# BIOLOGICAL ASSESSMENT FOR CACHUMA PROJECT OPERATIONS AND THE LOWER SANTA YNEZ RIVER

*Prepared for:*

**NATIONAL MARINE FISHERIES SERVICE**
Long Beach, CA

*Prepared by:*

**U. S. Bureau of Reclamation**
Fresno, CA

**April 7, 1999**

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Project No. 000000

**April 7, 1999**

In August, 1997, the National Marine Fisheries Service (NMFS) listed anadromous steelhead inhabiting the Southern California Evolutionarily Significant Unit (ESU), including any steelhead inhabiting the Santa Ynez River downstream of Bradbury Dam, as an endangered species under the Federal Endangered Species Act (ESA). The U.S. Bureau of Reclamation (Reclamation) operates the Cachuma Project (Project) to deliver water to the Project Member Units (Member Units). The Project is the primary water supply for Santa Barbara County, including the cities of Santa Barbara, Goleta, Carpinteria, Montecito, Santa Ynez, Solvang, and Buellton. It is the primary source of water to over 200,000 people and over 38,000 acres of cropland on Santa Barbara's south coast and a small portion of the Santa Ynez Valley. Within the Valley, it provides water for several communities and a multi-million dollar agricultural industry. Project operation includes capture and later release of water for downstream water rights as a condition of the Project's State Water Resources Control Board (SWRCB) permit.

Section 7 of the ESA requires federal agencies to consult on any actions they take that may affect species listed as threatened or endangered. While ongoing fisheries studies have not conclusively determined what proportion of the rainbow trout population in the lower Santa Ynez River are anadromous, since the project area is within the ESU, Reclamation and the Member Units are proceeding with consultation. Reclamation has determined that operation of the Project may have the potential to affect steelhead trout and their habitat and has therefore entered into consultation with NMFS, and is serving as the federal nexus between NMFS and the local water agencies.

Reclamation and the Member Units have critically reviewed the operations of Bradbury Dam to identify and evaluate potential effects on steelhead and instream habitats within the lower Santa Ynez River. Using scientific information collected through ongoing fisheries and water quality investigations, in combination with detailed analysis of historic hydrologic conditions and water project operations, revised operations have been developed which incorporate reasonable conservation measures to protect steelhead and their habitat in the lower Santa Ynez River. The Biological Assessment evaluates the proposed operations and conservation measures and their likely effects (both beneficial and adverse) on steelhead as compared to operations under Water Rights Order 89-18 (WR 89-18) issued by the State Water Resources Control Board (SWRCB) (environmental baseline conditions). The proposed actions, as outlined in the Biological Assessment, are a commitment by Reclamation and the Member Units to implement modifications to project operations and other conservation measures, both designed to protect and enhance habitat conditions for steelhead within the lower Santa Ynez River and its tributaries downstream of Bradbury Dam.

This assessment concludes that the proposed actions are not likely to adversely affect steelhead compared with environmental baseline conditions, but it will adversely impact water supply, reducing the reservoir's yield. The proposed modifications to project operations will improve the availability and quality of habitat for steelhead in the lower Santa Ynez River, and will create a net environmental benefit to the species. In addition, Reclamation and the Member Units will carry out specific conservation measures designed to contribute to the recovery of the steelhead population within the Southern California ESU. Implementation of the proposed actions will not result in jeopardy to the continued existence of the steelhead in the Southern California ESU.

**PLAN ELEMENTS**

The proposed operations and conservation measures are designed to:

- Protect and improve instream habitat within the mainstem Santa Ynez River and tributaries downstream of Bradbury Dam;

- Create opportunities for successful reproduction and survival of anadromous steelhead trout;

- Avoid adverse effects on other aquatic or riparian biological resources, including tidewater gobies inhabiting the lagoon at the mouth of the Santa Ynez River.

- Deliver water supplies and provide for routine maintenance of existing facilities; and

- Maintain groundwater recharge requirements as set forth in WR 89-18 (downstream water rights);

The ultimate objective of the proposed actions is to implement measures that will avoid jeopardy and promote recovery of the Santa Ynez River steelhead population. To achieve their objective, the proposed actions employ conservation measures which are consistent with water supply availability, project facilities, access to private lands, and competing demands for limited resources.

The proposed operations and conservation measures are based upon an adaptive management strategy, enabling them to respond to annual and seasonal variation in hydrologic conditions and water supply availability within the Santa Ynez River basin. The adaptive management strategy will also allow Reclamation and the Member Units to implement measures on public lands and private property as opportunities become available. The majority of steelhead habitat in the Santa Ynez River basin is located on private property. Phased implementation of specific project elements and management actions is included, based on access to lands and facilities. Implementation of actions will be accompanied by monitoring to evaluate performance of the action and to identify appropriate modifications, if needed.

Reaches of the mainstem and tributaries selected as having priority for habitat protection and improvement were identified based upon: (1) seasonal and annual instream flow patterns, (2) water temperature, (3) quality and suitability of existing habitat, (4) opportunities for habitat improvement, and (5) ownership of the subject habitat areas. Priority habitats include lower Hilton Creek, the mainstem Santa Ynez River between Hilton Creek and the Highway 154 Bridge, the mainstem Santa Ynez River between Bradbury Dam and Hilton Creek, and, in wet years, the mainstem down to Alisal Bridge (approximately 10.5 miles downstream of the dam).

Implementation of the proposed actions will benefit the steelhead population both directly and indirectly by (1) increasing habitat availability and quality, (2) reducing mortality associated with declining water levels or water quality, (3) increasing public awareness and support for beneficial actions, and (4) supporting voluntary actions to improve habitat on private lands. The conservation measures incorporated in the proposed operations to achieve these results include the following:

I. **Habitat Improvements** Actions to increase the availability and quality of habitat for steelhead include:

A. Provision of a Fish Reserve Account to provide up to 5,500 acre-feet (AF) in years when the reservoir spills, 2,000 AF in years when reservoir storage is more than 120,000 AF, and lesser amounts (decreasing below 2,000 AF on a pro-rata basis with the Member Units) in years when storage is less than 120,000 AF. Under the proposed operations, water in the Fish Reserve Account may be carried over from one year to the next. This account provides a dedicated supply of water to be used for improvement of steelhead habitat downstream of Bradbury Dam, including Hilton Creek. Surcharge of the reservoir by 1.8 feet will provide water to the account in years when spill occurs.

B. Modifications to Hilton Creek to provide additional new habitat through establishment of a reliable water supply meeting specific temperature and dissolved oxygen criteria; providing passage over a partial passage barrier at the chute pool to provide access to approximately 2,400 feet of upstream habitat; and construction of a 1,500-foot long channel extension, designed and managed specifically to provide steelhead spawning and rearing habitat.

C. Conjunctive use of water rights releases and the Fish Reserve Account to extend the period of time each year when instream flows improve habitat for steelhead rearing in Hilton Creek and the mainstem river to provide improved conditions and protection for steelhead. As a part of the proposed operation, releases into Hilton Creek and below Bradbury Dam will not be deducted from the Fish Reserve Account when they are scheduled to coincide with water right releases. Instead, they will be accounted for as water rights releases for the Above Narrows area. Modifications to reservoir operations will provide sustained target flows via Hilton Creek and/or the mainstem Santa Ynez River of 2.5 or 5 cubic feet per second (cfs) at Highway 154 depending on reservoir elevation, or of 10 cfs at Highway 154 Bridge in years when the dam spills. In critically dry years, when reservoir elevation falls below 660 ft MSL, pulse releases will be made to refresh mainstem pool habitat near Bradbury Dam. Conjunctive use will provide substantially more habitat below the dam in the critical late summer months than either baseline (WR 89-18) or historic (no storage) conditions.

D. Protection and enhancement of steelhead spawning and rearing habitat in tributaries through the establishment of conservation easements along approximately 6-8 miles of stream in the El Jaro watershed, and implementation of habitat improvements along those easements, such as riparian planting, structural improvements to instream habitat, and bank stabilization.

E. Removal of fish passage impediments in the tributaries to enhance the availability of habitat for steelhead spawning and rearing.

F. Structural improvements in mainstem pools to increase the amount and quality of suitable habitat.

II. **Reduced Fish Mortality** Fish rescue operations will reduce mortalities associated with declining water levels, adverse water temperatures or dissolved oxygen levels in Hilton Creek, and, on a case-by-case basis, in other areas of the Santa Ynez River basin below Bradbury Dam. These operations will provide a net environmental benefit when compared to the mortality anticipated to occur in the event that a rescue operation is not performed. Predator removal at relocation sites will reduce predation on relocated steelhead and thus improve habitat suitability for steelhead.

III. **Increased Public Awareness** Public education and outreach will provide direct and indirect benefits to steelhead resulting from increased awareness of local landowners and the public regarding types of actions and land-use practices which will benefit steelhead, and increased awareness and sensitivity regarding impacts to the steelhead population resulting from recreational and illegal harvest. This effort is anticipated to provide increased political support for obtaining additional funding for habitat improvement projects on the mainstem and tributaries, and other actions designed to protect and improve steelhead habitat.

IV. **Provision of Financial and Technical Assistance** Reclamation and the Member Units will provide technical assistance and financial support for voluntary actions to improve steelhead habitat on private land. This program will be supported through the Public Education and Outreach Program, to make landowners and the public aware of these resources.

## IMPLEMENTATION

The proposed actions will be implemented in a phased approach. Those measures under the jurisdiction of Reclamation and/or the Member Units that do not require the construction or modification of facilities will be implemented immediately. A schedule for accomplishing measures requiring the construction of facilities has been established for Reclamation property. Conservation measures that require the permission or participation of private landowners will be implemented in consultation with the landowners and NMFS.

Funding for the proposed conservation measures is available from Reclamation, the Member Units, the Cachuma Project Contract Renewal Fund, the Central Coast Water Authority's (CCWA's) Warren Act Trust Fund, and Santa Barbara County. Additional funding will be sought from state and federal sources and private foundations.

Conservation measures that can be implemented immediately (or as soon as weather conditions permit) include: (1) the Fish Reserve Account, (2) conjunctive use of the Fish Reserve Account and the downstream water rights releases, including ramping, (3) surcharging the reservoir 0.75 feet, and (4) development and implementation of a Public Education and Outreach Program. The remaining conservation measures will be completed in accordance with the following timetable: (1) facilities to be located on Reclamation property include the Hilton Creek supplemental water system (operational in 1999), (2) the Hilton Creek channel extension and fish passage project (in place in 2000), (3) pool habitat enhancement (in place in 2000), and (4) flashboards enabling a 1.8 foot surcharge (in place by 2001). Fish rescue operations will be undertaken on a case by case basis in consultation with NMFS and the California Department of Fish and Game (DFG). Funds for these actions have been committed by Reclamation and the Member Units, as well as a DFG grant for fish passage.

Actions on private lands will be implemented within the constraints and schedules established by landowners, permitting processes, and funding availability. By 2000, the Member Units expect to obtain conservation easements on properties in the El Jaro Creek drainage, which will protect 6 to 8 miles of upper El Jaro Creek and about 1 mile of Ytias Creek, a tributary of El Jaro Creek. Currently, the relevant landowners and the Cachuma Operation and Maintenance Board are entering into contracts to pursue investigations and negotiations for conservation easements. These actions will be funded by the Renewal Fund, the Warren Act Fund, and additional funding that can be secured.

**CONCLUSION**

Implementation of the proposed operations and conservation measures will not adversely affect steelhead trout habitat or populations that may exist in the Santa Ynez River. To the contrary, these actions will provide a substantial net benefit compared to baseline environmental conditions by increasing the amount of available habitat, increasing the quality of existing habitat, and increasing public awareness of steelhead and their habitat requirements. Additionally, the proposed actions will not adversely affect other protected species within the Santa Ynez basin, and are likely to improve the habitat of many of these species as well. The proposed actions incorporate a realistic schedule and firm funding has been identified for the implementation of its conservation measures.

Based upon the foregoing, the Biological Assessment determines that the proposed operations and conservation measures will not jeopardize steelhead populations in the Southern California ESU. Accordingly, Reclamation and the Member Units request that NMFS issue a finding to this effect, and issue a Biological Opinion authorizing the proposed actions.

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In August 1997, the National Marine Fisheries Service (NMFS) listed anadromous steelhead inhabiting the Southern California Evolutionarily Significant Unit (ESU), including the Santa Ynez River below Bradbury Dam, as an endangered species under the Federal Endangered Species Act (ESA). In response to this listing, the operations of the Cachuma Project (Project) were critically reviewed to identify and evaluate potential impacts on steelhead and instream habitats within the lower Santa Ynez River. Using scientific information collected through ongoing fisheries and water quality investigations, in combination with detailed analysis of historic hydrologic patterns and water project operations, modified project operations are proposed along with reasonable conservation measures to protect steelhead and their habitat in the lower Santa Ynez River.

The U.S. Bureau of Reclamation (Reclamation), and the Project Member Units (Member Units) consisting of the City of Santa Barbara, Montecito Water District, Carpinteria Valley Water District, Goleta Water District, and the Santa Ynez River Water Conservation District Improvement District #1 (ID #1), in association with the Santa Ynez River Water Conservation District (SYRWCD), the Central Coast Water Authority (CCWA), and the Santa Barbara County Water Agency (SBCWA) are proposing modifications to existing operations of the Cachuma Project to benefit steelhead trout. Reclamation, as the federal action agency, has formally requested consultation with NMFS under Section 7 of the ESA. To assist in the Section 7 consultation, Reclamation, with the concurrence of the entities listed above, has prepared the following Biological Assessment which evaluates the effects of existing and proposed modifications to Project Operations, as well as the proposed conservation measures on steelhead and their habitat in the lower Santa Ynez River and its tributaries.

## 1.1 REPORT ORGANIZATION

The remainder of this section of the Biological Assessment discuss the goals and objectives of the proposed operations and conservation measures, the scope and authority under which the proposed actions were developed, the constraints and limitation on the actions considered, the framework under which the proposed actions were developed, and adaptive management strategies for implementation of the proposed actions. Existing conditions in the Project area are described in Section 2.0, and were used as the baseline for evaluating the potential effects of project operations (existing and proposed) and the benefits expected from the conservation measures. Section 3.0 describes the proposed operations of the project and the reasonable conservation measures incorporated as part of the proposed actions. An evaluation of potential impacts and benefits of the proposed actions relative to operations under the California State Resources Control Board Water Rights Decision 89-18 (WR 89-18) is presented in Section 4.0 and Section 5.0 summarizes important findings. Implementation of the proposed actions is discussed in Section 6.0.

## 1.2 GOALS AND OBJECTIVES OF THE PROPOSED ACTIONS

The proposed operations for the Cachuma Project and associated conservation measures have been designed to:

- Protect and improve instream habitat within the mainstem Santa Ynez River and selected tributaries;
- Create opportunities for successful reproduction and survival of anadromous steelhead trout;
- Avoid adversely impacting other aquatic or riparian biological resources, including the habitat or population of tidewater goby in the lagoon.
- Deliver water supplies to the Member Units and provide for routine maintenance of existing facilities, including CCWA facilities and operations; and
- Make releases for downstream water rights as provided by State Water Resources Control Board (SWRCB) Order 89-18;

The ultimate objective of the actions considered in this Biological Assessment is to implement 1) operational changes to mitigate the effects of the Cachuma Project on steelhead, and 2) conservation measures promote recovery of the Santa Ynez River steelhead population. These actions have been developed to be consistent with water supply availability, project facilities, access to private lands, and competing demands for limited resources. The implementation of these actions will not result in jeopardy the Southern California Steelhead population, but will provide a net environmental benefit to the steelhead in the Santa Ynez River.

## 1.3 SCOPE AND AUTHORITY FOR THE BIOLOGICAL ASSESSMENT AND PROPOSED PROJECT ELEMENTS

As part of the formal consultation process between the NMFS and Reclamation in regard to steelhead trout, this Biological Assessment evaluates 1) the potential effects of the existing project operations, and 2) the potential effects of proposed modifications and conservation measures. Steelhead trout is listed as an endangered species under the 1973 ESA, as amended (16 U.S.C. 1531 et seq.). Section 7 of the ESA requires federal agencies to consult on any actions they take that may affect species listed as threatened or endangered. Reclamation has determined that operation of the Cachuma Project has the potential to affect steelhead trout.

The consultation is based on activities undertaken pursuant to Master Contract I75r-1802R, Warren Act Contract 5-07-20-W1281, water rights permits, and associated interrelated and interdependent actions. The scope of the Proposed Agency Action includes: continued operation and maintenance of the Cachuma Project and facilities including water diversion to storage within Lake Cachuma, releases from Bradbury Dam required to meet downstream water rights, delivery of State Water Project (SWP) water through Bradbury Dam's outlet works (including incidental releases of SWP water to the

Stilling Basin), and emergency winter operations to protect life and property downstream of Bradbury Dam.

Mitigation measures to offset effects of Cachuma Project operations are also included as part of the proposed Project Operations. These mitigation measures include, an allocation of water within Lake Cachuma each year to be released specifically for fish protection and instream habitat enhancement (Fish Reserve Account), reservoir surcharge to provide additional water to the Fish Reserve Account in wet years, and conjunctive operations of water rights releases with the Fish Reserve Account to expand and maintain instream habitat downstream of Bradbury Dam. These measures result in a net environmental benefit for steelhead in the Santa Ynez River downstream of Bradbury Dam.

In addition to the mitigation measures integrated into project operations, Reclamation and local water agencies are proposing conservation measures to promote the recovery of steelhead in the Santa Ynez River and its tributaries in recognition of Reclamation's obligation under 16 U.S.C. 1536 (a) (1) to utilize their authorities to carry out programs for the conservation of endangered species. Through the planning effort conducted by Santa Ynez River Consensus Committee (discussed further in Section 2) potential actions that would contribute to the steelhead recovery in the Santa Ynez River have been identified and ranked as potential conservation measures. These actions include habitat enhancement for tributaries to improve conditions for passage, spawning and rearing; mainstem pool habitat management, and public education programs to increase public awareness of steelhead and simple management techniques to improve habitat conditions. Reclamation and the Member Units commit resources to work with other agencies and local land owners to plan and implement the following actions: improvements to Hilton Creek; implementation of a fish rescue plan if needed in dry years, establishment of conservation easements in important tributary habitat; creation of a public education and outreach program; removal of tributary passage impediments.

For implementation, first priority will given to actions under the control and authority of the participating agencies such as expansion of tributary habitat within Hilton Creek, which includes construction of a supplementary water supply source from Lake Cachuma, creation of additional habitat in a channel extension, and passage facilities to provide access to upstream habitat. Fish rescue operations, if necessary, and structural enhancement of pool habitat will be conducted on Reclamation property and potentially other sites, depending on landowner approval. The Public Education and Outreach Program will be initiated. Other complementary conservation measures include protecting and enhancing tributary habitat by securing conservation easements and implementing habitat protection and enhancement actions along stream corridors, and removal of passage impediments on tributaries. These complementary measures require the willing participation of landowners, or involve actions to be taken by other state and/or federal agencies and the schedule for implementation will be coordinated with these parties and NMFS. These actions would be funded by Reclamation and the member units from project funds set aside for habitat enhancement. There is substantial local interest in these measures from conservation organizations and local land owners.

Several landowners have approached the SYRTAC about conservation easements that will protect over 6 - 8 miles of habitat on El Jaro Creek and its tributaries. These easements are currently under negotiation with the cooperation of the Santa Barbara Land Trust.

## 1.4 CONSTRAINTS AND LIMITATIONS

Several constraints and limitations were considered in developing the proposed actions. These include:

- Seasonal and geographic limitations on potentially suitable habitat within the mainstem river as a function of temperature gradients and habitat characteristics downstream of Bradbury Dam. The temperature of release water warms quickly as it move downstream. Suitable water temperatures are generally found downstream to the Highway 154 Bridge. Suitable habitat structure is generally found from the dam downstream to Solvang where the river changes to a predominately sand-bedded system, which SYRTAC studies indicate is primarily used by steelhead as a migration route.

- Hydrologic characteristics of the Santa Ynez River watershed. The Santa Ynez River watershed has high inter- and intra-annual variability in precipitation and runoff, with extremely wet and extended drought periods. The majority of rainfall and runoff occurs in the winter and early spring months. Even in high flow years there is often no flow or very low flow in the mainstem of the Santa Ynez River both above and below Lake Cachuma and in the lower reaches of the tributaries from July until the onset of the rainy season.

- Existing uses and obligations. Water supplies are limited. The Project is the principal water supply for four water districts and one city, or approximately 200,000 people. Downstream users, including several population centers and a multi-million dollar agricultural industry, are dependent on the river and its alluvium for water supply.

- Variability in downstream water rights releases. Water rights releases are made to recharge the groundwater between Bradbury Dam and the Narrows, and the Lompoc Valley. The water rights releases are generally made during normal and dry years between June and October depending on hydrologic conditions. During wet years no water rights releases may be needed because spills over the dam and tributary flows are sufficient to recharge the groundwater.

- Access to private lands. The majority of the Santa Ynez River below Bradbury Dam and its tributaries is in private ownership. Several conservation measures that would benefit steelhead require access to private land. These measures can only be undertaken with the permission and concurrence of the landowner. The successful implementation of these conservation measures will need a public outreach and technical support program.

- Multiple jurisdictions and authorities which are outside the direct authority and responsibility of Reclamation. The Project is only one of many activities and processes affecting steelhead in the Santa Ynez River. The lands next to the Santa Ynez River and along the tributaries support agriculture and are becoming more urbanized. The river channel and associated riparian vegetation has been altered by various land uses.

- Exotic species. Non-native fish (bass and catfish) and hatchery rainbow trout compete with steelhead for available habitat in the Santa Ynez River. Large populations of bass and catfish are found in Lake Cachuma and support an important recreational fishery there. Although these species are not planted or managed below Bradbury Dam, they escape from the lake during spills and reside in the reach targeted for steelhead management. These species compete, prey upon and interbreed with native steelhead, with adverse consequences to any steelhead that may exist below the Dam.

## 1.5 FRAMEWORK FOR DEVELOPING THE PROPOSED OPERATIONS AND CONSERVATION MEASURES

The proposed operations and associated conservation measures were developed to address and achieve a number of objectives for the lower Santa Ynez River, including protection and improvement in the quality and availability of instream habitat for steelhead, while also meeting contractual demands and requirements of the Cachuma Project for agricultural and urban water supplies. The proposed changes to project operations and conservation measures were developed based on an extensive series of iterative analyses designed to balance competing and complementary objectives. The resulting integrated water management and habitat plan addresses each of the goals and objectives identified in Section 1.2. Development of the proposed actions also relied heavily on operational flexibility utilizing an adaptive management strategy to respond to the high variability water supply, storage levels, releases, and mainstem and tributary habitat conditions. Information and data from extensive hydrologic monitoring and modeling analyses, in addition to results of the ongoing intensive fisheries and habitat investigations formed the foundation for the proposed actions.

One of the primary objective of the proposed modifications to operations and proposed conservation measures is to improve steelhead habitat and provide opportunities for the steelhead population in the Santa Ynez River to expand. To be successful in this, it is important to consider the factors currently limiting the steelhead in the basin.

A program of cooperative fisheries investigations led by Reclamation and the Santa Ynez River Consensus Committee under an MOU for Cooperation in Research and Fish Maintenance on the Santa Ynez River has been underway on the lower Santa Ynez River since 1993 (discussed further in Section 2.1). The results of these studies have provided scientific information regarding factors that influence the quality and availability of instream habitat for steelhead and other species. These factors include seasonal and inter-annual variation in streamflow, habitat conditions within the mainstem and tributaries, seasonal patterns in water temperature and dissolved oxygen, and impediments to migration. Information regarding these and other factors has been useful in identifying operational changes and conservation measures to protect steelhead. Although the results of these investigations have not provided definitive evidence whether the fish inhabiting the lower Santa Ynez River are anadromous steelhead or resident rainbow trout, it has been assumed, for purposes of developing this Biological Assessment, that steelhead inhabit the river downstream of Bradbury Dam. Through the technical studies conducted by the SYRTAC, the availability of good quality rearing habitat was identified as the primary limiting factor for steelhead populations. Thus the mitigation and conservation actions focused on providing year-round rearing habitat with suitable water temperatures and appropriate channel structure for use by young rainbow trout/steelhead.

Although the proposed actions have been focused on steelhead, consideration has also been given to avoiding potential adverse effects to other protected species of the lower Santa Ynez River. The revisions to existing operations and the conservation measures were designed to provide improvements to the quality and availability of instream habitat below Bradbury Dam, within the context of limiting factors such as the geographic distribution of acceptable water temperatures downstream of the dam, water supply availability, the ability to reliably implement the conservation measures, and other existing constraints on project operations. The framework for developing the proposed project operations and conservation measures recognized a variety of constraints and limitations(described above) which set bounds on what measures can successfully be implemented to benefit steelhead while still meeting the obligations of the Cachuma Project and the downstream water rights releases.

Water is in short supply along the South Coast of California, so one of the objectives was to use existing releases, such as the downstream water rights releases, to provide additional benefits to steelhead habitat. Adapting the operation of the Project to provide new water supplies that could be dedicated to supporting aquatic habitat downstream of the Bradbury Dam gave rise to the investigation and later adoption of surcharging to gain additional supply. Water temperatures in the mainstem river warm quickly. Therefore measures to improve habitat focused on areas where there was a good opportunity to provide water temperatures appropriate for young steelhead. Using an integrated framework for balancing hydrologic conditions and water supply operations with opportunities and constraints on instream habitat conditions, proposed modifications to project operations and conservation measures were developed for evaluation as part of this Biological Assessment. The proposed actions will mitigate the adverse effects of project operations, provide additional benefits to steelhead and their habitats and promote recovery of steelhead within the Santa Ynez River. These action in concert will have a net environmental benefit for steelhead and other aquatic species.

## 1.6 ADAPTIVE MANAGEMENT STRATEGY FOR PLAN IMPLEMENTATION

An adaptive management strategy is proposed to enable the proposed changes in Project Operations and the associated conservation measures to respond to inter- and intra-annual variation in hydrologic conditions and water supply availability within the Santa Ynez

River basin.  The proposed operations provide opportunities to extend acceptable habitat beyond Highway 154 downstream in the mainstem Santa Ynez River in years when precipitation, run-off, and storage are high.  They provide for maintenance of acceptable mainstem habitat within a reduced geographic area in those years in which available water supplies are low.  Both scenarios will improve the quality of  fish habitat in the section of the river upstream of Highway 154.  Several of the actions included within the proposed operations may be implemented immediately using existing facilities, while other conservation measures may require several years to be fully implemented. Accordingly, incidental take authorization for these actions, to be included as part of the Biological Opinion for the proposed project operations and conservation measures, is proposed to be in effect over a period of 10 years.

Implementation of actions will be accompanied by monitoring to evaluate successful performance of the action or identify appropriate modifications.  The proposed actions are designed to be flexible to take advantage of opportunities for habitat protection and improvement that may arise.

The modifications to project operations and the proposed conservation measures represent a commitment by Reclamation and the participating agencies to implement actions designed to protect and enhance habitat conditions for steelhead within the Santa Ynez River downstream of Bradbury Dam. Reclamation, local water agencies, and other interested parties have a framework, established by the Santa Ynez River Memorandum of Understanding (MOU), that will be used to coordinate and facilitate implementation of these actions.  Ongoing fisheries investigations under the direction of the Santa Ynez River Fisheries Technical Advisory Committee (SYRTAC) will provide additional information regarding opportunities for improving habitat conditions and protecting steelhead, while also providing scientific information that can be used to evaluate the performance of the revised operations and conservation measures.

This section is intended to provide a description of the existing conditions within the basin. These conditions form the basis from which the plan was developed and define the opportunities and constraints that resulted in the Proposed Operations. An understanding of these conditions is also necessary in order to evaluate the actions proposed. This section begins with a description of the Santa Ynez River watershed and presents the Cachuma project background. Section 2.2 describes the hydrology of the basin, which is critical to understanding both historic and current conditions. Section 2.3 describes the physical habitat conditions in the existing watershed. It discusses both the structural aspects of the environment as well as factors such as temperature and dissolved oxygen that have an overriding importance in defining suitable habitat for steelhead and other wildlife species. Section 2.4 describes the fish and wildlife populations that currently utilize the available habitats within the watershed. Section 2.5 discusses the physical facilities of the Cachuma Project and the CCWA and Section 2.6 presents reservoir operations and release schedules including WR 89-18. These operations are used as a baseline in the analysis of the proposed project. This section also includes a discussion of the water rights of various entities dependent on the operation of Bradbury Dam. An understanding of these elements and their interrelationships is vital to balancing the human and biological needs for water in the basin. This section forms the foundation from which proposed changes in operations were developed to benefit steelhead and on which the analysis of benefits and impacts is based.

