparian restoration, but was initially misidentified as *Carex nudata.* After researching, it was found that both species are native to the region and found in wetland-riparian communities locally according to Calflora and both are obligate wetland indicator species. For these reasons, VTA concluded that *Carex obnupta* was an appropriate substitute for *Carex nudata*.

Zone 5, mid to top of bank plants at Site 10, does not currently meet the Year-4 success criteria of 45% aerial cover. The reason for the lower percentage of aerial extent is because big leaf maple is not a fast growing tree and the increase in aerial extent is less than the other planted species. However, Zone 5 is doing better than in previous years probably due to the increase in precipitation in WY2016. California poppies, native grasses, and other planted species are growing and native recruits are also appearing in the understory. The entire Project area averages 71% aerial cover, which is over the criterion of 45%.

Native Species - Objective Two

Quantities of native herbaceous species, which include California rose, California blackberry, mugwort, nut-sedge, common bulrush, slough sedge, and hedge nettle, are shown in Table 2 and native trees and woody plants are shown in Table 3 (dead plants are not included). Zone 2 is not included in Table 2 because it contains only trees (alder and willow). Low survivability of herbaceous species in Zone 4 is due to the sediment deposition in the floodplain area. Flow for WY 2016 was greater than in other years and deposited sediment in Zone 4, covering and/or washing out the smaller plants in the understory. (Appendix B, Miscellaneous Photos, Photo 7). Zone 1 had a high number of recruits of California blackberry and mugwort.

Table 2. Extant Native Herbaceous Species

Species	Total Planted			Year 1 Survival			Year 2 Survival			Year 3 Survival			Year 4 Survival			Difference Between Total Planted and Year 4 Survival		
	Zone 1	Zone 4	Zone 5	Zone 1	Zone 4	Zone 5	Zone 1	Zone 4	Zone 5	Zone 1	Zone 4	Zone 5	Zone 1	Zone 4	Zone 5	Zone 1	Zone 4	Zone 5
California rose	7	0	4	6	0	6	8	0	4	6	0	4	7	0	5	0	0	1
California blackberry	18	0	2	19	0	2	15	0	2	26	0	3	43	0	2	25	0	0
Mugwort[1]	18	25	0	17	21	0	15	22	0	13	22	0	36	2	0	18	-23	0
Nut-sedge[1]	0	25	0	0	24	0	0	24	0	0	23	0	0	11	0	0	-14	0
Common bulrush[1]	0	30	0	0	21	0	0	45	0	0	59	0	0	13	0	0	-17	0
Slough sedge[1]	0	25	0	0	18	0	0	23	0	0	21	0	0	0	0	0	-25	0
Hedge nettle	0	4	0	0	4	0	0	5	0	0	3	0	0	8	0	0	4	0
SUBTOTAL	43	109	6	42	88	8	38	119	6	45	128	7	86	34	7	43	-75	1
GRAND TOTAL			158			138			163			180			127			-31
				Percent Survival	87%		Percent Survival	103%		Percent Survival	114%		Percent Survival	80%				

*Note: In Year 1 all of the common monkeyflower (4 plants) did not survive. In Year 2, all of the Torrey's melic (11 plants) died. Neither of these species were observed in Years 3 and 4. Since it is highly unlikely they will grow back, they are now excluded from this table.

[1] Zone 4 is located on the floodplain and rain events in 2015-2016 caused water flow on the floodplain and deposition of sediment. All of these species were washed away or covered in sediment.

The aerial percent cover value in Table 3 includes the native herbaceous species in Table 2, native woody species, native seed mix species, and any natural recruitments. The entire Project area averages 75% aerial cover.

Table 3. Aerial Percent Cover of Native Species

Aerial Percent Cover of Native Species Zone	Year 1		Year 2		Year 3		Year 4	
	Aerial % Cover	Criterion of 10% Met?	Aerial % Cover	Criterion of 25% Met?	Aerial % Cover	Criterion of 30% Met?	Aerial % Cover	Criterion of 35% Met?
Zone 1	70%	Yes	85%	Yes	90%	Yes	90%	Yes
Zone 2	60%	Yes	80%	Yes	85%	Yes	85%	Yes
Zone 4	90%	Yes	95%	Yes	95%	Yes	95%	Yes
Zone 5	10%	Yes	10%	No	20%	No	35%	Yes
Average	58%	Yes	68%	Yes	73%	Yes	75%	Yes

Note: For Year 4, the success criterion for Objective 2 is a minimum of 35% aerial cover of all native species within the riparian and restored upland area.

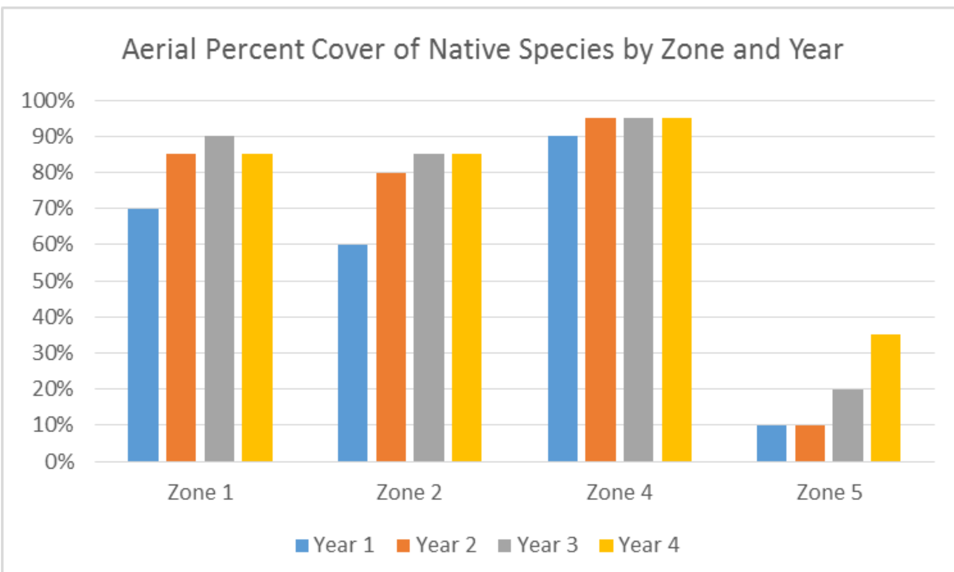


Figure 7. Percent Cover of Native Species by Zone and Year

Trees and Woody Plants- Objective Three

Trees and woody plants installed in the Project area include white alder, arroyo willow, coast live oak (*Quercus agrifolia*), big leaf maple, blue elderberry, toyon (*Heteromeles arbutifolia*), snowberry, and hollyleaf cherry (*Prunus ilicifolia*). The total number of trees and woody plants originally planted was 297 individuals. In Year 4, 343 individuals were surviving, including many of the original plantings plus new recruits, with the entire Project area demonstrating a 115% survival rate. See Table 4 for the quantity of each species present in individual zones during Year-4. Zone 2 is the only zone that is comprised exclusively of trees (alder and willow).

Table 4. Extant Trees and Woody Plant Species

	Total Planted				Year 1 Survival				Year 2 Survival				Year 3 Survival				Year 4 Survival				Difference Between Total Planted and Year 4 Survival			
Species	Zone 1	Zone 2	Zone 4	Zone 5	Zone 1	Zone 2	Zone 4	Zone 5	Zone 1	Zone 2	Zone 4	Zone 5	Zone 1	Zone 2	Zone 4	Zone 5	Zone 1	Zone 2	Zone 4	Zone 5	Zone 1	Zone 2	Zone 4	Zone 5
White alder	0	26	49	0	0	24	47	0	0	24	49	0	0	22	48	0	0	21	49	0	0	-5	0	0
Arroyo willow	0	78	73	0	0	71	75	0	0	78	73	0	0	79	74	0	0	109	80	0	0	31	7	0
Coast live oak	2	0	0	2	1	0	0	0	2	0	0	3	8	0	0	4	3	0	0	3	1	0	0	1
Big leaf maple	6	0	0	6	5	0	0	0	6	0	0	3	7	0	0	6	6	0	0	6	0	0	0	0
Blue elderberry	11	0	0	4	11	0	0	5	12	0	0	4	13	0	0	4	11	0	0	4	0	0	0	0
Toyon	4	0	0	7	3	0	0	7	11	0	0	5	11	0	0	4	13	0	0	4	9	0	0	-3
Snowberry	4	0	0	7	5	0	0	7	3	0	0	8	3	0	0	7	14	0	0	6	10	0	0	-1
Holly leaf cherry	18	0	0	0	16	0	0	0	19	0	0	0	15	0	0	0	14	0	0	0	-4	0	0	0
SUB TOTAL	45	104	122	26	41	95	122	19	53	102	122	23	57	101	122	25	61	130	129	23	16	26	7	-3
			Grand Total	297			Grand Total	277			Grand Total	300			Grand Total	305			Grand Total	343			Grand Total	46
							Percent Survival	93%			Percent Survival	101%			Percent Survival	103%			Percent Survival	115%				

Note: At each annual monitoring event, there will be a minimum of 75% survival rate of planted trees and woody plants.

Invasive Species- Objective Four

Invasive species are present in the Project area, but in very low numbers. During Year-4 monitoring, these species were not widespread and did not prevent the achievement of the Year-4 performance objectives. Species rated as having a high or moderate negative ecological impact (California Invasive Plant Council 2013) that were observed in or near the mitigation areas and could prevent the achievement of the following year's success criteria include: yellow star-thistle (*Centaurea solstitialis*), purple star-thistle (*Centaurea calcitrapa*), stinkwort (*Dittrichia graveolens),* periwinkle (*Vinca major*), and black mustard (*Brassica nigra*). While these species were not observed during the Year-4 monitoring, if any of these species are observed, they should be controlled as soon as possible. Management recommendations for invasive species are discussed below.

Photo-Documentation

A map of the permanent photo-documentation stations and photos taken during Year-4 monitoring are included in Figure 5 and Appendix B. For consistency, each photo was assigned a general compass direction and zone, as shown in Table 5. Photographs were taken during the September 2016 survey. The photos were taken from the middle of the creek channel since thick willows were obscuring the monitoring sites.

Table 5. Photo-Documentation Stations

Photo Station	Compass Direction	Zone	Latitude	Longitude
1	Southwest	Zone 2 (south bank)	37.396855	-121.799791
2	Southwest	Zone 1 & Zone 2 (south bank)	37.396829	-121.799954
3	Panorama (SW, NW, SE, NE)	Zone 1 & Zone 2	37.396671	-121.800495
4	Southwest	Zone 4 & Zone 5	37.399124	-121.797272

Natural Recruitment

Natural recruitment was observed in many of the planting zones (See Table 2 and Table 4). In Zones 1 and 2, species that were not planted but are recruiting in the project site include valley oak (*Quercus lobata*), California figwort (*Scrophularia californica*), California sagebrush (*Artemisia californica*), nut sedge, and California fuschia (*Epilobium canum*). In Zones 4 and 5, California sagebrush, snowberry, oaks, and California poppies and grasses were observed. This trend is expected to continue in the following years and aid in the achievement of the performance objectives.

Erosion

No erosion was observed in any of the zones. Due to natural recruitment of vegetation and trees, the erosion previously observed seems to be under control. Vegetation control crews should still exercise caution in Zone 1 due to the naturally erodible soil and ground squirrel burrows.

Management Recommendations

Fisheries Monitoring

There are no management recommendations for Fisheries Monitoring.

Geomorphic Monitoring

The quantitative surveys of the floodplain (Site 10) were a challenge this year due to vigorous willow and alder growth. This proved to be a major obstacle in surveying cross section (XS) 101 – only the upstream portion of the survey could be completed in a timely manner. The ability to capture accurate survey data in a cost-effective manner is diminishing each year. As such, it is recommended that starting Year 5 (2018), monitoring relies on qualitative descriptions, sediment plate measurements, and photo points to assess the condition of the floodplain, and eliminate the total station surveys. An established solid baseline survey dataset can be re-occupied, should issues arise with the site that would require measurement along the profiles.

Vegetation Monitoring

The Project area displayed a high level of success, surpassing the performance objective thresholds in Year-4 monitoring. To continue this trend in following monitoring years, it is recommended that invasive species are assessed monthly and controlled, as described in the HMMP. Although these species did not prevent the achievement of the performance objectives in Year-4, with neglect, invasive species could spread quickly and become more difficult to control. Although stinkwort was not observed this year, it is recommended that stinkwort, if detected during Year 5, is either sprayed or pulled by hand prior to seeding (this species blooms from September to November). Natural recruitment is occurring in the Project area, so great care should be taken during invasive species management to retain the maximum amount of native recruitments possible. Naturally erodible soil is present in Zone 1 of Site 13. Crews should be careful during weeding of this site and keep walking on the bank to a minimum.

It was apparent that the floodplain (Zone 4) became inundated with surface flow during 2015/2016. Many of the cages are damaged and thick sediment and organic debris has covered most of the floodplain (see Appendix B Miscellaneous Photos, Photo 6 and Appendix C Geomorphic and Hydrologic Monitoring Annual Report). This caused a loss of herbaceous species but has not compromised the site. Planted trees (willows, alders) are thriving. We suggest that the damaged cages and rebar be removed. There are no plants in the cages and the cages and rebar may get swept downstream into the creek when the floodplain becomes inundated again.

Due to the fact that numerous plants were installed in each zone, a high percentage of those plants survived, there is natural recruitment of native plant species, and all these plants will increase in both aerial cover and root establishment, Year-4 monitoring does not indicate a need for plant replacement.

References

California Invasive Plant Council. 2013. California Invasive Plant Inventory Database. Berkeley, CA. Available: http://www.cal-ipc.org/paf/. Accessed October 28, 2013.

Winzer and Kelly. 2012. Habitat Mitigation and Monitoring Plant for Alum Rock Park Bank Repair and Stream Restoration Project. Prepared for: City of San Jose, Parks, Recreation and Neighborhood Services, San Jose, CA.

Appendix A

Planting Site Plans

PLANT AND COMPOSITION SCHEDULE

RIPARIAN WOODLAND FISH PASSAGE — ACRES 0.06

OVERALL SPACING (FEET OFF CENTER)	QUANTITY PER ACRE	FREQUENCY (%)	SPECIES QUANTITY	VEGETATION STRATA/ SPECIES NAME	COMMON NAME	UNIT	SPACING TYPE	INDIVIDUAL SPACING (FT.)
ZONE 1								
18	134							
		30	2	*Quercus agrifolia*	COASTAL LIVE OAK	DP	RANDOM	36
		70	6	*Acer macrophyllum*	BIG LEAF MAPLE	DP	RANDOM	36
		100	8	= TOTAL				
12	303							
		60	11	*Sambucus mexicana*	BLUE ELDERBERRY	D6	RANDOM	15
		20	4	*Heteromeles arbutifolia*	TOYON	DP	RANDOM	26
		20	4	*Symphoricarpus alba*	SNOWBERRY	DP	RANDOM	26
		100	19	= TOTAL				
6	1210							
		25	18	*Prunus ilicifolia*	HOLLY LEAF CHERRY	TP	RANDOM	12
		10	7	*Rosa californica*	CALIFORNIA ROSE	DP	RANDOM	19
		25	18	*Rubus ursinus*	CALIFORNIA BLACKBERRY	D6	RANDOM	12
		15	11	*Melica torreyana*	TORREY MELICA	4" PLUG	RANDOM	15
		25	18	*Artemesia douglasiana*	MUGWORT	D6	RANDOM	12
		100	72	= TOTAL				
ZONE 2[1]								
5	1742					ACRES 0.05		
		25	26	*Alnus rhombifolia*	WHITE ALDER	TP	CLUSTER	10
		75	78	*Salix lasiolepis*	ARROYO WILLOW	LIVESTAKES	CLUSTER	6
		100	104	= TOTAL				

1. ZONE TWO LIVESTAKE PLANTING IN CLUSTERS OF 2-3 STAKES AROUND THE BANKROCK

CONTAINER NAME SIZE USES

DP = DEEPOT 40 = 2 1/2" DIAMETER x 10" LONG
D6 = DEEPOT 16 = 2" DIAMETER x 7" LONG
TP = TREEPOT 4 = 4' SQUARE x 14" DEEP

PLANT AND COMPOSITION SCHEDULE

RIPARIAN WOODLAND EROSION CONTROL SEEDING LIST — ACRES 0.50

OVERALL SPACING (FEET OFF CENTER)	QUANTITY PER ACRE	FREQUENCY (%)	SPECIES QUANTITY	VEGETATION STRATA/ SPECIES NAME	COMMON NAME	UNIT	SPACING TYPE	INDIVIDUAL SPACING (FT.)
ZONE 3[1]								
NA	60							
		6 LBS/ACRE	3	*Bromus carinatus*	CALIFORNIA BROME	LB OF P.L.S. 76%	SEED	NA
		12 LBS/ACRE	6	*Elymus glaucus*	BLUE WILD RYE	LB OF P.L.S. 76%	SEED	NA
		11 LBS/ACRE	5.5	*Vulpia micorstachys*	THREE WEEK FESCUE	LB OF P.L.S. 76%	SEED	NA
		12 LBS/ACRE	6	*Hordeum branchyantherum*	MEADOW BARLEY	LB OF P.L.S. 76%	SEED	NA
		4 LBS/ACRE	2	*Tritolium tridentantum*	TOMCAT CLOVER	LB OF P.L.S. 76%	SEED	NA
		6 LBS/ACRE	3	*Lupinus nanus*	SKY LUPINE	LB OF P.L.S. 76%	SEED	NA
		3 LBS/ACRE	1.5	*Eschscholtzia california*	CALIFORNIA POPPY	LB OF P.L.S. 76%	SEED	NA
		6 LBS/ACRE	3	*Hordeum californium*	CALIFORNIA BARLEY	LB OF P.L.S. 76%	SEED	NA
		60 LBS/ACRE	30	= TOTAL				

1. EROSION CONTROL MIX SHALL BE APPLIED ON AREAS DEPICTED ON THE DRAWINGS AND IN ANY LOCATIONS THAT HAS DISTURBED OR BARE SOIL RESULTING FROM CONSTRUCTION (INCLUDING SKID ROUTES).

PLANT AND COMPOSITION SCHEDULE

FLOODPLAIN CREATION AREA

OVERALL SPACING (FEET OFF CENTER)	QUANTITY PER ACRE	FREQUENCY (%)	SPECIES QUANTITY	VEGETATION STRATA/ SPECIES NAME	COMMON NAME	UNIT	SPACING TYPE	INDIVIDUAL SPACING (FT.)
ZONE 4 (FLOODPLAIN)								
5	1742						ACRES 0.05	
		40	49	*Alnus rhombifolia*	WHITE ALDER	TP	TRIANGULAR	8
		60	73	*Salix lasiolepis*	ARROYO WILLOW	LIVESTAKES	TRIANGULAR	6
		100	122	= TOTAL				
10	436						ACRES 0.07	
		100	30	*Scirpus robustus*	COMMON BULRUSH	TB	RANDOM	10
		100	30					
6	1210							
		30	25	*Artemesia douglasiana*	MUGWORT	D6	RANDOM	11
		5	4	*Mimulus guttatus*	COMMON MONKEYFLOWER	4" PLUG	RANDOM	28
		30	25	*Cyperus eragrostis*	NUT-SEDGE	TB	RANDOM	11
		30	25	*Carex nudata*	TORRENT SEDGE	TB	RANDOM	11
		5	4	*Stachys ajugoides*	HEDGE NETTLE	TB	RANDOM	28
		100	83	= TOTAL				
ZONE 5 (MID-TOP OF BANK)								
18	134						ACRES 0.06	
		20	2	*Quercus agrifolia*	COASTAL LIVE OAK	TP	SCATTERED	35
		80	6	*Acer macrophyllum*	BIG LEAF MAPLE	TP	RANDOM	35
		100	8	= TOTAL				
10	436							
		15	4	*Sambucus mexicana*	BLUE ELDERBERRY	D6	RANDOM	25
		30	7	*Heteromeles arbutifolia*	TOYON	DP	RANDOM	19
		30	7	*Symphoricarpus alba*	SNOWBERRY	DP	RANDOM	19
		15	4	*Rosa californica*	CALIFORNIA ROSE	DP	RANDOM	25
		10	2	*Rubus ursinus*	CALIFORNIA BLACKBERRY	D6	RANDOM	35
		100	24	= TOTAL				
NA	60							
		8 LBS/ACRE	0.48	*Bromus carinatus*	CALIFORNIA BROME	LB OF P.L.S. 76%	SEED	NA
		10 LBS/ACRE	0.6	*Elymus glaucus*	BLUE WILD RYE	LB OF P.L.S. 76%	SEED	NA
		12 LBS/ACRE	0.72	*Vulpia micorstachys*	THREE WEEK FESCUE	LB OF P.L.S. 76%	SEED	NA
		10 LBS/ACRE	0.6	*Hordeum branchyantherum*	MEADOW BARLEY	LB OF P.L.S. 76%	SEED	NA
		4 LBS/ACRE	0.25	*Eschscholtzia california*	CALIFORNIA POPPY	LB OF P.L.S. 76%	SEED	NA
		6 LBS/ACRE	0.36	*Lupinus nanus*	SKY LUPINE	LB OF P.L.S. 76%	SEED	NA
		2 LBS/ACRE	0.12	*Tritolium tridentantum*	TOMCAT CLOVER	LB OF P.L.S. 76%	SEED	NA
		8 LBS/ACRE	0.48	*Hordeum californium*	CALIFORNIA BARLEY	LB OF P.L.S. 76%	SEED	NA
		60 LBS/ACRE	3.61	= TOTAL				

DP = DEEPOT 40 = 2 1/2" DIAMETER x 10" LONG
D6 = DEEPOT 16 = 2" DIAMETER x 7" LONG
TP = TREEPOT 4 + 4' SQUARE x 14" DEEP
TB = TREEBAND 2 + 2.25" SQUARE x 3.75" DEEP

PLANT AND COMPOSITION SCHEDULE

MITIGATION TREES — ACRES NA

SPECIES QUANTITY	VEGETATION STRATA/ SPECIES NAME	COMMON NAME	UNIT	SPACING TYPE
15	*Quercus agifolia*	COASTAL LIVE OAK	15-GALLON CONTAINER	AS SHOWN ON DRAWINGS FP-L002, FP-L003 AND FP-L006
8	*Acer macrophyllum*	BIG LEAF MAPLE	15-GALLON CONTAINER	AS SHOWN ON DRAWINGS FP-L002, FP-L003 AND FP-L006
7	*Umbellularia californica*	CALIFORNIA BAY	15-GALLON CONTAINER	AS SHOWN ON DRAWINGS FP-L002, FP-L003 AND FP-L006
30	= TOTAL			

LEGEND

ZONE 1 PLANTING, SEE TABLES
ZONE 2 PLANTING, SEE TABLES
ZONE 3 PLANTING, SEE TABLES
ZONE 4 PLANTING, SEE TABLES
ZONE 5 PLANTING, SEE TABLES

SYMBOLS FOR MITIGATION TREES

(N) OAK TREE
(N) MAPLE TREE
(N) BAY TREE
W — DOMESTIC WATER IRRIGATION PIPING
UTILITY BOX

ABBREVIATIONS

LB	POUNDS
PLS	PURE LIVE SEED

FOR REFERENCE ONLY

NOT FOR CONSTRUCTION

REV	DATE	BY	SUB	APP	DESCRIPTION
A	20131024	AT	MN	RK	REQUEST FOR PROPOSAL

DESIGNED BY R. KEISH
DRAWN BY A. TOLENTINO
CHECKED BY M. NG
IN CHARGE R. KEISH
DATE

HNTB — HNTB Corporation, Engineers Architects Planners
1735 Technology Drive, Suite 650, San Jose, CA 95110-1005
Tel (408) 451-7300, Fax (408) 451-6942

SUBMITTED ______ APPROVED ______

VTA — BART SILICON VALLEY
BART SILICON VALLEY BERRYESSA EXTENSION

SVRT ENVIRONMENTAL MITIGATION – PLANT ESTABLISHMENT
ATTACHMENT B
REFERENCE DRAWINGS – ALUM SITE
PLANTING & IRRIGATION LEGEND
SHEET 6 OF 15

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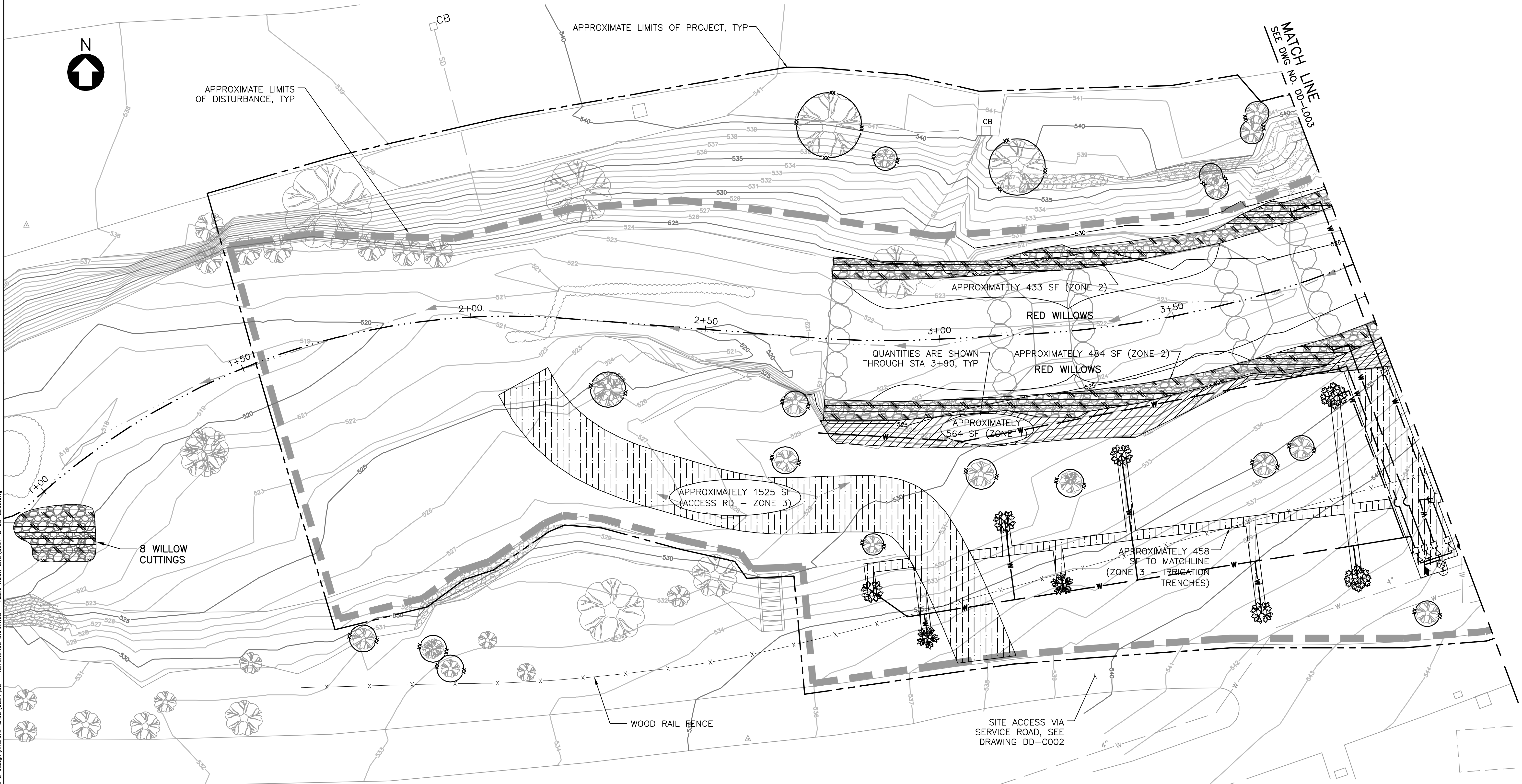
NOTE:

