VENTURA RIVER STEELHEAD RESTORATION AND RECOVERY PLAN

Prepared for:

Casitas Municipal Water District,
City of San Buenaventura,
Ventura County Flood Control District,
Ventura County Transportation Department,
Ventura County Solid Waste Management Department,
Ojai Valley Sanitary District,
Ventura River County Water District,
Ojai Basin Ground Water Management Agency,
Meiners Oaks County Water Districts, and
Southern California Water Company

Prepared by:

ENTRIX, Inc.
Walnut Creek, CA

and

Woodward Clyde Consultants
Santa Barbara, CA

Project No. 351001

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Prepared by:

ENTRIX, Inc.
590 Ygnacio Valley Road, Suite 200
Walnut Creek, California 94596

Woodward Clyde Consultants
130 Robin Hill Road, Suite 100
Santa Barbara, California 93117

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In August 1997, the National Marine Fisheries Service (NMFS) listed anadromous steelhead in Southern California as endangered under the Endangered Species Act (ESA). This listing means that any project or action that may affect steelhead or their habitats will require consultation with NMFS to obtain an incidental "take" permit. Since operation and maintenance of water diversions, river and stream channels managed for flood control purposes, transportation facilities, and sewage treatment plants may affect steelhead in the Ventura River, project operators will be required to consult with NMFS to obtain permits.

To assist them in addressing steelhead issues and possible permit requirements, a group of local public and private agencies with responsibilities for surface water, ground water, flood control and other public work facilities have collaborated to develop this management plan that can be used by these local agencies. These agencies ("sponsoring agencies") include Casitas Municipal Water District, City of San Buenaventura, Ventura County Flood Control District, Ventura County Transportation Department, Ventura County Solid Waste Management Department, Ojai Valley Sanitary District, Ventura River County Water District, Ojai Basin Ground Water Management Agency, Meiners Oaks County Water Districts, and Southern California Water Company.

A public process was used to develop the Ventura River Steelhead Restoration and Recovery Plan. Information on the Ventura River and its tributaries was collected regarding the hydrology, steelhead resources, and the operations and maintenance of water, wastewater, solid waste, transportation and flood control facilities of the sponsoring agencies. This was accomplished through review of the available literature, available hydrologic and fisheries data, and interviews with agencies and other individuals. Input has been solicited from local and state resource agencies, environmental groups, and other interested members of the public through public meetings and discussions with resource agency staff.

The objectives of the Ventura River Steelhead Restoration and Recovery Plan are twofold:

1. Identify measures to mitigate impacts of ongoing operations and maintenance activities and of future projects.

2. Identify and evaluate opportunities to promote recovery and restoration of steelhead in the watershed.

The plan considers a wide range of conservation actions that can be implemented by public agencies with facilities and interests in the watershed, as well as other interested individuals, groups, or resource agencies. Conservation actions are ranked based on biological effectiveness, feasibility, and costs.

The Ventura River watershed encompasses 228 square miles of coastal Southern California (Chapter 2.0). The mainstem river flows south about 16.5 miles from the confluence of Matilija and North Fork Matilija Creeks to the river's mouth. Like all of southern California, the Ventura River basin has a Mediterranean climate with a distinct seasonal pattern of wet-cool from November through March and dry-warm from April through October. Because the Ventura River watershed includes both steep mountains and coastal plains, spatial variation in average annual rainfall is considerable. For example, rainfall varies from about 16 inches per year near the river mouth to about 40 inches per year in mountainous headwater areas. The interannual variability in precipitation is high, a characteristic that greatly reduces the usefulness of calculating statistical averages to describe "normal" conditions. Rainfall records for the Ventura River basin document that dramatic and rapid shifts in precipitation can occur from year-to-year and that repeated cycles of dry and wet periods occur on approximately 20 to 30 year intervals. Portions of the upper mainstem dry during low-flow seasons, a condition typical of many southern California streams.

Steelhead in the Ventura River watershed historically migrated to tributaries in the upper watershed to spawn and rear (Chapter 3.0). Construction of dams and road crossings has created passage barriers that have blocked migration to and from upper stream reaches. Landlocked descendants of anadromous steelhead probably exist above the dams (Robles Diversion Dam, Matilija Dam and Casitas Dam), but extensive stocking of hatchery fish has probably affected the numbers and genetic composition of these stocks. Currently, anadromous steelhead can occur in the Ventura River below Robles Diversion Dam (mainly in the live reach between Oak View and Foster Park and below the Ojai Valley Sanitary District treatment plant) and portions of San Antonio Creek and Lion Creek. Moderate to high quality habitat exists in the North Fork Matilija Creek, live reach of the mainstem Ventura River, San Antonio and Lion Creeks, and upper sections Matilija Creek and its tributaries. There is a year-to-year and subbasin-to-subbasin variation in returns of adults and subsequent juvenile productivity because of the natural variation in rainfall and streamflow conditions.

The steelhead population is limited by several factors, including natural occurring conditions as well as development related impacts (Chapter 3.0). While ocean survival can be limited by ocean water conditions, fishery harvest, and predation, this report focused on factors affecting the freshwater portion of steelhead life history. The natural variation in streamflows and the potential effects of water withdrawal can affect the quality and quantity steelhead habitat. Passage barriers have eliminated access to spawning and rearing habitat in the upper watershed. Dams currently restrict passage to much of the upper watershed, which eliminates steelhead potential in the Matilija Creek subbasin (including Murietta and Upper North Fork Matilija creeks, and upper Coyote and Santa Ana creeks). Other passage barriers and impediments, both natural and manmade, exist throughout the watershed, including on Matilija Creek and its tributaries, North Fork Matilija Creek, and upper San Antonio Creek and its tributaries (including Lion Creek).

Other limiting factors in various reaches include low or complete lack of streamflows during the summer and fall, problems with stream sediments, lack of riparian vegetation, water quality (especially high temperatures), and low numbers of adult spawners. Lack of, or low, streamflows in summer and fall, particularly in dryer water years, limit the availability of juvenile rearing habitat in much of the watershed. This is especially true in upper San Antonio Creek and its tributaries (Thacher, Reeves, and Senior Canyon), parts of Matilija Creek upstream of Matilija Dam, Coyote Creek downstream of Casitas Reservoir, Canada Larga and Canada del Diablo, and the upper mainstem Ventura River downstream of Robles Diversion Dam. Excess fine sediments severely limit steelhead spawning and juvenile rearing in Coyote Creek downstream of Casitas Reservoir, Canada Larga, Canada del Diablo, and have low impacts in parts of the mainstem Ventura. Excess coarse sediments limit steelhead potential in parts of Matilija Creek, upper San Antonio Creek and its tributaries Thacher, Reeves, and Senior Canyon creeks, and parts of the mainstem Ventura River. Lack of riparian vegetation adjacent to the low flow channel and lack of pool habitat limits steelhead rearing potential throughout most of the watershed, except for North Fork Matilija Creek, parts of San Antonio Creek downstream of Ojai Valley, and the lower reach of the mainstem Ventura River. However, this lack of riparian is likely a natural condition in parts of the watershed, specifically the mainstem Ventura and potentially the mainstem Matilija Creek. Water quality problems with temperature and dissolved oxygen are often associated with low flows and are seen in most of the watershed when flows are low except for the North Fork Matilija Creek, other headwater areas with perennial flow, the mainstem of the Ventura River in the live stretch, and downstream of the Ojai Valley Sanitary District's treatment plant discharge. Lack of returning adults is likely currently an overall limitation for the steelhead population in the watershed.

Information on other listed and sensitive species found in the watershed is also provided (Chapter 4.0). Habitat improvements for steelhead have the potential to improve conditions for these species. In addition, mitigation measures for activities in the watershed (Chapter 7.0) will likely benefit other sensitive species as well as steelhead.

The sponsoring agencies operate many facilities in and near the Ventura River and its tributaries (Chapter 5.0). The major water development facilities include Matilija Dam on Matilija Creek, the Robles Diversion Dam and canal on the upper Ventura River, and Casitas Dam on Coyote Creek (Casitas Municipal Water District), and the Foster Park diversion facilities in the lower Ventura River (City of San Buenaventura). Smaller diversions of surface and ground water are conducted by agencies (Ojai Basin Ground Water Management Agency, Ventura River County Water District, Meiners Oaks County Water Districts, and Southern California Water Company) and private individuals. Other activities by the sponsoring agencies include flood control measures (Ventura County Flood Control District), maintenance of road crossings (Ventura County Transportation Department), wastewater treatment (Ojai Valley Sanitary District), and waste management (Ventura County Solid Waste Management Department). Land use or other activities by other entities that can affect the watershed's streams are reviewed in Chapter 6.0.

The sponsoring agencies' facilities require maintenance, repair, and replacement due to normal operations and unanticipated outages or failures from emergency conditions, such as floods. Some of these maintenance activities could directly or indirectly affect steelhead and their habitat in the watershed. Potential mitigation measures to avoid "take" and minimize impacts are described in Chapter 7.0. They include measures to avoid steelhead and aquatic habitats and to restore temporarily disturbed areas. These measures are designed to provide guidance to the sponsor agencies and to be incorporated into project plans when applying for permits for such maintenance, repair, and replacement activities. The permitting agencies may require additional mitigation based on steelhead and other resource considerations.

A range of potential conservation actions to promote recovery and restoration of steelhead was identified through analysis of limiting factors and discussions with regulatory agencies, plan sponsors, and public groups (Chapter 8.0). These 44 actions address factors limiting the freshwater portion of the steelhead life cycle and are divided into four categories: (1) passage measures to facilitate upstream and downstream migration, (2) non-flow related measures to improve habitat, (3) flow-related measures to improve habitat, and (4) population augmentation through supplementation of fish to increase steelhead populations.

The potential conservation actions were screened and ranked to eliminate infeasible actions from further consideration and to develop a prioritized list of actions to assist the sponsoring agencies and other interested parties in developing an implementation strategy (Chapter 9.0). The screening and ranking was performed in two stages. In the first stage, screening criteria were applied to each candidate conservation action to determine if it should be dismissed from further consideration. Removing a candidate action occurred only if there is a clear obstacle to implementation that cannot be removed under current legal, land use, or institutional conditions. The criteria included legal or institutional obstacles, technical infeasibility, cost infeasibility, other adverse environmental impacts, and ESA compliance. Of the 44 proposed conservation actions originally considered, only three conservation actions were screened out: laddering Matilija Dam and Casitas Dam (technologically infeasible due to the height of the dams) and removal of Matilija Dam (significant adverse social, economic, and short-term environmental impacts).

In the second stage, several ranking criteria were applied in a hierarchical approach to the remaining 41 candidate conservation actions in order to qualitatively assess their relative advantages and disadvantages. The three-step ranking process recognized that some criteria are more important than others in evaluation of the actions. The first ranking step assigned the greatest importance to the biological benefits of the action relative to improving steelhead populations. The second ranking step evaluated cost and success variables, which were used to determine which of the highly beneficial actions would provide a better alternative than the other similarly ranked beneficial actions. This level included technical and biological feasibility and risk of failure, fiscal costs, and issues related to reallocation of water and land resources. The third ranking step considered other biological benefits, incidental environmental impacts, the need for institutional coordination, and the effort associated with operations and maintenance. These variables are important to consider but usually they should not outweigh biological benefits, success or resource allocation criteria. This hierarchical analysis allowed us to incorporate the evaluation criteria at the appropriate point in the decision process.

Conservation measures that provided passage for steelhead to the upper basin received the highest ranking for biological benefits and, although costly, these ranked high relative to the other evaluation criteria. Availability of juvenile rearing habitat with suitable flows and water temperature is one of the most important factors in the freshwater environment that limit the Ventura basin steelhead population. Passing fish upstream into the upper basin provides access to the year-round rearing habitat in North Fork Matilija Creek and the Matilija Creek basin. Conservation actions with moderate biological benefits focus primarily on erosion control measures for tributaries upstream and downstream of Robles and habitat improvement to the channel structure of San Antonio Creek.

Based on these rankings, we recommended both actions that could be implemented in both the near term and actions requiring a longer time frame (Chapter 10.0). Some actions require the implementation of conjunctive actions in order to realize the expected benefits. Other actions can be undertaken independently. For some of the more expensive and complex measures, we suggested interim measures or pilot projects that can expedite achievement of benefits or remove uncertainty associated with some aspect of implementation.

Providing access to habitats upstream of Robles Diversion is one of the most important actions that can be taken to improve steelhead populations in the Ventura River. The best long term passage can probably be provided by (1) constructing a fish ladder at Robles Diversion, (2) installing a fish collection/bypass facility in the canal, and (3) perhaps maintaining a low flow passage channel from the live stretch (Foster Park) to Robles Diversion to assist fish in low flow years. Success will depend on appropriate design of passage facilities for upstream and downstream migrants, steelhead access to Robles, good quality spawning and rearing habitat being accessible in North Fork Matilija Creek, and a sufficient number of fish to utilize the passage facilities and the upstream habitat. Providing a low flow passage channel in the Ventura River from Foster Park to Robles Diversion Dam would make the upstream passage facilities accessible in all years except extremely dry years.

Recommendations for habitat improvement projects along the mainstem Ventura River were limited because periodic extreme high flows would likely limit the success of such projects. Habitat improvement pilot projects could be initiated in the tributaries, possibly San Antonio Creek and North Fork Matilija Creek. Measures include planting native riparian vegetation, removing non-native vegetation, installing habitat improvement structures (large tree roots or woody debris or boulders), or addressing reach specific water quality problems.

Streamflow enhancements were also suggested. Ramping flows from Matilija Reservoir would more closely resemble natural storm events. Continuing bypass flows during diversions at Robles will help to provide passage and improve rearing conditions in the live stretch. Managing the timing and duration of withdrawals in tributaries such as San Antonio Creek could improve surface flows, but would require a high degree of coordination among landowners and may not be feasible. Removing potential passage barriers from road crossings or other structures in tributaries (specifically along San Antonio Creek and North Fork Matilija Creek) could also benefit steelhead.

Studies to determine site-specific habitat enhancement measure need to be conducted. Long term monitoring of the response of steelhead population to whatever conservation actions are implemented will be important to assess the overall success of the program. Depending on which measures are implemented, an appropriate monitoring program could be designed. In addition, streamflow and water quality monitoring that already occurs in the watershed should continue and additional water quality sampling is recommended prior to implementation of habitat improvement projects.

1.1 BACKGROUND

On 11 August 1997 National Marine Fisheries Service (NMFS) listed anadromous steelhead trout in Southern California as endangered under the Endangered Species Act (ESA). Because of their listing status, any project or action that may affect steelhead or their habitats will require consultation with NMFS to obtain an incidental "take" permit. Since operation and maintenance of water diversions, river and stream channels used for flood control purposes, and sewage treatment plant activities may affect steelhead habitats in the Ventura River, project operators will be required to consult with NMFS to obtain the proper permits. NMFS has stressed the importance of local agencies in restoration and recovery planning, and has indicated that a local restoration and recovery plan will facilitate project review and the identification of appropriate mitigation measures.

In order to prepare for the listing of steelhead, a group of local public and private agencies with responsibilities for surface water, groundwater, flood control, and other public work facilities collaborated to develop this management plan. This plan is intended to be used by the sponsor agencies as a guidance document for considering steelhead issues as they start through the federal, state, and local permit process on a project by project basis. These sponsor agencies include:

- Casitas Municipal Water District
- City of San Buenaventura
- Ventura County Flood Control District
- Ventura County Transportation Department
- Ventura County Solid Waste Management Department
- Ojai Valley Sanitary District
- Ventura River County Water District
- Ojai Basin Groundwater Management Agency
- Meiners Oaks County Water Districts
- Southern California Water Company

A public process was used to develop the Ventura River Steelhead Restoration and Recovery Plan. Input has been solicited from local, state, and federal resource agencies, environmental groups, and other interested members of the public through public meetings and discussions with resource agency staff. Information on the Ventura River and its tributaries was collected regarding the hydrology, steelhead resources, and the operations and maintenance of water and wastewater facilities by the sponsoring agencies through review of the available literature and interviews with agencies and other individuals.

1.2 OBJECTIVES

The objectives of the Ventura River Steelhead Restoration and Recovery Plan are twofold:

1. Identify measures to mitigate impacts of ongoing operations and maintenance activities and of future projects.

2. Identify and evaluate opportunities to promote recovery and restoration of steelhead in the watershed

The plan considers a wide range of conservation actions that can be implemented by public agencies with facilities and interests in the watershed, as well as other interested individuals, groups, or resource agencies. Conservation actions are ranked based on biological effectiveness, feasibility, and costs. The plan may be used as the basis to develop a Habitat Conservation Plan (HCP), to acquire a Section 10 permit, or to complete Section 7 consultations, for all or some of the future activities in the watershed.

1.3 REGULATORY REQUIREMENTS

There are several federal and state agencies with jurisdiction over aquatic resources. The main enforcement tools are the Endangered Species Act (ESA), the California ESA (CESA), Federal Clean Water Act, and the California Fish and Game Code. The federal agencies responsible for the protection of native fish and wildlife in the Ventura River are the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Army Corps of Engineers (COE). The ESA requires formal consultation on those species currently listed as threatened or endangered when activities may result in the “take” of listed species. NMFS needs to be consulted for listed anadromous fishes and USFWS needs to be consulted for other listed fish and wildlife species. NMFS published the final rule on the steelhead listing in August 1997 and the prohibitions against “take” became effective in October 1997. The Federal Clean Water Act requires a permit to be issued by the COE for any activities in stream channels below the ordinary high water mark or in areas designated as wetlands. In addition, much of the Ventura River watershed is located on land managed by the U.S. Forest Service.

The state agency responsible for public trust responsibilities is the CDFG. None of the aquatic species, including steelhead, found within the Ventura River are currently listed under CESA. Steelhead are currently a Species of Special Concern in California, but formal consultation with CDFG for a potential "taking" of a State listed species is not anticipated to be required. However, a streambed alteration agreement with CDFG, pursuant to CDFG Code sections 1601-1603, must be in place prior to activity in the streambed, channel or bank. Other State agencies that have some regulatory authority over aquatic resource issues include the Regional Water Quality Control Board, the California Coastal Commission, the State Water Resource Control Board, the Department of Parks and Recreation and the State Lands Commission.

More detail about the roles of all of these federal and state agencies can be found in Chapter 3. Chapter 4 contains background information on other listed or sensitive species found in the Ventura River watershed.

1.4 PUBLIC INVOLVEMENT

The public and resource agency involvement program implemented during the preparation of the Ventura River Steelhead Restoration and Recovery Plan had three primary objectives: (1) to inform agencies, interested environmental groups, and the local community of the plan; (2) to elicit ideas and information that was useful in preparing the plan; and (3) to receive comments on the draft plan after its circulation to the public. The program involved two main elements. First, a newsletter was periodically issued during the preparation of the plan with information on the status of the plan, the steelhead listing, and meeting dates. Five newsletters and meeting announcements were issued between February and November 1997. A mailing list of over 250 agencies, environmental groups, interested parties, and local residents was developed for distributing the newsletters.

The second element of the public involvement program was comprised of three public and resource agency meetings, which were held to achieve the three objectives. The first meeting in March 1997 involve a presentation on the proposed steelhead listing and the scope and objectives of the plan. Following the presentation, the meeting was opened for public comment on the scope of the plan. The second meeting was conducted in April 1997. It included lengthy presentations on the background data collected for the plan and the potential management actions being considered in the plan. Comments were taken on these aspects of the plan. The third meeting was conducted in August 1997 to receive comments on the draft plan that had been circulated for public review. These comments were considered during the final plan preparation.

2.1 REGIONAL CONTEXT

The Ventura River drains a 228 square mile area of coastal Southern California in the Transverse Range. The headwaters are in the San Rafael and Topatopa Mountains on the north (maximum elevations about 6,000 feet), the Santa Ynez Mountains in the west central area (maximum elevations about 4,600 feet) and Sulphur Mountain in the east (maximum elevation 2,730 feet) (USBR 1954). The mainstem of the river flows southward about 16.5 miles from the confluence of Matilija and North Fork Matilija to the river mouth at the Emma Wood State Beach in the City of San Buenaventura (City) (Figure 2-1). The Ventura River has the highest suspended and bedload yield per unit watershed area in southern California (Brownlee and Taylor 1981 as cited in Keller and Capelli 1992). However, construction of dams in the upper watershed has reduced suspended and bedload sediment transport into the mainstem of the river since the late 1940s.

2.2 CLIMATE

Like all of southern California, the Ventura River basin has a Mediterranean climate with a distinct seasonal pattern of wet-cool from November through March and dry-warm from April through October. Occasionally, summer thundershowers also occur when tropical storms enter the region. Because the Ventura River watershed includes both steep mountains and coastal plains, spatial variation in average annual rainfall is considerable. For example, rainfall varies from about 16 inches per year near the river mouth to about 40 inches per year in mountainous headwater areas. The interannual variability in precipitation is high, a characteristic that greatly reduces the usefulness of calculating statistical averages to describe “normal” conditions.

Rainfall records for the Ventura River basin document that dramatic and rapid shifts in precipitation can occur from year-to-year and that repeated cycles of dry and wet periods occur on approximately 20 to 30 year intervals. Analysis of regional precipitation records by the USBR (1954) demonstrated major droughts in 1868-1877, 1893-1904, 1918-1934 and 1944-1951. Annual precipitation trends over the last century in the Lake Casitas area, analyzed by Casitas (1993), confirm the strong cyclic pattern of droughts approximately 20 to 25 years apart.

Figure 2-1. Ventura River Watershed Zones.

2.3 WATER DEVELOPMENT FACILITIES

2.3.1 OVERVIEW

Surface water of the Ventura River and its tributaries has been developed for use for over 200 years. However, the water development facilities constructed during this century have been the most structurally ambitious, involve the largest amounts of water, have included large intra-basin transfers of surface and groundwater between sub-basins, and have the most relevance for analyzing the existing system and planning for future management. Therefore, the following discussion is limited to facilities that have operated during the last 60 to 70 years and are reflected in the streamflow records. Additional details on the facilities and their operations and maintenance are presented in Chapter 5.

2.3.2 FOSTER PARK FACILITIES

Surface and Subsurface Facilities

An underground dam was constructed between 1906 and 1908 at the confluence of Coyote Creek and the Ventura River. The dam extends vertically to bedrock and laterally across the river valley about 973 feet. There is a gap of about 300 feet between the dam and the bedrock boundary on the east side of the river bottom (Fugro West 1996a). The surface diversion is near the eastern side of the river bottom, about 300 feet from the end of the subsurface dam. It is a simple weir about two feet wide and deep, with a perforated plate on its east side that is the intake to the receiving chamber.

The subsurface collector system consists of two 18-inch diameter perforated concrete pipes on the upstream side of the submerged dam that divert subsurface flows into the receiving chamber on the east side of the river bottom. A third pipe (36-inch diameter) exists, but is reportedly non-functional (Fugro West 1996a). Water from the surface water diversion and the subsurface collectors accumulates in a single receiving chamber that discharges to a 36-inch diameter concrete pipe that drains by gravity to the Kingston Reservoir at the City's water treatment plant.

The annual total surface and subsurface diversions at Foster Park do not increase proportionally during years that have high total runoff volumes, since the runoff volume is concentrated in a few major, short-duration storm events. The timing and duration of streamflow, and turbidity levels during high streamflow events are important controls on the actual diversions. Surface water can not be diverted when turbidity is high or when the intake is blocked by debris.

Groundwater Facilities

The City's Nye Wellfield presently has four active wells (Nos. 1, 2, 7 and 8), located between 1,000 and 2,890 feet north of the Foster Park subsurface dam near the "live stretch". The wells discharge to a separate 24-inch diameter pipeline that meets the surface and subsurface pipeline above the Kingston Reservoir (untreated water holding facility) at the City's Ventura Avenue water treatment plant (VATP).

2.3.3 MATILIJA DAM

Matilija Dam was constructed by Ventura County Flood Control District (VCFCD) in 1947 about 0.6 miles upstream of the confluence of Matilija Creek and North Fork Matilija Creek as a flood control and water supply facility to serve the Ojai Valley by pipeline (EDAW et al. 1981). It began storing water in spring 1948 and had an original storage capacity of about 7,020 acre-feet (at elevation 1,125 ft). Structural modifications in 1964 lowered the crest of the dam to elevation 1,095 ft. This change, along with siltation from floods of 1969 and 1978, reduced the reservoir's capacity to about 2,376 acre-feet as of 1978 and 1,480 acre-feet as of 1983. Siltation following the Wheeler Fire of 1985 and the high runoff in winter 1986 further reduced the capacity. Storage is presently estimated to be approximately 930 acre feet (Casitas pers. comm.). The reduction in storage capacity has proceeded much more rapidly than expected. For example, the USBR (1954) predicted the remaining capacity to be about 3,220 acre-feet in 1998 and 2,550 acre-feet in 2008.

2.3.4 CASITAS DAM

Casitas Dam was constructed on Coyote Creek about 2.5 miles upstream of the Ventura River as a water supply facility with a maximum reservoir storage capacity of 254,000 AF. It began impounding water in October 1959 (EDAW et al. 1981). The reservoir filled and spilled for the first time in March of 1978 and has spilled since then in 1979, 1980, 1983, 1986, 1993, 1995 (Casitas 1997). The direct drainage watershed above the dam is 34.3 square miles from Coyote and Santa Ana creeks. Another 74.3 square miles of indirect drainage area includes Matilija, North Fork Matilija, Upper North Fork Matilija, and Murietta creeks, which provide inflow to the reservoir via the Robles Diversion Dam and Robles-Casitas Canal.

2.3.5 ROBLES DAM AND CANAL

The Robles Diversion Dam is about two miles downstream of Matilija Dam. Since water year 1960, Robles Dam has diverted water via a canal to the Casitas reservoir. In general, flows up to 20 cfs are bypassed downstream to support the needs of pre-existing riparian water users (unless there is surface flow at Santa Ana Boulevard)[1]. The 500 cfs capacity of the canal limits the maximum diversion rate. No diversions occur when Casitas Reservoir is within 2 feet of spilling. The total amount of diversion is also affected by the timing of streamflow hydrographs on Matilija Creek and North Fork Matilija Creek. Generally, Matilija Reservoir is kept at 1,080 feet elevation (~280 AF

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[1] The conditions on operations of Robles Diversion Dam allow the bypass flows for riparian water users to be reduced below 20 cfs only when either: (1) the inflow to Matilija is less than 20 cfs; or, (2) surface water flows occurs downstream at Santa Ana Boulevard. The conditions do not specify that flow must be continuous downstream of Robles Dam since the purpose is related to groundwater recharge.

storage) to allow flood storage room to be maximized. Since the maximum storage capacity at the 1,095 feet elevation only adds an additional 600 AF of volume, Matilija does not moderate flood flows substantially. Temporary storage in Matilija reservoir is used to moderate the natural hydrograph highs and lows and increase the total amount of diversions possible. Flows exceeding 500 cfs usually only occur when Matilija reservoir is spilling.

As indicated in Figure 2-2, Robles diversions over the past 36 years most commonly are restricted to January, February and March (the only months with median magnitudes or number of days is over zero). Mean monthly diversions during these peak winter months ranges from 2,183 AF in January to 3,489 AF in February. Mean monthly diversions also exceed a couple of hundred acre-feet in the months of November, December, April, May and June. However, diversions in these 5 months only occurred in fewer than one-half of the years (hence the median diversions are zero). Diversions have only rarely occurred during summer and early fall, as evidenced by the low mean diversions and limited number of days of diversion in July, August, September and October. Diversions in these four months have occurred in only 14%, 8%, 11% and 5% of the years, respectively.

Maximum diversions volumes and days of diversion are much greater than the mean or median, indicating how infrequent such high values occur. The three winter months have had the largest maximum diversions, as expected, but amounts over 10,000 AF have also occurred in November and April. Maximum diversion volumes of record for several of the months occurred in the mid-to late 1960s during a series of above normal to wet years (and while Casitas Reservoir was filling) (see Appendix A).

During some above normal to wet years, the diversions were not extremely large, due to a lack of storage available at Lake Casitas (e.g., 1978, 1980, and 1982). In general, total annual diversions correlate well to rainfall (see Appendix A).

2.3.6 Other Diversion Facilities

In addition to Casitas and the City, there are numerous other water diverters in the Ventura River System, which are summarized by type of diversion and ownership for each major segment of the river in Table 2-1.

2.4 Watershed Zones

There are three distinct zones within the Ventura River watershed that differ in topography, geology, surface and groundwater hydrology, and their roles in water resource management: (1) Mountainous Uplands; (2) Alluvial Valleys; and, (3) the Lagoon (Keller and Capelli 1992; Fugro West 1996a) (Figure 2-1).

2.4.1 Mountainous Uplands

The Mountainous Uplands are the dominant area of water and sediment production with rugged topography, narrow valleys, little or no alluvial deposits, and steep streambed

Figure 2-2. Seasonal Pattern of Robles Diversions, WY 1960-1996.

Table 2-1. Surface and Well Diversions on the Mainstem Ventura River.

River Segment	Type of Diversion and Ownership	Number of Diversions	Type of Use	Average Annual Volume (AF)
Ventura River, Upstream of Robles Diversion Dam				
	Surface, Private	4	Domestic and Irrigation	N/A
	Surface, Meiners Oaks CWD (Since 1949)	1	Water District	N/A
	Well, Private	2	Domestic and Irrigation	N/A
Robles Diversion Dam				
	Surface, Casitas (Since 1960)	1	Water District	13,095 AF
Ventura River, Robles Diversion Dam to Foster Park				
	Surface, Private	1	Domestic	N/A
	Well, Private	19	Domestic and Irrigation	N/A
	Well, Meiners Oaks (Since 1949) and Ventura River CWDs (Since 1956)	7	Water District	1,300 AF 1,200 AF
Foster Park				
	Surface, City (Since pre-1930s)	1	Water District	2,564 AF
	Well, City (Since pre-1930s)	4	Water District	3,884 AF
Downstream of Foster Park				
	Surface, Private	5	Irrigation and Industrial	N/A
	Well, Private	1	Domestic	N/A

Source: EDAW 1981.
N/A – Not Available

gradients. The major sub-basins that have significant uplands include Matilija Creek, North Fork Matilija Creek, Coyote Creek and Santa Ana Creek, and San Antonio Creek (Table 2-2). This is also the zone where major water supply and flood control facilities are located. Storm runoff and sediment production from this portion of the system has been partially controlled by Matilija Dam since 1948 and Casitas Dam since 1959.

Approximately 80 percent of the entire watershed is uplands of hillslopes and ridges with surface geology comprised of Tertiary sedimentary rocks (3 to 70 million years old). The bedrock units of well-cemented sandstones, siltstones, conglomerates and shales have been severely deformed by folding and faulting, but have low permeability relative to the unconsolidated alluvial deposits in the main valleys.

2.4.2 ALLUVIAL VALLEYS

The Alluvial Valleys are primarily a zone of storage and transfer of water and sediment and includes the mainstem river, floodplain and valley bottom downstream of the confluence of Matilija and North Fork Matilija Creeks and the Ojai Valley (San Antonio Creek sub-basin). The Ojai Valley and mainstem above Foster Park are the primary zones of groundwater production and surface diversions, while the lower mainstem has limited production and is affected by return flows and treated effluent discharge.

The alluvial valleys are underlain by relatively shallow deposits ranging in age from actively reworked channel beds and floodplains to alluvial terraces 10,000 to 1,000,000 years old. The Ventura River has slowly migrated to the west during the late Quaternary, leaving a series of terraces marking former channel and floodplain locations (Putnam 1942 and Rockwell et al. 1984 as cited in Keller and Capelli 1992).

The alluvial deposits continue to be affected by active regional tectonic forces that tilt and bend sediments and create vertical and horizontal offsets (faults) that affect subsurface water flow and water levels. The alluvial valley fills constitute the major groundwater aquifers, and the major groundwater basins of the Ventura River watershed are located in the main valleys: the Ojai Valley basin, the Upper Ventura River basin (above Foster Park), and the Lower Ventura River basin (Fugro West 1996a). In addition, minor groundwater basins occur in the Upper Ojai Valley (along Lion Creek) and along lower San Antonio Creek (Turner 1971 as cited in EDAW et al. 1981).

Ojai Valley Ground Water Basin

The following information was derived primarily from Staal, Gardner & Dunne (1992), the *Ojai Basin 1995 Annual Report* by the Ojai Basin Groundwater Management Agency (Ojai Basin GMA) and information provided by Casitas (EDAW et al. 1981, Casitas 1989).

The Ojai Valley groundwater basin is approximately five miles long and extends in an east-to-west direction, comprising about 7.5 square miles and having a storage capacity of approximately 70,000 acre-feet. It includes the City of Ojai, the rural residential areas,

Table 2-2. Major Ventura River Watershed Sub-basins and Water Facilities.

Watershed Zone	Sub-basin	Unit Area (sq. mi.)	Percent of Area at Foster Park(%)	Storage and Diversion Facilities	Present Capacity
Uplands--Headwaters/Tributaries					
	Matilija Creek	55	29.3	Matilija Dam	930 * AF
	North Fork Matilija Creek	16	8.5		
	San Antonio Creek (includes Ojai Valley)	51	27.1		
	Coyote & Santa Ana Creeks	41	21.8	Casitas Dam	254,000 AF
Alluvial Valleys—Mainstem					
	Upper Ventura River	74**	39.4	Robles Dam	500 cfs or 990 AF/day
	Ventura River near Ventura at Foster Park	188**	100.0	Foster Park***	Surface: 10.8 cfs or 21.4 AF/day Sub-surface: 5.6 cfs or 11.1 AF/day
	Ventura River below Foster Park	100			
TOTAL		**228**			

*Estimated by Casitas, 1997.

**Includes area of all upstream sub-basins.

***Average daily capacity, exclusive of Nye wellfield. Maximum production is effectively limited by the 13 mgd (20 cfs) capacity of the water treatment plant.

and agricultural land east of the City of Ojai. The aquifer consists of undifferentiated and poorly consolidated deposits of sand, gravel, and boulders derived from stream channel and alluvial fan deposits of Pleistocene and Recent age. The basin has a relatively flat bottom with a maximum depth of about 700 feet. The groundwater is generally in an unconfined condition, and recharge is primarily through percolation from active streambeds. However, a confining clay layer is located in the southwest corner of the basin along San Antonio Creek at depths of up to 200 feet. Wells in this area are reported to become artesian when the water levels in the basin are high.

Upper Ventura River Ground Water Basin

The Upper Ventura River Basin aquifer is a very shallow, unconfined aquifer consisting of alluvium about 60 feet deep (Slade 1991). The total storage capacity of the basin is about 14,000 AF, and it essentially empties during a 1 to 3 year critical dry year period. However, it will refill within a period weeks during flood conditions. The groundwater generally occurs under unconfined conditions, with the dominant source of recharge being direct infiltration of precipitation and percolation from local streambeds. Areas of naturally shallow bedrock underlie portions of the valley, creating conditions that prevent groundwater from being lost to deep percolation and causing water levels to remain or rise near the surface (the natural bedrock barrier at Foster Park has been enhanced by the subsurface dam since 1908).

2.4.3 Lagoon

The Lagoon is the zone of interaction between riverine and coastal processes. It encompasses about 3.7 acres between the shoreline and a few hundred yards upstream of the U.S. Highway 101 bridge. The river lagoon includes the shifting channels and depositional environments at the mouth of the river, occurring in an arc-shaped delta that extends about one mile upstream from the ocean and is about two miles wide at the coast. It is an ecologically important area that is difficult to manage for flood protection due to stream dynamics and land use commitments.

Lagoons form in many California streams when a sandbar closes the river mouth (Smith 1990). Sandbar formation and breaching depends on wave action to deposit or remove sand, freshwater streamflow in the river, and tidal action. Lagoons generally open during periods of high river flows and storm-generated waves in the winter storm season. Low streamflows during drought years can prevent sandbar breaching; some California streams may be closed for multiple years under those conditions. Artificial breaching is practiced in many streams to reduce rising water levels in the lagoon and upstream (Capelli 1997a).

The Ventura River lagoon's dynamics are unusual compared to those of other southern California lagoons (Mark Capelli, pers. comm.). The Ventura River is one of the few actively expanding deltas on the coast, due to the basin's rapid tectonic uplift and erosion of unconsolidated marine sediments in the watershed. The river mouth extends out into the ocean and is exposed to more wave action; thus, the sandbar is not as substantial. Continuous stream flow from the upstream discharge of treated wastewater contributes to breaching by filling the lagoon and over topping and eroding the sandbar (Ferren et al. 1990).

The sandbar breaches readily under natural conditions and has never been artificially breached (M. Capelli, pers. comm.). The lagoon opens in winter after the first one or two major storms and usually remains open to early spring. With the sandbar open, water levels in the lagoon depend on tide levels and the height of the sandbar Tidal influence can extend to just above the U.S. Highway 101 bridge (Ferren et al. 1990). During the summer the lagoon will open periodically (Ferren et al. 1990), usually 2-6 times for brief periods (2-7 days) (M. Capelli, pers. comm.), but the sand and cobble bar eventually returns and the estuary fills again (Ferren et al. 1990). In high runoff/low beach building years, the sandbar may not close at all during the summer, as was seen in 1993 and 1995 (M. Capelli, pers. comm.). Breaching is probably less frequent during droughts. In recent time the longest period of closure was in 1991, when the lagoon did not breach during the summer.

2.5 STREAMFLOW CONDITIONS

The factors controlling surface streamflow differ considerably during the high flow season and flood events versus during low flow seasons or dry years. The following summary of historical conditions presents separate discussions of high and low flows to: (1) help clarify the relationship between streamflow conditions and various water resource developments and operations; and, (2) form a practical basis for impact analysis or management recommendations.

2.5.1 STREAMFLOW DATA SOURCES

Sources of historic streamflow data (from recording gages) include the U.S. Geological Survey (USGS), the Ventura County Flood Control District (VCFCD), and the Casitas Municipal Water District (Casitas). The gage locations are shown in Figure 2-3 and their periods of record are briefly described below, which influences their usefulness for analysis.

Upland Tributaries

A recording staff gage has been used at Matilija Creek at Matilija Hot Springs since water year 1927 (USGS 11115500; VCFCD #602). The gage is about 0.4 miles downstream of the Matilija Dam site, but was about 0.2 miles upstream of the dam site prior to 1939. The flow was regulated by Matilija Reservoir from March 1948 to 1963 when the top 30 feet of dam was removed, but has been only partially regulated since then due to a combination of dam modification and reservoir siltation. Since 1969, there has been a concrete slab in the channel at the gage site controlling the elevation.

North Fork Matilija Creek at Matilija Hot Springs, has been gaged upstream of the confluence of Matilija Creek since water year 1929 (USGS 11116000; VCFCD #604).

Figure 2-3. Ventura River Watershed Continuous Stream Gaging Stations.

The gage is presently 0.5 miles upstream of the confluence with Matilija Creek but was 0.3 miles further downstream prior to 1948.

San Antonio Creek at Casitas Springs has gage records since water year 1949 (USGS 11117500; VCFCD #605) and has no regulation upstream of the station, although there are irrigation wells about 100 feet upstream (Casitas & City 1984, City and Casitas 1990).

Coyote Creek near Oak View has been gaged since water year 1958 (USGS 11117600; VCFCD #600) and Santa Ana Creek near Oak View has been gaged since water year 1958 (USGS 11117800; VCFCD #606). These gages are 0.5 miles upstream of the normal elevation of Lake Casitas. Due to affects of shifting local controls and backwater influences from the reservoir, the gages were moved after 1969..

Mainstem Ventura River

The Ventura River near Meiners Oaks stream gage has been active since water year 1960, but is only accurate for streamflows under about 50 cfs (USGS 11116550; VCFCD #607). It is 500 feet downstream of Robles Dam and reflects flow regulation by Matilija Dam and the Robles Diversion Dam. This station's primary purpose is to record minimum releases below the diversion and monitor compliance with the operations criteria. Prior to October 1969 it was 1.25 feet lower than present and prior to September 1978 it was 500 feet upstream from the present site. Due to wash outs, the gage was not active from March 1983 to January 1984 and from February 1986 to April 1986 (Casitas & City 1984; City and Casitas 1990).

The Ventura River near Ventura gaging station (USGS 11118500; VCFCD #608) records begin in water year 1912, with continuous records since water year 1930. Diversions by the City begin prior to the gage records. The flow has been regulated by Matilija Reservoir since March 1948 (regulation has not been very effective since the mid 1970s) and by Robles Diversion Dam and Casitas Reservoir since October 1959. Diversions from the mainstem drainage to Casitas Reservoir on Coyote Creek begin in January 1959. However, the gage may underestimate low flows since it is located on the west bank, downstream of the Casitas Vista (Foster Park) bridge and away from some of the natural low flow channels. Streamflow at this gage represents net runoff flowing towards the ocean below Foster Park as a residual of the cumulative upstream water development and the City's diversions, but excluding input from Cãnada Larga and other downstream tributaries.

Combined records of the observed surface flow in the river at the Ventura River near Ventura station and the City's diversions have been reported since water year 1932 (USGS 11118501). These data are more representative of the natural flow in the mainstem than the #11118500 gage data, although they do not specifically correct for the effects of net storage in the reservoirs.

No continuous gage records from the Ventura River downstream of Foster Park are reported by the USGS. However, annual peak flows and other short-term periods of observations have been made by the VCFCD, Casitas and the City. Streamflow in the lower Ventura River is affected by inflow from Cãnada Larga Creek and Cãnada Del Diablo and other minor areas, and by wastewater effluent released from the Ojai Valley Sanitary District (OVSD) wastewater treatment plant. OVSD records of effluent discharge are available on a daily, monthly and annual basis.

Dam and Reservoir Operations Data

Matilija and Casitas reservoir operations have typically been summarized on a monthly basis and daily records for Casitas reservoir have been included in the annual hydrology reports. Robles Diversion Dam monthly diversion summaries and daily diversions are reported by Casitas and the City and downstream releases are reported in the form of the Ventura River near Meiners Oaks gaged flows.

2.5.2 River and Tributary Runoff Production

The production of runoff in various tributaries is generally related to sub-basin area, peak elevations, variations in vegetation and soil conditions, as well as local storm patterns. Runoff volumes, hydrograph timing, and sediment yield over the period of record has been greatly affected by interaction of fires and floods. Moderate fires associated with floods have occurred every ten years, while extreme fires and major floods have occurred every 20 years (Chubb 1997). The Matilija and North Fork Matilija sub-basins have experienced the most widespread, repeated fire damage, with major fires in 1932, 1949 and 1985 (the Wheeler fire). Some areas of the watershed have not burned for many years, such as the area around Casitas reservoir and parts of the San Antonio Creek basin. These locations may be susceptible to intense damage from future fires due to accumulated fuel loads (Chubb 1997).

Long-Term Averages

The long-term average runoff production for the gaged tributaries and the Ventura River is presented in Table 2-3. Matilija and San Antonio creeks sub-basins have the largest average annual runoff volumes, with Matilija Creek being the single most important sub-basin for total volume. North Fork Matilija Creek and Matilija Creek are the major water production areas, with long-term average runoff per square mile of watershed area of approximately 500 AF. San Antonio Creek has the lowest runoff production per unit area, but has a larger watershed than either Coyote or Santa Ana creeks. Therefore, the average annual runoff produced from the San Antonio Creek basin is approximately equal in volume to that from both the Coyote and Santa Ana sub-basins upstream of Casitas Reservoir.

Table 2-3. Long Term Average Runoff of the Ventura River and Tributaries.

Gaging Station	Period of Record	Unit Area (sq. mi.)	Average (mean) Annual Runoff (AF)	Unit Area Production (AF/sq. mi.)	Percent of "Ventura River, Combined"*
Matilija Creek	1927-present	55	26,442	480.8	55.6
North Fork Matilija Creek	1928-1931 1933-present	16	8,477	529.8	17.8
San Antonio Creek	1949-present	51	11,206	219.7	23.5
Coyote Creek	1958-1990		5,313		11.1
Santa Ana Creek	1958-1990		4,005		8.4
Coyote & Santa Ana		41	9,318	227.3	
Ventura River near Ventura	1912-1913 1930-present	188**	42,385		89.1
Ventura River near Ventura, Combined (unimpaired)	1930-present	188**	47,596	253.2	100

Source: USGS gage records; USB, 1954 and Casitas & City 1991.

*Tributary runoff as a proportion of the unimpaired runoff at Foster Park.

**Includes area of all upstream sub-basins

Water Year Types

The long-term average runoff production values, while valuable for comparing the relative importance of sub-basins, are the statistical means of the long term records, which include a very large amount of interannual variation. As shown in Figure 2-4, annual unimpaired runoff for the Ventura River watershed between 1930 and 1994 varies greatly, with several extremely high years with runoff much higher than the mean value. The totals range from a low of only 1,602 AF in WY 1961 to a maximum of 262,031 AF in WY 1941. The median annual unimpaired runoff, 18,165 AF, is much lower than the mean due to the statistical effect of a few extremely large runoff years. However, the median maybe a more reliable base amount and expected yield than the statistical mean.

The wide range streamflow production from year to year is not unusual for a semi-arid setting, but has important implications as a natural limitation to both the native fisheries resources and water supply management. Over typical planning time frames (20 to 50 years) such variability creates limitations to water supply management and native fisheries. However, when viewed from longer time spans, the conditions are less of a limiting factor than an evolutionary pressure affecting the traits of native fishes. We have analyzed and categorized the variation over the entire historical record into water year types. Standard hydrologic methods were used to rank the years and analyze the percent of years with certain ranges of values to create five classes from wet, above normal, normal to below normal and dry.

To best reflect the natural climatic and hydrologic response of the basin, the water year type has been determined using both the unimpaired runoff for the Ventura River, near Ventura (combined record, USGS #11118501) and precipitation from five basin stations (Table 2-4). Although runoff is typically the preferred variable for water year-typing; both runoff and precipitation have been used since the USGS gage 11118501 may under represent total runoff during years that Matilija and/or Casitas reservoirs experienced net increases in storage. The maximum effect of Matilija is limited due to the reservoir's storage capacity restrictions, but could have been as much as 7,000 AF during the 1950s or early 1960s. The potential effect of Casitas reservoir is larger due to the greater storage capacity. Examination of Robles diversion totals (see Figure 2-2) and Casitas Reservoir inflow/outflow records indicates that the effects of Casitas were greatest in the mid-to late- 1960s when the lake was filling.

Comparison of the water year types based on runoff to those based on precipitation does show a minor effect from reservoir storage on the designation, with some years having a 'drier' class if based on runoff (e.g. 1956, 1962, 1965, 1982 and 1991). The water year type only shifts one class except for WY 1965, which would be considered above normal based on precipitation, but is below normal based on runoff. There are no situations where the runoff is considered to be 'dry' but the precipitation would indicate above normal or wet. There are also several years pre-and post-Matilija Dam that have water year classes that are 'drier' when based on precipitation than when based on runoff (e.g. 1933, 1937, 1944, 1946, 1970, 1972, 1977 and 1989).

Figure 2-4. Annual Unimpaired Runoff, 1930-1996 (USGS gage 11118501).

Table 2-4. Water Year Types for the Ventura River Basin Based on Unimpaired Runoff and Estimated Basin Precipitation.

	Ventura River Runoff**	Water Year Type	Ventura Basin Rainfall***	Water Year Type
Water Year	Annual Volume (acre-feet)	Based onRunoff	Annual Total (inches)	Based on Precipitation
1930	7,419	BN	14.1	BN
1931	3,322	D	15.8	BN
1932	61,808	AN	26.2	AN
1933	20,141	N	12.0	D
1934	32,316	AN	15.4	BN
1935	44,554	AN	24.2	AN
1936	29,550	AN	19.9	N
1937	113,311	W	30.9	AN
1938	195,303	W	32.4	W
1939	24,773	N	15.2	BN
1940	16,807	N	17.6	N
1941	262,031	W	45.6	W
1942	27,751	N	17.1	N
1943	142,573	W	29.5	AN
1944	81,338	W	23.1	AN
1945	37,087	AN	19.1	N
1946	30,919	AN	15.4	BN
1947	19,268	N	15.2	BN
Matilija Dam began storing water in water year 1948				
1948	4,473	D	8.9	D
1949	4,308	D	10.4	D
1950	7,863	BN	15.4	BN
1951	3,574	D	10.1	D
1952	130,918	W	35.4	W
1953	14,112	N	13.3	BN
1954	14,102	N	18.5	N
1955	4,909	D	16.4	N
1956	14,972	N	21.1	AN
1957	5,804	D	14.0	BN
1958	165,177	W	38.9	W

(see next page)

* Wet, Above Normal, Normal, Below Normal and Dry classes determined by exceedance analysis using 20 percent intervals for each class (e.g., driest 20% of the years =Dry).
** Based on the USGS Gage #11118501, Ventura River near Ventura, Combined (flow plus Foster Park diversion).
*** Mean of five precipitation stations (Ventura, Ojai, Matilija Canyon, Lower Lake Casitas and Santa Ana Valley).

Table 2-4. Water Year Types for the Ventura River Basin Based on Unimpaired Runoff and Estimated Basin Precipitation (concluded).

	Ventura River Runoff**	Water Year Type	Ventura Basin Rainfall***	Water Year Type
Water Year	Annual Volume (acre-feet)	Based onRunoff	Annual Total (inches)	Based on Precipitation
Casitas Dam, Robles Diversion began functioning in water year 1959				
1959	10,847	BN	11.6	D
1960	4,238	D	14.0	BN
1961	1,602	D	9.1	D
1962	64,884	AN	33.0	W
1963	7,087	BN	16.5	N
1964	3,960	D	13.0	D
1965	6,155	BN	20.2	AN
1966	42,424	AN	23.4	AN
1967	35,642	AN	31.9	AN
1968	12,266	BN	15.3	BN
1969	254,100	W	46.6	W
1970	16,394	N	15.9	BN
1971	16,488	N	19.5	N
1972	8,669	BN	11.9	D
1973	52,739	AN	33.4	W
1974	18,165	N	19.1	N
1975	18,998	N	22.0	AN
1976	7,731	BN	15.7	BN
1977	6,558	BN	13.1	D
1978	242,412	W	48.8	W
1979	37,661	AN	24.6	AN
1980	137,703	W	33.4	W
1981	14,888	N	16.4	N
1982	10,121	BN	19.0	N
1983	221,222	W	45.9	W
1984	34,373	AN	15.3	BN
1985	8,820	BN	15.1	BN
1986	52,680	AN	31.4	AN
1987	10,523	BN	9.4	D
1988	12,087	BN	18.1	N
1989	7,011	BN	11.3	D
1990	3,672	D	9.0	D
1991	23,967	N	21.6	AN
1992	61,637	AN	27.8	AN
1993	101,855	W	42.2	W
1994	3,683	D	14.1	BN
1995			46.4	W
1996			17.3	N

* Wet, Above Normal, Normal, Below Normal and Dry classes determined by exceedance analysis using 20 percent intervals for each class (e.g., dries 20% of the years = Dry).
** Based on the USGS Gage #11118501, Ventura River near Ventura, Combined (flow plus Foster Park diversion).
*** Mean of five precipitation stations (Ventura, Ojai, Matilija Canyon, Lower Lake Casitas and Santa Ana Valley).

Although the base number of years differs for the pre-Matilija (1930-1947), Matilija-only (1948-1958), and post-Casitas/Robles (1959-1996) periods, the proportion of water year types in each period can be fairly compared (see Table 2-4). The post-Casitas period includes 36 years of the total record and has very evenly distributed water year types (~18-21% in each of the 5 classes). In contrast, the Matilija-only period has over half of its 11 years below normal or dry. The 18 years of record prior to Matilija have proportionally more wet and above normal years than either of the more recent periods.

2.5.3 High Flows and Flooding

Surface flows in streams of the Ventura River watershed during the wet season are derived almost entirely from rainfall and generally exhibit variability of flow that parallels the precipitation inputs. The streams have “flashy” storm hydrographs, with sudden rises in discharge immediately following the onset of precipitation and relatively rapid declines in streamflow after the rainfall ends. On the mainstem, flows can surge from near zero to thousands of cubic feet per second (cfs) within a few hours during major storms (USBR 1954).

The Ventura River has a long history of flooding, with ten major floods between 1938 and 1994 (Table 2-5). The largest flood occurred in February 1978, with a peak discharge of 63,600 cfs at the Ventura River near Ventura. The storage available at Matilija and Casitas Reservoirs to regulate peak flows from major storms has varied over the years. Matilija Dam was capable of appreciably lowering (by 50%) flood flows in the river for the first decade or two after construction. However, it presently has little effect on reducing the peak of major flood flows but is used to regulate the timing of diversions and releases at the Robles dam. Casitas Reservoir’s available capacity and the rate of flow above Robles Dam have become more important factors during major storms, even though they are not designed as flood control facilities. The 500-cfs diversion structure at Robles Dam has little effect on large peak flows, since the diversions do not occur under the high suspended sediment conditions associated with large peak flows. However, the 500-cfs diversion likely reduces the “moderate” peak events (flows at or near the capacity of the diversion) that would have occurred on the mainstem.