## 2.1 BACKGROUND ON BIOLOGICAL AND OPERATIONS ISSUES AND INVESTIGATIONS

The Santa Ynez River watershed, located in the central part of Santa Barbara County, California, is about 900 square miles in area (Figure 2-1). The Santa Ynez River originates in the San Rafael Mountains in the Los Padres National Forest, at an elevation of about 4,000 feet near the eastern border of Santa Barbara County. A small portion of the Santa Ynez River watershed lies within Ventura County. The river flows westerly about 90 miles to the ocean, passing through Jameson Lake, Gibraltar Reservoir and Lake Cachuma. The terrain on the south side of the river rises steeply to the crest of the Santa Ynez Mountains. These mountains range in elevation from about 2,000 to 4,000 feet and separate the Santa Ynez River basin from Santa Barbara and the South Coast. The north side of the basin is formed by the Purisima Hills and San Rafael Mountains, which range in elevation from 4,000 to 6,000 feet. Immediately upstream from Lake Cachuma, the river passes through a narrow trough between the mountains. Below Lake Cachuma, the river passes along the southern edge of the Santa Ynez Upland and flows past the broad part of the valley near Buellton. West of Buellton it flows through a narrow meandering stretch to the Lompoc Narrows and emerges onto the broad, flat Lompoc Plain. The river

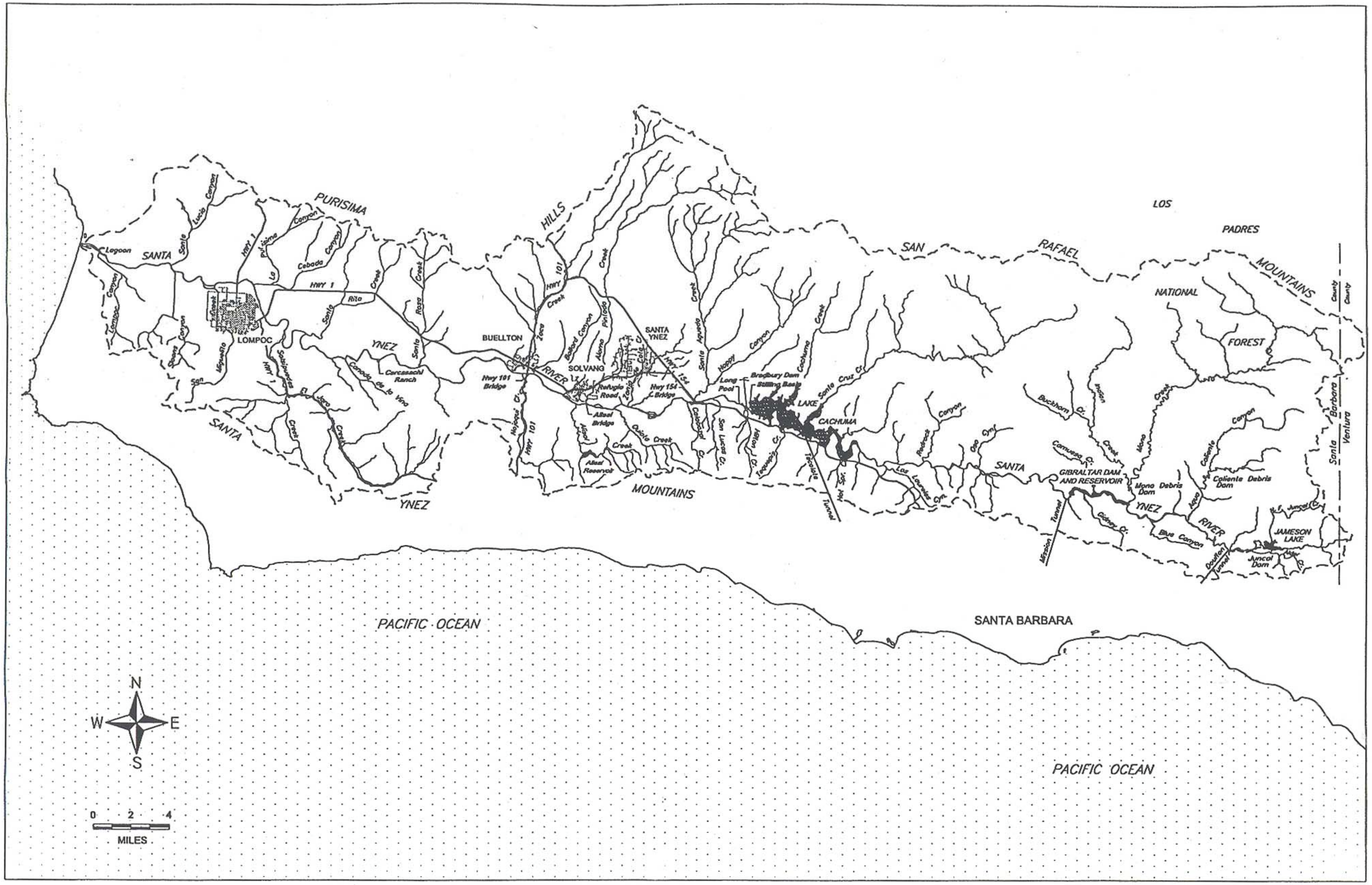



**Figure 2-1.** **Basin Map**

flows through the Lompoc Plain for about 13 miles before it empties into the Pacific Ocean at Surf. The gradient of the Santa Ynez River ranges from 25 to 75 feet per mile in the upper watershed to a gently sloping coastal plain in the lower watershed. As a result of these gradient changes, the Santa Ynez River is characterized by both narrow channel sections on bedrock and broad alluvial floodplains more than 1,000 feet wide near Solvang and Lompoc. Near Bradbury Dam, the active channel is approximately 40 feet wide. Farther downstream, near the confluence with Alamo Pintado Creek, the active channel is more than 400 feet wide.

Historically rainbow trout/steelhead primarily used the upper watershed (upstream of the present location of Lake Cachuma) for spawning and rearing (Shapovolov 1944a). Some tributaries downstream of Lake Cachuma also provided habitat, particularly in wet years. The mainstem river historically dried up during the summer. The California Department of Fish and Game (DFG) reports indicate that even in wet years, fish rescues were conducted to relocate young steelhead to perennial habitats. Some habitats had perennial water, such as mainstem pools and the lower portions of some of the tributaries, however warm water temperatures precluded the use of these areas by steelhead. The availability of and access to year-round rearing habitat with appropriate water temperatures was probably the major limiting factor associated with historical steelhead stocks in the Santa Ynez River and is the main limiting factor today.

In preparing the proposed operations and conservation measures presented in Section 3.0, opportunities were sought to increase the amount and quality of steelhead habitat in the mainstem river and in the tributaries downstream of Lake Cachuma. Actions were identified that were under the direct control of Reclamation and participating agencies, those requiring concurrence by other public agencies, and actions that required the permission of private landowners. First priority is given to actions that would create new habitat, then to actions that would benefit existing habitat, and finally to actions that would benefit steelhead stocks either directly or indirectly through public education and outreach programs.

For this evaluation, we had the advantage of a comprehensive base of information. Information was used from fisheries studies conducted both prior to and since the completion of Bradbury Dam in 1953. Much of the earlier information was obtained from DFG reports and internal memoranda (e.g., Clanton 1940 and 1943; Shapovalov 1940, 1944a&b, and 1946). These reports provide qualitative information on the steelhead populations during the late 1930s through 1952 (prior to the construction of the Project), including habitat conditions, fish rescue operations 1939-1946, and the impact of the 1947-1951 drought on steelhead. Studies in the 1980s associated with possible enlargement of Lake Cachuma provided information on steelhead in Salsipuedes Creek (Harper and Kaufman 1988) and the lagoon (Brown *et al*. 1988). Data on stream geomorphology was obtained from a 1989 California Department of Water Resources (DWR) study of scour-related impacts on channel incision and sediment (DWR 1989a). Information on riparian vegetation was obtained from a DFG study that compared aerial photography from 1973 and 1987 (DFG 1988), as well as a recent study of the Project's effects on vegetation (Jones and Stokes 1997).

In 1995, an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) was prepared for the Project Contract Renewal (Contract Renewal EIS/EIR) (Woodward-Clyde Consultants, *et al.* 1995), including a companion Fish Resources Technical Report (ENTRIX 1995a). The earlier studies described above are included by reference to these two documents. The fish resources technical report provided information on the fish community, stream habitat conditions including water temperature, passage requirements for upstream migrating steelhead, and a limiting factor analysis for rainbow trout/steelhead incorporating a variety of factors including temperature and instream flow versus habitat relationships. One of the conclusions of this report was that the availability of fry rearing habitat was limiting in the mainstem below Bradbury Dam, more so than habitat for spawning or juvenile rearing.

Since 1993, cooperative studies of the Santa Ynez River basin below Bradbury Dam have been conducted by the SYRTAC. Several parties with interests in the resources of Lake Cachuma and the lower river have worked together under a MOU for Cooperation in Research and Fish Maintenance on the Santa Ynez River downstream of Bradbury Dam.

The parties to this MOU are Reclamation, U.S. Fish and Wildlife Service (FWS), DFG, Cachuma Conservation Release Board (CCRB), SYRWCD ID#1, SYRWCD, SBCWA, and the City of Lompoc. The SYRTAC studies address the hydrology, water quality, water temperature, habitat characteristics, and fishery resources of the Santa Ynez River and its tributaries downstream of Bradbury Dam (SYRTAC 1997 and 1998). The objective of these studies is to develop and evaluate opportunities to enhance steelhead habitat in the lower river basin.

The development of the modifications to project operation also included simulations of streamflow and water delivery conditions under various water year types using the Santa Ynez River Hydrology Model (SYRM). These simulations provided the context for evaluating various elements of the proposed project operations and investigating their long-term feasibility.

## 2.2 SANTA YNEZ RIVER WATERSHED HYDROLOGY

### 2.2.1 CLIMATE

The Santa Ynez River Basin has a Mediterranean climate characterized by hot, dry summers and cool, wet winters. Temperature varies from 23°F (-5°C) to 115°F (46°C), with an average of 60°F (15°C). Almost all precipitation occurs between November and April, with large variations in annual amounts occurring between years. For example, near Gibralter Reservoir, precipitation has ranged from 11 inches (winter 1923-1924) to 66 inches (winter 1940-1941). Average annual rainfall ranges from approximately 14 inches near the Pacific Ocean to approximately 30 inches at Juncal Dam, with higher precipitation in the headwater areas resulting from orographic effects. Table 2-1 shows some of the regional locations of precipitation information with respective annual averages.

Weather modification, in the form of cloud seeding to augment natural precipitation within winter storms, has been applied intermittently in Santa Barbara County during the majority of the winter seasons since 1950. Studies performed by North American Weather Consultants concluded that natural precipitation above Jameson Lake and Gibraltar Reservoir could be increased, through cloud seeding efforts, up to approximately 20 percent during the October through April period. Since 1981, the cloud seeding program in the county has been conducted on an ongoing basis, with winter storms being seeded in various parts of Santa Barbara County depending on hydrologic, watershed, and reservoir storage conditions.

### 2.2.2 STREAMFLOW

Streamflow in the Santa Ynez River watershed is derived primarily from surface runoff and shallow groundwater inflow following storm events, which vary greatly in frequency and intensity from year to year. The soils, geology, and topography of the watershed create relatively rapid runoff conditions, with streamflow hydrographs showing a rapid rise and fall in response to precipitation. As a result, the Santa Ynez River is characterized as a "flashy" system, with intermittent surface flow conditions. When water rights releases are made from Fibraltor Dam and Bradbury Dam in the summer months, there are flows downstream of Gibraltar Reservoir and Lake Cachuma. In addition, the Lompoc Regional Wastewater Treatment Plant discharges approximately 3.5 million gallons of treated wastewater per day, creating almost year-round flow from the plant facility to the ocean.

Several major tributaries downstream of Bradbury Dam contribute significant flows to the lower Santa Ynez River, including Santa Agueda, Alamo Pintado, Zaca, Alisal, Salsipuedes, and San Miguelito Creeks (Santa Barbara County Flood Control and Water Conservation District 1992). Figure 2-2 shows the locations of these tributaries.

The Santa Ynez River watershed has a considerable amount of streamflow data available; much of it, however, for limited periods. There are several gages active within the watershed and many more locations where streamflow data has been collected over the years. Tables 2-2 and 2-3 show annual discharge at selected mainstem sites and all tributaries below the dam with more than ten years of record. The data from these gages demonstrate the year to year variability in streamflow within the watershed. These data also demonstrate the intermittent nature of streams within the watershed, with high flows available in the winter from winter storms and the likelihood of little or no flows in the summer. These conditions occurred both before and after the construction of Bradbury Dam in 1953 (Figures 2-3 and 2-4, respectively). The very big years affect the average in all months and typical years have much lower flows than average years.

**Table 2-1. Precipitation Data at Selected Stations in the Vicinity of the Santa Ynez Valley and Vicinity.**

| Location | Period of Record | Annual Average (in) |
|---|---|---|
| Santa Barbara[1] | 1868-1993 | 17.99 |
| Lompoc Water Treatment Plant | 1951-1993 | 14.09 |
| Salsipuedes Creek gaging station | 1942-1993 | 16.76 |
| Buellton CalTrans | 1963-1993 | 15.63 |
| Santa Ynez Fire Station | 1949-1993 | 14.99 |
| Los Alamos | 1910-1993 | 15.25 |
| Bradbury Dam | 1951-1993 | 19.30 |
| Los Prietos Ranger Station | 1943-1993 | 21.98 |
| Gibraltar Dam | 1920-1993 | 25.94 |
| Juncal Dam | 1926-1993 | 29.02 |

[1]The City of Santa Barbara is included because of its long record.

(Santa Barbara County Flood Control and Water Conservation District 1992)

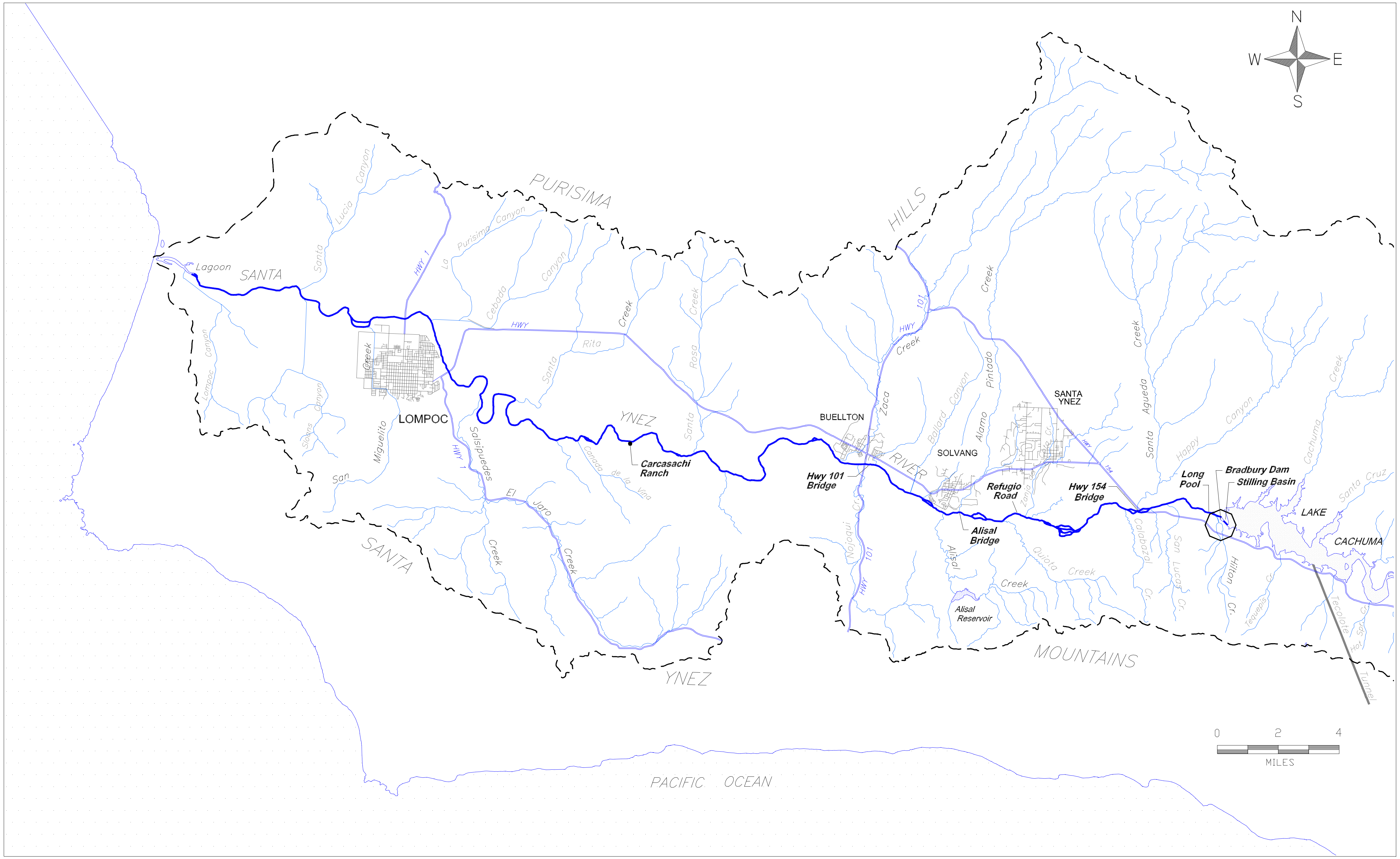



**Figure 2-2. Santa Ynez River Basin Downstream of Lake Cachuma**

## Table 2-2. Annual Flow at Selected Locations in the Santa Ynez River, 1908-1996.

Values in acre feet

| WaterYear | SYR b. Gibraltar | SYR @ Los Laureles Cyn | SYR @ Santa Ynez | SYR @ Solvang | SYR @ Narrows | SYR nr Lompoc |
|---|---|---|---|---|---|---|
| 1908 | 17,800 | | | | | 221,952 |
| 1909 | | | | | | 681,378 |
| 1910 | | | | | | 114,597 |
| 1911 | | | | | | 533,010 |
| 1912 | 16,900 | | | | | 50,402 |
| 1913 | 17,000 | | | | | 47,413 |
| 1914 | 137,000 | | | | | 545,788 |
| 1915 | 43,900 | | | | | 395,857 |
| 1916 | | | | | | 258,278 |
| 1917 | 44,500 | | | | | 137,387 |
| 1918 | 94,200 | | | | | 320,382 |
| 1919 | | | | | | 60,300 |
| 1920 | | | | | | 43,500 |
| 1921 | 907 | | | | | 16,800 |
| 1922 | 62,764 | | | | | 19,500 |
| 1923 | 5,815 | | | | | 13,000 |
| 1924 | 713 | | | | | 53,000 |
| 1925 | 308 | | | | | 73,000 |
| 1926 | 35,721 | | | | | 90,168 |
| 1927 | 23,726 | | | | | 151,749 |
| 1928 | 2,024 | | | | | 30,797 |
| 1929 | 448 | | | 7,696 | | 9,770 |
| 1930 | 407 | | 3,110 | 6,610 | | 5,781 |
| 1931 | 298 | | 0 | 3,163 | | 2,384 |
| 1932 | 31,514 | | 0 | 110,442 | | 142,046 |
| 1933 | 4,186 | | 11,600 | 17,217 | | 17,629 |
| 1934 | 13,412 | | 17,160 | 21,468 | | 24,167 |
| 1935 | 26,977 | | 42,230 | 55,043 | | 56,837 |
| 1936 | 16,044 | | 30,740 | 40,499 | | 40,818 |
| 1937 | 68,561 | | 156,630 | | | 209,037 |
| 1938 | 136,185 | | 273,250 | | | 352,394 |
| 1939 | 8,360 | | 18,700 | | | 32,958 |
| 1940 | 3,309 | | 10,460 | | | 20,610 |
| 1941 | 217,370 | | 475,120 | | | 652,340 |
| 1942 | 14,277 | | 32,580 | | | 67,314 |
| 1943 | 96,462 | | 183,620 | | | 231,881 |
| 1944 | 44,995 | | 90,820 | | | 119,364 |
| 1945 | 16,578 | | 39,450 | | | 50,695 |
| 1946 | 18,599 | | 34,120 | | | 38,975 |
| 1947 | 6,262 | | 10,670 | 14,922 | | 13,952 |
| 1948 | 24 | 59 | 0 | 2,404 | | 50 |
| 1949 | 23 | 385 | 420 | 2,904 | | 2,037 |
| 1950 | 38 | 339 | 1,550 | 3,223 | | 0 |
| 1951 | 41 | 12 | 0 | 1,492 | | |
| 1952 | 85,486 | 123,884 | 199,260 | 239,117 | | 261,811 |
| 1953 | 7,983 | 9,502 | 8,870 | 13,422 | 20,491 | 19,913 |
| 1954 | 9,240 | 11,683 | 3,560 | 6,401 | 5,832 | 5,580 |

## Table 2-2. Annual Flow[1] at Selected Locations in the Santa Ynez River, 1908-1996 (continued).

| Water Year | SYR b. Gibraltar | SYR @ Los Laureles Cyn | SRY @ Santa Ynez | SYR @ Solvang | SYR @ Narrows | SYR nr Lompoc |
|---|---|---|---|---|---|---|
| 1955 | 84 | 930 | 2,600 | 4,198 | 2,061 | 1,650 |
| 1956 | 3,483 | 9,778 | 1,900 | 12,137 | 28,754 | 28,866 |
| 1957 | 71 | 1,889 | 2,890 | 3,349 | 1,459 | 1,111 |
| 1958 | 123,611 | 164,827 | 44,000 | 91,635 | 139,990 | 140,173 |
| 1959 | 4,501 | 7,331 | 5,530 | 10,355 | 16,935 | 16,518 |
| 1960 | 2 | 55 | 3,180 | 3,153 | 1,568 | 1,261 |
| 1961 | 0 | 9 | 650 | 625 | 332 | |
| 1962 | 46,260 | 83,069 | 24,790 | 49,079 | 87,886 | |
| 1963 | 74 | 1,074 | 1,450 | 3,568 | 9,523 | |
| 1964 | 53 | 218 | 2,320 | 1,061 | | |
| 1965 | 1,478 | 4,873 | 7,110 | 5,886 | 4,977 | |
| 1966 | 65,317 | 70,396 | 2,800 | 16,929 | 29,241 | |
| 1967 | 123,470 | 146,250 | 139,040 | 148,680 | 161,692 | |
| 1968 | 1,403 | 2,793 | 6,690 | 5,186 | 5,701 | |
| 1969 | 316,372 | 401,123 | 482,510 | 548,779 | 617,713 | |
| 1970 | 13,611 | 21,007 | 4,050 | 4,411 | 8,495 | |
| 1971 | 19,485 | 24,683 | 12,550 | 9,446 | 7,422 | |
| 1972 | 687 | 4,718 | 6,810 | 4,383 | 3,177 | |
| 1973 | 69,781 | 116,509 | 34,310 | 48,096 | 80,769 | |
| 1974 | 18,325 | 26,040 | 7,180 | 10,703 | 20,404 | |
| 1975 | 26,265 | 37,675 | 21,030 | 34,491 | 61,854 | |
| 1976 | 481 | 2,163 | 4,710 | 2,312 | 3,977 | |
| 1977 | 162 | 717 | | 1,006 | | |
| 1978 | 195,116 | 256,104 | | 327,540 | 391,552 | |
| 1979 | 34,552 | 44,055 | | 54,349 | 70,180 | 72,647 |
| 1980 | 86,840 | 114,028 | | 196,284 | | 189,105 |
| 1981 | 4,868 | 11,108 | | 10,688 | 20,243 | |
| 1982 | 11,905 | 15,978 | | 3,916 | 6,447 | |
| 1983 | 236,488 | 316,850 | | 511,215 | 503,622 | |
| 1984 | 23,528 | 23,762 | | 24,859 | 34,107 | |
| 1985 | 24 | 1,118 | | 2,677 | 3,101 | |
| 1986 | 56,159 | 53,523 | | 12,297 | 30,108 | |
| 1987 | 70 | 49 | | 1,853 | 5,213 | |
| 1988 | 96 | 2,431 | | 4,119 | | |
| 1989 | 0 | 61 | | 1,758 | 32 | |
| 1990 | 0 | 21 | | 629 | 0 | |
| 1991 | 31,098 | 36,821 | | 12,361 | 20,896 | |
| 1992 | 90,978 | 122,443 | | 40,134 | 62,090 | |
| 1993 | 216,790 | 292,163 | | 364,086 | 391,525 | |
| 1994 | 3,322 | 4,852 | | 4,734 | 7,869 | |
| 1995 | 119,000 | 176,818 | | 269,191 | 244,720 | |
| 1996 | 5,779 | 8,598 | | 7,665 | 12,515 | |

[1] Values in acre feet

## Table 2-3. Annual Flow[1] at Selected Santa Ynez River Tributaries and Alisal Reservoir Storage[2], 1929-1996.

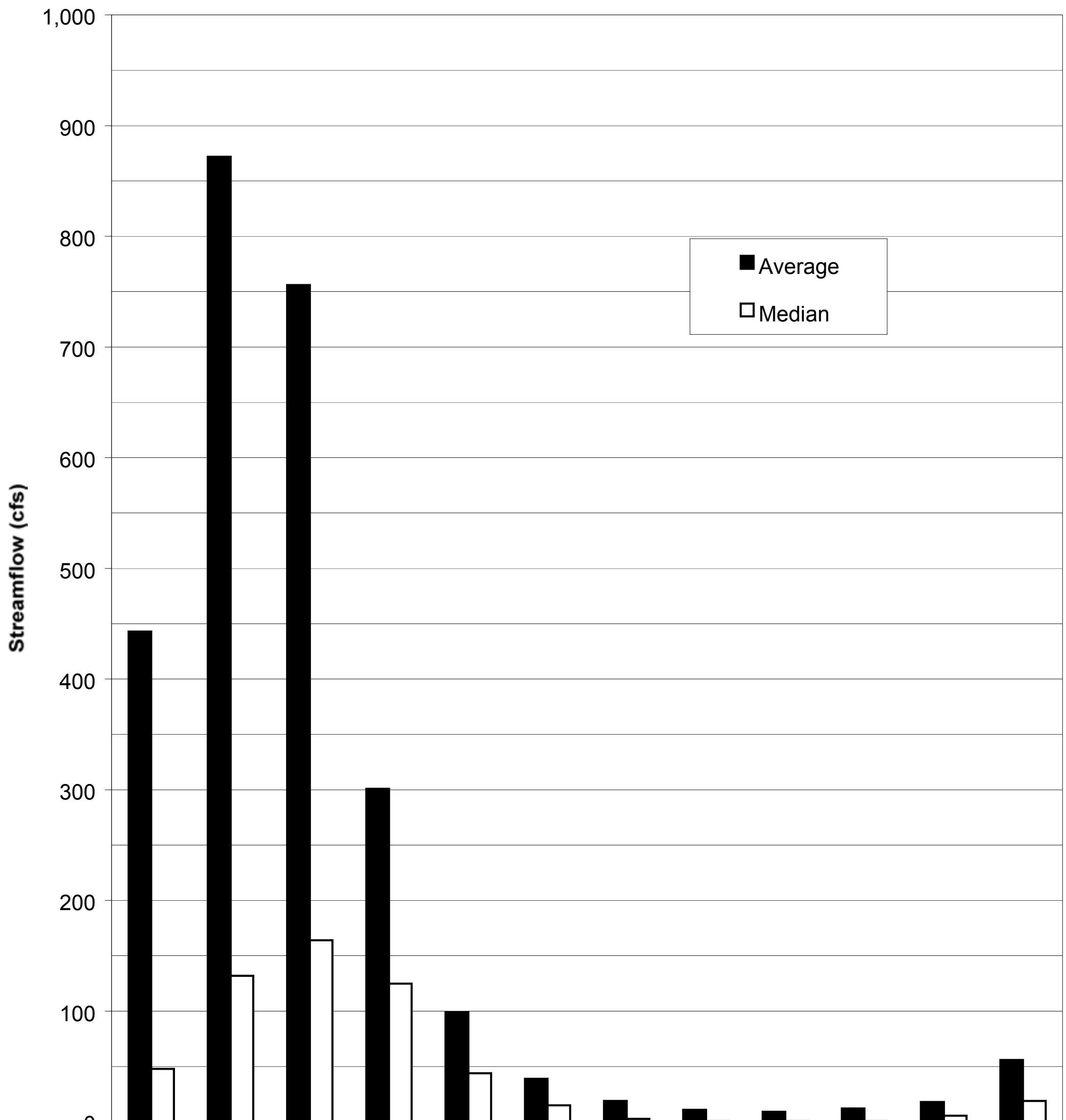
| Water Year | Santa Aqueda Creek | Alamo Pintado Creek | Alisal Creek | Alisal Reservoir | Zaca Creek | Salsipuedes Creek | Miguellito Creek |
|---|---|---|---|---|---|---|---|
| 1929 | | 140 | 1,241 | | | 1,956 | |
| 1930 | 87.1 | 170 | 421 | | | 845 | |
| 1931 | 78 | 175 | 0 | | | 420 | |
| 1932 | | | | | | | |
| 1933 | | | | | | | |
| 1934 | | | | | | | |
| 1935 | | | | | | | |
| 1936 | | | | | | | |
| 1937 | | | | | | | |
| 1938 | | | | | | | |
| 1939 | | | | | | | |
| 1940 | | | | | | | |
| 1941 | 18,176 | | | | | | |
| 1942 | 1,548 | | | | 97 | 10,652 | |
| 1943 | 6,632 | | | | 922 | 10,701 | |
| 1944 | 4,150 | | | | 462 | 8,874 | |
| 1945 | 1,980 | | | | 26 | 2,267 | |
| 1946 | 1,140 | | | | 20 | 1,787 | |
| 1947 | 558 | | | | 3 | 870 | |
| 1948 | 134 | | | | 0 | 402 | |
| 1949 | 141 | | | | 47 | 1,707 | |
| 1950 | 161 | | | | 23 | 1,281 | |
| 1951 | 116 | | | | 1 | 326 | |
| 1952 | 6,378 | | | | 1,093 | 16,871 | |
| 1953 | 515 | | | | 17 | 4,633 | |
| 1954 | 375 | | | | 3 | 2,406 | |
| 1955 | 150 | | 653 | | 7 | 1,319 | |
| 1956 | 1,206 | | | | 76 | 15,610 | |
| 1957 | 172 | | 906 | | 3 | 1,247 | |
| 1958 | 10,687 | | 15,751 | | 2,321 | 23,567 | |
| 1959 | 317 | | 1,727 | | 29 | 2,620 | |
| 1960 | 30 | | 295 | | 7 | 1,416 | |
| 1961 | 92 | | 85 | | 2 | 686 | |
| 1962 | 3,902 | | 10,892 | | 2,078 | 22,199 | |
| 1963 | 45 | | 1,586 | | 25 | 5,329 | |
| 1964 | 0 | | 101 | | 1 | 931 | |
| 1965 | 191 | | 1,314 | | 5 | 2,720 | |

[1] Values in acre feet, except as noted
[2] Alisal Reservoir storage is as of September 30 of each water year

## Table 2-3. Annual Flow[1] at Selected Santa Ynez River Tributaries and Alisal Reservoir Storage[2], 1929-1996 (continued).

