

Assessment of Steelhead Habitat and Migration Barriers within Watersheds Impacted by the Thomas, Whitter, and Topanga Wildfires

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Abstract

The primary goal of this project was to assess both man-made and natural barriers to steelhead trout (*Oncorhynchus mykiss*) migration within Southern California watersheds impacted by the Thomas, Whittier, Rye, and Topanga wildfires. All of these wildfires occurred during the 2017 to 2018 fire season. Each fire was followed by winter rain events which caused significant debris flows and increased sedimentation in streams located within burned areas. Some streams experienced significant debris flows which had potential impacts on *O. mykiss* migration barriers and habitat. To quantify the resulting impacts on *O. mykiss* migration barriers and habitat, habitat assessments were conducted in conjunction with barrier assessments. A total of 31 waterways and roughly 209 stream miles were surveyed. Surveys began during the driest portion of the year in October 2018 and continued through a higher than average winter precipitation season, progressing into the summer of June 2019. Habitat conditions fluctuated greatly over the duration of surveys as stream flow rates increased and decreased in relation to precipitation events. Assessments were made on all natural stream features and man-made structures such as bridges, dams, diversions, and grade controls which potentially could limit *O. mykiss* migration. A total of 182 previously documented barriers and 254 unlisted potential barriers were assessed. Habitat and barrier data was collected and analyzed to create a barrier remediation priority matrix to be utilized in *O. mykiss* restoration efforts.

Table of Contents

Abstract	2
1.0 Introduction and Project Information	6
2.0 Study Area/Watershed Overview	8
2.1 Conception Coast Watersheds.....	9
2.2 Ventura River Watershed	10
2.3 Santa Clara River Watershed	11
2.4 Topanga Creek Watershed	12
3.0 Methods	13
3.1 Sampling Strategy	13
3.2 Habitat Inventory Components	14
3.3 Barrier Assessments	16
3.3.1 First Pass Barrier Assessments: Reconnaissance Fish Passage Assessment	16
3.3.2 First Pass Barrier Assessments: Fish Passage Evaluation Filter.....	17
3.3.3 First Pass Barrier Assessments: Non-Road Crossing Barriers	18
3.3.4 First Pass Barrier Assessments: Passage Assessment Database	18
3.3.5 Second Pass Barrier Assessments: Detailed Assessments.....	18
3.4 <i>O. mykiss</i> Observations	19
4.0 Data Processing and Analysis	20
4.1 Habitat Data Analysis: Habitat Suitability Index Scoring.....	20
4.1.1 HSI Variables: Average Water Temperature.....	21
4.2 Unutilized HSI Variables	21
4.2.1 HSI Variables: Dissolved Oxygen.....	21
4.2.2 HSI Variables: Water Velocity over Spawning Areas.....	22
4.2.3 HSI Variables: Riffle Substrate	22
4.2.4 HSI Variables: Bank Stability Rating.....	22
4.2.5 HSI Variables: Streamwater pH	22
4.2.6 HSI Variables: Percent Fine Substrates	22
4.2.7 HSI Variables: Stream Shading between 1000-1400hrs)	23
4.2.8 HSI Variables (Annual Base and Mean Migration Streamflow	23
4.3 Additional Habitat Scoring Parameters	23
4.3.1 Southern California Steelhead Recovery Plan Core Stream Values.....	23
4.3.2 Salmonid Presence.....	23

4.3.3 Large Woody Debris.....	24
4.4 Barrier Assessment: FishXing Analysis, Limitations, and Modifications	24
4.4.1 FishXing: Tailwater Information.....	26
4.4.2 FishXing: <i>O. mykiss</i> Swimming Capabilities	27
4.4.3 FishXing: Streamflow Reduction Factors.....	27
4.4.4 FishXing (Streamflow Analysis Levels)	27
4.5 Non-Road Barrier Analysis.....	28
4.6 Barrier Remediation Priority Rankings	29
4.6.1 Barrier Remediation Ranking Criteria: Barrier Severity Scores.....	29
4.6.2 Barrier Remediation Ranking Criteria: Habitat Quantity Scores	29
4.6.3 Barrier Remediation Ranking Criteria: Watershed Position Scoring	30
4.6.4 Barrier Remediation Ranking Criteria: Habitat Value Scores	30
4.6.5 Barrier Remediation Ranking Criteria: Barrier Remediation Scores	30
5.0 Results.....	31
5.1 <i>O. mykiss</i> Habitat: Habitat Physical Measurements	31
5.2 <i>O. mykiss</i> Habitat Suitability Index Scores	33
5.3 Barrier Assessments and Barrier Remediation Scores	36
5.3.1 Barrier Assessments: Santa Clara River Watershed	37
5.3.2 Barrier Assessments: Ventura River Watershed.....	42
5.3.3 Barrier Assessments: Conception Coast Watersheds	59
5.3.3.1 Barrier Assessments: El Captain Creek Watershed	59
5.3.3.2 Barrier Assessments: Mission Creek Watershed	62
5.3.3.3 Barrier Assessments: Montecito Creek Watershed.....	65
5.3.3.4 Barrier Assessments: Oak Creek Watershed	74
5.3.3.5 Barrier Assessments: San Ysidro Creek Watershed	78
5.3.3.6 Barrier Assessments: Romero Creek Watershed	80
5.3.3.7 Barrier Assessments: Arroyo Paredon Creek Watershed.....	94
5.3.3.8 Barrier Assessments: Carpinteria Creek Watershed	97
5.3.3.9 Barrier Assessments: Rincon Creek Watershed.....	99
5.3.4 Barrier Assessments: Topanga Creek Watershed	103
6.0 Discussion	104
6.1 Stream Habitat Fluctuations	104
6.2 Quality Stream Habitat Location.....	107

6.3 Resident <i>O. mykiss</i> Populations	107
6.4 Barrier Assessments (FishXing).....	108
6.4.1 Barrier Assessments (Non-Road Crossing Barriers)	110
6.5 Future Recommendations.....	111
Acknowledgements	113
References.....	114
Appendix A – Santa Clara River Watershed Natural Barriers and Non-Barrier Structures	118
Appendix B – Ventura River Watershed Natural Barriers and Non-Barrier Structures	137
Appendix C – Conception Coast Watersheds Natural Barriers and Non-Barrier Structures	159
Appendix D – Topanga Creek Watershed Natural Barriers and Non-Barrier Structures	222

List of Maps

Figure 1. Assessed Conception Coast streams in relation to Whittier and Thomas wildfire scars.....	9
Figure 2. Assessed streams within the Ventura River watershed in relation to Thomas wildfire scar.....	10
Figure 3. Assessed streams in the Santa Clara watershed in relation to Thomas wildfire scar.....	11
Figure 4. Topanga Creek watershed in relation to Topanga wildfire scar.....	12
Appendix A Figure 1. Barrier locations in assessed portion of the Santa Clara River.....	134
Appendix A Figure 2. Barrier locations in assessed portion of Santa Paula Creek.....	135
Appendix A Figure 3. Barrier locations in assessed portion of Sesar Creek.....	136
Appendix A Figure 4. Barrier locations in assessed portion of Lion Canyon Creek watershed.....	137
Appendix B Figure 1. Barrier locations in assessed portions of Ventura River and Matilija Creek.....	157
Appendix B Figure 2. Barrier locations in assessed portion of San Antonio Creek watershed.....	158
Appendix B Figure 3. Barrier locations in assessed portion of North Fork Matilija Creek watershed.....	159
Appendix C Figure 1. Barrier locations in assessed portion of El Capitan Creek watershed.....	214
Appendix C Figure 2. Barrier locations in assessed portion of Rattlesnake Creek.....	215
Appendix C Figure 3. Barrier locations in assessed portion of Montecito Creek watershed.....	216
Appendix C Figure 4. Barrier locations in assessed portion of Oak Creek watershed.....	217
Appendix C Figure 5. Barrier locations in assessed portion of San Ysidro Creek watershed.....	218
Appendix C Figure 6. Barrier locations in assessed portion of Romero Creek watershed.....	219
Appendix C Figure 7. Barrier locations in assessed portion of Arroyo Paredon Creek watershed.....	220
Appendix C Figure 8. Barrier locations in assessed portion of Carpinteria Creek watershed.....	221
Appendix C Figure 9. Barrier locations in assessed portion of Rincon Creek watershed.....	222
Appendix D Figure 1. Barrier locations in assessed portion of Topanga Creek watershed.....	224

1.0 Introduction and Project Information

Oncorhynchus mykiss is a species of salmonid native to many freshwater streams found within the North American and Asian portions of the Pacific basin. Their current range extends from the Kamchatka Peninsula in Russia southeast through the western coast of Canada and the United States to the northern extent of the Mexican Baja Peninsula. Steelhead along the west coast of North America have been divided into Distinct Population Segments (DPS) based on discrete factors separating populations from each other. The most southern extent of the species range was declared a federally endangered evolutionary significant unit (ESU) in 1997 by the National Marine Fisheries Service (NMFS). This ESU initially extended from Point Conception to Malibu Creek, but was expanded to include all coastal streams from the Santa Maria River to the Mexican border in 2002. In 2006 NMFS distinguished the anadromous steelhead form of the species within southern California as a DPS. It is estimated that annual runs of steelhead within this DPS have declined from 32,000 – 46,000 annual returns to less than 500 (Good et al. 2005). Many scientists believe this to be the most endangered steelhead DPS in North America (Stoecker, 2004).

O. mykiss exhibit unique life history strategies depending on environmental conditions and available habitat. Resident *O. mykiss*, commonly referred to as rainbow trout, may remain in fresh water for the duration of their lives. The anadromous form of *O. mykiss*, known as steelhead trout, migrate to the ocean as smolts where they spend their adult lives before returning to freshwater streams to spawn. One of the numerous factors contributing to the decline of anadromous *O. mykiss* in southern California is the presence of manmade structures within stream channels. Such structures interfere with the life cycle of anadromous fish by limiting or in some cases completely inhibiting the ability of fish to migrate between freshwater spawning habitat and the ocean. Additionally, these structures often limit the passage of sediment and debris necessary for maintaining suitable downstream spawning habitat. (Brenkman et al. 2012). Structures limiting or preventing migratory fish movement are often significant impediments to the recovery of vulnerable fish species, including those listed under the Endangered Species Act (Headwaters Economics, 2016). The types of manmade barriers limiting *O. mykiss* migration include dams, bridges, culverts, water diversions, grade controls, and artificially constructed flood control channels. When these structures are removed a cascade of ecological improvements has been documented by researchers. Apart from reopening historical habitat, plant and animal health in the upper portions of watersheds becomes more robust due to ocean-derived nutrients being transported into the system by migrating fish (Tonra et al. 2015). Also, increased sediment movement improves plant and animal health in estuaries and river mouths (Baurick 2015) and overall stream water quality improves with the removal of these structures (Bednarek 2001).

Within California, documented manmade structures and naturally occurring formations which potentially could or are believed to present as some level of barrier to the migration of salmonids have been compiled within the California Fish and Wildlife (CDFW) fish Passage Assessment Database (PAD). This database lists a variety of parameters pertaining to each documented barrier and is publicly accessible on the CDFW website (<https://nrm.dfg.ca.gov/PAD/Default.aspx>). Previous efforts to assess migration barriers within the southern California steelhead DPS have been documented within the PAD. While wide ranging efforts have been made to document and remove migration barriers throughout California, a considerable amount of barriers still remain in place. Mitigation efforts have often included retrofitting structures such as culverts with weirs or baffles to create streamflow velocities and water depths suitable for fish passage. The construction of fish specific passage structures known as fishways has also been used to mitigate barriers such as dams and diversions. The effectiveness of fishways as well as weir and baffle retrofits in improving fish passage is dependent on several site specific conditions.

Incorrect instillation, improper maintenance, ineffective design, and changes in stream morphology have been documented as reasons for ineffective fish passage mitigation efforts (Lang 2008).

Within Santa Barbara and Ventura counties there are currently 1,634 PAD listings. Documented mitigation and removal efforts have taken place on 42 of these listings. The circumstances for removing and or mitigating manmade fish migration barriers is often dependent on a variety of fluctuating environmental, economic, and social factors. Each of these factors was impacted by the 2017 southern California fire season and subsequent winter rain events. In particular the Thomas (281,893 acres burned), Whittier (18,430 acres burned), Rye (6,049 acres burned), and Topanga (55 acres burned) wildfires burned portions of multiple watersheds containing streams with high priority steelhead habitat. According to the United States Forest Service Thomas Fire Fisheries Resource Report 1909 miles of stream habitat was affected by the Thomas Fire alone, nearly 80 miles of which is considered critical habitat for southern California steelhead. Following these wildfires, winter rain events further impacted steelhead habitat by greatly increasing the amount and rate of sedimentation into streams located within burn scarred areas. In some streams, significant debris flows caused rapid and significant alterations to the stream channel, riparian zone vegetation, and manmade structures within the floodplain. For instance, five bridges on California state highway 192 were damaged severely enough to warrant complete replacement.

Not only did these wildfires and the winter rain events following them impact the quality of *O. mykiss* habitat, but they also may have altered habitat accessibility by destroying existing barriers or creating new barriers to *O. mykiss* passage. To quantify these changes, assessments of *O. mykiss* habitat and potential barriers to anadromous steelhead and resident rainbow adult *O. mykiss* life stages were conducted by the Pacific States Marine Fisheries Commission (PSMFC), California Conservation Corps (CCC) and California Fish and Wildlife (CDFW) staff between October 2018 and June 2019 within watersheds impacted by the Thomas, Whittier, Rye, and Topanga wildfires. Funding for these assessments was supplied by the California Department of Transportation (Caltrans).

2.0 Study Area/Watershed Overview

O. mykiss habitat and potential barriers to their migration were assessed in nine wildfire impacted watersheds over the course of this project. Each assessed watershed is located within the northern half of the NMFS distinguished southern California steelhead DPS. The headwater streams in each of the assessed watersheds begin within east-west orientated transverse mountain ranges with many areas of steep topographic relief and elevations of up to 8,800 feet about sea level in the San Gabriel Mountains and drain out through valleys and coastal terraces to the Pacific Ocean. Much of the land area within the mountainous portions of the assessed watersheds is part of the Los Padres and Angeles National Forests. The dominant vegetation across all assessed watersheds is chaparral woodlands intermixed with savanna oak woodlands most commonly consisting of coast live oak (*Quercus agrifolia*), and valley oak (*Quercus lobate*). Groves of conifers such as big cone spruce (*Pseudotsuga macrocarpa*), grey pine (*Pinus sabiniana*), and coulter pine (*Pinus coulteri*) are present at higher elevations. Riparian areas within the assessed watersheds typically include sycamores (*Plantus racemose*), arroyo willow (*Salix lasiolepis*), white alder (*Alnus rhombifolia*), and fremont cottonwood (*Populus fremontii*). *Arundo donax*, an invasive reed has become widespread within the riparian zones of many of the assessed watersheds.

All assessed watersheds are located within a semi-arid Mediterranean climate characterized by wet winters and warm dry summers. Roughly 90% of annual precipitation occurs between November and April. Stream flows within the assessed watersheds tend to be flashy as they rise and fall quickly in response to precipitation events. Frequency, intensity, and duration of winter and spring precipitation events can vary greatly from year to year across the assessed watersheds. Extreme and persistent drought conditions occurred in southern California between 2011 and 2016. During this time period, annual precipitation ranged from 40-69% of normal in Santa Barbara County and 38-67% of normal in Ventura County (Santa Barbara Public Works Department 2019, Ventura County Watershed Protection District 2019). However, above average precipitation occurred in 2017 and 2018 across the assessed watersheds. Additionally, the amount of precipitation that occurs across the assessed watersheds can vary significantly with additional orographic precipitation occurring in the mountainous portions of these watersheds.

	Rainfall Gage Location and (elevation)	Ventura River Watershed		Carpinteria Creek Watershed	
		Ventura Govt Center (280 ft)	Wheeler Gorge (1900 ft)	Carpinteria Fire Station (30ft)	Edison Trail (1650 ft)
Water Year Measured Rainfall (inches) (% of average)	2011-2012	9.49 (59%)	14.48 (52%)	9.83 (57%)	15.39 (61.7%)
	2012-2013	5.80 (36.1%)	10.51 (37%)	8.33 (48%)	13.7 (55%)
	2013-2014	6.14 (38%)	14.74 (53%)	5.83 (34%)	9.21 (37%)
	2014-2015	9.15 (57%)	17.37 (62%)	8.48 (48%)	12.52 (50%)
	2015-2016	8.49 (53%)	14.16 (51%)	10.11 (58%)	15.35 (62%)
	2016-2017	19.11 (119%)	32.24 (116%)	21.75 (125%)	32.48 (130%)
	2017-2018	7.16 (45%)	14.7 (53%)	9.04 (52%)	15.52 (62%)
	2018-2019 (through May)	19.07 (119%)	37.09 (133%)	17.92 (103%)	33.18 (133%)

Table 1. Measured rainfall and percent of average at varying elevations over the last 8 water years in the Ventura River and Carpinteria Creek Watershed.

In contrast to winter and spring precipitation events, summer and autumn across the assessed watersheds are typically hot and dry. This leads to steady decreases in residual stream flow, eventually leading to significant portions of stream channels experiencing sub-surface flow or going dry. The

inconsistent dynamics of precipitation events and streamflow regimes associated with southern California steelhead DPS watersheds provides limited and specific timeframes in which steelhead trout make their attempts to migrate back from the ocean. This exacerbates the impact migration barriers have within the Southern California Steelhead DPS.

2.1 Conception Coast Watersheds

The northernmost watersheds assessed for this project lie along the Conception Coast within Santa Barbara County and drain the southern side of the Santa Ynez mountain range. These watersheds are relatively small in area as the Santa Ynez mountain range runs in close parallel proximity to the coastline. Conception coast streams assessed for the project include El Capitan Creek, East and West Forks of El Capitan Creek, Montecito Creek, San Ysidro Creek, Cold Springs Creek, East Fork Cold Spring Creek, Hot Springs Creek, Oak Creek, Rattlesnake Creek, Romero Creek, Picay Creek, Buena Vista Creek, Rincon Creek, Arroyo Paradon Creek, Carpinteria Creek, and Gobernador Creek. Picay Creek and Buena Vista Creek are tributaries to Romero Creek. Gobernador Creek is a tributary to Carpinteria Creek. Cold Springs Creek and Hot Springs Creek are tributaries of Montecito Creek. All of these watersheds with the exception of the El Capitan Creek watershed were impacted by the Thomas Fire. Additionally, it is worth noting that only a very small portion of the upper Rattlesnake Creek watershed was impacted by the Thomas Fire. The El Capitan Creek watershed was impacted by the Whittier Fire. Of the assessed Conception Coast watersheds the El Capitan Creek watershed is also different in that none of its watershed is within an urban area. Considerable development, primarily residential homes, has occurred in the lower portions of the other assessed Conception Coast watersheds. This development has also included the construction of numerous stream crossing and flood control structures. For instance, flood debris catchment basins have been constructed within Carpinteria Creek, Cold Springs Creek, Romero Creek, and Montecito creek. In response to recent large debris flows, instillation of ring nets to catch potential future debris flow materials are being constructed within Buena Vista Creek, San Ysidro Creek, and Cold Spring Creek.

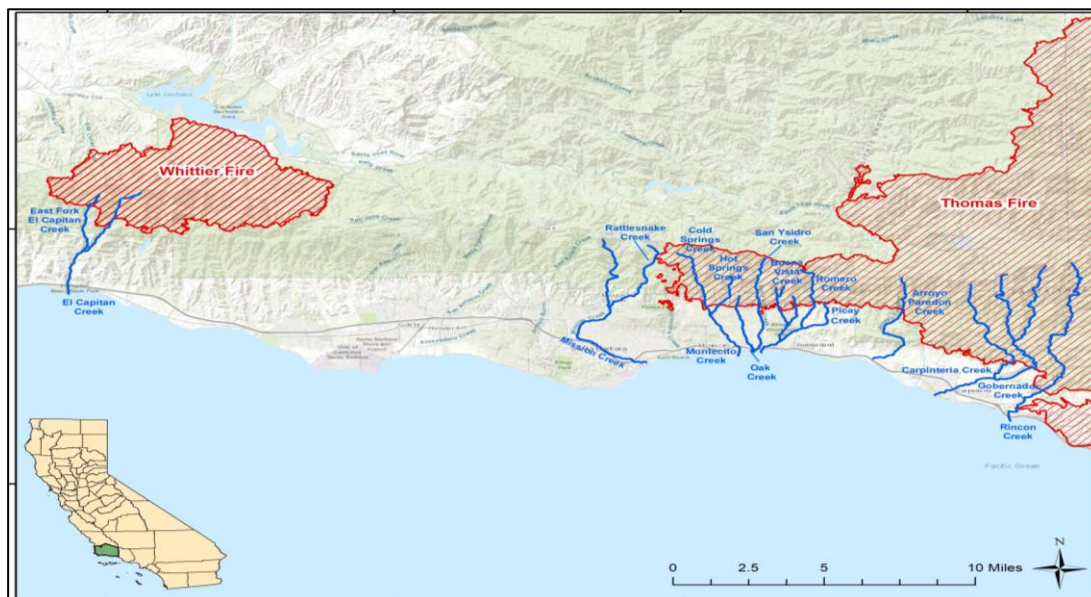


Figure 1. Assessed Conception Coast streams in relation to Whittier and Thomas wildfire scars.

2.2 Ventura River Watershed

The Ventura River watershed is primarily located within northeastern portion of Ventura County, but the headwaters of some watershed streams extend west into a small portion of Santa Barbara County. Streams within this watershed drain from the Topatopa and San Rafael mountain ranges. A considerable portion of the watershed was impacted by the Thomas Fire. The southern and eastern portion of the watershed contains considerable urban development. Two large dams are present within the watershed. The Matilija Dam is a total barrier and separates much of the Matilija Creek drainage from rest of the watershed. When flows permit the Robles Dam on the Ventura River diverts a portion of the watershed drainage into Lake Casitas. Streams assessed in the watershed include Bear Creek, Cannon Creek, Lion Creek, Matilija Creek, North Fork Matilija Creek, San Antonio Creek, Thatcher Creek, and the Ventura River. The Ventura River is the main stem stream of the watershed. Bear Creek and Cannon Creek are tributaries to North Fork Matilija Creek while Thatcher Creek and Lion Creek are tributaries to San Antonio Creek.



Figure 2. Assessed streams within the Ventura River watershed in relation to Thomas wildfire scar.

2.3 Santa Clara River Watershed

The Santa Clara River watershed drains approximately 1,634 square miles and is the 2nd largest watershed in southern California. The watershed encompasses portions of Ventura and Los Angeles County. The Santa Clara River flows in a westerly direction originating at Pacifico Mountain in the San Gabriel mountains. Tributary streams drain from the Topatopa Mountains to the north and the Santa Susana Mountains to the south. The far eastern portion of the watershed drains from the Sierra Pelona Mountains and Angeles National Forest. Approximately 90 percent of the watershed is mountainous terrain, with valley floors and coastal plains making up the other 10 percent of the watershed (RBF Consulting and Stillwater Sciences, 2009).

The watersheds encompass the urban areas of Santa Clarita, Fillmore, Oxnard, and Ventura. The Santa Clara river valley has largely been converted to agricultural land use. The Freeman Diversion Dam is a significant structure on the Santa Clara river and diverts 58,000 acre-feet of stream flow to the underground water supply each year (United Water Conservation District). The western portion of the watershed was impacted by the Thomas Fire and the eastern portion by the Rye Fire, which was much smaller than the Thomas Fire. Streams assessed in the watershed include Sespe Creek, Lion Creek, Sisar Creek, and Santa Paula Creek, and the Santa Clara River up to the confluence of Sespe Creek. The Santa Clara River extends east from its river mouth near Ventura Harbor towards Santa Clarita north of Los Angeles.

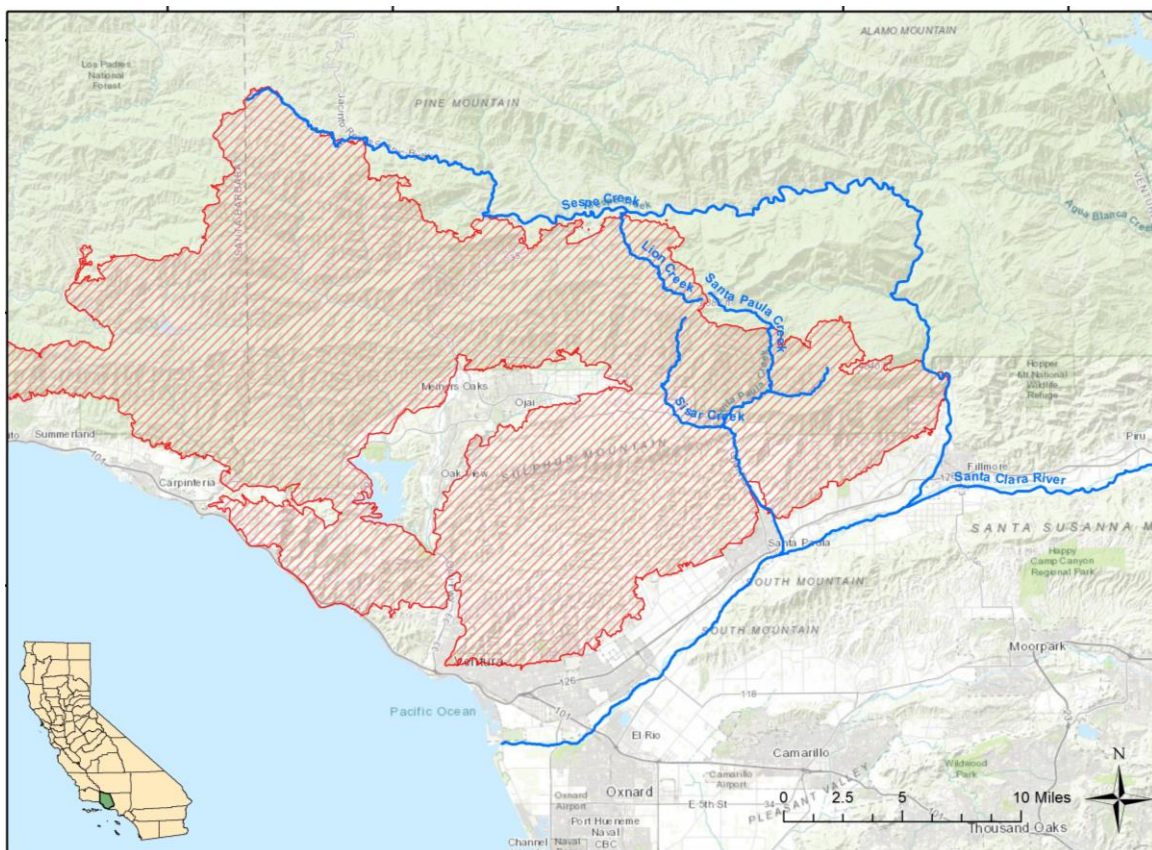


Figure 3. Assessed streams in the Santa Clara watershed in relation to Thomas wildfire scar.

2.4 Topanga Creek Watershed

The Topanga Creek watershed was the southernmost watershed assessed for this project. The Topanga Creek watershed is relatively small and drains the southern side of the coastal Santa Monica mountain range. The watershed contains some residential housing, but is relatively undeveloped. California state highway 27 runs alongside much of Topanga Creek, including several bridge crossings. The watershed was impacted by a 55-acre wildfire in 2017.

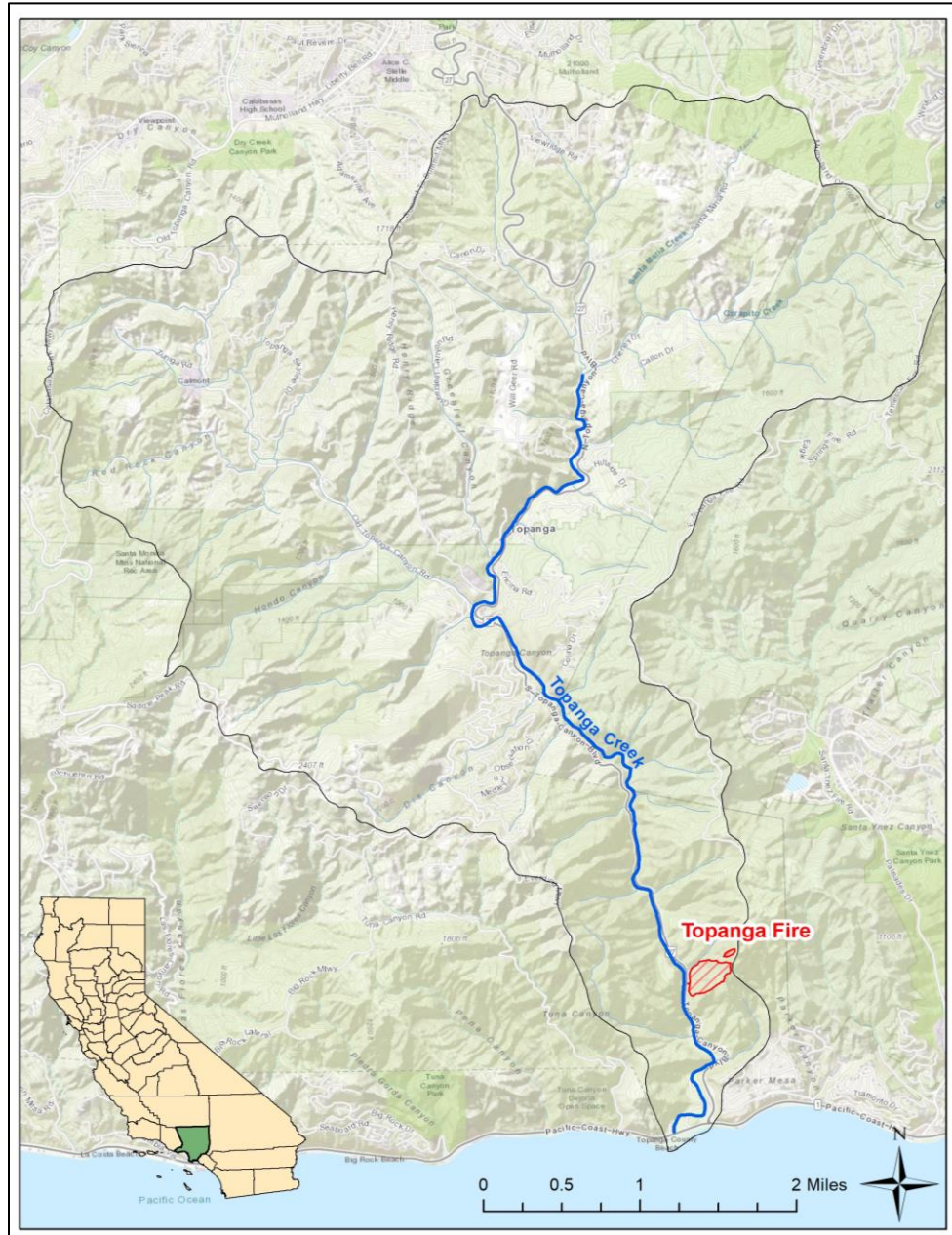


Figure 4. Topanga Creek watershed and in relation to Topanga wildfire scar.

3.0 Methods

Habitat and barrier assessment data was collected according to methods outlined in the 4th edition of the California Salmonid Stream Habitat Restoration Manual (CSSHRM) (Flossi et al., 1998). Caltrans Reconnaissance First Pass Assessment and Detailed Fish Passage Assessment protocols (HDR Engineering Inc. 2007) were used to assess roadway stream crossings. Barrier assessments and habitat surveys were conducted between October 2018 and June 2019 by two to four person crews consisting of Pacific States Marine Fisheries Commission (PSMFC), California Conservation Corps (CCC), and California Department of Fish and Wildlife (CDFW) trained staff. Assessments were conducted on streams with historical anadromous fish presence as documented by CDFW datasets and Steelhead/Rainbow Trout Resources South of the Golden Gate, California (Becker G. S. and Reining I. J. 2008).

3.1 Sampling Strategy

Habitat surveys and initial first pass reconnaissance barrier assessments were conducted by hiking upstream from the most downstream extent of each stream. When possible streams were surveyed to a total naturally occurring barrier feature representing the upstream limit to *O. mykiss* migration. Various circumstances limited the complete assessment of the following streams to their total naturally occurring barrier: Oak Creek, Picay Creek, Buena Vista Creek, Lion Creek, Arroyo Paredon Creek, Matilija Creek, and the Santa Clara River. Aspects limiting the extent of assessments in these streams are explained in the results and discussion portions of this report. Habitat inventory was conducted using the level II classification categories listed in the CSSHRM. This classification level categorizes stream habitat units into three types; riffles, pools, and flatwaters. Streamflow velocity crossovers were used in determining the downstream and upstream extent of habitat units. Level II habitat classification was chosen to allow for the collection of fundamental habitat characteristics over the large multiple watershed study area. Furthermore, to ensure habitat was assessed through the extensive length of streams across all watersheds, a 10% habitat data collection rule was applied to the selected habitat inventory method. Under this rule full Level II habitat data parameters were recorded for the first pool, flatwater, or riffle units encountered out of every ten units assessed. One additional unit out of every ten units was also randomly selected for full level II habitat parameter data collection. All other habitat units encountered were classified and measured for length along the thalweg. Additionally, the most downstream extent, or tail-out, of each pool unit was assessed for dominant substrate, substrate embeddedness, and water depth (within the thalweg).

3.2 Habitat Inventory Components

The following is the list of habitat parameters measured and recorded for this project as directed for level II habitat inventory by the CSSHRM.

- General Information:

The stream name, date, time, surveyors, equipment used, and starting latitude and longitude were recorded at the beginning of each day of assessments.

- Temperature:

Air and water temperature was recorded at the beginning of each assessment day with a handheld liquid in glass thermometer. Air temperature was recorded within the shade and within one foot of the water surface of each stream when water was present. Water temperature was recorded in a shaded flowing portion of the stream.

- Habitat Typing:

Each assessed flatwater, pool, and riffle habitat type was numbered sequentially. For areas in which the wetted portion of the channel was split the main wetted channel was assigned a continuation of sequential numbering and the side wetted channel units were numbered sequentially from the downstream main wetted channel unit they split from until they rejoined the upstream portion of the main wetted channel. Estuaries and areas in which flows went subsurface in the creek and their extent in length was recorded and labeled as “estuary” and “dry.” Areas in which streamflow passed through or over manmade structures present within the streambed were not included in habitat typing. These included structures such as culverts, dams, and grade controls. Areas in which streamflow passed under or within manmade structures present within the stream channel margins were assessed as habitat. Examples include streamflow under bridges and within flood control channels or debris basins. Portions of watersheds where access was denied by property owners or extreme terrain prevented assessment were not included with assessed habitat data.

- Habitat Area and Volume Measurements:

Habitat unit area and volume measurements (length, mean width, mean depth, maximum depth, pool tail-out depth) were recorded in feet to the nearest tenth using hip chains, tape measures, or stadia rods. In instances when the upstream extent of a habitat unit was not visible from the downstream extent of the unit, the latitude and longitude of the downstream and upstream extents of the unit were recorded with a handheld Garmin GPSMAP 64s unit. Unit length was calculated from the recorded unit extent location points with one of two methods. When a single wetted channel was present the distance between recorded unit location extents was determined with Arcmap GIS. Each habitat unit start and end GPS coordinates were snapped to a 24K CalStreams hydrography stream line layer allowing distance along the stream line to be quantified by Arcmap. This process was automated through use of the Arcmap model builder ensuring each dataset was treated in the same manner. When the wetted portion of stream channels were split the recorded unit extent location points were plotted in Google Earth software and the distance between them was obtained by using the ruler tool to measure the unit extent by manually tracing the stream channel as depicted on the most current satellite imagery.

- Pool Tail Substrate and Embeddedness:

The most visually dominant substrate type located within each pool tail-out area was recorded. The average portion of this substrate embedded within the surrounding finer substrate sediments was determined by selecting at least five individual dominant substrate particles and visually examining them. The following values were assigned based on the average percent of dominant substrate type embedded within the surrounding finer substrate through visual estimation: 0 – 25% (value 1), 26 – 50% (value 2), 51 – 75% (value 3) and 76 – 100% (value 4). A value of 5 was assigned to tail-out areas deemed unsuitable for spawning due to inappropriate substrate, such as bedrock, woody debris, boulders, or other considerations.

- Large Woody Debris (LWD) Count:

The number of LWD located within the bank full extent of the channel and the downstream and upstream margins of each fully assessed habitat unit was counted. To be counted as “large,” woody debris must have a diameter of at least 12 inches and a length of at least 6 feet. Two categories of LWD were counted, those with a length of 6 to 20 feet and those with a length over 20 feet. Size of woody debris was visually estimated.

- Instream Shelter/Cover Ratings:

For each fully assessed habitat unit materials were considered and counted towards instream shelter if they were within the margins of the unit and were deemed large enough to provide a juvenile *O. mykiss* of three inches in length protection from overhead predation. Nine types of cover were considered; undercut stream banks, small woody debris, large woody debris, root mass, terrestrial vegetation, aquatic vegetation, bubble curtain, boulders, and bedrock ledges. Only terrestrial vegetation within one foot of the water surface was considered as shelter. Two aspects of shelter were assessed; percentage of unit covered by shelter versus percentage of unit uncovered by shelter and percentage of each shelter type within the assessed unit. Cover percentages were visually estimated.

- Substrate Composition:

The most and 2nd most dominant substrates were visually estimated and recorded within each fully assessed habitat unit. Seven substrate class sizes were considered and distinguished by individual particle diameter; silt/clay (<0.01 inches), sand (0.01 – 0.08 inches), gravel (0.08 – 2.5 inches), small cobble (2.5 – 5 inches), large cobble (5–10 inches), boulder (>10 inches), and bedrock (> small car).

- Exposed Substrate:

Substrate was considered exposed if it was surrounded by the wetted portion of the unit it was located within. The amount of exposed substrate was visually estimated and assigned a percentage as compared to the total surface area of each fully assessed habitat unit.

- Canopy:

Canopy density values were measured as percentages and were obtained using modified handheld spherical densimeters as described in the CSSHRM. Densimeter measurements were taken at the center upstream extent of every fourth habitat unit and every fully assessed unit, giving an approximate 30% sub-sample of total stream canopy. For each measured canopy a visual percentage estimate of amount of deciduous versus evergreen vegetation types making up the canopy was also

made. Due to canopy measurements only being obtained at the upstream extent of each habitat unit the values obtained are considered an estimate of total stream shaded by vegetative canopy.

- **Bankside Composition and Vegetation:**

The dominate substrate composition and vegetation type located on both banksides within the downstream and upstream margins of fully assessed habitat units were recorded. Recorded bank compositions categories included bedrock, boulder, cobble/gravel, and silt/clay/sand. Recorded vegetation types included grass, brush, deciduous trees, evergreen trees, or no vegetation.

- **Comments:**

Additional notes were recorded for any habitat units with unique features. Examples include erosion, potential migration impediments, landmarks, and animal species observed.

3.3 Barrier Assessments

The assessment of all manmade structures and any naturally occurring stream features which posed as a potential *O. mykiss* migration barriers were conducted in two stages utilizing a variety of protocols. Initial assessments (first pass) were made in conjunction with habitat assessments. The goal of initial assessments was to identify structures and natural stream features which contained features with potential to prevent passage of any *O. mykiss* life stage. Road crossing structures found to contain fish passage constraints from this initial assessment were flagged for follow up (second pass) detailed assessments. All natural stream features and manmade structures assessed were classified using CDFW barrier passage status definitions (Table 2.)

Barrier Passage Status	Definition
Total	Structure/site is impassable to all fish species at all life stages under all streamflow conditions.
Temporal	Structure/site is impassable to all life stages of fish under some streamflow conditions.
Partial	Structure/site is impassable to particular fish species or life stages under all streamflow conditions.
Temporal & Partial	Structure/site is impassable to all species and life stages of fish under some flow conditions and also impassable to particular fish species or life stages under all streamflow conditions.
Not a Barrier	Structure/site has been determined not to present as a barrier to any fish species or life stages.
Unknown	Structure/site passage status unable to be determined without additional assessment(s).
Unassessed	Structure/site has not been assessed for fish passage.

Table 2. CDFW barrier passage statuses and definitions.

3.3.1 First Pass Barrier Assessments: Reconnaissance Fish Passage Assessment

The Caltrans reconnaissance fish passage assessment protocol was one of two protocols utilized to direct the initial assessment of all stream road crossings. This protocol was established by Caltrans and provides standardized methodology for identifying potential fish passage constraints at road crossings requiring follow up detailed assessment. Fish passage constraints as listed in the protocol included; an

active channel width greater than the crossing structure inlet width, channel slope greater than three percent, hardened or artificial stream channel bottom, crossing structure orientation to the stream channel greater than 45 degrees, and evidence of flow concentration created by the crossing structure. If a road crossing site contained any of these conditions, it was flagged for a follow up detailed assessment. Pictures of the inlet, outlet, upstream channel, and downstream channel were taken for each assessed road crossing. Measurements for channel slope calculations were collected with a hand level, stadia rod, and transect tape. Road crossing structure orientations were measured using a hand-held compass. All other fish passage constraint conditions were assessed visually.

3.3.2 First Pass Barrier Assessments: Fish Passage Evaluation Filter

The criteria listed in the CSSHRM fish passage evaluation filter flowchart (Figure 5) was utilized in conjunction to the Caltrans Reconnaissance Fish Passage Assessment during first pass barrier assessments to determine detailed barrier assessment needs. A majority of the passage status delineation criteria listed in this flowchart is the same as the criteria listed under the Caltrans Reconnaissance Fish Passage Assessment. Criteria specific to this flowchart include; residual streamflow inlet and outlet depths, structure outlet drop, and the presence of baffles or weirs. Stream road crossings determined to have a green status when assessed through these criteria were assumed to provide adequate passage for all salmonids at all life stages. Crossings determined to have a red or grey status were flagged for follow up detailed assessments. For assessments conducted when no streamflow was present residual inlet and outlet depths were estimated by visually comparing the most entrenched portion of stream channel at the inlet and outlet to the active channel margins.

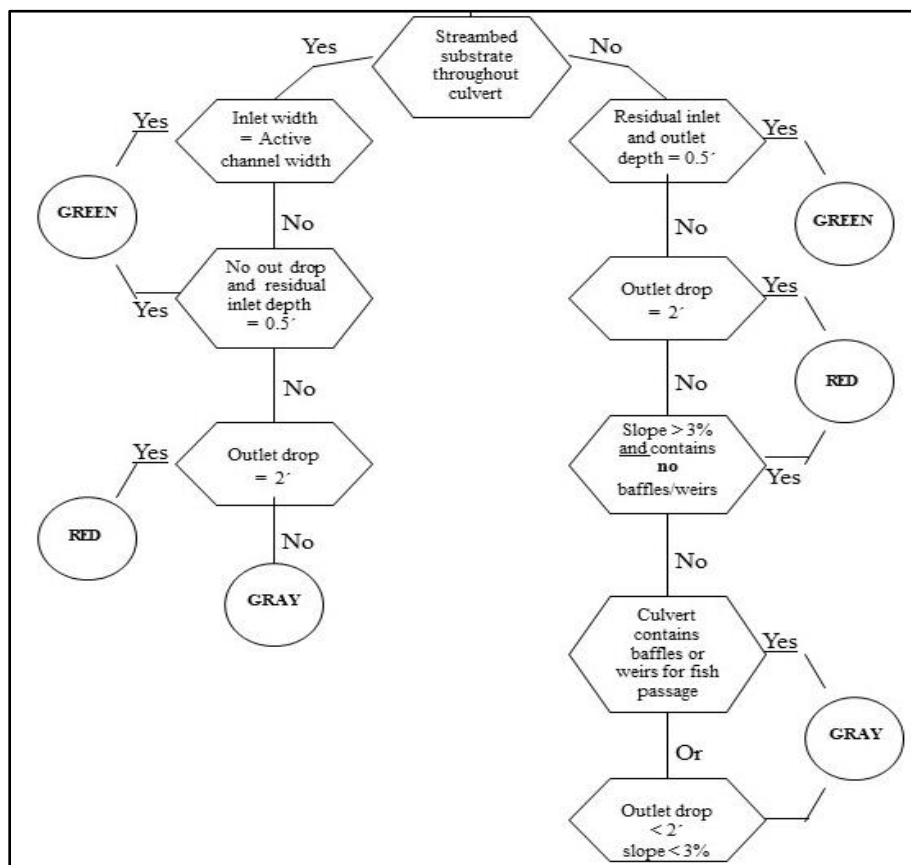


Figure 5. CSSHRM fish passage evaluation filter flowchart.

3.3.3 First Pass Barrier Assessments: Non-Road Crossing Barriers

All naturally occurring stream conditions and non-road crossing structures such as dams, diversions, and grade controls, which posed as potential barriers to *O. mykiss* were assessed using criteria listed in the Chapter 13 of the American Fisheries Society's Aquatic Habitat Assessment: Common Methods (Gallagher, 1999). The purpose of data collected under this protocol is to quantify barrier characteristics so likelihood of fish passage can be assessed. When possible, data collection included the dimensions of the potential barrier including mean width at its base, mean height (from water surface), and width along crest. If the stream flow cascaded over the barrier the breadth and length of the cascade were recorded and were used to calculate the gradient. Stream conditions downstream and upstream of the barrier were also measured. Data collected downstream of the barrier included water temperature, dissolved oxygen, pH, and conductivity. Also measured were downstream channel conditions such as active channel width, wetted width, visible bathtub ring height (from the stream water surface), dominant and sub dominant substrate types, water depth of the unit tail crest, water depth at the plunge point, and max unit water depth. Measurements taken upstream of the barrier included mean water depth, height and distance to the first potential resting area for successful passing *O. mykiss*, and the channel bank full width. Pictures of the inlet, outlet, upstream channel, and downstream channel were taken for each non-road crossing barrier. Finally, a description noting type of materials making up the barrier, fish passage facilities and its conditions, and any other unique characteristics was written.

3.3.4 First Pass Barrier Assessments: Passage Assessment Database

Information specific to the CDFW PAD was also recorded for all surveyed barrier types. PAD protocols directed the collection of data specific to making new listings in the database and for providing database updates. The only information included in PAD protocols which was not collected with the other utilized first pass barrier assessment protocols was information regarding mitigation of existing PAD barrier listings. To ensure all barriers listed within the PAD were accounted for in this project the location and status of existing PAD barrier records were uploaded into the GPS units utilized during first pass assessments for each stream surveyed. This ensured surveyors collected information for updating all PAD listings, including for barriers which did not exist anymore.

3.3.5 Second Pass Barrier Assessments: Detailed Assessments

Road crossings found to contain constraints to fish passage during first pass assessments were reassessed utilizing the Caltrans Detailed Fish Passage Assessment protocol (HDR Engineering Inc. 2007). Under this protocol the physical characteristics of the road crossing and surrounding stream channel features were measured through longitudinal and cross section geometry measurements. Longitudinal profiles and cross section elevation measurements were primarily collected using a tripod mounted automatic level to take level readings of 25-foot fiberglass stadia rod vertically placed at designated profile and cross section points. A Topcon GTS-250 total station and reflective prism was used to obtain elevation measurements at crossings with extreme geometry or space restrictions. A transect tape was used to obtain the station location points (horizontal datum) along profiles and cross sections. Longitudinal profile measurements were taken along the stream's thalweg at various points upstream, at, and downstream of the assessed road crossings. Points measured included the tailwater control of the first resting habitat upstream of the crossing, upstream and downstream extent of crossing structure aprons, crossing structure inlets and outlets, downstream unit max water depth and tailwater control, and channel slope change points. Channel cross section profiles were obtained between the channel bankfull width at the tailwater of the unit downstream of the crossing. At least nine points representative of channel slope breaks were measured between the bank full margins. The active channel

margins and thalweg point of the downstream unit tailwater control were always included in these measurements.

Other information obtained during detailed assessments included the height, width/span, and length of road crossing structure components. When culverts were present measurements were taken to estimate the volume of material encasing the culvert under the roadway. If culverts contained embedded substrate, the dominate substrate type was recorded and if possible, the depth of the substrate was measured with a stadia rod. Additionally, written descriptions and photographs of road crossing structures were also included in detailed assessments.

3.4 *O. mykiss* Observations

Instances in which individual *O. mykiss* were observed while conducting barrier or habitat assessments were recorded. All observations were made via bankside observation from above the surface of the water. The latitude and longitude location of each *O. mykiss* observation was recorded using a handheld Garmin GPSMAP 64s unit. Additionally, the estimated length of each individual *O. mykiss* observed was recorded. *O. mykiss* lengths were estimated to within 2-inch size bins (0-1.99 inches, 2-3.99 inches, 4-5.99 inches, etc.).

