VENTURA RIVER WATERSHED TECHNICAL INVESTIGATION

SUMMARY REPORT AND RECOMMENDATIONS

Funding Provided by the Department of Fish and Game and Proposition 13

Prepared for:

CITY OF SAN BUENAVENTURA
San Buenaventura, CA

Prepared by:

ENTRIX, INC.
Walnut Creek, CA

Project No. 325405

March 14, 2003

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In 1997, a number of agencies (Cooperating Agencies) with on-going activities in and adjacent to the Ventura River and its tributaries developed the *Ventura River Steelhead Restoration and Recovery Plan* (ENTRIX and WCC 1997). This Restoration Plan reviewed activities within the watershed and opportunities for steelhead habitat restoration. A number of information gaps were also identified.

The agencies that developed the Restoration Plan, along with the California Department of Fish and Game (DFG), understood the need for additional scientific study of the habitat quality and quantity within the watershed, for additional public education and outreach, and for a framework for understanding restoration project priorities within the watershed. Therefore, the agencies originally involved in the Restoration Plan requested funding support from the DFG's Fishery Restoration Grants Program to complete these activities. This report summarizes the work completed under the grant awarded by DFG to the City of San Buenaventura, as a representative of the Cooperating Agencies.

Section one of the report presents background on the effort, outlines what was undertaken as part of the grant, and the relationship of these activities to others within the watershed. Section two present the results of the additional field studies completed as part of the grant activity, namely habitat and passage studies in North Fork Matilija Creek and San Antonio Creek, using DFG habitat typing protocols. Finally, section three summarizes current steelhead habitat conditions within the Ventura River watershed and outlines priority geographic areas likely necessary for steelhead recovery. Key project types for steelhead habitat restoration within each of these areas are also identified and prioritized.

The results of this synthesis of information suggest that the upper Ventura River tributaries (North Fork Matilija and Matilija creeks) are fundamentally important to steelhead recovery, followed by the lower San Antonio Creek watershed and the mainstem Ventura River, especially the live reach. Further, restoring access through fish passage enhancement projects is the key project type to address limiting factors within the watershed, followed by projects designed to improve habitat quality. Public education and outreach remain an important component to the success of restoration efforts within the watershed because of the substantial portion of the mainstem river and San Antonio Creek that is privately owned.

1.1 PROJECT OVERVIEW

On August 18, 1997, the National Marine Fisheries Service (NMFS) listed the Southern California Evolutionarily Significant Unit (ESU) of steelhead (*Oncorhynchus mykiss*) as endangered under the federal Endangered Species Act (ESA) (62 FR 43937, August 18, 1997). The Southern California ESU originally ranged from the Santa Maria River south to Malibu Creek, although a recent action by NMFS has extended the ESU to the Mexican border (67 FR 21586, May 1, 2002). The Ventura River is an important coastal river in the Southern California ESU and provides an important opportunity for the restoration of steelhead habitat and recovery of southern steelhead populations.

In the *Steelhead Restoration and Management Plan for California*, the Department of Fish and Game (DFG) placed a high priority on steelhead restoration in the Ventura River (McEwan and Jackson 1996). In the 1940s, DFG estimated that 4,000 to 5,000 adult steelhead spawned in the Ventura River system (Clanton and Jarvis 1946), making it one of the largest runs on the south coast. Today the size of the run is estimated to be fewer than 100 fish (NMFS 1996). Over half of the historical steelhead spawning and rearing habitat in the Ventura watershed was found in headwaters tributaries in the Matilija Creek drainage. Access to this important tributary has been blocked by Matilija Dam and Robles Diversion Dam (Figure 1-1). Much of the spawning and rearing habitat presently accessible below Robles Diversion Dam has been degraded due to urban development, road crossings, and other impacts (McEwan and Jackson 1996, ENTRIX and WCC 1997).

In 1996, a coalition of local agencies sponsored the development of the *Ventura River Steelhead Restoration and Recovery Plan* (Restoration Plan; ENTRIX and WCC 1997). The Restoration Plan was prepared by environmental consultants under the direction of the Cooperating Agencies[1] and involved significant input from state and federal agencies, the environmental community, local landowners, and the general public. The Restoration Plan identified potential restoration actions that could be pursued to restore steelhead in the Ventura River. Furthermore, the Restoration Plan recommended that additional studies be performed to provide the information necessary to determine if certain potential restoration actions were warranted and to identify more specific habitat enhancement measures, where possible.

[1] The Ventura River Cooperating Agencies include: Casitas Municipal Water District, City of San Buenaventura, Ventura County Watershed Protection District, Ventura County Transportation Department, Ventura County Environmental, Energy, and Resources Department, Ventura County Parks Department, Ojai Valley Sanitary District, Meiners Oaks County Water District, Ventura River County Water District, Southern California Water Company, and Ojai Basin Groundwater Management Agency.

The Restoration Plan process identified the need for further study and effort in a number of areas to allow for more detailed recommendations on specific projects that could benefit steelhead in the Ventura River. Such efforts included the need for more recent habitat studies using DFG protocols in North Fork Matilija Creek and San Antonio Creek to allow for comparison of relative habitat values within the key geographic areas within the watershed[2]. This would also allow for many of the uncertainties outlined in the Restoration Plan to be addressed. Additional instream flow analyses were also included in the effort to help identify flow regimes which could lead to restoration and recovery of listed species.

The need for public education and landowner outreach was also identified by the Cooperating Agencies and DFG as a crucial element. A substantial portion of the Ventura River watershed, including the mainstem and San Antonio Creek, are primarily privately owned. Education and outreach activities create local support for restoration activities and provide opportunities for further study, identification of potential projects, and opportunities to implement projects on private lands. Finally, use of a geographic information system (GIS) to collect and overlay the relevant information within the watershed was identified as an important tool to assist in synthesis of the available information.

In order to accomplish these goals, the Cooperating Agencies sought matching funds to pursue this work from DFG's Fishery Restoration Grants Program. The overall purpose of this effort was to take the next step in moving towards an understanding of what actions should be undertaken within the watershed to restore steelhead habitat in the Ventura River. The objective of the project was to define and prioritize, to the extent possible given the available information, project-specific activities that could enhance steelhead habitat and conduct public outreach to improve enhancement opportunities in the Ventura River watershed. The identified projects and associated prioritization are to be used by anyone interested in implementing projects for steelhead restoration as a tool to identify high priority projects.

1.2 RELATIONSHIP TO THE VENTURA RIVER HABITAT CONSERVATION PLAN

A key component of the Restoration Plan was to review the activities undertaken by the Cooperating Agencies in and adjacent to Ventura River streams to determine what activities may be having an adverse effect on the Ventura River's aquatic environments. As a result of the Restoration Plan, the Cooperating Agencies determined that, with the listing of steelhead under the ESA, they needed an incidental take statement from NMFS and the U.S. Fish and Wildlife Service (FWS) for their on-going operation and maintenance activities associated with Ventura River aquatic and riparian environments.

In 1999, the Habitat Conservation Planning (HCP) process for the Cooperating Agencies to obtain incidental take statements for their ongoing operation and maintenance activities was initiated. As outlined above, the Cooperating Agencies had identified the

[2] A recent study had already been undertaken of the mainstem Ventura River (ENTRIX 2001).

need for additional studies within the watershed to provide a foundation for identification of high priority conservation actions that would provide substantial biological benefits to steelhead on a watershed-wide level. They further identified that public education and landowner outreach was key to the overall success of restoration efforts. Both of these activities are beyond the scope of the HCP permit process, although they would contribute to the success of the overall effort to restore steelhead, of which the HCP process was a part. Thus, these actions were complimentary to the actions being undertaken to complete the HCP and the incidental take permit process, but are not required by the ESA process. Because of the identified need, the City of Ventura (City) prepared and submitted a grant proposal, on behalf of the Cooperating Agencies, to pursue these efforts.

1.3 RELATIONSHIP TO OTHER AGENCIES AND PROCESSES

The enhancement activities identified in Section 3 of this report are designed to provide a framework for considering the relative biological benefit of potential enhancement projects based on the information available. The assessment contained herein is a watershed-wide view of restoration opportunities within the Ventura River and prioritizes, on a general scale, the relative biological benefits of actions in different geographic areas of the watershed and within the priority geographic areas. This process did not consider other regulatory or agency-driven priorities which are based on a number of factors including jurisdiction, availability of funding, regulatory guidance, and agency policies and practices, nor is it meant to supplant these other considerations. This process recognizes that these "other factors" play an important role in determining the order in which projects would be implemented.

Further, NMFS and DFG, the federal and state agencies charged with protecting steelhead, have their own processes underway to restore habitat and recover steelhead populations. In 1996, DFG produced the *Steelhead Restoration and Management Plan for California* (McEwan and Jackson 1996). This plan outlines the status of steelhead stocks throughout the state and recommends actions within each key watershed that would improve habitat conditions for this species. DFG works to implement this plan through a number of avenues including funding projects through their Fishery Restoration Grants program that are consistent with this plan.

In addition, NMFS is in the process of developing recovery plans for each listed salmon and steelhead ESU. Recovery planning, under the ESA and the specific guidance for listed salmonids (NMFS 2000), is a substantial, multi-year effort. For the Southern California steelhead ESU, this process is just beginning and it is estimated that the full process may take up to five years (pers. comm. C. Wingert, 2002). The Southern California steelhead ESU is part of the South-Central California Coast recovery domain. The recovery domains are the scientific planning unit for steelhead recovery although, ultimately, the NMFS recovery plan will establish guidance on specific recovery objectives and recommended restoration actions within each ESU and, it is anticipated, within each watershed within each ESU, including the Ventura River.

In the absence of the NMFS steelhead recovery plan, DFG, through their support of the project described herein, and other local agencies and organizations involved in steelhead restoration, determined that a biologically-based framework for comparison of the relative priority of potential enhancement efforts was needed. Ultimately, it is anticipated that the evaluation conducted herein will be considered by NMFS as they develop restoration recommendations specific to the Ventura River watershed.

1.4 OVERVIEW OF WORK COMPLETED

The sections below provide an overview of the efforts that have occurred for each of the various components of the project.

1.4.1 ADDITIONAL STUDIES

In order to develop and prioritize specific enhancement projects, detailed studies need to occur to determine where habitat enhancement projects are likely to (1) benefit the fishery, (2) be feasible, and (3) be durable (i.e. a lasting benefit). There is existing information on which to begin this process including information summarized in the Restoration Plan and a recent habitat study conducted on the mainstem (ENTRIX 2001). In order to fully analyze restoration potential within the accessible, or soon to be accessible (i.e. next few years), portions of the watershed, it is important that the majority of these areas be studied. As noted above, data gaps included North Fork Matilija Creek and San Antonio Creek[3]. Data gaps also included lower Coyote Creek, downstream of Casitas Dam. However, this portion of the original study was removed at DFG's request because this habitat was not considered to be promising for steelhead restoration (DFG 2001). As outlined in more detail in Section 2, approximately 30% of each of these tributaries were habitat typed using DFG protocols as part of this project. In addition, potential passage barriers were identified on both of these tributaries to understand current steelhead access and the potential for restoring access.

In addition to the habitat and passage studies, an instream flow study to better understand the amount of spawning and rearing habitat provided by various flow conditions was to be undertaken in portions of the mainstem. Transects were established, however due to low water conditions spring 2001, flows were too low to collect the necessary information to complete the study. Precipitation in the current (2003) water year has provided some opportunity to collect several of the measurements necessary for completion of the study. However the measurements will not all be completed by the termination of the study period (March 15, 2003) because much of the rainfall that has occurred to date has infiltrated into the aquifer, which was drawn down during the previous dry year preventing an early return of surface flow. The data reduction and analysis phase of the flow study would commence once all the flow data has been collected, and therefore will also not be completed as part of this study. Efforts will be made to obtain support for completion of this important study.

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[3] A 1996 study by Fugro West was conducted in San Antonio Creek however DFG protocols were not used which limited comparison of habitat values to other areas within the watershed. No passage assessment was conducted as part of the Fugro West study.

1.4.2 PUBLIC EDUCATION AND OUTREACH

The public education and outreach program involved three different components. A webpage was created to provide background information on the project including project partners, associated documents, and key links to resources for the public. In addition, two public workshops were held in the Ventura area. The first focused on what types of actions are already occurring within the Ventura River watershed that result in improving conditions for steelhead. The goal of this workshop was to provide information to the public about how they could get involved in steelhead restoration. This workshop also provided background information on the steelhead listing and lifehistory. The second workshop targeted outreach to landowners to better understand how they could undertake projects on their own lands that would benefit both their property and steelhead. Finally, two newsletters were created and distributed to the mailing list of interested parties created through the Restoration Plan and HCP processes. These newsletters echoed the information provided in the workshops by outlining basic background information on steelhead in the Ventura River watershed and activities that the public and landowners could undertake to improve conditions for steelhead.

Additional detail about the outreach activities, including the number of workshop attendees and materials prepared, are presented in Appendix B.

1.4.3 GEOGRAPHIC INFORMATION SYSTEM

A GIS system was constructed for the Ventura River watershed for use in assessing priorities within the watershed. A GIS database is a set of tools which integrates environmental data within a powerful and intuitive visual and analytical spatial framework. GIS databases are now widely used for managing geographic and resource data. The GIS system developed for this project was based on information provided by the County of Ventura for the Ventura River watershed. Layers include basic geographic information such as roads, cities, topography and waterbodies. As part of this project additional layers have been added to the system to incorporate the results of the studies completed as part of this project (e.g. habitat quality, passage barriers) as well as information that could be obtained from other systems. Layers prepared include:

- Steelhead rearing habitat quality, accessibility, and location;
- Steelhead spawning habitat quality, accessibility, and location;
- Known steelhead barriers within the watershed;
- Ventura River watershed boundary;
- Ventura River sub-watershed boundaries;
- Road crossings within the watershed;
- Land ownership; and
- Alluvial (groundwater) basins.