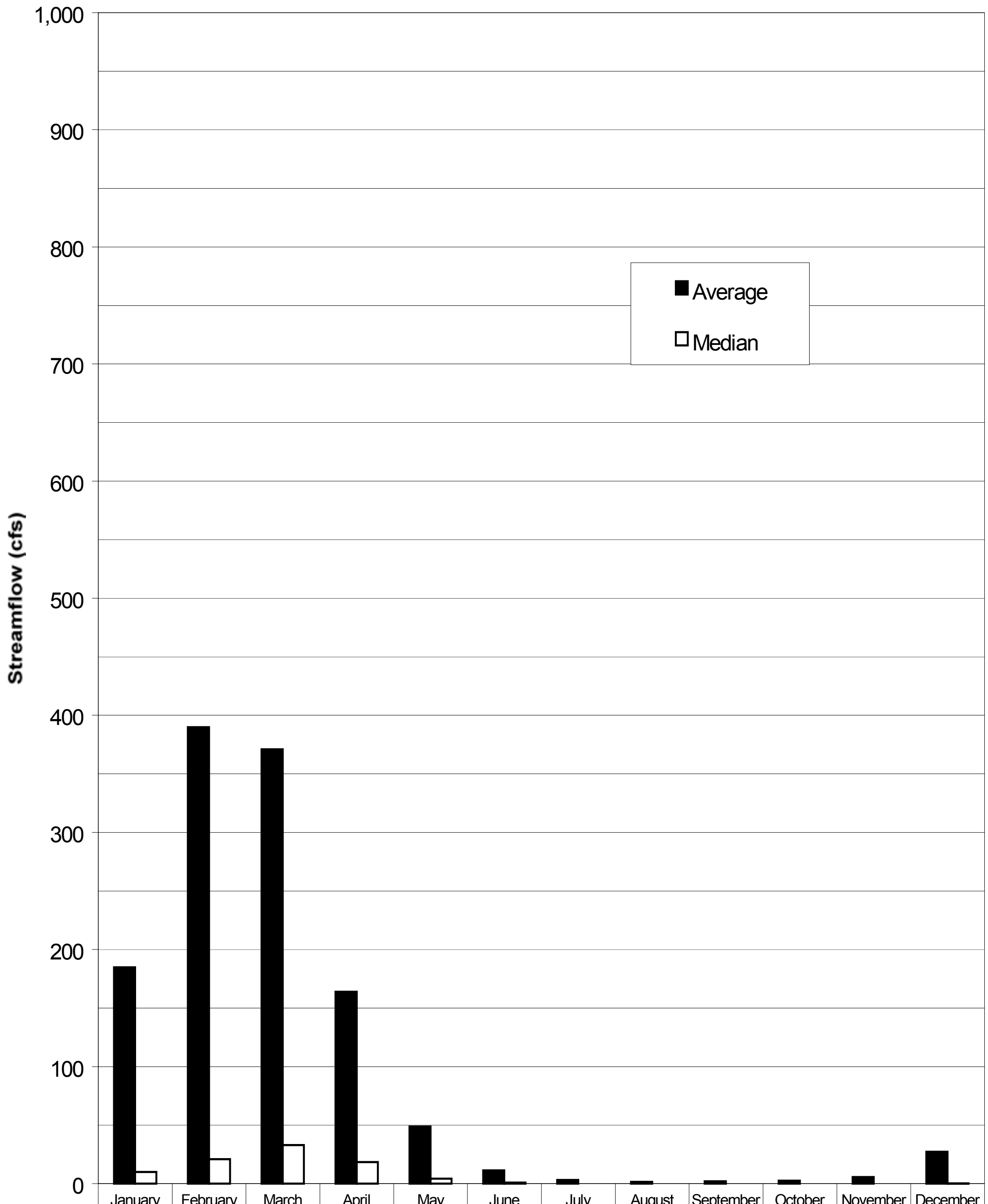
| Water Year | Santa Aqueda Creek | Alamo Pintado Creek | Alisal Creek | Alisal Reservoir | Zaca Creek | Salsipuedes Creek | Miguellito Creek |
|---|---|---|---|---|---|---|---|
| 1966 | 864 | | 8,352 | | 11 | 9,476 | |
| 1967 | 4,405 | | 6,506 | | 755 | 6,708 | |
| 1968 | 34 | | 132 | | 1 | 777 | |
| 1969 | 18,602 | | 20,779 | | 6,683 | 20,520 | |
| 1970 | 444 | | 198 | | 19 | 1,814 | |
| 1971 | 337 | 4 | 95 | | 6 | 1,182 | 172 |
| 1972 | | 0 | 112 | 756 | 2 | 517 | 108 |
| 1973 | | 173 | | 2,270 | 611 | 15,656 | 1,737 |
| 1974 | | 60 | | 2,260 | 56 | 5,316 | 833 |
| 1975 | | 107 | | 2,300 | 122 | 13,775 | 1,641 |
| 1976 | | 4 | | 2,240 | 23 | 1,518 | 361 |
| 1977 | 8 | 6 | | 2,180 | 11 | 597 | 124 |
| 1978 | | 2,220 | | 2,360 | 3,688 | 36,228 | 3,673 |
| 1979 | | 89 | | 2,230 | 185 | 8,414 | 1,097 |
| 1980 | | 998 | | 2,240 | 886 | 14,985 | 1,939 |
| 1981 | | 166 | | 2,180 | 349 | 5,065 | 916 |
| 1982 | | 22 | | 2,210 | | 1,612 | 544 |
| 1983 | | 4,507 | | 2,350 | | 36,853 | 5,766 |
| 1984 | | 556 | | 2,040 | | 3,355 | 974 |
| 1985 | | 390 | | 2,090 | | 1,165 | 687 |
| 1986 | | | | 2,180 | | 10,290 | |
| 1987 | | | | 2,120 | | 1,613 | |
| 1988 | | | | 2,090 | | 889 | 511 |
| 1989 | | | | 1,690 | | 207 | 142 |
| 1990 | | 0 | | 1,230 | 0 | 125 | 162 |
| 1991 | | 1,079 | | 2,080 | 588 | 4,424 | 855 |
| 1992 | | 1,694 | | 2,090 | 1,760 | 6,682 | 685 |
| 1993 | | | | 2,210 | | 17,026 | 1,706 |
| 1994 | | | | 2,060 | | 1,384 | 356 |
| 1995 | | 3,859 | | 2,180 | 2,821 | 29,421 | 5,019 |
| 1996 | | 1,139 | | 1,980 | 289 | 1,821 | 1,080 |

[1] Values in acre feet, except as noted
[2] Alisal Reservoir storage is as of September 30 of each water year




| | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 443 | 872 | 756 | 301 | 99 | 39 | 19 | 11 | 9 | 12 | 18 | 56 |
| Median | 48 | 132 | 164 | 125 | 44 | 15 | 2.7 | 0.8 | 0.8 | 0.7 | 5.5 | 19 |

**Figure 2-3. Average and Median Daily Flows for Each Month, 1908-1953 Santa Ynez River at Narrows or Near Lompoc.**




| | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 185 | 390 | 371 | 164 | 48.7 | 11.4 | 3.2 | 1.6 | 2.1 | 2.6 | 5.9 | 27.5 |
| Median | 10.0 | 21.0 | 33.0 | 18.5 | 4.5 | 0.9 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 |

**Figure 2-4. Average and Median Daily Flow for Each Month, 1954-1993 Santa Ynez River at Narrows**

Median flows from August through November are generally reduced to zero (Figures 2-3 and 2-4). Similar charts from other locations on the mainstem and its tributaries indicate that this is a basin-wide phenomenon. Generally average and median flows are less as one moves upstream along the mainstem of the Santa Ynez River. Flows in the tributaries are flashier as the watersheds become smaller, although the upper reaches of some tributaries may maintain flow much longer than the lower reaches where the gages are located. Many of these upper reaches may maintain flow or pools perennially.

### 2.2.3 GROUNDWATER RESOURCES DOWNSTREAM OF BRADBURY DAM

The majority of the water supply for irrigation, municipal and industrial uses in the lower Santa Ynez River basin is obtained through groundwater pumping. Within the Santa Ynez River basin, groundwater occurs primarily in younger unconsolidated alluvial deposits or in older unconsolidated deposits. In most cases, the older and often deeper deposits are not in hydrologic continuity with the shallower alluvial deposits. The principal sources of groundwater within the Santa Ynez River basin are: (1) the Santa Ynez River alluvial deposits; (2) the Santa Ynez Upland groundwater basin; (3) the Buellton Upland groundwater basin; (4) the Santa Rita Upland groundwater basin; and (5) the Lompoc Basin. Replenishment of the alluvial groundwater basins is by natural seepage from the river, seepage from tributaries, return flows and releases from Lake Cachuma to satisfy downstream water rights.

The Santa Ynez River traverses two groundwater basins downstream of Lake Cachuma: (1) the Santa Ynez River alluvial deposits, located upstream of the Lompoc Narrows, and (2) the Lompoc Plain, located downstream of the Narrows. The Santa Ynez River alluvial deposits are relatively thin, with a typical thickness of 30 to 80 feet, and a few areas of localized thicknesses greater than 100 feet. The storage capacity of this deposit under full water conditions is approximately 105,000 AF, although the usable storage is significantly less than this amount. The U.S. Geological Survey estimated the groundwater in storage in the Lompoc Plain is about 215,000 AF (80,000 AF in the Main Zone and 135,000 AF in the Shallow Zone) (Miller 1976). Much of this water is unusable because of high salt concentrations and is treated for human consumption.

The Lompoc Plain basin is an alluvial filled trough cut into the south limb of the Santa Rita syncline. The principal water-bearing units beneath the Lompoc Plain are the river-channel deposits and younger alluvium that compose the upper aquifer and the Paso Robles Formation and Careaga Sand that comprise the lower aquifer. Most of the percolation from the Santa Ynez River to the groundwater basin in the Lompoc Plain occurs between the Narrows and the Floradale Bridge.

The reported groundwater production from the Santa Ynez River alluvium (above Lompoc Narrows) and the Lompoc groundwater basins (below Lompoc Narrows) for the last 15 years are shown in Table 2-4. Lompoc groundwater production includes production from the Lompoc Plain, the Lompoc Upland, and the Lompoc Terrace.

**Table 2-4. Annual Reported Groundwater Production (acre-feet).**

| Fiscal Year (July-June) | Santa Ynez River Alluvium | Lompoc Area[1] |
|---|---|---|
| 1981-1982 | 9,729 | 25,163 |
| 1982-1983 | 9,113 | 20,170 |
| 1983-1984 | 10,955 | 21,171 |
| 1984-1985 | 9,721 | 23,086 |
| 1985-1986 | 9,923 | 24,551 |
| 1986-1987 | 10,182 | 29,129 |
| 1987-1988 | 8,178 | 28,484 |
| 1988-1989 | 10,257 | 26,624 |
| 1989-1990 | 10,014 | 25,930 |
| 1990-1991 | 10,313 | 25,603 |
| 1991-1992 | 11,118 | 25,941 |
| 1992-1993 | 8,923 | 26,493 |
| 1993-1994 | 8,429 | 24,408 |
| 1994-1995 | 8,677 | 21,726 |
| 1995-1996 | 8,848 | 21,701 |

[1] Includes production for Lompoc plain, uplands, and terrace areas.

## 2.3 HABITAT CONDITIONS

The quantity and quality of physical habitat available within the Santa Ynez River downstream of Bradbury Dam and its tributaries play an important role in determining the potential of the river to support steelhead and other aquatic resources. Physical habitat is defined by such parameters as the amount of space available, water depth, current velocity, substrate, availability of cover, water temperature, and water chemistry.

Habitat mapping has been conducted in parts of the Santa Ynez River and its tributaries to assess the quantity and quality of physical habitat available (ENTRIX 1995a, SYRTAC 1997). These surveys measured the extent of distinct types of habitat (riffles, pools, runs, etc.) that have different characteristics of water velocity and depth. Riffles are high gradient areas with shallow depth, relatively fast water velocities, and turbulent flow patterns. Runs have a lower gradient than riffles and are generally deeper. They have relatively uniform water velocity across the channel width, and minimal surface turbulence. Pools have low gradients, low water velocities and are generally deeper than riffles and runs. The different habitat types have differing potentials for supporting populations of fish, because of their different hydraulic characteristics and because species and life-stages of fish vary in their preference for these characteristics.

Other important habitat features such as substrate, cover, instream vegetation, and riparian canopy were also measured during these surveys. Riparian vegetation moderates thermal gain from solar radiation and can be an important source of nutrients in aquatic food chains. This habitat feature was assessed by estimating the amount of canopy coverage for each habitat unit.

Instream vegetation can provide cover and shade for smaller fishes and may be an important food base either directly or through the production of aquatic insects or other invertebrates. However, extensive aquatic growth may also lead to depressed levels of dissolved oxygen during the night or late in the season (late summer - fall) as the algae die and decompose. Instream aquatic vegetation can occur as rooted submerged plants, emergent plants such as cattails, and attached or floating algae. Surveys by the SYRTAC have indicated that instream vegetation in the form of floating algal mats can be extensive during the summer, particularly in the lower reaches of the river. The character and amount of instream vegetation is often indicative of other habitat conditions such as water temperature and nutrient levels.

Substrate can influence the abundance and distribution of fishes. Different species and different lifestages of the same species can have different substrate requirements. For instance, steelhead require gravel free of silt and sand for spawning, while large substrate such as boulders and large cobble can provide important habitat for immature steelhead during the winter. Sculpin tend to be more abundant in the Santa Ynez River where cobble and boulder substrate was found (SYRTAC 1997). This substrate type may provide them better cover and food production.

Water quality conditions, particularly instream water temperature and dissolved oxygen concentrations below Bradbury Dam, also have a direct influence on the quality and availability of habitat for steelhead. Water temperature is influenced by a variety of factors including seasonal air temperature, solar radiation, river shading, instream flow, temperature of water released from Bradbury Dam, water depth, and in some areas the influence of groundwater upwelling. Dissolved oxygen concentrations are influenced by turbulence and mixing, instream flows, water temperature, photosynthetic activity during the daytime, and metabolism by algae at night. In addition to water temperature and dissolved oxygen concentrations, salinity also influences species composition and habitat use within the Santa Ynez River Lagoon. Salinity conditions within the lagoon are influenced by the balance of saltwater intrusion from the ocean and freshwater inflow from the Santa Ynez River. These water quality parameters vary seasonally among locations within both the mainstem river and tributaries. Water temperature, dissolved oxygen, and salinity have been extensively monitored in the lower Santa Ynez River as part of the ongoing fish investigations since 1993 (ENTRIX 1995a, SYRTAC 1997 and 1998).

### 2.3.1 SANTA YNEZ RIVER MAINSTEM

The mainstem Santa Ynez River below Bradbury Dam (a distance of approximately 48 miles) is characterized by a longitudinal gradient of differing habitat types. Several reaches have been delineated based on geomorphology, as well as opportunities for management (Table 2-5). The Highway 154 reach, which extends 3.1 miles downstream from Bradbury Dam, has a more confined channel than reaches further downstream, as well as better riparian cover in general. As one moves further downstream, the ability to control stream water temperatures with water releases from the reservoir is reduced.

#### 2.3.1.1 Physical Habitat

Channel Structure, Substrate and Cover

The channel structure, substrate and cover are described below for each reach in the lower mainstem Santa Ynez River. Habitat surveys in 1994 indicated that much of the length of the Santa Ynez River between Bradbury Dam and Buellton was composed of areas where the flow of the river was split between two or more channels over some range of flow (ENTRIX 1995a). High flows during the winter of 1994-1995 scoured a more confined channel through much of the river and changed habitat composition in some areas. The discussion of habitat composition uses the most recent data available. In most cases, the July 1997 survey conducted by SYRTAC biologists with guidance from DFG was used.

Data for the Highway 154 reach is reported from the March 1994 survey conducted by ENTRIX, which is the only complete survey of this reach (ENTRIX 1995a). The reach below Lompoc was surveyed only in 1994 (ENTRIX 1995a).

**Highway 154.** The Highway 154 reach extends 3.1 miles from Bradbury Dam to the Highway 154 Bridge. The portion on Reclamation property measures about ¼-mile between the Stilling Basin and the property boundary. Property access issues have

**Table 2-5. Reaches in the Lower Mainstem Santa Ynez River**

| Reach Name | Landmarks | Reach Length (miles) | Miles below Bradbury Dam |
|---|---|---|---|
| Highway 154 | Bradbury Dam down to Highway 154 Bridge | 3.1 | 0 - 3.1 |
| Refugio | Highway 154 Bridge down to Refugio Road | 4.8 | 3.1 - 7.9 |
| Alisal | Refugio Road down to Alisal Bridge in Solvang | 2.6 | 7.9 - 10.5 |
| Avenue of the Flags | Alisal Bridge in Solvang down to Avenue of the Flags Bridge in Buellton | 3.1 | 10.5 - 13.6 |
| Buellton to Lompoc | Buellton to Highway 1 Bridge in Lompoc (includes Weister and Cargasachi study sites) | 23.9 | 13.6 - 37.5 |
| Below Lompoc | Highway 1 Bridge in Lompoc to lagoon | 8.3 | 37.5 - 45.8 |
| Lagoon | Above old 35th Street Bridge to mouth of river | 1.5 | 45.8 - 47.3 |

limited studies in this reach to Reclamation property, which extends approximately ¼-

limited studies in this reach to Reclamation property, which extends approximately ¼-mile between the Stilling Basin just below Bradbury Dam to the Reclamation property boundary. Habitat mapping in March 1994 showed that this reach was dominated by pool habitat (75 percent by length) (Table 2-6). Most of the pools in this reach (76 percent of total pool length) had a maximum depth less than 3 feet deep. Runs accounted for 18 percent of the total length, and riffles and dry channel made up 3 percent each (Table 2-6). Several large and deep perennial pools are present, including the Stilling Basin and the Long Pool on Reclamation property.

Substrate consisted primarily of cobble near Bradbury Dam but grades to greater proportions of sand and gravel downstream. This is typical of stream reaches just below dams because sediment-starved water from the reservoir picks up small substrate and carries it downstream. Habitat mapping surveys in 1994 noted that spawning-sized gravels were of extremely limited availability within the wetted channel between Refugio Road and Bradbury Dam (ENTRIX 1995a). High flow events in 1995 and 1998 have since resulted in additional gravels being moved into the system from Hilton Creek and other tributaries to the extent that gravel availability is no longer thought to be an issue (SYRTAC data).

From a fisheries perspective, riparian vegetation in most areas of the Lower Santa Ynez River is not well developed, and does not provide significant shading for aquatic habitats. The Highway 154 reach has moderate canopy coverage, better than canopy cover in reaches further downstream.

Instream aquatic vegetation, mainly algae, forms in the Highway 154 reach typically in pools. During snorkel surveys of the Long Pool in 1994, a large amount of aquatic algae was observed growing up from the bottom. Oxygen production was observed in the form of visible bubbles floating from the plants to the water surface. Daphnia populations were very dense. Upwelling of cool water was noted in several areas of the Long Pool. Observations at the Long Pool in 1994 indicated that surface algae was extensive prior to downstream water rights releases, but disappeared after the release was begun.

In July 1995, algal mats covered only one percent of the Highway 154 reach (only Reclamation property surveyed), and was far less extensive than mats in the Refugio or Alisal reaches. Observations later in the summer indicated that algae became abundant in some pools in the Highway 154 reach, particularly in the Long Pool. Differences in algal growth may be related to differences in water temperature and/or nutrient levels.

**Refugio Reach.** The Refugio reach is 4.8 miles long, extending from the Highway 154 Bridge (about 3.1 miles downstream from Bradbury) down to the Refugio Bridge (about 7.9 miles downstream from Bradbury). Flows in this area can become intermittent or non-existent during the summer. The habitat composition of 2.7 miles of this reach was surveyed in July 1997. This survey found that the habitat composition (percent of total length) was 33 percent pools, 32 percent runs, 17 percent glides, and 18 percent riffles

**Table 2-6. Habitat Mapping of Lower Mainstem Santa Ynez**

| | | Highway 154 Reach[1] | | Refugio Reach[2] | | Alisal Reach[2] | |
|---|---|---|---|---|---|---|---|
| | | Length | Percent | Length | Percent | Length | Percent |
| Habitat Type | Pool | 12,481 | 75 | 2,937 | 33 | 1,346 | 9 |
| | Run | 468 | 3 | 2,800 | 32 | 4,184 | 29 |
| | Glide | * | * | 1,494 | 17 | 3,859 | 27 |
| | Riffle | 3,088 | 19 | 1,543 | 18 | 4,991 | 35 |
| | Dry Channel | 554 | 3 | * | * | * | * |
| | Total Length | 16,591 | | 8,774 | | 14,380 | |
| Survey Date | | March 25, 1994 | | July 28, 1997 | | July 23, 1997 | |
| Release from Cachuma | | 0 cfs[3] | | 92 cfs | | 93 cfs | |
| Flow | | 42 cfs at Solvang | | 86 cfs at site | | 72 cfs at site | |

[1] ENTRIX 1995a
[2] SYRTAC 1999a
[3] Estimate flow below Hilton Creek was 4 to 6 cfs

* Not designated. Glides are grouped with runs.

(SYRTAC 1999a) (Table 2-6). Upwelling of cool groundwater water occurs in a few habitat units, which can provide a thermal refuge for fish in the summer (SYRTAC 1997).

The substrate is a mix of small cobble, gravel, and fine sediment. The 1994 habitat surveys noted that spawning-sized gravels were of extremely limited availability within the wetted channel between Refugio Road and Bradbury Dam. High flow events in 1995 and 1998 have resulted in additional gravel recruitment to this area tributary streams, and gravel availability is no longer thought to be an issue. Instream cover is moderate in pools. Riparian vegetation is not well developed and canopy coverage is low in this reach.

The Refugio reach generally has the most extensive growths of algae, followed by the Alisal Reach. In July 1995, algal mats were extensive and covered 68 percent of the aquatic habitat surface area. Although algal mats declined or disappeared during the winter of 1995-1996, they were again extensive by early summer 1996. In August 1996, following initiation of downstream water rights releases from Bradbury Dam, algae were not observed in any of the habitats where snorkel surveys were conducted, indicating that the releases had flushed the algae.

**Alisal Reach.** The Alisal reach extends about 2.6 miles from the Refugio Road Bridge (7.9 miles downstream from Bradbury) to the Alisal Road Bridge in Solvang (approximately 10.5 miles downstream from Bradbury). Quiota and Alisal Creeks join the mainstem Santa Ynez River in this reach, upstream of the Alisal Road Bridge. Flows in this area can become intermittent or non-existent during the summer. The habitat composition of this reach (percent of total length), as measured in a July 1997 survey of the main channel, was 35 percent riffles, 29 percent runs, 27 percent glides, and only 9 percent pools (Table 2-6) (SYRTAC 1999). Pool habitat declines as one moves downstream from Bradbury Dam to Alisal. Upwelling of cool groundwater water occurs in a few habitat units, which can provide a thermal refuge for fish in the summer (SYRTAC 1997).

The substrate was small cobble, gravel, and fine sediments. As with the Refugio reach, riparian vegetation is not well developed and canopy coverage is poor.

Floating mats of algae can be extensive in the summer, especially in the Alisal and Refugio reaches. In July 1995, algal mats covered an average of 60 percent of the aquatic habitat surface area in Alisal reach. Although algal mats declined or disappeared during the winter of 1995-1996, they were again extensive by early summer 1996. In August 1996, following initiation of downstream water rights releases from Bradbury Dam, algae were not observed in any of the habitats where snorkel surveys were conducted. In June 1997, algal mats were again prevalent in monitored pools (25 to 70 percent cover).

**Avenue of the Flags.** The Avenue of the Flags reach extends 3.4 miles, from Alisal Road Bridge down to the Avenue of the Flags Bridge in Buellton (about 13.6 miles downstream from Bradbury). The habitat is almost exclusively run. Substrate here is typically sand and gravel. Canopy cover is essentially zero (SYRTAC 1998).

**Buellton to Lompoc.** The mainstem between Buellton and Lompoc (about 37.5 miles downstream from Bradbury at the Highway 1 Bridge) extends 23.9 miles and is characterized by the Weister reach (about 16 miles downstream from Bradbury) and the Cargasachi reach (a 1.5 mile reach about 24 miles downstream from Bradbury). Upstream of Lompoc, near the confluence with Salsipuedes Creek (about 30 miles downstream from the dam), the channel is broad and braided, with little shading. In the 1995 survey, runs are the dominant habitat type, with some riffles and few pools (SYRTAC 1997). Substrate is mainly sand and small gravel. Canopy cover and instream cover is low in this reach. Coverage from algal mats in July 1995 was lower in this reach compared to the Refugio and Alisal reaches. In early summer 1996, algal mats were extensive in the Cargasachi reach, but were absent in August following initiation of downstream water rights releases.

**Below Lompoc.** This reach extends about 8.3 miles from the Highway 1 Bridge in Lompoc (37.5 miles downstream of Bradbury Dam) down to the lagoon. Habitat surveys in March 1994 of the two miles below the Lompoc Wastewater Treatment Facility found the reach dominated by deep pools formed by numerous beaver ponds (50 percent of length) (ENTRIX 1995a) Runs were also extensive, accounting for 37 percent of the reach, while shallow pools (maximum depth less than 3 feet deep) and riffles accounted for 12 percent and 1 percent, respectively.

Downstream of Bailey Avenue in Lompoc, progressively greater concentrations of riparian vegetation occur, including extensive growths of willows, both along the sides and within the river channel. The growth of willows and other vegetation in this area is supported by freshwater (treated effluent) releases to the channel from the Lompoc Wastewater Treatment Facility. Substrate in the area is typically sand and fine silt.

Passage Barriers

The Santa Ynez River between Buellton and Bradbury Dam was examined for passage barriers during the habitat surveys conducted in the late winter and early spring of 1994 (ENTRIX 1995a). Similar surveys were conducted by DWR and Thomas R. Payne in 1991 for the river reach between Lompoc and Buellton (Payne 1991). No falls or velocity barriers were observed, but areas with insufficient depth for upstream migration of adult steelhead were observed. These barriers were always related to shallow riffles or gravel bars, and not to permanent geomorphic features.

Water Temperature Monitoring

Water temperature is an important parameter that affects the quality and availability of habitat for steelhead. As discussed in further detail under steelhead life history (Section 2.4.1.1), three temperature levels have been used to evaluate habitat conditions within the lower Santa Ynez River. A temperature level of 20°C (68°F) for daily average water temperatures has been used in central and southern California by DFG to evaluate the suitability of stream temperatures for rainbow trout. This level represents a water temperature below which reasonable growth of rainbow trout may be expected. Data in the literature suggests that temperatures above 21.5°C (71°F) result in no net growth or a loss of condition in rainbow trout (Hokanson *et al*., 1977). The temperature level of 22°C (71.6°F) daily average temperature was also used to look at relative habitat suitability for sustaining fish. Maximum daily water temperatures greater than 25°C (77°F) were used to indicate potentially lethal conditions (Raliegh et al. 1984). These temperature levels serve as guidelines to indicate general seasonal and spatial trends where water quality conditions may be a concern, but the levels were not used to rule out particular reaches. Cool water refuges in deep pools or pools with upwelling are available to varying degrees along the mainstem, and the monitoring sites may not reflect this.

Results of water temperature monitoring have shown that Lake Cachuma becomes thermally stratified during the summer and fall and destratified (relatively uniform temperatures from the surface to the bottom) during the winter (SYRTAC 1997). During the period of stratification, water temperature and dissolved oxygen concentrations are greatest in the upper part of the water column (epilimnion), with cooler water temperatures and low dissolved oxygen concentrations (<2 mg/l) in the lower part of the water column (hypolimnion). This provides the opportunity to make cold water releases , suitable for rainbow trout/steelhead from the lake during the summer months. After fall turnover, water temperature and dissolved oxygen concentrations were relatively consistent throughout the water column.

Water temperature within the lower Santa Ynez River follows a general seasonal pattern with increasing temperatures during the spring and summer and decreasing temperatures during the fall and winter coincident with the seasonal pattern in air temperature. Water temperature is generally lowest near Bradbury Dam and increases with distance downstream. Water temperature increases rapidly in the first three miles downstream of Bradbury as it approaches equilibrium with air temperature, and then warms more gradually until mile 20 where water temperatures began to gradually cool due to the marine influence. In August, temperatures continue to warm gradually past mile 40. Due to the influence of cooler air temperature near the ocean, the water temperature of the lagoon is typically cooler than that at locations further upstream, with the exception of those locations immediately below Bradbury Dam.

Monitoring results show that water temperatures are suitable for steelhead throughout the system during the late fall, winter, and early spring. However, during summer (especially June-August) potentially adverse water temperatures (those exceeding either the average daily or daily maximum temperature levels) were observed in surface thermographs at all mainstem Santa Ynez River monitoring locations. The frequency that water temperatures exceeded 20°C (daily average), 22°C (daily average), and 25°C (daily maximum) in April through October, 1995-1997), is provided for the Long Pool, upper and lower Alisal reach and Buellton. The frequency and magnitude of potentially adverse water temperature conditions increased with distance downstream from Bradbury Dam. Water temperatures in the Long Pool were the coolest monitored in the mainstem (Table 2-7). Temperatures here sometimes exceeded 20°C daily average in the summer, but

## Table 2-7. Frequency Analysis of Water Temperature Exceedances in the Long Pool at Surface.

| MONTH | NO. DAYS MONITORED | FREQUENCY (DAYS) | | | | |
|---|---|---|---|---|---|---|
| | | Average Daily >20°C | Average Daily >22°C | Maximum Daily >25°C | Maximum Monthly (°C) | Maximum Monthly (°F) |
| *1995* | | | | | | |
| June | 15 | 0 | N/A | 0 | 17.3 | 63.1 |
| July | 31 | ***11*** | N/A | 0 | 22.3 | 72.1 |
| August | 31 | ***10*** | N/A | 0 | 21.6 | 70.9 |
| September | 30 | 0 | N/A | 0 | 20.8 | 69.4 |
| October | 31 | 0 | N/A | 0 | 18.5 | 65.3 |
| *1996* | | | | | | |
| April | 28 | 4 | 0 | 0 | 22.5 | 72.5 |
| May | 31 | N/A | 0 | N/A | -- | |
| June | 30 | N/A | 1 | N/A | -- | |
| July | 31 | ***18*** | ***17*** | 1 | 25.1 | 77.2 |
| August | 31 | 0 | 0 | 0 | 18.1 | 64.6 |
| September | 30 | 0 | 0 | 0 | 17.6 | 63.7 |
| October | 31 | 0 | 0 | 0 | 19.4 | 66.9 |
| *1997* | | | | | | |
| April | 30 | 0 | 0 | 0 | 19.3 | 66.7 |
| May | 31 | ***10*** | 0 | 0 | 23.4 | 74.1 |
| June | 30 | ***13*** | 0 | 0 | 23.2 | 73.8 |
| July | 21 | ***10*** | 0 | 0 | 23.2 | 73.8 |
| August | 31 | 0 | 0 | 0 | 17.5 | 63.5 |
| September | 30 | 0 | 0 | 0 | 17.5 | 63.5 |
| October | 31 | 0 | 0 | 0 | 18 | 64.4 |

***Bold/Italics*** 25-74% of the monitored days exceeded criterion

**Bold** 75% or more of the monitored days exceeded criterion

N/A data unavailable

Source: SYRTAC 1997, SYRTAC 1998, and other SYRTAC data

rarely exceeded 22°C daily average and never exceeded 25°C daily maximum. As the distance from Bradbury Dam increases, the frequency that water temperatures exceed the temperature guidelines increases. At Refugio Reach (3.4 miles downstream), temperatures often exceeded 20°C daily average in summer 1995 and August 1996, but rarely exceeded 22°C daily average or 25°C daily maximum (Table 2-8). In upper Alisal (7.9 miles downstream) in July through September, temperatures regularly exceeded 20°C daily average, and occasionally exceeded 22°C daily average and 25°C daily maximum (Table 2-9). In the lower Alisal reach (9.5 miles downstream), daily average temperatures regularly exceeded 20°C and 22°C June through September, and often exceeded 25°C daily maximum in July and August (Table 2-10). The frequency of temperature exceedances increased at Buellton (13.6 miles downstream), with nearly all summer days exceeding 20°C, many days exceeding 22°C average daily in July through September, and a significant proportion of days exceeding 25°C daily maximum in July and August (Table 2-11).

There is a greater daily variation in temperature (difference in the minimum and maximum temperatures observed) with distance downstream from Bradbury Dam. Diel temperature variation ranged from 2 to 3°C at the Long Pool (mile 0.5), 5 to 6°C at the Alisal Habitat Unit 9 (9.5 miles), and 7 to 8°C at Buellton (mile 13.6) and Cargasachi Ranch (mile 24.0). When water temperatures began to decrease in September, 24-hour diel variations between 2 and 4 °C were recorded throughout the lower river.

Diel water temperature variation at the bottom of pools (located 0.5, 7.8, 8.7, 9.5 miles downstream of the dam) were much smaller during both summer and fall than those recorded at the surface at the same locations (SYRTAC 1997). Generally, bottom temperatures were 2 to 3°C cooler than surface temperatures. Thermographs at 0.5, 8.7, and 9.5 miles below Bradbury Dam recorded variations of 0 to 3°C over a 24-hour period. The bottom thermograph at mile 7.8 recorded a slightly higher diel variation of 3 to 7°C during both summer and fall. Except for Alisal Habitat Unit 48, bottom thermographs in pools never recorded temperatures exceeding 24°C.

The 1996 downstream water rights releases ( July 19 - October 31) resulted in a reduction in diel temperature variation within the Long Pool, however, diel temperature variation was consistently higher at all monitoring locations between Alisal Habitat Unit 45 (7.9 miles downstream of Bradbury Dam), and Cargasachi Ranch (24 miles downstream of Bradbury Dam) after initiation of 1996 downstream water rights releases when compared with diel temperature variation prior to the controlled releases.