4.0 Data Processing and Analysis

All habitat and barrier assessments were recorded with hard copy datasheets. Habitat assessment and all first pass barrier assessment data was entered into a Microsoft Access 2016 (version 1802) database. Access data entry subforms were created for habitat assessments, non-road crossing assessments, and PAD datasheets. All data entered into Access subforms were analyzed using R (version 3.4.1, R Core Team 2017) and R Studio (version 1.0153, RStudio, Inc 2016). Data collected during second pass detailed barrier assessments was entered into and analyzed with FishXing software (version 3.0 Beta). FishXing “Fish Crossing” software is designed to assist in the evaluation and design of culverts for fish passage by modeling crossing structure characteristics, channel geometry, local hydrology, and comparing fish swimming capabilities to them. Specific swimming capabilities of different fish species and life stages can be selected and compared against.

4.1 Habitat Data Analysis: Habitat Suitability Index Scoring

Various methodologies have been developed to assess and quantify stream habitat for fish (Wesche and Rechar 1980, Fausch et al. 1988). Many of these methodologies have been used to assess *O. mykiss* habitat within southern California streams, but comparison of habitat data is difficult due to subjectivity and a lack of standardization between these methodologies. In order to provide standardized assessment of aquatic habitat across geographic locations the United States Fish and Wildlife Service (USFWS) developed Habitat Evaluation Procedures (HEP) (USFWS 1980). One component of HEP is the Habitat Suitability Index (HSI) which rates overall habitat quality over individual variables on a scale of 0 to 1, with 1 being the most optimal habitat.

HSI variables specific to assessing *O. mykiss* habitat suitability in freshwater streams have been specified by the United States Forest Service (USFS) (Raleigh et al. 1984). These *O. mykiss* specific HSI variables were developed for and have been applied to streams across much of North America. However, there has been minimal validation of using these variables to rate the unique habitat conditions typically present within southern California steelhead DPS streams. When compared to broader North American *O. mykiss* habitat, habitat conditions within the Southern California steelhead DPS can be harsh and highly variable. Consecutive years of extreme drought can be followed by periods of sudden elevated and swift stream flows. Unique conditions such as these may diminish the relative importance of habitat parameters as modeled in the USFS HSI formula and their appropriateness to Southern California steelhead. (Allen and Riley, 2004). To account for this Allen and Riley proposed adjustments to a portion of the *O. mykiss* specific HSI variable scoring curves, including water temperature, substrate size, and cover. These suggested HSI scoring adjustments were incorporated into the habitat suitability scoring conducted for this project. Additionally, only a subset of the 18 *O. mykiss* specific HSI variables were utilized to score collected habitat data for this project. The subset of HSI variables utilized were chosen based on the data collected and scale of habitat assessed. HSI variables not used for habitat scoring are listed below. Additional adjustments were made to two HSI variables (mean water temperature and mean depth) to account for seasonal habitat variations that occurred over the course of our data collection period (October – June).

To ensure habitat quality was captured in our habitat scoring, an HSI variable score was applied to each collected habitat unit data point. All assigned HSI variable scores were then averaged to provide an overall *O. mykiss* habitat suitability score between 0.0 and 1.0 for each assessed stream. Under this method a higher score assumes greater overall habitat suitability. A description of each HSI variable, applied adjustments, and utilized scoring method are provided below. Please refer to Raleigh et al. (1984)

and Allen and Riley (2004) for additional details about scoring deviations and for the specific model formulas.

4.1.1 HSI Variables: Average Water Temperature

Water temperature affects the development of all *O. mykiss* life stages by influencing metabolic and reproductive activities (Stoecker 2002). Numerous studies have identified solar radiation, air temperature, and substrate types as the main factors influencing stream water temperatures (Johnson and Wondzell). To account for seasonal solar radiation and air temperature fluctuations and their influence on water temperature over the course of data collection, two sets of HSI water temperature scoring curves were applied. One of these curves is distinguished to apply to water temperatures recorded during warm months (June – October) (Table 3) and the other curve is distinguished to apply to water temperatures recorded during cool months (November – May) (Table 4). These scoring ranges were established to match the mean of four water temperature scoring curves suggested by Allen and Riley, as they better represent warmer water temperatures of Southern California Steelhead DPS streams. We applied a single overall water temperature score to each assessed stream based on the mean recorded water temperatures and dates of data collection for each stream.

Warm Month (June – October) Water Temperature Scores	
Water Temperature Range (Celsius)	Score
< 16.99°	1
17° - 17.99°	0.9
18° – 18.99°	0.8
19° - 19.99°	0.7
20° – 20.99°	0.6
21° – 21.99°	0.5
22° – 22.99°	0.4
23° – 23.99°	0.3
24° – 24.99°	0.2
25° – 25.99°	0.1
> 26°	0

Table 3. Warm months water temperature HSI scores.

Cool Month (November – May) Water Temperature Scores	
Water Temperature Range (Celsius)	Score
< 12°	1
12.01° – 13.5°	0.9
13.51° – 15°	0.8
15.01° – 16.5	0.7
16.51° – 18°	0.6
18.01° – 19.5°	0.5
19.51° – 21°	0.4
21.01° – 22.5°	0.3
22.51° – 24°	0.2
24.01° – 25.5°	0.1
> 25.51°	0

Table 4. Cool months water temperature HSI scores.

4.2 Unutilized HSI Variables

A portion of the *O. mykiss* HSI variables developed by Ralieg et al. were unable to be applied to the limited dataset collected under CSSHRM Level II habitat assessment protocols. Descriptions of these unutilized variables are listed below.

4.2.1 HSI Variables: Dissolved Oxygen

DO is not a data point directed for collection under CSSHRM Level II habitat assessment protocols, but is directed for assessment of non-road migration barriers. Due to the inconsistency of non-road barrier locations we believed the DO readings obtained during this project were not spatially consistent enough to warrant consideration as a measure of overall *O. mykiss* habitat suitability within the

assessed streams. Additionally, optimal DO levels for *O. mykiss* are not well documented and are dependent on fish age, fish activity levels, water temperature, water velocity, and concentration of substances within the water (Raliegh et al. 1984). Fluctuating water temperatures, streamflow velocities, and substrate concentrations occurring over the multi-season data collection period likely would have also diminished the reliability of this variable in determining *O. mykiss* habitat suitability.

4.2.2 HSI Variables: Water Velocity over Spawning Areas

Water velocity measurements were not conducted, and specific spawning areas were not identified during this project. Furthermore, many assessments were conducted outside of the *O. mykiss* spawning season. Water velocity data is recorded and available for a small set of streams assessed for this project via United States Geological Survey (USGS) gauging stations. However due to stream sediment movement, areas optimal to *O. mykiss* spawning are not consistent. Thus, USGS gauging stations locations were considered unreliable for applying scores for this variable.

4.2.3 HSI Variables: Riffle Substrate

This variable is intended to serve as a measure of *O. mykiss* food production within a stream (Raleigh et al. 1984). Dominant substrate types were recorded in fully assessed riffle units, however this variable was not included into habitat suitability scores. This decision was made due to the abundance of riffle units in the majority of streams assessed and the considerable number of other aspects known to influence food production in streams. For instance, organic terrestrial flora and fauna inputs not only directly contribute to the food base in streams, but also contribute to stream heterogeneity and physical conditions which extend the availability of seasonal food resources (McCabe 2011).

4.2.4 HSI Variables: Bank Stability Rating

The bank stability rating is determined by visually estimating the percent of unit bankside area containing stable rocks and rooted vegetation and is a measure of erosion control and habitat consistency. This variable was not specified for assessment under CSSHRM protocols and thus not assessed or factored into HSI scores for this project. Additionally, this variable is listed as optional by Raliegh et al. (1984).

4.2.5 HSI Variables: Streamwater pH

For this project pH was only recorded during the assessment of non-road barriers. Due to the limited and unequal distribution of pH data collected it was not scored and factored into overall *O. mykiss* habitat suitability scores. Additionally “precise pH tolerance and optimal ranges are not well documented for *O. mykiss* (Raliegh et al. 1984).

4.2.6 HSI Variables: Percent Fine Substrates

This variable is a measure of fine substrate (sand and silt) present in riffle units and spawning areas. It is specific to *O. mykiss* fry in that it affects the ability of fry to utilize substrate for cover and their ability to move out from redds and into the stream. This variable was not specified for assessment under CSSHRM protocols and thus not assessed or factored into HSI scores for this project.

4.2.7 HSI Variables: Stream Shading between 1000-1400hrs)

This variable is a detailed measure of canopy closure and solar energy input into stream habitat unit. The large scale of habitat required to be assessed for this project made collection of specific shading data unfeasible and thus this variable was not assessed or factored into HSI scores for this project. This variable is also listed as optional by Ralieggh et al. (1984).

4.2.8 HSI Variables (Annual Base and Mean Migration Streamflow)

These variables measure general summer and migration streamflow suitability conditions. Annual base streamflow is a ratio of the mean low flow to mean annual flow. Mean migration streamflow is a ratio of the mean flow during periods of seasonal upstream migration (defined as December to March) and annual mean flow. USGS streamflow gauges are located in only four of the 30 streams assessed for this project. Given this limited availability of continuous streamflow data the ratios specified for these variables were not calculated and thus these variables were not factored into overall HSI scores.

4.3 Additional Habitat Scoring Parameters

Additional parameters not specified under USFS HSI scoring were applied and factored into determining overall *O. mykiss* habitat quality scores. Descriptions of these parameters and scores applied to them are listed below.

4.3.1 Southern California Steelhead Recovery Plan Core Stream Values

The National Oceanic and Atmospheric Administration (NOAA) and NMFS developed a detailed recovery plan for the southern California Steelhead DPS and identified key recovery watersheds with the physical and hydrological characteristics most likely to sustain independently viable populations of *O. mykiss*. These watersheds were ranked with core 1, 2, or 3 designations based on the condition of present *O. mykiss* populations, spatial redundancy, severity of threats within the watershed, potential of available ecological or genetic diversity, and potential of response to recovery actions. To account for these distinctions scores were applied to watersheds based off of their core level designations (Table 13). A majority of streams assessed for this project were designated as core 1 streams. Some Conception Coast watersheds (Montecito Creek, San Ysidro Creek, Oak Creek, Romero Creek, Arroyo Paredon Creek, Picay Creek, Buena Vista Creek, Cold Springs Creek, and Hot Springs Creek) were designated as core 3 streams. El Capitan Creek was the only creek assessed without a core recovery designation.

Core Stream Value Scoring	
Category	Score
Core 1 Watershed	1
Core 2 Watershed	0.67
Core 3 Watershed	0.33
Unrated Watershed	0

Table 13

4.3.2 Salmonid Presence

Scores were also applied to streams containing and supporting current *O. mykiss* populations. These scores represent the increased viability of streams that contain resident populations available for spawning with returning steelhead. Streams observed to contain a resident *O. mykiss* population during assessments conducted for this project were provided a score of 1. Streams not supporting a resident *O. mykiss* population were not provided an additional score.

4.3.3 Large Woody Debris

The CDFW Habitat restoration manual states that Large Woody Debris (LWD) “strongly influences stream habitat characteristics and biotic composition,” with increased cover, food production, pool formation, and spawning substrate retention. To account for these benefits, scores were applied to units in which LWD was present. Scoring was based on abundance of LWD and is shown in table 14. A single overall LWD score was applied to each assessed stream based on the mean of all LWD unit scores from each stream.

Large Woody Debris Scoring	
LWD Count Per Unit	Score
> 5	1
1 - 5	0.5
LWD Not Present	0

Table 14

4.4 Barrier Assessment: FishXing Analysis, Limitations, and Modifications

FishXing software (version 3.0.20) was utilized for the analysis of detailed barrier assessment data. FishXing software is designed to evaluate fish passage through culverts by modeling fish swimming performance against culvert and stream channel hydraulics. Fish passage through open bottom structures with a natural substrate base such as bridges can also be modeled with FishXing (Caltrans). However, FishXing is not designed for analyzing fish passage over instream structures, such as low flow crossings commonly referred to as slab fords or low-water crossings (Clarkin et al. 2006). Fish passage over low-water crossings has generally been estimated by comparing the researched swimming abilities of various fish species with stream flow velocities, which are typically estimated through the use of Manning’s equation.

Manning’s equation is an empirical formula using channel characteristics such as slope, surface roughness, and cross-sectional dimensions to estimate water flow velocities through open channels at varying depths. While Manning’s equation may be useful in generating estimates of flow velocity occurring directly over uniform geometry typical of most Arizona crossings, it may not be as accurate for highly variable natural channel conditions which rarely display uniform slope, roughness, or shape. Factors providing resistance to stream flow through natural channels include substrate particle arrangement and size, sediment loads, vegetation, channel expansions and contractions, sinuosity, turbulence, and water depth. Determining and selecting a single flow resistance variable to accurately represent these many dynamic factors governing stream flow is difficult and contributes to poor stream velocity estimates (Marcus et al. 1992). Manmade structures within channels such as Arizona crossings can add to the complexity of determining an accurate and representative flow resistance variable to include in Manning’s equation. Arizona crossings structures often do not share a uniform slope or alignment with the channel they cross and can often alter upstream and downstream channel morphology through increased channelization, grade degradation, and localized scouring (Forman and Alexander 1998).

Considering these limitations of Manning’s equation in estimating stream flow velocities, we determined simulating Arizona crossings and the surrounding channel conditions with FishXing would produce a more accurate assessment of *O. mykiss* abilities to pass over these structures. To simulate Arizona crossings within FishXing we attempted to emulate the conditions of Arizona crossings with the data parameter inputs available within the software. A horizontal ellipse culvert shape was determined to be the best option available within FishXing to represent and model Arizona crossings. The bankfull

width at each assessed Arizona crossing was set as the span (width) dimension of the crossing structure. The rise (height) of the crossing was set to $\frac{1}{4}$ of the span value. With these dimensional inputs FishXing modeled fish crossing abilities as if a large and highly eccentric horizontal ellipse culvert was present in the stream channel instead of an Arizona Crossing. A visual example is depicted in figure 6. The material of each assessed Arizona crossing, generally concrete, was input as well as the associated Manning's equation value representing the material's roughness and degree of hydraulic resistance to water flow velocity. The elevations of the crossing's inlet and outlet points were used to determine the culvert slope value. Additionally, FishXing inlet control values were selected to represent characteristics of each assessed Arizona crossing. Unless unique conditions were present, a low entrance water velocity loss coefficient of 0.2 K_e was input to represent streamflow moving directly from the stream channel substrate and onto Arizona crossings. Finally, the distance measured between each Arizona crossing inlet and outlet was entered as the culvert length. An example of information entered into FishXing for an Arizona crossing on Rincon Creek is shown in figure 7.



Figure 6. Depiction of low-water crossing modeling in FishXing with large horizontal ellipse culvert.

Crossing Input

Site Info: RNC_009_R Stream Name: Rincon Creek

Fish Information

Literature Swim Speeds | User-defined Swim Speeds | Hydraulic Criteria

Fish Length: 16 in

☐ Prolonged ☒ Use Both ☐ Burst

Prolonged Speed: 13 ft/s Burst Speed: 28.6 ft/s

Time to Exhaustion: 15 min Time to Exhaustion: 20 s

Min Depth: 0.7 ft Outlet Criteria: Max Outlet Drop ft

Velocity Reduction Factors

Inlet: 1 Barrel: 1 Outlet: 1

Tailwater: Tailwater Cross Section

Culvert Information

Culvert: 1 of 1

Shape: Horizontal Ellipse Details

Rise: 10.125 Span: 40.5 ft

Material: Concrete

Entrance Type: User Specified Details

Installation: ☒ Not Embedded ☐ Depth: 0 ft ☐ Percent: 0 %

Culvert Roughness (n): 0.013

Bottom Roughness (n):

Culvert Length: 14.9 ft

☒ Inlet Bottom Elevation: 97.30 ft

☐ Culvert Slope: 6.21 %

Outlet Bottom Elevation: 96.375 ft

Fish Passage Flows

Low: 3 cfs High: 1100 cfs

Save < Back Calculate

Figure 7. Rincon Creek (RNC_009_R) low-water crossing FishXing inputs.

Bridges were modeled in FishXing as box culverts as directed by Caltrans Detailed Fish Passage Assessment Data Collection Instructions and Procedures. Material under the bridge, including natural substrate, was used to determine the appropriate Manning's value to represent roughness of culvert. The span distance of the bridge was entered to represent the width of the culvert, and the culvert height was entered as a mean distance to the underside of the road surface. As done for low-water crossings, bridge inlet and outlet elevation and station values were used to determine culvert length and slope values entered into FishXing. Representative entrance type and associated entrance velocity coefficients were entered for each detailed assessed bridge.

Stream structures containing fish passage retrofits such as baffles or weirs increase water depths and decrease streamflow velocities. This presents complicated hydraulic conditions beyond the capabilities of FishXing to model. To assess fish passage at sites with retrofits the CSSHRM suggests making multiple assessments of conditions between baffles and weirs over varying streamflow velocities. Estimation of fish passage is made by comparing fish swimming abilities to all assessed conditions. Due to the substantial amount of stream and barriers assessed for this project structures containing baffles and weirs were only provided an initial first pass assessment. Barrier status for these structures was primarily determined from their existing status within the CDFW PAD and professional judgement.

4.4.1 FishXing: Tailwater Information

The specific measurements obtained for tailwater channel cross sections were entered into FishXing for low-water crossings, bridges, and culverts. A single Manning's roughness value representing the dominate substrate of each tailwater was entered for each cross section. Downstream channel bottom slope was calculated from the tailwater elevation and downstream channel points were measured from longitudinal profiles. An example of entered tailwater cross section information is shown in figure 8.

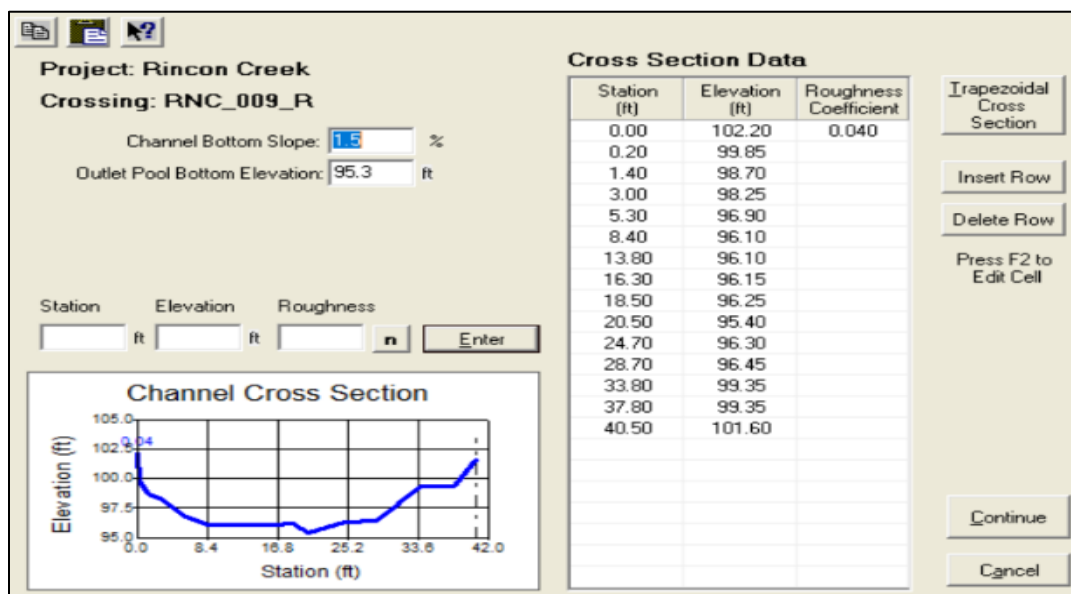


Figure 8. Rincon Creek (RNC_009_R) low-water crossing tailwater control profile FishXing inputs.

4.4.2 FishXing: *O. mykiss* Swimming Capabilities

O. mykiss swimming capability parameters entered into FishXing were drawn from a number of sources. Calculations were conducted individually for anadromous steelhead and adult resident rainbow trout. The strongest swimming capabilities according to reviewed literature were selected for anadromous steelhead representing the upper threshold limits of passage (Table 15). Selected values for adult resident rainbow trout were selected based on FishXing suggested values (Table 16).

FishXing Evaluated Anadromous Steelhead Swimming Capabilities		
FishXing Parameter	Value Assessed	Reference
Fish length	> 16 inches	Stoecker 2002
Prolonged Speed	13.7 feet per second	Powers and Osborn 1985
Time to Exhaustion	15 minutes	Hawkins and Quinn 1996
Burst Speed	28.6 feet per second	Powers and Osborn 1985
Time to Exhaustion	20 seconds	Hunter and Mayor 1986
Min Water Depth	0.7	California Department of Fish and Wildlife
Max Leap speed	26.5 feet per second	Powers and Osborn 1985

Table 15: Anadromous Steelhead swimming capabilities used in FishXing analysis.

FishXing Evaluated Adult Resident <i>O. mykiss</i> Swimming Capabilities		
FishXing Parameter	Value Assessed	Reference
Fish length	4.06 – 14.7 inches	FishXing (Jones et al. 1974)
Prolonged Speed	2.2 feet per second	FishXing (Jones et al. 1974)
Time to Exhaustion	10 minutes	FishXing (Jones et al. 1974)
Burst Speed	4.1 feet per second	FishXing (Hunter and Mayor 1986, Bainbridge 1960)
Time to Exhaustion	10 seconds	FishXing (Hunter and Mayor 1986, Bainbridge 1960)
Min Water Depth	0.5	California Department of Fish and Wildlife
Max Leap speed	11.7 feet per second	FishXing (Hunter and Mayor 1986, Bainbridge 1960)

Table 16. Adult resident *O. mykiss* swimming capabilities used in FishXing analysis.

4.4.3 FishXing: Streamflow Reduction Factors

A flow reduction factor is the ratio of fish occupied streamflow water velocity to the average streamflow water velocity at given channel cross section. Flow reduction factors are used to account for channel features which reduce streamflow water velocity and may be utilized by fish to conserve energy. According to the FishXing User Manual, flow reduction factors “vary substantially and are influenced by many factors, such as the shape and roughness of the culvert, the culvert alignment with the upstream channel, outlet conditions, and the size of the fish.” For this project, there was not sufficient data collected to specify factors capable of influencing streamflow velocity or migrating fish. Therefore, we did not incorporate flow reduction factors into FishXing analysis.

4.4.4 FishXing (Streamflow Analysis Levels)

Streamflow rate is one of the many variables factored into FishXing passage modeling. FishXing allows for modeling estimates to be made between user-set high and low rates of streamflow. The California Department of Fish & Wildlife (CDFW) guidelines specify streamflow exceedance values that determine what fish passage conditions structures should provide for. However, due to the flashy nature of streamflow in Southern California Steelhead DPS streams, exceedance values do not provide an accurate representation of the short lived streamflow spikes conducive to *O. mykiss* migration. For

example, the 1% annual exceedance flow for Carpinteria Creek is 45 ft³/s. To ensure all streamflow levels conducive to migration and possible barrier passage were evaluated in FishXing, the mean annual peak flow for each stream was set as the high evaluation flow. For Carpinteria Creek this was calculated to be 1,064.5 ft³/s. Mean annual peak flows were calculated from USGS streamflow gauge data accessible to the public (USGS 2019). Assessed streams with USGS streamflow gauges included Carpinteria Creek, Ventura River, Santa Paula River, and Matilija Creek. For assessed streams without USGS flow gauges, the mean annual peak flow was estimated with the use of a regional regression flow equation developed for the south coast region of California by the USGS (Waananen and Crippen 1977) (Figure 9). This equation provides mean annual peak flow estimations by comparing the drainage area and yearly peak flow of streams with USGS streamflow records to nearby non-gauged streams with a similar drainage area. To make estimations more robust the equation was used to make two estimated peak flow calculations based on comparisons to two individual gauged streams located nearby. The high flow rate for FishXing passage evaluation was calculated by taking the mean of these two comparisons. Arcmap GIS was used to measure the drainage area for all assessed streams.

$$Qu = Qg \left(\frac{Au}{Ag} \right)^h$$

Qu = Discharge at ungagged site
Qa = Measured discharge at nearby USGS gaged stream
Au = Drainage area of ungagged stream
Ag = Drainage area of gaged stream
^h = regionally based suggested exponent (0.14 for location of streams assessed for this project)

Figure 9. *Waananen and Crippen Regional Regression Flow Equation.*

4.5 Non-Road Barrier Analysis

To estimate the potential of natural stream features and non-road structures to present as barriers to *O. mykiss* upstream passage, the following barrier assessment conditions, as defined by CSSHRM, were considered.

1. Is the gradient of the structure less than 1?
 - Gradient = height of barrier / breadth (of streamflow over barrier)
 - Low gradients increase the jump distance required to clear the barrier and thus decrease likelihood of successful fish passage.
2. Is the maximum jumping height of anadromous steelhead *O. mykiss* (11 feet reported in Reiser and Peacock, 1985) greater than the height of the structure (measured from the surface of the water downstream of structure)?
3. Is the depth of the plunge pool downstream (directly below) of the potential barrier greater than 1.25 times the height of the structure?

The stream barrier remediation priority criteria as listed in the CSSHRM were used to determine barrier remediation rankings for this project. The objective in using these criteria was to classify man-made stream structures which limit *O. mykiss* upstream migration in order from high to low priority for remediation efforts. The ranking criteria listed below was used to assign remediation priority scores to each man-made structure assessed to limit upstream *O. mykiss* movement. Through this process barrier structures with higher scores reflect suggested higher priority for remediation efforts.

4.6 Barrier Remediation Priority Rankings

The stream barrier remediation priority criteria listed in the CSSHRM was utilized in the determination of barrier remediation rankings for this project. The objective in using these criteria was to classify each manmade stream structure assessed to limit *O. mykiss* upstream migration in order from high to low priority for remediation efforts. Ranking criteria listed below was used to assign remediation priority values to each manmade barrier structure. Through this process barrier structures with higher scores reflect suggested higher priority for remediation efforts.

4.6.1 Barrier Remediation Ranking Criteria: Barrier Severity Scores

Barrier severity scores were assigned to structures based on the degree to which they were assessed to limit *O. mykiss* upstream migration. Higher score values reflect higher severity of barrier to *O. mykiss*. For road crossing structures analyzed with FishXing, barrier severity score values were based off the estimated percent passable ranges for anadromous steelhead (Table 17). For barrier structures unable to be analyzed through the use of FishXing, assigned barrier passage statuses were used to assign barrier severity score ranges (Table 18). Professional judgement, which “plays an important part in deciding the order of barrier remediation treatment” as stated by the CSSHRM was then used to select a final point value from the established barrier passage status score ranges. Structures which were assessed to limit *O. mykiss* upstream migration to any degree in streams which currently are known to support populations of resident *O. mykiss* were assigned a barrier severity score of four or five. This score is intended to reflect the intrinsic benefits of anadromous steelhead regaining access to resident *O. mykiss* spawning reaches and populations.

FishXing Percent Passible Range	Severity Score
100% - 80%	1
79.99% - 60%	2
59.99% - 40%	3
39.99% - 20%	4
19.99% - 0%	5

Table 17. Road crossing barrier severity scoring.

Barrier Passage Status	Severity Score Range
Total	5
Temporal	1-3
Partial	2-4
Temporal & Partial	3-4
Unknown	1-5

Table 18. Non-road barrier severity scoring.

4.6.2 Barrier Remediation Ranking Criteria: Habitat Quantity Scores

Habitat quantity scores were based off the habitat quantity scoring criteria listed in the CSSHRM, which suggests 0.5 points be assigned for every 500 feet of stream deemed potentially suitable to *O. mykiss* that would become accessible if a barrier structure was remediated for *O. mykiss* passage (Table 19). Streams deemed potentially suitable to *O. mykiss* and therefor selected to be factored into the determination of habitat quantity scores were based off the following stipulations.

- Streams documented to have historically supported *O. mykiss*.
- Streams listed to contain critical *O. mykiss* habitat by NOAA and NMFS.
- Streams listed within Steelhead Assessment and Recovery Opportunities in Southern Santa Barbara County, California (Stoecker, 2002).
- Streams assumed to have potential to support *O. mykiss* based off professional judgement of CDFW and PSMFC staff with firsthand surveying experience.

Two sets of habitat quantity scores were calculated for each man-made barrier structure. The first set of habitat quantity scores were calculated from the distance within the stream to the next known upstream barrier, whether it be a man-made structure or naturally occurring feature. The second set of

habitat quantity scores were calculated from the total distance of all habitat upstream of each barrier, regardless of the presence of other upstream barriers. Barrier locations determined through assessments conducted for this report were used for habitat quantity score calculations. Existing PAD listings were used for determining habitat quantity calculations in streams not assessed for this report. In instances in which a stream did not contain PAD listings, habitat quantity calculations extended to the upstream extent of that particular stream layer. Stream distance values were determined by using Arcmap GIS to measure along stream layers.

4.6.3 Barrier Remediation Ranking Criteria: Watershed Position Scoring

Scores were also assigned to each man-made barrier based on their successional barrier location within each watershed. Through this criteria man-made barriers located upstream of other barriers received lower scores. The intention of this criteria was to reinforce the importance of remediating the most downstream located barriers limiting *O. mykiss* access to a watershed. “Steelhead passage improvement priorities should focus on [downstream] barriers prior to steelhead passage projects upstream barriers in their respective watershed, unless unique opportunities arise upstream that should be capitalized on” (Stoecker, 2002). Scoring values assigned under this criteria are listed in Table 20.

4.6.4 Barrier Remediation Ranking Criteria: Habitat Value Scores

Habitat value scores are a factor of habitat quantity scores and habitat quality as determined by HSI scores, described in section 4.1 and listed in section 5.2. Two habitat value scores were assigned to each man-made barrier structure by multiplying both of the habitat quantity scores assigned to each barrier with the HSI score assigned to the stream each barrier is located in. A final habitat value score was applied to each man-made barrier by taking the mean of its two habitat value scores.

4.6.5 Barrier Remediation Ranking Criteria: Barrier Remediation Scores

A barrier remediation score was assigned to each man-made barrier structure by adding together its barrier severity score, watershed position score, and final habitat value score.

Habitat Quantity Ranges (feet)	Score
0 – 500'	0.5
500' – 1,000'	1
1,000' – 1,500'	1.5
1,500' – 2,000'	2
2,000' – 2,500'	2.5
2,500' – 3,000'	3
3,500' – 4,000'	3.5
4,000' – 4,500'	4
4,500' – 5,000'	4.5
5,000' – 5,500'	5
5,500' – 6,000'	5.5
6,000' – 6,500'	6
6,500' – 7,000'	6.5
7,000' – 7,500'	7
7,500' – 8,000'	7.5
8,000' – 8,500'	8
8,500' – 9,000'	8.5
9,000' – 9,500'	9
9,500' – 10,000'	9.5
> 10,000'	10

Table 19. *Habitat quantity scoring criteria for barrier remediation rankings.*

Number of Barriers Downstream	Score
0	10
1	9
2	8
3	7
4	6
5	5
6	4
7	3
8	2
9	1
> 10	0

Table 20. *Watershed position scoring criteria for barrier remediation rankings.*

5.0 Results

The data collected for this project is representative of the environmental and physical conditions encountered at the time habitat and barriers were assessed. Significant changes to these conditions occurred over the course of data collection. Most notable were the fluctuations in streamflow levels. Physical changes to habitat and barrier dimensions were also experienced over the course of data collection. Additionally, data collection was prevented in some instances due to access restrictions. Discussion and analysis of these fluctuations and restrictions are provided in section 6 of this report. Summaries regarding data collected for habitat and barrier assessments and the analysis of that data are outlined in the following sections.

5.1 *O. mykiss* Habitat: Habitat Physical Measurements

A total of 1,770 habitat units were identified over all assessed streams. These units comprised 614,105.9 ft (116.3 miles) of stream channel and consisted of 359 pool units (20%), 531 flatwater units (30%), and 880 riffle units (50%). Pool units were typically much smaller than flatwater and riffle units, encompassing a total of 11,297.86 ft (1.8%) of all assessed units. Flatwater units made up 166,295.56 ft (27%) of assessed units. Many long, continuous shallow riffles were encountered and accounted for 436,512.41 ft (71%) of the units assessed. Riffle units had the greatest mean length (835.64 ± 337.2 ft [mean \pm SE]), followed by flatwater units (151.9 ± 23.3 ft [mean \pm SE]), and pool units (39.7 ± 8.44 ft [mean \pm SE]) (Figures 10 - 13).

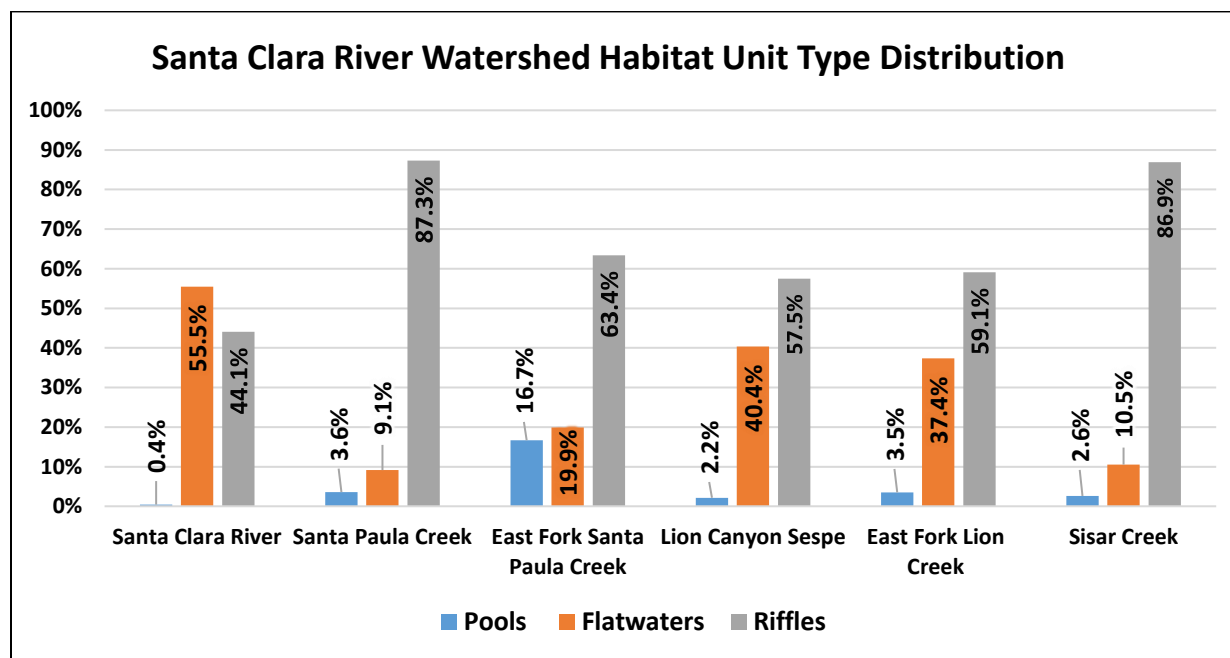


Figure 10. Santa Clara River watershed habitat unit distribution by stream assessed (calculated from unit length measurements).

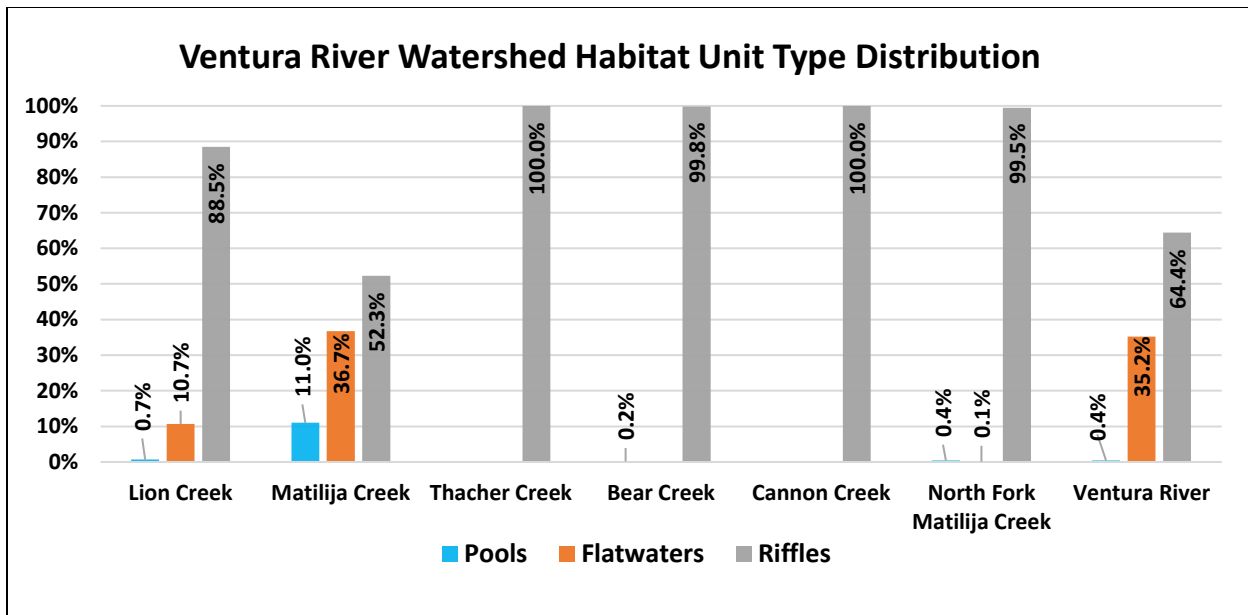


Figure 11. Ventura River watershed habitat unit distribution by stream assessed (calculated from unit length measurements).

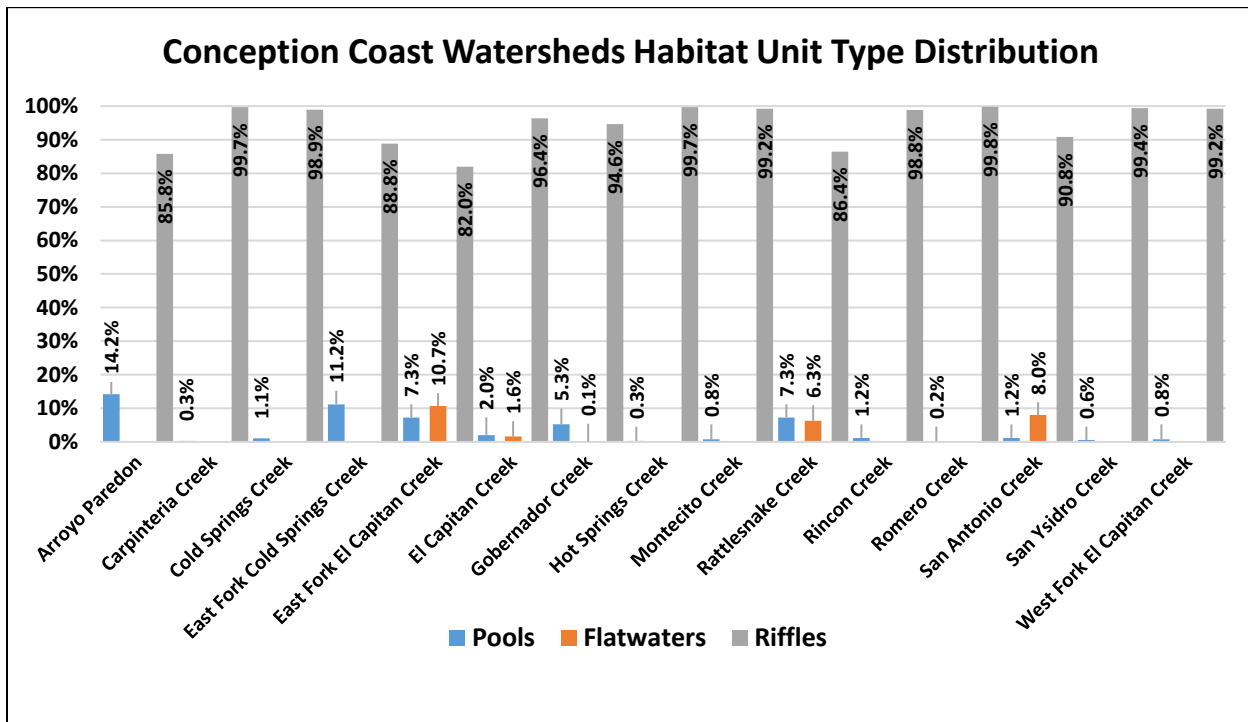


Figure 12. Conception Coast watersheds habitat unit distribution by stream assessed (calculated from unit length measurements).

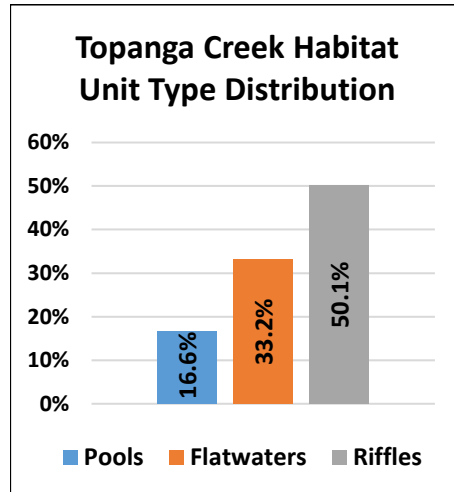


Figure 13. *Topanga Creek watersheds habitat unit distribution (calculated from unit length measurements).*

Habitat parameter values varied across streams assessed with streamflow present. The mean of max unit depths ranged from a high of 2.9 ± 0.1 ft (mean \pm SE) in Santa Paula Creek to 0.2 ± 0.2 ft in Cold Springs Creek, East Fork Cold Springs Creek, and Rincon Creek. The overall mean max unit depth of all assessed units was 1.29 ± 0.22 ft (mean \pm SE). Average mean unit depths ranged from 1.7 ± 0.1 ft (mean \pm SE) in Santa Paula Creek to 0.1 ± 0.1 ft in Cold Springs Creek and East Fork Cold Springs Creek. The overall mean unit depth of all assessed units was 0.69 ± 0.15 ft (mean \pm SE). Pool units were generally the deepest units in assessed streams. The mean depth of all assessed pool units was 1.19 ± 0.37 ft (mean \pm SE). Flatwater units had an overall mean depth of 1.04 ± 0.16 ft (mean \pm SE) and the overall mean unit depth of riffles was 0.48 ± 0.11 ft (mean \pm SE).

Presence of cover or shelter available to *O. mykiss* varied across the assessed streams, with a mean unit cover of $77.5 \pm 15.9\%$ (mean \pm SE) in Romero Creek and $5 \pm 0\%$ (mean \pm SE) in Bear Creek and Montecito Creek. Mean unit canopy distributions have a similar range to mean unit cover distribution with high mean unit canopy of $92.3 \pm 2.2\%$ (mean \pm SE) in the East Fork of Santa Paula Creek and $9 \pm 4.5\%$ (mean \pm SE) in Thatcher Creek. Gravel was the most common dominant substrate type ($n=13$) of all streams assessed, followed by silt/clay ($n=7$), boulders ($n=4$), sand ($n=3$), and small cobble ($n=1$).

5.2 *O. mykiss* Habitat Suitability Index Scores

O. mykiss habitat suitability scores ranged from 0 for Oak Creek, Picay Creek, and Buena Vista Creek which were completely dry when surveyed, to 0.649 for Sisar Creek (Figure 14). When comparing mean habitat suitability scores across the four assessed watershed areas, the Topanga Creek watershed had the highest score with 0.548, and Santa Clara River watershed had the second highest score of 0.532. The mean HSI score for the Ventura River watershed was 0.472 and 0.328 for the Conception Coast watershed.

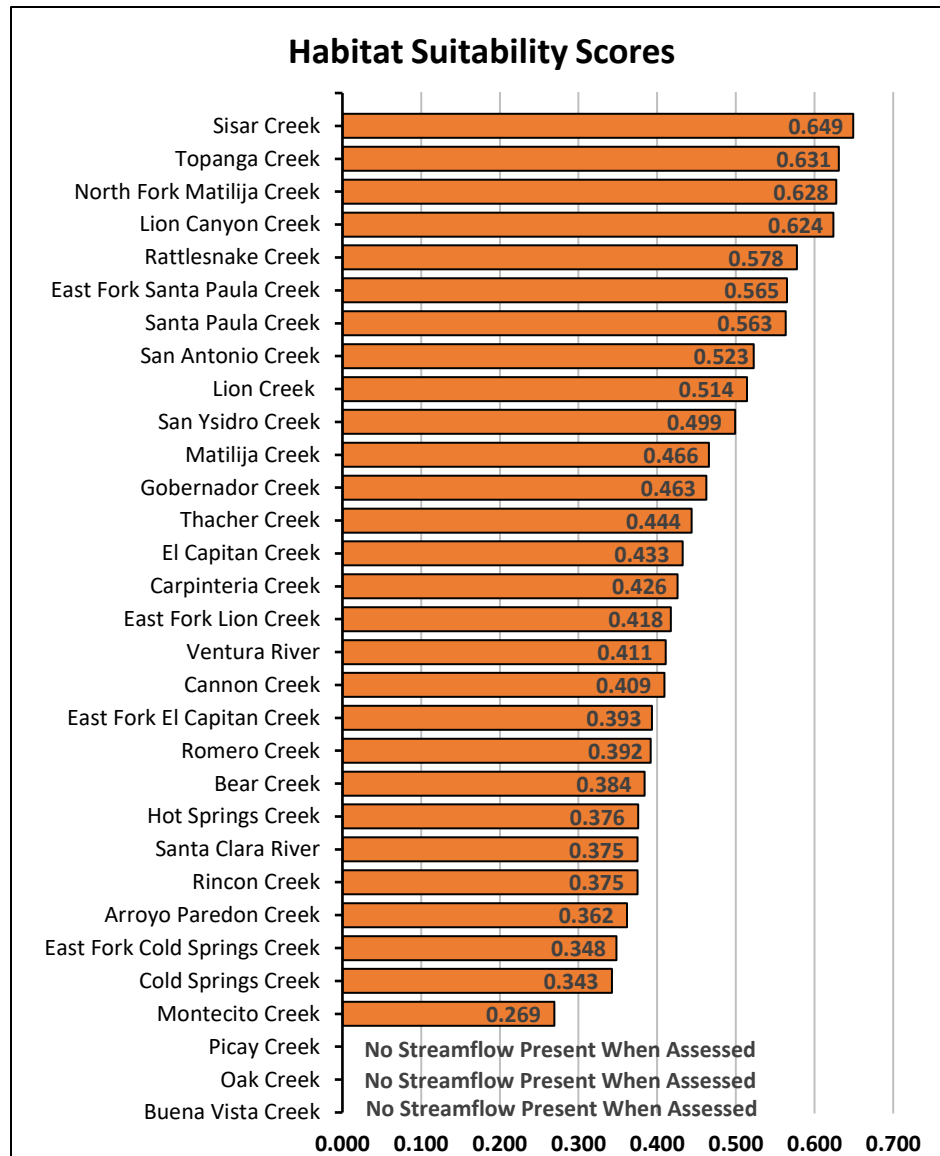


Figure 14. Assigned HSI scores for each assessed stream.

When comparing mean HSI scores for streams impacted by wildfires, our results show little variance. The average score for streams impacted by the Thomas Fire is 0.422 and average score for streams impacted by the Whitter Fire is 0.413. The Topanga and Rye wildfires were much smaller than the Thomas and Whitter wildfires and thus impacted fewer watersheds. The Topanga fire only impacted the Topanga Creek watershed and the only stream assessed for this project that was impacted by the Rye fire was the Santa Clara River, which was also impacted by the Thomas Fire.

Additional habitat suitability score comparisons were made by grouping assessed streams by various commonalities. One such grouping was that of inland tributary streams and coastal draining streams. Inland tributary streams had a slightly higher mean habitat suitability score of 0.433 when compared to coastal draining streams mean score of 0.386. Another comparison which yielded a greater gap between mean habitat suitability scores was between streams located predominantly in canyons with high degrees of topographic relief versus streams located in areas with more moderate topographic relief and wider flood plains. Canyon streams mean score was 0.487 and all other streams mean score was

0.312. Grouping of streams into these comparison categories was based on visually viewing the stream within the three dimensional topographical display within Google Earth and terrain characteristics noted during stream habitat surveys.