2.5.4 Low Flows

Under summer low flow or drought conditions, surface streamflow at various locations in the watershed is governed by a complex interaction of precipitation input, discharge from springs, groundwater levels, the effects of water diversions, water storage, water supply releases and treated wastewater discharge, and groundwater extraction.

It is not unusual for streams in southern California that are rain fed and lack groundwater support to dry up in summer months, in both average and below average precipitation years. In the Ventura River watershed, however, several of the small tributaries and even the mainstem have short perennial reaches that are fed by springs and/or the perched groundwater over shallow bedrock.

Table 2-5. Major Floods and Flow Regulation on the Ventura River Near Ventura.

Year	Flood Month	Ventura River Peak Discharge (cfs)	Matilija Reservoir Storage Capacity * (acre-feet)	Casitas Reservoir Available Storage ** (acre-feet)
1938	March	39,200	none	none
1943	January	35,000	none	none
1952	January	29,500	7,020	none
1969	January	58,000	2,500	137,000
1969	February	40,000	2,500	37,000
1978	February	63,600	2,500	76,000
1980	February	37,900	2,000	17,000
1983	March	27,000	1,400	40,000
1992	February	46,700	1,000	110,000
1993	January	12,500	990	42,000

*Maximum storage capacity, based on historic reports; storage available would be less than the maximum.

**Available storage, based on the difference between the 254,000 acre-feet capacity and reported "first of year" storage (Casitas, 1993).

Small summer streamflows maintained by springs were documented by the USBR (1954) in the upper reaches of the larger sub-basins. EDAW (1981) reported typical summer base flows of 1-2 cfs in North Fork Matilija Creek, 1-3 cfs in Matilija Creek, and less than 0.5 cfs in San Antonio Creek and Coyote Creek below Casitas Dam. The perennial flow in the “live stretch” of the river, defined as the portion upstream of Foster Park and including lower San Antonio Creek from State Highway 33 to its confluence with the Ventura River (Casitas & City 1984), is supported by groundwater in shallow alluvium over bedrock, which is artificially raised at Foster Park by the subsurface dam. Summer flows of about 3.5 cfs occur downstream of the OVSD wastewater treatment plant from effluent discharge.

Figure 2-5 illustrates the mean monthly minimum streamflows experienced at the Ventura River near Ventura station for four portions of the historical record. The 1930 to 1947 period is pre-Matilija Dam, the 1948-1959 period is pre-Casitas Dam, and the last two periods cover the remaining post-Casitas record. The data includes the effects of the City diversions at Foster Park for all time periods shown(uses USGS Gage 11118500). Initial analysis of the data clearly show the expected seasonal distribution of lowest minimum flows in summer and fall and higher minimums in winter and spring. The wide variation in minimum flows for the months of January through May reflects a combination of natural variation in streamflow due to precipitation amounts and timing and the effects of diversions. The overall importance of climate-driven variability is evident from the similarity of the 1930-1947 and 1978-1993 patterns to each other, rather than some progressive change between the 1930s and 1980s.

To examine the availability of natural runoff during various types of climatic conditions, 61 years of daily streamflow records for the Ventura River, near Ventura (combined) (USGS Gage 11118501) were grouped by water year type to prepare seasonal hydrographs (Figures 2-6 and 2-7) (also see Appendix A). While these data are not a perfect representation of the natural flow regime they provide a reasonable view of the seasonal flow in the main stem above Foster Park[1].

One distinctive feature of these hydrographs are the consistency of summer and fall months during all water year types, and the low variations between the mean and median values in the months of June through November. In contrast, flows in winter and spring months range widely by water year type, and it is only the wet years (~20% of total) that ever have median stream flows over 200 cfs. The large difference between mean and median values in winter and spring months reflects the observed pattern large and short-duration floods which enhance the mean flows but occur so rarely as to not increase the median significantly.

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[1] The gage data may under represent actual low flows due to gage location relative to low flow channels; and, diverted flows at Robles are not incorporated. However, flows from San Antonio Creek and Coyote Creek are included even though they might not naturally be available upstream of their confluence.

Figure 2-5. Historical Mean Monthly Minimum Flows, Ventura River Near Ventura.

Figure 2-6. Mean Daily Unimpaired Flows by Water Year Type (USGS gage 11118501).

Figure 2-7. Median daily Unimpaired Flows by Water Year Type (USGS gage 11118501).

If mean flows are used, it is only in above normal and wet years that any months have flows over 100 cfs. The other water year types would be expected to have mean winter and spring flows in the range of 20 to 40 cfs. The median flows, which indicate that 50% of the sample in the water year type will equal or exceed the value, demonstrate that only wet years consistently experience flows over 100 cfs, and those are only in February, March and April.

2.5.5 MIGRATION PERIOD STREAMFLOWS

Natural flows in the Ventura River did not provide passage to the upper watershed (above Robles) in every year. An analysis of daily streamflows for the steelhead migration period (December through May) has been performed to evaluate the frequency that steelhead had the opportunity to reach the upper watershed. The assessment addresses passage potential in the mainstem from Foster Park upstream (where the channel is wide and braided) to Robles Diversion. It does not assess river mouth opening or closure. Passage opportunity was assessed for the migration season, for each water year with daily streamflow data, WY 1930-1993 (USGS gage # 11118500). The Ventura River, near Ventura flow data are used to incorporate the effects of the City diversion and represent the historical availability of passage.

We analyzed the flow records using two different flow criteria, 50 cfs and 100 cfs. These estimated flow levels are intended only as preliminary estimates of the conditions required for adult steelhead to migrate within the mainstem, based on professional judgment and comparison to studies of nearby rivers. Due to the relatively short run of river from the mouth to the headwaters (10 to 15 miles), we assumed that if three consecutive days met the flow criteria, passage could be provided. The tally of the number of times that at least 3 consecutive days meeting the flow criteria occur in each month of each migration season for all 61 years is included in Appendix A. Table 2-6 summarizes the results of the passage analysis and provides cross reference to the water year types and the dates of major water development facilities.

For the entire period of record, nearly all water years classed as Wet, Above Normal or Normal would provide passage at both the 50 and 100 cfs criteria. The exceptions for the runoff-based W, AN, and N years, are 1953 (both flow levels), and 1954 and 1971 (100 cfs only). For the precipitation-based W, AN, and N years, 1955 and 1963 lack passage under both flow levels and 1965, 1971, 1982 and 1988 do not meet the 100 cfs criteria. Over the whole record, passage was not available during any runoff-based Dry years, and only occurred during two of the precipitation-based Dry years, 1933 and 1972.

For those years classed as Below Normal, passage availability is more varied than for the other classes of water year types. However, there is no clear pattern relative to the time period in which the BN years occur (i.e., not all BN years prior to the dams had passage while the BN years after dams lacked passage). Passage was available at the 50 cfs criteria in five of the 14 runoff-based BN years (WY 1930, 1965, 1972, 1982 and 1988;

Table 2-6. Estimated Passage Availability, WY 1930-1996.

	Water Year Type		Passage between December and May			
Water Year	Based on Runoff	Based on Precipitation	3 consecutive days of at least 50 cfs?		3 consecutive days of at least 100 cfs?	
1930	BN	BN	Y		Y	
1931	D	BN		N		N
1932	AN	AN	Y		Y	
1933	N	D	Y		Y	
1934	AN	BN	Y		Y	
1935	AN	AN	Y		Y	
1936	AN	N	Y		Y	
1937	W	AN	Y		Y	
1938	W	W	Y		Y	
1939	N	BN	Y		Y	
1940	N	N	Y		Y	
1941	W	W	Y		Y	
1942	N	N	Y		Y	
1943	W	AN	Y		Y	
1944	W	AN	Y		Y	
1945	AN	N	Y		Y	
1946	AN	BN	Y		Y	
1947	N	BN	Y		Y	
Matilija Dam began storing water in water year 1948						
1948	D	D		N		N
1949	D	D		N		N
1950	BN	BN		N		N
1951	D	D		N		N
1952	W	W	Y		Y	
1953	N	BN		N		N
1954	N	N	Y			N
1955	D	N		N		N
1956	N	AN	Y		Y	
1957	D	BN		N		N
1958	W	W	Y		Y	
Totals: No. Years (1930-1958)= 29			**21**	**8**	**20**	**9**
Percent of years with passage			**72%**		**69%**	

(see next page for post-1958)

W = Wet, AB = Above Normal, N = Normal, BN = Below Normal, D = Dry

Table 2-6. Estimated Passage Availability, WY 1930-1996 (concluded).

	Water Year Type		Passage between December and May			
Water Year	Based on Runoff	Based on Precipitation	3 consecutive days of at least 50 cfs?		3 consecutive days of at least 100 cfs?	
Casitas Dam, Robles Diversion began functioning in water year 1959						
1959	BN	D		N		N
1960	D	BN		N		N
1961	D	D		N		N
1962	AN	W	Y		Y	
1963	BN	N		N		N
1964	D	D		N		N
1965	BN	AN	Y			N
1966	AN	AN	Y		Y	
1967	AN	AN	Y		Y	
1968	BN	BN		N		N
1969	W	W	Y		Y	
1970	N	BN	Y		Y	
1971	N	N	Y			N
1972	BN	D	Y			N
1973	AN	W	Y		Y	
1974	N	N	Y		Y	
1975	N	AN	Y		Y	
1976	BN	BN		N		N
1977	BN	D		N		N
1978	W	W	Y		Y	
1979	AN	AN	Y		Y	
1980	W	W	Y		Y	
1981	N	N	Y		Y	
1982	BN	N	Y			N
1983	W	W	Y		Y	
1984	AN	BN	Y		Y	
1985	BN	BN		N		N
1986	AN	AN	Y		Y	
1987	BN	D		N		N
1988	BN	N	Y			N
1989	BN	D		N		N
1990	D	D		N		N
1991	N	AN	Y		Y	
1992	AN	AN	Y		Y	
1993	W	W	Y		Y	
Totals: No. Years (1959-1993)= 35			**23**	**12**	**18**	**17**
Percent of years with passage			**66%**		**51%**	

1930 also met the 100 cfs criteria). Streamflow met both the 50 and 100 cfs criteria in 7 of the 16 precipitation-based BN years (WY 1930, 1934, 1946, 1939, 1946, 1947, 1970, and 1984).

Prior to 1947, flows meeting both the flow criteria occurred every year except WY 1931, which was the only below normal/dry year in the pre-Matilija period. Matilija Dam began operation coincident with the worst drought period on record, complicating the evaluation of the effects of climate versus operations. As would be expected for the dry period, only a few of the years between 1948 and 1958 had passage. In WY 1954, Matilija Dam may have influenced passage availability for the 100 cfs criteria, since it was a normal water year and had passage at the 50 cfs criteria, but not at the 100 cfs criteria (see Table 2-6). For the post-Casitas Dam period, the overall percentage of years meeting the 50 cfs criteria does not change substantially from the earlier period, but there is a noticeable drop in the number of years meeting the 100 cfs criteria, to 51 percent. In WY 1965, 1971, 1972, 1982, and 1988, passage was available at the 50 cfs criteria, but not at the 100 cfs criteria, despite a range of water year types. Other than these few cases, the passage availability in the post-Casitas Dam period is consistent with climatic-driven water year types.

These results indicate the most important control on availability of passage has been the climatic-driven streamflow regime. However, there are a few specific years where the influence of water development operations can be detected, and there is a general effect on the percent of years that meet the 100 cfs criteria.

2.6 GROUND WATER

2.6.1 GROUND WATER HISTORY

Groundwater has been an important water source for irrigation and municipal supplies in the Ventura River watershed for many decades. As of the 1950s, there were over 100 wells along the Ventura River between Matilija Dam and the City wellfield, but the most extensive ground water development at that time was in the Ojai Valley (USBR 1954).

Upper Ventura River Basin

Groundwater levels have been regularly monitored at several locations to assess potential long-term net depletion of the groundwater basin (Table 2-7).

The City's Nye Wellfield presently has four active wells (Nos. 1, 2, 7 and 8), located between 1,000 and 2,890 feet north of the subsurface dam near the "live stretch".

The Meiners Oaks CWD has ten wells, but only produces water from four active wells along the Ventura River Valley between Foster Park and Matilija Dam. Well nos. 1 and 2 are located immediately adjacent to the Ventura River about one mile downstream from Matilija Dam. Well Nos. 4 and 7 are located on a terrace on the west side of the Ventura River, adjacent to Rice Road.

Table 2-7. Ground Water Monitoring Wells in the Upper Ventura River Basin.

Name/Owner	State Well ID	Ground Elevation (ft msl)	Well Depth (ft)	Period of Record
Meiners Oaks CWD	4N23W 09B05	663		
Rancho Matilija	4N23W 09B01	662	180	1949-present
Rancho Matilija	4N23W 16B02	600		
Sparks Well	4N23W 16C04	563	227	1949-present
Ventura River CWD #2	4N23W 16C07	559		
Charlotte Newton	4N23W 20A01	489		
Katherine Haley	4N23W 20Q02	427	47	1948-present
Ventura River CWD#7	4N23W 20J02	457	54	1928-present
Ignacio Vega	4N23W 29F02	397	65	1928-present
John Newman	4N23W 29L01	373	50	1948-present
Ventura River CWD #4	3N23W 05B01	293	70	1942-present
Nye Well #1	3N23W 08B05	250	150	1938-present
Nye Well #2	3N23W 08B02	251	72	1938-present
Nye Well #7	3NR23W 08B01	260	80	1940-present
Nye Well #8	3N23W 08C02	251	52	1940-present

Ojai Valley Ground Water Basin

Surface water was transferred via pipeline from Matilija Reservoir to the Ojai Valley spreading grounds for groundwater recharge periodically from the early 1950s through the 1960's. Casitas has subsequently delivered supplemental surface water supplies to the Ojai Basin for irrigation and municipal purposes in quantities ranging from about 1,400 to 5,000 AF since 1970 (Figure 2-8). The annual deliveries have been larger in below normal to dry water years, such as WY 1976, 1977, and 1987-1990. The deliveries have resulted in a decrease in groundwater use and satisfied increased irrigation demands over the past 25 years. The decrease in groundwater use and increase in groundwater recharge from applied imported water have resulted in the overall maintenance of high water levels in the Ojai Basin in the past 20 years. As of 1995, there were 115 active and inactive wells recorded in the basin, most of which are private wells.

Historic well data indicate that seasonal fluctuations along the northern, central and eastern portions of the basin are typically around 20 to 80 feet. Wells located in the west and southwest portions of the basin are relatively stable and typically fluctuate from 5 to 20 feet seasonally.

2.6.2 GROUND WATER TRENDS

Groundwater levels in the unconfined aquifer systems fluctuate seasonally, rising with rainfall inputs and declining during the summer extraction period. In addition, groundwater levels experience net increases or decreases in elevation from year-to-year as a function of the balance between recharge rates, groundwater extraction and other groundwater losses.

Water levels in the two major groundwater basins, Ojai Valley and the Upper Ventura River, experienced dramatic drops during periods of dry years with low recharge and high extraction, such as the period from 1944 to 1951 (USBR 1954) and more recently from 1986 to 1990 (Casitas 1993). However, a rapid rise of the groundwater levels occurred immediately following drought-breaking wet seasons in both 1952 (USBR 1954) and 1992 (Casitas 1993). This response illustrates the high degree of interaction between ground water and surface hydrology and suggests that groundwater extraction use during droughts has not exceeded recharge capability. The provision of supplemental surface water supplies from Casitas has contributed to the stability of the groundwater storage and water levels in the Ojai Valley Basin over the last 25 years.

Figure 2-8. Casitas Deliveries to Ojai Valley Basin, WY 1959 to Present.

3.1 LIFE HISTORY AND HABITAT REQUIREMENTS

Steelhead rainbow trout (*Oncorhynchus mykiss*) are an anadromous form of resident rainbow trout, spending part of their life in the ocean and part in freshwater. Steelhead were historically present in most coastal California streams and resident rainbow trout were present in lakes and streams that did not have access to the ocean. In many historical steelhead streams, passage barriers have blocked migration to and from upper stream reaches and resulted in residualization of steelhead populations, which are commonly called resident rainbow trout. On the Ventura River, as in many coastal California streams, there are natural and man-made barriers (e.g. dams and road crossings) to upstream migrations that separate populations of steelhead and resident rainbow trout. In addition, barriers exist upstream of habitat accessible to steelhead trout which potentially separate populations of resident rainbow trout (Figure 3-1). It should be noted, however, that some mature resident rainbow trout have been documented downstream of barriers (Shapovalov and Taft 1954), some resident populations may seed downstream habitats with juveniles that have the potential to become steelhead, and that there is a range migratory behaviors that may occur. For the purposes of this report, both the Ventura River populations with the current potential for anadromy and those that do not have access to the ocean because of man-made barriers are called steelhead. Populations upstream of natural barriers are referred to as resident rainbow trout and fish of hatchery origin are referred to as hatchery rainbow trout.

Steelhead usually spend one to two years in the ocean before returning to spawn for the first time (Shapovalov and Taft 1954). Unlike other anadromous pacific salmonids, steelhead may survive spawning, return to the ocean and spawn again in a later year (Shapovalov and Taft 1954, Moyle 1976). Steelhead typically migrate upstream when streamflows rise during a storm event (Moyle 1976) and after the sandbar, present across the mouth of most southern California streams, is breached (Shapovalov and Taft 1954). Depending on rainfall, upstream migration and spawning typically occur from January to March in most southern California streams (Shapovalov 1944 as cited in ENTRIX 1995, Moyle and Yoshiyama 1992, NMFS 1996), and can potentially occur through June in the Ventura River (NMFS 1996). They usually spawn at the heads of or in riffles with gravel substrate (Moyle 1976). Optimal size of gravel substrate ranges from 0.6 to 10.2 cm (Bjornn and Reiser 1991). The female digs a pit in the gravel where she deposits her eggs. Often more than one male will fertilize the eggs before the female covers the eggs with gravel, creating a redd (Moyle 1976).

During incubation, sufficient water must circulate through the redd to supply embryos with oxygen and remove waste products. Abundant fine sediments can interfere with this

Figure 3-1. Upstream Migration Barriers to Steelhead in the Ventura River Watershed.

process and result in embryo mortality (Bjornn and Reiser 1991). Juvenile steelhead emerge from the gravel in approximately five to eight weeks, between March and April, depending on water temperature (Shapovalov and Taft 1954, Moyle 1976). In water temperatures around 60^{o}F, which can be the case in the Ventura, steelhead can emerge from the gravel in as short as three weeks (Barnhardt 1991).

In California, juveniles generally spend one to three years in freshwater before migrating to the ocean usually between March and June (Shapovalov and Taft 1954). Studies in the nearby Santa Ynez River indicate that outmigration may more typically occur between February and May (ENTRIX 1994). Recent studies in the Santa Clara River indicate that outmigration can occur between January and June, with a peak in April and May (ENTRIX 1996). It also appears the southern California steelhead may have adapted to the unpredictable climate by being able to remain landlocked for many years or generations before returning to the ocean when flow conditions allow (Titus et al. 1994). In the mainstem Ventura River, steelhead can have very high growth rates, growing to smolt size during their first year, when warm water and higher than normal flow conditions are present (Moore 1980). Young-of-the-year steelhead often utilize riffle and run habitat during the growing season and move to deeper, slower water habitat during the high flow months (Baltz and Moyle 1984, Hearn and Kynard 1986). Larger steelhead, usually yearlings or older, have been observed to use heads of pools for feeding (Cunjak and Green 1983, Baltz and Moyle 1984). Coastal lagoons can also often provide important rearing habitat for juvenile steelhead, potentially providing the majority of the summer and fall rearing habitat in small coastal streams (Shapovalov and Taft 1954, Smith 1990). The productivity and use of lagoon habitat by steelhead depends on lagoon habitat and water quality and proximity to spawning habitat (Smith, pers. comm., 1997).

Temperature tolerances and preferences of steelhead vary among seasons, life stages, and stock characteristics. Juvenile steelhead can typically tolerate warmer temperatures than other pacific salmonids (Moyle 1976). Mortality of eggs begins at 56°F (McEwan and Jackson 1996). At temperatures greater than 70°F, steelhead have difficulty obtaining sufficient oxygen from the water (McEwan and Jackson 1996). The preferred temperature range is reportedly 12.8-15.6^{o}C (55.0-60.1^{o}F) (Rich 1987), although steelhead in the Ventura River have been reported at temperatures as high as 28^{o}C (82.4^{o}F) (Carpanzano 1996). The Critical Thermal Maximum (CTM, the temperature at which a fish loses equilibrium and dies) for this species has been reported to be up to 29.4^{o}C (84.9^{o}F) (Lee and Rinne 1980). Warmer water requires more abundant food resources for fish survival, because of the resultant increase in their metabolic rate (Brett 1971, Fausch 1984). It should be recognized, however, that streams with warmer water would be expected to have more productive insect productions, thus providing the abundant food resources need for fish survival and growth.

3.2 STEELHEAD REGULATORY STATUS

There are several federal and state agencies with jurisdiction over aquatic resources. The main enforcement tools are the Endangered Species Act (ESA) and California ESA

(CESA), the Federal Clean Water Act and the California Fish and Game Code. The federal agencies responsible for the protection of native fish and wildlife in the Ventura River are the National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Service (USFWS). ESA Section 7 (for projects with federal agency involvement) and Section 10(a) (for projects without federal involvement) (16USC 1531 et seq.) require formal consultation on those species currently listed as threatened or endangered. In addition, Section 9 of the ESA prohibits the "taking" of listed species. A taking would result if individuals of a listed species would be inadvertently harmed, harassed, or collected, or their habitat would suffer significant modification. NMFS needs to be consulted for listed anadromous fishes and USFWS needs to be consulted for other listed fish and wildlife species. On August 17, 1997, steelhead were listed as "endangered" by NMFS Service under the ESA in all Evolutionarily Significant Units (ESUs) south of and including the Santa Maria River watershed (NMFS 1997). Ventura River steelhead are located in the Southern California ESU, which extends to the southern extent of the species range. In their status review, NMFS (1996) stated that genetic data show differences in steelhead within the Southern California ESU as well as among steelhead populations in this ESU and populations in other ESUs to the north.

The U.S. Army Corps of Engineers has the responsibility of issuing Section 404 and Section 7 permits under the Federal Clean Water Act. Section 404 permits are required for activities in stream channels below the ordinary high water mark and in areas designated as wetlands. If a species listed under the ESA is associated with the stream channel or wetland, the Corps has the responsibility of requesting and conducting Section 7 consultations with either NMFS or USFWS.

In addition, much of the Ventura River watershed is located on U.S. Forest Service land. The Forest Service has the responsibility of managing its land for multiple uses, including biological resources. The Forest Service is in the process of preparing a watershed management plan for the Ventura River watershed, which will include various land management options to protect and enhance natural resources, including steelhead.

The state agency responsible for public trust responsibilities is the CDFG. None of the aquatic species, including steelhead, found within the Ventura River are currently listed under CESA. Steelhead are currently a Species of Special Concern in California, but formal consultation with CDFG for a potential "taking" of a State listed species is not anticipated to be required. A streambed alteration agreement with CDFG pursuant to CDFG Code sections 1601-1603, however, must be in place prior to activity in the streambed, channel or bank. The agreement describes CDFG's required measures to protect fish and wildlife, terms for amendment, termination, renewal, time extensions, and describe CDFG's authority to suspend or revoke the agreement. CDFG is also responds to other actions that fall under the California Environmental Quality Act (CEQA). Other State agencies that have some regulatory authority over aquatic resource issues follow. The Regional Water Quality Control Board regulates discharge into streams and other activities that may affect water quality. The California Coastal Commission exercised Federal Consistency Review authority for federally sponsored, funded or regulated activities in the state that affect resources within the Coastal Zone.

The State Water Resource control board regulates water rights and therefore water withdrawal from streams. The Department of Parks and Recreation owns land around the mouth of the Ventura River and is responsible for its management. The State Lands Commission manages activities on state lands.

3.3 FACTORS FOR DECLINE

The decline of steelhead populations in California can be attributed to a variety of anthropogenic and natural factors. The relative impacts of these factors vary for different streams and different years. The natural factors, by themselves, may have resulted in short-term declines in steelhead populations, but did not resulted in declines that jeopardized steelhead survival as a species. Steelhead have for many thousands of years been evolving to the natural climatic cycles. These natural factors, however, are more detrimental now that other factors are also acting to reduce the populations (NMFS 1996). Sever reductions in population size can also result in negative genetic effects, including inbreeding and reduction in adaptation potential (NMFS 1996). Some potential factors in declining adult steelhead returns that have been identified for different locations include: poor ocean survival; habitat degradation and blocked passage due to drought, floods, dams, water diversions, and poor water quality; predation; and fisheries management activities.

3.3.1 OCEAN SURVIVAL

There is evidence of strong oceanographic influences on survival of steelhead from California to British Columbia (Cramer and Van Dyke 1994, Fisher and Pearcy 1994, Cooper and Johnson 1992 all as cited in Cramer et al. 1995). The primary productivity in the near-shore ocean has been affected by a shift in the California Current that occurred in the mid-1970's. Between the mid-1940's and mid-1970's, there was a strong southward flow in the California Current. Since the mid-1970's there has been a weak southward flow, which results in warmer air and sea surface temperatures off the California coast. A reduction in the zooplankton volume and the abundance of northern anchovy occurred coincident with the shift in the California Current (Cramer et al. 1995). Survival trends of steelhead were also correlated to physical and biological changes in the ocean (Cramer et al. 1995).

El Nino has also been cited as a cause for decline of west coast salmonids. El Nino ocean conditions include warm seas surface temperatures and reduced upwelling (NMFS 1996). These conditions result in reduced ocean productivity and changes in the species distributions (NMFS 1996). El Nino conditions were recorded in 1940-41 and 1957-58 and not again until the 1980's (NMFS 1996). El Nino conditions have been recorded in five out of the last fifteen years (NMFS 1996).

There is evidence that ocean productivity has fluctuated cyclically (decades or more) for thousands of years (Fisher 1994 as cited in Cramer et al. 1995, NMFS 1996). These natural cycles may indicate that there have always been natural cycles in steelhead abundance, however, other causes are now contributing to the decline of steelhead populations and acting to exaggerate the detrimental effects of the natural changes in productivity that steelhead have evolved with other many thousands of years. Given variable ocean conditions and the scarcity of high quality near-shore habitat, freshwater habitat has become more crucial for the survival and persistence of many steelhead populations (NMFS 1996).

3.3.2 DROUGHT

Drought is another naturally occurring phenomenon that has played a role in the decline of steelhead. Drought impacts steelhead by reducing rearing area, reducing productivity of remaining freshwater habitats, reducing productivity of estuarine lagoons, and blocking migration (Cramer et al. 1995). However, there is evidence that the recent six-year drought in California may have been a mild event compared to past droughts (Stine 1994 as cited in NMFS 1996). Past droughts resulted in selective pressures on steelhead populations that contributed to the evolution of the species. Steelhead have evolved to be able to cope with a variety of environmental conditions, such as drought (NMFS 1996). Throughout California, particularly in southern California coastal streams, there are abundant competing uses for water. Water management activities can exacerbate the low flow conditions in streams because of higher rates of surface flow diversion and groundwater extraction during drought conditions.

3.3.3 FLOODS

Many streams have shown long-term damage as the result of landslides during major flood events. The years of major flood events vary between north and south coastal California streams, but the habitat impacts are similar. Landslides contribute abundant sources of debris, rock, and sediment that fill in pools and rip out riparian vegetation allowing the opportunity for non-native vegetation to colonize the area, thus reducing habitat complexity (NMFS 1996). Sedimentation of streambeds and spawning gravels has been suggested as a principle cause of the decline of salmonid populations (NMFS 1996). In addition, floods can scour and redeposit spawning gravels in areas that are inaccessible during typical water years (NMFS 1996). However, it is important to note that floods can also be important for delivering suitable spawning gravels to stream beds and in some cases cleaning gravels of fine sediments as well as rejuvenating riparian vegetation. In general, steelhead populations are probably more productive in flood years than in drought years.

3.3.4 DAMS (PASSAGE BARRIERS)

Dams have been constructed on most streams that produce steelhead in California. The major impact of dams has been to block passage of steelhead migrating upstream to historical spawning habitat (NMFS 1996). Dams also alter natural flow regimes downstream (NMFS 1996), including in some streams reducing flushing flows necessary to avoid fine sediment deposition and riparian vegetation encroachment in the active channel. This can be especially detrimental in southern California streams, where perennial flow for summer rearing may have only occurred historically in the headwater reaches of the system, or where the accessible reaches downstream of the dams are dewatered because of diversions at the dams. Dams may also block gravel recruitment to downstream reaches in some streams, thereby affecting habitat quality for spawning (NMFS 1996).

3.3.5 WATER DIVERSIONS

Water withdrawals, both direct (diversions from streams) and indirect (wells and groundwater pumping) can reduce stream flows and alter the timing of flow events. This can reduce the quantity and quality of habitat available for steelhead (NMFS 1996), especially for incubating eggs and rearing juveniles during the low flow months. Depletion of natural flows can also reduce fine sediment flushing from the spawning gravels and reduce gravel recruitment (NMFS 1996). Water use can cause water table levels to drop, which can affect riparian vegetation that provides cover and structure to the stream (NMFS 1996). Young steelhead smolts can also be entrained into diversion facilities (NMFS 1996).

3.3.6 LAND USE ACTIVITIES

Land use activities can contribute to degradation of stream habitat (McEwan and Jackson 1996). In-channel mining or gravel extraction can have both long and short-term water quality impacts as well as long-term spawning and food production habitat reduction. Activities such as timber harvest, livestock grazing, urban development (including roads, flood control, and waste treatment facilities), and out-of-channel mining or mineral extraction can impact stream habitat quantity and quality. These activities can change streambank and channel morphology, alter natural stream flow events (often increased, but shorter duration peak flows and reduced low flows), reduce water quality (e.g. increased temperatures, siltation, discharge of pollutants), shrink the riparian zone which affects channel structure and water quality, and block access to upstream spawning areas (e.g. road crossings and flood control channels) (NMFS 1996).

3.3.7 PREDATION (DISEASE)

Predation of juvenile steelhead in streams by native and non-native fishes including squawfish, striped bass, bass, and channel catfish has been documented (Cramer et al. 1995, NMFS 1996). In southern California streams, it is likely that only bass (large and small mouth) and channel catfish would have the potential to significantly impact juvenile steelhead, especially when stream temperatures are warm and more preferable to these species then to steelhead. Shore birds, specifically pelicans and gulls, have been seen feeding in the lagoons and off stream mouths in the spring when smolts are migrating to the ocean (Cramer et al. 1995, NMFS 1996). Other native predatory birds include great blue herons, green herons, egrets, and kingfishers. Pinnepeds (e.g. seals, sealions) have also been documented preying on adult steelhead in many systems and this predation has been documented to have increased with increased pinneped populations (Cramer 1995, NMFS 1996). According to NMFS, the numbers of California sea lions have been increasing by about 3% each year. Sea lion attack scars were observed on trapped upmigrant adult steelhead in the early 1950's (Shapovalov and Taft 1954). More recently marine mammal attack scars have been observed on between approximately 1 to 20 percent of individual stocks of salmonids (NMFS 1996). These increased pinneped populations and other native predators have likely been having more of an impact on steelhead populations during past century than prior to human activities. Still, NMFS and CDFG feel that predation by native predators is not a significant cause of decline of steelhead (McEwan and Jackson 1996, NMFS 1997).

Infectious disease can influence steelhead survival, but there is very little current or historical information available to quantify any changes in infection levels and mortality rates attributable to diseases (NMFS 1996). Studies have shown that wild steelhead stocks tend to be less susceptible to disease then hatchery steelhead (NMFS 1996).

3.3.8 HATCHERY PRACTICES (ARTIFICIAL PROPAGATION)

Supplementation of steelhead populations with artificially propagated fish may have contributed to the decline of wild stocks in California, mainly through loss of genetic diversity and reduction in fitness to the natural environment (Waples 1991a, McEwan and Jackson 1996, NMFS 1996). Genetic diversity loss is of special concern in southern California streams because there is some indication that southern stocks are genetically different from northern stocks, yet artificially propagated fish are often from northern and non-anadromous rainbow trout stocks (see 3.5 - Steelhead Genetics). Selection of steelhead for hatchery stock may have altered fish size and timing of migration and spawning. In addition, hatchery-reared fish may have reduced predator avoidance instincts as well as poorer foraging capabilities.

3.3.9 HARVEST

There is evidence that steelhead are capable of withstanding high rates of harvest in years when freshwater and ocean survival are high, but can sustain little or no harvest when freshwater and ocean survival are low (Cramer and Van Dyke 1994 as cited in Cramer et al. 1995). Even before habitat degradation, over-fishing by the first European settlers, led to the depletion of many steelhead stocks (NMFS 1996). Steelhead are harvested as juveniles in trout fisheries and as returning adults in sport steelhead fisheries in the ocean and in streams. There is no commercial harvest of steelhead in the ocean. In California, most steelhead are harvested in northern California steams, but sport fishing catch rates are low everywhere indicating declining steelhead numbers (NMFS 1996). At current low levels of survival and current low population levels due to other factors, any harvest exacerbates the population decline.

3.4 HISTORICAL RUN SIZES AND DISTRIBUTION IN VENTURA

The Ventura River reportedly supported a substantial run of steelhead up until the late 1940's when a prolonged drought and the construction of Matilija Dam apparently contributed to the decline of the species (Titus et al. 1994). The annual variation in adult returns and juvenile rearing success likely varied among years and within years among subbasin, because of the variations in the amount and pattern of rainfall and the resultant streamflows. In years when there is water suitable for adult migration and juvenile summer and fall rearing, production is likely very high (as per Moore 1980).

In 1946, the steelhead run size in the Ventura River was estimated to be 4,000 to 5,000 adults during normal water years (Clanton and Jarvis 1946). During drought conditions in March 1947 an estimated 250-300 adult steelhead, averaging in size between 61-66 cm, were observed holding in pools in the lower five miles of the Ventura River (Evans 1947). Until 1947, steelhead ranging in size from six to nine pounds were commonly taken from the Ventura River (Ventura County Fish and Game Commission (Commission) 1973).

The largest runs of steelhead in the Ventura River system occurred in Coyote Creek and Matilija Creek (Titus et al. 1994). The run of steelhead in Coyote Creek appeared to be doing well prior to a fire in the area in 1932 (Titus et al. 1994). In 1945, the estimated annual steelhead run in normal water years in the Coyote-Santa Ana Creek system was at least 2,500 and averaged about 3,000 (Clanton and Jarvis 1946). Similar adult return numbers were reported for Matilija Creek (Clanton and Jarvis 1946, Titus et al. 1994**).**

Between the late 1940's and 1973, the largest run of steelhead reportedly occurred in 1955 (Commission 1973). During that time, fishermen reported steelhead entering the Ventura River every year that the rains were sufficient to keep the sand bar at the mouth open for at least a week or more (Commission 1973). Observations of small numbers of adult steelhead in the Ventura River have continued through the present, including 1974, 1975, 1978, 1979, 1991 and 1993 (Titus et al. 1994).

Studies conducted by the City and Casitas since 1983 indicate that the annual variation in storms determines if upstream migration of steelhead is possible (Casitas and City 1984, City and Casitas 1990 and 1991). Two adult steelhead were observed in the Live Stretch, both in the summer of 1988. These fish likely migrated upstream from the ocean during a late February storm and had survived in the live stretch for 5 months before they were encountered. Juveniles were captured in the live stretch in the spring of 1984 and the spring and fall of 1989. It is unknown if these fish were native steelhead or resident rainbow trout rearing in the stretch, or hatchery (stocked) rainbow trout that moved downstream during high flows.

It should be pointed out that steelhead and rainbow trout stocking records for the Ventura River basin date back to 1878 (as discussed below). Various non-native strains have been stocked into the headwaters and mainstem of Ventura River, and continue to be stocked today. This stocking may have had an influence on the number of fish returning to spawn and the number of resident fish captured above barriers each year. Genetic analysis indicates that the steelhead/rainbow trout found in the headwater streams of the Ventura River Basin are dominated by fish with a more widespread (not specific to southern California) mitochondrial DNA type, as discussed below.

3.5 STEELHEAD GENETICS

Genetic analysis has been used to examine the population structure and stock origins of steelhead along the Pacific coast (Busby et al. 1996, Waples 1991b). Examination of variation in genetic markers such as mitochondrial DNA (mtDNA) can provide insight into patterns of reproductive isolation by revealing the genetic differences among populations.

Studies have documented geographic variation in genetic markers of steelhead (Nielsen et al. 1994, Cramer et al. 1995). Moyle and Yoshiyama (1992) concluded that southern steelhead (southward from San Luis Obispo County) were ecologically and physiologically adapted to the seasonally warm and intermittent streams of Southern California. For example, southern steelhead may have shorter freshwater residence as juveniles and protracted ocean residence during droughts (Titus et al. 1994). Although some of this phenotypic variation is undoubtedly a response to local conditions (Moyle 1976), it is reasonable to assume that there is a genetic basis as well.

The genetic diversity of geographically separated populations of steelhead trout in California has been studied using mtDNA. Nielsen et al. (1994) found 14 different mtDNA types from 33 coastal streams and five hatcheries. The California populations were dominated by four different mtDNA types, two of which were widespread throughout California but more commonly associated with north coast populations (types 1 and 3) and two of which were more commonly associated with south coast populations (types 5 and 8). Nielsen et al. (1994) also found three rare mtDNA types (types 6, 10, and 14) which were found only in southern California streams, although more recent analysis suggests that one or two of these (types 10 and 14) could be from hatchery fish of more northerly strains (i.e. north of California) (J. Nielsen pers. comm. 1996).

It is important to realize that knowing the mtDNA type of a single fish is insufficient to understand the stock origins of a population. Although fish with mtDNA type 1 are more common in northern populations and type 3 fish are more common in central California populations, these mtDNA types also occur naturally in southern populations, albeit at lower frequencies. Scientists look at the relative proportions of different mtDNA types from many fish in order to assess the origin of steelhead in a particular population.

Most genetic studies in the Ventura basin have focused on landlocked fish in Matilija Creek above Matilija Reservoir. Neilsen et al. (1994) found the four dominant mtDNA types in 24 steelhead/rainbow trout from Matilija Creek. In this sample 79% of the fish had more widespread mtDNA types (1 and 3) and 21% had mtDNA types found more commonly in southern California (5 and 8) (Table 3-1). Ten additional samples were subsequently taken from Matilija Creek steelhead/rainbow trout, upstream of Matilija Reservoir (Neely 1995). Again, only the four dominant mtDNA types were exhibited in these fish; 70% of which were found to have the more widespread mtDNA types and 30% of which had one of the two mtDNA types found more commonly in southern California (see Table 3-1). Carpanzano (1996, data subsequently incorporated into Nielsen et al. 1997) also examined steelhead/rainbow trout in the Ventura basin. The mtDNA types of two fish from the mainstem Ventura River above the Robles Diversion Dam were the widespread California mtDNA types. The mtDNA types of 32 steelhead/rainbow trout from several locations in Matilija Creek upstream of Matilija Reservoir included both the more widespread mtDNA types and the southern California mtDNA types.

In conclusion, steelhead/rainbow trout samples from above Robles Diversion Dam (n=68) were dominated (80%) by fish with the more widespread mtDNA types (24% type 1 and 56% type 3). This may reflect in part a long history of stocking in Matilija Creek with hatchery fish, which were frequently derived from northern stocks (see 3.6 Historical Stocking). Although sample sizes for some of the individual studies cited above were often small, the results are consistent across the studies and the aggregate sample size is sufficiently large enough to provide a good picture of mtDNA variability, given that there are only four common haplotypes.

Some steelhead/rainbow trout have been analyzed from the mainstem Ventura River below Robles Diversion Dam (Capelli 1997b). In this sample (n=9) there were seven type 3 fish and one each of types 1 and 5. This pattern appears similar to that seen above Robles, but the sample is too small to test statistically. Nielsen et al. (1997) analyzed three preserved steelhead specimens collected by angling in the Ventura River during the early 1940s, and found one each of mtDNA types 1, 3, and 5.

3.6 HISTORICAL STOCKING

Steelhead and rainbow trout stocking records for the Ventura River basin date back to 1878. The U.S. Forest Service (USFS) has documentation of New Hampshire rainbow trout and Maine Salmon being stocked in the basin in February 1878 (Chubb 1997). In 1894, 20,000 eastern brook trout, 10,000 rainbow trout, and 15,000 Tahoe trout were planted in the Ventura River headwaters (Chubb 1997). The following year, 62,500 rainbow trout were planted in Ventura County streams (Chubb 1997). Titus (1994) reported that 40,000 and 34,000 steelhead juveniles were stocked in the Ventura River watershed in 1930 and 1931, respectively. The mainstem of the Ventura River was stocked with one to several thousand rainbow trout several times per year between 1942 and 1947 and 1954 and 1974 (CDFG fish planting receipts). These fish were from several strains including Mount Whitney, Mount Shasta and Hot Creek. The Ventura River was also stocked with steelhead rescued from the Santa Ynez River: approximately

Table 3-1. Proportions of Different Types of Mitochondrial DNA in Steelhead/ Rainbow Trout From the Ventura River Basin.

Study	Location	Number of Fish	Number of mtDNA types 1	3	5	8
Nielsen et al. 1994	Matilija Creek	24	6	13	3	2
Neely 1995	Matilija Creek above Matilija Reservoir	10	3	4	3	0
Nielsen et al. 1997*	Matilija Creek above Matilija Reservoir	21	6	10	4	1
	Matilija Creek below Matilija Reservoir	2	0	2	0	0
	Upper North Fork of Matilija Creek	9	1	7	0	1
	Mainstem Ventura River above Robles Div. Dam	2	0	2	0	0
Capelli 1997b	Mainstem Ventura River below Robles Div. Dam	9	1	7	1	0
Nielsen et al. 1997	Mainstem Ventura River (1940's preserved fish)	3	1	1	1	0
All Ventura (%)		80=100%	22.5%	57.5%	15%	5%

*Data from Carpanzano (1996) was incorporated into Nielsen et al. (1997). Reach designations were provided in Carpanzano (1996) and by Nielsen (pers. comm.)

17,200 in 1943; 20,800 in 1944; and, 45,440 in 1945 (Titus et al. 1994). More recently the mainstem Ventura River was stocked with 11,000 steelhead in June 1976, 9,000 steelhead in June 1977, and 20,000 steelhead in June 1978. All of these fish were released as young-of-the-year and were obtained primarily from Mad River hatchery (2,000 of the 1977 fish were from Humboldt State University Hatchery (Moore 1980).

As on the mainstem of the Ventura River, thousands of juvenile rainbow trout from both Mount Whitney and Mount Shasta were stocked in Matilija Creek between 1938 and 1948 (CDFG fish planting receipts). The Upper North Fork Matilija Creek was stocked with 4,800 rainbow trout from Mount Shasta in 1948. Murietta Creek (West Fork Matilija Creek) was stocked twice in 1942 with 1,200 rainbow trout from Hot Creek and 1,800 rainbow trout from unspecified origin. The North Fork Matilija Creek was reportedly stocked annually with trout of unspecified origin at least until 1973 (Commission 1973). Stocking of catchable size trout has continued in the North Fork Matilija Creek until today.

Both steelhead and rainbow trout strains were stocked in the San Antonio Creek sub-basin, between 1933 and 1947 (CDFG fish planting receipts). About 26,000 steelhead trout from Mount Whitney were stocked in San Antonio Creek between 1933 and 1940. Another 16,250 rainbow trout from Mount Whitney, Mount Shasta and Hot Creek were stocked into San Antonio Creek between 1943 and 1947. There is one record of 10,000 rainbow trout from Mount Shasta being stocked into Senior Canyon Creek, a tributary to San Antonio Creek, in 1945.

There is an additional stocking record from 1940 of about 2,500 rainbow trout of unspecified origin being stocked into Santa Ana Creek, a tributary to Coyote Creek (CDFG fish planting receipt).

In the last 40 or so years, regular stocking of rainbow trout strain from Mount Whitney, Coleman, and Hot Creek has occurred in Matilija Creek upstream of Matilija Dam and in North Fork Matilija Creek (M. Cardenas, CDFG, pers. comm.). During this time, a few isolated instances stocking of steelhead strain from Mad River may have occurred. These stockings usually took place several times a year and contained both fingerling and catchable size trout. Stocking of Matilija Creek upstream of Matilija Dam has continued through 1997.

3.7 HABITAT CONDITIONS

Data was collected from various sources regarding the stream habitat conditions in the Ventura River water shed. 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 available. 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. In addition, steelhead have evolved to be adapted to the episodic natural events that alter habitat conditions.

CDFG site visit notes were reviewed for the Ventura River, Matilija and North Fork Matilija, Lion Creek and Santa Ana Creek between 1947 and 1956. These notes pertain mostly to streamflow conditions 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 available. More recently, habitat studies have been conducted in the Ventura River in the live reach near Casitas Springs and upstream of the Robles Diversion Dam, Matilija and North Fork Matilija creeks, and lower San Antonio Creek (USFS 1979, Moore 1980; Casitas Municipal Water District (Casitas) and City of San Buenaventura (City) 1984, 1990, and 1991; CDFG unpublished preliminary data from 1993, Capelli 1992, Carpanzano 1996; Fugro West Inc. 1996b; Chubb 1997; and Capelli 1997b).

A field reconnaissance was conducted as part of this study during the first week of April 1997 in the following streams:

- Matilija Creek downstream of Matilija Dam and upstream of Matilija Dam approximately five miles
- North Fork Matilija Creek upstream to its headwaters
- San Antonio Creek and its tributaries Lion, Senior Canyon, Thacher and Reeves creeks
- Coyote Creek downstream of Casitas Reservoir
- Canada Largo Creek
- Mainstem Ventura River

Access to Canada Del Diablo Creek was prohibited, so aerial photography and geologic maps were used to make a general assessment of probable habitat conditions. We were also unable to survey the tributaries to Matilija Creek because of difficulties in getting to these areas and associated time constraints, so USFS habitat survey information and aerial photography was used to describe the habitat conditions. We describe below the habitat conditions for each region, based on existing records and the April 1997 reconnaissance. Maps of the existing habitat conditions in the basin are provided in Figures 3-2 and 3-3.

3.7.1 MATILIJA CREEK

According to CDFG (then the Bureau of Fish Conservation) biologists, habitat conditions in Matilija Creek downstream of Matilija Reservoir between 1949 and 1952 were good because of good pools, shade and aquatic insect production. In 1956, this reach was

Figure 3-2. Potential Existing Steelhead Spawning Habitat.

Figure 3-3. Potential Existing Steelhead Rearing Habitat.

reportedly used to a considerable extent as a nursery area for juvenile fish (Unruh 1956). As observed in 1997, the creek flows through a canyon and the instream habitat is primarily boulder cascades and step runs and pools. The riparian vegetation and canyon walls provide fairly good canopy closure over the stream. However, this reach may be limited by available spawning habitat. According to CDFG, there are no spawning gravels or cobbles in this reach (CDFG unpublished data from 1993, S. Parmenter pers. comm.) Still, fish could move into this reach to rear during the low flow period because there is nearly always surface flow in this reach (Casitas unpublished data). During the 1997 survey, surface flows were approximately 10 cubic feet per second (cfs) and there was no evidence of persistent algae growth. Water temperature was 60 ^{o}F when the air temperature was 68^{o}F.

Upstream of Matilija Reservoir, CDFG surveys between 1949 and 1952 recorded the presence of hot sulfur springs along the stream margin. A 1950 survey of the stream indicated that there was aquatic plant growth in the stream along with some alga growth, a semi-open alder canopy, and rock rubble substrate. The biologists at that time felt that the stream above the dam would lend itself to habitat improvement. They recommended that the stream within a half-mile of the impoundment not be stocked with fish because of poor cover and lack of pools, but that the two miles upstream of the poor habitat continue to be stocked with fish because the habitat was good. During the summer of 1949 stream temperatures just upstream of the reservoir were as high as 85^{o}F and fishermen reported a fish kill (Evans 1949); no water temperatures were taken in the stream further upstream.

The USFS surveyed the Matilija Creek watershed in July 1979 and found that the entire lower reach, from the dam upstream to approximately one mile past the confluence with the Upper North Fork Matilija Creek, virtually lacked riparian canopy and had insufficient holding water due to high water temperatures and complete loss of surface flow in late summer and fall (Moore unpublished data 1979). However, the USFS noted that this reach did provide trout habitat during the winter and spring months and served as a migration route to the upper watershed where more appropriate rearing habitat was available. Upstream migration barriers (bedrock falls) occur approximately two miles upstream of the confluence with Upper North Fork Matilija Creek. The habitat in the one-mile section downstream of the falls was found to be fairly good for rearing steelhead. Although the riparian canopy had been somewhat removed from the significant flooding in 1978, there was adequate instream cover and shallow pools were common. Flow was estimated at 2.5 cfs during the July 1979 survey.

A recent habitat assessment by the USFS in Los Padres National Forest concluded that there was an approximately one to two mile section of spawning habitat in Matilija Creek just upstream from the confluence of Upper North Fork Creek and other short reaches with spawning habitat in the mid sections of some of the side forks and tributaries (Chubb 1997). Other areas of the Matilija creek subbasin were found to have either excess fine sediments (including Murietta Creek) or excess course sediments and little appropriate size gravels. Chubb (1997) concluded, however, that juvenile trout densities appeared to be more closely correlated to the amount and quality rearing habitat than the spawning habitat. Trout densities were high in much of the subbasin. The best rearing habitat was found in Murietta Creek and Upper North Fork Matilija Creek, while poor rearing habitat was found in the mainstem of Matilija Creek. Upstream migration barriers are located approximately one mile upstream from the confluence with Matilija Creek on Murietta Creek and approximately two and one half miles upstream from the confluence with Matilija Creek on Upper North Fork Matilija Creek.

Chubb's spawning habitat quality and quantity assessment was based on spawning substrates (gravels and proportions of silt) and channel morphology (width, depth and riffle habitat). The rearing habitat rating was based on substrates (cobble), channel morphology (run, glide, and similar habitats), and available flows. Lack of thermal refugia was identified as a separate, but potential limiting factor to late summer rearing habitat. Good thermal refugia habitat identified by presence of deep pools, shade canopy, and cool water inputs. Woody debris, for use as cover from predators and protection from high water velocities, was considered a potentially important habitat component, while taking into account that woody debris may be less of a factor in southern California streams. Woody debris is generally associated with more northern streams and may not be as important in southern streams where cobbles and boulders can often provide sufficient cover. Juvenile densities and growth rates have been documented to be high in the absence of woody debris (and riparian vegetation) in some parts of the watershed, when flow is available (Moore 1980).

Lack of riparian vegetation and instream woody debris, low stream flows and high water temperatures reduce the amount of rearing habitat in much of the mainstem Matilija Creek. However, Chubb pointed out that many of the highest densities of juvenile trout are found in seasonally intermittent reaches, including mainstem Matilija Creek. As found in the mainstem Ventura River (Moore 1980), lack of riparian vegetation and instream woody debris as well as high water temperatures do not necessarily limit production potential in wet years with relatively high summer streamflow and abundant food resources. Chubb concluded that the presence of juvenile fish in this reach indicated that although summer holding water and periodic floods may limit older fish, enough survive to successfully reproduce and reestablish the stream during the wet season. Based on the existing habitat, potential to improve the habitat, and the existing high productivity in much of the Matilija Creek watershed, Chubb concluded that this watershed along with the North Fork Matilija Creek watershed should be considered key to restoring steelhead in the Ventura River.

In Apri1 1997 similar habitat conditions the five miles upstream from Matilija Dam on mainstem Matilija Creek was surveyed. This reach lacked riparian vegetation, contained primarily shallow run habitat over cobbles, and contained abundant algae growth. Water temperature was good, 57^{o}F in the afternoon, when air temperature was 60^{o}F, and aquatic insects, food for rearing juveniles, appeared relatively abundant. It is possible that in years (or times of year) with adequate surface flows (e.g. the reach does not dry up) and non-lethal water temperatures, that this reach could be productive rearing habitat as the mainstem Ventura River in the live stretch can be (as per Moore 1980). The amount of riparian vegetation and types of instream habitat may also change depending on water year type. As noted on the mainstem Ventura River, the riparian vegetation grows back in the years subsequent to an extremely high flow year.