Temperature data collected during both snorkel surveys and from thermograph units, strongly suggests that localized areas of cool water upwelling exist in the mainstem Santa Ynez River that could offer refuge for over summering/rearing steelhead. During snorkel surveys, divers noted localized areas of cooler water in various habitat units. These areas were 2 to 3 °C cooler than the surrounding water and usually did not influence an area of more than 2 to 3 square feet under zero to low flow conditions. Some of these upwelling

**Table 2-8. Frequency Analysis of Water Temperature Exceedances in the Refugio Reach (3.4 miles Downstream of Bradbury Dam) at Surface.**

| MONTH | NO. DAYS MONITORED | FREQUENCY (DAYS) | | | | |
|---|---|---|---|---|---|---|
| | | Average Daily >20°C | Average Daily >22°C | Maximum Daily >25°C | Maximum Monthly (°C) | Maximum Monthly (°F) |
| *1995* | | | | | | |
| June | 16 | ***4*** | 0 | 0 | 23.9 | 75.0 |
| July | 31 | **26** | 5 | 6 | 26.4 | 79.5 |
| August | 31 | **29** | **9** | ***9*** | 26.5 | 79.7 |
| September | 30 | **25** | 0 | 1 | 25.0 | 77.0 |
| October | 31 | 1 | 0 | 0 | 24.1 | 75.4 |
| *1996* | | | | | | |
| July | 12 | 2 | 0 | 1 | 24.7 | 76.5 |
| August | 31 | **23** | 2 | ***8*** | 27.2 | 81.0 |
| September | 30 | ***9*** | 0 | ***9*** | 26.6 | 79.9 |
| October | 31 | ***8*** | 0 | 6 | 25.4 | 77.7 |
| *1997* | | | | | | |
| April | 30 | 0 | N/A | 0 | | |
| May | 0 | 0 | N/A | 0 | Dry | |
| June | 0 | 0 | 0 | 0 | Dry | |
| July | 14 | 0 | 0 | 0 | 23.0 | 73.4 |
| August | 15 | ***6*** | 0 | 0 | 24.9 | 76.8 |
| September | 30 | 7 | 0 | 0 | 23.8 | 74.8 |
| October | 31 | 0 | 0 | 0 | 22.2 | 72.0 |

***Bold/Italics*** 25-74% of the monitored days exceeded criterion

**Bold** 75% or more of the monitored days exceeded criterion

N/A data not available

Source: SYRTAC 1997, SYRTAC 1998, and other SYRTAC data

**Table 2-9. Frequency Analysis of Water Temperature Exceedances in the Alisal Reach (7.9 miles downstream of Bradbury Dam) at Surface.**

| MONTH | NO. DAYS MONITORED | FREQUENCY (DAYS) | | | | |
|---|---|---|---|---|---|---|
| | | Average Daily >20°C | Average Daily >22°C | Maximum Daily >25°C | Maximum Monthly (°C) | Maximum Monthly (°F) |
| *1995*[1] | | | | | | |
| May | 28 | 0 | 0 | 0 | 22.9 | 73.2 |
| June | 30 | ***12*** | 2 | 3 | 25.5 | 77.9 |
| July | 31 | $\boxed{\textbf{31}}$ | ***17*** | ***8*** | 25.7 | 78.3 |
| August | 31 | $\boxed{\textbf{31}}$ | ***22*** | 3 | 25.2 | 77.4 |
| September | 30 | $\boxed{\textbf{28}}$ | 0 | 0 | 24.0 | 75.2 |
| October | 31 | 0 | 0 | 0 | 22.6 | 72.7 |
| *1996* | | | | | | |
| May | 29 | 0 | 0 | 0 | 20.4 | 68.7 |
| June | 30 | 0 | 0 | 0 | 17.9 | 64.2 |
| July | 9 | 0 | 0 | 0 | 18.7 | 65.7 |
| August | 16 | $\boxed{\textbf{16}}$ | 0 | $\boxed{\textbf{15}}$ | 26.7 | 80.1 |
| September | 30 | $\boxed{\textbf{28}}$ | 3 | ***8*** | 25.8 | 78.4 |
| October | 31 | ***12*** | 0 | 0 | 24.3 | 75.7 |
| *1997* | | | | | | |
| April | 30 | ***10*** | 0 | 3 | 26 | 78.8 |
| May | 5 | ***2*** | 0 | 1 | 25.4 | 77.7 |
| June | 13 | ***8*** | 2 | 2 | 25.5 | 77.9 |
| July | 31 | $\boxed{\textbf{25}}$ | 0 | ***16*** | 26.7 | 80.1 |
| August | 30 | $\boxed{\textbf{31}}$ | 6 | $\boxed{\textbf{30}}$ | 27.3 | 81.1 |
| September | 31 | $\boxed{\textbf{30}}$ | 6 | ***9*** | 26.7 | 80.1 |
| October | 31 | 4 | 0 | 0 | 23.9 | 75.0 |

1 1995 site is in close proximity (but not exactly) to 1996/1997 site.

***Bold/Italics*** 25-74% of the monitored days exceeded criterion

$\boxed{\textbf{Bold}}$ 75% or more of the monitored days exceeded criterion

Source: SYRTAC 1997, SYRTAC 1998, and other SYRTAC data

**Table 2-10. Frequency Analysis of Water Temperature Exceedances at the Alisal Bridge (9.5 miles Downstream of Bradbury Dam) at Surface.**

| MONTH | NO. DAYS MONITORED | FREQUENCY (DAYS) | | | | |
|---|---|---|---|---|---|---|
| | | Average Daily >20°C | Average Daily >22°C | Maximum Daily >25°C | Maximum Monthly (°C) | Maximum Monthly (°F) |
| *1995* | | | | | | |
| July | 7 | **7** | **6** | 7 | 26.4 | 79.5 |
| August | 31 | **31** | 7 | 7 | 26.3 | 79.3 |
| September | 30 | ***9*** | 0 | 0 | 22.8 | 73.0 |
| October | 31 | ***5*** | 0 | 0 | 22.0 | 71.6 |
| *1996* | | | | | | |
| May | 28 | ***7*** | 0 | 2 | 25.6 | 78.1 |
| June | 30 | **28** | 2 | ***17*** | 28.0 | 82.4 |
| July | 31 | **31** | ***23*** | **30** | 28.2 | 82.8 |
| August | 31 | **30** | ***11*** | **30** | 28.0 | 82.4 |
| September | 30 | **30** | 7 | ***22*** | 27.5 | 81.5 |
| October | 31 | ***15*** | 0 | 9 | 26.3 | 79.3 |
| *1997* | | | | | | |
| April | 30 | 3 | 0 | 2 | 25.1 | 77.2 |
| May | 6 | ***2*** | 5 | ***2*** | 25.8 | 78.4 |
| June | 30 | ***19*** | 7 | ***8*** | 26.6 | 79.9 |
| July | 31 | **30** | ***8*** | ***16*** | 26.5 | 79.7 |
| August | 31 | **31** | 27 | **27** | 27.9 | 82.2 |
| September | 30 | **30** | 9 | ***15*** | 27.7 | 81.9 |
| October | 31 | 6 | N/A | 2 | 25.8 | 78.4 |

***Bold/Italics*** 25-74% of the monitored days exceeded criterion

**Bold** 75% or more of the monitored days exceeded criterion

N/A data not available

Source: SYRTAC 1997, SYRTAC 1998, and other SYRTAC data

**Table 2-11. Frequency Analysis of Water Temperature Exceedances at Buellton (13.6 miles Downstream of Bradbury Dam) at Bottom.**

| MONTH | NO. DAYS MONITORED | FREQUENCY (DAYS) | | | | |
|---|---|---|---|---|---|---|
| | | Average Daily >20°C | Average Daily >22°C | Maximum Daily >25°C | Maximum Monthly (°C) | Maximum Monthly (°F) |
| *1995* | | | | | | |
| May | 28 | 0 | 0 | 0 | 24.1 | 75.4 |
| June | 30 | 16 | 6 | ***10*** | 27.3 | 81.1 |
| July | 31 | 31 | 10 | ***14*** | 26.4 | 79.5 |
| August | 31 | 16 | 2 | 1 | 25.0 | 77.0 |
| September | 30 | 0 | 0 | 0 | 21.6 | 70.9 |
| October | 31 | 0 | 0 | 0 | 22.4 | 72.3 |
| *1996* | | | | | | |
| April | 30 | 5 | N/A | 0 | 24.8 | 76.6 |
| May | 27 | 0 | 0 | 0 | 20.6 | 69.1 |
| June | 30 | **23** | 0 | 0 | 22.6 | 72.7 |
| July | 31 | **30** | 14 | ***10*** | 27.6 | 81.7 |
| August | 31 | **30** | 16 | **29** | 28.1 | 82.6 |
| September | 30 | **30** | 5 | 2 | 25.0 | 77.0 |
| October | 31 | ***14*** | 0 | 0 | 22.4 | 72.3 |
| *1997* | | | | | | |
| May | 24 | 0 | 0 | 0 | 22.3 | 72.1 |
| June | 30 | **24** | 0 | 0 | 22.6 | 72.7 |
| July | 31 | **28** | 7 | 0 | 24.3 | 75.7 |
| August | 31 | **31** | **26** | ***12*** | 26.6 | 79.9 |
| September | 30 | **30** | ***15*** | 0 | 24.8 | 76.6 |
| October | 31 | 6 | 0 | 0 | 22.9 | 73.2 |

***Bold/Italics*** 25-74% of the monitored days exceeded criterion

**Bold** 75% or more of the monitored days exceeded criterion

N/A data not available

Source: SYRTAC 1997, SYRTAC 1998, and other SYRTAC data

areas were persistent in all reaches of the river. In summer, when flows are low (or at low flow releases), localized cool groundwater upwelling may provide acceptable conditions for steelhead to successfully inhabit pools and other areas (Matthews *et al*. 1994, Nielsen *et al*. 1994). This has been observed in the Alisal reach where the number of juvenile rainbow trout/steelhead remained relatively constant between August (34 fish) and December 1995 (31 fish), despite elevated water temperatures during the late summer.

Water temperature monitoring during the 1996 downstream water rights releases provided an opportunity to document seasonal changes in water temperature at various locations within the mainstem Santa Ynez River under conditions of controlled releases from Bradbury Dam (Figure 2-5). Results of temperature monitoring during these releases showed that instantaneous water temperatures increased rapidly between 0.5 miles (about 17°C) and 3.4 miles below the dam (about 21-24°C), and approached potentially adverse water temperatures for steelhead at locations 7.8 miles and further downstream of the dam, despite instream flow releases of 50 to 135 cfs and a release temperature of approximately 17°C. The rapid increase in water temperatures in spite of large flow releases reflects the influence of high ambient air temperatures, the broad channel, shallow depth, and lack of riparian vegetation along the stream corridor. This warming occurs in the reach that is relatively narrow and has well developed riparian vegetation compared to the rest of the river.

In summary, water temperatures are cool near the dam and in the Long Pool, and increase rapidly in the first three miles downstream of Bradbury. Surface water temperatures in the Refugio and Alisal reaches often exceed 20°C as a daily average, and 25°C as a daily maximum during July and August in Refugio and Alisal reaches, and these temperatures sometimes extend into September in the Alisal reach (SYRTAC 1997, 1998). These temperatures are at the upper range for sustaining the rainbow trout/steelhead population. There are some areas of localized cool water upwelling that could provide summer refugia for rainbow trout/steelhead.

Dissolved Oxygen Monitoring

Dissolved oxygen concentrations also affect habitat quality and use, physiological stress, and mortality for fish and other aquatic organisms. In general, dissolved oxygen concentrations less than 5 mg/l are considered to be unsuitable for most fish species, including both rainbow trout and steelhead (Barnhardt 1986). Salmonids do well at dissolved oxygen concentrations of 6-8 mg/l and up, but concentrations of 4 mg/l or less have been found to cause severe distress (Moyle 1976, Piper *et al*. 1982, Barnhardt 1986, Cech *et al.* 1990, Bjornn and Reiser 1991). Warm water species, such as largemouth bass and cool water species like salmonids, may be able to survive when dissolved oxygen concentrations are relatively low (<5 mg/l), but growth, food conversion efficiency, and swimming performance will be adversely affected. High water temperatures, which reduce oxygen solubility, compound the stress on fish caused by marginal dissolved oxygen concentrations.

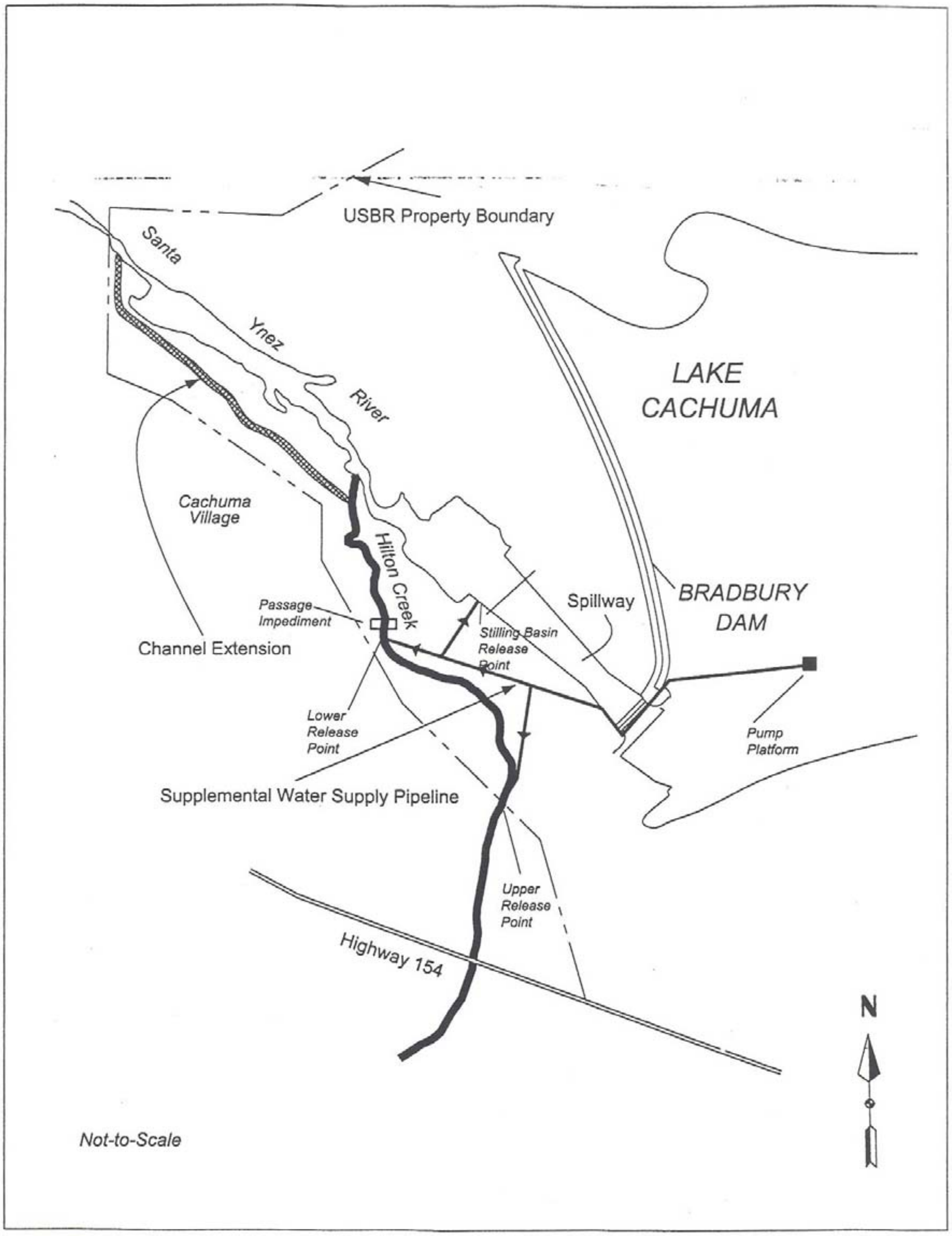



**Figure 2-5. Longitudinal gradient in instantaneous afternoon water temperature during the 1996 WR 89-18 release of 135 cfs, 70 cfs, and 50 cfs.**

Dissolved oxygen concentrations are influenced by turbulence and mixing, instream flows, water temperature, photosynthetic activity during the daytime, and metabolism by algae at night. During late spring and extending into early fall, the lower Santa Ynez River exhibits tremendous algae production in most of its surface waters. This abundant algal growth can contribute to substantial diel variation in dissolved oxygen concentrations and may adversely affect habitat quality for steelhead and other resident fish. During the day, when photosynthesis is taking place, algae production saturates the water with dissolved oxygen, particularly during summer. Conversely, during the dark hours, algae metabolize their sugars and consume oxygen. This process in combination with bacterial decomposition, and respiration by animals can remove significant amounts of dissolved oxygen from the water causing temporary oxygen depletion.

Diel fluctuations in dissolved oxygen concentrations were monitored in mainstem pools at times when algae was and was not present (SYRTAC 1997, 1998). Dissolved oxygen levels were good during the day(>5 mg/l and frequently 8-12 mg/l measured late in the afternoon), regardless of algal cover. Pre-dawn surveys conducted to detect the minimum dissolved oxygen found that concentrations were acceptable when algae was not present (usually about 6-9 mg/l). When algae was present, however, dissolved oxygen concentrations in some pools dropped to as low as 1-3 mg/l. Dissolved oxygen concentrations this low would be expected to result in stress and possibly mortality to fish if these conditions persist or if other microhabitat was not available. Fish are likely to respond by seeking out microhabitats with more oxygen, such as a riffle where the water is more aerated. The diel monitoring could have missed night-time refuge areas where dissolved oxygen conditions were more suitable for fish.

A vertical gradient in dissolved oxygen concentrations was observed at several deeper pool habitat units, with daytime dissolved oxygen concentrations being greatest near the surface, and markedly lower near the bottom. A similar vertical gradient in water temperature was observed at many of these locations, with highest water temperatures near the surface, and lowest water temperatures near the bottom. These results are consistent with the hypothesis that vertical stratification becomes established within deeper pool habitats in the absence of significant flow. Vertical stratification within these habitats during the summer would present a potential conflict in habitat selection by species such as steelhead in that areas having sufficient dissolved oxygen concentrations may also have elevated, and potentially stressful, water temperature conditions.

River flows provided by the 1996 downstream water rights releases (releases at flows of 135, 70, and 50 cfs) were sufficient to remove much of the algae from pool habitats and create sufficient turbulence and mixing to sustain higher dissolved oxygen concentrations (7 mg/l) during the critical morning hours at any of the flows tested. On July 16 prior to initiation of releases, early morning dissolved oxygen concentrations were over 8 mg/l in the Long Pool and at mile 3.4, but were 0.2-4.4 mg/l in shallow pools 3.4 to 13.9 miles downstream of the dam (SYRTAC 1997). On August 2 after WR 89-18 releases had been started, the accumulated filamentous algal mats had been removed and early morning dissolved oxygen levels exceeded 7.45 mg/l at all sites 3.4 to 13.9 miles downstream of the dam. Rooted aquatic vegetation remained abundant after high flows removed the algal mats. Early morning dissolved oxygen concentrations during the fall were substantially higher than those during the summer, coincident with a seasonal decline in algal cover and decreased temperatures.

#### 2.3.1.2 Flow-Related Habitat Conditions in the Mainstem Santa Ynez River

Some aspects of habitat are directly related to the flow of the river. Most important among these are water temperature, the amount of physical space available, and passage opportunities. In the following sections, the effect of flow on water temperatures based on a water temperature model developed by the SYRTAC (using the SNTEMP model developed by the U.S. Biological Survey) is addressed. We also examine how flow and spatial habitat are related based on studies designed and conducted by DFG in association with the SYRTAC (SYRTAC 1999).

Water Temperature Models

Water temperature in the Santa Ynez River was modeled as part of the Contract Renewal EIS/EIR (Woodward-Clyde Consultants, *et al.* 1995). This modeling effort utilized the the FWS's SSTEMP model, which included predictions of solar radiation and day length for the Santa Ynez River basin and stream shading based on topography and characteristics of riparian vegetation. Data used in the modeling included meteorological data on solar radiation, air temperature, relative humidity, sunshine, and wind speed. Hydrologic data included discharges from Bradbury Dam and Santa Ynez River tributaries, initial water temperature at the dam and tributaries, and estimates of temperature influences by groundwater and storm water runoff. The model also included consideration of stream geometry including elevations and distances, stream width, stream shading, and hydraulic gradients. The model was calibrated using water temperature data collected in the Long Pool (0.3 miles downstream of Bradbury Dam), San Lucas Ranch (1 mile downstream), and Alisal Bridge in Solvang (9.8 miles downstream).

Results of these simulation analyses showed: (1) a seasonal pattern of increasing watep temperatures during the summer months (with greatest water temperatures occurring during July and August); (2) a pattern of increasing water temperatures as a$function of distance downstream from Bradbury Dam; and (3) the distance downstream from Bradbury Dam within which average daily water temperatures were less than 20°C, at various instream flow releases ranged from 0.3 to 4.5 miles in July, and from 0.18 to 1.0 mile in August.

The models suggest that water temperatures increase rapidly with distance from the dam. Stressful water temperatures were predicted (and observed to occur) within 4.4 miles below the dam under all scenarios considered, regardless of flow release. These temperatures reduce the utility of otherwise suitable habitat as potential over-summering habitat for steelhead.

Rearing Habitat

Rearing habitat versus flow relationships were developed based on a study developed by the SYRTAC in consultation with DFG (SYRTAC 1999a). This study evaluated how the wetted width of the river (top width) changed in response to changing flow levels in riffles, runs, glides and pools. The study was conducted in late summer 1997 during the WR 89-18 water releases. Several habitat units of each habitat type (pool, run, glide, and riffle) were selected in the Refugio and Alisal reaches for study. Top width measurements were taken at flow releases from Bradbury Dam ranging from 2 to 50 cfs. From this, a log-log regression was fitted to the data to predict top width at different flow levels within this range (although the range was extended down to 0.1 cfs for purposes of this biological assessment to analyze the impacts of the various management scenarios). Field measurements were not taken in the Highway 154 reach for two reasons. First, much of the reach is on private property and is inaccessible. Second, the accessible reach just below Bradbury Dam is dominated by the Stilling Basin and the Long Pool, which are not representative of the habitat of this reach. In order to characterize the Highway 154 reach, we relied instead on the IFIM transects that were developed by DWR and used in the Contract Renewal EIS/EIR (Woodward-Clyde *et al.* 1995, ENTRIX 1995a) to develop similar relationships for the area of the river between Highway 154 and Bradbury Dam.

Top width is not a complete description of habitat, but it provides an index of the amount of habitat available (Swift 1976, Annear and Condor 1983, Nelson 1984). Top width is used in this context to analyze how habitat changes with the flow levels presented in the different alternatives.

Overall, top width increased most rapidly with flow between 1.5 and 5 cfs for all habitat types and in all reaches. The top width of riffles tended to increase the most as flow increased, while pools had the least change in top width with flow. Generally speaking, once flow increased beyond 10 cfs, there were only minor changes in top width of all habitat types at each sequential simulated flow. This was true in terms of both the absolute magnitude of the change and the percent increase.

In the Highway 154 reach, the greatest change in top width occurred when flow increased from 1.5 to 5 cfs (Figure 2-6). This change in flow resulted in a change in top width of 9 to 10 feet in run and riffle habitats, or a relative change of nearly 20 and 15 percent, respectively. The top width of shallow pools changed the most as flows went from 5 to 10 cfs (5 feet, 3 percent), while the top width of deep pools changed the most as flows went from 1.5 to 3 cfs (5 feet, 7 percent). As flows increased beyond 15 cfs, the relative change in the top width of all habitats was generally less than 3 feet (3 percent) between subsequent flow intervals. Top width increased by between 8 and 25 feet (11 and 45 percent), as flow was increased from 3 to 50 cfs, a 16-fold increase in flow. This

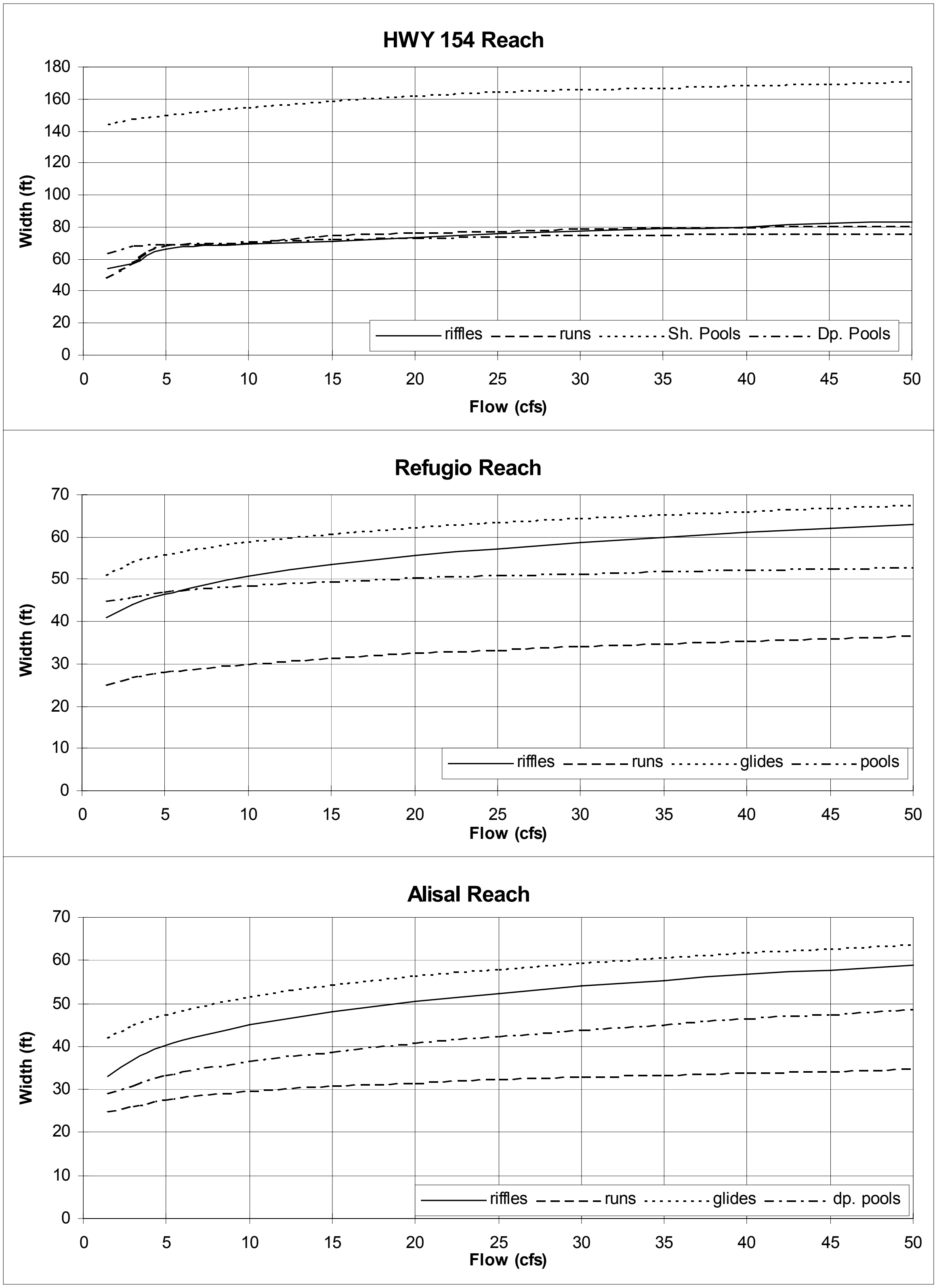



**Figure 2-6. Top Width vs. Flow Relationship for Three Reaches of the Santa Ynez River (flow = release from Bradbury Dam).**

increase was least in deep pools, which likely provide the best habitat for steelhead. Riffles and runs had the greatest cumulative increase in habitat.

In the Refugio reach, the absolute change in top width from one flow value to the next exceeded 4 feet only for riffle habitats as flow changed from 5 and 10 cfs. This flow interval had the greatest change in top width for all habitats, with changes ranging from 1.6 to 4.3 feet (3 to 9 percent). As flow increased above 15 cfs, the relative increase in top width between subsequent flow intervals was generally less than 2 feet (4 percent) for all habitat types, with the relative change diminishing with increasing flow. The cumulative percent change in top width as flow increased from 3 to 50 cfs, ranged from 5 feet (8 percent) in deep pools to 19 feet (43 percent) in riffles.

In the Alisal reach, top widths were less than in the Refugio reach for all habitat types except runs. The absolute magnitude of change in top width from one flow to the next is very similar to that for the Refugio reach, with the greatest changes occurring between 5 and 10 cfs for all habitat types. At this flow, top widths changed by between 2 and 5 feet depending on habitat. Because the top widths were generally less than in the Refugio reach, however, the relative change in top width was somewhat higher, with all habitat types except runs having relative changes in top width of 7 to 12 percent as flow increased from 5 to 10 cfs. As in the other two reaches, the relative change in top width decreases with increasing flow, generally increasing less than 3 feet (5 percent) between simulation flows as flow increased beyond 15 cfs. The cumulative change in top width ranged from 9 to 22 feet (34 to 58 percent) as flow increased from 3 to 50 cfs. Unlike the other two reaches, deep pools in the Alisal reach had the second highest proportional increase in top width, rather than the lowest increase. It should be noted that pools made up a much smaller percentage of habitat in the Alisal reach (9 percent) than in the Refugio reach (33 percent).

In general, deep pools had the least change in top width in response to changing flows, while riffles had the most change. In the Alisal reach, however, deep pools changed more than did glides or runs. In all reaches, the amount of increased flow needed to obtain a given increase in top width is proportionately much greater than the amount of habitat gained. For example, to increase glide top widths by 10 percent in the Refugio reach requires a more than 300 percent increase in flow. To attain a similar increase in deep pool habitats in the Highway 154 reach requires an increase in flow of nearly 1,300 percent. The habitats in the Alisal reach are more responsive than in the other reaches, requiring about a 200 to 250 percent change in flow to obtain a 10 percent change in top width for all habitat types.

Passage

The SYRTAC conducted a study to evaluate how much flow is needed for adult steelhead to migrate upstream (SYRTAC 1999b). Passage transects were placed at critical riffles in the Lompoc, Cargasachi, Alisal and Refugio reaches. The depth and velocity across these riffles was measured at flows ranging from 10 to 200 cfs. These transects were input into hydraulic models to simulate the depth and velocity of flow across the transects at unmeasured flows. The suitability of each of these transects for passage of adult steelhead was evaluated assuming minimum depth criteria of either 0.5 or 0.6 feet and width of suitable depths ranging from 3 feet to 25 percent of the channel width.

Under the most liberal passage criteria of 0.5 ft depth and 3 feet of width, passage at all transects was attained at a flow of 5 to 10 cfs (Table 2-12). Using an intermediate passage criteria with 0.5 feet of depth and 8 feet of width, the analysis indicated that up to 15 cfs would be required for passage at some transects. Increasing the required depth to 0.6 feet resulted in a required flow by 5 to 25 cfs at most transects, however, at the Lompoc 1 transect, the minimum flow was 30 cfs. The most stringent passage requirement of 0.6 feet of depth and 25 percent of the channel width (Thompson 1972) required approximately 100 cfs at the Lompoc 1 transect, but only 30 cfs or less at all other transects.

Upstream migrant trapping on the tributary streams has shown that steelhead/rainbow trout have moved upstream when flows in Lompoc are 40 cfs or less. In the 1999 monitoring, approximately 15 steelhead/rainbow trout were captured in the upstream migrant trap on Salsipuedes Creek (SYRTAC data), but flows at the Lompoc Narrows have not exceeded 40 cfs since January 2, 1999 (USGS preliminary data). Scale analyses need to be performed to confirm whether or not these were anadromous fish, but their presence indicates that the most conservative criteria (0.6 and 25 percent of channel width) resulting in the 100 cfs flow requirement at the Lompoc 1 transect, are overly restrictive.