FOR LEGEND, SYMBOLS, AND ABBREVIATIONS, SEE DRAWINGS DD-L001 & DD-X003



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FOR REFERENCE ONLY

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REV	DATE	BY	SUB	APP	DESCRIPTION
A	20131024	AT	MN	RK	REQUEST FOR PROPOSAL

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VTA BART SILICON VALLEY
BART SILICON VALLEY BERRYESSA EXTENSION

SVRT ENVIRONMENTAL MITIGATION - PLANT ESTABLISHMENT
ATTACHMENT B
REFERENCE DRAWINGS - ALUM ROCK SITE
PLANTING PLAN: FISH PASSAGE & RILL REPAIR SITE
SHEET 7 OF 15

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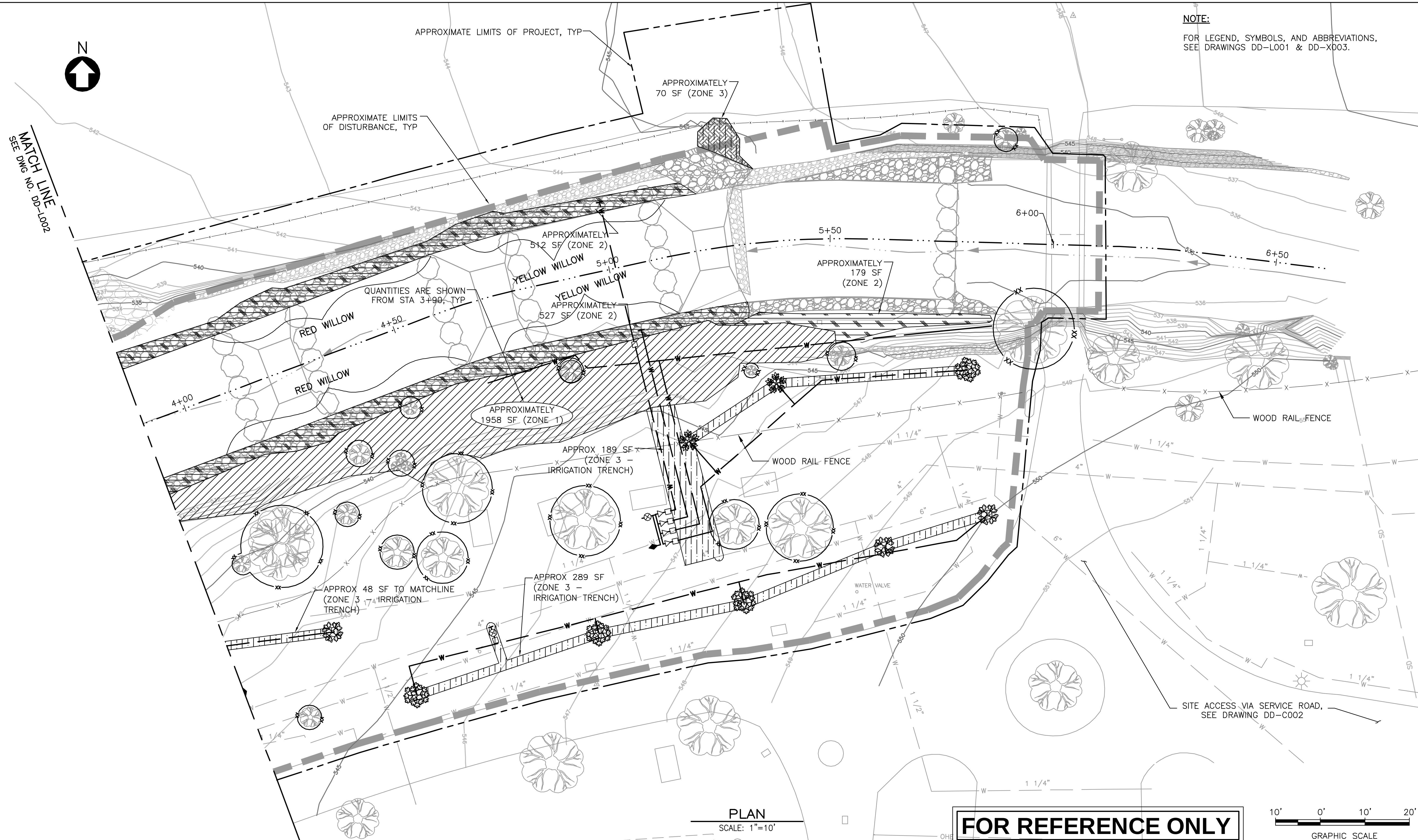

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FOR REFERENCE ONLY

10' 0' 10' 20'
GRAPHIC SCALE

REV	DATE	BY	SUB	APP	DESCRIPTION
A	20131024	AT	MN	RK	REQUEST FOR PROPOSAL

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VTA BART SILICON VALLEY
BART SILICON VALLEY BERRYESSA EXTENSION

SVRT ENVIRONMENTAL MITIGATION – PLANT ESTABLISHMENT
ATTACHMENT B
REFERENCE DRAWINGS – ALUM ROCK SITE
PLANTING PLAN: FISH PASSAGE & RILL REPAIR SITE
SHEET 8 OF 15

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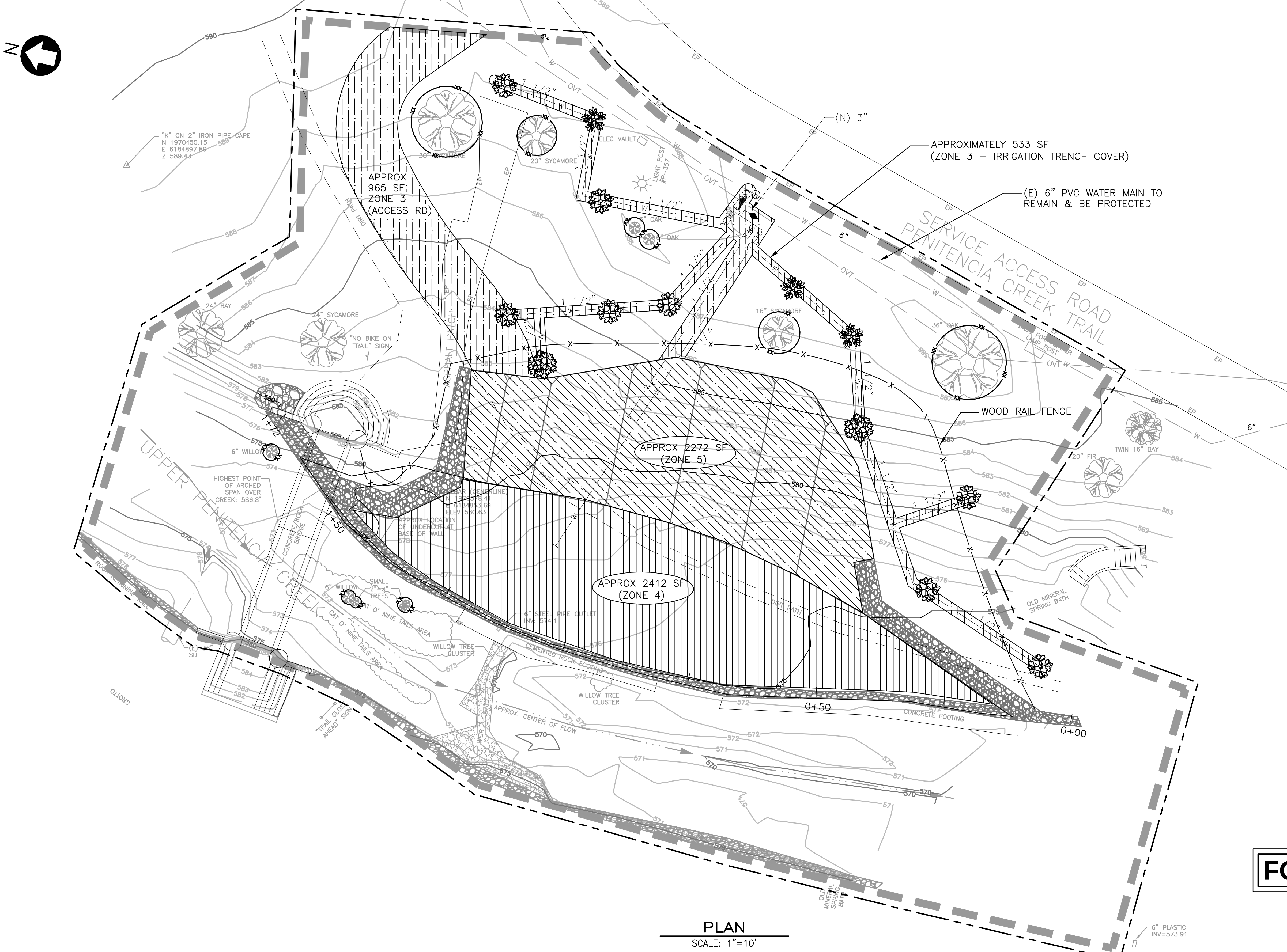
NOTE:

FOR LEGEND, SYMBOLS, AND ABBREVIATIONS, SEE DRAWINGS DD–L001 AND DD–X003.



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FOR REFERENCE ONLY

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SUBMITTED ______ APPROVED ______

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VTA BART SILICON VALLEY
BART SILICON VALLEY BERRYESSA EXTENSION

SVRT ENVIRONMENTAL MITIGATION – PLANT ESTABLISHMENT
ATTACHMENT B
REFERENCE DRAWINGS – ALUM ROCK SITE
PLANTING PLAN: FLOOD PLAIN EXPANSION SITE
SHEET 11 OF 15

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CONTRACT NO. C801		REV. A
AREA CODE DD	SHEET NO. L006	PAGE NO. 11

Appendix B

Permanent Photo Documentation Stations and Miscellaneous Site Photos

Photo Station 1 – looking southwest towards Zone 2

Photo Station 2 – looking southwest towards Zones 1 and 2

Photo Station 3 Zones 1 and 2 (Panorama). In order: SW, NW, SE, NE

Photo Station 4 – looking SW at Zones 4 and 5

Miscellaneous Photos

Photo 1. Looking west from YSI Bridge (Zones 1 and 2)

Photo 2. Site 2 (upstream of YSI Bridge) looking south.

Photo 3. Site 3 (under L Bridge) looking southwest.

Photo 4. Site 5 (downstream of YSI Bridge) looking north.

Photo 5. Looking northeast at Zones 4 and 5 from pedestrian path.

Photo 6. Looking southeast at Zone 4.

Photo 7. Organic debris and sediment at Zone 4.

Appendix C

Geomorphic and Hydrologic Monitoring Annual Report: Water Year 2016

Balance Hydrologics, Inc.®

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February 2, 2017

Ms. Ann Calnan
Manger, Environmental Program and Resources Management
Santa Clara Valley Transportation Authority
3331 North First Street, Building B-2
San Jose, California 95134-1927

Submitted via email

RE: Alum Rock Fish Passage Project geomorphic and hydrologic monitoring annual report: Water Year 2016

Dear Ms. Calnan,

We are pleased to provide you with the annual report for Water Year[1] 2016 (WY2016) geomorphic and hydrologic monitoring of the Alum Rock Fish Passage Project along Upper Penitencia Creek in Alum Rock Park in the City of San Jose. The project provides mitigation for the Santa Clara Valley Transportation Authority (VTA) Mission-Warren Truck Rail Project.

Geomorphic monitoring of this mitigation project began in September 2013 and will extend for a 10 year period through WY2023. The work is being conducted by Balance Hydrologics, Inc. (Balance) staff geomorphologists and hydrologists. The following provides a brief description of the project sites, the monitoring methods established at these sites, and discussion of the data collected in September 2016 in relation to baseline conditions.

Site Description and Monitoring Criteria

Project Site 13 is a fish passage project located downstream of the Youth Science Institute (YSI) Bridge (**Figure 1**), constructed in summer 2012 to improve riverine habitat conditions to support the recovery of Central California Coast steelhead (*Oncorhynchus mykiss*) through the removal of a barrier to fish passage, and enhancement of the quality and complexity of the creek habitat. The project reach is situated in a straight, deeply incised portion of the channel that is adjacent to a parking lot on the right bank, and the grounds of YSI on the left bank[2]. The project reach is approximately 300 feet in length, and consists of a series of pools, chutes, rock band structures, and one modified concrete grade control structure, designed to slow water velocity through the reach, prevent erosion, and control the streambed elevation. The uppermost rock band structure in the original channel design moved in the first year's set of storms

[1] A Water Year (WY) is defined as that period from October 1st of a preceding year through September 30th of the following year, and is named according to the following year. For example, WY2016 occurred from October 1, 2015 through September 30, 2016.
[2] Right and left bank orientation referred to in this document is from the perspective of looking downstream.

(i.e. two large storms in December 2012). This rock band structure was rebuilt in mid-September, 2013, after which all monitoring work commenced.

Project Site 10 is a floodplain constructed in summer 2012, approximately 120 feet long by 30 to 40 feet wide that begins just south of Bridge L (**Figure 2**). The elevated floodplain has been designed to be inundated periodically during high flows, and has been planted with riparian vegetation, including willow and alder saplings.

Per the National Marine Fisheries Service (NMFS) Biological Opinion (June 2012) and the Regional Water Quality Control Board (RWQCB) 401 certification (July 2012), the mitigation project has several success criteria that are based on the development of post-construction conditions, which must be assessed through qualitative and quantitative monitoring techniques. Each year, the monitoring program focuses on assessing geomorphic conditions of the project sites, characterizing hydrologic conditions over the past water year, and using these data and observations to assess the evolution, condition, and functionality of the fish passage and floodplain. The end of water year geomorphic and hydrologic monitoring report is designed to address the following questions:

- Have the sizes and shapes of the pools, chutes, rock band structures, and floodplain benches evolved? Have the riffles or pools aggraded or scoured?
- Have connections from the main channel to the newly constructed floodplain changed significantly over the year?
- Has the bed composition of the channel changed based on visual assessments? Has sedimentation on the floodplain affected its functionality?
- Has the floodplain flooded every 1 to 2 years? Have the creek corridor, thalweg, pools and riffles, floodplain benches, banks and backwater wetlands been stable?
- Has the stream corridor increased in habitat complexity? Has woody debris been deposited in the reach?

Assessment of these questions has been undertaken per the geomorphic and hydrologic monitoring methods described below.

Monitoring Methods

Hydrologic Monitoring

Because high flows during storm events are the main agent of geomorphic change within the project sites, and are the most important test of fish passage and floodplain functionality, a continuous record of water level data was collected over the course of the year. To provide context for the hydrologic and geomorphic data collected at Alum Rock, we present precipitation data from two nearby stations: the California Irrigation Management Information System (CIMIS) Station 171 in Union City (Union City Station, hereafter) and Weather Underground Station KCASANJO17 (Berryessa Station, hereafter). The Berryessa Station is located approximately 4 miles west of the Alum Rock mitigation site and the Union City Station is approximately 19 miles northwest of the mitigation site. The Berryessa Station and Union

City Station are characterized by a mean annual rainfall total similar to that for the Alum Rock mitigation site. The records from these stations are compared to each other to check for consistency. The San Jose Airport station (KSJC) precipitation record is used for comparing the WY2016 precipitation records to long-term averages; however, this record will not be used for analysis of individual storms as it was found to have missing values in WY2012 and WY2013.

Monitoring efforts at Project Site 10 included installation of two stream stage gages. Each gage consists of a self-contained water level recorder that records water depth and temperature[3] every 15 minutes, paired with a staff plate, which is a vertical ruler adjacent to the logger that is used for manual readings of water level. Staff plate readings are used to calibrate the 15-minute depth data recorded by the logger. The two gages were installed on September 26, 2013 directly adjacent to the floodplain. One gage, referred to hereafter as the "in-channel gage", was positioned to continuously record water surface elevations at baseflow conditions. During an April 24, 2016 field visit, this gage was found to be almost completely buried by gravels that had been transported from upstream; it was dug out and relocated approximately 40 feet downstream on June 23, 2016.

As described in the WY2015 report, a second gage is positioned up-slope with the intent that it will record overbank water surface elevations that are inundating the floodplain during high flow events. This gage is hereafter referred to as the "overbank gage". Locations of these gages are shown in **Figure 2**.

The water levels recorded at the project site are compared to those recorded at the Santa Clara Valley Water District's (SCVWD) Upper Penitencia Creek at Dorel Drive gage (Dorel, hereafter) for consistency, and to estimate discharge at the project site. This is a low-flow gage that has been operated by the SCVWD since 1935, excepting a period from 1961 to 1987 when it was operated by the United States Geological Survey Records of 15-minute stage and discharge extend from 1935 to the present. The Dorel WY2016 record will be compared to the project site gages to check for consistency, and to estimate discharge at the project site.

Geomorphic Monitoring, Project Site 13 (Fish Passage)

Quantitative surveys

Monitoring criteria for channel evolution indicate whether pools, chutes, rock band structures, and floodplain benches evolved and if aggradation or scour took place over the year. To quantitatively address these questions, seven cross-sections and one longitudinal profile were surveyed within the fish passage site on September 15, 2016 (shown in planview, **Figure 1**) and compared to data collected in previous years. These profiles were originally established and surveyed in September 2013 for the purpose of establishing baseline conditions and documenting channel form soon after construction. Subsequent surveys are compared to the baseline survey as a quantitative method for tracking deposition and mobilization in the channel and assessing change, if any, to constructed elements such as rock band structures and pools. Cross sections (XS) were selected to represent a range of constructed geomorphic structures: XS 1 and XS 4 cross the channel at the upstream portion of chutes. XS 2, 3 and 5 cross the channel through portions of pools 1, 2, and 4, respectively. XS 6 was established at the rock structure that

[3] Temperature data is not presented here, but has been archived and is available upon request.

forms the upstream edge of pool 5. XS 7 crosses at the downstream end of the final chute. The longitudinal profile survey begins at pedestrian bridge "L" (Station 0 feet) and continues downstream approximately 300 feet through five constructed pools and six constructed chutes.

The September 2016 survey was performed using the existing project benchmarks and datum established during construction, as well as temporary benchmarks established by Balance during the September 2013 survey. The survey was conducted with total station equipment. The survey was based on site control established during the construction phase, and therefore elevations and locations are in the vertical project datum (NAVD 88). Cross sections and longitudinal profile repeated in this year's survey were plotted against the previous survey profiles as an assessment of geomorphic change.

Geomorphic Visual Observations

Ten photo point locations were established in the fall of 2013 (**Figure 1**, PP #1 to #10), with an initial set of photos taken to record existing conditions. Repeat photographs were taken at each of the photo points to document year-to-year geomorphic change. Additional observations were noted, including composition of the bed, the presence of woody debris, and habitat complexity for steelhead, as well as the geomorphic evolution of pools and rock band structures.

Geomorphic Monitoring, Project Site 10 (Floodplain)

Quantitative Surveys

Two cross-sections and one floodplain elevational profile, originally established and surveyed in September 2013, were re-surveyed on September 15, 2016. At this site, the term floodplain elevational profile, or elevational profile, is used to distinguish it as a profile that extends across the floodplain, parallel to but not within the channel. This is distinct from a longitudinal profile, a term used to refer to a survey of the deepest part of a channel, or thalweg. The elevational profile survey for the Project Site 10 floodplain was conducted in the central portion of the floodplain, parallel to the channel, showing the overall slope and topography. Cross sections XS 101 and XS 102 (**Figure 2**) were surveyed at the upstream and downstream ends of the floodplain, and included the floodplain, the rock wall that bounds the floodplain near the creek, the active channel, and across the existing pathway on river right and onto the adjacent hillslope. These profiles will be re-surveyed on a yearly basis to measure any potential changes to floodplain geometry. Riparian vegetation has grown very densely on the floodplain and it is conceivable that all or portions of the cross sections and the profile may need to be skipped, or their locations estimated, due to the challenge of orientation within the riparian growth, and the potential for survey activities to damage to riparian plantings.

To directly measure sedimentation on the floodplain, Balance staff installed two sedimentation plates (approximately 1 square-foot plates mounted at the ground surface on a shaft driven into the floodplain) at the site (shown in **Figure 2**). On September 15, 2016, Balance staff measured the depth of accumulated sediment (not including organic litter) at four locations on each plate, one at each of the four cardinal directions, halfway between the center and edge of the plate. The average depth of accumulated sediment for each sedimentation plate location is presented in the results.

Geomorphic Visual Observations

Six photo point locations were established in the fall of 2013, with an initial set of photos taken to record existing conditions. Repeat photographs were taken at each of the photo points to document year-to-year geomorphic change on the floodplain, and compared to the baseline photos.

Overview of Annual Conditions

WY2016 was an *El Niño* year, characterized by above-average total precipitation that accumulated throughout the season. As a result, water levels were more frequently elevated, inundating the floodplain a total of six times, sometimes for several days at a time.

Hydrologic Monitoring Results

WY2016 was characterized by above-average total precipitation in the Alum Rock area, with 20.85 inches recorded at the Berryessa Station (**Figure 3**) and 19.28 inches accumulating at the Union City Station over the year (**Figure 4**). For comparison, the long-term average at the San Jose Airport (KSJC) is 14.67 inches.

Unlike previous years, in which much of the rain received fell during a few large storms, this season was characterized by smaller storms that occurred more frequently, starting on November 1, 2015 and continuing through May 2016. Many of these events were multi-day storms. Notable wet periods occurred from early to mid- January and mid-March. From January 4 to January 19, 2016, 4.2 inches and 5.6 inches of rain was recorded at the Union City Station and Berryessa Station, respectively. From March 3 to March 14, 2016, 4.6 inches and 3.36 inches of rain was recorded at the Union City Station and Berryessa Station, respectively. Peak one-day rainfall was recorded at March 5 at Union City Station (1.45 inches), and November 2 at Berryessa Station (1.19 inches).

Balance visited the site once during the rainy season and twice during the dry season to calibrate, repair, and download water level recorders. These data were used to create a continuous stage record for the site **(Figure 5).** Stage at the in-channel gage is plotted against time for the duration of the water year. Also plotted is the stage record for the nearby Dorel gaging station.

Figure 5 also shows the relationship between precipitation and water levels recorded at the gaging station. As in previous seasons, early-season rainfall events (e.g. November 2, 2015) do not correlate to peaks in the stage record at the project site; we surmise that the watershed was wetting up during this time period, and that soils were not saturated enough to produce a response in the channel at the gaging location. The first storm that produced a response at the gage was on December 22, 2015 – this storm produced the second-highest stage of the season at the in-channel gage (4.38 feet). Other relatively significant stage responses occurred on January 18, (4.77 feet), March 7 (3.82 feet), and March 12, 2016 (3.97 feet), with smaller peaks scattered throughout the record. Water levels remained elevated for several days following each peak. Between December 22 and early April, water levels in the channel were either peaking due to storms or at an elevated baseflow, which is approximately half a foot higher than dry season baseflow.

The stage record at Dorel followed a similar pattern to the gage at Project Site 10, with the largest peaks occurring on December 22, January 18, March 7, and March 12, and stage levels remained elevated for several days after large events. Similarly to previous years, the Dorel gage is more responsive to early season storms; small storms that occurred in November and early December produced small stake spikes, while no response was recorded at the Project Site 10 gage. This is likely due to the larger watershed area that drains to the Dorel gage.

Figure 6 shows the Alum Rock in-channel and overbank stage data converted to elevation in feet NAVD 88. Because the overbank sensor is located below the elevation of the floodplain, peaks at this gage do not necessarily represent inundation of the floodplain. The upper and lower extent of floodplain elevations adjacent to the gage are plotted with green dashed lines (**Figure 6**).

According to the stage record, the floodplain was inundated six times over the course of the wet season. The floodplain was inundated for approximately 15 days total between late December and mid-March. This was a marked change from the previous two years of monitoring; in WY2014, water did not reach the floodplain at all, and in WY2015, only two brief periods of inundation occurred. The above-average rainfall conditions during WY2016, which saturated soils more thoroughly and frequently, were more conducive to floodplain inundation.

A small daily fluctuation in water level was recorded in the in-channel stage and the Dorel stage throughout the period of record. The cause of this fluctuation is presently unknown, but we commonly observe natural daily fluctuations in stage during low flow periods due to changes in evapotranspiration, and even direct evaporation. We will continue to monitor these fluctuations during future site visits.

Hourly discharge records available from the Dorel gage have been used to approximate discharge at the Alum Rock sites. Terrain maps of the watershed were used to calculate the difference in drainage area between Project Site 10 and the Dorel gage. Project Site 10 has a contributing drainage area of approximately 21 square miles, and the Dorel gage, located 2.5 miles downstream, has a drainage area of 22.3 square miles, an additional 1.3 square miles. To provide some context for flows to evaluate inundation at Project Site 10, the Dorel discharge record is scaled by a factor of 0.94 to serve as rough estimate of discharge[4]. When flow reaches the overbank gage, the corresponding discharge at Dorel is approximately 2.4 cubic feet per second (cfs). The corresponding scaled discharge required to inundate the overbank gage is calculated to be 2.3 cfs, but because the gage is at a lower elevation than the floodplain, a higher discharge is required to inundate the floodplain. Based on comparing previous years' records at Dorel with our records at Project Site 10, we estimate that the floodplain is inundated when the discharge at Dorel reaches approximately 50 cfs. The recorded seasonal peak flow at Dorel far exceeded this, with flows reaching 615.8 cfs on December 22, 2015. However, it is our understanding that the Dorel gage is a low-flow gage and higher flows are not necessarily accurate, so reported high flows should be used for reference only, and simply as an indicator of when the Project Site 10 floodplain is inundated.

Geomorphic Monitoring Results, Project Site 13 (Fish Passage)

Visual Geomorphic Observations, Project Site 13

[4] Stage and discharge data available through the SCVWD ALERT website is preliminary; information was not available on the Dorel gage flow rating curve and maintenance record. These data are used here for information purposes only.

Visual inspections and photo point comparisons **(Figures 7-16)** of Project Site 13 show that despite the increased volume of flow passing through the project site in WY2016, the fish passage seems to be functioning as intended, and the rock band structures and pools were in good condition. This year we did see some larger rocks (~2 feet in diameter) move slightly, and we saw continued reworking of finer bed sediment, but in general these changes were localized and did not appear to be degrading the constructed elements. Like last year, some mobilization of the bed and reworking of gravel to cobble-size sediments was also observed. These reworked sediments provide an additional increase in habitat complexity, and are not expected to interfere with the structural integrity of the channel. Vegetation that had largely been scoured out at the time of last years' survey (WY2015) has grown back vigorously, and the site remains largely free of thick algal mats. The vegetation looks healthy and is anticipated to continue to provide habitat complexity (see photo points 5-7 for examples, **Figure 11-13**).