A CD-ROM containing the layers created under this project has been developed and will be available to the public. To obtain a copy of the GIS layers, please contact Ms. Karen Waln with the City of Ventura at (805) 677-4128 or via electronic mail at kwaln@ci.ventura.ca.us.

1.5 ORGANIZATION OF THE REPORT

Section 1 provides an overview of the project, including the purpose, objectives, and key components of the project effort. Section 2 presents the methods, results, and discussion for the habitat and passage studies undertaken as part of this project. A synthesis of conditions and limiting factors within the Ventura River watershed, based upon available information, including the studies conducted for this project, is presented in Section 3. Section 3 also outlines the priorities and recommendations for enhancement projects based on the synthesis of information. Finally, recommendations for further monitoring and study are also outlined. Figures, tables, and photographs are referenced, as appropriate, throughout the text and are located at the end of the report.

A series of appendices provide the more detailed information pertaining to particular efforts undertaken to complete this work. Appendix A presents a preliminary engineering analysis of potential solutions for three of the higher priority fish passage problems within the basin. Appendix B provides a more detailed summary of the public education and outreach program and presents documents prepared for that effort. Appendix C provides general information on the lifehistory and biology of steelhead. Appendix D presents written comments received on the draft prioritization documents.

2.1 INTRODUCTION

Habitat presently suitable for steelhead spawning and rearing below man made barriers in the Ventura River is limited to a short stretch of the mainstem Ventura River known as the live reach[1] and San Antonio Creek (ENTRIX and WCC 1997) (Figures 2-1, 2-2). Previous studies have concluded that this habitat is important to steelhead spawning and rearing but only has limited utility in the restoration of Ventura River steelhead because of its limited extent and quality (Moore 1980, Fugro West 1996, ENTRIX and WCC 1997, and Chubb 1997). Consequently, efforts have been concentrated on providing access to the headwater tributaries including Matilija Creek and North Fork Matilija Creek.

While reconnaissance surveys suggest high quality habitat exists in North Fork Matilija Creek, no recent, detailed habitat surveys have occurred. Further, the value and distribution of habitat in San Antonio Creek for steelhead is not well understood because survey methods of previous work (Fugro West 1996) have not been consistent with other studies or DFG protocols. This has limited the ability to assess, relative to other reaches of the watershed, the potential of these tributaries to contribute to steelhead recovery and to identify potential restoration actions that could improve the habitat for steelhead.

San Antonio Creek is presently accessible to migrating steelhead and North Fork Matilija Creek will be accessible when the Robles Fish Passage Facility is complete. North Fork Matilija Creek and Bear Creek are located in the upper Ventura River Watershed approximately 15 miles upstream of the Ventura River mouth (Figures 1-1 and 2-3). San Antonio Creek is located approximately 7 miles upstream of the Ventura River mouth and is the downstream-most tributary with known steelhead habitat in the Ventura River (Figures 1-1 and 2-4).

The purpose of this study to provide recent data that is comparable to other recent studies in the watershed that together will form the basis for identifying and prioritizing restoration actions. To this end, a steelhead habitat assessment and passage barrier study was conducted during baseflow conditions on North Fork Matilija Creek, Bear Creek, and San Antonio Creek during the months of April and May 2002.

[1] The live reach is the perennial reach near the Casitas Springs/Foster Park area and typically extends from approximately ½ mile upstream of the confluence with San Antonio Creek downstream to Foster Park. The upstream extent of this reach varies based on hydrologic conditions within the watershed.

2.2 MATERIALS AND METHODS

Habitat surveys were conducted utilizing DFG protocols presented in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 1998) consistent with methods used in the habitat assessment of the Ventura River (ENTRIX 2001). At least 30% of North Fork Matilija Creek and San Antonio Creek were mapped. North Fork Matilija Creek, including Bear Creek, was broken up into 6 reaches (A – F) (Figure 2-3) and San Antonio Creek was broken up into 5 reaches (A – E) (Figure 2-4, Table 2-1). Each reach was chosen due to changes in channel morphology, substrate complexity, riparian density and cover, and access.

Data collected included: habitat type, habitat lengths and widths, average and total depths, substrate composition, canopy and instream cover composition and proportions, channel slope, substrate embeddedness, percent algae, riparian composition and proportion, water and air temperature, flow, and barrier inventory data.

Spot checks were conducted in the Ojai Valley-portion of San Antonio Creek and its tributaries including Thacher Creek, Reeves Creek, and upper Lion Creek to assess flow conditions to determine if they were conducive to supporting trout populations (Table 2-1). A spot check was also conducted to assess spawning habitat near the confluence of the Ventura River and San Antonio Creek (Table 2-1).

Parameters such as water and air temperature, flow, habitat unit length, mean width, and mean and maximum depth were measured at each habitat unit. Percent substrate, canopy cover, cover complexity, spawning gravel, and algae were also measured at each habitat unit.

Migration barriers (partial and total) were noted and mapped throughout the North Fork Matilija Creek and San Antonio Creek watersheds where stream access was attainable. The entire length of North Fork Matilija Creek from the confluence with the Ventura River upstream to the Wheeler Gorge Campground was surveyed and substantial portions of San Antonio Creek from the Ventura River upstream to Soule Park were surveyed, although access was limited in some locations by private property.

Photographs were taken at representative habitat units, migration barriers, and at any impacted areas where habitat restoration or enhancement actions could improve conditions. The locations of these areas was noted in field logbooks.

All steelhead/rainbow trout and spawning redds encountered were documented during the survey. A separate notebook documented substrate embeddedness, native and exotic plant species, terrestrial organisms encountered, Rosgen channel type[2] (Rosgen 1996), and all other notes not included on field data sheets.

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[2] The Rosgen channel type is a classification system used to classify the geomorphology of stream channels. The classification system relies upon a set of morphologic parameters, including channel width to depth ratios, slope, and substrate among others. By classifying stream systems, it is possible

Most of the habitat survey was conducted on public land with a small portion conducted on private land. Approval was obtained prior to entering all private land. Landowner access was obtained with the help of the Ojai Valley Sanitation District.

2.3 RESULTS

This section summarizes the results of the Steelhead Habitat Assessment Study and the Fish Passage Inventory conducted on North Fork Matilija Creek, Bear Creek, and San Antonio Creek. A data summary including unit frequency and average dimensions for each reach surveyed can be found in Tables 2-2 through 2-4 for North Fork Matilija Creek, Bear Creek, and San Antonio Creek, respectively. Further detailed breakdown of this information by reach is presented in Tables 2-5 and 2-6.

2.3.1 NORTH FORK MATILIJA CREEK

In general, data collected during the steelhead habitat assessment and mapping study indicated that there is good spawning and rearing habitat available to steelhead in North Fork Matilija Creek. Instream habitat consisted primarily of boulder cascades (Photo 3), step-runs, low gradient riffles (Photos 6,10), and pools (Photos 1,2,4,5) (Figure 2-5). In the headwaters, the Rosgen channel type fluctuated from A to G which are characterized by an entrenched channel (no active flood plain). In the lower section below Wheeler Gorge Campground, the channel was typically Rosgen-type B, characterized by a moderately entrenched channel (limited flood plain). Habitat dimensions, frequency, and canopy and cover are presented in Table 2-5. Gravel retention was poor to moderate throughout most of the stream, likely due to seasonal flashy storm events (Photo 9). Further, embeddedness of gravels by calcified cementing was a problem in each reach surveyed (Photo 8). However there appeared to be enough spawning habitat available to seed future trout populations in the reaches surveyed. Gravel bars were abundant which can provide additional available spawning habitat during higher flows and provide a gravel source.

The riparian corridor was fairly dense in Reaches C, D, E, and F. The corridor was less dense in Reaches A and B with periodic openings where houses or roads have been built close to the channel. There was some algal growth within the Wheeler Gorge Campground and Reach A. This was most likely due to low stream flow and high stream temperatures in reaches with lower canopy cover. Stream flow was measured at 0.3 cfs in North Fork Matilija Creek above Bear Creek and 0.9 cfs in lower North Fork Matilija Creek. Stream flow was approximately 0.6 cfs in Bear Creek during the study.

In general, alder (*Alnus rhombifolia*) dominated the riparian corridor with various willow species (*Salix sp.)* occupying the subdominant category. These species were commonly present in clumps representing various age classes, which demonstrate an affinity for scour and removal by disturbance and subsequent reestablishment. California sycamore (*Platanus racemosa*) and coast live oak (*Quercus agrifolia*) were only present on an

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to reliably predict the general behavior of a stream, including its sediment transport regime, bed and bank stability, and inter-relationship with aquatic habitat conditions.

intermittent basis, but provided good shade cover based on the large profile of an established individual. Other species occurring in the riparian zone included California bay (*Umbellularia californicum*), big leaf maple (*Acer macrocarpa*) and Fremont's cottonwood (*Populus fremontii*); these species were rare. The understory was mainly composed of juvenile alder and willow interspersed with mulefat (*Baccharis pilularis*), mugwort (*Artemesia douglasiana*), coffee berry (*Rhamnus californica*) and annual grasses and forbs.

Stream temperatures during the survey ranged from 11.5°C (52.7°F) in the late morning when the air temperature was 14.0°C (57.2°F) to 18.0°C (64.4°F) in the late afternoon when the air temperature was 21.0°C (69.8°F). The late afternoon temperature is above the preferred range of steelhead (12.8-15.6ºC; Rich 1987) but within ranges that promote steelhead growth (see Appendix C). Canopy cover with the exception of Reach B, and instream cover are sufficient throughout North Fork Matilija Creek to maintain adequate temperatures and cover for steelhead trout. Many rainbow trout measuring approximately 2 to 5 inches were observed throughout the survey and a few spawning redds (nests) were observed at the downstream ends of pools where they tailout into swifter habitat types. The spawning redds observed were constructed in habitat with abundant clean gravel and also in habitat with small gravel pockets.

A fair weather road crossing forms a migration barrier within the Los Padres National Forest at Wheeler Gorge Campground (Photos 23,24). The crossing is likely a complete barrier due to the 11-foot drop from the crossing surface to the downstream channel and the shallow flow that would occur across the road's surface. Two bedrock and boulder cascades in reaches B and C were considered to be low flow barriers based on best professional judgement (Photos 21,22). During higher flows these boulder cascades are not anticipated to be barriers to upstream migration because of sufficient depth within the downstream jump pools and the decreased jump height at higher flows.

Detailed descriptions of habitat available within each reach are provided below.

2.3.1.1 Reach A

Reach A is the downstream-most section surveyed on North Fork Matilija Creek (Figure 2-3). The channel in this reach is indicative of a B2 or B3 channel type which is characterized as moderately entrenched, a slope between 0.02 to 0.039, and with boulders and cobbles as dominant substrate (Rosgen 1996). There was a fair amount of instream gravel in this section that would be available to steelhead for spawning.

Habitat types in this reach were comprised of 40.0% pools, 48.0% riffles, and 12.0% runs and glides (Figure 2-5). The mean maximum pool depth in this reach was 2.3 ft with the mean pool length at 74.6 ft. The mean instream cover was 32.5% with mean canopy cover at 21.8% (Figure 2-7). Spawning habitat in this reach was fairly abundant but was slightly embedded by calcification. Gravel is abundant and of moderate to high quality for steelhead spawning in this reach of North Fork Matilija Creek. The riparian corridor was dominated by alder, with lesser amounts of sycamore, and willow. Coast live oak occasionally provided some canopy cover. Mulefat was common in the understory (i.e.

the vegetation below the riparian canopy). A minimal amount of algal growth was evident in Reach A.

This data indicates that there is abundant high quality steelhead rearing habitat available during low flow conditions. The limiting factor in this reach is the lower percentage of canopy cover to maintain cool water temperatures.

2.3.1.2 Reach B

Reach B is located below the community of Wheeler Springs on North Fork Matilija Creek (Figure 2-3). The channel in this reach is indicative of a B1 or B2 channel type which is characterized as moderately entrenched, a slope between 0.02 to 0.039, and with bedrock and boulders as dominant substrate (Rosgen 1996).

Habitat types in this reach were comprised of 44.0% pools and 56.0% riffles with no runs or glides (Figure 2-5). The mean maximum pool depth in this reach was 2.45 ft with the mean pool length at 71.5 ft. The mean instream cover was 45.6% with mean canopy cover at 6.7% (Figure 2-7). Spawning habitat in this reach was marginal in abundance but was of moderate to high quality where gravels did exist. This reach is dominated by bedrock and boulders but contains some instream gravel that would be available to steelhead for spawning. The riparian corridor was composed of alder, willow, sycamore and mulefat, listed in decreasing abundance.

This data indicates that there is abundant high quality steelhead rearing habitat available during low flow conditions. The limiting factor in this reach is the lower percentage of canopy cover to maintain cool water temperatures.

2.3.1.3 Reach C

Reach C is located above the most downstream Highway 33 tunnel on North Fork Matilija Creek (Figure 2-3). The channel in this reach is indicative of a B1 or B2 channel type which is characterized as moderately entrenched, a slope between 0.02 to 0.039, and with bedrock and boulders as dominant substrate (Rosgen 1996).