Spawning Habitat

Spawning has been observed on the mainstem Santa Ynez River in the Highway 154 reach in 1993, 1995, and 1998 (SYRTAC 1998) and has been reported as far downstream as Buellton prior to the construction of Bradbury Dam (Shapovolov 1946). Habitat surveys conducted by ENTRIX in 1994 (see Section 2.3.1.1 and Table 2-6) found that spawning gravel was limited. However the limiting factor analysis conducted for the Contract Renewal EIS/EIR found that fry rearing habitat was more limiting to steelhead populations than the amount of available spawning habitat. Recent high flow years (1995 and 1998), have resulted in substantial gravel recruitment from tributary streams, including Hilton Creek and gravel availability is not currently a problem.

The relationship between spawning habitat and flow can be addressed using the top width versus flow relationships for riffle and run habitat types, the primary spawning habitats. This information provides an index of the amount of habitat that might be available at different flows. Review of Figure 2-5 indicates that the top width for riffles increases with flow, with the most rapid increase occurring as flows increase from 1.5 to 5 cfs. Above these flows, the top width increases more slowly with increasing flow. The

**Table 2-12. Flow at Which Passage Criteria Are Met For Each Transect (from SYRTAC 1999b).**

| Criteria | Lompoc 1 | Lompoc 2 | Cargasachi | Alisal 1 | Alisal 3 | Alisal 4 | Alisal 1(a) | Alisal 2 (a) | Refugio 1 | Refugio 2 | Refugio 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Top Width @ 25 cfs*** | *125ft* | *187ft* | *139ft* | *85ft* | *74ft* | *70ft* | *41ft* | *33ft* | *79ft* | *110ft* | *70ft* |
| **3ft wide 0.5 ft** | 5 | 5 | 5 | 5 | 5 | 10 | 10 | 5 | 5 | 5 | 10 |
| **3ft wide 0.6 ft** | 25 | 5 | 5 | 10 | 10 | 15 | 10 | 5 | 10 | 5 | 15 |
| **5ft wide 0.5 ft** | 5 | 5 | 5 | 5 | 15 | 10 | 10 | 5 | 10 | 5 | 10 |
| **5ft wide 0.6 ft** | 25 | 5 | 5 | 10 | 20 | 15 | 15 | 10 | 15 | 5 | 20 |
| **8 ft wide 0.5 ft deep** | 5 | 5 | 5 | 5 | 15 | 15 | 10 | 5 | 10 | 5 | 15 |
| **8 ft wide 0.6 ft deep** | 30 | 5 | 15 | 10 | 20 | 25 | 20 | 10 | 15 | 5 | 25 |
| **10% Contg. 0.5 ft** | 20 | 5 | 5 | 5 | 5 | 10 | 5 | 5 | 10 | 5 | 10 |
| **10% Contg. 0.6 ft** | 70 | 5 | 15 | 10 | 20 | 15 | 15 | 5 | 15 | 5 | 20 |
| **25%. 0.5 ft** | 55 | 5 | 15 | 15 | 15 | 10 | 10 | 5 | 10 | 5 | 20 |
| **25% 0.6 ft** | 100+ | 15/ 35 | 25/ 40 | 30 | 20 | 20 | 20 | 10 | 20 | 5 | 30 |

change in top width with increasing flow is less in the Highway 154 reach than it is in the Refugio or Alisal reaches, although the top widths are greater at all flows. Based on the habitat proportions provided in Table 2-6 the proportion of riffle and run habitat increases in a downstream direction. The Highway 154 reach is about 22 percent combined riffle and run habitat, the Refugio reach is about 50 percent riffle and run, and the Alisal reach is 64 percent riffle and run. This indicates that there is an increase in available spawning habitat with distance downstream, but this increase in availability is offset by the lack of suitable rearing habitat later in the year.

### 2.3.2 Santa Ynez River Lagoon

#### 2.3.2.1 Channel Structure

The lagoon is located at the mouth of the Santa Ynez River, about 9 miles west-northwest of the town of Lompoc, California. As with most California rivers, the lagoon typically forms as flows decline after the winter runoff period when the mouth of the river is filled with sand deposited by both the river and by the strong longitudinal drift of sand from north to south along the shoreline. This process is facilitated by decreasing erosional force from the river as flow declines and from the ocean as winter storm wave energy dissipates.

Typically, the Santa Ynez River is "flashy": its flow responds strongly to rainstorms in the watershed, but in dry weather, there is little flow (Section 2.2.2). High winter river flows are capable of opening an outlet, or breaching the river mouth, and transporting sand out of the outlet faster than the longitudinal drift can supply sand to it. Low summer flows, in combination with tidal flows, however, are insufficient to keep the outlet open.

The lagoon is about 13,000 feet long, with an average width of about 300 feet. Near the beach, it is substantially wider than at the upstream end. The average water depth is about 4 feet, and the water surface elevation during the July 1994 sampling period, with the mouth closed, was almost 5 feet MSL. The volume of water stored in the closed lagoon is approximately 300 AF. The lagoon supports the growth of emergent aquatic vegetation along the margins, but the majority of the lagoon is open water. Substrate in the lagoon typically consists of sand and silt.

#### 2.3.2.2 Water Quality

The lagoon represents a unique habitat characterized by saltwater/freshwater mixing. Water quality within the lagoon, particularly salinity, has a major influence on the distribution of fish and macroinvertebrates inhabiting this area of the system. Periodic surveys have been performed since 1993 to document salinity, temperature, and dissolved oxygen concentrations. Results of water quality monitoring have found differences between the upstream and downstream ends of the lagoon, both when the mouth was open and when it was closed.

When the lagoon is open and river flow is high, the currents in the lagoon may be strong enough to temporarily push virtually all the saltwater out of the estuary. When the lagoon is open and flows are moderate, the lagoon may become an estuary with both freshwater and higher salinity regions. Flow at the entrance reverses cyclically in response to the tides, although faster on the ebb than on the flood because of the fresh-water discharge. The flood tide brings ocean water into the lagoon, where it partly mixes with the freshwater, and because of its greater density, tends to settle to the bottom, particularly accumulating in the deeper areas of the lagoon. As river flows decrease, the saltwater tends to work its way upstream along the bottom due to density-induced currents. Consequently, when the lagoon closes, a substantial amount of saltwater can be trapped in the lagoon, mixed to varying degrees with the freshwater, and distributed unevenly throughout the lagoon. In a long, narrow lagoon such as the Santa Ynez River Lagoon, salinity increases with depth and generally decreases with distance from the ocean.

Vertical gradients in water temperature, dissolved oxygen, and salinity were observed within deeper areas of the lagoon during periods when the lagoon mouth was closed (Figures 2-7 and 2-8). Vertical stratification in water quality parameters varied substantially between locations and survey periods. Dissolved oxygen concentrations were generally greater than 5 mg/l in the upper three quarters of the water column during months when stratification within the lagoon had developed. The lower one quarter of the water column had dissolved oxygen levels less than 4 mg/l, with concentrations less than 1 mg/l within 1-foot of the bottom at most locations.

Average daily and maximum daily water temperatures within the lagoon during the summer were usually lower than water temperatures measured at upstream monitoring locations, with the exception of locations immediately downstream of Bradbury Dam (SYRTAC 1997). Surface and bottom temperatures frequently exceeded 20°C average daily and sometimes exceeded 25°C maximum daily from May to September (SYRTAC 1997, 1998).

Salinity levels within the Lagoon followed a consistent longitudinal pattern, with salinity near brackish/full strength sea water at Ocean Park, decreasing to freshwater at the upstream location. Salinity level varied at each site between months, reflecting seasonal variation in the balance between freshwater inflow and tidal influence. Higher salinity concentrations were observed at high tide at all three sites monitored, particularly when the Lagoon mouth was open.

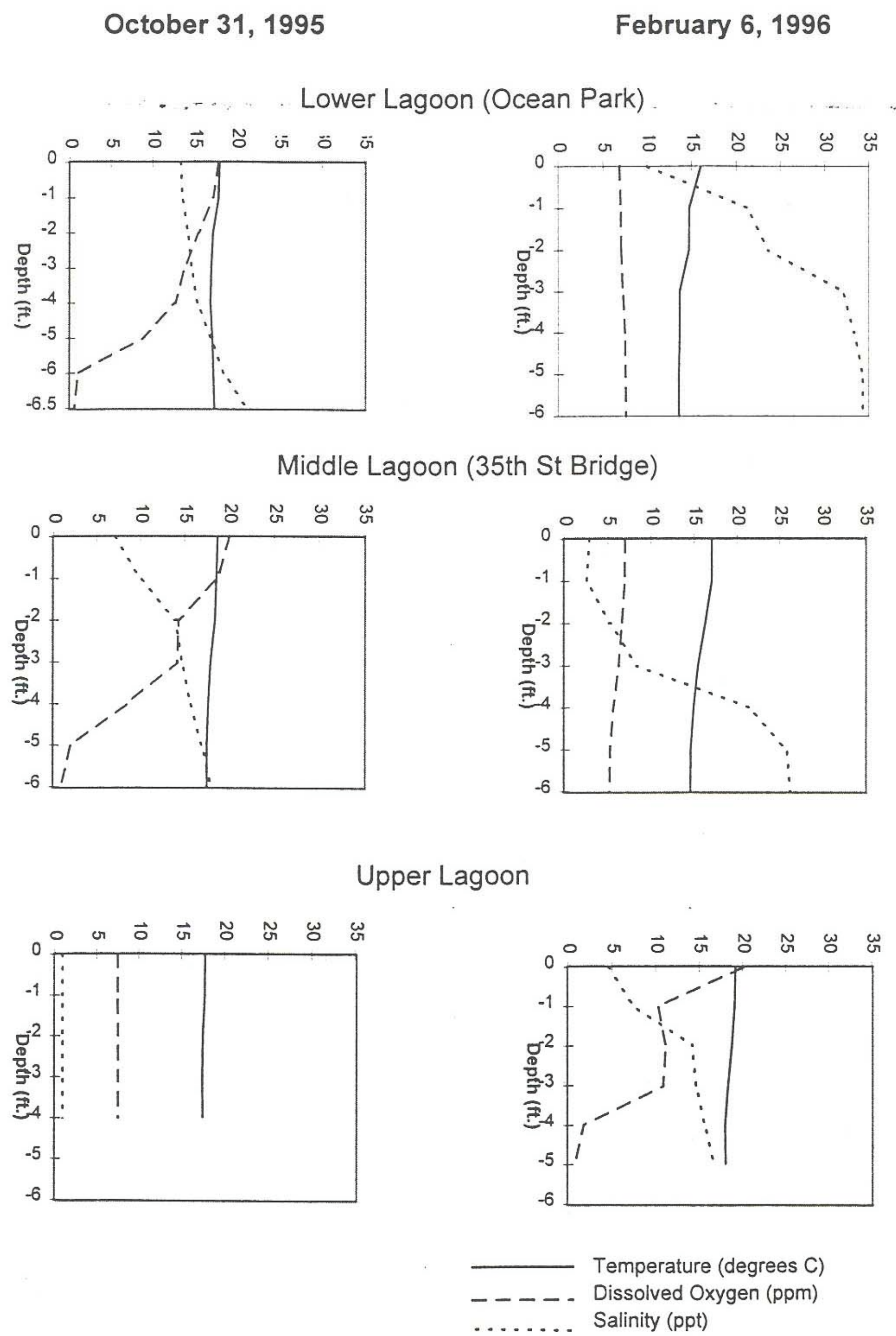
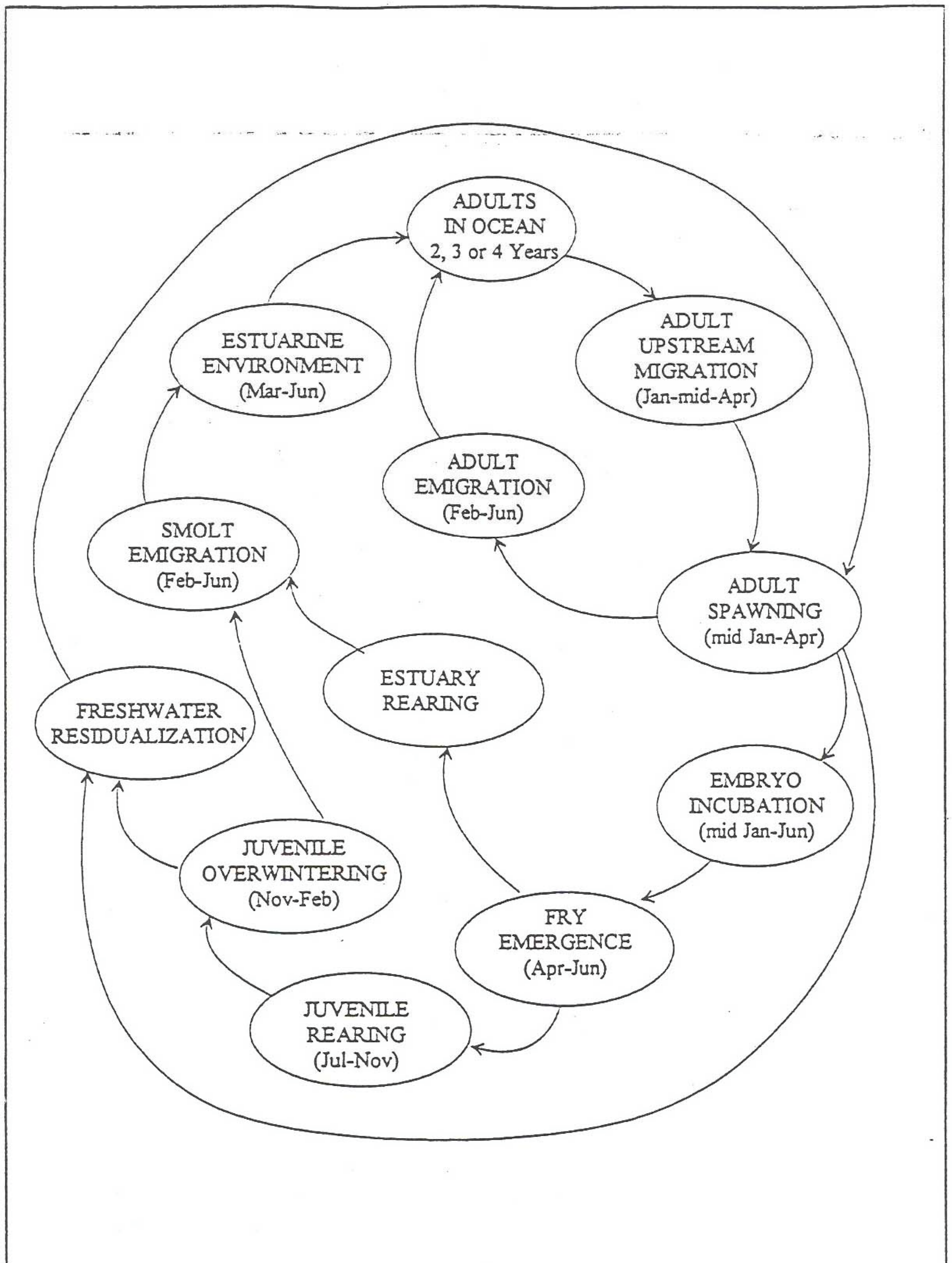



**Figure 2-7. Vertical Profiles of Lagoon Water Quality (Temperature, Dissolved Oxygen and Salinity) at Three Stations - October 1995 and February 1996.**




Data summarized from Barnhardt 1991, Shapovalov 1944, Shapovalov & Taft 1954, and Titus 1994.

**Figure 2-8. Vertical Profiles of Lagoon Water Quality (Temperature, Dissolved Oxygen and Salinity) at Three Stations - April and August 1996.**

2.3.3 TRIBUTARIES

### 2.3.3.1 Salsipuedes and El Jaro Creeks

Channel Structure

The Salsipuedes-El Jaro creek system is the largest drainage in the lower basin. Salsipuedes joins the Santa Ynez River just upstream of the town of Lompoc. El Jaro Creek is a tributary of Salsipuedes Creek. This system is the second tributary that returning steelhead encounter after entering the Santa Ynez River from the ocean, and the first that they can migrate up into.

Access to habitat within Salsipuedes and El Jaro Creeks by anadromous steelhead may be limited by low flow passage barriers associated with bridges or road crossings (SYRTAC data). Recent surveys by the SYRTAC biologist have documented two impediments, although an earlier survey reported three low-flow passage impediments (SYRTAC 1994 and 1997). These barriers were thought to impede the passage of both adult and juvenile fish primarily during periods of low flow. The Highway 1 Bridge #51-95 on lower Salsipuedes Creek is located approximately 3.6 miles upstream from the Santa Ynez River. This bridge has a 3 to 4 foot drop from the concrete apron into a pool downstream of the bridge. Pool depth may not be sufficient to allow fish to negotiate the apron. Another impediment is a road crossing and concrete apron on El Jaro Creek about 1/3-mile upstream of the confluence. It is an old ford on a private, unused road, with a 3-foot drop below.

Habitat surveys were conducted by SYRTAC in 1994 and 1996 (SYRTAC 1997, 1998). Lower Salsipuedes Creek (below the confluence with El Jaro Creek) was surveyed on June 12 and 13, 1996, at a flow of 2.06 cfs. The habitat was comprised primarily of shallow runs (72 percent of reach length), with some deep run (7 percent), step run (5 percent), pools (10 percent), and riffles (6 percent) (SYRTAC 1998). After the first quarter mile, the flood plain widened and there was minimal riparian vegetation and canopy (SYRTAC 1997). Canopy cover in 1996 averaged 24 percent for riffles and 16 percent for pools, but was less than 10 percent for all runs. Riparian vegetation was scoured from the main channel in the winters of 1995 and 1998. Several small pools with undercut banks and other features provide important summer habitat for steelhead (SYRTAC 1997). Instream cover averaged 34 percent in pools (vegetation, bedrock, some woody debris), 28 percent in deep runs (vegetation, bedrock, undercut banks), 18 percent in runs (vegetation with some bedrock and undercut banks), and 13 percent in riffles (mainly white water) (SYRTAC 1998). Following the heavy winter flows of 1998, a survey in June 1998 at a flow of about 10 cfs found mostly runs and slightly less pools (73 percent runs, 15 percent glides, 7 percent riffles, and 4 percent pools) (SYRTAC 1999a).

Substrate conditions varied by habitat in 1996, with silty conditions generally throughout lower Salispuedes Creek. Pools were dominated by fine sediments, and subdominated by bedrock and gravels. Riffles were dominated by small cobbles, and subdominated by gravels and large cobbles. Run habitats were dominated by gravels and fine sediments, and subdominated by small cobbles.

Above the confluence of El Jaro Creek, upper Salsipuedes Creek had excellent cover and shading in the 1994 survey (approximately 1,000 feet total from the confluence). In addition, suitable spawning gravels were observed in all riffle and pool tail areas. A survey conducted June 26, 1996 found that habitat was comprised mainly of runs (44 percent by length), followed by step runs (27 percent), pools (20 percent), and riffles (9 percent). Flow was 0.68 cfs in upper Salsipuedes and 2.0 cfs in lower Salsipuedes on that day. Canopy coverage was relatively high compared to lower Salsipuedes and El Jaro Creeks, averaging 48 percent in riffles, 29 percent in pools, 17 percent in runs, and 13 percent in step runs (SYRTAC 1998). Instream cover was 38 to 40 percent for all habitat types. Substrate composition was also similar across habitat types, with gravels dominant and, in pools and runs, fine sediments subdominant.

El Jaro Creek was very similar to lower Salsipuedes, but it had two to three times the flow of upper Salsipuedes. The 1994 survey near the confluence with Salsipuedes Creek documented large pools, good riparian cover with overhanging vegetation, good instream cover in the form of vegetation and boulders, and generally excellent trout habitat (SYRTAC 1997). Further upstream there were areas of marginal habitat with abundant fine sediment, slow flow, and medium canopy. Other sections had high gradient riffles, very rocky substrate, and appeared to provide quality trout habitat. Although some reaches upstream of the ford had excellent spawning and rearing habitat, no trout were observed in the stream for 2 miles. A greater incidence of destabilized banks and fine sediments were observed in the upstream portion of El Jaro Creek and in the lower section of Salsipuedes Creek.

El Jaro Creek was surveyed again on June 27, 1996 at a flow of 1.1 cfs. The survey (4,490 feet total) found primarily runs (61 percent by length), with lower proportions of pools (17 percent), step runs (13 percent), riffles (6 percent), and deep runs (3 percent) (SYRTAC 1998). Canopy cover averaged 26 percent in pools, 28 percent in riffles, 23 percent in deep runs, and only 5 percent in runs. Instream cover was greatest in pools (32 percent, vegetation and boulders), followed by runs (26 percent, vegetation and boulders), deep runs (15 percent, boulders and rootwads), and riffles (22 percent, vegetation, rootwads, and boulders). Substrate in pools and deep runs were dominated by fine sediments and subdominated by boulders and gravels. Riffles and runs were dominated by gravels, and subdominated by cobbles in riffles and fine sediments and large cobbles in runs. Following the heavy winter flows of 1998, a survey in July 1998 (4,548 feet total ) at a flow of 5.9 cfs found more riffles and fewer pools (66 percent runs, 19 percent riffles, 12 percent glides, and 3 percent pools) (SYRTAC 1999a). The large storms of 1995 and 1998 have altered this reach by filling in some pool habitat and scouring riparian vegetation.

Overall, the reaches with the best conditions are in Salsipuedes Creek upstream of the confluence with El Jaro. Surveys have not been conducted in either creek more than

1 mile above their confluence, however. General observations by the SYRTAC suggest that conditions are fairly consistent throughout the entire system.

Water Quality

Water temperatures were cooler in upper Salsipuedes Creek than in lower Salsipuedes or El Jaro Creeks. Mean daily temperatures exceeded 20°C much of the time in lower Salsipuedes and sometimes in El Jaro (just upstream of the confluence) during July and August.

Maximum water temperatures in upper Salsipuedes Creek (upstream of the confluence of El Jaro Creek) were monitored from 1995 to 1998. Water temperature was 2 to 3°C cooler in this portion of the stream than in El Jaro Creek or in lower Salsipuedes Creek. Water temperatures did not exceed 22°C in either 1995 or 1996, nor did average daily temperatures exceed 19°C.

Water temperatures in El Jaro Creek, just upstream of its confluence with Salsipuedes Creek and in lower Salsipuedes Creek, were relatively higher. Mean daily temperatures at both locations exceeded 20°C in July and August 1995, and maximum temperatures exceeded 24°C in these months as well.

#### 2.3.3.2 Hilton Creek

Channel Structure

Hilton Creek is a small tributary located immediately downstream of Bradbury Dam that has intermittent or no flows in its lower reaches during the dry season.. About 2,980 feet of Hilton Creek is on Reclamation property, including the confluence with the Santa Ynez River.

The lower reach of Hilton Creek is high gradient and well confined. The channel is shaded by riparian vegetation and the walls of the incised channel. Habitat mapping in 1995 classified the stream below the chute pool as 44 percent runs, 27 percent riffle, 26 percent pool, and 3 percent cascade (SYRTAC 1997). Channel width averaged 9.3 feet and maximum pool depth averaged 3 feet. Most pools had suitable spawning habitat at their tails. High flows in the winter of 1998 altered the lower few hundred feet of channel and moved the confluence with the Santa Ynez River further downstream. Habitat mapping was conducted in 1998 at 2.7 to 2.8 cfs of the entire creek on Reclamation property (total 2,975 feet). The lower creek up to the chute pool (1,380 feet) was comprised of 58 percent riffle/cascade, 27 percent run, and 15 percent pool (percent of total length).

A rocky cascade and bedrock chute are potential passage impediments for migrating steelhead, located about 1,380 feet upstream from the confluence with the river. The cascade is about 7 feet high. A shallow pool (the "chute pool") is at the base of the cascade. The bedrock chute immediately above it is about 100 feet long. Passage can be difficult here during high velocity flows, due to the lack of deeper water and resting sites.

Habitat surveys in 1998 above the chute pool to the Reclamation property boundary (1,593 feet total) documented 61 percent riffle/cascade, 34 percent run, and 5 percent pool (SYRTAC 1999a). The reach just above the bedrock chute (about 300 feet) is consecutive run/riffle habitats with little or no canopy cover. Above this open reach to the Highway 154 culvert (about 2,400 feet total) and beyond, habitat conditions are good to excellent with excellent riparian shading and cover. About 1,200 feet of this habitat is on Reclamation property. The culvert is a complete passage barrier and is located about 4,200 feet upstream from the confluence and about 1,200 upstream from the Reclamation property boundary.

<u>Water Quality</u>

Water temperatures have been monitored in lower reach (about 250 feet upstream of the confluence), middle reach in a pool downstream of the chute pool (about 1,000 feet upstream of the confluence), and in 1998 at the Reclamation property boundary (2,980 feet upstream of the confluence). Thermograph data, coupled with observations throughout the year, indicated that water temperatures are generally suitable for oversummering steelhead. Water temperatures are lowest at the upper Reclamation property boundary, with gradual warming occurring down to the mouth of the creek. Water temperatures in the chute pool are suitable through the summer, although the pool would be physically isolated from other areas of potential habitat during a portion of the year unless flows were supplemented.

Maximum water temperatures within Hilton Creek, 250 feet upstream of the mouth, ranged from 16.4 to 26.3°C during the summer of 1995 (June-August). Young-of-the-year steelhead were observed to be actively feeding at temperatures up to 25.8°C within Hilton Creek. Young-of-year steelhead were observed within Hilton Creek up to when fish rescue operations were conducted in July, 1995. Daily maximum water temperatures exceeded 25°C for only a few days in early August 1995. Maximum and average daily water temperatures April-October 1997, when the temporary watering system maintained summer flow at 4 cfs, never exceeded 18°C. In 1998, maximum water temperatures measured 250 feet upstream of the mouth exceeded 25°C for a few weeks in July and August, when flow was less than 1 cfs.

At a deep pool (upper Chute Pool) located approximately 1,200 feet upstream of the confluence, summer water temperatures were substantially lower than those measured further downstream. Water temperatures within this pool may be suitable through at least August, although the pool would be physically isolated from other areas of potential habitat during a portion of the year. This pool persisted into the summer during 1995, a wet year, however, it did not persist through the summer of 1996. Seasonal patterns in surface flows and the persistence of the deeper pool within Hilton Creek varies from one year to the next depending upon precipitation and runoff within the watershed.

Dissolved oxygen concentrations are suitable for rainbow trout/steelhead (>5 mg/l). Channel disturbance and water quality problems appear minimal. Hilton Creek maintains good clarity even after several days of rain.

#### 2.3.3.3 Other Tributaries

Quiota Creek

Quiota Creek enters the Santa Ynez River between the towns of Solvang and Santa Ynez. Studies were limited here due to lack of access on private property. Surveys of lower Quiota Creek in spring 1994 found little flowing water and degraded habitat conditions (ENTRIX 1995a, SYRTAC 1997). Oaks and willows were generally abundant, although riparian vegetation was lacking in many places. Silt was the predominant substrate, especially in pools. Summer flow appears to be intermittent in average and dry years in the lower section. Grazing had decreased the amount of streamside vegetation in this area.

Refugio Road crosses Quiota Creek many times starting with several crossing 1.3 to 1.6 miles from the mainstem Santa Ynez. In 1998, a survey was conducted from road crossings about 1.5 to 3 miles upstream from the confluence. Habitat conditions in this area are better, particularly after the storms of 1998. Good canopy conditions provide shading within this section. Additionally, pool habitats have good depth and complexity of instream cover. Numerous undercut banks exist (particularly in pools) which provide excellent rearing habitat. In contrast to several other tributaries, substrate is composed of larger size gravel, cobbles, and boulders.

An unnamed tributary that enters Quiota Creek about 4 miles upstream from the Santa Ynez confluence was examined in August 1994 (ENTRIX 1995a). The tributary was spring-fed and in a steep gully. There was little or no flowing water in late summer, and most habitats were produced by upwelling. In some places, there was good boulder cover and adequate pool depths that provided refuge for trout. Oaks and cottonwoods shaded a significant portion of the creek, but overall there was little riparian vegetation

The numerous road crossings of Refugio Road are impediments to upstream passage at low and high flows (SYRTAC data). All nine crossings are shallow-water Arizona crossings, with concrete beds and, at several sites, a 2 to 3 foot drop downstream of the concrete apron. Four of these crossings warrant further attention for passage enhancement. Refugio Road is maintained by the County of Santa Barbara.

No temperature monitoring was conducted on this stream. In the lower reach, lack of good shading suggests that warming may be a problem. Cattle fecal material was also observed in and around the stream in this area. Shading is better upstream, which may mean that water warming is less likely or frequent.

Alisal Creek

Alisal Creek enters the Santa Ynez River near Solvang. Habitat in lower Alisal Creek was not surveyed, although some observations were made from the road. During the summer flow did not reach the Santa Ynez River confluence, but little is known about water conditions further up. A small concrete structure just upstream of the confluence was a potential passage barrier, but it was washed out by storms in 1995. A dam and small reservoir exists about 2 to 3 miles upstream from the confluence, which completely blocks passage to steelhead migration. Conditions below the creek appeared fair, with decent riparian vegetation and canopy cover. The lower creek runs through a golf course. The habitat above the reservoir is very good and has perennial flow.

No temperature monitoring has been conducted, but observations suggest good temperature conditions in upper Alisal Creek.

Nojoqui Creek

Nojoqui Creek joins the Santa Ynez River near Buellton. Habitat surveys were conducted in 1994 and 1998. The lower reach of Nojoqui Creek from the confluence with the mainstem Santa Ynez River up to one-half to three-quarters of a mile had degraded conditions with no canopy, little vegetation, eroded banks, and little or no flow. Further upstream, however, conditions appeared good for spawning and rearing, although flow is fragmented and intermittent within this section, particularly during average and dry years. The stream had dense riparian vegetation and canopy cover, good instream cover from boulders, roots, and undercut banks. A habitat survey in 1998 found mainly shallow runs (63 percent runs, 17 percent riffle, 15 percent glide, and 4 percent pool). Summer water temperatures sometimes exceeded guidelines for rainbow trout/steelhead (daily 20°C daily mean and 24°C maximum).

No significant passage barriers are currently found. One low flow barrier exists about 3 miles upstream from the Santa Ynez River, and another may exist at a culvert under the Highway 101 bridge. The second possible impediment has not been evaluated yet. A small concrete dam that impeded passage washed out in 1995.

San Miguelito Creek

San Miguelito Creek flows into the Santa Ynez River at the city of Lompoc. The lower 2 miles of San Miguelito Creek is a concrete box culvert with several drop structures. This impedes fish passage at low flows due to shallow depth and at high flows due to high velocities. The culvert empties into the Santa Ynez River near V Street in Lompoc. The creek above this culvert has a narrow channel with well-developed riparian corridor and adequate spawning habitat. A couple other passage barriers exist, such as a bridge with a 30-foot concrete apron downstream that slopes to a 9-foot drop where the creek has downcut below the concrete.

Water temperature conditions appear to be good through the summer due to good canopy coverage and proximity to the ocean, although the data are somewhat limited.

## 2.4 Fish and Wildlife Populations

Ten fish species are native to the Santa Ynez River basin. Four of these species are found in the freshwater portion of the river, while the remaining six live only within the lagoon. Of the four species that live in the freshwater portion of the river, two are anadromous (steelhead and Pacific lamprey). Eighteen species have been introduced to the Santa Ynez River basin, of which at least 15 have established self-sustaining populations. These species include Arroyo chub and fathead minnow, which were introduced from nearby river basins, but most of the species are game species or baitfish for these species. These fish were originally planted in Lake Cachuma, but have since spread to the river both upstream and downstream of the reservoir. Many of the game fish can be substantial predators of steelhead and other native species. Most notable among these are largemouth and smallmouth bass, green sunfish, and bullheads.