3.7.2 North Fork Matilija Creek

Low flows and unsuitable spawning habitat reportedly made North Fork Matilija Creek poor habitat for steelhead as early as 1946 (Clanton and Jarvis 1946). However, a few years later, other CDFG biologists apparently disagreed with this assessment. In the early 1950's, North Fork Matilija Creek contained good trout habitat with good shade and pools and abundant aquatic food, except for a stretch above Wheeler Springs where there was a fire in 1949. However, water temperatures were as high as 72 to 75^{o}F as early as March and April. Habitat surveys conducted by CDFG in 1993 indicated that North Fork Matilija Creek provided good rearing and spawning habitat (CDFG unpublished data from 1993, S. Parmenter pers. comm.). A recent assessment of the North Fork Matilija Creek by Chubb (1997) indicated that the lower reach had the most suitable spawning and juvenile rearing habitat in the creek, while the middle reach provided the best pools and cool water refugia for summer/fall low flows and drought. Food availability was considered good.

Our 1997 assessment of North Fork Matilija Creek indicated that there was good habitat available to steelhead. The streamflows through a canyon and the instream habitat consisted of primarily boulder cascades and step-runs and pools. There was limited gravel retention throughout most of this stream, but there was likely enough spawning habitat available to seed the available rearing habitat. The riparian corridor is fairly dense, with limited openings where houses or roads have been built close to the channel. There was no evidence of alga growth. Stream temperature during our survey was 50^{o}F in the late morning when the air temperature was 60^{o}F. A fair weather road crossing forms a migration barrier within the Los Padres National Forest at Wheeler George Campground. Two other potential migration barriers exist within the campground on Bear Creek, a tributary to North Fork Matilija Creek. During higher flows two these crossings may not be complete barriers to migration. In addition, the barrier on North Fork Matilija Creek may help to direct fish into Bear Creek, where there is more habitat then upstream on North Fork Matilija Creek. Options for and potential benefits of barrier removal need to be investigated.

3.7.3 San Antonio Creek

In the late 1940's San Antonio Creek was reportedly of no value to fish life because of low summer flows. But is unclear from the CDFG records where observations were made to conclude that the stream was not appropriate for stocking. The streamflows and habitat conditions observed during that one survey were likely not representative of the potential habitat conditions that could have occurred in different water year types. No other historical records of stream habitat in San Antonio Creek were found.

More recently, two habitat surveys were conducted on lower San Antonio Creek. A survey of the lower four miles of San Antonio Creek was conducted by the Friends of the Ventura River in 1992 (Capelli 1992). These observations indicated that much of the low flow channel along the creek was clear of native riparian vegetation and that non-native giant reed (*Arundo donax*) was present in some areas within the low flow channel. After the storms of the 1992-93 winter, the native riparian vegetation was present only on the higher banks and consisted primarily of willow (*Salix* spp.). The winter rains also apparently scoured the channel, creating natural pool-riffle channel morphology. The survey also noted two potential passage barriers, one at Fraser Lane one at Old Creek Road, both low flow Arizona type (concrete roadway) crossings. These barriers are likely only represent complete barriers in years without high flow events, because steelhead have been observed upstream during years with sufficient high flow events.

The other survey was a detailed habitat mapping exercise conducted during January and February 1996 (Fugro West 1996b). During the survey, habitat conditions were recorded as suitable for steelhead. Good water temperatures, adequate pool habitat, good insect food production, adequate instream cover, and abundant spawning gravel existed in the surveyed section of San Antonio Creek during the habitat surveys. Summer streamflows and water quality conditions may still be questionable in some parts of San Antonio Creek in dryer water years, but many other habitat parameters appear good.

Observations in 1997 indicated that habitat in San Antonio Creek downstream of Ojai Valley was fairly good. Although short reaches with poor canopy closure and/or a wide or braided low flow channel existed (especially were roads are adjacent to the stream), much of San Antonio Creek had a fairly dense, adjacent riparian corridor. Habitat alternated between riffles, runs and pools and many of the pools contain instream cover in the form of undercut banks, root wads and overhanging vegetation. Some reaches of the stream contained mostly gravel substrate with some sand in pool habitats and other reaches contain cobble and small boulder substrates. There was limited algae production except in a few isolated reaches where the riparian canopy was less dense or where nutrient loading apparently occurred from adjacent land use practices. There were also reaches dominated by non-native vegetation. The stream temperature on the morning of our survey was 52^{o}F when the air temperature was 72^{o}F. The reach of San Antonio Creek downstream of Ojai Valley would benefit from local habitat improvement projects (as described in Chapter 8).

Upstream in Ojai Valley, San Antonio Creek and its tributaries, Thacher and Reeves creeks (which join to form San Antonio Creek) and Senior Canyon Creek, all have alluvial boulder wash type channels. There is limited riparian growth and most of these streams are contained within piled up dikes constructed by property owners. Flow was subsurface throughout most of these streams through the Ojai Valley and upstream into the canyons. It is likely that prior to the channelization by property owners these streams formed alluvial fans at the base of the canyons in the Ojai Valley and streamflow was subsurface during the dry season and/or dry years.

3.7.4 LION CREEK

As with San Antonio Creek, CDFG surveys conducted in the late 1940's concluded that Lion Creek was of no value to fish life. Additional water rights were not protested because CDFG biologists felt that the stream was already too dry for an important fishery. Again, this observation may have been made during a year when the San Antonio Creek did not benefit from good rainfall events.

Observations in 1997 indicated that habitat in Lion Creek is fairly good. We were unable to view the stream through the canyon area, but surveyed above the canyon in the valley area and downstream of the canyon where it flows into San Antonio Creek. The riparian corridor throughout the surveyed sections was dense and provided abundant shade to the stream. No alga growth was observed. The stream habitat alternated among riffle, run and pool habitats, and as with San Antonio Creek, the most of pool habitats had some cover variables associated with them. The substrate was primarily gravel with some areas of sandstone bedrock. A small reservoir on the stream formed a barrier to steelhead migration in the upstream valley area. It is unknown if there are other natural or manmade barriers in the canyon downstream.

3.7.5 COYOTE CREEK

Coyote Creek was identified as a steelhead stream as late as 1946, although juvenile steelhead had to be rescued from the lower portion of the creek when the flows subsided in dry years (Clanton and Jarvis 1946). No other records of historical habitat in Coyote Creek were found during our literature search. Although there were a couple of records of water rights requests on Santa Ana Creek, a tributary to Coyote Creek. The water rights were not protested by CDFG in 1949 because Santa Ana Creek reportedly carried insufficient water to be of any great value to recreational fishing.

Observations in 1997 indicated that Coyote Creek downstream of Casitas Dam was filled in with fine sediments from upstream gullies. Dense riparian vegetation shaded the stream and appears to have been growing in the low flow channel since at least the late 1970's, based on the current size of the tree trunks and local knowledge. Flow was intermittent throughout the reach between the dam and the confluence with the Ventura River. Accumulation of abundant fine sediment and encroachment of the riparian vegetation is a common problem downstream of water storage reservoirs. Periodically, when Lake Casitas is filled and spills into Coyote Creek downstream, these fine sediments are flushed from Coyote Creek and increase turbidity in the mainstem Ventura River downstream of Coyote Creek.

A recent habitat assessment in Coyote and Santa Ana creeks upstream of Casitas Reservoir was conducted by the USFS (Chubb 1997). Chubb's spawning habitat quality and quantity assessment was based on spawning substrates (gravels and proportions of silt) and channel morphology (width, depth and riffle habitat). The rearing habitat rating was based on substrates (cobble), channel morphology (run, glide, and similar habitats), and available flows. Lack of thermal refugia was identified as a separate, but potential limiting factor to late summer rearing habitat. Good thermal refugia habitat identified by presence of deep pools, shade canopy, and cool water inputs. Woody debris, for use as cover from predators and protection from high water velocities, was considered a potentially important habitat component, while taking into account that woody debris may be less of a factor in southern California streams. Woody debris is generally associated with more northern streams and may not be as important in southern streams where cobbles and boulders can often provide sufficient cover. Juvenile densities and growth rates have been documented to be high in the absence of woody debris (and riparian vegetation) in some parts of the watershed, when flow is available (Moore 1980).

Woody debris was found in localized areas in Coyote Creek along with a well developed riparian corridor. Chubb (1997) found that there was generally excellent spawning habitat, but that typical rearing habitat was nearly non-existent in Coyote Creek upstream of Casitas Reservoir. However, one of the best areas for late summer and drought refugia was found in mid-Coyote Creek. Complete upstream migration barriers are present a little over three miles upstream from Lake Casitas. In 1997, good adult resident rainbow trout densities and fairly poor juvenile densities existed between these barriers and Lake Casitas and no trout were observed upstream of the barriers. In Santa Ana Creek, the spawning habitat was found to be fair and the rearing habitat was found to be poor, however, there were localized areas with high densities of woody debris for cover.

3.7.6 CANADA LARGA CREEK

No historical information of stream habitat in Canada Larga Creek was located during our literature search. A field reconnaissance of this stream indicated that it was unsuitable for steelhead and most other associated native aquatic fauna. Large amounts of fine and coarse sediment fill the stream channel. The apparent sources of these sediments were unpaved roads and abundant hillslope gullies, presumably started from grazing activities. The gully systems appeared to be historical, persistent, and potentially difficult to repair. However, erosion control efforts could benefit the mainstem Ventura River and Lagoon, by reducing sediment load contributed from this tributary. There was limited riparian vegetation and abundant alga growth in the stream. The stream was intermittent during the survey in early April 1997, leading us to believe that water is limited in summer and fall in most water year types.

3.7.7 CANADA DEL DIABLO

No historical information of stream habitat in Canada Del Diablo Creek was located during our literature search. Our review of the aerial photography indicated that the geology in this stream is similar to the erodible soils found in the Canada Largo sub-basin. Abundant roads and excavated areas for oil pumps have contributed to erosion in the Canada Del Diablo watershed. As with Canada Larga Creek, erosion control efforts could benefit the mainstem Ventura River and Lagoon, by reducing sediment load contributed from this tributary.

3.7.8 VENTURA RIVER

In 1947 a CDFG biologist estimated that the lower five miles of the Ventura River could support approximately 1,000 spawners, even in low flow years. Low flow conditions in the mainstem Ventura River were a major concern of the CDFG biologists between 1947 and 1952. In January 1949, the river at the Foster Park bridge was reported to have been dry, presumably because of multiple diversions observed at that time. However, in 1947 (250-300 spawners) and 1955, large numbers of steelhead were observed in pools along the mainstem and at the river mouth. More recent studies have shown that the mainstem Ventura River can provide productive juvenile habitat as well.

The live stretch of the Ventura River has been studied more than other sections of the river or tributaries. In the late 1970's the habitat suitable for steelhead spawning and rearing was restricted to the Ventura River between the confluence of San Antonio Creek downstream to the OVSD wastewater sewage treatment plant (Moore 1980). During the late 1970's, the suitable steelhead habitat in the live stretch of the Ventura River was thought to be highly productive because of appropriate water temperatures, diverse and abundant invertebrate and vertebrate food sources, abundant instream vascular plant and algae vegetation, and negligible turbidity. Moore documented high growth rates (0.9 to 2.8 cm per month) during his study, indicating that juvenile steelhead could grow large enough to smolt and migrate to the ocean in their first year. Moore felt that the discharge from the sewage treatment plant was inadequately treated, making the habitat downstream unsuitable for steelhead rearing. However, OVSD has recently begun tertiary sewage treatment that removes excess nutrients from the discharged water (see Chapter 5.0). Addition of this treated water into the mainstem Ventura River has improved conditions for aquatic life (including the potential for the river to rear juvenile steelhead), such that conditions are likely better now then they were in many dry years when surface flow would have been limited.

The April 1997 survey of the mainstem Ventura River indicated that much of the steelhead rearing habitat was of generally of poor quality except in the live stretch. It should be pointed out, however, that there are different reaches of the river that offer diverse habitat conditions. Even within a given reach, habitat conditions can vary among years depending on flow conditions. Much of the mainstem consisted of single or multiple channel shallow habitats (runs and riffles) with gravel, cobble or small boulder alluvial substrate. At the low flows present during the survey, the water flowed through a channel(s) without adjacent riparian vegetation. The majority of the riparian vegetation is 50 to 200 feet away from the low flow channel(s). It should be noted that this lack of riparian vegetation in the mainstem Ventura River has previously been documented after other years with extremely high flow events. The vegetation tends to reestablish itself although the regrowth can take a couple years to become evident (Casitas and City 1984, City and Casitas 1990, 1991). Because of the lack of adjacent riparian vegetation in some years, there is little canopy closure at present and abundant alga growth occurs.

High water temperatures and or low or lack of flows likely limit the habitat suitability for rearing in much of the mainstem upstream of the live stretch, especially in dry water years. During the survey, surface flow was continuous from Santa Ana Boulevard downstream to the ocean, but intermittent between Robles Diversion Dam and Santa Ana Boulevard. In the live stretch, high water temperatures are probably only a problem in dryer water year years. The water temperature in the live stretch during our survey was $62^{o}F$ in the morning, when the air temperature was $60^{o}F$. In some cases, when there is continuous flow and abundant aquatic food sources, high juvenile steelhead growth rates and abundant production are possible even though water temperatures are above what is generally considered preferred for rearing (Smith and Li 1983, as observed by Moore

1980). This is probably the case for much of the lower mainstem in most years, especially now that OVSD is releasing tertiary treated water. There are also areas of the mainstem, particularly upstream of the Shell Road bridge, that also have some deep pool habitat. These deep pools are used as resting spots by upstream migrant adults and could be used as both low water and high water refuge habitats for juveniles.

The downstream approximately one and a half miles of the mainstem river channel was broad and controlled on the left bank by a flood control levee, during our 1997 survey. There were multiple high flow channels in this reach which were surrounded by abundant riparian vegetation, primarily non-native *Arundo*. The low flow channel had some adjacent riparian vegetation; however, it did not provide much shade because of the width of the low flow channel, the height of the vegetation and the orientation of the stream course in relation to the orientation of the summer sun.

Live Oak Creek is a small ephemeral tributary to the mainstem Ventura River that enters the river from the west side just upstream from San Antonio Creek. This small stream drains a small area (approximately a few square miles) near lake Casitas. It flows adjacent to the Ventura River through a rural residential area and has virtually no adjacent riparian vegetation. This stream is likely of no steelhead value because of the complete lack of flows during most of the year. Live Oak Creek may also be a source of fine sediments and nutrient loading, because of stream-side grazing operations.

3.7.9 Lagoon

Access to the lagoon has never been a problem because the sandbar breaches readily each winter (M. Capelli, pers. comm.). Migrating steelhead may not be able to move upstream, however, if flows are inadequate in the mainstem. Lagoons in other stream systems, and potentially in the Ventura River (M. Capelli, pers. comm.), can provide rearing habitat for juvenile steelhead (Smith 1990).

During the April 1997 survey the sandbar at the Ventura River's mouth was open. Flow was subsurface or intermittent from the Highway 150 crossing to approximately one mile downstream. The lagoon area appeared to be shallow, although water depths would increase once the sandbar closed during summer.

3.8 Distribution of Habitat and Fish Occurrence

Stream reaches were assigned based on channel type and habitat characteristics (Figure 3-4). Table 3-2 summarizes the current habitat conditions and potential fish use for each stream reach.

3.9 Review of Potential Limiting Factors

Limiting factors are physical, chemical, or biological factors that prevent a population from increasing, either by decreasing reproductive success and or productivity or by increasing mortality (Meehan 1991). The term limiting factor is an ecological concept and a limiting factor analysis integrates information on steelhead (life history attributes, habitat requirements, and sources of mortality) with information on environmental conditions. These factors can operate independently, but more often operate in concert with others to reduce the potential of the habitat to sustain a population. Moreover, limiting factors may have a cumulative or synergistic effect, such that one factor may slightly limit the potential of a population, but once the population is reduced, other limiting factors have a greater effect on limiting the population. Limiting factors are always present, even in unmodified ecosystems; however, most aquatic habitat management tries to deal with human imposed limiting factors (Meehan 1991).

A general review is first provided of the potential limiting factors, addressing the biological implications and life stages affected. Limiting factors can result from natural conditions and human activities. For example, the absence of perennial (year round) flow in a stream reach could be due to low rainfall in the watershed and/or diversion of water for human use. In addition, certain activities can result in multiple impacts, such as forest fires that have resulted in excess sedimentation (erosion), loss of riparian vegetation, and potential changes in run-off patterns. For the purposes of this report the potential limiting factors are grouped so that they can be easily related to management actions and mitigation measures discussed later in this plan. The groups include: streamflow, passage barriers, habitat conditions, water quality, and lack of adult spawners (which can lead to loss of genetic diversity). Factors acting on steelhead in the ocean were explained in Chapter 3 under potential causes of decline in California and will not be addressed in this chapter. These factors include ocean water conditions, incidental commercial and sport harvest, and ocean predation.

Because different limiting factors may operate in different regions, factors currently limiting the steelhead population in the Ventura River watershed are presented by reach. The basin is divided into eleven stream reaches according to watershed zone, physical conditions, and hydrological regime. The main analysis evaluates the occurrence and relative importance of each limiting factor under current conditions.

Figure 3-4. Stream Reaches.

Table 3-2. Current Habitat Conditions and Occurrence of Steelhead Along Stream Reaches.

Habitat or Steelhead Occurrence	Quality of Habitat or Occurrence of Steelhead													
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**
Existing Habitat Quality for different lifestages *(H = high, M = moderate, L = low)*														
Migration	L[1]	L[1]	L[1]	L[1]	L	H	L	M	L	M[2]	H[2]	M[2]	H	H
Spawning	L	H	H	H	M	H	L	L	M	M	H	H	H	--
Rearing	L[3]	H	H	H	L	M	L	L	M	L[3]	H	M	M[3]	M
Occurrence of steelhead spawning and rearing (X = presence)														
Potential Historic	X	X[4]	X[4]	X[4]	X[4]	X	X	X	X	X	X	X	X	X
Current Conditions						X				X	X	X	X	X

1/ Low quality passage conditions for these tributaries are due to major passage barriers downstream (Matilija Dam, Robles Diversion Dam, or Casitas Dam).
2/ These ratings are probably lower in years without storm events to allow passage.
3/ Quality could be better during wet water year types.
4/ Some natural barriers exist that limited access to all of the habitat on these tributaries.

Tributaries
A Mainstem Matilija Creek upstream of Matilija Dam approximately 5 miles
B Matilija Creek headwaters, Upper North Fork and Murietta creeks
C North Fork Matilija Creek, portion of Matilija Creek downstream of Matilija Dam
D Coyote and Santa Ana Creeks above Casitas Dam.
E Senior Canyon, Thacher Creek and Reeves Creeks, tributaries to San Antonio Creek
F San Antonio Creek, from the Ventura River upstream through Soule Park, including Lions Creek
G Coyote Creek downstream of Casitas Dam
H Canada Larga and Canada del Diablo
Mainstem Ventura
I Between the confluence of Matilija and North Fork Matilija creeks and Robles Diversion Dam
J Between Robles Diversion Dam and the upstream end of the live stretch (Oak View)
K Live stretch (between Foster Park and Oak View)
L Between Foster Park Bridge and OVSD effluent
M Between OVSD effluent and Main Street Bridge
N Ventura River Lagoon

3.9.1 MIGRATION BARRIERS

Natural Barriers

Steelhead passage can be blocked by natural stream features such as waterfalls, boulder cascades, bedrock slides, and shallow riffles. Waterfalls and cascades are more common in high gradient reaches of stream headwaters in the Ventura River watershed where there are often multiple barriers to migration. These types of barriers can be persistent, historical features or can be relatively recently formed features (geologically and/or evolutionarily speaking). For example, earthquakes can cause rock slides creating passage barriers. Removal of some of these barriers can allow passage to valuable upstream habitat. However, in the Ventura River most of these types of migration barriers are located at steep gradient changes in the channel in the headwaters of tributary streams and would be considered persistent, historical features. Removal of these types of barriers does not add considerably to the available habitat, because there is not a lot of habitat upstream. As such, they will not be dealt with further in this report.

Bedrock slides and riffles may not be complete migration barriers but may make passage more difficult and can become more significant during dry years. These passage impediments not only limit upstream passage by adults but may also inhibit movement of juveniles into summer refuge habitat. These low flow or dry year passage impediments only limit the population potential in those water year types, but do not limit the population compared to historical conditions unless streamflows have been altered or the number and location of impediments have changed due to increased sedimentation.

Dams

Dams block access to upstream reaches of a stream system and thus limit the quantity of spawning and rearing habitat available to steelhead. Historically, in most southern California streams, most spawning and rearing took place in these upstream (headwater) reaches. Therefore, blocking access to these areas severely limits a steelhead population's ability to sustain itself, unless the habitat downstream of the dam is suitable for spawning and rearing. In addition, dams also alter the natural streamflow regime downstream of the dams. This altered flow regime can limit production downstream by allowing vegetation to encroach the active channel, reducing spawning gravel transport and availability, and allowing fine sediment deposition in gravel beds. Four dams block access to headwaters in the Ventura River system: Robles Diversion Dam (access to North Fork Matilija and Matilija Creeks), Matilija Dam (Matilija Creek), Casitas Dam (Santa Ana and Coyote Creeks), and a small dam on Lion Creek for an irrigation reservoir.

Road Crossings and Culverts

Road crossings, culverts, and structures associated with bridges (concrete structures below the bridge in the channel placed to prevent scouring) can also be complete barriers or partial impediments to upstream migration. These smaller, but more numerous, barriers and impediments often go undetected even though, like dams, they block access to upstream spawning and rearing areas, especially in the absence of high flow events. At low flows the water may be too shallow to allow passage. At very high flows, these structures can become velocity barriers because the flow is very rapid and no resting pools exist along the smooth surface. There are many such barriers in the Ventura River basin, which could limit the potential steelhead production of the system. In addition, given the few numbers of adults returning in most years in combination with the short duration of adequate passage flows, even impediments can significantly reduce the likelihood of fish passage to upstream spawning sites. All the public road crossings, culverts and bridges are identified in Chapter 5 (Ventura County Department of Transportation section) and Chapter 6 (USFS section).

3.9.2 STREAMFLOWS

Streamflows can limit the steelhead production potential in several ways. In the warm Mediterranean climate of southern California, low flow conditions are more common, severe, and detrimental to the population over the long run than the extreme high flow conditions, but both are described below. Chapter 2 provides a detailed description of natural occurring streamflow conditions that could limit the steelhead population as well as streamflow conditions that occur due to water supply development in the watershed.

Lack of Surface Flows (for summer/fall rearing)

Lack of surface flows can occur during summer and fall in many reaches of the Ventura River watershed. If flows are subsurface for any extended period of time (more than one day), this eliminates the potential for juvenile steelhead to rear in a stream environment. When surface flows are reduced, dissolved oxygen in isolated pools can drop to critical levels. In addition, aquatic invertebrate food production in riffles is depressed or eliminated and downstream transport of terrestrial and aquatic invertebrates into the pool habitats is curtailed. At the same time, water temperatures are often high, so that juveniles require more food to survive. During dry years, summer conditions in the Ventura River watershed severely reduce fish growth, survival, and health; this may be the most restrictive bottleneck that reduces population size and limits growth and recruitment in the system (Chubb 1997). In some reaches and in some years, stream dewatering may occur early in summer, potentially during the egg incubation period. Dewatering during incubation can destroy developing eggs and alevins in the gravel. Many small tributary streams and stream reaches of the Ventura River basin naturally have ephemeral or intermittent flow. Some streams and stream reaches may dry up, or dry up for longer periods of time, because of water development. It should be pointed out, however, that while fish cannot rear in reaches where flow is subsurface, the subsurface flow can be cooler than surface water because it does not get heated by the sun and ambient warm air conditions. Downstream reaches where water resurfaces (such as the Casitas Springs live stretch) can benefit from the resultant cooler water temperatures.

Inadequate Flows (for summer/fall rearing)

As with complete lack of surface flow, low flow conditions limit the amount of rearing habitat available, reduce the amount of aquatic invertebrate food moving through the stream, and usually result in increased stream temperatures. All of these effects limit the number of fish any reach is capable of sustaining and can reduce the growth rate of the remaining fish. Given southern California's climate, low flows and higher water temperatures occur naturally in many streams and stream reaches in the Ventura River basin. These conditions have presumably acted as selective pressures on steelhead on an evolutionary time scale allowing them to tolerate the variable conditions present in southern California streams.

Inadequate Winter/Spring Flows for migration

Low flows during the winter upstream migration season (January-March peak, extending to May) can produce shallow conditions that restrict or impair the passage of adult steelhead. This is especially problematic in reaches where the channel is wide and a deep thalweg is not present. Low flows during the spring downstream migration (February-May peak, extending to June) of smolts (and potentially spawned-out adults) can reduce the number of fish successfully migrating to the ocean. Although steelhead are flexible in their life history timing, being able to remain in the ocean or in the stream until migration conditions improve, multiple years of low flows during the upstream and downstream migration seasons will limit the steelhead protection potential in the system. Those fish that attempt to migrate during periods of inadequate flow may not survive because of poor conditions for summer rearing or holding and/or due to increased predation in the resultant shallow water areas. Inadequate migration flows can occur in most of the Ventura River watershed, especially in dry years.

Excessive High Flows

Extremely high flow events can have several negative effects on steelhead and their habitat. High flows during the egg incubation period (February-April peak, extending to June) can scour redds, thereby destroying eggs and alevins in the gravel. Redd scour can severely limit production in high flow years. In addition, juveniles can be flushed out of streams during high flow events, usually when there is a lack of refuge habitat in the system. In the Ventura River system, the problem of high flows is compounded by the fact that juvenile rearing now takes place in the mainstem, where streamflows and velocities are high**.** Extremely high flows can also destroy riparian vegetation that provides structure and shading to the stream (lack of riparian vegetation is discussed below). On the other hand, periodic, natural high flow events are necessary for gravel recruitment and flushing of fine sediment from spawning gravels. In many systems periodic high flows are also important for riparian vegetation renewal. Depending on the timing of the high flow events, it is often the case that these events trigger abundant adult returns, spawning, and production; and may therefore be very beneficial to the population as a whole.

3.9.3 HABITAT CONDITIONS

Physical modification and degradation of habitat can affect the quantity and quality of stream habitat, both directly (e.g. physical changes to stream geomorphology) and indirectly (e.g. increased water temperatures due to loss of canopy cover). The main categories of habitat modification and degradation considered in this section are excess fine sediment, excess coarse sediment, riparian vegetation removal, and lack of pool habitat. Habitat modification and degradation is usually considered to primarily affect spawning and rearing, but can also be associated with migration problems (small barriers or critical riffles) and lack of adult holding habitat (no deep pools).

Excess Fine Sediment

Fine sediments are considered excessive and detrimental to a steelhead population if they make up more than 15% of the streambed. Fine sediments are inappropriate for spawning because they do not allow oxygen filtration through the bed to the eggs. Fine sediments can also decrease aquatic invertebrate food production, which can further limit the steelhead production potential in a stream or stream reach. The Ventura River watershed has a naturally high fine-sediment load of due to the geologic materials, tectonic uplift, and natural upland vegetation types. However, fine sediment input has likely increased from historical conditions because of land use activities in the basin including agricultural development, grazing activities, unpaved roads, and extensively developed slopes (including oil field and residential developments). Forest fires in the upper watershed, especially wildfires, have also resulted in erosion of fine sediment into the streams. Historically, fires were set periodically in the upper watershed to improve grazing.

Excess Coarse Sediment

Abundant coarse sediment loading can also reduce steelhead production potential in streams by reducing the quality of spawning habitat. Coarse sediments (cobbles and boulders) are often too large for steelhead to move during redd construction. Although many reaches with coarse sediments often have some pockets of appropriate size spawning gravels, good spawning habitat should have a high percentage of gravels (>20%) (Chubb 1997). Coarse sediments are also often embedded with fine sediments, which can reduce insect production potential. Streams or stream reaches with excessive coarse sediments can have limited riparian vegetation recruitment and limited pool development. However, coarse sediments usually provide good insect production areas and can offer juvenile steelhead some cover from predators and protection from high water velocities. As with fine sediment input, the Ventura River appears to have areas of abundant coarse sediment input.

Lack of Overhanging Riparian Vegetation and Encroachment of Non-native Vegetation

The riparian zone borders the stream and is the transition area between upland terrestrial habitat and aquatic ecosystems. There is an interaction between the riparian zone, the fluvial processes of the channel, and fish habitat (Baltz and Moyle 1984, Murphy and Meehan 1991, Flosi and Reynolds 1994). Riparian vegetation serves several functions for stream habitat (Murphy and Meehan 1991, Platts 1991, Flosi and Reynolds 1994). Canopy cover 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. Streamside vegetation supports both terrestrial and aquatic insect production for fish food. Inputs of woody debris can increase stream channel complexity by aiding formation of pools (discussed below). Alder, which can withstand the erosive power of debris flows and floods, appear to contribute the most woody debris input in the upper Ventura River watershed (Chubb 1997). It should be noted that a lack of riparian vegetation along most of the mainstem Ventura River has been documented after years with extremely high flow events. The vegetation tends to reestablish itself although the regrowth can take a couple years to become evident (City and Casitas 1983, 1990, 1991). It should be noted, however, that in some cases, streams can be highly productive in the absence of abundant riparian vegetation and associated shade and woody debris input (Moore 1980).

Non-native riparian vegetation such as tamarisk and *Arundo* also 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 can reduce available surface water and contribute to adverse water temperatures and chemistry (Chubb 1997).

Lack of Pool Habitat

Pools provide feeding sites, low flow escape cover and holding habitat, and high flow refuges for steelhead (Baltz and Moyle 1984). Deep pools may also retain cooler water near the bottom, offering a thermal refugia to fish in late summer when streamflows are low (Mathews 1996 as cited in Chubb 1997). Important factors in formation and maintenance of channels and aquatic habitat development include: amount of instream woody debris, amount and type of sediment, channel gradient, streamflow volume, extent and type of riparian vegetation, and geologic setting (Montgomery et al. 1995). Many stream reaches in the Ventura River watershed have reduced or no pool habitat (Chubb 1997). The lower Ventura River has several deep pools where adult steelhead have been observed to be holding during past migration seasons. These pools are especially important when there are a lack of high flow storm events during dry winters.

3.9.4 WATER QUALITY

Water Temperatures

Temperature tolerances and preferences of steelhead vary among seasons, life stages, and stock characteristics. In general, eggs are more sensitive to extreme water temperatures than are other life stages. Juvenile steelhead can typically tolerate warmer temperatures than other Pacific salmonids (Moyle 1976), and southern California steelhead may be able to withstand higher temperatures than other stocks (Higgens 1991). The preferred temperature range is reportedly 12.8-15.6°C (55.0-60.1°F) (Rich 1987), although steelhead in the Ventura River have been reported at temperatures as high as 28°C

(82.4°F) (Carpanzano 1996). The Critical Thermal Maximum (CTM, the temperature at which a fish loses equilibrium and dies) for this species has been reported to be up to 29.4°C (84.9°F) (Lee and Rinne 1980). Warmer water requires more abundant food resources for fish survival, because of the resultant increase in their metabolic rate (Brett 1971, Fausch 1984). Thus, fish can die or growth rates can be reduced even if CTM is not reached because abundant food is not available. It is often the case, however, that warm water temperatures can result in abundant aquatic insect production and thus fish growth.

Dissolved Oxygen

Low dissolved oxygen levels can result from abundant organic wastes (which take oxygen to decompose), abundant algae (which can suppress oxygen levels during the night), extremely high water temperatures (which reduce oxygen solubility in water), and/or reduction of surface flows (which reduces oxygen infiltration from the air). In systems with flowing water, oxygen is incorporated into the water in turbulent areas. No oxygen is incorporated when stream flows are subsurface. Reduced surface flows can occur from water withdrawal operations or naturally, especially in late summer and fall. The recommended minimum dissolved oxygen concentration for anadromous salmonids such as steelhead is 5 mg/l (Bjornn and Reiser 1991). Levels below 5 mg/l adversely affect growth and swimming performance, and can result in death. High water temperatures can compound the stress on fish caused by marginal dissolved oxygen conditions. In the Ventura River watershed, high temperatures and poor dissolved oxygen conditions occur in many stream reaches, reducing steelhead production potential.

Nutrients and Pollutants

Eutrophication can occur when excess nutrients enter the stream due to runoff or seepage from terrestrial nutrient sources (e.g. yard and agriculture fertilization, livestock waste, and faulty septic systems) and direct discharge of treated sewage. Excess nutrients can cause abundant alga growth and thus reduce dissolved oxygen in streams, as discussed earlier. Regions with extensive agriculture or livestock operations, such as along San Antonio Creek and Live Oak Creek, and reaches downstream of sewage treatment plants, such as the lower mainstem Ventura River downstream of the Ojai Valley Sanitary District's (OVSD) wastewater treatment plant, are candidates for potential eutrophication problems. Measures to improve water quality of the effluent from the wastewater treatment plant have been recently implemented, which will eliminate this problem in the lower mainstem and lagoon. Opportunities for pollutants to enter the streams in the Ventura basin may still be present through the continued use of fertilizers, leachate from abandoned oil fields and equipment, and the possibility of contaminated soil in the watershed. In addition, storm water run off drains into the lower Ventura River. These types of non-point source pollution are difficult to control, but is beginning to be investigated. It should be noted that the Ventura River is not known to be a very polluted system. The upper watershed is located primarily on Forest Service land and protected against development and associated pollution. The lower Ventura River watershed has more potential to become polluted, but there is little run-off from agricultural fields because water is scarce and there are strict guidelines to reduce potential run-off from oil fields.

3.9.5 LACK OF ADULTS/LOSS OF GENETIC DIVERSITY

Even if habitat is available, population growth can be limited by a lack of returning adult steelhead because fewer eggs are produced. The current Ventura River steelhead population is likely below the 200 fish threshold (Chubb 1997) that is associated with a high risk of extinction (Franklin 1980 as cited in Chubb 1997). So, although the original decline of the steelhead population in the Ventura River basin is the result of the cumulative effects of the above mentioned limiting factors, the entire watershed may now be limited by the lack of adults left to seed the habitat. Loss of natural genetic diversity is also a risk with small populations. This can hamper a population's ability to grow optimally and reproduce and to adjust to fluctuating environments. Theoretically, genetically diverse populations would be more likely to contain individuals that are more tolerant of a condition (e.g. warmer water temperature) that may be devastating to the rest of the population. These individuals could thus sustain the population during periods of unfavorable conditions. There is the potential that the remaining land-locked individuals in the headwater streams could reseed the watershed if access to the ocean is restored.

3.10 LIMITING FACTORS BY REACH

Not all of the limiting factors described above affect every reach of the Ventura River system. A summary of limiting factors for each stream reach is presented in Table 3-3. The relative importance of factors was ranked, depending on degree and extent (H = high and/or extensive impact , M = moderate impact, L = low and/or localized impact). Reach-specific categories that were thought to have little or no impact were left blank.

As discussed earlier in Section 3.7, habitat conditions in the Ventura River watershed are limited by several conditions. Dams currently restrict passage to the upper watershed, which eliminates steelhead potential in the Matilija Creek subbasin (including Murietta and Upper North Fork Matilija creeks, and upper Coyote and Santa Ana creeks). Other passage barriers, both natural and manmade, exist throughout the watershed, including on Matilija Creek and its tributaries, North Fork Matilija Creek, and upper San Antonio Creek and its tributaries (including Lion Creek).

Lack of or low summer/fall streamflows limit steelhead potential by impacting juvenile rearing habitat in much of the watershed, especially in upper San Antonio Creek and its tributaries (Thacher, Reeves, and Senior Canyon), much of Matilija Creek upstream of Matilija Dam, Canada Larga and Canada del Diablo, Coyote Creek downstream of Casitas Reservoir and the upper mainstem Ventura River downstream of Robles Diversion Dam. Excess fine sediments severely limit steelhead spawning and juvenile rearing in Coyote Creek downstream of Casitas Reservoir, Canada Larga, Canada del Diablo, and have moderate to high impacts in parts of the mainstem Ventura depending on water year type. Excess coarse sediments limit steelhead potential in most of Matilija Creek, upper San Antonio Creek and its tributaries Thacher, Reeves, and Senior Canyon creeks, and potentially parts of the mainstem Ventura River. Lack of riparian vegetation adjacent to the low flow channel and lack of pool habitat limits steelhead rearing potential throughout most of the watershed, except for North Fork Matilija Creek, parts of San Antonio Creek downstream of Ojai Valley and the lower reach of the mainstem Ventura River.

Water quality problems with temperature and dissolved oxygen are often associated with low flows and are seen in most of the watershed, except for the North Fork Matilija Creek, other headwater areas with perennial flow, the mainstem of the Ventura River in the live stretch, OVSD's discharge. Lack of returning adults is an overall limitation for the steelhead population in the watershed.

There are a few areas that still have relatively good steelhead habitat, but many reaches are severely limiting. The reaches with the most significant limitations for steelhead production include the following.

1. Matilija Creek just above Matilija reservoir - spawning and rearing are limited due to low flows during summer, lack of riparian vegetation and pools, likely high water temperatures, and areas with excess fine sediment or excess coarse sediment. Passage through this reach to the headwaters could be a problem in years with low winter flows due to long shallow regions and lack of resting pools.

2. The upper Ventura River below Robles - severe problems with lack of flows in summer, due to natural seepage into the porous alluvial sediments of this reach and the diversion. It should be noted that the diversion is operated primarily during high flow events (Chapter 2), and is not operated during the summer and fall. High water temperatures and lack of riparian vegetation are also other major concerns.

3. The tributaries of upper San Antonio Creek (Senior Canyon, Thacher Creek, and Reeves Creek) have limited steelhead potential due to major problems with low or no streamflow and high water temperatures. Lack of riparian vegetation and pool habitat also limit steelhead potential.

4. Coyote Creek downstream of Lake Casitas, Canada Larga, and Canada del Diablo cannot support steelhead spawning or rearing because of lack of summer flow and major problems with fine sediments.

Mainstem Ventura River - Lack of riparian vegetation, lack of pools, and water quality problems (high water temperature and low dissolved oxygen) moderately limit steelhead production throughout much the mainstem Ventura in dryer water years. However, in years with adequate flows, the mainstem can have high juvenile production (Moore 1980).

Table 3-3. Limiting Factors Under Current Conditions Along Stream Reaches.

Limiting Factors	Occurrence of Limiting Factors in Stream Reaches													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Passage Barriers														
Natural Barriers		L		L	L		L	L						
Dams	H	H	H	H		L			H					
Road Crossings/Culverts			H		M	M	M							
Streamflows														
Lack of flow in summer/fall	M			L	H	L	H	H		H		M		
Low flows in summer/fall	M	L	L	L	H	L	H	H	L	H	L	H	L	
Lack of high flows in winter/spring (depends on water year)	L			L	M	L	M	L		M	L	M	L	
Excessive, high flows (depends on water year)	M				L		L	M		L	L	L	L	
Habitat Conditions														
Excessive fine sediments		L					H	H	L	L	L	L	M	
Excessive coarse sediments	H			L	M					L	L	L	L	
Little/no riparian vegetation	H			L	M	L		M	L	M	M	M	M	
Little/no pool habitat	H			L	M	M	M	M		M	M	M	M	
Water Quality														
High temperatures	H	L	L	L	H	L	M	H	L	H	M	H	M	M
Low dissolved oxygen	M			L	M	M	L	M	L	M	M	M	L	M
Nutrients & Pollutants						M				L	L	L	M	M
Lack of Adults/Loss of Genetic Diversity														
Few returning spawners	H (throughout basin)													

H = High and/or extensive impact, M = Moderate impact and extent, L = Low impact and/or localized extent

Tributaries

A Mainstem Matilija Creek upstream of Matilija Dam approximately 5 miles
B Matilija Creek headwaters, Upper North Fork and Murietta creeks
C North Fork Matilija Creek, portion of Matilija Creek downstream of Matilija Dam
D Coyote and Santa Ana Creeks above Casitas Dam.
E Senior Canyon, Thacher Creek and Reeves Creeks, tributaries to San Antonio Creek
F San Antonio Creek, from the Ventura River upstream through Soule Park, including Lions Creek
G Coyote Creek downstream of Casitas Dam
H Canada Larga and Canada del Diablo

Mainstem Ventura

I Between the confluence of Matilija and North Fork Matilija creeks and Robles Diversion Dam
J Between Robles Diversion Dam and the upstream end of the live stretch (Oak View)
K Live stretch (between Foster Park and Oak View)
L Between Foster Park Bridge and OVSD effluent
M Between OVSD effluent and Main Street Bridge
N Ventura River Lagoon

4.1 SENSITIVE NATIVE FISH, AMPHIBIANS, REPTILES, AND BIRDS

A variety of other vertebrate species (fish, amphibians, reptiles, birds, and mammals) occur in the aquatic, estuarine, and riparian habitats of the Ventura River and its tributaries. A summary of the status of such species listed as threatened or endangered by the state or federal government is provided below for additional information. As elements of the Plan are refined and implemented, the potential impacts of the conservation actions and mitigation measures, as well as their incidental benefits, to these other sensitive species will need to be carefully considered.

Existing data on the occurrence of other sensitive vertebrate species in the watershed are variable. There is very good information on the occurrence of such species at the mouth of the river and along the lower river from the ocean to Foster Park due to several recent proposed projects that required biological field studies to support environmental documents. Data on sensitive species along the mainstem of the river upstream of Foster Park and along San Antonio Creeks is mostly lacking. Data was not provided by the U.S. Forest Service on sensitive species found within Los Padres. As such, the summary of occurrence provided below should considered preliminary for a substantial portion of the watershed.

Various previous studies were examined to assemble data on the occurrence of other sensitive species. Studies that included field observations and habitat analysis used for this summary are as follows:

- Ferren, W., et al., 1990. Botanical Resources at Emma Wood State Beach and the Ventura River Estuary, California. Inventory and Management. University of California, Santa Barbara.

- Fugro West, Inc., 1997. Biological Assessment for the Avenue Treatment Plant and Foster Plan Master Plan. For the City of Ventura.

- Greaves J., D. Haupt, and Z. Labinger, 1993. Least Bell's vireos on the Santa Clara and Ventura Rivers, Ventura County, California, in 1993. Unpubl. report for Sweetwater Environmental Biologists, San Diego, California.

- Greaves. 1995. Survey of Ventura River for least Bell's vireos within 1,000 feet of Main Street Bridge during 1995. Prepared for Fugro West).

- Hunt, L., P. Lehman, and M. Capelli, 1992. Vertebrate resources at Emma Wood State Beach and the Ventura River Estuary: Inventory and Management.

- Hunt, L., 1991. Environmental Impact Report on the Vertebrate Resources of the Lower Ventura River for the S.P. Milling Sand and Gravel Mining Operations. For Dames & Moore.

- Hunt, L., 1994. Biological Assessment for the Ventura River Trail. For the City of Ventura.

- Wetlands Research Associates, 1992. Ventura River Estuary Enhancement, Existing Conditions. For the City of Ventura.

4.2 FISH, AMPHIBIANS, AND REPTILES

4.2.1 TIDEWATER GOBY

The tidewater goby *(Eucyclogobius newberryi)* is a small estuarine fish that was listed as endangered under the federal Endangered Species Act (ESA) in February 1994. This species is considered a "species of special concern" by the CDFG. It is native to California's lagoons, coastal streams, and brackish marshes (Swift et al. 1989, Lafferty et al. 1996). The tidewater goby prefers habitat with low-salinity conditions and minimal water currents or wave wash, such as the seasonally closed lagoon at the mouth of the Ventura River. It has a prolonged spawning season that peaks in spring and again in late summer. Males dig burrows in sand or soft sediment, where they care for eggs until they hatch. Fish can spawn several times during their lifetimes. This species lives only one year, with most adults dying after the spring spawning season. Threats to the tidewater goby throughout its range include alteration and degradation of habitat (e.g. development of coastal wetlands and waterways, artificial breaching of sandbar at the lagoon's mouth, water diversions, and stream channelization) and, to a lesser degree, predation by exotic fishes (Lafferty et al. 1996).

This species is a resident of the Ventura River lagoon (Hunt et al. 1992). There appears to be no studies on the status, size, condition, or upstream distribution of the population. In June of 1996, gobies were observed in the lagoon and upstream to the railroad bridge crossing, but were not found at the Main Street Bridge crossing.

4.2.2 CALIFORNIA RED-LEGGED FROG

The California red-legged frog *(Rana aurora draytonii)* is a federal threatened species and a "species of special concern" by the CDFG. It species historically ranged from Southwest British Columbia to Northwest Baja California, primarily west of the Cascade-Sierran range (Stebbins 1985). Different life stages occur in different habitat types in different seasons. Frogs breed during the winter and early spring from late November through April (USFWS 1997). Breeding sites include coastal lagoons, marshes, springs, permanent and semi-permanent natural ponds, ponded and backwater portions of streams, and small artificial impoundments (USFWS 1997, Stebbins 1985). Eggs are laid in ponds or backwater pools in creeks attached to emergent vegetation and hatch within 6 to 14 days (USFWS 1997). Tadpoles transform into young frogs within 3.5 to 7 months (USFWS 1997). Young California red-legged frogs inhabit slow moving, shallow riffle habitats in creeks or margins of ponds. Older California red-legged frogs can be found close to ponds or deep pools in creeks where there is emergent vegetation, undercut banks, or rootwads that offer shelter from predators (USFWS 1997). Older frogs may also be found in a variety of upland areas near ephemeral water bodies or many meters from the water taking refuge in small mammal or other animal burrows (USFWS 1997).

There are no recent records of this species in the watershed. Records from the 1940s documented is presence in the mainstem of the Ventura River (near Foster Park) and along San Antonio Creek). These historic specimens were tadpoles. Records from the 1970s include other locations, such as 0.5 mile downstream of Matilija Dam, and Matilija Creek at Hot Springs. Frogs were also recorded along San Antonio Creek in the 1970s. Red-legged frogs may be present in the watershed, restricted to the headwaters in the National Forest where bass and bullfrogs are not common. It is likely to be extirpated from the mainstem of the river and along San Antonio Creek (Hunt et al. 1992). No red-legged frogs were observed at Foster Park in 1997 by Fugro West (1997).

4.2.3 Southwestern Pond Turtle

This species is considered a "species of special concern" by the CDFG. It is not a federal listed, proposed, or candidate species. It was formerly abundant in most freshwater and brackish water streams in California. It inhabits a wide variety of permanent and intermittent natural and man-made aquatic habitats, particularly with slow-moving water and pools. Habitat alteration and the introduction of non-native predators and competitors (e.g., bullfrogs, crayfish, bass) have eliminated or greatly reduced most populations south of Ventura County. Turtles are long-lived. They overwinter, as well as nest, outside the watercourse in grassland or scrub habitat, usually within 500 feet of the watercourse.

Turtles have been observed at several locations at the Ventura River estuary and along the lower river, downstream of Foster Park. For example, several dozen individuals have been observed on rock outcroppings between the Main Street and Shell Road bridges (Hunt et al. 1992). There are no confirmed sightings or records of the species along other portions of the Ventura River and San Antonio Creek. Upstream of Foster Park, the pond turtle may be restricted to the headwaters in the National Forest where bass and bullfrogs are not common. It is likely to be extirpated from the mainstem of the river upstream of Foster Park and along San Antonio Creek due to presence of predators and historic alteration of aquatic habitats.

4.3 Sensitive Birds

4.3.1 California Least Tern

The California least tern (*Sterna antillrum browni*) is a state and federal endangered species. It winters in South America, and breeds on beaches of southern California. The nearest breeding location is at the mouth of the Santa Clara River. Birds disperse widely from breeding sites to feed at lagoons and river mouths, including the mouth of the Ventura River. Least terns have been observed at the river mouth and nearby beaches in

July and August of most years when this species visits the lagoon during the post-breeding season. During the summer of 1990 and 1991, 10 to 20 birds were present daily on sand bars and beaches of the estuary, including fledglings (Hunt et al. 1992). There are no records of breeding at the Ventura River mouth (Greaves, pers. comm.).

4.3.2 Brown Pelican

The Brown Pelican (*Pelecanus occidentalis californicus*) is a state endangered and federal threatened species that is resident to the nearshore waters of the region. Small numbers are often present at the river mouth in the summer, foraging offshore and using the lagoon for resting. The nearest known breeding location for this species in on the Channel Islands.

4.3.3 Western Snowy Plover

The western snowy plover (*Charadrius alexandrinus nivosus*) is a federal endangered species. The nearest nesting location occurs at the mouth of the Santa Clara River, where it occurs with the least tern nesting population. There are not records of plovers breeding at the mouth of the Ventura River. However, post-breeding birds from McGrath State Beach are observed foraging at the Ventura River lagoon in the summer and fall. The number of birds ranges from several to over 100 individuals.

4.3.4 Belding's Savannah Sparrow

The Belding's Savannah sparrow (*Passerculus sandwichensis beldingi*) is a state endangered species that resides in coastal salt marshes of southern California. It nests in dense pickleweed stands and forages in adjacent salt marsh and transitional habitats. Breeding birds were observed at the Ventura River estuary in 1976 (Hunt et al. 1992). In 1992, sparrows were observed feeding fledgling young in salt marsh habitat west of the lagoon. The population at the river mouth is likely to consist of only several pairs. The nearest known breeding population is at Carpinteria Salt Marsh.

4.3.5 Least Bell's Vireo

The least Bell's vireo (*Vireo belli pusillus*) is a state and federal endangered species that is a summer resident of riparian woodland in major drainages of southern California. Its historical range included interior northern California, Sacramento and San Joaquin Valleys, Sierra Nevada foothills, and the Coastal Ranges from central California to upper Baja (Grinnell and Miller 1944, Franzreb 1989). The least Bell's vireo typically arrives at nesting sites along southern California streams from mid-March through mid-April (ENTRIX 1994). Both parents incubate the eggs which hatch in approximately 14 days. Once hatched, the young fledge in about 10 to 12 days. In addition to loss and degradation of breeding habitat, the least Bell's vireo has been negatively impacted by nest parasitism by brown-headed cowbirds (*Molothrus ater*).

In Ventura County, several very small populations breed along the upper and middle portions of the Santa Clara River between Saticoy and the Los Angeles County line. The earliest nesting season record from the Ventura River was a single territorial male seen on the lower river in 1981.

In 1993, the Ventura River from the river mouth to Foster Park was surveyed for least Bell's vireos (Greaves et al. 1993). Similar surveys were conducted in 1994, and Jim Greaves conducted another survey in 1995. (Greaves. 1995)

Breeding vireos were observed along the lower river in 1993, 1994, and 1996. During the breeding season in 1993, two males and at least one (possibly two) females were found on the Ventura River for the first time in several decades. Prior to these sightings, the most recent encounter was of a solitary male singing near the river mouth in the 1980's (Paul Lehman, pers. comm.). The 1993 and 1994 breeding site was on the west side of the river, about one mile upstream of Highway 101 on an abandoned site formerly used by S. P. Milling for a mine processing facility. The 1995 location was on the east side of the river within 250 feet of the Main Street bridge. There were no formal surveys conducted in 1996 and 1997. Greaves conducted a mid-day survey in late spring 1996 at the Main Street bridge area, but found no vireos at the 1995 location. Only one pair of vireos was found in each of the three years for which there are data from this lower part of the river.

In each year (1993, 1994, and 1995), a pair of vireos successfully raised at least one brood of young each. In 1993, the brood was only successful in raising only two young vireos (from 3 eggs) after a freshly hatched brown-headed cowbird was removed from the nest.

The 1993 birds consisted of a first-breeding-year banded male from a 1992 nest on the San Luis Rey River, San Diego County and an unknown origin banded female. Another male which was seen only briefly on site, courting a female that had been banded as a nestling on the Santa Clara River. In 1994, a pair was seen feeding fledglings, but observers were unable to determine the whether or not they were banded birds from the previous year. In 1995, an unbanded male was seen with two fledglings further down stream from the prior two years' sightings.

Least Bell's vireos on the Ventura River used contiguous areas of willow woodland that are traversed by the main channel of the river. In 1993 and 1994, they were on the west side in a mixed emergent willow and mulefat thicket growing adjacent to a rapidly drying cattail marsh. This area was adjacent to the base of the mountain on the west side of the river, and the vireo territory extended from the slope to the river channel, where the dominant species was red willow and other riparian understory species. Understory in the west (or main) part of the territory was not well-developed, and the ground beneath the willows was bare, with many cracks from drying after having been inundated. The nest that was found in 1993 was suspended in mulefat shaded by willow at the edge of coastal scrub at the base of the hill.

The male and two juveniles (and a possible female) found in 1995 were more than half a mile downstream from this location, and foraged still further down stream to within 250 feet of the Main Street bridge. This area consisted of older stream side willows and understory with poison oak and other shrubby weeds, as well as foraging areas in a recovering mixed chaparral stand on flat land between a flood control road and the willows.