The predominant habitat types in this reach were pools (51.6%) and riffles (43.8%) with a small fraction of runs and glides (4.7%) (Figure 2-5). The mean maximum pool depth in this reach was 1.92 ft with the mean pool length at 59.2 ft. The mean instream cover was 37.2% with mean canopy cover at 28.6% (Figure 2-7). Spawning habitat in this reach was fairly abundant but was highly embedded by calcification. Gravel was of low to moderate quality (due to calcification) for steelhead spawning in this reach of North Fork Matilija Creek. The riparian corridor was dominated by alder and willow, with lesser amounts of big leaf maple, oak and sycamore. Mulefat and juvenile alder dominated the riparian understory.

This data indicates that there is abundant high quality steelhead rearing habitat available during low flow conditions. The limiting factor in this reach is the lower percentage of canopy cover to maintain cool water temperatures.

2.3.1.4 Reach D

Reach D is located above the Highway 33 bridge on Bear Creek (Figure 2-3) and is described in Section 2.3.2 below.

2.3.1.5 Reach E

Reach E is located above the barrier within Wheeler Gorge Campground on North Fork Matilija Creek (Figure 2-3). The channel in this reach is indicative of a B2 or B3 channel type which is characterized as moderately entrenched, a slope between 0.02 to 0.039, and with boulders and cobbles as dominant substrate (Rosgen 1996).

Habitat types in this reach were comprised of 44.4% pools, 48.1% riffles, and 7.5% runs and glides (Figure 2-5). The mean maximum pool depth in this reach was 1.69 ft with the mean pool length at 45.7 ft. The mean instream cover was 24.8% with mean canopy cover at 43.0% (Figure 2-7). Spawning habitat in this reach was fairly abundant but was slightly embedded by calcification. Gravel is of moderate to high quality for steelhead spawning in this reach, depending on the level of calcification. Riparian composition in this reach was typical of the larger watershed with dominant alder cover and lesser amounts of willow, sycamore and coast live oak. A minimal amount of algal growth was evident within the campground in Reach E.

This data indicates that there is moderate amount of high quality steelhead rearing habitat available during low flow conditions. Habitat quality is high but steelhead production would be limited by the smaller pool volume relative to other reaches, and lower percentage of instream cover.

2.3.1.6 Reach F

Reach F is located above the Highway 33 bridge on North Fork Matilija Creek (Figure 2-3). The channel in this reach is indicative of a A2 or G2 channel type which is characterized as entrenched, a slope between 0.04 to 0.099 (A2) or 0.02 to 0.039 (G2), and with boulders as the dominant substrate (Rosgen 1996). There was a fair amount of instream gravel in this section that would be available to steelhead for spawning.

Habitat types in this reach were comprised of 44.0% pools, 52.0% riffles, and 4.0% runs and glides (Figure 2-5). The mean maximum pool depth in this reach was 1.68 ft with the mean pool length at 46.7 ft. The mean instream cover was 25.2% with mean canopy cover at 50.0% (Figure 2-7). Spawning habitat in this reach was fairly abundant but was slightly embedded by calcification. The most common riparian species were represented in this reach, with dominant alder cover and lesser amounts of willow, sycamore and coast live oak.

This data indicates that there is moderate amount of high quality steelhead rearing habitat available during low flow conditions. Overall habitat quality is high but the amount of space is limited by small pool volumes and less instream cover.

2.3.2 BEAR CREEK

No published habitat studies have been conducted on Bear Creek yet the results of this survey document that it contains suitable spawning and rearing habitat for steelhead trout. A spring feeds Bear Creek in its headwaters creating perennial conditions that are important to steelhead spawning and rearing success in this region.

Instream habitat consisted of primarily step-runs and pools and low gradient riffles (Photos 10,11,12). The upper half of Bear Creek was Rosgen channel type was A, characterized by an entrenched channel in the headwaters, while the lower half of the surveyed reach was channel type Bm characterized by a moderately entrenched channel. The instream substrate consisted of primarily cobble and boulder with abundant gravel beds (Photo 9). The riparian corridor was very dense with good canopy cover throughout the stream channel. Riparian composition in the surveyed reach of Bear Creek was characterized by alder and willow species, which displayed alternating dominance. Towards the upstream end of the reach species such as California bay, coast live oak and big leaf maple became increasingly common. Cottonwood was rare. Instream cover consisted primarily of boulders, rootwads, and overhanging banks. Stream flow was measured at approximately 0.6 cfs in Bear Creek.

Stream temperatures during our survey ranged from 10.0^{o}C (50.0^{o}F) in the late morning when the air temperature was 14.0^{o}C (57.2^{o}F) to 15.0^{o}C (59.0^{o}F) in the late afternoon when the air temperature was 20.0^{o}C (68.0^{o}F); all within ranges suitable for steelhead (see Appendix C). Canopy cover and instream cover are sufficient throughout Bear Creek to maintain adequate temperatures for steelhead trout. A few trout measuring approximately 2 to 3 inches and a single spawning redd were observed in Bear Creek. The redd was constructed with small clean gravel at the tail of a main channel pool located upstream of the Highway 33 crossing.

At this time the fair weather crossing in Wheeler Gorge Campground (Photos 23,24) is likely a complete migration barrier impeding steelhead access to the headwaters of the North Fork Matilija and Bear creeks. Additionally, two small, fair-weather crossings exist on Bear Creek within the Wheeler Gorge Campground (Photo 25, 26). These crossing are low flow barriers.

2.3.2.1 Reach D

Reach D is located above the Highway 33 bridge on Bear Creek (Figure 2-3). The channel in the lower 50% of this reach is indicative of a B4 or B4-a channel type which is characterized as moderately entrenched, a slope between 0.02 to 0.039 (B4) or 0.04 to 0.099 (B4a), and with gravels as dominant substrate (Rosgen 1996). The channel in the upper 50% of this reach is indicative of a A4 or A2 channel type which is characterized as entrenched, a slope between 0.04 to 0.099, and with gravels (A4) or boulders (A2) as the dominant substrate (Rosgen 1996).

Habitat types in this reach were comprised of 40.0% pools, 48.0% riffles, and 12.0% runs and glides (Figure 2-5). The mean maximum pool depth in this reach was 1.20 ft with

the mean pool length at 33.4 ft. The mean instream cover was 27.7% with mean canopy cover at 46.9% (Figure 2-7). Spawning habitat in this reach was fairly abundant but was slightly embedded by calcification.

This data indicates that there is moderate amount of high quality steelhead rearing habitat available during low flow conditions. The limiting factors in this reach are small pool volumes and less instream cover which limit the amount of rearing habitat available to steelhead.

2.3.3 SAN ANTONIO CREEK

Data collected during this study indicated that there is only marginal spawning and rearing habitat available to steelhead in San Antonio Creek. This is mainly due to development adjacent to the stream, cattle grazing, exotic plant species including large patches of giant reed (*Arundo donax)* and watercress (*Rorippa nasturtum-aquticum*), high substrate embeddedness, lack of deep pools and instream cover, and numerous road crossings which restrict fish movement at lower flows.

San Antonio Creek was dominated by riffle habitat (52.1%; Photo 13, 19; Figure 2-6) followed by almost equal portions of runs and glides (Photos 14, 17) and pools (Photos 15,16) at 24.9% and 23.0%, respectively. Due to an abundance of watercress within portions of the channel, it was difficult to accurately quantify the instream substrate (Photo 18). Watercress was not included as instream cover because it only exists during low flows. However, it should be noted that during this survey watercress contributed approximately 80% to 100% instream cover in reaches A, B, and D. The substrate that was visible consisted mainly of boulders, cobbles, gravels, and some sands. The most abundant spawning substrate was found below Reach A at the confluence with the Ventura River and in reaches D and E. The substrate in Reach C consisted almost entirely of bedrock. Cattle grazing also heavily impacted this section. Each reach was impacted to some degree by fine sediments consisting mainly of sand with some silt. These fine sediments can suffocate steelhead spawning redds reducing the chance for survival at hatching and can decrease food production in riffles.

Stream temperatures during the survey ranged from 15.0^{o}C (59.0^{o}F) in the late morning when the air temperature was 17.0^{o}C (62.6^{o}F) to 27.5^{o}C (81.5^{o}F) in the late afternoon when the air temperature was 32.2^{o}C (90.0^{o}F). Temperatures during this survey exceeded the preferred range for steelhead and, at times, were potentially lethal (see Appendix C). It must be noted, however, that temperature was taken at one location and therefore does not thermal variation within the reach, nor the potential for thermal refuges. However it does suggest that temperature is likely a limiting factor for steelhead use of this tributary.

Human disturbance adjacent to the stream was evident in all reaches surveyed. In some instances, property lines extended to the bank of San Antonio Creek where riparian species were absent. Canopy cover and instream cover was minimal throughout most of the channel. The riparian corridor was primarily dominated by native species such as willow (*Salix sp*.), alder (*Alnus rhombifolia*), and cottonwood (*Populus fremontii*). Two

exotic species were prevalent throughout the surveyed reaches; these were giant reed, which occupied mid and upper level stages in the corridor, and watercress. Instream cover consisted primarily of boulders and overhanging banks and the seasonal presence of watercress.

Four Arizona-low flow crossings were observed within San Antonio Creek from the Old Creek Road crossing (Reach A) to Ten-Mile Curve (Reach E) (Photos 29-32). More crossings of this type may exist on private property that were not surveyed due to access issues. The crossings observed are most likely migration barriers during dry years that lack sufficient flows for upstream migration (i.e. during low-flow conditions only). A severe, and likely complete, upstream migration barrier exists in the Soule Park Golf Park Course in Ojai (Photos 33,34). This assessment is based on professional judgement of ENTRIX fisheries biologists because of the approximately 11-foot drop between the top of the structure and the downstream channel, and the broad, flat nature with which water would flow over the surface of the structure.

Steelhead/rainbow trout sightings by DFG and NMFS biologists (Cooper and Polakovic 1999, NMFS date unknown, a) at a pool directly downstream of the Soule Golf Course barrier suggest road crossings below this point do not block upstream migration of adult fish. The location of this barrier is on San Antonio Creek directly downstream of its confluence with Thacher Creek. Consequently, this structure is a migration barrier to upstream habitat on San Antonio Creek and Thacher Creek, potentially at all flows.

2.3.3.1 Spot Check Surveys

Spot check surveys were conducted to access the presence of perennial headwater conditions upstream from dry channel reaches. Perennial conditions that can provide a refuge to steelhead can often persist in headwater reaches of tributaries that de-water further downstream where they have a broader alluvial aquifer. Spot checks were limited to areas that were readily accessible and therefore do not reflect conditions that may occur in the steeper canyons in Los Padres National Forest. A list of locations where spot checks were made is provided in Table 2-1.

Spot checks in the upper San Antonio Creek watershed and its tributaries including Thacher Creek, Reeves Creek, and Lion Creek indicated that most of these streams are ephemeral in nature in the reach observed (i.e. the portion that crosses the Ojai Valley). Reeves Creek (see Figure 2-4) did sustain low flow during the initial survey but was dry on subsequent spot checks. The upper headwaters of San Antonio Creek and its tributaries were not observed as part of this study. Historically, Gridley Creek was documented to have a steelhead population (NMFS date unknown, b) and perennial conditions may exist in many years (pers. com. P. Jenkin, 2003). It is unknown whether the remainder of the San Antonio Creek headwater tributaries provide perennial habitat nor whether barriers exist in these tributaries within Los Padres National Forest. Additional surveys would be necessary to conclusively determine if the upper headwaters could provide suitable spawning and rearing habitat for steelhead.

Below are detailed descriptions of steelhead habitat available in each surveyed reach of San Antonio Creek.

2.3.3.2 Reach A

Reach A is the lowest section surveyed on San Antonio Creek located upstream of the Old Creek Road crossing (Figure 2-4). The channel in this reach is indicative of a channel type C3 which is characterized as slightly entrenched, a slope between 0.01 to 0.02, and cobbles as the dominant substrate (Rosgen 1996). There was a fair amount of instream gravel in this section that would be available to steelhead for spawning. Additionally, sand comprised between 10% and 30 % of the substrate matrix in this reach.

Habitat types in this reach were comprised of 44.5% pools, 37.0% riffles, and 18.5% runs and glides (Figure 2-6). The mean maximum pool depth in this reach was 0.85 ft with the mean pool length at 79.3 ft. The mean instream cover was 23.1% with mean canopy cover at 35.8% (Figure 2-8). Spawning habitat in this reach was fairly abundant but was slightly embedded by sand substrate. Gravel is abundant and of high quality (good size, low embeddedness) for steelhead spawning near the mouth of San Antonio Creek and in a small section of the Ventura River below the confluence with San Antonio Creek. Riparian cover was dominated by willow, with *Arundo,* alder and cottonwood present in decreasing abundance. Watercress was prolific within the active channel.

These data indicate that there is low to moderate quality steelhead rearing habitat available during low flow conditions. The limiting factors in this reach are small pool volumes and limited instream cover which reduce the amount of rearing habitat available to steelhead.

2.3.3.3 Reach B

Reach B is located above Crown Hill Ranch on San Antonio Creek (Figure 2-4). The channel in this reach is indicative of a channel C3 or C4 type which is characterized as slightly entrenched, a slope between 0.01 to 0.02, and cobbles (C3) or gravels (C4) as the dominant substrate (Rosgen 1996). There was a fair amount of instream gravel and sand comprised between 10% and 30% of the substrate matrix in this reach.

