UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

June 6, 2012

In response refer to:
2012/00047

Mr. Bruce Henderson
U.S. Army Corps of Engineers
Los Angeles District, Ventura Field Office
Regulatory Division
2151 Alessandro Drive, Suite 110
Ventura, California 93001

Dear Mr. Henderson:

Enclosed with this letter is NOAA's National Marine Fisheries Service (NMFS) Biological Opinion for the Army Corps of Engineers' (Corps) permitting of the County of San Luis Obispo's pipeline-protection project (proposed action) in Arroyo Grande Creek, San Luis Obispo County, California. The biological opinion describes the effects of the proposed action on threatened South-Central California Coast (SCCC) steelhead (*Oncorhynchus mykiss*) and designated critical habitat for the species in accordance with Section 7 of the U.S. Endangered Species Act (ESA), as amended (16 U.S.C. 1531 *et seq.*).

The Biological Opinion concludes the proposed action is not likely to jeopardize the continued existence of SCCC steelhead, or result in the destruction or adverse modification of designated critical habitat for this species. However, NMFS anticipates take of SCCC steelhead as a result of the proposed action, thus an incidental take statement with non-discretionary reasonable and prudent measures and terms and conditions is included with the enclosed Biological Opinion.

Please contact Brittany Struck at (562) 432-3905 if you have a question concerning this ESA Section 7 consultation, or if you require additional information.

Sincerely,

for Rodney R. McInnis
Regional Administrator

Enclosure

cc: Roger Root, USFWS, Ventura
Margaret Roper, CDFG, San Luis Obispo
Mark Hutchinson, San Luis Obispo County Dept. of Public Works
Katie Drexhage, San Luis Obispo County Dept. of Public Works
Copy to Administration file: 151422-SWR-2012PR00014

BIOLOGICAL OPINION

AGENCY: U.S. Army Corps of Engineers

ACTION: Permit construction of a roughened channel in Arroyo Grande Creek to protect existing water pipeline in San Luis Obispo County, California.

CONSULTATION CONDUCTED BY: National Marine Fisheries Service, Southwest Region

TRACKING NUMBER: **2012/00047**

DATE ISSUED: **June 6, 2012**

I. CONSULTATION HISTORY

NOAA's National Marine Fisheries Service (NMFS) reviewed the U.S. Army Corps of Engineers' (Corps) January 5, 2012, request for formal consultation under Section 7 of U.S. Endangered Species Act (ESA). The Corps' request concerns the County of San Luis Obispo's (applicant) proposal to protect an exposed water pipeline (proposed action) where Rodriquez Bridge crosses Arroyo Grande Creek (AGC) in San Luis Obispo County, California. Following review of the Corps' request for consultation, including the accompanying information regarding the proposed action, NMFS determined that the Corps' request did not provide information necessary to develop a clear understanding of the potential effects of the proposed action on threatened steelhead (*Oncorhynchus mykiss*) and designated critical habitat for this species, in accordance with regulations governing initiation of formal consultation under Section 7 of the ESA (50 CFR § 402.14(c)). In a letter dated March 5, 2012, NMFS notified the Corps that formal consultation could not be initiated and described the information that NMFS requires to develop an understanding of the effects of the action on the species and designated critical habitat.

On March 27, 2012, through electronic communications, the applicant provided the Corps and NMFS with three different reports, including the *Pipeline Crossing at Rodriquez Road, Arroyo Grande Creek: Streambed Stabilization Concept Memorandum*, dated August 24, 2009, and a revised version of the *Technical Recommendations Memorandum* from Waterways Consulting dated March 8, 2010, presenting cost estimates of stabilization plan options for protecting the water pipeline. The applicant provided a second *Technical Memorandum* by Waterways Consulting dated April 21, 2011, which addressed fish passage hydrology and roughened channel hydraulics in terms of NMFS' fish-passage design criteria. Attached to this report were the 50-percent design drawings for the proposed action as well as the hydraulic calculations including, *Hydraflow Express* results, Manning's roughness calculations (i.e. Manning n values),

engineered streambed material (ESM) calculations, and the calculations to determine the dimensions of the weir/sill boulders.

On April 2, 2012, through electronic communications, the applicant provided the Corps and NMFS with the *Technical Specifications for Rodriguez Bridge Waterline Crossing Fish Passage Improvements Project* (San Luis Obispo County 2012), dated March 13, 2012, the 90-percent design drawings for the proposed action, and a response letter, titled *Information Needed for NMFS' Consultation for the Rodriquez Waterline Grade Stabilization Project*, addressing comments and questions contained in NMFS' March 5, 2012, letter to the Corps. Through electronic communications, on April 10, 2012, NMFS received a complete consultation package from the Corps including the applicant-provided information mentioned above. NMFS determined the provided information was sufficient to initiate formal consultation on April 10, 2012. The official letter and consultation package was received by NMFS on April 13, 2012. NMFS[1] conducted a site visit with the applicant[2] on April 25, 2012, to evaluate the current conditions within the action area in terms of available spawning and rearing steelhead habitat (e.g., streambed substrate), stream channel profile (e.g., current streambed gradient), and physical characteristics of the stream such as bankfull channel and active channel margins. On May 2, 2012, a conference call was held among NMFS, the Corps, the applicant, USFWS, and Waterways Consulting, Inc. project engineers to discuss the 100-percent draft design plans submitted to NMFS electronically by the applicant on April 26, 2012. The applicant supplemented the draft design plans with a response document titled, *Rodriquez Waterline Crossing Grade Stabilization Project, NMFS' Comments from 4.25.12 field visit*, addressing NMFS' concerns and questions raised during the site visit. On May 7, 2012, Waterways Consulting, Inc. provided additional calculations for juvenile and adult fish passage at high and low flow scenarios in a document entitled *Rodriguez Bridge Waterline Crossing Fish Passage Improvement Project – Supplemental Fish Passage Calculation Results*, which NMFS requested on the conference call.

This biological opinion is based on the best scientific and commercial data available, including information provided by the Corps to NMFS in the consultation package received by NMFS on April 10, 2012. A complete administrative record of this consultation is on file at the NMFS Southwest Regional Office (Southern California Office) in Long Beach, California (501 West Ocean Blvd., Suite 4200, Long Beach, CA 90802).

II. DESCRIPTION OF THE PROPOSED ACTION

The Federal action under review in this Section 7 consultation is the proposal by the Corps to authorize through permit issuance the applicant to protect an exposed water pipeline (proposed action) where Rodriquez Bridge crosses Arroyo Grande Creek in San Luis Obispo County, California. The purpose of the proposed action is to reduce the risk of damage to the pipeline from further scour and channel incision. The proposed action generally involves construction of a roughened channel in AGC downstream of the Rodriquez Bridge, which requires altering the current streambed elevation to eliminate the existing vertical drop of approximately three feet at the water pipeline.

[1] NMFS: Dr. David Crowder, Habitat Conservation Division; Brittany Struck, Protected Resources Division
[2] San Luis Obispo County, Public Works Department: Katie Drexhage; Tom Trott, P.E.

To stabilize the water pipeline and prevent further scour the proposed action involves the construction of approximately 225 linear feet of roughened riffle rock segments (approximately 1315 cubic yards of engineered streambed material (ESM) and 333 cubic yards of weir/sill boulders). During low to moderate flows, the existing exposed pipeline creates a partial fish-passage barrier, which the proposed action is expected to remedy. For instance, the streambed elevation will be raised at the water pipeline crossing and resting pools will be created for enhanced fish passage downstream of the pipeline. AGC will be accessed for grading and scour protection, which will necessitate tree and sediment removal, weir boulder placement, ESM grade establishment, installation of fabric-wrapped soil pockets, and log structure installation. Dewatering of the creek within the action area is proposed and will involve a temporary dam installed upstream of the work area. The applicant proposes a water-tight, flexible pipe to bypass surface flows around the work area for release about 25-feet downstream.

All phases of the proposed action include a set of avoidance and minimization measures, including pre-construction surveys and diversion/dewatering activities to avoid and minimize incidental take of threatened steelhead, and a variety of mitigation measures to minimize adverse impacts on biological resources. Best Management Practices (BMPs) include, placement of silt fencing on slope contours, a spill and clean-up kit available onsite at all times, and temporary and permanent erosion and sediment-control measures. Additional erosion-control measures will prevent the discharge of earthen materials to the AGC from disturbed areas under construction and from completed construction areas (San Luis Obispo County 2012). Protective barriers will be erected around sensitive areas using plastic safety fencing and maintained during construction. Tree protection from damage during construction is proposed for three trees[3] located within the stream channel (San Luis Obispo County 2012). A proposed Habitat Mitigation and Monitoring Plan (HMMP) includes specific measures for restoration and revegetation of all temporarily disturbed areas. The proposed action also includes the Dust Suppression Plan to control dust amounts on access and haul roads as well as the Hazardous Materials Control and Spill Prevention Plan, which includes provisions for preventing hazardous materials entering the stream (San Luis Obispo County 2012).

The following is a detailed description of components of the proposed action based on the nature of the activity and type of measures to minimize adverse effects to threatened steelhead and designated critical habitat.

A. Grade Stabilization: Materials, Quantities, and Design

1. <u>Design of downstream pools</u>

The applicant proposes to maintain the existing position of the pipeline, since it provides grade control for the stream. The applicant believes removal of the water pipeline will result in transportation of large amounts of sediment downstream (Environmental Programs Division, Department of Public Works 2012). The proposed action includes the creation of pools downstream of the pipeline that provide resting areas for steelhead. The length (50 feet long) of the first designed pool downstream of the water pipeline was dictated by the location of the

[3] 1 (20'' Willow), 1 (42'' Cottonwood), 1 (18'' Willow)

existing bridge piles, while the second downstream pool length (50 feet as well) was sized using commonly accepted design criteria of setting pool length equivalent to the bankfull width (Utilities Division, Department of Public Works 2012). Below the downstream pool, a sill is proposed across the entire width of the channel to act as a "rock band" at the head of the riffle. The sill is proposed for construction at grade with the bench to help protect against avulsion and subsequent incision through the floodplain surface. This structure will be tied into the channel banks up to an elevation equal to the water-surface elevation of the 2-year storm event. The slopes across both pools will be one percent, compared to the 2.5 percent slope for the roughened-riffle segments.

2. Roughened channel (riffle segments)

The roughened-riffle segments are proposed at a steeper grade than the existing bed slope to gradually transition the elevation drop (approximately 3 feet) downstream of the water pipeline crossing. Segments will conform into a V-shaped channel to concentrate flows conducive to fish passage. The design width of the thalweg is estimated to be 14 feet and with side slopes tied into the existing channel banks. Buried-rock groins are proposed to extend into the banks at the head of each riffle segment. The surface of the groins will be constructed to the 10-year water surface elevation, while rock for buried groin construction will be sized to be immobile during the 100-year discharge. Buried-rock groins will be spaced at approximately 35-foot intervals along the length of the modified channel to provide grade control above the bankfull channel and to minimize flanking in the event that beaver dams obscure the low flow channel. Both the roughened riffle and rock groins require that large immobile boulders be incorporated to maintain design slopes and provide channel stability during flooding events.

The width of the roughened channel comprised of ESM will range anywhere from 40 feet to 60 feet depending on the distance from the bridge. The applicant proposes to use EMS that is sized to remain stable during the 100-year discharge, with a thickness of 3.8 feet. The elevation change from the upstream to downstream end of each pool will be 0.5 feet to meet the NMFS and California Department of Fish and Game (CDFG) maximum jump height for juvenile salmonids. The proposed action will result in two roughened-riffle segments at a 2.5 percent slope. A low-flow triangular notch will be constructed with a 3:1 side slope at 1-foot deep to provide for low-flow fish passage. The roughened-riffle segments will extend from the channel thalweg up the banks to the estimated 2-year water-surface elevation. The first riffle segment is approximately 47 feet in length, while the second riffle at the downstream end of the project reach will be approximately 78 feet in length. The ESM will be placed in a manner to conform to existing roots where trees are to be retained. A recent addition to the design plans at the 90-percent design phase includes a two-foot layer of ESM placed below the bridge. The additional ESM has been included to protect this area against scour and alleviate future maintenance efforts at this location. The bridge-deck height will accommodate construction, and conveyance under the bridge is not a concern (Utilities Division, Department of Public Works 2012).

3. Weir boulder/sill placement

Weir boulders will provide steps in the stream profile. The applicant is proposing a total of five weirs across the stream channel. Weir boulders will be placed directly upstream and

downstream of both designed resting pools. The weirs will be V-shaped in plan and cross section to focus flows towards the center of the channel. Boulder-size calculations were conducted for construction of the proposed weirs, and the applicant will use weir boulders with minimum y-axis dimension of four feet. The applicant will also place weir backing beneath the weirs. Backing will have a minimum depth of six inches and a maximum depth of 1.5 feet to backfill all voids found within the weir structure. With the exception of the weir boulder adjacent to the pipeline encasement, all weir boulders will have a boulder sill component. The sill component will have two rows of boulders. A rock weir trench will be excavated a few feet downstream of the water pipeline, then ESM will be placed between the pipeline and weir boulder in order to prevent scour between the pipeline, which is exposed in the bed of the channel for approximately 38 feet between the banks of AGC (Northwest Hydraulic Consultants, Inc. 2009; Waterways Consulting, Inc. 2011), and the weir structure. Weir backing will be placed between the weir boulder and the water pipeline encasement. This weir will have an invert set 0.5-feet higher than the encasement invert. A low-flow segment has been incorporated into the weir cross section to concentrate low flows across the encasement and provide adequate flow depth (one foot) for upstream fish passage across the water pipeline encasement. Additionally, on the right streambank (looking downstream) there is a terrace where rock sills will extend out from the ends of all rock weirs and rock bands and across the terrace to prevent flanking of the weirs and prevent channel avulsions. The sills will extend up to an elevation equal to the water-surface elevation of the 10-year storm event. All weirs will have a hydraulic drop of six inches to satisfy NMFS juvenile fish passage criteria.

4. <u>Log-boulder structure design and placement</u>

An in-channel log structure is proposed to form additional complex flow patterns with variations in depth and velocity. The log structure has been designed to remain stable during the 100-year discharge event. There will be log/boulder and log/log connection for securing the logs, thus preventing the structure from failing. Log-ballasting calculations were conducted during the design process of this structure. All logs will be free of significant decay and meet the following criteria: length: 25-35 feet, diameter: 18-30’’ (minimum at any point), with at least one log with root wad attached per structure. The actual structure will be within the second resting pool downstream of the bridge. The applicant explained that the placement of the foundation logs and rocks is critical to the success of the proposed structure; the applicant will use a portable pump or other method to de-water excessive ground water from the excavation, as necessary (San Luis Obispo County 2012).

5. <u>Tree removal and soil pockets and live stake bundles placement</u>

Six trees between 10-24’’ diameter at breast height (dbh) will be removed. A number of other trees[4] smaller than 6’’ dbh will be removed. Five fabric-wrapped soil pockets, planted with native vegetation, and 70-live stake bundles will be installed throughout the project area to reestablish vegetation along the project reach, avoiding permanent loss of shade and cover due to the proposed action. Total area for the proposed fabric-wrapped soil pockets is 330 square feet (minimum). Pockets will be wrapped in a double layer of an erosion control blanket.

[4] On the May 2, 2012, conference call, the applicant was unable to give a more precise number of trees that will be removed which have a dbh less than 6’’.

Biodegradable erosion control fabric will be placed coincident with ESM installation, and filled with planting soil. Live-stake bundles will consist of groups of four or more live stakes, where stakes are woody plant cuttings, capable of rooting, that are salvaged on site from willow and cottonwood trees and shrubs. After placement of bundles, all voids will be backfilled and water-jetted to remove air pockets.

B. Access and Staging

Construction access is limited to the southern side of Rodriguez Bridge on the western side of AGC. Access will require construction of ramps and graded haul roads at slopes up to approximately 20 percent. The proposed slope ratio for the temporary access roads will be 4H:1V[5]. The bridge-pile supports beneath the bridge will limit the ability to construct extensive stabilization measures under the bridge. There is sufficient clearance to allow construction equipment access in the upstream/downstream direction between the bridge pile rows on the western bank to accomplish the proposed action. Staging and access to the action area will primarily occur within County Right-of-Way along Rodriguez Street and Lopez Drive. The applicant will seek an easement on the adjacent open space portion of the Las Ventanas Ranch to accommodate roughened riffle structure construction. Although some willows may be trimmed to access the construction area, the applicant will not remove trees which could compromise creek bank stability.

C. Dewatering

During the May 2, 2012, conference call among NMFS, the Corps, and the applicant, the applicant proposed an updated in-stream work window of August 1 to November 1. Dewatering activities will only occur during this time period to conduct pipeline-stabilization activities. One or more culverts will be placed in the creek for dewatering. The bypass system will be capable of passing 11 cubic feet per second (cfs), with a minimum of 12 inches of freeboard between the top of the pipe and top of dam. Sandbag and visqueen diversion dams will be used to direct flow into the culverts. A secondary diversion dam may be installed to help retain water that leaks through the primary dam. A sump pump will direct water retained between the dams into the culvert mouth. A mesh screen will be used to cover the intake in accordance with NMFS' screening criteria for pump intake screen mesh material[6]. Fish block nets will be installed upstream of the temporary dam and below the flexible pipe outlet, and a minimum of six inches of water will flow through the culverts.

The applicant proposes a water-tight, flexible pipe to bypass surface flows around the work area for release about 25-feet downstream. Only clean, non-turbid water will be returned to the creek. During the dry season, release rates at Lopez Dam are approximately equivalent to the flow at the work area, where summer release rates range between 4.7 – 10.9 cfs. If creek flows increase creating turbidity at the dewatering discharge site, water will be released through filter bags or on the vegetated bank where filtering can occur before entering the water body. The dewatering

[5] The relationship of the horizontal (H) and vertical (V) planes (i.e. slope ratio), between tiered banks as a result of excavations for access roads.
[6] NMFS Juvenile Fish Screen Criteria for Pump Intakes. Environmental and Technical Services Division. Portland, OR. May 9, 1996.

activities will extend upstream approximately 75 feet within which to construct the stream diversion structure. Dewatering activities will extend downstream of the bridge approximately 275 feet to encompass the discharge area for the diverted flows. The total length of stream that will be dewatered is 350 feet (275 + 75 feet). Prior to the removal of dewatering structures, fine sediments will be removed and disturbed areas will be restored. NMFS' effects analysis considers the methods for excess sediment removal and restoration of disturbed areas as part of the proposed action.

A temporary sediment basin is proposed downstream of the fourth weir boulder near the limit of disturbance area. The basin depth will be a minimum of three feet and side slopes with a minimum ratio of 2H:1V. The basin capacity is approximately 30 cubic yards. The basin and interior side slopes will be temporarily lined with non-woven geotextile filter fabric. Throughout the proposed action, the basin will detain sediment-laden runoff from disturbed areas long enough for the majority of the sediment to settle out in the basin.

D. Habitat Mitigation and Monitoring Plan (HMMP*)*

The plan provides the applicant's approach for the restoration, enhancement, and replacement of wildlife habitat temporarily lost as a result of the proposed action. The plan includes creek-protection measures, BMPs, and a riparian-revegetation plan. This plan identifies 31,363 square feet for restoration of riparian habitat, and includes measures for site preparation, planting materials, establishment, success criteria, and long-term maintenance of the area. Implementation of this plan will begin prior to and during construction activities, and a minimum of three years following implementation of the restoration plan. Trees removed for access to the work area will be replaced in excess of original numbers. Temporary disturbed areas will be hydroseeded with native seed mix and vegetation in the action area will be enhanced at a 2:1 ratio. To mitigate any tree loss, trees will be planted at a 3:1 or 10:1 ratio (reference Appendix B for specific mitigation ratios per square foot and per tree proposed for removal).

Willows will be salvaged and maintained at the applicant's greenhouse facility so that these plants can later be replanted on site once construction activities are complete. To mitigate for a loss of habitat at a 2:1 ratio, a total minimum replacement area of 0.72 acre will be enhanced and revegetated. Willows and cottonwoods will also be planted within the 0.72-acre area proposed for revegetation and vegetation enhancement activities. Additionally, willow cuttings and 1 to 5-gallon plants will be planted along the creek banks to mitigate for temporary impacts. The applicant has proposed that if plant mortality rate exceeds 30 percent, then replacement planting will take place. Planting will occur in the fall and winter to maximize likelihood of success, and planting will be spaced in a natural, random manner to mimic distributions normally found along AGC.

Monitoring of the structure will occur annually in coordination with the revegetation effort (Utilities Division, Department of Public Works 2012). Specifically, the applicant will conduct repeated (annually or after large floods) cross section surveys at established monitoring locations (three total locations). The applicant will also take pictures from established photo points (at monitoring cross sections) for year to year comparison of the installed structures and vegetation establishment. The applicant will also take velocity measurements within the project reach at

known discharge rates (i.e. high and low fish passage flows) for comparisons to design calculations (Utilities Division, Department of Public Works 2012).