Most of the reptiles of the Santa Ynez River are fully terrestrial and, therefore, are not expected to be affected by changes in the operation of Bradbury Dam. Exceptions include turtles and garter snakes that live in aquatic environments. Amphibians require an aquatic environment to complete their lifecycle and are expected to occur throughout the Santa Ynez watershed. Two species are known to be abundant: the pacific treefrog and the western toad. Red-legged frogs were probably common historically, but recently have become rare. The introduced bullfrog (*Rana catesbeiana*) has become common throughout the watershed. This species is large, highly predatory and is at least partly responsible for the decline of native species such as the red-legged frog.

Twenty-one endangered or threatened species occur within the Santa Ynez River basin (Woodward Clyde Consultants 1995, DFG 1998). These include 4 species of plants, 2 species of fish, 2 species of reptile or amphibian, and 13 species of birds (Table 2-13). In the immediate vicinity of Lake Cachuma, the effects of the proposed project operations are likely to occur only due to increased water levels resulting from surcharging or gateholding and in the area between Bradbury Dam and Lompoc due to water releases. As a result, only six of the 21 species are likely to be in the area affected by project operations. These are: (1) rainbow trout/steelhead (*Oncorhynchus mykiss*); (2) California red-legged frog (*Rana aurora draytonii*); (3) southwestern willow flycatcher (*Empidonax traillii extimus*); (4) least Bell's vireo (*Vireo bellii pusillus*); (5) bald eagle (*Haliaeetus leucocephalus*); and (6) American peregrine falcon (*Falco peregrinus anatum*). The other species occur either further upstream of Lake Cachuma or in or near the lagoon where project operations have little effect on the physical or biological environment.

**Table 2-13. Federal and State Listed Threatened and Endangered Species in the Santa Ynez River basin Below Bradbury Dam.**

| Species | Status | Locality and Habitat | Adversely Affected by Project |
|---|---|---|---|
| **Plants** | | | |
| Beach Layia *Layia carnosa* | FE | Coastal foredunes. | No |
| Beach Spectaclepod *Dithyrea maritima* | CT, FC | Back slopes of coastal foredunes | No |
| La Graciosa Thistle *Cirsium loncholepis* | CT, FC | Brackish and freshwater wetlands near the coast. Previously reported at Surf and 2 miles inland. Not observed during 1994 surveys. Presumed extirpated. | No |
| Surf Thistle *Cirsium rhothophilum* | CT, FC | Coastal foredunes | No |
| **Fish** | | | |
| Steelhead trout *Oncorhynchus mykiss* (Southern California ESU) | FE | Santa Ynez River and its tributaries downstream of Bradbury Dam. | Yes |
| Tidewater Goby *Eucyclogobius newberryi* | FE | Lagoon | No |
| **Amphibians and Reptiles** | | | |
| Arroyo Southwestern Toad *Bufo microscaphus californicus* | FE | Tributaries upstream of Lake Gibralter | No |
| California Red-legged Frog *Rana aurora draytonii* | FT | Santa Ynez River up- and down-stream of Lake Cachuma | No |
| California Tiger Salamander *Ambystoma californiense* | FC | Isolated ponds between Buellton and Santa Ynez, not on the mainstem | No |
| **Birds** | | | |
| California Brown Pelican *Pelecanus occidentalis californicus* | CE, FE | Occasional transient found at mouth of Santa Ynez | No |
| California Condor *Gymnogyps californianus* | CE, FE | Only 35 individuals in the wild. May be transient in the project area. | No |
| Bald Eagle *Haliaeetus leucocephalus* | CE, FT | Lake Cachuma and at the river mouth. | No |
| American Peregrine Falcon *Falco peregrinus anatum* | CE, FE | Resident near Lake Cachuma. Winter migrants anywhere in the project area, especially near the lagoon. | No |
| California Black Rail *Rallus logirostris obsoletus* | CT, | One transient observed at mouth in 1981. | No |
| Light-footed Clapper Rail *Rallus longirostris levipes* | CE, FE | Not likely to occur in project area. | No |

**Table 2-13. Federal and State Listed Threatened and Endangered Species in the Santa Ynez River basin Below Bradbury Dam (concluded).**

| Species | Status | Locality and Habitat | Adversely Affected by Project |
|---|---|---|---|
| **Birds (continued)** | | | |
| Western Snowy Plover *Charadrius alexandrinus nivosus* | FT | 7-12 nests on the beach near river mouth. Nests are placed in sand above the drift zone. Fairly common in winter. | No |
| California Least Tern *Sterna antillarum browni* | CE, FE | Lagoon frequented by adults and juveniles in August. Nesting occurs 2 mi. north of mouth. | No |
| Western Yellow-billed Cuckoo *Coccyzus americanus occidentalis* | CE | Not likely to occur in project area. | No |
| Southwestern Willow Flycatcher *Empidonax traillii extimus* | FE | Known to breed along the Santa Ynez River. | Unlikely |
| Bank Swallow *Riparia riparia* | CT | Unsubstantiated rumors of its occurrence along the Santa Ynez River. | No |
| Least Bell's Vireo *Vireo bellii pusillus* | CE, FE | Upper Gibralter Reservoir/Mono Creek/Aqua Caliente. Santa Ynez River near mouth of Salsipuedes Creek. | Unlikely |
| Belding's Savannah Sparrow *Passerculus sandwichensis beldingi* | CE | Common near the river mouth, but thought to be hybridized. | Unlikely |

FE Federally listed as Endangered
FT Federally listed as Threatened
FC Federal Candidate Species (formerly Category 1 candidates)
CE California Endangered
CT California Threatened

### 2.4.1 RAINBOW TROUT/STEELHEAD (*ONCORHYNCHUS MYKISS*) - FE

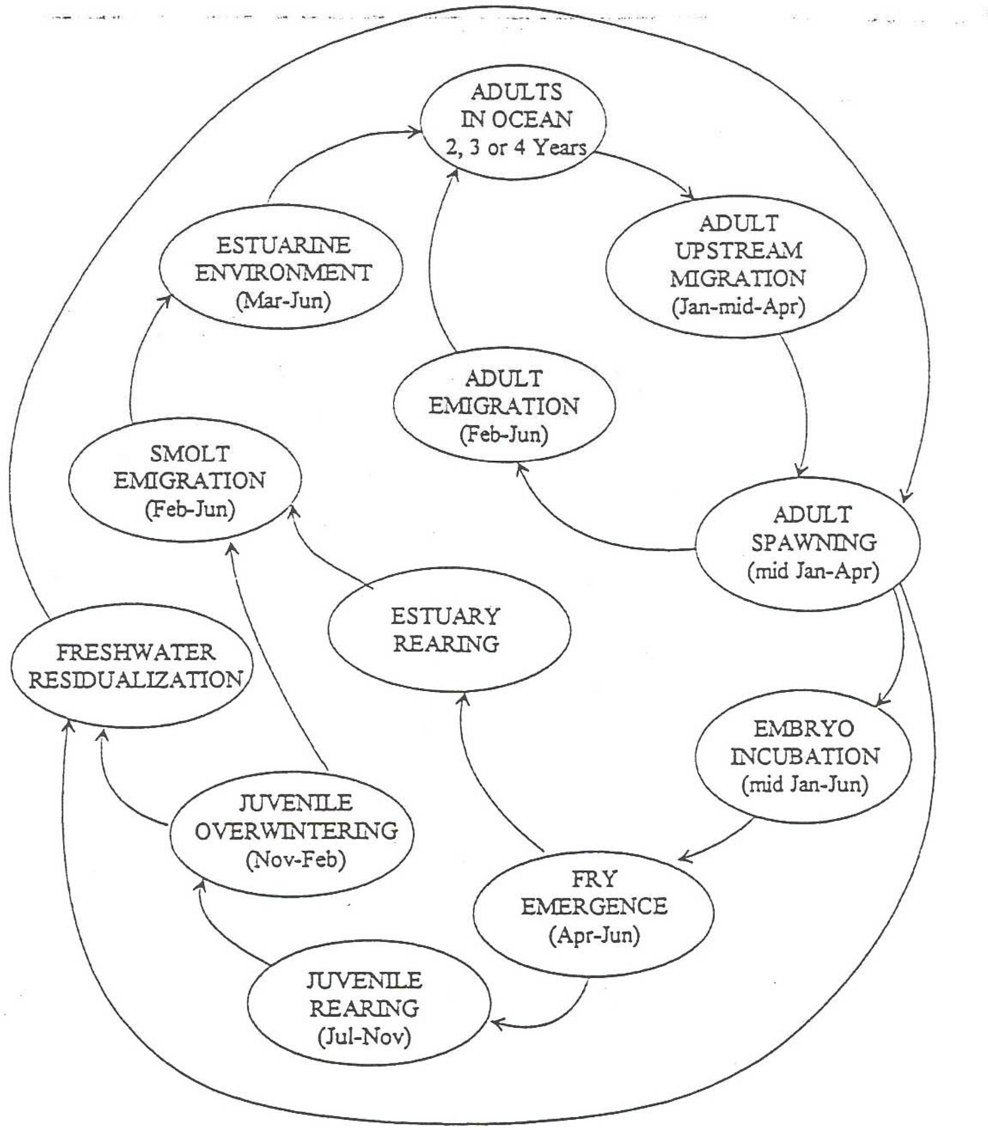
#### 2.4.1.1 Life History

Rainbow trout are an extremely popular game fish that are native to the Santa Ynez River. Coastal rainbow trout exhibit two distinctive life history strategies: freshwater residency or anadromy. Resident rainbow trout live their entire lives in freshwater. Anadromous steelhead are born in freshwater, emigrate to the ocean as smolts to rear to maturity, and then return to freshwater to spawn. It is common to find populations exhibiting both life history strategies within the same river system.

In many historical steelhead streams, passage barriers have blocked migration to and from upper stream reaches and resulted in residualization of steelhead populations, forcing them to adopt a resident life history strategy (resident rainbow trout). On the Santa Ynez 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 may exist upstream of habitat accessible to steelhead trout which can separate populations of resident rainbow trout (i.e. Gibraltar Dam and Juncal Dam). It should be noted, however, that a range of migratory behaviors may occur. Some mature resident rainbow trout have been documented downstream of barriers (Shapovalov and Taft 1954) and some proportion of the offspring of resident populations may exhibit the anadromous life history. Individuals exhibiting one life history strategy can produce offspring that exhibit the other strategy (J. Nielsen, pers. comm., 1998). In the highly variable conditions of the watersheds along the south central California coast, it is common for one form to decline to extremely low numbers in some years. The population can be subsequently rebuilt from recruits produced by adults exhibiting the other life history strategy.

Migration and life history patterns of southern California steelhead depend more strongly on rainfall and streamflow than do steelhead populations farther north (NMFS 1995). The steelhead life cycle starts in the winter with the return of mature adults from the ocean (Figure 2-9). In many southern California streams, including the Santa Ynez River, access to the river is blocked by a sandbar that forms across the mouth during the summer. Historically, in the Santa Ynez River, steelhead were reported to congregate off the mouth of the river prior to the opening of the sandbar (Titus et al. 1994). In some years the sandbar may not breach at all. In those situations, steelhead may seek another stream that is open for spawning. Steelhead typically migrate upstream after the sandbar is breached (Shapovalov and Taft 1954) and when streamflows rise during a storm event (Moyle 1976).

Depending on rainfall, upstream migration and spawning in most southern California streams typically occurs from January to March (Shapovalov 1944). In the Santa Ynez River, upstream migration has been reported from late December through early April, but occurs primarily from January through March (Figures 2-9 and 2-10). Weir traps placed in




Data summarized from Barnhardt 1991, Shapovalov 1944, Shapovalov & Taft 1954, and Titus 1994.

**Figure 2-9. Life Cycle of Steelhead Trout.**

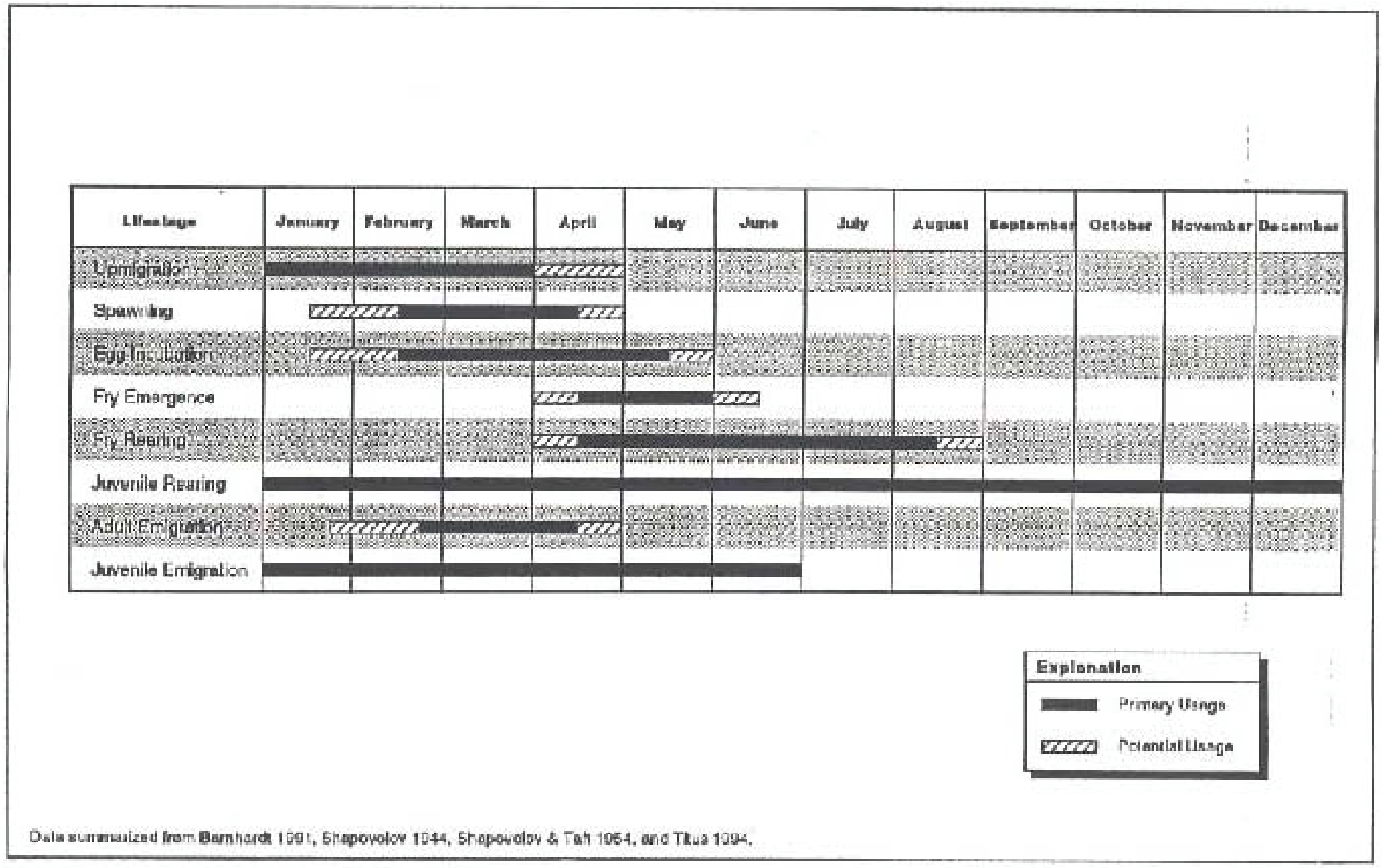


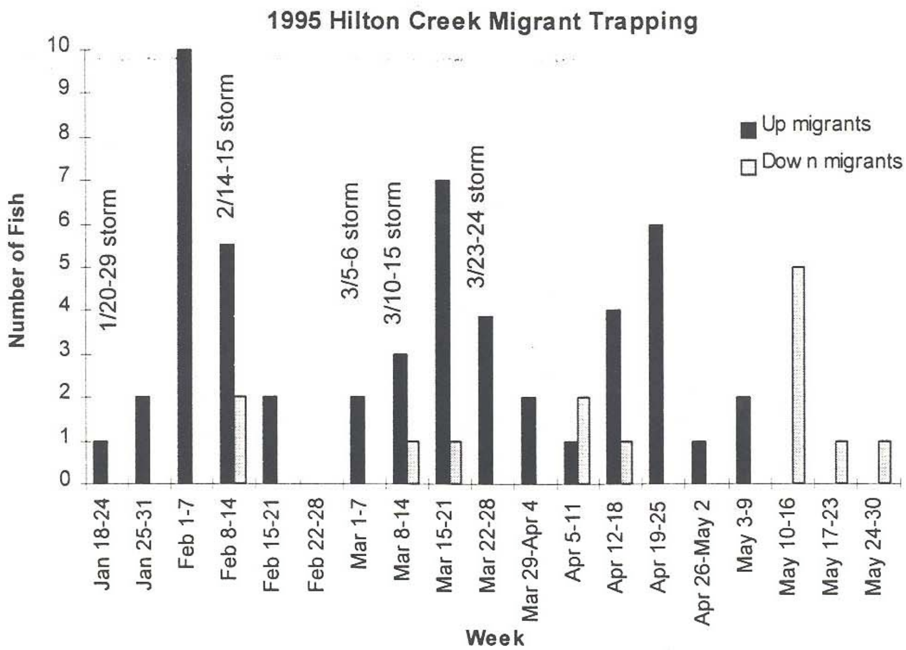

**Figure 2-10. Phenology of Steelhead Trout.**

the tributaries (Salsipuedes Creek and Hilton Creek) generally captured rainbow trout/steelhead migrating upstream from February through April (Figure 2-11). Some of these fish may be resident rainbow trout. Size distributions of captured fish revealed very large fish at Hilton Creek in 1995 (270 to 520 millimeters [mm]) and small fish in Salsipuedes Creek in 1997 (mostly 125 to 250 mm) (Figure 2-12). Fish in Salsipuedes Creek have been observed spawning at about 150 mm (6 inches).

Adult steelhead usually spawn in the same stream in which they rear, when access is available at the ocean. Northern steelhead have been reported to spawn at temperatures of 3.9 °C to 9.4 °C. These values may be inappropriate for use with southern stocks, but no temperature preference data are available for southern steelhead. Unlike other anadromous Pacific salmonids, steelhead may survive spawning, return to the ocean and spawn again in subsequent years (Shapovalov and Taft 1954, Moyle 1976). Males may spawn in sequential years. Both anadromous and resident females commonly skip a year between spawning.Rainbow trout/steelhead usually spawn in the tail of pools or in riffles with gravel substrate (Moyle 1976). Optimal size of gravel substrate ranges from 0.6 to 10.2 centimeters (cm) (Björnn 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). Biweekly redd surveys conducted in 1997 documented 14 redds in lower Salsipuedes Creek (just below the confluence with El Jaro Creek), 11 redds in Upper Salsipuedes Creek (just below the confluence with El Jaro Creek), 18 redds in El Jaro Creek near the confluence with Salsipuedes Creek, and 49 redds in San Miguelito Creek Peak spawning activity was in March and April (Figure 2-13) (SYRTAC 1998). The eggs and newly-hatched fry (alevins) buried in the gravel require a slow but constant flow of water through the gravel to provide dissolved oxygen and to carry away metabolic waste products. This water exchange is a function of stream gradient and substrate composition. If fine sediments accumulate within or over the redd, they can interfere with water exchange and adversely affect the eggs and alevins (Björnn and Reiser 1991).

Steelhead alevins emerge from the gravel in approximately five to eight weeks after the eggs have been deposited, between March and May, depending on water temperature (Shapovalov and Taft 1954, Moyle 1976). In water temperatures around 15.6°C (60°F), which are frequently observed on the Santa Ynez at this time of year, steelhead can emerge from the gravel in as short as three weeks (Barnhardt 1991).

During the early part of their lives, young rainbow trout and steelhead are indistinguishable, both in appearance and in habitat use. Rainbow trout/steelhead fry and juveniles feed on a variety of invertebrates including aquatic and terrestrial insects, and amphipods and snails (Moyle 1976). 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). Larger steelhead, usually yearlings or



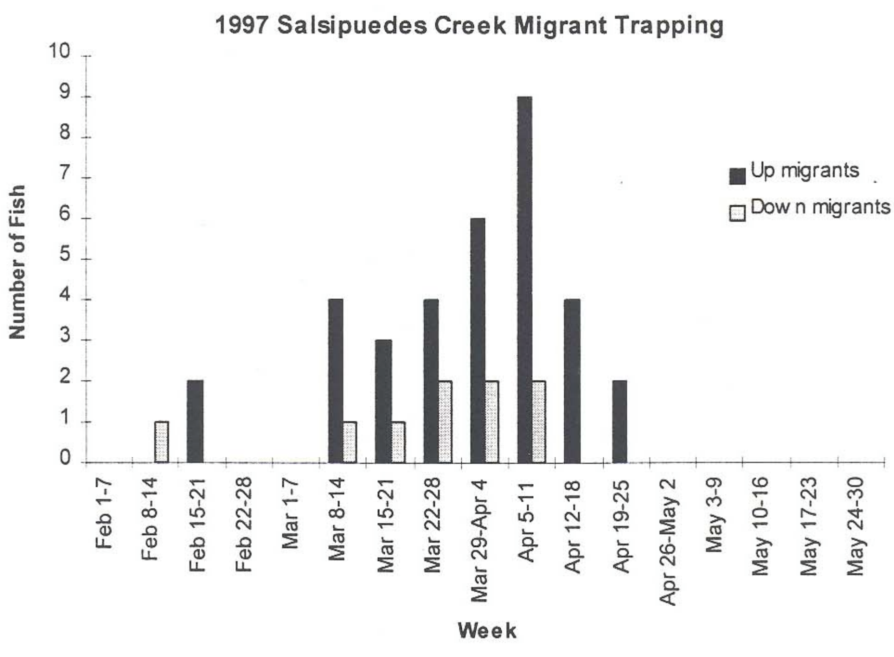
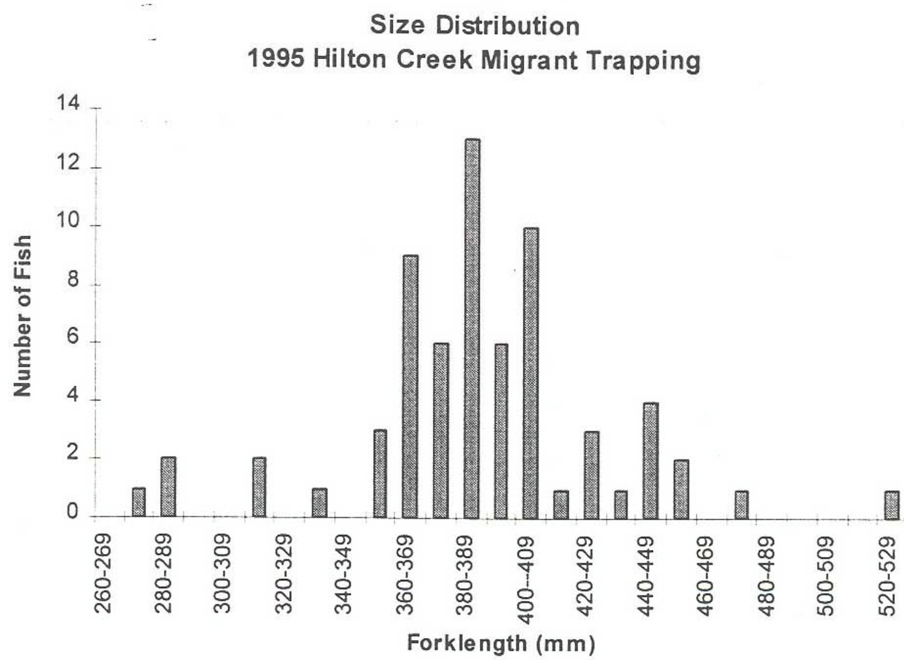




**Figure 2-11. Seasonal Trapping Results in Hilton Creek (1995) and Salsipuedes Creek (1997).**



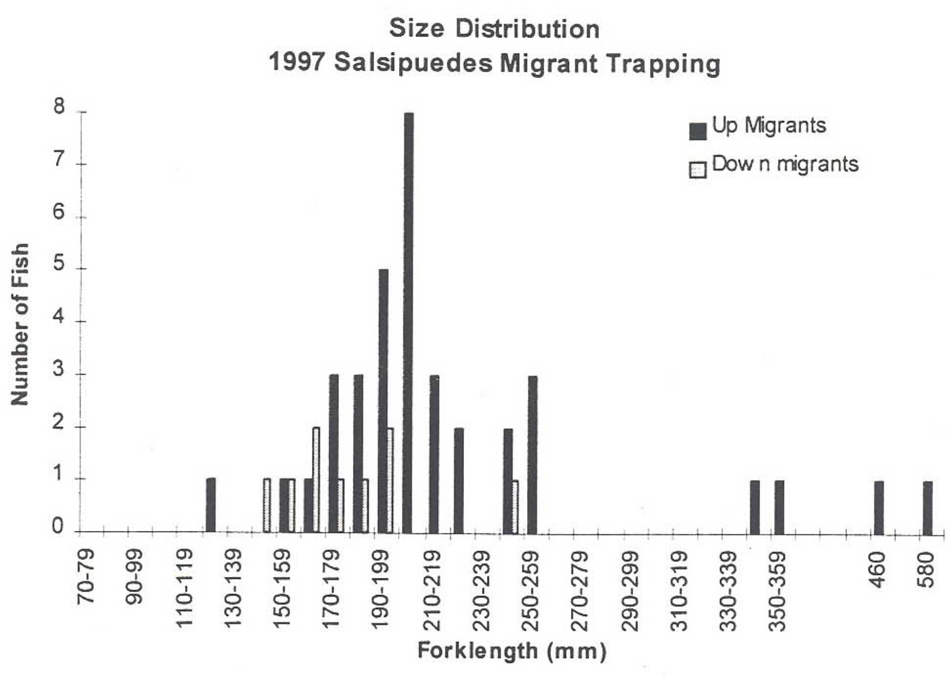




**Figure 2-12. Size Distribution of Rainbow Trout/Steelhead Captured in Migrant Traps in Hilton Creek (1995) and Salsipuedes Creek (1997)**

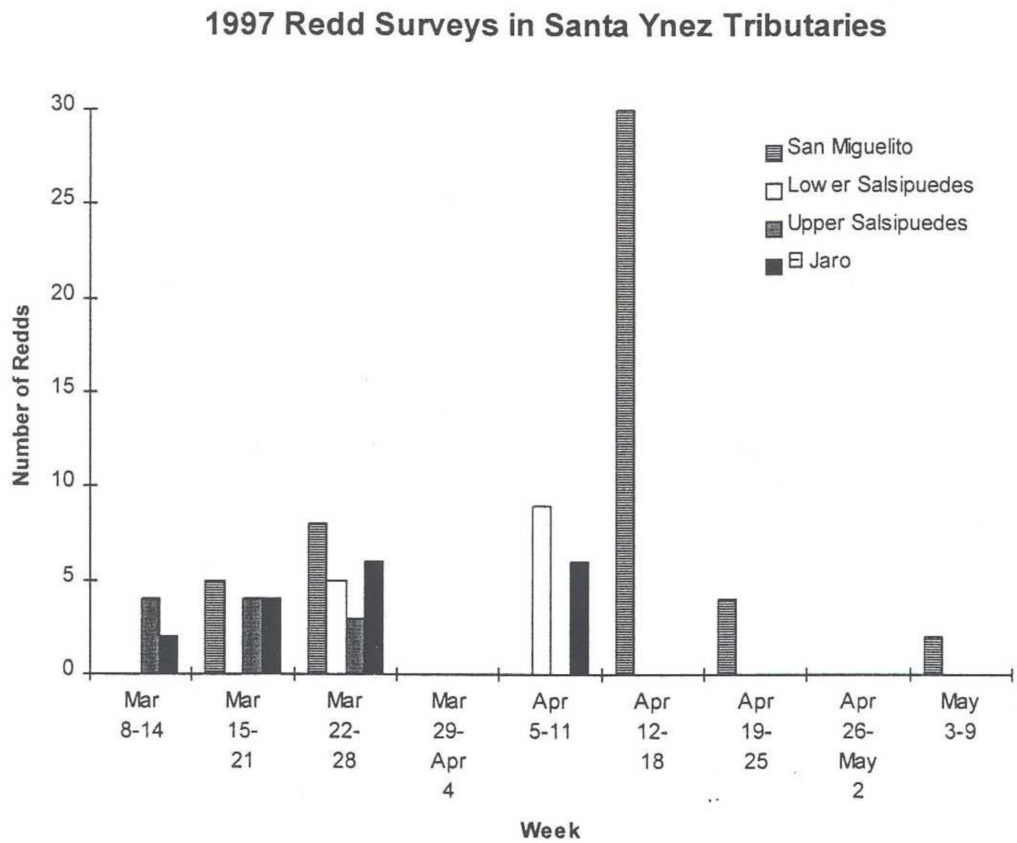



**Figure 2-13. Spawning Timing of Rainbow Trout/Steelhead from Redd Surveys in Salsipuedes, El Jaro and San Miguelito Creeks, 1997**

older, have been observed to use heads of pools for feeding (Baltz and Moyle 1984). Pools provide over-summer refugia for trout in small streams during low flow conditions.

Coastal lagoons can also provide 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, J. Nielsen pers. comm. 1998). The productivity and use of lagoon habitat by steelhead depends on lagoon habitat and water quality and proximity to spawning habitat (J. Smith, SJSU, pers. comm., 1997). Trapping in the Santa Ynez lagoon in November 1998 found two rainbow trout/steelhead adults (280 mm and 344 mm). These fish had loose deciduous scales, and one fish was very silvery (344 mm). The scale patterns of both fish indicated that they were about three to four years old and neither had gone to sea (R. Titus, CDFG, pers. comm. 1999), suggesting that they resided in the lagoon.

In southern California, steelhead typically migrate to the ocean as one or two year olds (125 to 250 mm in length). The juvenile outmigration period for steelhead in the Santa Ynez River is typically February through May, but the timing of migration is dependent upon streamflows (ENTRIX 1995a). Recent studies in the Santa Clara River indicate that outmigration can occur between January and June, with a peak in April and May (ENTRIX 1995b). Fish rescued in 1944 in the lower mainstem were virtually all young-of-the-year (Shapovalov 1944), suggesting that mainstem Santa Ynez steelhead smolted and emigrated to the ocean primarily at age 1 (Titus et a. 1994). Steelhead can have very high growth rates and can grow to smolt size during their first year when warm water and higher than normal flow conditions are present, as Moore (1980) documented in the Ventura River. 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).

Resident rainbow trout may reach maturity and spawn in their second year of life, although the time of first spawning is generally in their third year. Steelhead usually spend one to two years in the ocean before returning to spawn for the first time (Shapovalov and Taft 1954).

Temperature tolerances and preferences of steelhead vary among life stages. Much of the literature is based on data collected on steelhead in the Pacific Northwest and/or on resident rainbow trout populations. Mortality of eggs begins at 56°F (13.3°C) (McEwan and Jackson 1996). Favorable rearing temperatures for juvenile steelhead of northern stocks have been reported as 13 to 19°C (Raleigh et al. 1984). At temperatures greater than 70°F (21.1°C), steelhead have difficulty obtaining sufficient oxygen from the water (McEwan and Jackson 1996). The preferred temperature range is reportedly 12.8 to 15.6°C (55.0 to 60.1°F) (Rich 1987). The Critical Thermal Maximum (CTM), the temperature at which a fish loses equilibrium and dies, for Apache trout has been reported to be up to 29.4°C (84.9°F) (Lee and Rinne 1980).