Habitat types in this reach comprised of 25.0% pools, 42.0% riffles, and 33.0% runs and glides (Figure 2-6). The mean maximum pool depth in this reach was 2.07 ft with the mean pool length at 93.3 ft. The mean instream cover was 14.0% with mean canopy cover at 10.0% (Figure 2-8). Spawning habitat in this reach was fairly abundant but was moderately embedded by sand substrate. Willow dominated the riparian vegetation in this reach. Other species represented included: alder, *Arundo*, sycamore and black walnut.

This data indicates that there is low to moderate quality steelhead rearing habitat available during low flow conditions. The limiting factors in this reach are the lack of instream cover for refuge and canopy cover to maintain cool water temperatures.

2.3.3.4 Reach C

Reach C is located below Rancho Cielo on San Antonio Creek (Figure 2-4). The channel in the lower half of this reach is indicative of a C3 or C4 channel type which is characterized as slightly entrenched, a slope between 0.01 to 0.02, and cobbles (C3) or gravels (C4) as the dominant substrate. The channel in the upper half of this reach to the confluence with Lion Creek is indicative of a C1 channel type which is characterized as slightly entrenched, a slope between 0.01 to 0.02, and bedrock as the dominant substrate (Rosgen 1996). There was a some instream gravel in lower half of this reach and sand comprised between 10% and 30% of the substrate matrix in this reach.

Habitat types in this reach comprised of 46.0% pools, 35.0% riffles, and 19.0% runs and glides (Figure 2-6). The mean maximum pool depth in this reach was 1.48 ft with the mean pool length at 97.1 ft. The mean instream cover and mean canopy cover were both 9.2% (Figure 2-8). Spawning habitat in this reach was lacking in abundance and quality for steelhead spawning. This reach was mostly dominated by bedrock substrate with some gravel patches. Canopy cover was very poor in this reach due to livestock grazing. Willow and mulefat were occasionally present in seedling and juvenile stages. There were only rare occurrences of mature, established trees (sycamore, willow and coast live oak), but the relatively wide nature of the stream did not allow for provision of shade cover.

This data indicates that there low quality steelhead rearing habitat available during low flow conditions. The limiting factors in this reach are the lack of instream cover for refuge and canopy cover to maintain cool water temperatures, and the dominance of bedrock in the upper half of the reach where lack of thermal refugia and spawning habitat is an issue.

2.3.3.5 Reach D

Reach D is located at Camp Comfort on San Antonio Creek (Figure 2-4). The channel in this reach is indicative of a channel C4 or C3 type which is characterized as slightly entrenched, a slope between 0.01 to 0.02, and gravels (C4) or cobbles (C3) as the dominant substrate (Rosgen 1996). There was a fair amount of instream gravel in this section and sand was minimal in the reach.

Habitat types in this reach comprised of 33.0% pools, 42.0% riffles, and 25.0% runs and glides (Figure 2-6). The mean maximum pool depth in this reach was 1.76 ft with the mean pool length at 50.1 ft. The mean instream cover was 8.8% with mean canopy cover at 25.0% (Figure 2-8). Spawning habitat in this reach was fairly abundant and of moderate quality due to slight embeddedness. Canopy cover was primarily composed of willow and *Arundo* with some occurrences of sycamore. *Arundo* was very dense along the banks of the creek limiting growth of other riparian vegetation. Watercress was prevalent throughout this reach, and commonly chokes the margins of the channel where water velocities were low.

This data indicates that there is low quality steelhead rearing habitat available during low flow conditions. The primary limiting factor in this reach is the lack of instream cover for refuge although additional canopy cover would also improve conditions.

2.3.3.6 Reach E

Reach E is located at 10-mile curve on San Antonio Creek (Figure 2-4). The channel in this reach is indicative of a channel type C3 which is characterized as slightly entrenched, a slope between 0.01 to 0.02, and cobbles as the dominant substrate (Rosgen 1996). There was a fair amount of instream gravel in this section although sand and silt comprised between 10% and 30% of the substrate matrix in this reach.

Habitat types in this reach were comprised of 33.0% pools, 56.0% riffles, and 11.0% runs and glides (Figure 2-6). The mean maximum pool depth in this reach was 1.40 ft with the mean pool length at 45.7 ft. The mean instream cover was 22.2% with mean canopy cover at 20.0% (Figure 2-8). Spawning habitat in this reach was fairly abundant but of poor to moderate quality due to sand and silt infiltration of spawning gravels (Photo 20). *Arundo* was widespread throughout this reach, with alder, willow and sycamore also present. Watercress was common in the wetted channel.

These data indicate that there is low to moderate quality steelhead rearing habitat available during low flow conditions. The limiting factors in this reach are the lack of instream cover and canopy cover, and smaller pool volumes.

2.4 DISCUSSION AND RESTORATION RECOMMENDATIONS

2.4.1 NORTH FORK MATILIJA CREEK

Data collected during this study indicate that there is good spawning and rearing habitat available to steelhead in North Fork Matilija Creek. Perennial flow, good canopy cover, instream cover, and water quality, and sufficient spawning substrate yields good spawning and rearing habitat quality for steelhead in North Fork Matilija Creek. This creek has the potential to play an important role in the steelhead recovery effort in the Ventura River watershed.

Private property and associated development/anthropogenic activity does exist on portions of this creek (Figure 2-9) but most of the watershed is owned and managed by the Los Padres National Forest. A large portion of the North Fork Matilija, especially in the headwaters, is most likely not used for recreational purposes due to its dense riparian zone and inaccessibility. With many Southern California public lands being heavily utilized, these isolated reaches of the North Fork Matilija will more than likely be significant to the spawning and rearing success of Ventura River steelhead.

Observations during this study indicate that the North Fork Matilija Creek has a healthy population of resident rainbow trout. Offspring of resident rainbow trout have been known to exhibit anadromy (see Appendix C) and can therefore serve as a source of fish that will head to the ocean and return to the Ventura River to spawn. Thus, the healthy North Fork Matilija Creek rainbow trout population, combined with access for these fish

to return to this high quality habitat, can ultimately increase the numbers of steelhead in the watershed.

Recommendations for restoration actions in North Fork Matilija Creek include providing access to the upper watershed and Bear Creek at the Wheeler Gorge Campground barrier. Bank stabilization structures need to be restored in Reach A where Hwy 33 is being undercut. This point of scour can become an increasing sediment source in North Fork Matilija Creek.

Calcified gravel bars could be cleaned and replaced in the active channel to improve spawning conditions. This would greatly improve the quality and quantity of spawning habitat in North Fork Matilija Creek. Because the durability of such actions is uncertain and because of the habitat disturbance involved in such efforts, it is recommended that this action not be pursued unless it is determined that spawning gravels limit the production of this system. From the observations made during this survey, that does not appear to be the case although no fish population density study has been conducted.

2.4.2 Bear Creek

Data collected during this study indicated that there is good spawning and rearing habitat available to steelhead in Bear Creek. Perennial flow, good canopy cover, good instream cover, cool water temperatures (thermal refugia during summer months), good water quality, and good spawning and rearing habitat, make Bear Creek important to steelhead recovery in the Ventura River watershed.

Bear Creek can only be accessed by people from the Highway 33 bridge however lush riparian vegetation makes access difficult. With heavy impacts to other streams in the Ventura River watershed, this isolation will more than likely contribute to the spawning and rearing success of Ventura River steelhead

The only recommendation for restoration actions in Bear Creek would be to create access to steelhead by constructing a fish passage structure at the Wheeler Gorge Campground barrier and improve access at the two road crossings within the campground that cross Bear Creek itself.

2.4.3 San Antonio Creek

Data collected during this study indicate that there is only marginal spawning and rearing habitat available to steelhead in San Antonio Creek. This is mainly due to development and landowner activities adjacent to the stream, cattle grazing, exotic plant species including large patches of giant reed and watercress, high substrate embeddedness due to the mobilization of fine sediments, and numerous low-flow barriers (road crossings).

Even with the poorer quality habitat, San Antonio Creek is important to Ventura River steelhead production and recovery. It is the most downstream tributary in the Ventura River watershed that is used by steelhead and is currently the only tributary accessible to steelhead spawning and rearing habitat in the Ventura River watershed (NMFS date unknown, a). Isolated steelhead/rainbow trout sightings (NMFS date unknown, a) still

occur in San Antonio Creek which is evidence that steelhead/rainbow trout continue to attempt to use spawning habitat to reproduce in this heavily impacted creek. No steelhead/rainbow trout were sighted during the San Antonio Creek survey.

Stream restoration in areas where the highest quality habitat still exists in San Antonio Creek could increase the numbers of successful adult spawners. This would most likely occur in the upper perennial stretch from above Camp Comfort to the Soule Golf Course in Ojai.

Depending on the quality of headwaters habitat, tributaries to San Antonio Creek may have limited utility in the recovery of Ventura River steelhead. Dry conditions in San Antonio Creek starting upstream of Soule Park, Thacher Creek, Reeves Creek, and Lion Creek along with migration barriers and poor habitat quality give the portion of these tributaries near the Ojai Valley limit the usefulness of these areas for steelhead spawning and rearing. The potential, remains, however, for these tributaries to be useful to steelhead as migratory corridors to upstream, headwaters habitat if the upstream habitat is found to have suitable habitat structure and perennial flow. As noted above, available information currently suggests that only Gridley Creek historically provided habitat for steelhead (NMFS date unknown, b) and currently maintains perennial conditions (pers. com. P. Jenkin, 2003). Until further information is known about the condition of the remainder of these headwaters tributaries, modification of the majority of the passage barriers within the Ojai Valley is not recommended. Projects that would improve access to Gridley Creek are recommended for inclusion, however, because of the limited amount of habitat available, such projects are not considered a high priority.

Further study to assess the existence, quality, and quantity of perennial steelhead habitat in the headwaters of San Antonio Creek within Los Padres National Forest is warranted. If perennial habitat does not exist or habitat quantity is limited, then modifying barriers in the Ojai Valley would not be warranted given the numerous barriers (Figure 2-10) and high cost of modifying existing road structures. Low flow barriers located in the perennial reach downstream of the Soule Park Barrier should be modified in the future to improve connectivity between habitats for steelhead adults and juveniles during low flow conditions.

In addition, the eradication of giant reed would be instrumental in restoring native riparian species in San Antonio Creek. Native riparian restoration would improve canopy cover possibly lower water temperatures and eliminate sediment sources which will improve steelhead spawning and rearing success. The establishment of grazing buffers to keep cattle out of the stream channel will improve water quality and the restoration of native riparian species. Once bank stability, riparian restoration, and grazing buffers have been obtained, then instream modifications such as increasing pool depths, introducing plunge pool habitats, gravel cleaning, and introducing instream structure would be feasible.

3.1 INTRODUCTION

The overall purpose of this effort was to take the next step in moving towards an understanding of what actions could be undertaken within the watershed to restore steelhead habitat in the Ventura River. The objective of the project was to define and prioritize, to the extent possible, project-specific activities that could enhance steelhead habitat and conduct public outreach to improve enhancement opportunities in the Ventura River watershed. In this section, a summary of the available information pertaining to steelhead habitat quality and quantity is first presented. Limiting factors for steelhead and steelhead habitat enhancement opportunities are outlined. Finally, the general recommendations presented in the Restoration Plan have been refined, based upon the new information and discussions with resource agency staff, the Cooperating Agencies, and members of local non-governmental agencies. These recommendations are presented in Section 3.4 below.

3.2 INFORMATION SOURCES

Information is available from various sources regarding the stream habitat conditions in the Ventura River watershed. It should be pointed out that many of these sources provide a snap-shot look at the habitat conditions at the time of the survey; and therefore, do not completely express the range of habitat conditions possible given the widespread variability of streamflows that occur. In some cases, streams which appear to have poor habitat for steelhead in a year with low flow conditions, may provide extremely good habitat conditions (and associated steelhead production) in years with adequate streamflows. Steelhead have evolved to be adapted to the episodic natural events that alter habitat conditions.

Sources from which information was synthesized included:

- DFG notes for site visits to the Ventura River, Matilija and North Fork Matilija creeks between 1947 and 1956 were reviewed. These notes pertain mostly to streamflow and habitat conditions as they relate to trout stocking and suitability for a recreational fishery. Little habitat detail is included in these notes, but some general habitat information is provided.

- More recent habitat studies have been conducted in the Ventura River in the live reach near Casitas Springs, the reaches upstream of the Robles Diversion Dam, and Matilija and North Fork Matilija creeks (Moore 1980; Casitas and City 1984: City and Casitas 1990, and 1991; DFG unpublished preliminary data from 1993; Capelli 1992; Carpanzano 1996; Fugro West Inc. 1996; Chubb 1997; and Capelli 1997).

- A field reconnaissance conducted during the first week of April 1997 in the Ventura River watershed summarized in the Restoration Plan (ENTRIX and WCC 1997). The

reaches surveyed included Matilija Creek down- and upstream of Matilija Dam approximately 5 miles; North Fork Matilija Creek upstream to its headwaters; Coyote Creek downstream of Casitas Dam; and all of the mainstem Ventura River.

- United States Forest Service (USFS) habitat survey information and aerial photography describing the habitat conditions on the tributaries to Matilija Creek (USFS file data).

- Steelhead habitat survey conducted in May 2000 using DFG protocols studied portions of the Ventura River (Highway 101 Bridge to the confluence of Matilija Creek and North Fork Matilija Creek) (ENTRIX 2001).

- North Fork Matilija Creek, Bear Creek, and San Antonio Creek habitat and passage studies using DFG protocols summarized in Section 2.