The operations and maintenance of water and wastewater facilities along the Ventura River and its tributaries by the sponsoring agencies, as well as any of their activities that directly or indirectly affect the river, are described in the following subsections. The subsections are presented by agency, in alphabetical order.

5.1 CASITAS MUNICIPAL WATER DISTRICT

5.1.1 BACKGROUND INFORMATION

Casitas Municipal Water District (Casitas) is a special district formed in 1952 (under its previous name of the Ventura River Municipal Water District) to develop water supply for growers and residents of the Ojai and Ventura areas. The entire City of San Buenaventura boundary as it existed in 1952 was included in the Casitas service area. Upon its formation, Casitas entered into an agreement with the Bureau of Reclamation (USBR) that led to the construction of Casitas Dam and associated facilities (the Ventura River Project), which were completed in 1959. The facilities were built by the USBR under a repayment contract to Casitas; repayment will be complete in 2012. The facilities are presently owned by the USBR, but Casitas operates and maintains these facilities under contract to the USBR. Casitas diverts water from the Ventura River, Matilija Creek, and Coyote Creek under several water rights licenses issued by the State Water Resources Control Board.

5.1.2 SERVICE AREA AND CUSTOMERS

The service area of Casitas encompasses about 150 square miles, and includes the City of Ojai and the western half of the City of Ventura (Figure 5-1). Casitas provides water for irrigation and municipal and industrial (M&I) uses to both users and water purveyors. Casitas provides water to 14 public and private water agencies, including the City of Ventura, Ventura River County Water District, Meiners Oaks County Water District, and others. All but the City of Ventura rely primarily on ground water as their primary source. A summary of Casitas' water deliveries in recent years is provided below in Table 5-1. These data indicate that the largest users are water purveyors and agricultural users. Direct delivery to M&I users is only a small proportion of the total annual deliveries.

Casitas serves a population of about 63,000 through 2,606 service connections, 250 irrigation connections, and 33 other utility connections. Most of the residential users are served through wholesale connections to other water agencies. Casitas services 7,973 residential users directly. The largest M&I users in Casitas' service area are the City of Ojai and the City of Ventura. The former derives most of its water supply from the Ojai Basin, while the City of Ventura derives the majority of its water supply from a

Figure 5-1. Casitas Municipal Water District Service Area.

Table 5-1. Recent Water Deliveries From Casitas.

Year	Annual Deliveries (AF) by Water Users			Total Deliveries
	Resale to other water purveyors	Irrigation	M&I	
1976	8,482	5,243	2,104	15,829
1977	8,594	5,594	1,891	16,079
1978	5,829	4,763	1,737	12,329
1979	1,079	5,670	2,042	14,791
1980	10,018	6,289	2,013	18,320
1981	8,767	5,757	7,900	22,424
1982	7,888	4,690	2,021	14,599
1983	9,957	7,065	2,632	19,654
1984	9,564	8,030	2,624	20,215
1985	8,535	7,198	2,312	18,045
1986	8,601	9,328	2,492	20,421
1987	9,530	8,324	2,728	20,582
1988	9,647	9,835	2,574	22,056
1989	9,853	11,705	3,109	24,667
1990	7,771	9,118	2,550	19,439
1991	2,850	6,414	2,360	11,624
1992	2,952	6,178	2,133	11,263
1993	3,643	6,616	2,262	12,521
1994	3,280	6,161	2,409	11,850
1995	3,610	6,834	2,903	13,347

combination of surface water diversions on the lower Ventura River, and ground water extractions outside the Ventura River watershed.

There are about 12,500 acres of agricultural lands (as defined by Reclamation) in the service area of Casitas. About 6,000 acres of land is irrigated by water from Casitas. The other irrigated lands are served by private wells or other agencies.

5.1.3 WATER SUPPLY AND DEMAND

Water demands from Lake Casitas include water delivered to Casitas' customers through its treatment and distribution system, and a minor release from the distribution system to Coyote Creek downstream of the dam for water rights purposes. In addition, there are evaporative losses from the lake and minor losses in the distribution system. As noted above, the average annual water deliveries during the period 1959 through 1996 is 13,945 acre-feet per year. The average annual water release to Coyote Creek during this same period was 134 acre-feet per year; these releases have been about 73 acre-feet per year since 1980 by agreement with downstream landowners. These releases are delivered to downstream water rights users in a pipeline, not through releases to Coyote Creek.

A graph depicting the water deliveries since 1959 is provided on Figure 5-2 demonstrating the steady increase in water deliveries up to and through the 1987-1990 drought. Since 1991, there was been a decrease in water deliveries due to a series of wet years and increased water conservation by Casitas' customers. The average annual delivery from 1959 through 1996 was 13,945 acre-feet per year, with a range of 586 acre-feet per year (in 1959, the first year of operation) to 24,667 acre-feet per year (in 1989, the last year of the recent drought).

In 1990, Casitas estimated water demand for its service area based on the water usage during the drought years of 1986 through 1989 in which there was a slow decline in groundwater usage as water levels dropped, and a concomitant increase in purchases of water from Casitas. The estimates are shown in Table 5-2, updated with the actual 1989 deliveries from Lake Casitas and the actual surface diversions by the City of Ventura at Foster Park. These data indicate that under drought conditions, there would be a water shortage in the Casitas service area of about 5,000 acre-feet per year. This shortage may not be realized as private pumpers would likely increase extractions beyond the safe yield of the Ojai Basin for as long as possible**.**

5.1.4 WATER PRODUCTION FACILITIES

Casitas produces water from Lake Casitas, which captures runoff from a large portion of the Ventura River watershed. Facilities associated with water production and delivery include Robles Diversion Dam, the Robles-Casitas Canal, Casitas Dam, 95 miles of distribution pipelines, nine pump stations, four chlorination stations, and 14 regulating reservoirs. Casitas recently constructed a pressure filtration plant near Casitas Dam designed to meet current and proposed state and federal drinking water standards related to turbidity and pathogens. These facilities are shown in Figure 5-3.

Figure 5-2. Water Deliveries by Casitas Municipal Water District, 1959-1996.

Table 5-2. Estimated Water Supply and Demand Under Drought Conditions.

Water Source	Average Drought Year (1986-1989) Demand (acre-feet)	Safe Annual Yield (acre-feet)
Lake Casitas (w/ Lake Matilija operations)	22,073	21,920
Ojai Basin[1]	4,500	4,200
Ventura River Basin		
Matilija-Robles subbasin[1]	2,827	2,800
Robles-Foster Park subbasin[1]	2,393	1,987
Total	**30,907**	**31,793**
Difference	**(866)**	

[1]Data from Casitas (1989).

Figure 5-3. Casitas Municipal Water District Facilities.

Lake Casitas

Lake Casitas is a water supply reservoir created by Casitas Dam, located on Coyote Creek (Figure 5-4). The total storage of Lake Casitas is 254,000 AF, with a usable storage of 250,000 AF. The lake receives runoff from 34.29 square miles of direct drainage from Coyote and Santa Ana creeks, and from 74.25 square miles of indirect drainage from Matilija, North Fork Matilija, Upper North Fork Matilija, and Murietta creeks (see Figure 5-4) via the Robles Diversion Dam and Robles-Canal on the upper Ventura River. An average of 55 percent of the total inflow to Lake Casitas has been from indirect drainage from the Robles Diversion Dam. The lake began storing water in 1959 and spilled for the first time in 1978. It has spilled six more times in 1979, 1980, 1983, 1986, 1993, and 1995. Recent inflow and releases for Lake Casitas are summarized in Table 5-3.

Estimates of the safe annual yield of the reservoir vary based on the critical dry period used in the calculations, differing Lake Casitas evaporation rates, and the storage capacity of Lake Matilija. Safe annual yield is determined from annual yield available over the most critical dry period of record. That is, the amount of water that can be delivered every year, without shortfalls in deliveries. The most critical runoff period of record for Lake Casitas is 1944-1965. This period of record was used to calculate the current estimate of safe annual yield of 21,920 AF per year. Casitas' current estimate of safe annual yield was adopted by the Board of Directors in 1989 (Casitas 1989). Without the integrated operations of Lake Matilija, the safe annual yield from Lake Casitas is 21,500 AF per year.

Lake Matilija

Matilija Dam was completed in 1948, at which time it had a storage capacity of about 7,000 AF. As a result of sediment deposition and lowering of the spillway crest (from 1,125 to 1,095 feet in 1965) the active storage capacity was reduced to about 3,350 acre feet by 1965. Present active storage is estimated to be about 930 AF.

Since the construction of Casitas Dam, Lake Matilija has been used to increase the yield from Lake Casitas as described below. Reclamation initially estimated that Lake Matilija would increase the safe annual yield of Lake Casitas by about 1,900 AF per year. Under its present condition, it is estimated that Lake Matilija contributes about 400 AF per year of additional safe annual yield to Lake Casitas. This contribution will decrease in the future as the lake continues to be filled with sediments. It was recently estimated that the lake will have no active storage by the year 1999 after several years of high runoff and sediment loading or after a major wildfire in the watershed. Under a dry weather cycle, it is estimated that active storage would be present until the year 2010.

Operation of Matilija Dam

Matilija Dam is owned by Ventura County Flood Control District and operated by Casitas. Water in Lake Matilija is temporarily stored each winter and released for diversion at the Robles Diversion Dam. The maximum release from Matilija Dam is 250

Figure 5-4. Watershed Map of the Ventura River.

Table 5-3. Recent Inflow and Releases from Lake Casitas, WY 1991-1996.

Water Year	Inflow Direct	Inflow Robles	Inflow Total	Water Deliveries	Releases from Dam	Releases Spills
1991	11,923	17,254	29,177	16,931	72	0
1992	19,995	42,721	62,650	13,190	73	0
1993	43,914	36,532	80,445	11,694	73	13,395
1994	2,417	3,504	5,921	15,575	73	0
1995	52,101	1,323	53,424	12,107	72	27,499
1996	4,545	1,662	6,207	16,135	41	0

cfs. Releases are made from the outlet works at the base of Matilija Dam. Periodic releases are made each year during the period January through April when flows in the river are no longer sufficient for diversion at Robles. Releases from Matilija Dam continue until depleted. Several releases occur during most winters, allowing diversions during receding flows and providing available storage in Lake Matilija for future runoff events.

Robles Diversion Dam

Robles Diversion Dam is located on the Ventura River upstream of Lake Casitas and about 2 miles downstream of Matilija Dam (Figure 5-5). It is a concrete structure located on the western bank of the river (see Figure 5-5). It has three radial diversion gates that convey water to the Robles-Casitas Canal, and four radial by-pass gates (combined width of 58 feet). The three diversion gates have a capacity of 500 cfs, and the by-pass gates have a capacity of 7,000 cfs. Excess water spills over the earthen part of the dam. Water is routed to the structure by grading the 5-acre basin above the diversion to direct runoff towards the gates. Excessive sediment is removed from the basin after high runoff years. A 350-foot-long and 9.5-foot high earthen dam is located across the river to divert flows to the diversion structure (see Figure 5-5).

The drop off in elevation from the by-pass gates to the river channel below the gates is about 7 feet. The outlets of the by-pass gates are smooth concrete and extend into a small stilling pond across a 20-foot-long concrete apron. Downstream of the stilling pond is a 12-foot wide, concrete, dry weather crossing used to provide access to the diversion structure and flow measurement weir.

The three diversion gates are protected by a wooden trash wall in the basin and bar screens at the mouth of each diversion inlet. The gates are elevated about 5 feet above the floor of the diversion basin, requiring the development of a basin pool in order to divert water to Lake Casitas. Each of the diversion inlets are controlled by radial gates with dimensions of 11’6” by 10”6”.

Operation of Robles Diversion Dam

Since 1959, the Robles Diversion Dam has been operated under the guidelines established by the “Trial Operation Criteria for Robles-Casitas Diversion Facilities.” In general, under these criteria, flows up to 20 cfs are by-passed downstream, unless there is surface flow at Santa Ana Boulevard in Oak View, downstream of the diversion. Flows at the Robles Diversion Dam in excess of 20 cfs are diverted to the Robles-Casitas Canal and Lake Casitas, up to the canal’s capacity of 500 cfs. Flows reaching Robles Diversion Dam in excess of 500 cfs are passed downstream, either through the by-pass gates (up to 7,000 cfs), or through the by-pass gates and over the earthen dam if by-pass flows exceed 7,000 cfs. Flows greater than 500 cfs generally occur only when Matilija Dam is spilling.

Figure 5-5. Plan View of Robles Diversion Dam.

The requirement to by-pass 20 cfs changes under the following circumstances:

- More than 20 cfs must be released if water levels in the river alluvium downstream of the diversion dam do not rise as expected under natural circumstances, thereby affecting ground water users along the Upper Ventura River Basin.

- Less than 20 cfs may be released if surface water occurs, and can be maintained, at Santa Ana Boulevard, or if the amount of rising water at the mouth of San Antonio Creek occurs in such volume that water would reach the ocean.

Diversions typically occur during winter and spring, but the diversion timing and duration can vary widely according to the water year (Table 5-4). The contributions of the Robles Diversion Dam to Lake Casitas volume can fluctuate due to variation in rainfall years and preexisting storage in the lake. In recent times the percentage of Casitas inflows from the Robles Diversion Dam has varied from 3 percent (1995) to 68 percent (1992).

Other specific operational guidelines used by Casitas at Robles Diversion Dam include the following (among others):

1. When diversions are about to begin, the by-pass gates are set to pond water, while still allowing necessary by-pass flows.

2. The diversion is manned when diversions exceed 300 cfs. If diversions are less, the dam will be unmanned, but periodically checked by crews.

3. During periods of clear weather and stable conditions, up to 500 cfs can be diverted. During periods of high runoff, canal inflow should not exceed 450 cfs.

4. Flows to the canal should be maintained at a minimum of 50 cfs. If it is not possible to divert 50 cfs, the diversion is ceased and water is stored in Lake Matilija to elevation 1087 feet, then release water from Matilija Dam to create 250 cfs at the diversion dam.

5. No water is diverted when Lake Casitas water surface is within 2 feet of spilling.

Recent diversions at Robles Diversion Dam are summarized below in Table 5-5.

The high amount of diversions in 1986, 1992, and 1993 reflect high available runoff in very wet years.

Maintenance at Robles Diversion Dam

A shallow channel is often created at the Robles Diversion Basin to direct low flows to the diversion structure. This shallow channel is re-constructed after high runoff events, and may not be required every year. In addition, excess sediments that accumulate along the upstream face of the earthen dam are periodically removed. For example, sediments

Table 5-4. Monthly Diversions (AF) at the Robles Diversion Dam, WY 1986-1996.

Water Year	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1986	0	0	0	1,386	14,921	12,414	5,427	1,422	1,748	0	0	0
1987	0	0	580	0	0	1,306	0	0	0	0	0	0
1988	0	0	0	1,368	1,533	4,725	885	642	0	0	0	0
1989	0	0	0	0	524	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	366	0	367	11,776	4,186	925	0	0	0	0
1992			1,847	1,026	14,826	15,898	7,228	2,460	413	0	504	0
1993	0	0	0	21,013	10,889	0	0	961	1,039	785	0	0
1994	0	0	0	0	1,645	934	0	926	0	0	0	0
1995	0	0	0	319	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	1,291	0	373	0	0	0	0

Table 5-5. Recent Annual Diversions (AF) at Robles Diversion Dam.

Water Year	Diversions at Robles (AF)	Flows at Foster Park, downstream of Diversion (AF)	Percent of Flows at Foster Park
1986	41,803	45,138	93
1987	1,036	2,802	37
1988	9,733	4,457	218
1989	524	1,428	37
1990	0	362	0
1991	17,254	18,578	93
1992	42,721	63,447	67
1993	36,534	199,620	18
1994	3,505	6,035	58
1995	1,319	277,085	0
1996	1,664	12,389	13

Data from CMWD.

were recently removed in 1996. The creation of the shallow channel and removal of excess sediments is accomplished by a wheeled front-loader when flows are very low or absent. Maintenance of the diversion basin and channel occurs on an as-needed basis when flows are absent.

5.1.5 Recreation at Lake Casitas

Lake Casitas is open to the public for non-body contact recreational activities. All recreational facilities are operated by Casitas. The Recreation Area encompasses about 4,097 acres and consists primarily of open space. The recreational facilities are located on about 400 acres scattered about the perimeter of the lake, as shown on Figure 5-6. Existing recreational facilities include camping, picnicking, motor boating, sailing, canoeing, and fishing. The lake is also used by bird watchers to view the many migratory birds that use Lake Casitas as they pass through the Pacific flyway. Facilities include stores, campgrounds, RV campgrounds, showers, restrooms, picnic areas, boat ramps, RC airplane landing strip, and boat and trailer storage. Casitas does not allow body contact sports at the reservoir.

Lake Casitas is famous for it's record fish catches. Fishing takes place from docks, boats, and shore. Lake Casitas contains a warm water fishery including bass (primarily large mouth), catfish, sunfish, and crappie. These fish are non-native and were introduced when the lake was formed, but now are self-sustaining populations. Both CDFG and Casitas also stock the lake annually with catchable size rainbow trout, which are unable to sustain themselves, despite access to tributary streams for spawning and rearing.

5.1.6 Future Projects

Casitas does not have any plans for future water production, delivery, or treatment projects in the next 10 years. Routine maintenance and repairs of existing facilities will continue on an ongoing basis. As described in Section 5.1.3, recent water demands (11,000 to 16,000 AFY) have been well under the safe annual yield of Lake Casitas (21,920 AFY). Casitas anticipates that demands will remain well under the safe annual yield for the foreseeable future, and that Casitas will be able to meet demands during future droughts (equal to or less than the 1944-65 drought) without shortfalls. No future water development projects are planned or contemplated by Casitas.

5.2 City of San Buenaventura

5.2.1 Background Information

The City of San Buenaventura (City) was founded in 1782 and used the Ventura River as its source of water. Streamflow was diverted near the present-day Foster Park and conveyed in an aqueduct built by the Chumash Indians, under the supervision of the mission fathers, to a reservoir near the Mission. Within the period from 1869 to 1923 water facilities were developed and operated for the City by several companies. In 1923, the City acquired the water system from Southern California Edison and assumed

Figure 5-6. Lake Casitas Recreation Area.

responsibility for providing water to the City's residents. In 1926, the water rights originally established by the mission and other subsequently developed rights were acquired by the City. In years following, the City developed additional sources of water, including wells in the eastern portion of the City and improvements to the surface diversion from the Ventura River.

In 1952, the Ventura River Municipal Water District, later renamed the Casitas Municipal Water District (Casitas) was formed, encompassing the entire City boundary as it existed at that time. Casitas began delivering water to the City in 1959.

As the City expanded to the east, additional wells were developed. The City purchased land near Montalvo and in the 1960s drilled two wells that became known as the Golf Course Wells. With eastern expansion, the City incorporated land within the United Water Conservation District (United). As a result, the City annexed most of the Mound Water Company's service area and purchased the water company in the late 1950s. The water company's facilities were never incorporated into the City's distribution system due to their poor condition. Additional growth lead to the purchase of the Saticoy Water Company in 1968 and one production well. In 1975, to keep up with increasing water demands, the City drilled Victoria Well, located near the Ventura County Government Center. During the recent drought, the City conducted studies to identify alternative and emergency water supplies, focussing on desalination.

5.2.2 SERVICE AREA AND WATER SUPPLY

The City's service area includes the entire incorporated lands, including a portion of the City (City boundaries as of 1952) that is within the Casitas service area (Figure 5-7). Presently, there are five water sources for the City: Casitas, Ventura River Foster Park facilities, Mound Ground Water Basin, Oxnard Plain Ground Water Basin, and Santa Paula Ground Water Basin. The City also produces reclaimed water from the Ventura Wastewater Reclamation Facility.

The City generally uses its water supplies in the following order: Ventura River, Casitas, and ground water. The Ventura River use includes surface and subsurface diversion and ground water pumping, which is covered in Section 5.2.3. A portion of the City's allocation in the Oxnard Plain Ground Water Basin (managed by the Fox Canyon Ground Water Management Agency) is not used during average wet years due to ground water banking. This ground water bank is established and expanded by using less than the City's allocated amount, reserving the right to extract the banked water during droughts or emergencies.

Information about water supplies from the Ventura River is provided in Section 5.2.3. Information on water from Casitas and local ground water basins is provided below based on the City's 1996 *Urban Water Management Plan* and the 1993 *Evaluation of Long Term Alternative Water Sources* by Montgomery Watson.

Figure 5-7. City of Ventura Service Area.

Casitas Supplies

The City generally purchases water from Casitas on an as-needed basis. Per the contract between Casitas and the USBR, water from Lake Casitas can only be used in the service area of Casitas. Hence, the City can only take delivery of that amount of Lake Casitas water that can be used in the western end of the City. Until 1997, the City treated the water it receives from Casitas at the Ventura Avenue Treatment Plant (VATP). Beginning in 1997, the City receives water directly into the City's water system from Casitas' filtration plant.

The average annual delivery from Casitas to the City between 1959 and 1990 was 6,948 AF per year. The maximum purchase by the City was 11,998 AF in 1974. In the twenty year period from 1971 through 1990, the average annual deliveries were 8,662 AF per year. The City recently signed an agreement with Casitas which establishes a minimum annual purchase by the City of 6,000 AF per year after July 1997 for the next 28 years.

Ground Water Supplies

In addition to ground water wells as part of the Ventura River supply, the City has wells in the Mound Ground Water Basin, Oxnard Plain Ground Water Basin, and Santa Paula Ground Water Basin. The City has two wells that extract water from the Mound Ground Water Basin, Victoria Well No. 1 and No. 2. Well No. 1 was installed in 1982 and Well No. 2 was installed in 1995. The poor quality of ground water has reduced the yields from Well No. 1. The estimated long term production capacity from this well is 2,500 AF per year. Well No. 2 is the primary production source from the basin, with a long term annual production capacity of 4,500 AF per year. A third well, Mound No. 1, is currently in design to replace Victoria No. 1.

Wells near the Buenaventura Golf Course have been operating since 1961. All of the wells produce from the Fox Canyon Aquifer of the Oxnard Plain Basin. Average annual production from these wells since 1981 has been about 5,400 AF per year. Production will be decreased in the future pursuant to restrictions by the Fox Canyon Ground Water Management Agency. Long-term production will be about 4,000 AF per year.

The City operates one well in the Santa Paula Ground Water Basin, Saticoy Well No. 2. Under an agreement with United and local private pumpers, the City can pump up to 3,000 AF per year. Currently, the City considering a third well in the Santa Paula Basin.

5.2.3 VENTURA RIVER FACILITIES

Overview

The City's Foster Park facilities include a surface water diversion, an underground dam, two subsurface intake pipes and four shallow wells (Nye Wells) within the Ventura River alluvium (Figures 5-8 and 5-9). Water produced at the facilities is conveyed by gravity and pumping to the Kingston Reservoir at the Ventura Avenue Treatment Plant (VATP).

Figure 5-8. Location of Foster Park Facilities.

Figure 5-9. Layout of Foster Park Facilities.

The subsurface and surface diversion facilities at Foster Park are located on land owned by Ventura County. The City retains a permanent right to operate, maintain and develop water-related facilities in the park area. The Nye wells are on City-owned property.

The surface and subsurface diversions at Foster Park occur all year, provided there are sufficient flows. Water is produced from wells to supplement surface diversions in order to meet demands. The surface and subsurface intakes at Foster Park deliver water to a receiving chamber that discharges to a 36-inch diameter concrete pipe that has been slip-lined with a 29-inch diameter pipe. The wells discharge to a separate 24-inch diameter pipe that connects to the same receiving chamber and also continues downstream in a separate pipeline to the VATP, where it joins the 36-inch pipeline just prior to the master meter and Kingston Reservoir.

Subsurface Dam

The subsurface dam was built between November 1906 and July 1908, extending 973 feet across both the Ventura River and Coyote Creek, just above their confluence (see Figure 5-9). The dam effectively delineates the boundary between the Upper and Lower Ventura River ground water basins. The dam impedes subsurface flow causing it to buildup upstream and directs it toward the east side of the river. The crest of the dam is at elevation 224.3 feet above sea level. The poured concrete dam is as shallow as five feet deep on its west end at Coyote Creek and gradually deepens to a maximum depth of about 40 feet at its eastern end. It rests on sandstone and shale bedrock. The dam does not extend completely across the river. On the eastern side of the river, a gap of about 300 feet was not constructed when the subsurface flows and increasing depth to bedrock made it impossible to pour any more concrete for the dam. In recent years, the crest of the dam has been exposed along the west side of the river channel.

Surface Diversion

The surface water diversion consists of a simple weir structure located about 300 feet west of the east end of the dam, on the eastern bank of the river's current low-flow channel (see Figure 5-9). The surface diversion consists of a flume 5 feet wide and 33 inches deep. The downstream end of the flume is fitted with stop logs and the east side of the flume has a perforated aluminum plate that allows water to flow into the receiving chamber. This perforated aluminum plate is referred to as the fish screen. (The fish screen was designed and installed in 1976 by CDFG as part of a juvenile steelhead study conducted by Mark Moore as part of his Master’s thesis.). The diverted water spills over a v-notch weir into the receiving chamber where it flows into the 36-inch pipeline. The receiving chamber has a slide gate to shut-off surface inflow to the chamber and a slide gate at the entrance to the 36-inch pipeline. This pipe is two feet below the crest of the dam. The original 36-inch concrete pipe was slip-lined in 1991 resulting in its current diameter of 29 inches. This slip-lined pipe has carried as much as 14 million gallons per day (mgd) and is expected to be capable of handling larger flows.

An earthen training dike is constructed by the City to direct the surface flow into the diversion flume when the riverbed configuration changes during high flow events and surface flows spill over the dam, rather than through the weir (see Figure 5-9). The dike is constructed by pushing and piling channel material using a wheeled front loader. The dike is usually only two to five feet high. Its location and length varies depending each year. The dike is constructed across portions of the river channel and directs some or all river flows to the diversion structure. The length of the dike has varied from 20 to 100 feet. City staff rebuilds the earthen training dike out of the riverbed material as soon as practicable after a major runoff event occurs. Dikes may be constructed and re-constructed several times a year, during the period February through August, depending upon flows that damage the structure.

A narrow ditch (three to five feet wide, two feet deep) of varying length may also be constructed to efficiently convey water to the diversion structure. A smaller ditch may also be constructed to convey excess surface flows from the diversion structure back to the main river channel. Examples of training dikes and associated ditches from 1995 are shown on Figure 5-10. The City has constructed training dikes in each of the past 10 years.

In 1988, the City executed a 1601 Streambed Alteration Agreement with the California Department of Fish and Game (CDFG) to allow as-needed construction of training dikes. The Agreement requires that the City notify CDFG 24 hours prior to the work. It allows work to occur in the live stream, provided turbidity levels in the stream are kept to a minimum. Riparian vegetation can be removed to construct dikes, but the removal must be minimized. In practice, the City must work in the live stream when constructing or repairing the dike; however, the work is completed within one day. Any riparian vegetation removed is usually low-growing herbaceous plants that have become established along the live stream after the winter flood flows. The Agreement states that training dikes shall not impede the passage of fish. At this time, the City is also working with the Corps of Engineers to acquire a 404 permit for the training dikes, as well as with the Regional Water Quality Control Board to acquire a 401 water quality certification.

A small pond usually forms upstream of the flume entrance at the diversion structure. When pieces of the algae mats slough off into the flowing water upstream of the diversion, the mats clog the intake perforations of the fish screen. The algae accumulation is manually swept off the fish screen by City staff when the surface inflow drops noticeably. The reduction in inflow can be substantial, requiring the screen to be cleared as often as every two hours.

During high river runoff, reduced amounts of surface water are taken due to the high turbidity of the water. Normal streamflow diversions are also halted when the turbidity of the surface diversion, combined with the subsurface flow and Nye well water, exceeds 50 NTUs. This is done primarily to insure that the treated water meets state turbidity standards.

Figure 5-10. Recent Training Dikes at Foster Park.

Subsurface Infiltration Pipes

The subsurface infiltration pipes are located upstream of the dam (see Figure 5-9). Two pipes each extend about 300 feet from the receiving chamber extend outward from the base of the dam in either direction. The 18-inch diameter concrete pipes have had portions of the joints broken out to allow inflow. Subsurface water behind the dam enters the pipes and flows into the receiving chamber. The receiving chamber, or wet well, is 22 feet below the crest of the dam. The pipes were inspected in 1989 and appeared clear and unobstructed. A third non-functional shallow 36-inch diameter perforated concrete infiltration pipe is located on the upstream side of the submerged dam extending to the west of the receiving chamber. This pipe was severely damaged in a storm and is filled with rocks and debris. Two turbine pumps in the receiving chamber discharge the water into a 36-inch diameter pipeline to the VATP. The pumps have a combined capacity of 2,500 gallons per minute.

Nye Wells

The City has four active wells (Nye Well Nos. 1, 2, 7 and 8) upstream of the submerged dam which extract water from the lower portion of the Upper Ventura River Basin (see Figure 5-9). The extracted water is derived from percolating river water which is stored in the alluvium. The wells extend through the thickness of the river alluvium, which averages about 50 feet in this area. The pumps on these wells are set at 50 feet. The maximum production from Nye Well Nos. 1, 2, 7, and 8 are approximately 775, 475, 1,850, and 850 gpm, respectively.

Operations at Foster Park

The surface and subsurface diversions at Foster Park occur all year, provided there are sufficient subsurface and/or surface flows. Water is produced from wells to supplement surface diversions in order to meet demands and water quality objectives by blending.

The surface diversion can deliver 10.83 cfs, which would produce 7,841 AF per year if surface diversions occur year-round. In practice, surface diversions are curtailed for varying amounts of time each year because of: (1) flood flows; (2) poor quality water; (3) inefficient diversion of the river flows to the diversion structure; and/or (4) maintenance requirements.

The monthly amount of water from the three sources at Foster Park (surface and subsurface diversions, and Nye Wells) for the period WY 1981 through WY 1996 are shown in Table 5-6. These data indicate that the total average water production from the Foster Park facilities is 6,6,37 AF per year over this period, and that the surface diversions and subsurface (including wells) diversions accounted for about 25 and 75 percent of the total production, respectively. In dry years, such as in 1990, no surface diversions occurred.

Table 5-6. Subsurface and Surface Diversions and Well Production at Foster Park and Unimpaired Runoff, WY 1981-1996.

Water Year	Foster Park Production (AF)			
	Surface	**Subsurface**	**Nye Wells**	**Total**
1981	391	858	5,708	6,957
1982	820	639	4,748	6,207
1983	2,943	749	2,681	6,373
1984	1,278	979	3,479	5,736
1985	1,315	867	3,311	5,493
1986	4,375	681	2,510	7,566
1987	2,046	491	3,037	5,574
1988	2,507	1,315	2,981	6,803
1989	40	729	3,090	3,859
1990	0	407	2,451	2,858
1991	1,247	927	3,282	5,456
1992	2,812	1,971	5,091	9,874
1993	1,580	1,917	5,416	8,913
1994	2,031	1,151	4,380	7,562
1995	2,882	1,717	4,443	9,042
1996	979	1,397	5,550	7,926
Average	1,515	1,049	3,884	6,637

Production from the Ventura River is a function of several factors including diversion capacity, local hydrology, the storage capacity of the Ventura River alluvium and upstream diversions. Surface flow is frequently not available or cannot be efficiently diverted. The surface diversion alone is capable of providing enough water to operate the VATP at full capacity when there is enough flow in the river that can be diverted by the surface diversion structure, i.e., about 8 cfs.

The primary limiting factor on consistent yield from Foster Park is the ground water storage capacity of the Upper Ventura River Basin. The Upper Ventura River Basin is estimated to have a storage capacity of 14,000 AF (EDAW, Inc., 1978). During periods of low runoff, most of the City's production must be derived from ground water, which is capable of being rapidly depleted. It is estimated that 2,200 AF per year is drawn from the Upper Ventura River ground water basin by local users upstream of Foster Park (EDAW, Inc., 1978). Thus, if the City were to extract 5,500 acre-fee per year from the river, less than the historical average, and there were no natural replenishment, the river's ground water basin could be depleted in less than two years.

Long-term total average diversions from Foster Park were 4,781 AF per year for the period of 1933 through 1995 as shown in Figure 5-11. During the period of 1971-1990, the diversions averaged 5,866 AF per year. The average annual diversions during the period 1990 - 1995 was 7,284 AF per year. The maximum production was 7,785 AF per year in 1986. The minimum yield from Foster Park was 1,463 AF per year in 1951 at the end of a four-year drought.

Maintenance Activities at Foster Park

Routine maintenance activities at the Foster Park facilities include the following:

- clean algae and debris from the fish screen at the surface diversion on a daily basis;
- inspect and repair surface diversion after summer weekends to remove rocks or other debris piled in, or in front of, the flume by park users;
- construct training dikes in the spring and summer, as needed;
- inspect and repair well heads on an as-needed basis.

Inspection of Nye Well Nos. 2, 7, and 8, and any required maintenance, requires foot or vehicle access in or across the riverbed. Repairs to the surface diversion structure would require only minor encroachment into the river.

The City does not anticipate a need for any routine repairs or maintenance to the submerged dam or infiltration pipelines. Non-routine repairs would be needed if the wells, buried pipelines, or the surface diversion structure were damaged during a flood event.

Figure 5-11. Diversions at Foster Park Facilities, 1933-1995.

Ventura Avenue Treatment Plant

Water from the Foster Park facilities is treated and chlorinated at the VATP, a conventional treatment plant with a capacity of about 13.mgd. Raw water from Foster Park is stored in the 10 million gallon capacity Kingston Reservoir, and after treatment, it is stored in Power Reservoir and distributed to the City. The plant treats water twenty-four hours per day.

5.2.4 SUPPLY AND DEMAND

A summary of the City's recent water production from different sources since 1981 is provided in Table 5-7.

A summary of the City's historic, current, and projected water supply is provided in Table 5-8.

As noted above, the average annual diversions from the Ventura River were 4,781 AF per year for the period of 1933 through 1990. During the period of 1971 through 1990, the diversions averaged 5,866 AF per year. The average annual diversions during the period 1990 through 1995 was 7,284 AF per year. The maximum production was 9,974 AF per year in 1992 at the end of the drought. The maximum production was

The City has estimated water demand through the year 2040. Additional water supplies will not be needed until sometime after the year 2010. Thereafter, the City may need supplemental water supplies. Per the 1994 Comprehensive Water Resources Management Plan (Plan), the City has implemented annual review of critical water supply conditions and a biennial report with a ten year projection on water supply conditions. At this time, the City does not have a need to secure supplemental water supplies. Hence, there are no plans to increase the amount of diversion from the Ventura River compared to historic levels. The diversions will continue in a manner that "...balances the needs of the water system and environmental concerns regarding the river." The Plan indicates that the yield from the river will depend on runoff conditions, and could range from 700 to 11,000 AF per year. For the future, the City has estimated that average annual diversions from the Ventura River to be about 6,700 AF per year, as shown in Table 5-8.

5.2.5 FUTURE PROJECTS

As noted in Section 5.2.4, the City does not have a need to secure supplemental water supplies at this time or in the near future. Hence, there are no plans to increase the amount of diversion from the Ventura River from historic levels.

As part of the City's current study on improvements for the VATP, the City is examining methods to improve the efficiency and reliability of ground water pumping from Foster Park. Optimizing ground water production from Foster Park will require modification of existing wells and pipelines, and additional new facilities. With the improvements, there

Table 5-7. 1990-1996 Water Deliveries by the City (AF).

Year	Ventura River	Casitas	Oxnard Plain Basin	Mound Basin	Santa Paula Basin	Total
1990	2,859	6,175	5,749	4,365	0	**19,148**
1991	5,456	3,166	2,703	2,838	497	**14,660**
1992	9,874	1,126	784	3,086	1,601	**16,471**
1993	8,914	2,353	2,408	1,254	2,540	**17,459**
1994	7,561	5,037	2,704	3,175	503	**18,980**
1995	9,042	1,622	2,603	2,169	2,594	**18,030**

From City of San Buenaventura, Urban Water Management Plan. May 1996.

Table 5-8. Historic and Projected Water Source Supply Availability (AF).

Year	Surface Water Lake Casitas	 Ventura River	 Mound Basin	Ground Water Oxnard Plain	 Santa Paula	 Total Supply
Historic Water Use						
1980	7,544	7,276	0	5,198	2,129	22,147
1985	9,099	5,493	2,360	6,172	46	23,170
1990	6,175	2,859	4,365	5,749	0	19,148
1995	1,622	9,042	2,169	2,603	2,594	18,030
1996	4,446	7,926	2,789	2,768	1,599	19,528
Projected Water Available						
1997	8,000	6,700	4,200	4,900	3,000	26,800
2000	8,000	6,700	4,200	4,600	3,000	26,500
2010	8,000	6,700	4,200	4,100	3,000	26,100
2040	8,000	6,700	4,200	4,100	3,000	26,100

From City of San Buenaventura, Urban Water Management Plan. May 1996.

would be increased ground water production during high water levels when surface flows are too turbid to divert, and during low water levels when surface flows have ceased. The new or modified wells would optimize available drawdown and selectively take advantage of the maximum thickness of aquifer deposits. The recommended improvements identified during the initial phase of the study are as follows:

- add new pump bowl and more powerful motor to Nye Well Nos. 1 and 8,
- re-locating Nye Well No. 2 out of the river channel,
- install variable speed motor to Nye Well No. 7,
- repair and replace worn portions of the pipelines in the well field.

Additional recommendations included improved system of debris removal from the intake screen on the surface diversion structure, possibly a mechanized system, and a semi-permanent dike to divert river flows to the structure. Completion of the subsurface dam were not determined to be cost effective. The feasibility of installing a new subsurface collector is currently being studied.

5.3 MEINERS OAKS COUNTY WATER DISTRICT

5.3.1 BACKGROUND INFORMATION

Meiners Oaks County Water District (Meiners Oaks CWD) is an independent special district formed in 1949. The Meiners Oaks CWD office is located on El Roblar. It provides water to residential, commercial, and agricultural customers. It has about 1,200 service connections. The service area encompasses about 1,300 acres, and includes the community of Meiners Oaks Acres on the east side of the Ventura River (Figure 5-12).

5.3.2 WATER PRODUCTION FACILITIES

Meiners Oaks CWD has four active wells that produce from the Upper Ventura River Ground Water Basin, which extends along the Ventura River Valley from Foster Park to Matilija Dam, and is bordered on the east by the Ojai Basin (Figure 5-13). The basin is composed of alluvium about 60 feet deep (Slade 1991).

Well Nos. 1 and 2 are located immediately adjacent to the Ventura River about one mile downstream from Matilija Dam (see Figure 5-12). Well Nos. 4 and 7 are located on a terrace on the west side of the Ventura River, adjacent to Rice Road (see Figure 5-12). Water from the wells is chlorinated at the well head, then distributed directly to customers through a system of pipelines and storage facilities in the service area. Well operations are automated.

Periodic well maintenance is required. The upstream wells are located outside the Ventura River and do not require access from the river. The downstream wells are

Figure 5-12. Meiners Oaks Water District.

Figure 5-13. Ventura River and Ojai Ground Water Basin.

located on a river terrace and are accessed by a dirt road. These wells are located about 300 feet west of the main channel in the river. These wells are routinely inspected and maintained.

5.3.3 Supply and Demand

Meiners Oaks CWD produces about 1,300 AF per year from its wells. All four wells are operated at the same time. However, the upstream wells produce more than the downstream wells. Meiners Oaks CWD anticipates that it can meet current and future demands from its wells, except in drought years. It has an agreement to purchase water from Casitas during emergencies and drought conditions. Meiners Oaks CWD anticipates only a minor increase in demands in the future because its service area is mostly built out with residential land uses.

5.3.4 Operations and Maintenance

Well operations are automated. Pumping is highest in the summer and fall months. Periodic well maintenance is required. The upstream wells are located outside the Ventura River and do not require access from the river. The downstream wells are located on a river terrace and are accessed by a dirt road. These wells are located about 300 feet west of the main channel in the river. These wells are routinely inspected and maintained.

5.3.5 Future Projects

Meiners Oaks CWD does not anticipate any major improvements or additions to its water production or distribution systems in the next 5 to 10 years.

5.4 Ojai Basin Ground Water Management Agency

5.4.1 Background Information

The Ojai Basin Ground Water Management Agency (Ojai Basin GMA) was formed by the state legislature in 1991 in a response to the needs and concerns of local water agencies, water users, and well owners in the Ojai Basin. The mission of the Ojai Basin GMA is "... to preserve the quantity and quality of ground water in the Ojai Basin to protect and maintain the long term water supply for the common benefit of the water users in the Basin." The Ojai Basin GMA has responsibilities for overseeing the management of the Ojai Basin. It has completed a comprehensive ground water investigation (Staal, Gardner, & Dunne 1992), prepared a management plan, and enacted several ordinances.

5.4.2 Programs

The Ojai Basin is not adjudicated and there are no restrictions on pumping at this time. However, the Board of Directors has various authorities under the enabling legislation "...for the purpose of monitoring, regulating, conserving, managing, and controlling the use and extractions of ground water within the boundary of the agency." For example, the Ojai Basin GMA prohibits the export of water outside the boundaries of the Ojai Basin without approval by the Board of Directors.

The Ojai Basin GMA has established a well registration program and has also instituted a metering program. The Ojai Basin GMA levies a pumping fee of no more than $7.50 per acre-foot pumped per year on all public and private wells to provide funding for the agency's administrative costs. Each well owner is responsible for participating in the metering program and paying annual well pumping fees. The Ojai Basin GMA produces an annual report on the status of the basin and the activities of the agency.

5.4.3 Overview of the Ojai Basin

The following information was derived primarily from Staal, Gardner, and Dunne (1992) and the *Ojai Basin 1995 Annual Report* by the Ojai Basin GMA.

Physical Features

The Ojai Basin is approximately five miles long and extends in an east-to-west direction, comprising about 7.5 square miles (see Figure 5-13). It includes the City of Ojai, the residential areas and agricultural land east of the City. Geographically, the basin is situated between the Topa Topa Mountains to the north and east, Black Mountain to the south, and the Arbolada area to the west. The Ojai Basin is comprised of alluvium deposited within a structural depression. Underlying the basin are non-water-bearing sedimentary rocks.

Surface waters within the basin drain to the southwest toward the Ventura River. San Antonio Creek is the major stream draining the southern slopes of the Topa Topa Mountains and the Ojai Basin (see Figure 5-13). San Antonio Creek originates in Senior Canyon, flows southwest across the basin, and discharges from the basin at Camp Comfort. Other streams draining the Topa Topa Mountains east of the basin include Thacher Creek (emanating from Horn Canyon) and its tributary Reeves Creek (originating in Wilsie Canyon). The latter joins Thacher Creek in the southeast corner of Ojai Valley, then Thacher Creek continues to its confluence with San Antonio Creek at Soule Golf Course.

Streams in the Ojai Basin are generally dry except during and immediately after rainfalls. Low flows are readily absorbed and transmitted to the ground water basin through the permeable alluvium that comprises the basin. In addition, some of the surface water in Senior, Gridley, and Horn canyons are diverted by growers to irrigate orchards in the foothills.

The aquifer in the basin consists of undifferentiated and poorly consolidated deposits of clay, sand, gravel, and boulders derived from stream channel and alluvial fan deposits of Pleistocene and Recent age. The basin has a relatively flat bottom with a maximum depth of about 700 feet.

A confining clay layer is located in the southwest corner of the basin along San Antonio Creek where it reaches depths of up to 200 feet. Wells in this area are reported to become artesian when the water levels in the basin are high.

Water Levels

Historic well data indicate that water levels fluctuate more in the along the northern perimeter of the basin, and in the central and eastern portions of the basin. Seasonal fluctuations for wells in these areas are typically around 20 to 80 feet. Wells located in the west and southwest portions of the basin have shown relatively stable water levels that have typically fluctuated from 5 to 20 feet seasonally.

Since 1971, over 2,000 acre feet per year has been delivered to the Ojai Basin by Casitas for irrigation purposes. The annual deliveries have increased to about 3,500 AF per year. The deliveries have resulted in a decrease in ground water use, and have satisfied increased irrigation demands over the past 25 years. The decrease in ground water use and increase in ground water recharge from excess applied imported water have resulted in the overall maintenance of high water levels in the Ojai Basin in the past 20 years.

Storage and Discharge

Ground Water storage has been estimated from the period 1975 through 1991 from key monitoring wells. The maximum storage occurred in 1983 at 83,785 AF. The minimum storage occurred in 1990 and was estimated at 69,046 AF. The historic low storage occurred in 1951 at 42,700 AF.

There are no estimates of discharges from the Ojai Basin from San Antonio Creek. It is believed that ground water discharges readily to San Antonio Creek when the basin is full. When the basin water levels are low, little or no discharge may occur to San Antonio Creek.

Water Quality

The quality of the ground water in the basin is generally good, with the exception of localized elevated nitrate concentrations.

Ground Water Use

Agricultural water use is the largest single demand in the Ojai Basin. It is met by private wells and imported water from Casitas Municipal Water District (Casitas). Municipal and industrial water demands in the City of Ojai are met by Southern California Water Company. About 90 percent of its water production is from four wells in the center of the basin. The remainder of its production is derived from purchases of water from Casitas.

In 1995, there were 115 active and inactive wells recorded in the basin, most of which are private wells. The estimated annual pumpage from private wells during the period 1970 through 1995 ranged from 1,924 acre feet in 1989 (at the height of the drought) to 6,052

AF in 1992. The estimated private pumping in 1995 was 2,587 AF. In 1995, Southern California Water Company produced 1,845 AF from its wells and purchased 205 AF from Casitas. Total ground water extractions in 1995 from private wells and from Southern California Water Company (and seven other small water purveyors) were estimated to be 4,432 AF, of which about 60 percent was used for irrigation purposes.

Imported Water from Casitas

Casitas provides imported surface water from Lake Casitas to many agricultural users in the Ojai Basin. Annual importation to the basin over the period 1970 through 1995 has varied between 1,476 AF in 1973 to 5,169 AF in 1989. Casitas delivered 3,530 AF to users in the basin in 1995.

Water Balance

Water use and replenishment in the Ojai Basin has been in balance from 1992 through 1995. The basin suffered significant declines in storage and production during the drought years of 1987 through 1991. The basin was replenished by above-average rainfall during the water years 1991-92 and 1992-93. The 1993-94 water year was below-average, but was followed by high rainfall years in 1994-95 and 1995-96.

In the 1992 ground water study (Staal, Gardner, and Dunne, 1992), it was concluded that the water supply and demand in the Ojai Basin is largely in balance, and that the significant amount of ground water in storage is available to withstand future annual demands during period of extended drought without exceeding the historic maximum storage depletion.

A summary of the water supply and demand in the Ojai Basin in 1995 and 1996 is provided in Table 5-9.

5.4.4 Future Ground Water Use

Ground Water pumping is not expected to substantially increase in the near future for several reasons: (1) The rate of urban development is very low due to land use restrictions. Hence, M&I demands are not expected to increase. (2) Land suitable for agricultural uses is very limited in the Ojai Valley and most of it is already cultivated. However, ground water pumping from the basin could increase substantially if importation of Casitas water (about 3,500 AF per year) were curtailed due to pricing or availability.

The irrigation demand in the 1960s and 1970s was about 6,000 AF per year. It increased dramatically in the 1980s (due to increases in irrigated lands and greater avocado acreage) to about 8,000 AF per year. As noted above, the increased irrigation demand was met by

Table 5-9. Supply and Demand (AF) in the Ojai Basin in 1995 & 1996.

Year	Irrigation Demand	Water Imported from Casitas for (mostly irrigation use)	Pumping from Private Wells (mostly irrigation use)	Ground Water Extracted by So. Cal. Water Company (M&I use)	Total Ground Water Extractions
1995	6,189	3,530	2,659	1,845	4,504
1996	6,799	4,468	2,331	1,608	3,939

From the Ojai Basin 1995 and 1996 Annual Reports.

increased importation of Casitas water rather than from increased ground water pumping, which as remained relatively constant at about 5,000 AF per year since 1980. Irrigation water demand has decreased since 1993. It is not known if this trend will continue.

5.5 OJAI VALLEY SANITARY DISTRICT

5.5.1 BACKGROUND INFORMATION

The Ojai Valley Sanitary District (OVSD) originated in 1985 as a result of the consolidation of the Ventura Avenue, Oak View, and Meiners Oaks Sanitary Districts, and the Sanitation Department of the City of Ojai. The predecessor districts were formed in the 1960s in conjunction with the construction of the Oak View Treatment Plant, located along the lower Ventura River and south of Foster Park, which served them, as well as the City of Ojai. The service area of the OVSD includes the City of Ojai and surrounding communities, as well as communities along the lower Ventura River (Figure 5-14). Wastewater is collected and delivered to the Ojai Valley Wastewater Treatment Plant (Treatment Plant) by about 120 miles of pipelines and five pump stations in the service area. About 95 percent of the wastewater is from residential and commercial uses, and the remaining five percent is from industrial uses.

5.5.2 FACILITIES

Treatment Plant

The Ojai Valley Wastewater Treatment Plant (Treatment Plant) is located about five miles from the ocean and about one mile downstream of Foster Park (Figure 5-15). The Treatment Plant currently (early 1997) discharges about 2.28 million gallons per day (MGD) of tertiary treated effluent to the river. It has a design capacity of 3.0 MGD (dry weather flow). The peak wet weather flow is 9.0 MGD.

In 1990, the Regional Water Quality Control Board (Regional Board) issued Waste Discharge Requirements (Order No. 90-062) to OVSD. The order required decreases in Biological Oxygen Demand (BOD) and suspended solids in the effluent discharged from the treatment plant to the Ventura River. It also required filtration to meet Title 22 of the California Code of Regulations regarding water quality for body contact recreation in the Ventura River. That order was replaced in 1996 with Order No. 96-041.

The order required that OVSD perform a study to: (1) determine the cause of low dissolved oxygen concentration and nuisance plant growth in the river below the plant; (2) determine if there is a relationship between the low dissolved oxygen and nuisance plant growth; and (3) identify corrective actions. The results of the study by Montgomery-Watson (1993) were as follows:

1. The low dissolved oxygen conditions in the river downstream of the Treatment Plant during the late summer and early fall appear to be independent of nuisance plant growth. Relatively high BOD and low dissolved oxygen concentrations in

Figure 5-14. OVSD Service Area and Treatment Plant.

Figure 5-15. Major OVSD Sewer Pipelines.

the effluent appear to be more direct factors relating to low dissolved oxygen concentrations.

2. Plant growth downstream of the Treatment Plant is heavier than above the plant due to other factors such as increased nutrient levels downstream of the Treatment Plant, and the presence of increased aquatic habitat, both due to pools and the continuous plant discharges.

3. As dissolved oxygen concentrations in the river appear to be independent of plant growth, the reduction of nutrient levels would have a negligible effect on oxygen levels. However, the reduction in nutrient levels in the effluent due to the plant upgrade would reduce plant biomass by about 19 percent, and reduce plant stems by 36 percent.

The required upgrade of the Treatment Plant began in 1995 and was completed in August, 1997. The new treatment processes were fully operational before the Regional Board's Cease and Desist Order deadline of January 1, 1998. The new facilities were constructed on the existing six-acre site. The upgrade did not change the plant capacity or discharge amounts.

The upgrade required demolition of nearly all the existing facility and the construction of new treatment processes. The upgraded facilities include influent pump station and grinding, grit removal and fine screen, biological odor control, activated sludge technology utilizing oxidation ditches with anaerobic and anoxic zones for nutrient/BOD removal, final clarification, continuous backwash sand medium tertiary filters, ultraviolet and chlorination/dechlorination disinfection facilities, re-aeration, and discharge to the Ventura River via a pre-existing outflow line. A new overflow outflow line was installed to provide adequate capacity for effluent flows during high flow events in the Ventura River that have historically caused back-flooding of the effluent discharge. Solids handling consists of aerobic digestion, belt filter press, sludge drying beds, and solid disposal by landfill, land application, and/or composting. The new effluent limitations that must be met by January 1, 1998 are shown below in Table 5-10.

The pH of the effluent must be between 6.5 and 8.5. In addition, the temperature of the effluent shall not exceed 80°F, except when the ambient temperature of the receiving water is higher than 80°F.

The following receiving water requirements (among others) must be observed downstream of the plant:

- The temperature of the receiving water at any time or place shall not be increased by more than 5°F (or above 70°F if the ambient temperature of the receiving water is less than 60°F as a result of the effluent discharge.

Table 5-10. Selected Effluent Limitations for the OVSD Treatment Plant.