E. Action Area

The action area refers to all areas to be affected directly or indirectly by the proposed action and not merely the immediate area involved in the action (50 CFR § 402.02). NMFS describes the action area in the following way: starting approximately 730 feet (~ 223 meters) downstream of Lopez Dam, including all riparian and in-stream habitat upstream of the proposed work area for the roughened channel, and extending approximately 1,724 feet (~ 525 meters) downstream of the water pipeline crossing. The coordinates for the start of the action area are: 35°11'6.60''N and 120°29'26.28''W. The action area ends approximately at the following coordinates: 35°10'54.20''N and 120°30'13.97''W. Reference Appendix A for the action area determined by NMFS.

III. STATUS OF THE LISTED SPECIES AND CRITICAL HABITAT

This biological opinion analyzes the effects of the proposed action on the following species and its designated critical habitat:

> **Threatened South-Central California Coast Steelhead** (*Oncorhynchus mykiss*)
> Listing determination: August 18, 1997 (62 FR 43937); listing reconfirmed January 5, 2006 (71 FR 834).
> Critical habitat designation: September 2, 2005 (70 FR 52488).

A. Description and Status of the Species

Oncorhynchus mykiss is one of seven Pacific salmonid in the genus *Oncorhynchus* that are native to the Pacific Coast of North America. The natural history of this species dictates the terminology fisheries biologists and resource managers use when discussing *O. mykiss*, its habitat, and distribution. If the species remains in freshwater throughout their entire life cycle, they are referred to as resident trout (non-anadromous), or rainbow trout. The anadromous or ocean-going form of *O. mykiss*, and its progeny, is referred to as steelhead, as the life history allows the species to utilize both freshwater and saltwater depending on the timing within the life cycle. Steelhead typically grow much larger than the rainbow trout (NOAA OPR 2011). Globally, steelhead are found in the western Pacific through the Kamchatka Peninsula in Asia, east to Alaska, south to southern California, and even reported in Baja California del Norte (Ruiz-Campos and Pister 1995).

The SCCC steelhead DPS is near the southern limit of the anadromous form of *O. mykiss* in North America. The status of the SCCC steelhead populations was assessed by NMFS' Biological Review Team (BRT) in 1996 (Busby et al. 1996), and 2005 (Good et al. 2005). Abundance of adult steelhead in the SCCC DPS declined from a historical high abundance of 25,000 returning adults to fewer than 500 adults currently. However, neither the historical estimate nor the present status of the steelhead population within the DPS has been sustained through comprehensive field surveys. The SCCC steelhead DPS includes all naturally spawned anadromous populations of *O. mykiss* in coastal river basins from the Pajaro River in Monterey

County southward to but not including the Santa Maria River in San Luis Obispo County. South of the Big Sur coast, steelhead watersheds include, San Simeon, Santa Rosa, San Luis Obispo, Pismo, and Arroyo Grande Creeks (62 FR 43937; 71 FR 834). In general, adult steelhead spawn in upstream reaches within coastal watersheds, and the progeny rear in freshwater or estuarine habitats prior to migrating to the sea. Additional details on life history follows.

1. Life History

O. mykiss is considered to have the most complexity and variation of all species in the genus in terms of the time and location spent at each life-history stage (Behnke 1992). Distinctly different than other Pacific salmon, steelhead adults can survive their first spawning and return to the ocean to reside until the next year to reproduce again. For returning adults, the specific timing of spawning can vary by a month or more among rivers or streams within a region, occurring in winter and early spring. The spawning time frames depend on physical factors such as the magnitude and duration of run-off and sand bar breaching. Once they reach their spawning grounds, females will use their caudal fin to excavate a nest (redd) in streambed gravels where they deposit their eggs. Males will then fertilize the eggs and afterwards, the females cover the redd with a layer of gravel, where the embryos (alevins) incubate within the gravel. Hatching time can vary from approximately three weeks to two months depending on surrounding water temperature. The young fish (fry) emerge from the redd/gravel two to six weeks after hatching. As steelhead begin to mature, juveniles or "parr," will rear in freshwater streams anywhere from 1-3 years. Juvenile steelhead can also rear in seasonal coastal lagoons or estuaries of their natal creek, providing over-summering habitat.

Juvenile steelhead emigrate to the ocean (as smolts) usually in late winter and spring and grow to reach maturity at age 2-4, but steelhead can reside in ocean waters for an additional 2-3 years before returning to spawn. The timing of emigration is influenced by a variety of parameters such as photoperiod, temperature, breaching of sandbars at the river's mouth and streamflow. Research on juvenile residency has shown that residency can be greatly influenced by the hydrologic cycle in southern California. Extended droughts can cause juveniles to become land-locked, unable to reach the ocean (Boughton et al. 2006, 2007). These events underscore the importance of stream restoration in not only mainstem portions of creeks but tributaries as well.

Ocean behaviors while in the ocean such as movement patterns, trends, and spatial distribution are still poorly understood and have not been extensively studied. Current knowledge from available studies suggests that the species does not generally congregate in large schools as other Pacific salmon of the genus *Oncorhynchus* (Groot and Margolis 1991; Burgner et al. 1992), making it difficult to study their movement patterns. However, some steelhead remain in coastal waters in proximity to their natal rivers as opposed to others that may have a wider range in the North Pacific (Quinn 2005).

Through scientific research studying the otolith (small ear stone) microchemistry of *O. mykiss*, researchers have come to further understand the complex and intricate life history of steelhead. Specifically, rainbow trout can have steelhead as progeny; likewise, steelhead can have rainbow trout as progeny (Zimmerman and Reeves 2000). Additionally, evidence indicates that switching between freshwater and anadromous life cycles is likely occurring. Examples include inland

resident fish exhibiting smolting characteristics and river systems producing smolts with no regular access for adult steelhead. This evidence suggests the ecological importance of the resident form to the viability of steelhead, which can translate into management implications for fish passage in upper portions of watersheds where migration barriers exist.

2. Habitat Requirements

Habitat requirements of steelhead generally depend on the life history stage. Steelhead encounter several distinct habitats during their life cycle. In general, discharge, water temperature, and water chemistry must be appropriate for adult and juvenile migration. Suitable water depth and velocity, and substrate composition are the primary requirements for spawning. Furthermore, dissolved oxygen concentration, pH, and water temperature are factors affecting survival of incubating embryos. The presence of interspatial spaces between large substrate particle types is important for maintaining waterflow through the nest as well as dissolved oxygen levels within the nest. These spaces can become filled with fine sediment, sand, and other small particles. Additionally, juveniles need abundant food sources, including insects, crustaceans, and other small fish. Habitat must also provide places to hide from predators, such as under logs, root wads and boulders in the stream, and beneath overhanging vegetation. Steelhead also need places to seek refuge from periodic high-flow events (side channels and off channel areas), and may occasionally benefit from the availability of cold-water springs or seeps and deep pools during summer. Estuarine habitats can be utilized during the seaward migration of steelhead, as these habitats have been shown to be nurseries for many species of fish and invertebrates. Estuarine or lagoon habitats can vary significantly in their physical characteristics from one another, but remain an important habitat requirement as physiology begins to change while steelhead become acclimated to a saltwater environment.

B. Description and Status of Critical Habitat

1. SCCC DPS Critical Habitat

NMFS has designated critical habitat for steelhead throughout all portions of Arroyo Grande Creek below Lopez Dam[7] (NMFS 2005b). Within the process of designating critical habitat, NMFS developed a list of Primary Constituent Elements (PCEs) (NMFS 2005a) for habitat sites essential to support one or more life stages of the DPS, such as sites for spawning, rearing, migration and foraging (50 CFR. 424.12(b)); PCE's specific to steelhead are further explained at 50 C.F.R. 226.211 (*see also* Table 1). These sites in turn contain physical or biological features essential to the conservation of the DPS (for example, spawning gravels, water quality and quantity, side channel, forage species). There are 30 occupied watersheds within this DPS, of which 1,250 miles of stream habitat and 3 square miles of estuarine habitat were designated as critical habitat (70 FR 52488). See Appendix D for a tabulation of the designated watersheds and river/stream reaches. The mouths of many rivers and streams in the DPS are seasonally closed by sand berms that form during periods of low flow in the summer. The physical or biological features that characterize these sites include water quality, quantity, depth, and velocity, shelter/cover, living space, and passage conditions.

[7] Endpoint: (35.1868, -120.4881); 70 CFR 52488.

The critical habitat analytical review teams assembled as part of the effort to designate steelhead critical habitat ranked the conservation value of habitat for watersheds known to be occupied by steelhead (NMFS 2005b). In terms of conservation value to the overall DPS, six watersheds received a low rating (20%), 11 received a medium rating (~ 37%), and 13 received a high rating (~ 43%) of conservation value (NMFS 2005b). The rating of habitat areas as having a high, medium, or low conservation value provided information useful to inform NMFS' decision process for designating areas as critical habitat.

Activities with the potential to affect critical habitat for the South-Central California Coast steelhead DPS include: (1) forestry, (2) grazing and related rangeland activities, (3) agriculture and associated water withdrawals, (4) road building and maintenance, (5) modifications of the creek channel or bank, (6) urbanization, (7) sand and gravel mining, (8) mineral mining, (9) dams, (10) irrigation impoundments and water withdrawals, (11) wetland (including estuaries) loss or removal, (12) introduction of exotic or invasive species, and (13) impediments to fish passage (NMFS 2005b).

Table 1. Physical or biological features which are critical to the conservation of sites determined essential to support one or more life stages of steelhead (NMFS 2005b).

PCE	Physical Characteristics	Essential to Conservation
Freshwater spawning sites	With water quantity and quality conditions and substrate supporting spawning, incubation and larval development.	Without them the species cannot successfully spawn and produce offspring.
Freshwater rearing sites	With water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.	Without them juveniles cannot access and use the areas needed to forage, grow, and develop behaviors (*e.g.*, predator avoidance, competition) that help ensure their survival.
Freshwater migration corridors	Free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.	Without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner; allow steelhead adults in a nonfeeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.
Estuarine areas	Free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.	Without them juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean; they provide a final source of abundant forage for adult steelhead that will provide the energy stores needed to make the physiological transition to fresh water, migrate upstream, avoid predators, and develop to maturity upon reaching spawning areas.
Nearshore marine areas	Free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.	Without them juveniles cannot successfully transition from natal streams to offshore marine areas.
Offshore marine areas	With water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.	Without them juveniles cannot forage and grow to adulthood.

2. <u>Arroyo Grande Creek Critical Habitat</u>

Based on information available to NMFS, the only dam which is a full barrier to steelhead in AGC is Lopez Dam. Its presence and operation have certainly contributed to declines in the

quality and quantity of critical habitat for steelhead, but evidence indicates that steelhead still use AGC for spawning and rearing (NMFS 2005b). Arroyo Grande Creek is one of the few streams at the southern portion of the DPS where age-0 and older juvenile steelhead occur during summer and fall, and sexually ripe adults occur in winter and early spring (NMFS 2005b). Further, AGC had medium conservation value as evaluated by analytical review teams, which determined it was essential for the conservation of the DPS. The AGC steelhead population is within the San Luis Obispo Terrace Biogeographic Population Group (BPG) in the South-Central California Steelhead Recovery Planning Area (NMFS 2007).

Arroyo Grande Creek is a coastal watershed located in west-central San Luis Obispo County. The mainstem of AGC flows through the cities of Arroyo Grande and Oceano and is a regional waterway, providing agricultural and municipal water to the communities of Arroyo Grande, Grover Beach, Oceano, Pismo Beach, and Avila Beach by way of Lopez Reservoir located in the upper portion of the watershed. The accessible reaches for steelhead within the mainstem of AGC consist of approximately 13 miles of channel. A growing urban population and a desire to maintain the region's agricultural land use priorities results in an increasing demand on the natural and biological resources of the AGC watershed.

Arroyo Grande Creek consists of approximately 20 stream miles and drains a watershed of about 153 square miles. The creek joins the Pacific Ocean west of the town of Oceano. Lopez Dam, constructed in 1968, is located at approximately stream mile 13. Since dam construction and commencement of operations, an average of 2,330 acre-feet of water has been released into AGC between April and October to recharge ground water pumped for agricultural use downstream (Becker and Reining 2008). Reservoir releases occur at a rate of approximately 1 to 11 cfs. In terms of stream flow and connectivity documented by CDFG, long sections of the creek contained permanent water throughout the entire year (CDFG 1960). Habitat surveys were conducted on AGC in 1999 and 2000 (SEI 2004), which concluded that spawning gravel quality and availability remain potential limiting factors affecting steelhead abundance as well as reproductive success in AGC. Based on stream inventory efforts in 2004, AGC habitat conditions were such that suitable size spawning substrate was limited to relatively few reaches (CCC 2004). According to a watershed management plan for AGC published in 2004, the lack of vegetated buffer strips along roads, poor stream crossings, and unmaintained ditch and culvert systems result in a significant erosion hazard during peak storm events (SHG 2004). Additionally, sources of direct, unmanaged release of fine sediment to the stream channel include: farm fields, roads, and agricultural ditches that all lack buffering vegetation. NMFS Technical Recovery Team (TRT) described the historical populations of the SCCC steelhead DPS, and based on a suite of distinguishing geologic, climatic, and hydrographic characteristics, the TRT identified four Biogeographic Population Groups for the SCCC steelhead DPS: Interior Coast Range, Carmel River Basin, Big Sur Coast, and San Luis Obispo Terrace (Boughton et al. 2007). San Luis Obispo Creek, Pismo Creek, and Arroyo Grande Creek exhibit the highest number and severity of sources of threats to steelhead habitats within the San Luis Obispo Terrace BPG.

Habitat assessments of the entire mainstem of AGC below Lopez Reservoir were conducted in the summer of 2004 by the California Conservation Corps (Close and Smith, 2004). Those data were then used to develop a random sample of discrete habitat units for a fish-abundance survey

conducted in the fall of 2006 (Swanson 2006). All of the habitat units were sampled via snorkeling and one of the habitat units for every reach (total of seven reaches) was sampled via both snorkeling and electrofishing. The number of steelhead observed via electrofishing and snorkeling within AGC totaled to 27 and 207, respectively. Authors also included density estimates for age 1+ and 2+ steelhead in AGC for each sampling site; the overall average density was 2.9 (Age 1+ and 2+ steelhead per 100 feet sampled). Authors suggest that the lack of channel-flushing high flows, due to capture in Lopez Reservoir, has resulted in a narrow channel that lacks complexity and contains silt in the substrate (Swanson 2006). Another habitat survey concluded that both water quality and habitat area/volume are diminishing within the lower half mile of AGC due to reduced flow (DPR 2007). According to authors, reduced flow in this lower segment of AGC is likely due to agricultural irrigation groundwater withdrawals from the alluvial plains near the lower miles of AGC.

Table 2. Physical and Land Use Characteristics of AGC Watershed in the San Luis Obispo Terrace BPG. *Abbreviated table from NMFS' South-Central Coast Steelhead Recovery Planning Area, Conservation Action Planning (CAP) Workbook Threats Assessment (2008).

Physical Characteristics				Land Use				
Watershed	Area (acres/ miles^2)	Stream Length (miles)	Average Annual Rainfall (inches)	Human Population	Public Ownership	Urban Area	Agricultural/ Barren	Open Space
Arroyo Grande Creek	97,873/ 153	175	18	45,378	20%	7%	9%	84%

C. Regional Climatic Variation and Trends

For the Southwest region (southern Rocky Mountains to the Pacific Coast), the average temperature has already increased roughly 1.5^{o}F compared to a 1960-1979 baseline period. By the end of the century, average annual temperature is projected to raise approximately 4°F to 10°F above the historical baseline, averaged over the entire region (U.S. Global Change Research Program (USGCRP) 2009). The southern California region is also experiencing an increasing trend in droughts, measured by the Palmer Drought Severity Index from 1958 to 2007 (USGCCRP 2009). Precipitation trends are critical to consider. The Southwest region, including the state of California, showed a 16% increase in the number of days with very heavy[8] precipitation from 1958 to 2007. In general, for most areas of the country, the fraction of precipitation falling as rain versus snow has increased during the last 50 years (USGCCRP 2009). Climate variability in the western United States has also been observed through spring indicators such as lilacs, honeysuckles, and streamflow (Cayan et al. 2001). All three indicators exhibited trends toward earlier spring timing since the mid-1970s. Spring climate variability will continue to be an important factor in evaluating how the status of the species is influenced by a changing climate.

[8] Defined as the heaviest one percent of all events.

Addressing climate trends and projections on an ecoregional scale within south-central California provides a focused summary of expected trends (PRBO Conservation Science 2011). The action area lies within the Central Western California Ecoregion where a collection of regional climate models have projected trends in temperature and precipitation, among other parameters. Specifically, regional climate models project mean annual temperature increases of 1.6–1.9°C by 2070 (PRBO Conservation Science 2011). Using a regional climate model, Bell et al. (2004) project a significant increase in some extreme temperature events in the Central Coast. Most of the regional climate models agree that the projected impacts of climate change on thermal conditions in Central Western California will be warmer winter temperatures, earlier warming in the spring, and increased summer temperatures. Although precipitation models show more uncertainty in precipitation projections compared to temperature models (PRBO Conservation Science 2011), Snyder and Sloan (2005) project mean annual precipitation in Central Western California will decrease by 1.6 cm (2.8%) by the end of the 21st century.

In general, changes in vegetation patterns for this region will include substantial increases in the amount of grassland and decreases in most other major vegetation communities (e.g., chaparral, coastal scrub, blue oak woodland, and foothill pine). Many of these climatic trends and projections are likely to further degrade SCCC steelhead habitat by, for example, reducing stream flows during the summer (Miller et al. 2003) and raising summer water temperatures (Eaton and Scheller 1996). Impacts to steelhead will likely result in increased thermal stress even though this species has shown to already endure higher body temperatures than are reportedly preferred or tolerated for the species as a whole (Spina 2007).

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species and critical habitat in the action area. The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone consultation, and the impacts of state or private actions which are contemporaneous with the consultation in process (50 CFR § 402.02), including dam construction/operations, road construction and agricultural activities. Water for municipal use is diverted directly from Lopez Dam into the water pipeline which terminates at a small treatment reservoir located on a tributary to the lower mainstem of Arroyo Grande Creek, prior to being diverted to end users. Since the installation of the water pipeline, the creek has adjusted in response to the altered hydraulic and geomorphic conditions following construction of the dam, resulting in channel incision downstream (Mitigated Negative Declaration and Notice of Determination 2010). Over time, the streambed has shifted and adjusted in elevation, consequently exposing the once buried water pipeline. The applicant expressed concern that future incision downstream of the crossing may result in undermining of the pipeline encasement and ultimately result in structural failure of the pipeline (Mitigated Negative Declaration and Notice of Determination 2010).

A. Status of Listed Species in the Action Area

NMFS described historical and recent steelhead abundance and distribution for the south-central and southern California coast through a population characterization (Boughton 2006). Results indicate that steelhead in the Arroyo Grande Creek system may have been the most extensive of populations within the County. In 1961, before the construction of Lopez Dam, CDFG estimated a run size of approximately 1,000 adult steelhead. Additionally, since 1940 the runs have decreased to an average of approximately 100-200 adults annually for the past ten years (DFG 1961). In 1996, a population estimate of juvenile steelhead below Lopez Dam was 7,000 individuals (Alley 1997). During habitat surveys downstream from Lopez Dam in 2000, CDFG observed multiple *O. mykiss* year classes including individuals with physical characteristics representative of smolts. In an effort to study the genetic structure of *O. mykiss* in southern California, AGC was sampled in 2003, and results indicated no significant difference between above and below barrier groups for the Arroyo Grande Creek drainage (Girman and Garza 2006). Authors believe the population upstream from Lopez Dam is of coastal steelhead ancestry. Juvenile steelhead abundance was surveyed within the action area and within close proximity to the action area in 2006 (Swanson 2006), and a total of 13 juvenile steelhead were observed via snorkeling. This provided a combined (only sample sites 28-30 fall within the determined action area for the proposed action) steelhead density of 13.4 (Age 1+ and 2+ steelhead per 100 feet sampled) within the portion of AGC just below Lopez Dam. In 2007, there were approximately 30 fish (multiple species), of which some were identified as juvenile steelhead, found dead in AGC after a chemical spill from the Lopez Lake water treatment plant (Sneed 2007).

B. Status of Critical Habitat in the Action Area

Arroyo Grande Creek, in addition to other systems such as Santa Rosa Creek in north county and San Luis Obispo Creek in central county, serves as important over-summering habitat for juvenile steelhead (Payne and Associates 2004). NMFS produced maps of potential unimpaired habitat in San Luis Obispo County, including data on historical and current evidence of steelhead use (Boughton 2006). However, habitat within the action area has been significantly degraded from various anthropogenic activities, such as irrigated agriculture and rural residences. Within the defined action area, AGC channel is incised. Riparian vegetation within the action is dense with an equally dense and extensive canopy. The action area includes freshwater spawning and rearing areas, and a freshwater migration corridor. There are no sources of tributary inflow that feed into AGC upstream of the action area.