- NMFS's "Current Stream Habitat Distribution Table" for the Southern California steelhead ESU (NMFS date unknown, a).

- Algae inventory conducted by the Ojai Valley Sanitary District in 2001 and 2002 (URS 2002).

- Water quality monitoring data for the watershed collected by Santa Barbara ChannelKeeper and the Matilija Coalition (2002).

3.3 SUMMARY OF CONDITIONS AND LIMITING FACTORS WITHIN THE WATERSHED

This section provides a summary of existing conditions within the Ventura River watershed, as determined from a review of the sources identified in Section 3.2, and outlines how these conditions can limit steelhead production within the watershed. Limiting factors affect the suitability of habitat for use by steelhead at one or more stages of their lifecycle. Analysis of existing conditions and limiting factors is key to identifying where potential enhancement activities could result in improved conditions for steelhead. Specific recommendations about enhancement activities that should be pursued and the priorities for completion of recommended projects is presented in Section 3.4.

In general, detailed analysis of habitat in the Matilija Creek and Coyote Creek watersheds (Figure 3-1) was not included in this synthesis. Available information was summarized in the Restoration Plan. Removal of Casitas Dam, which would restore access to the Coyote Creek watershed, remains infeasible for the reasons outlined in the Restoration Plan (see also Section 3.4.1). Habitat studies are currently underway in Matilija Creek as part of the Matilija Dam feasibility study. That process is designed to weigh the biological benefit of restoring access to Matilija Creek, above the dam, against potential costs and environmental impacts associated with dam removal. That process is the more appropriate place to evaluate this keystone steelhead enhancement project that would make these habitats accessible to steelhead and therefore this habitat is not discussed in

detail in the summary below. Although the barrier presented by Matilija Dam, and the relative benefits of removal based on existing information, is still discussed.

3.3.1 MIGRATION BARRIERS

Migration barriers are frequently one of the most easily identifiable and most important limiting factors for steelhead because they can prevent or impair access to otherwise suitable habitat. The majority of steelhead habitat loss throughout their range, and especially in the Ventura River, is due to the construction of man-made migration barriers. Natural barriers to migration also exist in the Ventura River watershed, typically in the form of low-flow barriers (places in the river, typically at riffles, where flow becomes too shallow at lower flows for fish to pass) or waterfalls and cascades which prevent further upstream migration. The latter are typically found in the headwaters and often do not warrant physical modifications due to the limited amount of habitat such efforts would make accessible. Modification of man-made barriers, however, is frequently one of the most cost effective methods of restoring steelhead habitat.

Table 3-1 presents a summary of migration barriers based on the review of available information and site-specific surveys conducted as part of this study. Figure 3-2 shows the location of these barriers within the watershed. Table 3-1 summarizes barriers in tributaries that have historically or recently documented steelhead/rainbow trout production (e.g. mainstem Ventura River, Matilija Creek, North Fork Matilija Creek, San Antonio Creek watershed, and Coyote Creek). These passage barriers were evaluated to estimate the biological benefit of removing or modifying these structures to provide or improve passage. Table 3-1 ranks all barriers for which there was sufficient information. Barriers were ranked based on the amount and suitability of habitat that could be made accessible and the degree to which that habitat is already accessible (i.e. the severity of the existing barrier).

In general, complete barriers received a higher priority and low-flow impediments received lower priorities because they already allow some access to upstream habitat. Where low-flow barriers limit the ability of fish to distribute to habitat with better quality up and/or downstream of the site, a medium priority was established. The severity of the barriers were determined based a number of factors including the height of the jump from the downstream pool to the top of the barrier, the depth and size of the downstream jump pool, anticipated velocity and depth of flow over the surface of the barrier, and the presence of alternate routes at higher flow levels (i.e. at higher flows, side channels that provide access could be available). Where the suitability of upstream habitat is currently unknown, barriers were not given a priority and the need for information on upstream habitat was noted in the comments section.

Existing barriers currently limit the distribution of steelhead to the mainstem Ventura River below the Robles Diversion Dam, San Antonio Creek below the Soule Park Golf Course Crossing (except, perhaps, under high flow conditions), and Coyote Creek downstream of Casitas Dam. In addition, there are numerous barriers in the Ojai Valley

(Figure 3-2) making restoration of access to habitat that could potentially existing within the headwaters located in Los Padres National Forest more difficult and costly.

3.3.2 STREAMFLOW

The Ventura River watershed receives the majority of its precipitation in the winter/spring months and then experiences prolonged periods where there is little or no rainfall (see Section 2 in ENTRIX and WCC 1997 for a detailed description of the basin's hydrology). Even in typically perennial reaches, the amount of flow varies considerably with rainfall and the status of the groundwater aquifers located in the alluvial valleys (Figure 3-3). Lack of surface flows can occur during summer and fall in many reaches of the Ventura River watershed. Lack of flow or low flow conditions in the summer and fall limit the amount of rearing habitat available, reduce the amount of aquatic invertebrate transport, and usually result in increased stream temperatures. Low flow conditions during winter and spring can produce shallow conditions that restrict or impair adult upstream and downstream migration and smolt downstream migration. In addition, several reaches within the Ventura River watershed may provide spawning habitat when winter flows are present, however some of these areas can dry up decreasing the production from these reaches unless offspring successfully migrate to perennial reaches (Figure 2-1). For these reasons, streamflow is a critical indicator of areas that have the potential to provide spawning and rearing habitat for steelhead.

Some reaches of the mainstem Ventura River tend to go dry on a yearly basis. This typically includes the Ventura River reach in the area of Santa Ana Road upstream to approximately the Robles Diversion. The upper Ventura River reach from the confluence of Matilija and North Fork Matilija creeks downstream to the alluvial aquifer (Figure 3-3) and, in wetter years, to the Robles Diversion can maintain perennial flow as can the "live reach" beginning about ½ mile upstream from the confluence with San Antonio Creek and running downstream to Foster Park; although the extent of these reaches is determined by rainfall and antecedent groundwater conditions. The extent to which the live reach historically existed, prior to the construction of the sub-surface dam is unknown. Finally, the Ventura River downstream from the Ojai Valley Sanitary District treatment plant to the estuary typically retain flows year round due to releases from the treatment plant. In addition, migration flow conditions can be affected in the mainstem Ventura River by surface diversions of up to 500 cfs by operations at the Robles Diversion Dam.

San Antonio Creek typically goes dry upstream from Soule Park across the Ojai Valley, but is typically perennial downstream to the confluence with the Ventura River. These were the conditions present during the San Antonio Creek habitat assessment conducted for this project. Thacher Creek, McNell Creek, and Reeves Creek typically go dry yearly within the Ojai Valley although Reeves Creek can maintain flow for slightly longer than the other tributaries. No studies have been conducted to assess perennial habitat in the headwaters of these tributaries. As noted in Section 2, historic information (NMFS, date unknown-b) and recent observations (pers. comm. P. Jenkin, 2003) suggests that at least Gridley Creek maintains perennial habitat in many years. Finally, North Fork Matilija

Creek and Bear Creek retain perennial surface flows except, potentially, during long periods of severe drought.

3.3.3 SPAWNING HABITAT

As adult steelhead return from the ocean to complete their lifecycle, they search for spawning habitat with suitable sized, clean gravels and appropriate flow conditions for the redds to be successful (see Appendix C). The habitat assessment conducted on the Ventura River in May 2000 (ENTRIX 2001) describes the quantity and quality of spawning habitat on the mainstem as generally quite low, although this was most likely an underestimate because it did not account for highly embedded gravel and dry gravel bars. The best known mainstem spawning habitat (i.e. redds sighted) is near Foster Park. Reeves Creek within the Ojai Valley may provide some spawning habitat as gravels were present (ENTRIX 2001), however it is uncertain whether redds would be successful because this creek typically dries.

The results of the recent habitat analysis suggest that San Antonio Creek provides moderate spawning habitat in terms of quality and quantity. Quality is decreased by the presence of fine sediments which embed the gravels and reduce water circulation which is important to successful egg incubation (see Appendix C). Further, higher water temperatures in San Antonio Creek could decrease the survival of steelhead eggs.

North Fork Matilija Creek and Bear Creek generally provide high quality spawning habitat, although some gravels within the North Fork Matilija Creek drainage would not be available for use due to their embedded nature. Because of the small size of the current steelhead population, the amount of spawning habitat is not anticipated to be the limiting factor for this population within the Ventura River watershed. Over time, as steelhead numbers increase, this conclusion will need to be re-evaluated.

3.3.4 WATER QUALITY

Suitable steelhead habitat must also have suitable water quality parameters including temperature, dissolved oxygen, and nutrient/pollutant levels. Temperature data collected during the steelhead habitat surveys show that morning temperatures can be several degrees cooler than afternoon temperatures. Water quality data collected by Santa Barbara ChannelKeeper in conjunction with the Matilija Coalition (2002) demonstrate the anticipated seasonal pattern with warmer temperatures in the late spring through fall and cooler temperatures in winter. Temperature measurements can be affected by variations in canopy, water depth, and conditions upstream of the sampling sites. Because of this, existing temperature data provide some indication of conditions to which fish may be exposed, however a reading at a single point that exceeds the theoretical thermal maximum for steelhead/rainbow trout does not mean that the entire reach of river could not support trout.

In general temperatures in the Ventura River watershed can be at the higher end of the range of steelhead tolerance levels during the low-flow summer season. The May 2000 (ENTRIX 2001) survey of the mainstem found that water temperatures in the afternoon

ranged from 23 to 25 ºC (73.4-77 ºF) temperatures that are stressful to steelhead. These are consistent with mainstem temperatures recorded during the August 2001 algae study (URS 2002). ChannelKeeper data show slightly lower, but still stressful maximum temperatures (20-22 ºC; 68-71.6 ºF), however the majority of this data was collected before noon when temperatures had not yet achieved their daily high values. For the mainstem, on average, water temperatures at ChannelKeeper's sampling sites were in the 15 to 18 ºC (59-64.4 ºF) range.

Studies in the mainstem (Moore 1980) have shown that steelhead in the live reach of the Ventura River (near Casitas Springs) had growth rates similar to or higher than those observed in other populations. This indicates that there was sufficient food production during that study to offset the high water temperatures even during drought conditions. These results suggest that while higher temperature may degrade the habitat quality in the live reach for steelhead, steelhead can still use this habitat for rearing.

The results of the habitat study presented in Section 2 demonstrate that temperatures are generally suitable in North Fork Matilija and Bear creeks. ChannelKeeper data from their monitoring site in lower North Fork Matilija Creek confirm this with a mean temperature of 16 ºC (60.8ºF) and a maximum of just under 20 ºC (68ºF).

Temperatures during the San Antonio Creek survey for this project exceeded the thermal maxima generally accepted for steelhead suggesting that temperature may limit steelhead use of this habitat. ChannelKeeper data shows average temperatures at their sites for 2001 were between 15 and 18 ºC (59-64.4 ºF) with maximum ranging from 19 to 23 ºC (66.2-73.4 ºF) depending on the sites.

Dissolved oxygen, nutrients, and other toxic pollutants were not measured as part of either of the recent steelhead habitat surveys and data was not available to assess whether dissolved oxygen conditions could limit steelhead use of habitat. ChannelKeeper (2002) data found an increase in nitrate levels during the summer at the San Antonio Creek watershed sites. Phosphate levels did not increase in the water quality sampling. In general, nutrient loading and associated negative impacts on dissolved oxygen are anticipated primarily in the San Antonio Creek basin because of the presence of horse and cattle operations in and adjacent to the creek.

3.3.5 POOL HABITAT

Steelhead frequently use pool habitat for rearing, especially as fish grow larger over the course of the rearing season. Pool habitat provide the necessary water depth, cover elements, and food source/transport (at the head of the pool) for successful rearing. Pool habitat in the mainstem Ventura River is deeper and more frequent in reaches above Foster Park although there is some good pool habitat in the Shell Pool area near Brooks Institute in the lower river. Run and riffle habitat are the dominant habitats in the mainstem Ventura River.

San Antonio Creek lacks good, deep pool habitat mostly due to fine sediment aggradation, and anthropogenic activities adjacent to the stream including flood control,

grazing, and development. The lower reaches of Thacher Creek, Reeves Creek, and middle reach of San Antonio Creek (in the Ojai Valley) go dry annually so they lack year-round pool habitat that is important for steelhead rearing.

North Fork Matilija Creek has abundant deep pool habitat in the lower reaches within and below Wheeler Gorge Campground. Bear Creek has plenty of pool habitat in the reach surveyed but lacks depths over one foot which can provide refuge. Dense canopy cover and sufficient instream cover compensate for the lack in pool depths. Overall, access to reaches with high quality pool habitat for juvenile rearing is currently limited within the watershed.

3.3.6 FINE SEDIMENTS

Fine sediments can contribute to the lack of pool habitat for rearing steelhead and the embeddedness of spawning gravels which limit their use as spawning habitat. The Ventura River watershed has a naturally high fine-sediment load due to the geologic materials, tectonic lift, periodic forest fires, and natural vegetation types. However, fine sediment input has likely increased from historical conditions because of land use activities including agricultural development, grazing activities, unpaved roads, and extensively developed slopes (including oil field and residential developments) (ENTRIX and WCC 1997).

Fine sediment sources stated above are most evident in the mainstem Ventura River, San Antonio Creek, Thacher Creek, and Reeves Creek. The headwaters reaches of streams in upper Ojai are less developed than the lower reaches so they likely experience less fine sediment input although surveys to confirm this have not been conducted. North Fork Matilija Creek and Bear Creek tend to experience minimal fine sediment loading unless the watershed has been recently disturbed by forest fire.