Elevated summer water temperatures have been identified as a problem for rainbow trout/steelhead in many southern California streams (NMFS 1995). Studies by the SYRTAC have shown that summer water temperatures in the mainstem Santa Ynez River and portions of the tributaries can reach temperatures close to levels that are thought to be stressful or lethal to rainbow trout/steelhead (SYRTAC 1997). However, southern California steelhead are often presumed to be more tolerant of warm water than steelhead from more northerly stocks because they evolved at the southern limit of trout distribution in North America.

Physiological studies of temperature tolerance and CTM have not found increased resistance to high temperatures in rainbow trout from southern populations, including some southwestern trout species (Lee and Rinne 1980) and Kern River golden trout (Myrick and Cech 1996). Another study compared juveniles of a warm-water-adapted rainbow trout with juveniles of two hatchery strains (Kaya 1978). The warm-water strain inhabited Firehole River in Yellowstone Park, where temperatures in summer exceeded 25°C for a few days each summer. The Firehole fish tolerated elevated temperatures longer than the two hatchery strains at intermediate acclimation temperatures, but the incipient lethal temperatures of all fish acclimated to 21°C and 24.5°C were identical (26.2°C). These studies suggest that the upper lethal temperature for southern California rainbow trout/steelhead may not be greater than that of other steelhead stocks (26.2°C), although southern fish may be better able to tolerate temperatures slightly lower than these lethal limits.

To contribute to the maintenance of a population, young fish must not only survive, but also grow and mature. A fish's metabolic rate increases in warmer water, resulting in increased energetic demands for oxygen and food until the upper incipient lethal temperature is reached (Fry 1948 in Brett 1956, Brett 1971, Fausch 1984). In studies of juvenile rainbow trout, Hokanson et al. (1977) concluded that the highest constant temperature at which the effects of growth and mortality balance out was 23°C. They also performed tests in which temperature was caused to fluctuate daily ±3.8°C about a mean. At an average fluctuating temperature of 22°C, growth was not significantly different from zero, and all fish died within ten days. The authors further noted that reports of increased trout mortality at above-optimum (for growth) temperatures were common in the literature. This suggests that rainbow trout/steelhead actively feeding at temperatures at or above 23°C are living at the outer edge of their survival envelope. Rainbow trout/steelhead have been observed feeding at temperatures about 24-25 $^{o}$C in the Santa Ynez system (SYRTAC data), and fish have been reported in the Ventura River at temperatures as high as 28$^{o}$C (Carpanzano 1996). These observations suggest that steelhead/rainbow trout in southern California have different temperature tolerances than fish of more northern stocks. These observations have not been confirmed, however, with laboratory studies. These fish are probably not growing, and in fact are likely experiencing higher rates of mortality from direct and indirect effects of elevated temperature. Streams with warmer water, however, would be expected to have increased insect production and thus abundant food resources for fish.

Water temperature guidelines, based on general knowledge of the temperature relations of this species (e.g. Hokanson et al. 1977, Raleigh et al. 1984), have been proposed as 20°C and 22°C average daily temperature and 25°C daily maximum. The California Department of Fish and Game has used a temperature criterion of 20°C (68°F) for daily average temperatures to evaluate the suitability of stream temperatures for rainbow trout in central and southern California (ENTRIX 1995a). The FWS guidelines for rainbow trout (Raleigh *et al.* 1984) call for an upper limit of 25°C, "only for short periods of time." In the SYRTAC studies, these guidelines have been used to evaluate habitat suitability and to identify potentially stressful situations, such as in the mainstem several miles below Bradbury Dam (SYRTAC 1997).

Dissolved oxygen concentrations also affect habitat quality and use, physiological stress, and mortality for fish and other aquatic organisms. In general, dissolved oxygen concentrations less than 5 mg/L are considered to be unsuitable for most fish species, including both rainbow trout and steelhead (Barnhardt 1986).

#### 2.4.1.2 Population Status

Rainbow trout occur throughout the Santa Ynez River basin and its tributaries where conditions are favorable for their persistence. Current populations are of uncertain genetic heritage due to the long history of hatchery stocking in the region to support the popular sport fishery (Titus *et al.* 1994). While native stock may persist in some areas (e.g. above Juncal Dam), the DFG has planted a variety of different strains throughout the basin above Bradbury Dam including Whitney, Coleman, Hot Creek, Whitney and Kamloop crosses and Hot Creek-Wyoming (Adams, DFG Fillmore Hatchery, pers. comm.).

<u>Mainstem</u>

Steelhead are currently limited to the mainstem Santa Ynez River and the accessible portion of its tributaries below Bradbury Dam. Prior to 1954, when the dam was constructed, steelhead likely used the mainstem below Bradbury Dam only for passage to more favorable spawning and rearing areas that now lie above Bradbury Dam (but below Gibraltar Dam, which was the upstream limit of migration between 1920, when it was constructed) (Shapovalov 1944). The area below the current location of Bradbury Dam typically went dry in the summer and therefore was not suitable spawning or rearing habitat. Shapovalov (1944) reports rescuing rainbow trout/steelhead from the area of the mainstem above the current location of Bradbury Dam.

SYRTAC studies conducted from 1993 to 1998 have documented rainbow trout/steelhead both in the mainstem Santa Ynez River and in several tributary streams downstream of Lake Cachuma (Table 2-14). These studies have occurred during a wet period, and therefore these results probably do not reflect distribution and relative abundance in dry years.

**Table 2-14. Relative Abundance of Rainbow Trout/Steelhead in the Lower Santa Ynez River Basin.**

| Location | Miles Below Bradbury | Young of the Year: Average WY (1996 & 1997) | Young of the Year: Wet (1995) and Very Wet (1998) | Juveniles: Average WY (1996 & 1997) | Juveniles: Wet (1995) and Very Wet (1998) | Adults: Average WY (1996 & 1997) | Adults: Wet (1995) and Very Wet (1998) |
|---|---|---|---|---|---|---|---|
| **MAINSTEM** | | | | | | | |
| Highway 154 | 0 - 0.5 | P | C | P | C | P | C |
| Refugio | 3.4 - 7.9 | NP | C | P * | P | P * | P-C |
| Alisal | 8 - 10.5 | NP | A | P * | C * | P * | C |
| Avenue of the Flags | 14 | NP | NP | NP | NP | NP | P |
| Weister Ranch | 16 | NP | NP | NP | NP | NP | NP |
| Santa Rosa Park | 20 | NP | NP | NP | NP | NP | P ('98) |
| Cargasaschi | 24 | NP | NP | NP | NP | NP | NP |
| **TRIBUTARIES** | | | | | | | |
| Hilton Creek | | P | A | NP | NP | P | P-C |
| Quiota Creek & unnamed trib | | P | C | C | C | P | C |
| Alisal Creek (below reservoir) | | -- | -- | -- | -- | P | -- |
| Nojoqui Creek | | NP | NP | NP | NP | NP | P |
| Salsipuedes Creek | | P | C | P | C | P | P-C |
| El Jaro Creek | | P | C | P | C | P | P-C |
| San Miguelito Creek | | A | A | P | P | A * | A |

A Relatively abundant
C Relatively common
P Present but in low numbers
NP Not present
-- Not sampled
* Present only in pools

Data from snorkel surveys in summer and fall, 1995-1998 (SYRTAC 1997, 1998, data). All comparisons are within the lower Santa Ynez basin only, where fish densities are generally low.

Spawning has been observed in the mainstem directly downstream of Bradbury Dam in 1993 and 1998 (SYRTAC data), but no redds were reported in 1997 (SYRTAC 1998). Additionally, Pacific lamprey have also been observed spawning directly below the spill basin. While no spawning has been observed downstream of the Highway 154 reach, young-of-the-year have been documented here in 1995 and 1998, both very wet years.

Snorkel surveys provide some indication of presence and relative abundance. Snorkel surveys have been conducted in several months in 1995 and 1996, June and October 1997, and June 1998 (SYRTAC 1995, 1997, 1998). Each year, several pool and run habitat units were selected for monitoring in the Highway 154 (Reclamation property only), Refugio, Alisal, and Cargasachi reaches. Two observers snorkeled up from the downstream end and recorded the number and species of fish observed. Two passes were made of each unit. The results of the surveys (number of fish per 1,000 feet of stream) for the Highway 154 (Reclamation property only), Refugio, and Alisal reaches are presented in Tables 2-15, 2-16, and 2-17 respectively. No rainbow trout/steelhead were observed in Cargasachi reach.

In the mainstem, rainbow trout/steelhead are limited to deep pools during the summer months. The fish observed in these habitats have been somewhat larger individuals that are not as susceptible to predation as younger fish. These pools are also occupied by non-native fish such as largemouth and smallmouth bass and green sunfish which may prey on rainbow trout/steelhead fry. Near Bradbury Dam in the Highway 154 reach, the deep pools of the stilling basin and the Long Pool provide important habitat for rainbow trout larger than 250 mm. In 1996, 10 adults were removed from the Stilling Basin during dewatering and fish rescue operations. Snorkel surveys of the Long Pool have documented mainly fish larger than 150 mm, ranging from 47 to 82 fish in 1995 and 11 to 23 fish in 1996 (SYRTAC 1997).

Pools, particularly deep pools, provide habitat for juvenile and older age classes of rainbow trout/steelhead, largemouth bass and sunfish. In SYRTAC surveys conducted in the mainstem in 1995, all rainbow trout/steelhead greater than 12 inches and the majority of trout 6 to 12 inches in length were seen in pools. Rainbow trout/steelhead have been sighted over the summer in pools in the mainstem as far as 9.5 miles downstream from Bradbury Dam. In addition, one rainbow trout/steelhead (estimated at over 12 inches) was seen in August 1996 approximately 15 miles downstream of Bradbury Dam about 2 miles upstream of Santa Rosa Creek.

In average water years, such as 1996 and 1997, adults and juveniles were found in pools down to the Alisal reach (10.5 miles below Bradbury Dam). Young-of-the-year fish were generally restricted to the Highway 154 reach (mainly runs and riffles) and were likely the result of spawning activity in Hilton Creek. In wet (1995) and very wet (1998) years, rainbow trout/steelhead can extend further downstream, with adults present down to Buellton (14 miles below the Dam) and juveniles present to the Alisal reach. In a very wet year (1998), young-of-the-year were relatively abundant down to the Alisal reach

**Table 2-15. Number of Rainbow Trout/Steelhead Observed in Highway 154 Reach on Snorkel Surveys (Reclamation Property Only).**

| Reach | Year | Month | Habitat | | Number of Fish/1000' (according to size class) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Habitat Type | Total Length (feet) | 0-3" | 3-6" | 6-12" | >12" |
| Hwy 154 | 1995 | Aug | Pool | 1447 | 15.9 | 6.9 | 10.4 | 47.7 |
| | | | Run | 132 | 272.7 | 151.5 | 0 | 0 |
| | | Sep | Pool | 1459 | 2.1 | 16.4 | 12.3 | 37.0 |
| | | | Run | 195 | 0 | 76.9 | 0 | 0 |
| | | Oct | Pool | 1452 | 0 | 21.3 | 2.1 | 33.7 |
| | | | Run | 201 | 0 | 84.6 | 0 | 0 |
| | 1996 | May | Pool/run/riffle | 1681 | 0.0 | 0.0 | 0.6 | 3.6 |
| | | June | Pool/run/riffle (no Long Pool)[1] | 406 | 0.0 | 0.0 | 9.9 | 0.0 |
| | | Aug | Pool/run/riffle | 1681 | 0.0 | 0.0 | 1.2 | 14.3 |
| | | Oct | Pool/run/riffle | 1681 | 0 | 0.0 | 1.8 | 11.9 |
| | 1997 | Oct | Pool/run/riffle (no Long Pool)[1] | 406 | 0.0 | 17.2 | 17.2 | 0.0 |
| | 1998 | June | Pool/run/riffle | 1459 | 154.2 (mostly YOY) | | | |

Data from SYRTAC 1995 and S. Englblom

1. Poor visibility prevented snorkel survey of the Long Pool in these months

**Table 2-16. Number of Rainbow Trout/Steelhead Observed Refugio Reach on Snorkel Surveys.**

| Reach | Year | Month | Habitat | | Number of Fish/1000' (according to size class) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Habitat Type | Total Length (feet) | 0-3" | 3-6" | 6-12" | >12" |
| Refugio | 1995 | Aug | Pool | 1366 | 0 | 5.9 | 31.5 | 0 |
| | | | Run | 374 | 0 | 2.7 | 0 | 0 |
| | | Sep | Pool | 1387 | 0 | 0 | 0.7 | 0 |
| | | | Run | 367 | 0 | 0 | 8.2 | 0 |
| | | Oct | Pool | 1291 | 0 | 0 | 3.1 | 0 |
| | | | Run | 377 | 0 | 0 | 15.9 | 0 |
| | | Nov | Pool | 1390 | 0 | 0 | 12.2 | 0 |
| | | | Run | 366 | 0 | 0 | 0 | 0 |
| | | Dec | Pool | 1571 | 0 | 0 | 8.3 | 0 |
| | | | Run | 383 | 0 | 0 | 2.6 | 0 |
| | 1996 | Jan | Pool | 1077 | 0 | 0 | 9.3 | 0 |
| | | | Run | 615 | 0 | 0 | 8.1 | 0 |
| | | June | Pool | 1225 | 0 | 0 | 1.6 | 0 |
| | | | Run | 588 | 0 | 0 | 0 | 0 |
| | | Jul | Pool | 1322 | 0 | 0 | 0 | 0 |
| | | | Run | 617 | 0 | 0 | 0 | 0 |
| | | Aug | Pool | 1322 | 0 | 0 | 0.8 | 0 |
| | | | Run | 617 | 0 | 0 | 0 | 0 |
| | | Sep | Pool | 1328 | 0 | 0 | 1.5 | 0 |
| | | | Run | 612 | 0 | 0 | 0 | 0 |
| | | Oct | Pool | 1322 | 0 | 0 | 0 | 0.8 |
| | | | Run | 612 | 0 | 0 | 0 | 0 |
| | 1997 | June | Pool & Run | 3625 | 0 | 0 | 0 | 0 |
| | 1998 | June | Pool | 590 | 0 | 845.8 | 10.2 | 35.6 |
| | | | Run | 1030 | 2.9 | 166.0 | 0 | 6.8 |
| | | | Glide | 170 | 0 | 41.2 | 0 | 0 |
| | | | Riffle | 70 | 0 | 85.7 | 0 | 0 |

Data from SYRTAC 1995, 1998, and unpubl. data

**Table 2-17. Number of Rainbow Trout/Steelhead Observed in Alisal Reach on Snorkel Surveys.**

| Reach | Year | Month | Habitat | | Number of Fish/1,000' (according to size class) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Habitat Type | Total Length (feet) | 0-3" | 3-6" | 6-12" | >12" |
| Alisal | 1995 | Aug | Pool | 1108 | 0 | 12.6 | 15.3 | 2.7 |
| | | | Run | 347 | 0 | 0 | 0 | 0 |
| | | Sep | Pool | 683 | 0 | 0 | 39.5 | 0 |
| | | | Run | 103 | 0 | 0 | 0 | 0 |
| | | Oct | Pool | 870 | 0 | 1.1 | 42.5 | 0 |
| | | | Run | 265 | 0 | 3.8 | 0 | 0 |
| | | Nov | Pool | 1045 | 0 | 0 | 35.4 | 1.0 |
| | | | Run | 325 | 0 | 0 | 0 | 0 |
| | | Dec | Pool | 1055 | 0 | 0 | 28.4 | 0.9 |
| | | | Run | 352 | 0 | 0 | 0 | 0 |
| | 1996 | Jan | Pool | 1025 | 0 | 0 | 35.1 | 5.9 [1] |
| | | | Run | 257 | 0 | 0 | 0 | 0 |
| | | May | Pool | 1085 | 0 | 0 | 8.3 | 0.9 |
| | | | Run | 286 | 0 | 0 | 0 | 0 |
| | | June | Pool | 1076 | 0 | 0 | 27.9 [2] | 0.9 |
| | | | Run | 0 | | | | |
| | | Jul | Pool | 1085 | 0 | 0 | 3.7 | 0 |
| | | | Run | 284 | 0 | 0 | 0 | 0 |
| | | Aug | Pool | 1085 | 0 | 0 | 0 | 0 |
| | | | Run | 284 | 0 | 0 | 0 | 0 |
| | | Sep | Pool | 1085 | 0 | 0 | 0.9 | 9.2 |
| | | | Run | 284 | 0 | 0 | 0 | 0 |
| | | Oct | Pool | 1085 | 0 | 0 | 0.9 | 6.5 |
| | | | Run | 284 | 0 | 0 | 0 | 0 |
| | 1997 | June | Pool & Run | 2409 | 0 | 0 | 0.4 | 0 |
| | | October | Pool & Run | 2409 | 0 | 0 | 0 | 0 |
| | 1998 | June | Pool | 1500 | 0.7 | 147.3 | 6.7 | 9.3 |
| | | | Run | 905 | 1.1 | 19.9 | 0 | 1.1 |
| | | | Glide | 900 | 0 | 3.3 | 0 | 0 |
| | | | Riffle | 0 | | | | |

Data from SYRTAC 1995, 1998, and unpubl. data
1. Fish count includes 5 fish collected in the 11-13" size range.
2. Fish count includes 10 fish collected in the 10-13" size range.

and some adults were seen as far downstream as a pool near Santa Rosa Park (20 miles downstream). Snorkel and electrofishing surveys in the Highway 154 reach (0 to 3.4 miles below the Dam) in 1993, a very wet year, and 1994, a below average year, found only a few adults in this reach (ENTRIX 1995a).

Lagoon

The lagoon has been sampled sporadically and with a variety of gear, including fyke net (August 1997 and November 1998), seine (August 1993 and December 1998), and gill net (July 1987 through January 1988) (SYRTAC 1997). The gill net survey conducted by DFG captured one 12-inch rainbow trout/steelhead (SYRTAC 1997). The two-day fyke net survey in November 1998 captured two rainbow trout/steelhead (344 and 280 mm). Their scales indicated that the larger fish was 4+ years old and the smaller fish was 3+ years old, but neither fish's scales showed evidence of ocean residence. The mouth of the lagoon was open, as it had been most of 1998 due to the unusually high flows. The salinity at the trap ranged from 4 ppt at the surface to 24 ppt at the bottom (3.5 feet). No rainbow trout/steelhead were captured by seining or during the August 1997 fyke net sampling.

Tributaries

Tributaries on the south-side of the basin downstream of Bradbury Dam provide spawning and rearing habitat, although they often dry in the lower reaches near the confluence with the mainstem. Rainbow trout/steelhead have been observed in several tributary streams, most notably Hilton Creek and the Salsipuedes/El Jaro Creeks system (Table 2-14).

**Hilton Creek** is a small, intermittent stream located immediately downstream of Bradbury Dam. In general, steelhead are known to migrate to the uppermost accessible reaches in a river seeking spawning habitat. Adults migrating up the Santa Ynez River are blocked by Bradbury Dam and must find spawning habitat downstream of the dam. Hilton Creek currently provides the most upstream spawning habitat available to anadromous fish in the lower Santa Ynez basin.

Hilton Creek is inhabited by rainbow trout/steelhead up to the chute pool (1,380 feet upstream of its confluence with the Santa Ynez River) and prickly sculpin to about 800 feet upstream from the mainstem. Sculpin cannot negotiate a small bedrock cascade and are not present in the upper portions of the creek. No introduced warmwater species, such as bass, bullhead or sunfish, are found in Hilton Creek.

Adult passage to upper Hilton Creek is hampered first at a cascade and bedrock chute (1,380 feet upstream from the confluence) and then at a culvert at the Highway 154 crossing (4,180 feet upstream from the confluence). Spawning is generally limited to an area about 400 feet long immediately below the chute pool. No spawning or young-of-the-year have been observed above this cascade to the Reclamation property boundary (about 2,980 feet upstream from the mainstem). Anecdotal reports indicate that trout were historically present in upper Hilton Creek above the Highway 154 culvert.

Adult rainbow trout/steelhead have been documented migrating into Hilton Creek in all years that observations have been made, but numbers were low in years with low winter runoff. Migrant trapping captured 2 adults in 1994, 52 in 1995 during the wet winter, 3 in February 1996 when the creek briefly flowed, 10 in January 1997 before flows declined, and several during abbreviated trapping in 1998 (SYRTAC 1997 and 1998). Actual spawning with production of young-of-the-year was documented in 1995, 1997, and 1998. Production has been especially good during high runoff years such as 1995 and 1998, when many adults enter the Creek. In 1995, migrant traps captured 52 adults between January 16 and April 17, and the actual numbers were likely higher since the trap is inoperable at high flows (no trapping on 21 of 93 days) (Figure 2-10). Adults migrating into Hilton are often large (Figure 2-11) and could be anadromous steelhead from the ocean (particularly in wet years), rainbow trout that spilled over from Cachuma Reservoir, or fish that are resident in the river, its tributaries or the lagoon (SYRTAC 1997).

Because the stream goes dry during the summer, however, young-of-the-year cannot complete rearing in lower Hilton Creek under natural conditions (SYRTAC 1997). The fish are either stranded or must enter the mainstem where they are exposed to predatory bass and catfish. Fish rescue operations were conducted in 1995 and 1998 to move young-of-the-year from the drying stream to better habitat. In July and August 1995, over 220 young-of-the-year and 5 adults were relocated from Hilton Creek. In June 1998, 831 young-of-the-year (up to 100 mm) and 3 adults were captured in 1,200 linear feet of stream (Reclamation 1998a), but no juveniles were observed in the creek. Many young-of-the-year and all three adults were found at the upper chute and pool area just below the cascade, as well as many young-of-the-year in the lower reach of the creek. Some young-of-the-year that were not captured in the 1998 fish rescue operations did oversummer successfully in the lower chute pool (locate approximately 1,000 feet upstream of the confluence).

**Quiota Creek**, which enters the river between the towns of Solvang and Santa Ynez, also supports rainbow trout/steelhead. Studies for Quiota Creek were limited due to lack of access on private property. A survey in February 1995 documented redds and adults approximately 1 mile upstream of the confluence with the Santa Ynez River (SYRTAC 1997). Observations from road crossings in late 1998 documented good numbers of young fish about 1.5 to 3 miles upstream from the confluence (SYRTAC data). In an unnamed tributary about 4 miles upstream from the Santa Ynez River, an August 1994 survey documented good numbers of young-of-the-year, juveniles, and adults (SYRTAC 1997).

**Alisal Creek** enters the Santa Ynez River near Solvang. Fish surveys were limited to February 1995, when access to the property was briefly available for some migrant trapping and an electrofishing survey (SYRTAC 1997). Prior to 1995, migration into Alisal Creek was blocked by a concrete drop structure and apron. This structure was washed away by high flows in early 1995, and rainbow trout/steelhead were subsequently captured in the lower creek. Juvenile and adult rainbow trout were found via electro-fishing above Alisal Reservoir, which is a passage barrier for steelhead. Bass and sunfish inhabit the reservoir. Brief operation of a trap in lower Alisal Creek in January 1995 captured two adult rainbow trout/steelhead migrating upstream into the creek. Electrofishing above the reservoir also produced 20 resident rainbow trout, mostly juveniles and a few adults (78 to 235 mm fork length) (SYRTAC 1997). Many other rainbow trout of various size classes were observed within the upper portions of Alisal Creek above Alisal Reservoir (SYRTAC 1997).

**Nojoqui Creek** joins the Santa Ynez River near Buellton. Surveys and trapping from 1994 to 1997 have failed to find any rainbow trout/steelhead in this stream (SYRTAC 1997 and 1998). In 1998, a single adult was trapped in an upstream migrant trap (SYRTAC data). Although physical habitat conditions appear good, the lack of fish in this stream suggests that the habitat is not suitable or perhaps an unknown passage barrier exists. Anecdotal reports from locals are conflicting on the degree to which steelhead historically used Nojoqui Creek.

**Salsipuedes and El Jaro Creeks** The Salsipuedes and El Jaro creek system is the largest drainage in the lower basin, and rainbow trout/steelhead have been observed in both streams. Salsipuedes joins the Santa Ynez River just upstream of the town of Lompoc. El Jaro Creek is a tributary of Salsipuedes Creek. This system is the second tributary that returning steelhead encounter after entering the Santa Ynez River from the ocean, and the first that they can migrate up into. The best habitat observed in this system is in upper Salsipuedes Creek (upstream of the two creeks' confluence) and in El Jaro Creek (just above the confluence).

In March 1987, an electrofishing survey by the U.S. Fish and Wildlife Service collected two adult females and two adult males (Harper and Kaufman 1988). Of these adults, only one female had confirmed ocean residence. Captured juveniles did not exhibit smolting characteristics, although several juveniles observed from the bank appeared to have smolting characteristics (Harper and Kaufman 1988).

In 1997, an average rainfall year when 34 fish were captured in the upstream migrant traps, the fish tended to be small but mature fish (125 to 256 mm, n=30) that are likely resident rainbow trout, and a few large adults (345 to 580 mm, n=4) that could be anadromous steelhead from the ocean (Figure 2-11). Trapping of migrating fish and observations of redds in wet years such as 1995 and 1998 was limited due to difficulty of trapping and low visibility when flows are high and turbid. Spawning has been documented in both streams (SYRTAC 1997). Redd surveys have found most redds in El Jaro (18 redds) within ½-mile above the confluence, and upper Salispuedes (11 redds), with 14 redds also located on lower Salsipuedes Creek within 2 miles downstream of the two creeks' confluence (Figure 2-12).

Fish of all size classes have been found in the Salsipuedes-El Jaro system. During summer months when conditions are warm, they are typically found in pools and deep runs. In 1994, an electrofishing survey in May and August found young-of-the-year and juvenile rainbow trout/steelhead around the confluence of Salsipuedes and El Jaro, and one adult larger than 250 mm was found in Salsipuedes upstream of the confluence (SYRTAC 1997). In 1997, snorkel surveys in lower Salsipuedes found mainly juveniles and small adults (about 150-225 mm), while surveys in upper Salsipuedes and El Jaro found young-of-the-year as well as juveniles and adults (SYRTAC 1998).

Downstream migrant trapping in Salsipuedes Creek indicates that most movement occurs in March and April (Figure 2-10). In 1994, five fish were captured in June, but none appeared to be smolts (SYRTAC 1997). In 1996, four fish were captured between February and April, and two of them (131 and 153 mm) had smolting characteristics (i.e. deciduous scales, silvery appearance, darkened fin margins). In 1997, nine fish (148 to 240 mm) were captured in between February and April, of which appeared to be smolts.

**San Miguelito Creek** flows into the Santa Ynez River at the city of Lompoc. Passage from the Santa Ynez River is completely blocked by a two-mile concrete flood control culvert. There are a couple of other passage barriers on the creek, such as a bridge with a long concrete apron that is raised four feet above the downcut channel. Young-of-the-year and adult rainbow trout/steelhead were relatively abundant near San Miguelito Park (about 3 miles upstream of Lompoc) in 1996 surveys (SYRTAC 1997). Spawning surveys in 1997 found 49 redds (Figure 2-12).

<u>Summary</u>

A summary of potential spawning and rearing habitat for rainbow trout/steelhead in the lower basin is provided in Figures 2-14 and 2-15. Habitat quality can vary annually depending on rainfall. In wet years, habitat quality is improved and good conditions are more widespread (i.e. further down the mainstem). It is worth noting that these assessments are based on studies conducted during a relatively wet period for the Santa Ynez River.

Good spawning habitat for rainbow trout/steelhead can be found in Hilton Creek and mid-to-upper Quiota Creek (Figure 2-13). Spawning habitat in Salsipuedes and El Jaro Creeks is moderate, due to the presence of fine sediments and sand in the stream, with some areas of good habitat. Good habitat exists above passage barriers in San Miguelito and upper Alisal Creeks. Spawning has been observed in the mainstem directly downstream of Bradbury Dam in 1993 and 1998. While no spawning has been observed downstream of the Highway 154 reach, young-of-the-year have been documented here in 1995 and 1998, very wet rain years.