The flows of WY2016 continued to move large wood in the channel. Photo point 1 (**Figure 7**) shows that a large log has shifted a few feet up the bank in WY2015 has now accumulated several more pieces of small to large-sized wood, and a similar debris pile has formed on the right bank, potentially improving habitat structure and function. In photo point 2 (**Figure 8**), looking at the bridge from the downstream side, a sizeable log can be seen on the right bank, which was presumably transported during one of the season's more significant flows.

Quantitative Geomorphic Observations, Project Site 13

Figures 17-23 show results of the September 2016 cross sections surveys. Comparisons of these survey data to the previous years' data generally confirm visual observations – major geomorphic change, such as significant bank widening, mobilization or deposition, did not take place in the fish passage structure over WY2016, but movement of individual boulders and localized variations in bed elevations were detected. XS 1 (**Figure 17**) shows that while the channel profile is stable, the large log that shifted during high flows (**Figure 7**) is now located within the cross section. Several rocks were surveyed in the 2016 profile. Visual inspection of the photo points confirm that these rocks did not move, but are the result of a slight alignment deviation in the path of the surveyed profile. In a boulder-filled section such as this, even an alignment shift of a few inches can have this result. Slight changes in the channel bed due to the reworking of fine sediments, as observed in the visual observations and photo points, can be seen XS 2 and XS 3 (**Figure 18**, **Figure 19**). XS 4 (**Figure 20**) crosses through a section of channel that underwent some movement by larger boulders; visual observations confirmed that a large (~2 foot diameter) boulder shifted slightly downstream, and now sits along the right side of the profile of XS 4. Some smaller boulders along the left bank appear to have shifted as well. These are boulders that sit in the bed of the channel, and do not appear to support major structural elements. Along XS 5 (**Figure 21**), a smaller boulder may have shifted into the profile on the upper left bank, but this is a heavily vegetated area and this could not be visually confirmed. Further downstream XS 6 and 7 (**Figure 22**, **Figure 23**) remain largely unchanged.

Figure 24 shows results of the 2016 longitudinal profile survey. This profile provides greater detail on which areas experienced mobilization and/or deposition. Despite the wet year, the profile remains largely unchanged from the previous year. Pools which deepened in the December 2014 flood, such as through a segment approximately 20 to 60 feet downstream of the YSI bridge and downstream of XS 4, have deepened, but by half a foot or less. Through this upper reach, pools are approximately 1 foot deeper than when constructed. Sediment which accumulated in pools from Station 175 to 200 and below Station 300 during WY2015 has been mobilized again, with pool bed elevations dropping by about half a foot. As expected from the cross section surveys, there is some change in the profile around XS 5, where large boulder movements were observed, but the overall bed elevation has not changed appreciably. The tops of rock band structures and weirs are at the same elevations as last year. The surveyed profiles suggest geomorphic stability, but active channel dynamics at Project Site 13, which are likely due to post-drought, episodic conditions upstream of the site.

Geomorphic Monitoring Results, Project Site 10 (Floodplain)

Visual Geomorphic Observations, Project Site 10

Visual assessment of geomorphic change at Project Site 10 was marked by fine sediment deposition on the floodplain, coarse sediment deposition in the channel, and continued growth of alders and willows, as is evident in the photo points (**Figures 25-30**). Aggradation was observed on the floodplain; evidence included organic debris wrack lines from high water, movement of large and small wood onto the flood plain, and fresh sediment deposits. This is consistent with the stage record of inundation. The connections from the main channel to the constructed floodplain have not changed significantly; however, a substantial amount of coarse sediment was transported into the channel bed below the elevation of the floodplain, presumably during one or more of the high-flow events occurring from December 2015 to March 2016. Coarse sand to cobble–sized particles filled in the pool that contained the in-channel gage, burying the gage in 1-2 feet of sediment and transforming the channel adjacent to the floodplain into a coarse riffle. The increased bed elevation through this reach will likely increase the likelihood of flows reaching the floodplain.

Quantitative Geomorphic Observations, Project Site 10

Table 1 gives a summary of the depths of sediment accumulated on the sedimentation plates installed on the floodplain.

Table 1. Summary of sediment accumulation on sedimentation plates 1 and 2.

	Sedimentation Plate 1 *feet of accumulation*	**Sedimentation Plate 2** *feet of accumulation*
Year 1 - WY2014	0.00	0.00
Year 2 – WY2015	<0.01	<0.01
Year 3 – WY2016	0.25	0.25

The depth of sediment accumulated on the floodplain sedimentation plates was measured on September 15, 2016. Both plates had been inundated during flood flows, and were covered in fine sediment and organic debris. Both plates had accumulated approximately 0.25 feet (7.5 centimeters) of sediment. This was the first year that the floodplain had been inundated for extended periods of time, and more deposition of fine sediments than in previous years was expected. Our observations suggest the floodplain is functioning as intended, and sediment deposition, while not excessive, is occurring.

The quantitative surveys of the floodplain were a challenge this year due to the vigorous willow and alder growth. This proved to be a major obstacle in surveying XS 101 – only the upstream portion of the survey could be completed in a timely manner. Our ability to capture accurate survey data in a cost-effective manner is diminishing each year. As such, we recommend that starting next year, we rely on qualitative descriptions, sediment plate measurements, and photo points to assess the condition of the floodplain, and eliminate the total station surveys. We have established a solid baseline survey dataset that can be re-occupied, should issues arise with the site that would require measurement along the profiles.

Figures 31-32 show the results of the September 2016 cross sections surveys. Comparison of this year's data to previous surveys generally confirm the results of the visual observations: a small amount of deposition is occurring on the floodplain, especially on downstream portions, and coarse sediment deposition took place in the channel. There is no evidence of major erosion on the floodplain, toe wall, nor evidence of channel widening or downcutting.

Figure 33 shows the results of the September 2016 floodplain elevational survey. The elevation of the floodplain generally appears to be consistent with or slightly elevated from the baseline survey by a few inches. In some upstream portions there is evidence of a few inches of scour, which is possible due to the inundations that took place over the course of the water year. The magnitude of elevational changes is minor, however, and does not hinder the habitat function of the floodplain. The surveyed profile suggests geomorphic stability within Project Site 10. Note that in 2014, the survey was continued over the rock wall at the upstream end of site. While this path was not repeated in other years, it is included in the plot for informational purposes.

Conclusions

WY2016 was the first year with above-average precipitation following a prolonged regional drought. The results of this year's monitoring suggest a post-drought episode of sediment delivery and transport. We have observed post-drought episodic sedimentation during WY2016 at numerous other monitoring sites in the region, which is important to consider when evaluating the results of our monitoring at Project Sites 10 and 13. A pulse of sediment is migrating downstream through Alum Rock Park. This pulse may affect stream conditions in the short term, but sediment storage is limited. We will evaluate the sedimentation conditions over the remaining years of the required monitoring program. Overall, as of the end of WY2016, the Alum Rock mitigation projects at Project Sites 10 and 13 remain in a condition very similar to that of the constructed condition, with natural channel and floodplain dynamics beginning to develop through localized sedimentation and scour due to increased flows in WY2016. As the Project Site 10 floodplain flooded six times during WY2016, to date the project meets the criteria requiring inundation every one to two years. Project Site 10 experienced deposition of both fine and coarse sediment. Over the next year, this sediment may work its way into the Project Site 13 fish passage reach, which in WY2016 continued to be characterized by slight erosion of pools. Sedimentation of this nature is natural and we do not expect it to threaten the longevity and function of the restoration. All structural elements in the fish passage held up well to this years' many storms. Habitat complexity associated with the fish passage design at Project Site 13 has increased, largely through the continued increase in riparian vegetation cover and the reworking of bed sediments. Some scour and aggradation was observed in pools, but overall constructed elements remain stable. Monitoring high stages and flows at these sites will continue to be a priority for the upcoming water year.

Closing

We greatly appreciate the opportunity to assist you with this monitoring effort and look forward to reporting on the geomorphic and hydrologic monitoring efforts one year from now.

Sincerely,

BALANCE HYDROLOGICS, Inc.

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Encl. Figures 1 through 33

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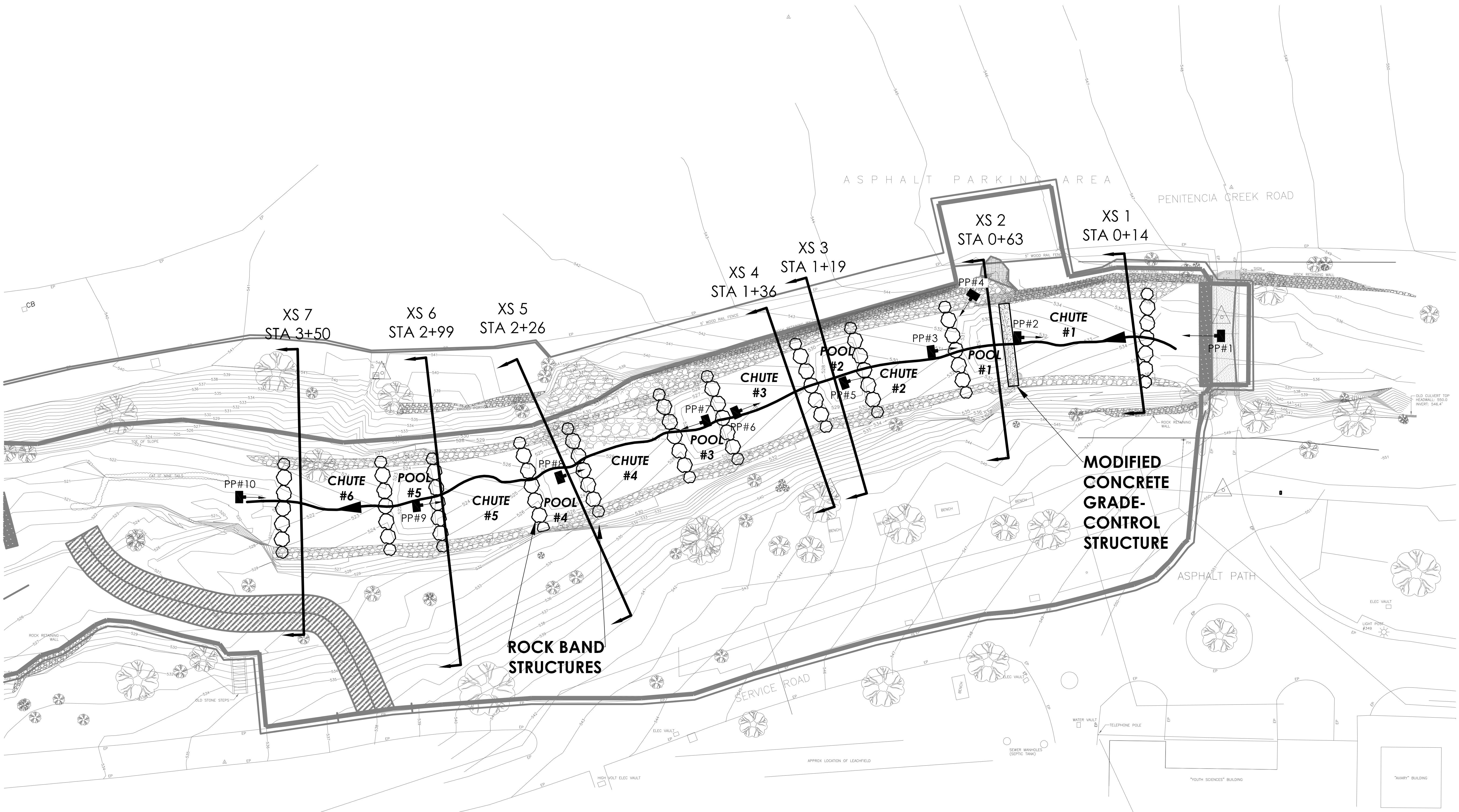

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Figure 1. Upper Penitencia Creek, Alum Rock Monitoring, Santa Clara County, California. Project Site 13, a 300-foot long fish passage improvement project.

213017 monitoring workmap.dwg

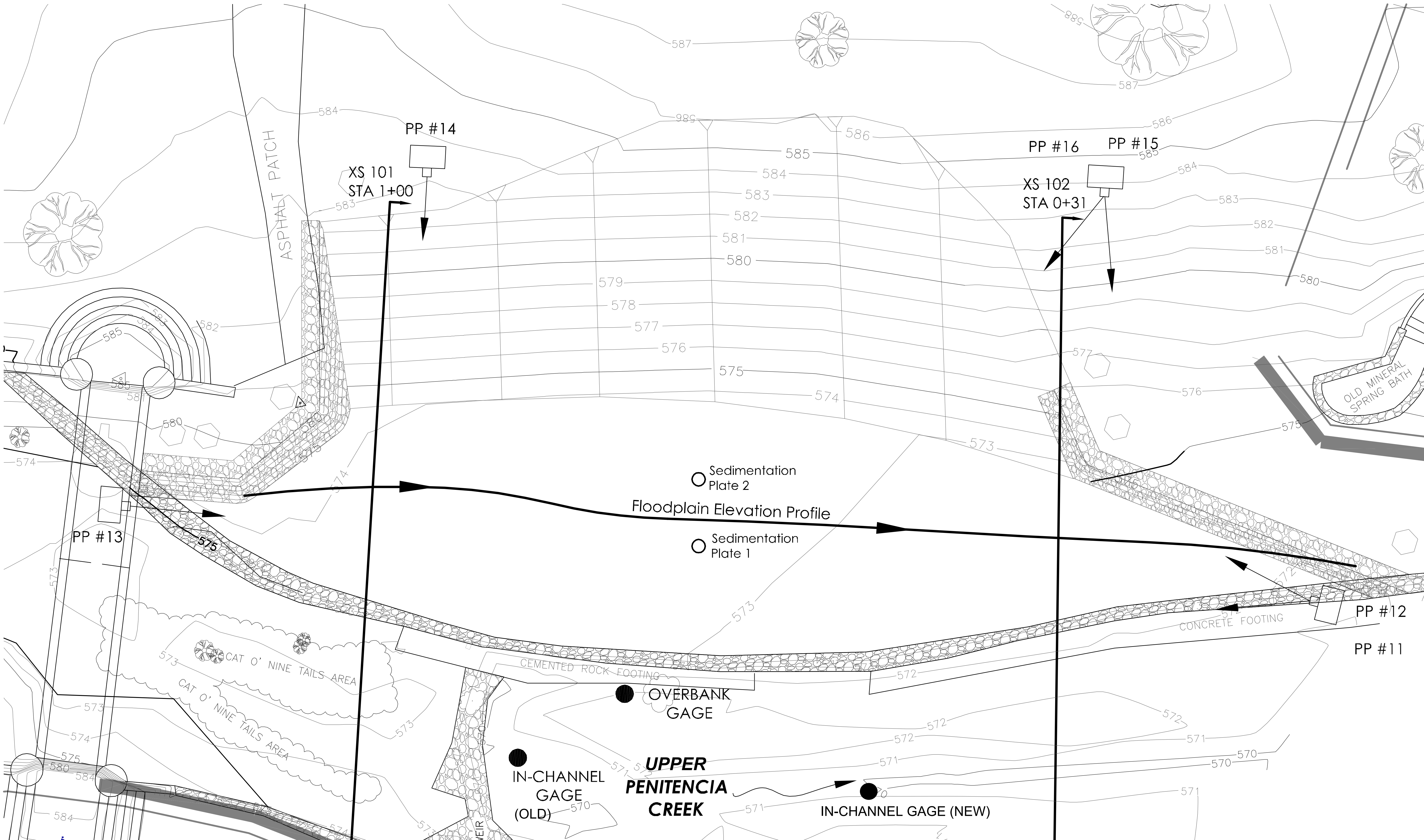

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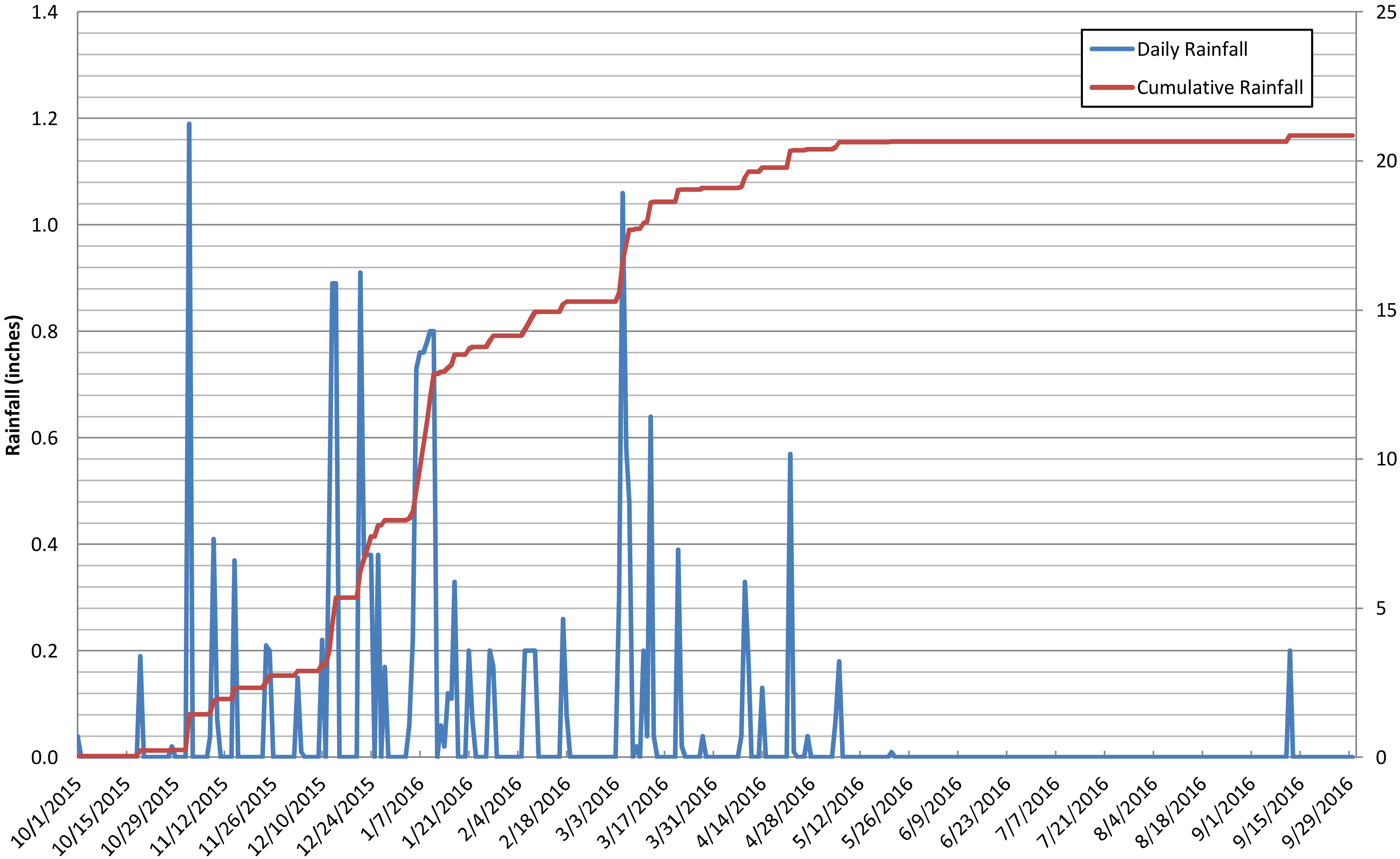
Figure 2. Upper Penitencia Creek, Alum Rock Monitoring, Santa Clara County, California.
Project Site 10, a 120-foot long, 30-40 foot wide newly constructed floodplain.

213017 monitoring workmap.dwg

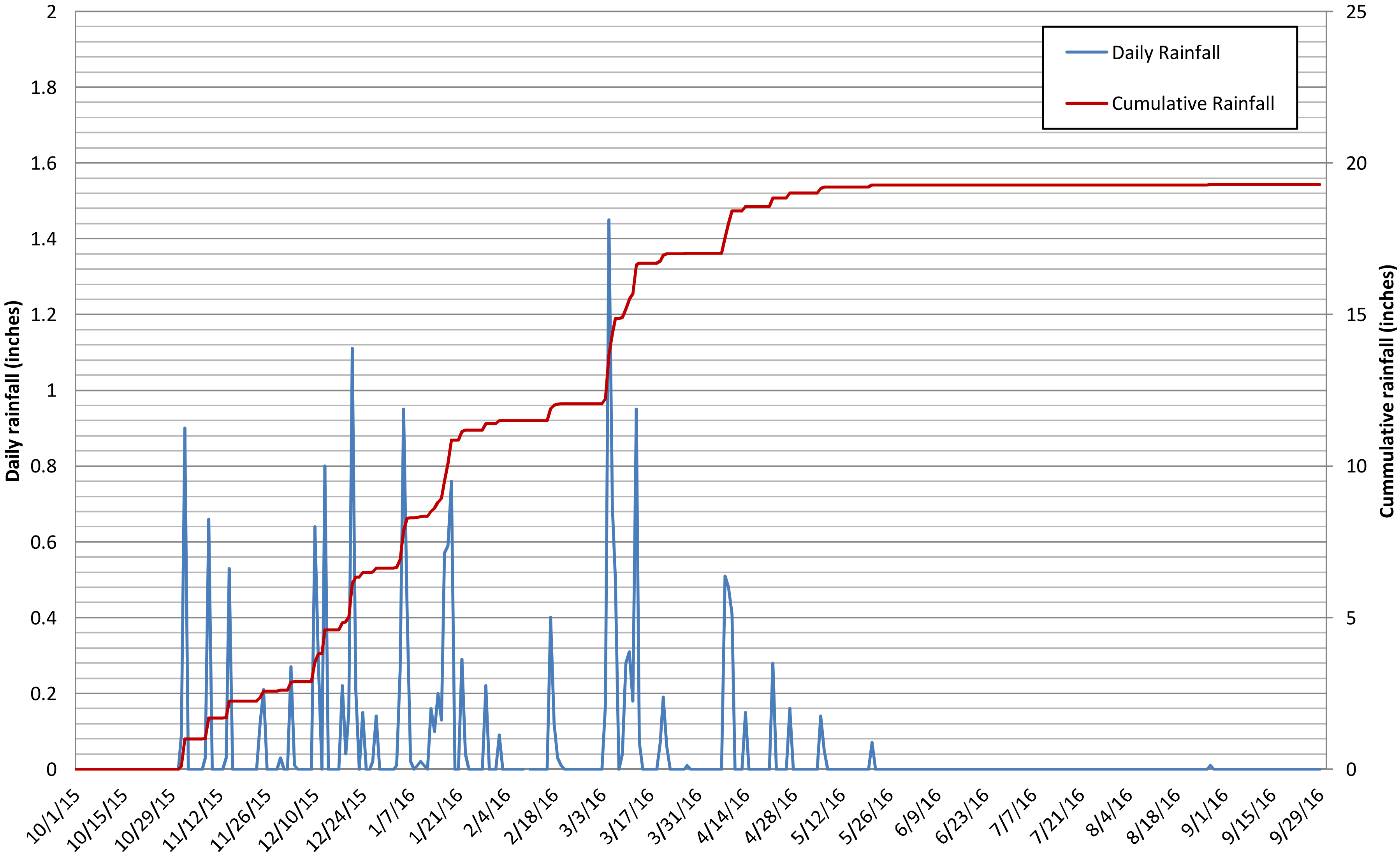


Source: Weather Underground

Balance Hydrologics, Inc.

Figure 3. Daily Rainfall and Cumulative Rainfall, Berryessa, California (Weather Underground Station KCANSANJO17). Alum Rock Monitoring, WY2016, Santa Clara County, California.

Rainfall_WY2016.xls

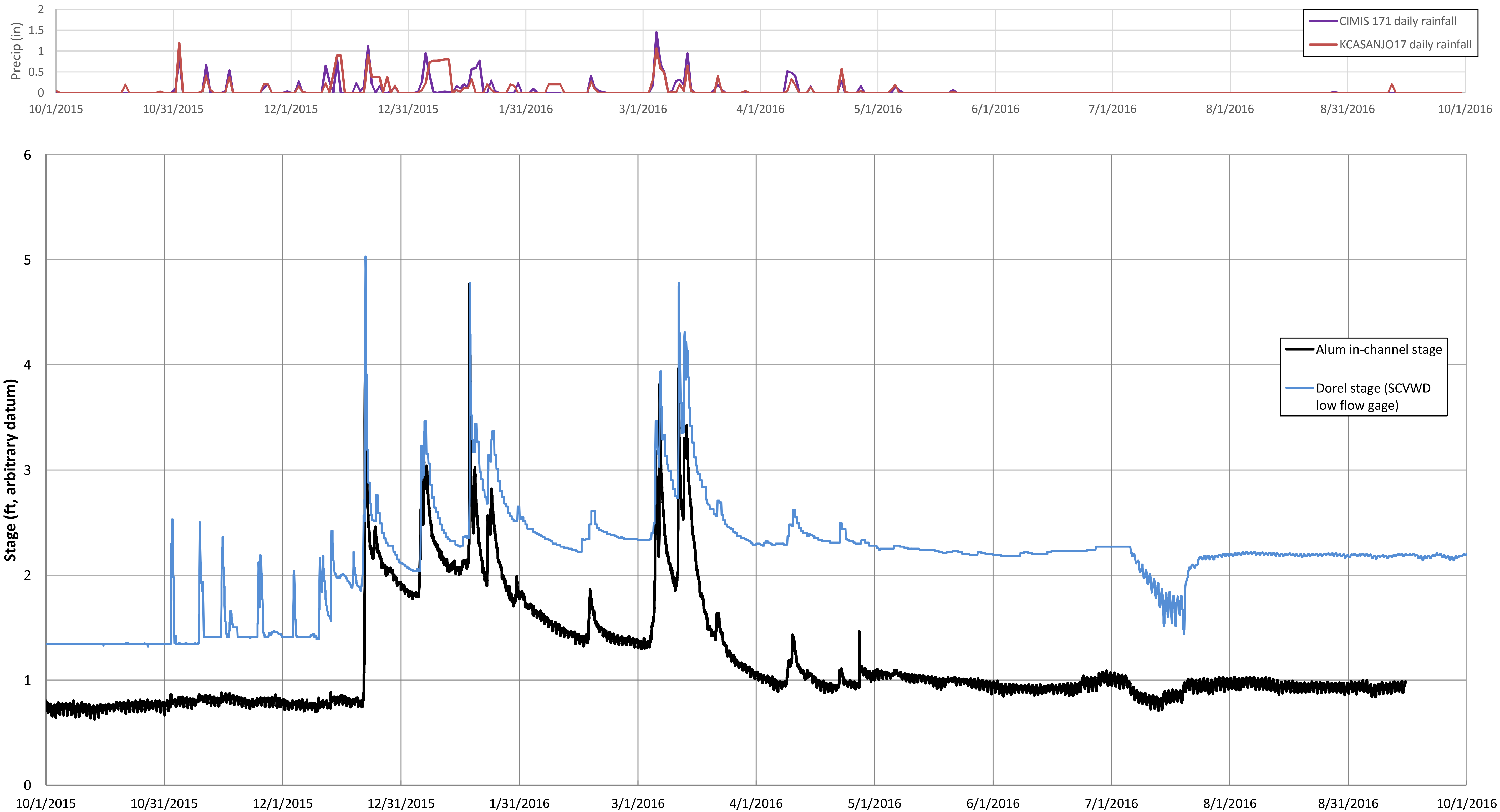


Source: CIMIS

Balance Hydrologics, Inc.