Constituent	Unit	Discharge Limitation	
		30-Day Average	Daily Maximum
BOD	mg/l	10	15
	lbs/day	250	375
Suspended solids	mg/l	10	15
	lbs/day	250	375
Oil and grease	mg/l	10	15
	lbs/day	250	375
Residual chlorine	mg/l	NA	0.1
Settleable solids	ml/l	0.1	0.2
Total dissolved solids	mg/l	NA	1,500
	lbs/day	NA	37,500
Sulfate	mg/l	NA	500
	lbs/day	NA	12,500
Chloride	mg/l	NA	300
	lbs/day	NA	7,500
Nitrate+Nitrite	mg/l	NA	10
	lbs/day	NA	250

NA = no applicable limitation.

- Ambient pH levels shall not be changed by more than 0.5 units as a result of the effluent discharge.

- The dissolved oxygen in the receiving water shall not be depressed below 5 mg/l as a result of the effluent discharge.

- The ammonia in the receiving water shall not exceed concentrations specified in the Basin Plan to protect aquatic life.

- The effluent shall not contain substances that cause increases in BOD that adversely affect beneficial uses.

- The effluent shall not contain substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.

- The effluent shall not degrade surface water communities and populations, including vertebrate, invertebrate, and plant species.

The plant upgrade will ensure compliance with the Regional Board's order and the water quality objectives in the Basin Plan. As such, the designated beneficial uses in the Ventura River and Ventura River Estuary will be protected. These beneficial uses include (among others): contact and non-contact recreation; warm freshwater habitat; cold freshwater habitat; wildlife habitat; rare, threatened and endangered species; migration of aquatic organisms, spawning, reproduction, and early development of wetland habitat.

The tertiary treatment at the upgraded plant will result in decreased nutrient levels, BOD (which will result in higher dissolved oxygen levels), ammonium levels, and turbidity. Prior to the upgrade, excessive aquatic plant growth in the river downstream of the plant degraded habitat for native fish. The upgraded plant decreases BOD downstream from the plant and reduces nutrient levels in the effluent that stimulate plant growth. As a consequence, the downstream dissolved oxygen levels will more closely resemble natural conditions, and the quality of aquatic habitat for native species will be improved over previous conditions.

Order No. 96-041 also included a comprehensive monthly and weekly water quality monitoring program of the effluent and the receiving waters to ensure compliance. Receiving water monitoring samples currently are being collected at seven locations that extend from upstream of the Treatment Plant on San Antonio Creek and the Ventura River, to the mouth of the river.

Recent effluent discharge to the Ventura River from the Treatment Plant averages about 2.28 mgd. This discharge is equivalent to about 2,550 AF per year or a mean daily discharge of 3.5 cfs. The discharge from the plant is compared to the average monthly streamflow at the stream gage at Foster Park below the City of Ventura's diversion facilities. These data indicate that the plant's discharge in the winter months is negligible compared to natural winter flows. However, the discharge from the plant in the summer can exceed 50% of the stream flow below the Treatment Plant (Table 5-11).

Pipelines

There are over 120 miles of collection system pipelines and five pump stations in the OVSD service area. Major trunk lines are shown on Figure 5-15. Along the Ventura River, the buried pipeline is at least 100 feet from the river. In contrast, the trunk line along San Antonio Creek is often directly adjacent to the creek.

Major creek or river crossings are shown on Figure 5-15 and listed below in Table 5-12.

Most of the pipeline system works from gravity flow. However, there are five pump stations: Santa Ana Blvd. Pump Station No. 1; Santa Ana Blvd. Pump Station No. 2; Ventura Avenue Pump Station No. 1; Ventura Avenue Pump Station No. 2; and Rancho Matilija Pump Station.

Pipelines are routinely inspected and maintained with repairs on an as-needed basis. The pipelines are 34-70 years old and will require ongoing replacement on a periodic basis. Pipeline failures and resulting spills have occurred in 1969, 1971, 1978, 1981, 1983, and 1995. They generally occurred due to erosion and bank washout from flood flows. For example, a large length of the main trunk line was washed out between Oak View and Casitas Springs during the 1969 floods. This line was relocated away from the river when it was replaced. The 1969 floods severed the pipeline crossings at the Santa Ana Blvd. and State Route 150 bridges, and at Canada Larga. These floods also caused pipeline breaks at two locations along San Antonio Creek. In the winter of 1995, a pipeline adjacent to Creek Road was washed out by flood flows in San Antonio Creek.

Repair and maintenance of the OVSD pipelines and crossings noted above would require access to the river or creek bed for equipment and personnel. Emergency outages are likely to occur during severe winter flood flows. Hence, emergency repairs would either be conducted under adverse conditions, or if access to the river or creek is not possible, temporary pipelines utilized to by-pass the damaged lines could be attached to the affected bridge to continue service until repairs in the river can be accomplished. If routine maintenance of a pipeline or crossing is required due to minor exposure of the pipeline during the winter, the work would occur in the summer when river and stream flows are minimal or absent.

The OVSD has developed a spill response plan which specifies procedures in the event of a pipeline failure resulting in spills to watercourses. The plan requires that signs be placed immediately along the affected watercourse indicating the presence of untreated wastewater. OVSD will immediately notify the Ventura County Environmental Health Division and the Regional Board of the spill, as well as the local news media.

Table 5-11. Average Monthly Streamflow and OVSD Effluent Discharge, WY 1981-1996.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean stream discharge	193	220	307	101	37	14	7.7	3.3	2.5	4.1	12	16
OVSD Discharge	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
% of total stream discharge from OVSD effluent	1.8	1.6	1.1	3.5	9.5	25.0	45.5	106	140	85.4	29.2	21.9

Total flow in river below OVSD plant reflects sum of mean discharge at Foster Park and effluent discharge.

Table 5-12. Major OVSD Wastewater Pipeline Creek Crossings.

Location	Pipeline Information
San Antonio Creek Crossings	
Ojai Avenue (SR 150)	4”, 6”, 8” triple barrel siphon
Fox Cyn. Drainage (trib. to S.A.) near Ventura St.	8” & 12” diameter, encased in concrete
Creek Road S. of Saddle Lane.	8” & 12” diameter, encased in concrete
Creek Road near Country Club Drive	8” & 12” diameter, encased in concrete
Creek Road near Camp Comfort	12” & 16” diameter, encased in concrete
Creek Road S. of Encina Dr.	12” & 16” diameter, encased in concrete
Route 33 near Old Creek Rd.	12” & 16” diameter, encased in concrete
Ventura River Crossings	
State Route 150 (Baldwin Rd.)	18” diameter, partially encased
Santa Ana Blvd.	10” diameter, encased in concrete
Canada Larga Crossing	
Ventura Ave. near Crooked Palm Rd	10 and 12 inch diameter

Treatment Plant Bank Protection

Removal of riparian vegetation that is threatening the integrity of bank protection is an OVSD maintenance activity. This maintenance activity typically occurs in the summer of the fall prior to winter storms when the excessive growth of riparian vegetation is apparent.

5.5.3 FUTURE PROJECTS

The OVSD does not anticipate a need to increase the capacity of the Treatment Plant for future demands because: (1) there is unused capacity at the current plant to accommodate future increases; and (2) the increase in wastewater flows in the future is expected to be very low due to the generally low rate of development in the Ojai Valley.

The OVSD has contemplated the possibility of a satellite water reclamation plants near Oak View and the City of Ojai in the future to supplement water supplies in the watershed when potable water supplies become more limited. These projects have only been discussed at a conceptual level and are not likely to be seriously considered for many years.

5.6 SOUTHERN CALIFORNIA WATER COMPANY

5.6.1 BACKGROUND INFORMATION

Southern California Water company (SCWC) provides municipal and industrial water to the City of Ojai. It also provides water to 135 connections in the Arbolada area outside the city limits. About 90 percent of its water production is from four wells that extract water from the Ojai Ground Water Basin, located in the approximate center of the basin. The remainder of its production is derived from purchases of water from Casitas Municipal Water District (Casitas). In 1995, SCWC produced 1,845 AF from its wells and purchased 205 AF from Casitas.

5.6.2 OPERATIONS AND MAINTENANCE

SCWC has a system of pipelines, pumps, and storage facilities throughout the City of Ojai. A major water distribution pipeline crosses San Antonio Creek at the Grand Avenue bridge in the city. This 16-inch diameter steel pipeline was installed in 1993. It is encased in concrete to prevent erosion and damage from high flows. SCWC visually inspects the condition of the pipeline during and after high flows. Absent a catastrophic failure from a major flood event, the pipeline is not expected to need replacement for decades.

Repair and maintenance of the pipeline would require access to the creek bed for equipment and personnel. Emergency outages are likely to occur during severe winter flood flows. Hence, emergency repairs would either be conducted under adverse conditions, or if access to the creek was not possible, a temporary pipeline could be attached to the bridge to continue service until repairs in the creek could be accomplished. If routine maintenance of the pipeline or crossing is required due to minor exposure of the pipeline during the winter, the work would occur in the summer when creek flows are absent.

5.6.3 FUTURE PROJECTS

Water production by SCWC is not expected to substantially increase in the near future because the rate of urban development in the City of Ojai is very low due to land use restrictions. Hence, SCWC does not anticipate the need for any major facility improvements or additions in the future.

5.7 VENTURA COUNTY FLOOD CONTROL DISTRICT

5.7.1 BACKGROUND INFORMATION

The Ventura County Flood Control District (VCFCD) has responsibility for protecting life and property from flood hazards through floodplain management activities and flood control improvements. The latter include channel clearing; construction of flood control channels and debris basins, and maintenance of such facilities. VCFCD does not construct or maintain andy flood control improvements on private property. VCFCD's activities are funded primarily by property taxes, land developement fees, and the Benefit Assessment Program. The Ventura River watershed comprises Zone I of the VCFCD. With available funds, the agency designs and constructs necessary improvements on a hazard priority basis, conducts routine maintenance on all existing facilities on an as-needed basis, and performs emergency repairs during and after the flood season.

The VCFCD was formed by the Ventura County Flood Control Act of 1944, as amended. The primary purposes of the VCFCD as indicated in the Act are to: (1) provide for the control and conservation of flood and storm waters; (2) protect watercourses, watersheds, public highways, life, and property from floods; (3) prevent waste or loss of water supply; (4) import water into the district, retain and recycle storm and flood flows, and conserve all such water for beneficial uses; and (5) provide for recreational use and beautification as part of the flood control and water conservation objectives by acquiring or constructing recreational facilities or landscaping as part of any district project. In 1981, VCFCD developed policies and best management practices to guide the routine and emergency flood control activities. These policies and practices were adopted by the Board of Supervisors as part of the County's 208 Non-source Pollution Control Plan. The policies and practices emphasize protection of environmental resources and natural riparian process while protecting life and property from floods.

Since 1994, when the Countywide Stormwater Quality permit was issued by the Los Angeles Regional Water Quality Control Board, VCFCD has taken the lead role in stormwater quality managment in Ventura County.

Table 5-13. Existing VCFCD Facilities in the Ventura River Watershed.

Facility	Map Location	Description
Lower Ventura River		
Corps of Engineers Ventura River Levee and side drains	1	15 to 20-foot high earthen levee along east side of river along Hwy 33; constructed 1948
Central and Upper Ventura River		
Fresno Drainage Channel and Outlet (Y-1-0091)	2	Concrete box culvert outlet with grouted rip-rap apron, and earthen pilot channel in river; cons. 1968
Ventura River Bank Restoration Project at Casitas Springs	3	Rock rip-rap on eastern banks, 12-15 feet high; three CMP storm drain outlets in levee; 6000 linear feet; cons. 1978; repaired in 1995 (Y-1-0507)
Ventura River Bank Restoration at Oak View (Y-1-0368)	4	Rock rip-rap on eastern banks, ~5 feet high; two lengths, totaling 1200 linear feet; cons. 1979
Ventura River Bank Restoration at Live Oak Acres (Y-1-0325)	5	Rock rip-rap on western banks, 12-15 feet high; two CMP storm drain outlets in levee; 4700 linear feet; cons. 1978; repaired in 1995 (Y-1-0552)
Riverside Dike (Y-1-0378)	6	20-foot wide earthen dike, 5 feet tall on stream terrace with drainage swell on upstream side with outlet to river in rock rip-rap levee; cons. 1979
Skyline Drain Unit 1 (Y-1-0412)	7	Rip-rap lined channel, about 5 feet deep; 4500 linear feet along Hwy. 33; empties into natural channel, about 700 feet from river; cons. 1983
Happy Valley Drain Unit 1 (Y-1-0244)	8	Open concrete box culvert under Rice Rd., emptying into sloped concrete outlet with energy dissipater in riverbed; stilling pond present; 30 foot drop off; cons. 1973
McDonald Canyon Drain (Y-1-0151)	9	Open earthen channel with rip-rap on southern banks; 60 feet wide, 6 feet deep; Rice Rd to river outlet; one dry weather crossing for private road
San Antonio Creek		
No facilities are currently maintained by VCFCD downstream of the City of Ojai.		

Figure 5-16. Existing VCFCD Facilities.

5.7.2 FACILITIES

Flood Control Facilities

VCFCD maintain various facilities in the Ventura River watershed, as listed in Table 5-13. Their locations are shown on Figure 5-16. Only facilities that occur on the mainstem of the Ventura River, Matilija Creek, North Fork Matilija Creek, or San Antonio Creek, or in close proximity to these watercourses are listed below.

In addition to the above facilities, the VCFCD maintains various other flood control channels, drain outlets, and debris basins in urbanized areas (e.g., in and near the City of Ojai), and industrialized areas (e.g., Ventura Avenue area) that are not in proximity to the mainstem of the Ventura River or San Antonio Creek. Major debris basins include Stewart Debris Basin, Dent Drain Debris Basin, upper San Antonio Creek Debris Basin (west of McAndrew Road), and the Gridley Canyon Debris Basins.

Maintenance Activities for Flood Control Facilities

Maintenance of existing facilities include the following activities:

1. Removal of large riparian vegetation that is threatening the integrity of bank protection such as excessively large trees growing at the base of rip-rap or amongst the rocks. This maintenance activity typically occurs in the summer of fall prior to winter storms when the excessive growth of riparian vegetation is apparent.

2. As-needed repairs of concrete storm drain outlets. Normally these activities occur in the summer when flows are absent.

3. As-needed sediment removal at Santa Ana Road Bridge to remove excessive sediments that reduce the design capacity of the channel below the bridge. This maintenance or repair activity typically occurs during the summer and fall as preventative action prior to the following winters.

4. Maintain or repair of bank protection damaged by storm flows. This maintenance activity may occur during the winter under emergency conditions, or the summer and fall for restoration to pre-existing conditions.

5. Rehabilitation and upgrading existing bank protection to provide the level of protection required by current standards. This activity would occur in the summer or fall when flows are absent.

Matilija Dam

VCFCD owns and maintains Matilija Dam, while Casitas operates the dam outlet works to maximize diversions at the Robles Diversion Dam under an agreement with VCFCD executed in 1954 and amended in 1958. The agreement ends in 2004. Casitas has responsibility for maintaining the outlet works, conduit, and associated water conveyance facilities at the dam.

VCFCD keeps records of the structural integrity and movement of Matilija Dam. It conducts motion surveys the dam on an annual basis surveying known points on the face of the dam from fix locations downstream. Motion detectors have also been placed on the dam. VCFCD also coordinates with the State Division of Dam Safety on all matters related to the dam.

Trespassers at the dam and Lake Matilija are frequent in the summer. VCFCD maintains the fences and gates around the dam; there are no fences around the lake. The Sheriff's Department conducts regular security patrols at and near the dam to exclude trespassers. Trails and access points to Lake Matilija are periodically checked by the Sheriff's Department to remove trespassers.

5.7.3 FUTURE FLOOD CONTROL PROJECTS

The following proposed projects have been identified in the Ventura River watershed and could occur in the next 1 to 5 years, depending upon funding. Only projects that would occur on the mainstem of the Ventura River, Matilija Creek, North Fork Matilija Creek, or San Antonio Creek, or in close proximity to these watercourses are listed below.

- *Santa Ana Bridge Pier Extension Project.* Extension of two bridge piers (upstream and downstream) to reduce downstream erosion. Enhancement of existing finger dike of river run material on eastern bank downstream of bridge. Removal of excess river run material to upland location. Placement of river run rock to protect portion of western bank downstream of the bridge; Placement of river run material on portion of eastern bank upstream of bridge to further protect existing rip-rap slope. The project is planned for 1998, and is an element of the following project. (Project No. 81052).

- *Ventura River Levee Bank Protection Modification.* Raise existing levee on the west bank of the Ventura River from Santa Ana Boulevard upstream about one mile (Project No. 81052).

- *Ventura River Levee Bank Modification at Casitas Springs.* Raise the existing levee by 4 to 6 feet to provide 100-year flood protection to the community of Casitas Springs. (Project No. 81041).

- *Live Oak Creek Diversion Project.* Construct an earthen dam on Live Oak Creek for detention (29 AF) and 1,300-foot long concrete box conduit from the dam to an earthen channel, then to the Ventura River where a rock rip-rap outlet will be installed. (Project No. 81211).

- *Thacher Creek Unit I.* Various channel improvements to an existing concrete channel in eastern Ojai Valley. (Project No. 81441).

- *San Antonio Debris Basin Modification.* Install an approximately 70 foot pipe through the spillway to allow lower storm flows to pass through the basin.

5.8 VENTURA COUNTY PUBLIC WORKS AGENCY - TRANSPORTATION DEPARTMENT

5.8.1 BACKGROUND INFORMATION

The County of Ventura, Public Works Agency, Transportation Department has responsibility for maintaining County roads, bridges, and drainage facilities (i.e., side drains and culverts) associated with roads. Routine maintenance of these County-owned facilities is performed on an as-needed basis. Often, it involves emergency repairs due to damage from erosion or flooding during the winter. Other maintenance activities are conducted as roads and drainage facilities become worn or in need of repair. Resurfacing of roads occurs as the need arises due to roadway use. All but the emergency repairs are conducted in the spring, summer, and fall in order to avoid wet weather conditions.

5.8.2 FACILITIES

Inventory of Facilities

The Transportation Department maintains nine dry weather crossings (Table 5-14) and the 44 bridges (Table 5-15) in the Ventura River watershed. Their locations are shown on Figure 5-17.

The Transportation Department maintains the following major culverts in the Ventura River watershed. These culverts consist of either corrugated metal pipe or small concrete box culverts underlying roadways. Only the major culverts are listed in Table 5-16. Other smaller or older ones may be present, but are too numerous to list in this plan.

5.8.3 MAINTENANCE ACTIVITIES

Specific maintenance activities that occur along County roadways in the Ventura River watershed are listed below:

1. Clearing of dry weather crossings by removing brush, rock, sediments, or other debris from the crossing when such debris is an impediment to essential traffic or otherwise presenting a hazard to life or property. This maintenance activity would most likely occur in the winter or early spring after flood flows have deposited debris and sediments.

Table 5-14. Dry Weather Crossings Maintained by the County.

Creek or River	Map Location (see Fig. 5-17)	Specific Location
San Antonio Creek	1	Fraser Street
San Antonio Creek	2	Old Creek Road
Coyote Creek	3	Camp Chaffee Road
Thacher Creek	4	Grand Avenue
Thacher Creek	5	McNell Road
Rattlesnake Creek	6	Matilija Road, 0.8 mi. west of SR 33
Tributary to Matilija Creek	7	Matilija Road, 3.3 mi. west of SR 33
Tributary to Matilija Creek	8	Matilija Road, 4.2 mi. west of SR 33
Ventura River	9	Camino Cielo (also known as Bridge No. 320) - this bridge may be overtopped and still be passable; hence, it functions also as a "splash crossing."

Table 5-15. Bridges Maintained by the County in the Ventura River Watershed.

Watercourse	Map Location (see Fig. 5-17)	Roadway	Type of Bridge	Channel Conditions	Vegetation Conditions
Crossings in Rural or Natural Areas, and near the Ventura River or its Primary Tributaries					
Canada Larga Creek	300	Canada Larga Rd.	C	L, E	AQ
Canada Larga Creek	301	Canada Larga Rd.	S	N	RW, AQ
Canada De Alisos Creek	302	Canada Larga Rd.	S	N	RW, AQ
Coche Canyon Creek	303	Canada Larga Rd.	S	N	RS
Canada Larga Creek	304	Canada Larga Rd.	S	N	RS
Hammonds Creek	305	Canada Larga Rd.	S	N	RS
Coyote Creek	375	Santa Ana Rd.	S	N, E	RW, AQ
Coyote Creek	307	Casitas Vista Rd.	S	N	RS, AQ
Coyote Creek	308	Casitas Vista Rd.	S	N	W
Fresno Canyon	376	Edison Rd.	C	L	none
San Antonio Creek	314	Creek Rd.	S	N, E	RW, AQ
San Antonio Creek	315	Creek Rd.	S	N, E	RW, AQ
San Antonio Creek	316	Creek Rd.	S	E, G	RW, AQ
San Antonio Creek	365	Grand Ave.	S	N, E, G	
Thacher Creek	335	Boardman Rd.	C	B	none
Thacher Creek	333	Ave. de la Verda	C	B	none
Thacher Creek	334	Ave. del Recreo	C	B	none
Thacher Creek	330	Carne Rd.	S	N	W
Thacher Creek	329	McAndrew Rd.	C	B, E	W
Reeves Creek	399	McAndrew Rd.	C	B, E, G	RS
McNell Creek	331	Thacher Rd.	C	N	W
McNell Creek	364	McNeil Rd.	C	N	W
McNell Creek	347	Carne Rd.	C	N	W
McNell Creek	356	Gorham Rd.	C	N	W
North Fork Matilija Creek	319	Matilija Rd. South	S	N	RW, AQ
Cozy Dell Drain	317	Meyer Rd.	C	N	W
Ventura River	394	Santa Ana Blvd.	S	N, E	W, AQ, RS

Table 5-15. Bridges Maintained by the County in the Ventura River Watershed (concluded).

Watercourse	Map Location (see Fig. 5-17)	Roadway	Type of Bridge	Channel Conditions	Vegetation Conditions
Concrete Box Culverts or Span Bridges in Urbanized Areas					
Happy Valley Drain (South)	369	Old Baldwin Rd.			
Happy Valley Drain (South)	361	La Luna Rd.			
Happy Valley Drain (South)	313	Rice Rd.			
Happy Valley Drain	372	Pueblo St.			
Happy Valley Drain	374	Padre Juan Ave			
Happy Valley Drain	370	Lomita Ave.			
Live Oak Creek	398	Santa Ana Blvd.			
Live Oak Creek	367	Chaparral Rd.			
Live Oak Creek	312	Burnham Rd.			
McDonald Canyon (South)	362	La Luna Ave			
McDonald Canyon (South)	363	Fernando Dr.			
McDonald Canyon (South)	338	El Roblar Dr.			
Mira Monte Drain	368	Cruzero St.			
Mira Monte Drain	321	Tico Dr.			
Oakview Drain	373	Old Ventura Ave.			
Santa Ana Creek	311	Santa Ana Rd.			
Skyline Drain	384	Catalina Drive			
19 watercourses		44 bridges			

Bridges are mostly small box culverts with lined channel banks and little or no natural riparian vegetation.

KEY:

- Type of bridge: C=box culvert; S=span bridge with or without piers.
- Channel conditions: L=fully lined open concrete channel upstream or downstream; N= natural bed and banks upstream or downstream; B=upstream or downstream channels lined on banks only; G=downstream grade control structure; E=concrete or rip-rap embankment protection.
- Type of habitat near bridge: RW=riparian woodland near bridge; RS=riparian scrub near bridge; W=wash, mostly devoid of riparian vegetation; AQ=aquatic habitat, at least seasonally.

Figure 5-17. Major Dry Weather Crossings and Bridges.

Table 5-16. Major culverts maintained by the County.

Road	Culverts
Burnham Rd.	7
Calle Vista Del Monte	1
Camille Dr.	1
Camp Chaffee Rd.	3
Catalina Dr.	1
Casitas Vista Rd.	16
Creek Rd.	29
Crooked Palm Rd.	7
Cruzero St.	1
Canada Larga Rd.	18
Edison Rd.	1
El Roblar Dr.	1
El Toro Rd.	1
Encino Dr.	4
Old Baldwin Rd.	1
Rice Rd.	7
Santa Ana Blvd.	5
Santa Ana Rd.	39
Shell Rd.	2
Verano Dr.	1
Ventura Ave,	21
Villanova Rd.	3
22 Roads	**170 roadway crossings**

2. Periodically resurfacing or repairing asphalt surfaces of dry weather crossings, including pot-hole repairs. Normally these activities occur in the summer when flows are absent. However, emergency conditions often require this action in the winter.

3. Clearing or repair of roadside drains and culverts under roads when they are clogged or damaged such that they cannot perform their normal function and are in danger of further damaging the roadway, thereby affecting the free flow of essential traffic or otherwise creating a hazard to life or property. This maintenance or repair activity could occur during the winter when sedimentation or erosion have clogged drains and culverts, or in the summer and fall as preventative action prior to the following winter at those drains and culverts that have restricted capacity.

4. Repair of bridges when they are damaged such that they cannot perform their normal function and are in danger of further damaging the roadway, thereby affecting the free flow of essential traffic or otherwise creating a hazard. This maintenance or repair activity could occur during the winter under emergency conditions, or in the summer and fall as preventative action for the following winter at those bridges that have suffered damage. Clearing of debris under a bridge that would reduce the channel capacity and possibly result in flooding and damage to a bridge.

5. Maintaining road shoulders and repairing embankments due to heavy erosion or washouts when such erosion or washout damage would clearly, or has a strong potential to, damage the roadway, thereby affecting the free flow of essential traffic or otherwise creating a hazard to life or property. This maintenance or repair activity could occur during the winter under emergency conditions, or in the summer and fall as preventative action for the following winter along those roadways that have suffered damage.

6. Emergency restoration and repair of other roadway structures and facilities such as cutoff walls, retaining walls, and rip-rap bank protection along the sides of roads when erosion or washout damage would clearly, or has a strong potential to, damage the roadway, thereby affecting the free flow of essential traffic or otherwise creating a hazard to life or property. This maintenance or repair activity could occur during the winter under emergency conditions, or in the summer and fall as preventative action for the following winter along those roadways that have suffered damage.

7. Resurfacing of roadways due to normal wear from traffic. This activity occurs in the summer when temperatures are suitable for resurfacing. Roadways in the Ventura River watershed that may be resurfaced in the near future include: Casitas Vista Road, Canada Larga Road, Creek Road, Old Creek Road, Reeves Road, Santa Ana Road, Santa Ana Boulevard, and Camino Cielo.

The most recent roadway repairs and maintenance occurred due to damage from the 1995 floods. Due to the floods, the Transportation Department made emergency repairs at two locations along Creek Road where San Antonio Creek eroded the banks and threatened the roadways, and along the western embankment of Santa Ana Boulevard Bridge where the river had impinged on the banks and washed out a lane of Santa Ana Boulevard. After the floods, the Transportation Department applied for permits for maintenance and repairs at over 23 locations in the watershed. A summary of the recent road repairs and maintenance activities in the watershed that required 404 permits from the Corps of Engineers is provided in Chapter 6.0. A large number of the recent permit actions related to the 1995 flood damage. Road and drainage facility repairs are very common along Matilija Road.

5.8.4 FUTURE PROJECTS

There are no future projects for new or improved roads and bridges in the Ventura River watershed that would occur at or near the river or its primary tributaries.

5.9 VENTURA COUNTY SOLID WASTE MANAGEMENT DEPARTMENT

The Solid Waste Management Department of the County of Ventura (SWMD) has responsibility for managing the County's solid waste facilities. In 1992, SWMD received a Notice of Violation from the County of Ventura, Resource Management Agency, Environmental Health Division acting as the Local Enforcement Agency for the California Integrated Waste Management Board. This was based on observations of exposed solid waste in the former Ojai disposal site. The site is located adjacent to the Ventura River near the State Route 150 Bridge. It was operated as a burn dump site during the 1950s and 1960s by the County of Ventura Public Works Agency. In the 1970s, it was converted to a solid waste transfer station until 1992. The exposed solid waste appears to be related to the disposal site operations of the 1950s and 1960s.

The disposal site consists of 10 acres and is owned by the County of Ventura. The use of the site for waste disposal began before 1945. Typical landfill operations in the 1940s and 1950s consisted of placement and periodic burning of refuse in trenches. As operations proceeded, a mound of solid waste accumulated within the trenches. Waste Discharge Requirements were issued for the site in 1962 for solid inert fill only. It appears the disposal operations ended about 1964. The site was graded for a transfer station in 1971.

The nature of the wastes at the site is poorly documented. However, it is inferred from historic practices and available records that most of the wastes consist of ash, metals, construction debris, some asbestos, farm and ranch trash, and other materials deemed nonflammable and nonvolatile waste after burning. During the 1960s, a characteristic of most burn dump waste is that most of the decomposable material and residues of flammables, insecticides, and herbicides are eliminated by burning, and that the remaining waste does not exhibit significant settlement or generation of landfill gases. The volume of waste is also poorly documented, but is likely to be less than 75,000 cubic yards.

The site is situated about 10 to 15 feet above the Ventura River and normally surface drains to the river. The site is located in the floodplain of the Ventura River, and as such, is vulnerable to washout or bank erosion. An earthen berm of riverbed material about 15 feet high was constructed around the perimeter of the site to protect it from bank erosion. A portion of the berm was partially eroded during the 1992 high river flows. Erosion of the berm apparently exposed the solid waste material behind the berm.

A conceptual design was prepared by Fugro West (1992) to provide erosion control along portions of the berm where the 1992 erosion occurred. The plan involved replacing 300 feet of the berm where erosion was most severe, and protecting it with a gabion wall. The plan had not been implemented when the high flows in January 1995 exacerbated the condition, causing significant additional erosion of the berm around the site. As an emergency corrective action, the County placed rip-rap along about 200 feet of the berm in 1995.

At this time, SWMD is seeking permits to place rip-rap bank protection along the remainder of the berm that occurs in the riverbed which was also significantly damaged during the 1995 floodwaters. This encompasses about 700 linear feet. The project would require access to the riverbed to reshape the berm and bury the toe of the rip-rap, if used, to contain currently exposed dump materials. The proposed bank protection would represent a permanent erosion control measure. No ongoing maintenance of the rip-rap would be anticipated after its installation.

5.10 VENTURA RIVER COUNTY WATER DISTRICT

5.10.1 BACKGROUND INFORMATION

The Ventura River County Water District (Ventura River CWD) is an independent special district formed in 1956. The Ventura River CWD provides water to residential, commercial, and agricultural customers. It has about 2,100 service connections. The service area encompasses about 2,220 acres, and includes the Live Oak Acres and most of the neighborhoods between Oak View and Mira Monte on both sides of the Ventura River (Figure 5-18). The Ventura River CWD's offices and maintenance buildings are located on Old Baldwin Road, east of the State Route 150 bridge.

5.10.2 WATER SUPPLY AND FACILITIES

The Ventura River CWD has wells that produce from the Upper Ventura River Ground Water Basin, which extends along the Ventura River Valley from Foster Park to Matilija Dam, and is bordered on the east by the Ojai Basin (see Figure 5-13). The Upper Ventura River Basin is comprised of alluvium about 60 feet deep (Slade 1991).

Figure 5-18. Ventura River CWD Service Area.

The Ventura River CWD produces water from three active wells. Well Nos. 1 and 2 are located near the offices of the Ventura River CWD, while Well No. 5 is located about one mile to the east. Water from the wells is chlorinated at the well head, then distributed directly to customers through a system of pipelines and storage facilities in the service area. Information about the producing wells is summarized in Table 5-17.

The Ventura River CWD produces about 1,200 AF per year. At this time, the entire production is from wells. In the past, the Ventura River CWD purchased a portion of its water from Casitas Municipal Water District (Casitas). Since the installation of Well No. 5 in 1993, the Ventura River CWD anticipates that it can meet current and future demands from its wells, except in drought years. The Ventura River CWD purchases water from Casitas during emergencies and drought conditions. Casitas water is purchased for 200 connections on a continuing basis.

The Ventura River CWD has a 5-year agreement with the City of Ventura that will expire in may 1999, specifying that the Ventura River CWD will not extract more than 1,800 AF in any 12 month period. This agreement is likely to be renewed upon its expiration.

The Ventura River CWD anticipates only a minor increase in demands in the future because its service area is mostly built out with residential land uses. The Ventura County Honor Farm, located within the service area, has relied on the Ventura River CWD since October 1990 due to declining water quality in their well. The Honor Farm continues to use its well for pasture and farm water use. The expected demand from the Honor Farm is about 150 AF per year for domestic uses. Farm demands are estimated at about 200 AF per year.

5.10.3 Operations and Maintenance

Well operations are automated. Pumping is highest in the summer and fall months, as shown in Table 5-18 which displays monthly deliveries during 1991-1996.

A summary of the annual water deliveries by the Ventura River CWD is presented in Table 5-19.

Periodic well maintenance is required; however, the wells are located outside the Ventura River and do not require access from the river.

A water pipeline traverses the Ventura River immediately downstream of the State Route 150 bridge. This steel pipeline was installed in 1969. The depth to the pipeline varies depending upon river scouring and deposition. The pipeline was installed 15 feet below the surface. It is encased in concrete. The pipeline provides water to customers on the west side of the river, and provides emergency deliveries from Casitas to the west side of the river. The Ventura River CWD has no record of any repair requirements after the installation.

Table 5-17. Ventura River CWD Producing Wells.

Well No.	State No.	Depth of Well (feet)	Maximum Production (gpm)
1	4N/23W-16C8	242	1,200
2	4N/23W-16C7	230	1,200
5	4N/23W-158	558	150

Table 5-18. Ventura River CWD Monthly Water Deliveries 1991-1996.

Year	Monthly Water Deliveries (AF)												Total
	J	F	M	A	M	J	J	A	S	O	N	D	
1991	54.1	69.6	45.8	58.5	97.8	96.9	110.8	112.5	105.5	100.9	80.3	69.9	1024.8
1992	52.3	47.0	47.1	76.7	95.5	118.4	122.1	150.4	121.9	101.0	76.2	55.6	1064.1
1993	47.8	42.7	55.9	53.4	117.8	116.8	127/2	134.5	116.2	16.2	86.2	64.9	1125.6
1994	80.5	49.7	47.9	82.4	96.2	140.6	143.5	156.8	126.1	98.4	85.3	65.0	1172.4
1995	129.3	70.2	102.2	83.5	92.4	115.0	156.1	175.1	167.8	114.2	80.8	86.0	1372.4
1996	83.4	55.8	62.4	101.0	109.2	136.4	178.5	171.1	155.0	136.8	65.3	54.8	1309.5
Avg %	6.5%	4.7%	5.1%	7.0%	8.8%	10.3%	11.9%	12.7%	11.5%	9.4%	6.7%	5.6%	100%

Table 5-19. Ventura River CWD Annual Water Deliveries 1989-1996.

Water Year	Diversions (AF)
1989	1,633
1990	1,417
1991	1,200
1992	1,110
1993	1,207
1994	1,330
1995	1,377
1996	1,366

Repair and maintenance of the pipeline requires access to the riverbed for equipment and personnel. Emergency outages could occur during severe winter flood flows. Hence, emergency repairs would either be conducted under adverse conditions, or if access to the river was not possible, a temporary pipeline could be placed on the State Route 150 bridge to continue service until repairs in the river can be accomplished. If routine maintenance of the pipeline or crossing is required due to minor exposure of the pipeline during the winter, the work would occur in the summer when river flows are minimal or absent.

In the event of a significant pipeline failure at this crossing, the Ventura River CWD anticipates installing a permanent pipeline on the State Route 150 bridge.

5.10.4 FUTURE PROJECTS

Ventura River CWD does not anticipate any major improvements or additions to its water production or distribution systems in the next 5 to 10 years.

A variety of other activities occur along the Ventura River and its tributaries by other agencies, commercial and industrial interests, and private parties. Some of these activities could potentially affect steelhead and their habitat in the watershed. A brief summary of these activities is provided below.

6.1 LOS PADRES NATIONAL FOREST

As shown on Figure 6-1, the northern half of Ventura River watershed is contained within the Los Padres National Forest (Forest), Ojai District. The Forest is managed for many purposes. The Los Padres National Forest Land and Resource Management Plan (Forest Plan) contains both forest-wide guidelines, as well as specific “management areas” which have a set of compatible management goals and practices. In general, the Forest in the Ventura River watershed contains the following management objectives: recreation, visual resources, wilderness preservation, watershed, and biological resources. The watershed of upper Matilija Creek is within the Matilija Wilderness where access is only allowed by foot along established trails. In contrast, most of the remainder of the Forest in the watershed is designated as semi-primitive motorized or roaded natural areas.

There are six management areas in the Forest in the upper Ventura River watershed, as shown on Figure 6-1. The primary management prescriptions for each area are summarized below from the Forest Plan:

- *Area 39* - Land above Lake Casitas that consists primarily of chaparral covered hills. The headwaters of Coyote and Santa Ana Creeks occur in this area. The management emphasis is on watershed management. Prescribed burning is to be used to maintain a mixed vegetation age class to protect soil and water resources from wildfire, erosion, and flooding. Fuelbreak systems are maintained. Other activities in the area must be consistent with watershed emphasis. Existing trails are to be maintained to meet public demand; trail construction is not emphasized. General forest camping is allowed. Existing fish and wildlife habitat is to be managed to increase diversity and habitat capability. Prescribed burning is to be implemented on 30-year rotation on slopes less than 60 percent. Grazing is allowed.

- *Area 37c* - Land above Ojai Valley, consisting mostly of chaparral covered hills. The headwaters of San Antonio Creek occur in this area such as Senior, Thacher, and Gridley Creeks. Many private landholdings are present. The management emphasis is on maintaining the rugged natural character of the landscape, and improving visual resources by rehabilitation of visual intrusions. Other resources

Figure 6-1. Management Areas in the National Forest.

are to be managed consistent with this emphasis. Recreational management activities include providing access from State Route 33, providing vistas and turnouts for viewing opportunities, developing trails, and allowing general forest camping. Existing fish and wildlife habitat is to be managed to increase diversity and habitat capability. Prescribed burning is to be implemented on 30-year rotation on slopes less than 60 percent. Grazing is allowed.

- *Area 63b.* Lands between Wheeler Springs and Rose Valley, including the upper portions of the North Fork of Matilija Creek. These lands are mountainous with chaparral and coniferous woodlands. The management emphasis is recreation and visual resources. Recreation is to be provided to the public for moderate to high density uses at developed campsites and trails. Additional trails and campsites may be developed to meet public demand. Landscapes are to be maintained at natural appearing levels, and rehabilitated when possible. Existing fish and wildlife habitat is to be managed to increase diversity and habitat capability. Prescribed burning is to be implemented on 30-year rotation on slopes less than 60 percent. Grazing is allowed.

- *Area 67.* Dry Lakes Ridge Botanical Area on the ridge separating the Ventura River and Sespe watersheds. The management emphasis is to preserve unique botanical resources for public and scientific uses. Recreation is to be day use opportunities only. Other resource activities are not encouraged. Grazing is not allowed.

- *Area 64.* This area is the Matilija Wilderness (Further Planning Area) which encompasses the Upper Matilija Creek, Upper North Fork of the Matilija Creek, and Murietta Creek. The management emphasis is wilderness preservation. All activities must be compatible with wilderness standards. Recreational uses are to include trails and forest camping with visitor entry and use restrictions. The visual character of the area is to be maintained. Habitat is to be managed to maintain viable populations of native fish and wildlife, including anadromous fish. Grazing is only allowed in areas with prior established grazing allotments. Prescribed burning is not emphasized.

- *Area 28.* This area includes Matilija Reservoir and the creek upstream of the reservoir. It is mostly mountainous terrain with chaparral, oak woodlands, and coniferous woodland. The management emphasis is non-motorized general forest recreation, water yield enhancement, and wildlife. Recreation is to include extended trip and day use hiking and equestrian use and general forest camping. Wildlife habitat is to be enhanced. The visual character of the area is to be maintained. Prescribed burning is to be implemented on 30-year rotation on slopes less than 60 percent. Grazing is allowed. The watershed should be improved, including water yield improvement through vegetation manipulation.

Recreational facilities in the Forest in the Ventura River watershed include the following campgrounds: Matilija, Murietta, Middle Matilija, Valleyview, Gridley, The Pines, Holiday Grove, and Wheeler Gorge. Their locations are shown on Figure 6-2. Holiday Grove and Wheeler Gorge Campgrounds are located along the North Fork of Matilija Creek. These campgrounds are very popular. Many camp sites are located adjacent to the creek, which is heavily used for hiking, fishing, and playing. In addition, there are several bridges and dry weather crossings.

Numerous trails occur in the Forest and are used for hiking, mountain biking, and horseback riding. Fire breaks and services roads are also used for the same purposes, as well as by off-road vehicles and motorcycles.

There are significant private land inholdings along the southern boundary of the Forest, and particularly along Matilija Creek, where there are many residences adjacent to the creek. These residences include domestic pets, small vegetable gardens, horses, and small livestock.

Almost the entire Forest in the Ventura River watershed was burned in the 1985 Wheeler Fire. Hence, the vegetation age class in the watershed is very young, and risks of another catastrophic fire are low. Erosion in the watershed has slowly decreased since the fire to pre-fire conditions.

The Forest Service is preparing a watershed management plan for federal lands in the Ventura River watershed. The plan will include various land management options to protect and enhance natural resources, including the steelhead. The preparation of the plan will require several years. In the meantime, the Forest Service is planning several projects to identify steelhead habitat improvement needs, implementing habitat improvements on a small scale, and seeking partnerships with local agencies and organizations (such as the agencies sponsoring this Plan) to address steelhead habitat improvement in the Forest.

The watershed plan being developed by the Forest Service, entitled the Ventura Watershed Analysis, is based on a steelhead management emphasis. In the upcoming analyses, measures will be identified to improve habitat in the forest which will likely require coordination and partnering with local agencies and cooperative funding. The Forest Service has strongly indicated their desire to work with the sponsoring agencies of this Plan to implement habitat improvement projects, coordinate planning efforts, and seek funding from outside sources together.

The Ojai District of the Forest is also developing a Fire Management Plan for the Ojai Front Country, which encompasses the Ventura River watershed. The Fire Management Plan will designate areas suitable for prescribed burning. There is an existing prescribed burning program in the watershed for public safety purposes, managed jointly by the Forest Service and Ventura County Fire Protection District. The Fire Management Plan will be designed to create varying aged vegetation stands to prevent another catastrophic fire like the 1985 Wheeler Fire. Another objective will be to conduct prescribed burning

Figure 6-2. Recreational Facilities.

in areas that will increase water yield to nearby streams for steelhead winter migration or summer rearing.

In 1998, the Ojai District will also be expanding the current noxious weed program from the Sespe watershed to the Ventura River watershed. The Forest Service seeks to remove *Arundo donax* and other non-native vegetation from the river and its tributaries because it displaces native vegetation and reduces streamflow by high evapotransporation. The Forest Service believes that a watershed-wide approach to weed eradication supported by all agencies in the watershed should be implemented, and that the program should be pro-active and aggressive, not based on opportunistic weed removal during other project activities along the river.

6.2 DEPARTMENT OF FISH AND GAME

The California Department of Fish and Game (CDFG), as discussed in Chapter 3, currently stocks rainbow trout in the Ventura River watershed. Stocking generally occurs in Lake Casitas, in Matilija Creek upstream of Matilija Dam, and in North Fork Matilija Creek. Most of the stocking consists of catchable-size trout, which supports a popular sport fishery. In addition, when excess juveniles are reared at the hatchery, juvenile fish are stocked in the watershed. The amount of stocking varies from year to year. These stockings will be prohibited if steelhead are provided access to these upstream tributaries in the future.

6.3 DEPARTMENT OF PARKS AND RECREATION

The California Department of Parks and Recreation (State Parks) owns and manages the 115-acre Emma Wood State Beach, located at the mouth of the Ventura River (see Figure 6-2). The western portion along the beach is used for family camping, while the eastern portion adjacent to the Ventura River Estuary is used for group camping. Portions of the park near the river and lagoon are also used by the homeless and feral animals.

State Parks and the City of Ventura prepared a Ventura River Estuary Enhancement Plan in 1994 to enhance natural resources and public access around the estuary, including Emma Wood State Beach and the City’s Seaside Wilderness Park. The primary purpose of the plan is to preserve and expand existing habitat vales at the estuary by improving water quality, eliminating non-native species, installing native plants, and promoting natural physical process that sustain native biological communities. A secondary purpose of the plan is to provide public access opportunities by developing trails and interpretive facilities with associated programs.

Plan includes three phases of implementation and numerous actions. To date, a significant weed removal and riparian restoration program has been implemented west of the lagoon at the State Beach. Other phases and actions will be implemented as funding allows.

6.4 OTHER RECREATIONAL FACILITIES

As noted above, Seaside Wilderness Park, which is owned and managed by the City of Ventura, occurs at the mouth of the Ventura River. The only improvement at the park is the multi-purpose Omer Rains Trail on the east side of the river. This trail was built by the California Department of Parks and Recreation. It is 3.5 miles long and begins at San Pedro Street in Ventura. From that point it runs along the beach by the County Fairgrounds and through Seaside Wilderness Park, across the Main Street Bridge, and into Emma Wood State Beach. It provides access for pedestrians and bicyclists only. Portions of Seaside Wilderness Park near the river and lagoon are used by the homeless and feral animals.

The Ojai Valley Trail is operated by Ventura County. It extends 9.5 miles from Foster Park to Soule Park in Ojai (see Figure 6-2). The trail follows the abandoned Southern Pacific railroad right-of-way. It was designed to be a multi-use trail to serve bicyclists, equestrians, and pedestrians. It consists of a 10-foot wide wood chip equestrian path, separated by a 4-foot high wood rail fence. The trail is very popular. It is estimated that over 300,000 people use the trail annually. The trail is situated nearest the Ventura River between Foster Park and Oak View; in this reach, the trail occurs on the banks above the river. It traverses San Antonio Creek via a splash crossing structure downstream of the Route 33 bridge.

The City of Ventura has recently proposed the Ventura River Trail, a multi-purpose trail that would extend from Foster Park to the beach. The City is currently evaluating alternative routes, particularly at the southern terminus where the trail will connect with the Omer Rains Trail. The currently adopted trail would follow the Southern Pacific abandoned railroad right-of-way from Foster Park, south to the Crooked Palm Road underpass at Highway 33 (see Figure 6-2). This reach of the trail would be designed to accommodate pedestrians, bicyclists, and equestrians. The trail would be situated near the river for about a mile, but would not provide access to the riverbed. This portion of the trail is expected to be constructed in 1998.

The equestrian trail would end at the Crooked Palm Road underpass at Highway 33, while the pedestrian and bicycle trail would continue along the railroad right-of-way through the commercial and industrial land uses along Ventura Avenue. Several options for connecting the trail to the beach are being considered, but none have been selected to date.

Other parks in the watershed near the Ventura River and its tributaries (excluding Lake Casitas Recreation Area) are shown on Figure 6-2 and listed below:

- Foster Park - This park is owned and managed by Ventura County. It occurs adjacent to the Ventura River and includes picnicking areas, camping, and sports. Visitors to Foster Park often play in the river during the summer.

- Camp Comfort - This park is also owned and managed by Ventura County for group day use and special camps. It is located along San Antonio Creek and provides ready access to the creek for water activities.

- Ojai Valley Country Club - This is a privately owned and managed golf course and country club that occurs in the western portion of Ojai. The southern boundary of the club includes a portion of San Antonio Creek.

- Soule Park and Golf Course - These facilities are owned and managed by Ventura County. The park is used for daytime activities, such as picnicking and special events. San Antonio Creek traverses the golf course, while Thacher Creek traverses the park. The creek within the golf course is mostly kept cleared of vegetation to allow golfing. There is wood and concrete bridge across the creek that was repaired after the 1995 floods due to damage to the embankments.

- Ventura Beach Resort (RV Park) - This privately owned facility is located on the west side of the river in the floodplain between Main Street and Highway 101. The park has suffered several major floods due to its low-lying location in the floodplain. Park users can access the river directly.

In addition to the above facilities, there are many small commercial and residential equestrian facilities and stables in the watershed for boarding horses, equestrian training, and general equestrian recreation. Many of these stables are located along San Antonio Creek, and include pastures and corrals that traverse the creek. Some horse-related facilities, grooming areas, manure or hay stockpiles, and training areas occur in or immediately adjacent to San Antonio Creek on private property. Equestrian riders routinely use informal trails in the bed and on the banks of the Ventura River and San Antonio Creek for recreation.

6.5 URBAN LAND USES

Ojai is the most density populated and urban-like portion of the watershed. However, the City has a rural atmosphere and lifestyle. Industrial activities in Ojai are few and primarily related to agricultural support. The City attracts many out-of-town tourists due to the large number of cultural events, many small shops and art galleries, and various outdoor recreation and resort facilities. In 1979, the City implemented growth management controls that remain in place today. Future development in the City will continue to occur at a very slow rate, one of the slowest growth rates in the state, and will primarily involve infill projects rather than outward expansion and annexation.

The overall land use pattern in Ojai is well established and is not intended to substantially change over time according to the General Plan. The overall goal of the Land Use Element of the General Plan is to preserve the community’s “small town” character. In addition, the Land Use Element specifies that the large expanses of open lands surrounding the city be preserved as agricultural open space or very low intensity residential development (less than one unit per 10 acres). The Land Use Element also indicates that traditional suburban development around the perimeter of Ojai will be discouraged because they are separated from the main town and contrary to the character of Ojai.

The Land Use Element of the General Plan also states that the City will take a s stewardship role in the management of natural environments in the Ojai Valley where development may impinge on the community character of Ojai. In the review of individual projects, the City will consider natural features such as arroyos and creeks, hillsides, and viewsheds as critical elements of the design that must be preserved.

Outside of Ojai, there are many small rural residential communities, including Meiners Oaks, Oak View, Live Oak Acres, and Casitas Springs. In general, residences and commercial buildings do not encroach into the river, except along selected portions of San Antonio Creek, Coyote Creek, and Live Oak Creek. Development in these areas is under the jurisdiction of Ventura County.6.6 Other Agencies and Utilities

6.6 INDUSTRIAL LAND USES

The major industrial area along the Ventura River and its tributaries occur along the lower river where oil development occurs in the hills above the river, and industrial activities occur along Ventura Avenue, east of the river. The latter consists of various manufacturing, construction, processing, and industrial storage facilities mostly north of School Canyon Road (see Figure 6-2). South of this road is primarily a residential and commercial area. All land uses east of State Route 33, including all the industrial uses noted above, drain to the river through large storm drains under the highway and flood control levee.

A large abandoned chemical facility, PetroChem, is located adjacent to the river south of the OVSD treatment plant. The owner of the refinery, USA Petroleum Company, has proposed to sell the refinery so that the site can be remediated and used for residential development. This project is expected to be subject to a CEQA review by the City of Ventura in 1998. Other industrial facilities adjacent to the river include the OVSD wastewater treatment plant, City of Ventura's Avenue Treatment Plant (for potable water). Enviro-Lene, Ventura County Fire Station No. 24, Mills School office complex, and Ojai Rubbish.

Extensive oil development in the hills above the lower river has created a large system of well pads and access roads in relatively steep and rugged terrain. Primary access to the Cal Resources (formerly Shell) oil fields on the west side of the river is across Shell Road bridge (see Figure 6-2). There is an extensive series of oil-related paved and dirt roads in the mountains on both sides of the Ventura River floodplain. Oil development has resulted in extensive bare areas in the hills for pads, roads, and work areas.

There is an active aggregate mine, the Ojai Schmidt Rock Quarry, operating on the hillsides over the North Fork of the Matilija Creek near State Route 33 (see Figure 6-2). The mine operates under a Conditional Use Permit from Ventura County. The mine has steep barren slopes that exhibit evidence of severe erosion and sediment production that could enter the creek..

The in-channel sand mine along the lower river operated by S.P. Milling for many decades was closed in 1992. The site has been undergoing reclamation since that time, resulting in the development of dense willow woodland on the west side of the river downstream of the Shell Road bridge.