The mean vegetation HSI variable had the highest mean score (0.80) across all streams containing streamflow. The mean depth HSI variable produced the lowest mean score for all streams (0.12). Scores of 0 were common and apart from the mean cover variable were produced for at least one stream for all other habitat suitability variables. When solely considering HSI variables defined by Raleigh et al. (1984) *O. mykiss* cover type had the greatest variation with ten streams receiving 0 scores and seven streams receiving 1 scores.

Stream gradient values calculated for the assessed portion of each stream ranged from gentle to moderate. The assessed portion of Hot Springs Creek had the highest gradient (9.9%) and the assessed portion of Santa Paula Creek had the lowest gradient (0.27%). As is typical the upper reaches of each creek general exhibited greater gradients. When comparing stream gradients to HSI scores there appears to be very little correlation, with a coefficient of -0.078 (Figure 15).

All sightings of resident *O. mykiss* were within the upper reaches of the assessed watersheds. Streams in which resident *O. mykiss* were documented to be present included Sisar Creek, Santa Paula Creek, Lion Canyon Creek, and Topanga Creek. These streams were among the highest HSI scoring streams and together had a mean HSI score 0.617.

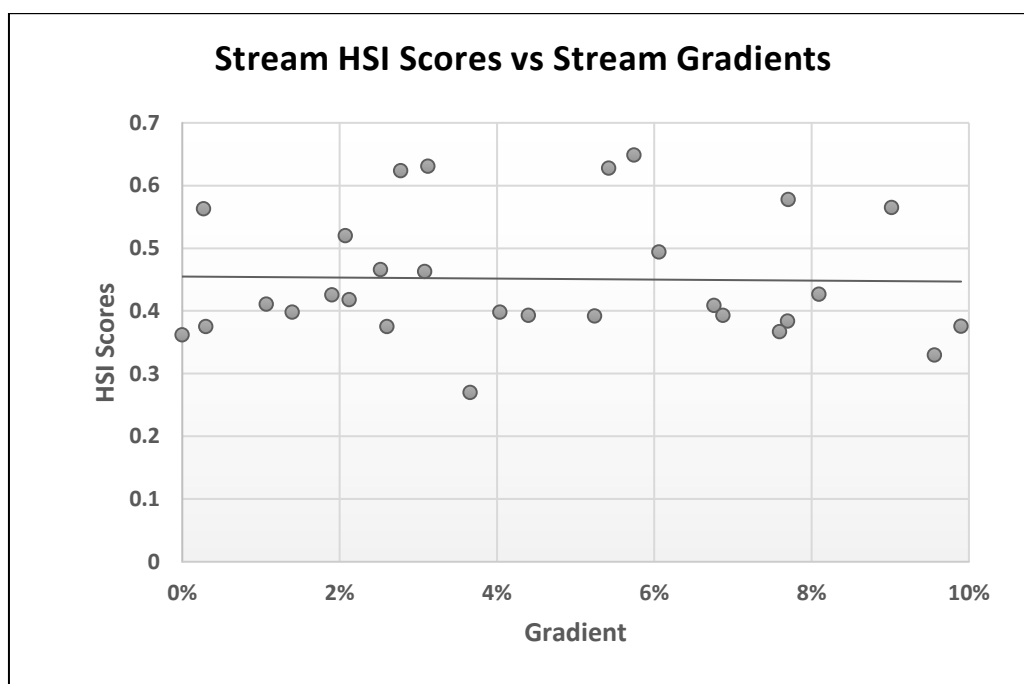


Figure 15. Low correlation of stream gradient with HSI scores.

5.3 Barrier Assessments and Barrier Remediation Scores

A total of 479 barrier assessments were conducted for this project. Out of these assessments 136 man-made structures and 125 natural features were found to constrict *O. mykiss* upstream movement to some degree. Of all man-made structures assessed to contain passage constraints, 55 (40%) of them were roadway structures. 165 of the 220 (75%) roadway structures assessed were determined to be free of *O. mykiss* passage constraints. 44 Caltrans owned structures were assessed and seven (15%) were found to contain passage constraints. Barrier remediation scores ranged from 19.6 to 2.0 with a mean of 9.8. Table 21 lists the ten barriers with the highest remediation scores.

Barrier ID	PAD ID	Stream	Remediation Score
SPL_003_NR	723742	Santa Paula Creek	19.6
RNC_001_R	707368	Rincon Creek	18.8
SPL_005_NR	705338	Santa Paula Creek	18.6
SYD_002_R	707370	San Ysidro Creek	18.35
SCL_005_NR	700025	Santa Clara River	17.8
SNT_009_R	None Assigned	San Antonio Creek	17.2
VEN_007_NR	705339	Ventura River	17.1
GOB_008_NR	706500	Gobernador Creek	16.9
ELC_002_R	707398	El Capitan Creek	16.8

Table 21. Barriers with top 10 highest remediation scores.

Detailed assessments were not able to be performed on all road crossing structures containing *O. mykiss* passage constraints. This was largely due to access restrictions associated with the private land some road crossings structures were located on. Despite attempts to contact landowners many did not respond to provide permission for detailed barrier assessments to be conducted on structures under their ownership. This limited definitive barrier determination for several structures. Additionally, changes to the condition of barriers were occasionally observed between initial first pass assessments and second pass detailed assessments. These documented changes increased the severity of some barriers while decreasing the severity of others. In a few instances passage constraints noted during first pass assessments were no longer present when second pass assessments took place. Information regarding the fluctuation of environmental and physical conditions occurring over the course of this project as well as limitations due to access restrictions are explained in the following sections.

Also provided the following sections are overviews of barrier conditions within each assessed watershed. These overviews are followed by a listing of each man-made structure assessed to constrict *O. mykiss* upstream movement within each particular watershed. Also listed in the following sections is documentation of barrier remediation within each assessed watershed. This includes instances in which PAD listings for man-made barrier structures and natural barrier features were assessed to no longer contain passage constraints. All listings are in sequential order from their downstream to upstream location. Descriptions and structure dimensions which highlight passage constraints are provided. If an assessed man-made structure has an existing listing in PAD the associated PAD identification number is listed. All structures and features assessed over the course of this project were assigned a barrier identification number regardless of their barrier status or having a PAD identification number assigned to them. These barrier identification numbers are also listed. The assessed barrier status is listed for each structure and if the structure had been assigned a previous barrier status that is listed as well. Barrier remediation scores calculated for each structure are also listed. All stream mileage distances are

approximate. Listings of all naturally occurring stream features assessed to contain passage constraints and man-made structures assessed to be free of passage constraints are listed in for their associated watershed in appendixes A, B, C, and D. Maps depicting the location of all barriers within each assessed watershed are also posted in appendixes. All Caltrans owned structures are highlighted in yellow.

5.3.1 Barrier Assessments: Santa Clara River Watershed

The Santa Clara River watershed is unique in that it's larger tributaries are a further inland than many of the tributaries in the other watersheds assessed for this project. There are roughly 16 stream miles between the Santa Clara River mouth at the Pacific Ocean and Santa Paula Creek, which is the first tributary in the watershed migrating steelhead have historically been documented to spawn in (Becker G. S. and Reining I. J. 2008). Santa Paula Creek was assessed up to a total natural barrier. Sisar Creek is a tributary to Santa Paula Creek and was also assessed up to a total natural barrier. Sespe Creek is the next major tributary and is roughly an additional 6.25 stream miles upstream of the Santa Paula Creek confluence. The Sespe Creek confluence was the upstream extent of the Santa Clara River surveyed for this project. The Sespe Creek watershed was minimally impacted by the Thomas Fire and was not assessed, but Lion Canyon Creek, a tributary to Sespe Creek was assessed. Lion creek did not contain any presence of man-made barriers and was survived up to a total natural barrier on its east fork. In total seven man-made structures were assessed to constrict *O. mykiss* passage within the assessed portion of the Santa Clara River watershed.

Santa Clara River Watershed - Santa Clara River - Vern Freeman Diversion Dam						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
SCL_005_NR	70025	34.29891, -119.10867	Partial	Partial	17.8	16 - 17

Over the 22.25 stream miles of the Santa Clara River surveyed between the Pacific Ocean and the Sespe Creek confluence the only structure assessed to contain passage constraints was the Vern Freeman diversion dam, which is owned and operated by the Bureau of Reclamation and the United Water Conservation District. Located 10.7 stream miles from the Pacific Ocean the Vern Freeman diversion dam spans 1200 feet across the river channel and a height of roughly 25 feet. The dam contains a Denil fishway and when streamflow permits operates at a 35 ft³/s to 100 ft³/s flowrate. When the dam was assessed for this project the fishway was operating. Successful steelhead passage through the fishway has been documented although not since 2012. Currently a video camera and DIDSON sonar camera are being used to document occurrences of fish passage. Streamflow not passing through the fishway primarily cascades over and down the face of the dam. Some streamflow is directed through a separate passageway for *O. mykiss* smolts migrating downstream. In previous passage assessments NOAA personnel identified insufficient fishway attraction flows as a potential limiting factor for upstream migrating steelhead (CDFW PAD). Debris blockage and strong flow velocities are other possible passage issues with the Denil fishway at this site. When the fishway is operating the Vern Freeman diversion dam should be considered a partial barrier. However, when the



Figure 16. Downstream view of Freeman Diversion Dam

fishway is not operational the dam is a total barrier. United Water is currently in the process of evaluating several possible alternative engineering designs to improve fish passage. A recent court decision (Wishtoyo et al. vs. United 2018) has mandated that a preferred design alternative be selected and submitted as a component within a draft Habitat Conservation Plan by June 2020.



Figure 17. Freeman Fish Ladder

Santa Clara River Watershed - Santa Paula Creek - Army Core of Engineers Flood Control Stream Modifications						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
None Assigned	723741	34.35152, -119.04864	Not a Barrier	Not a Barrier	NA	18
SCL_003_NR	72342	34.37555, -119.0561	Total	Unknown	19.6	18

To provide flood control for the city of Santa Paula, roughly 1.6 miles of the lowest 1.8 miles of Santa Paula Creek has been modified by the U.S. Army Core of Engineers (USACE). These modifications include concrete and boulder rip rap flood control channelization (PAD ID: 723741) and a concrete grade control structure (PAD ID: 723742). The flood control channel contained a natural streambed substrate and was assessed to be free of passage constraints. However, the confined channel was primarily void of vegetation and lacked channel complexity. 96.9 percent of the flood control channel was assessed as shallow riffle habitat with few areas likely suitable for migrating *O. mykiss* to spawn or rest. The 277-foot long grade control structure rises roughly 23 feet and is located at the upstream extent of the concrete flood control channel. A concrete steel reinforced weir and pool fishway is located in the center of the structure. Conditions within the fishway did not appear favorable to *O. mykiss* passage as all weirs were degraded and each bay contained sediment and vegetative debris accumulation causing shallow turbulent streamflow conditions. Additionally, a minimal portion of the streamflow was flowing through the fishway at the time of assessment (3/19/19), despite a streamflow rate of roughly 70 ft³/s (USGS). Considering the conditions encountered at the time of assessment this structure is likely a total barrier, but due to complexities of streamflow hydraulics in the fishway a definitive barrier status for the structure was not able to be determined. Total barrier status was assigned when this structure and fishway was previously assessed in 2005 following historic streamflow levels and flooding (Stoecker 2002).



Figure 18. USACE grade control and flood control channel on Santa Paula Creek.

Santa Clara River Watershed - Santa Paula Creek – Harvey Diversion Dam						
Barrier ID	PAD ID	Location	Pervious Barrier Status	Current Barrier Status	Remediation Score	Figures
SPL_005_NR	705338	34.39557, 119.07605	Total	Total	18.6	19 - 20

The Harvey Diversion Dam is located 3.6 miles upstream from the Santa Clara River confluence. The dam has two significant plunge points and a concrete fishway. The dam was assessed on 3/21/19 and 3/25/19. During the initial first pass assessment no water was passing through the fishway and the each fishway bay contained excessive sediment. During the follow up assessment water was passing through the fishway, but the entrance of the fishway appeared inaccessible to upstream migrating *O. mykiss*. The height to the entrance bay of the fishway was measured to be 4.2 ft. At the time of assessment the water depth below the entrance was only 1.8 feet with turbulent conditions as shown in figure 20. Under these conditions *O. mykiss* are unable to access the fishway and the dam was assigned a total barrier status. Caltrout has received funding to conduct a fish passage restoration project at the Harvey diversion dam in which the dam will be partially removed and the downstream channel stabilized with grade control structures (Caltrout).



Figure 19. Downstream view of Harvey Dam plunge points.



Figure 20. Harvey Dam fishway entrance (3/25/19.)

Santa Clara River Watershed - Santa Paula Creek – Grade Control Structures						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
SPL_007_NR	None Assigned	34.42621, -119.08852	No Status	Partial	13.95	22
SPL_008_R	723744	34.42651, -119.08941	Partial	Partial	15.6	21

Two grade control structures were assessed to constrict *O. mykiss* upstream passage on Santa Paula Creek. The initial of these two structures (SPL_007_NR) consists of large chain linked boulder riprap and is located 5.1 stream miles from the Santa Clara River confluence. These boulders create numerous plunge and cascade points with a mean height of 4.1 ft. A large pool unit is located downstream of these boulders and when assessed on 3/28/19 the mean water depth below the plunge was 2.6 ft. A majority of the stream flow was directed through a cascade on river left. Under the conditions assessed a strong steelhead could likely make successful passage through this cascade, but the stream flow velocity would likely prevent all other *O. mykiss* life stages from gaining successful passage. The other grade control (SPL_008_R) constraining *O. mykiss* upstream passage on Santa Paula Creek is a concrete structure located 5.2 stream miles from the Santa Clara River confluence. This structure is located between concrete boulder riprap channel walls and beneath a highway 150 free spanning bridge. The structure creates a distinct plunge point with a mean height of 2.3 ft. When assessed on 4/23/19 the downstream pool unit had a mean water depth of 5 ft below the plunge. This plunge point water depth should allow steelhead to jump the grade control structure and gain passage, however it is unlikely resident *O. mykiss* life stages could successfully make the jump required for passage.

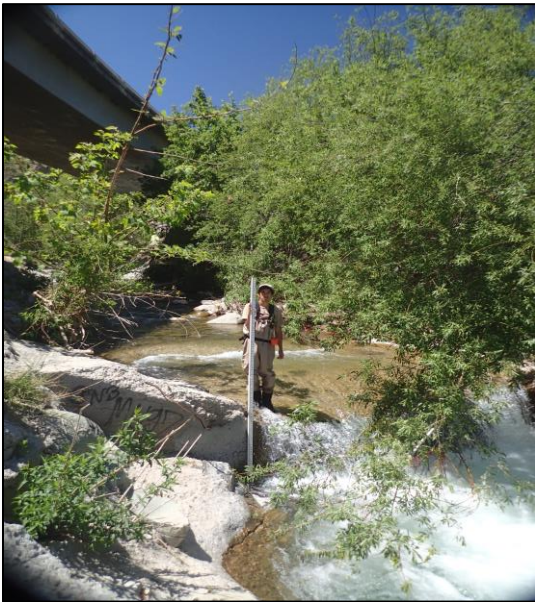


Figure 21. Concrete grade control below Hwy 150.

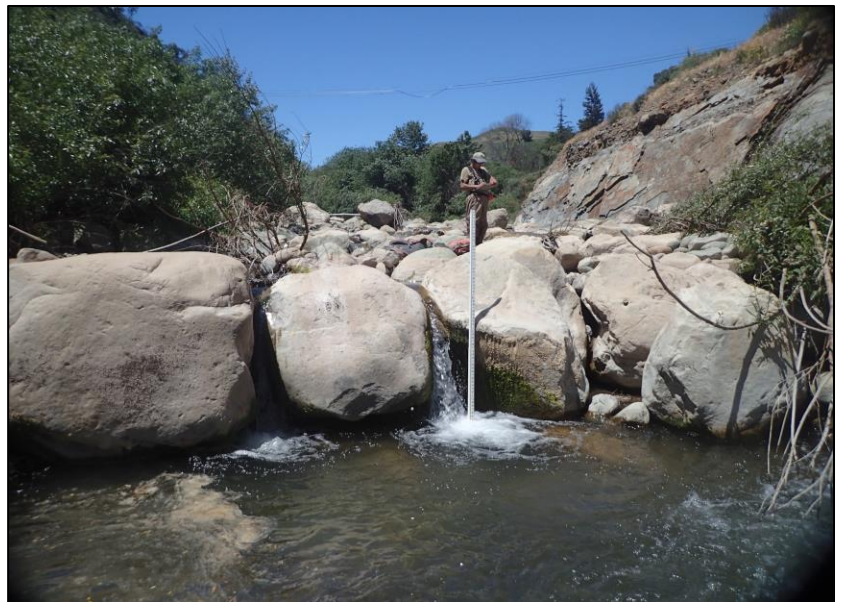


Figure 22. Boulder rip rap grade control downstream of Hwy 150 bridge.

Santa Clara River Watershed - Sisar Creek – Private Road Low-Water Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
SIS_006_R	None Assigned	34.42842, -119.11304	No Status	Unknown	16.5	23

The first structure encountered with passage constrains in assessing Sisar Creek is a private concrete low-water crossing located 1.4 stream miles from the confluence with Santa Paula Creek. When the first pass assessment was performed on 3/19/19 streamflow was shallow as it flowed over the crossing and plunged 4.8 feet to the downstream pool. A detailed 2nd pass assessment was unable to be performed due to access restrictions associated with the private property this structure is located on. A definitive barrier status determination was unable to be made due to the limited data collected at this crossing, however it is likely this structure is a temporal and partial barrier passable only at high rates of stream flow to the strongest anadromous steelhead.



Figure 23. Private road low-water crossing on Sisar Creek.

Santa Clara River Watershed - Sisar Creek – Osborn Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
SIS_008_NR	723746	34.43221, -119.12373	Partial	Temporal & Partial	14.5	24 - 26

The next structure constraining *O. mykiss* passage on Sisar Creek was the Osborn Road low-water crossing located 2.1 stream miles from the Santa Paula Creek confluence. This crossing included two corrugated steel culverts running through the concrete crossing. Both culverts are moderately damaged and had partial vegetation debris blockage. The river left culvert was more severely damaged and streamflow was passing below this culvert instead of through it. FishXing modeling predicted a steelhead could potentially pass through the culvert between streamflow rates of 68 ft³/s and 309 ft³/s. These calculations were based off conditions within an undamaged and debris free culverts, so it is likely FishXing steelhead passage calculations are an over estimation, however due to FishXing indicating possible passage this structure was deemed to be a temporal and partial barrier. This crossing was previously assessed to be a partial barrier by Stoecker in 2005.



Figures 24 – 26. Osborn Road Crossing with damaged and debris filled culverts

5.3.2 Barrier Assessments: Ventura River Watershed

The Ventura River watershed contains many streams with historical documentation of *O. mykiss* presence and spawning (Becker G. S. and Reining I. J. 2008). Due to time constraints and access restrictions not all of these streams were able to be assessed for this project. Streams within the watershed that were assessed included the Ventura River, Matilija Creek, North Fork Matilija Creek, San Antonio Creek, Lion Creek, Thatcher Creek, Bear Creek, and Cannon Creek. No man-made barriers were assessed within Lion Creek. Three major dams exist within the Ventura watershed, the Robles Diversion Dam, the Matilija Dam, and the Casitas Dam. Of these dams the Robles Diversion Dam is the only to contain an operating fishway. A considerable portion of the Ventura watershed was severely impacted by the Thomas Fire and sedimentation occurring from post fire rain events. Following the Thomas Fire the USFS assessed five streams within the Ventura Watershed containing critical *O. mykiss* habitat and determined that 85.5% of these sub-watersheds were burned (Klose, 2018). In total 28 man-made structures were assessed to contain *O. mykiss* passage constraints within the assessed portion the Ventura River watershed.

Ventura River Watershed – Ventura River – Foster Park Diversion Dams						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
VEN_007_NR	705339	34.35483, -119.30975	Not a barrier	Partial	17.1	27 & 28

The most downstream structures assessed to constrict *O. mykiss* upstream movement on the Ventura River were two small concrete diversion dams located adjacent to Foster Park, 6.2 stream miles from the Pacific Ocean. These diversion dams were previously assigned a non-barrier status by CDFW in 2009, however due to the sheeting cascade of stream flow over the downstream dam and vertical drop present at the upstream dam it was determined these structures likely prevent passage for most *O. mykiss* life stages and thus a partial barrier status was assigned. The downstream dam likely contains more difficult passage conditions than the upstream dam as reflected in assessment measurements (Table 22). During the occurrence of high rates of streamflow it is likely anadromous steelhead have the ability to pass upstream of these diversion dams.

Foster Park Diversion Dams	Mean Depth Below Plunge (ft)	Mean Height of Structure (ft)	Mean Cascade Length (ft)	Mean Breadth (ft)
Downstream Dam	2.5	2.1	7.0	6.2
Upstream Dam	7.0	2.0	2.2	1.0

Table 22. Dimensions of diversion dams near Foster Park.



Figure 27. Downstream Foster Park diversion dam.



Figure 28. Upstream Foster Park diversion dam.

Ventura River Watershed – Ventura River – Low-Water Crossing downstream of Robles Diversion						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
VEN_010_R	713899	34.4635, -119.2906	Unknown	Temporal and Partial	12.15	29

A concrete low-water crossing is located 14.5 stream miles from the Pacific Ocean and roughly 500 feet downstream of the Robles Diversion Dam. The crossing has a width 17 ft and a small plunge located at its outlet with a height of 2.2 ft at the time of assessment on 6/13/19. FishXing analysis of the crossing estimated conditions conducive to steelhead passage occurring above streamflow rates of 110 ft³/s. A temporal and partial barrier status was assigned to the crossing.



Figure 29. Concrete low-water crossing downstream of Robles diversion dam.

Ventura River Watershed – Ventura River – Robles Diversion Dam						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
VEN_011_NR	713886	34.46454, -119.29061	Remediated, fish response unconfirmed	Partial	16.1	30

The Robles Diversion Dam is located roughly 14.35 stream miles upstream from the Pacific Ocean. The dam was originally constructed in 1958 and diverts water from the Ventura River Lake Casitas reservoir. The dam was eventually retrofitted with a fish passage facility following the listing of the southern California steelhead DPS under the Endangered Species Act, but this facility did not operate to allow for upstream *O. mykiss* migration until 2006 (Casitas Municipal Water District, 2017). The current fishway facility is designed to operate at a 50 ft³/s flowrate when streamflow permits and anadromous steelhead have been documented to successfully pass upstream through the fishway, but not since 2010 (Casitas Municipal Water District, 2011). Documentation of resident *O. mykiss* life stages passage through the facility have only occurred for downstream smolts. It is unlikely a resident *O. mykiss* could pass upstream through the facility fish ladder. The dam is listed in PAD with a barrier status of “remediated, fish response unconfirmed.” This status was provided following several alterations made to improve the fish passage through the facility. Considering no *O. mykiss* have been documented passing upstream through facility since these improvements were made it was determined that the dam presents as a partial barrier.



Figure 30. Downstream view of Robles Diversion Dam. Fish ladder entrance is located at the left of image, in the wetted portion of channel.

Ventura River Watershed – Ventura River – Remediated Barriers				
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status
None Assigned	713890	34.30331, -119.30282	Unknown	No longer present, not a barrier
None Assigned	713888	34.29324, -119.30732	Unknown	No longer present, not a barrier
None Assigned	713889	34.28945, -119.30753	Unknown	No longer present, not a barrier

PAD listings for an agricultural diversion dam (PAD ID: 713890), gas utility line (PAD ID: 713888), and surface diversion (PAD ID: 713889) located within the lower reaches of the Ventura River were no longer present and thus do not constrict *O. mykiss* upstream movement.

Ventura River Watershed – San Antonio Creek – Low-Water Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure(s)
SNT_008_R	705685	34.40297, -119.28173	Temporal	Not a barrier	NA	31 & 32
SNT_009_R	None Assigned	34.40796, -119.27743	Unassessed	Unknown	17.2	33
SNT_027_R	713877	34.46728, -119.20393	Unknown	Temporal and Partial	11.2	34

San Antonio Creek is a tributary to the Ventura River with a confluence located 8 stream miles upstream from the Ventura River mouth at the Pacific Ocean. Five low-water crossings were assessed over the course of San Antonio Creek, but only two of these crossings were assessed to constrict *O. mykiss* upstream movement. Two of the other three crossings passed through the natural streambed substrate of the stream. The Fraser Street low-water crossing (SNT_008_R) was initially assessed to contain passage constraints during first pass assessments due to a significant plunge at its outlet on 10/15/18, but when surveyed for a detailed assessment on 5/16/19 the downstream pool unit had been completely filled in with sediment and the crossing was assessed to no longer constrict upstream *O. mykiss* movement. Figures 31 and 32 depicts the change due to this sediment filling.



Figures 31 & 32. Fraser Street low-water crossing prior to (left) and after sedimentation (right).

The two low-water crossings on San Antonio Creek assessed to contain passage constraints did not have PAD records indicating previous barrier status. The initial of these two low-water crossings (SNT_009_R) is located 3.2 stream miles upstream of the Ventura River confluence. Unfortunately, this crossing is private and permission to conduct a detailed assessment was not received. Without a detailed assessment being performed a definitive barrier status was not assigned. The concrete crossing contained three small cylindrical culverts encased just below the road surface, but each was completely embedded under sediment and not visible at the inlet. Due to the minimal plunge from the road surface at the outlet

this crossing is likely only a temporal barrier. The Hermitage Road crossing (SNT_027_R) is the other low-water containing passage constraints and is located at the confluence of Gridley Creek, Senior Creek, and San Antonio Creek, 9.74 stream miles upstream of the Ventura River confluence. This crossing also marks the upstream extent of San Antonio Creek. This concrete crossing also contains a single cylindrical culvert beneath the road surface. At the time of assessment this culvert was also fully embedded under sediment at its inlet. A 1.02 ft plunge was measured from the road surface outlet to the downstream unit. FishXing analysis estimated this crossing would be passable to steelhead at streamflows greater than 164 ft³/s, but deemed it unpassable to resident adult *O. mykiss*, thus resulting in this crossing being designated as a temporal and partial barrier.



Figure 33. SNT_009_NR low-water crossing on San Antonio Creek.



Figure 34. Hermitage Road low-water crossing on San Antonio Creek.

Ventura River Watershed – San Antonio Creek – Grade Control Structures						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
SNT_019_NR	None Assigned	34.45401, -119.22186	Unassessed	Temporal	11.75	35
SNT_020_NR	None Assigned	34.45418, -119.22183	Unassessed	Temporal	12.3	36

Two concrete grade control structures with 4 ft wide notches at their centers were assessed downstream of the Grand Avenue bridge crossing or 8.15 stream miles upstream of the Ventura River confluence. Each grade control extends across the entire width of the stream channel, which is lined with boulder riprap on both banks. Each grade control was also partially embedded within the channel substrate. The initial grade control (SNT_019_NR) had a mean height of 1.0 ft and the next grade control (SNT_020_NR) had a mean height of 0.7 ft. Both grade controls were assigned a temporal barrier status due to the likelihood of all *O. mykiss* life stages requiring specific streamflow rates to successfully gain passage.



Figure 35. Downstream notched grade control with Grand Avenue bridge in background.



Figure 36. Upstream notched grade control with Grand Avenue bridge in background.

Ventura River Watershed – San Antonio Creek – Remediated Barriers				
Barrier ID	PAD ID	Location	Current Barrier Status	Assessed Barrier Status
SNT_003_R	713867	34.38042, -119.3074	Temporal	Not a Barrier
SNT_008_R	705685	34.40297, -119.28173	Temporal	Not a barrier
SNT_013_R	705658	34.42695, -119.25841	Temporal	Not a Barrier
SNT_016_R	713871	34.44198, -119.23275	Partial	Not a Barrier
SNT_018_R	713873	34.44914, -119.22465	Partial	Not a Barrier
SNT_021_R	705661	34.45435, -119.22173	Temporal and Partial	Not a Barrier
None Assigned	713875	34.45856, -119.21973	Total	No longer present, not a barrier
None Assigned	713874	34.45584, -119.22162	Total	No longer present, not a barrier
None Assigned	713868	34.39035, -119.29683	Unknown	No longer present, not a barrier

Several PAD listings of barriers on San Antonio Creek were assessed to no longer constrict *O. mykiss* upstream movement. This included six road crossings and two dams. The most downstream of these structures assessed to be free of passage constraints was the highway 33 bridge crossing (PAD ID: 713867) located 0.17 stream miles upstream of the Ventura River confluence. This bridge had previously been assigned a temporal barrier status by CDFW in 2013. The Creek Road bridge crossing (PAD ID: 705658) is located 5.1 stream miles from the Ventura River confluence and had previously been assigned a temporal barrier status by the Ventura County Planning Division in 2004. The Soule Park Golf Course pedestrian crossing (PAD ID: 713871) is located 7.1 stream miles upstream of the Ventura River confluence was listed in PAD as a low-water crossing with a partial barrier status. When assessed for this project the low-water crossing was no longer present and appeared to have been replaced by a free spanning pedestrian bridge. Located 7.5 stream miles upstream of the Ventura River confluence the highway 150 bridge (PAD ID: 713873) was assessed by the city of Ojai to be a partial barrier in 2004. According to Caltrans bridge logs the current highway 150 bridge was constructed in 2010. This new bridge is free spanning over natural streambed substrate and was assessed to be free of passage constraints. Although no record could be located it appears the Grand Avenue bridge (PAD ID: 705661) located 9.36 stream miles upstream of the Ventura River confluence was also replaced at some point following its designation as a temporal and partial barrier by the city of Ojai in 2004. Assessments conducted by Entrix Incorporated in 2004 also documented the presence of two dams upstream of the Grand Avenue crossing (PAD IDs: 713875 & 713874). During assessments conducted for this project no evidence of these dams were found. Finally, a PAD listing (PAD ID: 713868) for a road crossing located 1.3 stream miles upstream of the Ventura River confluence was found to no longer be present.

Ventura River Watershed – Lion Creek – Remediated Barrier				
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status
None Assigned	713892	34.41985, -119.2444	Partial	No longer present, not a barrier

Lion Creek is a tributary to San Antonio Creek with a confluence located 4.4 stream miles upstream of the San Antonio Creek and Ventura River confluence. Lion Creek flows through private ranch property and access was only granted to the initial 1.8 stream miles of the creek. Over this portion of the creek no man-made structures were assessed to constrain *O. mykiss* upstream movement. A natural bedrock feature assessed to be a partial barrier by Entrix Incorporated in 2003 is no longer present and therefore is no longer a barrier.

Ventura River Watershed – Thacher Creek – Boardman Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
THC_001_R	705662	34.4447, -119.22289	Total	Total	15.4	37

Thacher Creek is a tributary to San Antonio Creek with a confluence located 7.3 stream miles from the San Antonio Creek and Ventura River confluence. The first barrier assessed on Thacher Creek was a large set of concrete box culverts at the Boardman Road crossing half a mile upstream from the San Antonio Creek confluence. These culverts were separated with a concrete divider and each culvert base was lined with steel plates. Each culvert also had a vertical plunge point onto a concrete outlet apron. The plunge had a uniform height of 2.5ft. The presence of the outlet apron had appeared to largely prevent the occurrence of scour in the downstream unit. As a result, the max water depth within the downstream unit was only 0.6ft when a detailed assessment was conducted at the crossing on 3/5/19. FishXing analysis estimated this lack of downstream depth would prevent all life stages of *O. mykiss* from successfully jumping over the outlet plunge and gaining passage. The total barrier status assigned matched the existing barrier status assigned to the crossing by the Ventura County Planning Division in 2004.



Figure 37. View of Boardman Road crossing culvert outlets.

Ventura River Watershed – Thatcher Creek – Grade Control Structures						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
THC_002_NR	None Assigned	34.44507, -119.22047	Unassessed	Temporal	10.3	38
THC_003_NR	None Assigned	34.44516, -119.22012	Unassessed	Temporal	9.3	39
THC_004_NR	None Assigned	34.4451, -119.21975	Unassessed	Temporal	8.3	40
THC_006_NR	None Assigned	34.44501, -119.2192	Unassessed	Temporal and Partial	11.4	41

Four grade control structures were assessed on Thatcher Creek. Three of these structures consisted of center notched steel crossbars extending across the width of a chain linked fence lined stream channel (THC_002_NR, THC_003_NR, and THC_004_NR). These three grade control structures were located within close succession of each other 0.7 stream miles from the San Antonio confluence. The mean height of these three grade control structures was 1.3ft, 1.2ft, and 0.6ft. At the time of assessment (12/20/18) no streamflow was present, however the uniform distribution of streambed substrate upstream and downstream of these three grade likely results in long shallow riffle units. Due to the lack of stream water depth that likely occurs in this part of Thatcher Creek during low rates of streamflow these three grade control structures were assigned a temporal barrier status.



Figure 38. Downstream view of THC_002_NR.



Figure 39. Downstream view of THC_003_NR.



Figure 40. Downstream view of THC_004_NR.

The fourth grade control on Thatcher Creek is a cemented boulder riprap apron structure (THC_006_NR) located 0.8 stream miles from the San Antonio Confluence. The structure expands the width of the channel which is lined with vertical cement walls. The center of structure inlet has a small “V” shaped notch. The structure was assessed to be 29ft in length and have a mean height of 2.4ft. Successful passage of the structure would likely be challenging for all *O. mykiss* life stages, however due to the narrow constricted nature of the channel at this location high rates of streamflow may create deep laminar flow conditions conducive to *O. mykiss* passage. Due to the perceived possible passage a temporal and partial barrier status was assigned to the structure.



Figure 41. Downstream view of THC_006_NR.

Ventura River Watershed – Thacher Creek – Private Bridge Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
THC_010_R	None Assigned	34.44688, -119.20334	Unassessed	Unknown	9.65	42

A private free spanning ranch bridge with a concrete cobble riprap apron below it was documented during first pass surveys located 1.7 stream miles from the San Antonio Creek confluence. Unfortunately access for a follow up detailed assessment was not granted and without such an assessment being performed a definitive barrier status could not be determined. During the first pass survey the length of the apron was estimated to be roughly 20 ft and the outlet of the apron was 2.7ft above the downstream substrate. At the time of this survey (12/20/18) no streamflow was present at this crossing, but lack of scour in the streambed downstream of the apron outlet suggests a lack of water depth at the plunge point when streamflow is present. This likely makes this private crossing and apron beneath it passable to only the strongest *O. mykiss* lifestages and only at high rates of streamflow.



Figure 42. Downstream view of private crossing and apron below it on Thacher Creek.

Ventura River Watershed – Thacher Creek – Low Water Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
THC_011_R	705681	34.44756, -119.1972	Partial	Temporal and Partial	9.4	43
THC_013_R	705680	34.45547, -119.18988	Total	Total	8.1	44
THC_015_R	None Assigned	34.46399, -119.17919	Unassessed	Temporal and Partial	3.9	45

Three low-water road crossings were assessed on Thacher Creek to present as barriers to *O. mykiss*. The McNell Road crossing (THC_011_R) is located 2.1 stream miles from the San Antonio Creek confluence and was the initial low-water crossing assessed. This crossing has a short concrete outlet apron measured to have a length of 5.9ft and a height of 1.63ft. At the time of assessment (3/22/19) riffle units were present immediately upstream and downstream of the crossings, which contribute to an increased difficulty of *O. mykiss* passage. FishXing analysis estimated an anadromous steelhead life stage *O. mykiss* would be able to successfully gain passage once stream flows were above 173 ft³/s, but also estimated the adult resident life stage would not be able to pass the crossing under any rate of stream flow. Due to this the crossing was assigned a temporal and partial barrier status. The Ventura County Planning Division had assigned the crossing a partial barrier status in 2004. The Grand Avenue crossing (THC_013_R) is located 2.8 stream miles from the San Antonio Creek confluence was the other low-water crossing assessed on Thacher Creek. The Grand Avenue crossing has a significant concrete boulder riprap outlet apron which was assessed to have a length of 121ft and a height of 25.6 ft. This outlet apron makes this crossing impassible by all life stages of *O. mykiss* over all rates of streamflow as indicated by FishXing analysis. This also matches the barrier status assigned by the Ventura County Planning Division in 2004. Finally, the Thacher Road crossing (THC_015_R) passes through the natural substrate of the streambed and is located 3.7 stream miles from the San Antonio Creek confluence. Substantially sized boulders appeared to have been placed downstream of the crossing outlet to serve as foundation for the crossing. These boulders created a cascade downstream of the crossing that was measured to be 32 ft in length and 9.3 ft in height. FishXing analysis estimated the crossing would be passable to steelhead lifestage *O. mykiss* at streamflow rates greater than 229.5 ft³/s, but not passable to resident adult *O. mykiss* lifestages. This led to a temporal and partial barrier status being assigned to the crossing.



Figure 43. Downstream view of McNell Road low-water crossing on Thacher Creek.



Figure 44. Downstream view of significant outlet apron at Grand Avenue crossing on Thacher Creek.



Figure 45. Boulder cascade downstream of the Thacher Road low-water crossing on Thacher Creek.

Ventura River Watershed – Thacher Creek – McAndrew Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
THC_014_R	705666	34.46141, -119.18349	Partial	Total	6.25	46 - 47

The McAndrew Road crossing is a free spanning bridge over a fully concrete lined channel. The concrete lining extends downstream to include a significant concrete boulder riprap apron which has a length of 33.4 ft and a height of 7.9 ft. A cascade over boulders is present at the outlet of this apron and has a height of 5.4 ft to the downstream pool unit. Additionally, the concrete lining extends upstream of the crossing to form an inlet apron measured to have a length of 25.3 ft and a height of 1.75 ft. The crossing is located 3.4 stream miles from the San Antonio Creek confluence and FishXing analysis estimated this crossing to be unpassable by all life stages of *O. mykiss* over all rates of streamflow. The total barrier status assigned from this analysis differs from the partial barrier status previously assigned to the crossing by the Ventura County Planning Division in 2004.



Figure 46. Downstream view of concrete boulder riprap outlet apron at the McAndrew Road crossing.



Figure 47. Upstream view of concrete lined inlet apron at the McAndrew Road crossing.

Ventura River Watershed – Matilija Creek –USGS Gauging Station Grade Control						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
MAT_001_NR	713885	34.48287, -119.30177	Partial	Temporal and Partial	12.95	48 - 49

Matilija Creek begins at the upstream extent of the Ventura River and the confluence point with the North Fork of Matilija Creek. A concrete boulder riprap grade control and weir gauging station is located 0.2 miles upstream of this confluence point. Moderately deep pool units are located immediately downstream and upstream of the structure which should allow strong steelhead *O. mykiss* life stages to successfully jump this structure given the gauging station record indicates perennial flow occurs at this location. All other life stages of *O. mykiss* likely would have difficulty making an upstream passage of this structure due to the moderate cascade length (6.2 ft) and breadth (5ft). Our assessment concludes that this structure continues to present as a partial barrier to *O. mykiss*.



Figure 48. Matilija Creek concrete boulder riprap grade control structure.



Figure 49. Low flow cascade point over Matilija Creek grade control structure.

Ventura River Watershed – Matilija Creek – Matilija Dam						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
MAT_002_NR	719058	34.48435, -119.3082	Total	Total	14.7	50

The defining structure on Matilija Creek is the Matilija Dam, which was constructed in 1947, and is a total barrier to all *O. mykiss* life stages. The dam has been considered obsolete for decades and aspirations to remove it led all vested parties and agencies to adopt a removal plan in 2016 (O,Neal 2016). The date in which actions begin to physical remove the dam is dependent on various removal preparation steps and funding. 17 stream miles of *O. mykiss* spawning, rearing, and foraging habitat will be reopened once the dam is finally removed as the only manmade barrier listed in PAD on Matilija Creek upstream of the dam is an low-water crossing through natural substrate with a temporal barrier status. The Matilija Dam also marks the upstream extent of Matilija Creek survived for this report.



Figure 50. Downstream view of Matilija Dam.

Ventura River Watershed – North Fork Matilija Creek – Boulder Riprap Grade Control						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
NFM_001_NR	None Assigned	34.48721, -119.30569	Unassessed	Temporal and Partial	16.3	51

The initial barrier an upstream migrating *O. mykiss* would encounter on the North Fork of Matilija Creek is a newly constructed boulder riprap grade control 0.35 stream miles from the Ventura River and Matilija Creek confluence. This boulder riprap grade control appeared to be constructed in conjunction with a Highway 33 roadway reinforcement project that was taking place at the time assessments were being made on North Fork Matilija Creek (12/10/18 – 12/13/18) located between postmile 15 and 16. Streamflow was low at the time of assessment and was being directed down a central cascade point in the grade control. The length of this cascade is 18 ft, with a height of 5.8 ft, and breadth of 15.5 ft. Additionally a small downstream pool unit was present with a mean depth of 1.0 ft. Under these conditions it is unlikely any life stage of *O. mykiss* could migrate upstream past this grade control. However higher streamflows would likely provide additional cascade and plunge points over and around the grade control as the boulder riprap did not extend across the entire width of the stream channel. This provided the rationale to assign a temporal and partial barrier status to the man-made feature. Follow up assessments would provide increased accuracy to barrier status determination, especially as the riprap nature of the grade control is likely to change shape over the occurrence of future high flow events.



Figure 51. Downstream view of boulder riprap grade control on North Fork Matilija Creek.

Ventura River Watershed – North Fork Matilija Creek – Wheeler Gorge Campground Low-Water Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
NFM_013_R	707666	34.51281, -119.27416	Total	Total	13.8	52
NFM_014_R	713883	34.51672, -119.27217	Partial	Temporal and Partial	13.3	53

The next set of barriers an upstream migrating *O. mykiss* would encounter on North Fork Matilija Creek are a set of concrete low-water crossings located within the Wheeler Gorge Campground. The initial low-water crossing (NFM_013_R) is located 4.3 stream miles from the Ventura River confluence and contains a significant cascade down a steep concrete boulder riprap outlet apron. This outlet apron is 16.7 ft in length and 9.6 ft in height. The downstream unit was a shallow pool with a mean water depth of 2.6 ft. FishXing analysis indicated the crossing to be impassable to all *O. mykiss* life stages over all rates of streamflow. This corresponds with the existing total barrier status assigned to the crossing. The 2nd low-water crossing in Wheeler Gorge Campground (NFM_014_R) is located 4.6 stream miles from the Ventura River confluence and also contains a concrete boulder riprap outlet apron. This outlet apron has a shorter length (10.2 ft) and height (2.48 ft) than the outlet apron of the initial low-water crossing. FishXing analysis estimated that a steelhead life stage *O. mykiss* would be able to pass the crossing at streamflows greater than 190 ft³/s. FishXing analysis also projected that a resident life stage *O. mykiss* would not be able to gain upstream passage of the crossing under any rate of streamflow. Due to this and the higher flows required for steelhead to successfully gain passage a temporal and partial barrier status was assigned. A partial barrier status had previously been assigned to this crossing by Entrix Incorporated in 2003. Fortunately, funding was awarded in 2018 to Earth Island Institute through the CDFW Fisheries Restoration Grant Program (FRGP) to create mitigation designs for these low-water crossing barriers (CDFW FRGP Proposal Funding Summaries).



Figure 52. NFM_013_R Wheeler Gorge Campsite low-water crossing.



Figure 53. NFM_014_R Wheeler Gorge Campsite low-water crossing.

Ventura River Watershed – North Fork Matilija Creek – Milepost 24.1 Highway 33 Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
NFM_016_R	713767	34.53671, -119.24493	Total	Total	5.5	54 - 55

California state highway 33 crosses North Fork Matilija Creek ten times. All of these crossings are free spanning bridges over natural streambed substrate assessed to be free of passage constraints, except the most upstream crossing. This highway 33 crossing consists of significant sediment fill with a moderately sized fully lined concrete box culvert running through it. The culvert was assessed to have a slope of 5.2° and a vertical plunge from the outlet apron to a shallow downstream pool unit of 10.3 ft. FishXing analysis assessed the crossing to be a total barrier to all *O. mykiss* life stages, which matches the pervious assessment status made by the Ventura County Flood Control District in 2006. Additionally, this crossing marked the upstream extent of surveys conducted for North Fork Matilija Creek due to the total barrier status and poor quality of *O. mykiss* habitat visible upstream of the crossing as shown in figure 55.



Figure 54. Downstream view of plunge at outlet of Hwy 33 culvert crossing.



Figure 55. Low quality *O. mykiss* habitat visible upstream of Hwy 33 culvert crossing.

Ventura River Watershed – North Fork Matilija Creek – Remediated Barriers				
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status
None Assigned	737363	34.48934, -119.30628	Total	No longer present, not a Barrier
None Assigned	713766	34.52852, -119.26132	Partial	No longer present, not a Barrier

Two PAD listings of barriers on North Fork Matilija Creek were assessed to no longer constrict upstream *O. mykiss* movement. A listing of a cascade barrier (PAD ID: 737363) caused by a 2006 landslide located near the Ojai Rock Quarry half a stream mile from the Ventura River confluence was determined to no longer be present. Additionally, a listing for a natural barrier (PAD ID: 713766) located 5.3 stream miles from Ventura River confluence was also assessed to no longer be present.

Ventura River Watershed – Bear Creek – Wheeler Gorge Campground Low-Water Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
BER_001_R	707652	34.51283, -119.27367	Partial	Temporal and Partial	8.85	
BER_002_R	707662	34.51312, -119.27313	Partial	Temporal and Partial	9.5	

Bear Creek is a tributary to North Fork Matilija Creek and its confluence is located within the Wheeler Gorge Campground. Within the campground there are two concrete low-water crossings across Bear Creek. These low-water crossings are located 160 ft and 329 ft from the North Fork Matilija Creek confluence. The initial low-water crossing (BER_001_R) has a 2.1 ft vertical plunge point from the road surface to the downstream substrate and FishXing analysis predicted it to be passable by steelhead life stage *O. mykiss* at streamflow rates above 60.1 ft³/s. The other low-water crossing (BER_002_R) has a concrete boulder riprap outlet apron with a length of 9.8 ft and a height of 3.6 ft. FishXing analysis predicted the this low-water crossing to be passable by steelhead above streamflow rates of 152.9 ft³/s. Both of these low-water crossings were predicted to be impassable to resident *O. mykiss* life stages over all rates of streamflow. Temporal and partial barrier statuses were assigned to both of these low-water crossings. Both crossings had previously been assigned partial barrier status by the USFS in 2001.



Figure 56. Downstream view of initial low-water crossing (BER_001_R) on Bear Creek.



Figure 57. Downstream view of BER_002_R low-water crossing on Bear Creek.

Ventura River Watershed – Cannon Creek – Forest Service Road Culvert Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
CAN_001_R	None Assigned	34.51625, -119.27724	Unassessed	Total	10	58 - 59

Cannon Creek is a tributary to the North Fork of Matilija Creek with a confluence located at the northern extent of the Wheeler Gorge Campground. The initial barrier on Cannon Creek is located 0.6 stream miles from the North Fork Matilija Creek confluence and is a gravel forest service road crossing with two small corrugated steel culverts running through it. At the time of assessment (2/21/19) both culverts contained multiple areas of damage and the inlet of the river right culvert was nearly fully embedded with woody debris. Both culverts were also partially embedded with gravel substrate and also had a small plunge at the outlet with a mean height of 1.0 ft. Both culverts had the same dimensions, diameter 4.2 ft and length 40 ft. FishXing analysis estimated this crossing to be a total barrier to all *O. mykiss* life stages over all rates of streamflow. This estimation was due to the extreme hydraulics that would occur through the small culverts at the occurrence of higher streamflow. The damage to the culverts is likely evidence of such hydraulics.



Figure 58. Outlet of culverts under forest service road on Cannon Creek.



Figure 59. View of damage within river left culvert.