Figure 4. Daily Rainfall and Cumulative Rainfall, Union City (CIMIS 171). Alum Rock Monitoring, WY2016, Santa Clara County, California.

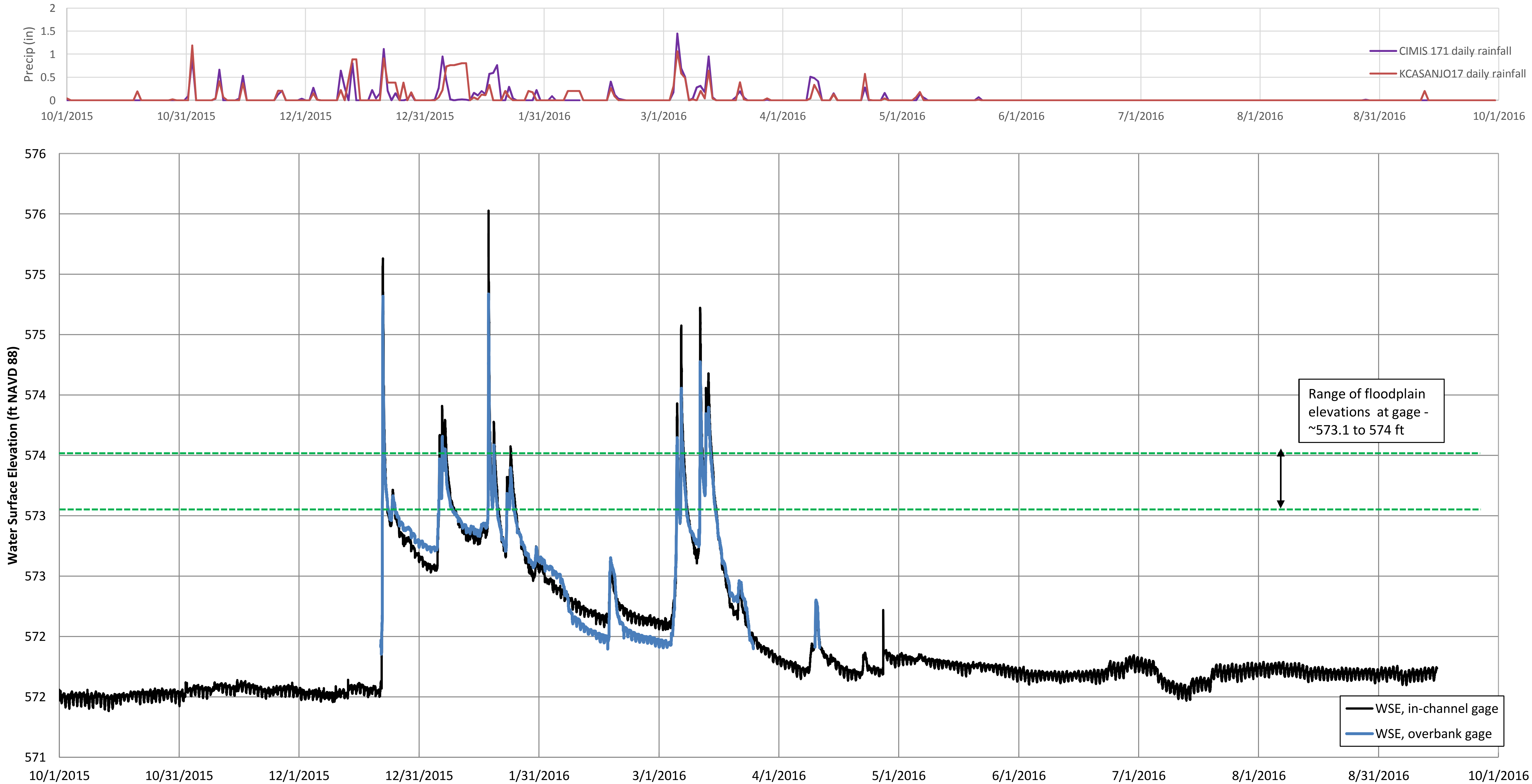
Rainfall_WY2016.xls



Balance Hydrologics, Inc.

Figure 5 . **Alum Rock 15 minute stage record from upstream channel-bottom pressure tranducer, WY2015, Alum Rock monitoring, Santa Clara County, California.** Red squares mark manual readings from the upstream staff plate. These data are compared with hourly stage data from the Dorel gage, located approximately 2.5 km downstream from project sites 10 and 13. Precipitation from nearby gages (KCASANJ17, CIMIS171) are shown above.

Sources: Balance Hydrologics and http://alert.valleywater.org/sgi.php,



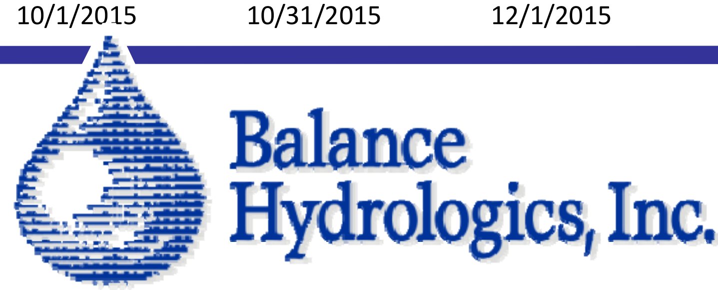


Figure 6. Alum Rock water surface elevations measured within the channel and on the floodplain, WY2016, Alum Rock monitoring, Santa Clara County, California. In-channel water surface elevation (WSE) is calculated from surveys of the staff plate at the upstream datalogger. Floodplain WSE is approximated by adjusting stage records to match flooding peaks in the in-channel record. Floodplain stage records are only plotted during times of inundation. According to discharge records for the SCVWD Dorel gage, a flow of approximately 2.3 cfs is needed to see a response at the overbank gage, and a flow of approximately 50 cfs is needed to inundate the floodplain. Dorel discharge has been scaled for watershed size to estimate Alum Rock discharge.

Sources: Balance Hydrologics and http://alert.valleywater.org/sgi.php,

Balance Hydrologics, Inc.

Figure 7. **Photo point 1, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 1 photographs taken from pedestrian bridge, looking downstream at the first rock band structure and chute of the fish passage project. Refer to Figure 1 of this report for photo point locations.

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Figure 8. **Photo point 2, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 2 photographs looking upstream to bridge below first rock band structure and chute of the fish passage project. Refer to Figure 1 of this report for photo point locations.

November 2013

September 2014

October2015

September 2016

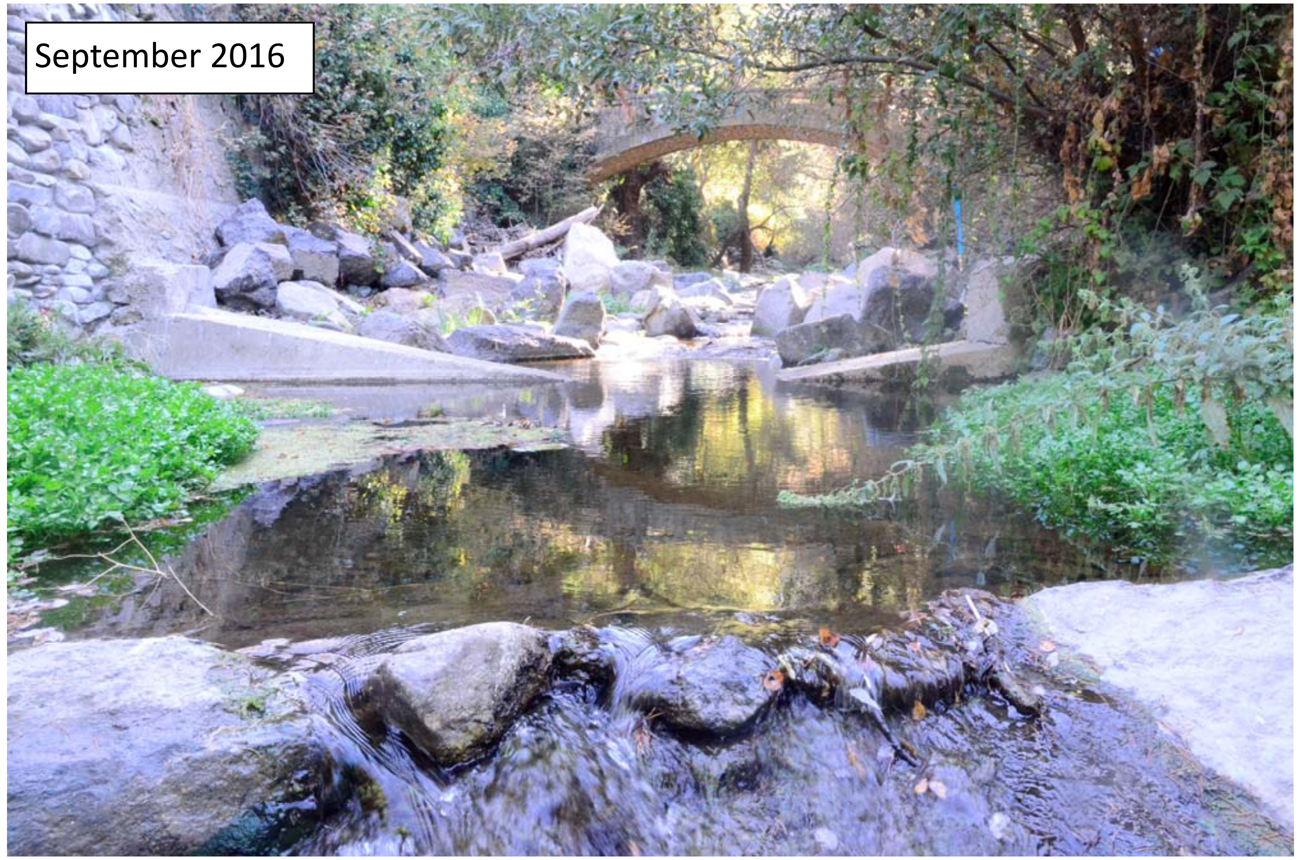

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Figure 9. **Photo point 3, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 3 photographs looking upstream across pool 1 at the modified concrete grade control structure and pedestrian bridge in the fish passage project. Refer to Figure 1 of this report for photo point locations.

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Figure 10. **Photo point 4, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 4 photographs taken on right bank from top of the modified concrete grade control structure wall looking downstream across chute 2 along the fish passage project. Refer to Figure 1 of this report for photo point locations.

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Figure 11. **Photo point 5, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 5 photographs looking upstream across chute 2 to modified concrete grade control structure and bridge in the fish passage project. Refer to Figure 1 of this report for photo point locations.

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Figure 12. **Photo point 6, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 6 photographs looking upstream across pool 2 and chute 2 in the fish passage project. Refer to Figure 1 of this report for photo point locations.

Balance Hydrologics, Inc.

Figure 13. **Photo point 7, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 7 panoramic photographs looking downstream at rock band structure and chute 3 in the fish passage project. Refer to Figure 1 of this report for photo point locations.

November 2013

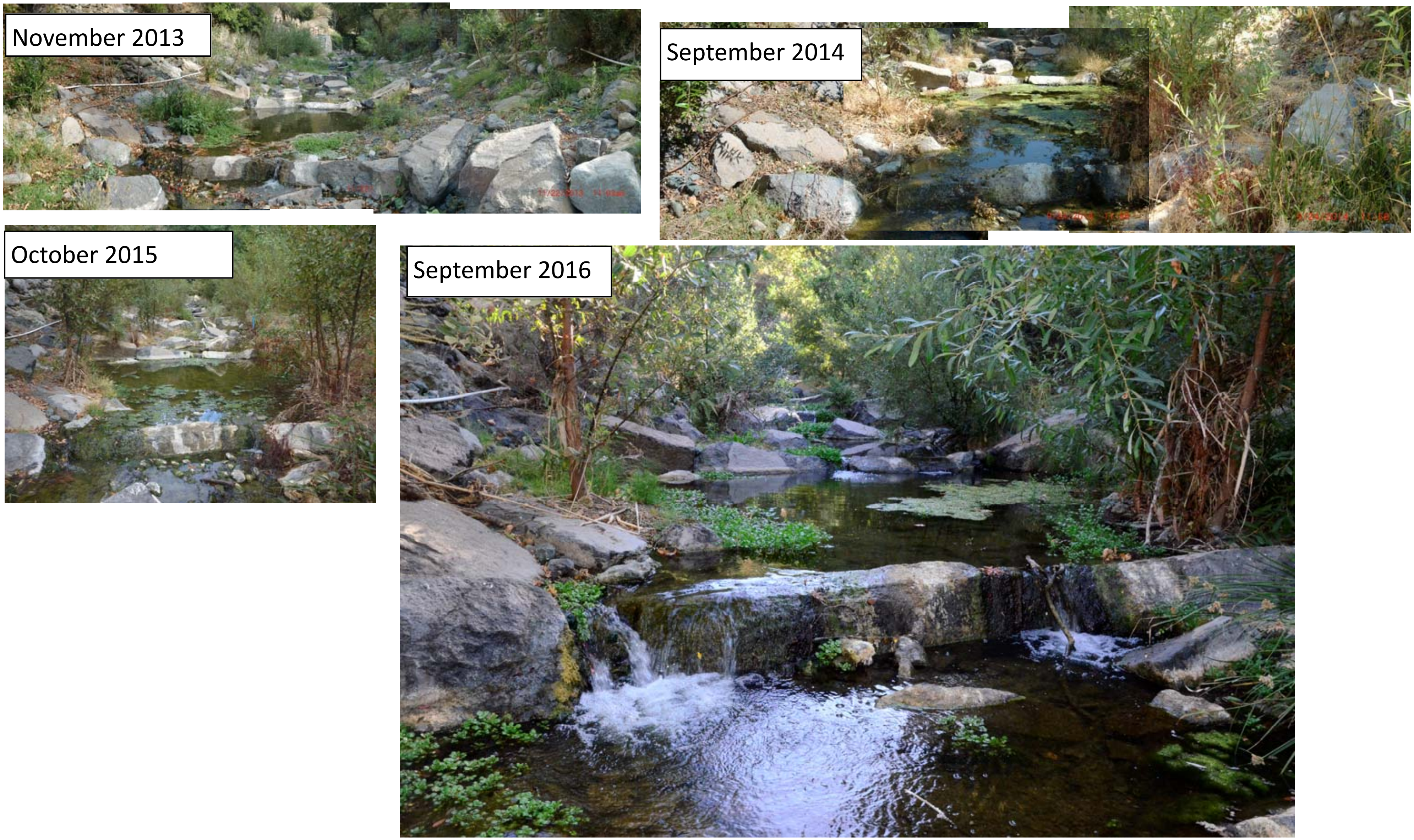
September 2014

October 2015

September 2016

Balance Hydrologics, Inc.

Figure 14. **Photo point 8, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 8 photographs looking upstream across rock band structure and pool 3 in the fish passage project. Refer to Figure 1 of this report for photo point locations.



Balance Hydrologics, Inc.

Figure 15. **Photo point 9, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 9 photographs looking upstream across rock band structure and pool 4 in the fish passage project. Refer to Figure 1 of this report for photo point locations.

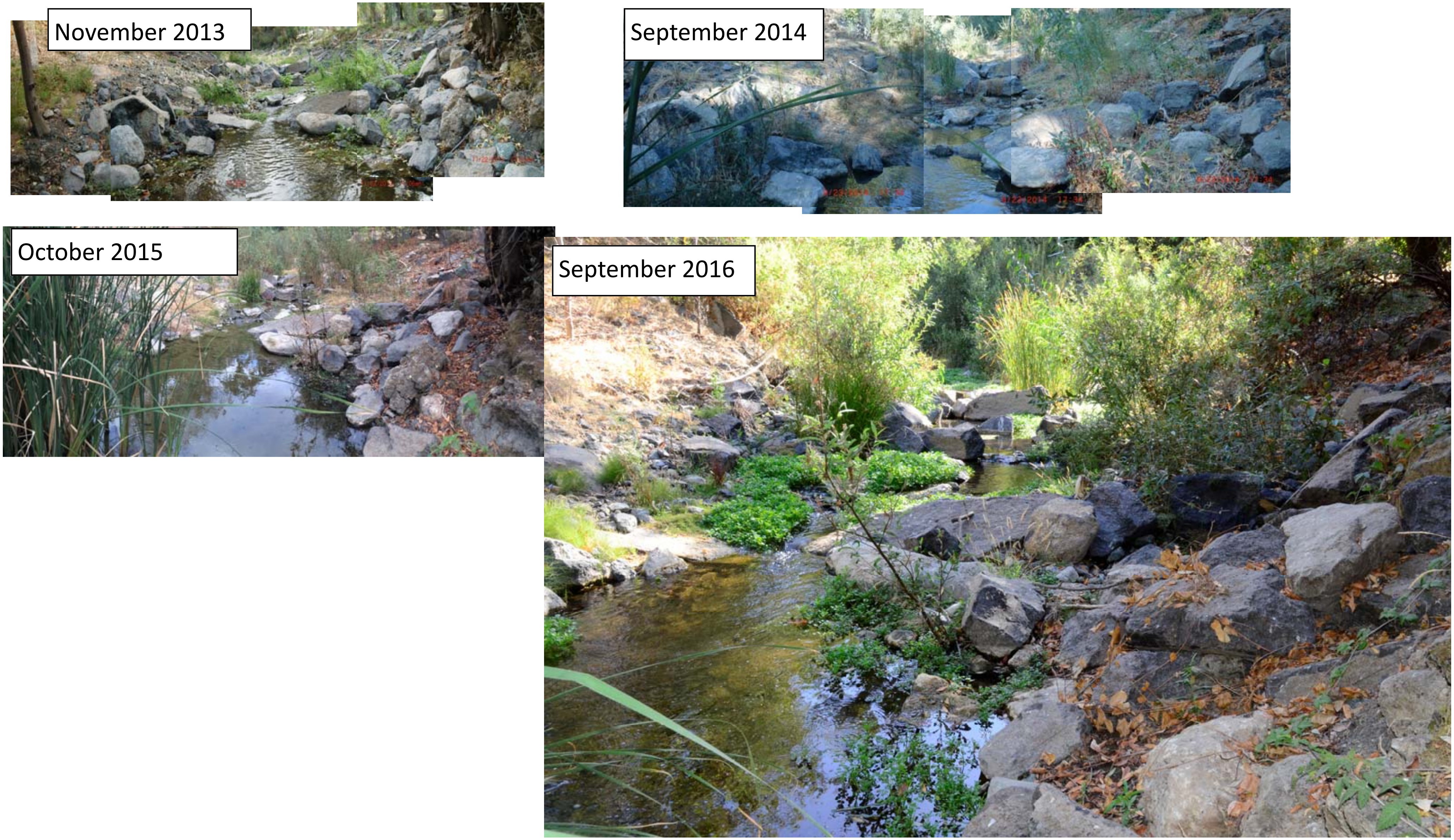


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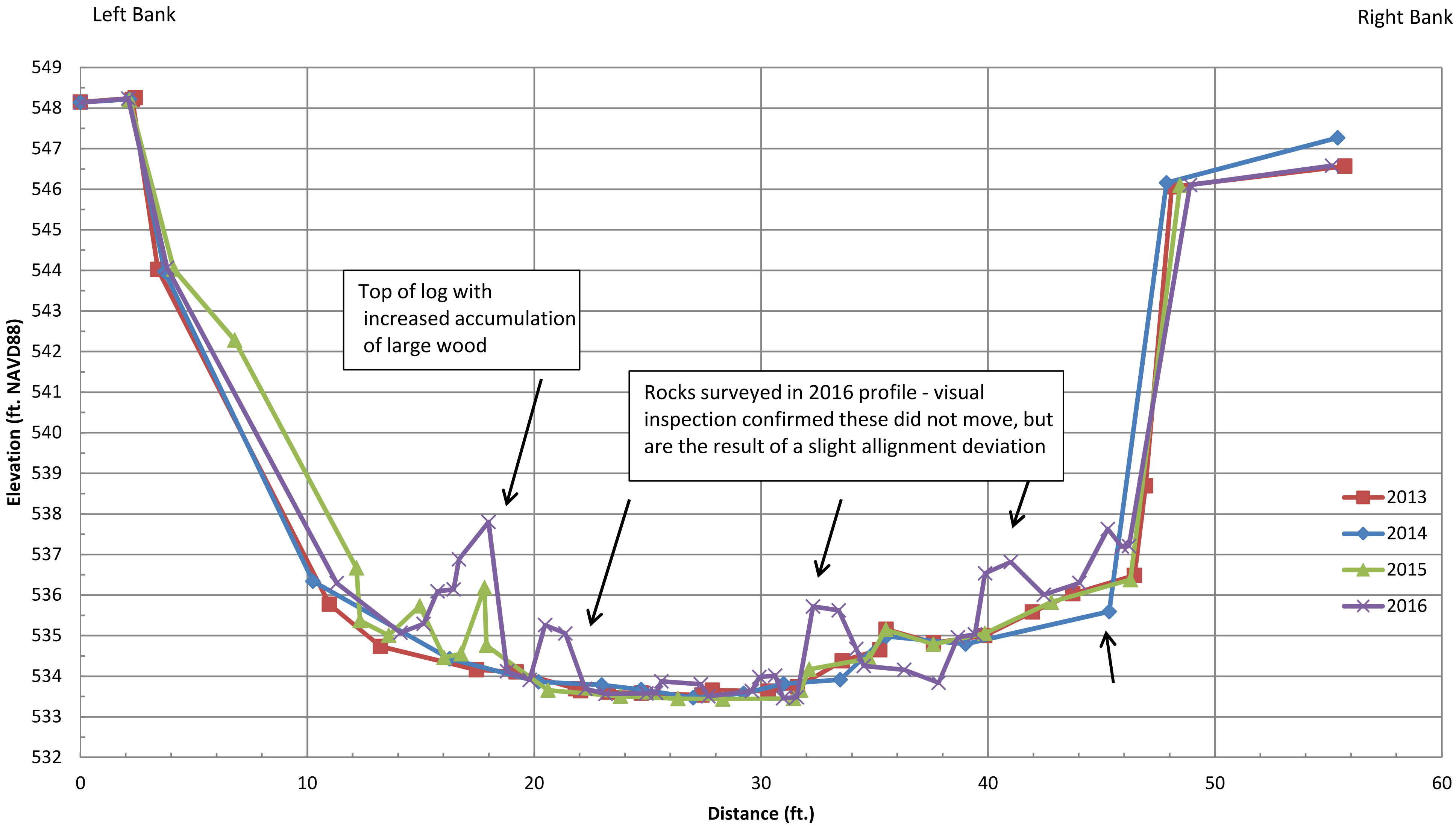
Figure 16. **Photo point 10, Site 13, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 10 looking upstream from bottom of fish passage project. Refer to Figure 1 of this report for photo point locations.



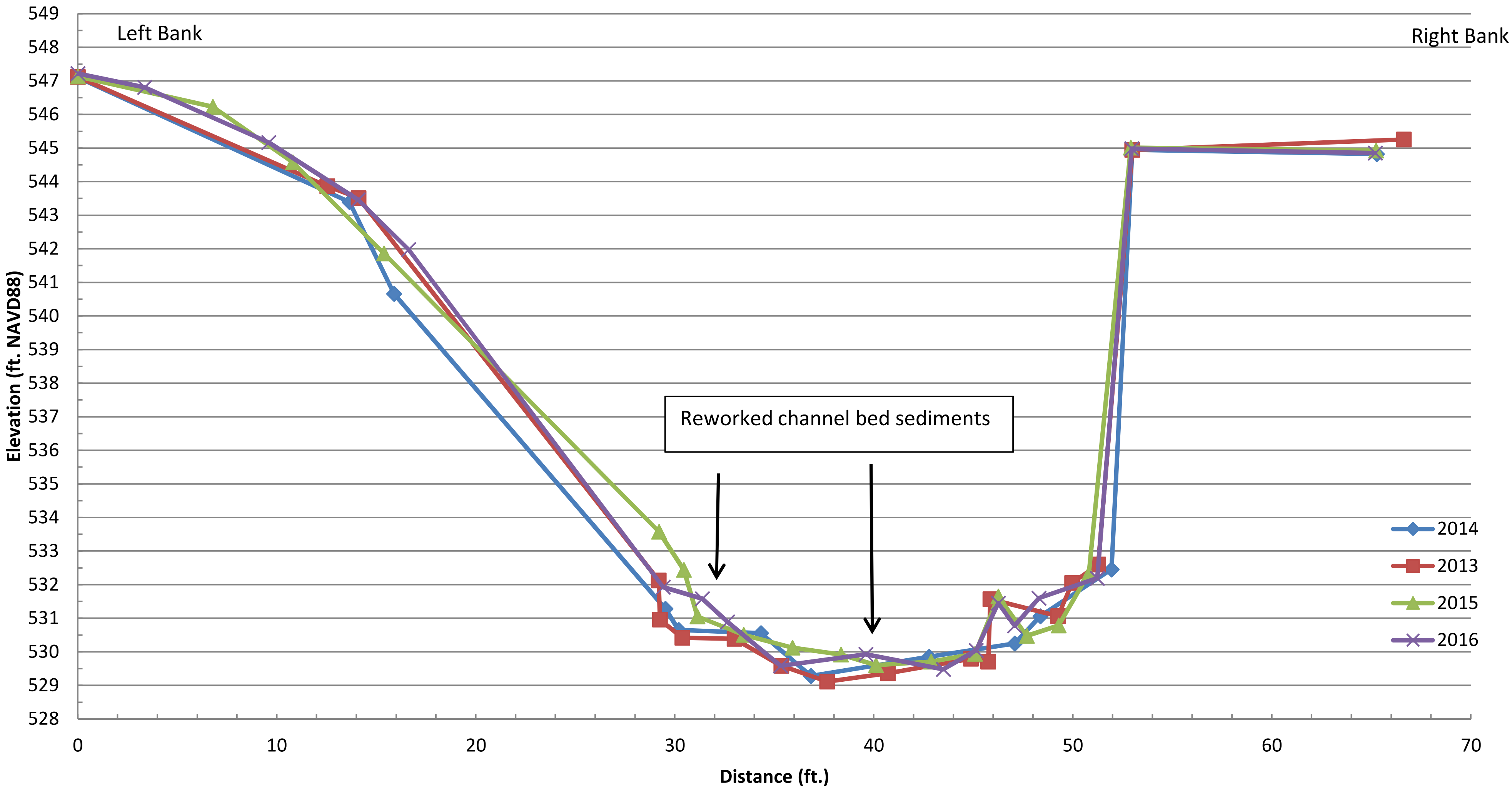
Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Balance Hydrologics, Inc.

Figure 17 . Cross section 1, Alum Rock WY2016 monitoring, Santa Clara County, California.