6.7 AGRICULTURAL LAND USES

Agricultural-related activities along the river and its tributaries are listed below and shown on Figure 6-3: (1) scattered orchards among industrial and residential development, east of State Route 33 along Ventura Avenue; (2) orchards on the west side of the river across from the OVSD site; (3) dryland farming and cattle grazing between Santa Ana Road and the river, on the west side of the river between Foster Park and Santa Ana Road bridge and along lower Live Oak Creek; (4) dryland farming and cattle grazing at the Farmont property west of the river, between State Route 150 and the National Forest; (5) cattle grazing in the hills south of San Antonio Creek and along Lions Creek; (6) extensive orchards in the northern and eastern portions of Ojai Valley adjacent to upper San Antonio Creek and major tributaries to San Antonio Creek, including Thacher, Reeves, McNell, Senior, Wilsie Canyon, Steward Canyon, McDonald Canyon, Gridley, and Cozy Dell creeks; (7) scattered orchards on both sides of the river on narrow terraces between Meiners Oaks and the confluence of Matilija Creek and the North Fork; and (8) orchards and row crops on the floodplain west of the river and north of Main Street.

6.8 OTHER AGENCIES AND UTILITIES

Caltrans maintains several bridges along Route 150 that cross the Ventura River, San Antonio Creek, Thacher Creek, and Lion Creek (see Figure 5-14). In addition, there are many state bridges along Highway 33 that cross the North Fork of Matilija Creek. Bridge maintenance includes road resurfacing and repair of in-channel piers and structures due to storm damage. In addition, Caltrans is responsible for maintaining the State Routes 150 and 33, which involves road repair and resurfacing, culvert maintenance and repair, and landslide control.

The Gas Company maintains a 20-inch diameter gas line that traverses the Ventura River near Casitas Springs, a 16-inch diameter pipeline that traverse the Ventura River near Main Street, and a third line that traverses the lower river about 1.5 miles upstream of Main Street. The latter crossing is armored with concrete. The crossing has been repeatedly exposed by river scour, and currently has created a 2 to 3-foot high drop-off in the channel of the river.

Figure 6-3. Agricultural Areas near the River and Its Tributaries.

6.9 MUNICIPAL STORMWATER PERMIT PROGRAM

The Ventura County Flood Control District (VCFCD) is a co-permittee along with ten other for a National Pollution Discharge Elimination System (NPDES) permit for publicly owned municipal storm drain systems in Ventura County. The co-permittees prepared a Ventura Countywide Storm Water Management Program which describes group and entity-specific activities to manage stormwater discharges in compliance with applicable NPDES regulations. VCFCD is the Principal Co-Permitee with overall responsibility for permit implementation and coordination of activities among other co-permittees. The co-permittees are responsible for adopting and enforcing stormwater pollution prevention ordinances, implementation of monitoring programs, and implementation of Best Management Practices.

In 1994, the Los Angeles Regional Water Quality Control Board (Regional Board) issued Order No. 94-082 to the co-permittees, which includes waste discharge requirements for stormwater management and urban runoff discharges. The Order includes specific prohibitions against the discharge of pollutants, limitations on the discharges that could cause adverse impacts to beneficial uses of waters or cause a nuisance, and a requirement to implement the proposed countywide stormwater management program over a 5-year period. The program contains both source and treatment control BMPs to be implemented by each co-permittee, including the City of Ojai, through education, regulation, and agency actions for residential discharges, industrial and commercial discharges, public infrastructure projects, illicit discharges, land development, and construction sites.

The Ventura County stormwater management program is a comprehensive phased program with extensive inter-agency coordination effort and annual reporting requirements. The City of Ojai is an active participant and co-permittee in the countywide program. The City plans to adopt stormwater ordinance in 1997, in accordance the countywide program. Through the full implementation of the program over the next several years, it is anticipated that pollutants from urban runoff into San Antonio Creek will be reduced to the greatest extent possible under existing law and regulation.

It should be noted stormwater discharges from unincorporated areas and from agricultural fields are not regulated under similar regulations. Control of discharges from these sources are achieved through notice of violations for discharges of pollutants that violate applicable water quality objectives, impair beneficial uses, or cause a public nuisance.

6.10 REGULATORY ACTIVITIES BY THE REGIONAL WATER QUALITY CONTROL BOARD

The Regional Water Quality Control Board (Regional Board) has various regulatory authorities in the watershed to protect water quality. For example, the Regional Board develops and implements a Water Quality Control Plan (Basin Plan) that considers regional beneficial uses of water, water quality characteristics, and water quality problems. The Basin Plan: (1) designates beneficial uses for surface and groundwater;

(2) sets numeric and narrative objectives that must be maintained to protect the designated beneficial uses and to conform to the state's antidegradation policy; and (3) describes implementation programs to protect all waters in the Region. The Basin Plan implements elements of the state's Porter-Cologne Water Quality Control Act and the federal Clean Water Act.

Beneficial uses for surface waters and groundwater in the Ventura River watershed are listed in Tables 6-1 and 6-2, respectively. These uses were presented in the most recent (February 1995) version of the Basin Plan and do not reflect the change in status of the steelhead to an endangered species.

The Regional Board has regulatory authority over point and non-point source pollutants. The former are regulated through various programs. The first program is the 401 water quality certification of 404 permits issued by the Corps. Under Section 401 of the Clean Water Act, the Regional Board must certify that discharges authorized under a nationwide or individual 404 permit meet water quality standards. Applicants seeking a 404 permit must separately apply for a water quality waiver or certification from the Regional Board. Certifications may include terms and conditions to protect beneficial uses and to meet applicable water quality objectives.

The Regional Board also regulates all wastewater discharges to surface or groundwater through the issuance of Waste Discharge Requirements (WDRs), pursuant to the National Pollutant Discharge Elimination System (NPDES). Any private party or local agency that proposes to discharge wastes to waters must acquire a WDR which will specify discharge limitations and monitoring requirements. Discharges are categorized according to their nature and quantity. Point source discharges typically include wastewater from treatment plants and industrial facilities. Agricultural irrigation return flows and runoff are not regulated. The Regional Board also issues WDRs for wastewater from landfills, surface impoundments, waste piles, mines, and confined animal feedlots. The Regional Board has delegated authority to regulate residential septic tanks to local health departments, except for multiple-dwelling units and some large non-domestic septic tank systems.

Stormwater discharges are regulated by: (1) the State Water Resources Control Board through statewide general permits for industrial activities and construction activities (for projects affecting 5 acres or more); and (2) municipal stormwater permits issued by the Regional Board, as described in Section 6.9. The former permits are issued on a statewide basis. Applicants must comply with general conditions, submit Notices of Intent to use the permits, and monitor compliance.

Table 6-1. Beneficial Uses for Surface Water in the Ventura River Watershed.

Streams	Beneficial Uses (see key below)																						
	MUN	IND	PROC	AGR	GWR	FRSH	NAV	POW	REC1	REC2	COMM	AQUA	WARM	COLD	SAL	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL	WET
Ventura River Lagoon																								
Estuary							E		E	E	E		E			E	E	E		E	E	E	E	E
Mainstem Ventura River																								
Lower river	P	E		E	E	E			E	E			E	E				E		E	E	E		E
Upper river	E	E	E	E	E	E			E	E			E	E				E		E	E	E		E
San Antonio Creek																								
Lower Creek	E	E	E	E	E				E	E			E	E				E			E	E		E
Upper Creek	E	E	E	E	E	E			E	E			E	E				E			E	E		E
Lions Creek	I	I	I	I					I	I			I	I				E						
Reeves Creek	I	I	I	I	I				I	I			I	I				E			I	I		
Others																								
Lake Casitas	E	E	E	E	P	P		P	P	E			E	E				E		E				
Lake Casitas tributaries	E			P	E				E	E			E	E				E		P	E	E		E
Coyote Ck b/l lake	P				E				P				E	E				E			E	E		E
Canada Larga	P		I	I	I	I			I	I			I	I				E		E				
Matilija Lake	E			E	E	E			E	E			E	E				E			E	E		E
Matilija Ck	P				E				E	E				E				E			E	E		E
Murrietta Ck	P				E				E	E				E				E			E	E		E
N.F. Matilija Ck	E	E	E	E	E				E	E			E	E				E		E	E	E		E

E = Existing beneficial use. P = potential beneficial use. I = Intermittent use.

Table 6-1. Beneficial Uses for Surface Water in the Ventura River Watershed (conclued).

Beneficial Uses:
MUN - Municpal and domestic supply
AGR - Agricultural supply
PROC - Industrial service supply
GWR - Groundwater recharge
FRSH - Freshwater replenishment
NAV - Navigation
POW - Hydroelectric generation
REC-1 - Water contact recreation
REC-2 - Non-contact water recreation
COMM - Commercial and sport fishing
AQUA - Aquaculture
WARm - Water freshwater habitat
COLD - Cold freshwater habitat
SAL - Inland saline water habitat
EST - Estuarine habitat
WET - Weltand habitat
MAR - Marine habitat
WILD - Wildlife habitat
BIOL - Preservation of biological habitats
RARE - Rare, threatened, or endangered species
MIGR - Migration of aquatic organisms
SPWN - Spawning, reproduction, and/or early development
SHELL - Shellfish harvesting

Table 6-2. Beneficial Uses of Groundwater in the Ventura River Watershed.

Basin	Beneficial Uses (see key in Table 6-1)				
	MUN	IND	PROC	AGR	AQUA
Upper Ojai Valley	E	E	E	E	-
Lower Ojai Valley	E	E	E	E	-
Upper Ventura River alluvial basin	E	E	E	E	-
San Antonio Ck alluvial basin	E	E	E	E	-
Lower Ventura River alluvial basin	P	E	P	E	-

E= existing. P = potential.

6.11 PERMITTING ACTIVITIES BY THE CORPS OF ENGINEERS IN WATERSHEDS

The U.S. Army Corps of Engineers (Corps) regulates the discharge of dredged or fill material into "waters of the United States" under the authority of Section 404 of the Clean Water Act. "Waters" are broadly defined to include rivers, streams, intermittent creeks, lakes, ponds, and wetlands. In the Ventura River watershed, most activities or projects that require access to the river or its tributaries, or that involve earthmoving in the river or its tributaries, require a 404 permit from the Corps. Both private parties and local government agencies must acquire permits.

There are several types of 404 permits. Nationwide permits for small activities and projects that have minimal impacts have been issued. They can be used by permittees, often without notification of the Corps. For larger projects, or projects that involve more than minimal impacts, an individual 404 permit is required. The latter requires a formal application and public review process.

The Corps is very active in the Ventura River watershed. A summary of the permit actions during a 30-month period (1995 to late 1997) is provided in Table 6-3. This table indicates a wide variety of permit actions have taken place, including issuance of permits, withdrawal of permit applications, enforcement actions for illegal fill, and pre-application consultations. Most of the permit actions have occurred along the mainstem of the Ventura River and San Antonio Creek. A wide variety of applicants have been involved, including local government agencies, Caltrans, Chevron, and other private companies. However, the most frequent permittee is Ventura County Public Works Agency, Transportation Department and Flood Control District. These agencies are continually repairing and maintaining roads, culverts, and levees near the river.

6.12 PRIVATE WELLS NEAR THE RIVER AND ITS TRIBUTARIES

There are over 300 wells that have been installed along the Ventura River and its tributaries, extracting groundwater from the Ventura River Alluvial Basin, outside of the Ojai Basin. Records of groundwater wells were examined at the Ventura County Public Works Agency, Water Resources Division. A summary of the wells recorded and mapped is provided in Table 6-4/Figure 6-4. Data are unavailable for most wells. However, based on the limited data, it appears that most of the wells are shallow (less than 200 feet), drilled for domestic use, and potentially intact. The available data do not indicate how many wells are still operating. A large number of the wells appear to have been installed during the 1986-1991 drought period. Because the vast majority of the wells are private, there is no monitoring of extractions and therefore, no estimate of annual private pumping from the alluvial basin.

The greatest concentration of wells is in the Oak View, Live Oak Acres, and western Mira Monte area where there is significant residential development. A high number of wells is also located along San Antonio Creek. The data in Table 6-4 do not include wells in the Ojai Basin.

Table 6-3. Summary of Permit Actions in the Ventura River Watershed, 1995-1997.

Name	Project Type	Last Permit Action	Date of Last Action
Projects Along the Ventura River			
City of San Buenaventura (975028500)	Avenue Treatment Plant-Foster Park Master Plan	Pre-application consultation	July 1997
County of Ventura Solid Waste Mgmt Dept. (975023800)	Ojai Landfill Bank Stabilization #2	Pre-application consultation	July 1997
Ojai Valley Sanitary District (975023700)	Ventura River Trunk Sewer Repair and Encasement	Violation confirmed: unauthorized activity letter sent	December 1996
Appel, Mary (975012000)	FOIA Request	FOIA response signed: respond to Freedom of Information Request	February 1997
Department of Transportation (975010800)	Seismic Retro- Fit of Ventura River Bridge on Route 150	No action required	October 1996
Ojai Valley Sanitary District (975009100)	Sewer Line Repair, Ojai Valley Sanitary District	No action required	July 1997
City of Ventura (975003300)	Construction of Water Diversion Berm, Foster Park Water TX Plant	Violation confirmed: unauthorized activity letter sent	November 1996
Enviro-lene (975000700)	Unauthorized Fill at Enviro-lene Company	Violation confirmed: unauthorized activity letter sent	September 1996
City of San Buenaventura (965036700)	Exploratory Activities at Foster Park	Pre-application consultation	July 1996
City of San Buenaventura (965023500)	Seismic Retrofit of Bridge Crossing Ventura River at Main Street	Nationwide permit issued	May 1996
City of San Buenaventura (965022500)	Ventura River Bike Trail	Nationwide permit issued	August 1997
Applied Environmental Technologies, Inc. & Atlas Bulk Carriers (965020200)	Ventura River Gas Tanker Spill Site Remediation	Nationwide permit issued	April 1996

Table 6-3. Summary of Permit Actions in the Ventura River Watershed, 1995-1997 (continued).

Name	Project Type	Last Permit Action	Date of Last Action
Casitas Municipal Water District (965004700)	Robles Diversion Dam Maintenance, Ventura River	Individual permit issued	February 1996
Ventura County Flood Control District (965001600)	Ventura River Levee Repair at Casitas Springs, VCFCD	Voluntary restoration accomplished	October 1997
Ventura County Flood Control District (965000800)	Ventura River Bank Restoration	Exempt from permit regulations	June 1997
Chevron (955037100)	Chevron Pipeline Protection	Withdrawn. No permit required	August 1995
Ojai Valley Sanitary District (955034600)	Ojai Valley Sanitary District Levee Repair and Channel Excavation	Individual permit issued	October 1995
Southern Pacific Transportation Company (955030600)	Southern Pacific Transportation Railroad Abandonment, Ventura River	Information requested (application request letter sent)	July 1995
Ventura County Flood Control District (955029700)	Ventura River Levee at Live Oak Acres	Withdrawn by applicant; request withdrawn	November 1996
Chevron (955027300)	Chevron Pipeline Protection	Withdrawn by applicant; request withdrawn	January 1996
Ventura County Public Works Agency, Transportation Dept. (955022400)	Bank Stabilization at Camino Cielo Road Bridge 320 at Ventura River	Nationwide permit issued	August 1995
Ventura County Public Works Agency, Transportation Dept. (955021400)	Emergency Road Repairs and Bank Stabilization	Nationwide permit issued	August 1995
Ventura County Public Works Agency, Transportation Dept. (955016600)	Emergency Flood Control Maintenance at Camino Cielo Road and Ventura River	Nationwide permit issued	August 1995
Ventura Beach RV Park (955014000)	Ventura Beach RV Park Violation Investigation	No permit required	April 1995

Table 6-3. Summary of Permit Actions in the Ventura River Watershed, 1995-1997 (continued).

Name	Project Type	Last Permit Action	Date of Last Action
Ventura County Public Works Agency, Transportation Dept. (955013500)	Bank Stabilization Santa Ana Blvd.	Nationwide permit issued	August 1995
Casitas Municipal Water District (955012700)	Maintenance of Robles Diversion Facility	Pre-application consultation complete	February 1995
Farmont Corporation (955012500)	Farmont Golf Club	Nationwide permit issued	June 1995
MCI (955008200)	MCI Directional Drill	No permit required	February 1995
Oakley, Mike, Z. (955007800)	Pipeline and Well- Head Repair	Pre-application consultation complete	January 1995
City of San Buenaventura (955005100)	Seismic Retrofit of Bridge Crossing Ventura River at Main Street	Withdrawn by applicant; request withdrawn	June 1997
California Department of Transportation (955005000)	Seismic Retrofit Bridge Piers Over the Ventura River	Nationwide permit issued	March 1995
Ventura County Flood Control District (955002400)	County of Ventura- Ojai Landfill	Nationwide permit issued	April 1995
City of Ventura (945081000)	Ventura River Estuary Enhancement Plan	No permit required	March 1995
Oakley, Mike, Z. (955007800)	Pipeline and Wellhead Repair	Pre-application consultation complete	January 1995
Projects along San Antonio Creek			
Ojai Valley Sanitary District (975023200)	San Antonio Creek/ Hermosa Road, Rip-Rap Revegetation Project	No action required	January 1997
Soule Park (975003900)	Channel Maintenance at Soule Park Golf Course	Violation confirmed: unauthorized activity letter sent	December 1996
Camp Comfort (975003800)	Camp Comfort Bank Stabilization Activities	Pre-application consultation	November 1996
Ventura County Public Works Agency, Transportation Dept. (965028100)	Unauthorized Rip- Rap Installation and Channel Clearing	Voluntary restoration accomplished	July 1996

Table 6-3. Summary of Permit Actions in the Ventura River Watershed, 1995-1997 (continued).

Name	Project Type	Last Permit Action	Date of Last Action
Ventura County Public Works Agency, Transportation Dept. (965026700)	Two Unauthorized Bank Stabilization Projects, Ventura County Public Works	Violation confirmed: unauthorized activity letter sent	June 1996
Kalish, Joel (965026600)	Unauthorized Bank Stabilization and Fill	No action required	February 1997
Ventura County Flood Control District (965025500)	San Antonio Creek- 25 Year Capacity Pilot Channel- VCFCD	Withdrawn by applicant; request withdrawn	March 1996
Ojai Valley Sanitary District (965020700)	Bank Protection- San Antonio Creek- Ojai Valley Sanitary District	Nationwide permit issued for project	March 1996
Ojai Water Conservation District (955032100)	Alteration of San Antonio Creek for Spreading Grounds	Information requested (application request letter sent)	July 1995
Ventura County Public Works Agency, Transportation Dept. (955022600)	Emergency Road Repairs and Bank Stabilization	Nationwide permit issued	August 1995
Ventura County Public Works Agency, Transportation Dept. (955021600)	Emergency Road Repairs and Bank Stabilization	Nationwide permit issued	August 1995
Ventura County Public Works Agency, Transportation Dept. (955016800)	Emergency Flood Control Maintenance at Creek Road at San Antonio Creek	Nationwide permit issued	August 1995
Ventura County Flood Control Department (955015100)	San Antonio Creek- 25 Year Capacity Pilot Channel- VCFCD	Withdrawn by applicant; request withdrawn	February 1996
Projects Along Coyote Creek			
Casitas Municipal Water District (965017600)	Utility Line Installation- Walker Treatment Plant- Coyote Creek	Nationwide permit issued	February 1996
Casitas Municipal Water District (965000700)	Casitas Dam Spillway and Coyote Creek Channel Maintenance	Nationwide permit issued	February 1996

Table 6-3. Summary of Permit Actions in the Ventura River Watershed, 1995-1997 (continued).

Name	Project Type	Last Permit Action	Date of Last Action
Ventura County Public Works Agency, Transportation Dept. (955016700)	Emergency Flood Control Maintenance at Camp Chaffee Road and Coyote Creek	Nationwide permit issued	August 1995
Projects at Other Locations			
Ventura County Flood Control District (975028900)	Live Oak Creek Dam and Channel Diversion Project	(Information requested) application request letter sent	July 1997
Holmes Enterprises, Inc. & Silver, Robert & Needham, Robert (965041600)	Bank Stabilization on Private Property in Oak View	Nationwide permit issued	May 1997
Fedele, Joe (965039600)	Debris Removal in Lion Creek	Withdrawn by applicant; request withdrawn	October 1996
Southern California Gas Company (965020400)	Pipeline Repair, Southern California Gas, Canada Larga Creek	Nationwide permit issued for Project	February 1996
Farmont Corporation (955025800)	Farmont Corporation's Inlet Pond, Ojai	Individual permit issued	July 1995
Ventura County Public Works Agency, Transportation Dept. (955022900)	Emergency Road Repair and Bank Stabilization	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955022500)	Bank Stabilization at 3 Bridges Near Over Canada Larga Drainage	Nationwide permit issued	August 1995
Ventura County Public Works Agency, Transportation Dept. (955022300)	Emergency Road Repairs and Bank Stabilization	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955022100)	Bank Stabilization at Ventura Ave Bridge 300 at Canada Larga	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955021500)	Bank Stabilization at Meyer Road Bridge 31 at Cozy Dell Canyon	Nationwide permit issued for project	August 1995

Table 6-3. Summary of Permit Actions in the Ventura River Watershed, 1995-1997 (concluded).

Name	Project Type	Last Permit Action	Date of Last Action
Ventura County Public Works Agency, Transportation Dept. (955021200)	Emergency Road Repairs and Bank Stabilization	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955021100)	Emergency Road Repairs and Bank Stabilization	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955020900)	Emergency Road Repairs and Bank Stabilization	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955020700)	Emergency Road Repairs and Bank Stabilization	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955017400)	Emergency Flood Control Maintenance at Cozy Dell Canyon and Rice Road	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955017300)	Emergency Flood Control Maintenance at Reeves Creek	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955017200)	Emergency Flood Control Maintenance at Thacher Creek and McNell Road	Nationwide permit issued for project	August 1995
Ventura County Public Works Agency, Transportation Dept. (955017100)	Emergency Flood Control Maintenance at Matilija Road	Nationwide permit issued for project	August 1995
Ojai Land Company (955012600)	Emergency Repair of Exposed Gas Pipeline	Information requested (application request letter sent)	February 1995

Table 6-4. Summary of Wells Adjacent to the Ventura River and Its Tributaries.

Area (see Figure 6-4)	No. of Wells				Type of Well			
	Active	**Inactive or Abandoned**	**Unknown**	**Total**	**Domestic or Municipal**	**Irrigation**	**Unknown**	**Total**
A. Estuary area, including Seaside and Emma Wood Parks	?	?	7	7	?	?	7	7
B. Lower river, between Main Street bridge and Foster Park	2	1	7	10	5	?	5	10
C. Foster Park area	?	1	22	23	3	?	20	23
D. Coyote Creek below the dam	?	?	6	6	1	?	5	6
E. Casitas Springs area	?	?	9	9	1	1	7	9
F. San Antonio Creek, below Soule Park	?	1	49	50	4	1	45	50
G. Santa Ana Creek watershed above Lake Casitas	?	?	18	18	10	?	8	18
H. Oak View, Live Oak Acres, and western Mira Monte	?	1	139	140	10	2	128	140
I. Mira Monte (western Ojai Valley)	?	?	25	25	4	2	19	25
J. Upper River, between Meiners Oaks and Matilija Ck.	?	?	24	24	4	2	18	24
K. N. F. Matilija Creek	?	?	12	12	10	?	2	12
L. Matilija Creek	?	?	1	1	1	0	0	1
Total=				**325**				**325**

Data from Ventura County Public Works Agency, Water Resources Division.
? = Unknown.

Figure 6-4. Location and Number of Wells near the River and Its Tributaries.

As described in Chapter 5, the sponsoring agencies operate many facilities in and near the Ventura River and its tributaries that require maintenance, repair, and replacement due to normal operations and due to unanticipated outages or failures from emergency conditions, such a floods. Some of these maintenance activities could directly or indirectly affect steelhead and its habitat in the watershed. Potential mitigation measures to avoid "take" and minimize impacts due to routine maintenance and repair are described in this chapter.

7.1 APPLICABLE MAINTENANCE ACTIVITIES

The most common maintenance activities that could directly or indirectly affect steelhead or their habitat in the watershed are listed below by agency. The stream reaches (see Chapter 3 for definition and locations of stream reaches) where the activities occur are also listed for each activity.

7.1.1 CASITAS MUNICIPAL WATER DISTRICT

- Managing vegetation growth and sediments in Coyote Creek at the base of Casitas Dam (Reach G)

- Managing vegetation and sediments in Robles Diversion Dam Basin (Reach H)

- Maintenance, repair, or replacement of Casitas Gravity Main, Live Oak Acres Main, and Santa Ana Main pipelines at their river crossings, and the Villanova Main where it crosses Thacher Creek, and Villanova Reservoir Main where it crosses San Antonio Creek (Reaches E, F, I, J, K, L, and M).

7.1.2 CITY OF VENTURA

- Cleaning algae and debris from fish screen at the Foster Park surface diversion (Reach K)

- Clearing of rocks and debris from the Foster Park surface diversion chamber (Reach K)

- Construction or repair of diversion dike at the Foster Park surface diversion (Reach K)

- Inspect and repair of water wells located near the river at Foster Park (Reach K)

7.1.3 MEINERS OAKS COUNTY WATER DISTRICT

Wells are located above and outside the riverbed. Hence, maintenance activities and access to the wells would not have any direct or indirect effect on steelhead.

7.1.4 OJAI BASIN GROUND WATER MANAGEMENT AGENCY

The Ojai Basin GMA does not own or operate any facilities.

7.1.5 OJAI VALLEY SANITARY DISTRICT

- Maintenance, repair, or replacement of various wastewater pipelines that traverse the Ventura River or San Antonio Creek, or that are located directly adjacent to the river or creek. (Reaches F, J, K, and L)

- Maintenance and repair of bank protection and removal of vegetation on the banks at the Treatment Plant (Reach M)

7.1.6 SOUTHERN CALIFORNIA WATER COMPANY

- Maintenance, repair, or replacement of a water pipeline along Grand Avenue that traverses San Antonio Creek (Reach E)

7.1.7 VENTURA COUNTY FLOOD CONTROL DISTRICT

- Removal of large riparian vegetation that is threatening the integrity of existing bank protection such as excessively large trees growing at the base of rip-rap or amongst the rocks. This maintenance activity typically occurs in the summer or fall prior to winter storms when the excessive growth of riparian vegetation is apparent. (Reaches F, I, J, K, L, and M).

- As-needed repairs of concrete storm drain outlets. Normally these activities occur in the summer when flows are absent. (Reaches I, J, K, L, and M).

- As-needed sediment removal at Santa Ana Road Bridge to remove excessive sediments that reduce the design capacity of the channel below the bridge. This maintenance or repair activity typically occurs during the summer and fall as preventative action prior to the following winter. (Reach J).

- Maintain or repair bank protection damage by storm flows. This maintenance activity may occur during the winter under emergency conditions, or in the summer and fall for restoration to pre-existing conditions. (Reaches E, F, I, J, K, L, and M).

- Rehabilitation and upgrading bank protection to provide the level of protection required by current standards. This activity would occur in summer or fall when flows are absent. (Reaches E, F, I, J, K, L, and M).

7.1.8 Ventura County Public Works Agency - Transportation

- Clearing of dry weather crossings by removing brush, rock, sediments, or other debris from the crossing when such debris is an impediment to essential traffic or otherwise presenting a hazard to life or property. This maintenance activity would most likely occur in the winter or early spring after flood flows have deposited debris and sediments. (Reaches A, B, E, F, and G).

- Periodically resurfacing or repairing asphalt surfaces of dry weather crossings, including pot-hole repairs. Normally these activities occur in the summer when flows are absent. However, emergency conditions often require this action in the winter. (Reaches A, B, E, F, and G).

- Clearing or repair of roadside drains and culverts under roads when they are clogged or damaged such that they cannot perform their normal function and are in danger of further damaging the roadway, thereby affecting the free flow of essential traffic or otherwise creating a hazard to life or property. This maintenance or repair activity could occur during the winter when sedimentation or erosion have clogged drains and culverts, or in the summer and fall as preventative action prior to the following winter at those drains and culverts that have restricted capacity. (Reaches F, G, H, L, and M).

- Repair of bridges when they are damaged such that they cannot perform their normal function and are in danger of further damaging the roadway, thereby affecting the free flow of essential traffic or otherwise creating a hazard. This maintenance or repair activity could occur during the winter under emergency conditions, or in the summer and fall as preventative action for the following winter at those bridges that have suffered damage. Clearing of debris under a bridge that would reduce the channel capacity and possibly result in flooding and damage to a bridge is also the responsibility of the County Transportation Department. (Reaches C, E, F, G, H, I, J, K, L, and M).

- Maintaining road shoulders and repairing embankments due to heavy erosion or washouts when such erosion or washout damage would clearly, or has a strong potential to, damage the roadway, thereby affecting the free flow of essential traffic or otherwise creating a hazard to life or property. This maintenance or repair activity could occur during the winter under emergency conditions, or in the summer and fall as preventative action for the following winter along those roadways that have suffered damage. (Reaches A, B, E, F, G, and H).

- Emergency restoration and repair of other roadway structures and facilities such as cutoff walls, retaining walls, and rip-rap bank protection along the sides of roads when erosion or washout damage would clearly, or has a strong potential to, damage the roadway, thereby affecting the free flow of essential traffic or otherwise creating a hazard to life or property. This maintenance or repair activity could occur during the winter under emergency conditions, or in the summer and fall as preventative action for the following winter along those roadways that have suffered damage. (Reaches A, B, E, F, and G).

- Resurfacing of roadways due to normal wear from traffic. This activity occurs in the summer when temperatures are suitable for resurfacing. Roadways in the Ventura River watershed that may be resurfaced in the near future include: Casitas Vista Road, Canada Larga Road, Creek Road, Old Creek Road, Reeves Road, Santa Ana Road, Santa Ana Boulevard, and Camino Cielo. (Reaches A, B, E, F, and G).

7.1.9 VENTURA COUNTY WASTE MANAGEMENT DEPARTMENT

- SWMD is seeking a permit to place bank protection along the remainder of the existing berm around the former Ojai disposal site, which was damaged by 1995 flood flows. (Reach J).

7.1.10 VENTURA RIVER COUNTY WATER DISTRICT

- Repair and/or replacement of a water pipeline across the Ventura River near the State Route 150 bridge if the pipeline were to fail or become inoperative due to age. (Reach J).

7.2 CANDIDATE GENERAL MITIGATION MEASURES

The candidate mitigation measures listed below represent best management practices that could be used to avoid adverse impacts to steelhead and their habitat during temporary maintenance or repair work by the sponsoring agencies along the river under current conditions. It is anticipated that some or all of these measures would become standard practices to be observed by sponsoring agencies when working in the river. Furthermore, these practices could be incorporated into permits (e.g., 404 permits and 1601/1603 Agreements issued by the Corps of Engineers and California Department of Fish and Game, respectively) to the sponsoring agencies for maintenance and repair work. Many of the measures listed below represent standard conditions for 404 permits and 1601/1603 Agreements recently issued to agencies for work along the Ventura River and its tributaries.

The candidate mitigation measures described in this chapter are intended to be applied where it is necessary to avoid impacts to steelhead. However, these measures may be applied to other portions of the Ventura River and its tributaries by permitting agencies in order to avoid or reduce impacts to other aquatic and riparian resources. In addition, these permitting agencies may require field surveys at proposed project sites and pre-construction surveys in order to evaluate permit applications and issue necessary permits, respectively. Incorporation of the following mitigation measures into project plans will not guarantee issuance of a 404 permit or 1601/1603 Agreement, nor preclude additional mitigation that permitting agencies may impose based on other resource considerations.

Note that diversions at Matilija Dam, Robles Diversion Dam, and the Foster Park facilities are considered permanent, ongoing operations, not maintenance activities as defined in this chapter. Hence, conservation actions to avoid “take” and reduce impacts to steelhead and their habitat from ongoing diversions at these facilities are addressed in Chapter 8.

Candidate general mitigation measures to be considered for implementation by the sponsoring agencies are listed below. These measures could also be adopted by other public agencies and private parties working in the river and its tributaries. The following measures are presented in a format that can be directly incorporated into any required permits for work in the river.

The following mitigation measures are intended for routine maintenance, repair, or replacement work. **They are not designed for activities that must be carried out under emergency conditions.** The latter are defined in this Plan to occur when there is an imminent threat to life or property, such as those situations that could potentially result in unacceptable hazard to life, a significant loss of property, or an immediate, unforeseen, and significant economic hardship if corrective action requiring a permit is not taken immediately.

1. *Work on the river or creek banks, or within the river or creek bed, shall occur during the period June 30th through December 1st, or when streamflow is absent, to the greatest extent feasible to avoid effects on migrating and spawning steelhead.*

2. *Work areas and access roads within the bed of the river or creek shall be flagged (and if necessary, staked) to identify limits of access and disturbance.*

3. *Staging and storage of construction equipment shall occur outside the river or creek bed.*

4. *Any equipment or vehicles driven and/or operated within or adjacent to the river or creek bed shall be checked and maintained daily to prevent leaks of materials that, if introduced to water, could be deleterious to steelhead.*

5. *Stationary equipment such as motors, pumps, generators, and welders, located within or adjacent to the river or creek bed shall be positioned over drip pans.*

6. *No equipment maintenance shall be conducted within river or creek beds.*

7. *No debris, soils, silt, sand, bark, slash, sawdust, rubbish materials, solid waste, cement, or concrete or washings thereof, oil or petroleum products or other organic or earthen material, from any construction or associated activity shall be allowed to enter into, or placed where it is likely to be washed by rainfall or runoff into, a river or creek.*

8. *Temporary stockpiled materials shall not be located in portions of a river or creek bed where it is likely to be washed into the river or stream.*

9. *Erosion and sedimentation control measures shall be incorporated into project plans and fully implemented when planned, non-emergency work is conducted during the*

winter runoff period (November 1st through April 30th) and/or when work must occur in a live stream or wetted area. The exact methods to be used shall be determined based on site-specific conditions, but shall include provisions to isolate the work area and to divert water around the work area by means of a temporary barrier made of river-run material, temporary culverts, new channels, or other methods as approved by permitting agencies. Any stream diversion devices or methods shall include provisions for the movement of steelhead around the work area if the work is occurring between January 1st and June 30th. Sedimentation shall be controlled by methods that include placement of silt fencing, hay bales, or sand bags downstream of the work area, or by the construction of temporary sediment retention ponds downstream of the work area. The placement of any structure or material into the live stream or in a wetted area at any time of the year shall be approved by the permitting agencies to ensure that impacts to steelhead, their habitat, and their migration are minimized or avoided.

10. *Vehicle and heavy equipment travel shall be restricted to the non-wetted hardened or scoured portions of the river or creek bed, unless the work area is located in a wetted area or live stream, or if the only access to the work area traverses a wetted area or live stream.*

11. *Temporary access roads that must traverse a live stream shall include steel pipe culverts or other devices to allow fish movement at the crossing during the period of January 1st through June 30th. The culvert shall have a minimum diameter of 24 inches and a length no greater than 30 feet. Channels leading to and from the culvert openings must have depth (at least 18 inches) and suitable velocities (at least 0.5 foot per second) to allow smooth passage of fish.*

12. *Native riparian trees (over 4 inches in diameter at breast height) that are located adjacent to pools or a live stream suitable for steelhead (and that currently provide shade for aquatic habitat) that must be removed from a temporary work site to accomplish construction shall be replaced after construction at or near the same location in accordance with specific planting and monitoring requirements of the permitting agency.*

13. *Riparian vegetation adjacent to live streams and pools suitable for steelhead that must be permanently removed from a project site shall be replaced at or near the project site where the establishment of such vegetation shall improve aquatic habitat conditions for steelhead in accordance with specific planting requirements of the permitting agency.*

14. *If a pool (defined as a body of water more than three feet deep) in a reach where migrating or oversummer steelhead may occur must be temporarily dewatered or disturbed for work, it shall be examined for the potential occurrence of steelhead by a qualified biologist. The agency shall contact the local CDFG fisheries biologist to discuss the possible need to relocate them to nearby suitable pools prior to the work. Relocation shall be accomplished in accordance with incidental take and scientific collecting permits issued by CDFG and NMFS, if and when such permits are issued.*

15. *If it is necessary to permanently remove a pool (defined as a body of water more than three feet deep) or relocate a live stream channel in order to accomplish the work, the pool and stream channel shall be reconstructed at nearby locations in a manner that resembles the original pool and channel, using river-run material for the new substrate. Prior to removal, the pool shall be examined for the potential occurrence of steelhead by a qualified biologist. The agency shall contact the local CDFG fisheries biologist to discuss the possible need for electrofishing for steelhead in order to relocate them to the new pools prior to the work. Electrofishing and relocation shall be accomplished in accordance with incidental take and scientific collecting permits issued by CDFG and NMFS, if and when such permits are issued.*

16. *All noxious non-native vegetation (i.e., giant reed, tamarisk, pampas grass, and castor bean) removed during the course of any work in a river or creek shall be disposed in a manner and at a location that prevents it from re-establishing from the disposed materials.*

17. *No herbicides or pesticides shall be sprayed or otherwise applied in close proximity of the live stream or pools with habitat suitable for summer rearing steelhead as documented in this Plan. Herbicides applied for purposes of removing non-native invasive weeds and the application methods shall be approved by CDFG and NFMS, and include protective measures to avoid impacts to aquatic habitat and steelhead.*

Stream reaches where the candidate mitigation measures would be applied are shown in Table 7-1. Measures would be applied to stream reaches where maintenance activities by one or more sponsoring agency could affect migrating or oversummering steelhead. These measures may be applied to other portions of the Ventura River and its tributaries by permitting agencies in order to avoid or reduce impacts to other aquatic and riparian resources

7.3 AGENCY-SPECIFIC MITIGATION MEASURES

The following mitigation measures would be applied to maintenance of specific facilities by individual agencies. These measures could be incorporated into any 404 permit and/or 1601/1603 Agreement with the Corps and CDFG, respectively, when and if such approvals are needed for these maintenance activities. Please note that not specific mitigation measures have not been developed for all sponsoring agencies participating in the Plan. For agencies not listed below, it was determined that the general mitigation

Table 7-1. Applicability of steelhead mitigation measures to stream reaches along the Ventura River under current conditions.

Mitigation Measures	Stream Reaches (see below and Figure 3-4)												
	Mat Ck.		N.F. Mat.	Coyote and S. Ana	Cks. in Ojai Val	San Ant.	Coyote Ck.	Cn. Larga, Diablo	Ventura River Reaches (see below)				
	A	B	C	D	E	F	G	H	I	J	K	L,M	N
General Mitigation Measures for all Sponsoring Agencies													
1					X	X	X		X	X	X	X	X
2					X	X	X		X		X	X	X
3					X	X	X		X		X	X	X
4					X	X	X		X		X	X	X
5					X	X	X		X		X	X	X
6					X	X	X		X		X	X	X
7					X	X	X		X		X	X	X
8					X	X	X		X		X	X	X
9					X	X	X		X		X	X	X
10					X	X	X		X		X	X	X
11					X	X	X		X		X	X	X
12					X	X	X		X		X	X	X
13					X	X	X		X		X	X	X
14					X	X	X		X		X	X	X
15					X	X	X		X		X	X	X
16					X	X	X		X		X	X	X
17					X	X	X		X		X	X	X
Agency-Specific Mitigation Measures													
18											X		
19											X		
20											X		
21						X	X		X	X	X	X	X
22						X	X		X	X	X	X	X
23					X	X	X						
24									X	X			

Table 7-1. Applicability of steelhead mitigation measures to stream reaches along the Ventura River under current conditions (concluded).

Stream Reaches:

A Mainstem Matilija Creek upstream of Matilija Dam for about 5 miles
B Matilija Creek headwaters, including Upper North Fork and Murietta creeks
C North Fork Matilija Creek
D Coyote Creek and Santa Ana Creek above Lake Casitas
E Senior Canyon, Thacher Creek and Reeves Creeks, tributaries to San Antonio Creek
F San Antonio Creek, from the Ventura River upstream through Soule Park, including Lions Creek
G Coyote Creek downstream of Casitas Dam
H Canada Larga and Canada del Diablo
I Ventura River, between Matilija Dam and Robles Diversion Dam
J Ventura River, between Robles Diversion Dam and the upstream end of the live stretch
K Ventura River, live stretch (between confluence with San Antonio Ck and Foster Park)
L Ventura River, between Foster Park and OVSD effluent discharge
M Ventura River, between OVSD effluent discharge and Main Street Bridge
N Ventura River below Main Street Bridge, lagoon

measures described in Section 7.2 would be adequate for the anticipated work in the river or its tributaries.

7.3.1 City of San Buenaventura

1. *When and if the City of Ventura conducts maintenance of the diversion dike at the Foster Park surface diversion facility, the following measures should be considered by the City as methods to minimize impacts to migrating steelhead during the period of December 1st through June 30th:*

    - *A qualified fish biologist shall be consulted during the planning of the reconstruction of the diversion dike each spring. The City shall incorporate design features for the dike and associated diversion channel that will create a single narrow, deep, and fast-moving channel leading to, and exiting from, the surface diversion structure. This type of channel shall be constructed to facilitate safe passage of steelhead by avoiding shallow areas with higher water temperature, and flows that are diffuse and undirected. A qualified fish biologist shall be present when the diversion dike and associated channel are reconstructed each spring to provide direction on constructing a suitable channel, as well as to ensure compliance with general mitigation measures to avoid impacts to fish present in the area.*

    - *The City shall avoid, to the extent feasible, creating side channels above and around the surface diversion that would result in shallow, high temperature flows, possibly stranding outmigrating steelhead that do not follow the main channel along the diversion dike through the surface diversion facility.*

2. *The fish screen shall be modified to provide screening of high flows that overtop the vertical screen and spill into the intake weir, possibly entraining outmigrating steelhead.*

3. *The City shall meet with the local CDFG biologist to discuss the adequacy of the by-pass opening at the downstream end of the diversion structure, and the need, if any, to : (1) improve the size or configuration of the opening to prevent harm to steelhead passing through the opening; and (2) minimize hydraulic effects in the diversion structure that could temporarily entrap fish in the chamber under low flow conditions.*

7.3.2 Ventura County Flood Control District

1. *The District shall consider the use of bio-engineering techniques for bank protection (if hydraulic and bank conditions are conducive to such methods) for new bank protection in the watershed in stream reaches where steelhead migration, spawning, and/or rearing is expected to occur most often.*

2. *The District shall plant medium stature willow trees, such as sandbar or arroyo willow, at the base of any new or repaired rip-rap bank protection to provide shade*

at the base of the bank protection, in the event that stream migrates to the base of the bank protection at some time in the future. Establishing a band of willows that could provide shade for the stream will create more favorable temperature conditions for steelhead that may use the stream at the base of the bank protection for passage or rearing.

7.3.3 VENTURA COUNTY PUBLIC WORKS AGENCY, TRANSPORTATION DEPARTMENT

22. *The Department shall provide surfaces and structures at dry weather crossings owned and maintained by the County, to facilitate upstream movement by steelhead, whenever the Department must replace dry weather crossings owned by the County. Such surfaces and structures should be designed in consultation with a fish biologist, and would include such items as rock rampways at the downstream end to create a more gradual transition over the crossing that can be used by fish during high flows.*

23. *The Department shall employ all reasonable measures to avoid, or reduce to the extent feasible, runoff of oily or otherwise contaminated substances (e.g., emulsions, asphalt, oil, wash water) from road surfaces when roads are being resurfaced or repaired in order to prevent discharge of such substances to storm drains leading the river and its tributaries*

7.3.4 VENTURA COUNTY SOLID WASTE MANAGEMENT DEPARTMENT

25. *The SWMD shall consider the use of bio-engineering techniques for repairing the damaged banks at the Ojai disposal site if hydraulic and bank conditions are conducive for such methods, provided such methods also meet the requirements for containing landfill contents. If the SWMD elects to install rip-rap bank projection, it shall plant medium stature willow trees, such as sandbar or arroyo willow, at the base of any new or repaired rip-rap bank protection to provide shade at the base of the bank protection, in the event that stream migrates to the base of the bank protection at some time in the future. Establishing a band of willows that could provide shade for the stream will create more favorable temperature conditions for steelhead that may use the stream for passage.*

Stream reaches where the above agency-specific candidate mitigation measures would be applied are shown in Table 7-1. These measures would be applied to stream reaches where maintenance activities by one or more sponsoring agency could affect migrating or oversummering steelhead.

7.4 MITIGATION MEASURES UNDER FUTURE CONDITIONS

In the event that upstream and downstream passage for steelhead is provided at one or both of the major passage barriers (i.e., Matilija Dam, Robles Diversion Dam), Mitigation Measures 2 through 18 would be applied to the upstream reach where passage for steelhead was provided. All other mitigation measures for that reach would remain as shown in Table 7-1.

8.1 INTRODUCTION

This section introduces potential approaches for improving steelhead habitat, steelhead passage conditions, and the steelhead population in the Ventura River basin. In order to achieve the objectives (Chapter 1), it is first necessary to identify the factors that limit the existing population (Chapter 4) and then identify and evaluate means of overcoming these limiting factors. This chapter introduces a large range of potential actions that warrant consideration. Potential conservation actions have been identified through our analysis of limiting factors and discussions with regulatory agencies, project sponsors, and public groups. Conservation actions are suggested solely for the purpose of improving habitat for steelhead. They differ from mitigation measures, which may be required as a permit condition, in that they and would be implemented on a discretionary basis. Many of the actions require public involvement and therefore a public education process and/or incentive program would need to be developed. In addition, for many of the actions a detailed engineering study would need to be conducted to determine design feasibility and specifics. Funding would also need to be secured for these actions. Design details and funding options are not within the scope of this plan.

All of the conservation actions introduced in this section have the potential to provide direct benefits to steelhead or their habitat. These actions address the freshwater portion of the steelhead life cycle and have been divided into four categories:

- Passage measures to facilitate upstream and downstream migration
- Non-flow related measures to improve habitat
- Flow-related measures to improve habitat
- Population augmentation through supplementation of fish

Potential benefits to steelhead, possible engineering or hydrologic problems, and estimates of costs are outlined for each potential action, but no recommendations of preferred actions are made in this chapter. In Chapter 9, these actions are screened and ranked according to potential biological benefits, likelihood of success, technical feasibility, costs, land or water right constraints, operations and maintenance requirements, and incidental biological benefits.

8.2 CONSERVATION ACTIONS FOR THE MAINSTEM VENTURA

The range of potential conservation actions for the mainstem Ventura River (up to Robles Diversion Dam) and the stream reaches they potentially affect are outlined in Table 8-1.

8.2.1 PASSAGE IMPROVEMENT MEASURES FOR THE MAINSTEM

1. Construct and maintain a single thread channel above and below Robles

When winter and spring streamflows are low in the mainstem Ventura River, steelhead have difficulty migrating upstream through the multiple shallow mainstem channels particularly in the reach downstream of Robles Diversion Dam. Long reaches of shallow water can also make passage difficult for downstream migrating smolts. High water temperatures, lack of resting habitat, and increased predation risk are also commonly associated with extensive reaches of shallow water. These conditions exist in the Ventura River primarily between San Antonio Creek and the Robles Diversion (Reach J).

As described in Chapter 2 (Migration Period Streamflows section), passage conditions to allow upstream steelhead migrations did not historically and do not now occur every year in the Ventura River. A decision to ladder Robles Diversion and/or implement other conservation actions upstream, needs to be made with the knowledge that steelhead may not be able use the ladder every year because of the lack of water to facilitate passage. Construction of the low flow passage channel would provide much more favorable passage conditions at lower flows and more frequently then is currently provided by the existing channel.

A slightly sinuous, natural-appearing side channel could be constructed along the margin of the active riverbed. It would be separated from the wide, shallow active channel by a broad, low-elevation berm and designed to convey streamflows less than 50 cfs. Streamflows greater than 50 cfs would be carried by the broad active river channel. The entrance to the low-flow passage channel would be constructed to prevent high streamflows from entering the channel. The passage channel would be constructed with a track hoe and large bulldozer during the summer period when flows are low or absent. The basic concept would be to connect existing low elevation areas to form a continuous watercourse along one side of the main channel. The passage channel would consist of a simple triangular cross section approximately 2.5-3 feet deep with one steep side (approximately $^{3}/4$:1 side slope) and one gently sloping side (approximately 5:1 or 6:1 side slope). The steep side would alternate from the right to the left bank of the constructed channel, always being on the outside of a gently curving sinuous channel. Such a channel would maintain a continuous deep-water thread over the 20 to 50 cfs flow range of interest.

Due to the large amount of sediment moving in the Ventura River during storm events, it is likely that reconstruction and/or maintenance of portion of the passage channel would be required after each year containing significant flow events. Because of the erodibility of the constructed channel during flood events and the expected maintenance, a channel

Table 8-1. Range of Potential Conservation Actions for the Mainstem Ventura River.

	Candidate Conservation Actions	Reaches Potentially Affected													
		A	B	C	D	E	F	G	H	I	J	K	L	M	N
	Passage and Migration														
1.	Construct single-thread channel above & below Robles										X	X			
2.	Ladder Robles Diversion Dam			X						X					
3.	Screen Robles Diversion			X						X	X	X	X	X	X
4.	Fish collection facilities at canal			X						X	X	X	X	X	X
5.	Trap and truck adults upstream of Robles Diversion Dam			X						X	X	X	X	X	
6.	Trap and truck juveniles & adults downstream past Robles			X						X	X	X	X	X	X
	Habitat Improvement														
7.	Construct low flow channel										X	X			
8.	Reduce erosion and sedimentation									X	X	X	X	X	X
9.	Plant riparian vegetation									X	X	X	X	X	
10.	Install instream structures for cover and pool formation										X	X			
11.	Conservation easements									X	X				
	Flow-Related Measures														
12.	Bypass flows at Robles Dam to improve downstream habitat										X	X	X	X	X
13.	Recirculate flows in live stretch										X				
14.	Purchase water/water rights for instream flows										X	X	X	X	X
15.	Release water from Lake Casitas through Coyote Creek											X	X	X	X
16.	Release water from Lake Casitas to mainstem										X	X	X	X	X
17.	Manage timing and duration of ground-water withdrawals										X	X	X	X	X
	Population Augmentation														
18.	Wild steelhead hatchery										X	X	X	X	X
19.	Supplement mainstem habitat with upstream juveniles										X	X	X	X	X

Table 8-1. Range of Potential Conservation Actions for the Mainstem Ventura River (concluded).

Tributaries
A Mainstem Matilija Creek upstream of Matilija Dam approximately 5 miles
B Matilija Creek headwaters, Upper North Fork and Murietta creeks
C North Fork Matilija Creek, portion of Matilija Creek downstream of Matilija Dam
D Coyote and Santa Ana Creeks above Casitas Dam.
E Senior Canyon, Thacher Creek and Reeves Creeks, tributaries to San Antonio Creek
F San Antonio Creek, from the Ventura River upstream through Soule Park, including Lions Creek
G Coyote Creek downstream of Casitas Dam
H Canada Larga and Canada del Diablo

Mainstem Ventura
I Between the confluence of Matilija and North Fork Matilija creeks and Robles Diversion Dam
J Between Robles Diversion Dam and the upstream end of the live stretch (Oak View)
K Live stretch (between Foster Park and Oak View)
L Between Foster Park Bridge and OVSD effluent
M Between OVSD effluent and Main Street Bridge
N Ventura River Lagoon

constructed primarily to facilitate upstream passage, would be less costly to construct and maintain than a low-flow channel designed to contain complex channel geometry and specific amounts of habitat (e.g. pools and riffles) for spawning and rearing. (*Construction of a low-flow channel that provides spawning and rearing habitat in addition to passage is discussed under habitat enhancement measures that follow.*)

Another factor to be considered in the evaluation of the low flow passage channel is the effect it could have on groundwater percolation. Groundwater levels would need to be monitored to insure that this action was not impacting the groundwater recharge rates. It is possible that the envisioned low flow channel could severely reduce or eliminate the percolation that currently occurs in this reach. Also, since the river is privately owned in this reach, permission would need to be obtained from landowners to get access to the river.

The total length of the reach were a low-flow passage channel may be beneficial is approximately four miles. The cost of initial design and channel construction would be approximately $50,000 per mile (for a maximum of about 4 miles), with design costs being approximately 10 percent. Annual maintenance costs may average $10-20,000 per mile. These estimates do not include costs associated with the potential need to purchase private land along the river channel or other costs associated with coordination with landowners.

2. Ladder Robles Diversion Dam

Fish passage upstream of Robles Diversion Dam would allow fish access to the upper portion of the Ventura River and North Fork Matilija Creek (Reach B). North Fork Matilija Creek currently supports a population of resident rainbow trout and would provide good rearing habitat for young steelhead. A fish ladder could be constructed at Robles Diversion Dam to restore access. The appropriate type of facility would depend on the range of streamflow under which the ladder would be operational and the debris loading that could be expected. Depending on the design, stream flows of approximately 10-20 cfs would be required to provide passage through the ladder. A portion of the existing 20 cfs minimum bypass flow, or a portion of the bypass flow, which is currently released from January to April, could be passed through the ladder during the upstream migration season, mainly February to April. In dry years, the fish ladder may be ineffective because low streamflow may prevent steelhead from migrating as far upstream as Robles Diversion. The low flow passage channel discussed above would reduce the passage impediments and provide passage conditions at flow as low as 20 cfs. Construction of the low flow passage channel would allow upstream migrants to reach the ladder a greater percentage of the time.