Ventura River Watershed – Cannon Creek – Highway 33 Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
CAN_002_R	731525	34.51533, -119.27916	Unassessed	Temporal and Partial	4.9	60 - 61
CAN_003_R	731797	34.51496, -119.28338	Unassessed	Temporal and Partial	3.6	62

California state highway 33 crosses Cannon Creek in two locations. Side by side concrete lined box culverts with inlet and outlet aprons between wingwalls are present at both crossings. The initial of these two crossings (CAN_002_R) is located 0.7 stream miles from the North Fork Matilija Creek confluence. At the time a detailed assessment was conducted on this crossing (3/13/19) the downstream half of both culverts was partially embedded with gravel substrate. This build up of substrate extended past the outlet and caused stream water to pool within the downstream portion of each culvert. Additionally, at the inlet the center divider of the culverts had a small buildup of woody debris. The length of the river right culvert is 55.4 ft and the length of the river left culvert is 47.4 ft. FishXing analysis estimated this crossing to be passable for the steelhead *O. mykiss* life stage at streamflow rates greater than 160.2 ft³/s, but not passable for the adult resident life stage. As a result this crossing was assigned a temporal and partial barrier status. The other highway 33 crossing of Cannon Creek (CAN_003_R) is located 1.0 stream miles from the North Fork Matilija confluence. The length of the river left culvert is 42 ft and the length of the river right culvert is 44.6 ft. A small plunge with a mean height of 1.6 ft was present below the outlet apron. FishXing analysis estimated this crossing to be passable for the steelhead at streamflow rates greater than 130 ft³/s, but not passable for the adult resident life stage. As a result this crossing has also been assigned a temporal and partial barrier status.



Figure 60. View of outlet at CAN_002_R Hwy 33 crossing.



Figure 61. Debris at inlet of CAN_002_R Hwy 33 crossing.



Figure 62. Outlet of CAN_003_R Hwy 33 crossing.

5.3.3 Barrier Assessments: Conception Coast Watersheds

There is considerable variance in the abundance, severity, and type of barriers assessed to be present within the watersheds assessed along the Conception Coast in Santa Barbara County. As expected, streams located in more developed areas, particularly within the township of Montecito, contained a greater number of man-made barriers than streams located in less developed areas of the coast. In particular Montecito Creek, Romero Creek, and Hot Springs Creek all contain numerous grade control structures limiting the ability of *O. mykiss* to move upstream. On the other hand many of the man-made structures in some streams such as Carpinteria Creek and Gobernador Creek have had their passage constraints remediated. The following listings of assessed streams are organized from the furthest western located watershed to the furthest eastern located watershed along the Conception Coast.

5.3.3.1 Barrier Assessments: El Capitan Creek Watershed

The defining structure assessed to contain constraints to *O. mykiss* upstream migration within the El Capitan Creek watershed is the highway 101 crossing (ELC_002_R). This crossing is located only 0.4 stream miles from the Pacific Ocean and thus plays a significant role in determining steelhead accessibility to the watershed. The passage constraints assessed at this crossing are discussed below. The other defining aspect of the watershed in regards to barriers are the presence of multiple natural barriers within the east and west forks of El Capitan Creek. These forks were the only tributaries to El Capitan Creek assessed within the small watershed. The West Fork of El Capitan Creek was assessed up to a total natural barrier and the East Fork of El Capitan Creek was assessed beyond a total natural barrier. In total two man-made structures were assessed to contain passage constraints to *O. mykiss* within the entire watershed.

Conception Coast Watersheds – El Capitan Creek – El Capitan State Beach Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
ELC_001_R	706331	34.4607, -120.02235	Temporal	Temporal	14.45	63

The initial barrier on El Capitan Creek is a large steel corrugated pipe arch culvert encased in concrete with inlet and outlet wingwalls at the El Capitan Creek State Beach Road crossing. This crossing is located 0.2 stream miles from the creek mouth at the Pacific Ocean. At the time of assessment (2/27/19) the bottom of the culvert contained some areas of minimal damage and was partially embedded with substrate. The crossing also contained short concrete aprons at the inlet and outlet. No plunge points were present at the crossing. The culvert has a length of 28 ft, maximum height of 9.6 ft, and average width of 16 ft. FishXing analysis estimated the crossing to be passable to all life stages of *O. mykiss* at stream flow rates of 104 ft³/s. As a result the crossing was assigned a temporal barrier status, which matched the previous status assigned to the crossing by Stoecker Environmental Consulting in 2003.



Figure 63. View of outlet of El Capitan State Beach Road crossing.

Conception Coast Watersheds – El Capitan Creek – Highway 101 Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
ELC_002_R	707398	34.46397, -120.02259	Remediated, fish response unconfirmed	Unknown	16.2	64 - 65

A long concrete pipe arched culvert with inlet and outlet wingwalls runs under the highway 101 crossing located 0.4 stream miles from the Pacific Ocean. The culvert has a mean width of 11.5 ft and the height at the inlet is 13 ft and 8.3 ft at the outlet. The bottom of the culvert contains concrete center notched weirs throughout its length, which according to the crossings PAD listing were installed in 2007 to provide more favorable conditions for *O. mykiss* passage. All weir bays contained gravel and cobble sediment at the time of assessment. The culvert was previously assessed by CDFW in 2009 and a “remediated, fish response unconfirmed” status was assigned. No records of successful steelhead passage were obtained in the research conducted for this report. The sediment filling documented within the weir bays appeared to have reduced the capacity for the weirs to create conditions conducive to allowing successful *O. mykiss* passage. Turbulent streamflow was present throughout the culvert and lack of water depth within the weir bays diminished possible resting areas for any *O. mykiss* attempting to gain passage. Unfortunately, due to the complexities of streamflow hydraulics occurring between weirs within this culvert FishXing analysis could not be used and a definitive barrier status was not determined. The passage constraints documented under the conditions assessed during the first pass assessment likely limit or possibly prevent *O. mykiss* passage abilities.



Figure 64. View of culvert outlet at Hwy 101 El Capitan Creek crossing.



Figure 65. View of culvert inlet and weir at Hwy 101 El Capitan Creek crossing.

Conception Coast Watersheds – El Capitan Creek Watershed – Remediated Barriers					
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Figure
ELC_003_NR	706441	34.46444, -120.02264	Remediated, fish response unconfirmed	Not a Barrier	66
ELC_004_R	706642	34.46498, -120.02263	Remediated, fish response unconfirmed	Not a Barrier	67
None Assigned	706332	34.49875, -120.01425	Total	Not a Barrier	68

Two PAD listings on El Capitan Creek and one PAD listing on the West Fork of El Capitan Creek were assessed and confirmed to no longer constrict *O. mykiss* upstream movement. The initial of the two PAD listings on El Capitan Creek was a for a grade control structure which also supports a metal crossbar pipe over the stream channel (PAD ID: 706441). This structure is still present within the stream, but its base appeared to be buried within the streambed substrate and therefore is no longer a barrier. The PAD listing for this grade control structure indicates that it received barrier remediation treatment in 2007. As future high flow events shift streambed sediments over time the base of this grade control structure could potentially become exposed again and present as a barrier. The other PAD listing confirmed to no longer constrict *O. mykiss* movement is the El Capitan Canyon Resort road crossing (PAD ID: 706642). This crossing is a free spanning bridge over natural streambed substrate, which replaced a concrete low-water crossing in 2008. The PAD listing on the West Fork of El Captian Creek assessed to no longer be a barrier is for a culvert located under an abandoned gravel road (PAD ID: 706332). This culvert and the road it was located under was found to be completely blown out. Remnants of the culvert and road fill were present, but the stream now flows unobstructed at this location.



Figure 66. Remediated grade control structure on El Capitan Creek.



Figure 67. Remediated El Capitan Canyon Resort road crossing.



Figure 68. Upstream view of blow out forest service road on West Fork El Capitan Creek.

5.3.3.2 Barrier Assessments: Mission Creek Watershed

The only stream assessed within the Mission Creek watershed was Rattlesnake Creek, which is a tributary to Mission Creek. Seven man-made structures were assessed to contain passage constraints to *O. mykiss* on Rattlesnake Creek. Four of these structures were assessed to be total barriers. All previous barrier assessments on Rattlesnake Creek were conducted by Stoecker Environmental Consulting in 2002. There are four PAD listings for temporal barriers on Mission Creek located downstream of the Rattlesnake Creek confluence.

Conception Coast Watersheds – Rattlesnake Creek – Grade Control Structures						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
RAT_001_NR	706550	34.44837, -119.70878	Partial	Partial	12.75	69
RAT_005_NR	706551	34.45296, -119.70338	Total	Total	12.3	70
RAT_009_NR	706553	34.45582, -119.69827	None Assigned	Temporal	7.2	71

Three grade control structures were assessed to contain passage constraints on Rattlesnake Creek. The first of these structures was the initial barrier assessed on Rattlesnake Creek located just 150 feet from the confluence with Mission Creek. This grade control (RAT_001_NR) was a concrete structure and extended across the width of the stream channel. The plunge height is 3.7 ft and at the time of assessment (2/6/19) the water depth below the plunge was 4 ft. Considering streamflow was likely above average for Rattlesnake Creek at the time of assessment successful passage for resident *O. mykiss* life stages is unlikely. Due to the water depth below the plunge steelhead likely would be able to successfully jump this structure. As such a partial barrier status was assigned which matches the previous barrier status assigned to the structure. The 2nd grade control structure (RAT_005_NR) is also a concrete structure, but is located within a short and narrow 11 ft wide section of stream channel that is lined by concrete and boulder riprap for flood control. The structure is located 0.3 stream miles from the Mission Creek confluence and has a total height of 4.9 ft consisting of two plunge points creating a total cascade length of 13 ft. The water depth below the structure at the time of assessment was 4 ft. The main factor likely limiting *O. mykiss* passage of this structure is the constricted nature of the stream channel as it causes a significant increase in the turbulence and velocity of streamflow over the structure. Additionally, the water depth between the two plunge points was only 0.9 ft which also increases the difficulty of passage for upstream migrating *O. mykiss*. Due to these factors it is unlikely any life stage of *O. mykiss* could successfully pass this structure at any rate of streamflow. The total barrier status assigned matches the previously assigned barrier status. The 3rd grade control structure is also concrete structure and had a plunge height of 1.3 ft. The water depth below the plunge was 1.5 ft. This structure is located 0.7 stream miles from the Mission



Figure 71. Downstream view of RAT_005_NR grade control on Rattlesnake Creek.



Figure 70. Downstream view of RAT_005_NR grade control on Rattlesnake Creek.

Creek confluence and is listed in PAD as an obsolete diversion dam. A rusted and non-operational pump was located above the structure and the intake pipe for this pump was encased in the structure. Due to the minimal height of the plunge it is assumed all life stages of *O. mykiss* could successfully pass this structure at higher rates of stream flow. As such a temporal barrier status was assigned. The structure had previously been assigned a partial barrier status.

Conception Coast Watersheds – Rattlesnake Creek – Private Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
RAT_006_R	706552	34.45343, -119.70241	Temporal and Partial	Temporal and Partial	10.75	71

The next barrier assessed on Rattlesnake Creek is located 0.4 stream miles from the Mission Creek confluence and is a private road crossing bridge with a concrete apron under it. The outlet of the apron had a plunge point with a height of 2.6 ft and at the time of assessment (2/6/19) the water depth below the plunge was 2.2 ft. Permission to conduct a detailed assessment was not received from the private owner of the crossing. Due to the shallow and accelerated stream flow occurring over the apron it is believed resident *O. mykiss* life stages would not be able to gain upstream passage of this crossing. Steelhead *O. mykiss* life stages potentially could successfully gain passage, but likely only under specific stream flow rates. Due to this assessment the crossing was assigned a temporal and partial barrier status which matches the status assigned in 2002 by Stoecker Environmental Consulting.



Figure 71. Downstream view of private road crossing on Rattlesnake Creek.

Conception Coast Watersheds – Rattlesnake Creek – Las Canoas Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
RAT_013_R	706555	34.45769, -119.6923	Total	Total	6.3	72

The Las Canoas Road crossing is located 1.1 stream miles from the Mission Creek confluence and is a free spanning bridge over a fully concrete lined channel with a steep 26 ft long outlet apron containing a 3.8 ft plunge point at its base. At the time of assessment (2/12/19) the water depth below the plunge was 3.1 ft. The concrete streambed lining also extends 14 ft upstream from the inlet of bridge. The road crossing is located 1.1 stream miles from the Mission Creek confluence. FishXing analysis of this crossing indicated the structure is not passable to any *O. mykiss* life stages at any rate of streamflow. The total barrier status assigned to the crossing structure matches its previously assigned barrier status.



Figure 72. View of outlet apron and plunge point at Las Canoas Road crossing on Rattlesnake Creek.

Conception Coast Watersheds – Rattlesnake Creek – Dams						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
RAT_014_NR	706556	34.45964, -119.69215	Total	Total	6	73
RAT_016_NR	706558	34.46288, -119.69092	Total	Total	5.6	74

Two dam structures were assessed on Rattlesnake Creek. A concrete boulder riprap debris basin dam (RAT_014_NR) is located 1.3 stream miles from the Mission Creek confluence. A small culvert with a diameter of 4 ft is located at the outlet of the dam. Stream water flows out of this covert and onto a concrete apron which has a plunge point of 7.5 ft and at the time of assesses (2/27/19) water depth below the plunge was 1.3 ft. Due to this height of the plunge and stream flow velocities occurring at the outlet culvert and apron this dam is a total barrier to all *O. mykiss* life stages. This matches the previous barrier status assigned to the dam. The other dam (RAT_016_NR) assessed on Rattlesnake Creek consists of remnants from a dam constructed in the early 1800's that provided water to the Santa Barbara Mission. The structure is located 1.5 stream miles from the Mission Creek confluence. The center of the dam has been blown out, but a significant plunge with a height of 12.2 ft remains. The depth below this plunge was measured to be 3.3 ft. Due to the height of the plunge and turbulent stream flow channeled through it the structure remains a total barrier to all *O. mykiss* life stages.



Figure 73. View of outlet culvert at debris basin dam on Rattlesnake Creek.



Figure 74. View of old mission dam plunge point on Rattlesnake Creek.

5.3.3.3 Barrier Assessments: Montecito Creek Watershed

Montecito Creek was surveyed from its mouth at the Pacific Ocean upstream to its end point, the confluence between Cold Springs Creek and Hot Springs Creek. Both Cold Springs Creek and Hot Springs Creek were surveyed up to total natural barriers. Additionally, the East Fork of Cold Springs Creek was also surveyed from its confluence with Cold Springs Creek to a total natural barrier. The main feature limiting upstream *O. mykiss* migration within the Montecito Creek Watershed is an abundance of grade control structures. In total 11 grade control structures were assessed within the creek. All except one of these grade controls has been previously assessed and is listed in PAD. All previous passage assessments conducted within the watershed were completed by Stoecker Environmental Consulting in 2002 and 2003. The other significant structure within the watershed containing passage constraints is a large fully concrete lined debris basin. In total 26 man-made structures were assessed to contain passage constraints to *O. mykiss* within the watershed.

Conception Coast Watersheds – Montecito Creek – Flood Control Channels						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
MON_025_NR	707371	34.41833, -119.63392	Partial	Temporal and Partial	14.5	75
MON_018_NR	707372	34.42824, -119.64038	Partial	Unknown	6.7	76

The initial structure assessed to contain passage constraints to *O. mykiss* on Montecito Creek is a fully concrete lined flood control channel (MON_025_R) which begins just 380 feet from the mouth of the creek at the Pacific Ocean. This concrete lining extends 756 ft upstream and has a mean width 64 ft. To assess passage conditions the structure was modeled within FishXing as a box culvert. This analysis estimated steelhead could successfully gain passage through structure at stream flow rates of 221 ft³/s or greater, but also estimated resident life stages of *O. mykiss* would not be able to gain passage over any rates of streamflow. A temporal and partial passage state was assigned to the structure as a result of FishXing estimations. The structure had previously been assigned a partial barrier status. The other portion of Montecito Creek converted to a fully lined concrete flood control channel (MON_018_NR) begins immediately upstream of a debris basin and 1.0 stream miles upstream from the Pacific Ocean. The concrete lining extends upstream within the channel for 723 ft. A 2.6 ft wide notch which is also fully lined with concrete is located at the center of the channel and runs the length of the structure. The depth of the notch varies and occasional small weirs are present within the lower portion of the notch. It is likely this notch is intended to improve passage conditions for *O. mykiss*. The presence of the notch and weirs within it significantly add to the complexities of stream flow hydraulics occurring through this flood control channel. Due to this FishXing was not able to model this structure and perform passage analysis. As a result, a definitive passage status could not be determined for this structure. A partial barrier status was previously assigned to the structure. Excessive water velocities likely occur through this flood control channel during the occurrence of stream flow rates conducive to steelhead migration resulting in very difficult passage for even the strongest steelhead.






Figure 75. Flood control channel at mouth of Montecito Creek.







Figure 76. Flood control channel upstream of debris basin with center notch.

Conception Coast Watersheds – Montecito Creek – Grade Control Structures

The 11 grade control structures within Montecito Creek were all assessed when no streamflow was present. This limited the amount of passage assessment data which could be collected at these structures. As a result, professional judgement was largely relied on in the determination of passage status at these grade control structures. Information regarding each assessed grade control structure within Montecito Creek is listed in table 23 below.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: MON_004_NR PAD ID: 706250	34.42303, -119.63485	Temporal	Temporal & Partial	Small concrete grade control between concrete channel walls. Mean height: 2.3 ft Mean breadth: 3.3 ft Mean cascade length: 3.8 ft Remediation score: 12.1	
Barrier ID: MON_005_NR PAD ID: 706514	34.42317, -119.63528	Temporal	Temporal & Partial	Considerable concrete grade control between boulder rip rap channel walls. Mean height: 5.5 ft Mean breadth: 3.4 ft Mean cascade length: 6.7 ft Remediation score: 12.1	
Barrier ID: MON_007_NR PAD ID: 706515	34.42329, -119.63567	Temporal	Temporal & Partial	Large segments of damaged concrete grade control. Mean height: 2.5 ft Mean breadth: 0.5 ft Mean cascade length: 2.6 ft Remediation score: 10.1	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: MON_008_NR PAD ID: 706516	34.42367, -119.63586	Partial	Temporal & Partial	Concrete boulder riprap apron grade control. Mean height: 3.1 ft Mean breadth: 3.7 ft Mean cascade length: 4.8 ft Remediation score: 9.1	
Barrier ID: MON_009_NR PAD ID: None Assigned	34.42382, -119.63599	Unassessed	Temporal & Partial	Long concrete grade control between concrete walls. Mean height: 3.3 ft Mean breadth: 48.3 ft Mean cascade length: 48.6 ft Remediation score: 9.1	
Barrier ID: MON_010_NR PAD ID: 706517	34.4244, -119.63633	Partial	Temporal	Concrete boulder riprap grade control. Mean height: 3.1 ft Mean breadth: 3.2 ft Mean cascade length: 4.6 ft Remediation score: 7.4	
Barrier ID: MON_011_NR PAD ID: 706518	34.42477, -119.63644	Partial	Temporal & Partial	Concrete boulder riprap grade control. Mean height: 3.1 ft Mean breadth: 4.7 ft Mean cascade length: 6.2 ft Remediation score: 7.4	





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: MON_012_NR PAD ID: 706519	34.42541, -119.63667	Partial	Temporal	Small concrete boulder rip rap grade control Mean height: 2.5 ft Mean breadth: 4.4 ft Mean cascade length: 4.5 ft Remediation score: 5.4	
Barrier ID: MON_013_NR PAD ID: 706520	34.42567, -119.63742	Partial	Temporal & Partial	Concrete boulder riprap grade control. Mean height: 3.8 ft Mean breadth: 3.8 ft Mean cascade length: 7.0 ft Remediation score: 5.4	
Barrier ID: MON_014_NR PAD ID: 706521	34.42571, -119.63815	Partial	Temporal & Partial	Small concrete boulder rip rap grade control. Mean height: 2.5 ft Mean breadth: 1.0 ft Mean cascade length: 2.6 ft Remediation score: 4.4	
Barrier ID: MON_016_NR PAD ID: 706523	34.42691, -119.63943	Partial	Temporal & Partial	Small concrete boulder rip rap grade control at outlet of debris basin. Mean height: 1.1 ft Mean breadth: 1.2 ft Mean cascade length: 1.6 ft Remediation score: 3.4	

Table 23. Grade control structures on Montecito Creek.

Conception Coast Watersheds – Montecito Creek – Private Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
MON_015_R	706522	34.42601, -119.63842	Partial	Total	6.4	77

A private bridge crossing located 0.8 stream miles from the Pacific Ocean was assessed to contain passage constrains to *O. mykiss*. The bridge itself was free spanning, but the structure included a fully lined concrete and boulder riprap channel with a 2.6 ft plunge point at its outlet. The channel lining extended upstream and downstream of the bridge and has a total length of 39.6 ft. No stream flow was present at the time of assessment (10/29/18), but minimal scour below the plunge point indicates a likely difficult jump conditions at the plunge point during the occurrence of migration streamflow rates. FishXing analysis of the crossing estimated the structure to be unpassable to all life stages of *O. mykiss*. As a result the crossing structure was assigned a total barrier status.



Figure 77. View of outlet at total barrier private road crossing/grade control on Montecito Creek.

Conception Coast Watersheds – Montecito Creek – Private Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
MON_017_NR	706251	34.42792, -119.64035	Partial	Unknown	6.4	

A large fully concrete lined debris basin is located 0.9 stream miles from the Pacific Ocean on Montecito Creek. The debris basin contains a wide and steep inlet apron leading into the basin. The height of this apron is 21 ft. The entire length of the structure is 512 ft. A steel slate fishway is located on the river left side of the basin. The previous assessment of the basin indicated a general lack of stream flow through the fishway. No streamflow was present at the time of assessment and the functionality of the fishway could not be determined. As a result, no definitive barrier status could be assigned to the structure. The debris basin and fishway leads directly into to an extended concrete flood control channel (MON_018_NR). The combination of passage constraints present between the debris basin, its fishway, and the upstream flood control channel likely greatly limit upstream passage of all life stages of *O. mykiss* and may present as a total barrier. Extending the fishway upstream past the inlet of the flood control channel would likely greatly improve the chances for successful *O. mykiss* passage.



Figure 78. Upstream view of debris basin and inlet apron on Montecito Creek.



Figure 79. View of debris basin outlet and fishway entrance on Montecito Creek.

Conception Coast Watersheds – Montecito Creek – Remediated Barriers						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
MON_022_NR	706527	34.43521, -119.64404	Partial	Not a barrier	NA	80
MON_023_NR	706528	34.43898, -119.64706	Partial	Not a barrier	NA	NA




Two PAD listings of grade control structures presenting as barriers to *O. mykiss* on Montecito Creek were assessed to no longer contain passage constraints. One of these grade controls is no longer present within the channel (MON_023_NR) and the top of the other grade control structure is level with the stream substrate (MON_022_NR). It is possible this control structure was buried or severely damaged during the extreme debris flow event following the Thomas Fire. Future high stream flow events may cause scouring to occur within the stream channel. If enough sediment is removed through scouring the remnants of this grade control structure has potential to become a barrier to *O. mykiss* again.






Figure 80. Remnants of MON_022_NR grade control structure.

Conception Coast Watersheds – Hot Springs Creek – Grade Control Structures

Hot Springs Creek is similar to Montecito Creek in that it contains numerous grade control structures which limit the ability of *O. mykiss* to migrate upstream. In total six grade control structures and two areas of flood control channel were assessed to contain passage constrains. Hot Springs Creek also lacked the presence of stream flow when assessed making barrier status determination of grade control structures primarily dependent on professional judgment. Information regarding each assessed grade control structure within Hot Springs Creek is listed in the table 24 below.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: HSP_002_NR PAD ID: None Assigned	34.44499, -119.64916	Unassessed	Temporal	Concrete boulder riprap grade control. Mean height: 6.0 ft Mean breadth: 15.3 ft Mean cascade length: 16.5 ft Remediation score: 5.15	
Barrier ID: HSP_003_NR PAD ID: None Assigned	34.44533, -119.64877	Unassessed	Temporal	Small and damaged concrete boulder riprap grade control. Mean height: 2.4 ft Mean breadth: 3.0 ft Mean cascade length: 3.5 ft Remediation score: 3.15	
Barrier ID: HSP_004_NR PAD ID: None Assigned	34.44533, -119.6487	Unassessed	Temporal	Partially damaged concrete boulder riprap grade control. Mean height: 3.2 ft Mean breadth: 4.6 ft Mean cascade length: 6.6 ft Remediation score: 3.15	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: HSP_006_NR PAD ID: None Assigned	34.44608, -119.64745	Unassessed	Temporal & Partial	Concrete grade control between wing walls with vertical plunge. Mean height: 2.5 ft Mean breadth: 0.8 ft Mean cascade length: 2.0 ft Remediation score: 4.05	
Barrier ID: HSP_010_NR PAD ID: None Assigned	34.44831, -119.64654	Unassessed	Total	Damaged concrete streambed channel lining grade control with vertical plunge. Mean height: 6.6 ft Mean breadth: 2.0 ft Mean cascade length: 7.2 ft Remediation score: 5.95	
Barrier ID: HSP_011_NR PAD ID: None Assigned	34.44896, -119.64626	Unassessed	Temporal	Concrete boulder riprap grade control downstream of East Mountain Drive bridge crossing. Mean height: 5.6 ft Mean breadth: 14.7 ft Mean cascade length: 14.9 ft Remediation score: 5.4	

Conception Coast Watersheds – Hot Springs Creek – Flood Control Channels						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
HSP_008_NR	None Assigned	34.44626, -119.64736	Unassessed	Temporal and Partial	5.05	81
HSP_009_NR	None Assigned	34.44646, -119.64725	Unassessed	Temporal and Partial	4.15	82

Two relatively short portions of stream channel within Hot Springs Creek are fully lined with concrete boulder riprap for flood control. These flood control channels are located roughly 250 ft from each other and 0.3 stream miles from the Montecito Creek confluence. The initial of these two flood control channels (HSP_008_NR) has a length of 75 ft and a small 3.4 ft plunge point at its outlet. The other flood control channel (HSP_009_NR) has a length of 126 ft and a plunge point of 2.6 ft at its outlet. The concrete lining of the stream bed in these locations increase the difficulty of passage for all *O. mykiss* life stages as it limits stream flow dynamics and depth while also increasing streamflow velocity. It is likely these structures are only passable at higher rates of streamflow. A temporal and partial barrier status was assigned to each flood control channel.



Figure 81. Downstream view of HSP_008_NR flood control channel.



Figure 82. Downstream view of HSP_009_NR flood control channel.

Conception Coast Watersheds – Cold Springs Creek – Debris Basin						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
CSP_003_NR	706530	34.45003, -119.65356	Total	Total	5.9	84

The only man-made structure assessed to contain passage constraints to *O. mykiss* on Cold Springs Creek was a concrete boulder riprap lined debris basin located 0.6 stream miles from the Montecito Creek confluence. A culvert was located at the outlet of the basin, but was not passable to *O. mykiss* due to concrete apron at the outlet of the culvert with a height of 10.1 ft. The mean height of the basin structure was 27.6 ft. A total barrier status was assigned to the debris basin. It is highly unlikely any life stage of *O. mykiss* could successfully pass upstream of this debris basin.



Figure 84. View of debris basin outlet on Cold Springs Creek.

5.3.3.4 Barrier Assessments: Oak Creek Watershed

Oak Creek was surveyed from its mouth at the Pacific Ocean upstream 1.4 stream miles to an extended culvert structure assessed to be a total man-made barrier. Oak Creek was the only stream assessed within the small watershed. In total seven man-made structures were assessed to constrict or prevent *O. mykiss* upstream passage on Oak Creek. No streamflow was present during first pass assessments conducted on 11/14/18 and only a trickle of streamflow was present at the time of detailed assessments conducted on 3/5/19. Due to the lack of streamflow, professional judgment was primarily relied upon to assign barrier status to structures in which a detailed assessment could not be performed for.

Conception Coast Watersheds – Oak Creek – Flood Control Channel						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
OAK_001_R	None Assigned	34.41998, -119.62647	Unassessed	Total	11	85

The initial structure assessed to limit *O. mykiss* upstream migration on Oak Creek is a fully concrete lined flood control channel and is located at the mouth of the creek. This flood control channel was measured to have a length of 213.3 ft and a uniform width of 12.1 ft. A small concrete and boulder riprap apron was present at the outlet and the concrete lining ran under the Fernald Point Lane road crossing bridge. FishXing was used to assess the structure by modeling it as a box culvert and estimated accelerated stream flow velocities occurring during high rates of stream flow through the narrow channel would prevent all life stages of *O. mykiss* from gaining successful passage. As a result, a total barrier status was assigned to the structure.



Figure 85. Downstream view of flood control channel at mouth of Oak Creek and Fernald Point Lane bridge.

Conception Coast Watersheds – Oak Creek – North Jameson Lane Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
OAK_004_R	None Assigned	34.42126, -119.62572	Unassessed	Temporal & Partial	11	86

The North Jameson Lane Road crossing is a free spanning bridge crossing over two small concrete grade control structures. Each of these structures had a mean height of 2.0 ft. This crossing is located 0.1 stream miles from the Pacific Ocean. FishXing was used to assess *O. mykiss* passage abilities and estimated steelhead are likely to gain passage at streamflow rates greater 86.1 ft³/s, but also estimated resident *O. mykiss* life stages would not be able to gain passage at any rate of streamflow. A temporal and partial barrier status was assigned to the crossing to reflect this assessment.



Figure 86. View of inlet of North Jameson Lane bridge.

Conception Coast Watersheds – Oak Creek – Palmer Lane Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
OAK_006_R	None Assigned	34.42259, -119.62677	Unassessed	Temporal & Partial	10	

The Palmer Lane crossing is located 0.3 stream miles from the Pacific Ocean and is a bridge over a fully concrete lined box culvert with inlet and outlet aprons. The length of the culvert is 36.1 ft, with a uniform width of 10.5 ft, and mean height of 6.3 ft. FishXing analysis of this culvert estimated steelhead were likely to gain passage at streamflow rates greater than 54.2 ft³/s, but also estimated the crossing would not be passable to resident *O. mykiss* life stages. This analysis was reflected with a temporal and partial barrier status being assigned to the crossing.



Figure 87. Downstream view of Palmer Lane road crossing culvert.

Conception Coast Watersheds – Oak Creek – Hixon Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
OAK_007_R	None Assigned	34.42359, 119.62698	Unassessed	Temporal & Partial	9	88

The Hixon Road crossing is located 0.4 stream miles from the Pacific Ocean and is similar to the Palmer Lane crossing in that it is a fully lined concrete box culvert with inlet and outlet aprons. It is different from the Palmer Lane crossing in that its orientation is not consistent. The length of culvert is 42.7 ft, has a uniform width of 7.0 ft, and mean height of 10 ft. FishXing analysis of this culvert estimated steelhead were likely to gain passage at streamflow rates greater than 55.1 ft³/s, but also estimated the crossing would not be passable to resident *O. mykiss* life stages. This analysis was reflected with a temporal and partial barrier status being assigned to the crossing.



Figure 88. Hixon Road crossing concrete box culvert.

Conception Coast Watersheds – Oak Creek – Santa Rosa Lane Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
OAK_016_R	None Assigned	34.43283, -119.63151	Unassessed	Total	11	89

The Santa Rosa Lane crossing also contains a fully concrete lined box culvert with inlet and outlet aprons located between vertical concrete wingwalls. The outlet apron also contains boulder riprap and extends 47.4 ft downstream from the culvert outlet. The outlet apron has a considerable height of 7.8 ft. The culvert has a length of 23.1 ft, uniform width of 17.5 ft, and mean height of 8.7 ft. FishXing analysis estimated the height and length of the outlet apron makes the structure impassable to all life stages of *O. mykiss* at all rates of streamflow and thus is a total barrier.



Figure 89. View of boulder and concrete outlet apron at Santa Rosa Lane crossing on Oak Creek.

Conception Coast Watersheds – Oak Creek – Private Bridge Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
OAK_019_R	None Assigned	34.43559, -119.63183	Unassessed	Unknown	7	90

A private bridge crossing over concrete and boulder riprap lined streambed is located 1.2 stream miles from the Pacific Ocean. The mean height of the bridge above the streambed was 10.5 ft. Unfortunately access restrictions prevented a detailed assessment from being performed and no definitive barrier status could be assigned. However, the streambed lining did not have a steep slope or any distinctive plunge points so it is unlikely this crossing structure is anything greater than a temporal barrier.



Figure 90. Private bridge crossing with concrete streambed lining on Oak Creek.

Conception Coast Watersheds – Oak Creek – Extended Box Culvert						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
OAK_020_R	None Assigned	34.43678, -119.63182	Unassessed	Total	9	91

The inlet of an extended fully concrete lined box culvert is located 1.3 stream miles from the Pacific Ocean. This culvert runs underground for approximately 12,000 ft and crosses under both California state highway 192 and San Ysidro Road. A steep concrete outlet apron is also present between concrete channel walls. The uniform width of the culvert is only 8.0 ft and the height at the outlet is only 5.0 ft. Multiple storm drains empty rainwater into the culvert. The confined dimensions of the culvert prevented a detailed assessment from being performed. Despite the lack of detailed assessment it is highly unlikely any life stage of *O. mykiss* could overcome the accelerated velocity of water flow that occurs through this culvert and down the outlet apron. Due to the total barrier status assigned to this culvert and the low quality of *O. mykiss* habitat assessed through Oak Creek no surveys were conducted upstream of this structure on Oak Creek.



Figure 91. Outlet of extended total barrier box culvert on Oak Creek.

5.3.3.5 Barrier Assessments: San Ysidro Creek Watershed

San Ysidro Creek was surveyed from its mouth at the Pacific Ocean upstream 3.2 stream miles to a total natural barrier. San Ysidro Creek was the only stream assessed within the small watershed. A total of four man-made structures were assessed to constrict *O. mykiss* upstream migration on San Ysidro Creek. As was the case with many of the Conception Coast watersheds a lack of streamflow at the time of assessments limited data collection and professional judgment was primarily relied upon to assign barrier status to structures in which a detailed assessment could not be performed for.

Conception Coast Watersheds – San Ysidro Creek – Fernald Point Lane Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
SYD_002_R	707370	34.42031, -119.62394	Partial	Temporal and Partial	18.35	92

The Fernald Point Lane crossing of San Ysidro Creek is a free spanning bridge over a fully concrete and boulder riprap lined stream channel. The bridge contains a small outlet apron constructed within the concrete channel lining with a length of 4.7 ft and a mean height of 1.0 ft. The mean height of the bridge above the streambed was 5.6 ft and its span across the stream was a uniform 23.5 ft. FishXing analysis estimated streamflow depth and velocity would be conducive to steelhead upstream passage at rates above 295.86 ft³/s. FishXing analysis estimated the crossing structure to be unpassable to resident *O. mykiss* life stages leading to a temporal and partial barriers status being assigned.



Figure 92. View of inlet at Fernald Point Lane Crossing on San Ysidro Creek.

Conception Coast Watersheds – San Ysidro Creek – Grade Control Structures						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
SYD_002_NR	706505	34.43866, -119.62014	Partial	Temporal and Partial	14.35	93
SYD_003_NR	706506	34.43879, -119.62024	Not a barrier	Temporal and Partial	14.1	94

San Ysidro Creek contains two concrete boulder riprap grade control structures which were assessed to limit *O. mykiss* upstream movement. These two grade controls are located 85 ft from each other and 1.5 stream miles from the Pacific Ocean. Both grade controls span the entire width of the channel, which is lined with cement and brick walls. Both grade controls also contain vertical plunge points with a mean height of 4.5 ft at the downstream grade control (SYD_002_NR) and a mean height of 2.4 ft at the upstream grade control (SYD_003_NR). Both structures were assigned a temporal and partial barrier status.



Figure 93. Plunge of SYD_002_NR grade control.



Figure 94. Plunge of SYD_003_NR grade control.

Conception Coast Watersheds – San Ysidro Creek – Debris Basin Structures						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
SYD_007_NR	706510	34.44924, -119.62268	Total	Total	13.45	95

San Ysidro Creek contained a debris basin located 2.4 stream miles from the Pacific Ocean. A large concrete boulder riprap apron with a cylindrical culvert running through it is located at the outlet of the debris basin. The height of the apron was measured at 26.4 ft with a cascade length of 27 ft. The culvert runs through the middle portion of the apron and is assumed to be impassable to all life stages of *O. mykiss* due to excessive and turbulent water velocities that would occur through the culvert and down the face of the outlet apron during migration streamflow rates.



Figure 95. Debris basin outlet culvert and apron on San Ysidro Creek.

Conception Coast Watersheds – San Ysidro Creek – Remediated Barriers					
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Figure
None Assigned	706502	34.41944, -119.62520	Partial	No longer present, not a barrier	NA
None Assigned	706509	34.44927, -119.62250	Total	Not a barrier	NA
SYD_017_NR	706513	34.4624, -119.6240	Partial	No longer present, not a barrier	NA

Three of the listings within PAD for barriers on San Ysidro Creek were assessed to no longer constraint *O. mykiss* upstream movement. The initial of these listings was for a small concrete structure (PAD ID: 706502) located near the mouth of the creek. No evidence of this grade control structure was found. It is possible this structure has been buried under the streambed sediment. If this is the case future scouring could cause the structure to re-exposed and potential become a barrier again. A utility crossing located just downstream of the San Ysidro debris basin was listed in PAD as a total barrier (PAD ID: 706509). When assessed for this project a pipe utility crossing was present, but was suspended above the stream channel as shown in figure 95. Finally a listing for a natural boulder waterfall (PAD ID: 706513) located in the upper reaches of the watershed was found to no longer be present.

5.3.3.6 Barrier Assessments: Romero Creek Watershed

Three streams were assessed within the Romero Creek watershed. Romero Creek was surveyed from its mouth at the Pacific Ocean upstream 3.5 stream miles to a total natural barrier. Buena Vista Creek was surveyed from its confluence with Romero Creek upstream 1.8 stream miles to the Park Lane crossing. Picay Creek was surveyed from its confluence with Romero Creek upstream 0.6 miles to a private road crossing. The defining aspect limiting upstream *O. mykiss* movement within the watershed was the abundance of grade control structures, especially on Romero Creek. In total 41 man-made structures were assessed to constrict *O. mykiss* movement within the watershed. None of the barriers assessed in the watershed had been previously assessed.

Conception Coast Watersheds – Romero Creek – Flood Control Channel						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
ROM_000_NR	None Assigned	34.41948, -119.62115	Unassessed	Unknown	16.05	96

The initial structure assessed to present as a barrier to *O. mykiss* attempting to move upstream was fully concrete lined flood control channel that extended approximately 900 ft from the creek mouth. The channel had a mean width of 34 ft, but did not follow a linear path. The lack of uniform orientation likely has specific effects on streamflow occurring within the flood control channel that FishXing cannot accurately model. Due to this a definitive barrier status could not be determined. Significant streamflow is likely necessary to create adequate water depth necessary for steelhead passage attempts. It is possible significant rates of streamflow could cause high water velocities which could prevent successful steelhead passage.



Figure 96. Flood control channel at mouth of Romero Creek.

Conception Coast Watersheds – Romero Creek – Loureyo Road Low-Water Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
ROM_005_R	None Assigned	34.42324, -119.61584	Unassessed	Temporal and Partial	11.15	97

The Loureyo Road crosses Romero Creek 0.5 stream miles from the Pacific Ocean. The crossing is a concrete low-water crossing with two small cylindrical culverts encased in the concrete. At the time of assessment (12/6/18) the inlets to both of these culverts were buried under streambed substrate. A pool unit with a mean depth of 1.5 ft was present at the outlet of the culverts despite active streamflow in the stream. FishXing analysis estimated steelhead could successfully pass the crossing at streamflow rates greater than 143.8 ft³/s, but estimated the crossing to be unpassable to resident *O. mykiss* life stages at any rate of streamflow. A temporal and partial barrier status was assigned to reflect this analysis.



Figure 97. Loureyo Road low-water crossing on Romero Creek.

Conception Coast Watersheds – Romero Creek – Sheffield Drive Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
ROM_006_R	None Assigned	34.42319, -119.61308	Unassessed	Temporal and Partial	11.05	98 - 99

Sheffield Drive crosses Romero Creek 0.7 stream miles from the Pacific Ocean. The crossing is a bridge over a partially concrete lined box culvert. The box culvert was unique in that it contained a concrete grade control structure in the center of its base. The grade control has a plunge height of 1.9 ft, with enough scouring below it to create a small pool unit within the culvert. At the time of assessment (12/6/18) the mean water depth in this pool was 1.2 ft. The grade control structure has a concrete apron that extends to the inlet of the culvert. The culvert had a length of 35 ft, uniform width of 15.4 ft, and mean height of 9.7 ft. FishXing analysis estimated the crossing to be passable to steelhead at streamflow rates greater than 111.1 ft³/s, but estimated the crossing to be unpassable to resident *O. mykiss* life stages at any rate of streamflow. A temporal and partial barrier status was assigned to reflect this analysis.



Figure 98. Outlet of Sheffield Drive bridge crossing.



Figure 99. Grade control structure under Sheffield Drive bridge crossing.

Conception Coast Watersheds – Romero Creek – Birnam Wood Golf Course Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
ROM_008_R	None Assigned	34.43072, -119.60485	Unassessed	Unknown	8.15	100
ROM_010_R	None Assigned	34.43321, -119.59979	Unassessed	Unknown	6.95	101

Two notched low-water crossings over Romero Creek are located on the Birnam Wood Golf Course. These crossings are located 0.8 and 1.2 stream miles from the Pacific Ocean. The notch in both of these crossings has low clearance and is fully lined with concrete. The notch at the second crossing is separated by a concrete support. Permission to perform a detailed assessment on these crossings was not obtained from the golf course. As a result no definitive barrier status could be determined for these crossings although it is assumed with adequate streamflow both crossings could be passed by all life stages of *O. mykiss*.



Figure. 100 Initial (ROM_008_R) Birnam Wood Golf Course crossing.



Figure. 101 Second (ROM_010_R) Birnam Wood Golf Course crossing.

Conception Coast Watersheds – Romero Creek – Debris Basin						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
ROM_023_NR	720271	34.44648, -119.59161	Total	Total	6.1	102 – 103

Romero Creek also contains a debris basin which was assessed to be total barrier to all life stages of *O. mykiss*. A large concrete boulder riprap embankment with a drainage culvert running through it formed the downstream portion of the basin. This embankment had a mean height of 14 ft and breadth of 131 ft. The cylindrical culvert had a diameter of 3 ft and a concrete debris rack cover at its intake. This debris basin was the only structure on Romero Creek which had an existing PAD listing.



Figure 102. Drainage intake for debris basin on Romero Creek.



Figure 103. Outlet of debris basin on Romero Creek.

Conception Coast Watersheds – Romero Creek – Bella Vista Drive Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
ROM_013_R	None Assigned	34.44291, -119.59091	Unassessed	Temporal and Partial	3.3	104





Located 3.4 stream miles from the Pacific Ocean the Bella Vista Drive crossing on Romero Creek consists of boulders and gravel fill with three cylindrical culverts running through it. A concrete road surface has been laid on top of the fill. The center culvert has a diameter of 4 ft and the diameter of the two side culverts was 3 ft. All three culverts have a length of 50 ft and project from the road fill at both the inlet and outlet. At the time of assessment on 10/30/18 no plunge was present at the outlet of the culverts. This crossing structure was recently constructed as the former crossing structure was blown out during the debris flow event following the Thomas Fire. The new crossing structure is also likely susceptible to damage during high flow events due to its shallow fill. FishXing analysis estimated the culverts to be passable by steelhead at streamflow rates between 58.6 ft³/s and 255.2 ft³/s, but not passable to resident life stages of *O. mykiss* at any rate of streamflow. A temporal and partial barriers status was assigned to reflect this status.











Figure 104. View of culvert outlets at Bella Vista Drive crossing.





Conception Coast Watersheds – Romero Creek – Grade Control Structures
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Numerous grade control structures which limit *O. mykiss* upstream migration are present within Romero Creek. In total 26 grade control structures were assessed to contain passage constraints. These structures were located throughout the assessed portion of the stream, but were most concentrated upstream of the Picay Creek confluence. Many of the grade control structures assessed within the stream appeared to have been eroded and damaged. It is likely some of the damaged is associated with the extreme debris flow event that followed the Thomas Fire on 1/9/18. Information regarding each of the grade control structures assessed within Romero Creek is listed in table 25 below.





Barrier and PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: ROM_001_NR PAD ID: None Assigned	34.42055, -119.62044	Unassessed	Temporal	Small concrete grade control structure partially buried under streambed sediment. Mean height: 2 ft Mean breadth: 0.05 ft Mean cascade length: 2.5 ft Remediation score: 12.05	
Barrier ID: ROM_002_NR PAD ID: None Assigned	34.42289, -119.61657	Unassessed	Temporal & Partial	Concrete grade control structure spanning width of stream channel. Mean height: 1.6 ft Mean breadth: 0.5 ft Mean cascade length: 2.0 ft Remediation score: 11.05	
Barrier ID: ROM_004_NR PAD ID: None Assigned	34.42982, -119.60559	Unassessed	Total	Extended concrete boulder riprap apron grade control. Mean height: 9.5 ft Mean breadth: 19.5 ft Mean cascade length: 21 ft Remediation score: 12.05	
Barrier ID: ROM_005_NR PAD ID: None Assigned	34.43217, -119.60263	Unassessed	Temporal & Partial	Concrete grade control between wing walls with vertical plunge. Mean height: 2.3 ft Mean breadth: 1.0 ft Mean cascade length: 2.5 ft Remediation score: 8.25	

Barrier and PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: ROM_006_NR PAD ID: None Assigned	34.43906, -119.59735	Unassessed	Temporal & Partial	Concrete apron grade control Mean height: 2.3 ft Mean breadth: 5 ft Mean cascade length: 5.6 ft Remediation score: 6.45	
Barrier ID: ROM_007_NR PAD ID: None Assigned	34.43916, -119.5972	Unassessed	Total	Substantial concrete boulder rip rap grade control structure. Mean height: 4.8 ft Mean breadth: 6.6 ft Mean cascade length: 8.2 ft Remediation score: 6.45	
Barrier ID: ROM_008_NR PAD ID: None Assigned	34.43929, -119.59718	Unassessed	Total	Substantial concrete boulder rip rap grade control structure immediately upstream of ROM_008_NR grade control. Mean height: 13.4 ft Mean breadth: 15 ft Mean cascade length: 24 ft Remediation score: 6.45	
Barrier ID: ROM_009_NR PAD ID: None Assigned	34.43958, -119.59697	Unassessed	Temporal & Partial	Concrete boulder riprap grade control. Mean height: 2.4 ft Mean breadth: 1.9 ft Mean cascade length: 3.6 ft Remediation score: 4.35	

Barrier and PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: ROM_010_NR PAD ID: None Assigned	34.43975, -119.59689	Unassessed	Temporal & Partial	Concrete apron grade control with distinct center flow point. Mean height: 3.5 ft Mean breadth: 4.5 ft Mean cascade length: 5.6 ft Remediation score: 4.35	
Barrier ID: ROM_011_NR PAD ID: None Assigned	34.4402, -119.59669	Unassessed	Total	Remnants of concrete boulder riprap grade control with significant scour below plunge. Mean height: 9.0 ft Mean breadth: 9.0 ft Mean cascade length: 13.6 ft Remediation score: 6.35	
Barrier ID: ROM_012_NR PAD ID: None Assigned	34.44059, -119.59658	Unassessed	Total	Concrete boulder riprap grade control with center plunge point. Mean height: 3.0 ft Mean breadth: 1.3 ft Mean cascade length: 4.0 ft Remediation score: 6.35	
Barrier ID: ROM_013_NR PAD ID: None Assigned	34.44071, -119.59642	Unassessed	Temporal & Partial	Concrete boulder riprap grade control creating cascade. Mean height: 3.3 ft Mean breadth: 6.4 ft Mean cascade length: 8.3 ft Remediation score: 5.3	

Barrier and PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: ROM_014_NR PAD ID: None Assigned	34.44111, -119.59599	Unassessed	Total	Concrete grade control with center plunge point. Mean height: 9.5 ft Mean breadth: 26.0 ft Mean cascade length: 29 ft Remediation score: 6.4	
Barrier ID: ROM_015_NR PAD ID: None Assigned	34.443, -119.59452	Unassessed	Total	Concrete boulder riprap grade control with two distinct plunge points. Mean height: 23.8 ft Mean breadth: 92 ft Mean cascade length: 100 ft Remediation score: 6.1	
Barrier ID: ROM_016_NR PAD ID: None Assigned	34.44366, -119.59392	Unassessed	Total	Damaged concrete boulder riprap grade control with scour below plunge. Mean height: 4.3 ft Mean breadth: 2.2 ft Mean cascade length: 5.8 ft Remediation score: 6.1	
Barrier ID: ROM_017_NR PAD ID: None Assigned	34.44402, -119.59354	Unassessed	Temporal & Partial	Damaged concrete boulder riprap grade control with scour below plunge. Mean height: 6.5 ft Mean breadth: 3.4 ft Mean cascade length: 7.9 ft Remediation score: 5	

Barrier and PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: ROM_018_NR PAD ID: None Assigned	34.44459, -119.59335	Unassessed	Temporal & Partial	Concrete boulder riprap grade control creating cascade. Mean height: 2.0 ft Mean breadth: 1.6 ft Mean cascade length: 3.1 ft Remediation score: 5	
Barrier ID: ROM_019_NR PAD ID: None Assigned	34.44497, -119.59312	Unassessed	Temporal & Partial	Concrete boulder riprap grade control with cascade and plunge point. Mean height: 3.5 ft Mean breadth: 2.8 ft Mean cascade length: 5.8 ft Remediation score: 5	
Barrier ID: ROM_020_NR PAD ID: None Assigned	34.44509, -119.59304	Unassessed	Temporal & Partial	Concrete boulder riprap grade control creating cascade. Mean height: 1.4 ft Mean breadth: 0.7 ft Mean cascade length: 1.7 ft Remediation score: 4	
Barrier ID: ROM_021_NR PAD ID: None Assigned	34.44533, -119.59291	Unassessed	Temporal & Partial	Damaged concrete boulder riprap grade control with scour below plunge. Mean height: 4.0 ft Mean breadth: 1.2 ft Mean cascade length: 4.6 ft Remediation score: 4.9	

Barrier and PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: ROM_022_NR PAD ID: None Assigned	34.44561, -119.59251	Unassessed	Temporal & Partial	Concrete boulder riprap grade control creating cascade and plunge point. Mean height: 3.8 ft Mean breadth: 2.5 ft Mean cascade length: 4.8 ft Remediation score: 4	
Barrier ID: ROM_024_NR PAD ID: None Assigned	34.45101, -119.59016	Unassessed	Total	Significantly damaged concrete boulder riprap grade control with scour below plunge. Mean height: 17.4 ft Mean breadth: 6.0 ft Mean cascade length: 17.7 ft Remediation score: 5.5	
Barrier ID: ROM_025_NR PAD ID: None Assigned	34.4515, -119.59024	Unassessed	Total	Moderately damaged concrete boulder riprap grade control with some scour below plunge. Mean height: 9.0 ft Mean breadth: 4.0 ft Mean cascade length: 11 ft Remediation score: 5.4	
Barrier ID: ROM_026_NR PAD ID: None Assigned	34.45191, -119.59045	Unassessed	Total	Concrete boulder riprap grade control apron. Mean height: 7.0 ft Mean breadth: 11.5 ft Mean cascade length: 13.5 ft Remediation score: 5.4	



Barrier and PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: ROM_027_NR PAD ID: None Assigned	34.45251, -119.59068	Unassessed	Total	Significantly damaged concrete boulder riprap grade control with scour below plunge. Mean height: 11.1 ft Mean breadth: 4.4 ft Mean cascade length: 12.3 ft Remediation score: 5.3	
Barrier ID: ROM_028_NR PAD ID: None Assigned	34.45314, -119.59101	Unassessed	Temporal & Partial	Wide concrete boulder riprap grade control with eroded center. Mean height: 3.9 ft Mean breadth: 4.0 ft Mean cascade length: 6.0 ft Remediation score: 3.4	

Table 25. Grade control structures on Romero Creek.