The channel downstream of Lopez Dam is much flatter, where the valley is much wider. The channel within the action area has a low gradient, which makes sediment transport difficult (Dvorsky 2010). The lack of channel flushing flows has resulted in a narrow low-flow channel that lacks complexity (Close and Smith 2004; Swanson 2006). In addition, much of the bed of the channel consists primarily of silt that likely limits spawning. The presence of excessive fine sediment loads in streams has been shown to limit macro-invertebrate production, reduce the amount of cover habitat available to juvenile salmonids, and limit successful spawning (Terhune 1958; McNeil and Ahnell 1964; Vaux 1962; Cooper 1965; Daykin 1965; Swanson 2006). These past observations were confirmed with collected information and observations during the site visit by NMFS on April 25, 2012. The project reach is mainly pool/glide habitat likely serving as important over-summering habitat for steelhead with well-developed bank and instream

vegetation for cover and refuge from predators. Baseline conditions are such that in-stream substrate within the work area boundaries is mainly silt and fine grained material, with minimal areas of small gravel and cobble that likely provide very low quality spawning habitat for steelhead. However, upstream from Rodriquez Bridge, beyond the proposed work area boundary but still within the action area, is drastically improved in-stream habitat for steelhead spawning and rearing. Spawning gravels and cobble appear to provide suitable spawning grounds unlike areas downstream of the water pipeline (see field photos, Appendix C). The following description is based on results from a habitat survey conducted in the summer of 2004 (Close and Smith 2004). The report documents characteristics and conditions of the designated action area:

> *The portion of the AGC channel that could not be classified*[9]*, can be separated into two geographic areas; the first located immediately below Lopez Dam; and the second located upstream of Biddle Park. Both channels lack habitat complexity; with consecutive fine substrate, mid-channel pools dominating stream habitats. The channel at both locations is highly impacted due to either man-made alteration or dispersed beaver dams. The channel below Lopez Dam is a slightly entrenched, low gradient, meandering, narrow channel with eroding banks. Channel substrate is composed of depositional, silt/sand, soils. The channel is braided near the dam outflow where the stream connects to large marsh habitats tangent to stream. The large marsh/pool areas are classified as gravel pits in the County of San Luis Obispo Habitat Conservation Plan (2004). The floodplain is expansive with established forested vegetation below access area to dam. The stream reach above Biddle Park is a slightly entrenched, low slope, wide, mid-channel pool stream; with eroding banks. Substrate consists of depositional soils; silt/sand channel. The channel is threaded connecting extremely large pools. Stream flow is dispersed throughout multiple side channels and large pool habitats. Emergent vegetation grows throughout the shallow portions of the main channel. Main channel lacks mature vegetation; side channels are dense with young willow growth (page 7 and 8).*

The channel near the project reach is approximately 25 feet deep below adjacent agricultural land and has steep banks. The low flow channel upstream of the crossing has a width of approximately 20 feet, and both banks are well vegetated. The pipeline crossing is about 20 feet upstream of the Rodriquez Bridge, and in a cross section view at the pipeline, the main channel is located near the left (looking downstream) bank, and a gently sloping floodplain about 60 feet wide occurs along the right bank (Northwest Hydraulic Consultants Inc. 2009). Downstream of the bridge, the floodplain on the right bank expands further. Past the scour hole, the low flow channel narrows to about four feet in width upstream of the bridge before expanding again under the bridge and downstream. A small amount of rock riprap is visible in the banks on both sides of the channel at the pipeline crossing. There may be additional rock buried in the banks and bed downstream of the pipeline (Northwest Hydraulic Consultants Inc. 2009). There is also a rock quarry upstream of the project reach but within the action area. The channel profile upstream of the crossing is flat in the area surveyed by the applicant. Additionally, the water pipeline crossing provides grade control within the channel (Northwest Hydraulic Consultants Inc. 2009; Environmental Programs Division, Department of Public Works 2012). Downstream of the

[9] In channels where significant modifications have occurred, it is difficult to apply the Rosgen system (standard lexicon to describe streams), primarily due to the lack of established geomorphic indicators (Close and Smith 2004).

crossing, the stream profile is also relatively flat – survey flow line elevations show approximately 0.5 feet drop over approximately 300 feet downstream of the bridge (Northwest Hydraulic Consultants Inc. 2009).

C. Factors Affecting Species Environment within the Action Area

The following factors are not mutually exclusive and can be grouped into a few general threat categories related to land use activities. These factors largely determine the pervasive lower quality of steelhead habitat downstream of Rodriguez Bridge. Land use activities concentrated along the narrow, coastal terrace floodplains magnify impacts to instream and riparian habitats (Hunt & Associates Biological Consulting Services 2008). The predominant factors[10] affecting instream habitat within the action area are: (1) agricultural and road development, (2) groundwater extraction, and (3) regulation of flows at Lopez Dam. The threats of these factors to threatened steelhead in the action area are described in greater detail as follows.

1. Agricultural and road development

Arroyo Grande Creek is bordered by a restricted 100-year floodplain, most of which has been converted to agriculture (HCP 2004). Row crops, orchards, and vineyards dominate the agricultural landscape. Cultivated fields and open farmland are on either side of AGC within the action area. Lopez Drive comes close to AGC at Biddle Park (approximately half a mile downstream of the action area) and again aligns closely with AGC just downstream of Rodriguez Bridge for approximately 0.16 miles, continuing to follow AGC upstream of Rodriquez Bridge for 0.21 miles. Agricultural conversion of floodplain lands and increased density of roads and placement of roads in or near the riparian corridor are recurring sources of threats to instream and riparian habitats within the action area.

2. Groundwater extraction

Winter peak flows are stored in Lopez Reservoir for release in the dry summer months for groundwater recharge for municipal and agricultural uses (Dvorsky 2010). These releases for agricultural irrigation groundwater recharge typically occur between April and October (HCP 2004) and average 2,330 acre-feet annually for downstream agricultural use. The applicant includes expectations and predictions of the agricultural water demand with the HCP (2004):

> *With regard to groundwater, recent investigations conducted by the Department of Water Resources (DWR, Bulletin 118 draft, 2002) indicate that the sustained yield of the San Luis Obispo Valley groundwater basin is estimated at 5,900 acre-feet per year. Note that agricultural water demand is expected to range from 12,400 to 16,500 AFY. It is conceivable that agricultural water needs could fully utilize available groundwater yield. Thus, it can be concluded from this overview of water needs in the Five Cities area that Lopez Reservoir may play a major role in meeting the predicted 4,950 AFY increase in urban water needs (page 1-31).*

[10] Factors are ranked in order of frequency of occurrence and severity (see Hunt & Associates Biological Consulting Services 2008 for details).

3. Operation of Lopez Dam

Water-regulating activities outside of the action area influence the current habitat characteristics and conditions within the action area. Upstream of the action area is Lopez Dam, an earth-fill dam, constructed in 1967-1968, with a spill crest elevation of 522.6 feet (1986 datum). The 2004 Habitat Conservation Plan (HCP)[11] offers this description of Lopez Reservoir:

> *Lopez Reservoir serves as the primary municipal water supply source for the communities of Arroyo Grande, Grover Beach, Oceano, Pismo Beach, Avila Beach, Avila Service Area, and County Service Area 12. Water from Lopez Reservoir is released directly into Arroyo Grande Creek, as well as bypassed through a pipeline to a terminal reservoir and water treatment plant. Release from the dam through the outlet structure into Arroyo Grande Creek (non-spill events) generally occurs at a rate of 100 cfs or less. By agreement, an average of 2,330 AF of water has been released from the reservoir into Arroyo Grande Creek each year, between April and October, to meet downstream demands for agricultural irrigation supplies… The rate of releases from Lopez Reservoir into Arroyo Grande Creek to meet agricultural demands varies from approximately 1 to 11 cfs (page 1-1;1-5).*

After construction of Lopez Dam, AGC is classified as a semi-perennial creek with riparian woodland corridors dominated by willows and freshwater marsh (HCP 2004). In January 1999, a reduction in releases from Lopez Dam caused a portion of AGC to go dry, interrupting in-stream habitat connectivity, which lead to two adult steelhead stranded (HCP 2004).

> *To address these fishery issues, the District commissioned investigations of steelhead and redlegged frogs and their habitat in the lower reaches of Arroyo Grande Creek (Alley 1996, 1997). The District initially agreed to maintain an interim minimum release from Lopez Reservoir of 7.7 cfs (5 mgd). Subsequently, after completion of a series of stream studies and discussions with CDFG and NOAA Fisheries, the release rate was adjusted to 6.2 cfs (4 mgd) to protect the steelhead habitat and to support the scientific data collection for this HCP (page 1-4).*

Historic and recent incision along AGC through the project reach has exposed the concrete encasement and now results in a partial barrier to fish passage for steelhead (Waterways Consulting, Inc. 2011). The actual pipeline, constructed in 1969, is located approximately 3,000 feet downstream of Lopez Dam. Downstream of the vertical drop from the pipeline, a scour hole is present (Northwest Hydraulic Consultants Inc. 2009). Incision of the stream is likely not entirely natural, but heavily influenced by both natural forces and historical and contemporary human activities such as vegetation clearing, confinement of the channel and floodplain, and reservoir construction (Northwest Hydraulic Consultants Inc. 2009; NMFS personal observations).

4. The effects of climate change are as discussed in the "Status of the Species" Section.

[11] Final Draft: Arroyo Grande Creek Habitat Conservation Plan (HCP) and Environmental Assessment/Initial Study (EA/IS) for the Protection of Steelhead and California Red-legged Frogs. February 2004.

V. ANALYTICAL FRAMEWORK FOR ASSESSING EFFECTS OF THE PROPOSED ACTION

A. Jeopardy Analysis

Under section 7(a)(2) of the ESA, Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The proposed action under review in this biological opinion occurs within designated critical habitat and is likely to have effects on critical habitat, owing to elements of the proposed action, including proposed BMPs, and instream conditions and characteristics that are expected at the time the proposed action is implemented. Below, NMFS outlines the conceptual framework and key steps and assumptions utilized in the jeopardy analysis for the South-Central California Coast (SCCC) steelhead DPS.

In accordance with Section 7(a)(2) of the ESA, implementing regulations (50 CFR Part 402), and associated guidance documents (*e.g.*, USFWS/NMFS Consultation Handbook, 1998), NMFS' biological opinions present: (1) a description of the proposed Federal action; (2) a summary of the status of the affected listed species and designated critical habitat; (3) a summary of the environmental baseline within the action area; (4) a detailed analysis of the effects of the proposed action on the affected species and critical habitat; (5) a description of cumulative effects (future non-Federal actions that are reasonably certain to occur); and (6) a conclusion as to whether the proposed action, taken together with the cumulative effects, is likely to jeopardize the listed species or result in the destruction or adverse modification of the species designated critical habitat. By regulation (50 CFR § 402.02), the "effects of the action" include the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline. To evaluate whether an action is likely to result in jeopardy to a listed species or result in the destruction or adverse modification of designated critical habitat, NMFS considers the combination of the status of the species and critical habitat (i.e., the environmental baseline), the "effects of the action" and the cumulative effects of future non-Federal actions that are reasonably certain to occur. An action that is not likely to jeopardize the continued existence of the listed species is one that is not likely to appreciably reduce the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution (50 CFR § 402.02).

NMFS must evaluate the effects of a proposed action within the context of the current condition of the species and critical habitat including other factors affecting the survival and recovery of the species. Additionally, the risk assessment conducted should consider the effects of climate change, as well as ocean conditions, on the species and critical habitat and our understanding of the expected impacts from a proposed action. Lastly, NMFS evaluates the effects of the proposed action on a species' likelihood of both survival and recovery (the "jeopardy standard" at 50 CFR § 402.02) by evaluating the species' risk of extinction. This approach, its relationship to the legal standard "likelihood of both survival and recovery," and the best available scientific information relating to viable salmonid populations (McElhany et al. 2000), are further described in terms of how they will be applied to the ecological conceptual framework for analysis of the proposed action.

1. Viable Salmonid Populations

NMFS uses a conceptual model of the species to evaluate the impact of the proposed action. For this consultation, the conceptual model involves the listed SCCC steelhead DPS and is based on a hierarchical organization of individual fish, population unit (i.e., watershed-specific populations), and the DPS. The guiding principle behind this conceptual model is that the likelihood of survival and recovery of the species is dependent on the likelihood of survival and recovery of populations which comprise the species, specifically the Arroyo Grande Creek population within the San Luis Obispo Terrace Biogeographic Population Group (BPG) in the South-Central California Steelhead Recovery Planning Area (NMFS 2007). The second principle is that the likelihood of survival and recovery of each population unit is dependent upon the fitness (growth, survival, or reproductive success) of the individuals that comprise that population. Accordingly, NMFS uses the Viable Salmonid Populations (VSP) criteria (McElhany et al. 2000) to describe the recent status of the SCCC DPS, which will provide a basis for assessing how the proposed action may affect long-term survival and recovery of the species. Additionally, for a focused population evaluation, NMFS will rely on both the *Federal Recovery Outline for the DPS of South-Central California Coast Steelhead* (NMFS 2007) and NOAA's Technical Memorandum (2006), *Steelhead of the South-Central/Southern California Coast: Population Characterization for Recovery Planning*, to provide the best available scientific information on steelhead populations including abundance, productivity, and spatial structure information, within the SCCC steelhead DPS range, including the determined action area for the proposed action. NMFS will also rely on a more recent report entitled *Arroyo Grande Creek: Steelhead Distribution and Abundance Survey* conducted by Swanson Hydrology & Geomorphology (2006), to estimate abundance and density of steelhead within the action area.

2. Assessment Method (Exposure, Response, and Risk)

To assess whether the proposed action is likely to jeopardize the listed species or result in the destruction or adverse modification of critical habitat, NMFS uses a basic exposure-response-risk framework adapted from other accepted risk-analysis frameworks such as those used by the Environmental Protection Agency (*e.g.*, EPA 1992 and 1998). Because alteration of critical habitat represents the primary mechanisms by which the proposed action will affect individual steelhead, the second approach in the assessment involves a habitat-based assessment framework.

The assessment methods used in this biological opinion include addressing exposure type, extent, duration, and magnitude of direct and indirect effects on steelhead, expected responses by steelhead to adverse effects, and risk of exposure to steelhead (*i.e.*, the likelihood that individual steelhead will be affected). Within the exposure assessment, common stressors (physical, chemical, or biotic) directly or indirectly caused by the proposed action to which steelhead may be exposed will be identified and considered in terms of impacts to steelhead abundance and distribution and the availability and quality of habitat for this species. Other factors that will be considered include: transport of disturbed sediment (persistence and concentration) within critical habitat. Likewise, these effects will also be evaluated on a larger scale by considering the impact on steelhead populations within the entire DPS. The evaluation as to the extent and duration of exposure to stressors, either on steelhead or essential habitat features, including

expected responses by steelhead to adverse effects, serves as the exposure and response profiles provided in this biological opinion.

The risk assessment will include a problem formulation, risk examination and risk characterization. Risk characterization includes the effects on individual steelhead and the effects on habitat, while also considering potential impacts on the DPS. In this section, NMFS evaluates the likely effects of the proposed action to steelhead within the action area based on the exposure and response framework described above. NMFS will determine to what extent the proposed action, when added to the environmental baseline conditions, will increase risk to individual steelhead. The final steps in NMFS' jeopardy risk assessment are to evaluate whether anticipated effects from the proposed action, in combination with cumulative effects including future environmental variation, are reasonably likely to result in changes in the extinction risk for the AGC steelhead population and for the SCCC steelhead DPS as a whole. Completion of the assessment relies on the information available about the species and the specific population units in terms of current levels of abundance, productivity, diversity, and spatial structure characteristics, as presented in the Status of the Species and Environmental Baseline sections.

Throughout the assessment, NMFS has a responsibility to use the best scientific and commercial data available for producing a biological opinion, in particular analyzing the effects of the proposed action. While the information provided in the Corps' complete initiation package (April 2012) helps to describe the proposed action among other things (see 50 CFR § 402.12 for details), NMFS relies on the best available scientific and commercial data available, which may include appropriate ecological literature, resource and guidance documents, and past information, collected in previous years by the applicant, documented in the official record for the proposed action. Specifically, NMFS will describe the concept and implications of constructing a roughened channel, which is one outcome from the proposed action in the action area. NMFS will consider the scope and duration of the project in terms of the type, amount, and extent of expected adverse effects. Furthermore, when evaluating and assessing both short- and long-term effects, NMFS can determine and identify any net benefits for steelhead from the proposed action.

B. Adverse Modification Analysis

This biological opinion does not rely on the regulatory definition of destruction or adverse modification of critical habitat at 50 CFR 402.02[12]. Instead, NMFS relies upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

The adverse modification analysis in this biological opinion relies on four components: (1) the Status of Critical Habitat, which evaluates the range-wide and watershed-wide condition of critical habitat for the SCCC steelhead DPS in terms of primary constituent elements (PCEs – sites for spawning, rearing, and migration), the factors responsible for that condition, and the resulting conservation value of the critical habitat overall; (2) the Environmental Baseline, which evaluates the condition of critical habitat in the action area, and the factors responsible for that condition; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the

[12] This regulatory definition has been invalidated by Federal Courts.

PCEs in the action area and how that will influence the conservation value of affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the conservation value of affected critical habitat units. If the proposed action will negatively affect PCEs of critical habitat in the action area, NMFS will then assess whether or not this reduction will impact the value of the DPS critical habitat designation as a whole.

For the purpose of the adverse-modification determination, NMFS adds the effects of the proposed Federal action on critical habitat of SCCC steelhead in the action area, and any Cumulative Effects, to the Environmental Baseline. This allows NMFS to determine if the resulting changes to the conservation value of critical habitat in the action area are likely to cause an appreciable reduction in the conservation value of critical habitat range-wide.

C. Information Review, Synthesis, and Key Expectations

NMFS is consulting on the proposed action, which involves the permanent alteration to streambed and riparian habitat within designated critical habitat of AGC. Permanent changes will result in two outcomes: (1) structural protection of an exposed water pipeline, and (2) changed streambed elevation to eliminate a three-foot drop in the streambed caused by the water pipeline. The U.S. Department of the Interior, Bureau of Reclamation's *Erosion and Sedimentation Manual* (2006)[13], River Processes and Restoration (Chapter 7), specifically New Channel Designs and Relocations is used to generally inform an understanding of the likely short-term adverse effects of sediment disturbance considering the scope and nature of the proposed action. NMFS will rely on, *inter alia*, information within the *California Salmonid Stream Habitat Restoration Manual*[14] for evaluating the proposed action and the methods which the applicant plans to use for conducting the proposed action. This evaluation would ensure consistency with state and Federal protocols and methods for altering streambed elevation and engaging in riparian-habitat restoration. An additional guidance document that served to be informative is the *Riparian Area Management: Process for Assessing Proper Functioning Condition* (DOI and BLM 1998). To evaluate the effects of the proposed sediment removal on threatened steelhead, which will be required for streambank grading activities, NMFS will rely on the *Sediment Removal from Freshwater Salmonid Habitat* guidance document (2004).

Based on the description of the proposed action, including the hydraulic calculations and modeling for the design, construction, and sustained function of the roughened channel, NMFS' expectations include the following: (1) passable conditions for steelhead can be maintained over the water pipeline, (2) the channel has reached an equilibrium slope and will not down cut substantially in the future (during the project's lifespan), and (3) proposed infrastructure is placed such that it is extremely unlikely that invasive maintenance (e.g., reconstruction of the entire roughened channel) is needed.

[13] http://www.usbr.gov/pmts/sediment/kb/ErosionAndSedimentation/index.html
[14] http://www.dfg.ca.gov/fish/resources/habitatmanual.asp

VI. EFFECTS OF THE PROPOSED ACTION

The purpose of this section is to identify the direct and indirect effects of the proposed action, and any interrelated or interdependent activities, on threatened SCCC steelhead and designated critical habitat. Information to quantitatively determine the precise effects of the proposed action are limited or unavailable due to the experimental nature of the proposed action and lack of past, similar projects in the same watershed. Therefore, the species and habitat effects analyses rely predominately on a qualitative assessment based on knowledge and review of the species life history and ecological literature and other relevant materials. This information was used to gauge the expected effects of the proposed action on steelhead via an exposure and response framework that focuses on stressors (physical, chemical, or biotic), directly or indirectly, caused by the proposed action. NMFS will then evaluate the expected response of steelhead to these stressors in terms of changes to steelhead survival, growth, and reproduction, and changes to the ability of critical habitat to support species spawning, rearing, and migration in the action area.

Construction activities associated with bank stabilization and placement of engineered streambed material (ESM) are expected to affect steelhead through fish relocation and temporary increased turbidity restricted to the action area. The expected duration of the proposed action is from August 1, 2012 to November 1, 2012. Only juvenile steelhead are expected to be in the action area (Appendix A). Effects to SCCC steelhead and designated critical habitat in the action area include the building of ESM segments, placement of five boulder weirs, removal of current instream-vegetation including six trees within the action area, and incorporation of two resting pools with one pool containing a log-boulder structure. The expected effects of these activities are described as follows.