A detailed engineering and hydrologic study would be needed to determine the appropriate location and type of ladder that should be installed. This study should also address other measures that could be taken to improve passage at the structure, including altering the concrete slab outfall below the release gates. The ladder could be constructed across the river from the diversion facility to avoid interaction with the diversion facilities and minimize the potential for fish entrainment and potential debris jam problems. While this location may eliminate some of the engineering problems associated with the flashy high flows in the Ventura, it may prove difficult to attract fish to the ladder from downstream in years without high flow events, given the existing braided channel below the dam. Fish ladders such as the Denil, the Alaska steep pass, or the pool and weir operate well with low debris and sediment loads and relatively constant flow rates and water surface elevations; such conditions are not the case in the Ventura River. A concrete vertical slot ladder is more suitable for the high debris and sediment loads and wide range of flow conditions commonly found in the Ventura River. The channel downstream of the Robles Diversion may need to be modified to direct fish to the entrance of the ladder. The low flow road crossing just downstream of the dam also needs to be modified to allow passage under a all flow conditions.

Design and construction of a ladder would likely cost between $100,000 and $400,000, depending on the range of streamflows (and debris loads) over which the ladder would be expected to pass fish. The facility would require annual maintenance. This effort could vary greatly depending on the water year type.

3. Screen Robles Diversion

Since the goal of the conservation actions is to enhance the anadromous steelhead population in the Ventura River, downstream passage is an important issue to address. Unlike salmon, steelhead adults return to the ocean after spawning and downstream passage facilities at Robles must pass both adults and juvenile fish. If upstream passage is provided at Robles Diversion Dam to reestablish steelhead spawning in the North Fork Matilija Creek, then downstream migrating juveniles and spawned adults risk entrainment at the Robles Diversion. The unscreened diversion would probably entrain a substantial portion of the smolt produced upstream.

Fish screens are frequently used at water diversion facilities to avoid entrainment and can be highly effective. However, installing effective fish screens at Robles Diversion will be challenging because the diversion rate often exceeds the bypass flow and a very large volume of debris is transported with high streamflow events. The California Department of Fish and Game (CDFG) has established velocity criteria for fish screens which has been generally adopted by National Marine Fisheries Service. For salmonid fry, the approach velocity (the velocity through the screen) must not exceed 0.33 ft/sec. Thus, for a 300 cfs diversion, the cross sectional area of the screen would be approximately 900 ft^2. The sweeping velocity, or the velocity parallel to the screen, is designed to prevent impingement on the screen and must be 2 times the approach velocity. This could be very difficult to achieve when the bypass flow is smaller than the diversion unless the fish collection or bypass facility is constructed within the diversion canal (as described below). The fish screen design also needs to address annual maintenance, blockage or damage to screens from floating debris or sediment loading, and general overall effectiveness of the screening operation. During high flow events, the amount of debris floating downstream could severely limit the success of a screen at the inlet to the channel. Actions to limit or block the amount of debris coming from upstream would need to be investigated.

Screening technology offers two basic types of screens, fixed wedge-wire screens or rotary drum screens. The type and overall cost of the screen depends on the local conditions and the amount of water to be screened. Costs for screening per cubic foot of water generally run between $1000 for simple screens to $15,000 for complex screens in areas with high debris loading. Given the present operations at Robles and the type of sediment and debris loading a fixed wedge-wire screen could probably be designed and installed for $700,000 to $1,000,000. Periodic cleaning and annual maintenance would also be required.

4. Fish Collection Facility in Canal

Rather than installing a screen to prevent entrainment in the canal, a fish collection facility could be placed within the diversion canal. Collecting fish in the diversion canal could be more successful than screening at the entrance to the canal because of our ability to operate fish traps under more controlled hydraulic conditions.

Although a detailed engineering study would need to be done to determine the feasibility of this action, similar facilities have been used in other systems. The envisioned trapping facility would consist of several stationary screens arranged in the shape of an elongated "V" pointed upstream or an acute diagonal across the canal. The sweeping velocity along the face of the screen would concentrate the fish at the downstream end of the screen where flow through an 18 to 14 inch pipe, called a fish gulper, would transport fish into a holding basin. A screened pump would recover the transport water from this holding basin and return it to the canal. Fish would be collected from this holding basin and could be transported to the river. Release points may vary depending on the size of the fish captured and water conditions in the river and estuary. Besides being highly effective at preventing outmigrants from entering Lake Casitas, this type of screening facility could provide an excellent base for counting or marking outmigrants in support of monitoring or other field studies.

Rather than transporting juveniles from the collection facility to the river, a bypass channel could be constructed to deliver fish back to the mainstem habitat as long as flow was not subsurface at the delivery point. This type of operation, which eliminates handling would be preferred because it would be less labor intensive and less stressful on the fish especially when water temperatures are high.

Design and construction of this type of trapping or bypass facility in the canal would likely cost the same as a screen upstream from the canal, but would require less bypass flow. Annual operation of the facility would cost on the order of $15,000 to 30,000.

5. Trap and truck adults upstream of Robles Diversion

Trap-and-truck operations provide upstream passage of adult steelhead at natural or man-made barriers. Adult steelhead swimming upstream to spawn are trapped below the most downstream passage barrier, and are transported upstream via tanker truck. These fish are released above the most upstream barrier to continue their upstream migration, or near their spawning habitat in the tributaries.

At low flows, trapping and trucking can be an effective and relatively inexpensive method of moving fish upstream, but can cause stress and mortality because of the high water temperatures that can accompany low flows even during the winter months in the Ventura River. During high flows traps can be very difficult to operate because of the large amount of water to be "trapped", high water velocities, and large amounts of sediment and debris. Even during low-flow years when trapping has the potential to be most effective, runoff events will occur which are capable of damaging trapping facilities not removed from the main channel. In addition, steelhead usually move upstream during the high flow events, making trapping difficult. In the Ventura River, trapping upstream migrating adults is further complicated because there are currently few adults to capture and missing those few migrants is likely during moderate to high flow events.

In order for trapping to be possible, a weir would be required to direct fish into the trap. Trapping of upstream migrants should occur in a relatively stable single thread portion of the mainstem some distance above the estuary. Review of aerial photography resulted in the identification of three candidate sites: the oil company bridge, the Ojai Sanitary District water treatment plant, and the Foster Park bridge. On-site reconnaissance and landowner cooperation would be the principal determinants of site selection.

Trapping and trucking adults upstream would be most successful during periods of low to moderate streamflow and would probably cost on the order of $100,000 annually. A portion of this cost would be shared by the downstream passage measures that would also be required. This action will require active intervention every year that streamflows are sufficient to allow steelhead passage through the upper Ventura River..

6. Trap and truck adults and juveniles downstream past Robles Diversion Dam

Trap-and-truck operations can also be used for downstream migrating juveniles and spawned-out adults. During low to moderate streamflows trapping could be highly effective, but trapping can be very difficult and ineffective during periods of high streamflow. Trapping would be easier in the diversion canal where flow rates and debris loads are more manageable, than in the main channel (see Action 4). Candidate release points would be the estuary, the live reach, or the river below Robles Diversion Dam depending on the habitat conditions and the age of migrants. In low flow years, young of the year migrants may be released into North Fork Matilija for rearing since they would need to stay in the system another year.

This operation would need to be conducted every year during the spawning and outmigration season (about January-June), even in dry years; although spawning adults may not be able to pass the mainstem Ventura in dry years, juveniles produced in previous years may attempt outmigration. The costs associated with trap-and-truck operations for downstream migrants would similar to that for upstream migrants.

8.2.2 HABITAT IMPROVEMENT FOR THE MAINSTEM

7. Construct a low-flow channel

In addition to improving fish passage, construction of a narrower, deeper, single thread channel in Reach J could enhance and extend summer rearing habitat for juvenile steelhead attempting to rear in the mainstem Ventura River. The envisioned low-flow channel would add streambed topography (variation in bed profile and cross section), cover objects, and spawning substrate to the passage channel previously described. The location and planform of the two channels would be very similar.

By providing a mix of shallow fast-water riffles and deeper low-velocity runs and pools, the basic habitat requirements of juveniles could be met. The major drawbacks to this option is the lack of streamflow in the Ventura River during the summer period and high probability of winter storm events causing damage to portions of the constructed channel. The channel would provide rearing habitat only during the spring and early summer months when water is present. High temperatures may also be a concern, but may be expected to be lower than what occur now in the unshaded channel. However, the water downstream in the live stretch, which normally comes from below ground and is therefore cooler than water that flows above the surface, may become warmer. Water temperature affects would need to be monitored. Summer and fall rearing habitat is already present in the live reach. Constructing a channel with specific habitat features may improve the live stretch, but may not significantly improve rearing conditions for juveniles. This channel would require periodic, probably annual, maintenance and reconstruction because of high runoff altering portions of the desired channel geometry, filling pools, and removing cover objects.

Initial design and construction costs would be on the order of $100,000-$150,000 per mile. This estimate does not include the initial cost of securing a right-of-way or easements from private property owners. The participating agencies or groups would not have authority to trespass on private land to construct or maintain the channel without a right of entry. Annual reconstruction and/or maintenance would cost on the order of $25,000-$50,000 per mile.

8. Reduce erosion and sedimentation

Abundant fine sediment loading reduces spawning and rearing potential in some areas of the mainstem Ventura, including rearing potential in the estuary. Some bank erosion occurs along the left bank (looking downstream) of the Ventura River near Oak View (Reach K) and further downstream along the right bank (Reach L and M), but it does not appear to be a substantial amount. Dirt roads can also contribute sources of sediment to the river. Although the majority of dirt roads and erosional banks occur in tributaries, some directly contribute fine sediment to the mainstem, particularly the roads around the oil pumps in the Shell oil fields (which also contribute abundant sediment to Canada Larga and Canada del Diablo). Treating unsurfaced roads (by paving them) and eroding banks (potentially with bioengineering which would include planting native riparian where possible) can reduce delivery of fine sediments to the mainstem. However, upslope treatment of gullies and streambank erosion on tributaries (see action 28) would probably be much more effective at improving habitat in the watershed than treating mainstem sources further down in the watershed.

Sedimentation control can vary dramatically depending on amount of area and type of erosional processes. Erosion control projects can range from as little as $5,000 to $100,000 or more per site. Asphalt concrete paving usually costs on the order of $500,000-$1,000,000 per mile depending on road width. Oil and coverstone surfacing is about half as expensive, but will not support as heavy vehicles as asphalt concrete.

9. Plant native riparian vegetation and remove non-native vegetation

Enhancement of native riparian vegetation can improve stream habitat by stabilizing the banks, thereby allowing the formation of undercut banks where fish can seek cover and reducing fine sediment production due to bank erosion. Shading from the riparian canopy may also reduce stream temperatures and minimize algal growth. Terrestrial food production may also be improved. Riparian enhancement should only be implemented after the causes for the existing poor condition of riparian vegetation are well understood (e.g. ground water levels, livestock grazing, high scouring flows). Otherwise, the success and long-term benefits of the planting effort may be highly questionable.

Near stream riparian vegetation is lacking, scarce, or patchily distributed downstream of Robles Diversion through the Casitas Springs live stretch (Reaches I, J, and K). It should be noted that this lack of riparian vegetation in the mainstem Ventura River has previously been documented after other years with extremely high flow events. The vegetation tends to reestablish itself although the regrowth can take a couple years to become evident (City and Casitas 1983, 1990, 1991). The live stretch would be an appropriate section of river (Reach K) to try propagating cottonwoods and willows to improve aquatic habitat in an area that has water year-round. It would likely be difficult to have successful propagation in areas that have no surface water or shallow groundwater available to the vegetation. The east bank of the river near the Casitas Springs levee would benefit from native riparian vegetation planting, where it has been removed. The west bank of the river through the live stretch already has a narrow corridor of riparian vegetation that improves habitat and helps stabilize the bank. Planting would need to occur in January or early February. Costs of planting cottonwood or willow cuttings by volunteer groups or unskilled labor would be low.

Non-native riparian vegetation such as tamarisk and *Arundo* also limit steelhead habitat potential in the mainstem Ventura River, especially along the lower river. In general these invasive species do not add woody debris to streams or provide shading, and they can reduce available surface water and contribute to adverse water temperatures and chemistry (Chubb 1997). Eradication has proved difficult and resource agency staff is now trying to actively control these invasive species. As with planting, some of the removal can be done by volunteers or in partnership with private businesses to reduce costs. Large scale removal will require experts and heavy equipment. Operation of one large piece of heavy equipment costs on the order of $1,000 per day. Removal of invasive species in the lower river alone would take many days each year.

10. Install instream structures for cover and pool formation

Use of instream structures can improve spawning, foraging and rearing habitat in a number of ways. Placement of instream structures can enhance gravel deposition to form bars and riffles. Pool depth and frequency can be increased by placing structures, such as root wads, logs or boulders, in locations that will cause local streambed scouring. These structures can also provide cover for fish. It is imperative that the decision to use structures be made within the context of site-specific habitat limitations and watershed processes. Although the entire mainstem (Reaches I, J, K, L, and M) could benefit from the increased complexity that habitat structures usually provide, the recurrent high streamflows and their associated large bed loads would makes it very difficult to retain structures installed in the mainstem Ventura with any permanent degree of success. These types of measures are more appropriate for tributary streams, rather than main reaches of flashy rivers with large bedloads, like the Ventura.

11. Conservation easements along river channel

Conservation easements may be useful in regions where the compatibility of land ownership with riparian or aquatic habitat improvements is questionable. Obtaining formal conservation easements would ensure that future actions by the landowner would not negate the value being derived from habitat improvements. Along the mainstem Ventura River, there are few areas where there is a need for such easements, except where flood control (Reaches K and M) or farming practices (Reach I) are currently removing riparian vegetation. Ventura County Flood Control District currently removes large riparian vegetation that is threatening the integrity of bank protection such as excessively large trees growing at the base of rip-rap or amongst the rocks along levees. These easements may also be costly, but are a one-time expenditure. This type of action has been suggested in the past and dismissed because of opposition by adjacent land owners and would therefore require extensive public interaction and education to be of any success.

8.2.3 FLOW-RELATED MEASURES FOR THE MAINSTEM

12. Bypass flows at Robles Diversion Dam to improve downstream habitat

Passing water by the Robles Diversion could improve aquatic habitat and fish passage conditions downstream of the diversion. The timing and duration of the release would be primary determinants of the life history phase that would benefit, while the magnitude of the release would determine the amount of habitat improvement. Passing flow during winter months would benefit upstream migrants, and possibly provide additional mainstem spawning habitat. Sustained streamflows during winter and spring could improve incubation and downstream migration, whereas releases during summer would benefit juvenile steelhead rearing.

Diversions do not take place at Robles unless a flow of at least 50 cfs is available, therefore, diversions normally take place between December and April and do not usually occur during the summer and fall. Typically, inflow to Matilija Reservoir is released downstream and allowed to flow past Robles Diversion once diversions have ceased for the year. Therefore natural flow conditions exist during summer and fall months in most years and water is not usually available to bypass past Robles for rearing in summer and fall. (Releases from Matilija to augment flows are described in Action 36.). Water could be bypassed to improve passage and incubation conditions in winter and spring.

The current required bypass past Robles Diversion is 20 cfs (when Casitas is diverting water and it is available) or enough water to keep flows above the surface at the Santa Ana Boulevard crossing (see Section 5.1.4). These bypass flows are required to satisfy downstream groundwater pumpers and was not originally intended to be for fish habitat enhancement. Once flows are below about 10 cfs at Robles Diversion, flow goes subsurface downstream and resurfaces at the live stretch, improving rearing habitat in the live stretch but not allowing passage in the reach upstream. Additional bypass flows from Robles could improve passage conditions up to Robles Diversion Dam if enough water is available to allow passage in the wide channel between Santa Ana and Robles Diversion (see Action 1 and Chapter 2 – Migration Period Streamflows section). Passage conditions through this reach typically only exist for a short period and not every year under existing conditions and prior to diversions at Robles.

The cost of this measure would depend on the amount of water bypassed and therefore the amount of water needed to replaced.

13. Recirculate/recycle flows in live stretch

Spawning and rearing habitat could be enhanced in the live reach (Reach K) by recycling base level stream flows with a pumping system. This sort of recirculation may allow for better flow conditions to occur in the live stretch for a longer part of the dry season. However, it would reduce late summer and fall base flows in the lower Ventura River. This reduction of streamflows downstream would reduce the habitat potential of the estuary, which also supports other sensitive species. This action would also require construction of an expensive pumping plant at the downstream end of the live reach, a means to prevent entrainment of fish in the pump, a pipeline to the upstream release point, and a means to elevate dissolved oxygen, lower water temperature, and minimize the erosion potential of the release water. Maintaining suitable water temperature and water quality could be challenging during the warmer summer months. Landowner agreement would also be necessary for the pipeline easement and construction of the pumping facility. The basic intent of this action would be to augment natural streamflows in the live reach by recycling water that has already flowed through the reach. Given the current use of water at the diversions in the live stretch, this action is not feasible. Implementation of this action would likely require purchasing water rights and finding alternative sources of water for those diverters.

14. Purchase water/water rights for instream flows

Water for instream flows might be obtained by purchasing water (and potentially land) from existing licensed users. The purchase price would need to be high enough to attract sellers and the contract of long enough duration that it would be more profitable for the existing licensed user to sell water for instream flow releases than to maintain the existing use. Obtaining formal water rights for instream flows would be needed to ensure that future (downstream) appropriations would not negate the value being derived from leaving the water in the stream channel. Legislation allowing the reservation of water rights for instream flows would need to be written and approved. This type of legislation currently exists in other states, but instream flow water is generally considered junior to other rights and therefore may not be available in dry years. It should be noted that in dry water years, there is not enough safe yield in the Ventura River basin to satisfy demand, so additional sources of water would need to be secured. Other sources may included desalination, which is costly, but being investigated in other areas; and state water project water, which is already over appropriated and may have less water in the future because of endangered species concerns in the Central Valley.

15. Release water from Lake Casitas to Coyote Creek

Water could be released from Lake Casitas into Coyote Creek to supplement stream flows in the mainstem Ventura River. Releases from Casitas would need to be screened to avoid introduction of non-native fishes into Coyote Creek and the mainstem Ventura River. These releases could improve mainstem rearing habitat conditions downstream of Coyote Creek, which includes the lower section of the live reach that is downstream of Foster Park (Reach L, M, and N). More water released into Coyote Creek could result in growth of riparian vegetation and cooler water temperatures in the mainstem during summer and fall. Downstream of this location the Ventura River periodically goes dry for about a mile until the Ojai Valley Sanitary District Treatment Plant effluent enters the river. Releases to improve habitat conditions in Coyote Creek were also considered under tributary conservation actions (Action 40).

These supplemental rearing flows, which may be on the order of up to 5 cfs, would extend the downstream terminus of the live reach and increase the amount of mainstem habitat available by approximately a mile (downstream to OVSD Treatment Plant). This type of flow augmentation could also have severe impacts on the water supply of the area, were there is currently not enough safe yield to satisfy demand in dry years. Currently rearing habitat is found in the live stretch that extends between 3 to 4 miles. The value of adding a mile of habitat to this reach depends on the water temperatures. Although cool water would be available from the reservoir, heating would occur in Coyote Creek and in the Ventura River itself. Studies on expected water temperatures would be needed to determine if water temperatures were likely to be suitable in the reach between the live stretch and the Ojai Sanitary District's discharge.

The primary costs associated with this measure would include the purchase of water for instream flows (or the purchase of additional out-of-basin replacement water). As with the purchase of other water rights (mentioned above), legislation would need to be drafted to enable the purchase of water for instream flows.

16. Release water from Lake Casitas directly to the mainstem

Mainstem flows could also be supplemented with water from Lake Casitas via a siphon to improve rearing and passage conditions. The likely release point would be the top of the live stretch, so that conditions in that reach (Reach K) would be improved. The water would have similar benefits as discussed above for water released into Coyote Creek, although the potential for adverse warming is greater. In the mainstem river, the greater width of the channel and the reduced shading make increased water warming a potential problem.

This action would require construction of a pumping facility at Lake Casitas, a pipeline between the lake and the release point, and an energy dissipation structure to minimize erosion and elevate dissolved oxygen of the release water. Maintaining suitable water temperature and water quality may be difficult in summer months. Landowner agreement would be required for construction of the pipeline and release point. As with releases directly from the dam, costs would include the purchase of water for instream flows (and potentially the purchase of additional out-of-basin replacement water) as well as structural costs. Again, this type of flow augmentation could also have severe impacts on the water supply of the area, were there is currently not enough safe yield to satisfy demand in dry years. There is currently no replacement water available.

17. Manage timing and duration of ground water withdrawals

Groundwater pumping that affects base streamflow levels might be reduced or curtailed during periods of low streamflow to improve summer/fall rearing conditions in the mainstem Ventura. Since groundwater levels affect the amount of surface flows in the live stretch (Reach K), this action would likely result in increasing surface flows in and downstream of that reach. Although based on the small size of the aquifer and the short rate of recharge, the amount of increased surface flow expected from short duration pumping changes would be expected to be small. To accomplish this without significantly impacting existing users, costs would include the purchase of replacement water that would need to be provided.

8.2.4 POPULATION AUGMENTATION

18. Wild steelhead hatchery

Populations of steelhead in the Ventura River may be low because there are too few adults to effectively restart the population when good conditions occur. The steelhead population of the Ventura River watershed could be directly supplemented by producing fish at a hatchery (probably Filmore Hatchery). The brood stock ideally would come from the Ventura River, either from residualized stocks in Matilija Creek and North Fork Matilija Creek or possibly from returning adults. If these potential sources are unavailable, the next most preferable stock would be southern steelhead from other nearby streams. This may be infeasible, however, if other basins' stocks are also at low levels and unavailable for use. Northern steelhead stocks should not be considered because their habitat requirements and life history patterns are thought to be different from those of southern steelhead, which have adapted to warmer conditions.

This type of hatchery would be consistent with CDFG policy only if the population in the Ventura is deemed as in imminent danger of extinction and then only temporarily to improve initial adult returns. According to the policies of the CDFG and the Fish and Game Commission, artificial supplementation and rearing would only be allowed if current factors that are limiting the population (e.g. passage barriers, habitat disturbances) are alleviated (D. McEwan, CDFG, pers. comm.). Therefore, this type of facility would not alleviate the need for passage, habitat, streamflow and water quality conditions to be improved. Population supplementation should be phased out once the number of returning adults is above critical levels. Using Filmore hatchery, rather than a streamside rearing facility would be inexpensive. However, even a small streamside rearing facility would be relatively inexpensive compared to many of the other potential actions. A streamside rearing facility would also have the benefit of allowing the fish to imprint on their natal waters, rather than water from a different watershed.

19. Supplement downstream habitat with upstream juveniles

Local populations of steelhead in the lower Ventura River watershed could be supplemented by trapping smolts in upstream reaches that are above man-made passage barriers (e.g. North Fork Matilija and Matilija Creeks). Releasing captured smolts into the live stretch or downstream of the OVSD effluent in the lower river may be an effective way of promoting anadromy in the remaining steelhead population. This would be an inexpensive way of supplementing the current population in the Ventura River, on the order of a few thousand dollars annually, depending on the magnitude of the project.

8.3 CONSERVATION ACTIONS FOR THE TRIBUTARIES

The range of potential conservation actions for the tributaries and the stream reaches potentially affected are outlined in Table 8-2. Note that some of tributary actions should only be considered if passage to those habitats is restored. For example, Actions 30, 31, and 32 should only be consider in Matilija Creek upstream of Matilija Dam if passage is provided past Robles Diversion Dam and Matilija Dam. Note also that some tributary actions can affect mainstem habitat. For example, trapping smolts upstream of barriers and releasing them into the mainstem would affect mainstem production. Likewise, erosion control measures in tributaries would be expected to reduce fine sediment loading problems in the mainstem downstream of those tributaries.

8.3.1 PASSAGE AND MIGRATION MEASURES FOR THE TRIBUTARIES

20. Remove Matilija Dam

Removal of Matilija Dam would restore access to about 19 miles of headwater spawning and rearing habitat in Matilija Creek and its tributaries (Reaches A and B). This represents approximately fifty percent of the historic spawning habitat in the Ventura basin (Clanton and Jarvis 1946). The present habitat conditions for steelhead in mainstem Matilija Creek are relatively poor. The channel is aggraded and composed of primarily run/riffle habitat with cobbles and boulders. There is little pool habitat and little streamside vegetation throughout most of the mainstem Matilija Creek (Chubb 1997) and there is abundant algae growth. Still, this type of habitat can be productive in wet water years, when streamflow, insect production and water temperatures are suitable throughout summer (Moore 1980). Some of the tributaries, especially Murietta Creek and parts of Upper North Fork Matilija Creek appear to have an excessive amount of fine sediment in the stream bed that may limit spawning success (Chubb 1997), but otherwise currently provide good rearing habitat for resident trout. There is evidence of good resident rainbow trout production in upper Matilija Creek and its tributaries (Upper North Fork and Murietta creeks), indicating access to this habitat could aid in the recovery of steelhead in the Ventura River (Chubb 1997). However, the highest resident trout densities were found upstream of natural passage barriers, so that these areas would not be available to steelhead even if Matilija Dam was removed.

To gain the benefits of removing Matilija Dam, passage would need to be provided at the Robles Diversion Dam, either by a trap and truck operation or by a fish ladder. Screening (as described under Actions 3 and 4) would also be required. Removal of Matilija Dam would involve dismantling the dam and removing an estimated 4 million cubic yards of sediment from the impoundment zone and upstream river corridor. Order of magnitude costs for sediment removal are $8-10 per cu. yd. or 32-40 million dollars including transportation and disposal costs offset by resale of any of the sediment (Ventura County pers. comm.). Dam removal would include demolition and removal of the structure,estimated at 9 million dollars ($90 per cu. yd.). Additional costs for

Table 8-2. Range of Potential Conservation Actions for the Tributaries.

	Candidate Conservation Actions	Reaches Potentially Affected													
		A	B	C	D	E	F	G	H	I	J	K	L	M	N
	Tributary Passage Barriers														
20.	Remove Matilija Dam	X	X												
21.	Ladder Matilija Dam	X	X												
22.	Trap & truck adults upstream of Matilija Dam	X	X												
23.	Trap & truck fish downstream of Matilija & Robles dams	X	X												
24.	Ladder Casitas Dam				X										
25.	Trap & truck adults upstream of Casitas Dam				X										
26.	Trap & truck fish downstream of Casitas dams							X					X	X	X
27.	Remove potential passage barriers from road crossings			X		X	X	X							
	Tributary Habitat Enhancements														
28.	Erosion control measures	X	X					X	X					X	X
29.	Construct low flow channel							X							
30.	Add pool forming & instream cover structures	X	X		X		X	X							
31.	Add spawning gravels	X		X											
32.	Plant riparian vegetation	X			X	X	X		X						
33.	Conservation easements along tributary channel				X	X	X		X						
34.	Manage sources of nutrient loading and pollutants					X	X								
	Tributary Flow-Related Measures														
35.	Ramping flows from Matilija Res.			X						X					
36.	Minimum flows from Matilija Res.			X						X		X			
37.	Remove sediment from Matilija Reservoir for flow augmentation			X						X		X			
38.	Scheduled diversion for surface irrigators				X	X	X								
39.	Minimum summer flows from small irrigation reservoir(s)						X								
40.	Minimum flows from Casitas Res.							X					X		
41.	Purchase water/water rights for instream flows					X	X								
42.	Manage groundwater withdrawals					X	X								
43.	Wild steelhead hatchery	X	X	X			X								
44.	Supplement tributaries with upstream juveniles	X	X	X			X								

Table 8-2. Range of Potential Conservation Actions for the Tributaries (concluded).

Tributaries

A Mainstem Matilija Creek upstream of Matilija Dam approximately 5 miles
B Matilija Creek headwaters, Upper North Fork and Murietta creeks
C North Fork Matilija Creek, portion of Matilija Creek downstream of Matilija Dam
D Coyote and Santa Ana Creeks above Casitas Dam.
E Senior Canyon, Thacher Creek and Reeves Creeks, tributaries to San Antonio Creek
F San Antonio Creek, from the Ventura River upstream through Soule Park, including Lions Creek
G Coyote Creek downstream of Casitas Dam
H Canada Larga and Canada del Diablo

Mainstem Ventura

I Between the confluence of Matilija and North Fork Matilija creeks and Robles Diversion Dam
J Between Robles Diversion Dam and the upstream end of the live stretch (Oak View)
K Live stretch (between Foster Park and Oak View)
L Between Foster Park Bridge and OVSD effluent
M Between OVSD effluent and Main Street Bridge
N Ventura River Lagoon

transportation and disposal of concrete, noise and dust control measures and mitigation, road repair costs, wetland replacement costs, and habitat restoration of the stream corridor within and upstream of Matilija Reservoir would be incurred. Removal of the dam and the sediment would destabilize the stream channel through Matilija Reservoir and upstream to the first prominent bedrock control. Thus, if Matilija Dam is removed, the sediment that has been deposited in the aggraded portion of the stream should also be removed, and the stream corridor reclaimed and restored.

Depending on the way Matilija Dam and the sediment behind it was removed, there may also be associated negative short-term environmental effects from sediment loading, increased water turbidity, reduced or lack of bypass flows around the construction area, excessive noise and traffic, and air quality. Allowing all or part of the sediment to flush through the system would have longer term negative environmental effects to the habitat. The adverse environmental impacts associated with removing Matilija Dam are greater and more complex than those impacts associated with removal of other dams that are closer to the ocean. The dam removal alternative allowing sediments to flush downstream of Ringe Dam, which is approximately 2.5 miles from the ocean, was dismissed because of negative impacts to downstream habitat. Abundant sediment would also tend to fill in the area behind Robles Diversion Dam and would increase maintenance costs associated with the diversion operations. Finally, increased sediment loading in the highly developed Ventura River valley downstream of the dam would impact private property and potentially increase property damage due to flooding.

Negative air quality impacts and traffic and noise problems would also be associated with sediment removal, which would take several years. For example, the removal of the approimately 1 million cubic years of sediment behind Ringe Dam by truck is estimated to take 2 years. Excavation would take place during the dry period and would require approximately 50,000 truckloads (in a 20 cubic yard, two trailer dump truck). Depending on the number of trucks and truckloads per day, hauling activities would occur on approximately 400 to 500 days. For Ringe Dam, this removal is expected to take 2 years. For Matilija Dam, approximately four times the amount of sediment needs to be removed. Removal of 4 million cubic yards would require approximately 200,000 trips of a 20 cubic yard, two trailer dump truck. If 100 truckloads per day were hauled from Matilija Dam to the coast or some other dump site and excavation took place on 200 or 250 days per year; removal of all of the sediment would take 8 to 10 years. In addition to air quality and traffic issues, this number of truckloads would have greatly increased road repair costs.

All of these impacts would need to be mitigated. The total estimated cost for removal of Matilija Dam including sediment removal, dam removal and concret disposal, habitat restoration, and mitigation requirements would be on the order of 30 to 150 million. A more detailed discussion of the technical constraints and costs of Matilija Dam removal are provided in Appendix B.

21. Ladder Matilija Dam

Laddering Matilija Dam would provide access to upstream habitat as discussed in the preceding action description. Downstream passage would also need to be provided, so that juveniles would not have to "fall" over the dam on their way downstream. Given current technology, the construction of a fish ladder at Matilija Dam to provide access for migrating steelhead is not feasible. The modified crest of Matilija Dam is approximately 135 feet above the creek. The narrow canyon and the high lift combine to make laddering Matilija Dam technically infeasible.

22. Trap and truck adults upstream of Matilija Dam

As discussed above in Action 5, trap-and-truck operations can be used to facilitate upstream passage of adult steelhead at natural or man-made passage barriers such as Matilija Dam. A trap-and-truck operation would provide access to about 19 miles of spawning and rearing habitat in Matilija Creek and its tributaries (Reaches A and B) as described above. Adult steelhead swimming upstream to spawn would be trapped and then transported upstream via tanker truck. These fish would be released above the most upstream barrier (Matilija Dam or barriers farther upstream) or near spawning habitats in upstream tributaries.

At low flows, trapping and trucking can be an effective and relatively inexpensive method of moving fish upstream, but can cause stress and mortality because of the high water temperatures that often accompany low flows. During high flows traps can be very difficult to operate because of the large amount of water to be "trapped", high water velocities, and large amounts of sediment and debris. Even during low-flow years when trapping has the potential to be most effective, runoff events will occur which are capable of damaging trapping facilities not removed from main channel. Trapping and trucking adults upstream would probably cost on the order of $50,000-$75,000 annually. A portion of this cost would be shared by the downstream passage measures that would also be required. This action will require active intervention every year that streamflows are sufficient to allow steelhead passage through the upper Ventura River.

Trapping of upstream migrants should occur in a relatively stable single thread portion of the mainstem some distance above the estuary. Review of aerial photography resulted in the identification of three candidate sites: the oil company bridge, the Ojai Sanitary District waste water treatment plant, and the Foster Park bridge. On-site reconnaissance and landowner cooperation would be the principal determinants of site selection. If passage is provided at Robles Diversion, then trapping could occur close to Matilija Dam. It should be noted that efforts to trap upstream migrating adult steelhead at Matilija Dam in the past were unsuccessful. One potential release point could be at the end of the road to Los Padres National Forest, approximately 3.5 miles upstream from the dam. This would provide steelhead access to important headwater habitat without the cost and environmental consequences of removing the dam. However, it will be relatively difficult to capture fish during the high flows in which they migrate and given the low numbers of returning adults, the overall success of this action is questionable.

23. Trap and truck juveniles and adults downstream of Matilija and Robles dams

This measure assumes upstream passage for adult spawners has been provided by another conservation action. Trap-and-truck operations can assist downstream migrating juveniles to safely pass Matilija Dam, Robles Diversion Dam, and the reach downstream of Robles where flows often go subsurface (Reach J). Downstream transport of juveniles and adults has generally been less successful than upstream transport of adults because it is much more difficult to collect downstream migrants, due to typical streamflow conditions and fish behavior. Furthermore, large numbers of juveniles must be trapped and successfully transported in order to produce a discernible effect in the number of returning adults. The release point should be far enough downstream (e.g. the live reach or estuary) to avoid other passage problems, and the release should be made in a manner that minimizes thermal shock and/or predation.

Downstream fish trapping operations above Matilija Dam would likely cost on the order of $100,000-$150,000 annually. This operation will need to be conducted every year during the spawning and outmigration season (about January-June), even in dry years; although spawning adults may not be able to pass the mainstem Ventura in dry years, juveniles produced in previous years may attempt outmigration. Trap-and-truck operations would not be needed for outmigrants from the North Fork Matilija if fish collection facilities were installed at Robles Diversion (Action 4). Trap-and-truck operations may need to be provided for outmigrants on San Antonio Creek in order to ensure outmigration during some average-flow and all low-flow years. This trapping may cost $50,000 annually if performed in conjunction with outmigrant trapping above Matilija or trap-and-truck of adults.

24. Ladder Casitas Dam

Laddering Casitas Dam would provide upstream access to habitat in Coyote and Santa Ana creeks. In order to use the habitat in Coyote and Santa Ana creeks, adult steelhead would have to migrate through Casitas Lake and find the inlets to those streams. Upstream migration barriers exist approximately three and four miles upstream from the lake impoundment on Coyote Creek on Coyote and Santa Ana creeks, respectively. During a recent survey, no trout were found upstream of these barriers (Chubb 1997). This survey indicated that there was excellent spawning habitat, but relatively poor rearing habitat in these streams downstream of these barriers (Chubb 1997). Resident adult rainbow trout densities were good, but juvenile densities were relatively poor. However, one of the best areas for late summer and drought refugia was found in mid-Coyote Creek.

Given current technology, the construction of a fish ladder at Casitas Dam to provide access for migrating steelhead is not feasible. The crest of Casitas Dam is at 580 feet above mean sea level, and the elevation of the creek is approximately 350 feet above mean sea level; indicating the dam height is approximately 230 feet, to high to feasibly pass fish, even with a switchback ladder. In addition to the technical problems with constructing an effective fish ladder of the magnitude required at Casitas, there would be difficulties in getting downstream migrants through the reservoir (without flow cues) and with abundant predation in and upstream of the reservoir from highly predatory, non-native resident fish. Finally, introduction of an endangered species into Lake Casitas could adversely affect the economically important resident lake fishery.

25. Trap and truck adults upstream of Casitas Dam

As discussed above in Action 5, trap-and-truck operations can be used to facilitate upstream passage of adult steelhead at natural or man-made passage barriers such as Casitas Dam. A trap-and-truck operation would provide access to approximately seven or eight miles of spawning and rearing habitat (as described in the preceding action description) in Coyote and Santa creeks (Reach D) upstream of the Casitas Lake impoundment. Adult steelhead swimming upstream to spawn would be trapped below the most downstream passage barrier and then transported upstream via tanker truck. These fish would be released above the impoundment. Associated technical operations and difficulties, and costs would be similar to those described for trap-and-truck operations above Matilija Dam (Action 22).

26. Trap and truck juveniles and adults downstream of Casitas Dam

This measure assumes upstream passage for adult spawners has been provided by another conservation action. Trapping of smolts without upstream passage is not recommended unless genetic analysis shows that resident trout from Coyote and Santa Ana creeks are of southern steelhead stock. Abundant stocking of northern rainbow trout has taken place in Lake Casitas that likely affects the gene pool from these streams.

Trap-and-truck operations can assist downstream migrating juveniles to safely pass Casitas Dam and the reach downstream of Casitas on Coyote Creek where flows often go subsurface (Reach G). Downstream transport of juveniles and adults has generally been less successful than upstream transport of adults because it is much more difficult to collect downstream migrants, due to typical streamflow conditions and fish behavior in large reservoirs. Furthermore, large numbers of juveniles must be transported in order to produce a discernible effect (i.e. number of returning adults). The release point should be far enough downstream (e.g. the live reach or estuary) to avoid other passage problems, and the release should be made in a manner that minimizes thermal shock and/or predation. Costs associated with downmigrant trapping in the Coyote Creek subbasin, may be slightly more than those for Matilija Creek, because both Coyote and Santa Ana Creeks would need to be monitored. There is the additional complication of differentiating between rainbow trout juveniles (offspring from trout stocked in the lake) and steelhead juveniles. This action (along with the upmigrant trapping) could potentially have an impact on the sport fishery in Lake Casitas, because steelhead have ESA status.

27. Remove potential passage barriers from road crossings or other obstructions

Arizona-type road crossings can pose serious passage barriers for migrating steelhead if not constructed and maintained to provide passage. Box culverts at road crossings and boulder cascades that are also found in the tributaries can also be complete passage barriers or low flow year passage impediments.

A few passage impediments exist in lower North Fork Matilija Creek (Reach C) which are associated with large boulders. Some of these obstructions may have been caused by road construction activities and some may be natural barriers to steelhead migration. These obstructions could be removed at minimal costs by blasting.

Several Arizona crossings exist on both San Antonio Creek and North Fork Matilija Creek (Reaches C and F). There is also one Arizona crossing along lower Coyote Creek (Reach G). The crossings are typically concrete aprons placed across the streambed to permit vehicles to drive through the stream on a firm surface during periods of low or no streamflow, and permit debris and sediment to pass downstream during periods of high streamflow. Generally these crossings require little maintenance to provide access across the stream. However, they often flatten the local stream gradient upstream, gradually developing a broad shallow channel (filled in by sediment). Downstream an incised channel often develops (scoured by high velocity flows). Upstream migrants have difficulty swimming across the Arizona crossing due to shallow depth or in some instances the amount of downstream incision requires fish to jump onto the crossing.

Migration barriers associated with Arizona road crossings can be eliminated by either replacing the crossing with a small bridge or by constructing jump pools in the downstream reach. Relatively inexpensive bridges can be made from retro-fitted railroad flat cars and pre-fabricated, modular bridges. In some locations large boulders can be used downstream of the crossing to construct weirs that form backwater pools which typically only hold water during periods of high streamflow. Steelhead migrating during periods of moderate to high streamflow can jump and swim between the backwater pools until they reach the crossing and swim across it.

Most of the Arizona crossing in San Antonio Creek are associated with private property. Modifying the depth of flow across these crossings would reduce their utility at some flow levels making travel inconvenient. Landowners may not be able to afford other improvements to achieve adequate passage conditions. The high degree of coordination between landowners and the costs of replacing the Arizona crossing with bridges may reduce the likelihood of success in removing passage barriers from San Antonio Creek without some other source of funds. Lower cost bridges will likely improve coordination.

There are also road related passage barriers on tributaries to San Antonio Creek (Reach E). The concrete bottom of the box culvert forms a broad shallow barrier during low flow and often acts to form a barrier downstream of the grade control because of a drop in the streambed elevation. Downstream bolder weirs can often provide adequate backwater during high streamflows to drown the culvert outfall and provide passage. If site conditions prevent use of backwater weirs, then the bottom of the box culvert might be modified by adding large roughness elements or bridges and arch culverts should be installed. It may not, however, be necessary to correct passage problems related to Arizona crossing on tributaries to San Antonio Creek. Here, flow usually goes subsurface early in spring and there is little rearing habitat in the tributaries through the Ojai Valley. The existing passage barriers may prevent fish from spawning in habitat that would later become unsuitable and result in a loss of production. Before passage improvements are considered in these tributaries, the suitability of the habitat should be evaluated.

8.3.2 Habitat Improvements for the Tributaries

28. Control erosion from roads and gullies

Sedimentation is a problem in lower Coyote Creek, Canada Larga, and Canada del Diablo (Reaches G and H). Measures to control erosion from roads and gullies in these sub-basins will reduce inputs of fine sediments into the creeks. Actions for roads include paving or improving roadside drainage for unsurfaced roads, winter closure of unsurfaced roads, revegetating roads with little use, and improving design and construction of new unsurfaced roads. Controlling erosion from steep hillside gullies, however, is very difficult to achieve. Planting vegetation can help stabilize eroding gullies, but water is needed to establish and maintain the vegetation. Native drought tolerant species may be able to reestablish without much water, but efforts to try to reestablish vegetation in similar sandy soils in Santa Cruz county have been unsuccessful. Even removal of the some of the original causes of the erosion (e.g. cattle grazing) has done little to reverse the erosion process. Thus, the most likely erosion control measures to be implemented would consist of hard armoring and planting native semi-arid vegetation. These types of gully repairs would cost between $5,000 to 10,000 per site. Other factors, such as lack of flow in summer/fall reduce the value of these reaches as steelhead habitat, therefore the value of the habitat should be assessed before conservation measures such as these are implemented.

To avoid fine sediment impacts to the mainstem Ventura River, sediment debris basins could be excavated in selected tributaries. This involves dredging out ponds that slow the velocity of water at the downstream ends of tributaries. The slower velocity water can no longer carry the smaller sediment particles, which are deposited into the ponds before the storm water enters the mainstem. These types of ponds have been constructed on other systems with some success. The annual maintenance cost of dredging the ponds depends on the amount of sediment to be dredged and the quality of the material. Studies to determine the sediment production rates and the size and locations of the sediment basins need to be conducted. The initial costs including these initial studies, purchasing land and dredging. In addition, in areas where sediment basins have been used, annual dredging is required, becoming a long-term maintenance cost if the source of erosion cannot be controlled.

29. Reconstruct channel and aquatic habitats

Coyote Creek downstream of Lake Casitas (Reach G) could be enhanced by channel reconstruction to provide up to 2.5 miles of juvenile rearing habitat, but sedimentation from the surrounding watershed and abundant inchannel riparian growth would be a continual challenge for maintenance. Periodic high flow events would be needed to flush out the sediments and restore the channel, but this would have negative water quality impacts in the mainstem downstream of Coyote Creek. The low gradient of this reach makes it of poor quality for spawning, even if spawning gravels are placed in the channel. The best results for constructing aquatic habitat in Coyote Creek would require a year-round release from Lake Casitas of 1-2 cfs and periodic flushing flows during winter. Releases from Lake Casitas into Coyote Creek were also discussed in Action 15.

30. Add pool-forming/instream cover structures

Installation of in-stream structures can improve spawning, foraging and rearing habitat in a number of ways. Placement of in-stream structures can enhance gravel deposition to create bars and riffles. Pool depth and frequency can be increased by anchoring structures such as root wads, logs or boulders at locations to increase scouring. These structures can also provide cover for fish. Structures are most effective when designed within the context of site-specific habitat limitations, geomorphological processes, hydrology, and sediment production. Lack of pools was identified as a concern in several tributaries by our assessment of limiting factors. Likely reaches for enhancement with this measure include regions where summer streamflow is usually present, such as San Antonio Creek, Lion Creek, and the mainstem Matilija Creek (Reaches A and E). Enhancement would be more difficult in reaches with low summer streamflow or serious sedimentation problems, such as tributaries of the Upper San Antonio Creek, Coyote Creek downstream of Casitas, Canada Larga and Canada del Diablo (Reaches D, F, and G). Instream habitat structures vary in costs, generally ranging between $500 and $1,500 apiece for small streams. They should be done a few at a time over 3-4 years to reduce annual expenditures.

31. Add spawning gravels

Recent assessments of North Fork Matilija Creek indicate that spawning gravel is rare. It is not known if this lack of spawning substrate is currently limiting production in the North Fork. If conservation actions were taken to ensure that adult steelhead could successfully enter the North Fork Matilija Creek (Reach C) past Robles Diversion and any other natural barriers that may be present on the lower creek, periodic addition of spawning gravel in the North Fork Matilija Creek could improve and maintain spawning habitat. Up to five miles of habitat could be potentially enhanced, although surveys would be required to determine the number and location of areas that would benefit. Because of the steep gradient in the North Fork, addition of gravel would need to be repeated after high flow years, potentially every year, in order to maintain a reasonable amount of good quality gravel in the North Fork.

Mainstem Matilija Creek is also lacking suitable size spawning gravels and could benefit from gravel addition. As with North Fork, periodic high flow events would tend to wash placed gravel downstream and therefore gravel would need to be added in most years. River gravel itself is inexpensive. The major cost is transportation and placement, which can easily make the total cost of placing small amounts of gravel (less than 100 cubic yards) in small streams $100-$200 per cubic yard. A small, high gradient, stream like the North Fork Matilija Creek could receive 300-500 cubic yards annually.

32. Plant native riparian vegetation and remove non-native vegetation

Lack of riparian vegetation is a limiting factor in the upper San Antonio Creek watershed (Senior Canyon, Thacher Creek, and Reeves Creek) (Reach E) and the mainstem Matilija Creek (Reach A) above Matilija Reservoir. Planting and/or enhancement of riparian vegetation can improve stream habitat by stabilizing the banks, thereby allowing the formation of undercut banks where fish can seek cover. Shading from the riparian canopy can improve water quality by reducing stream temperatures. As noted above, riparian vegetation can reduce fine sediment production due to bank erosion. Terrestrial food production may also be improved. Riparian enhancement should only be implemented after the causes for the loss and/or degradation of riparian vegetation are understood (e.g. ground water levels, livestock grazing, scouring by flood flows). For example, excess coarse sediments in these reaches can hamper establishment and retention of vegetation, which would be more easily uprooted during high streamflows. Otherwise, the long-term success of the planting effort will remain highly questionable, particularly in as arid an environment as occurs in the Ventura watershed. Riparian enhancement measures can vary in costs depending on the amount of effort put into the project. Planting costs are typically reduced by using volunteers.

Non-native riparian vegetation such as tamarisk and *Arundo* also limit steelhead habitat potential in the Ventura River tributaries, especially along the lower San Antonio Creek and the mainstem Matilija Creek around and upstream of the reservoir. In general these invasive species do not add woody debris to streams or provide shading, and they can reduce available surface water and contribute to adverse water temperatures and chemistry (Chubb 1997). Eradication has proved difficult and resource agency staff is now trying to actively control these invasive species. As with planting, some of the removal can be done by volunteers to reduce costs. Large scale removal will require experts and heavy equipment. Costs would be the same as for the mainstem (Action 9).

33. Conservation easements along tributary channel

Conservation easements may be useful in regions where the compatibility of land ownership with riparian or aquatic habitat improvements is questionable. Obtaining formal conservation easements would ensure that future actions by the landowner would not negate the value being derived from habitat improvements. Along the tributaries, there may be few areas where there is a need for such easements, except where flood control or farming practices are currently removing riparian vegetation. Flood control practices include removal of large riparian vegetation that is threatening the integrity of bank protection such as excessively large trees growing at the base of rip-rap or amongst the rocks. Residences, horse corrals, and recreational activities are located within or adjacent to San Antonio Creek and its tributaries (Reaches E and F). Steelhead currently use San Antonio Creek upstream through Soule Park for spawning and rearing, but passage barriers limit upstream migration to tributaries. Barriers need to be removed from the tributaries and the persistence of flows need to be investigated before easements should be considered on the tributaries. These easements may also be costly, but are a one-time expenditure that may prove less expensive than repeated flood control maintenance, flood damages, and associated hazards.

34. Manage sources of nutrient loading and pollutants

Land use practices could be instituted along San Antonio Creek (Reach F) to reduce nutrient input into streams from farms and/or agriculture. There are currently no regulations outlined by the Regional Water Quality Control Board (Board) that restrict non-point source pollution in rural areas (such as agricultural run-off). Small point source pollutants (such as manure dumping) can be restricted if extreme detrimental effects are noted. The best near term and long term action to avoid nutrient and pollutant loading into Ventura River basin streams is public education of the associated impacts of such actions. It should be noted that these types of problems were only noted in isolated areas. Still, they can affect water quality by causing alga blooms (especially when the riparian corridor is lacking) and adding to the total biological oxygen demand, resulting in poor dissolved oxygen conditions in the water which directly affects fish survival. Other possible solutions include setbacks and/or live stock exclusion fencing along stream channels.

8.3.3 FLOW-RELATED MEASURES FOR THE TRIBUTARIES

35. Ramping flows from Matilija Reservoir

The current practice of releasing water from Matilija to be diverted at Robles Diversion could be changed to improve habitat conditions downstream (Reach I). Currently, flows of approximately 250 cfs are released from Matilija Reservoir, without distinct periods of ramping up or down (gradually changing flow rates). In order to improve fish habitat and avoid any potential impacts to fish either migrating or rearing in the reach downstream of the dam, flows should be ramped up and down. Ramping flows up and down would more closely resemble a natural storm event and would be less likely to result in fish stranding on the edges of the stream. In addition, juveniles would be able to move to and use the lower velocity edge habitat to avoid being washed out of the reach. This action could result in a slight loss of water due to increased percolation during the ramping periods, therefore, it should not be considered unless passage at Robles is achieved. Since this type of release is only done to divert at Robles, it does not affect flow rates in the mainstem Ventura downstream of Robles Diversion.

36. Minimum flows from Matilija Reservoir

Summer rearing habitat conditions could be improved downstream of Matilija Dam if minimum flow releases could be provided from Matilija Reservoir when streamflows are low. This area includes 0.6 miles of Matilija Creek to the confluence with North Fork Matilija Creek (part of Reach C) and about 1.4 miles of the Upper Ventura River (Reach I). In Matilija Creek juvenile rearing habitat is relatively good and spawning habitat is available in limited patches. The Ventura River above Robles is in poorer condition and its broader channel would require more water to improve. If the entire capacity of Matilija Reservoir (about 930 AF) were available for downstream release during critical periods of low flow (about 6-8 months, mainly summer into fall) this would amount to a maximum average daily flow of about 2-2.5 cfs. The degree and extent of habitat improvement would depend on channel conditions in the reach. Habitat improvements, specifically riparian enhancement, would be beneficial just upstream of Robles Diversion Dam, but the rest of the reach above Robles offers good rearing conditions for steelhead. It is unlikely that supplemental summer releases of less than 10 cfs from Matilija Reservoir would remain above surface all the way to Robles Diversion Dam, much less to the mainstem Ventura River below Robles. However, these releases will recharge the shallow groundwater basin and could improve flow conditions at the live stretch. Challenges for this action include addressing potential water temperature problems (water from the reservoir's outlet may be too warm), and providing replacement water for existing users.

37. Remove sediment from Matilija Reservoir to provide storage for flow augmentation

The storage capacity of Matilija Reservoir has been severely reduced to about 930 AF due to excessive sedimentation. Removal of the sediment could increase the reservoir's capacity, and the additional water held in storage could be used to augment streamflows for fish. The amount of sediment to be removed would be determined by anticipated instream flow release. For example, a 4 cfs release below Matilija for 6-8 months in dry periods would require approximately 1,400 to 1,900 AF of water. If all the existing capacity of Matilija Reservoir was devoted to flow augmentation (930 AF), obtaining the additional capacity of 500 to 1,000 AF to provide the 4 cfs release for 6 to 8 months would require removal of about 800,000 to 1,600,000 cubic yards of sediment (1.1 to 2.2 million tons).