Conception Coast Watersheds – Buena Vista Creek – Birnam Wood Golf Course and Community Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
BV_004_R	None Assigned	34.4305, -119.61011	Unassessed	Total	9	105
BV_005_R	None Assigned	34.43145, -119.60876	Unassessed	Unknown	5	106
BV_006_R	None Assigned	34.43208, -119.6083	Unassessed	Unknown	3	107

Three Buena Vista Creek road crossings within the Birnam Wood community were assessed to contain passage constraints to *O. mykiss*. Two of these crossings were on the community's golf course. The most downstream these crossings is located 0.3 stream miles from the Romero Creek confluence and is a concrete and boulder riprap low-water crossing with a small cylindrical culvert running through it (BV_004_R). The diameter of the culvert is 2 ft and its outlet is perched above the streambed with a 4.2 ft plunge. This plunge and the high turbulent streamflow velocities that occur through the culvert make this crossing structure impassable to all life stages of *O. mykiss*. The next crossing (BV_005_R) is located 0.4 stream miles from the Romero Creek confluence and is a free spanning bridge over concrete channel lining. A notched grade control structure is also included in the channel lining. The grade control notch has a uniform width of 3.2 ft. The Birnam Wood Drive crossing (BV_006_R) is the third structure within the community to contain passage constraints and is located 0.5 stream miles from the Romero Creek confluence. The crossing was a bridge over a fully concrete lined box culvert. A small grade control with a height of 1.5 ft was located within the center of the culvert. Additionally, a concrete cobble riprap apron extended upstream from the culvert inlet. Unfortunately access to conduct detailed assessments within the community was not granted and a definitive barrier status could not be assigned for the BV_005_R and BV_006_R crossings. However, it is likely steelhead can gain passage at these two crossings when streamflow rates permit adequate conditions.



Figure 105. Outlet of culvert for BV_004_R crossing.



Figure 106. Downstream view of BV_005_R crossing.



Figure 107. Downstream view of Birnam Wood Drive (BV_006_R) crossing.

Conception Coast Watersheds – Buena Vista Creek – Buena Vista Drive Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
BV_024_R	None Assigned	34.44711, -119.61059	Unassessed	Total	6	108

Buena Vista Drive includes a concrete low-water crossing of Buena Vista Creek 1.6 stream miles from the Romero Creek confluence. Significant scour downstream of the crossing has created a 7 ft high cascade at the outlet of the crossing. Boulders and cobble were located below this cascade creating an extended riffle unit. Due to this cascade FishXing analysis estimated this crossing to be impassable by all life stages of *O. mykiss*.



Figure 108. Downstream view of Buena Vista Drive crossing.

Conception Coast Watersheds – Buena Vista Creek – Park Lane Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
BV_025_R	None Assigned	34.44711, -119.61059	Unassessed	Total	5	109-110

A large 14 ft high arched culvert is present at the Park Lane crossing of Buena Vista Creek. This crossing is located 1.7 stream miles from the Romero Creek confluence and marks the upstream extent of surveys conducted on Buena Vista Creek. When assessed on 3/11/19 the culvert was partially embedded with cobble, gravel, and boulders. The depth of the embedded substrate could not be determined, but appeared to be much greater at the inlet of the culvert than the outlet. A 4.6 ft long concrete apron is located at the outlet of the culvert. Scour has occurred downstream of the outlet apron creating a 3 ft plunge point. The length of the culvert is 115 ft and it runs under soil fill. FishXing analysis estimated the crossing to be impassable to all life stages of *O. mykiss*.



Figure 109. Park Lane culvert outlet.



Figure 110. Embedded Park Lane culvert inlet.

Conception Coast Watersheds – Picay Creek – Highway 192 Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
PCY_002_R	732104	34.43618, -119.59157	Unknown	Temporal and Partial	2	

The California state highway 192 crossing was the first structure assessed to contain passage constraints on Picay Creek. This crossing is a bridge over natural substrate and is located 0.4 stream miles from the Romero Creek confluence. Vertical brick channel walls are located under the bridge. The crossing contains a 18.3 ft long concrete outlet apron with a 3 ft high plunge point to the downstream substrate. Minimal scour was present below the plunge at the time of assessment. The width of the bridge is only 8.5 ft. FishXing analysis estimated a steelhead could pass the structure at streamflow rates greater than 50 ft³/s, but would not be passable to resident life stages of *O. mykiss*. A temporal and partial barrier status was assigned to reflect this analysis.



Figure 111. Outlet apron and plunge point at Hwy 192 crossing on Romero Creek.

Conception Coast Watersheds – Picay Creek – Private Road Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
PCY_003_R	None Assigned	34.43628, -119.58989	Unassessed	Unknown	3	112
PCY_004_R	None Assigned	34.4363, -119.58913	Unassessed	Unknown	3	113

Two brick and cement lined arched culverts run under private road crossings upstream of the highway 192 crossing. Both of these crossing structures were assessed to contain passage constraints. The initial of these two crossings (PCY_003_R) is located 0.5 stream miles from the Romero Creek confluence. This crossing contains a short outlet apron with a 4 ft plunge to the downstream substrate. The culvert has a mean width 7.5 ft and a mean height of 6.2 ft. The next crossing (PCY_004_R) is located 0.6 stream miles from the Romero Creek confluence and marks the upstream extent of surveys conducted within Picay Creek. This crossing contains an inlet apron and a small 0.8 ft plunge point within the culvert. Permission to perform detailed assessments of these two crossing structures was not received from the private landowners and a definitive barrier status could not be determined. The 4 ft plunge point on the PCY_003_R crossing likely greatly limits *O. mykiss* passage.

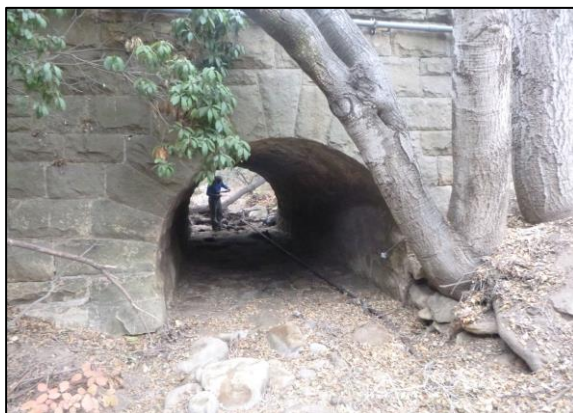


Figure 112. Inlet of PCY 003 R private crossing culvert.



Figure 113. Outlet of PCY_004_R private crossing culvert.

5.3.3.7 Barrier Assessments: Arroyo Paredon Creek Watershed

Arroyo Paredon Creek was the only stream assessed within this watershed. Surveys were conducted from the estuary upstream 3.1 stream miles to a private road crossing. Five man-made structures were assessed to constrict *O. mykiss* upstream movement within the stream. Evidence of damage from debris flows and sedimentation following the Thomas Fire was present within the stream channel and the man-made barrier structures located within it. Existing barrier PAD listings for Arroyo Paredon Creek indicate all previous barrier assessments were conducted between 2002 and 2007 by Stoecker Environmental Consulting. Listings for a debris basin (PAD ID: 706244) with a total barrier status, a private road crossing (PAD ID: 706245) with a unknown barrier status, and total natural barrier (PAD ID: 706246) were unable to be assessed due to access restrictions.

Conception Coast Watersheds – Arroyo Paredon Creek – Private Road Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
AYP_001_NR	None Assigned	34.42256, -119.53893	Unassessed	Temporal	13.9	114

The initial structure assessed to contain *O. mykiss* passage constraints on Arroyo Paredon Creek is a small concrete grade control structure located 1.4 stream miles from the Pacific Ocean. At the time of assessment most of the structure appeared to be buried under streambed sediment. The exposed portion of the structure had a mean height of 2.2 ft, breadth of 0.7 ft, and cascade length of 2.6 ft. The small structure is likely easily passable to all life stages of *O. mykiss* under moderate and high rates of streamflow.



Figure 114. Exposed portion of concrete grade control on Arroyo Paredon Creek.

Conception Coast Watersheds – Arroyo Paredon Creek – Private Road Crossings						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
AYP_005_R	706240	34.42356, -119.53828	Unknown	Unknown	14.45	115
AYP_008_R	706243	34.43391, -119.54981	Unknown	Total	10.8	116
AYP_010_R	None Assigned	34.43639, -119.54854	Unassessed	Unknown	9.8	117

Three private road crossings with passage constraints are present within Arroyo Paredon Creek. The initial of these structures (AYP_005_R) is located 1.5 stream miles from the Pacific Ocean. This crossing contained two cylindrical culverts running through shallow gravel road fill reinforced with boulder riprap. Both culverts projected from the fill, but were at the level of streambed substrate. The diameter of both culverts is 4.8 ft. The crossing structure appeared as if it may have been reconstructed after damage from post Thomas Fire debris flows. Damage from future high stream flow events is appears to be possible due to the shallow road fill. The landowner did not respond to inquiries for permission to conduct a detailed assessment and a definitive barrier status could not be determined, however if the condition of the crossing does not change steelhead likely can successfully pass under adequate rates of streamflow. The next private road crossing (AYP_008_R) on Arroyo Paredon Creek is located 2.8 stream miles from the Pacific Ocean. This configuration of this crossing is similar to the AYP_005_R crossing as it contains two cylindrical culverts under shallow gravel road fill. This crossing however was reinforced with a concrete road surface. The culverts and road surface of this crossing were heavily damaged at the time of assessment. A gradual cascade with a height of 3.8 ft and length of 9.5 ft was present at the outlet of the culverts. FishXing analysis estimated the crossing to be impassable to all life stages of *O. mykiss*. The third private road crossing (AYP_010_R) is located 3.1 stream miles from the Pacific Ocean and is a fully concrete lined box culvert with wingwalls at the inlet and outlet. The culvert at this crossing has a steep slope, but could not be measured as the landowner asked surveyors to leave before culverts measurements could be conducted. This landowner also denied access for any further upstream surveys so this crossing marked the upstream extent of barrier and habitat assessments on Arroyo Paredon Creek. Due to the lack of data collected a definitive barrier status could not be determined for this private road crossing, however considering the steep slope of the culvert high flow velocities likely occur through the structure and prevent any life stages of *O. mykiss* from successfully gaining passage at this crossing structure.



Figure 115. Inlet of culverts at AYP_005_R private road crossing.



Figure 116. Outlet of culverts at AYP_008_R private road crossing.



Figure 117. Outlet of box culvert at AYP_010_R private road crossing.

Conception Coast Watersheds – Arroyo Paredon Creek – Toro Canyon Park Road Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
AYP_009_R	None Assigned	34.43529, -119.54954	Unassessed	Partial	6.1	118-119

The Toro Canyon Park Road crossing is located 3.0 stream miles from the Pacific Ocean and contains three cylindrical culverts running under concrete, gravel, boulder road fill, and an asphalt road surface. The inlets of the culverts are fully encased in a concrete headwall and the outlets are under gravel and boulder fill. All three culverts have a diameter of 3.7 ft, length of 41 ft, and were level with streambed substrate at the time of assessment. This crossing structure was rebuilt due to severe damage from the debris flow event following the Thomas Fire. FishXing analysis estimated the crossing to be passable by steelhead between streamflow rates of 13 ft³/s and 255 ft³/s, but not passable to resident *O. mykiss* life stages.



Figure 118. Outlet of Toro Canyon Park Road crossing culverts on Arroyo Paredon Creek..



Figure 119. Inlet of Toro Canyon Park Road crossing culverts Arroyo Paredon Creek.

Conception Coast Watersheds – Arroyo Paredon Creek – Remediated Highway 192 Crossing Barrier						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
AYP_004_R	706239	34.41703, -119.54416	Temporal	Not a barrier	NA	120

The debris flow event on Arroyo Paredon Creek following the Thomas Fire severely damaged the highway 192 crossing. A new free spanning bridge was constructed and finished in 2019. This new bridge was assessed to be free of *O. mykiss* passage constraints. The previous crossing structure had been assigned a temporal barrier status.



Figure 120. Downstream view of new Hwy 192 bridge crossing on Arroyo Paredon Creek.

5.3.3.8 Barrier Assessments: Carpinteria Creek Watershed

Carpinteria Creek and Gobernador Creek were the two streams assessed within this watershed. Carpinteria Creek was surveyed from its estuary upstream 4.2 stream miles to a total natural barrier. Gobernador Creek was surveyed from its confluence with Carpinteria Creek upstream 3.2 stream miles to a total natural barrier. The watershed stands apart from other Conception Coast watersheds because extensive restoration work has been completed to remediate structures which once limited upstream *O. mykiss* migration. Two of the structures listed to have been remediated in PAD were assessed to still contain passage constraints. In total only three man-made structures and three natural features were assessed to contain passage constraints in the watershed.

Conception Coast Watersheds – Carpinteria Creek – Debris Basin Remnants						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
CRP_009_NR	706491	34.41328, -119.47491	Remediated, fish response unconfirmed	Temporal	1.3	121

The only man-made structure assessed to constrict *O. mykiss* upstream passage on Carpinteria Creek is a concrete structure located 3.7 stream miles from the Pacific Ocean. This structure is assumed to be leftover remnants of a debris basin that had been remediated through restoration efforts. The stream channel appeared to have experienced significant scour and erosion in this location from the debris flow event following the Thomas Fire. It is assumed remnants of the debris basin structure that had been buried under streambed sediment prior to the debris flow have been exposed. The exposed concrete structure contains a center apron with a cascade length of 1.7 ft, breadth of 1.3 ft, and a mean height of 2.7 ft. A pool unit was located below the structure at the time of assessment with a mean depth of 2.0 ft. At moderate and high flows this structure is likely passable to all life stages of *O. mykiss*.



Figure 121. Downstream view of concrete debris basin remnants on Carpinteria Creek.

Conception Coast Watersheds – Gobernador Creek – Private Low-Water Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
GOB_004_R	706496	34.40569, -119.46981	Temporal	Temporal	15	122

The initial of only two structures containing passage constrains within Gobernador Creek is a concrete low-water crossing located 1.1 stream miles from the Carpinteria Creek confluence. The crossing surface gradually elevated to 1.1 ft above the downstream streambed substrate at the time of assessment. FishXing analysis estimated steelhead would be able to successfully pass the crossing at streamflow rates greater than 63 ft³/s and resident *O. mykiss* at streamflow rates greater than 98 ft³/s. A temporal barrier status was assigned to reflect this analysis, which matched the previously assigned barrier status listed in PAD.



Figure 122. Private low-water crossing on Gobernador Creek.

Conception Coast Watersheds – Gobernador Creek – Debris Basin						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
GOB_008_NR	706500	34.40798, -119.46278	Remediated, fish response unconfirmed	Temporal and Partial	16.9	123

The debris basin on Gobernador Creek is located 1.6 stream miles from the Carpinteria Creek confluence. The outlet of the debris basin contains a two grade control structures between slanted concrete boulder riprap channel walls. The initial downstream grade control is an extension of the channel walls into the stream channel. This grade control has a height of 4.2 ft, breadth of 9 ft, and cascade length of 10.8 ft. A pool unit was located below this grade control with a mean water depth of 1.7 ft. At high rates of streamflow the downstream unit depth would increase and allow steelhead to make successful passage. It is however unlikely resident *O. mykiss* can successfully pass this concrete and riprap grade control structure. The next grade control structure consists of a series of concrete trash rack walls with perpendicular and parallel orientations in relation to the stream channel. A notch with a mean width of 6.8 ft is present at the center of these concrete walls. A small cascade caused by scattered boulders was present at the time of assessment just downstream of this notch. Under assessed conditions this cascade and the concrete boulders walls are likely easily passed by steelhead under adequate rates of streamflow.



Figure 123. Outlet and grade control of debris basin on Gobernador Creek.

Conception Coast Watersheds – Gobernador Creek – Remediated Barriers					
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Figure
GOB_001_R	758783	34.40048, -119.47968	Unassessed	No longer present, not a barrier	NA
GOB_003_R	706495	34.40476, -119.47138	Partial	No longer present, not a barrier	NA

Two listings within PAD for structures on Gobernador Creek were assessed to no longer be present within the stream channel. Both of these crossings were removed through remediation efforts. The initial of these listings (GOB_001_R) was a low-crossing which PAD indicated was planned to be removed over the summer of 2015. The other PAD listing (GOB_003_R) is for a utility pipe crossing. No evidence of this utility pipe remains in the stream channel.

5.3.3.9 Barrier Assessments: Rincon Creek Watershed

The Rincon Creek watershed was the furthest east Conception Coast watershed assessed. Rincon Creek was the only stream assessed within the watershed and was surveyed from its estuary upstream 4.2 stream miles to a total natural barrier. The stream contains seven man-made structures which constrict *O. mykiss* upstream movement. Despite past remediation efforts leading to the removal of some barrier structures on Rincon Creek it remains one of the most inaccessible streams to returning steelhead among the assessed Conception Coast watersheds. Five structures within Rincon Creek were determined to be total barriers to all *O. mykiss* life stages.

Conception Coast Watersheds – Rincon Creek – Highway 101 Crossing						
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figures
RNC_001_R	707368	34.37745, -119.47813	Total	Total	18.8	124-125

The highway 101 crossing is the initial structure limiting *O. mykiss* upstream movement on Rincon Creek and is located at the upstream extent of the estuary. A large arched culvert fully encased in concrete passes 880 ft under the road surface and railroad tracks. The culvert is fully lined with concrete and its base is tapered inward slightly so streamflow is channeled to the center of the culvert. The culvert maintains a uniform height of 16.7 ft and width of 20 ft. The structure contains a 39 ft long concrete inlet apron centered between concrete wingwalls. The apron descends 6.2 ft from its upstream extent to the inlet of the culvert. This apron creates high streamflow velocities and was estimated to be the main factor preventing passage to all life stages of *O. mykiss* at this crossing structure from FishXing analysis. This structure prevents steelhead from accessing the entire Rincon Creek watershed.



Figure 124. Inlet of Hwy 101 culvert on Rincon Creek.



Figure 125. Inlet apron at Hwy 101 crossing structure on Rincon Creek.

Conception Coast Watersheds – Rincon Creek – Grade Control Structure

Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Remediation Score	Figure
RNC_007_NR	706214	34.39672, -119.45228	Partial	Temporal	13.7	126

A small concrete and cobble riprap grade control structure is located adjacent to a private residence 2.8 stream miles from the Pacific Ocean. The structure contains two distinct cascade points over concrete. The mean height of the structure is 2.4 ft, with a mean breadth of 4.9 ft, and mean cascade length of 3 ft. A pool unit is located downstream of the structure with a mean water depth of 1.7 ft at the time of assessment on 11/28/18. The downstream pool unit and the minimal height of the structure likely allow for successful passage of all *O. mykiss* life stages at higher rates of streamflow.



Figure 126. Downstream view of grade control structure on Rincon Creek.

Conception Coast Watersheds – Rincon Creek – Low-Water Crossings

Five low-water crossings with passage constraints are present on Rincon Creek upstream of the Casitas Creek confluence. The initial two of these crossings are private roads and the three subsequent crossings occur from repeated Stanley Park Road crossings. Information regarding each low-water crossing structure assessed to constrict *O. mykiss* upstream movement within Rincon Creek is listed in the table 26 below.

Barrier and PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: RNC_008_R PAD ID: 706215	34.39814, -119.45144	Temporal & Partial	Total	Concrete low-water crossing with extended concrete boulder riprap outlet apron. Outlet apron cascade length: 27 ft Outlet apron height: 4 ft Water depth below cascade: 1.7 ft Road surface width: 11.5 ft Remediation score: 14.5	A photograph of a concrete low-water crossing with a riprap outlet apron. The structure is surrounded by trees and rocks.
Barrier ID: RNC_009_R PAD ID: 706216	34.39869, -119.45123	Temporal	Temporal	Concrete low-water crossing with small plunge at outlet. Outlet plunge height: 1.0 ft Water depth below plunge: 1.3 ft Road surface width: 13 ft Remediation score: 9.75	A photograph of a concrete low-water crossing with a small plunge at the outlet. The structure is surrounded by trees and rocks.

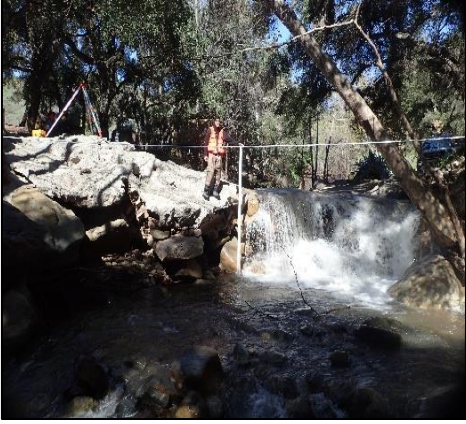


Barrier and PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description, Dimensions, and Remediation Score	Picture
Barrier ID: RNC_010_R PAD ID: 706217	34.40206, -119.44678	Temporal	Total	Concrete low-water crossing with short outlet apron and downstream scour creating significant plunge from outlet apron onto boulders. Outlet apron length: 17.7 ft Outlet apron height: 4 ft Outlet plunge height: 4.5 ft Water depth below plunge: 2.4 ft Road surface width: 16.3 ft Remediation score: 12.15	
Barrier ID: RNC_011_R PAD ID: 706218	34.40395, -119.4467	Temporal & Partial	Total	Concrete low-water crossing with short outlet apron and downstream scour creating significant plunge from outlet apron into pool. Outlet apron length: 4 ft Outlet apron height: 1.7 ft Outlet plunge height: 5.85 ft Water depth below plunge: 3.1 ft Road surface width: 24.4 ft Remediation score: 11.15	
Barrier ID: RNC_013_R PAD ID: 706220	34.40673, -119.44547	Temporal	Total	Concrete low-water crossing with downstream scour and damage creating significant cascade over boulder and concrete from outlet. Outlet cascade height: 8 ft Outlet cascade length: 8.4 ft Water depth below cascade: 0.8 ft Road surface width: 12.9 ft Remediation score: 9.95	

Table 26. Low-water crossings on Rincon Creek.

Conception Coast Watersheds – Rincon Creek – Remediated Barriers					
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Figure
RNC_012_R	706219	34.40456, -119.44573	Temporal	No longer present, not a barrier	NA
RNC_014_R	706221	34.40758, -119.44527	Temporal	Not a barrier	127

Two listings within PAD for low-water crossings on Rincon Creek with temporal barrier statuses were assessed to no longer constrict upstream *O. mykiss* movement. The low-water crossing for one of these listings (RNC_012_R) is no longer present within the stream channel and is assumed to have been eroded away. The other low-water crossing (RNC_014_R) is still present, but the gravel roadway appeared to be seldomly used and the low-water crossing portion of the roadway was buried under sediment. If this roadway is utilized for vehicle crossings again in the future any efforts to reestablish the low-water crossing could potentially lead to conditions which limits upstream migrating *O. mykiss*.



Figure 127. Upstream view of sediment buried RNC_014_R gravel low-water crossing.

5.3.4 Barrier Assessments: Topanga Creek Watershed

Topanga Creek was the only stream surveyed within this small watershed and was assessed from its estuary to a total natural barrier 3.2 miles upstream. No man-made structures were assessed to constrict *O. mykiss* movement in Topanga Creek. Five PAD listings for both man-made and natural features were assessed to no longer constrain *O. mykiss* upstream movement. Additionally, seven other PAD listings for natural barrier features were not assessed because they are located upstream of the total natural barrier assessed during surveys conducted for this project. These various PAD listings are specified and discussed below. CDFW and California Trout Incorporated are listed as the two agencies to have conducted all previous barrier assessments on Topanga Creek.

Topanga Creek Watershed – Topanga Creek – Remediated Barriers					
Barrier ID	PAD ID	Location	Previous Barrier Status	Current Barrier Status	Figure
TPC_001_R	716891	34.03932, -118.58303	Partial	Not a Barrier	128
None Assigned	723591	34.04736, -118.57967	Partial	No longer present, not a barrier	NA
None Assigned	723592	34.04777, -118.58037	Partial	No longer present, not a barrier	NA
None Assigned	716995	34.05754, -118.58393	Temporal	No longer present, not a barrier	NA
None Assigned	716993	34.07129, -118.58725	Temporal	No longer present, not a barrier	NA

The only man-made structure on Topanga Creek assessed to no longer constrict *O. mykiss* movement is the highway 101 bridge crossing. The bridge passes over standing estuary water and thus all life stages of *O. mykiss* can easily swim under the bridge. All other PAD listings assessed to no longer constrict *O. mykiss* upstream movement were for natural features and in all cases no evidence of the listed natural feature was present within the stream channel.



Figure 128. Standing estuary water under Hwy 1 bridge on Topanga Creek.

Topanga Creek Watershed – Topanga Creek – Unassessed Natural Feature Barriers				
Barrier ID	PAD ID	Location	Current Barrier Status	Current Barrier Status
None Assigned	723595	34.07612, -118.59044	Partial	Unassessed
None Assigned	723596	34.07654, -118.59110	Partial	Unassessed
None Assigned	716994	34.07988, -118.59469	Total	Unassessed
None Assigned	723597	34.08046, -118.59482	Total	Unassessed
None Assigned	723598	34.08112, -118.59535	Partial	Unassessed
None Assigned	723599	34.08141, -118.59629	Partial	Unassessed
None Assigned	723600	34.08262, -118.59690	Total	Unassessed
None Assigned	723601	34.08422, -118.59883	Partial	Unassessed

The above PAD listings for natural barrier features on Topanga Creek were not assessed because they are located upstream of the total natural barrier assessed during surveys conducted for this project.

6.0 Discussion

There are a number of factors to be considered when interpreting this report and using it as a reference for barrier remediation or other stream habitat restoration efforts in the Ventura River, Santa Clara River, Topanga Creek, and Conception Coast watersheds. The data represented in this report was influenced by fluctuating seasonal conditions. These fluctuations primarily influence *O. mykiss* habitat conditions, but also influence *O. mykiss* abilities to move within a stream. These influences should be considered when interpreting the habitat and barrier data listed in this report. As a result the barrier remediation scores generated and listed in this report are not intended to be absolute and should be one of many resources utilized in directing barrier remediation efforts. As noted by Robison et al. (2000) numerous social and economic factors also should be considered when determining the exact order of treating barriers and how they should be treated. These many social and economic factors were not considered in the results listed in this report. Specific discussion regarding various factors influencing the data and results listed in this report are summarized in the following sections.

6.1 Stream Habitat Fluctuations

The most influential habitat fluctuation encountered over the course of this project were highly seasonal and reactionary streamflow regimes. This is a common trend for any stream, but streamflow fluctuations in southern California streams are often distinctly pronounced. Significant streamflow reductions occur during the dry summer and fall months, often leading to dry portions of stream channel. Many streams were assessed during the height of the southern California dry season and thus had minimal surface streamflow. In the case of Oak Creek, Picay Creek, and Buena Vista Creek no surface streamflow was present during first pass initial barrier and habitat assessments. Other streams assessed during dry portions of the year were also found to be predominantly dry, Cannon Creek (85.5% dry), Romero Creek (70.4% dry), Carpinteria Creek (55.5% dry). The assessed portions of Cold Springs Creek, Hot Springs Creek, Montecito Creek, Rincon Creek, San Antonio Creek, San Ysido Creek, and Thacher Creek were found to be between 30% and 46% dry. Other streams containing portions of dry channel (< 20%) when assessed were Arroyo Paredon Creek, Bear Creek, and North Fork Matilija Creek. Overall for all streams assessed 86,052.2 ft, or 12.3% of channel was dry when assessed. Many other streams were surveyed during the rainy season under high flow conditions. Streams assessed under high flow conditions included Sisar Creek, Santa Paula Creek, El Capitan Creek, West Fork El Capitan Creek, Rattlesnake Creek, Lion Canyon Creek, and the East Fork of Lion Canyon Creek.

O. mykiss habitat suitability scoring was altered to account for seasonal fluctuations, however the level to which those specific HSI scoring adjustments account for seasonal habitat quality variation is difficult to measure. Furthermore, habitat suitability scoring did not account for seasonal habitat quantity fluctuations. The quantity of habitat present at the time habitat was assessed is only partially reflected by the total length of habitat units assessed in each stream. It is likely that the time of year in which habitat assessments were conducted influenced the results of habitat data described in this report. Better representation and comparison of *O. mykiss* habitat quality and quantity would be achieved from repeated seasonally consistent assessments of all streams. Specifically, this approach would allow for identification of channel areas that tend to experience annual drying or retain perennial stream flow, which is necessary for the sustainment of resident *O. mykiss* populations. Due to the scale of the watersheds assessed for this project multiple survey crews would likely be required to successfully complete seasonally synchronized habitat assessments. Frequent habitat assessments would also help track habitat recovery following the Thomas, Whittier, Rye, and Topanga wildfires.

The impacts of wildfire should also be considered in the interpretation of habitat conditions depicted in this report. The Thomas, Whittier, Rye, and Topanga wildfires occurred within two years of our habitat assessments and the data collected is likely representative of degraded habitat. Several wildfire caused impacts to streams are described in the USFS Thomas Fire Burned Area Emergency Response (BAER) report. Such changes include reduced benthic macroinvertebrate populations, decreased bank stability, water quality fluctuations, decreased habitat unit depth, increased dissolved nutrients, pH levels, water temperature, and turbidity (Klose 2018). Additionally, each of these impacts can create individual chain reactions that further alter habitat. For instance, increased water turbidity interferes with sunlight penetration and reduces aquatic vegetation photosynthesis resulting in lower dissolved oxygen concentration. Turbidity may also clog the gills of fish and result in decreased growth rates for juvenile salmonids (California Fish Passage Assessment Database 2019). Overall stream ecosystem impacts associated with wildfire adversely impact fish populations as the quality and quantity of habitat available to them is reduced. However, the number and severity of wildfire impacts on stream systems and their inhabitants may be pronounced or subdued depending on multiple factors (Klose 2018). Such factors include, fire burn severity, timing of subsequent rainfalls, intensity and duration of ensuing rains, and volume of debris and sediment entering streams (Klose 2018). In the case of the 2017 Thomas, Whittier, Rye, and Topanga wildfires burn severity was generally low to moderate due to rapid burn movement and brief burning nature of chaparral coastal scrub vegetation which is predominant in the areas burned.

Most impacted by post fire rain events were streams within the Thomas Fire burn scar. Rain events not only occurred directly following the fire, but also delivered intense rates of rainfall of up to 0.60 inches in just a five-minute period (National Weather Service 2019). This produced destructive debris flows which caused rapid and significant alterations to the stream channel, riparian zone vegetation, and destroyed multiple man-made structures within the floodplain. This extreme sedimentation was visually evident during habitat assessments. An example of this sedimentation is shown in figures 129 & 130. When comparing our unit dimension results to those documented prior to the Thomas, Whittier, Rye, and Topanga wildfires, there is an evident decrease in unit depths and widths as well as an increase in mean unit lengths (Table 27). Unfortunately, these past snorkel reports did not include documentation of unit types so a comparison of pool, flatwater, and riffle abundances within these streams prior to and post fire and debris flows is not possible. Despite this, the comparison of unit dimensions reflects the general shift observed in stream habitat from diverse habitat structure to one dominated by long shallow low gradient riffles. While shallow riffles are suitable habitat for *O. mykiss* fry and small juveniles due to the protection they provide from predation and competition, larger adults require pool habitat units in order to thrive (Raleigh et al. 1984; Rosenfeld and Boss 2001). The reduction in overall stream depth limits the available habitat for adults to access in future spawning seasons.

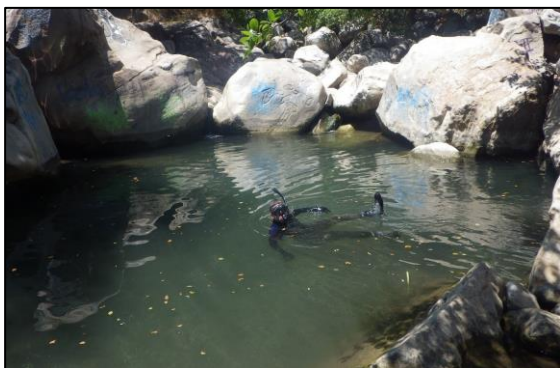


Figure 129. North Fork Matilija Creek Aug 2016 (CDFW Unpublished Data)

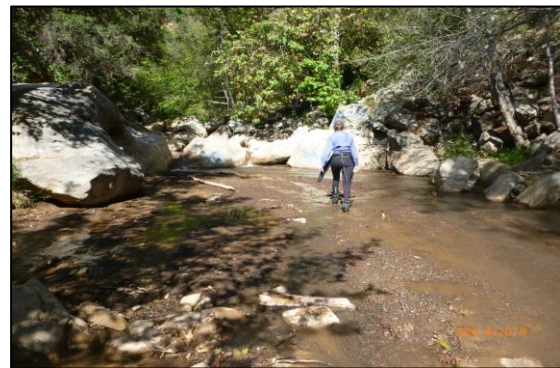


Figure 130. Same location of North Fork Matilija June 2018 (Horgan et al. 2018)

Stream	Dates Assessed	Number of Units with mean depth > 0.7 ft	Mean Unit Length (ft)	Mean Unit Width (ft)	Mean Unit Depth (ft)	Mean Unit Max Depth (ft)
North Fork Matilija Creek	7/28/15 – 8/13/15	167	25.8	12.5	1.3	2.2
North Fork Matilija Creek	12/10/18 – 12/13/18	5	1,299.4	9.0	1.0	2.0
Rattlesnake Creek	4/15/14	21	19.9	12.0	Not Recorded	1.8
Rattlesnake Creek	2/6/19 – 3/12/19	35	66	13.9	1.3	2.1
Santa Paula Creek	6/30/16 – 8/24/16	196	14.8	5.5	0.7	1.1
Santa Paula Creek	4/15/19 – 6/17/19	80	255.8	19.3	1.8	3
San Antonio Creek	9/20/16 – 9/26/16	29	53.3	8.5	0.7	1.4
San Antonio Creek	10/15/18 – 1/24/19	15	309.7	11.9	1.2	2.2
Sisar Creek	9/28/16 – 10/4/16	58	16.6	6.9	0.9	1.6
Sisar Creek	2/12/19 – 5/23/19	27	314	15.8	1.3	2.4

Table 27. Comparison of mean unit dimensions recorded during pre-wildfire CDFW snorkel surveys to mean unit dimensions recorded during habitat surveys conducted post-wildfire for this barrier assessment report. * CDFW snorkel surveys only survey habitat units with a mean depth of 0.7 ft thus only the mean dimensions of habitat units assessed during barrier assessments with an mean depth of 0.7 ft are included in this comparison.

A reduction in mean stream depth likely affects *O. mykiss* migration and barrier conditions as well. Streamflow velocity and turbulence tends to be higher in channel areas with shallow flow conditions and thus requires *O. mykiss* to expend more energy in their upstream movements. Additionally, increased sedimentation following wildfires has decreased the abundance of pool and flatwater units. Pool and flatwater units generally contain areas of sediment scour that allow for reductions in streamflow velocities and are thus conducive to providing resting areas for fish. Reduced water depths can contribute to the severity of barriers by diminishing *O. mykiss* jump height abilities. *O. mykiss* upstream movement is considered difficult or impossible when the water depth within a unit becomes less than 1.25 times the height of a barrier feature or structure (Stoecker 2004). For example, a feature or structure with a height of 4 feet would require the unit downstream to have a water depth of roughly at least 5 feet to allow for potential steelhead passage (Stoecker 2004). Due to the flashy streamflow regimes typical of southern California streams there are limited windows of streamflows conducive to *O. mykiss* migration. Diminished stream depths due to sedimentation from wildfires are likely to only further limit these migration windows. Multiple stream surveys for this project were conducted during periods of low or non-existent streamflows. Under these conditions many natural stream features could be considered potential temporal barriers. However, to more accurately assess the barrier status of these features multiple assessment under varying levels of streamflow should be conducted. Without multiple assessments being made it can only be concluded that these features contribute to the difficulty of *O. mykiss* migration.

Another factor within the Santa Clara and Ventura Rivers contributing to diminished water depth are the Vern Freeman, Robles, and Forster Park diversion dams. The maximum diversion rate for the Robles dam on the Ventura River is 500 ft³/s and the Vern Freeman dam diverts approximately 58,000 acre feet of Santa Clara River streamflow annually (Casitas Water and United Water Districts). Exact rates of diversion for the two diversion dams located near Foster Park on the Ventura River could not be found, but in a lawsuit filed by Santa Barbara Channelkeeper in 2014 claims hundreds of millions of gallons of water are diverted each year at this location (Coyne 2018). The degree to which these

diversions impact *O. mykiss* migration due to diminished streamflow is not well understood. However according to the California Fish PAD Fish Passage Report “diminished instream flows as a result of water diversions may present as serious and as chronic a barrier to fish passage as large dams.”

As streams recently impacted by wildfire experience more rain events and elevated streamflow, scouring will occur and habitat unit water depths will increase. Such natural scouring processes associated with elevated streamflow contributes to the creation and continuance of fish habitat (Saldi-Carommile et al. 2004). Calculation methods to predict scouring events and impacts on stream channels do exist, but are not considered reliable outside of the hydraulics caused by relatively stable man-made structures in predominantly sandy substrates. However, moderate and frequent streamflow scour events tend to promote more complex high value stream habitat than streams with more extreme streamflow events (Power et al. 1996). Given the tendency of Southern California streams to exhibit infrequent flashy and generally intense streamflow spikes the recovery of habitat associated with scour may take longer than it would in other streams with more moderate and frequent streamflow events.

6.2 Quality Stream Habitat Location

O. mykiss habitat suitability index scores are based off the mean values of assessed habitat parameters collected throughout the entire assessed portion of each stream. Therefore, these scores are generalized to the average of overall habitat conditions in each stream and may not accurately characterize habitat variations that occur throughout the course of a stream. For example, the lower reaches of Santa Paula Creek have been significantly altered by concrete boulder riprap channelization. This channelization has significantly degraded habitat conditions in this portion of Santa Paula Creek. On the other hand, the upper reaches of Santa Paula Creek flow through undeveloped Los Padres National Forest land and contains high quality habitat. This variation in habitat quality within Santa Paula Creek is not well reflected in a single HSI score applied to the entirety of the stream. Understanding where quality habitat is located within each stream could contribute to barrier remediation priorities and decision making as it provides a more robust picture of the type of habitat that would become accessible to *O. mykiss* if a particular barrier was remediated. Future habitat assessments consider distinguishing specific and standardized survey reaches within each stream so habitat quality comparisons can be made over the course of each stream.

6.3 Resident *O. mykiss* Populations

The degradation to stream habitat caused by recent wildfires in the watersheds assessed for this report likely have also adversely affected resident *O. mykiss* populations. Data collected from ongoing *O. mykiss* monitoring surveys conducted within Conception Coast, Ventura and Santa Clara River watersheds indicate resident populations are small and may be in decline (CDFW unpublished data 2019). Although there are various factors to consider, historic drought conditions experienced in these watersheds from 2011 to 2016 adversely impacted freshwater habitat. Data from CDFW snorkel surveys conducted in 2014 and 2015 recorded observations of resident *O. mykiss* in San Ysidro Creek (n=19), Carpinteria Creek (n=14), and North Fork Matilija Creek (n=189)(Table 28), CDFW unpublished data 2018). A snorkel survey conducted in North Fork Matilija Creek after the Thomas Fire in July of 2018 resulted in one *O. mykiss* observation (Horgan et al., CDFW unpublished data 2018). Zero *O. mykiss* were observed in these streams during the habitat and barrier assessments conducted for this report. It is unlikely San Ysidro Creek and Carpinteria Creek continue to support a resident *O. mykiss* population at this time considering the numerous negative impacts on stream habitat conditions from persistent drought, wildfire, and subsequent sediment influxes. A more definitive assessment of current resident *O. mykiss* population status within these streams would be obtained from snorkel surveys.

Stream	Dates of Survey	Individual <i>O. mykiss</i> Observed	Distance Surveyed (Stream Miles)
San Ysidro Creek	8/3/15 – 8/11/15	19	1
Carpinteria Creek	11/17/14 – 11/18/14	14	0.85
Carpinteria Creek	10/20/15 – 10/22/15	14	0.94
North Fork Matilija Creek	7/8/14 – 7/28/14	105	4.35
North Fork Matilija Creek	7/28/15 – 8/13/15	84	4.58
North Fork Matilija Creek	7/4/18 – 7/18/18	1	4.35

Table 28. CDFW snorkel survey data.

Streams in which *O. mykiss* were observed during habitat and barrier assessments conducted for this report include Lion Canyon Creek, Topanga Creek, Sisar Creek, and Santa Paula Creek. Snorkel surveys conducted by CDFW during the summer of 2018 observed 133 individual *O. mykiss* in Sisar Creek and 2,716 individual *O. mykiss* in Santa Paula Creek (CDFW unpublished data 2018). These observations were made in the most upstream anadromous accessible reaches of these creeks. The upper reaches of these creeks were also assessed to contain some of the highest quality *O. mykiss* habitat within all the watersheds assessed for this report, as is reflected in the HSI scores displayed in figure 14 and discussed in the section 5.2.

6.4 Barrier Assessments (FishXing)

There are many complexities associated with assessing and determining the degree to which low-water crossings, dams, diversions, flood control channels, bridges, culverts, grade controls, and natural stream features present as barriers to fish migration. Each of these structures and features contains a distinct set of dimensions and thus has unique influences on hydraulic streamflow conditions that continuously fluctuate with changing rates of streamflow. For this project FishXing software was used to model hydraulic conditions occurring at man-made structures and compare *O. mykiss* swimming capabilities to those conditions. While a useful tool, FishXing is not without issues and limitations as it does not account for all of the variables associated with fish passage. As with most statistical models, the generated estimates should be interpreted with discretion. Many studies assessing the accuracy of FishXing modeling have concluded its estimates tend to be conservative (Blank et al. 2005; Poplar-Jeffers et al. 2008; Mangin et al. 2010). Shortcomings associated with FishXing can be attributed to imprecise or limited crossing dimensional input and incomplete knowledge of fish physiology and behavior.

FishXing assessments of fish passage are based on generalized dimensional inputs of the crossing structure and downstream channel. For instance, only a select set of elevation measurement points (crossing inlet, crossing outlet, outlet pool bottom, outlet pool tailout, and downstream channel) taken along the thalweg of streamflow are factored into FishXing calculations. This leaves the hydraulic conditions occurring along the margins of each stream channel and within each crossing structure to be assumed based on the tailwater cross section inputs and height, width, span, and rise dimensions of the crossing structure. The generalized modeling associated with FishXing may discount unique crossing structure features or dimensions and their potential impacts on hydraulic conditions and subsequently *O. mykiss* passage abilities. Features documented within crossing structures assessed for this project that likely were not well represented within FishXing modeling included inlet and outlet aprons, structure deteriorations, and presence of multiple crossing segments with differing orientations. Attempts were made to accurately represent these unique features within FishXing. For example, inlet and outlet apron measurements were often factored into the crossing length and slope of a structure. Another major instance of adapting FishXing to represent crossing characteristics is the modeling of low-water crossings as large eccentric horizontal elliptical culverts. Of the culvert shape options available to be selected within

FishXing this was the most representative of the general shape associated with low-water crossings. However, as depicted in figure 131 the outer margins of an ellipse become increasingly steep as the vertexes are approached and thus do not accurately represent the outer margins typically associated with low-water crossings. This difference is likely to be most reflected in FishXing calculations for high rates of streamflow which fill the entire width of the stream channel.



Figure 131. Profile depiction of horizontal ellipse culvert (black), vertex points (red), and low-water crossing (grey) margin differences.

Another aspect FishXing does not factor into its modeling calculations are the conditions occurring upstream of each man-made structure. Upstream conditions are important when assessing the full degree of barrier severity. Upstream conditions often require fish to provide additional swimming efforts before reaching an initial resisting habitat. The longitudinal profiles created during detailed barrier assessments extended to the first resting habitat upstream of each assessed crossing. The mean distance to the initial resting habitat of crossings assessed for this project was 56.2 feet, however long shallow riffle units persisted for hundreds of feet upstream of some crossings. In these instances, the challenging hydraulic conditions associated with these long shallow riffle units may potentially cause a portion of migrating fish to reach exhaustion and be pushed back downstream of a barrier structure.

The degree to which fish may successfully be able to pass through a culvert, under a bridge, or over a low-water crossing is also largely dependent on their swimming and leaping capabilities. These capabilities can vary greatly with “species, life-stage, body size, motivation, presence or predators, water temperature, streamflow, and many other factors” (Cahoon et al. 2007). The physiological swimming and leaping capabilities of *O. mykiss* utilized for barrier analysis in this report have predominantly been derived through experimental means including swim chamber testing (Hawkins and Quinn 1996) and predictive equations (Powers and Osborn 1985). These capability estimates can be misleading as they do not account for an extensive migration through natural stream conditions and areas with turbulent streamflow (Hinch & Rand 1998).

Fish behavior, including how, when, and where fish make barrier passage attempts is also not well represented within FishXing. This is largely due to the limited understanding associated with the behaviors fish exhibit when they encounter man-made barrier structures. Specifics such as to what extent fish attempt to swim in areas of reduced flow associated with barrier structure boundaries or whether fish exhibit avoidance of barrier structures is not fully understood (Kemp et al. 2005, 2008). One biological parameter incorporated within FishXing is the minimum water depth required to allow fish to swim effectively. This parameter is important for predicting the minimum streamflow required for potential successful passage attempts and is also likely a considerable factor in determining barrier statuses within southern California streams considering their tendency to exhibit persistent low flow conditions. For this report the lowest required minimum swimming depths and strongest swimming capabilities stated in reviewed literature were used in FishXing barrier analysis. These values were selected in attempt to represent the upper threshold of *O. mykiss* passage abilities.