3.3.7 CANOPY COVER

Canopy from overhanging vegetation shades the stream, which reduces water temperatures and provides cover for fish. Masses of streamside vegetation can trap sediments necessary to build and maintain productive streambanks (ENTRIX and WCC 1997).

The mainstem Ventura River lacks dense overhanging riparian vegetation throughout most of the channel especially after extremely high flood events. This is typical of the mainstem river because of the mobility of the substrate and the braided nature of the river which typically prevents substantial riparian habitat from becoming established on banks of the low-flow channel (ENTRIX 2001c).

Thacher Creek, Reeves Creek, and Senior Canyon lack dense riparian canopy cover as well. It must be pointed out that the headwater reaches of these creeks might support dense riparian canopy and, as noted above, warrant further study. The reach of Lion Creek surveyed in 1997 had a dense riparian corridor which provided abundant shade to the stream (ENTRIX and WCC 1997).

Some reaches of San Antonio Creek especially above Camp Comfort support marginal riparian canopy cover but most of the creek has minimal canopy cover. Canopy cover is fairly dense in most of North Fork Matilija Creek and Bear Creek. This dense canopy cover should provide abundant shade to the stream maintaining low water temperatures important to steelhead survival.

3.3.8 NON-NATIVE SPECIES

Non-native riparian vegetation such as tamarisk and *Arundo* can limit steelhead habitat potential in the Ventura River watershed. In general, these invasive species do not add woody debris to streams or provide shading, and they reduce available surface water and contribute to adverse water temperatures and chemistry (Chubb 1997). In addition, non-native predatory fish such as bass inhabit parts of the watershed and can prey on juvenile steelhead.

Riparian vegetation in many reaches of the mainstem Ventura River is choked with invasive species including *Arundo* and tamarisk. These invasive species also exist on Thacher Creek, Reeves Creek, and Matilija Creek below and above the dam. San Antonio Creek has been highly impacted by invasive species. In some reaches the riparian vegetation is comprised almost entirely of *Arundo* with large amounts of watercress occupying the channel. Riparian vegetation in North Fork Matilija Creek and Bear Creek was dominated by native species which created good canopy cover over both creeks. The overall quality and quantity (due to water losses) of steelhead are affected by the presence of these non-native species which replace native riparian habitat.

Predatory fish (including both large- and small mouth bass) inhabit Matilija and Casitas reservoirs and have been found in stream habitat near these facilities (Chubb 1997). These fish prey on juvenile steelhead. Crayfish have also been observed (Chubb 1997) and are known to prey on eggs and fry in spawning beds.

3.3.9 ALGAE

An algae inventory was conducted by URS Corporation for the Ojai Valley Sanitary District on the lower Ventura River and San Antonio Creek during August 2001 and October 2002 (URS 2002). The results of this study indicate a natural high presence of algae in the mainstem Ventura River above and below Ojai Valley Sanitary District's treatment plant and in lower San Antonio Creek during low flow conditions. High water temperatures, an open canopy during low flow conditions, and nutrient loading facilitate algae growth. High water temperatures occur on the mainstem Ventura River and San Antonio Creek mainly because of a lack of riparian cover which would help maintain cool water temperatures during the hot summer months. The Ojai Valley Sanitary District's two-year study did note that the amount of algae decreased in the second year and was replaced by substantial amounts of vascular aquatic and emergent plants. This transition was facilitated by the lack of flows during winter 2001/spring 2002 which typically would scour the channel of algae and other plant material. Further, no correlation was observed between treatment plant releases and algal abundance.

Algae was not quantitatively assessed during the habitat evaluation conducted for this study. The presence or absence of algae was noted on North Fork Matilija Creek and Bear Creek during the survey. A low presence of algae was evident in all reaches surveyed on North Fork Matilija Creek and Bear Creek. The lack of algal growth is most likely due to cool water temperatures and a fairly well developed canopy. Algae was not readily observable during the 2002 survey of San Antonio Creek because it was replaced by watercress, as was noted in the URS study. Dense algal mats were observed in Lion and San Antonio Creeks during the summer of 2001 (Santa Barbara ChannelKeepers and Matilija Coalition 2002).

3.3.10 Lack of Adults

The Ventura River steelhead population is currently estimated to be comprised of approximately 100 adults (NMFS 1996) although no formal population studies have been conducted in this river. The Ventura River population is severely depressed from historical estimates of 4,000-5,000 adults which were based on streambank observations and discussions with local fisherman (Clanton and Jarvis 1946). Even if habitat is available, population growth can be limited by a lack of returning adult steelhead because fewer eggs and, therefore, offspring are produced. Restoration of the Ventura River steelhead population, and the overall Southern California steelhead ESU, may be limited by the size of the overall population.

3.4 Recommendations

Section 3.3 provides a summary of the key habitat conditions available to steelhead and their distribution within the Ventura River Watershed. For steelhead to successfully complete their lifecycle, they must be able to access spawning habitat that is closely associated with perennial rearing habitat. The habitat must be able to maintain its suitability for one or more years while the offspring rear to smolt size, and then the smolts must be provided an opportunity to emigrate to the ocean. Spawning and rearing habitat must maintain flow and have appropriate gravels, depth, water quality, and instream cover elements to make the habitat suitable for steelhead. The degree to which the latter elements are present in an area determine the quality of that habitat for steelhead. This section outlines which geographic areas within the Ventura River watershed possess the necessary components for steelhead use and therefore have the potential to foster steelhead recovery. This section then presents restoration projects that could enhance steelhead habitat within each of the geographic areas. Priorities are established for both the geographic areas and within-area projects based on the current status of the habitat, the degree to which habitat is currently protected, historic steelhead use, and restoration opportunities.

3.4.1 Priority Areas for Steelhead Recovery

Under current conditions, the available information suggests that steelhead currently have access to habitat areas that have the necessary elements, but are of poorer quality than other areas within the watershed that are not currently accessible. Based on the available information, including the location of perennial habitat, spawning and rearing habitat

currently exists within the upper Ventura River and live reaches of the mainstem, San Antonio Creek downstream of the Soule Park Golf Course barrier, lower Lion Canyon, North Fork Matilija Creek and its tributaries, Matilija Creek and its tributaries (Chubb 1997), and Coyote and Santa Ana creeks above Casitas Dam (Chubb 1997). Of these areas where steelhead habitat of varying quality exists, neither of the areas where the majority of the historic steelhead production occurred (Matilija Creek drainage and Coyote Creek drainage, Clanton and Jarvis 1946) are currently accessible to steelhead. Further, as described in Section 3.3, the habitat that is currently accessible is considered of poor to fair quality while the inaccessible habitat, especially in the Matilija Creek and North Fork Matilija Creek drainages, are of higher quality (see Figures 2-1, 2-2). Therefore, access to suitable habitat is considered the most severe limiting factor for steelhead within the Ventura River system.

Spawning habitat is not abundant within the Ventura River watershed at baseflow conditions, however, it does not appear that spawning gravels are limiting the size of the current steelhead population in the Ventura River. Figure 2-1 shows the locations of steelhead spawning habitat within the Ventura River. Steelhead are currently more limited by the amount of perennial rearing habitat available and the quality of the existing habitat. Figure 2-2 shows the location and extent of rearing habitat or potentially accessible rearing habitat within the Ventura River.

Given the current state of the Ventura River watershed, and the constraints outlined above, geographic areas within the watershed were first prioritized to determine which basins had the best potential for contributing to recovery of steelhead in the Ventura River watershed. The sub-basins within the Ventura River watershed are outlined in Figure 3-1.

Restoration potential was based on the quality and quantity of steelhead habitat that currently exists, the degree to which this habitat is protected and therefore likely to maintain its existing quality, and the need for steelhead populations to be distributed within the Ventura River watershed. Habitat that is currently in good condition was given a higher weight than habitat that is currently marginal. In addition, prioritization of geographic areas were limited to those which had the potential to be accessed in the foreseeable future. The Matilija Creek sub-watershed is considered in the evaluation because a feasibility study to remove Matilija Dam is currently underway and therefore removal of this dam is considered a possibility. However, the Coyote Creek drainage above Casitas Dam was not included in the prioritization because the removal of Casitas Dam is not anticipated to occur nor is providing fish passage at the dam considered feasible[1]. A trap-and-truck operation may be able to restore connectivity between lower Coyote Creek (below Casitas Dam) and Coyote and Santa Ana creeks above Casitas Dam, however analysis of the feasibility, cost, and biological benefits of such a project is beyond the scope of this project. Finally, as outlined in Section 1.4.1 above, guidance

[1] Based on an extensive literature search, no dam structures as tall as Casitas Dam (334 ft. high) have been successfully laddered to date. See also Section 9.2.2 of ENTRIX and WCC 1997.

from DFG (DFG 2001) suggests that restoration actions in lower Coyote Creek are not promising and therefore are not recommended in this report.

Given these constraints, there are three remaining accessible or potentially accessible geographic areas known to currently provide some level of steelhead habitat and therefore have the ability to contribute to steelhead recovery in the Ventura River: upper Ventura River tributaries (including North Fork Matilija Creek, Matilija Creek and their tributaries); San Antonio Creek watershed; and the mainstem Ventura River. Based on the information provided above, these three areas have been prioritized in order of importance for Ventura River steelhead restoration as outlined below.

Priority No. 1 – Upper Ventura River Tributaries

These reaches were identified as the highest priority because of the historic importance of this area to the Ventura River steelhead population, because this habitat is in the process of being made accessible (through Robles Fish Passage Facility project and potentially, through the Matilija Dam Removal feasibility process), and because the habitat values are largely intact, and anticipated to stay intact, due to their location within Los Padres National Forest. In addition, both Matilija and North Fork Matilija creeks currently support healthy rainbow trout populations. The primary limiting factor within this area is access to the habitat. Secondary limiting factors include reduced canopy cover and bank erosion in the lower reaches of North Fork Matilija creek and embedded spawning gravels.

Priority No. 2 – San Antonio Creek Watershed

These reaches were identified as the second priority because of the amount of potential habitat currently accessible within this reach, the general integrity of the channel, perennial conditions, and the potential for restoration actions successfully improve habitat quality. Restoration actions within the San Antonio Creek watershed should be focused on the perennial reaches downstream of the Soule Park Barrier, including the area of relatively higher quality habitat upstream of Camp Comfort. Enhancement activities above the Soule Park Barrier are a lower priority because of the small amount of known habitat that could be provided and the substantial cost and effort associated with providing access to this habitat. Should additional surveys (see Section 3.4.3) determine that there is a substantial amount of high quality, perennial, and accessible habitat present in headwater tributaries to San Antonio Creek, then the priority of potential fish passage enhancement projects in the Ojai Valley (see Table 3-1) would increase.

The goal of restoration efforts in the mainstem of San Antonio Creek would be to improve habitat conditions so that San Antonio Creek would sustain a stable local steelhead sub-population. This goal is consistent with increasing the spatial distribution of populations within the Southern California ESU, a feature important to overall restoration of the Ventura River population and the ESU (62 FR 43937, see page 43949). A sub-population in San Antonio Creek would not be adversely impacted to the same degree by catastrophic events in the upper Ventura River headwaters (e.g. fire) or large

flood events in the mainstem. Therefore, a San Antonio Creek population could serve as an important source population to other areas of the Ventura River, should such large disturbance events occur, contributing to the long-term stability of the entire Ventura River steelhead population. Limiting factors within this reach are habitat quality, especially water quality and sedimentation. Low flow access within the perennial reach of San Antonio Creek is a secondary limiting factor.

Priority No. 3 – Mainstem Ventura River

The mainstem Ventura River was identified as third priority because, while it maintains marginal habitat for steelhead, opportunities to improve habitat conditions within this reach are limited as is the extent of potential habitat. Three key areas within the mainstem have the ability to contribute to steelhead restoration. The live reach portion of the mainstem is one of the few areas within the watershed that currently maintains the existing steelhead population and is therefore considered important to recovery efforts, especially until habitat quality and access can be provided to other reaches. The upper Ventura River reach can provide new spawning and rearing habitat once the Robles Fish Passage Project is complete and requires little enhancement. Finally, the lagoon may be of importance to the steelhead population and should be further studied. The primary limiting factor in this reach is the amount of habitat with suitable structure and water quality, specifically temperature and dissolved oxygen.

It must be noted that while some geographic areas within the Ventura River are considered higher priority than others, all of the areas identified are important to the success of recovery efforts within this watershed. Having multiple geographic areas providing habitat for endangered steelhead limits the potential impact of natural variations in conditions and episodic events like wildfires on the overall population within the river. Therefore, while the prioritization outlined above helps determine priority recovery areas for steelhead, restoration opportunities in lower priority areas should not be neglected.

3.4.2 Priority Restoration Projects within each Priority Area

Each area has different limiting factors and, therefore, the restoration actions associated with them differ. This section outlines the projects recommended for each area and provides a generalized sequencing for projects within the priority area. The combination of the geographic area-priority and the within-area project priority combine to provide a relative indication of which projects within the watershed have a relatively higher priority and which, a relatively lower priority. However, a number of different factors, including cost, access, and opportunity will factor into specific implementation decisions. The prioritizations below are meant to be used as a guideline for assessing relative biological benefit of implementing an enhancement project in the absence of these other considerations.