A. Effects on Steelhead

1. Fish Relocation Activities

Temporary dewatering of AGC will require a diversion of flow using a water-tight, flexible pipe to bypass surface flows around the work area and release about 25-feet downstream for approximately 60 days. Proposed dewatering necessitates the need to relocate steelhead from the action area. Juvenile steelhead will likely be the only captured salmonids based on the proposed work window; adult steelhead are not expected in the work area where dewatering activities are proposed (based on the timing of the project, adults will have migrated further downstream). Due to the extent of pool habitat within the proposed work area and factors discussed in the Environmental Baseline, NMFS expects rearing juvenile steelhead will be present. Based on the number of steelhead observed during previous steelhead and habitat surveys (e.g., Swanson 2006), and the length of creek dewatered specified by the description of the proposed action (350 feet), NMFS estimates the number of juvenile steelhead relocated from the 350-foot dewatering area will likely be fewer than 50. Based on the average juvenile steelhead density calculated by Swanson (2006) of 13.4 per 100 feet sampled, the density is reasonable to assume for the proposed action under current habitat conditions, therefore NMFS determined 50 steelhead is an appropriate upper limit of expected steelhead within the work area to be dewatered.

The proposed action is expected to take approximately nine weeks; however NMFS' experience and familiarity with similar instream construction projects suggests delays could extend the work period to 12 weeks when configuring the proposed action timeline and anticipating the encounter rate of steelhead. NMFS expects the dewatering process to cause temporary loss of aquatic habitat, a temporary barrier to upstream migration, and increase the risk that steelhead will be harmed as a result of habitat modification that can impair essential behavioral patterns[15]. Before dewatering occurs, steelhead will be relocated to suitable habitat downstream if found to be present in the action area. The process of capture and relocation can have physiological impacts including inducing stress and temporary disorientation. Direct injury and mortality result from physical trauma, which can be caused by direct and indirect contact with humans or machinery. Specifically, direct injury may impair fish movement, feeding, and survival. Fish collecting gear, whether passive (Hubert 1996) or active (Hayes et al. 1996), has some associated risk to fish, including stress, disease transmission, injury, or death. Throughout relocation efforts, elevated stress and increased distortion can be a result of potential overcrowding during the transfer phase. The amount of unintentional injury and mortality attributable to fish capture, steelhead stranding in residual wetted areas during dewatering, and actual relocation efforts varies widely depending on the method used, the ambient conditions, and the expertise and experience of the field crew; however, NMFS expects the amount of unintentional injury and mortality to be limited and not subject to the variation discussed above due to the use of only passive fish collecting gear and the experience of County-retained biologist in (1) pre-construction surveys for steelhead, (2) monitoring all phases of dewatering events, and (3) relocation activities.

Data on fish-relocation efforts on AGC have not been documented, thus mortality rates from relocation activities are not available for AGC. During the actual placement and construction of the water diversion dam before the work area is dewatered completely, NMFS expects pulses of turbid water to result in limited, unintentional injury of steelhead if dewatering activities go without continual turbidity assessment and monitoring during the dewatering phase of the proposed action (this limited injury is included in the calculations of the final sentence of this paragraph). Unintentional injury will be limited by the use of fish block nets as proposed by the applicant to direct fish movement away from the water diversion dam while the work area remains dewatered. Fish that avoid capture during relocation effects will be exposed to a rapid decrease in water level resulting in potential stranding. Past relocation efforts had low mortality with one out of 249 juvenile steelhead observed dead during the dewatering process (Santa Barbara County, Quiota and El Jaro Creeks (2008-2011)). During the dewatering process, steelhead may become trapped if not observed, identified and caught before the process begins. Stream flow dewatering and work area isolation could harm individual rearing juvenile steelhead by concentrating or stranding them in residual wetted areas (Cushman 1985). Generally, dewatering may cause steelhead to move to adjacent habitats with poor habitat conditions. Specifically, dewatering the work area may injure or kill steelhead by temporarily confining them to areas predisposed to dewatering or desiccation, increased water temperature, decreased dissolved oxygen, and predation (Cushman 1985). Based on an evaluation of previous relocation

[15] For the purposes of this proposed action given the proposed work window, the behavioral patterns of rearing, sheltering, and migrating are likely to be temporarily impaired.

events during similar activities[16] in pool habitat, farther south within the endangered Southern California steelhead DPS, NMFS believes no more than one juvenile steelhead would be killed or injured out of the 50 juveniles handled during capture and relocation, or during any phase of dewatering activities[17].

Except for steelhead killed or injured in the process (discussed above), while steelhead may endure temporary stress and disorientation, NMFS does not believe relocation or dewatering activities will significantly reduce the fitness of individual steelhead. If steelhead relocation activities are necessary, they will be conducted by qualified fisheries biologists with experience in handling and relocating salmonid species so direct effects to and mortality of steelhead during capture will be minimized. Additionally, the temporary barrier proposed to divert water around the work area will not delay migration behaviors for steelhead based on the timing of the proposed action, and rearing juvenile steelhead will still have access to upstream and downstream pools within the action area, therefore NMFS believes the temporary barrier will not reduce the fitness of individual steelhead.

2. Altering Background Sedimentation and Turbidity Levels

There will be additional in-channel work for placement of ESM and boulder weirs. Any in-channel work creates unnatural disturbance to the riparian habitat on which steelhead rely during migration. An increased input of sediment into creeks is a major stressor during streambed alteration activities and vegetation removal. As a result, increased turbidity in creeks can reduce spawning or rearing habitat. Even small pulses of turbid water will cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat and/or increase competition and predation, decreasing chances of survival. Prolonged exposure to elevated concentrations of inorganic sediment can cause decreased growth in salmonids (Shaw and Richardson 2001). The magnitude and degree of the potential water-quality alteration is unknown because the specific sedimentation and turbidity rates have not been predicted, however potential flushing of fine sediment stored downstream of the existing water pipeline is probable. Water quality degradation may: affect the ability of steelhead to feed, block or delay juvenile or adult steelhead migration, cause juvenile steelhead to move into areas of higher predator density, and/or cause short- or long-term physiological damage that ultimately prevents threatened steelhead from successfully reproducing.

The removal of accumulated sediment within the work area and the actual placement of ESM itself will result in sediment disturbance. Following ESM placement, the rock surface will be jetted with water to improve compaction and embed the fine sediment within the mix. Consequently, NMFS expects increased turbidity levels within the creek. The applicant will include a temporary downstream sediment basin to minimize the amount of sediment input beyond the work area (i.e. beyond the dewatered area). Responses to increased turbidity can

[16] Similar projects occurred in San Luis Obispo, Santa Barbara, and Ventura Counties, including a tributary of Lower Santa Ynez River. Relocation evaluation came from monitoring reports for the following: El Jaro Creek – Rancho San Julian Fish Ladder (2009), El Jaro Creek – Cross Creek Ranch Fish Passage Project (2009), Quiota Creek Crossing 2 – Bottomless-Arched Culvert Project (2011), and Quiota Creek Crossing 6 Bottomless-Arched Culvert (2009).

[17] Documented steelhead mortality in other instances of one *O.mykiss* dead at the bottom of a plunge pool as the dewatering process was finalized (Quiota Creek Crossing 2 – Bottomless-Arched Culvert Project (2011)).

include fish mortality, reduced fish feeding efficiency, and a decrease in food availability (Berg and Northcote 1985; Velagic 1995; Thompson and Larson 2004). However, the applicant proposes to mitigate impacts of temporarily elevated sedimentation and turbidity through the following: (1) placement of a cobble/gravel blanket on areas within the channel that may be disturbed, and (2) treatment of disturbed slopes with biodegradable slope stabilization fabric (Zacharia 2012). To mitigate for any potential long-term changes in erosion and sedimentation rates, the applicant will incorporate vegetation structures within the streambed including live stake bundles and placement of biodegradable erosion control fabric under the proposed soil pockets for planting.

The implementation of the design, erosion control mechanisms, and BMPs will minimize the risk of significant surface erosion affecting the stream channel. The expected impacts will likely be localized, which will reduce any increases in turbidity levels downstream of the work area. Therefore, any significant effects downstream of the work area resulting from turbidity are discountable. Additionally, juvenile steelhead will be relocated prior to any measurable changes in water quality (i.e., increased turbidity) occurring within the action area as a result from the installation of the temporary water diversion for AGC.

3. Temporary Decrease in Available Shade and Cover Habitat

With six trees being removed, ranging in size from 10 to 24 inches, and an unspecified and unknown number by the applicant of smaller tress with a dbh of less than six inches, the existing extent of cover will be temporarily removed for approximately one year. Specifically, shaded areas are important for minimizing heat and maintaining water temperatures that support the life stages present, especially during warmer months. Cover is an important component of adult holding and juvenile rearing habitat. The adverse effects of temporary changes in cover will be minimized by protecting trees, which provide extensive cover and protection for trees that remain critical for bank stabilization. Additionally, willows will be salvaged and maintained at the applicant's greenhouse facility so that these plants can later be replanted on site once construction activities are complete. Through the proposed HMMP, long-term mitigation for permanent tree removal includes a total minimum replacement area of 0.72 acre, which will be enhanced and revegetated. To ensure successful growth of newly planted vegetation, NMFS believes the current goal survival rate of 70% of vegetation as described in the HMMP is merely adequate to avoid effects which might affect the fitness of fish ; NMFS recommends increasing the a goal survival rate to 80% to further minimize and avoid adverse effects to critical habitat within the work area. Juvenile steelhead will be relocated prior to loss of shade and cover occurring in the work area. However any steelhead present within the work area once construction is complete, will likely have less shaded, cool areas for resting and avoiding predators until bank and instream vegetation has fully developed. Further, there will be a transition period after the proposed action is complete in which shade and cover will not be available to the same degree as before construction, owing to the time needed for plants to mature and develop. Effects on steelhead from removal of in-channel vegetation can include: a change to a less complex channel, reduction in the prey base for juvenile steelhead, reduction in habitat diversity by reducing large woody debris for example, and reduction in the amount of vegetative matter as a food source for steelhead prey. Based on the reduction in cover as described in the project description, changes to water temperature within the work site and

throughout the action area are expected to be insignificant. Although some areas will be less suited to steelhead use during the re-growth period, adequate substitute areas nearby provide similar quality shading and will not result in overcrowding, therefore, these changes are not expected to reduce the fitness of individual steelhead. Considering the extent of the work area compared to available cover within the action area, the response of any steelhead to temporary loss of shade or cover within the work area is not expected to result in adverse effects to the SCCC steelhead DPS.

4. Expected Hydraulic Design Performance Related to Fish Passage

Aspects of the proposed fish passage design are included below and serve to be informative when analyzing the generally risks involved with an experimental design approach. Design modifications can influence the degree in which the proposed structure will function as intended in terms of the formation of the designed downstream pools and avoiding broad-crested weir flows as discussed in this section. The risk of broad-crested weir flows is unlikely if the as built structure is maintained and functions as intended, specifically to provide passage to both juvenile and adult steelhead over the pipeline encasement such that the upstream weir backwaters the pipeline to a depth of six inches.

The alignment of boulder weirs will impact the direction of flowing water through the project reach. That is, specific design modifications for the first constructed weir will likely reduce scouring events, but at the same time will influence water depth over the concrete encasement, which creates a risk to steelhead in terms of physical contact with the encasement during passage if adequate water depth (six inches) is not maintained. The weir directly downstream of the concrete encasement is only slightly arched for the following two reasons as described by the applicant (Response Memo 2012):

> *(1) The boulder weir configuration needs to conform to the existing straight configurations of the encased pipeline directly upstream of the weir and the bridge piers downstream of the weir, and*
> *(2) The area directly downstream of the boulder weir is an existing scour problem area. Concentrated scour is a significant concern in this area because the bridge piers have already experienced heavy scouring and some piers are now only three feet deep. A straighter weir configuration allows for larger flows over the weir to be more spread out and not so concentrated, reducing scour. This is especially important since little to no sediment is transported to this area from upstream (the dam is just upstream from this location and there are no tributaries upstream of this location).*

Weir alignment and placement within the streambed can also influence the degree to which the design pools will actually form and function as intended. The weirs at the downstream sections of both pools are slightly arched/angled toward the center of the stream channel. Arching the weirs helps provide stability for the weirs and will help promote the formation of a jump pool downstream of the weir notch. Additionally, these weirs provide grade control as well as stabilize the ESM. Therefore, NMFS determined the proposed design avoids creating undesirable scouring of the ESM and promotes the formation of the design pools downstream of the water pipeline.

Some of the boulder sills extend out on either side of the normal stream channel and appear to direct flows toward the bank instead of toward the center of the stream channel, which was identified by NMFS as a general risk to successful steelhead passage, when undergoing construction of a roughened channel. NMFS conveyed concern over this configuration to the applicant due to the possibility that the sill placement could result in scouring of the banks during larger storm events. The applicant explained the following (Response Memo 2012):

> *The boulder sills that extend on either side of the boulder weirs extend to the 10-year storm flow elevations. Their purpose is to extend across flood plain benches and key into higher ground to minimize the likelihood of side channel development. The sills do not operate like weirs - the top of the boulder sills are roughly the same elevation as existing ground on both the upstream and downstream sides of the sill. The weir portion of the boulders is located within the 2-year storm flow elevations (the area where engineered streambed material is located)…With this being the case, water will flow over the sills without a change in direction, just like it would normally in these flood plain benches.*

Based on the further clarification of the design, NMFS believes the sills should not become exposed, therefore will not likely operate as weirs, nor increase the risk of creating passage barriers with hydraulic drops greater than six inches. The proposed action does incorporate and meet NMFS' 6-inch weir drop height criteria for juvenile passages. The overall hydraulic design proposes an ESM slope (2.5%) to ensure successful migration of steelhead at various life stages through the project reach. Based on the design proposed, NMFS expects the exposed pipeline will be backwatered six inches; however there is a possibility of undesirable broad-crested (shallow, fast, supercritical) weir flows over the pipeline, over the upstream rock weir constructed with two rows of boulders as well as between these two structures (NMFS' Habitat Conservation Memo 2012). Furthermore, NMFS conveyed on May 2, 2012 via conference call to the Corps and the applicant the importance of ensuring that the upstream rock weir (adjacent to the pipeline) is not constructed such that it functions as a broad-crest weir and making sure it backwaters the pipeline. Otherwise, this will cause steelhead, particularly juveniles, to swim through more than nine (potentially up to 15-20) feet of shallow, fast flows. As described in the proposed action, the applicant will conduct annual monitoring of the roughened channel including velocity measurements for comparison to design calculations. Since the applicant did not specify monitoring reports will be submitted to NMFS for review but did specify that reports will be submitted to California Department of Fish and Game, NMFS presumes the monitoring results will be made available to NMFS as well within 45 days of monitoring efforts..

The proposed action includes a truncated fish passage window, which can influence steelhead migration for both juvenile and adult steelhead during low flow conditions. However, based on additional modeling results, NMFS does not believe the truncated window will significantly influence steelhead migration. The proposed fish passage windows which meet NMFS' fish passage guidelines are approximately from 4.5 to 21.7 cfs for juveniles and approximately from 6.4 to 106.7 cfs for adult steelhead (Table 3). However, the current NMFS (2001) guidelines do not explicitly apply to streams with regulated releases and that do not have 'natural' or 'unimpaired' hydrographs, nor do the guidelines define appropriate fish passage windows in highly regulated streams such as AGC. Subsequently, NMFS requested from the applicant on

the conference call[18] additional analyses including velocity and depth calculations for juvenile and adult low passage design flows at a weir as well as the maximum discharge meeting depth and velocity criteria for both juveniles and adults. Under the pre-dam flood recurrence interval data provided by the applicant, NMFS (2001) guidelines establish a juvenile fish passage window of 1 to 200 cfs and an adult fish passage window of 3 to 1000 cfs. Therefore, the applicant has proposed a truncated fish passage window based on post-dam construction daily release records from Lopez Dam (Waterways Consulting, Inc. 2012) because pre-dam flow exceedance data remains unavailable. Again, by using post-dam release flows when pre-dam flow data is unavailable, the applicant truncated the upper fish passage window[19]. This action has implications for possible future efforts in getting threatened steelhead past Lopez Dam into the upper watersheds because a truncated fish passage window may not allow for successful adult migration if fish passage at Lopez Dam is addressed. For addressing these future efforts, NMFS prefers to use a natural hydrograph in terms of calculating proper fish passage windows. A wider fish passage window becomes important to ensure the species an opportunity to gain full access to the watershed. However, after considering the history of regulated flows from Lopez Dam, NMFS determined the proposed fish passage windows[20] for the proposed action will not result in adverse modification of critical habitat or result in take of steelhead based on the following, which reflect the current flow regime: (1) the presence of higher base flows within the project reach; (2) NMFS expects the current flow regime to continue; (3) the proximity of the action area to the dam itself; and (4) the design will probably provide fish passage windows that are wider than those described in Table 3.

The proposed design incorporates instream structures to provide topographic complexity via roughness elements within the project reach, thus velocity shelters for juvenile steelhead should be available within the project reach. NMFS expects multiple pathways for juvenile migration and sufficient space for juveniles to occupy habitat features and structures within the streambed (Waterways Consulting, Inc. 2011). Likewise, the applicant provided proposed hydraulic conditions within the roughened channel (Table 3). The applicant estimated and proposed fish passage windows from flow duration/exceedance curve information derived from flows occurring after the construction of Lopez Dam. Below is a comparison between the design flow depth along with other parameters such as design stream discharge and design average velocity to guidelines described by NMFS (2001) for both juvenile and adult steelhead passage. Results indicate that minimum water depths and maximum average velocities fall within the NMFS' passage criteria. NMFS determined the proposed fish passage windows, considering the hydraulic design and the current flow regime, will not result in take of threatened steelhead and will not adversely affect the SCCC steelhead DPS as a whole.

[18] May 2, 2012.

[19] The applicant's methodology and actual fish passage windows used here for the proposed action should not be applied elsewhere where pre-dam data exists and is available.

[20] The proposed fish passage window is a truncated window and is not the most conservative window in terms of an unimpaired hydrograph. Since AGC is regulated, the hydrograph has been manipulated. For example, the reservoir will attenuate/eliminate any large peak flow events that may occur during the first winter after construction (Zacharia 2012).

Table 3. Fish Passage Parameters under Low and High Flow Scenarios (Waterways Consulting, Inc. Technical Memo, April 21, 2011)

Species and Life Stage	Design Flow	Percent Annual Exceedance Flow	Design Stream Discharge (cfs)	Design Flow Depth (ft)	Required Depth[1,2] (ft)	Design Average Velocity (ft/s)	Max. Average Allowable Water Velocity[1,2] (ft/s)
Juvenile Salmonid	Low	95%	4.5	1	0.5	0.9	1
Adult Salmonid		50%	6.4	1.3	1	0.6	1
Juvenile Salmonid	High	10%	21.7	1.7	1	1	1
Adult Salmonid		1%	106.7	2.7	1	2	6

[1] National Marine Fisheries Service Southwest Region, "Guidelines for Salmonid Passage at Stream Crossings". September 2001.
[2] State of California Resources Agency, Department of Fish and Game, "Culvert Criteria for Fish Passage". May 2002.

B. Effects on Critical Habitat

1. Altering Structure and Function

The action area of the proposed action is designated critical habitat for SCCC steelhead. PCEs of designated critical habitat for SCCC steelhead in the action area include sites for migration, spawning and rearing. The proposed action will permanently change the function of critical habitat within the work area to areas of migration and rearing only. That is, spawning habitat will likely not be available within the 225 linear feet of roughened channel.

As addressed previously in the Environmental Baseline, available spawning habitat within the proposed work area (which will ultimately be converted to migration and rearing habitat) is extremely limited, of low value, and degraded with large amounts of accumulated silt and fine sediment covering approximately 90 percent of the work area. Water clarity is extremely low throughout the work area, with low quality spawning areas covering likely less than five percent of the work area. It is extremely unlikely that steelhead are spawning in the work area, thus it is highly likely that steelhead are spawning elsewhere, where clean spawning gravels are currently available in addition to clear, flowing water, which increase the value of spawning habitat (NMFS personal observations). Habitat upstream of the water pipeline, beyond the work area but within the action area, provides suitable habitat for spawning activities and, based on the description of the proposed action, changes to upstream suitable habitat are expected to be insignificant after the proposed action is complete.

The proposed design will result in a change within the work area from primarily pool habitat to primarily riffle habitat, where the primary function is migratory passage for adult and juvenile steelhead. NMFS believes the secondary function of the passage design within the work area is to: (1) introduce habitat complexity within this portion of the stream by incorporating in-stream vegetation (live stake bundles and fabric-wrapped soil pockets), and (2) provide rearing and resting areas by incorporating pool habitat for steelhead.