213017 Alum_WY2016_survey master working.xlsx



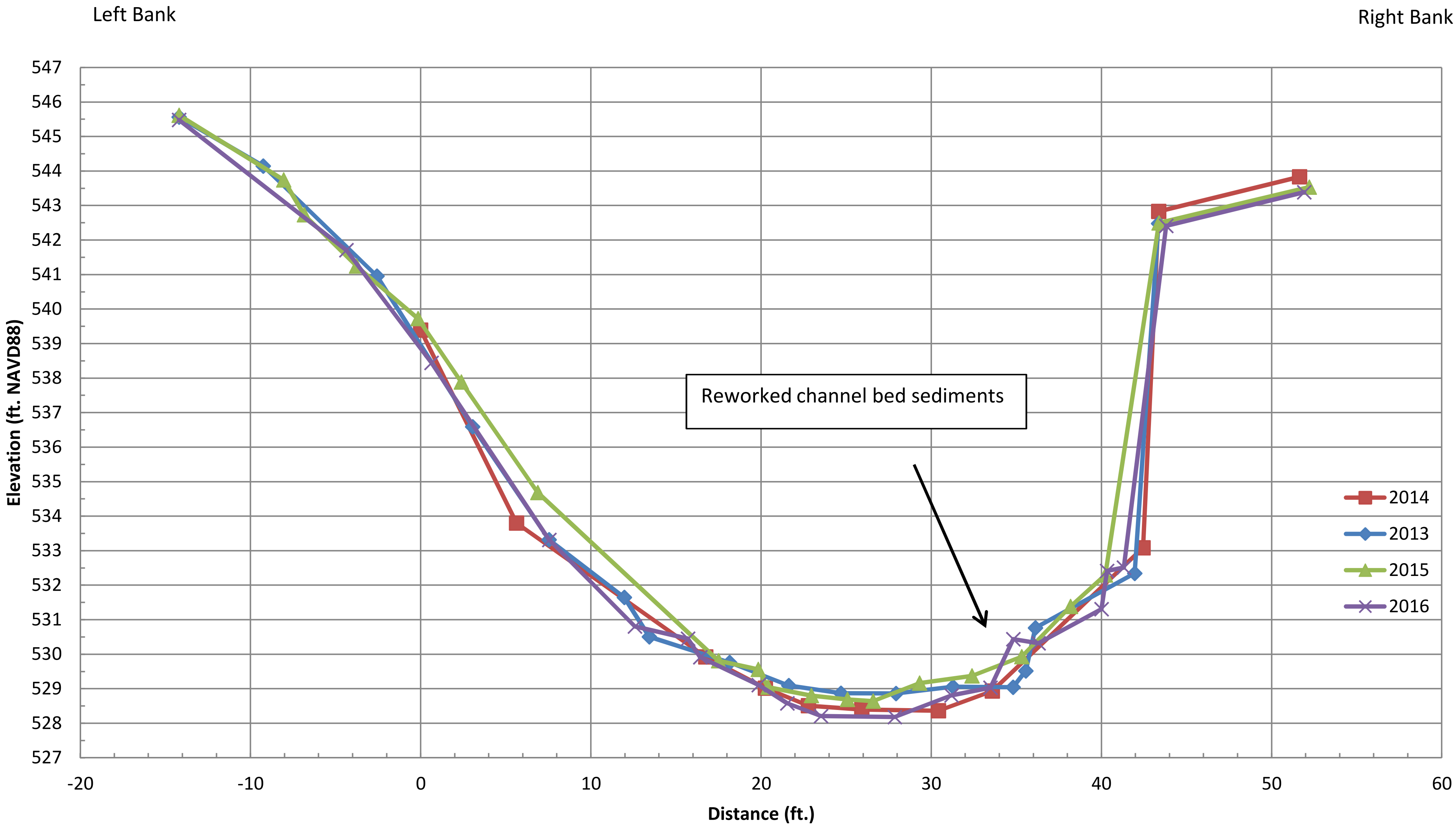
Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Balance Hydrologics, Inc.

Figure 18 . Cross section 2, Alum Rock WY2016 monitoring, Santa Clara County, California.

213017 Alum_WY2016_survey master working.xlsx



Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Figure 19 . Cross section 3, Alum Rock WY2106 monitoring, Santa Clara County, California.

Balance Hydrologics, Inc.

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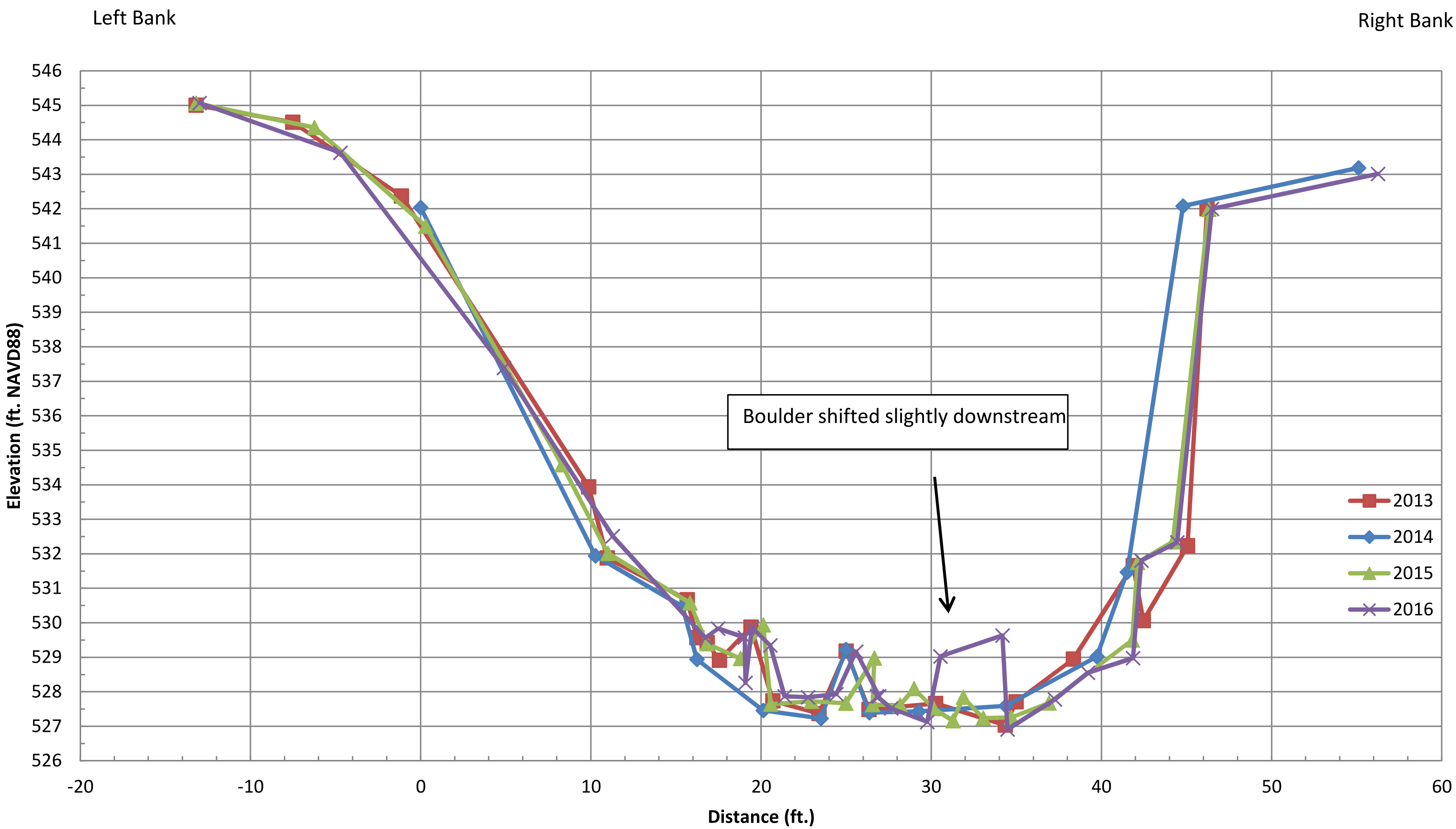


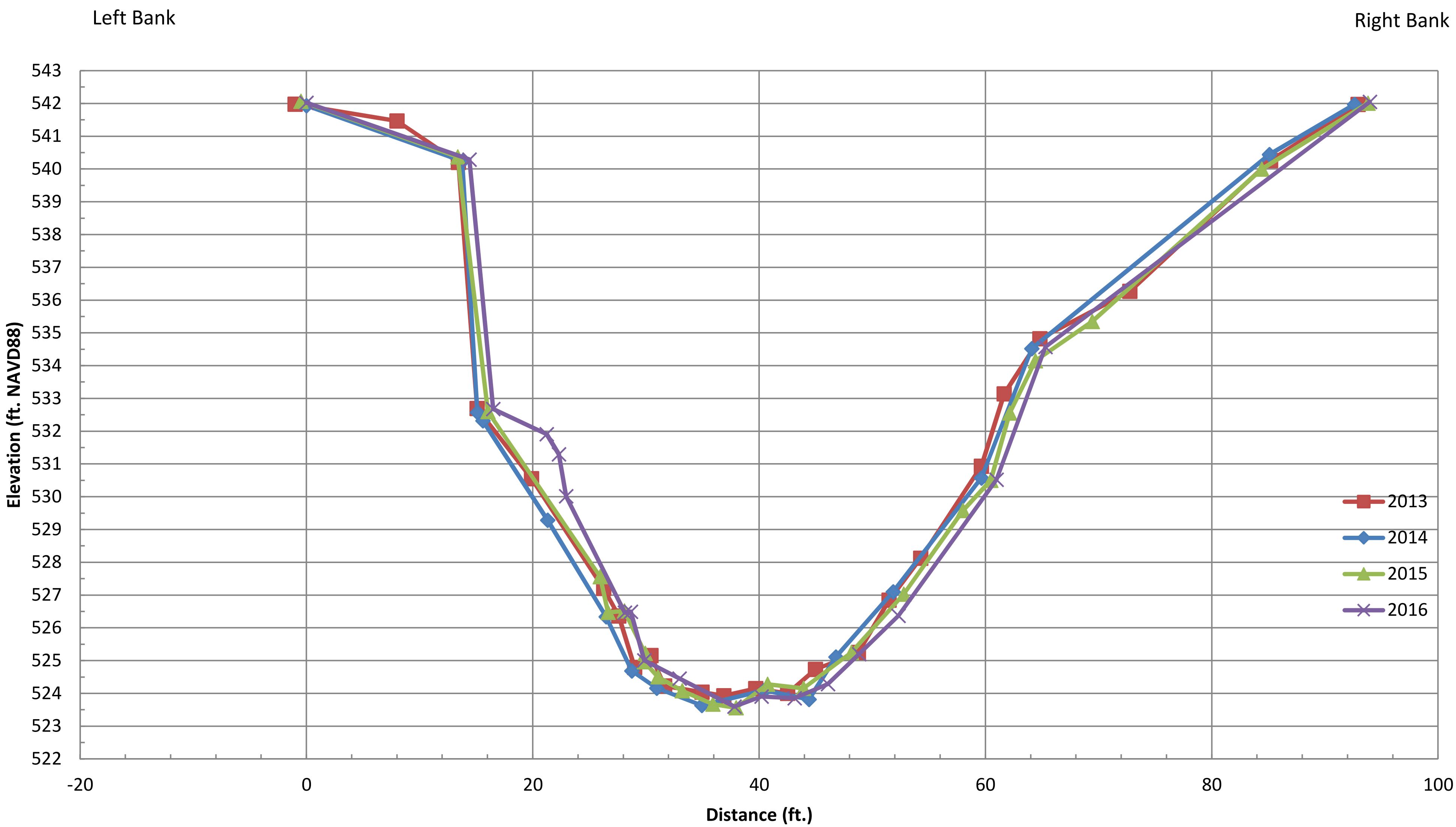
Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Balance Hydrologics, Inc.

Figure 20 . Cross section 4, Alum Rock WY2016 monitoring, Santa Clara County, California.

213017 Alum_WY2016_survey master working.xlsx



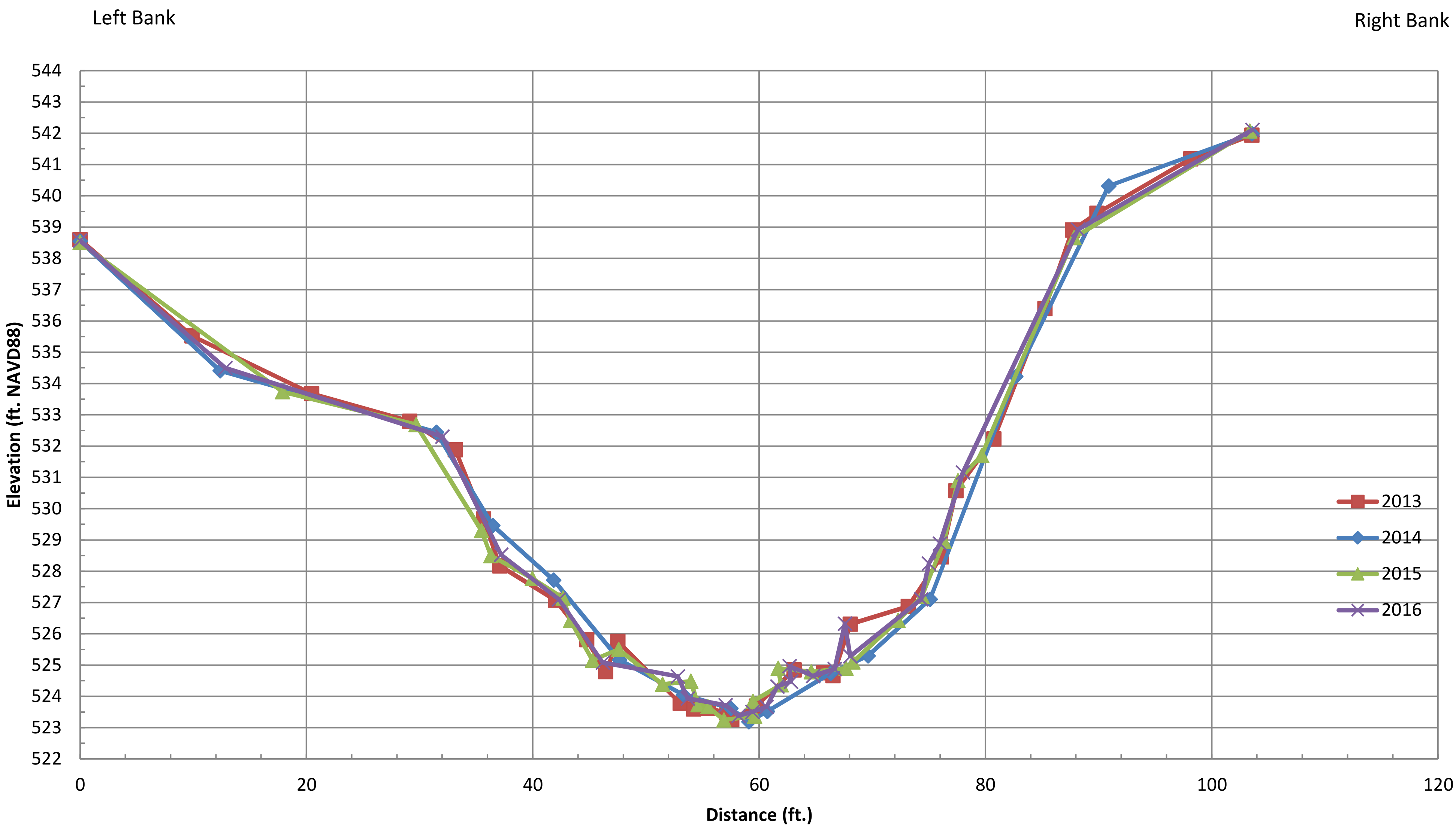
Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Balance Hydrologics, Inc.

Figure 21 . Cross section 5, Alum Rock WY2016 monitoring, Santa Clara County, California.

213017 Alum_WY2016_survey master working.xlsx



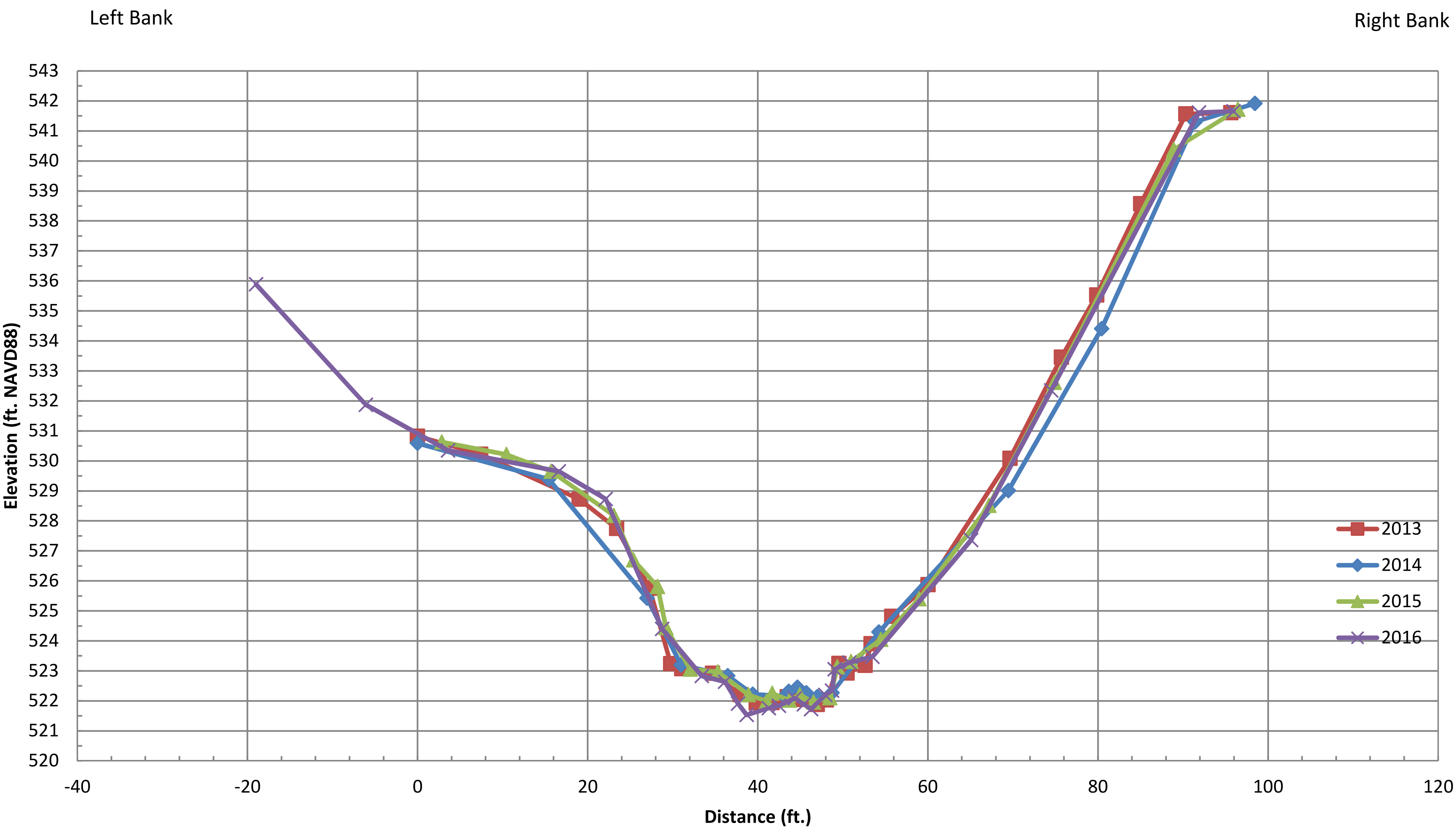
Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Balance Hydrologics, Inc.

Figure 22 . **Cross section 6, Alum Rock WY2016 monitoring, Santa Clara County, California.**

213017 Alum_WY2016_survey master working.xlsx



Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Balance Hydrologics, Inc.

Figure 23 . Cross section 7, Alum Rock WY2016 monitoring, Santa Clara County, California.

213017 Alum_WY2016_survey master working.xlsx

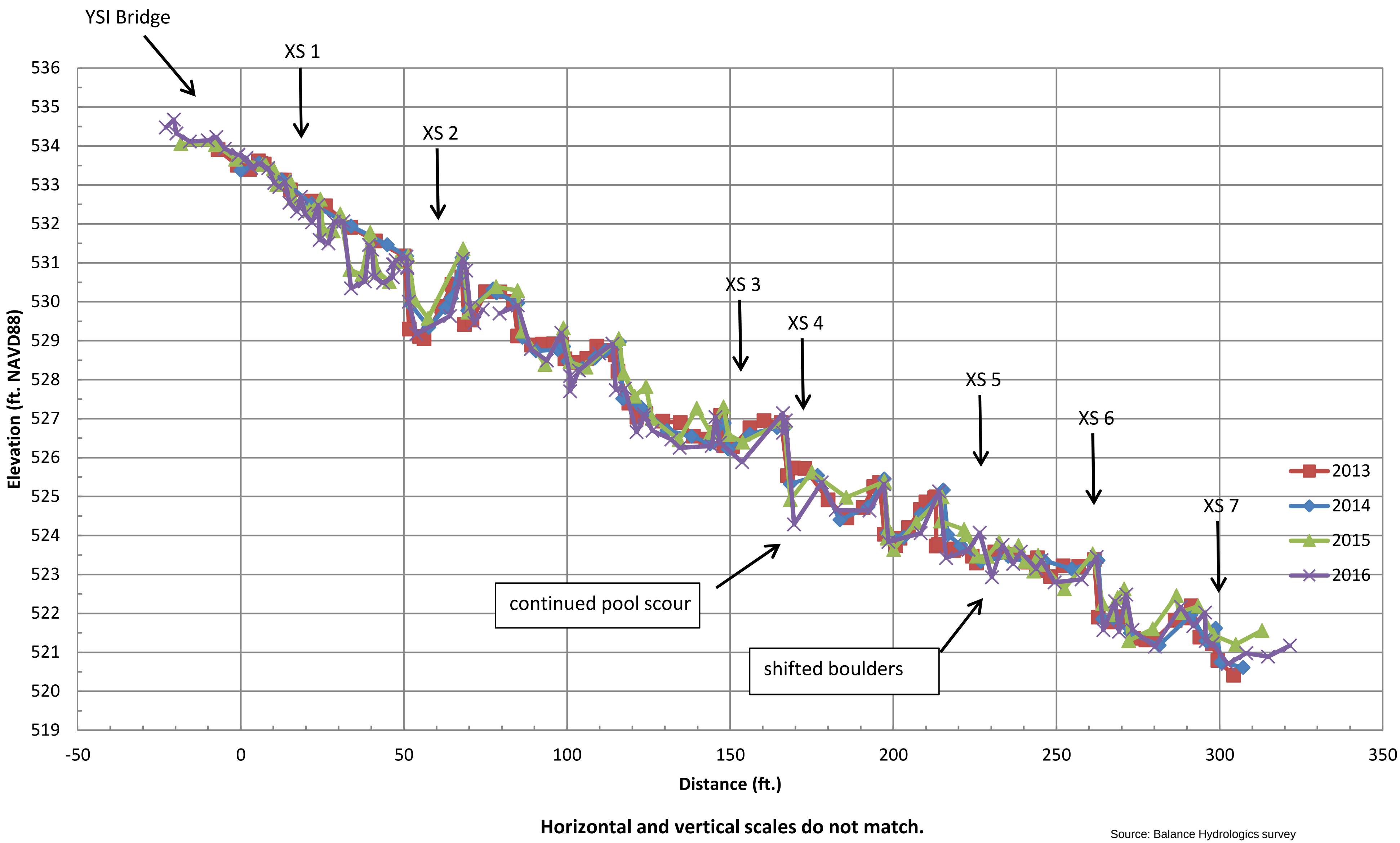


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Figure 24 . Thalweg longitudinal profile, Site 13 (Fish Passage), Alum Rock WY2016 monitoring, Santa Clara County, California.

213017 Alum_WY2016_survey master working.xlsx

Balance Hydrologics, Inc.

Figure 25. **Photo point 11, Site 10, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 11 looking upstream at Site 10 floodplain toward foot bridge. Refer to Figure 2 of this report for photo point locations.

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Figure 26. **Photo point 12, Site 10, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 12 looking upslope at the downstream edge of the Site 10 floodplain. Refer to Figure 2 of this report for photo point locations.

Figure 27. **Photo point 13, Site 10, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 13 looking downstream from foot bridge at Site 10 floodplain. Refer to Figure 2 of this report for photo point locations.

Figure 28. **Photo point 14, Site 10, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 14 looking from upslope across XS 101 at Site 10 floodplain. Refer to Figure 2 of this report for photo point locations.

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Figure 29. **Photo point 15, Site 10, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 15 looking from upslope across XS 102 at Site 10 floodplain. Refer to Figure 2 of this report for photo point locations.

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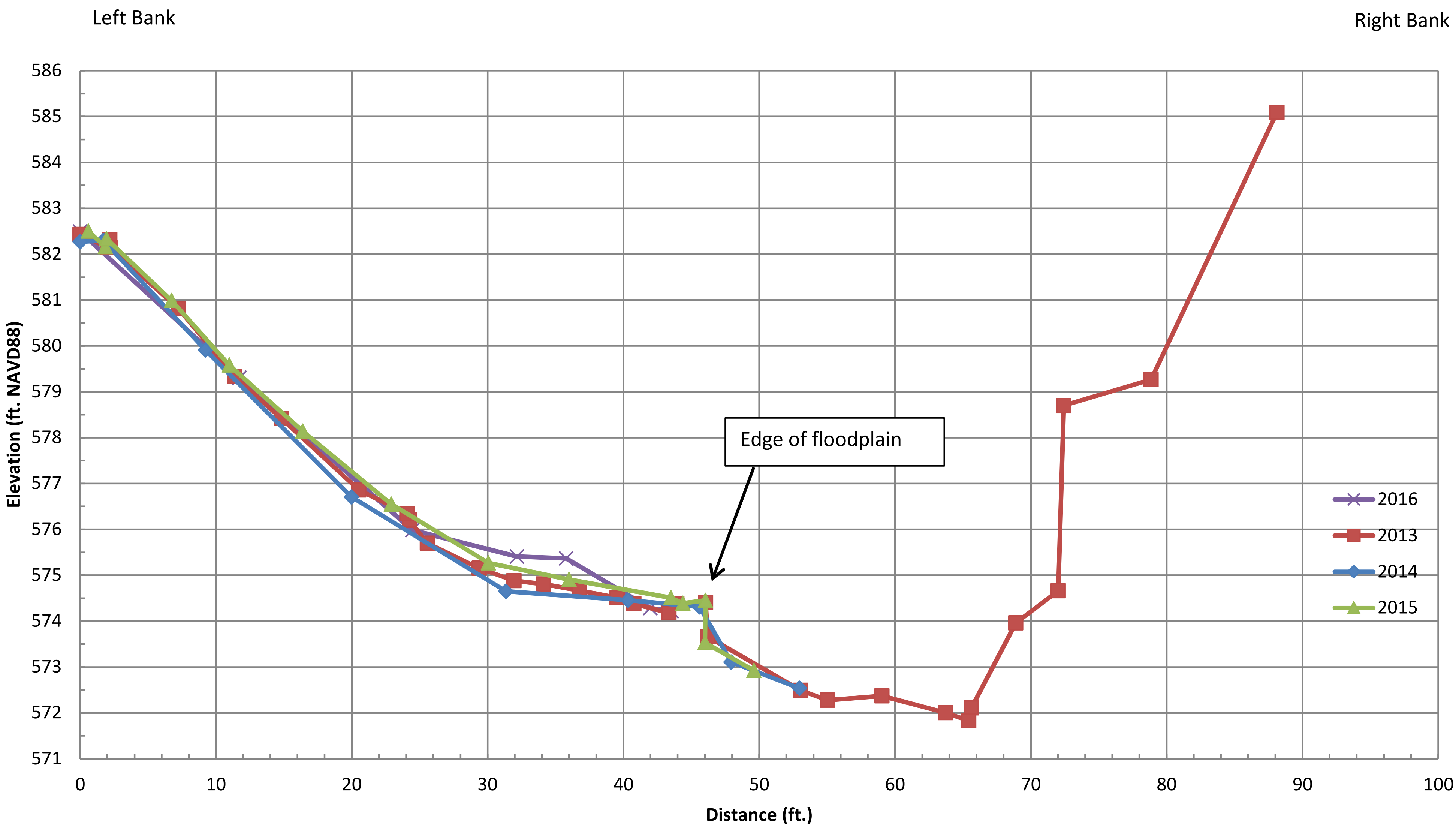
Figure 30. **Photo point 16, Site 10, Years 0-3. Alum Rock Monitoring, Upper Penitencia Creek, Santa Clara County, California .** Photo point 16 looking from upslope to the footbridge at Site 10 floodplain. Refer to Figure 2 of this report for photo point locations.