Accessing and excavating the sediment will be a major challenge (see Appendix B). Periodic sediment removal would also be required because of the highly erosive nature of this basin. In addition, the integrity of the dam needs to be addressed before this action can be considered.

38. Scheduled diversions for irrigators

In small streams with low summer flows, surface diversions by riparian users can deplete streamflow and adversely affect juvenile rearing habitat. Summer streamflow is one of the major limiting factors for steelhead in San Antonio Creek and its tributaries. At times during hot spells and on weekends, people living along the stream withdraw water at the same time, causing short-term depletion of the streamflows and dewatering of some reaches. Other drainages have successfully reduced these episodes by coordinating water withdrawal to reduce the impact on the stream. This option requires a substantial degree of coordination among land owners to achieve the benefit and may not be feasible with a large number of parties potentially involved in San Antonio Creek. However, many of the groundwater users are members of Ojai Basin Groundwater Management Agency or various other irrigation or resource conservation districts, which will help to facilitate coordination.

39. Minimum summer flows from small reservoir

A small amount of water (0.5 cfs) might be released from the small agricultural impoundment on upper Lion Creek to sustain stream flows and provide potential rearing habitat for juveniles. This release would likely need to be associated with removing sediment and enlarging this impoundment to store an additional 200 AF. Site conditions may not support such as an increase in storage volume. Another potential problem could be warm water temperatures of the release flows, depending on the degree of warming in the impoundment.

40. Minimum flows from Lake Casitas

Water could be released from Lake Casitas into Coyote Creek to sustain stream flows and provide habitat. The low gradient of Coyote Creek between the Dam and the Ventura River renders much of this reach unsuitable for spawning. However, good rearing habitat could be provided with a streamflow of 1 or 2 cfs and physical channel improvements, as discussed above in habitat enhancement actions 26 and 27. In addition, flow released from Casitas would improve conditions downstream of the live stretch and upstream of OVSD discharge on the mainstem Ventura (as discussed in Actions 15 and 16).

Several additional considerations must be addressed to fully assess the biological benefits, feasibility and cost of this action. To avoid problems with high water temperatures, releases should come from deep in Lake Casitas. However, this deep water may have associated low dissolved oxygen and may need addition aeration during release. Current dissolved oxygen in the lake is as low as 2 to 4 ppm, even with current aeration activities. Study will be required to determine the appropriate depth for release water. Casitas Dam may need to be retrofitted with a different outlet structure for releases. Retrofitting the dam would be an expensive undertaking to release 1 cfs into a short reach of a tributary downstream in the Ventura watershed, but it may be one of the few options available for this area.

A controlled release of 1 cfs throughout the year would require 720 AF of storage and streamflow variability would depend entirely upon the natural runoff pattern. To accomplish this without significantly impacting existing users, arrangements for replacement water must be made. There is currently no replacement water available, except potentially through the state water project.

41. Purchase water/water rights for instream flows

Purchasing water rights of surface diverters is a common practice to increase streamflows. Purchase of water or water rights from water users along the tributaries of the Ventura River could increase instream flows. This measure would only be possible if water or water rights are available for purchase and if water needs of users are met through other means. As mentioned earlier, there is no additional water available as the Ventura River watershed is already above the safe yield standard during dry water years. It is unclear what quantity of surface diversions are available, but it is likely that most diversions are from groundwater pumping which are difficult to regulate and difficult to relate directly to streamflows. Testing would need to occur to determine if there would be biological benefits from this action. In addition, legislation would need to be drafted to allow the use of water right water to be used for instream flows (as discussed above in Action 14).

42. Manage timing and duration of ground water withdrawals

Groundwater pumping that affects base streamflow levels might be reduced or curtailed during periods of low streamflow. To accomplish this without significantly impacting existing users, replacement water must be provided. Groundwater pumping for residential use probably has no significant effect of streamflow, but pumping for agricultural use could have an effect on stream flows during low flow periods. The most pronounced use of groundwater for agriculture occurs along San Antonio Creek and its tributaries (Reaches E and F).

8.3.4 POPULATION AUGMENTATION

43. Wild steelhead hatchery to supplement tributaries

Populations of steelhead in the Ventura River watershed may be low because there are too few adults to effectively restart the population when good conditions occur. As discussed earlier for the mainstem (Action 19), the steelhead population of the Ventura River watershed could be directly supplemented by producing fish at a hatchery (probably Filmore Hatchery). The brood stock ideally would come from the Ventura River, either from residualized stocks in Matilija Creek and North Fork Matilija Creek or possibly from returning adults. If these potential sources are unavailable, the next most preferable stock would be southern steelhead from other nearby streams. This may be infeasible, however, if other basins' stocks are also at low levels and unavailable for use. Northern steelhead stocks should not be considered because their habitat requirements and life history patterns are thought to be different from those of southern steelhead, which have adapted to warmer conditions.

This type of hatchery would be consistent with CDFG policy only if the population in the Ventura is deemed as in imminent danger of extinction and then only temporarily to improve initial adult returns. According to the policies of the CDFG and the Fish and Game Commission, artificial supplementation and rearing would only be allowed if current factors that are limiting the population (e.g. passage barriers, habitat disturbances) are alleviated (D. McEwan, CDFG, pers. comm.). Therefore, this type of facility would not alleviate the need for passage, habitat, streamflow and water quality conditions to be improved. Population supplementation should be phased out once the number of returning adults is above critical levels. Using Filmore hatchery, rather than a streamside rearing facility would be inexpensive. However, even a small streamside rearing facility would be relatively inexpensive compared to many of the other potential actions. A streamside rearing facility would also have the benefit of allowing the fish to imprint on their natal waters, rather than water from a different watershed.

44. Supplement downstream tributaries with upstream juveniles

Local populations of steelhead in the lower Ventura River watershed could be supplemented through addition of juveniles from upstream reaches, especially reaches above man-made passage barriers (e.g. North Fork Matilija and Matilija Creeks). Trapping of smolts (which have been observed upstream of Robles Diversion Dam) and releasing them downstream of barriers in San Antonio Creek, for example, could be an effective way of seeding the remaining steelhead habitat. This would be an inexpensive way of supplementing the current population in the Ventura River watershed, on the order of $5,000 annually.

9.1 OVERVIEW OF PROCESS

Screening and ranking conservation measures is a critical part of the planning process. The purpose of this screening and ranking is to: (1) eliminate infeasible actions from further consideration; and (2) develop a prioritized list of actions to assist the sponsoring agencies and other interested parties in developing an implementation strategy. The information presented in Chapter 8.0 on the individual conservation actions was used as a basis for both the screening and ranking discussed in this section.

The screening and ranking is performed in two stages. In the first stage, screening criteria are applied to each candidate conservation action to determine if the action is infeasible and should be dismissed from further consideration. The removal of proposed candidate action would occur only if there was a clear obstacle to implementation that cannot be removed under current funding, legal, land use, or institutional conditions. The conservation actions that pass through the screening process are considered candidate conservation actions.

In the second stage, the candidate conservation actions are evaluated to assess qualitatively their relative advantages and disadvantages and to rank them according to the degree to which they meet the overall objectives of the restoration and recovery planning process. Several ranking criteria are applied in a three-step hierarchical approach to each candidate conservation action. This three-step ranking process recognizes that some criteria are more important than others in evaluation of the actions.

9.2 SCREENING OF CONSERVATION ACTIONS

Each candidate conservation action identified in Chapter 8.0 was evaluated relative to the screening criteria listed below. All screening criteria have equal importance, and any candidate conservation action that does not pass all criteria is dismissed.

9.2.1 SCREENING CRITERIA

1. *Legal or institutional obstacles* – Will existing water rights, legal obligations or prohibitions, and/or property rights clearly preclude the implementation of the conservation action? Such obstacles that are not likely to be resolved in a timely and cooperative manner amongst public agencies and private interests would preclude implementation.

2. *Technical infeasibility* – Are proven technical solutions not available to implement the conservation action?

3. *Cost infeasibility* – Are the costs of the conservation action prohibitive for the involved agencies, taking into account: (1) the current financial and legal constraints

facing public agencies as they meet their operational costs and debt obligations; and (2) the economic, legal, and political difficulties of developing additional public funds for the capital and operational costs of a conservation action?

4. _Other unacceptable environmental impacts_ – Are anticipated detriments to the natural environment, public health and safety, and overall public interest associated with implementation of the conservation action so severe that the action is unlikely to be approved by a regulatory agency?

5. _Not allowable under the Endangered Species Act_ – Would the conservation action clearly not minimize take of the species, and would it likely result in jeopardy to the local population along the Ventura River?

9.2.2 Screening Process

Most conservation actions successfully passed the screening process except three: installation of a fish ladder on Matilija Dam (Action 21), installation of a fish ladder on Casitas Dam (Action 24), and removal of Matilija Dam (Action 20). The 135-foot height of Matilija Dam is too high for conventional fish passage facilities to be effective. Some experimental work is being conducted, but the technology is not yet available to pass fish over heights of 135 feet within a confined canyon with any large degree of success. Similarly, the height of Casitas Dam makes a fish ladder technically infeasible at this time.

Removal of Matilija Dam was also screened out because of projected costs, existing technical difficulties, and negative environmental impacts including biological, air quality, and transportation impacts. All of these impacts would need to be mitigated. The total estimated cost for removal of Matilija Dam including sediment removal, dam removal and concret disposal, habitat restoration, and mitigation requirements would be on the order of 30 to 100 million. A more detailed discussion of the technical constraints and costs of Matilija Dam removal are provided in Appendix B.

These actions did not pass the screening criteria as set up a'priori for this report. This does not mean, however, that there may not be technologic advances and/or future funding alternatives to allow exploration into these actions in the future.

9.3 Evaluation of Conservation Actions

9.3.1 Ranking Process

The candidate conservation actions that were not eliminated during the screening process were evaluated using several criteria that address biological benefits, resource allocation, legal or institutional constraints, and incidental environmental impacts. In the process of ranking the candidate conservation actions, we considered eight different criteria. Some evaluation criteria were more important to the decision-making process than others. For example, the likelihood of success should have more influence on the decision than additional environmental benefits. A candidate conservation measure with a low likelihood of success should rank lower than a measure with a high likelihood of success and few additional environmental benefits. Similarly, a measure with high likelihood of success and additional environmental benefits should outrank both of the other measures. To provide for different degrees of importance to the ranking process, we used a hierarchical three-step approach.

Level 1: Benefit to Steelhead Restoration and Recovery

Level 2: **Cost and Success Variables**
Likelihood of Success
Total Cost (capital, operations, maintenance and monitoring)
Land and Water requirements

Level 3 Other Considerations
Operational and maintenance requirements
Potential for other incidental biological benefits
Institutional coordination and agreements
Incidental environmental impacts

We assigned the greatest importance to the biological significance of the action relative to improving steelhead populations. The objective of the plan is to identify actions that would assist in the restoration and recovery of steelhead stocks in the Ventura River and we wanted to ensure that the primary emphasis of the decision-making process focused on providing benefits to steelhead. The second highest level of importance was assigned to cost and success variables and included an evaluation of the likelihood of success, total cost, and the need to acquire or reallocate land and water resources. Along with the benefit to steelhead, these are criteria that most heavily influenced the overall ranking of candidate restoration measures. These variables were used to determine which of the highly beneficial actions would provide a better alternative than the other similarly ranked beneficial actions. In this level, we recognized the technical and biological feasibility and risk of failure. We also include the fiscal costs as well as issues related to reallocation of water and land resources. The final set of variables evaluated included other considerations such as other biological benefits, incidental environmental impacts, the need for institutional coordination, and the effort associated with operations and maintenance. These variables are important to consider but usually they should not outweigh biological benefits, success or resource allocation criteria. Using this hierarchical analysis allowed us to incorporate the evaluation criteria at the appropriate point in the decision process.

Evaluation ratings are relative in nature. That is, the ratings for each action are relative to other actions. For each criterion, there are five rating levels: 1 being the least beneficial or most problematic to 5 being the most beneficial or least problematic. The evaluation criteria are described in more detail in the following sections.

9.3.2 PRIMARY RANKING ACCORDING TO BIOLOGICAL BENEFITS

The most important consideration in evaluating the range of conservation actions is "Will it benefit steelhead?" Ranking according to the biological benefits was therefore the first step. The ranking was based on our understanding of the factors currently limiting the steelhead population in the Ventura River (Chapter 4). The ranking criterion for biological benefits is as follows:

- *Biological benefits* - To what extent would the successful implementation of the conservation action improve habitat conditions for steelhead, population levels, and/or reproduction along the Ventura River watershed?

Highly ranked conservation actions were those that addressed the most serious limiting factor(s) in the basin, addressed multiple limiting factors, or provided benefits over a wide geographic range or prolonged time period. The primary rankings for the candidate conservation actions are presented in Table 9-1.

The highest biological benefit rankings (5) were given to actions which allow passage at Robles Diversion Dam, giving steelhead access to some of their historical spawning and rearing habitat (Actions 2, 3, and 5). Lack of access to headwater areas has been suggested as the most important limiting factor to steelhead in southern California streams (D. McEwan, CDFG, pers. comm.).

The next highest rankings (4) were given to actions that involve achieving passage through the lower Ventura River up to Robles Diversion Dam (Actions 1, 5, 6,12). The hydrologic analysis suggested that passage through the lower Ventura River, particularly between Santa Ana Boulevard and Robles Diversion Dam, did not historically and does not now occur every year. These actions are intended to improve habitat and/or flow conditions, therefore increasing the frequency of appropriate passage conditions. These actions are particularly important since we are recommending that passage at Robles Diversion Dam be restored. While we may accept that passage may not occur every year, agencies or others who may fund passage structures at Robles may not feel that the structures are warranted if passage only occurs in one of two years. Trap-and-truck operations are only recommended either prior to passage structures being built at Robles Dam or in very low flow years when passage through the lower river is not possible.

Moderate relative rankings (3) were given to many of the other actions including interim hatchery supplementation (Actions 18 and 43), trap-and-truck operations at Matilija Dam to allow access to more historical spawning habitat (Actions 22 and 23), some flow releases from Matilija and/or Casitas reservoirs (Actions 16, 36, and 37) and other flow management actions (Actions 14 and 41), and some habitat enhancement measures to reduce sedimentation and improve instream habitat structure and water quality (Actions

Table 9-1. Primary Ranking According to Biological Benefits of Candidate Conservation Actions.

Rating levels (1 to 5) 1 = Very low biological benefit, 5 = Very high biological benefit

Action #	**Mainstem** Conservation Actions	Biological Benefits
	Passage Barriers	
1.	Construct single-thread passage channel above & below Robles	4
2.	Ladder Robles Diversion Dam	5
3.	Screen Robles Diversion	5
4.	Fish collection canal at Robles	5
5.	Trap and truck adults upstream of Robles Diversion Dam	4
6.	Trap and truck juveniles & adults downstream past Robles	4
	Habitat Enhancements	
7.	Construct low flow channel	2
8.	Reduce erosion & sedimentation	2
9.	Plant riparian vegetation, remove non-native vegetation	2
10.	Install instream structures for cover and pool formation	2
11.	Conservation easements along river channel	1
	Flow-Related Measures	
12.	Bypass flows at Robles Dam to improve downstream habitat	4
13.	Recirculate/recycle flows in live stretch	1
14.	Purchase water/water rights for instream flows	3
15.	Release water from Lake Casitas through Coyote Creek	2
16.	Release water from Lake Casitas to mainstem	3
17.	Manage timing and duration of ground-water withdrawals	1
	Lack of Adults	
18.	Wild steelhead hatchery for mainstem production	3
19.	Supplement mainstem habitat with upstream juveniles	2

Action #	**Tributaries** Conservation Actions	Biological Benefits
	Passage Barriers	
22.	Trap and truck adults upstream of Matilija Dam	3
23.	Trap and truck fish downstream of Matilija & Robles dams	3
25.	Trap and truck adults upstream of Casitas Dam	2
26.	Trap and truck fish downstream of Casitas Dam	2
27.	Remove potential passage barriers from road crossings	3
	Habitat Enhancements	
28.	Erosion control measures for roads and gullies	3
29.	Construct low flow channel	2
30.	Add pool forming & instream cover structures	3
31.	Add spawning gravels	2
32.	Plant riparian vegetation, remove non-native vegetation	3
33.	Conservation easements	3
34.	Manage sources of nutrient loading and pollutants	3
	Flow-Related Measures	
35.	Ramping flows from Matilija Reservoir	2
36.	Minimum flows from Matilija Res.	3
37.	Remove sediment from Matilija Res. for storage for flow augment.	3
38.	Scheduled diversion for surface irrigators	2
39.	Minimum summer flows from small irrigation reservoir(s)	1
40.	Minimum flows from Casitas Res	2
41.	Purchase water/water rights for instream flows	3
42.	Manage timing and duration of ground-water withdrawals	2
	Lack of Adults	
43.	Wild steelhead hatchery for tributary production	3
44.	Supplement tributary habitat with upstream juveniles	2

27, 28, 30, 32, and 37). Stocking is recommended as a short-term measure that will help to ensure that there is native wild steelhead stock in the Ventura River to benefit from other improvements. Given other technological constraints, a trap-and-truck operation at Matilija Dam is the best available solution to allowing steelhead to use historical habitat. This action was given a moderate rating because it comes with the associated drawbacks of handling fish and because much of the mainstem habitat is inhospitable except in wet years. Although good habitat exists in the tributaries, it would be difficult for fish to travel through the mainstem Matilija Creek to reach those tributaries in dryer years. During wet years the success of trapping would be questionable. Given the small amount of water stored in Matilija Reservoir and that currently natural inflow into the reservoir is released downstream during summer and fall, flow releases would likely only benefit the reach just downstream of the dam. If storage could be increased, more benefit could be achieved, but structural problems limit the likelihood of increased storage (as indicated by the subsequent ranking of this action). Flow releases from Casitas Reservoir into the mainstem Ventura near the live stretch may benefit fish rearing in the mainstem, especially the reach between the live stretch and the OVSD effluent. However, warm water temperatures resulting from these releases would need to be addressed and would limit the biological benefit of this action. In addition, supplemental water would need to be obtained to replace this water. Finally, various habitat improvement measures would benefit steelhead, usually in associated short reaches. These habitat improvements could have a cumulative important benefit if implemented and maintained for many years.

The rest of the measures received relatively poor rankings (2 or 1) with regard to biological benefit because they only benefited a very small section of stream or small portion of the population, have an associated high risk to steelhead, or have questionable outcome. For example, ramping flows from Matilija Dam (Action 35) during flushing releases to divert at Robles, only benefits a small section of stream and the current way of releasing only detrimentally effects a small number of the fish rearing in that reach. Trap-and-truck operations have associated high risks, as mentioned earlier, which, in the case of passage past Casitas Dam (Actions 25 and 26), do not outweigh the benefits given the difficulties with non-native predators from the reservoir, the natural barriers upstream, and the problems with the potential loss of juveniles into the reservoir. Actions such as managing timing and duration of groundwater withdrawals (Actions 17 and 42) has questionable outcome and benefits given the current knowledge of the shallow aquifers in the watershed and the current high rates of pumping.

9.3.3 Secondary Ranking According to Likelihood of Success, Cost, and Requirements for Land or Water Rights

Once the conservation actions were ranked according to the biological benefits provided, the second step was to evaluate how well the action would perform to benefit steelhead. Another important consideration is the cost, both initial and continuing. A third potential obstacle is the land and water rights necessary for implementation of a conservation action. These ranking criteria are described as follows:

1. *Likelihood of success* - What is perceived as the probability that the conservation action can be implemented in the envisioned manner and will result in the

anticipated benefits to steelhead? The likelihood of success included an evaluation of the technical feasibility of the action and the degree to which innovative or unproven technology would be required to accomplish the conservation action. It also includes an evaluation of whether the steelhead will respond to the action as anticipated, i.e. will a trapping program be successful in capturing steelhead migrants given poor trap performance in high flows. [Rating: 1 = very low probability of success, 2 = low probability, 3 = moderate probability, 4 = high probability, 5 = very high probability]

2. *Total costs* – What are the estimated costs for the conservation action, including initial planning and permitting costs, capital costs for facilities, and long-term operations and maintenance costs? [Rating: 1 = very high costs, 2 = high costs, 3 = moderate costs, 4 = low costs, 5 = very low costs]

3. *Land and water right requirements* – What is the relative degree of difficulty in acquiring private property or easements, water rights, or legal agreements needed to implement the conservation action? [Rating: 1 = very high difficulty, 2 = high difficulty, 3 = moderate difficulty, 4 = low difficulty, 5 = very low difficulty]

The ratings from this secondary ranking of the 41 conservation actions (which are categorized according to the degree of biological benefit each provides) are presented in Table 9-2. Ten conservation actions that rated poorly (rank = 1) were eliminated from further consideration for the purposes of this plan. These actions would have very great difficulty acquiring land easements or water rights: conservation easements (Actions 11 and 33), purchase of water rights (Actions 14 and 41), releasing water from Lake Casitas (Actions 15, 16, and 40). Two actions were eliminated because they had a very low likelihood of successfully improving conditions for steelhead: scheduled diversions for surface irrigators along tributaries (Action 38) and managing ground water withdrawals in the tributaries (Action 42). No actions were eliminated because of high costs.

9.3.4 TERTIARY RANKING ACCORDING TO OTHER CRITERIA

In the final ranking stage the remaining 31 conservation actions were evaluated according to the following criteria:

1. *Operations and maintenance requirements* – What is the relative effort of operation and/or maintenance activities associated with the conservation action? [Rating: 1 = very high effort, 2 = high effort, 3 = moderate effort, 4 = low effort, 5 = very low effort]

2. *Potential for other incidental biological benefits* – What is the likelihood of incidental beneficial effects occurring to other biological resources or species? [Rating: 1 = very low benefit, 2 = low benefit, 3 = moderate benefit, 4 = high benefit, 5 = very high benefit]

Table 9-2. Secondary Ranking of Conservation Actions.

Rating levels (1 to 5) 1 = Least beneficial or most problematic, 5 = Most beneficial or least problematic
Actions rated with a "1" were eliminated from further consideration.

Action #	Mainstem or Trib?	**Candidate Conservation Actions** (Grouped by Biological Benefit)	**Important Evaluation Criteria** Likelihood of Success	Costs	Land & Water Right Requirements	Continue to Consider?
Very High Biological Benefit						
2.	Mainstem	Ladder Robles Diversion Dam	5	3	3	Yes
3.	Mainstem	Screen Robles Diversion	4	2	4	Yes
4.	Mainstem	Fish collection in Robles Canal	4	2	3	Yes
High Biological Benefit						
1.	Mainstem	Construct single-thread channel above & below Robles for passage	3	3	3	Yes
5.	Mainstem	Trap and truck adults upstream of Robles Diversion Dam	3	3	4	Yes
6.	Mainstem	Trap and truck juveniles & adults downstream past Robles Diversion	3	3	4	Yes
12.	Mainstem	Bypass flows at Robles Dam to improve passage	3	2	2	Yes
Moderate Biological Benefit						
14.	Mainstem	Purchase water/water rights for instream flows in mainstem	3	2	1	No
16.	Mainstem	Release water from Lake Casitas to mainstem	3	2	1	No
18.	Mainstem	Wild steelhead hatchery for mainstem production	3	2	3	Yes
22.	Tribs	Trap and truck adults upstream of Matilija Dam	3	3	4	Yes
23.	Tribs	Trap and truck fish downstream of Matilija & Robles dams	3	3	4	Yes
27.	Tribs	Remove potential passage barriers from road crossings and other barriers in tributaries	5	4	3	Yes
28.	Tribs	Erosion control measures for roads and gullies in tributaries	3	4	5	Yes
30.	Tribs	Add pool forming & instream cover structures in tributaries	3	5	5	Yes
32.	Tribs	Plant riparian vegetation in tributaries, remove non-native vegetation	3	5	4	Yes
33.	Tribs	Conservation easements along tributary channels	3	2	1	No
34.	Tribs	Manage sources of nutrient loading and pollutants in tributaries	3	4	3	Yes
36.	Tribs	Minimum flows from Matilija Reservoir	3	3	3	Yes
37.	Tribs	Remove sediment from Matilija Res. for storage for flow augment.	2	2	2	Yes

Table 9-2. Secondary Ranking of Conservation Actions (concluded).

Action #	Mainstem or Trib?	**Candidate Conservation Actions** (Grouped by Biological Benefit)	**Important Evaluation Criteria** Likelihood of Success	Costs	Land & Water Right Requirements	Continue to Consider?
Moderate Biological Benefit						
41.	Tribs	Purchase water/water rights for instream flows in tributaries	3	2	1	No
43.	Tribs	Wild steelhead hatchery for tributary production	3	2	3	Yes
Low Biological Benefit						
7.	Mainstem	Construct low flow channel in mainstem for rearing	2	3	3	Yes
8.	Mainstem	Reduce erosion and sedimentation in mainstem	3	4	5	Yes
9.	Mainstem	Plant riparian vegetation in mainstem, remove non-native vegetation	2	4	4	Yes
10.	Mainstem	Install instream structures for cover and pool formation in mainstem	2	4	4	Yes
15.	Mainstem	Release water from Lake Casitas through Coyote Creek	3	2	1	No
19.	Mainstem	Supplement mainstem habitat with upstream juveniles	2	4	4	Yes
25.	Tribs	Trap and truck fish downstream of Casitas Dam	2	2	3	Yes
26.	Tribs	Trap and truck fish downstream of Casitas Dam	2	2	3	Yes
29.	Tribs	Construct low flow channel in Coyote Creek	3	3	4	Yes
31.	Tribs	Add spawning gravels in tributaries	3	5	4	Yes
35.	Tribs	Ramping flows from Matilija Reservoir	4	4	3	Yes
38.	Tribs	Scheduled diversion for surface irrigators along tributaries	1	3	4	No
40.	Tribs	Minimum flows from Casitas Reservoir to Coyote Creek	3	2	1	No
42.	Tribs	Manage timing & duration of ground-water withdrawals along tributaries	1	3	3	No
Very Low Biological Benefit						
11.	Mainstem	Conservation easements along mainstem	4	2	1	No
13.	Mainstem	Recirculate/recycle flows in live stretch	3	3	3	Yes
17.	Mainstem	Manage timing and duration of ground-water withdrawals along mainstem	2	3	3	Yes
39.	Tribs	Minimum summer flows from small irrigation reservoir(s) on tributaries	2	3	3	Yes
44.	Tribs	Supplement tributary habitat with upstream juveniles	2	4	4	Yes

3. *Institutional coordination and agreements* – What is the relative degree cooperation needed among land owners, sponsor agencies, interest groups, and regulatory agencies to implement the conservation action? Action that require the cooperation of a large number of parties were ranked lower than those requiring the cooperation of a few parties. Action requiring active participation of a local landowners were ranked lower than those requiring the active participation of local governmental agencies or organized groups. [Rating: 1 = very high coordination, 2 = high coordination, 3 = moderate coordination, 4 = low coordination, 5 = very low coordination].

1. *Incidental environmental impacts* – What is the magnitude of associated environmental impacts that would affect other biological resources, public health and safety, water quality, aesthetics, recreation, land use, and socioeconomic conditions? [Rating: 1 = very high impacts, 2 = high impacts, 3 = moderate impacts, 4 = low impacts, 5 = very low impacts].

The results of this tertiary ranking are presented in Table 9-3.

9.4 CONCLUSIONS

Of the 44 proposed conservation actions originally considered, only three conservation actions were screened out prior to the ranking process, due to serious problems with technical infeasibility, cost, and/or significant negative environmental impacts. These included various measures to provide fish passage above Matilija Dam and Casitas Dam (Action 20 - remove Matilija Dam, Action 21 - fish ladder at Matilija Dam, Action 24 - fish ladder at Casitas Dam)

Conservation measures that provided passage for steelhead to the upper basin received the highest ranking for biological benefits and, although costly, these ranked high relative to the other evaluation criteria. Availability of juvenile rearing habitat with suitable flows and water temperature is one of the most important factors in the freshwater environment that limit the Ventura basin steelhead population. Passing fish upstream into the upper basin provides access to the year-round rearing habitat in North Fork Matilija Creek and portions of the Matilija Creek basin. These high ranking measures include continued bypass releases from Robles Diversion Dam during times of diversion for improved passage conditions through the lower river for upmigrating adults and downstream migrating juveniles.

Conservation actions that would have moderate biological benefits included restoring access to habitat upstream of Matilija Dam through trap-and-truck operations, hatchery supplementation, flow releases from Matilija and Casitas reservoirs, and tributary habitat enhancement measures. Some of these actions have other associated difficulties that will make implementation difficult. As explained earlier, trap-and-truck operations are difficult during high flow years, when the most productive habitat conditions exist. During low flow years, when trapping would be feasible, much of the habitat would be either already fully seeded with resident rainbow trout stock or would be inhospitable for

Table 9-3. Tertiary Ranking of Conservation Actions.

Rating levels (1 to 5) 1 = Least beneficial or most problematic, 5 = Most beneficial or least problematic

Action #	Mainstem or Tribs?	**Candidate Conservation Actions** (Grouped by Biological Benefit)	**Moderately Important Evaluation Criteria**			
			O&M Requirements	Other Biological Benefits	Institutional Coordination	Incidental Environmental Impacts
Very High Biological Benefit						
2.	Mainstem	Ladder Robles Diversion Dam	3	2	4	4
3.	Mainstem	Screen Robles Diversion	3	2	4	4
4.	Mainstem	Fish collection in Robles Canal	3	4	4	3
High Biological Benefit						
1.	Mainstem	Construct single-thread passage channel above & below Robles for passage	2	3	2	2
5.	Mainstem	Trap and truck adults upstream of Robles Diversion Dam	2	2	2	4
6.	Mainstem	Trap and truck juveniles & adults downstream past Robles Diversion Dam	2	2	2	4
12.	Mainstem	Bypass flows at Robles Dam to improve downstream habitat	3	3	3	2
Moderate Biological Benefit						
18.	Mainstem	Wild steelhead hatchery for mainstem production	2	1	2	3
22.	Tribs	Trap and truck adults upstream of Matilija Dam	2	2	2	3
22.	Tribs	Trap and truck adults upstream of Matilija Dam	2	2	2	3
23.	Tribs	Trap and truck fish downstream of Matilija & Robles dams	2	2	2	3
27.	Tribs	Remove potential passage barriers from road crossings and other barriers in tributaries	4	2	3	4
28.	Tribs	Erosion control measures for roads and gullies in tributaries	4	4	3	4
30.	Tribs	Add pool forming & instream cover structures in tributaries	3	4	3	4
32.	Tribs	Plant riparian vegetation in tributaries	4	4	2	3
34.	Tribs	Manage sources of nutrient loading and pollutants in tributaries	3	3	2	4
36.	Tribs	Minimum flows from Matilija Reservoir	3	2	3	3
37.	Tribs	Remove sediment from Matilija Res. for storage for flow augment.	1	3	1	1
43.	Tribs	Wild steelhead hatchery for tributary production	2	1	2	3

Table 9-3. Tertiary Ranking of Conservation Actions (concluded).

Action #	Mainstem or Tribs?	Candidate Conservation Actions (Grouped by Biological Benefit)	Moderately Important Evaluation Criteria			
			O&M Requirements	Other Biological Benefits	Institutional Coordination	Incidental Environmental Impacts
Low Biological Benefit						
7.	Mainstem	Construct low flow channel in mainstem for rearing	3	4	2	2
8.	Mainstem	Reduce erosion and sedimentation in mainstem	4	4	2	5
9.	Mainstem	Plant riparian vegetation in mainstem	3	4	3	4
10.	Mainstem	Install instream structures for cover and pool formation in mainstem	3	4	3	4
19.	Mainstem	Supplement mainstem habitat with upstream juveniles	4	1	2	3
25.	Tribs	Trap and truck fish downstream of Casitas Dam	2	2	1	2
26.	Tribs	Trap and truck fish downstream of Casitas Dam	2	2	1	2
29.	Tribs	Construct low flow channel in Coyote Creek	3	3	2	2
31.	Tribs	Add spawning gravels in tributaries	3	2	4	2
35.	Tribs	Ramping flows from Matilija Reservoir	3	2	3	3
Very Low Biological Benefit						
13.	Mainstem	Recirculate/recycle flows in live stretch	2	2	1	4
17.	Mainstem	Manage timing and duration of ground-water withdrawals along mainstem	3	3	2	4
39.	Tribs	Minimum summer flows from small irrigation reservoir(s) on tribs	3	2	3	4
44.	Tribs	Supplement tributary habitat with upstream juveniles	4	1	2	3

rearing. Supplementation posses difficulties because the Department of Fish and Game's current supplementation policy only allows stocking when the species is in imminent danger of extinction. Since there is evidence that tributary resident rainbow trout stocks contain fish with native steelhead genotypes, steelhead in the Ventura are not currently considered in danger of extinction. Localized small and large-scale habitat improvement actions, particularly along San Antonio Creek would also be beneficial to steelhead rearing and spawning habitat. Flow releases from Matilija and Casitas may improve localized reaches of the river for rearing, but there are associated problems with water availability.

Although many stream reaches would benefit substantially from increased summer/fall streamflows, low flow season streamflow augmentation is not a major component of our recommended action plan. Water storage facilities do not exist in the upper portions of the watershed where controlled releases would be of most benefit to rearing juvenile steelhead. If storage facilities were constructed, sedimentation would soon render them ineffective. During extended periods of low streamflow insufficient water exists in the watershed to meet existing demand. A small amount of water might be obtained from lake Casitas during years with above normal precipitation, but that water would be available only for mainstem rearing juveniles and too infrequently to be a significant component to a steelhead recovery plan.

All of the mitigation measures described in Chapter 7 to avoid "take" and minimize impacts to steelhead and other aquatic resources should be implemented. The outlined mitigation measures for specific activities should be included as part of permit applications.

From the rankings of the conservation actions in Chapter 9.0, we developed the following recommendations for implementing conservation actions that would have meaningful benefits to steelhead in the Ventura River. We have recommended both actions that could be implemented in the near term and actions requiring a longer time frame. Some actions require the implementation of conjunctive actions in order to realize the expected benefits. Other actions can be undertaken independently. For some of the more expensive and complex measures, it will likely take time to secure funding, prepare design specifications, or demonstrate some aspect of feasibility. In these cases, we have suggested interim measures or pilot projects that can expedite achievement of benefits or remove uncertainty associated with some aspect of implementation.

10.1 PASSAGE/MIGRATION ACTIONS

10.1.1 PROVIDE ACCESS TO HABITATS UPSTREAM OF ROBLES DIVERSION

Providing access to habitats upstream of Robles Diversion is one of the most important actions that can be taken to improve steelhead populations in the Ventura River. There is not currently, nor likely historically, much potential for increasing production in the mainstem downstream of Robles. Productive rearing conditions can exists in the mainstem in above normal and wet water years. However, as in many southern California streams, low summer/fall flows, highly permeable streambeds, and elevated water temperatures limit the rearing potential of mainstem habitat in below normal water years. In the Ventura River between Robles diversion and the Foster Park area, the mainstem river often dries, even though Robles Diversion is not operated and inflow to Matilija Reservoir is bypassed during the low flow periods. Historically, the Ventura River also went dry between Robles Diversion and Foster Park. The basin characteristics contributing to this were discussed in Chapter 2.0.

Upstream passage at Robles Diversion would allow adult steelhead to access important historical spawning and rearing habitat in North Fork Matilija Creek. It is unlikely that historical flow conditions provided passage to and from tributary spawning habitat every year, and thus guaranteed passage every year should not be expected in the future. Historically, adults could not enter tributaries in some years and juvenile steelhead remained in headwater areas where conditions were favorable until passage was possible in a subsequent year. Aquatic habitat in North Fork Matilija Creek remains in relatively good condition. Fish population and habitat surveys conducted by the U.S. Forest Service (USFS) and the California Department of Fish and Game (CDFG) indicate that resident rainbow trout production in North Fork Matilija Creek is high, indicating that existing habitat conditions are suitable for steelhead (see Chapter 3).

Long term passage can probably be provided for Ventura River steelhead by (1) constructing a fish ladder at Robles Diversion, (2) installing a fish collection/bypass facility in the canal, and (3) perhaps maintaining a low flow passage channel from the live stretch (Foster Park) to Robles Diversion assist fish in low flow years (as described in the next section). Providing the opportunity for adult steelhead to successfully arrive at and pass over Robles Diversion Dam would provide access to approximately 5 miles of upstream habitat for spawning and rearing. The success of this conservation action depends on several factors: appropriate design of passage facilities for upstream and downstream migrants, steelhead access to Robles, good quality spawning and rearing habitat being accessible in North Fork Matilija Creek, and a sufficient number of fish to utilize the passage facilities and the upstream habitat.

In preparation for implementing the envisioned long-term solution, studies need to be conducted in the near term to address a variety of engineering and biological questions. Some of these studies will be no more elaborate than site visits, review of existing information and discussions with knowledgeable individuals. Other studies will require detailed analysis of streamflow records, site conditions, and fish behavior.

Engineering studies need to identify the range of streamflows and diversion rates under which passage facilities must operate. Biologist and hydrologists need to identify the time of year and flow range for which the passage facilities must be most effective. The location of the fish ladder relative to the location of the existing diversion facilities and upstream flow patterns in the impoundment behind Robles diversion Dam must be carefully considered for several combinations of streamflow and diversion rates. The location of the fish ladder (or ladders) must also be carefully considered relative to stability of foundation materials, sediment and debris loading.

The specific location and nature of downstream passage facilities must be considered as well as where the captured juvenile fish will be deposited. Based on streamflow records, juvenile fish may enter the facility when streamflows downstream of Robles might be too low to ensure their successful outmigration or rearing. Depending on mainstem streamflows, we may need to consider if juvenile fish should be delivered to the mainstem habitat (upstream of or in the live stretch), the estuary, or potentially returned to upstream habitats. Rigorous investigation of existing streamflow records will provide insight into the frequency and duration of flows at which a narrow, single-thread, low flow channel might be important.

Some additional biological questions that should be answered relate to the interaction of the resident rainbow trout population in the North Fork Matilija and the re-introduced steelhead populations. We need to know if juvenile steelhead could compete effectively with the larger resident rainbow trout, of mixed ancestry, inhabiting the subbasin. Catchable-size trout have been planted in the headwaters of the Ventura River watershed periodically for over a hundred years, and quite regularly since Robles Diversion Dam was constructed. These stocks, mostly derived from northern coastal rainbow stocks, were bred for characteristics associated with resident rainbow trout. If interbreeding occurred, there is a slight chance that the offspring would have a tendency to residualize in North Fork Matilija. Another question the regulatory agencies would need to address is whether a rainbow trout sport fishery could co-exist with steelhead recovery efforts.

The construction of fish passage facilities at Robles would require time to conduct the site-specific hydraulic and engineering evaluations needed to prepare conceptual plans, design drawings, and construction schedules. Since the total cost of upstream and downstream passage facilities at Robles would be between $1-2 million, time would likely be required to obtain funding.

A near term (interim) measure to provide passage at Robles may be trap-and-truck operations around Robles diversion for upstream and downstream migrants. Upstream migrating adults could be trapped in the lower mainstem and trucked above Robles Diversion. Potential trapping sites are the Shell Oil Company Bridge, near the Ojai Valley Sanitary District wastewater treatment facility, or near the Santa Ana Road crossing (downstream of Foster Park). Adults could potentially be trucked upstream to North Fork Matilija Creek (and maybe San Antonio Creek when flows are not high enough to allow passage into that subbasin). Downstream migrants could be trapped near the channel constriction just downstream of the confluence of Matilija and North Fork Matilija creeks. Trapping efforts may be difficult during high flow events and provisions would have to be made to preclude a finding of “take” if some downmigrants were diverted into Casitas Lake during these interim activities. Tributaries could be surveyed for redds and juvenile abundance as described below to determine the ability of the existing habitat to support spawning and sustain juvenile fish. These surveys may also identify the need for potential habitat restoration projects for various stream reaches.

10.1.2 PROVIDE PASSAGE BETWEEN FOSTER PARK AND ROBLES DIVERSION

Providing adequate passage at Robles could become the focal point of the steelhead recovery effort for the Ventura River. In order for the passage facilities to contribute in a meaningful way to steelhead recovery, adult fish must have access to the proposed ladder on a fairly frequent basis; perhaps no less than three out of five years over the long term. However, current information suggests that upmigrating steelhead may have difficulty reaching passage facilities as Robles when streamflows are less than about 50 cfs given the current channel configuration. Several shallow and often discontinuous braided channel reaches (particularly between the live stretch and Robles Diversion Dam) appear to be serious passage impediments, potentially also impacted juveniles migrating downstream. And, although adult steelhead are opportunistic and may be able to enter the lower Ventura River, they may not be able to migrate upstream past Robles, or smolts may be unable to migrate downstream to the live stretch in some years.

There have been many years (30 to 50 percent), during the gaged period of record (pre and post water development projects) in which passage flows were never achieved during the entire upstream migration period (see Chapter 2.0, Migration Period Streamflows section). Providing a low flow passage channel in the Ventura River from Foster Park to Robles Diversion Dam would benefit steelhead by making the upstream passage facilities at Robles Diversion and therefore tributary habitat accessible in more years, because it would make passage possible at lower flows. We estimate that flows of approximately 20 cfs would provide deep enough water in the low flow channel to allow upstream passage. Allowing access to upstream habitat every year or on a more frequent basis is likely more important while trying to rebuild the steelhead population and may become less important as the steelhead stocks recover to a sustainable level. This action needs additional hydrologic (surface and groundwater) and engineering studies to determine its feasiblity, including investigating the available water sources.

In the interim, if a trap-and-truck operation is implemented for Robles Diversion, the construction of a low flow passage channel could be tested on a modest scale as a pilot project. By constructing several hundred feet of low flow passage channel in the two or three locations between Robles Diversion and Foster Park, construction techniques and cost effectiveness could be evaluated. We would also be able to assess the relative stability of the passage channel after it is subjected to high streamflows. This knowledge may assist with developing more stable and less costly channels to maintain in the long term. Habitat improvement sites (as discussed below) could be used as receptacles for adults trapped during their upstream migration and monitored for spawning and rearing success.

Removing potential passage barriers from road crossings or other structures in tributaries (specifically along San Antonio Creek and North Fork Matilija Creek) would also benefit steelhead. Some of these barriers may be complete migration barriers and others may only be impediments in years when there are not high streamflows during the migration season. Some of these barriers, specifically along San Antonio Creek and its tributaries, are on private property and will require substantial coordination to improve. A few barriers need to be assessed for the actual benefit removal would provide. For example, the barriers along the upper part of San Antonio Creek and its tributaries, currently block steelhead access to habitat that is in poor condition and usually has subsurface flow conditions. And the barrier on North Fork Matilija Creek may serve to direct fish into a tributary, Bear Creek, which has better habitat than upstream on North Fork Matilija Creek. Therefore, detailed habitat and flow analysis should be done prior to removal of these few barriers. Coordination with public agencies and private landowners will be required for removal of many of these barriers.

10.2 HABITAT IMPROVEMENT ACTIONS

Only one pilot habitat improvement project is recommended for the mainstem Ventura River because periodic extreme high flows and the abundant sediment load would likely limit the success of such projects. In areas where riparian vegetation has been removed, riparian vegetation should be replaced, especially along the live stretch where there is enough water to support riparian growth. In the past, there was a notable lack of riparian vegetation, which reduces channel structure, along most of the mainstem Ventura River after years with extremely high flow events. In years that lack high flow events, the vegetation tends to reestablish, but regrowth can take several years and is quickly removed again during the next high flow event. If a pilot project is not successful in the mainstem, because of high scouring flows, additional riparian enhancement projects should not be initiated. Non-native riparian vegetation removal, specifically along the lower rivers, should be implemented. These actions were given a low biological benefit rating because of the relatively small about of habitat they have the potential to affect.

Selected habitat improvement projects are recommended for some of the tributaries. In the tributaries, habitat improvements, such as planting native riparian vegetation, removing non-native vegetation, and installing habitat improvement structures (large tree roots or woody debris or boulders) should be initiated. There may be a need in some cases to initiate pilot projects to adapt techniques to the Ventura River watershed prior to initiating large-scale habitat improvement projects. Treatment sites should be monitored for spawning and juvenile rearing success. Possible streams to consider are San Antonio Creek and North Fork Matilija Creek. Sites that need habitat improvements can be determined by reviewing the detailed habitat survey studies that have been done in both subbasins (Fugro 1996b, Chubb 1997). For example, along both North Fork Matilija Creek and especially San Antonio Creek, there are short reaches that lack riparian vegetation or have bank erosion problems. Planting vegetation or otherwise treating the banks will improve conditions in those reaches and could improve water temperatures downstream. Matilija Creek, and especially its tributaries, could also be a candidate for habitat improvement projects if passage is restored. However, periodic high flow events and abundant sediment load would limit the success of such projects in the mainstem. There are reaches along tributaries to Matilija Creek where banks are eroding and riparian vegetation could be restored. It would also be useful to educate private landowners on the importance of riparian vegetation and woody debris in streams, so that future removal is kept to a minimum.

Another potential habitat improvement related to water quality in the tributaries would be to manage sources of nutrient loading and pollutants. The best near term and long term action to avoid nutrient and pollutant loading into Ventura River basin streams is public education of the associated impacts of such actions. Nutrient loading from things such as manure and fertilizer run off increases the biological oxygen demand in a stream and reduces the amount of dissolved oxygen available to fish. It should be noted that these types of problems were only noted in isolated areas, but can be especially detrimental to water quality when the riparian corridor is lacking and sunlight causes algae blooms, further reducing the amount of dissolved oxygen available to fish.

10.3 STREAMFLOW IMPROVEMENT ACTIONS

Few streamflow options are feasible because of the lack of water available in the system and the existing water demand. In addition, in the mainstem, substantial water would be need for flow augmentation because of the permeable nature of the mainstem channel and the natural tendency for flows to go subsurface. There is also a greater opportunity to increase production potential by allowing passage to headwater reaches with perenial water, than trying to improve mainstem habitat with reaches that are often dewatered.

Ramping flows (gradually changing flow rates) from Matilija Reservoir would improve the habitat downstream during diversions at Robles Diversion Dam. The current practice of releasing water from Matilija to be diverted at Robles Diversion should be changed to improve habitat conditions downstream (lower part of Reach B). Currently, flows of approximately 250 cfs are released from Matilija Reservoir, without distinct periods of ramping up or down. In order to improve fish habitat and avoid any potential impacts to fish either migrating or rearing in the reach downstream of the dam, flows should be ramped up and down. Ramping flows up and down would more closely resemble a natural storm event and would be less likely to result in fish stranding on the edges of the stream. In addition, juveniles and smolts would be able to move to and use the lower velocity edge habitat to avoid being washed out of the reach. This action could result in a slight loss of water due to increased percolation during the ramping periods; therefore, it may not be necessary unless passage at Robles is achieved. In addition, to ramping during flushing releases at Matilija, water should continue to be bypassed at Robles dam during diversions to facilitate passage up to and through a passage structure.

Managing the timing and duration of withdrawals in tributaries could improve surface flows. In small streams with low summer flows, surface diversions by riparian users may deplete streamflow and adversely affect juvenile rearing habitat. Summer streamflow is one of the major limiting factors for steelhead in San Antonio Creek and its tributaries. At times during hot spells and on weekends, people living along the stream withdraw water at the same time, causing short-term depletion of the streamflows and dewatering of some reaches. Other drainages have successfully reduced these dewatering episodes by coordinating water withdrawal to reduce the impact on the stream. This option requires a substantial degree of coordination among landowners to achieve the benefit and may not be feasible with the large number of parties potentially involved in San Antonio Creek.

10.4 POPULATION AUGMENTATION ACTION

A wild steelhead hatchery could be used to supplement production in tributaries once other habitat improvement actions have been initiated. Even under the best ocean and freshwater habitat conditions and low predation and disease rates, it could take many generations to recover the steelhead populations. A part of the Filmore hatchery could be used to rear fish for release in the Ventura River drainage. The Filmore hatchery has been dedicated to raising catchable rainbow trout, which are planted throughout the region. Dedicating a portion of these facilities to propagate indigenous steelhead would have benefits beyond the Ventura River. The brood stock ideally would come from the Ventura River, from residualized stocks in Matilija Creek and North Fork Matilija Creek. The hatchery facilities could provide the additional fish needed to jump-start the recovery of southern Steelhead. Any type of change in hatchery operations would require coordination with California Department of Fish and Game regional office and then approval from the State Fish and Game Commission. When the stocks are sufficiently recovered, the facilities could be returned to producing catchable trout for release into reservoirs that support intensive recreational activity. Habitat improvement sites could be used as stocking sites for wild hatchery steelhead.

10.5 MONITORING NEEDS

Biological studies to collect baseline data on physical habitat characteristics (e.g. vegetation, water quality) and fish populations should be conducted. These data will help determine reach or stream specific limiting factors to steelhead and would be useful for habitat improvement action site selection. Long term monitoring of implemented actions and of the response of steelhead population to these actions will be important to assess the overall success of the program. Depending on which measures are implemented, an appropriate monitoring program, including a monitoring schedule could be designed. A plan for implementation of mitigation measures and conservation actions would include a description of the monitoring effort and the responsible parties. In addition, streamflow and water quality monitoring that already occurs in the water shed should continue.

10.5.1 STREAMFLOW MONITORING

Streamflows are monitored at several locations along the Ventura River and its tributaries. The Casitas Municipal Water District (Casitas) currently monitors stream flows on Matilija Creek at the reservoir and just downstream from Matilija Reservoir; On the Ventura River near Meiners Oaks, at Robles Canal, and in the Live Stretch; on Santa Ana Creek near Hwy. 150; and on Coyote Creek at Lake Casitas and downstream of the Dam. The U.S. Geological Survey (USGS) gages the flows in the mainstem Ventura River near Foster Park. The City of Ventura records the amount of the City's surface diversion at Foster Park. Ojai Valley Sanitary District (OVSD) monitors streamflows periodically at several points from upstream of Foster Park to the estuary, and records the amount of effluent discharged into the river at their wastewater treatment plant. These data provide us with essential information to assess the feasibility of habitat improvement projects and to forecast their potential benefits. In addition, flow data will allow us to determine if natural flow events (e.g. periods of drought or flood) have contributed to the perceived success or failure of a conservation action. Periodic monitoring of streamflows in tributary reaches where habitat improvement projects might be implemented should be done prior to implementation. It will also be necessary to continue monitoring streamflows downstream of Robles to insure that passage conditions in the entire lower river are met if it is to be feasible to ladder Robles and monitor its success.

10.5.2 WATER QUALITY MONITORING

The City and OVSD monitor water quality. Casitas, on a regular, scheduled basis monitors water temperature, dissolved oxygen, and numerous other water quality parameters at specific locations and depths in Lake Casitas. OVSD monitors various water quality parameters including temperature, dissolved oxygen and nutrient levels in their discharge water, and the maintem Ventura River from the confluence of San Antonio Creek downstream to the estuary. The City conducts weekly temperature monitoring at their Foster Park diversion facility. In the past (1981 to 1993), Casitas conducted detailed temperature and related water quality monitoring in various sections of the Ventura River with emphasis on the live stretch of the river near Foster Park. Additional temperature monitoring would be useful, especially in San Antonio Creek and

Matilija Creek, to further evaluate the potential for those streams to provide steelhead habitat and to determine the appropriate sites for habitat improvements.

10.5.3 Steelhead Population Monitoring

Steelhead population monitoring would likely include redd counts and juvenile sampling in North Fork Matilija and potentially San Antonio Creek if adults are moved into that subbasin. The success of local habitat improvement pilot projects should be monitored with juvenile sampling in addition to water quality and quantity measurements as described above. Juvenile sampling might consist of snorkeling or electrofishing to determine habitat utilization on a presence or absence basis. Electrofishing is a necessary technique to quantify abundance, age structure and/or growth rates, as well as to determine microhabitat use, but may not be allowed if steelhead are listed under the endangered species act. It could also be useful to monitor the mainstem Ventura River for steelhead use. Eventually there could be a counting system at fish passage facilities at Robles for both upstream and downstream migrant. In the interim, fish counting could be conducted during trap-and-truck operations. These types of monitoring efforts would require an active role by the appropriate resource agencies.

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APPENDIX A

HYDROLOGY ANALYSES

APPENDIX B

PRELIMINARY EVALUATION OF MATILIJA DAM REMOVAL