Table 4. Current and future (after roughened channel is constructed as part of the proposed action) spatial distribution of habitat types both within the work area and throughout the action area. Estimated percentages and utility* ratings are based on NMFS' previous knowledge of

steelhead activity, expectation of proposed design function, and information on current habitat distribution during April 25, 2012 site visit.

	Function	Structure	Current Spatial Extent	Utility Rating	Information Considered for Rating
Work Area	Spawning	silty gravel	5%	extremely low	Environmental
	Rearing	pool habitat	90%	high	Baseline
	Migration	limited corridor	5%	medium	(EB)
	Function	**Structure**	**Future Spatial Extent**	**Expected Utility Rating**	
	Spawning	limited source for adequate-sized gravel	0%	low	EB
	Rearing	two designed pools	35%	medium	Proposed Action
	Migration	partial fish passage barrier eliminated	65%	high	Proposed Action
	Function	**Structure**	**Current Spatial Extent**	**Utility Rating**	**Information Considered for Rating**
Action Area	Spawning	clean gravels	20%	low (limited access)	EB
	Rearing	large pools	45%	medium (limited access)	EB
	Migration	limited corridor	35%	medium	Proposed Action
	Function	**Structure**	**Future Spatial Extent**	**Expected Utility Rating**	
	Spawning	all possible gravels	15%	high (access available)	EB
	Rearing	natural and designed pools	40%	high (upstream of water pipeline)	Hydraulic Design
	Migration	passage corridor to Lopez Dam	45%	high (access available)	Hydraulic Design

*Utility ratings generated from expected level of use by steelhead present in the listed areas given available habitat.

2. Hydraulic Design Approach

The proposed action is a hydraulic design which considers swimming ability and behavior of steelhead. The proposed design incorporates 6-inch weir drop heights, two resting pools, and relatively low gradient riffles to reduce velocities and shear stresses. The hydraulic design approach is based on the premise that a structure with appropriate hydraulic conditions will allow target species to swim through it (*Fish Passage Design and Implementation*, California Salmonid Stream Habitat Restoration Manual, XII-15, 2009). Specifically, the roughened channel (also termed chute and pool design), in this instance, is providing profile control in conjunction with an existing water pipeline crossing and passage over a low-head drop structure (perched encasement of the water pipeline). Below is an excerpt from *Fish Passage Design and Implementation* (2009) on roughened channels:

> *Roughened channels, sometimes referred to as nature-like fishways, are constructed channel reaches stabilized with an immobile framework of large rock mixed with smaller material. Roughened channels provide fish passage by controlling the channel profile and adding roughness and structure to it. By design, they create hydraulic diversity that emulates conditions found in steeper or confined natural channels. Unlike individual rock weirs used to control the channel profile, the bed framework forming a roughened channel creates a continuous stable channel structure that is able to flex and move slightly while continuing to function as intended. Unlike stream simulation, a roughened channel is designed with an immobile bed and is not necessarily based on a reference reach in the same channel. Roughened channels are designed using the hydraulic approach (page XII-57).*

The expected effects to the PCEs of designated critical habitat associated with the hydraulic approach design include the temporary loss of juvenile steelhead rearing sites during

construction, short-term disturbance of the streambed and banks, and short-term increases of turbidity in the action area. The proposed action and incorporated design elements that will avoid exacerbating future erosion at this site include fabric-wrapped soil pockets planted with native vegetation, biodegradable erosion control fabric placed with ESM, and the incorporation of live stake bundles. The soil pockets and live stake bundles have not been used in previous projects in San Luis Obispo County, so effective monitoring of growth and function will be critical to ensure proper functioning success of these experimental measures. NMFS' determined the proposed action includes measures to avoid adverse modification of critical habitat within the action area and will not appreciably reduce the value of all designated critical habitat for the SCCC steelhead DPS as a whole.

Although hydraulic approach designs have an element of uncertainty in terms of achieving expected results in the field setting, the applicant has proposed to monitor the work area and to ensure proper function of instream structures and newly planted vegetation. Lopez Dam continually alters both the hydrology and sediment continuity for the project reach, which has significant implications for achieving a properly functioning design, however the proposed action includes design elements which likely provide for fish passage despite the current hydrology and sedimentation rates. As a result from these alterations due to the construction of Lopez Dam, an incised channel formed in which larger sediment particles are stored in the dam and no longer pass downstream. Therefore, it remains crucial that any grade control and fish passage structures (e.g. rock weirs/bands, riffles, etc.) used to provide fish passage be well sealed and designed to operate effectively in a sediment 'starved' stream reach and prevent subsurface flows (NMFS' Habitat Conservation Division Memo 2012). The applicant proposed methods to ensure the ESM is properly sealed and address the sediment starved issue (San Luis Obispo County 2012). Depending on the design specifications, soft channel bed material might subject rock weirs/sills to additional settling (on soft material); extra care in initial placement is needed, and future maintenance[21] might be necessary based on the applicant's commitment to adhere to the design protocols. The applicant proposes one-footer rocks below weirs to ensure stability and minimize any potential settling of the weirs. Additionally, the applicant has specified placement procedure for both weirs and sills in such a way to minimize any potentially settling within the streambed (San Luis Obispo County 2012).

Placing ESM over the generally fine-grained native soil may result in unfavorable hydraulic drops (i.e., greater than six inches) for steelhead passage, and to address this concern, the ESM will be designed as an evenly-graded mixture of material sizes to be placed at a thickness just under four feet. The evenly-graded ESM mixture placed as a thick, continuous layer will provide similar functionality and characteristics of a filter blanket[22] (Zacharia 2012). The transition from ESM into the natural finer bed and bank materials is one potential source of flanking until vegetation on the banks is reestablished. The downstream segment of the roughened channel transitions from 2.5% to 1.7% prior to conforming to existing grade. The 1.7% section is approximately 17 feet long and will allow for some energy dissipation prior to discharge to native materials. Additionally, the applicant expects dense riparian vegetation to quickly populate the area and further assist with the transition (Zacharia 2012). Therefore,

[21] This may include replacing smaller material that has washed out from any ESM or resetting weir inverts.
[22] CDFG (2009) Chapter XII (pg 76) suggests that a granular filter blanket or geotextile fabric may need to be placed under the ESM, particularly if the D15 of the ESM is more than five times the D85 of the native material.

NMFS determined the design components and measures to avoid the potential for settling of instream structures will promote the intended function of the roughened channel, thus present PCEs of critical habitat within the work area will not be adversely modified.

NMFS considered the design approach and associated components given the applicant's decision to protect the water pipeline by creating a roughened channel. The net benefit of the proposed action to PCEs[23] of critical habitat (freshwater rearing sites and migration corridors only) based on the design elements, minimization measures, and proposed implementation is listed below:

- Creation of habitat pools that provide calm water refuges within the roughened channel;
- Upon completion of the proposed action, the ESM will provide diverse flow paths for steelhead fry, juveniles, and adults during both winter and summer;
- The proposed action will not exacerbate scour around the existing concrete abutments at Rodriguez Bridge;
- Avoidance of significant head cutting[24] upstream of the pipeline encasement by maintaining the existing grade control within AGC;
- Elimination of a partial fish passage barrier at the water pipeline encasement by altering streambed elevation downstream via a roughened channel; and
- Introduction of habitat complexity and available in-stream cover for refuge from potential predators through placement of in-stream log structure downstream of the water pipeline that can be used by steelhead at multiple life stages.

Considering the expected improvements to raise the current environmental baseline, NMFS does not anticipate the available critical habitat PCEs within the action area to be adversely affected in the short or long term by the proposed action. Permanent change (eliminating limited, poor quality areas where steelhead spawning activities are extremely unlikely) to critical habitat within the work area will result from the proposed action; however, for the reasons stated herein, this will not appreciably reduce the value of spawning PCE within the action area as described above (Table 4). Based on the level of impact and length of the impact within the work area, when compared to the life cycle of steelhead and associated behaviors during spawning (adults) and rearing (juveniles), permanent changes are not expected to affect the fitness of individual steelhead and therefore, NMFS believes the permanent change will not result in adverse modification to critical habitat.

NMFS expects the value of velocity shelters for juvenile steelhead within the project reach to become fully apparent once installation of instream structures (log-boulder structure) and associated vegetative cover (soil pockets and live stake bundles) are functioning properly as expected and have fully developed. NMFS estimates full development of instream vegetation will take approximately six months to one year. During the development phase of these instream structures, suitable downstream pool habitat is available for resting and rearing juvenile steelhead and is likely to be used during the work window when habitat within the work area is

[23] PCEs considered essential for the conservation of the South-Central California Steelhead DPS are those sites and habitat components that support one or more life stages and contain physical or biological features essential to survival, growth, and reproduction. See 50 CFR 424.12b and 226.211 for a complete description of PCEs.
[24] This head cutting could potentially extent all the way to Lopez Dam (Utilities Division Department of Public Works 2012).

not accessible. Based on the habitat conditions within the action area and the multiple pools available both downstream and upstream of the work area, NMFS does not believe there will be overcrowding of juvenile steelhead, which can lead to increased competition for food resources between juvenile steelhead. Thus, NMFS determined the development phase will not significantly affect the fitness of individual steelhead, nor will it adversely modify available PCEs downstream and upstream of the work area.

3. Vegetation and Sediment Removal During Grading Activities

Vegetation removal will be extensive throughout the work area (access areas along the stream bank), within streambed habitat near the location of the second proposed pool (three willows removed), and along the project reach to place sills up to the 10-year water surface elevation (vegetative grubbing). Vegetative grubbing[25] (clearing) will occur within the project reach[26] in order to place the sills, which extend up to the 10-year water surface elevation. Depending on the specific features of a proposed action, this activity may temporarily alter channel stability, which in this case would negatively impact the anticipated function of the sills along the right bank terrace (looking downstream) by increasing the risk of flanking (personal communications, Marcin Whitman, California Department of Fish and Game). Vegetation will be removed only to the extent necessary to perform the work (Zacharia 2012). Additionally, the project footprint has been adjusted at numerous locations around the perimeter to avoid mature vegetation (see Appendix E, site plan C2). In light of the various BMPs and minimization measures to be employed, the cobble/gravel blanket and the treatment of disturbed slopes with biodegradable slope stabilization fabric, NMFS does not expect channel instability or improper function of the sills along the right bank as designed.

Riparian zones provide hydraulic diversity and structural complexity to the stream channel, buffer runoff energy from storm events, moderate water temperatures through shading, protect water quality, and provide a source of food and nutrients. NMFS expects there to be localized short-term adverse effects with the removal of vegetation including temporary (approximately one year) loss of shade within the work area, resulting in the possibility of increased water temperatures within the work area. However, as described previously, there are adequate areas of cover, where juvenile steelhead overcrowding is not expected by NMFS, downstream of the work area. Juvenile steelhead will likely be able to avoid areas where water temperature may be elevated and avoid predation (i.e. areas with less cover during the vegetation development phase), which, considering the entire life cycle of steelhead, will not affect the individual fitness of steelhead. NMFS believes the HMMP and the proposed pool structures within the roughened channel will avoid sustained adverse effects to critical habitat within the work area. NMFS expects decreased shade within the work area to last approximately one year. The mature vegetation within the action area will provide alternative areas of shade for rearing juveniles or resting adults while new vegetation develops within the work area. Therefore, NMFS does not expect decreased shade to result in take of threatened steelhead or adverse modification of critical habitat within the action area. Specifically in terms of habitat complexity, pool structures

[25] Grubbing shall consist of the removal of all stumps, roots, buried logs, old piling, old paving, concrete, abandoned utilities, timbers, fencing, and other objectionable matter encountered within the specified excavations (San Luis Obispo County 2012).
[26] Existing vegetation shall be protected to the extent feasible (San Luis Obispo County 2012).

in streams provide refuge from predators and high-flow events for juvenile salmon especially steelhead that are known to rear for extended periods in freshwater. Removal of riparian and aquatic vegetation and removal of sediment and debris from the stream channel will temporarily alter channel morphology and hydraulic conditions that support fish movement. General effects of removing sand and gravel as well as vegetation from a bank are below (Table 5). However, the applicant proposes several features that are desirable for fish passage/movement: using natural materials (with the exception of the exposed concrete pipeline) to create nature-like fish passage conditions; 6-inch weir drop heights, two resting pools, relatively low gradient riffles to reduce velocities and shear stresses; a log-habitat feature; and soil pockets to provide vegetative habitat diversity and cover (NMFS' Habitat Conservation Division Memo 2012).

Table 5. Summary of expected effects of instream sediment removal, and implications for salmonid habitat (source: NMFS 2004).

Element of Instream Sediment Removal	Physical Effect	Possible Consequence for Salmonid Habitat
Removal of sand and gravel from a location or from a limited reach.	Propogates stream degradation both upstream and downstream from removal site.	Loss or reduction in quality of pool and riffle habitats.
	Scour of upstream riffles.	Lower success of spawning redds.
	Reduced pool areas.	Loss of spawning and rearing habitat.
	Bed surface armoring.	Lower quality of spawning and rearing habitat; changes to invertebrate community.
	Scour or burial of armor layer.	
	Surface caking or pore clogging.	
Removal of vegetation and woody debris from bar and bank.	Reduce shade.	Increase water temperature in inland, narrow rivers.
	Decrease channel structure from wood.	Possibly reduce cover; reduce number and depth of pools; reduce area of spawning gravel; limit channel stability.
	Decrease drop-in food, nutrient inputs.	Decrease stream productivity.

NMFS anticipates the temporary and permanent activities associated with the proposed action will not result in sustained adverse effects to critical habitat or steelhead population recovery because (1) the adverse effects of decreased shade and expected increased water temperature are temporary and will be restored once revegetated areas have fully developed while shaded habitat is available both downstream and upstream of the work area; (2) the area of riparian habitat impacted (permanently, i.e., ESM and weirs,[27] and temporarily) represents a small fraction of the total area of riparian habitat in the action area for current steelhead activities of rearing and migration and other habitat areas for spawning and rearing activities will be accessible via a roughened channel; and (3) the applicant will employ various BMPs and minimization measures (Environmental Programs Division, Department of Public Works 2012) to ensure channel stability is maintained. Additionally, areas within the channel that may be disturbed outside of the proposed ESM will receive a cobble/gravel blanket and disturbed slopes will be treated with biodegradable slope stabilization fabric (Zacharia 2012).

[27] The placement of the ESM and boulder weirs is considered by NMFS a permanent impact to the streambed as it is intended to stay within the streambed to protect the existing water pipeline.

VII. CUMULATIVE EFFECTS

Cumulative effects include effects of future State, local or private actions (hereafter *future actions*) that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the project action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA, as amended.

The cumulative effects provided in the applicant's biological assessment (Environmental Programs Division, Department of Public Works 2012) to NMFS generally included descriptions of the Arroyo Grande Creek Channel Waterways Management Program (Program) and the Arroyo Grande Creek Habitat Conservation Plan (HCP). The Program is an action that NMFS considers to be outside of the determined action area for this consultation on the proposed action near Rodriguez Bridge (reference Appendix A for the extent of the determined action area by NMFS). Although the applicant included the HCP by reference, it is not finalized and is not reasonably certain to occur; therefore, NMFS was aware of but did not rely on the draft HCP in reaching final determinations for this opinion. .

VIII. INTEGRATION AND SYSTHESIS OF EFFECTS

This section integrates the current conditions described in the Environmental Baseline with the effects of the proposed action and the cumulative effects of future actions. The purpose of this synthesis is to develop an understanding of the likely short-term and long-term responses of listed species to the proposed action. NMFS also considers the effects analysis of the proposed action to the species as a whole and to the entire designated critical habitat for SCCC threatened steelhead.

The presence of steelhead is expected considering the available habitat within the action area; exposure risk to direct and indirect effects of relocation, transfer, and dewatering activities is likely high. NMFS also considered the hydrologic classification of AGC as a semi-perennial creek (regulated flows by Lopez Dam) and past relocation efforts in other watersheds during similar activities to the proposed action (i.e., dewatering). Where increased turbidity levels are expected to occur, minimization measures include specific project design considerations, such as dewatering and implementation of BMPs, to decrease the risk of take through the duration of project construction. NMFS expects the overall juvenile steelhead encounter rate to be elevated based on the following: (1) the work window for the proposed action including possible delays and, (2) the existing habitat conditions including extensive instream cover for rearing juveniles and pool habitat within the action area. NMFS concludes that capture during relocation and dewatering activities is likely to equal 50 or fewer steelhead juveniles, with a total of one lethal or injurious take out of the 50, thus the risk of mortality to any encountered steelhead is low. Any juvenile steelhead present in the action area during the construction window likely make up a small proportion of the SCCC steelhead DPS. It is unlikely that potential lethal take of one juvenile steelhead resulting from dewatering activities, relocation efforts, and stranding events will impact future adult returns of steelhead in Arroyo Grande Creek or the entire SCCC steelhead DPS range.

The hydraulic design approach includes several features that are desirable for fish passage: using natural materials to create nature-like fish passage conditions; 6-inch weir drop heights, two resting pools, relatively low gradient riffles to reduce velocities and shear stress; a log-habitat feature; and soil pockets to provide vegetative habitat diversity and cover (NMFS' Habitat Conservation Memo 2012). Based on the hydraulic design of the roughened channel, the fish passage design should not delay migrating steelhead or result in the harm, injury, or death of listed species. However, this approach is experimental[28]; the applicant, as proposed, must observe and ensure proper function of the structure as designed. NMFS considers the important points to include, but are not limited to, the following: (1) making sure flow conditions are passable from just upstream of the pipeline encasement downstream to the hydraulic drop of the first (upstream) weir, (2) the perching of and/or creation of undesirable broad-crested weir conditions over any of the rock weirs and rock bands, (3) undesirable settling due to either utilizing only one row of footer rocks in the rock weirs/bands and/or the softer/finer bed material present within the project reach, (4) the stability, performance, and establishment of vegetation within the soil pockets in order to provide effective vegetative cover, (5) making sure that depth and velocity values over the weirs and riffles reflect predicted computations, and (6) making sure the weirs and riffles are well sealed such that flows do not go subsurface and/or flow does not go through the weirs and not backwater/create the pools as expected. [29]

The proposed action will ultimately change the current function of designated critical habitat within the work area. The proposed design (see site plans in Appendix E) will result in a change from pool habitat to primarily riffle habitat, where the primary function is to allow migratory passage for adult and juvenile steelhead. One the other hand, the proposed action will introduce habitat complexity within this portion of the stream by incorporating in-stream vegetation (live stake bundles and fabric-wrapped soil pockets) and provide rearing and resting areas by creating pool habitat for steelhead. Considering the permanent nature of a roughened channel, NMFS also considered climatic trends and future long-term projections in precipitation within the action area, where a decrease in mean annual precipitation (Snyder and Sloan 2005) may impact regulated flows downstream of Lopez Dam. However, on a shorter timescale, when considering the El Niño/La Niña weather cycles, the SCCC steelhead DPS can experience highly variable rainfall. Considering the flow regime within this watershed, variable rainfall should not significantly influence the continued function of the designed roughened channel. Finally, NMFS believes the effects of the proposed action will not reduce the value of the SCCC steelhead DPS critical habitat designation as a whole, and NMFS believes the roughened channel, as designed, will provide fish passage over the water pipeline to upper portions of the action area.

IX. CONCLUSION

After reviewing the best scientific and commercial data available, the recent status of the species, the environmental baseline, and expected effects of the streambed alteration activities, including placement of ESM and weir/sill boulders, it is NMFS' biological opinion that the proposed

[28] NMFS views this approach as experimental given the lack of long-term data on how roughened channels perform over time.

[29] Pursuant to NMFS's conservation recommendations, this should be elaborated upon in a well-designed maintenance and monitoring plan.

action is not likely to jeopardize the continued existence of the threatened south-central California steelhead DPS, and is not likely to destroy or adversely modify designated critical habitat.

X. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

A. Amount or Extent of Take

The installation and removal of cofferdams and fish relocation during the proposed action is expected to result in incidental take of threatened south-central California steelhead. The number of ESA-listed steelhead that may be incidentally taken during proposed activities is expected to be moderate. Steelhead present during the construction window or stranded in residual wetted areas as a result of streamflow division and workspace dewatering will need to be relocated to a suitable instream location immediately downstream of the workspace. NMFS assessed the anticipated amount of take based on the following: (1) past relocation trends during similar dewatering activities elsewhere in southern watersheds within the endangered Southern California steelhead DPS and, (2) specific proposed action information (*i.e.*, action area and timeline). Therefore, take is quantified as: capture of no more than 50 steelhead juveniles. NMFS anticipates out of the potential steelhead encountered during project activities, no more than 1 juvenile steelhead will be killed or injured during relocation and dewatering efforts. If more than 50 juvenile steelhead are captured for relocation, or more than 1 juvenile steelhead is killed or injured during relocation or dewatering activities, incidental take will have been exceeded and consultation will need to be reinitiated.

B. Effect of the Take

In the accompanying opinion, NMFS determined this level of anticipated take is not likely to result in jeopardy to the species.

C. Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize the take of SCCC steelhead. The results of the effects analysis provide the basis for the following reasonable and prudent measures:

1. Undertake measures to ensure that harm and mortality to SCCC steelhead resulting from dewatering activities, water diversion construction, and fish relocation is minimized;
2. Undertake measures to maintain water quality at pre-construction levels to avoid or minimize harm to steelhead; and
3. Prepare and submit reports to document effects of construction and relocation activities, efficacy of the impact minimization and habitat enhancement measures and the overall performance of the fish passage.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps, its permittee, and their contractors or designees must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. The following terms and conditions implement reasonable and prudent measure No. 1.

   A. The applicant shall provide a list of all BMPs and the terms and conditions of this biological opinion to their employees and contractors that are involved with implementation of the proposed action, and ensure these terms and conditions are followed for the duration of the project. The applicant shall retain a biologist to monitor the work area during placement and removal of cofferdams and fish block nets and to monitor during construction within the channel to ensure that any adverse effects to steelhead are minimized. Project activities shall only be conducted when steelhead are least likely to be present or affected by the proposed action (June 1 - November 30). The project biologist shall have a high level of expertise in the areas of salmonid biology and ecology, biological monitoring, and handling, collecting, and relocating salmonid species.

   B. The *Surface Water Diversion and Steelhead Relocation Plan*, including a construction/work schedule, diagrams, field pictures, and material list shall be sent to NMFS for review 12 working days before construction begins via email (Brittany.Struck@noaa.gov). NMFS will review the plan and recommend revisions to the plan, if necessary. The plan shall include equipment proposed to be used for capturing and relocating fish, when those actions will take place, how will fish be transported, and a description of the habitat where fish will be relocated. The applicant must receive NMFS agreement for the final *Surface Water Diversion and Steelhead Relocation Plan* prior to implementing the *Surface Water Diversion and Steelhead Relocation Plan*.

   C. The applicant-retained biologist shall be on site during all dewatering events to capture, handle, and safely relocate juvenile steelhead. The biologist shall note and

document the number of steelhead collected/observed in the action area, the number of steelhead relocated, the date and time of collection and relocation, and a physical description of the habitat where steelhead were relocated. Juvenile steelhead shall be relocated to a suitable instream location immediately downstream of the workspace. One or more of the following preferred methods shall be used to capture steelhead: dip net, seine, throw net, minnow trap, or by hand. Electrofishing is prohibited. The biologist shall report the above information to NMFS (Brittany Struck, 501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802), including information on the actual dewatered areas - dimensions of area dewatered (width, length, average depth), as directed in Reasonable and Prudent Measure No.5.

D. SCCC steelhead shall be handled with extreme care and kept in water to the maximum extent possible during relocation activities. All captured steelhead shall be kept in cool, shaded, aerated water protected from excessive noise, jostling, or overcrowding any time they are not in the stream until released.

E. The applicant shall minimize mobilization of bank sediment into the creek from access roads and construction activities. Specifically, any sandbags to be used during the construction of the coffer dam for the water diversion shall only be filled with clean/washed sands or gravels. All fill material for cofferdams or access ramps shall be completely removed from the channel by November 30. All sediment-laden runoff generated by the jetting activities on the rock surface (ESM) shall be pumped to a settling tank to reduce elevated turbidity levels relative to background turbidity levels (see Term and Condition B described above).

2. The following terms and conditions implement reasonable and prudent measure No. 2.

A. The applicant shall visually monitor turbidity levels beyond the work area boundaries and downstream when instream construction activities occur. Turbidity monitoring equipment shall be available on site, and turbidity shall be measured any time visual monitoring indicates any increase of turbidity outside of the work area. NMFS shall be notified immediately by the contractor if at any time the turbidity monitoring indicates exposure of steelhead to levels of turbidity outside of the described work area of more than a 20 NTU increase above background levels. The applicant-retained biologist shall monitor in-channel activities and performance of sediment control or detention devices for the purpose of identifying and reconciling any condition that could result in take of steelhead. When turbidity levels below the work area rise above 20 percent greater than background turbidity levels, the biologists shall halt work activity to recommend measures for avoiding adverse effects to steelhead and critical habitat and ensure sediment control mechanisms are properly working. Turbidity measurements shall be documented, compiled into a report, and submitted to NMFS' Southern California Office (501 W. Ocean Blvd., Suite 4200, Attn: Brittany Struck, Long Beach, California 90802).

B. The applicant shall provide NMFS with a copy of the site specific *Sediment Control Plan* or applicable plan(s) such as *A Construction Period Erosion Prevention and*

Contingency Plan, which specify BMPs to control mobilization of sediment from the work area on Arroyo Grande Creek. The plan should provide minimization measures to the same extent as in the *California Salmonid Stream Habitat Restoration Manual* (DFG 2003, pg. 50-53). The plan shall be submitted no fewer than 30 days prior to implementing the proposed action (*i.e.*, on or before July 2 of the year to be implemented if beginning on August 1). If BMPs must be modified, or when additional BMPs are implemented, the submitted plan will be updated to reflect needed changes. Documents shall be submitted to NMFS' Southern California Office (501 W. Ocean Blvd., Suite 4200, Attn: Brittany Struck, Long Beach, California 90802) and emailed to Brittany.Struck@noaa.gov.

3. The following terms and conditions implements reasonable and prudent measure No. 3.

A. The Corps' permittee shall provide a written yearly report to NMFS by January 15 following completion of construction and for a period of eight years following construction completion. The report shall be submitted to NMFS Southern California Office (501 W. Ocean Blvd., Suite 4200, Attn: Brittany Struck, Long Beach, California 90802) as well as emailed to: Brittany.Struck@noaa.gov. The report shall contain, at a minimum, the following applicable (depending on year) information:

i. **Construction related activities** – The report shall include the dates construction began and was completed; color photographs taken before, during, and after the activity from photo reference points; a discussion of any unanticipated effects or unanticipated levels of effects on steelhead and their habitat, a description of any and all measures taken to minimize those unanticipated effects and a statement as to whether or not the unanticipated effects impacted threatened steelhead or designated critical habitat.

ii. **Fish Habitat** – The report shall document how the new habitat structures meet or exceed the expected benefits to steelhead rearing and migration habitat. The report will describe observed steelhead and other fish species use of the habitat structures and any observed inter-species interactions during peak juvenile migration and rearing periods. The report will detail any repair or re-vegetation necessary to maintain the structural integrity and fisheries habitat quality of the structures.

iii. **Revegetation** – The report shall include a description of the locations planted or seeded, the area (m^2) revegetated, a plant palette, planting or seeding methods, the efforts taken to ensure success of new plantings, performance or success criteria, and pre- and post-planting color photographs of the revegetated areas.

iv. **Steelhead Relocation and Observations** – The report shall include a description of the location from which fish were removed and the release site including color photographs; the date and time of the relocation effort; a description of the equipment and methods used to collect, hold, and transport steelhead; the number of fish relocated; number of steelhead injured or killed; number of steelhead observed but were not collected for relocation; a description of any problems which may have arisen during

the capture and relocation activities and a statement as to whether or not the activities had any unforeseen effects; and field observations of steelhead during required monitoring and measurement efforts after completion of roughened channel.

B. Dead steelhead shall be collected and placed in an appropriately sized whirl-pack or zip-lock bag, labeled with the date and time of collection, weight, fork length, location of capture, condition of the individual, suspected cause of injury or death, and then frozen as soon as possible. If any steelhead are injured or fatally wounded, the applicant biologist will immediately notify NMFS (Brittany Struck, 562-432-3905). The purposes of the contact shall be to review the activities resulting in lethal take, to determine if additional protective measures are required, and to discuss handling procedures for injured or dead steelhead. If a steelhead mortality does occur, the project biologist shall coordinate with NMFS (Brittany Struck, 562-432-3905) to ship the carcass as soon as possible on dry ice through overnight express mail to NMFS (Brittany Struck, 501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802).

XII. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, or to develop information.

NMFS offers the following Conservation Recommendations for the Corps in order to develop additional information on the impacts of streambed stabilization and the sustained function of the roughened channel design within Arroyo Grande Creek for the SCCC steelhead DPS as a whole:

1.) The Corps should undertake a comprehensive inventory of any past streambed stabilization projects authorized throughout the County of San Luis Obispo, for the purpose of quantifying the amount of streambed which has been hardened with rock and concrete and lacking associated vegetation.
2.) The Corps should conduct an instream habitat survey downstream and upstream of the project reach to document, verify, and describe the current baseline conditions throughout the determined action area. This updated information would prove valuable to Federal, State, and local government involved in various projects within Arroyo Grande Creek Watershed (e.g., the draft Habitat Conservation Plan).
3.) Early coordination and productive communication between the Corps and NMFS will likely increase efficiency and productivity during future formal consultations within the County of San Luis Obispo and throughout the entire threatened SCCC steelhead DPS range. Specifically, timely contact from the Corps during the early stages of project design (the conceptual design stage of a proposed action for example) will provide opportunities for NMFS to engage and provide opportunities for the Corps to delivery project-related information and data to NMFS.

4.) The Corps and permit applicant should allow any NMFS employee(s), or any other person(s) designated by NMFS, to accompany field personnel to visit the work area during activities described in this opinion. The applicant should allow NMFS to visit the work area unaccompanied by the applicant to observe flow conditions during storm events if the applicant is unable to make observations during such times.
5.) To account and reconcile uncertainties owing to the fish-passage design element of the proposed action, the applicant should develop a *Maintenance Plan*. Generally, the purpose of the plan is to describe the proposed methods of repair and maintenance of the roughened channel and measures to create adequate stability and achieve elevations as described in the 100% draft design plans. To this end, the plan should include the proposed methods for identifying and reconciling (1) any potential settling of the first rock weir downstream of the water pipeline encasement and all rock weirs/bands within the project reach, (2) failure to establish water depth of six inches (backwatered) over the pipeline encasement, (3) perching of and/or creation of undesirable broad-crested weir conditions over any of the rock weirs and rock bands, (4) depth and velocity values over the weirs and riffles that do not reflect predicted computations, (5) flows going subsurface or through the weirs preventing the pools to form as expected, (6) lack of effective vegetation cover as expected from live stake bundles and vegetation on fabric-wrapped soil pockets.
6.) For a period of eight years after construction of the proposed action is complete, the applicant or the contractor should visually monitor the action area and work area to document riparian zone development and habitat (fabric-wrapped soil pockets and stake bundles) during peak juvenile migration and summer rearing periods. If large rock elements of the structures become dislodged or stripped of associated vegetation, measures should be taken in order to revegetated and/or repair the structures.
7.) The applicant should undertake measures to ensure a performance criterion of 80-percent survival of planted trees and plants for a period of five consecutive years, and an additional three years without assistance.
8.) The applicant should measure pool depths below weirs, measure velocities and depths in weir notches, measure depth and velocity at several locations across a cross-section of each riffle at a variety of discharges, particularly at lower flows. The applicant should take elevation data at cross-sections profiles of each weir and each riffle section such as to monitor any key changes in elevation (e.g. thalweg, locations of breaks in slope). Drop heights as built at each boulder weir (low flow channel notches) should not exceed six inches (before any potential settling). Depth immediately below each weir should be at least two feet. For a period of eight years after project completion, all above field measurements should occur two separate times during the dry season (June 1 to November 30), after each spill event, once four years post construction, and after all major storm events (greater than the 5-year event). The monitoring report should also summarize the number and maximum discharge associated with significant storm events that have occurred during each wet year. The ESM material should be photographed to assess how it is changing over time.
9.) The applicant should ensure adequate flow conditions over the pipeline encasement. Adequate flow is defined as when the entire pipeline encasement area and the entire ESM area between the encasement and first downstream weir boulder (and backing) is always backwatered and passable (at least six inches in depth during juvenile passage flows and

at least one-foot deep during adult passage flows) by juvenile and adult steelhead. The concrete encasement protection (ESM plus the weir boulder) as shown in design plans should not operate as a broad-crested weir (e.g. have shallow, fast, supercritical flows). If this occurs, the applicant should take measures to repair the instream features to achieve adequate flow conditions over these features. To document adequate flow conditions as described above and to report fish passage conditions over the pipeline and first weir annually after the eight-year monitoring requirement, the applicant should provide colored photographs of the concrete encasement protection once a year for every year the water pipeline is present within the Arroyo Grande Creek streambed.

10.) The applicant should make certain that the as built weir and rock band elevations match the design elevations and that any settling of one or more of the constructed structures does not create hydraulic drops of more than nine inches at any time in the future. NMFS is including this term and condition because one-footer rock may not provide enough stability to prevent movement of the crest weir boulder and the fine-grained composition of the existing bed and bank materials, which are susceptible to settling. If movement occurs, the applicant should take measures to create adequate stability while maintaining elevations as described in the final design plans. Monitoring should be conducted to detect any movement of the weir crest/tail pool elevations within the work area.

11.) The applicant should seal all placed ESM and weirs within the streambed to ensure water flow does not filtrate through this material, which would compromise the hydraulic function of the proposed design for fish passage. There should be no void spaces within the mix of the ESM used or within boulder/sill configurations. The applicant should monitor for slides or sliding in any part of the engineered fill during its construction, or during the eight year period after completion of the project. The applicant should establish cross sections on each of the riffles to monitor and validate depths as they relate to the Manning's "n" equations and depth-based roughness calculations used to determine roughness coefficient of the roughened channel.

XI. REINITIATION NOTICE

This concludes formal consultation for the proposed action of streambed stabilization in Arroyo Grande Creek to protect the exposed water pipeline crossing in San Luis Obispo County, California. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

XII. REFERENCES CITED

Alley, D.W., D.W. Alley & Associates. 1997. Assessment of Juvenile Steelhead Habitat and Fish Densities in Arroyo Grande, 1996.

Becker, G.S. and I.J. Reining. 2008. Distribution and current status of steelhead/rainbow trout (*Oncorhynchus mykiss*) south of the Golden Gate, California. Cartography by D.A. Asbury. Center for Ecosystem Management and Restoration. Oakland, CA.

Behnke, R. J. 1992. Native trout of western North America. *American Fisheries Society Monograph* 6, Bethesda, Maryland.

Bell, J. L., L. C. Sloan, and M. A. Snyder. 2004. Regional changes in extreme climatic events: A future climate scenario. *Journal of Climate* 17:81-87.

Berg, L., and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. *Canadian Journal of Fisheries and Aquatic Sciences*. Vol. 42:1410-1417.

Boughton, D. A., P. B. Adams, E. Anderson, C. Fusaro, E. Keller, E. Kelley, L. Lentsch, J. Nielsen, K. Perry, H. Regan, J. Smith, C. Swift, L. Thompson, and F. Watson. 2006. Steelhead of the south-central/southern California coast: population characterization for recovery planning. *NOAA Tech. Memo*. NMFS-SWFSC-394.

Boughton, D. A., P. B. Adams, E. Anderson, C. Fusaro, E. Keller, E. Kelley, L. Lentsch, J. Nielsen, K. Perry, H. Regan, J. Smith, C. Swift, L. Thompson, and F. Watson. 2007. Viability Criteria for Steelhead of the South-Central and Southern California Coast. *NOAA Tech. Memo.* NMFS-SWFSC-407.

Burgner, R. L., J. T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito. 1992. Distribution and origins of steelhead trout (Oncorhynchus mykiss) in offshore waters of the north Pacific Ocean. *International North Pacific Fisheries Commision Bulletin*. Number 51, 92 pp.

Busby, P.J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. *NOAA Tech. Memo*. NMFS-NWFSC-27, 261p.

California Conservation Corps. 2004. Stream Inventory Report, Arroyo Grande, Draft. Report by Bobby Jo Close and Smith Stacy.

California Department of Fish and Game. 2009. Fish Passage Design and Implementation, California Salmonid Stream Habitat Restoration Manual, XII-15 – 57.

Cayan, D. R., S. A. Kammerdiener, M. D. Dettinger, J. M. Caprio, and D. H. Peterson. 2001. Changes in the Onset of Spring in the Western United States. *Bulletin of the American Meteorological Society*. Vol. 82, No. 3: 399- 415 (March).

Close, B. and S. Smith. 2004. Stream inventory report: Arroyo Grande Creek, Summer 2004. Prep. for Central Coast Salmon Enhancement, Arroyo Grande, CA. 37 pp., plus appendices.

Cooper, A.C. 1965. The effects of transported stream sediments on the survival of sockeye and pink salmon eggs and alevin. Publ. no. 18. *International Pacific Salmon Fisheries Commission*; 71 p.

Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. *N. Am. J. Fish. Man*. 5:330-339.

Daykin, P. N. 1965. Application of mass transfer theory to the problem of respiration of fish eggs. *Journal of the Fisheries Research Board of Canada*. 22(1): 159-171.

Department of Fish and Game. 1960. Arroyo Grande Stream Survey, May 12, 17. Report by Max R. Schreiber.

Department of Fish and Game. 1961. Lopez Project.

Department of Parks and Recreation (DPR). 2007. Aquatic Survey, Arroyo Grande Creek and Lagoon. Report by Douglas Rischbieter, et al.

Dvorsky, J. 2010. Arroyo Grande Creek Channel Waterway Management Program. Final Report. October. Waterways Consulting, Inc. 55 p.

Eaton, J.G., and R.M. Scheller. 1996. Effects of Climate Warming on Fish Thermal Habitat in Streams of the United States. *Limnology and Oceanography*, Vol. 41, No. 5 (July): 1109-1115.

Environmental Programs Division, Department of Public Works. 2012. Project Biological Assessment. *Rodriquez Road Waterline Crossing Grade Stabilization Project*, San Luis Obispo County Public Works Department.

EPA. 1992. *Framework for Ecological Risk Assessment*. Risk Assessment Forum. U.S. Environmental Protection Agency. Washington, D.C. 20460. EPA/630/R-92/001. February. http://rais.ornl.gov/documents/FRMWRK_ERA.PDF

EPA. 1998. *Guidelines for Ecological Risk Assessment*. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, D.C. EPA/630/R095/002F. April. http://www.epa.gov/raf/publications/pdfs/ECOTXTBX.PDF

Girman, D., and J. C. Garza. 2006. Population structure and ancestry of *O. mykiss* populations in South-Central California based on genetic analysis of microsatellite data. Final report of the National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, California, for the California Department of Fish and Game, Project No. P0350021 and Pacific States Marine Fisheries, Contract No. AWIP-S-1.

Good, T. P., R. S. Waples, P. Adams. 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. *NOAA Tech. Memo*. NMFS-NWFSC-66.

Groot, C. and L. Margolis. 1991. Pacific Salmon: Life Histories. UBC Press. The University of British Columbia. Vancouver, BC. ISBN: 0-7748-0359-2.

Habitat Conservation Plan (HCP), Final Draft: Arroyo Grande Creek and Environmental Assessment/Initial Study (EA/IS) for the Protection of Steelhead and California Red-legged Frogs. February 2004. County of San Luis Obispo, California.

Hayes, S. A., M. H. Bond, C. V. Hanson, E. V. Freund, J. J. Smith, E.C. Anderson, A. J. Ammann, and B. MacFarlane. 2008. Steelhead growth in a small central California watershed: upstream and estuarine rearing patterns. *Transactions of the American Fisheries Society*. Vol. 137:114–128.

Hubert, W. A. 1996. Passive capture techniques. B.R. Murphy and D.W. Willis, editors. Pages 157-192 in Fisheries Techniques, 2nd edition. *American Fisheries Society*. Bethesda, Maryland. 732 pages.

Hunt & Associates Biological Consulting Services. 2008. South-Central California Coast Steelhead Recovery Planning Area, Conservation Action Planning (CAP) Workbooks Threats Assessment. Pg. 1-87.

McElhany, P., M. H. Rucklelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionary significant units. *NOAA Tech. Memo*. NMFS-NWFSC-42.

McNeil, W. J., and W. H. Ahnell. 1964. Success of pink salmon spawning relative to size of spawning bed material. U.S. Fish and Wildlife Service Special Scientific Report Fisheries 469.

Miller, N. L., K.E. Bashford, and E. Strem. 2003. Potential Impacts of Climate Change on California Hydrology. *Journal of the American Water Resources Association*. August: 771-784.

Mitigated Negative Declaration and Notice of Determination. 2010. County of San Luis Obispo. Environmental Determination No. ED08-116. Project/Entitlement: Public Works – Arroyo Grande Creek at Rodriquez Road Grade Stabilization Project, 300369.

National Maine Fisheries Service. 2004. *Sediment Removal from Freshwater Salmonid Habitat: Guidelines to NOAA Fisheries Staff for the Evaluation of Sediment Removal Actions from California Streams*. NOAA Fisheries – Southwest Region. April 19, 2004. http://swr.nmfs.noaa.gov/hcd/policies/April19-2004.pdf

National Marine Fisheries Service. 2005a. *Endangered and Threatened Species; Designation of Critical Habitat for 12 Evolutionarily Significant Units of West Coast Salmon and Steelhead in Washington, Oregon, and Idaho; Final Rule*. Federal Register 70 (170): 52630 – 52858.