To better assess the shortcomings of FishXing and accuracy of its passage calculations, specific hydraulic measurements and fish passage attempt observations would be required at barrier structures under numerous rates of streamflow. Such efforts would be time consuming and instances of steelhead passage attempts would be rare. As is the case with all assessment and calculation methods FishXing is subject to error, however the advantages of FishXing lie in its ability to provide relative rapid passage estimations for numerous fish species and life stages at selected ranges of streamflow. Additionally, the conservative nature of FishXing passage estimations help to ensure the expensive costs associated with restoration and barrier remediation are focused where they are truly necessary (Mahlum et al. 2014).

6.4.1 Barrier Assessments (Non-Road Crossing Barriers)

For natural stream features and non-road structures such as dams, diversions, and grade controls that are unable to be modeled with the use of FishXing the determination of barrier severity is perhaps even more complex. “Identification of total physical barriers to migrating fish [such as large dams or waterfalls] is often relatively straight-forward” (Coffman, 2005), however determining what constitutes a temporal or partial barrier is far more convoluted. In many instances impediments to fish movement occur temporally only under specific streamflow conditions when depths are insufficient or streamflow velocities exceed swimming capabilities. This was particularly evident in the streams assessed for this project. For example, many miles of stream could be considered a temporal barrier during periods of low flow and as portions of stream become dry. Each natural feature and non-road structure that is passable, but only under specific streamflow conditions should be considered an impediment that complicates the movement of fish through a stream. Collectively these features and non-road structures contribute to an overall narrowing window of opportunity for successful migration to reach suitable spawning areas (Stoecker and Kelley 2005).

As is often the case for all barrier types natural features and non-road structures presenting as barriers contain plunge points or cascades that require fish to make jumps or overpower turbulent high streamflow velocities to achieve successful passage. Basic assessment criteria listed in the CSSHRM and section 4.5 of this report were used to estimate the potential of fish passage abilities at natural features and non-road structures. As is the case with FishXing analysis these criteria do not account for all of the complex hydraulic conditions migrating fish must typically contend with. Also these criteria are based on the swimming abilities of steelhead, which are much stronger swimmers than resident *O. mykiss* life stages. More direct detailed measurement analysis and observation of passage attempts would be required to more accurately determine the barrier statuses of natural stream features and non-road structures. In many cases surveys to assess the degree to which a man-made structure or natural stream feature presents as a barrier to fish migration include a “degree of expert opinion and subjective assessment, often without any validation” (Kemp and O’Hanley 2010).

To further complicate the assessment of fish passage, the dynamic nature of streams leads to changes in channel characteristics over time, which can change the status of barriers. The measurements, analysis, and assessment of data collected for this project represents a snapshot in time of passage conditions. Due to this, follow up assessments of individual barriers are recommended prior to conducting any remediation efforts. Follow up assessments should also take into consideration additional aspects likely to impact barrier remediation prioritization, which were not assessed for this report. These considerations include cost of potential remediation treatment options as well as feasibility and opportunities to implement those options.

6.5 Future Recommendations

To build off of this report and further aid effective restoration and recovery efforts within the southern California *O. mykiss* DPS, the following actions are recommended:

1. Continue habitat assessment and *O. mykiss* abundance surveys. Due to the broad approach of habitat assessments conducted for this report additional studies to monitor stream habitat and resident *O. mykiss* population fluctuations would be beneficial. Specifically, additional seasonally coordinated habitat assessments across these watersheds would allow for more accurate identification of perennial flowing stream sections with the potential to support resident *O. mykiss* populations and provide spawning and rearing habitat. Additional habitat assessments with greater focus on the assessment of *O. mykiss* habitat suitability index parameters and specific locational distinction of these parameters within each stream would likely be the most favorable approach. Attention should also be given to fine sediment loads, which was not a focus within this project. Sediment concentrations of 3,000 parts per million or greater suspended within the water column have been shown to cause physiological damage to *O. mykiss* gill filaments (Herbert and Merkens, 1961). Fine sediments that settle out of the water column have been observed to cover substrate suitable to *O. mykiss* spawning, suffocate eggs, or prevent the emergence of recently hatched young (Cordone and Kelly 1961).
2. In addition to assessing natural factors of influence on *O. mykiss* habitat, attention should also be given to assessing anthropogenic factors of influence. This includes the impacts of water diversions on *O. mykiss* habitat and their migration abilities within these watersheds. It is also recommended that continued efforts are made to contact private land and barrier structure owners. Considering a portion of the road crossings assessed within these watersheds were located on private property the inclusion of these property owners is essential to future restoration efforts.
3. Considerable focus should be given to ensuring barrier remediation efforts are effective. Particular deliberation should be given to considerations of retrofitting barrier structures with baffles, fishways, or other artificial passage facilities. Studies evaluating the effectiveness of such facilities and their ability to create conditions conducive to sustained fish passage have revealed various shortfalls (Stoecker 2004). Generally, baffles and fishways only provide passage conducive conditions when operating under the specific streamflow levels they were designed for. This tends to make them most effective when used in streams with consistent streamflow. Southern California streams are characterized by inconsistent streamflow that generally only supports upstream migration for short periods following winter rain events. Even when streamflow is adequate to provide passage through baffles or fishways the difficulty of passage may require steelhead to make multiple passage attempts. Delays and energy expended due to failed passage attempts may hinder passage past additional upstream temporal barrier features and prevent steelhead from reaching spawning habitat. An additional limitation to baffle and fishway barrier retrofits are the maintenance efforts typically required to ensure they remain effective in providing conditions suitable to fish passage. Artificial passage facilities are highly dependent on continual debris and sediment removal. They also may reduce stream flow capacity and are therefore prone to structural failure during intense high streamflow events. If baffles or fishways are constructed within culverts they may increase the likelihood of damage occurring to the culvert itself or structure the culvert passes through. Structural damage to artificial passage facilities may make them ineffective and prevent upstream steelhead passage until they can be repaired.

4. It is widely accepted that road crossings which most closely mimic natural stream conditions are the most effective in allowing passage of all aquatic species (Katapodis, 2005). The importance of considering crossing designs that are conducive to allowing passage of all aquatic species should not be ignored. Aquatic ecosystems and the species inhabiting them are interdependent thus making survival of a target species such as *O. mykiss* largely dependent on an ecosystem-based design approach for all habitat restoration efforts (Forest Service Stream-Simulation Working Group, 2008). In most cases free spanning bridges over natural substrate generally are the most conducive structures to allowing for natural stream conditions to persist and allow for unimpeded passage of all species and life stages under the widest range of streamflow conditions (Stoecker 2004). Bridges also generally provide greater high streamflow conveyance capacity thus often making them more cost effective as they tend to require less maintenance and last longer than culverts. Bridges passing over natural streambeds also provide aquatic habitat that serves to maintain riparian connectivity. Additionally, aesthetically designed bridges have potential to increase the value of surrounding properties.

7.0 Conclusion

The resident *O. mykiss* populations and riparian habitat they inhabit within the Ventura River, Santa Clara River, Conception Coast, and Topanga Creek watersheds have been impacted significantly as a result of recent drought, wildfire, and debris flows. These impacts likely have led to declines in the number of individual *O. mykiss* in these populations. However, the resiliency of the southern California *O. mykiss* have allowed populations to persist. The watersheds assessed for this report include some of the few remaining *O. mykiss* populations within Southern California. Despite this resiliency, the presence of numerous barriers continue to limit and prevent *O. mykiss* abilities to migrate while also fragmenting and reducing habitat available to them. As a result southern California *O. mykiss* populations are isolated from one another and their ability to transfer genetics through spawning is greatly limited. In turn this lack of genetic diversity limits *O. mykiss* abilities to adapt to environmental fluctuations and recover from disease. This fragmentation and reduction of available habitat “correlates directly to the reduction in population size of the species that uses that habitat” (Netti, 1997). This increases the potential magnitude of benefits that come with remediating barriers to *O. mykiss* migration in these watersheds. Historical habitat that is reopened through the removal of barriers will allow for an expanded range of Southern California *O. mykiss* populations. Streams currently unoccupied by resident *O. mykiss* may be recolonized by returning steelhead migrations. The benefits of remediating migration barriers may come to fruition in a relatively short period of time as steelhead returns are still documented within these watersheds. Within the course of this project an anadromous steelhead was observed in the pool unit immediately downstream of the Robles Diversion Dam on March 7th, 2019 by two Casitas Municipal Water District (CMWD) fisheries biologists (Lewis et al. 2019). Removing barriers within streams and mitigating the numerous negative impacts associated with them is critical to the perpetuation of the anadromous life cycle of steelhead and overall survival of *O. mykiss* in Southern California streams.

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Appendix A – Santa Clara River Watershed Natural Barriers and Non-Barrier Structures




This appendix lists all naturally occurring barrier features which were assessed to limit upstream *O. mykiss* movement and all man-made structures which were assessed to be free of *O. mykiss* passage constraints within the assessed portion of the Santa Clara River watershed. All Caltrans owned structures are highlighted in yellow. Maps depicting the locations of all barrier types for each assessed stream are posted at the end of this appendix.






Santa Clara River Watershed - Santa Clara River – Natural Barriers

No naturally occurring barrier features are currently present within the Santa Clara River between the river estuary and the Sespe Creek confluence. The Santa Clara River was not assessed upstream of the Sespe Creek confluence and thus the presence of natural barrier features within the upper reaches of the Santa Clara River is unknown.

Santa Clara River Watershed - Santa Clara River – Non-Barrier Structures

Eight man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of the Santa Clara River. A list of those structures is included in the below table.





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SCL_001_R PAD ID: None Assigned	34.23628, -119.25648	Unassessed	Not a Barrier	Harbor Boulevard bridge over natural streambed substrate with multiple concrete supports in stream channel.	
Barrier ID: SCL_002_R PAD ID: None Assigned	34.23495, -119.2168	Unassessed	Not a Barrier	Victoria Avenue bridge over natural streambed substrate with multiple concrete supports in stream channel.	
Barrier ID: SCL_003_R PAD ID: 759874	34.24263, -119.1893	Unassessed	Not a Barrier	Hwy 101 bridge over natural streambed substrate with many cylindrical concrete supports in stream channel. Post Mile: 23.29	



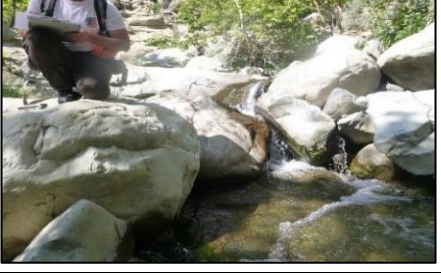


Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SCL_004_R PAD ID: 736264	34.27691, -119.13911	Not a Barrier	Not a Barrier	Hwy 118 bridge over natural streambed substrate with multiple cylindrical concrete supports in stream channel. Post Mile: 1.91	
Barrier ID: SCL_006_R PAD ID: None Assigned	34.34808, -119.05154	Unassessed	Not a Barrier	Bridge over natural streambed substrate with multiple concrete supports in stream channel.	
Barrier ID: SCL_007_NR PAD ID: 758971	34.35159, -119.04469	Unassessed	Not a Barrier	Large, earthen diversion dam. Land is cut out for water for agriculture. Used to have screen but is now blasted out.	
Barrier ID: SCL_008_NR PAD ID: None Assigned	34.24103, -119.19115	Unassessed	Not a Barrier	Railroad bridge with multiple concrete supports over natural streambed substrate.	
Barrier ID: None Assigned PAD ID: None Assigned	34.34806, -119.05167	Unassessed	Not a Barrier	Screened pump in pool behind 12 th Street bridge.	

Appendix A Table 1. Man-made non-barrier structures in assessed portion of the Santa Clara River.

Santa Clara River Watershed - Santa Paula Creek – Natural Barriers

Nine natural stream features were assessed to constrict *O. mykiss* upstream movement in Santa Paula Creek. All of these features are located within the upper reaches of the stream. Information regarding each assessed natural barrier on Santa Paula Creek is listed in the table below.





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SPL_011_NR PAD ID: 723745	34.4496, -119.05848	Total	Temporal & Partial	Bedrock step pools with plunge and cascade. Total height of barrier: 6 ft Water depth below plunge: 2.4 ft Water depth below cascade: 1.6 ft	
Barrier ID: SPL_012_NR PAD ID: None Assigned	34.44952, -119.05846	Unassessed	Temporal	Cascade at bedrock chute. Barrier height: 4.4 ft Water depth below cascade: 3.8 ft	
Barrier ID: SPL_013_NR PAD ID: None Assigned	34.44918, -119.05804	Unassessed	Temporal	Cascade over boulders. Barrier height: 5.6 ft Water depth below cascade: 2.1 ft	
Barrier ID: SPL_014_NR PAD ID: None Assigned	34.44914, -119.05797	Unassessed	Temporal	Plunge over bedrock. Barrier height: 3.4 ft Water depth below plunge: 4 ft	



Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SPL_015_NR PAD ID: None Assigned	34.44876, -119.05786	Unassessed	Temporal & Partial	Cascade over boulders and bedrock. Barrier height: 5.7 ft Water depth below plunge: 2.1 ft	
Barrier ID: SPL_016_NR PAD ID: None Assigned	34.44865, -119.05769	Unassessed	Temporal	Cascade over boulders and on to bedrock sheet. Barrier height: 4.2 ft Water depth below cascade: 1.1 ft	
Barrier ID: SPL_017_NR PAD ID: None Assigned	34.44870, -119.05666	Unassessed	Temporal	Cascade over boulders and onto bedrock. Barrier height: 5.5 ft Water depth below cascade: 0.3 ft	
Barrier ID: SPL_018_NR PAD ID: None Assigned	34.44897, -119.05633	Unassessed	Temporal & Partial	Cascade over bedrock. Barrier height: 4.2 ft Water depth below cascade: 1.7 ft	
Barrier ID: SPL_019_NR PAD ID: 705163	34.44908, -119.05673	Total	Total	Waterfall over bedrock. Barrier height: >17 ft Water depth below cascade: 8.3 ft	

Appendix A Table 2. Natural barrier features in the assessed portion of Santa Paula Creek.

Santa Clara River Watershed - Santa Paula Creek – Non-Barrier Structures

Santa Paula Creek was assessed to contain six man-made structures free of passage constraints to *O. mykiss*.




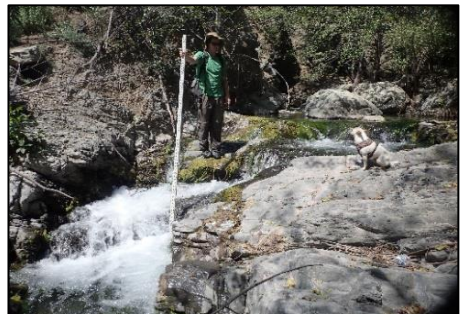
Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SPL_001_R PAD ID: 759932	34.35495, -119.04829	Unassessed	Not a Barrier	Hwy 126 north and southbound bridges both with two concrete supports in stream channel. Span is over natural streambed substrate and concrete boulder riprap channel walls. Post Mile: 12.71	
Barrier ID: SPL_002_R PAD ID: None Assigned	34.35818, -119.04893	Unassessed	Not a Barrier	Free spanning bridge over natural substrate and concrete flood control walls.	
Barrier ID: SPL_004_R PAD ID: None Assigned	34.38976, -119.07235	Unassessed	Not a Barrier	Free spanning steel bridge with wood base over cement channel walls and natural streambed substrate	
Barrier ID: SPL_006_R PAD ID: None Assigned	34.41256, -119.08204	Unassessed	Not a Barrier	Free spanning concrete bridge over natural streambed substrate	



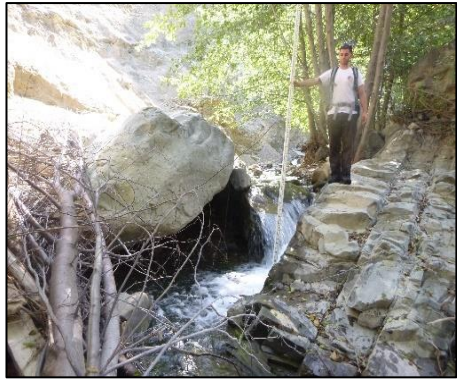

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SPL_009_R PAD ID: 705162	34.42755, -119.09085	Not a Barrier	Not a Barrier	Hwy 150 free spanning bridge over natural streambed substrate. Post Mile: 28.54	
Barrier ID: SPL_010_R PAD ID: None Assigned	34.43674, -119.08673	Unassessed	Not a Barrier	Low-water crossing through natural streambed substrate with boulder cascade at outlet.	




Appendix A Table 3. *Man-made non-barrier structures in assessed portion of Santa Paula Creek.*

Santa Clara River Watershed – East Fork Santa Paula Creek – Natural Barriers

The presence of natural barriers within the East Fork of Santa Paula Creek is similar to the condition of natural barriers located on the upper reaches of the main stem of Santa Paula Creek. Table 4 below lists all assessed East Fork Santa Paula Creek natural barriers, none of which had been previously assessed and listed in PAD. Additional temporal and partial natural barriers were located between the EFSP_10_NR barrier and the EFSP_11_NR total barrier, but due to time constraints data was not collected on these barriers.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: EFSP_001_NR PAD ID: None Assigned	34.44868, -119.05675	Unassessed	Temporal & Partial	Cascade over bedrock. Cascade height: 6.4 ft Water depth below cascade: 1.7 ft	
Barrier ID: EFSP_002_NR PAD ID: None Assigned	34.44866, -119.05621	Unassessed	Temporal & Partial	Cascade over bedrock. Cascade height: 6.8 ft Water depth below cascade 1.7 ft	
Barrier ID: EFSP_003_NR PAD ID: None Assigned	34.44863, -119.05607	Unassessed	Temporal & Partial	Plunge over bedrock. Plunge height: 6.7 ft Water depth below plunge: 1 ft	
Barrier ID: EFSP_004_NR PAD ID: None Assigned	34.44831, -119.05486	Unassessed	Temporal & Partial	Cascade over bedrock. Cascade height: 5.1 ft Water depth below plunge: 2 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: EFSP_005_NR PAD ID: None Assigned	34.44796, -119.05205	Unassessed	Partial	Cascade step pools over bedrock. Height of 1 st cascade: 3.9 ft Height of 2 nd cascade: 3.6 ft Water depth below 1 st cascade 1.6 ft Water depth below 2 nd cascade 1.6 ft	
Barrier ID: EFSP_006_NR PAD ID: None Assigned	34.44714, -119.05130	Unassessed	Temporal & Partial	Cascade over landslide rock rubble. Cascade height: 6.2 ft Water depth below cascade: 0.8 ft	
Barrier ID: EFSP_007_NR PAD ID: None Assigned	34.44728, -119.05008	Unassessed	Temporal & Partial	Plunge point over and between bedrock. Plunge height: 3.6 ft Water depth below plunge: 1.5 ft	
Barrier ID: EFSP_008_NR PAD ID: None Assigned	34.44683, -119.04963	Unassessed	Temporal & Partial	Plunge over large boulders. Plunge height: 4.7 ft Water depth below plunge: 2.0 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: EFSP_009_NR PAD ID: None Assigned	34.44676, -119.04964	Unassessed	Temporal & Partial	Narrow plunge point between bedrock and boulders. Plunge height: 3.2 ft Water depth below plunge: 2.5 ft	
Barrier ID: EFSP_010_NR PAD ID: None Assigned	34.44703, -119.04784	Unassessed	Temporal & Partial	Three plunge points and step pools over large boulders. Total height of barrier: 10.1 ft Depth below 1st plunge: 1.8 ft Depth below 2 nd plunge: 1.4 ft Depth below 3 rd plunge: 1.1 ft	
Barrier ID: EFSP_011_NR PAD ID: None Assigned	34.44727, -119.03366	Unassessed	Total	Waterfall over bedrock. Waterfall height: 16.5 ft Depth below plunge: 0.6 ft	




Appendix A Table 4. Natural barrier features in assessed portion of East Fork Santa Paula Creek.



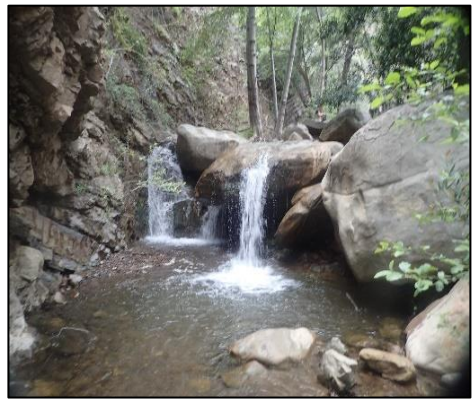
Santa Clara River Watershed – East Fork Santa Paula Creek – Non-Barrier Structures Barriers

No man-made structures of any type are present within the East Fork of Santa Paula Creek.

Santa Clara River Watershed - Sisar Creek – Natural Barriers

The upper reaches of Sisar Creek contained several natural barrier features, each of which is listed below in table 5. Only the total natural barrier was previously assessed and listed in PAD.





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SIS_007_NR PAD ID: None Assigned	34.43186, -119.12341	Unassessed	Temporal & Partial	Plunge over boulders and bedrock. Height of barrier: 7.2 ft Water depth below plunge: 3 ft	
Barrier ID: SIS_012_NR PAD ID: None Assigned	34.46339, -119.12982	Unassessed	Temporal & Partial	Cascade between boulders and bedrock. Height of barrier: 9.4 ft Water depth below cascade: 3 ft	
Barrier ID: SIS_013_NR PAD ID: None Assigned	34.46513, -119.12646	Unassessed	Temporal & Partial	Cascade over boulders. Height of barrier: 8.5 ft Water depth below cascade: 0.5 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SIS_015_NR PAD ID: None Assigned	34.46812, -119.12519	Unassessed	Temporal & Partial	Plunge over large boulders. Height of barrier: 6.1 ft Water depth below plunge: 1.3 ft	
Barrier ID: SIS_016_NR PAD ID: None Assigned	34.46829, -119.12498	Unassessed	Temporal & Partial	Cascade over large boulders. Height of barrier: 6.0 ft Water depth below cascade: 3.3 ft	
Barrier ID: SIS_017_NR PAD ID: 723747	34.46997, -119.12427	Total	Total	Plunge off of overhanging bedrock and large boulder. Height of barrier: 9.4 ft Water depth below plunge: 1.5 ft	

Appendix A Table 5. *Natural barrier features in assessed portion of Sisar Creek.*

Santa Clara River Watershed - Sisar Creek – Non-Barrier Structures

Nine man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of the Sisar Creek. A list of those structures is included in the table 6 below.





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SIS_001_R PAD ID: 761522	34.42761, -119.09191	Not a Barrier	Not a Barrier	Hwy 150 free spanning concrete bridge over natural streambed substrate. Post Mile: 28.48	
Barrier ID: SIS_002_R PAD ID: None Assigned	34.42735, -119.09473	N/A	Not a Barrier	Private, free spanning metal bridge over natural substrate.	
Barrier ID: SIS_003_R PAD ID: 713896	34.42711, -119.10062	Not a Barrier	Not a Barrier	Free spanning metal bridge over natural streambed substrate.	
Barrier ID: SIS_004_R PAD ID: None Assigned	34.42725, -119.10571	N/A	Not a Barrier	Free spanning metal bridge over natural streambed substrate.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SIS_005_R PAD ID: 713897	34.42741, -119.10822	Not a Barrier	Not a Barrier	Free spanning metal bridge over concrete supports on channel walls. Over natural streambed substrate.	
Barrier ID: SIS_009_R PAD ID: 713880	34.43473, -119.12742	N/A	Not a Barrier	Free spanning steel bridge over concrete supports on channel walls. Over natural streambed substrate.	
Barrier ID: SIS_010_R PAD ID: 713882	34.45127, -119.1352	N/A	Not a Barrier	Low-flow crossing through natural streambed substrate.	
Barrier ID: SIS_011_R PAD ID: None Assigned	34.46234, -119.13049	N/A	Not a Barrier	Low-flow crossing through natural streambed substrate.	
Barrier ID: SIS_014_R PAD ID: None Assigned	34.46545, -119.1263	N/A	Not a Barrier	Low-flow crossing through natural streambed substrate.	

Appendix A Table 6. Man-made non-barrier structures in assessed portion of Sisar Creek.

Santa Clara River Watershed – Lion Canyon Creek and East Fork Lion Canyon Creek – Natural Barriers





Lion Canyon Creek splits into an east and west fork approximately 2.5 stream miles from its confluence with Sespe Creek. Assessments were only conducted on the main stem and the east fork. A total of four natural features were assessed to constrict upstream *O. mykiss* movement on Lion Canyon Creek and East Fork Lion Canyon Creek. These features are listed in the table below.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: LYN_001_NR PAD ID: None Assigned	34.55537, -119.16569	Unassessed	Temporal & Partial	Plunge over bedrock and boulders. Height of barrier: 5.0 ft Water depth below plunge: 2.0 ft	
Barrier ID: LYN_006_NR PAD ID: None Assigned	34.53871, -119.16095	Unassessed	Temporal & Partial	Cascade over boulders. Height of barrier: 3.7 ft Water depth below cascade: 2.6 ft	
Barrier ID: LYN_007_NR PAD ID: None Assigned	34.53886, -119.16003	Unassessed	Temporal & Partial	Cascade over bedrock and boulders. Height of barrier: 12 ft Water depth below cascade: 2.8 ft	
Barrier ID: ELYN_001_NR PAD ID: 723785	34.52751, -119.14328	Total	Total	Waterfall and cascade over bedrock. Height of barrier: > 25 ft Water depth below plunge: > 10 ft	

Appendix A Table 7. Natural barrier features in assessed portions of Lion Canyon Creek and East Fork Lion Canyon Creek.

Santa Clara River Watershed – Lion Canyon Creek and East Fork Lion Canyon Creek – Non-Barrier Structures

Four man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of the Lion Canyon Creek and East Fork Lion Canyon Creek. A list of those structures is included in the below table.

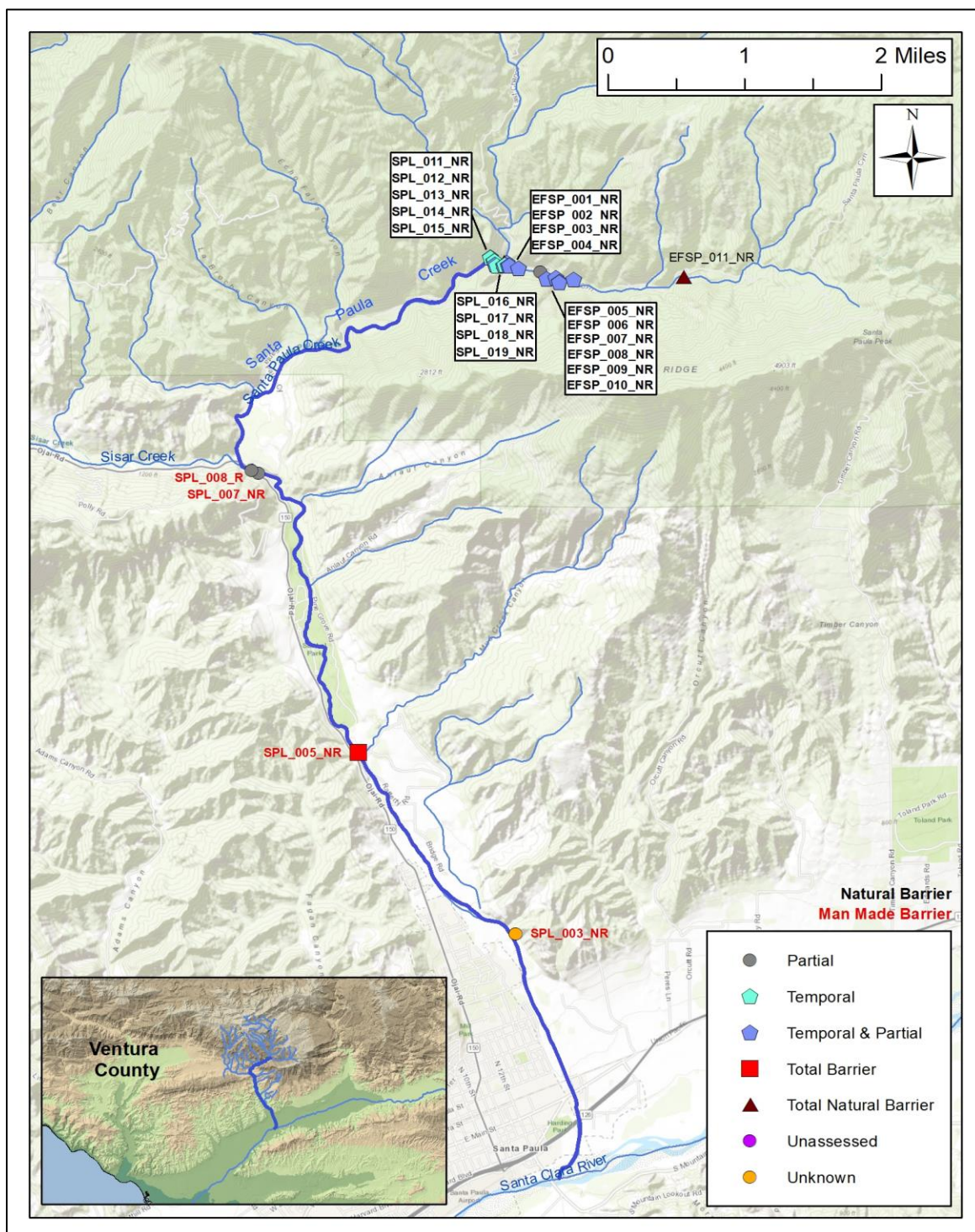
Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: LYN_002_NR PAD ID: None Assigned	34.55161, -119.16541	N/A	Not a Barrier	Concrete boulder rip rap. Small dam remnants on river left bank.	
Barrier ID: LYN_003_NR PAD ID: None Assigned	34.55097, -119.16541	N/A	Not a Barrier	Concrete boulder rip rap over bedrock sheet. Remnants of dam on both banks.	
Barrier ID: LYN_004_NR PAD ID: 723782	34.54996, -119.16605	Not a Barrier	Not a Barrier	Concrete boulder rip rap over bedrock sheet. Remnants of dam on both banks.	
Barrier ID: LYN_005_NR PAD ID: 723783	34.54338, -119.1637	Remediated, fish response unconfirmed	Not a Barrier	Remnants of old concrete dam. Concrete on both banks.	

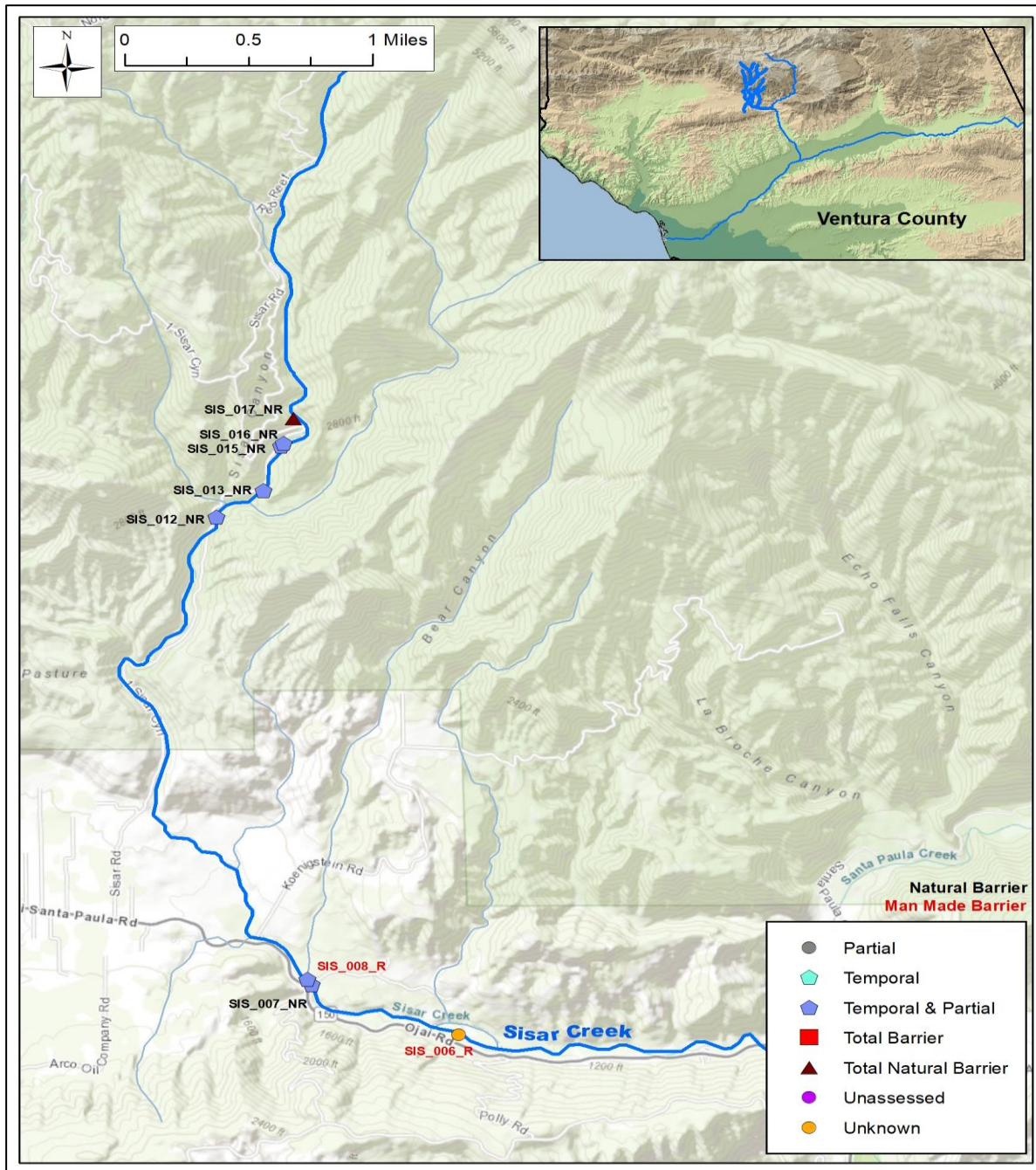
Appendix A Table 8. Man-made non-barrier structure in assessed portion of Lion Canyon Creek and East Fork Lion Canyon Creek.

Santa Clara River Watershed Barrier Location Maps

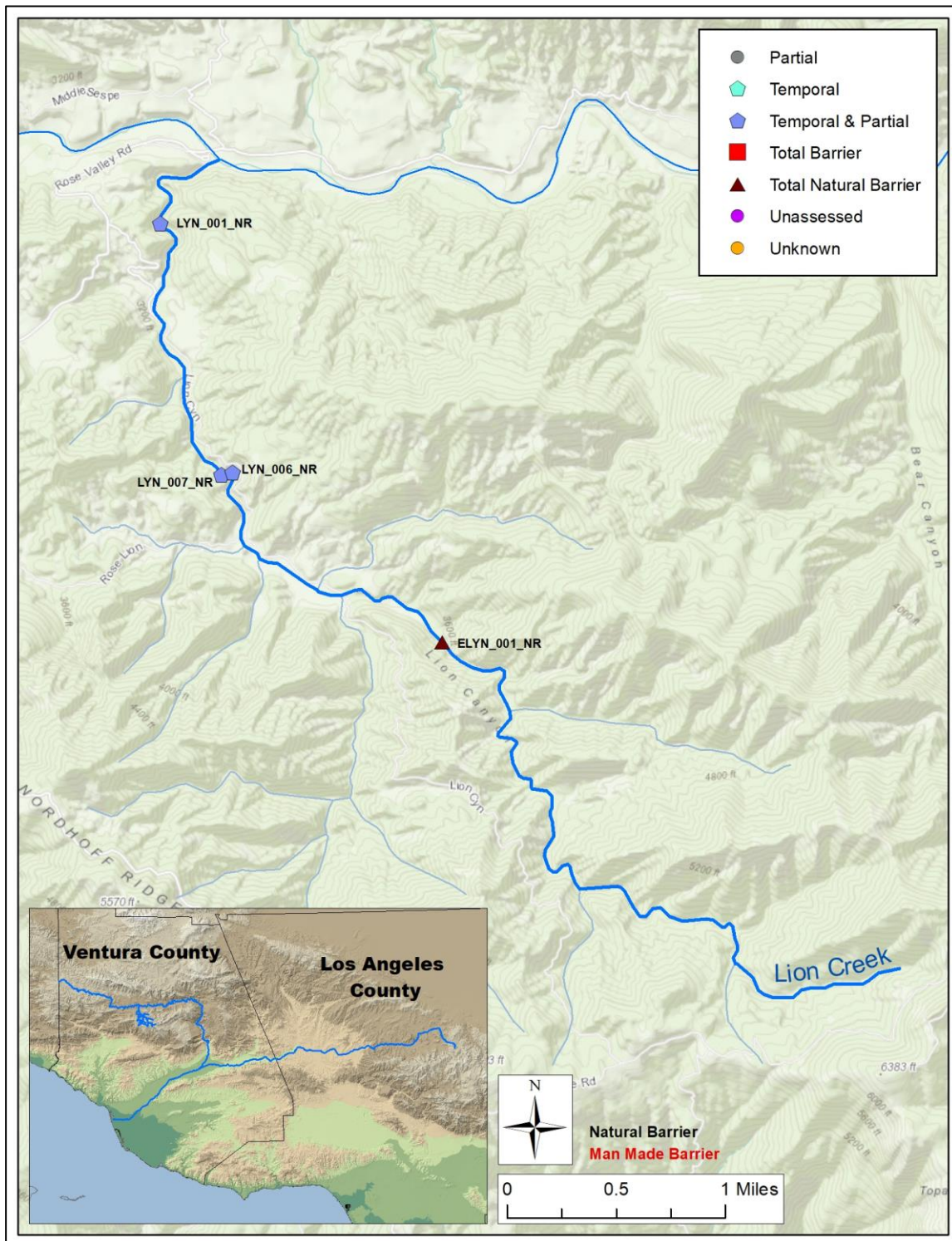


Appendix A Figure 1. Location of single man-made structure in assessed portion of the Santa Clara River.





Appendix A Figure 3. Location of man-made barrier structures and natural barrier features barriers in assessed portions of Sisar Creek.



Appendix A Figure 4. Location of natural barrier features in assessed portions of Lion Canyon Creek and East Fork of Lion Canyon Creek

Appendix B – Ventura River Watershed Natural Barriers and Non-Barrier Structures




This appendix lists all naturally occurring barrier features which were assessed to limit upstream *O. mykiss* movement and all man-made structures which were assessed to be free of *O. mykiss* passage constraints within the assessed portion of the Ventura River watershed. All Caltrans owned structures are highlighted in yellow. Maps depicting the locations of all barrier types for each assessed stream are posted at the end of this appendix.



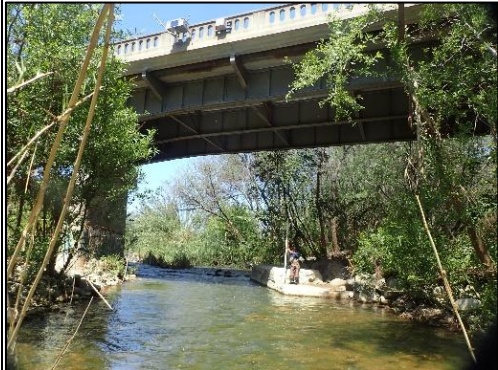

Ventura River Watershed – Ventura River – Natural Barriers




No naturally occurring barrier features were documented within the Ventura River when assessed (1/28/19 – 5/8/19) for this report.

Ventura River Watershed – Ventura River – Non-Barrier Structures

Ten man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of the Ventura River. A list of those structures is included in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: VEN_001_R PAD ID: 759879	34.2801, -119.3084	Unassessed	Not a Barrier	Large concrete Hwy 101 northbound and southbound bridges over natural substrate with concrete supports in streambed. Post Mile: 31.05	
Barrier ID: VEN_002_R PAD ID: None Assigned	34.28201, -119.30867	Unassessed	Not a Barrier	Concrete bridge over natural substrate with concrete supports in streambed.	
Barrier ID: VEN_003_NR PAD ID: None Assigned	34.3138, -119.29719	Unassessed	Not a Barrier	Suspended utility crossing.	


Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: VEN_004_NR PAD ID: None Assigned	34.31556, -119.2963	Unassessed	Not a Barrier	Suspended utility crossing.	
Barrier ID: VEN_005_R PAD ID: None Assigned	34.31654, -119.29594	N/A	Not a Barrier	Tall bridge with two concrete supports in channel. Over natural streambed substrate.	
Barrier ID: VEN_006_R PAD ID: None Assigned	34.35243, -119.308	N/A	Not a Barrier	Bridge with two concrete supports in channel over natural substrate. Boulder rip rap channel walls.	
Barrier ID: VEN_008_R PAD ID: 705673	34.39968, -119.30833	N/A	Not a Barrier	Concrete bridge with two concrete supporting walls that extend laterally (to bridge) into channel. Over natural substrate.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: VEN_009_R PAD ID: 732198	34.425143, -119.30268	N/A	Not a Barrier	Large concrete bridge with multiple concrete supports over natural substrate. Post Mile: 15.59	
Barrier ID: VEN_012_R PAD ID: 705683	34.48287, -119.29639	Not a Barrier	Not a Barrier	Concrete bridge over concrete channel bottom with two instream supports.	
Barrier ID: None Assigned PAD ID: None Assigned	34.48441, -119.29815	N/A	Not a Barrier	Free spanning suspended foot bridge.	

Appendix B Table 1. *Man-made non barrier structures in assessed portion of the Ventura River.*

Ventura River Watershed – San Antonio Creek – Natural Barriers


One naturally occurring stream feature was assessed to constrict *O. mykiss* upstream movement within San Antonio Creek. This natural barrier feature is located approximately 9.35 miles upstream from the Ventura River confluence and information regarding it is contained within the table below.





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SNT_023_NR PAD ID: None Assigned	34.46452, -119.2077	Unassessed	Temporal and Partial	Centralized plunge point over large boulders Height of the plunge: 3.8 ft Water depth below plunge: 1.2 ft	





Appendix B Table 2. Natural barrier features in the assessed portion of San Antonio Creek.





Ventura River Watershed – San Antonio Creek – Non-Barrier Structures





Twenty One man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of San Antonio Creek. A list of those structures is included in the below table.





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SNT_001_R PAD ID: 713866	34.38073, -119.3074	Remediated, fish response unconfirmed	Not a Barrier	Bike trail crossing bridge with instream concrete supports.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SNT_002_NR PAD ID: None Assigned	34.38084, -119.30519	N/A	Not a Barrier	Concrete utility pipe mostly embedded in channel substrate.	
Barrier ID: SNT_003_R PAD ID: 713867	34.38042, -119.3074	Temporal	Not a Barrier	Hwy 33 bridge with instream supports over natural substrate. Some upstream debris accumulation. Post Mile: 7.65	
Barrier ID: SNT_004_NR PAD ID: None Assigned	34.38218, -119.30258	N/A	Not a Barrier	Embedded utility pipe with damaged concrete encasing.	
Barrier ID: SNT_005_R PAD ID: 705684	34.2822, -119.30277	Remediated, fish response unconfirmed	Not a barrier	Free spanning bridge over natural substrate.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SNT_006_R PAD ID: None Assigned	34.39279, -119.29175	N/A	Not a Barrier	Low water crossing through natural streambed substrate. Dirt road.	
Barrier ID: SNT_007_R PAD ID: 713869	34.39375, -119.29102	N/A	Not a Barrier	Low water crossing through natural streambed substrate. Dirt road.	
Barrier ID: SNT_008_R PAD ID: 705685	34.40297, -119.28173	Temporal	Not a Barrier	Concrete low water crossing at stream substrate level.	
Barrier ID: SNT_010_R PAD ID: None Assigned	34.41578, -119.27145	N/A	Not a Barrier	Low water crossing through natural streambed substrate. Dirt road.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SNT_011_R PAD ID: None Assigned	34.42075, -119.26686	N/A	Not a Barrier	Bridge with two supports in channel over natural streambed substrate.	
Barrier ID: SNT_013_R PAD ID: 705658	34.42695, -119.25841	Temporal	Not a Barrier	Free spanning concrete bridge with rip rap on both banks. Over natural streambed substrate. Concrete channel wall downstream on river right.	
Barrier ID: SNT_014_R PAD ID: 705659	34.43151, -119.25352	Not a Barrier	Not a Barrier	Free spanning concrete bridge over natural streambed.	
Barrier ID: SNT_015_R PAD ID: 705660	34.43481, -119.24658	N/A	Not a Barrier	Free spanning bridge over natural substrate. Boulder rip rap channel walls under bridge.	



Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SNT_016_R PAD ID: 713871	34.44198, -119.23275	Partial	Not a Barrier	Free spanning golf course bridge over natural streambed substrate.	
Barrier ID: SNT_017_R PAD ID: 713872	34.44445, -119.23015	Remediated, fish response unconfirmed	Not a Barrier	Free spanning golf course bridge over natural streambed substrate.	
Barrier ID: SNT_018_R PAD ID: 713873	34.44914, -119.22465	Partial	Not a Barrier	Hwy 150 bridge over natural streambed substrate with instream concrete supports. Post Mile: 18.76	
Barrier ID: SNT_021_R PAD ID: 705661	34.45435, -119.22173	Temporal & Partial	Not a Barrier	Bridge with six sets of support pillars over natural substrate; four of which are in the stream bed. Boulder rip rap on channel banks.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: SNT_022_R PAD ID: 713876	34.46131, -119.21491	N/A	Not a barrier	Low water crossing through natural streambed substrate. Dirt road.	
Barrier ID: SNT_024_R PAD ID: None Assigned	34.46497, -119.20721	N/A	Not a Barrier	Low water crossing through natural streambed substrate. Dirt road.	
Barrier ID: SNT_025_NR PAD ID: None Assigned	34.46634, -119.20532	N/A	Not a Barrier	Water diversion structure with intake on river right bank.	
Barrier ID: SNT_026_NR PAD ID: None Assigned	34.46703, -119.20389	N/A	Not a Barrier	Grade control extending 80% across channel. River left is open for fish passage.	

Appendix B Table 3. Man-made non-barrier structures in assessed portion of San Antonio Creek.

Ventura River Watershed – Lion Creek – Natural Barriers



Two naturally occurring stream features were assessed to constrict *O. mykiss* upstream movement within Lion Creek. Information regarding them is contained within the table below.

Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description and Dimensions	Picture
Barrier ID: LNC_002_NR PAD ID: None Assigned	34.42084, -119.26294	N/A	Temporal	Cascade over a bedrock outcropping. Height of cascade: 1.2 ft Water depth below cascade: 0.6 ft	
Barrier ID: LNC_004_NR PAD ID: 713891	34.41879, -119.24934	Temporal	Temporal & Partial	Bedrock outcropping with plunge point and cascade. Height of plunge point: 3.1 ft Water depth below plunge: 1.3 ft Height of cascade: 3.3 ft Length of cascade: 15.2 ft	

Appendix B Table 4. Natural barrier features in the assessed portion of Lion Creek.

Ventura River Watershed – Lion Creek – Non-Barrier Structures


Two man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Lion Creek. A list of those structures is included in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description	Picture
Barrier ID: LNC_001_R PAD ID: 713879	34.421, -119.26288	Remediated, Fish response Unconfirmed	Not a Barrier	Free spanning bridge over boulder rip rap in natural streambed substrate.	
Barrier ID: LNC_003_R PAD ID: None Assigned	34.41917, -119.25957	N/A	Not a Barrier	Low water crossing through natural streambed substrate.	

Appendix B Table 5. *Lion Creek non-barrier man-made structures.*

Ventura River Watershed – Thacher Creek – Natural Barriers



Only one naturally occurring stream feature on Thacher Creek was assessed to limit *O. mykiss* upstream movement. This feature is the total natural barrier and limit to anadromy on Thacher Creek.




Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description and Dimensions	Picture
Barrier ID: THC_017_NR PAD ID: None Assigned	34.46666, -119.17474	N/A	Total	Series of cascades over sheer bedrock outcropping. Measurements only taken for most downstream cascade. Cascade height: 6.4 ft Cascade length: 32.5 ft Water depth below cascade: 1.0 ft	

Appendix B Table 6. Natural barrier feature in the assessed portion of Thacher Creek.