Projects identified within each geographic area have been prioritized into three “tiers” with “tier 1” are the highest priority. Tiers are based on biological benefit and indicate priority for implementation. All projects identified have biological benefit and therefore

merit consideration for implementation. Where other factors are consistent between projects, then this prioritization would suggest that restoration dollars should first be spent on first tier projects in the area with the highest priority (i.e. Upper Ventura River tributaries). Second tier projects in the first priority area and first tier projects in the second priority area form the next level of priority efforts, and so on. Table 3-2 summarizes the recommended projects for each geographic area, including watershed-wide projects, and their assigned tier.

Tiered rankings were assigned based on the degree to which the project would ameliorate limiting factors within its geographic area. Projects that would address the primary limiting factor were placed in higher tiers while projects that addressed secondary limiting factors were placed in tiers 2 or 3. The degree to which the project addressed the primary or secondary limiting factors was also key. For example, the primary limiting factor in the Upper Ventura River Tributaries is access. Therefore, a project that substantially addressed access issues to this area (e.g. Robles fish passage project) was assigned "tier 1" while a project that only moderately (e.g. low flow impediment on Bear Creek at Wheeler Gorge Campground) improved access was given a "tier 2" ranking.

Numerous potential projects are outlined in the sections below. Cost estimates for the majority of the projects have not been made although some indication of potential costs can be identified through projects that are underway, have been completed, and/or the preliminary cost estimates provided in Appendix A. For example, the construction of the fish passage facilities at the Robles Diversion Dam are estimated to cost approximately six million dollars. Installing a bridge to replace an existing low flow crossing or other structure less suitable for fish passage is typically on the order of a few hundreds of thousands of dollars. Passage can often be improved at smaller low flow impediments on the order of tens of thousands of dollars with minor modifications to the structure or installation of downstream weirs. The cost of habitat enhancement projects, such as bank stabilization work and riparian re-vegetation, depends on the size of the area treated, but is typically also in the tens of thousands of dollars-range. In considering implementation of the projects identified, it is important to consider the potential biological benefit of each project against the project-specific cost in determining whether each project should move forward. Further, projects that benefit steelhead will can also benefit other inhabitants of the aquatic and riparian corridor; both protect species (e.g. California red-legged frog) and other natives. Potential benefits and/or impacts to these species should also be considered in determining if the project should be implemented.

3.4.2.1 Upper Ventura River Tributaries

The primary limiting factor for this high priority area is access to the basin itself although embedded spawning gravel, reduced canopy cover, and bank erosion were localized problems in surveyed portions of North Fork Matilija Creek and Matilija Creek (Chubb 1997). Based on the priorities presented in Table 3-1, there are four "tier 1" barriers in this area that should be addressed. These are presented in order from downstream to upstream, below:

1. The Robles Diversion – This structure currently defines the upstream limit of accessible steelhead habitat within mainstem Ventura River (65 FR 7764). Providing passage at this facility would restore access to approximately 1.6 miles of habitat in the upper Ventura River, 0.6 miles of habitat in Matilija Creek below Matilija Dam, and 4.1 miles of habitat North Fork Matilija Creek (to the Wheeler Gorge Campground barrier). A fish passage facility is slated for construction at the Robles Diversion Dam during 2003-2004.

2. Matilija Dam – This dam currently has little value for production of water and blocks access to one of the two historically most-productive areas in the Ventura River watershed. Matilija Creek upstream of the dam maintains suitable habitat (Chubb 1997) that is protected within the boundaries of Los Padres National Forest. A study is currently underway to determine the feasibility of removing this structure.

3. Wheeler Gorge Campground (North Fork Matilija Creek) - This barrier is in the form of a low flow crossing in the Wheeler Gorge Campground which has been severely downcut downstream creating about a 12-foot drop. Following the completion of the Robles Diversion Fish Passage Facilities, the removal of this barrier would allow access to high quality steelhead habitat in Upper North Fork Matilija Creek and Bear Creek. The U.S. Forest Service has expressed interest in providing passage at this site.

4. Wheeler Gorge Campground (upper North Fork and Bear creeks) - Two potential barriers exist in the form of low flow crossings on Bear Creek and another low flow crossing is located on North Fork Matilija Creek in the Wheeler Gorge Campground. These crossings are estimated to be only low flow passage barriers but could become a more serious problem in the future. In addition, high quality habitat exists in Bear Creek and North Fork Matilija Creek and improving access to this habitat would improve conditions for steelhead.

In addition to allowing physical passage at migration barriers, the flow necessary to provide passage to and from the area must be available for this habitat to be used by steelhead. Migration opportunities within the Ventura River are currently affected by storage of water in Matilija Dam and diversion operations at the Robles Diversion Dam. Storage in Matilija Dam is limited to a few hundred acre-feet and therefore does not substantially alter the migration flow regime in the watershed.

Diversion operations at the Robles Diversion Dam are currently the subject of consultation with NMFS to improve migration opportunities for steelhead in the river downstream of this facility. NMFS has recommended a flow regime designed to enhance migration opportunity relative to existing conditions (NMFS 2002) and the U.S. Bureau of Reclamation (Reclamation) has agreed to provide this flow regime under all conditions except during a prolonged drought (Reclamation 2003). These actions, combined with the construction of the fish passage facilities at the Robles Diversion Dam by Casitas Municipal Water District, are anticipated to restore the ability of steelhead to access the historic habitat above Robles Dam in most years. A substantial monitoring effort is also included in Reclamation's proposal to NMFS for Robles Dam operations. The

monitoring program is designed to evaluate the success of the proposed operational regime, including whether the regime successfully provides a suitable migration opportunity. Therefore, no further flow-related recommendations to enhance migration opportunity are recommended until the operations are implemented and evaluated.

While Matilija Dam does not substantially alter migration flow conditions, releases from Matilija Dam for later diversion at the Robles Dam can result in fluctuating water levels which may affect rearing and spawning conditions within the reach between the two facilities. Operation of Matilija Dam in conjunction with the Robles Facility is anticipated to end with the conclusion of the existing operations agreement (January 1, 2009) and therefore the duration of the existing effects is limited in time. However, it is recommended that operations of Matilija Dam be reviewed to determine if releases should be ramped to reduce potential impacts on steelhead. Such a review is included in the HCP process currently underway and, if necessary, actions will be implemented that are designed to improve conditions for steelhead.

Two mainstem passage enhancement projects are warranted and are discussed here because, while not specifically located in the Upper Ventura River tributaries, these impediments affect access to this important geographic area. Currently a subsurface dam exists at the City of Ventura's surface diversion at the lower end of the live reach. Portions of this dam are being exposed and currently can form a low flow barrier if the channel is oriented such that water flows over the exposed dam. This potential low-flow impediment could limit access to all of the priority reaches identified upstream. Notching of the sub-surface dam could remove this potential impediment. In addition, a concrete-encased pipeline maintained by the Ojai Valley Sanitary District crosses the mainstem just north of the Highway 150 bridge. A portion of this pipeline has been exposed, and, like the subsurface dam, when the low flow channel is oriented so that water flows over the pipeline, a low flow barrier can occur. It is recommended that the Sanitary District work to remove this pipeline from the channel.

The habitat values within this area are largely intact and few site-specific enhancement projects were identified during the project survey. Bank undercutting adjacent to Highway 33 on North Fork Matilija Creek (Reach A, Photo 7) needs to be repaired to minimize erosion and potential road failure. In addition, riparian restoration efforts could benefit the lower reaches (Reach A, B, and C) of North Fork Matilija Creek where lower canopy cover is associated with warmer water temperatures. Such riparian restoration projects should also target areas where bank erosion is contributing sediments to the stream. Comments provided by NMFS further identified the need to revegetate approximately 1/8-mile of stream bank adjacent to the Ojai/Schmidt Rock Quarry along lower North Fork Matilija Creek, a location that currently contributes fine sediment to the tributary (NMFS 2003). Additional site-specific projects will likely be identified during the habitat studies currently underway in Matilija Creek as part of the Matilija Dam Feasibility Study process. These projects should be considered for implementation if Matilija Dam removal becomes a reality.

Finally, there are several activities that could be undertaken on a watershed-wide scale that would benefit this area (see Section 3.4.2.4). Specific applications of these

watershed-wide activities to the upper Ventura River tributaries area include improving management practices adjacent to creeks where private in-holdings are present (Figure 2-9), installation of interpretive facilities along Highway 33 in Los Padres National Forest (a major point of public contact with and access to this important steelhead habitat), and purchasing conservation easements to improve opportunities for fish-friendly riparian and upland land management where private in-holdings exist.

3.4.2.2 San Antonio Creek Watershed

The San Antonio Creek watershed currently exhibits marginal habitat quality for steelhead (see Section 2). The reaches below the Ojai Valley are typically perennial, however this reach is limited by habitat quality due to invasive species, high fine sediment loading, poor canopy cover. Low flow access within the perennial reach of San Antonio Creek is a secondary limiting factor.

A number of passage barriers were identified within this drainage (see Table 3-1). The Soule Park Golf Course crossing, which is likely a barrier at all flows, severely limits the distribution of fish to potential steelhead habitat in this tributaries' headwaters. Numerous additional barriers exist between the Soule Park barrier and Los Padres National Forest (see Figure 3-2). As noted on multiple occasions, additional study of the potential biological benefit (i.e. presence of habitat) of providing access to San Antonio Creek tributary headwaters within the national forest is necessary prior to incurring the substantial cost associated with providing access to these areas. Until such surveys are completed, barriers in these tributaries are not a priority (Table 3-1). Note that barriers limiting access to Gridley Creek, including the Soule Park Golf Course (No.15) and crossing at Grand Avenue (No. 14) were prioritized because perennial conditions and historic habitat are known to exist upstream. Appendix A provides a preliminary examination of the options and cost associated with modification of the Soule Park barrier.

Most of the remaining barriers within the perennial reach downstream of Soule Park are low-flow barriers and do not limit steelhead access to known habitat, however they do limit the ability of steelhead to move to more suitable rearing areas during the low-flow season. In addition, these barriers limit the overall opportunity of adult steelhead to use this tributary as the frequency of moderate to high flow conditions within the Ventura River watershed is limited by the regions climate. Therefore these barriers (Nos. 16 through 20) are worth modifying as opportunities and funding become available, but are considered 2nd tier projects because they do not prevent use of this habitat.

More habitat enhancement projects are recommended for implementation in San Antonio Creek because of the lower quality of this habitat, relative to the upper Ventura River tributaries. Habitat restoration efforts should first be focused on the removal of non-native species (both plant and wildlife) and managing sources of nutrient, pollutant, and sediment loading. With landowner cooperation, numerous types of projects could be implemented. Removal of non-native vegetation, bank/riparian stabilization and revegetation projects using native species, and an assessment of sediment, nutrient, and pollutant sources would be beneficial enhancement actions that would address limiting

factors for steelhead within this reach. Several specific locations of severe erosion (Photo 17) and potential nutrient loading were identified during the habitat study undertaken as part of this project and others are likely to exist in reaches not surveyed. Benefits to steelhead habitat quality from these types of activities will result from a cumulative effort to implement enhancement projects on numerous properties within the watershed.

Because San Antonio Creek is largely in private ownership, achieving these goals should be accomplished through a targeted landowner education and outreach program designed to (1) provide resources for landowners to implement projects and proper management practices on their properties, (2) provide access to their lands for others to undertake enhancement projects, and (3) encourage collaboration between landowners, the Ojai Valley Land Conservancy, and project proponents to obtain conservation easements so that appropriate management can be implemented. Finally, as with the other priority areas, San Antonio Creek would benefit from the watershed-wide efforts outlined in Section 3.4.2.4 including flood-plain management activities, public education and outreach, and removal of non-native vegetation.

Once these key limiting factors have been addressed, habitat improvements targeted at improving the types of habitat available to rearing steelhead (e.g. installing pool forming structures), improving habitat complexity (e.g. installing root wads or other cover elements), and/or improving spawning habitat quality (e.g. cleaning spawning gravels) have the potential to succeed. These types of habitat enhancement measures are currently considered "tier 3" priority because of they are less likely to be successful until the underlying problems are addressed.

3.4.2.3 Mainstem Ventura River

The mainstem Ventura River is the third priority geographic area for enhancement activities. The mainstem includes both perennial and non-perennial reaches and portions are used for steelhead rearing (e.g. upper Ventura River reach, live reach, and potentially, the lagoon) while other areas are primarily used as migratory habitat (e.g. mainstem between Foster Park and the lagoon, upstream of the live reach). The primary limiting factors within the mainstem perennial reaches are the amount of habitat with suitable structure (e.g. reduced canopy cover, lack of pool habitat) and water quality (e.g. temperature and dissolved oxygen).

Opportunities for improving rearing habitat conditions within the upper Ventura River reach and the live reach are limited by the natural structure of this channel (broad and braided), the highly mobile substrate, and periodic flood flow conditions. Opportunities that do exist include creating additional habitat structure at stream margins through riparian vegetation restoration, reduction of in-channel maintenance activities (especially in the live reach), appropriate flood plain management, installation of instream habitat structures, installation of interpretive facilities, and review of the timing and magnitude of water extraction from these reaches. Conversely, efforts to create more pools (e.g. by installing pool-forming structures) are not likely to be successful because of the natural conditions the mainstem is subject to including the highly mobile bed substrates and periodic flood flow conditions. In addition, opportunities to decrease water temperatures

are limited by the broad nature of this channel (i.e. riparian vegetation would not be able to sufficiently shade the channel to reduce water temperatures).