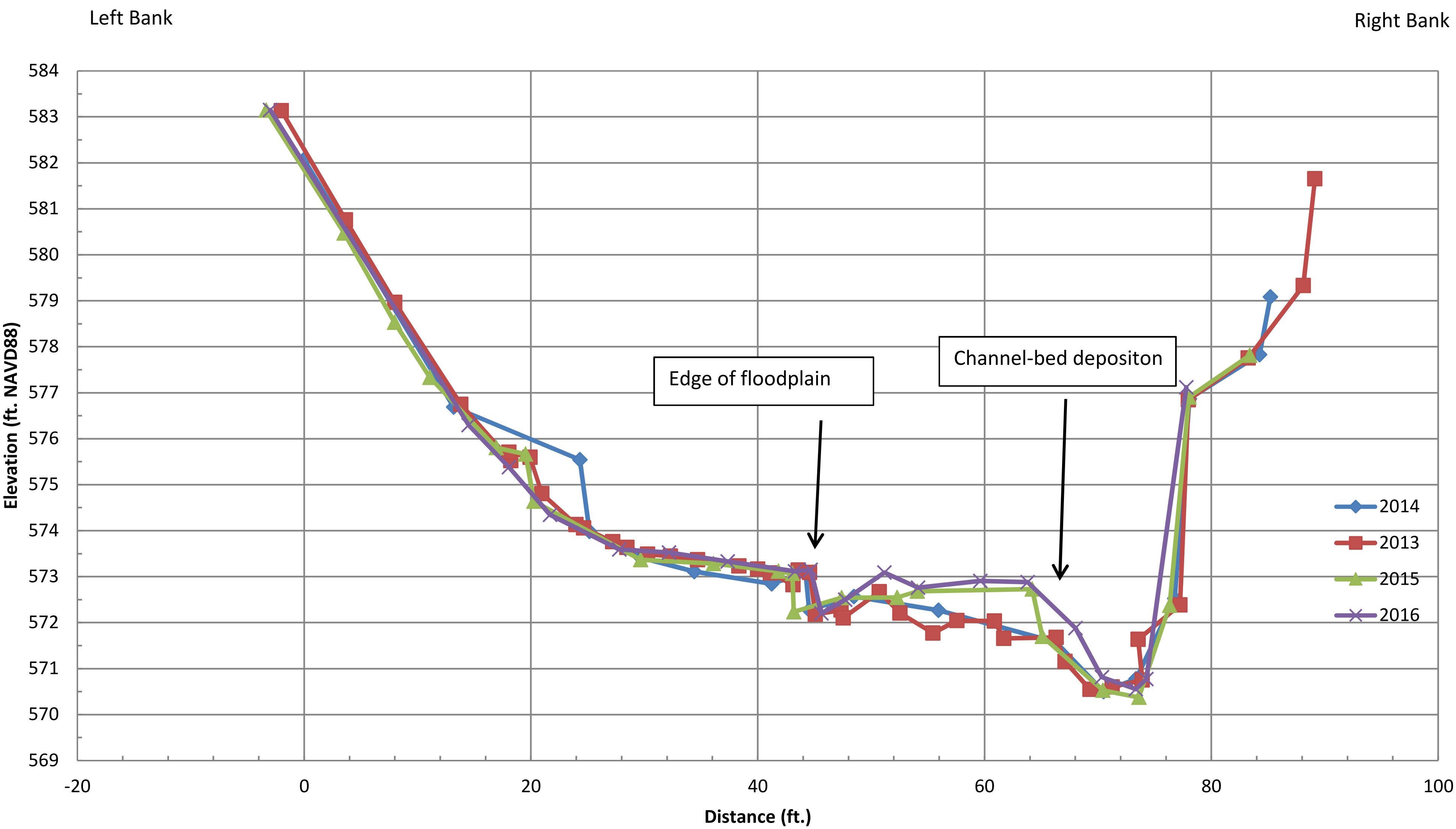
Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Balance Hydrologics, Inc.

Figure 31 . Cross section 101, Alum Rock WY2016 monitoring, Santa Clara County, California.

213017 Alum_WY2016_survey master working.xlsx



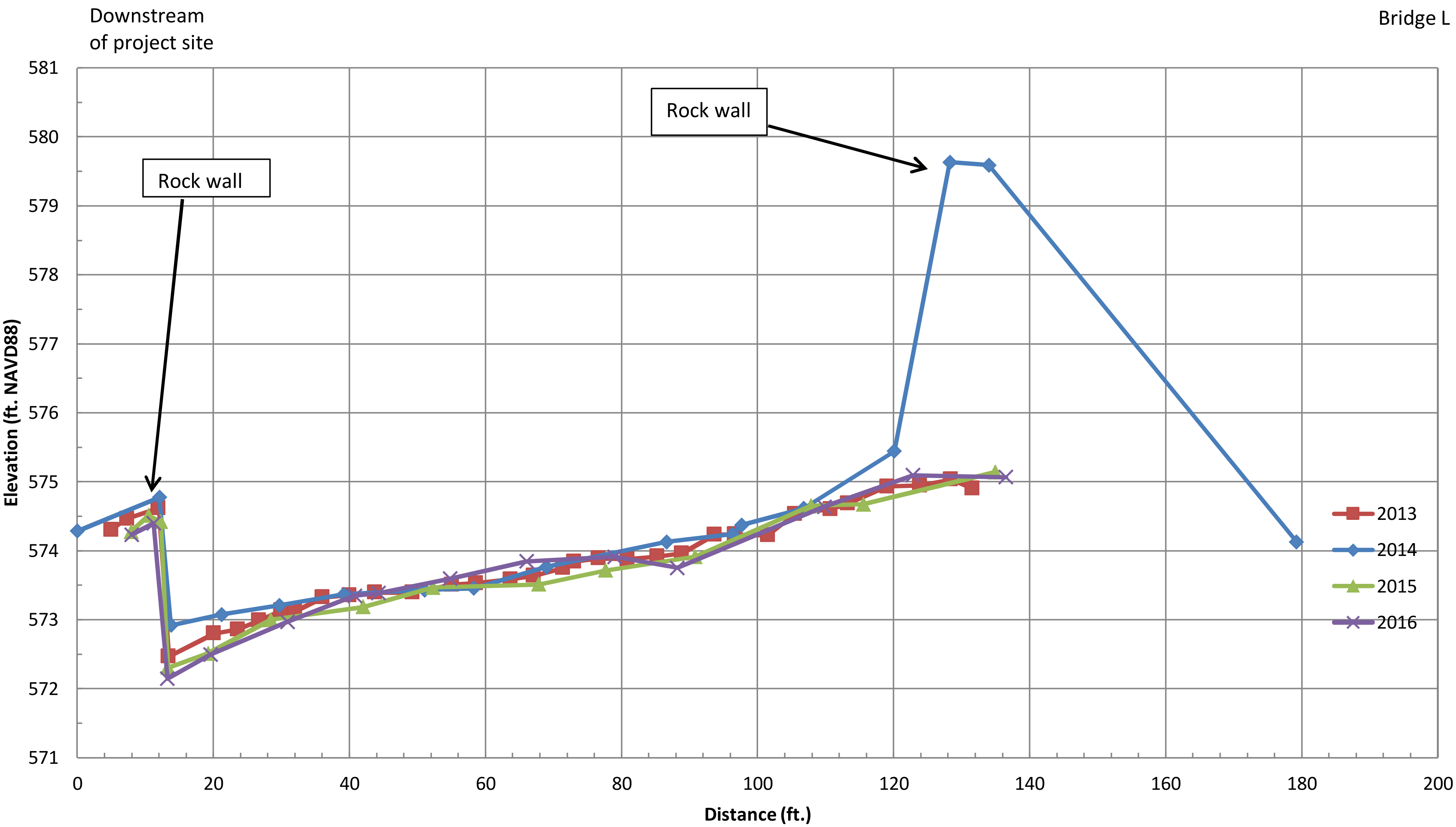
Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Balance Hydrologics, Inc.

Figure 32 . Cross section 102, Alum Rock WY2016 monitoring, Santa Clara County, California.

213017 Alum_WY2016_survey master working.xlsx



Horizontal and vertical scales do not match.

Source: Balance Hydrologics survey

Balance Hydrologics, Inc.

213017 Alum_WY2016_survey master working.xlsx

Figure 33. Site 10 (Floodplain) elevational profile, Alum Rock WY2016 monitoring, Santa Clara County, California. Note that due to thick planted vegetation, line-of-sight is difficult. In order prevent damage to plantings, long profile may vary slightly year to year.

Appendix D

Alum Rock Park Fish Passage Improvement Project: Year 4 Fisheries Monitoring

H. T. HARVEY & ASSOCIATES
Ecological Consultants

Alum Rock Park Fish Passage Improvement Project:

Year 4 Fisheries Monitoring

Project #3518-02

Prepared for:

Santa Clara Valley Transportation Authority
3331 N. First Street, Bldg. B-2
San Jose, CA 95134

Prepared by:

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March 2017

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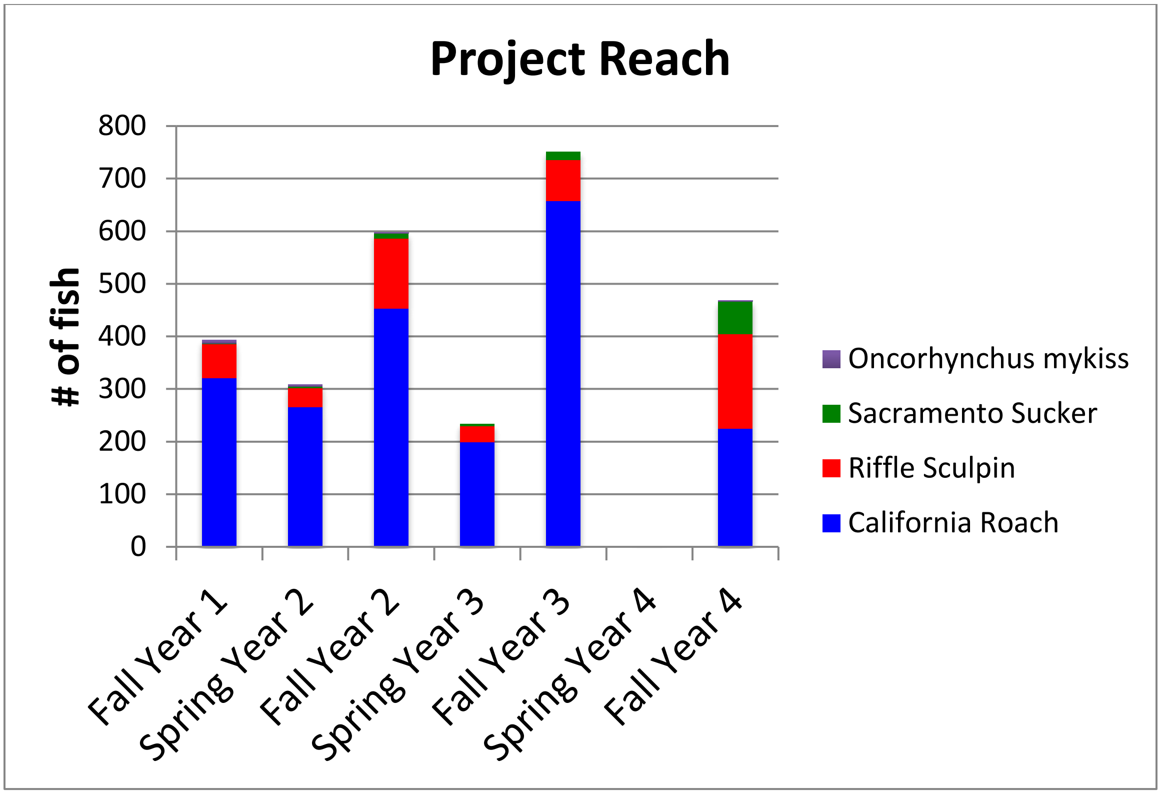
Executive Summary

The Alum Rock Fish Passage Improvement Project (Project) was implemented by the Santa Clara Valley Transportation Authority (VTA) to improve fish passage in Upper Penitencia Creek, a tributary to Coyote Creek in San Jose, Santa Clara County, California. Upper Penitencia Creek is designated as critical habitat for Central California Coast steelhead (*Oncorhynchus mykiss*), a distinct population segment listed as threatened under the Federal Endangered Species Act. In 2012, fish passage was improved by modifying a concrete weir and constructing a roughened channel. On behalf of VTA, H. T. Harvey & Associates (H. T. Harvey) developed and implemented a fisheries monitoring plan to meet the requirements of the biological opinion prepared by the National Marine Fisheries Service for the Project. Plan goals were to (1) document the fish species occupying the Project reach and (2) document habitat associations in the Project and reference reaches upstream from the Project. Year 1 monitoring (fall only) was completed in 2013. Monitoring will continue, as described in the plan (spring and fall), through Year 5 (2017).

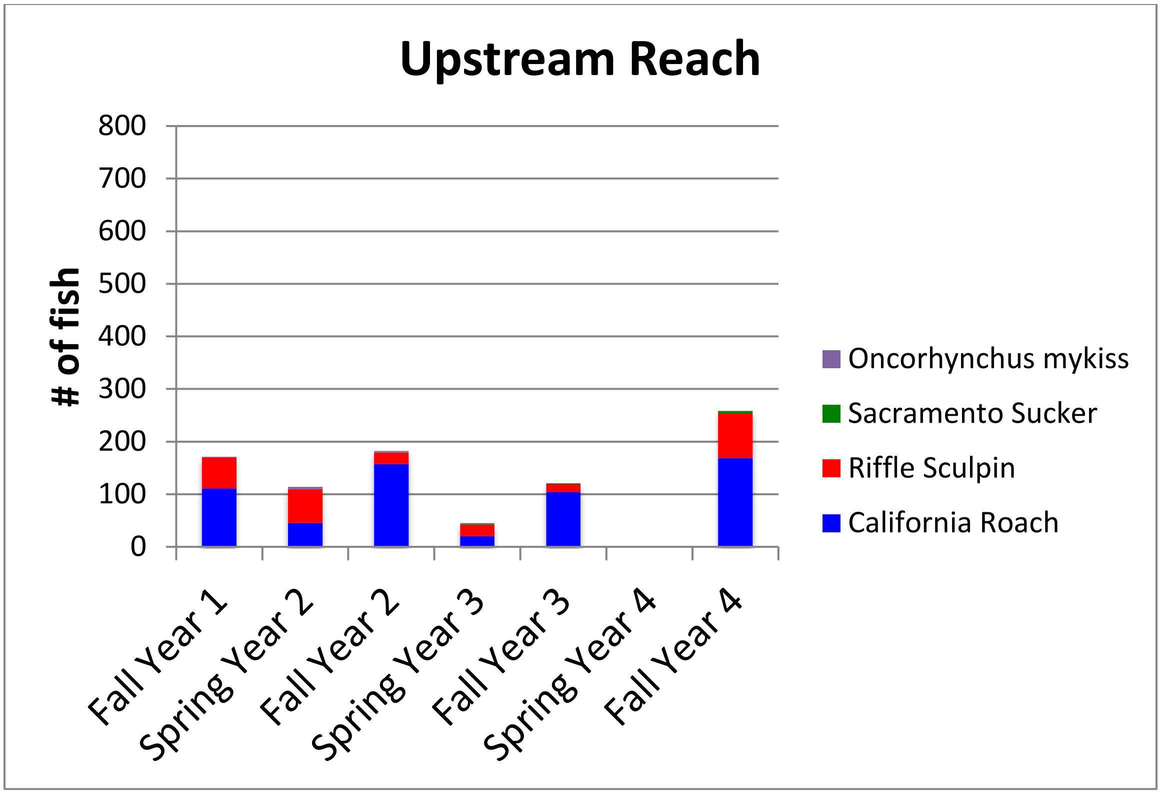
In Year 4, H. T. Harvey fish ecologists documented habitat types and characteristics in the Project reach and the upstream reference reaches (Upstream reach) and electrofished all habitat units in Fall 2016; no sampling was conducted in the Spring (fish numbers indicated as "NA" in the tables below) to avoid stressing fish already impacted by prolonged drought conditions. The fish community documented during Year 4 was dominated by three native species: California roach (*Hesperoleucus symetricus*), riffle sculpin (*Cottus gulosus*), and Sacramento sucker (*Catostomus occidentalis*). Two golden shiners (*Notemigonus crysoleucas*) were recorded in the Upstream reach this year for the first time from this monitoring project, and evidence of *O. mykiss* presence was found (see the following figures, which present totals for 2013–2016 for the Project and Upstream reaches). The same dominant species were documented in Years 1-3. Special attention was given to the occurrence of steelhead because of its listing status, but no *O. mykiss* was captured during Year 4 although a single individual was observed during monitoring efforts (see the figure showing Project reach totals, below).



Native Fishes of the Project Reach

	Fall - Year 1	Spring - Year 2	Fall - Year 2	Spring - Year 3	Fall - Year 3	Spring - Year 4	Fall - Year 4
California Roach	321	265	453	199	657	NA	225
Riffle Sculpin	65	37	133	31	78	NA	180
Sacramento Sucker	1	3	10	4	16	NA	62
Oncorhynchus mykiss	6	4	2	0	0	NA	1*

* Observed but not captured.



Native Fishes of the Upstream Reach

	Fall - Year 1	Spring - Year 2	Fall - Year 2	Spring - Year 3	Fall - Year 3	Spring - Year 4	Fall - Year 4
California Roach	111	45	157	20	104	NA	188
Riffle Sculpin	59	65	22	22	15	NA	54
Sacramento Sucker	0	0	0	2	2	NA	4
Oncorhynchus mykiss	1	4	3	1	0	NA	0

Despite a near-normal water year following several years of drought, opportunities for adult and juvenile *O. mykiss* migration through Upper Penitencia Creek were limited. As a result, successful spawning by steelhead was possible, but no evidence in support of this was observed. Similarly, juvenile outmigration was possible although peak flows were earlier than optimal and no evidence for or against juvenile migration was available. One *O. mykiss* was observed in the Project reach during the fall survey; no spring electro-fishing surveys were permitted. Although only a single *O. mykiss* was sighted during Year 4, the number of Riffle sculpin Sacramento suckers captured in the Project reach and the high number of California roach and sculpin captured in both reaches suggest that the fish passage improvements do provide passage and rearing habitat for native fish, likely including *O. mykiss*, and that Project goals regarding these improvements continue to be met.

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List of Preparers

Sharon Kramer, Ph.D., Principal Fish Ecologist
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Pete Nelson, Ph.D., Senior Fish Ecologist, Project Manager
Ken Lindke, M.S., Fish Ecologist

Section 1.0 Introduction

1.1 Project Purpose

The Alum Rock Park Fish Passage Improvement Project (Project) was implemented by the Santa Clara Valley Transportation Authority (VTA) to improve fish passage for native resident and anadromous fishes in Upper Penitencia Creek, a tributary to Coyote Creek. Upper Penitencia Creek provides some of the most important spawning and rearing habitat in the Coyote Creek watershed for the federally threatened Central California Coast steelhead (CCC steelhead) (*Oncorhynchus mykiss*) distinct population segment (Leidy et al. 2005). Upper Penitencia Creek is also designated as critical habitat for CCC steelhead (NMFS 2005). This report describes fish survey results from Year 4 post-construction monitoring surveys and briefly summarizes monitoring results from Years 1-3. It is the fourth of five reports required as part of the Project's long-term post-construction monitoring.

1.2 Background

Fish passage in the Project reach was improved by modifying a 4.5-foot-high concrete weir. The crest of the weir was lowered to the level of the normal pool surface and a 225-foot-long roughened channel was constructed to improve passage for *O. mykiss* and other native fishes (Figures 1 and 2). Post-construction monitoring is required to "assess the biological performance of the fish passage improvement Project and evaluate the ability of the site to pass steelhead" (NMFS 2012). To meet this goal, a 5-year fisheries monitoring plan was developed by H. T. Harvey & Associates (H. T. Harvey), approved by the National Marine Fisheries Service (NMFS), and implemented beginning in September 2013 (H.T. Harvey 2013a, 2014). The plan involves conducting electrofishing surveys and habitat typing to document the fish species and habitat associations in the Project reach. During monitoring, fish ecologists document all the fish species encountered while focusing on CCC steelhead. Both CCC steelhead and resident rainbow trout have been documented in Upper Penitencia Creek, including upstream of the Project reach (Leidy et al. 2005, Leicester 2011, Leicester and Smith 2012, Leicester and Smith 2013a, Leicester and Smith 2013b, Leicester and Smith 2014, Leicester and Smith 2015, HTH 2013b). Because *O. mykiss* may adopt anadromous or resident life history strategies, all anadromous steelhead and resident rainbow trout observed during surveys are referred to as *O. mykiss* in this report. Other Project monitoring components performed by other firms and not summarized in this report include vegetation monitoring and streambed hydrological monitoring, all of which, when combined, will improve understanding of the evolving habitat conditions and species use in the restored channel.

Figure 1. Concrete Weir before Modification, August 8, 2012 (Looking Upstream)

Figure 2. Modified Concrete Weir, November 9, 2016 (Looking Downstream)

Section 2.0 Methods

2.1 Survey Reach Identification

H. T. Harvey fish ecologists identified survey reaches in coordination with California Department of Fish and Wildlife (CDFW) regional biologists to avoid duplicating reaches electrofished during annual CDFW surveys. Survey reaches contain individual habitat units concentrated in two areas: the Project reach and a reference reach referred to as the Upstream reach. Habitat units were defined primarily by hydrological and geological features, such as pools, riffles, boulders, and bedrock that characterize the physical environment for fishes and are separable by abrupt changes in depth, flow, or slope. Habitat units were categorized using the Level III (identifies riffle and pool types, e.g., “low gradient riffle”) and Level IV (includes subcategories based on cause of formation, e.g., “scour pool—boulder formed”) habitat types described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2010). Level IV habitat types are the most descriptive in the classification hierarchy. Each habitat description reflects the cause of formation, channel gradient velocity, depth, and particle size in each unit (evaluated for this monitoring qualitatively). For the purpose of describing apparent trends in fish habitat association in this report, such as when describing whether fish(es) were found in functionally equivalent units such as main channel pools versus scour pools, Level III habitat types were used.

The Project reach is approximately 500 feet long and contains all habitat units in the installed roughened channel and additional contiguous habitat units immediately upstream of the limits of construction (37.396881, -121.798217 to 37.396789, -121.799943) (Figure 3). During the spring of Year 4, H. T. Harvey fish ecologists took environmental data (water temperature and conductivity) and conducted a qualitative habitat assessment (i.e., based on visual observations only) in the Project and Upstream reaches, but, per instructions from NMFS, did no electroshocking to sample fishes. During the fall of Year 4, H. T. Harvey quantitatively surveyed 10 contiguous habitat units in the Project reach (combined length = 476.4 feet) and seven contiguous habitat units in the Upstream reach (combined length = 212 feet). All habitat units were categorized by habitat type, measured, and electrofished. Fewer habitat units were distinguished and sampled in Year 4 than in previous monitoring efforts for two reasons: (1) Flood events during the previous winter had removed some of the smaller rock or boulder dams that broke these reaches into smaller units, and (2) flow rates were moderately higher than they had been in years past during monitoring efforts, contributing to the effect of combining previously distinct habitat units (note average depth and area, Appendix A, Table A-4). The units in the Upstream reach were located between the Alum Rock Falls Road bridge in Alum Rock Park (37.396944, -121.798121) and the Sycamore Grove picnic area in Alum Rock Park (37.400026, -121.796802) (Figure 3).

The number, type, and combined length of the habitat units may vary from year to year, depending on ambient flow conditions, and prior changes to the stream channel. Changes in the number and type of habitat units surveyed in different years are attributable primarily to natural fluvial processes and the ambient flow. To minimize variability in descriptions of the habitat units, the same H. T. Harvey fish ecologist was tasked with describing the units in both reaches.