National Marine Fisheries Service. 2005b. *Endangered and threatened species: designated critical habitat for seven evolutionarily significant units of Pacific salmon and steelhead in California*. Federal Register 70 (170): 52488-52586.

National Marine Fisheries Service. 2006. *Endangered and threatened species: final listing determinations for 10 distinct population segments of west coast steelhead*. Federal Register 71 (3): 834-862.

National Marine Fisheries Service. 2007. Federal Recovery Outline for the Distinct Population Segment of South-Central California Coast Steelhead. Southwest Regional Office. September. Pg. 1-56.

National Marine Fisheries Service. 2012. Response Letter to Corps' Request for Formal Consultation. March 5. Southwest Region. Long Beach, CA. 90802. F/SWR/2012/00047

National Marine Fisheries Service. 2012. NOAA Memorandum. *Review of Arroyo Grande Creek Pipeline Project 100% Draft Designs*. May 22. David Crowder, Ph.D., Habitat Conservation Division.

NOAA Fisheries, Office of Protected Resources. 2011. *Steelhead Trout* (*Oncorhynchus mykiss*). Last updated on October 14, 2011. http://www.nmfs.noaa.gov/pr/species/fish/steelheadtrout.htm

Northwest Hydraulic Consultants Inc. 2009. Pipeline Crossing at Rodriguez Road, Arroyo Grande Creek, Streambed Stabilization Concept Memorandum, DRAFT for County review. (submitted electronically to NMFS on March 27, 2012).

PRBO Conservation Science. 2011. *Projected Effects of Climate Change in California: Ecoregional Summaries Emphasizing Consequences for Wildlife*. Version 1.0. February. 3820 Cypress Drive, Suite 11, Petaluma, CA 94954.

Quinn, T. P. 2005. The behavior and ecology of Pacific salmon and trout. *American Fisheries Society*, Bethesda, Maryland, and University and Washington Press, Seattle.

San Luis Obispo County Flood Control and Water Conservation District. 2012. *Technical Specifications for Rodriguez Bridge Waterline Crossing Fish Passage Improvements Project*, 90% Submittal. March 13. Emailed to NMFS on April 2, 2012.

Ruiz-Campos, G., and E. P. Pister. 1995. Distribution, habitat, and current status of the San Pedro Mártir rainbow trout, Oncorhynchus mykiss nelson (Evermann). *Bulletin of the Southern California Academy of Sciences*. Vol. 94: 131-148.

Shaw, E. A. and J. S. Richardson. 2001. Direct and indirect effects of sediment pulse duration on stream invertebrate assemblages and rainbow trout (*Oncorhynchus mykiss*) growth and survival. *Can. J. Fish. Aquat. Sci*. Vol. 58: 2213 – 2221.

Sneed, D., The San Luis Obispo Tribune. 2007. *Chemical gets into Arroyo Creek.*

Snyder, M. A., and L. C. Sloan. 2005. Transient future climate over the western United States using a regional climate model. Earth Interactions 9:Article No. 11.

Spina, A. 2007. Thermal ecology of juvenile steelhead in a warm-water environment. *Environ. Biol. Fish.* Vol. 80: pg. 23-34. DOI 10.1007/s10641-006-9103-7

Stetson Engineering, Inc. 2004. Draft Arroyo Grande HCP. Report by Hanson Environmental Inc. and Stetson Engineering Inc.

Swanson Hydrology & Geomorphology. 2004. Final Technical Report, *Arroyo Grande Creek Watershed Management Plan, Geomorphic and Hydrologic Conditions Assessment*, for Central Coast Salmon Enhancement, December 8.

Swanson Hydrology & Geomorphology. 2006. *Arroyo Grande Creek: Steelhead Distribution and Abundance Survey*. Prepared for Central Coast Salmon Enhancement in association with Hagar Environmental Science. December 21.

Terhune, L.D.B. 1958. The Mark VI Groundwater Standpipe for Measuring Seepage Through Salmon Spawning Gravel. *Canada Fisheries Research Board Journal*, 15:1027-1063.

Thomas R. Payne & Associates. 2004. *Distribution and Abundance of Steelhead in the San Luis Obispo Creek Watershed, California*. Utilities Department, City of San Luis Obispo, 879 Morro Street, San Luis Obispo, California 93401.

Thompson, L. C. and R. Larson. 2004. *Fish Habitat in Freshwater Streams*. University of California. Division of Agriculture and Natural Resources. Publication 8112. Farm Water Quality Planning. Reference Sheet 10.3

U.S. Department of the Interior, Bureau of Land Management. 1998. *Riparian Area Management: Process for Assessing Proper Functioning Conditions*. Don Prichard, Working Group Leader, Riparian-Wetland Coordinator. Service Center, CO. ftp://ftp.blm.gov/pub/nstc/techrefs/Final TR 1737-9.pdf

U.S. Department of the Interior, Bureau of Reclamation. 2006. *Erosion and Sedimentation Manual*. November. Technical Service Center. Sedimentation and River Hydraulics Group. Denver, CO. http://www.usbr.gov/pmts/sediment/kb/ErosionAndSedimentation/index.html

U.S. Department of Interior (Bureau of Reclamation). 2009. *End of Project Compliance Report for Quiota Creek Crossing 6*. Submitted by Cachuma Operation and Maintenance Board to the Bureau of Reclamation. April 28, 2009. Project Title: Quiota Creek Crossing 6 Bottomless-Arched Culvert. 15 pages.

U.S. Department of Interior (Bureau of Reclamation). 2009. *End of Project Compliance Report*

for El Jaro Creek San Julian Fish Ladder. Submitted by Cachuma Operation and Maintenance Board to the Bureau of Reclamation. April 28, 2009. Project Title: El Jaro Creek – Rancho San Julian Fish Ladder. 11 pages.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. *Endangered Species Act Consultation Handbook: Procedures for Conducting Section 7 Consultations and Conferences*. March 1998 Final.

U.S. Global Change Research Program (USGCRP). 2009. *Global Climate Change Impacts in the United States*. National Climate Assessment, Scientific Assessment Report. State of Knowledge Report of Global Climate Change Impacts in the U.S. Contact Dr. Fabien Laurier. http://globalchange.gov/publications/371

Utilities Division, Department of Public Works. 2012. *Information Needed for NMFS' Consultation for the Rodriquez Waterline Grade Stabilization Project*. (submitted electronically to NMFS on April 2). County of San Luis Obispo, California.

Utilities Division, Department of Public Works. 2012. Response Memorandum: *Rodriguez Waterline Crossing Grade Stabilization Project NMFS' Comments from 4.25.12 field visit* (submitted electronically to NMFS on April 26). County of San Luis Obispo, California.

Vaux, W.G. 1962. Interchange of stream and intragravel water in a salmon spawning riffle. US Fish Wild. Serv. Spec. Sci. Rep. Fish. No. 405. 11p.

Velagic, E. 1995. *Turbidity study: a literature review*. Prepared for Delta planning branch, California Department of Water resources by Centers for Water and Wildland Resources, University of California, Davis.

Waters, T. F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. *American Fisheries Society Monograph* 7.

Waterways Consulting, Inc. 2011. 50% Design Memorandum for the Rodriguez Crossing Fish Passage Improvements Project. (submitted electronically to NMFS on March 27, 2012).

Waterways Consulting, Inc. 2012. Rodriguez Bridge Waterline Crossing Fish Passage Improvement Project – Supplemental Fish Passage Calculation Results. May 7. 15p.

Waterways Consulting, Inc. 2012. Email communication to NMFS with subject line: *Rodriguez Bridge Waterline Crossing Fish Passage Improvement Project – Supplemental Fish Passage Calculations*. May 16. Author: Brent Zacharia, MS, PE, Senior Engineer.

Whitman, Marcin. 2012. Personal communications with California Department of Fish and Game.

Zimmerman, C. E., and G. H. Reeves. 2000. Population structure of sympatric anadromous and

nonanadromous *Oncorhynchus mykiss*: evidence from spawning surveys and otolith microchemistry. *Canadian Journal of Fisheries and Aquatic Sciences*. Vol. 57: 2152-2162.

Appendix A: Determined Action Area by NMFS
(Pipeline located ~ eight miles upstream of Highway 101)

Appendix B: Habitat Mitigation and Monitoring Plan, May 17, 2011, San Luis Obispo County Department of Public Works (excerpted from page 2).

Table 1: Mitigation Strategy

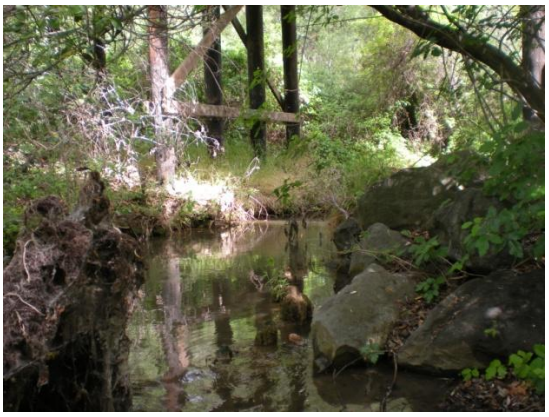
Impact	Mitigation	# and species
0.36 acre of temporary disturbance for equipment access	Replace at 2:1 ratio	0.72 acre: native hydroseed mix; mugwort, California sagebrush, California blackberry, and toyon (1- to 5-gallon)
Loss of 2 12" willows	Replace at 3:1 ratio	6 willow stakes
Loss of 1 14" willow	Replace at 3:1 ratio	3 willow stakes
Loss of 2 10" cottonwoods	Replace at 3:1 ratio	20 cottonwoods (1 gallon)
Loss of 1 24" willow	Replace at 10:1 ratio	10 willow stakes

Appendix C: Assortment of images from site visit, April 25, 2012.

Spawning gravel available upstream ~ 75 feet from the crossing.

Downstream of the pipeline crossing; present gravel covered in silt.

Present cover habitat available downstream of the waterline crossing.



Habitat features leading up to Rodriguez Bridge, just downstream of the waterline crossing.

Exposed concrete encasement (waterline crossing) with an ~ three foot drop.

Flat gradient just upstream of the concrete encasement, exposed; to the right of the main flow channel.

Upstream habitat at approximately 150 feet from the waterline crossing.

Appendix D: Designated Critical Habitat for the SCCC DPS

Designated critical habitat for the South-Central California Coast Steelhead DPS includes habitat areas within the following occupied watersheds (70 CFR 52488):

Pajaro River Hydrologic Unit (#3305): Watsonville Hydrologic Sub-area (#330510): Pajaro River, Browns Creek, Casserly Creek, Corralitos Creek, Gaffey Creek, Gamecock Canyon, Green Valley Creek, Ramsey Gulch, Redwood Canyon, Salsipuedes Creek, Shingle Mill Gulch. Santa Cruz Mountains Hydrologic Sub-area (#330520): Pajaro River, Bodfish Creek, Pescadero Creek, Tar Creek, Uvas Creek, Blackhawk Canyon, Little Arthur Creek, Pescadero Creek. South Santa Clara Valley Hydrologic Sub-area (#330530): San Benito River, Pajaro River, Arroyo Dos Picachos, Bodfish Creek, Carnadero Creek, Llagas Creek Miller Canal, Pacheco Creek, San Felipe Lake, Tar Creek, Tequisquita Slough, Uvas Creek. Pacheco-Santa Ana Creek Hydrologic Sub-area (#330540): Arroyo Dos Picachos, Pacheco Creek, Arroyo Dos Picachos, Cedar Creek, North Fork Pacheco Creek, Pacheco Creek, South Fork Pacheco Creek. San Benito River Hydrologic Sub-area (#330550): San Benito River, Bird Creek, Pescadero Creek, San Benito River, Sawmill Creek.

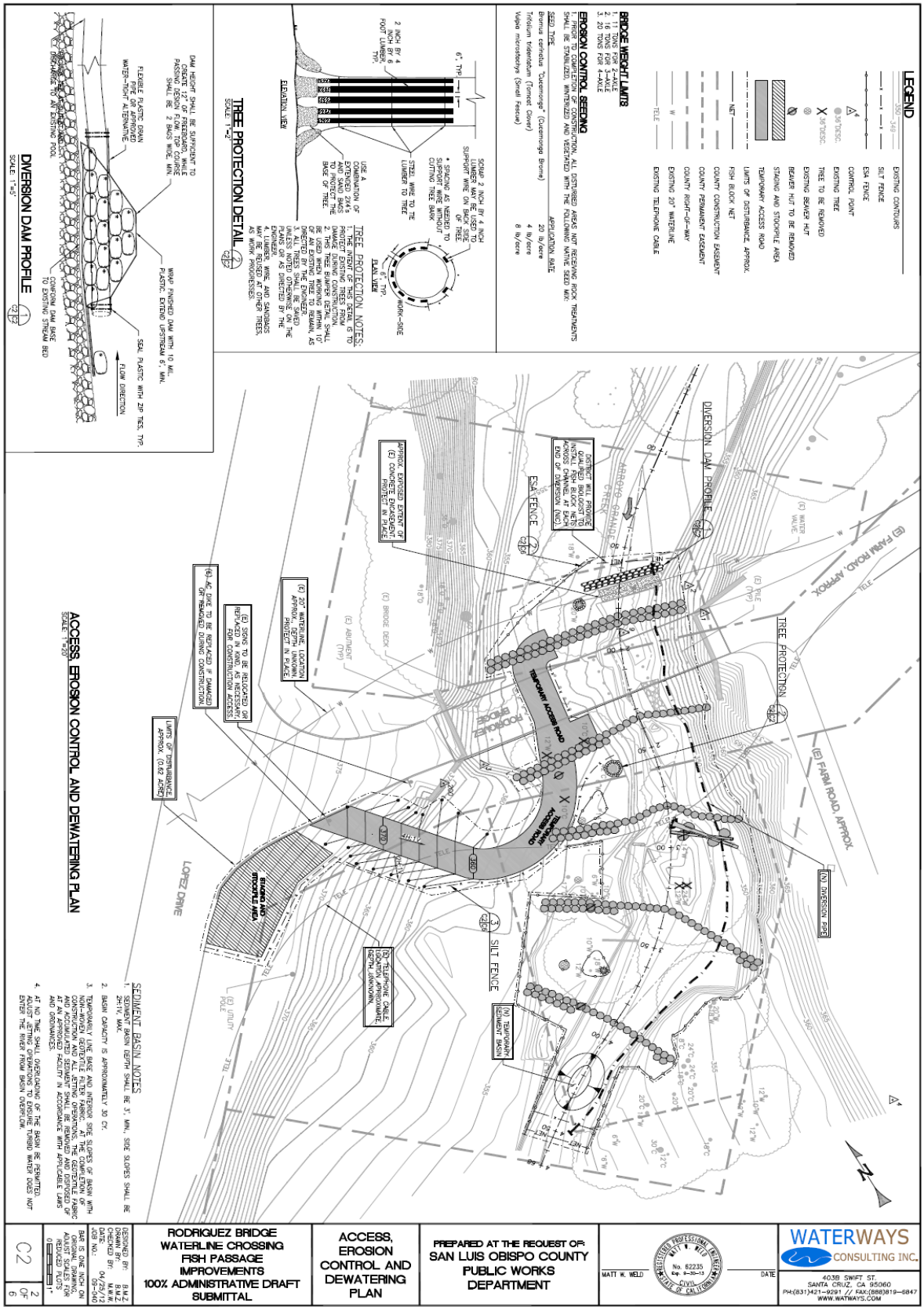
Carmel River Hydrologic Unit (#3307): Carmel River Hydrologic Sub-area (#330700): Carmel River, Aqua Mojo Creek, Big Creek, Blue Creek, Boronda Creek, Bruce Fork, Cachagua Creek, Carmel River, Danish Creek, Hitchcock, Creek Canyon, James Creek, Las Garzas Creek, Milles Fork, Pinch Creek, Pine Creek, Potrero Creek, Ran Creek, Rattlesnake Creek, Roberson Canyon, Robertson Creek, San Clemente Creek, Tularcitoas Creek, Ventana Mesa Creek.

Santa Lucia Hydrologic Unit (#3308): Santa Lucia Hydrologic Sub-area (#330800): Alder Creek, Big Creek, Big Sur River, Bixby Creek, Limekiln Creek, Little Sur River, Malpaso Creek, Mill Creek, Partington Creek, Plaskett Creek, Prewitt Creek, Rocky Creek, Salmon Creek, San Jose Creek, Vicente Creek, Vila Creek, Willow Creek, Big Creek, Devil's Canyon Creek, Garrapata Creek, Joshua Creek, North Fork Big Sur River, Redwood Creek, Rocky Creek, San Jose Creek, South Fork Little Sur River, Wildcat Canyon Creek, Williams Canyon Creek.

Salinas River Hydrologic Unit (#3309): Neponset Hydrologic Sub-area (#330911): Salinas River, Gabilan Creek, Old Salinas River, Tembladero Slough. Chualar Hydrologic Sub-area (#330920): Gabilan Creek. Soledad Hydrologic Sub-area (#330930): Salinas River, Arroyo Seco River, Reliz Creek; Upper Salinas Valley Hydrologic Sub-area (#330940): Salinas River. Arroyo Seco Hydrologic Sub-area (#330960): Arroyo Seco River, Reliz Creek, Vasqueros Creek, Arroyo Seco River, Calaboose Creek, Church Creek Horse Creek, Paloma Creek, Piney Creek, Reliz Creek, Rocky Creek, Santa Lucia Creek, Tassajara Creek, Vaqueros Creek, Willow Creek. Gabilan Range Hydrologic Sub-area (#330970): Gabilan Creek. Paso Robles Hydrologic Sub-area (#330981): Salinas River, Atascadero Creek, Graves Creek, Jack Creek, Nacimiento River, Paso Robles Creek, Salinas River, San Antonio River, San Marcos Creek, Santa Margarita Creek, Santa Rita Creek, Sheepcamp Creek, Summit Creek, Tassajera Creek, Trout Creek, Willow Creek.

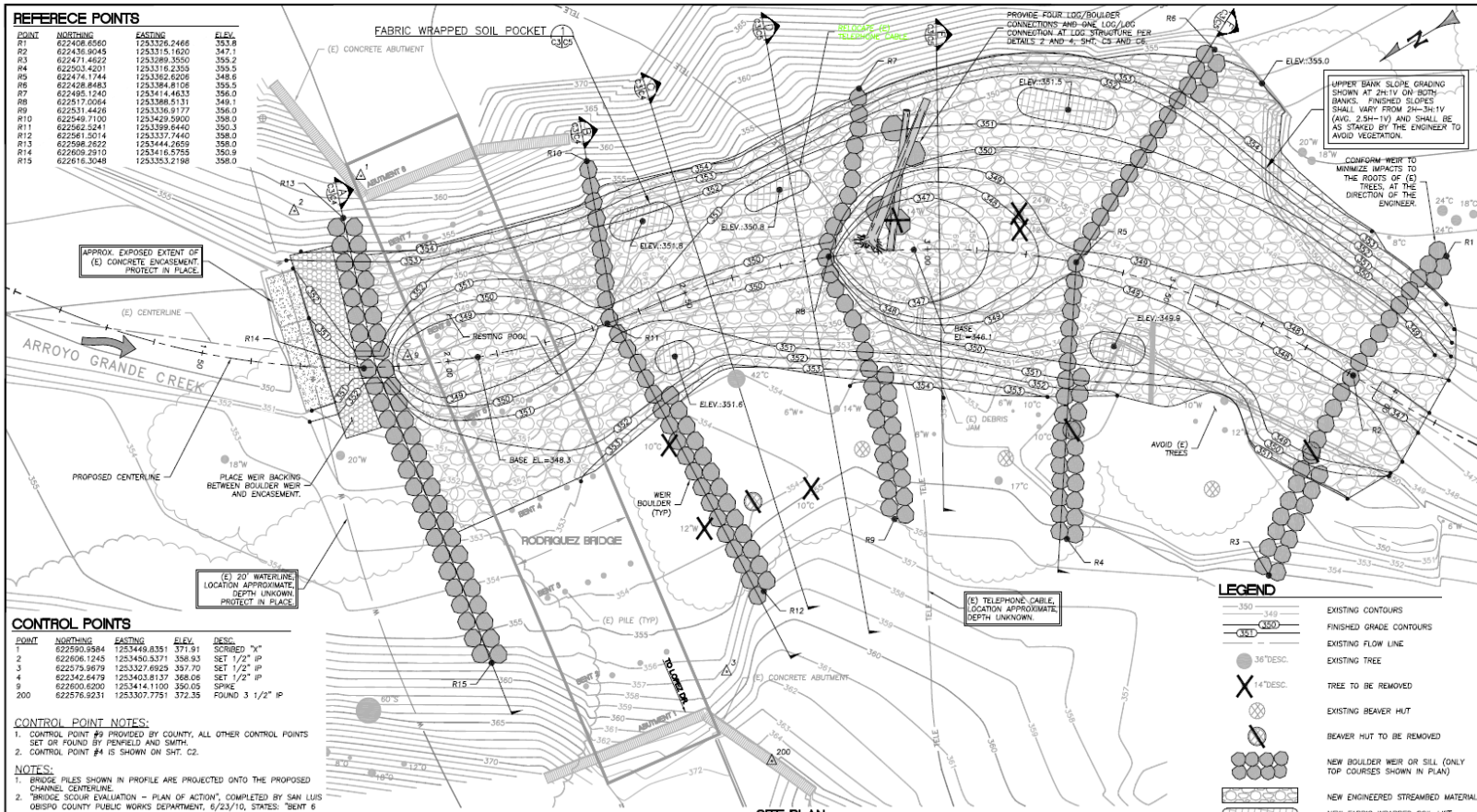
Estero Bay Hydrologic Unit (#331010): San Carpoforo Hydrologic Sub-area (#331011): San Carpoforo Creek, Dutra Creek, Estrada Creek, San Carpoforo Creek, Unnamed tributary, Wagner Creek. Arroyo De La Cruz Hydrologic Sub-area (#331012): Arroyo De La Cruz Creek, Burnett Creek, Green Canyon Creek, Marmolejo Creek, Spanish Cabin Creek, Unnamed Tributary, West Fork Burnett Creek. San Simeon Hydrologic Sub-area (#331013): Arroyo del Corral, Arroyo del Puerto, Little Pico Creek, Oak Knoll Creek, Pico Creek, San Simeon Creek, Arroyo Laguna, North Fork Pico Creek, South Fork Pico Creek, Steiner Creek, Unnamed Tributaries, Van Gordon Creek. Santa Rosa Hydrologic Sub-area (#331014): Santa Rosa Creek, Green Valley Creek, Perry Creek, Santa Rosa Creek, Unnamed Tributaries. Villa Hydrologic Sub-area (#331015): Villa Creek, Unnamed Tributaries. Cayucos Hydrologic Sub-area (#331016): Cayucos Creek, Unnamed tributaries. Old Hydrologic Sub-area (#331017): Old Creek. Toro Hydrologic Sub-area (#331018): Toro Creek, Unnamed Tributary. Morro Hydrologic Sub-area (#331021): Morro Creek, East Fork Morro Creek, Little Morro Creek, Unnamed Tributaries. Chorro Hydrologic Sub-area (#331022): Chorro Creek, Dairy Creek, Pennington Creek, San Bernardo Creek, San Luisito, Unnamed Tributary. Los Osos Hydrologic Sub-area (#331023): Los Osos Creek; San Luis Obispo Creek, Brizziolari Creek, Froom Creek, Perfumo Creek, See Canyon Creek, Stenner Creek, Unnamed Tributary. Point San Luis Hydrologic Sub-area (#331025): Coon Creek, Islay Creek, Unnamed Tributaries. Pismo Hydrologic Sub-area (#331026): Pismo Creek East Corral de Piedra Creek, Unnamed Tributary. Oceano Hydrologic Sub-area (#331031): Arroyo Grande Creek, Los Burros Creek.