Ventura River Watershed – Thacher Creek – Non-Barrier Structures

Five man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Thacher Creek. A list of those structures is included in the below table.



Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description	Picture
Barrier ID: THC_005_R PAD ID: 705663	34.44512, -119.21983	N/A	Not a Barrier	Free spanning bridge over concrete channel walls and natural substrate.	
Barrier ID: THC_007_R PAD ID: 705664	34.44513, -119.2187	N/A	Not a Barrier	Free spanning bridge over concrete channel walls and natural streambed substrate.	

Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description	Picture
Barrier ID: THC_008_R PAD ID: 731449	34.44666, -119.21101	N/A	Not a Barrier	Free spanning Hwy 150 bridge over concrete channel walls and natural streambed substrate. Post Mile: 19.57	
Barrier ID: THC_009_R PAD ID: 705665	34.44687, -119.2063	N/A	Not a Barrier	Free spanning bridge over concrete channel walls and natural streambed substrate.	
Barrier ID: THC_012_R PAD ID: None Assigned	34.44948, -119.19453	N/A	Not a Barrier	Low water crossing with natural streambed. Textile channel lining on river left.	

Appendix B Table 7. *Thacher Creek non-barrier man-made structures.*

Ventura River Watershed – North Fork Matilija Creek – Natural Barriers





Two naturally occurring stream features were assessed to present as barriers to *O. mykiss* in North Fork Matilija Creek. These are located between the two most upstream highway 33 road crossings of the creek approximately 5.1 and 5.7 stream miles from the Ventura River confluence. Details regarding these natural barriers are listed in the table below.





Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description	Picture
Barrier ID: NFM_002_NR PAD ID: 713765	34.52739, -119.26364	Partial	Temporal & Partial	Large boulder pile cascade lacking any steps. Height of barrier: 6.6 ft.	
Barrier ID: NFM_003_NR PAD ID: None Assigned	34.53307, -119.25797	Unassessed	Temporal & Partial	Large boulder pile in narrow channel with plunge into shallow pool. Height of plunge: 5.7 ft	



Appendix B Table 8. Natural barrier features in the assessed portion of North Fork Matilija Creek.

Ventura River Watershed – North Fork Matilija Creek – Non-Barrier Structures

Thirteen man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of North Fork Matilija Creek. A list of those structures is included in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description	Picture
Barrier ID: NFM_001_R PAD ID: 705672	34.48534, -119.30068	N/A	Not a Barrier	Free spanning bridge over natural channel.	
Barrier ID: NFM_002_R PAD ID: 731844	34.48558, -119.30224	N/A	Not a Barrier	Hwy 33 free spanning bridge over natural channel. Post Mile: 15.54	
Barrier ID: NFM_003_R PAD ID: 731927	34.48875, -119.30486	N/A	Not a Barrier	Hwy 33 bridge with two concrete supports in stream bed. Post Mile: 15.85	
Barrier ID: NFM_004_R PAD ID: 732341	34.49274, -119.30668	N/A	Not a Barrier	Hwy 33 free spanning bridge with concrete channel walls. Post Mile: 16.13	


Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: NFM_005_R PAD ID: 731769	34.50702, -119.29569	Not a Barrier	Not a Barrier	Hwy 33 bridge with concrete support in river left channel. Over natural substrate. Post Mile: 17.42	
Barrier ID: NFM_006_R PAD ID: None Assigned	34.50801, -119.29569	N/A	Not a Barrier	Private bridge with two supports over natural substrate and concrete boulder rip rap walls.	
Barrier ID: NFM_007_R PAD ID: None Assigned	34.5083, -119.2895	N/A	Not a Barrier	Private bridge with concrete supports on both channel banks. Over natural substrate and boulder rip rap channel walls.	
Barrier ID: NFM_008_R PAD ID: 731490	34.50855, -119.28833	Not a Barrier	Not a Barrier	Hwy 33 free spanning bridge over natural substrate. Post Mile: 17.85	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: NFM_009_R PAD ID: 731490	34.50572, -119.27782	Not a Barrier	Not a Barrier	Free spanning bridge over natural substrate with concrete channel walls. Post Mile: 18.7	
Barrier ID: NFM_010_R PAD ID: 731723	34.50751, -119.27574	Not a Barrier	Not a Barrier	Free spanning bridge over natural streambed substrate. Post Mile: 18.9	
Barrier ID: NFM_011_R PAD ID: 731804	34.50804, -119.27522	Not a Barrier	Not a Barrier	Free spanning bridge over natural streambed and concrete channel walls. Post Mile: 18.93	
Barrier ID: NFM_012_R PAD ID: 707669	34.51068, -119.27515	Not a Barrier	Not a Barrier	Free spanning bridge over natural substrate. Concrete channel walls and wing walls at inlet and outlet.	
Barrier ID: NFM_015_R PAD ID: 731366	34.51861, -119.27081	Not a Barrier	Not a Barrier	Free spanning bridge over natural substrate with old concrete support structure remnants under bridge on both channel banks. Post Mile: 19.73	

Appendix B Table 9. North Fork Matilija Creek non-barrier structures.

Ventura River Watershed – Bear Creek – Natural Barriers


The only natural feature constraining *O. mykiss* upstream movement on Bear Creek is a waterfall located 1.7 stream miles from the North Fork Matilija Creek confluence.

Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description and Dimensions	Picture
PAD ID: None Assigned Barrier ID: BER_004_NR	34.51004, -119.24998	Unassessed	Total	Waterfall with plunge greater than 25 ft.	

Appendix B Table 10. Natural barrier features in the assessed portion of Bear Creek.

Ventura River Watershed – Bear Creek – Non-Barrier Structures



One man-made structure was assessed to be free of *O. mykiss* passage constraints within the assessed portion of Bear Creek. It is included in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description	Picture
Barrier ID: BER_003_R PAD ID: 731352	34.51378, -119.27207	Not a Barrier	Not a Barrier	Hwy 33 free spanning concrete bridge over natural substrate. Post Mile: 19.37	

Appendix B Table 11. Bear Creek non-barrier man-made structures.

Ventura River Watershed – Cannon Creek – Natural Barriers

Two natural barriers were assessed on Cannon Creek. Both natural barriers are in close proximity to each other 1.3 stream miles from the North Fork Matilija Creek confluence. The table below lists information regarding these barriers.

Barrier & PAD ID	Location	Previous Barrier Status	Assessed Barrier Status	Description	Picture
Barrier ID: CAN_004_NR PAD ID: None Assigned	34.51713, -119.28642	Unassessed	Temporal & Partial	Bedrock and boulder cascade with cascade length of 10.5 ft and height of 5.2 ft.	
Barrier ID: CAN_005_NR PAD ID: None Assigned	34.51737, -119.28649	Unassessed	Total	Bedrock and boulder cascade in narrower bedrock lined canyon with cascade length of 24 ft and height of 9.7 ft.	

Appendix B Table 12. Natural barrier features in the assessed portion of Bear Creek.

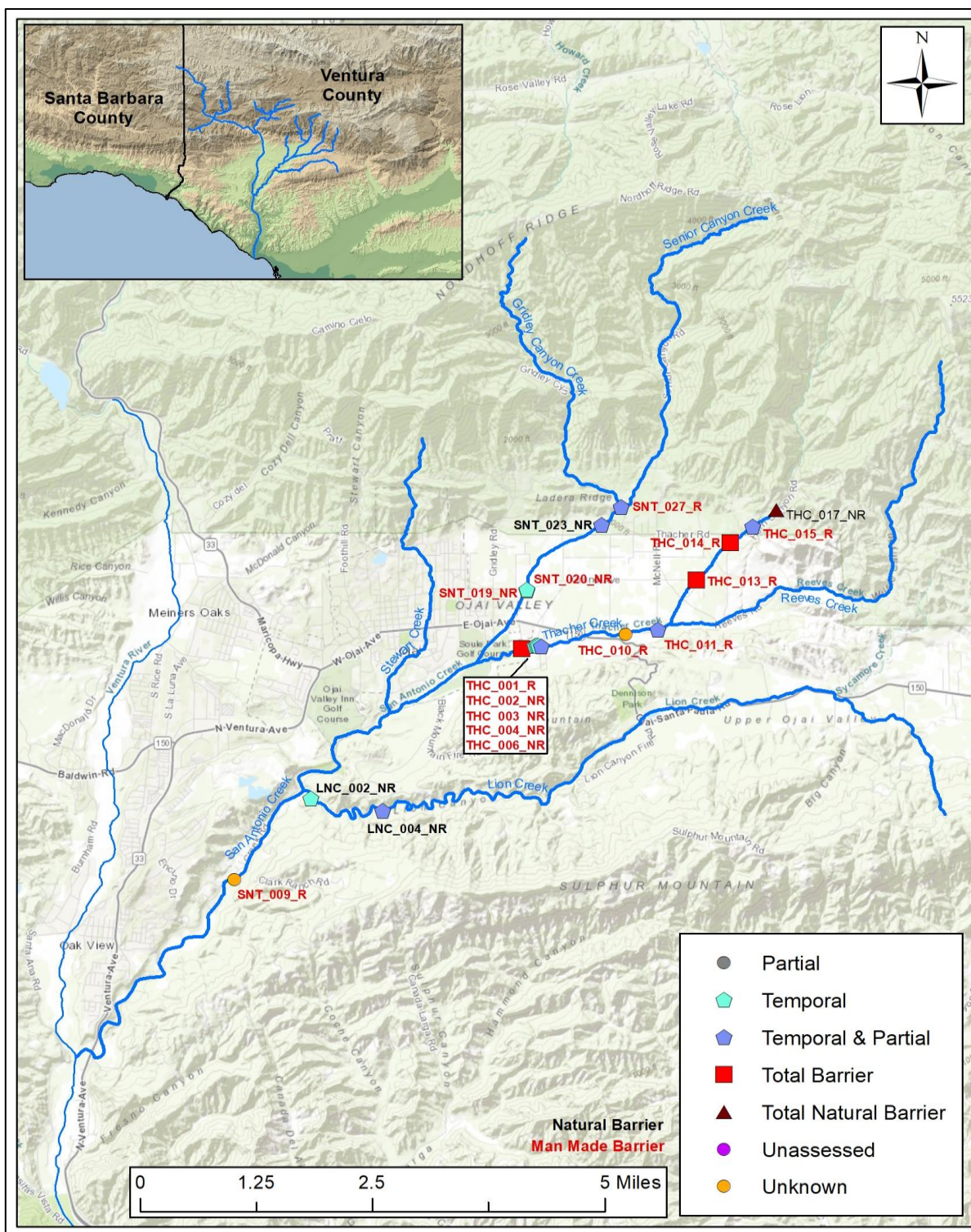
Ventura River Watershed – Cannon Creek – Non-Barrier Structures

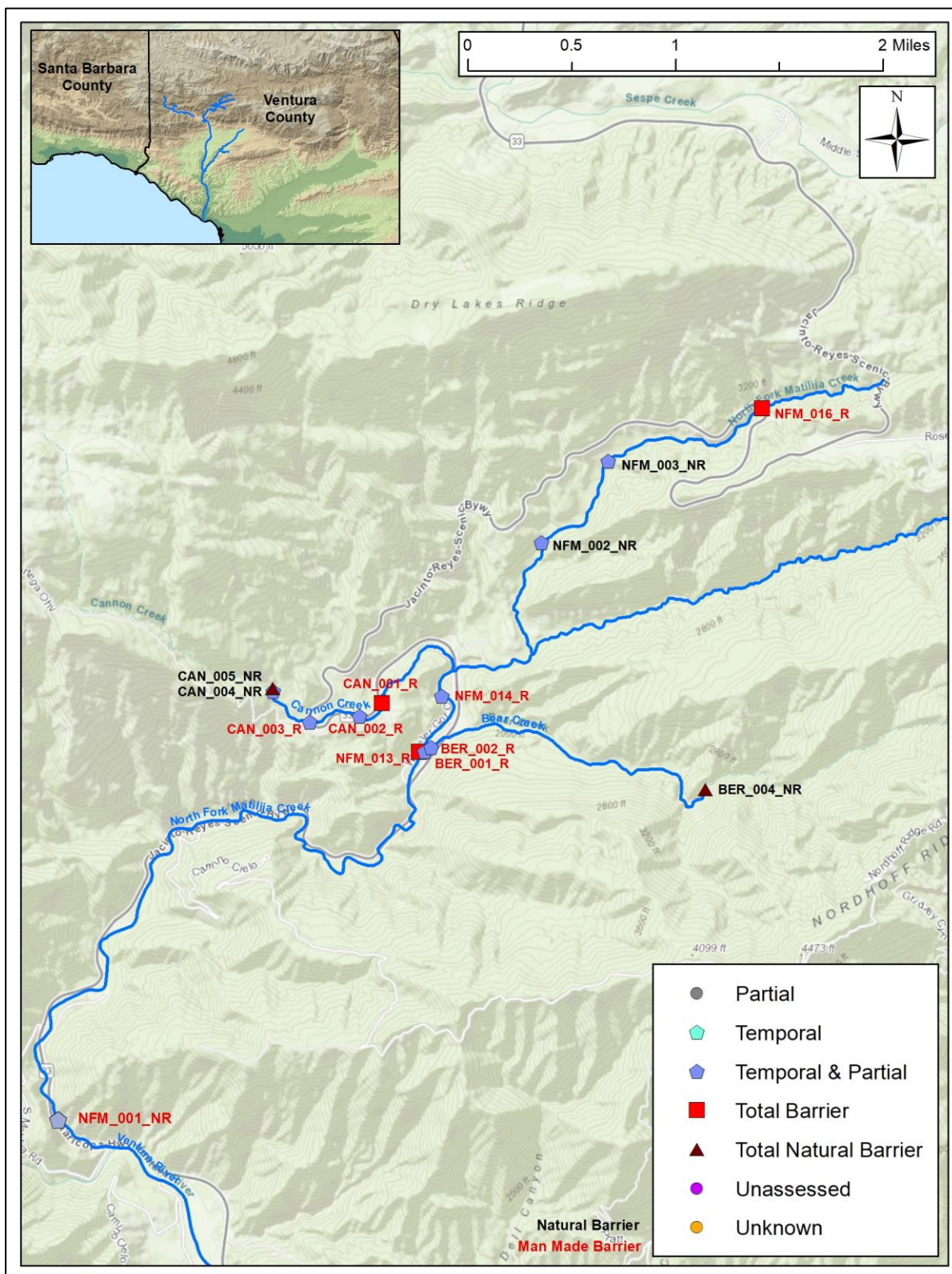
There were no man-made structures that were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Cannon Creek.

Ventura River Watershed Barrier Maps



Appendix B Figure 1. Location of man-made barrier structures and natural barrier features in assessed portion of the Ventura River and Matilija Creek.







Appendix C – Conception Coast Watersheds Natural Barriers and Non-Barrier Structures

This appendix lists all naturally occurring barrier features which were assessed to limit upstream *O. mykiss* movement and all man-made structures which were assessed to be free of *O. mykiss* passage constraints within the assessed portions of Conception Coast watersheds. All Caltrans owned structures are highlighted in yellow. Maps depicting the locations of all barrier types for each assessed stream are posted at the end of this appendix.

Conception Coast Watersheds – El Capitan Creek Watershed – El Capitan Creek – Natural Barriers






Two naturally occurring features were assessed to limit upstream *O. mykiss* movement on the main stem of El Capitan Creek. A list of those features is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: ELC_006_NR PAD ID: None Assigned	34.47044, -120.02164	N/A	Temporal	Large boulder field causing high gradient cascade with minimal rest pools. River left channel barrier height: 8.2 ft River right channel barrier height: 4.8 ft Water depth below cascades: 1.1 ft	
Barrier ID: ELC_009_NR PAD ID: None Assigned	34.47044, -120.01876	N/A	Temporal & Partial	Boulder and woody debris causing pile/log jam. Total height of barrier: 5.2 ft Water depth below plunge: 3 ft	

Appendix C Table 1. Natural barrier features in assessed portion of El Capitan Creek.

Conception Coast Watersheds – El Capitan Creek Watershed – El Capitan Creek – Non-Barrier Structures





Five man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of El Capitan Creek. A list of those structures is listed in the below table.





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description	Picture
Barrier ID: ELC_003_NR PAD ID: 706641	34.46444, -120.02264	Remediated, fish response unconfirmed	Not a Barrier	Metal pipe above channel with many instream supports. Anchored by concrete grade control.	
Barrier ID: ELC_004_R PAD ID: 706642	34.46498, -120.02263	Remediated, fish response unconfirmed	Not a Barrier	Free spanning bridge over natural substrate.	
Barrier ID: ELC_005_R PAD ID: None Assigned	34.46516, -120.02261	N/A	Not a Barrier	Free spanning pedestrian bridge over natural substrate.	
Barrier ID: ELC_007_R PAD ID: None Assigned	34.47121, -120.02151	N/A	Not a Barrier	Free spanning bridge over natural substrate with concrete wingwalls at inlet and outlet.	
Barrier ID: ELC_008_R PAD ID: None Assigned	34.47811, -120.01981	N/A	Not a Barrier	Free spanning pedestrian bridge over natural substrate.	


Appendix C Table 2. Man-made non-barrier structures in assessed portion of El Capitan Creek.

Conception Coast Watersheds – El Capitan Creek Watershed – East Fork El Capitan Creek – Natural Barriers

Nine naturally occurring features were assessed to limit upstream *O. mykiss* movement on the East Fork of El Capitan Creek. A list of those features is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: EELC_001_NR PAD ID: None Assigned	34.48839, -120.0103	N/A	Temporal & Partial	Fallen tree with plunges on both sides of channel. Total height of barrier: 2.5 ft Water depth below plunge: 1.1 ft	
Barrier ID: EELC_002_NR PAD ID: None Assigned	34.49016, -120.00835	N/A	Temporal & Partial	Boulder cascade with fallen tree. Total height of barrier: 7.3 ft Water depth below plunge: 1.4 ft	
Barrier ID: EELC_003_NR PAD ID: None Assigned	34.49187, -120.00703	N/A	Temporal & Partial	Bedrock/boulder cascade. Total height of barrier: 6.3 ft Water depth below plunge: 1.6 ft	
Barrier ID: EELC_004_NR PAD ID: None Assigned	34.49373, -120.0066	N/A	Temporal & Partial	Bedrock slide. Total height of barrier: 4.4 ft Water depth below plunge: 1.8 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: EELC_005_NR PAD ID: None Assigned	34.4941, -120.0058	N/A	Total	Steep bedrock slide. Total height of barrier: 8.8 ft Water depth below plunge: 2 ft	
Barrier ID: EELC_006_NR PAD ID: None Assigned	34.49495, -120.00492	N/A	Temporal & Partial	Bedrock step into pool. Shallow at inlet. Total height of barrier: 3 ft Water depth below plunge: 0.7 ft	
Barrier ID: EELC_007_NR PAD ID: None Assigned	34.49504, -120.00471	N/A	Temporal & Partial	Long, shallow bedrock slide. Total height of barrier: 3.1 ft Water depth below plunge: 1.5 ft	
Barrier ID: EELC_008_NR PAD ID: None Assigned	34.49552, -120.00475	N/A	Temporal & Partial	Bedrock/boulder plunge. Total height of barrier: 2.5 ft Water depth below plunge: 2.9 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: EELC_009_NR PAD ID: None Assigned	34.49574, -120.00448	N/A	Temporal & Partial	Long bedrock chute over shallow substrate. Total height of barrier: 4.3 ft Water depth below plunge: 1.9 ft	



Appendix C Table 3. East Fork El Capitan Creek natural barriers.





Conception Coast Watersheds – El Capitan Creek Watershed – East Fork El Capitan Creek – Non-Barrier Structures





At the time surveys were conducted for the this project no man-made non-barrier structures were present within the East Fork of El Captain Creek.





Conception Coast Watersheds – El Capitan Creek Watershed – West Fork El Capitan Creek – Natural Barriers




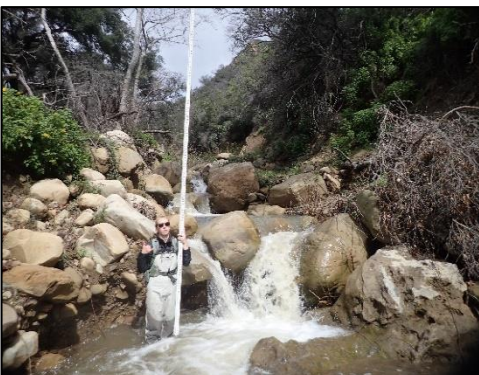
23 naturally occurring features were assessed to limit upstream *O. mykiss* movement on the West fork of El Capitan Creek. A list of those features is listed in the below table.





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: WELC_001_NR PAD ID: None Assigned	34.4958, -120.01323	N/A	Temporal & Partial	Shallow sheet cascade over bedrock to plunge. Total height of barrier: 4.9 ft Water depth below plunge: 1.9 ft	
Barrier ID: WELC_002_NR PAD ID: None Assigned	34.49179, -120.01165	N/A	Temporal & Partial	Long section of bedrock. Narrow chutes with resting areas. 4 steps. Total height of barrier: 8.6 ft Water depth below plunge: 1.8 ft	


Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: WELC_003_NR PAD ID: None Assigned	34.49242, -120.01151	N/A	Temporal & Partial	Narrow bedrock chute/cascade. Total height of barrier: 4.7 ft Water depth below plunge: 1.6 ft	
Barrier ID: WELC_004_NR PAD ID: None Assigned	34.49256, -120.01157	N/A	Temporal & Partial	Sheet cascade over bedrock. Total height of barrier: 4.3 ft Water depth below plunge: 2.3 ft	
Barrier ID: WELC_005_NR PAD ID: None Assigned	34.49278, -120.01171	N/A	Temporal & Partial	Sheet cascade over bedrock. 3 steps. Total height of barrier: 6.7 ft Water depth below plunge: 2.6 ft	
Barrier ID: WELC_006_NR PAD ID: None Assigned	34.49326, -120.0116	N/A	Temporal & Partial	Chute cascade over slick bedrock. Total height of barrier: 5 ft Water depth below plunge: 1.4 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: WELC_007_NR PAD ID: None Assigned	34.49371, -120.01167	N/A	Temporal & Partial	Narrow chute cascade over slick bedrock. Total height of barrier: 5.2 ft	
Barrier ID: WELC_008_NR PAD ID: None Assigned	34.49387, -120.01173	N/A	Temporal & Partial	Bedrock plunge into shallow pool. Total height of barrier: 3.2 ft Water depth below plunge: 1.2 ft	
Barrier ID: WELC_009_NR PAD ID: None Assigned	34.49405, -120.0121	N/A	Temporal & Partial	Cascade over bedrock. 3 steps. Total height of barrier: 6 ft Water depth below plunge: 2.3 ft	
Barrier ID: WELC_010_NR PAD ID: None Assigned	34.49489, -120.01258	N/A	Temporal & Partial	Plunge over bedrock. Total height of barrier: 4.5 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: WELC_011_NR PAD ID: None Assigned	34.49513, -120.01273	N/A	Temporal & Partial	Cascade over bedrock. Total height of barrier: 4.2 ft	
Barrier ID: WELC_013_NR PAD ID: None Assigned	34.49791, -120.01365	N/A	Temporal & Partial	Bedrock/boulder cascade. Total height of barrier: 4.9 ft Water depth below plunge: 1.9 ft	
Barrier ID: WELC_014_NR PAD ID: None Assigned	34.49963, -120.01455	N/A	Temporal & Partial	Narrow, turbulent cascade/bedrock chute. Total height of barrier: 3.5 ft Water depth below plunge: 1.8 ft	
Barrier ID: WELC_015_NR PAD ID: None Assigned	34.49998, - 120.01443	N/A	Temporal & Partial	Bedrock chute. Total height of barrier: 4.8 ft Water depth below plunge: 2 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: WELC_016_NR PAD ID: None Assigned	34.50014, -120.01431	N/A	Temporal & Partial	Bedrock chute/cascade. Total height of barrier: 4.5 ft Water depth below plunge: 2.4 ft	
Barrier ID: WELC_017_NR PAD ID: None Assigned	34.50026, -120.01428	N/A	Temporal & Partial	Narrow bedrock chute with 3 steps. Total height of barrier: 9.2 ft Water depth below plunge: 1.2 ft	
Barrier ID: WELC_018_NR PAD ID: None Assigned	34.50141, -120.01444	N/A	Temporal & Partial	Narrow and turbulent bedrock chute. Total height of barrier: 5.7 ft Water depth below plunge: 2.6 ft	
Barrier ID: WELC_019_NR PAD ID: None Assigned	34.50194, -120.01411	N/A	Temporal & Partial	Bedrock/boulder cascade. 3 steps. Total height of barrier: 9.2 ft Water depth below plunge: 1.8 ft	


Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: WELC_020_NR PAD ID: None Assigned	34.50237, -120.01371	N/A	Temporal & Partial	Narrow and turbulent bedrock/boulder cascade. Total height of barrier: 4.7 ft Water depth below plunge: 1.6 ft	
Barrier ID: WELC_021_NR PAD ID: None Assigned	34.50252, -120.01372	N/A	Temporal & Partial	Bedrock chute. Total height of barrier: 3.8 ft Water depth below plunge: 1.3 ft	
Barrier ID: WELC_022_NR PAD ID: None Assigned	34.50307, -120.01354	N/A	Temporal & Partial	Bedrock/boulder cascade. Total height of barrier: 8.5 ft Water depth below plunge: 1.4 ft	
Barrier ID: WELC_023_NR PAD ID: None Assigned	34.50325, -120.01344	N/A	Temporal & Partial	Bedrock/boulder cascade with woody debris. Total height of barrier: 7.5 ft Water depth below plunge: 1.3 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: WELC_024_NR PAD ID: None Assigned	34.50357, -120.01317	N/A	Total	Steep and lengthy boulder cascade with little rest areas. Total height of barrier: 15 ft Water depth below plunge: 1.4 ft	

Appendix C Table 4. *Natural barrier features in assessed portion of West Fork El Capitan Creek.*

Conception Coast Watersheds – El Capitan Creek Watershed – West Fork El Capitan Creek – Non-Barrier Structures





There is one man-made non-barrier structure present within the West Fork of El Capitan Creek. A list of those structures is listed in the below table.

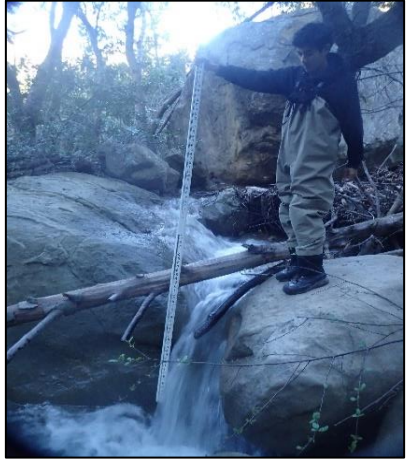


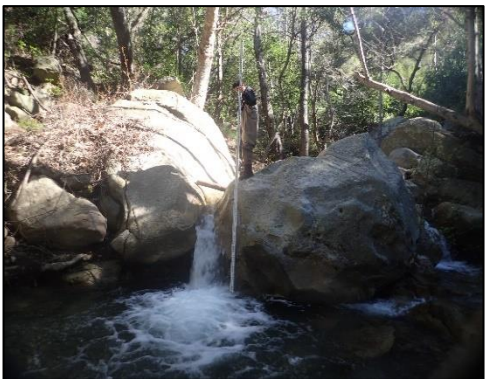
Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: WELC_012_NR PAD ID: 706332	34.49762, -120.01365	Total	Not a Barrier	Culvert and road fill have been blasted out. Previous road is no longer present. Steep gradient cutting through the area. Total height of barrier: 25.2 ft	





Appendix C Table 5. *Non-barrier structures in assessed portion of West Fork El Capitan Creek.*





Conception Coast Watersheds – Mission Creek Watershed – Rattlesnake Creek – Natural Barriers



18 naturally occurring features were assessed to limit upstream *O. mykiss* movement within the assessed portion of Rattlesnake Creek. A list of those features is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: RAT_011_NR PAD ID: None Assigned	34.45712, -119.69317	N/A	Temporal & Partial	Significant natural barrier/steep grade made of bedrock, large boulders, woody debris, and sediment. Total height of barrier: 17.1 ft Water depth below cascade: 1.3 ft	
Barrier ID: RAT_012_NR PAD ID: None Assigned	34.45751, -119.69242	N/A	Temporal & Partial	Large collection of boulders with a vertical plunge into downstream pool. Total height of barrier: 4.3 ft Water depth below plunge: 2 ft	
Barrier ID: RAT_015_NR PAD ID: 706557	34.4614, -119.69152	Partial	Temporal & Total	Significant bedrock waterfall through narrow channel. Potential total barrier due to large woody debris in chute. Total height of barrier: 12.5 ft Water depth below plunge: 4 ft	
Barrier ID: RAT_017_NR PAD ID: None Assigned	34.46328, -119.69055	N/A	Temporal & Partial	Small bedrock chute with shallow plunge pool. Total height of barrier: 5 ft Water depth below plunge: 0.2 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: RAT_018_NR PAD ID: None Assigned	34.46377, -119.68975	N/A	Temporal & Partial	Natural boulder/bedrock plunge with log jam at inlet. Total height of barrier: 4.8 ft Water depth below plunge: 4.6 ft	
Barrier ID: RAT_019_NR PAD ID: None Assigned	34.46389, -119.68961	N/A	Temporal & Partial	Natural boulder plunge. Total height of barrier: 4.7 ft Water depth below plunge: 2.2 ft	
Barrier ID: RAT_020_NR PAD ID: None Assigned	34.46406, -119.68842	N/A	Temporal & Partial	Boulder cascade with two steps. Total height of barrier: 5.5 ft Water depth below plunge: 3 ft	
Barrier ID: RAT_021_NR PAD ID: None Assigned	34.46405, -119.68813	N/A	Temporal & Partial	Vertical bedrock plunge. Total height of barrier: 4.8 ft Water depth below plunge: 3.7 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: RAT_022_NR PAD ID: None Assigned	34.46422, -119.68796	N/A	Total	Significant cascade over boulders and bedrock. Two resting pools within cascade. Total height of barrier: 20.5 ft Water depth below cascade: 1.2 ft	
Barrier ID: RAT_023_NR PAD ID: None Assigned	34.46532, -119.68726	N/A	Temporal & Partial	Vertical boulder plunge. Total height of barrier: 4.5 ft Water depth below plunge: 1.4 ft	
Barrier ID: RAT_024_NR PAD ID: None Assigned	34.46558, -119.68702	N/A	Temporal & Partial	Vertical boulder plunge. Total height of barrier: 4.8 ft Water depth below plunge: 2.5 ft	
Barrier ID: RAT_025_NR PAD ID: None Assigned	34.46571, -119.6869	N/A	Temporal & Partial	Vertical boulder plunge to shallow pool. Total height of barrier: 4.9 ft Water depth below plunge: 1.6 ft	





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: RAT_026_NR PAD ID: None Assigned	34.46598, -119.68681	N/A	Temporal & Partial	Vertical boulder plunge to large, wide pool. Total height of barrier: 4 ft Water depth below plunge: 2.4 ft	
Barrier ID: RAT_027_NR PAD ID: None Assigned	34.46612, -119.68694	N/A	Temporal & Partial	Long, extended boulder cascade with few rest pools. Total height of barrier: 21.9 ft Water depth below cascade: 0.8 ft Total cascade length: 95 ft	
Barrier ID: RAT_028_NR PAD ID: None Assigned	34.46671, -119.68701	N/A	Temporal & Partial	Vertical boulder plunge with multiple cascades into pool. Total height of barrier: 5.8 ft Water depth below plunge: 2.3 ft	
Barrier ID: RAT_029_NR PAD ID: None Assigned	34.46711, -119.68723	N/A	Temporal & Partial	Vertical boulder plunge with multiple cascades. Protected pool under bedrock. Total height of barrier: 3.8 ft Water depth below plunge: 1.2 ft	



Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: RAT_030_NR PAD ID: None Assigned	34.46737, -119.68739	N/A	Temporal & Partial	Boulder plunge with bedrock wingwalls. Total height of barrier: 3.8 ft Water depth below plunge: 1.2 ft	
Barrier ID: RAT_031_NR PAD ID: None Assigned	34.46749, -119.68758	N/A	Total	Long bedrock chute with narrow/shallow cascade and high velocity water flow. Total height of barrier: 4.8 ft Water depth below plunge: 5.2 ft	

Appendix C Table 6. *Natural barrier features in assessed portion of Rattlesnake Creek.*

Conception Coast Watersheds – Mission Creek Watershed – Rattlesnake Creek – Non-Barrier Structures

Six man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Rattlesnake creek. A list of those structures is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: RAT_002_R PAD ID: None Assigned	34.4521, -119.70696	N/A	Not a Barrier	Small, private, free spanning bridge over natural substrate.	
Barrier ID: RAT_003_R PAD ID: None Assigned	34.45241, -119.70428	N/A	Not a Barrier	Small, free spanning bridge over natural substrate. Concrete channel walls under bridge.	
Barrier ID: RAT_004_R PAD ID: None Assigned	34.45277, -119.70338	N/A	Not a Barrier	Free spanning, private bridge over boulder rip rap channel walls.	
Barrier ID: RAT_007_R PAD ID: None Assigned	34.45397, -119.70159	N/A	Not a Barrier	Free spanning private bridge over natural streambed substrate.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: RAT_008_R PAD ID: None Assigned	34.45475 -119.70089	N/A	Not a Barrier	Free spanning private bridge over natural streambed substrate and boulder/cement rip rap channel walls.	
Barrier ID: RAT_010_NR PAD ID: 706554	34.45705, -119.69345	Total	Not a Barrier	Utility pipe over channel with two instream supports.	



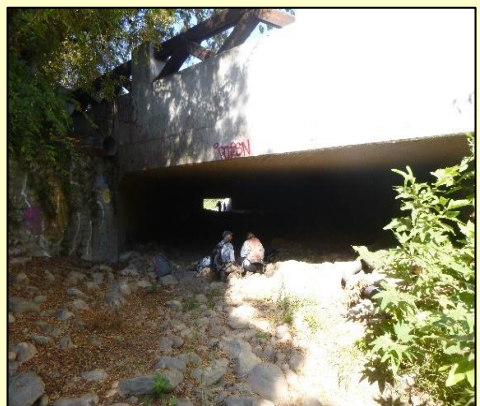
Appendix C Table 7. *Man-made non-barrier structures in assessed portion of Rattlesnake Creek.*





Conception Coast Watersheds – Montecito Creek Watershed – Montecito Creek – Natural Barriers

At the time surveys were conducted for this project there were no naturally occurring features constraining upstream *O. mykiss* movement within the assessed portion of Montecito Creek.

Conception Coast Watersheds – Montecito Creek Watershed – Montecito Creek – Non-Barrier Structures

Eight man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Montecito Creek. A list of those structures is listed in the below table.


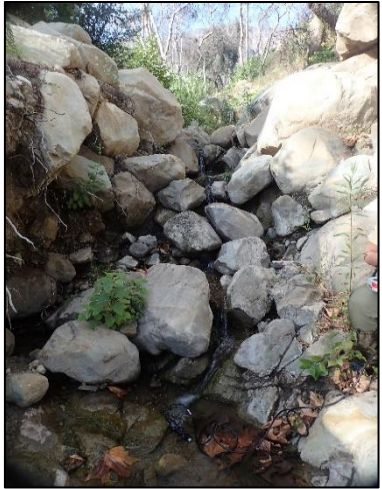
Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: MON_001_R PAD ID: None Assigned	34.41798, -119.63397	N/A	Not a Barrier	Free spanning bridge over concrete lined flood control channel.	
Barrier ID: MON_002_R PAD ID: None Assigned	34.41933, -119.63363	N/A	Not a Barrier	Free spanning concrete bridge.	
Barrier ID: MON_003_R PAD ID: None Assigned	34.42301, -119.63479	N/A	Not a Barrier	Hwy 101 free spanning concrete bridge with low clearance over natural streambed substrate. Post Mile 10.2	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: MON_006_R PAD ID: None Assigned	34.42316, -119.63537	N/A	Not a Barrier	Free spanning concrete bridge over cement boulder rip rap channel walls. Grade control structure near outlet.	
Barrier ID: MON_018_R PAD ID: None Assigned	34.42899, -119.6404	N/A	Not a Barrier	Free spanning bridge over concrete lined channel.	
Barrier ID: MON_019_R PAD ID: None Assigned	34.42964, -119.6405	N/A	Not a Barrier	Free spanning bridge over concrete lined channel.	
Barrier ID: MON_020_R PAD ID: None Assigned	34.43063, -119.64143	N/A	Not a Barrier	Short, free spanning bridge over natural streambed substrate.	
Barrier ID: MON_024_R PAD ID: None Assigned	34.43996, -119.64812	N/A	Not a Barrier	Free spanning bridge over natural substrate. Boulder rip rap on channel walls.	

Appendix C Table 8. Man-made non-barrier structures in assessed portion of Monticetio Creek.

Conception Coast Watersheds – Montecito Creek Watershed – Hot Springs Creek – Natural Barriers




Two naturally occurring features were assessed to constrict *O. mykiss* upstream movement within the assessed portion of Hot Springs Creek. A list of those features is listed in the below table.



Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: HSP_014_NR PAD ID: None Assigned	34.45571, -119.63861	N/A	Temporal & Partial	Scoured out boulders, roots, and earth with significant drop. Total height of barrier: 7 ft	
Barrier ID: HSP_015_NR PAD ID: None Assigned	34.45643, -119.63869	N/A	Total	Boulder cascade with steep gradient. Total height of barrier: 21 ft Water depth below plunges: 0.22 ft Total cascade length: 48 ft	

Appendix C Table 9 . Natural barrier features in assessed portion of Hot Springs Creek.

Conception Coast Watersheds – Montecito Creek Watershed – Hot Springs Creek – Non-Barrier Structures

Five man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Hot Springs Creek. A list of those structures is listed in the below table.



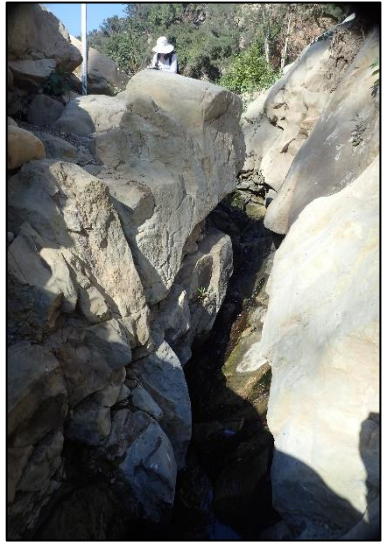
Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: HSP_001_R PAD ID: None Assigned	34.44335, -119.65005	N/A	Not a Barrier	Private, free spanning stone bridge over natural substrate.	
Barrier ID: HSP_005_R	34.44542, -119.64856	N/A	Not a Barrier	Free spanning concrete bridge over natural substrate.	
Barrier ID: HSP_007_R PAD ID: None Assigned	34.44611, -119.64746	N/A	Not a Barrier	Free spanning concrete bridge over natural substrate.	

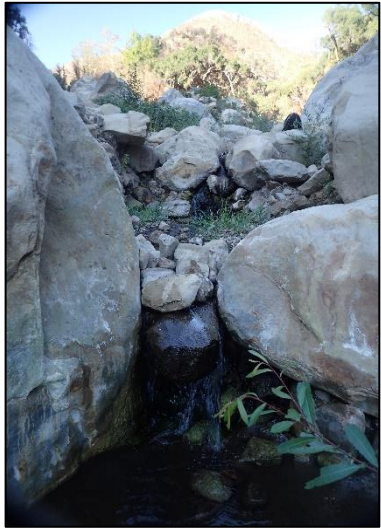
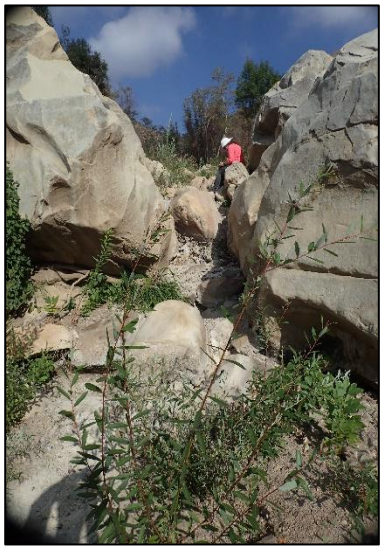

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: HSP_012_R PAD ID: None Assigned	34.44918, -119.64617	N/A	Not a Barrier	Free spanning concrete bridge with concrete apron at outlet.	
Barrier ID: HSP_013_R PAD ID: None Assigned	34.45186, -119.64324	N/A	Not a Barrier	Low-water crossing.	


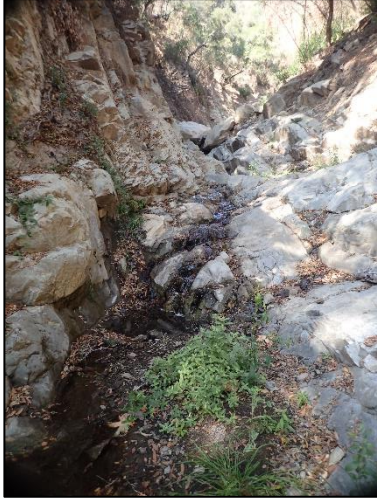
Appendix C Table 10. *Man-made non-barrier structures in assessed portion of Hot Springs Creek.*

Conception Coast Watersheds – Montecito Creek Watershed – Cold Springs Creek – Natural Barriers

23 naturally occurring features were assessed to limit upstream *O. mykiss* movement on Cold Springs Creek. A list of those features is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: CSP_001_NR PAD ID: None Assigned	34.44333, -119.65059	N/A	Not a Barrier	High gradient cascade of boulder and cobble. Total height of barrier: 7.1 ft Water depth below plunge: 0.2 ft Total cascade length: 20.8 ft	
Barrier ID: CSP_004_NR PAD ID: None Assigned	34.45587, -119.65328	N/A	Total	Bedrock/boulder chute. Total height of barrier: 4.05 ft Water depth below plunge: 1.04 ft	
Barrier ID: CSP_005_NR PAD ID: None Assigned	34.45635, -119.65327	N/A	Total	Double waterfall. Boulder/bedrock chute. Total height of barrier: 8 ft Water depth below plunge: 0.6 ft	


Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: CSP_006_NR PAD ID: None Assigned	34.45876, -119.65437	N/A	Temporal & Partial	Natural boulder cascade. Total height of barrier: 7 ft Water depth below plunge: 0.3 ft	
Barrier ID: CSP_007_NR PAD ID: 706254	34.45904, -119.6544	Total	Temporal & Partial	Boulder cascade. Total height of barrier: 7.7 ft Total cascade length: 17 ft	
Barrier ID: CSP_008_NR PAD ID: None Assigned	34.45953, -119.6546	N/A	Temporal	Plunge over boulders. Total height of barrier: 8.6 ft Total cascade length: 13.5 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: CSP_009_NR PAD ID: None Assigned	34.46162, -119.65508	N/A	Temporal & Partial	Plunge over boulders. Total height of barrier: 8.1 ft	
Barrier ID: CSP_010_NR PAD ID: 706531	34.4663, -119.65853	Total	Total	Bedrock cascade. Total height of barrier: 16.8 ft Water depth below plunge: 0.2 ft Total cascade length: 33 ft	

Appendix C Table 11. *Natural barrier features in assessed portion of Cold Springs Creek.*

Conception Coast Watersheds – Montecito Creek Watershed – Cold Springs Creek – Non-Barrier Structures

One man-made structures was assessed to be free of *O. mykiss* passage constraints within the assessed portion of Cold Springs Creek. That single structure is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: CSP_002_R PAD ID: None Assigned	34.44605, -119.65114	N/A	Not a Barrier	Free spanning bridge over natural substrate. Boulder rip rap on channel walls.	


Appendix C Table 12. Non-barrier structures in assessed portion of Cold Springs Creek.





Conception Coast Watersheds – Oak Creek Watershed – Oak Creek – Natural Barriers





At the time surveys were conducted for this project no naturally occurring features were assessed to limit upstream *O. mykiss* movement on Oak Creek.

Conception Coast Watersheds – Oak Creek Watershed – Oak Creek – Non-Barrier Structures

13 man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Oak Creek. A list of those structures is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: OAK_002_R PAD ID: None Assigned	34.42077, -119.62563	N/A	Not a Barrier	Free spanning bridge with concrete lined channel walls.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: OAK_003_R PAD ID: 734353	34.42111, -119.62563	Unassessed	Not a Barrier	Hwy 101 free spanning bridge with concrete lined channel walls. Post Mile 9.7	
Barrier ID: OAK_005_R PAD ID: None Assigned	34.4221, -119.62684	N/A	Not a Barrier	Free spanning bridge with low clearance. Over partially concrete lined flood control channel.	
Barrier ID: OAK_008_R PAD ID: None Assigned	34.42417, -119.62776	N/A	Not a Barrier	Free spanning bridge over concrete lined walls. Also has four small grade control structures under bridge but all have less than 1 ft drop.	
Barrier ID: OAK_009_R PAD ID: None Assigned	34.42483, -119.62851	N/A	Not a Barrier	Small pedestrian bridge.	





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: OAK_010_R PAD ID: None Assigned	34.42525, -119.62884	N/A	Not a Barrier	Free spanning arch bridge over brick lined channel walls.	
Barrier ID: OAK_011_R PAD ID: None Assigned	34.4265, -119.62948	N/A	Not a Barrier	Free spanning wooden private driveway bridge over boulder rip rap lined channel walls.	
Barrier ID: OAK_012_R PAD ID: None Assigned	34.42696, -119.6294	N/A	Not a Barrier	Private road bridge over concrete boulder lined channel walls.	
Barrier ID: OAK_013_R PAD ID: None Assigned	34.42718, -119.62949	N/A	Not a Barrier	Free spanning bridge with concrete lined channel walls.	

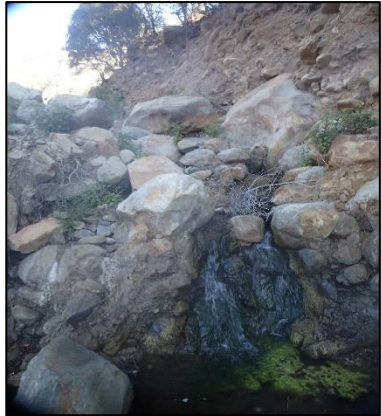

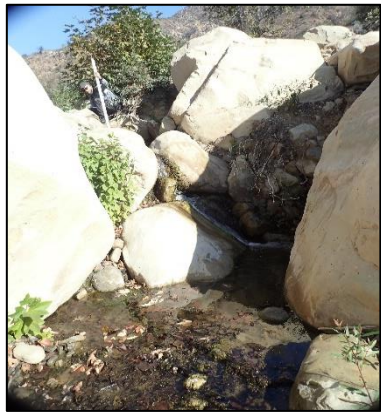

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: OAK_014_R PAD ID: None Assigned	34.4289, -119.62997	N/A	Not a Barrier	Free spanning bridge with concrete lined channel walls.	
Barrier ID: OAK_015_R PAD ID: None Assigned	34.43222, -119.631	N/A	Not a Barrier	Free spanning pedestrian bridge over natural substrate.	
Barrier ID: OAK_017_R PAD ID: None Assigned	34.43324, -119.63175	N/A	Not a Barrier	Concrete low-water crossing.	
Barrier ID: OAK_018_R PAD ID: None Assigned	34.43515, -119.63196	N/A	Not a Barrier	Free spanning pedestrian bridge over natural substrate.	

Appendix C Table 13. Man-made non-barrier structures in assessed portion of Oak Creek.

Conception Coast Watersheds – San Ysidro Creek Watershed – San Ysidro Creek – Natural Barriers

Eight naturally occurring features were assessed to limit upstream *O. mykiss* movement on the assessed portion of San Ysidro Creek. A list of those features is listed in the below table.