N:\Projects3500\3518-01\02\Reports\November 2015\Fig 3 Survey Reach Map_Revision.mxd

H. T. HARVEY & ASSOCIATES
Ecological Consultants

Figure 3: Survey Reach Map
Alum Rock Park Fish Passage Improvement Project
November 2016

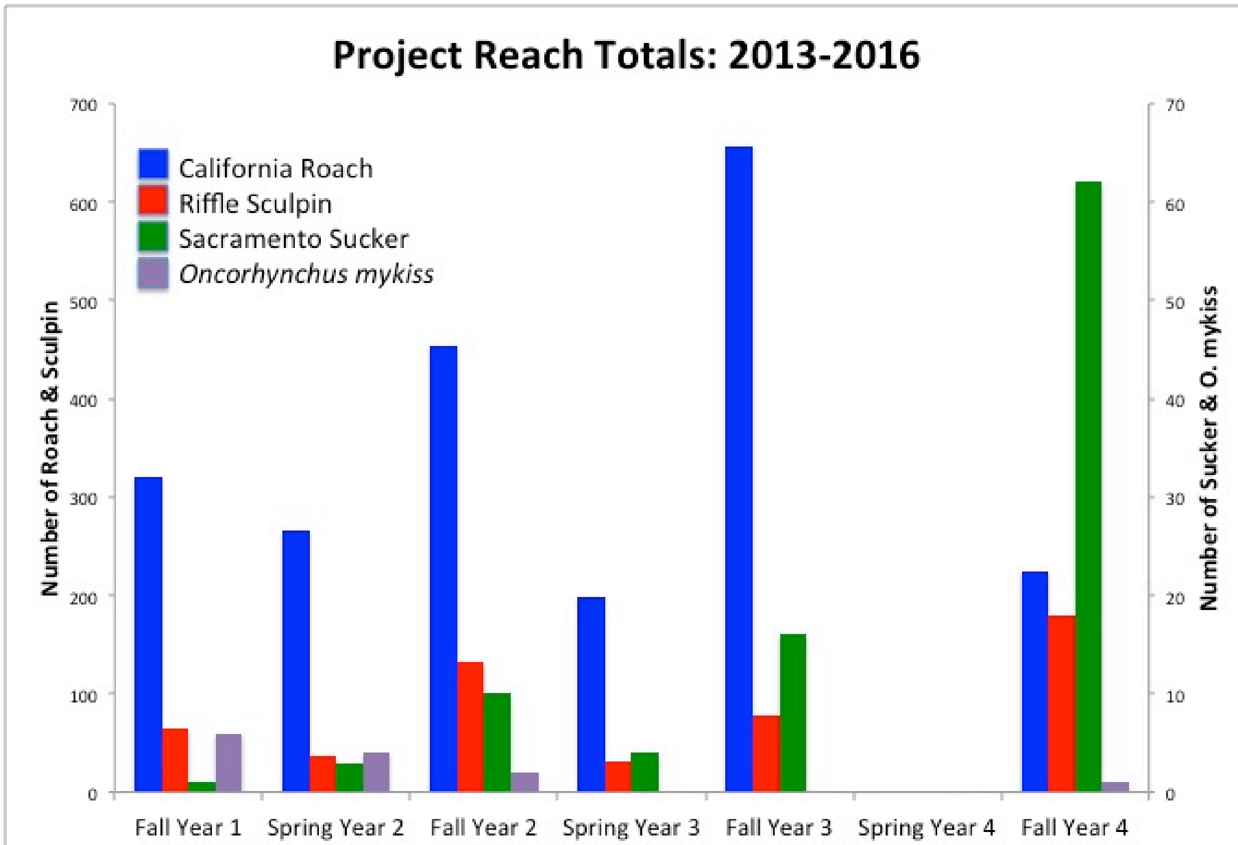
2.2 Electrofishing

Each unit was electrofished using a single-pass approach (Flosi et al. 2010) to document fish-habitat associations. No spring Year 4 electrofishing surveys were conducted; fall electrofishing surveys were conducted on October 24, 2016. H. T. Harvey fish ecologists conducted the electrofishing surveys using a Smith-Root LR-24 backpack electrofishing unit, following NMFS (2000) guidelines. Ambient conductivity and temperature were measured to generate power correction factors to serve as starting points for determining safe and effective electrofishing settings (Appendix A, Table A-1). H. T. Harvey fish ecologists also followed CDFW techniques (Leicester pers. comm. 2012) developed specifically for electrofishing in the high-conductivity waters found in portions of Upper Penitencia Creek. Final electrofishing unit settings were determined by observing the threshold response behavior of target species. Standard operating procedure for electrofishing suspended surveys when measured water temperatures reached or exceeded 18 °C (Appendix A, Table A-1).

Before electrofishing, H. T. Harvey fish ecologists isolated target units from other units by using block seines or natural features, such as falls or dams, or by using a combination of both. Fish captured during electrofishing were placed in a plastic bucket containing cool, clean, shaded, aerated stream water. The first 20 fish of each species captured were identified, weighed, and measured (total length [TL] to the nearest millimeter (mm); weight to the nearest 0.1 grams), and returned to the unit from which they were captured. The remaining fish were identified, tallied, and released to the unit from which they were captured. Standard operating procedure for captured *O. mykiss* included an examination for features associated with smoltification (e.g., silver color, faded parr marks), which would indicate that the fish were preparing to emigrate and that they were the anadromous, rather than resident, form of *O. mykiss*.

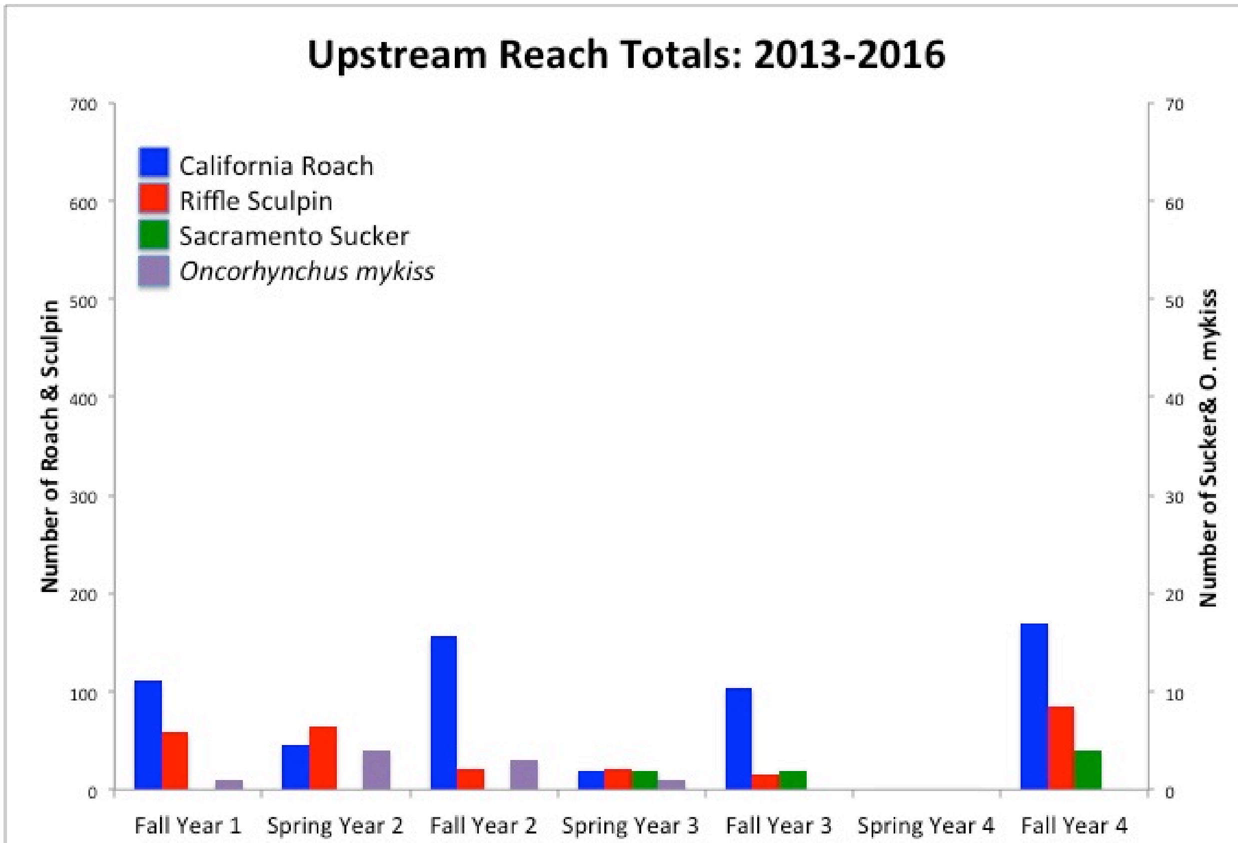
Section 3.0 Electrofishing Survey Results

The fish community documented during Year 4 surveys was composed of four native species: California roach (*Hesperoleucus symetricus*), riffle sculpin (*Cottus gulosus*), Sacramento sucker (*Catostomus occidentalis*), and *O. mykiss*; one introduced species, golden shiner, (*Notemigonus crysoleucas*), was also present. In total, 715 fishes were captured during fall (Figure 4 and 5). California roach were the most abundant (n=413), followed by riffle sculpin (n=234). These species were found in both the Project and the Upstream reaches in nearly all the habitat types surveyed (Table 1, Appendix A [Tables A-2, A-3]). Sacramento suckers were scarce (n=4) in the Upstream reach, but markedly abundant in the Project reach (n=62), more than three times as abundant as in Fall 2015 (Year 3). Two golden shiners were captured, the first occurrence of this species during these monitoring efforts. One *O. mykiss* was observed in the Project reach but not captured; no *O. mykiss* were observed in the Upstream reach this year.



	Fall Year 1	Spring Year 2	Fall Year 2	Spring Year 3	Fall Year 3	Spring Year 4	Fall Year 4
California Roach	321	265	453	199	657	NA	225
Riffle Sculpin	65	37	133	31	78	NA	180
Sacramento Sucker	1	3	10	4	16	NA	62
Oncorhynchus mykiss	6	4	2	0	0	NA	1
totals	393	309	598	234	751	NA	468

Figure 4. Project Reach Fish Totals: 2013–2016



Upstream Reach Totals	Fall Year 1	Spring Year 2	Fall Year 2	Spring Year 3	Fall Year 3	Spring Year 4	Fall Year 4
California Roach	111	45	157	20	104	NA	169
Riffle Sculpin	59	65	22	22	15	NA	85
Sacramento Sucker	0	0	0	2	2	NA	4
Oncorhynchus mykiss	1	4	3	1	0	NA	0
totals	171	114	182	45	121	NA	258

Figure 5. Upstream Reach Totals: 2013–2016

The dominant species captured in Year 4 were the same as those captured in Years 1-3. During the first 4 years of monitoring in the Project reach, all four species were captured most often in pool habitat types (Figures 6–9), the most common habitat types identified in the Project reach (Table 1, Appendix A [Table A-2]). Nearly all fishes in the Upstream reach were captured in pool habitat types, but, in the Upstream reach, our electrofishing deliberately targeted pool habitat most likely to contain *O. mykiss*.

Table 1. **Species Distribution in the Project Reach and the Upstream Reach—Year 4**

Unit	Habitat Type (Level IV)	California Roach	Riffle Sculpin	Sacramento Sucker	*Oncorhynchus mykiss*
1	Lateral Scour Pool—bedrock formed	37	68	37	0
2	Lateral Scour Pool—boulder formed	15	15	1	0
3	Lateral Scour Pool—boulder formed	10	9	6	0
4	Lateral Scour Pool—boulder formed	10	10	3	0
5	Lateral Scour Pool—boulder formed	10	5	3	0
6	Lateral Scour Pool—boulder formed	10	10	3	1
7	Lateral Scour Pool—boulder formed	28	14	1	0
8	Lateral Scour Pool—boulder formed	46	8	5	0
9	Lateral Scour Pool—boulder formed	32	8	3	0
10	Lateral Scour Pool—boulder formed	27	33	0	0
	Project Reach subtotals	225	180	62	1
11	Lateral Scour Pool—bedrock formed	66	7	4	0
12	Trench Pool	51	5	0	0
13	Trench Pool	9	0	0	0
14	Trench Pool	14	2	0	0
15	Pocket Water	2	10	0	0
16	Glide	38	8	0	0
17	Glide	8	22	0	0
	Upstream Reach subtotals	188	54	4	0
	Grand totals	**413**	**234**	**66**	**1**

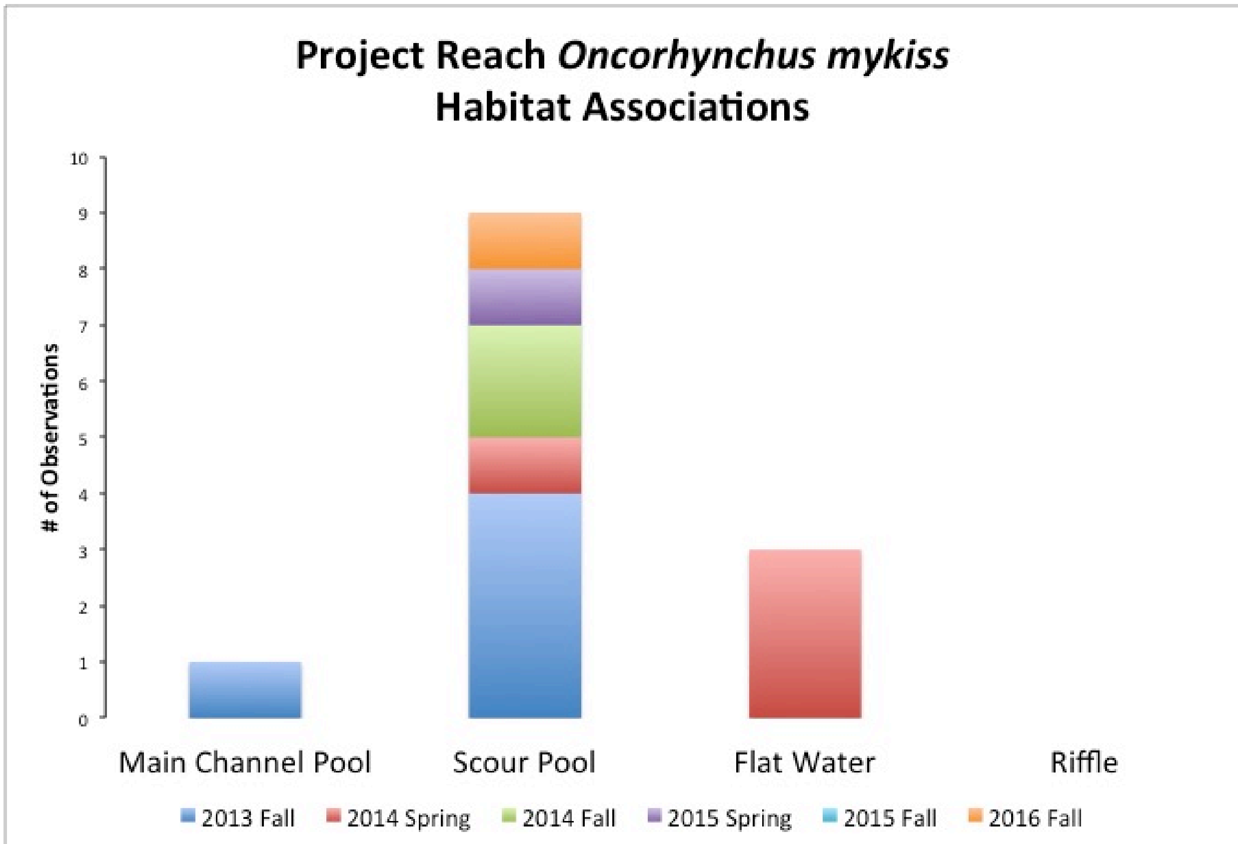


Figure 6. Habitat Associations of *O. mykiss* in the Project Reach, 2013–2016 (No 2013 or 2016 Spring Surveys)

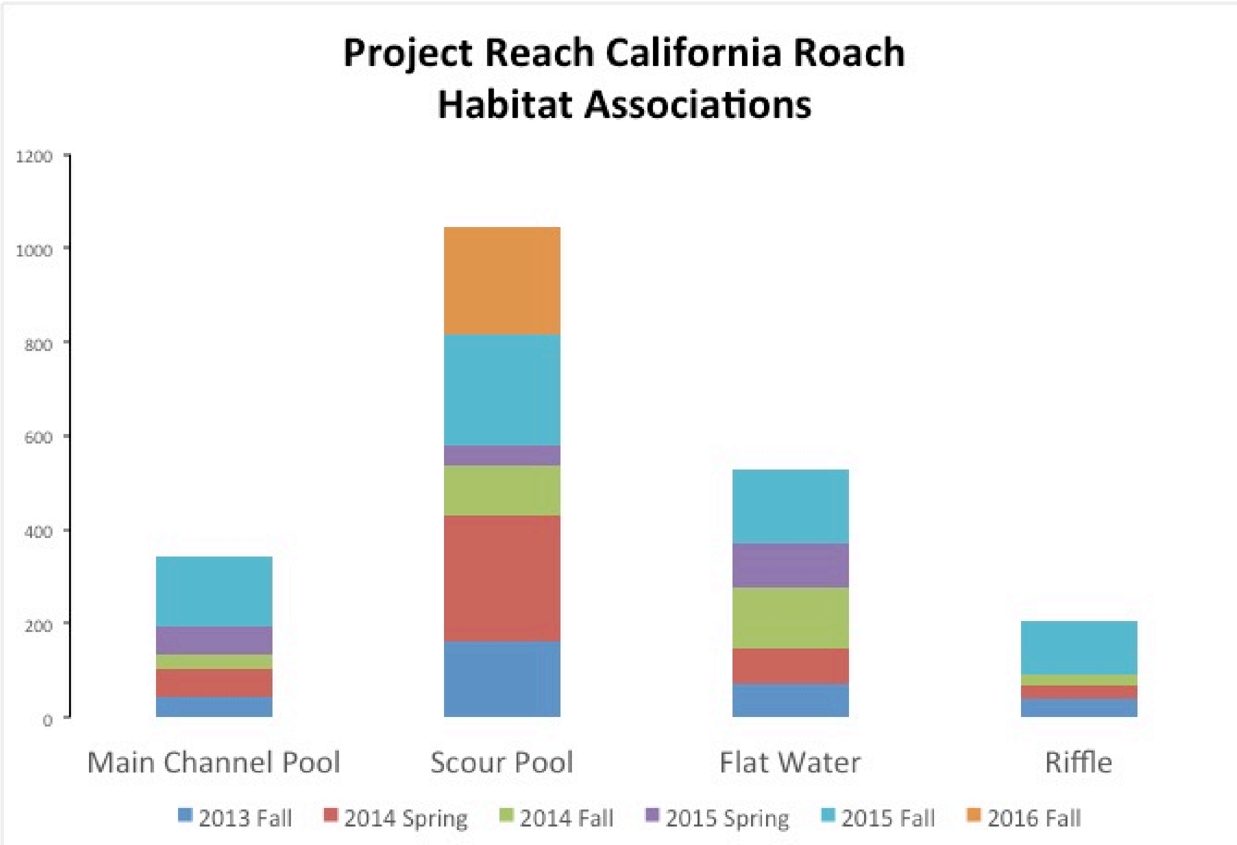


Figure 7. Habitat Associations of California Roach in the Project Reach, 2013–2016 (No 2013 or 2016 Spring Surveys)

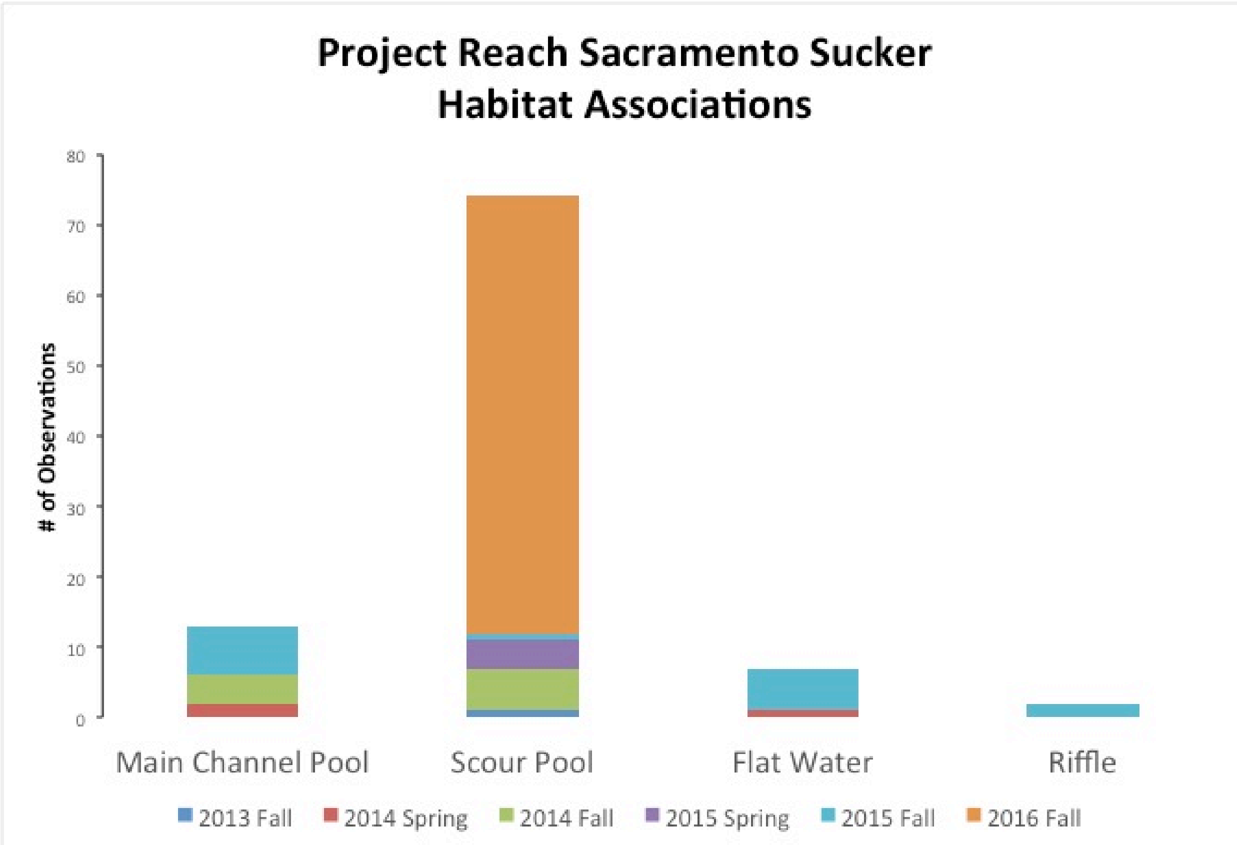


Figure 8. **Habitat Associations of Sacramento Suckers in the Project Reach, 2013–2016 (No 2013 or 2016 Spring Surveys)**

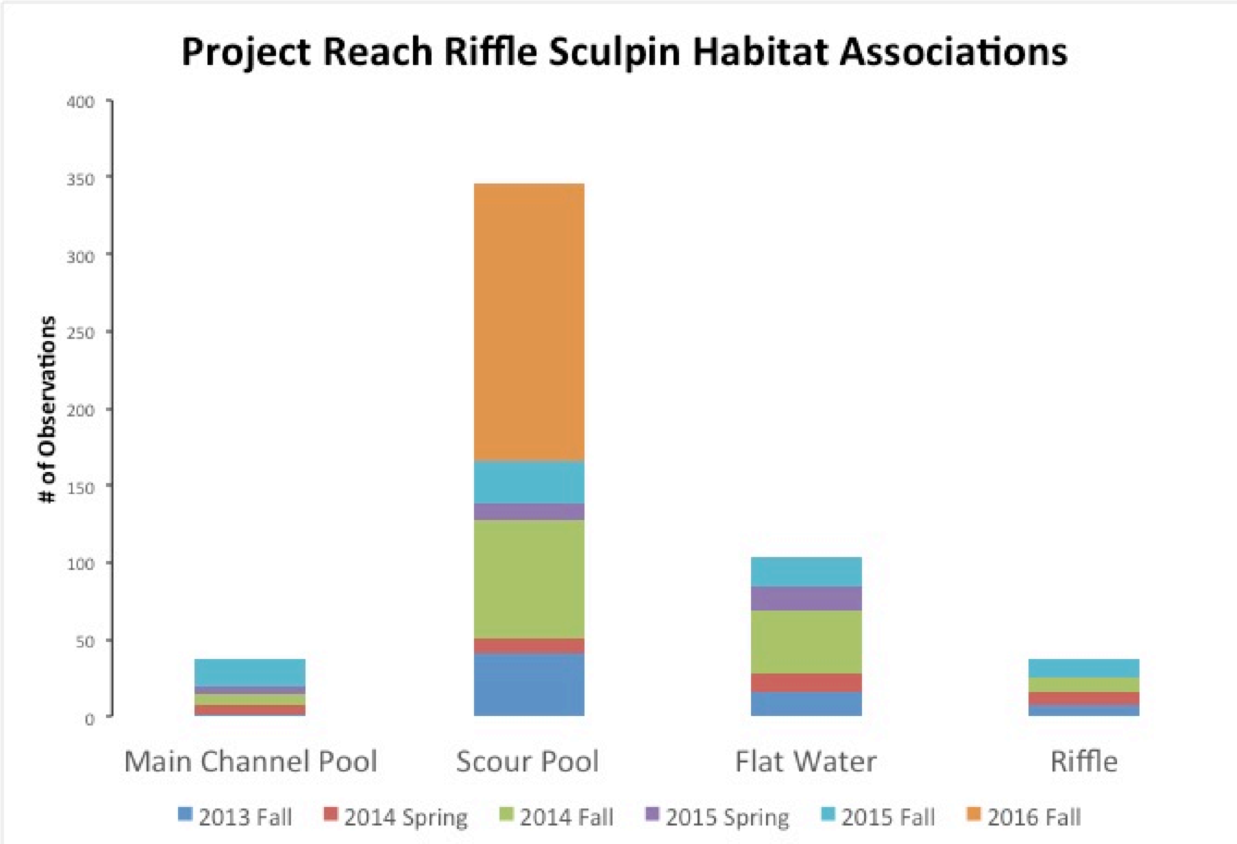


Figure 9. Habitat Associations of Riffle Sculpin in the Project Reach, 2013–2016 (No 2013 or 2016 Spring Surveys)

As in previous years following fish passage improvement work, *O. mykiss* were scarce (see Discussion [section 4.0]). No electrofishing was conducted during spring (2016) because of low-flow conditions and concerns that the additional stress introduced by sampling in this manner would be excessive. One *O. mykiss* was observed but not captured during the fall survey (Project reach, Unit 6, lateral scour, boulder-formed pool). The Project and Upstream reaches consisted primarily of small pool habitat units (Table 1, Appendix A [Table A-4]) with some flatwater and riffle habitat units.

In the Year 4 fall surveys, no *O. mykiss* were captured using electrofishing (i.e., 0.0 *O. mykiss* per 100 feet of surveyed habitat in both the Project reach and the Upstream reach) (Table 2). Because the *O. mykiss* observed during the surveys was not captured, this fish was not used in calculating fish density.