Opportunities for improving baseflow conditions in the lower mainstem are limited due to the nature of the Upper Ventura River groundwater aquifer which naturally drains over time creating the perennial habitat in the live reach (ENTIRX 2001b). A part of the Ventura River HCP process (see Section 1.2) is to determine appropriate changes to the amount and timing of water withdrawals and releases within the live reach (i.e. water extract by the City of Ventura). Modifications to the City's existing surface and subsurface water extraction activities are being considered. Through the Ventura River HCP, specific changes, if any, necessary to improve baseflow conditions in the live reach will be developed. The HCP, when implemented, is therefore anticipated to result in improved flow conditions within the live reach of the Ventura River. At this time, this effort is considered a "tier 1" priority and it is recommended that this existing process to determine any necessary changes in water withdrawal move forward, be implemented, and adequately monitored prior to any further flow recommendations.

As noted above, habitat enhancement opportunities in the upper Ventura River and live reach are limited by the geomorphology of the mainstem river (ENTRIX 2001c), however there are actions that could be implemented to improve the quality of this habitat and therefore the quantity of suitable habitat. The City of Ventura's main water supply facilities are located in the live reach near Foster Park. These facilities consist of surface and subsurface diversions and a number of wells. The City regularly accesses their facilities in the channel for maintenance and has constructed training dikes to direct water to the surface diversion in recent years. These activities can substantially alter the habitat structure in this perennial reach and can potentially result in direct adverse effects to steelhead rearing habitat in this reach. The City is actively investigating the feasibility of removing the in-channel facilities that require vehicular access and substrate movement for maintenance.

The highly mobile sediment within the Ventura River has the ability to scour riparian vegetation and therefore it is currently uncertain whether revegetation efforts would be successful. However, since canopy cover and the associated stream-margin habitat structure it provides is a limiting factor within these reaches, and because the perennial conditions would provide the vegetation with the necessary water source, riparian re-vegetation may be a viable option. In addition, installation of instream habitat structures that could improve complexity of habitat or create localized scour pools may also be warranted. Such projects also may not be as durable as other projects identified because of the geomorphology of the river. However, such projects are also fairly inexpensive and can be implemented along with associated riparian revegetation or bank stabilization projects. Opportunities for these stream-margin habitat improvement projects to have biological benefit would be increased if they were completed at locations adjacent to spawning habitat.

Because of the uncertainty that riparian revegetation and in-channel habitat enhancement projects would be durable, it is recommended that such efforts be initially limited to a pilot projects conducted with associated multi-year monitoring to assess project success

(both durability and biological benefit). If the projects are successful, more widespread riparian restoration and/or in-channel habitat enhancement efforts would be warranted. NMFS (2003) notes that re-vegetation efforts are warranted along the two-mile long flood control levee in Casitas Springs and adjacent to the Casitas Vista Bridge at Foster Park. A portion of this levee or restoration adjacent to the bridge would be appropriate locations for the pilot project. Further, to the extent practicable, efforts should be made to retain existing riparian vegetation in any future bank stabilization efforts.

As with other watershed-wide activities (see Section 3.4.2.4), public education, removal of non-native vegetation, and flood-plain management all would benefit the mainstem Ventura River. Flood-plain management within the perennial reaches could improve spawning and rearing habitat conditions, however such management activities are warranted throughout the mainstem as they can improve the functioning of the river-floodplain system, reduce the need for flood control projects, and improve migratory habitat for steelhead. Interpretive facilities could be installed at Foster Park, located adjacent to the mainstem in the live reach, and in the parcel located between the Robles Diversion and Highway 150 that is in the process of being acquired by the Ojai Valley Land Conservancy. While the latter is not adjacent to perennial habitat, this acquisition does provide a unique opportunity for public access and education regarding the riverine environment and its important to steelhead.

Finally, the Ventura River lagoon may provide perennial habitat for rearing steelhead. Coastal lagoons can be an important rearing location for juvenile steelhead, however no recent studies of the suitability of the lagoon to support rearing steelhead have occurred. In addition, the Ventura River lagoon has been substantially altered from historic conditions by the installation of the flood control levee on the eastern bank, substantial development adjacent to the lagoon, installation of coastal structures (e.g. groins and spits) near the river's mouth, presence of non-native vegetation and disruption of sediment transport in the river due to construction of Matilija and Casitas dams. These modifications have altered the size, habitat structure (e.g. depth, associated vegetation), and frequency with which the sandbar closes to the ocean. Multiple factors are associated with determining the suitability of lagoon habitat for rearing steelhead including water quality (temperature, salinity, dissolved oxygen), food production, and proximity to spawning habitat (Smith 1990). Available information does not allow for adequate conclusions regarding the importance of this habitat to steelhead restoration in the Ventura River watershed. Therefore, it is recommended that further study of the quantity and quality of habitat potentially available to rearing steelhead be undertaken and appropriate management recommendations developed at that time. Regardless of the suitability of lagoon habitat for steelhead, substantial public access to the Ventura River estuary exists makes installation of interpretive facilities a recommended activity.

3.4.2.4 Watershed-Wide Projects

In addition to those geographic-specific projects identified above, there are several actions that could be taken on a watershed-wide level. Many of these actions could also be focussed within specific areas as funding and opportunities warrant. The primary limiting factor for steelhead within the Ventura River watershed is access to historic

habitat and the secondary limiting factor is public awareness including access to lands to conduct enhancement projects and general awareness of steelhead and the efforts needed to restore their habitat. Access issues have been addressed within the geographic-area priorities discussed above. Because of this, the tiered priorities for watershed-wide projects are considered to fit with the geographic area-based priorities as a "second priority area" equivalent to San Antonio Creek. Therefore, "tier 1" watershed wide projects would be equivalent, in their overall ranking, to "tier 1" projects identified for the San Antonio Creek watershed (see Section 3.4.2 for further information).

Public education and outreach is fundamentally important to the success of steelhead restoration in the Ventura River. The support of the general public will be necessary to generate the overall interest and funding necessary to implement activities to enhance steelhead habitat. In addition, day-to-day actions of the public affect the quality of existing habitat and impacts can be reduced through education. Further, public outreach can provide opportunities for the public to feel connected to their local watersheds and the species that inhabit them. Finally, landowner-specific activities can result in direct, on-the-ground benefits to steelhead and their habitat through improved management of lands adjacent to creeks, creek habitat, and habitat protection. Landowner involvement is also key to restoration in the mainstem Ventura River and San Antonio Creek, where the majority of the land is in private ownership (Figure 2-9). It is therefore recommended, and considered a high priority, that outreach programs targeted to both the public and landowners adjacent to habitat in the priority areas be initiated.

Some anthropogenic activities adjacent to the Ventura River and its tributaries have historically degraded habitat quality and continue to impact steelhead habitat. Floodplain management was identified above as a recommended action within all priority areas. It is first recommended that an assessment of the policies and practices of those entities with control over the type of activities that are permitted within the floodplain and associated riparian and aquatic habitats be examined. This will help determine the degree to which local, state, and federal policies and regulations have already been altered to address historic degradation of these important areas. Based on this assessment, a series of recommended changes to these policies and practices should be made and implemented. This action would provide the regulatory framework to protect important habitat and should be accompanied by appropriate landowner outreach, assistance, and incentives to implement restoration actions where appropriate and to manage floodplain resources to protect habitat into the future.

Until such time as the assessment is complete, it is recommended that partnerships be developed between landowners and those with the ability to enhance and restore steelhead habitat. The Ojai Valley Land Conservancy currently works within the Ventura River watershed to purchase lands and conservation easements, many of which are associated with the Ventura River and its tributaries, and can serve as a vehicle for implementing such partnerships. The Conservancy is currently in the process of purchasing a large parcel of land that includes two minor tributaries to the Ventura River and almost the entire mainstem from the Highway 150 bridge to the Robles Diversion. Acquisitions of this nature allow the stream channels and associated riparian and flood plain to be managed in the long-term to protect aquatic resources, including steelhead.

Where enhancement actions are recommended within the watershed, conservation easements can be a useful tool to obtain access to implement the proposed projects and to protect the restoration investment. It is recommended that partnerships between the Ojai Valley Land Conservancy, local landowners, and those with the ability to implement restoration projects be developed. Conservation easement acquisition typically occurs where opportunities arise, however, to the extent possible, efforts should be focused on obtaining easements (1) adjacent to perennial reaches to allow for enhancement projects to move forward, (2) where important steelhead habitat and/or well developed riparian habitat currently exists, and (3) where development in the floodplain is likely. NMFS (2003) and others identified several properties that they believe warrant consideration for purchase or easements (see Appendix D).

Non-natives are present throughout the Ventura River watershed and affect the quality and quantity of steelhead habitat. Non-native vegetation removal and revegetation with native species is a substantial undertaking and needs to occur on a watershed-wide basis in order to be successful. Non-native wildlife, including bass and sunfish inhabit the aquatic corridors within portions of the watershed. Removal of these predatory fish, can improve conditions for steelhead and other listed species. However, permanent removal of non-native wildlife is extremely difficult and, in the case of predatory fish, likely impossible given that populations are currently sustained within Matilija and Casitas reservoirs. These efforts are given a "tier 3" priority because of feasibility concerns and because the biological benefit is uncertain (i.e. it is uncertain if a non-native removal program would successfully remove non-natives in the long term). In addition, there are substantial institutional, jurisdictional, logistical and funding issues associated with such an undertaking. These efforts, especially *Arundo* removal, are worth pursuing but will require a watershed-wide, coordinated, long-term commitment.

Finally, the activities outlined above are targeted to provide access to existing habitat, improve habitat quality and quantity, and protect habitat values. However, as noted in Section 3.3.10, given the depressed nature of the steelhead population, it is uncertain the degree to which these habitat restoration efforts, by themselves, will be successful in restoring the steelhead population. NMFS is in the process of identifying how operations of existing steelhead hatcheries can be modified to provide a benefit to listed steelhead ESUs rather than continue to contribute to problems currently associated with hatchery reared stocks (e.g. genetic introgression with wild stocks). Operation plans for these "conservation hatcheries" are still being developed. As no steelhead hatchery currently exists within the Southern California ESU, development of such a hatchery, even as a conservation hatchery, would be a difficult and costly undertaking. However, given the low numbers of steelhead within the Southern California ESU and the Ventura River, it may be necessary in the future to consider the conservation hatchery concept to serve either as a repository for Southern California ESU genetic material as a protection against a catastrophic loss within the natural population, or to "jump start" the ESU's population towards recovery. It is recommended that the concept of a conservation hatchery be considered if the steelhead population does not respond to the implementation of key habitat restoration activities outlined above.

3.4.3 MONITORING AND ADDITIONAL STUDIES

During the synthesis of available information, several data gaps in existing knowledge of steelhead habitat conditions were identified. Key data gaps include headwaters tributaries to San Antonio Creek including Gridley, Senior, Horn, and Wilsie canyons, Cañada Larga, and the Ventura River estuary. DFG habitat surveys are currently underway in Matilija Creek as part of the Matilija Dam feasibility study which will provide more recent information on this key tributary.

In addition to assessing steelhead conditions, a watershed-wide barrier assessment is also warranted. Table 3-1 summarizes the available information on barriers within the watershed, however many questions remain about the severity of some barriers and several reaches have not been thoroughly surveyed to determine if other barriers may be present. It is recommended that once DFG finalizes their barrier survey protocol, this method should be consistently applied to barriers within streams known to provide steelhead habitat and priority rankings adjusted as needed.

Numerous monitoring programs are either underway within the watershed or soon to be implemented and will continue to provide valuable information necessary to better understand where enhancement actions are needed and the degree to which they are being successful in achieving improved habitat conditions for aquatic and riparian species. Substantial water quality monitoring occurs within the watershed through programs implemented by local agencies and the volunteer organization facilitated by Santa Barbara ChannelKeepers. In addition, a steelhead monitoring program is proposed as part of the fish passage project being implemented at the Robles Diversion (Reclamation 2003) which will yield important information on the suitability of migration habitat within the mainstem and provide information, over time, on population trends within the watershed.

3.4.4 WATERSHED LEVEL PLANNING ACTIVITIES

In addition to the need to conduct site-specific enhancement activities, watershed-level efforts that could be undertaken to improve public trust resources, including steelhead, were identified through discussions with local stakeholders. These ideas are considered beyond the scope of this project as they are not specific actions to enhance steelhead habitat, however they merit further consideration as actions that could coordinate overall enhancement efforts.

Potential ideas include development of a watershed council which could serve as a nexus for identifying and implementing actions on a watershed-wide basis. The County of Ventura currently has a grant to implement a watershed council and plans are currently being formulated to determine the scope of the activities that this council will undertake. In addition, preparation of an integrated watershed management plan which could evaluate, again basin-wide, water use, land use, and other factors influencing steelhead and aquatic habitat condition. Finally, developing and implementing effective regulatory mechanisms to avoid, minimize, and mitigate problems associated with activities in and

about aquatic environments. All of these activities could be implemented through the afore-mentioned watershed council or some other appropriate body.

3.5 CONCLUSIONS

The Restoration Plan (ENTRIX and WCC 1997) provided a sound basis for considering potential impacts to steelhead and their habitat within the Ventura River watershed. As a result of that plan, key restoration activities were put in motion including construction of fish passage facilities at the Robles Diversion Dam and associated modifications to diversion operations and development of a Habitat Conservation Plan for many of the other water development and on-going maintenance activities that occur within the watershed. In addition, the Matilija Dam study is now underway to determine the feasibility of removing a keystone barrier within the river.

The recommendations outlined above further refine and identify where restoration actions to improve conditions for steelhead should be focused and geographic area-specific activities that can be undertaken by any interested party to promote steelhead recovery within the Ventura River watershed.

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