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SYD_008_NR PAD ID: None Assigned	34.45253, -119.62183	N/A	Temporal & Partial	Boulder cascade/waterfall. Total height of barrier: 10.1 ft Water depth below plunge: 0.4 ft	
Barrier ID: SYD_009_NR PAD ID: 706511	34.45533, -119.62348	Partial	Temporal & Partial	Boulder/bedrock chute. Total height of barrier: 6.5 ft Water depth below plunge: 0.8 ft Total cascade length: 20 ft	
Barrier ID: SYD_010_NR PAD ID: None Assigned	34.5551, -119.6234	N/A	Temporal & Partial	Boulder/bedrock chute. Total height of barrier: 4.5 ft Water depth below plunge: 1.8 ft Total cascade length: 6 ft	
Barrier ID: SYD_011_NR PAD ID: 706512	34.45556, -119.62337	Total	Temporal & Partial	Cascade over bedrock. Total height of barrier: 4.4 ft Water depth below plunge: 1.1 ft Total cascade length: 6.5 ft	




Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SYD_012_NR PAD ID: None Assigned	34.4566, -119.6234	N/A	Temporal & Partial	Cascade over bedrock and boulders. Total height of barrier: 9 ft Water depth below plunge: 0.7 ft	
Barrier ID: SYD_013_NR PAD ID: None Assigned	34.45703, -119.62286	N/A	Temporal & Partial	Cascade over bedrock and boulders. Total height of barrier: 5.1 ft Water depth below plunge: 0.7 ft	
Barrier ID: SYD_014_NR PAD ID: 706249	34.45722, -119.62298	Partial	Temporal & Partial	Boulder cascade/waterfall. Total height of barrier: 8 ft Water depth below plunge: 1.2 ft	
Barrier ID: SYD_016_NR PAD ID: None Assigned	34.46092, -119.62404	N/A	Total	Bedrock chute. Total height of barrier: 12 ft Total cascade length: 37.3 ft	

Appendix C Table 14. Natural barrier features in assessed portion of Oak Creek.

Conception Coast Watersheds – San Ysidro Creek Watershed – San Ysidro Creek – Non-Barrier Structures

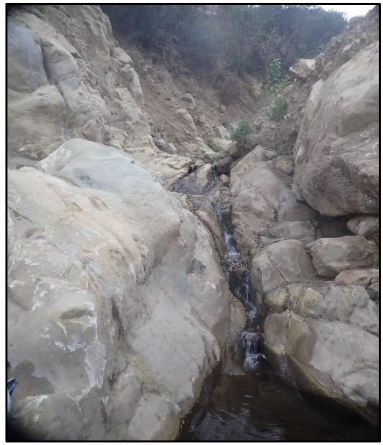
Seven man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of San Ysidro Creek. A list of those structures is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SYD_001_R PAD ID: None Assigned	34.41953, -119.62463	N/A	Not a Barrier	Small free spanning private driveway bridge.	
Barrier ID: SYD_003_R PAD ID: 734342	34.42102, -119.62373	Unassessed	Not a Barrier	Free spanning Hwy 101 bridge with low clearance (5.5 ft) and concrete channel walls. Post Mile: 9.56	
Barrier ID: SYD_004_R PAD ID: None Assigned	34.42117, -119.6237	N/A	Not a Barrier	Free spanning bridge over natural substrate with rip rap channel walls.	
Barrier ID: SYD_005_R PAD ID: None Assigned	34.42538, -119.62132	N/A	Not a Barrier	Free spanning bridge over natural substrate with concrete channel walls.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: SYD_006_R PAD ID: None Assigned	34.43737, -119.61977	N/A	Not a Barrier	Free spanning bridge over natural substrate with concrete channel walls.	
Barrier ID: SYD_007_R PAD ID: None Assigned	34.43902, -119.62033	N/A	Not a Barrier	Free spanning bridge over natural substrate with concrete channel walls.	
Barrier ID: SYD_008_R PAD ID: None Assigned	34.43954, -119.62051	Unassessed	Not a Barrier	Free spanning Hwy 192 bridge with concrete channel walls. Post Mile: 9.6	

Appendix C Table 15. Man-made non-barrier structures in assessed portion of San Ysidro Creek.



Conception Coast Watersheds – Romero Creek Watershed – Romero Creek – Natural Barriers





Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: ROM_029_NR PAD ID: None Assigned	34.45474, -119.59222	N/A	Total	Bedrock chute. Total height of barrier: 13.5 ft	



Appendix C Table 16. Natural barrier features in assessed portion of Romero Creek.

Conception Coast Watersheds – Romero Creek Watershed – Romero Creek – Non-Barrier Structures

Eight man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Romero Creek. A list of those structures is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: ROM_001_R PAD ID: None Assigned	34.42052, -119.62078	N/A	Not a Barrier	Bridge with row of small support beams across concrete flood control channel.	
Barrier ID: ROM_002_R PAD ID: 705161	34.42128, -119.61943	Unassessed	Not a Barrier	Free spanning concrete bridge over natural streambed substrate.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: ROM_003_R PAD ID: None Assigned	34.42144, -119.61983	N/A	Not a Barrier	Free spanning bridge with rip rap on channel walls.	
Barrier ID: ROM_004_R PAD ID: None Assigned	34.42266, -119.61737	N/A	Not a Barrier	Free spanning bridge over natural streambed substrate.	
Barrier ID: ROM_007_R PAD ID: None Assigned	34.43004, -119.60545	N/A	Not a Barrier	Golf course pedestrian bridge with concrete. Instream wooden support structure for pipes parallel to bridge.	
Barrier ID: ROM_009_R PAD ID: None Assigned	34.43226, -119.6025	N/A	Not a Barrier	Free spanning pedestrian bridge on golf course.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: ROM_011_R PAD ID: None Assigned	34.43425, -119.59763	N/A	Not a Barrier	Low clearance bridge with instream concrete support over natural streambed substrate.	
Barrier ID: ROM_012_R PAD ID: 762292	34.43615, -119.59793	N/A	Not a Barrier	Newly constructed free spanning Hwy 192 bridge with concrete channel walls. Post Mile: 10.93	




Appendix C Table 17. *Man-made non-barrier structures on Romero Creek.*

Conception Coast Watersheds – Romero Creek Watershed – Buena Vista Creek – Natural Barriers

At the time surveys were conducted for this project zero natural features were assessed to limit upstream *O. mykiss* movement within the assessed portion of Buena Vista Creek.





Conception Coast Watersheds – Romero Creek Watershed – Buena Vista Creek – Non-Barrier Structures

20 man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Buena Vista Creek. A list of those structures is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: BV_001_R PAD ID: None Assigned	34.42678, -119.60976	N/A	Not a Barrier	Free spanning bridge with cemented channel walls and partially cemented channel bottom.	
Barrier ID: BV_002_R PAD ID: None Assigned	34.42949, -119.61052	N/A	Not a Barrier	Golf course bridge with one support beam structure in middle of channel and concrete/boulder rip rap channel bottom.	
Barrier ID: BV_003_R PAD ID: None Assigned	34.42984, -119.61049	N/A	Not a Barrier	Narrow golf course pedestrian bridge with one support structure near right channel bank.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: BV_007_R PAD ID: None Assigned	34.43303, -119.60787	N/A	Not a Barrier	Free spanning pedestrian golf course bridge.	
Barrier ID: BV_008_R PAD ID: None Assigned	34.43438, -119.60696	N/A	Not a Barrier	Free spanning pedestrian golf course bridge.	
Barrier ID: BV_009_R PAD ID: None Assigned	34.43536, -119.60645	N/A	Not a Barrier	Free spanning bridge with boulder and concrete sloping walls under bridge.	
Barrier ID: BV_010_R PAD ID: None Assigned	34.43551, -119.60637	N/A	Not a Barrier	Free spanning pedestrian golf course bridge.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: BV_011_R PAD ID: None Assigned	34.43569, -119.60614	N/A	Not a Barrier	Free spanning pedestrian golf course bridge.	
Barrier ID: BV_012_R PAD ID: None Assigned	34.43646, -119.60559	N/A	Not a Barrier	Free spanning pedestrian golf course bridge.	
Barrier ID: BV_013_R PAD ID: None Assigned	34.4368, -119.60593	N/A	Not a Barrier	Free spanning road bridge with concrete boulder rip rap channel walls.	
Barrier ID: BV_014_R PAD ID: 762294	34.43712, -119.60577	Unassessed	Not a Barrier	Hwy 192 free spanning bridge with concrete wing walls. Post Mile: 10.48	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: BV_015_R PAD ID: None Assigned	34.43844, -119.60594	N/A	Not a Barrier	Free spanning pedestrian golf course bridge with cement/boulder rip rap channel walls.	
Barrier ID: BV_016_R PAD ID: None Assigned	34.43867, -119.60612	N/A	Not a Barrier	Free spanning private driveway bridge with concrete channel walls.	
Barrier ID: BV_017_R PAD ID: None Assigned	34.4391, -119.60658	N/A	Not a Barrier	Free spanning private pedestrian bridge.	
Barrier ID: BV_018_R PAD ID: None Assigned	34.43952, -119.60671	N/A	Not a Barrier	Free spanning bridge with concrete channel walls and wing walls.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: BV_019_R PAD ID: None Assigned	34.44022, -119.60709	N/A	Not a Barrier	Free spanning private pedestrian bridge.	
Barrier ID: BV_020_R PAD ID: None Assigned	34.44066, -119.6074	N/A	Not a Barrier	Free spanning road bridge with concrete channel walls and wing walls.	
Barrier ID: BV_021_R PAD ID: None Assigned	34.44245, -119.60839	N/A	Not a Barrier	Free spanning bridge with concrete channel walls and wing walls. Grade control just downstream of outlet.	
Barrier ID: BV_022_R PAD ID: None Assigned	34.44312, -119.60873	N/A	Not a Barrier	Free spanning bridge with concrete walls and wing walls.	
Barrier ID: BV_023_R PAD ID: None Assigned	34.44613, -119.61018	N/A	Not a Barrier	Free spanning private pedestrian bridge.	


Appendix C Table 18. Man-made non-barrier structures on Buena Vista Creek.

Conception Coast Watersheds – Romero Creek Watershed – Picay Creek – Natural Barriers

At the time surveys were conducted for this project zero natural features were assessed to limit upstream *O. mykiss* movement within the assessed portion of Picay Creek.

Conception Coast Watersheds – Romero Creek Watershed – Picay Creek – Non-Barrier Structures


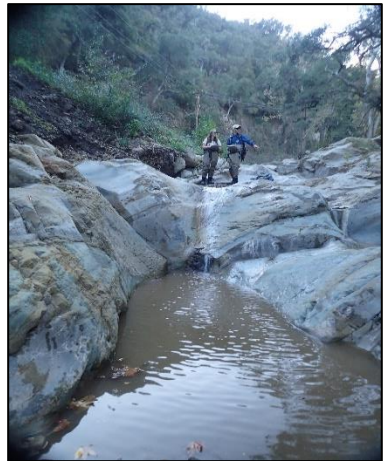

One man-made structure was assessed to be free of *O. mykiss* passage constraints within the assessed portion of Picay Creek. That single structure is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: PCY_001_R PAD ID: None Assigned	34.43545, -119.59386	N/A	Not a Barrier	Free spanning private bridge over natural streambed substrate.	

Appendix C Table 19. Man-made non-barrier structures on Picay Creek.

Conception Coast Watersheds – Arroyo Paredon Creek Watershed – Arroyo Paredon Creek – Natural Barriers




Three naturally occurring features were assessed to limit upstream *O. mykiss* movement on the assessed portion of Arroyo Paredon Creek. A list of those features is listed in the below table.




Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: AYP_002_NR PAD ID: 706241	34.4295, -119.54433	N/A	Temporal & Partial	Boulder/bedrock cascade. Total height of barrier: 4.5 ft	
Barrier ID: AYP_003_NR PAD ID: None Assigned	34.4305, -119.54875	N/A	Temporal & Partial	Narrow bedrock chute. Total height of barrier: 6.2 ft Total cascade length: 11 ft	
Barrier ID: AYP_004_NR PAD ID: None Assigned	34.43328, -119.55016	N/A	Temporal & Partial	Bedrock/boulder cascade. Total height of barrier: 4 ft	

Appendix C Table 20. Natural barrier features in assessed portion of Arroyo Paredon Creek.

Conception Coast Watersheds – Arroyo Paredon Creek Watershed – Arroyo Paredon Creek – Non-Barrier Structures

Six man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Arroyo Paredon Creek. A list of those structures is listed in the below table.




Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: AYP_001_R PAD ID: None Assigned	34.41402, -119.55893	N/A	Not a Barrier	Free spanning bridge over stagnant estuary water.	
Barrier ID: AYP_002_R PAD ID: 734310	34.41414, -119.55699	Not a Barrier	Not a Barrier	Hwy 101 free spanning north and southbound bridges over concrete channel walls and natural streambed substrate. Post Mile: 5.6	
Barrier ID: AYP_003_R PAD ID: None Assigned	34.41405, -119.55666	N/A	Not a Barrier	Free spanning bridge over concrete channel walls and natural streambed substrate.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: AYP_004_R PAD ID: 706239	34.41703, -119.54416	Temporal	Not a Barrier	Newly constructed free spanning Hwy 192 bridge over natural substrate. Post Mile: 15.52	
Barrier ID: AYP_006_R PAD ID: None Assigned	34.43156, -119.55042	N/A	Not a Barrier	Free spanning pedestrian bridge.	
Barrier ID: AYP_007_R PAD ID: 706242	34.4325, -119.55036	N/A	Not a Barrier	Bridge with concrete channel walls.	

Appendix C Table 21. Man-made non-barrier structures in assessed portion of Arroyo Paredon Creek.

Conception Coast Watersheds – Carpinteria Creek Watershed – Carpinteria Creek – Natural Barriers





Three naturally occurring features were assessed to limit upstream *O. mykiss* movement on the assessed portion of Carpinteria Creek. A list of those features is listed in the below table.




Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: CRP_011_NR PAD ID: 706493	34.41819, -119.47913	Temporal	Temporal & Partial	Bedrock chute. Total height of barrier: 9 ft Water depth below plunge: 1.9 ft	
Barrier ID: CRP_012_NR PAD ID: None Assigned	34.41897, -119.47933	N/A	Total	Bedrock/boulder cascade.	
Barrier ID: CRP_013_NR PAD ID: 706494	34.41969, -119.47953	Temporal & Partial	Total	Bedrock waterfall Total height of barrier: 15.2 ft Water depth below plunge: 2.4 ft	

Appendix C Table 22 . Natural barrier features in assessed portion of Carpinteria Creek.

Conception Coast Watersheds – Carpinteria Creek Watershed – Carpinteria Creek – Non-Barrier Structures

Eight man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Carpinteria Creek. A list of those structures is listed in the below table.


Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: CRP_001_R PAD ID: None Assigned	34.39348, -119.51166	N/A	Not a Barrier	Concrete bridge with multiple instream supports.	
Barrier ID: CRP_002_R PAD ID: 731247	34.40129, -119.48718	Not a Barrier	Not a Barrier	Hwy 192 free spanning concrete bridge over natural streambed substrate. Post Mile: 19.11	
Barrier ID: CRP_003_NR PAD ID: 706231	34.40128, -119.48668	Not a Barrier	Not a Barrier	Grade control structure at utility crossing.	
Barrier ID: CRP_004_R PAD ID: None Assigned	34.39348, -119.48586	N/A	Not a Barrier	Open arch culvert under Lilington road.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: CRP_005_R PAD ID: 706489	34.40495, -119.48333	Remediated fish response unconfirmed	Not a Barrier	Free spanning bridge on private property.	
Barrier ID: CRP_006_R PAD ID: 706490	34.40854, -119.4813	Remediated, fish response unconfirmed	Not a Barrier	Free spanning bridge on private property.	
Barrier ID: CRP_007_R PAD ID: 706233	34.41008, -119.48049	Remediated, fish response unconfirmed	Not a Barrier	Free spanning bridge on private property.	
Barrier ID: CRP_014_R PAD ID: 707182	34.394438, -119.50951	Not a Barrier	Not a Barrier	Newly constructed free spanning Hwy 101 northbound and southbound bridges over natural streambed substrate. Post Mile: 2.43	No pictures taken due to construction occurring at time of survey.

Appendix C Table 23. Man-made non-barrier structures on Carpinteria Creek.

Conception Coast Watersheds – Carpinteria Creek Watershed – Gobernador Creek – Natural Barriers



One naturally occurring feature was assessed to limit upstream *O. mykiss* movement on the assessed portion of Gobernador Creek. That single feature is listed in the below table.



Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: GOB_009_NR PAD ID: 706501	34.42077, -119.47244	Total	Total	Total waterfall in bedrock slot canyon. Total height of barrier: 11.6 ft Water depth below plunge: 4 ft	

Appendix C Table 24. Natural barrier features in assessed portion of Gobernador Creek.

Conception Coast Watersheds – Carpinteria Creek Watershed – Gobernador Creek – Non-Barrier Structures

Seven man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Gobernador Creek. A list of those structures is listed in the below table.



Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: GOB_002_R PAD ID: 758784	34.40095, -119.47805	Unassessed	Not a Barrier	Free spanning bridge with no passage constraints.	
Barrier ID: GOB_005_R PAD ID: 706497	34.40656, -119.46821	Remediated, fish response unconfirmed	Not a Barrier	Free spanning bridge with no passage constraints.	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: GOB_007_R PAD ID: 706499	34.40871, -119.46423	Remediated, fish response unconfirmed	Not a Barrier	Free spanning bridge with no passage constraints.	
Barrier ID: GOB_010_R PAD ID: None Assigned	34.40629, -119.46888	N/A	Not a Barrier	Low-water crossing with natural streambed substrate.	

Appendix C Table 25. *Man-made non-barrier structures in assessed portion of Gobernador Creek.*

Conception Coast Watersheds – Rincon Creek Watershed – Rincon Creek – Natural Barriers




Two naturally occurring features were assessed to limit upstream *O. mykiss* movement on the assessed portion of Rincon Creek. A list of those features is listed in the below table.



Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: RNC_015_NR PAD ID: 706222	34.43328, -119.55016	Temporal	Temporal	Plunge over bedrock. Total height of barrier: 7.1 ft Water depth below plunge: 0.4 ft	
Barrier ID: RNC_016_NR PAD ID: 707369	34.41265	Total	Total	Boulder cascade. Total height of barrier: 7 ft Total cascade length: 9 ft	

Appendix C Table 26. Natural barrier features in assessed portion of Rincon Creek.

Conception Coast Watersheds – Rincon Creek Watershed – Rincon Creek – Non-Barrier Structures

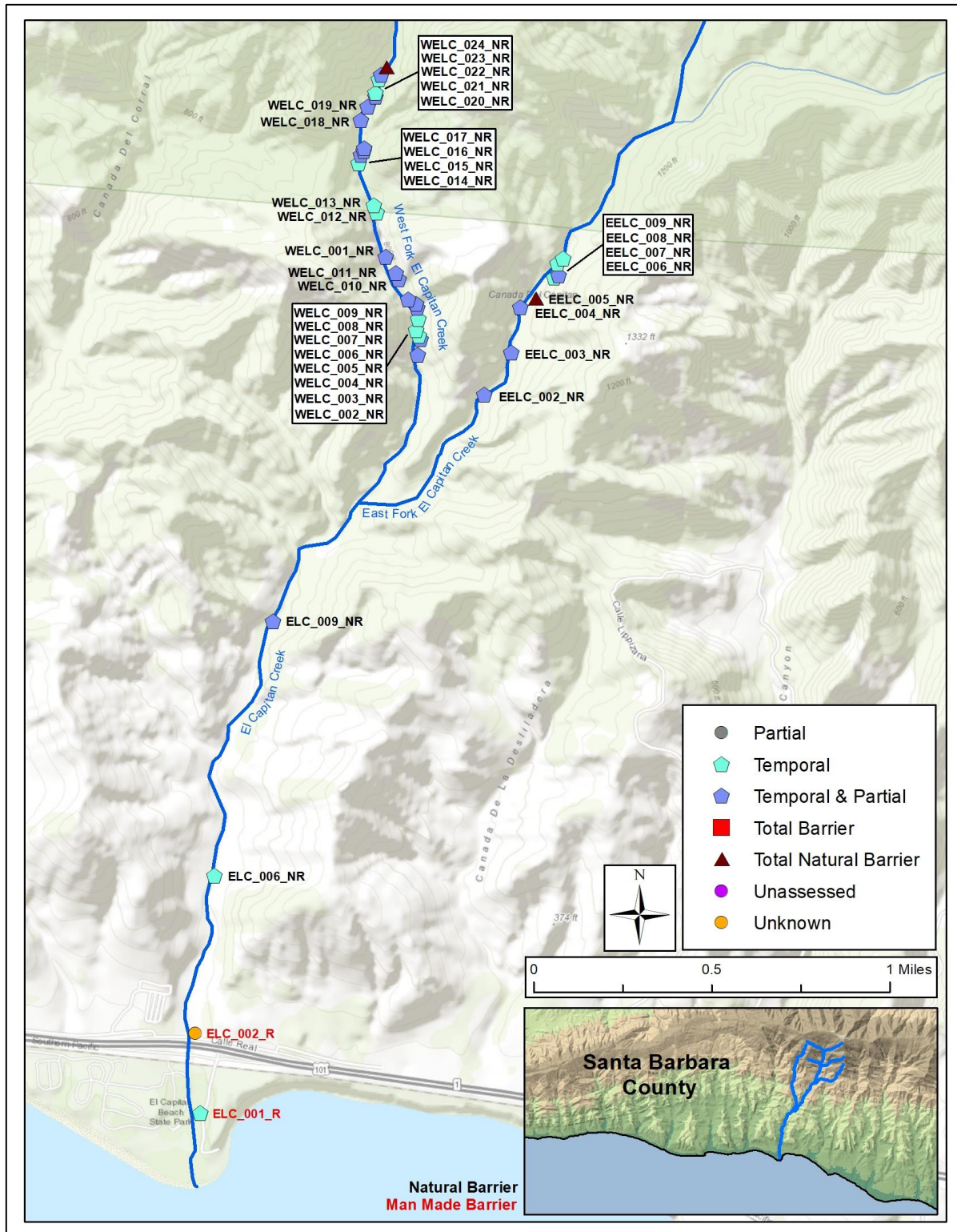
Five man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of Rincon Creek. A list of those structures is listed in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: RNC_002_R PAD ID: None Assigned	34.38708, -119.47533	N/A	Not a Barrier	Free spanning bridge over natural streambed.	
Barrier ID: RNC_003_R PAD ID: 706212	34.38806, -119.46881	Remediated, fish response unconfirmed	Not a Barrier	Free spanning Hwy 150 bridge over natural streambed substrate with concrete and boulder riprap channel walls. Post Mile: 1.12	
Barrier ID: RNC_004_R PAD ID: 706213	34.39051, -119.46314	Remediated, fish response unconfirmed	Not a Barrier	Free spanning Hwy 150 bridge over natural streambed substrate with concrete and boulder riprap channel walls. Post Mile: 1.5	

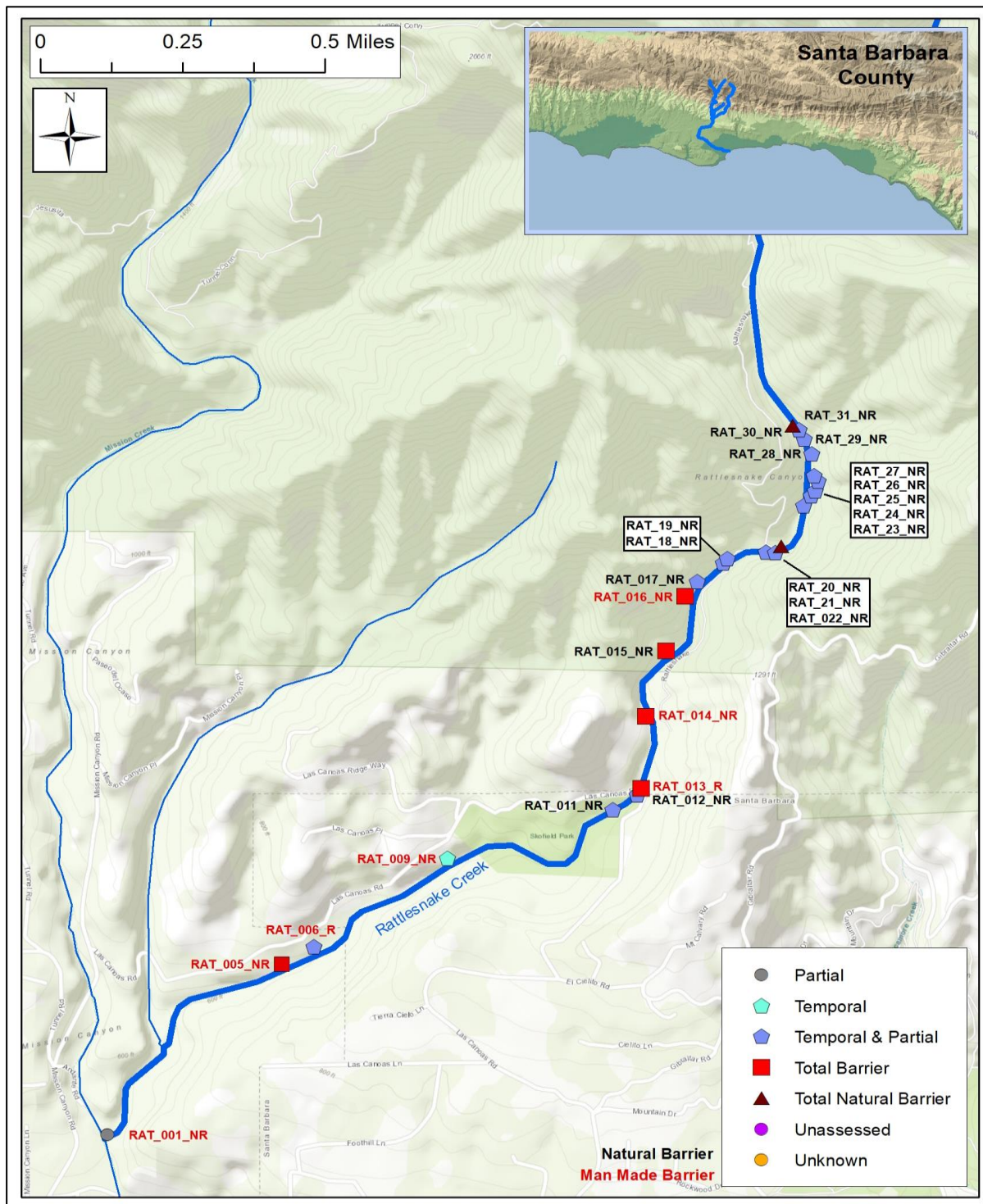
Barrier ID: RNC_005_R PAD ID: None Assigned	34.39411, -119.45723	N/A	Not a Barrier	Free spanning bridge over natural streambed substrate with concrete and boulder riprap channel walls.	
Barrier ID: RNC_006_R PAD ID: 732269	34.39608, -119.45359	Not a Barrier	Not a Barrier	Free spanning Hwy 150 bridge over natural streambed substrate with concrete channel walls. Post Mile: 0.006	

Appendix C Table 27. *Non-barrier structures on Rincon Creek.*

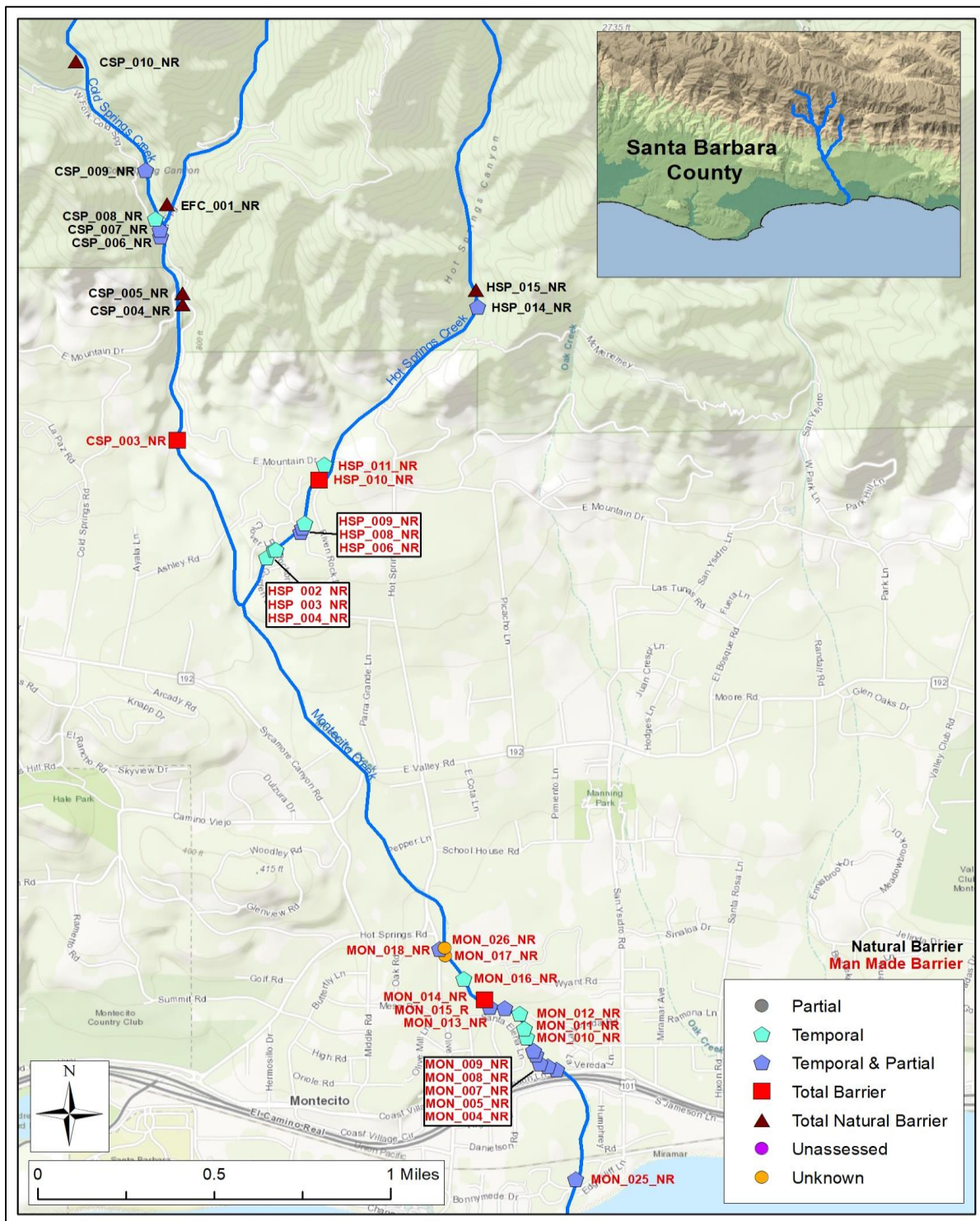
Conception Coast Watersheds Barrier Maps



Appendix C Figure 1. Location of man-made barrier structures and natural barrier features in assessed portion of the El Capitan Creek watershed.

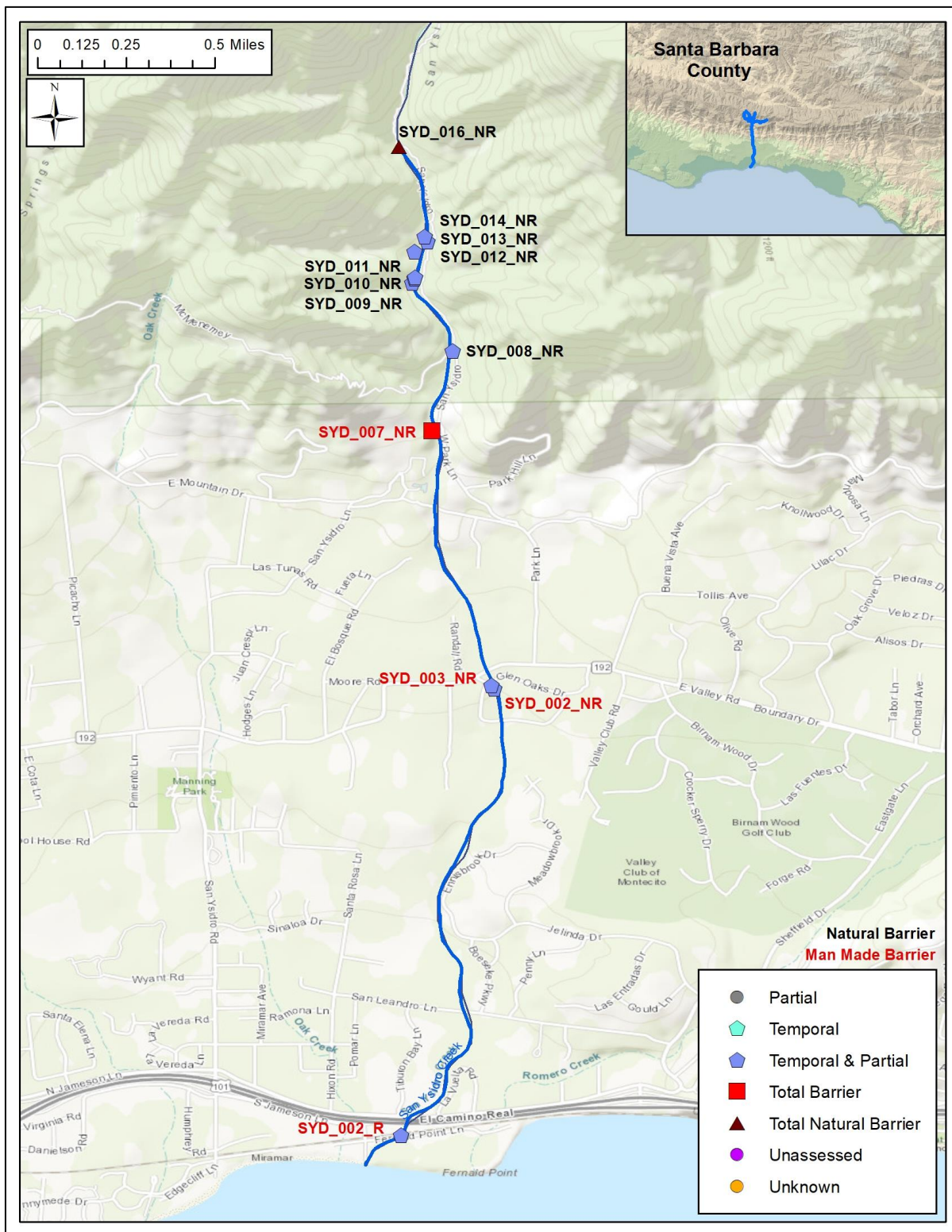


Appendix C Figure 2. Location of man-made barrier structures and natural barrier features in assessed portion of Rattlesnake Creek.

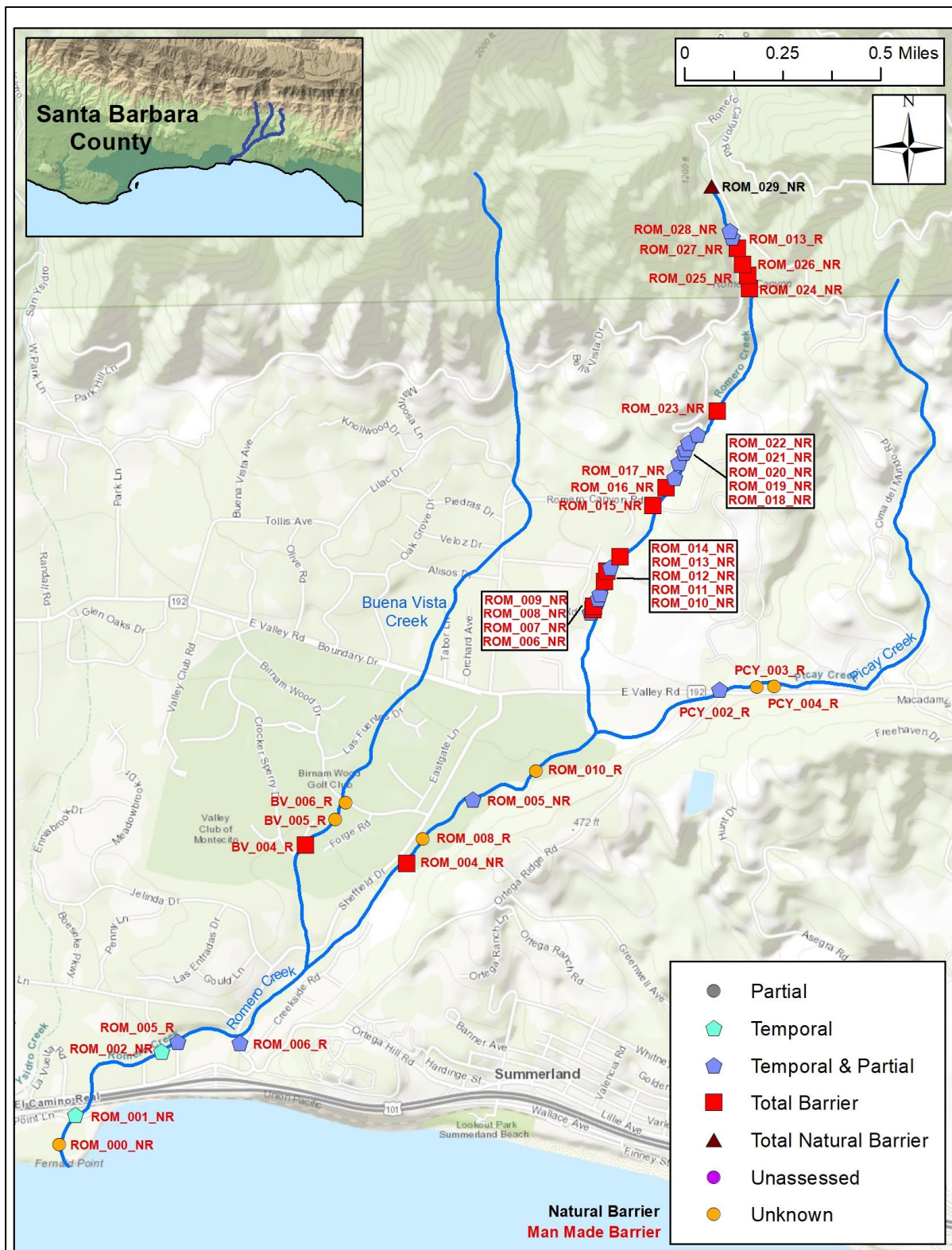


Appendix C Figure 3. Location of man-made and natural barriers within the assessed portion of Montecito Creek watershed.

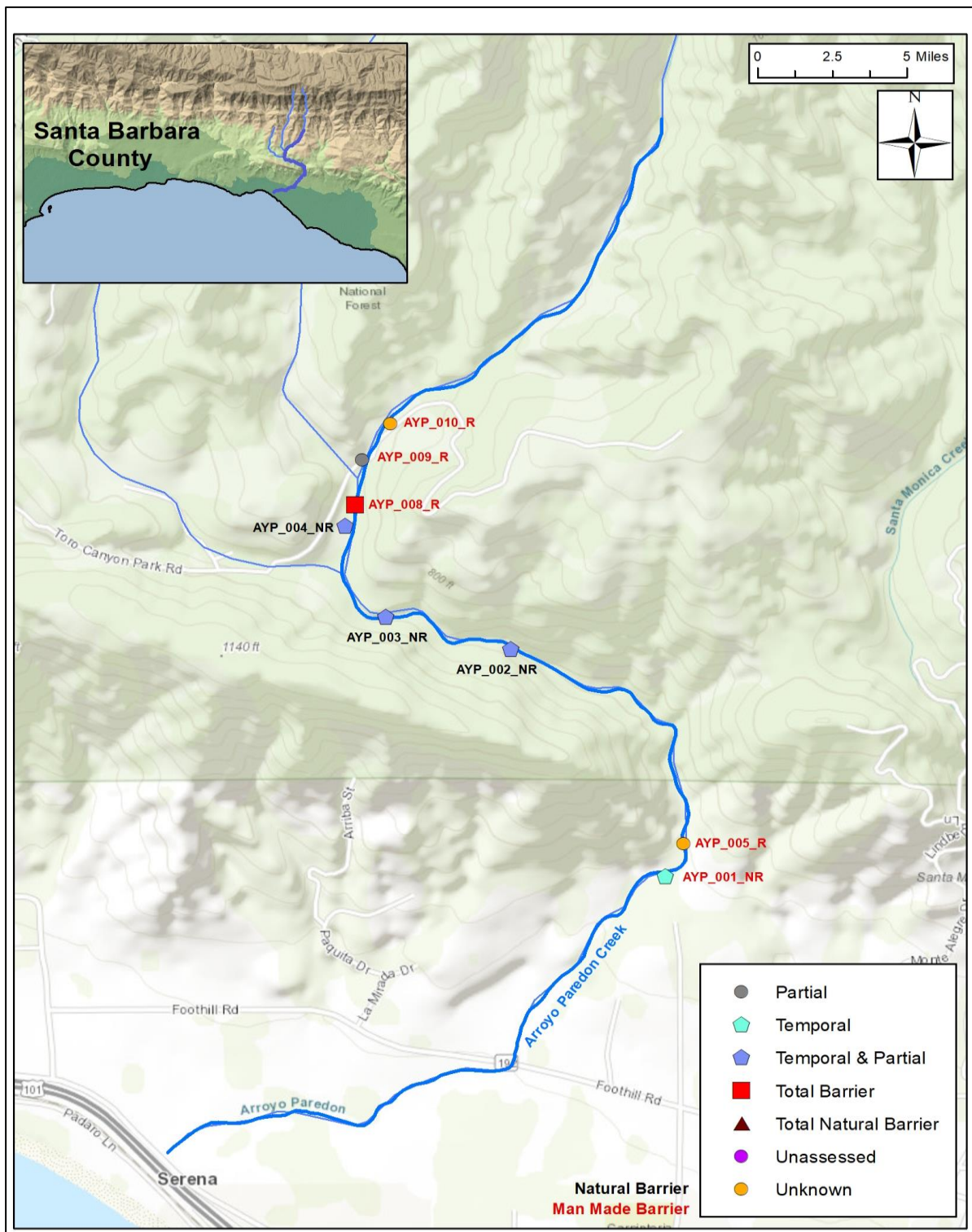




Appendix C Figure 5. Location of man-made structures and natural feature barriers in assessed portion of San Ysidro Creek watershed.



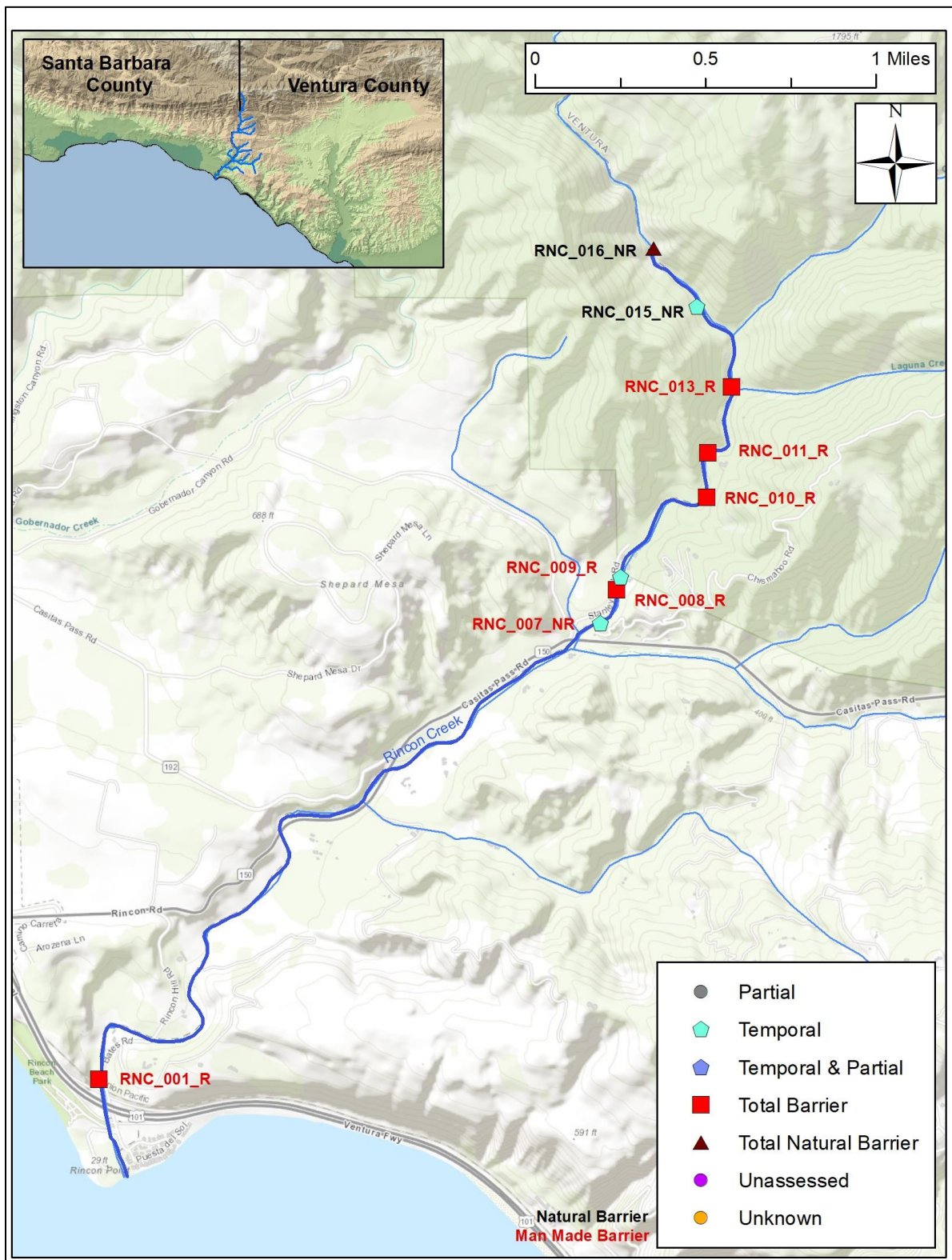
Appendix C Figure 6. Location of man-made structures and natural feature barriers in assessed portion of Romero Creek watershed.



Appendix C Figure 7. Location of man-made barrier structures and natural barrier features in assessed portion of Arroyo Paredon Creek watershed.



Appendix C Figure 8. Location of man-made barrier structures and natural barrier features in assessed portion of Carpinteria Creek watershed.






Appendix C Figure 9. Location of man-made barrier structures and natural barrier features in assessed portion of Rincon Creek watershed.


Appendix D – Topanga Creek Watershed Natural Barriers and Non-Barrier Structures

This appendix lists all naturally occurring barrier features which were assessed to limit upstream *O. mykiss* movement and all man-made structures which were assessed to be free of *O. mykiss* passage constraints within the assessed portion of the Topanga Creek watershed. All Caltrans owned structures are highlighted in yellow. Maps depicting the locations of all barrier types for each assessed stream are posted at the end of this appendix.

Topanga Creek Watershed – Topanga Creek – Natural Barriers

Four natural stream features were assessed to constrict *O. mykiss* upstream movement in Topanga Creek. Information regarding each assessed natural barrier on Topanga Creek is listed in the table below.



Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: TPC_002_NR PAD ID: 723593	34.05085, -118.58158	Partial	Partial	Natural bedrock chute with shallow jump pool. Total height of barrier: 3.2 ft Water depth below plunge: 0.8 ft Total cascade length: 12.6 ft	
Barrier ID: TPC_003_NR PAD ID: 723594	34.05311, -118.58189	Partial	Temporal & Partial	Natural boulder cascade with bedrock chute. Potentially passable at high flows. Total height of barrier: 4.2 ft Water depth below plunge: 1.7 ft	
Barrier ID: TPC_005_NR PAD ID: None Assigned	34.0699, -118.58702	N/A	Temporal & Partial	Bedrock chute/fall. Total height of barrier: 5.5 ft Water depth below plunge: 2.5 ft	

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: TPC_006_NR PAD ID: None Assigned	34.07548, -118.58987	N/A	Total	Bedrock chute/fall with extremely constricted plunge. Total height of barrier: 12.5 ft Water depth below plunge: 1.1 ft	

Appendix A Table 1. Natural barrier features in assessed portion of Topanga Creek.

Topanga Creek Watershed – Topanga Creek – Non-Barrier Structures

Two man-made structures were assessed to be free of *O. mykiss* passage constraints within the assessed portion of the Topanga Creek. It is included in the below table.

Barrier & PAD ID	Location	Previous Barrier Status	Current Barrier Status	Description and Dimensions	Picture
Barrier ID: TPC_001_R PAD ID: 716891	34.03932, -118.58303	Partial	Not a Barrier	Hwy 1 bridge with in stream concrete supports and concrete walls over natural streambed substrate. Post Mile: 40.99	
Barrier ID: TPC_004_R PAD ID: 716894	34.06429, -118.58785	Not a Barrier	Not a Barrier	Hwy 27 free spanning bridge over natural streambed substrate. Post Mile: 2.04	

Appendix A Table 2. Man-made barrier structures on assessed portion of Topanga Creek.

224