Table 2. Density of *O. mykiss* in Upper Penitencia Creek

Location	Survey Year	Survey Date	Length of Survey Reach (feet)	*O. mykiss* Density (number of fish per 100 linear feet)	Surveyor
ARFPIP—Project reach	2016	October 24	476	present*	HTH
ARFPIP— Upstream reach	2016	October 24	212	0.0	HTH
1st bridge, Alum Rock Park	2016	October 4	190	0.0	CDFW
Eagle Rock Picnic Area, Alum Rock Park	2016	October 4	211	0.0	CDFW
Upstream of YSI weir, Alum Rock Park	2016	October 4	259	0.0	CDFW
Upstream of stone bridge, upstream of springs [upstream from 'Upstream reach']	2016	0ctober 4	70	4.2	CDFW
Near confluence with Arroyo Aguague	2016	October 4	209	16.3	CDFW
ARFPIP—Project reach	2015	November 15 and 16	420	0.0	HTH
ARFPIP—Upstream reach	2015	November 15 and 16	250	0.0	HTH
ARFPIP—Project reach	2015	May 13	470	0.0	HTH
ARFPIP— Upstream reach	2015	May 13	230	0.4	HTH
Upstream of King Road	2015	NA	NA	Dry	CDFW
Above and Below Mabury Road	2015	NA	NA	Dry	CDFW
Downstream of Hwy 680	2015	NA	NA	Dry	CDFW
Downstream of Wildlife Center	2015	NA	NA	Dry	CDFW
Downstream of Upper Percolation Ponds	2015	NA	NA	Dry	CDFW
Dorel Drive	2015	NA	NA	Dry	CDFW
1st Bridge in Alum Rock Park	2015	14 November	190	0.0	CDFW
Eagle Rock Picnic Area	2015	14 November	211	0.0	CDFW
Visitor Center in Alum Rock Park	2015	12 November	NA	Present: Observed from bank	CDFW
Upstream of YSI Weir in Alum Rock Park	2015	14 November	259	0.0	CDFW
Trail Halfway from Upper Vehicle Bridge to the Arroyo Grande Confluence	2015	NA	NA	Dry	CDFW
ARFPIP—Project reach	2014	November 4	440	0.5	HTH
ARFPIP— Upstream reach	2014	November 5	310	1.0	HTH
ARFPIP—Project reach	2014	May 1	450	0.9	HTH
ARFPIP— Upstream reach	2014	May 1	320	1.25	HTH
Upstream of King Road	2014	NA	NA	Dry	CDFW
Above and Below Mabury Road	2014	NA	NA	Dry	CDFW
Downstream of Hwy 680	2014	NA	NA	Dry	CDFW

Location	Survey Year	Survey Date	Length of Survey Reach (feet)	*O. mykiss* Density (number of fish per 100 linear feet)	Surveyor
Downstream of Wildlife Center	2014	NA	NA	Dry	CDFW
Downstream of Upper Percolation Ponds	2014	NA	NA	Dry	CDFW
Dorel Drive	2014	NA	NA	Dry	CDFW
1st Bridge in Alum Rock Park	2014	28 September	190	0.0	CDFW
Eagle Rock Picnic Area	2014	28 September	211	0.0	CDFW
Visitor Center in Alum Rock Park	2014	28 September	190	0.0	CDFW
Upstream of YSI Weir in Alum Rock Park	2014	28 September	259	0.4	CDFW
Trail Halfway from Upper Vehicle Bridge to the Arroyo Grande Confluence	2014	NA	NA	Dry	CDFW
ARFPIP—Project reach	2013	September 16	384	1.6	HTH
ARFPIP— Upstream reach	2013	September 17	185	0.5	HTH
Upper Penitencia Creek Floodplain Restoration Project	2013	September 18	484	1.0	HTH
Upstream of King Road	2013	7 October	285	0.4	CDFW
Downstream of Hwy 680	2013	30 August	305	0.0	CDFW
Downstream of Upper Percolation Ponds	2013	30 August	301	0.0	CDFW
1st Bridge in Alum Rock Park	2013	30 August/27 September	218	1.8	CDFW
Eagle Rock Picnic Area	2013	27 September	212	0.9	CDFW
Upstream of YSI Weir in Alum Rock Park	2013	30 August	259	1.2	CDFW
Trail Halfway from Upper Vehicle Bridge to the Arroyo Grande Confluence	2013	27 August	234	10.3	CDFW
Downstream of Hwy 680	2012	16 August	343	1.2	CDFW
Downstream of Wildlife Center	2012	7 October	565	0.5	CDFW
Downstream of Upper Percolation Ponds	2012	16 August	336	0.0	CDFW
Dorel Drive	2012	7 October	55	3.6	CDFW
1st Bridge in Alum Rock Park	2012	5 October	190	2.1	CDFW
Eagle Rock Picnic Area	2012	16 August	188	4.3	CDFW
Visitor Center in Alum Rock Park	2012	5 October	230	3.5	CDFW
Upstream of YSI Weir in Alum Rock Park	2012	5 October	204	4.5	CDFW
Trail Halfway from Upper Vehicle Bridge to the Arroyo Grande Confluence	2012	12 October	348	27.8	CDFW
Trail halfway from upper vehicle bridge to the Arroyo Aguague confluence	2011	December 31	278	13.0	CDFW

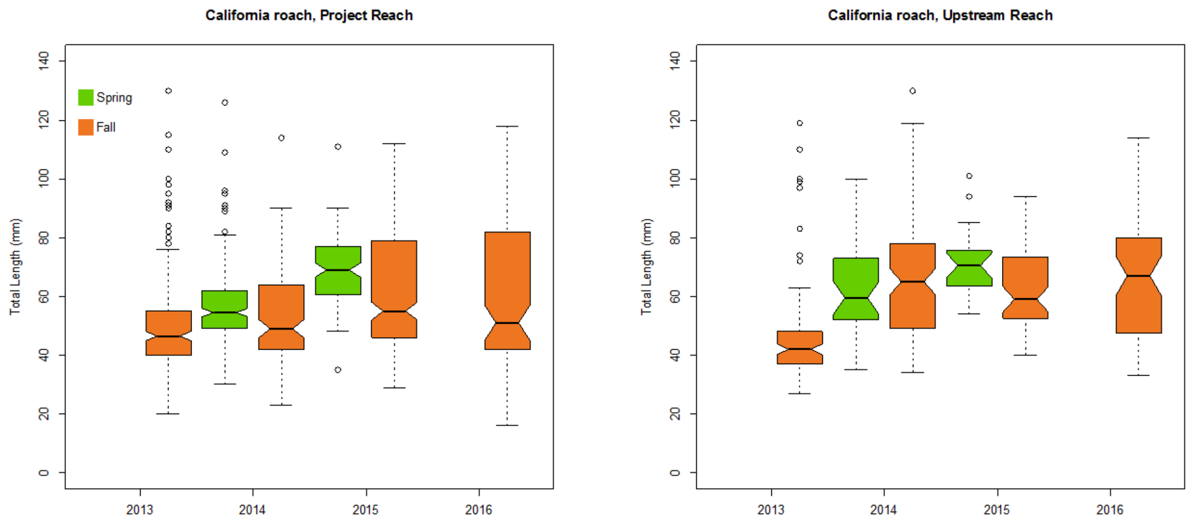
Location	Survey Year	Survey Date	Length of Survey Reach (feet)	*O. mykiss* Density (number of fish per 100 linear feet)	Surveyor
Upstream of YSI weir—Alum Rock Park	2011	August 14	258	0.4	CDFW
Visitor center—Alum Rock Park	2011	October 22	308	2.3	CDFW
Eagle Rock Picnic Area—Alum Rock Park	2011	October 22	208	3.4	CDFW
First bridge in Alum Rock Park	2011	August 14	210	2.9	CDFW
Dorel Drive	2011	September 19	235	0.8	CDFW
Downstream of percolation pond outfall	2011	August 14	358	0.0	CDFW
Downstream of wildlife center	2011	September 19	457	0.0	CDFW
Downstream of Interstate 680	2011	August 14	309	0.0	CDFW
Upstream of YSI bridge—Alum Rock Park	2010	August 31	288	0.7	CDFW
Eagle Rock Picnic Area—Alum Rock Park	2010	October 19	215	7.1	CDFW
Near first bridge in Alum Rock Park	2010	August 31	437	4.1	CDFW
Upstream of percolation ponds at Dorel Road	2010	August 30	120	0.0	CDFW
Downstream of percolation pond outflow	2010	August 31	314	4.1	CDFW
Downstream of percolation pond outflow	2010	October 19	354	1.4	CDFW
Piedmont Road	2010	October 19	315	0.3	CDFW
Upstream of Capitol Avenue; downstream of wildlife center	2010	August 30	338	0.0	CDFW
Downstream of Interstate 680	2010	August 30	298	0.0	CDFW

* Observed, but not captured.

Notes: CDFW = California Department of Fish and Wildlife; HTH = H. T. Harvey & Associates; YSI = Youth Science Institute; ARFPIP = Alum Rock Fish Passage Improvement Project

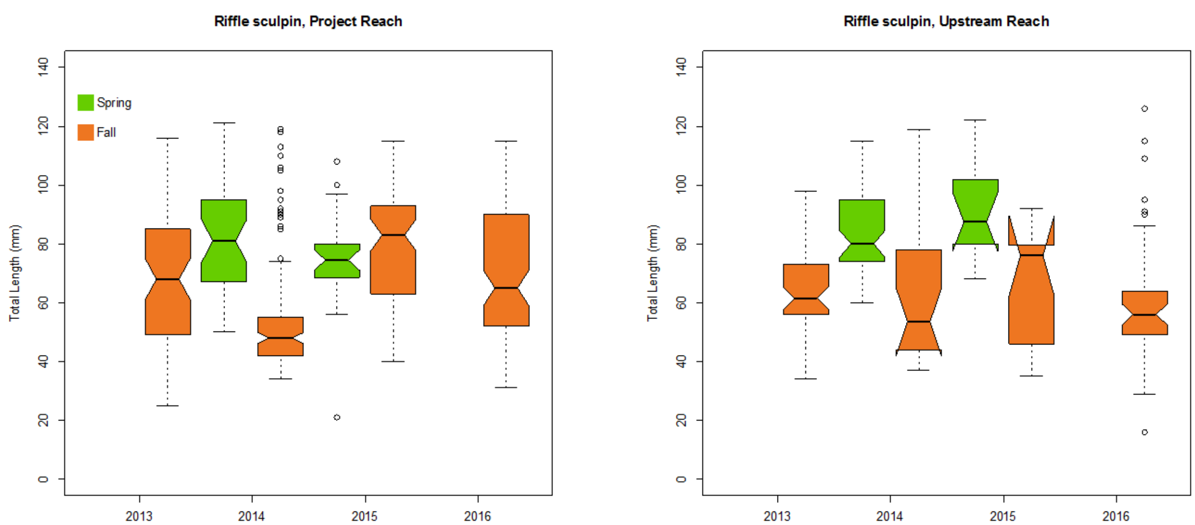
CDFW Data: Leicester 2011, Leicester and Smith 2012, Leicester and Smith 2013a, Leicester and Smith 2013b, Leicester and Smith 2014, Leicester and Smith 2015

Mean lengths for California roach captured in fall 2016 were comparable to fall roach sizes from prior years (Figure 10). Riffle sculpin, too, were similar in size to those from other years (Figure 11). Sixty-six Sacramento suckers were captured during Year 4 sampling efforts; they ranged from 45 mm to 343 mm, with a mean length of 104 mm.



Note: Box and whisker plots of total length for California roach captured by electrofishing in Alum Rock Park from fall 2013 through fall 2016. Horizontal bars indicate median total length, upper and lower ends of boxes indicate 25th and 75th quartiles, whiskers extend to ±1.5 times the interquartile range, and points indicate outliers.

Figure 10. Box Plot of Mean Lengths for California Roach



Note: Box and whisker plots of total length for riffle sculpin captured by electrofishing in Alum Rock Park from fall 2013 through fall 2016. Horizontal bars indicate median total length, upper and lower ends of boxes indicate 25th and 75th quartiles, whiskers extend to ±1.5 times the interquartile range, and points indicate outliers.

Figure 11. Box Plot of Mean Lengths for Riffle Sculpin

Section 4.0 Discussion

The fish species documented in surveyed reaches were comparable to the species documented in surveys from other reaches in Upper Penitencia Creek (Leicester 2011, Leicester and Smith 2012). In the past, eight native fish species have been documented in different reaches of the Upper Penitencia Creek watershed including: *O. mykiss*, Pacific lamprey (*Entosphenus tridentatus*), California roach, hitch (*Hesperoleucus exilicauda*), Sacramento blackfish (*Orthodon microlepidotus*), Sacramento sucker, prickly sculpin (*Cottus asper*), and riffle sculpin (Buchan et al. 1999, as cited in Stillwater Sciences 2006; Santa Clara Valley Water District 2008). However, these species occupy different habitats in the watershed and are not found in all reaches of Upper Penitencia Creek. Pacific lamprey, hitch, prickly sculpin, and Sacramento blackfish were not observed in the survey reaches during 2016 monitoring (see [section 4.2]). Two golden shiners, an introduced species not previously known from Upper Penitencia Creek (Leicester and Smith 2016), were captured this year.

A greater number of fishes were captured in pools compared to other habitat types. However, the abundance of fish captured in midchannel pool habitat and scour pool habitat reflects the abundance of these habitat types rather than habitat preference. In addition, it is easier to capture fish in pools during electrofishing because the water is deeper and there are typically fewer obstructions to netting fish.

4.1 Native Species Detected

4.1.1 California Central Coast Steelhead

In winter 2015–2016, there were at least four streamflow events that probably provided continuous streamflow from Alum Rock Park to Coyote Creek (H. T. Harvey and Balance Hydrologics 2016). However, it is unknown if continuous streamflow occurred at other times during the water year, October 2015–September 2016, or if streamflow events were sufficiently long in duration and volume to provide for steelhead passage upstream. There were no reports of juvenile or spawning adult steelhead in the Coyote Creek watershed in winter 2015–2016, although outmigration of smolts should have been possible (Smith 2016). Surveys conducted before the restoration of the Project reach documented the occurrence of *O. mykiss* upstream of the Project reach (Leicester 2011, Leicester and Smith 2012), but since 2011, the density (i.e., number of fish per 100 feet) of *O. mykiss* in the survey reaches has been low, and Year 4 surveys were no exception (Table 2, also Leicester and Smith 2016). Poor stream connectivity (i.e., low and intermittent flow) during successive years of drought conditions could affect upstream movement of adults and juveniles, and downstream migration of smolts. Leicester (2011) documented poor *O. mykiss* reproductive success in Upper Penitencia Creek between 2009 and 2011, and there was no evidence of steelhead spawning in 2016 (Leicester and Smith 2016). Although we saw only one *O. mykiss* during Year 4 surveys, greater numbers are present in deeper refugia in Alum Rock Park (Leicester and Smith 2016).

The scarcity of *O. mykiss* and steelhead in particular is probably attributable to the continuing effects of multiple low-water years, which limit fish passage and reduce water quality in this watershed (Leicester and Smith 2016, Smith 2016). Although the movement of *O. mykiss* in Upper Penitencia Creek and associated streams was, as a consequence, restricted, the abundance of riffle sculpin in all 4 years of this monitoring effort suggests that in the Project and Upstream reaches in Alum Rock Park, habitat and water quality were good, probably at least adequate for *O. mykiss* (see Moyle 2002). Nonetheless, multiple years of low or no water flow have likely had a severe and deleterious effect on *O. mykiss* in Upper Penitencia Creek (see also Leicester and Smith 2016).

4.1.2 Riffle Sculpin

Riffle sculpin and prickly sculpin occupy similar habitats, and these two sculpin species are difficult to differentiate because their physical characteristics are similar. Riffle sculpin also may hybridize with prickly sculpin, further complicating positive identification, especially in small individuals (Moyle 2002). CDFW reports that riffle sculpin occur in Alum Rock Park (i.e., Project and Upstream reaches) and that prickly sculpin occur in low-elevation reaches downstream of the park (Leicester pers. comm. 2014). We found no clear indication that both species of sculpin were captured during Year 4 surveys and have assumed, based on CDFW reports from previous years, that all sculpin captured were riffle sculpin. Riffle sculpin were abundant this year (Figures 4, 5, and 9, Table 1). The riffle sculpin size distribution may be skewed toward smaller individuals because larger riffle sculpin often were not observed exhibiting electrotaxis (fish swimming induced by an electric current) and when shocked they remained on the channel bottom, where they were more difficult to capture. Nonetheless, the presence of riffle sculpin in survey reaches indicates relatively healthy habitat conditions for steelhead because riffle sculpin require cold, highly oxygenated water (Moyle 2002).

4.1.3 Sacramento Sucker

Before the weir modification, Sacramento suckers were abundant in pools and glides below the unmodified grade control weir (H.T. Harvey 2013b). Leicester and Smith (2012) reported that no Sacramento suckers had ever been captured in Upper Penitencia Creek above this barrier. Following the modifications to the weir as part of the Project restoration, Sacramento suckers have been able to move into reaches upstream of the weir in the Project site, and their numbers this year were nearly triple totals from all previous years (Figures 4 and 8). Low numbers of Sacramento sucker in the Upstream reach are probably a reflection of both habitat preference and a significant passage barrier (Figure 12) in this reach.

4.1.4 California Roach

California roach were the most abundant species in both the Project reach and the Upstream reach and were captured in nearly every habitat unit surveyed during 2016 monitoring (Figures 4 and 5, Table 1). In both reaches, the mean length of California roach captured in Year 4 was greater than in Year 1, and the size distribution contained a wider range of lengths. Aquatic vegetation may have covered a greater portion of the channel during drought conditions (Years 2 and 3), thereby offering greater refuge to small fish during electrofishing and thereby skewing the size distribution toward larger fish in Years 2 and 3. The abundance and wide distribution of California roach during surveys probably were attributable to the ability of California roach to tolerate a variety of water quality conditions and to the low numbers of predatory fishes in the Project and Upstream reaches.

4.2 Absent Species

Several fish species that had been documented previously in the Upper Penitencia Creek watershed and that could distribute into the Project reach were not observed during monitoring in Year 1 through Year 4: Pacific lamprey, hitch, and Sacramento blackfish.

4.2.1 Pacific Lamprey

As discussed above, past surveys (Leicester 2011, Leicester and Smith 2012) documented lamprey in the low-elevation reaches of Upper Penitencia Creek. Leicester and Smith (2012) indicate that adult or juvenile lamprey have not been reported above the percolation ponds in 35 years. We did not observe lamprey during the Year 4 surveys. Intermittent flow and barriers in Upper Penitencia Creek, including a concrete barrier in the Upstream reach (Figure 12), may create unsuitable conditions for lamprey migration, spawning, and rearing.

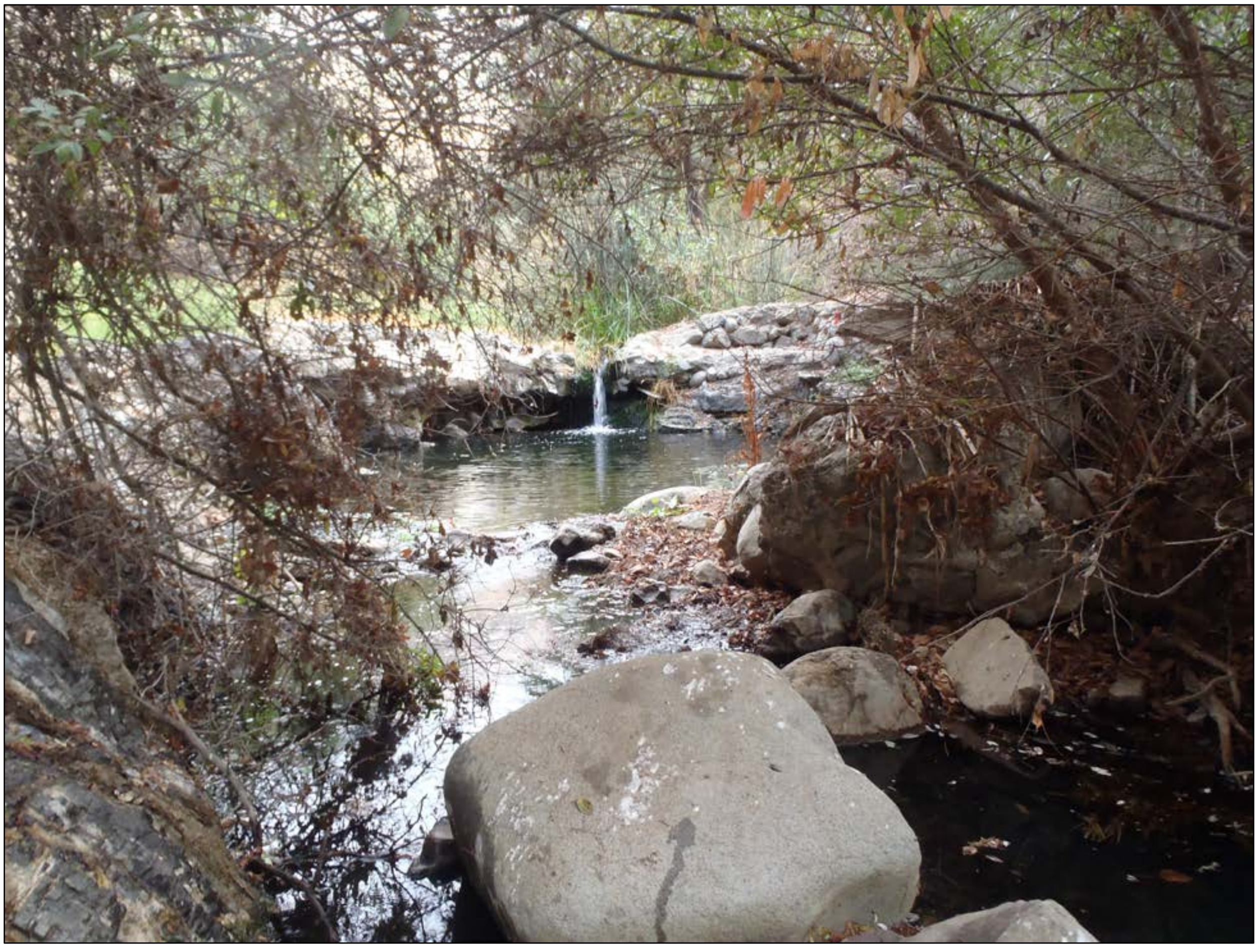


Figure 12. Concrete Barrier in Upstream Reach (ca. November, 2015)

4.2.2 Hitch

Although no hitch were captured during Year 4 surveys, hitch are native to Coyote Creek, where they may hybridize with California roach (Moyle 2002). Hitch are typically found in low-gradient, low-elevation streams in quiet water (Moyle 2002), which may explain their absence from the relatively high-gradient reaches present in Alum Rock Park.

4.2.3 Sacramento Blackfish

No Sacramento blackfish were captured during the Year 4 surveys. However, the past occurrence of Sacramento blackfish in Upper Penitencia Creek may have been the result of a temporary introduction from the South Bay Aqueduct (Abel pers. comm. 2005, as cited in Stillwater Sciences 2006).

Section 5.0 Conclusions

The results of the Year 4 surveys indicate that a stable community of native fishes inhabit the Project reach and the Upstream reach. *O. mykiss* maintain a presence in these reaches, albeit at low levels. The density (i.e., number of fish per 100 feet) of *O. mykiss* in Upper Penitencia Creek has been low since 2011, likely attributable to drought conditions during this timeframe, and the single *O. mykiss* observed was probably resident (see also Leicester and Smith 2016). Although fish passage issues still exist in reaches upstream (e.g. Figure 12) and downstream of the Project reach, with the ease of access gained through the modification of the concrete weir, native fishes of all life stages can now migrate more easily through the Project reach to upstream habitat when flow conditions allow. Year 4 survey results are consistent with previous monitoring results indicating that Project goals regarding fish passage improvements continue to be met.

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Appendix A. Fish Habitat Summaries

Table A-1. Water Quality and Electrofishing Settings

Date	Time	Temperature (°C)	Ambient Conductivity (uS)	Waveform	Frequency (Hz)	Voltage	Duty Cycle (%)
24 Oct 2016	0815	14.8	675	PDC	30	150	30
24 Oct 2016	1212	14.9	905	PDC	30	150	30
13 May 2015	0815	14.6	2030	PDC	30	150	25
13 May 2015	1340	17.5	410	PDC	30	150	25
15 Oct 2015	0815	17.3	2766	PDC	30	150	25
15 Oct 2015*	1345	20.0	2806	PDC	30	150	25
16 Oct 2015	0830	16.8	2675	PDC	30	150	25
16 Oct 2015*	1125	18.0	398	PDC	30	150	25

*Electrofishing surveys were suspended due to water temperature

Table A-2. Number of Fish by Species in Level III Habitat Types in the Project Reach

Level III Habitat Type	Year	Season	Number of Units	California Roach	Riffle Sculpin	Sacramento Sucker	*O. mykiss*
Main channel pool	2013	Fall	2	43	2	0	1
	2014	Spring	5	60	6	2	0
		Fall	1	33	7	4	0
	2015	Spring	5	59	5	0	0
		Fall	4	148	18	7	0
	2016	Spring	NA	NA	NA	NA	NA
		Fall	0	NA	NA	NA	NA
Scour pool	2013	Fall	11	164	41	1	4
	2014	Spring	6	107	10	0	1
		Fall	10	265	76	6	2
	2015	Spring	3	45	11	4	0
		Fall	7	237	28	1	0
	2016	Spring	NA	NA	NA	NA	NA
		Fall	10	225	180	62	1*
Flatwater	2013	Fall	5	72	16	0	0
	2014	Spring	7	74	12	1	3
		Fall	5	131	41	0	0
	2015	Spring	7	95	15	0	0
		Fall	3	158	19	6	0
	2016	Spring	NA	NA	NA	NA	NA
		Fall	0	NA	NA	NA	NA
Riffle	2013	Fall	3	42	7	0	1
	2014	Spring	2	24	9	0	0
		Fall	3	24	9	0	0
	2015	Spring	2	0	0	0	0
		Fall	3	114	13	2	0
	2016	Spring	NA	NA	NA	NA	NA
		Fall	0	NA	NA	NA	NA

Note: NA = not available because this habitat type was not present or was not surveyed in the season shown.

* *Oncorhynchus mykiss* observed, but not captured.

Table A-3. Number of Fish by Species in Level III Habitat Types in the Upstream Reach

Habitat Type	Year	Season	Number of Units	California Roach	Riffle Sculpin	Sacramento Sucker	*O. mykiss*
Main channel pool	2013	Fall	NA	NA	NA	NA	NA
	2014	Spring	NA	NA	NA	NA	NA
		Fall	2	11	10	0	0
	2015	Spring	3	4	7	2	0
		Fall	1	57	0	2	0
	2016	Spring	NA	NA	NA	NA	NA
		Fall	4	48	40	0	0
Scour pool	2013	Fall	6	74	31	0	1
	2014	Spring	5	37	17	0	3
		Fall	5	120	8	0	3
	2015	Spring	5	16	8	0	1
		Fall	4	19	6	0	0
	2016	Spring	NA	NA	NA	NA	NA
		Fall	3	140	14	4	0
Flatwater	2013	Fall	2	16	17	0	0
	2014	Spring	5	8	48	0	1
		Fall	3	26	4	0	0
	2015	Spring	1	0	0	0	0
		Fall	2	1	1	0	0
	2016	Spring	NA	NA	NA	NA	NA
		Fall	0	NA	NA	NA	NA
Riffle	2013	Fall	2	21	11	0	0
	2014	Spring	NA	NA	NA	NA	NA
		Fall	NA	NA	NA	NA	NA
	2015	Spring	NA	NA	NA	NA	NA
		Fall	2	27	7	0	0
	2016	Spring	NA	NA	NA	NA	NA
		Fall	0	NA	NA	NA	NA
Backwater pool	2013	Fall	NA	NA	NA	NA	NA
	2014	Spring	NA	NA	NA	NA	NA
		Fall	NA	NA	NA	NA	NA
	2015	Spring	1	0	7	0	0
		Fall	1	0	1	0	0
	2016	Spring	NA	NA	NA	NA	NA
		Fall	0	NA	NA	NA	NA

Note: NA = not available because this habitat type was not present or was not surveyed in the season shown.

Table A-4. Average Pool Depth and Area, 2016

Season	Reach	Average Pool Depth (meters)	Average Pool Area (meters^2)
Spring	Project reach	NA	NA
Spring	Upstream reach	NA	NA
Fall	Project reach	0.58	36.51
Fall	Upstream reach	0.48	15.27

Note: NA = not available because no surveys were conducted in the season shown.