Appendix E: 100% draft design plans (selected pages only)



REFERECE POINTS

POINT	NORTHING	EASTING	ELEV.
R1	622408.6560	1253326.2466	353.8
R2	622436.9045	1253315.1620	347.1
R3	622471.4622	1253289.3550	355.2
R4	622503.4201	1253316.2355	355.5
R5	622474.1744	1253362.6206	348.6
R6	622428.8483	1253384.8106	355.5
R7	622495.1240	1253414.4633	356.0
R8	622517.0064	1253368.5131	349.1
R9	622531.4426	1253336.9177	356.0
R10	622549.7100	1253429.5900	358.0
R11	622562.5241	1253399.6440	350.3
R12	622561.5014	1253337.7440	358.0
R13	622598.2622	1253444.2659	358.0
R14	622609.2910	1253416.5755	350.9
R15	622616.3048	1253353.2198	358.0



CONTROL POINTS

POINT	NORTHING	EASTING	ELEV.	DESC.
1	622590.9584	1253449.8351	371.91	SCRIBED "X"
2	622606.1245	1253450.5371	356.93	SET 1/2" IP
3	622575.9679	1253327.6925	357.70	SET 1/2" IP
4	622342.6479	1253403.8137	368.06	SET 1/2" IP
9	622600.6200	1253414.1100	350.05	SPIKE
200	622576.9231	1253307.7751	372.35	FOUND 3 1/2" IP

CONTROL POINT NOTES:

1. CONTROL POINT #9 PROVIDED BY COUNTY, ALL OTHER CONTROL POINTS SET OR FOUND BY PENFIELD AND SMITH.
2. CONTROL POINT #4 IS SHOWN ON SHT. C2.

NOTES:

1. BRIDGE PILES SHOWN IN PROFILE ARE PROJECTED ONTO THE PROPOSED CHANNEL CENTERLINE.
2. "BRIDGE SCOUR EVALUATION – PLAN OF ACTION", COMPLETED BY SAN LUIS OBISPO COUNTY PUBLIC WORKS DEPARTMENT, 6/23/10, STATES: "BENT 6 TIMBER PILE EXTENSIONS ONLY EXTEND TO A DEPTH OF APPROXIMATELY 1 METER BELOW THE INVERT."
3. ALL WORK WITHIN 5 FT. OF THE BRIDGE PILES WILL BE OBSERVED BY THE ENGINEER.

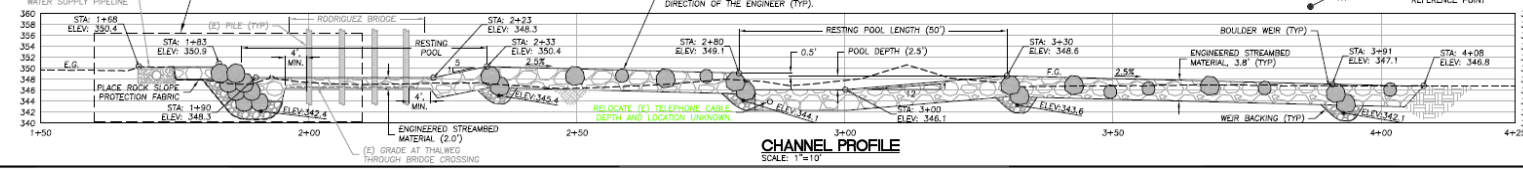
SITE PLAN

SCALE: 1"=10'

LEGEND

- EXISTING CONTOURS
- FINISHED GRADE CONTOURS
- EXISTING FLOW LINE
- EXISTING TREE (36"DESC.)
- TREE TO BE REMOVED (14"DESC.)
- EXISTING BEAVER HUT
- BEAVER HUT TO BE REMOVED
- NEW BOULDER WEIR OR SILL (ONLY TOP COURSES SHOWN IN PLAN)
- NEW ENGINEERED STREAMBED MATERIAL
- NEW FABRIC WRAPPED SOIL LIFT
- EXISTING TELEPHONE CABLE
- EXISTING 20-INCH WATERLINE
- CONTROL POINT
- REFERENCE POINT

1 CONCRETE ENCASEMENT PROTECTION DETAIL



CHANNEL PROFILE

SCALE: 1"=10'

WATERWAYS CONSULTING INC.
4039 SWIFT ST
SANTA CRUZ, CA 95060
PH:(831)421-9291 FAX:(831)421-9847
WWW.WATERWAYS.COM

DATE

MATT W. WELD

PREPARED AT THE REQUEST OF:
SAN LUIS OBISPO COUNTY
PUBLIC WORKS
DEPARTMENT

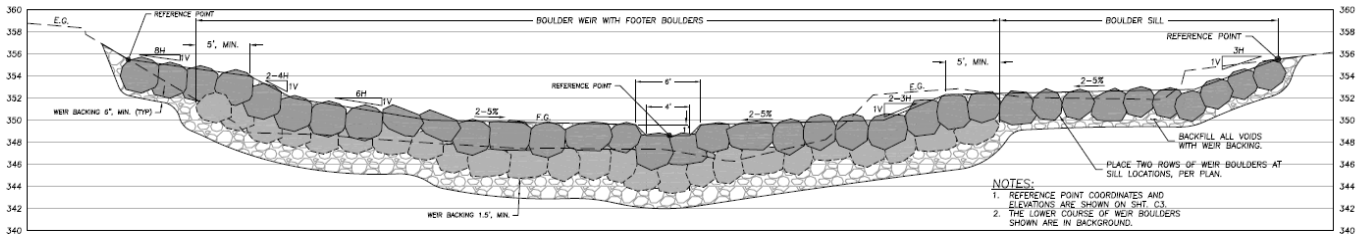
SITE PLAN AND PROFILE

RODRIGUEZ BRIDGE
WATERLINE CROSSING
FISH PASSAGE
IMPROVEMENTS
100% ADMINISTRATIVE DRAFT SUBMITTAL

DESIGNED BY: B.M.Z.
DRAWN BY: B.M.Z.
CHECKED BY: M.W.W.
DATE: 04/25/12
JOB NO.: 09-040

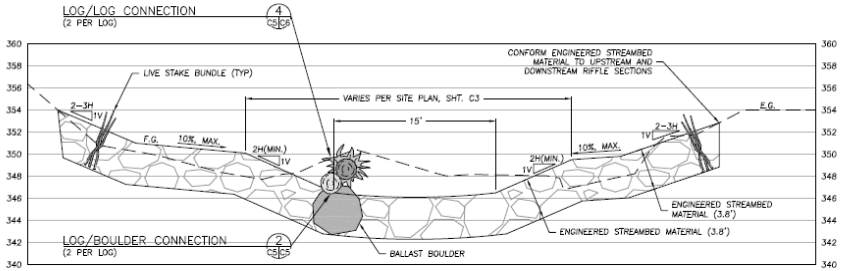
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C3 | 3 OF 6

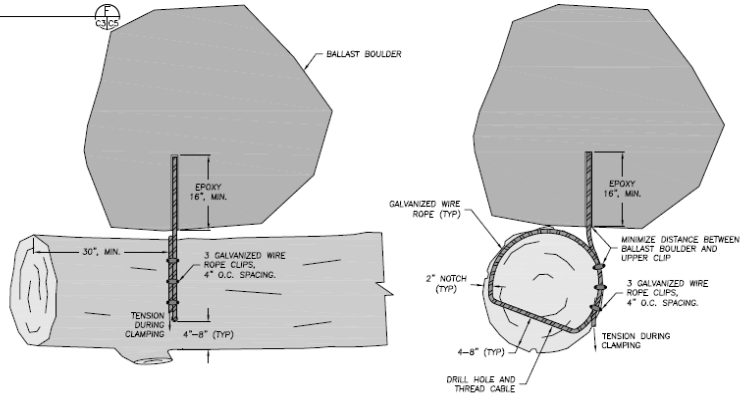


NOTES:
1. REFERENCE POINT COORDINATES AND ELEVATIONS ARE SHOWN ON SHT. C3.
2. THE LOWER COURSE OF WEIR BOULDERS SHOWN ARE IN BACKGROUND.

WEIR ELEVATION AT EXPANDED SECTION
SCALE: 1"=5'

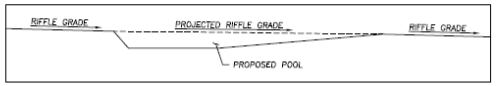


POOL SECTION
SCALE: 1"=5'



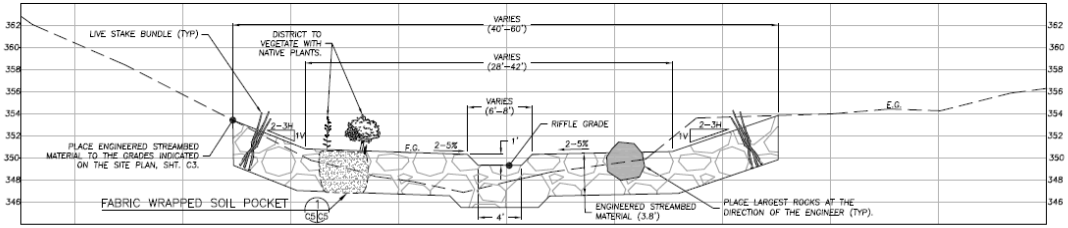
LOG/BOULDER CONNECTION
SCALE: 1"=1'

LIVE STAKE BUNDLE NOTES:
1. DISTRICT TO SUPPLY AND PLACE LIVE STAKE BUNDLES.
2. CONTRACTOR SHALL COORDINATE INSTALLATION WITH THE DISTRICT.
3. LIVE STAKE BUNDLES TO BE INSTALLED WITHIN ENGINEERED STREAMBED MATERIAL, 3', MIN. ABOVE THE RIFFLE GRADE OR PROJECTED RIFFLE GRADE AT 7' ON-CENTER SPACING.
4. LIVE STAKE BUNDLES TO CONSIST OF LIVE STAKES 1"-2" IN DIA. AT THE BASAL END AND 4.5'-5.5' FEET LONG.
5. TOP ENDS OF STAKES SHALL BE BLUNT AND BASAL ENDS SHALL BE ANGLED AT 45 DEGREES.
6. AFTER PLACEMENT, BACKFILL AND WATER-JET ALL VOIDS AROUND LIVE STAKE BUNDLES TO REMOVE AIR POCKETS.
7. AFTER INSTALLATION CLEANLY CUT EACH STAKE TO LEAVE 12" EXPOSED, MAX.
8. 70 LIVE STAKE BUNDLES TOTAL SHALL BE INSTALLED.

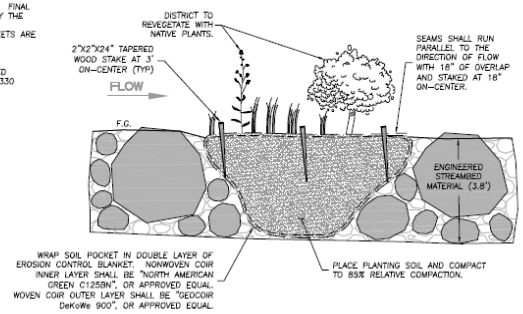


RIFFLE GRADE DIAGRAM
N.T.S.

FABRIC WRAPPED SOIL POCKET NOTES:
1. LOCATIONS SHOWN ON PLAN ARE APPROX. FINAL LOCATIONS TO BE STAKED IN THE FIELD BY THE ENGINEER.
2. ELEVATION OF FABRIC WRAPPED SOIL POCKETS ARE SHOWN ON PLAN.
3. FIVE (5) INDIVIDUAL FABRIC WRAPPED SOIL POCKETS SHALL BE CONSTRUCTED.
4. THE TOTAL SURFACE AREA OF CONSTRUCTED FABRIC WRAPPED SOIL POCKET SHALL BE 330 SQ.FT., MIN.



TYPICAL ROUGHENED CHANNEL SECTION
SCALE: 1"=5'



FABRIC WRAPPED SOIL POCKET
SCALE: 1"=2'

WATERWAYS CONSULTING INC.
4035 SWIFT ST.
SANTA CRUZ, CA 95060
PH:(831)421-9291 FAX:(888)911-0847
WWW.WATWAYS.COM

DATE

MATT W. WEID
No. 62235
Exp. 6/30/13
PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

PREPARED AT THE REQUEST OF:
SAN LUIS OBISPO COUNTY
PUBLIC WORKS
DEPARTMENT

DETAILS

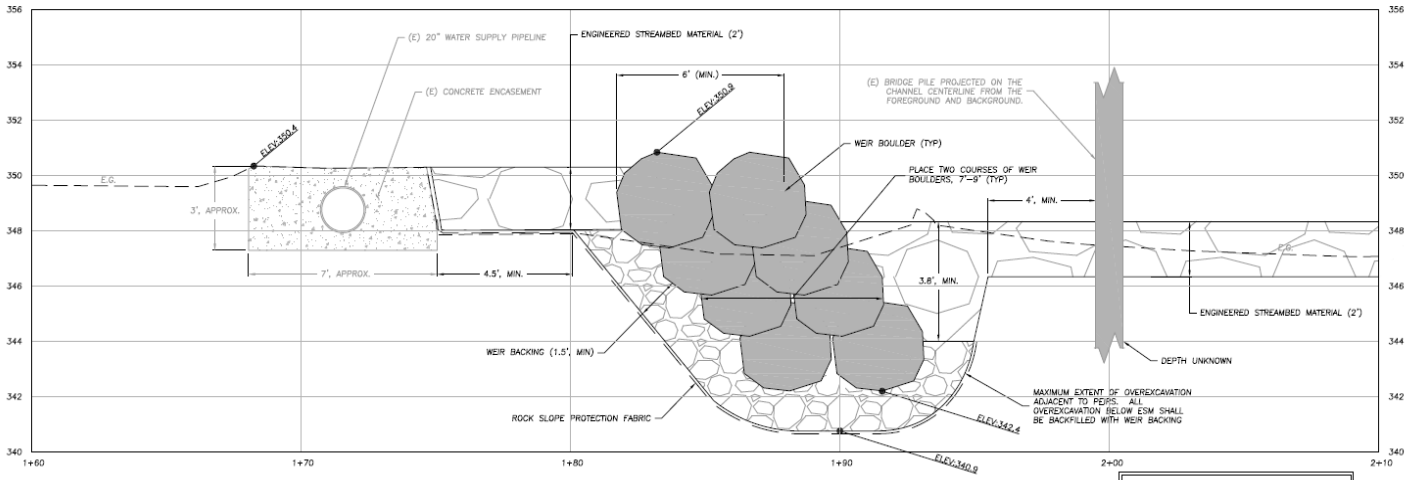
RODRIGUEZ BRIDGE
WATERLINE CROSSING
FISH PASSAGE
IMPROVEMENTS
100% ADMINISTRATIVE DRAFT
SUBMITTAL

DESIGNED BY:	B.M.Z.
DRAWN BY:	B.M.Z.
CHECKED BY:	M.W.W.
DATE:	04/25/12
JOB NO.:	09-040

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C5

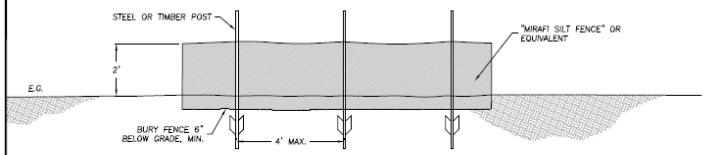
5 OF 6

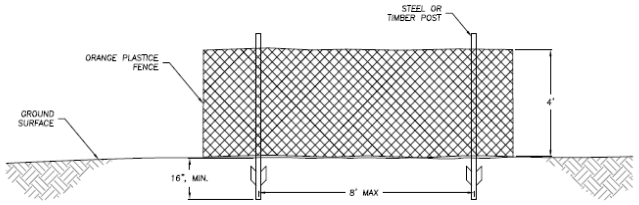


CONCRETE ENCASEMENT PROTECTION DETAIL

SCALE: 1"=2' (1 C3|C6)

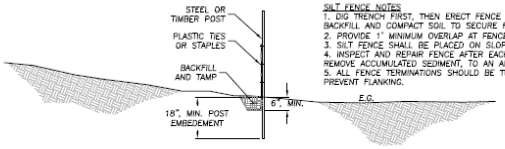
NOTE:
ALL WORK WITHIN 5 FT. OF CONCRETE ENCASEMENT WILL BE OBSERVED BY THE ENGINEER.





ESA FENCE DETAIL

SCALE: 1"=2' (2 C2|C6)

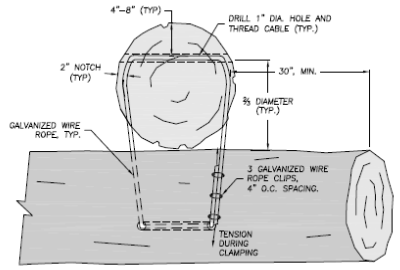


SILT FENCE NOTES
1. DIG TRENCH FIRST, THEN ERECT FENCE IN TRENCH. BACKFILL AND COMPACT SOIL TO SECURE FABRIC.
2. PROVIDE 1' MINIMUM OVERLAP AT FENCE SPLICES.
3. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS.
4. INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE ACCUMULATED SEDIMENT, TO AN APPROVED AREA.
5. ALL FENCE TERMINATIONS SHOULD BE TURNED UPSLOPE TO PREVENT FLANKING.

SILT FENCE

SCALE: 1"=2' (3 C2|C6)

LOG NOTES:
1. ALL LOGS SHALL BE DOUGLAS FIR OR REDWOOD, SOUND AND FREE OF SIGNIFICANT DECAY AND MEETING THE FOLLOWING CRITERIA.
   A. LENGTH: 25 – 35 FEET
   B. DIAMETER: 18"–30" (MIN. AT ANY POINT)
   C. AT LEAST ONE LOG WITH ROODWAD ATTACHED PER STRUCTURE
2. ROOTWADS SHALL HAVE A MINIMUM DIAMETER OF 5 FEET.



LOG/LOG CONNECTION

SCALE: 1"=1' (4 C5|C6)

WATERWAYS CONSULTING INC.
4038 SWIFT ST.
SANTA CRUZ, CA 95060
PH:(831)421-9291 // FAX:(866)819-6847
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