Good quality summer rearing habitat can be found in the mainstem just below Bradbury Dam (Highway 154 reach) and in tributaries including upper Salsipuedes, upper Quiota,

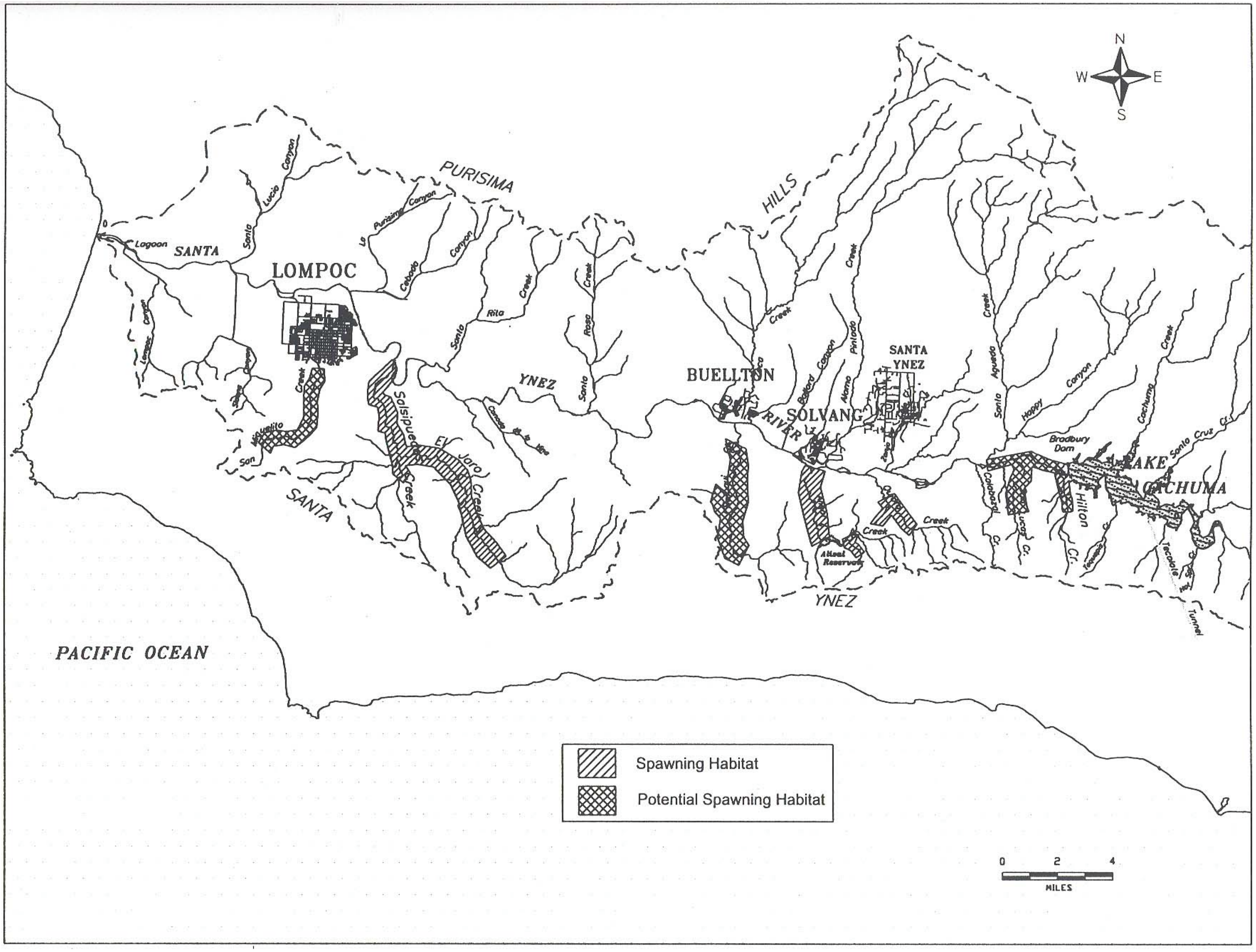



**Figure 2-14. Potential Spawning Habitat for Rainbow Trout/Steelhead in the Lower Santa Ynez River**

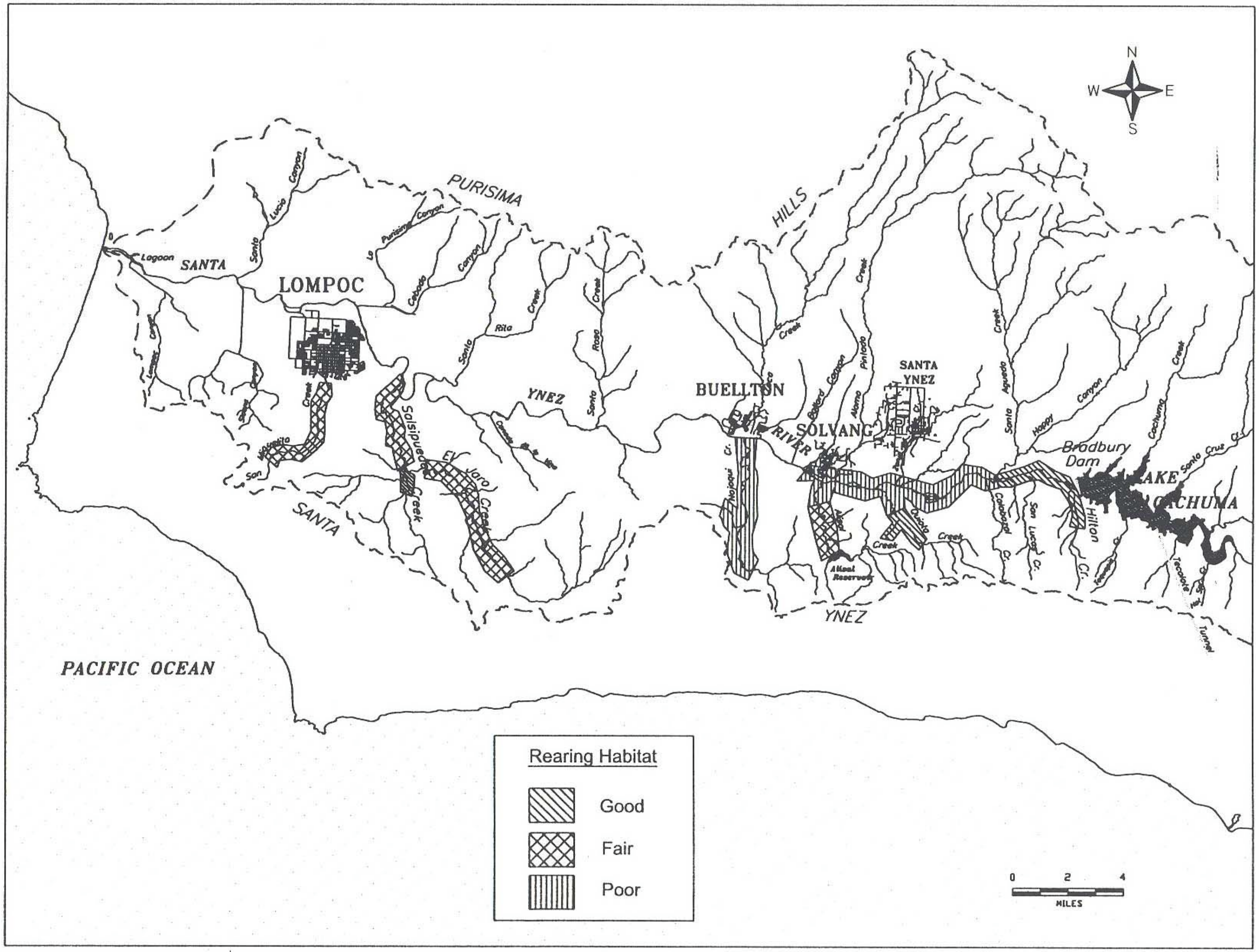



**Figure 2-15. Potential Summer Rearing Habitat for Rainbow Trout/Steelhead in the Lower Santa Ynez River.**

and lower Hilton Creeks when flow is present (Figure 2-14). Fair to good habitat exists above passage barriers in San Miguelito and upper Alisal Creeks. Fair conditions are found on lower Salsipuedes, El Jaro, and the mainstem (Refugio and Alisal reaches). Poor conditions exist downstream of the mainstem Alisal reach and on lower Quiota. While Nojoqui Creek appears to have some good habitat elements, the lack of fish suggests otherwise.

### 2.4.2 CALIFORNIA RED-LEGGED FROG (*RANA AURORA DRAYTONII*) - FT

The California red-legged frog is a federally threatened species. It historically occurred in coastal mountains from Marin County south to northern Baja California, and along the floor and foothills of the Central Valley from about Shasta County south to Kern County (Jennings, *et al.* 1992). Currently, this subspecies occurs primarily in the coastal portions of its historic range; it is apparently extinct in the valley and foothills and in most of southern California south of Ventura County.

California red-legged frogs are confined strictly to aquatic habitats, such as creeks, streams, and ponds, and occur primarily in areas having pools 2 to 3 feet deep with dense emergent or shoreline vegetation (Hayes and Jennings 1988). Although frogs may move between breeding pools and foraging areas, they rarely leave the dense cover of the riparian corridor (Jennings, *et al.* 1992).

California red-legged frogs breed from November to March when eggs are attached to emergent vegetation. Eggs hatch within 6 to 14 days, and metamorphosis occurs July and September. Red-legged frogs are omnivorous and will eat other animals including other amphibians and small mammals. Major predators include introduced fish, bullfrogs, and native garter snakes, all of which occur in the mainstem below Lake Cachuma.

Jennings (1993) reports that California red-legged frogs occur above Bradbury Dam in the Santa Ynez River and a number of tributaries, including Blue Canyon, Agua Caliente Canyon, Mono Creek, Indian Creek, Camusea Canyon, Oso Canyon, and Santa Cruz Creek. Because of predatory fish in Lake Cachuma, it is unlikely that the frog would occur there, but it does occur in tributaries that flow into the lake. Below Bradbury Dam, Jennings reports red-legged frogs in Zaca Creek and Salsipuedes Creek. Field surveys conducted in 1994 located individuals in Nojoqui and Salsipuedes Creeks (Woodward-Clyde Assoc., *et al.* 1995). Additionally, red-legged frogs have been reported from a tributary flowing through agricultural land west of Lompoc, but they were not observed during 1994 surveys. Although habitat for California red-legged frogs exists downstream from Bradbury Dam, no frogs were found during 1994 field surveys, perhaps due to the presence of predatory fish and bullfrogs throughout this portion of the system.

Much of the Santa Ynez River, above Alisal Road, becomes dry by early summer, and is, therefore, unlikely to support California red-legged frogs due to the lack of permanent water. However, portions of the river below Buellton support large areas of habitat for the frog, and pools in this area probably contain permanent water due to agricultural and urban runoff and discharges from wastewater treatment plants. The presence of bullfrogs, bass, and green sunfish indicate the perennial nature of these pools, but the presence of these predators probably limits the potential for red-legged frogs to use this habitat.

### 2.4.3 SOUTHWESTERN WILLOW FLYCATCHER (*EMPIDONAX TRAILLII EXTIMUS*) - CE, FE

The southwestern willow flycatcher occurs in riparian habitats along rivers, streams, or other wetlands, where dense growths of willows and other riparian vegetation are present. These riparian communities provide nesting and foraging habitat. This species has experienced substantial habitat loss over much of its range and has also been subject to brood parasitism by the brown headed cowbird (*Molothrus ater*). Nests are built in thickets of trees or shrubs more than 3 meters in height with dense foliage. Narrow riparian zones are not selected as nesting or singing habitats. This sub-species almost always nests where there is surface water or saturated soil present. Males establish territories in mid-May and nesting occurs late May-August. This species is insectivorous, foraging within and above the dense riparian vegetation.

There are two known breeding populations of southwestern willow flycatchers in Santa Barbara County, both along the Santa Ynez River. One population is located approximately 1 mile west of Buellton, with several breeding pairs and up to eight individuals. Mark Holmgren (Lehman, pers. comm.) located a nest in 1993 which had been parasitized by a cowbird. The second population is in the Lompoc area, near the prison, extending down to the last set of willows before the mouth of the Santa Ynez River. In 1993, there were about six birds in this area, two breeding pairs and several non-paired birds (Lehman, pers. comm.). There may be additional nesting areas between Buellton and Lompoc (few surveys have been performed there). Additional surveys in 1994 found at least 8 pairs of willow flycatchers between Buellton and Santa Rosa Park, resulting in an estimate that there were between 15 and 20 pairs breeding between Buellton and the coast, along the Santa Ynez River. There are also a few recent records in the Gibraltar Reservoir area. There is little likelihood of breeding willow flycatchers at Lake Cachuma or between Cachuma Lake and Buellton, as the habitat does not appear to be capable of supporting them.

### 2.4.4 LEAST BELL'S VIREO (*VIREO BELLII PUSILLUS*) - CE, FE

Least Bell's vireo have declined due to loss of habitat and cowbird nest parasitism. In Santa Barbara County, they currently nest in the Upper Gibraltar Reservoir/Mono Creek/Agua Caliente area (Lehman 1994). This population has been censused regularly and appears healthy and stable. Away from this area, nesting had not been recorded since the 1950's. There are several records of single birds that could represent nesting individuals, although it is thought unlikely (Lehman pers. comm.). Recently, a possible population has been reported on the Santa Ynez River near the confluence with Salsipuedes Creek (G. Greenwald, U.S. Fish and Wildlife Service, pers. comm.).

Most nests are constructed at a height of three to eight feet near the edge of a thicket in riparian scrub or riparian forests, 30 to 650 feet away from the nearest edge of water (Olson and Gray 1989). Large-scale removal or degradation of suitable breeding areas in riparian habitats have accounted for much of the least Bell's vireo decline (Franzreb

1988, 1989; Olson and Gray 1989). Overgrazing, diversion of waterways, stream channelization for flood control, land development, and depletion of the state's water resources (surface flow in streams) are factors that have all contributed to the overall alteration or reduction of riparian systems.

#### 2.4.5 BALD EAGLE (*HALIAEETUS LEUCOCEPHALUS*) - CE, FE

Bald eagles eat fish, supplemented by ducks, coots, other birds, mammals, and occasionally reptiles and amphibians. Bald eagles inhabit coastal bays, estuaries, and deep-water lakes. Eggshell thinning due to DDT contamination, and perhaps loss of habitat, contributed to their decline (Evans 1983). A pair of bald eagles bred successfully at Lake Cachuma from 1989 to at least 1994, fledging one young each year except in 1990 when two were successfully feldged (Mesta, pers. comm.; DWR 1991; and SAIC surveys 1990, 1994). A search for prey remains in 1990 disclosed that these eagles ate primarily catfish and other types of fish, coots, and surprisingly, southwestern pond turtles (DWR 1991; Weinstein unpublished data). This pair is believed to be the only pair currently nesting in southern California.

In winter, Cachuma Lake hosts relatively large numbers of bald eagles. During the past 10 years, counts have ranged from 2 to 18 birds. The number of wintering birds appears to have increased substantially over the past 30 years (analysis of data cited by Lehman, 1994). A first year-plumaged bald eagle wintered at the mouth of the Santa Ynez River in 1993-1994 (Lehman 1994; SAIC survey 1994); this bird could have been an off-spring from the nesting pair at Lake Cachuma, or could have been a migrant from elsewhere. Bald eagles are not normally thought to winter in the area of the Santa Ynez River mouth, although there is a previous record from Vandenberg Air Force Base (AFB) in 1976.

#### 2.4.6 AMERICAN PEREGRINE FALCON (*FALCO PEREGRINUS ANATUM*) - CE, FE

Peregrine falcons eat medium size birds which they catch on the wing (Bent 1937). Nests are on cliff ledges, usually near water. During the nesting season, peregrines may forage up to 10 or more miles from the nest, especially over water. Peregrines do occur near enough to the project area to occasionally be found within it. In 1994, a pair nested in the mountains southeast of the Lake, near Upper and Lower Osos Campgrounds (Schmitt, pers. comm.). It is not known where they forage, but Lake Cachuma is within the foraging range of this species (FWS 1981). Peregrines may also nest on Vandenberg AFB, on sea cliffs (Aulman, pers. comm.). In winter, resident peregrine falcons are augmented by migrants from the north, which may be found foraging anywhere in the project area, most particularly at the mouth of the Santa Ynez River.

### 2.5 FACILITIES

The Cachuma Project was constructed in the early l950s by Reclamation under contract with the SBCWA for delivery of water to the Member Units. The Member Units consist of the City of Santa Barbara, Goleta Water District, Montecito Water District, Carpinteria Valley Water District, and the ID#1 (pursuant to an assignment agreement with the SYRWCD*)*. The Member Units entered into contracts with the SBCWA for the purpose of delivering water from the Project for the use and benefit of the Member Units. Over the past 43 years, the Project has been the principal water supply for South Coast communities and a portion of the Santa Ynez Valley, delivering an average of about 20,000 acre-feet (AF) per year.

The Project was authorized by the Secretary of the Interior pursuant to Section 9(a) of the Reclamation Project Act of 1939. The original Project Water Service Contract (Master Contract) was initially executed in 1949 and became effective upon initial deliveries of water in 1955. The Member Unit Contracts became effective at the same time. The master and member unit contracts were renewed in 1996 for a 25-year period dating from May 1995.

Reclamation constructed and owns all Project facilities and operates Bradbury Dam. Operation and maintenance of the Project facilities, other than Bradbury Dam, were transferred in 1956 to the Member Units who formed the Cachuma Operation and Maintenance Board (COMB) to carry out these responsibilities.

### 2.5.1 LAKE CACHUMA FACILITIES

Lake Cachuma is formed by Bradbury Dam which is 48.7 river miles from the Pacific Ocean. It is the largest and farthest downstream of the three reservoirs on the Santa Ynez River. The dam is a 205 foot high (structural height is 275 feet) earth-fill structure with a 2,975 feet crest length set at elevation 766 feet above mean sea level (MSL). The spillway is a broad-crested weir in the south abutment of the dam consisting of four bays, each with a 50-foot wide by 31-foot high radial gate. The gates open from the bottom and are seated in the weir invert at elevation 720 feet MSL. The normal full operating level of the reservoir is 750 feet MSL (with the gates fully closed). The storage capacity of Lake Cachuma, when constructed, was 204,874 AF with a surface area of 3,090 acres. Based on the 1990 silt survey, the capacity of the reservoir has been reduced to 190,409 AF with a corresponding surface area of 3,043 acres. The watershed area above Bradbury Dam is approximately 417 square miles, 216 square miles of which are above Gibraltar Dam.

Diversions to the South Coast are conveyed through the 6.4 mile long Tecolote Tunnel completed in 1956. The diverted lake water enters the tunnel via a pentagonal intake tower, with conduit from tower to tunnel, near the south bank of the reservoir, about 3.7 river miles upstream from Bradbury Dam. Tecolote Tunnel north portal elevation is about 660 feet MSL (south portal elevation is 650 feet MSL). When lake levels fall near this elevation, as they did during the 1986-1991 drought, diversions to the South Coast are continued by pumping from the lake through a floating conduit into the intake tower.

Downstream releases to the Santa Ynez River have historically been accomplished through outlet works containing the following basic features: an inlet box at elevation 600 feet in the reservoir; a 1,500-foot long, 7-foot diameter tunnel with a 38-inch pipe running from beneath the inlet box to the outlet building on the downstream toe of the dam adjacent to the north side of the spillway Stilling Basin; two 30-inch hollow-jet valves, and a 10-inch butterfly valve set at elevation 563 feet MSL, which, when opened, directs water into the Stilling Basin for a downstream release. The outlet works have been modified to provide a variable intake. "Until recently, ID # 1 received deliveries of Cachuma Project water through the outlet works and the Santa Ynez Extension. In addition, ID # 1 makes minor diversions from the lake to serve the County park at the resevoir".

The dam has recently undergone structural modifications to make it seismically safe. Presently modifications are underway on the spillways of the dam. As part of these modifications, a water supply system to Hilton Creek will be constructed.

### 2.5.2 CCWA Facilities

In 1997, SWP water deliveries were started to ID#1 and Lake Cachuma via the Coastal Branch, Phase II which serves water to project participants in San Luis Obispo and Santa Barbara Counties. SWP pipeline extends from Devil's Den in Kern County to Vandenberg Air Force Base in Santa Barbara County and include a water treatment plant in San Luis Obispo County known as the Polonio Pass Water Treatment Plant (PPWTP), which is owned and operated by the CCWA. Project participants in Santa Barbara County receive treated State Water from the CCWA via a pipeline extension known as the Mission Hills and Santa Ynez Extension.

CCWA delivers State Water to Lake Cachuma for delivery to the SWP contractors on the South Coast. The treated State Water is dechloraminated at the Santa Ynez Pumping Facility and then pumped via the Cachuma Pipeline through the existing Bradbury outlet works into Lake Cachuma. The commingled pumped water is then delivered through Tecolote Tunnel and the Southcoast Conduit to the Member Units on the South Coast.

The extension delivers water to ID#1 in exchange for their Project entitlement, as well as contracted SWP water, as described under operations in Section 2.6.5 and provides water to South Coast project participants through delivery to Lake Cachuma. The CCWA delivery works to Lake Cachuma are tied directly into the outlet works at Bradbury Dam by means of a pumping plant located near Santa Ynez. Water is delivered into Lake Cachuma through the outlet works. This constrains the operation of the outlet works and delivery of water from CCWA. If no release is being made from Lake Cachuma, then the CCWA water can be delivered directly into the lake. However, if releases are being made, then CCWA deliveries cause commingled Project and SWP water to be released into the Stilling Basin. The water composition and temperature of water is controlled to provide protection to steelhead, as discussed in Section 3.0.

Up to 22 cubic feet per second (cfs) may be delivered by CCWA to Lake Cachuma or the Santa Ynez River in 5.5 cfs increments. These increments are determined by the capacity of the four individual pumps at the Santa Ynez Pumping Facility. Prior to delivery, the water is dechloraminated using sodium bisulfite. Built in safety systems automatically shut off the pumps when a disinfectant residual is detected.

## 2.6 RESERVOIR OPERATIONS & RELEASES

### 2.6.1 YIELD AND DIVERSIONS FROM THE PROJECT

Under the Reclamation Act of 1939 and State Water permits, the Project is authorized to develop water for municipal, industrial, domestic, irrigation supply, with incidental recreation and salinity control purposes. The original yield of the Project was estimated to be approximately 32,000 AF per year. Incorporating the 1951 drought into the hydrologic study period resulted in a lowering of project yield to about 27,800 AFY. Silt surveys performed in 1989 indicated that Lake Cachuma had lost about 15,000 AF of active storage, further reducing Project yield to about 24,800 AF per year. Since 1992, the Member Units have been using an operational yield of 25,714 AF per year that allows for some delivery shortages during periods when the reservoir storage drops below 100,000 AF. Table 2-18 summarizes annual Project statistics since its construction in 1953. This table does not include the contribution of groundwater inflow into Tecolote Tunnel as a part of the Project yield. This inflow averaged 2,000 to 3,000 AF per year.

### 2.6.2 SPILLS AND LAKE LEVELS

Cachuma has spilled 15 times since its completion (Table 2-18, not including the 1998 spill). The term spill means an uncontrolled discharge through open gates or over the spillway or controlled discharge through spillway gates or outlet works made only for the purpose of meeting operating procedures relating to maximum reservoir levels or winter precautionary releases related to anticipated high reservoir levels. Spills generally occur when reservoir elevation exceeds or is expected to exceed 750 MSL due to an anticipated storm event.

These spills have ranged from 27 to 179 days in duration and from about 1,000 to 168,000 AF in magnitude (including 1995, when the normal definition of spill did not apply because of seismic retrofitting of the dam, when spills were released below the 750 feet elevation). The 179 day spill occurred during 1995 (January 10 - July 8) when there were operating restrictions on the reservoir due to seismic retrofitting. The next longest spill was 159 days. The median spill length has been 87 days. The most recent spills (1993, 1995, and 1998) have been of great magnitude and have lasted into July.

### 2.6.3 DOWNSTREAM WATER RIGHTS

Current water rights for users downstream of Lake Cachuma were set forth by the SWRCB in 1973 (WR 73-37), as amended in 1989 (WR 89-18). These water rights and their associated releases from Lake Cachuma are principally structured by creating two accounts, and accruing credits (storing water) for the above and below Narrows areas, in Lake Cachuma. Releases from the Above Narrows Account (ANA) are made at

# Table 2-18. Summary of Lake Cachuma Operations, 1953-1996 (acre-feet).

| Water Year | End-of-Year Storage | Computed Inflow | Precipitation on Reservoir | Reservoir Evaporation | Estimated Spill | Diversion to Tunnel | Park Diversions | SYRWCD ID #1 Deliveries | Downstream Release* |
|---|---|---|---|---|---|---|---|---|---|
| 1953 | 9,158 | 17,912 | 106 | 1,319 | 0 | 0 | 0 | 0 | 7,541 |
| 1954 | 21,749 | 18,955 | 598 | 2,327 | 0 | 0 | 0 | 0 | 4,635 |
| 1955 | 21,164 | 4,941 | 936 | 2,540 | 0 | 0 | 0 | 0 | 3,922 |
| 1956 | 38,209 | 24,330 | 1,482 | 4,200 | 0 | 2,118 | 0 | 0 | 2,449 |
| 1957 | 31,632 | 6,151 | 1,163 | 4,642 | 0 | 5,467 | 0 | 0 | 3,782 |
| 1958 | 196,889 | 219,129 | 4,459 | 11,210 | 35,738 | 4,850 | 0 | 0 | 5,060 |
| 1959 | 187,178 | 15,068 | 3,629 | 14,624 | 1,068 | 8,432 | 0 | 0 | 4,284 |
| 1960 | 163,149 | 2,643 | 2,669 | 13,613 | 0 | 11,410 | 169 | 0 | 4,149 |
| 1961 | 134,493 | 795 | 2,382 | 12,015 | 0 | 17,309 | 662 | 239 | 1,608 |
| 1962 | 190,475 | 100,134 | 4,963 | 12,446 | 21,822 | 11,921 | 402 | 890 | 1,633 |
| 1963 | 171,736 | 4,270 | 3,788 | 12,158 | 0 | 10,595 | 510 | 694 | 2,843 |
| 1964 | 141,506 | 2,439 | 2,378 | 11,786 | 0 | 17,352 | 447 | 1,504 | 3,898 |
| 1965 | 122,308 | 12,314 | 3,043 | 10,204 | 0 | 14,909 | 182 | 1,837 | 7,423 |
| 1966 | 168,926 | 79,352 | 3,707 | 12,524 | 0 | 17,522 | 345 | 2,129 | 3,862 |
| 1967 | 191,622 | 208,961 | 5,774 | 12,683 | 138,587 | 14,155 | 246 | 2,575 | 23,789 |
| 1968 | 160,871 | 10,404 | 2,414 | 13,524 | 0 | 18,199 | 357 | 3,669 | 7,820 |
| 1969 | 190,181 | 526,726 | 9,727 | 12,305 | 468,143 | 15,031 | 240 | 2,597 | 7,467 |
| 1970 | 176,407 | 27,967 | 1,793 | 13,525 | 0 | 20,689 | 335 | 4,115 | 4,888 |
| 1971 | 161,345 | 31,045 | 3,497 | 12,239 | 0 | 22,800 | 357 | 3,115 | 11,028 |
| 1972 | 121,314 | 8,754 | 2,231 | 11,454 | 0 | 28,162 | 167 | 4,471 | 6,769 |
| 1973 | 185,591 | 125,804 | 5,948 | 12,056 | 23,665 | 18,456 | 129 | 3,552 | 9,617 |
| 1974 | 182,039 | 34,023 | 4,112 | 12,677 | 1,405 | 17,805 | 138 | 3,469 | 5,840 |
| 1975 | 184,467 | 50,650 | 5,867 | 11,866 | 16,804 | 20,854 | 128 | 3,057 | 1,275 |
| 1976 | 145,187 | 5,474 | 3,189 | 11,804 | 0 | 26,020 | 148 | 4,655 | 5,152 |
| 1977 | 112,077 | 1,520 | 2,601 | 10,775 | 0 | 18,740 | 98 | 4,583 | 3,035 |
| 1978 | 193,424 | 329,219 | 9,573 | 13,535 | 209,494 | 20,701 | 114 | 3,011 | 10,591 |
| 1979 | 183,949 | 61,692 | 5,250 | 13,917 | 25,852 | 20,102 | 147 | 4,029 | 12,198 |
| 1980 | 187,382 | 153,603 | 6,003 | 13,353 | 105,763 | 22,057 | 139 | 2,483 | 13,189 |
| 1981 | 168,871 | 22,066 | 4,019 | 13,811 | 0 | 20,856 | 178 | 5,007 | 4,743 |
| 1982 | 159,528 | 26,848 | 3,868 | 11,479 | 0 | 20,956 | 187 | 2,963 | 4,474 |
| 1983 | 196,347 | 428,601 | 10,995 | 12,630 | 332,479 | 22,616 | 183 | 1,532 | 34,922 |
| 1984 | 171,599 | 39,087 | 3,340 | 14,534 | 12,184 | 25,601 | 193 | 5,054 | 9,679 |
| 1985 | 135,748 | 5,061 | 2,816 | 12,275 | 0 | 22,781 | 142 | 2,664 | 5,862 |
| 1986 | 171,873 | 76,564 | 4,830 | 12,783 | 0 | 21,689 | 108 | 2,686 | 8,010 |
| 1987 | 128,352 | 2,374 | 1,996 | 12,147 | 0 | 27,209 | 150 | 3,812 | 4,573 |
| 1988 | 99,150 | 8,732 | 4,092 | 9,794 | 0 | 23,917 | 102 | 2,803 | 4,911 |
| 1989 | 66,098 | 4,044 | 1,459 | 8,366 | 0 | 20,632 | 86 | 2,802 | 6,601 |
| 1990 | 34,188 | 2,627 | 909 | 6,019 | 0 | 16,384 | 66 | 863 | 4,792 |
| 1991 | 60,995 | 53,566 | 2,057 | 6,373 | 0 | 15,762 | 43 | 1,656 | 4,983 |
| 1992 | 157,066 | 135,828 | 4,022 | 11,239 | 0 | 18,170 | 52 | 891 | 13,427 |
| 1993 | 177,479 | 333,322 | 8,875 | 13,428 | 297,827 | 22,582 | 79 | 2,042 | 3,826 |
| 1994 | 151,046 | 16,350 | 4,298 | 12,390 | 0 | 22,772 | 74 | 1,819 | 10,021 |
| 1995 | 134,855 | 365,072 | 10,063 | 10,301 | 354,402 | 23,887 | 64 | 109 | 2,563 |
| 1996 | 120,503 | 33,240 | 2,653 | 11,614 | 0 | 24,721 | 76 | 2,119 | 11,715 |

* Downstream releases include: leakeage, miscellaneous releases, precautionary and flood control release, through outlet works, water right release and Fish Reserve Account releases.

Source: U.S. Bureau of Reclamation

Bradbury Dam for the benefit of downstream water users between the dam and the Lompoc Narrows. Releases from the Below Narrows Account (BNA) are conveyed to the Narrows for the benefit of water users in the Lompoc basin. Carriage water used in delivering the BNA water from the Bradbury Dam to the Narrows is deducted from the ANA.

The credits to the two accounts are determined based on the impairment in the amount of natural replenishment from the Santa Ynez River to the groundwater basins downstream of Bradbury Dam caused by the operation of Lake Cachuma. The above Narrows credits are calculated based on the surface water observations and groundwater depletion in the above Narrows basin. The below Narrows credits are calculated based on constructive flows at Narrows and constructive percolation from the Santa Ynez River in the Lompoc basin.

The amendments to WR 73-37, as ordered under WR 89-18, significantly increased the below Narrows releases for the Lompoc area, resulting in an operation benefiting both the above and below Narrows areas. Therefore, historical releases under WR 73-37 cannot represent the present release regime under WR 89-18. Tables 2-19 and 2-20 show the historic releases at Bradbury Dam for the above and below Narrows areas under WR 73-37 and WR 89-18, respectively.

Releases are generally made in late spring, summer or early fall to replenish the downstream ground-water basins. However, downstream releases are not made in wet years because the ground-water basins are replenished by natural runoff in the Santa Ynez River. In dry years, there are generally two or three periods of releases to provide water to the users in the above Narrows area. In normal years and in some dry years, depending on hydrologic conditions and availability of water in the ANA and BNA, combined releases are made to replenish the ground-water basins in the above and below Narrows areas.

Downstream water right releases are made when the Santa Ynez River bed is dry and water levels in the ground-water basins have receded so that there is at least 10,000 AF of dewatered storage available. The duration and rate (including initial rate) of releases would vary, depending on whether water is released for the purpose of recharging only the above Narrows area or both above and below Narrows areas together. For example, combined releases for the above and below Narrows areas may begin at the rate of 135-150 cfs and are maintained at a steady rate for about 12-15 days before it is gradually decreased to lower flow rates. During the initial period of 12-15 days, the flow moves at the rate of less than three miles per day. As the recharge rate decreases in the river bed, the release rate is also gradually reduced depending on groundwater levels. In essence, the release rates are maintained at such rates that water would disappear in the lower reaches of the Santa Ynez River channel. The reduced releases could extend two to three months and then are gradually ramped down to match scheduled releases from the Fish Reserve Account. Releases for the above Narrows areas are made for shorter durations

**Table 2-19. Downstream Water Rights Releases[1] Under WR 73-37 by Calendar Year.**

| Calendar Year | ANA Release | BNA Release | Total Release |
|---|---|---|---|
| 1974 | 1,353 | 0 | 1,353 |
| 1975 | 1,152 | 0 | 1,152 |
| 1976 | 4,237 | 0 | 4,237 |
| 1977 | 2,299 | 0 | 2,299 |
| 1978 | 56 | 0 | 56 |
| 1979 | 1,200 | 0 | 1,200 |
| 1980 | 0 | 0 | 0 |
| 1981 | 4,175 | 0 | 4,175 |
| 1982 | 6,655 | 755 | 7,410 |
| 1983 | 0 | 0 | 0 |
| 1984 | 3,162 | 0 | 3,162 |
| 1985 | 5,686 | 0 | 5,686 |
| 1986 | 5,317 | 1,780 | 7,097 |
| 1987 | 3,887 | 0 | 3,887 |
| 1988 | 5,050 | 1,283 | 6,333 |

**Table 2-20. Downstream Water Rights Releases[1] Under WR 89-18 by Calendar Year.**

| Calendar Year | ANA Release | BNA Release | Total Release |
|---|---|---|---|
| 1989 | 5,192 | 0 | 5,192 |
| 1990 | 4,792 | 0 | 4,792 |
| 1991 | 7,745 | 3,638 | 11,383 |
| 1992 | 4,930 | 3,287 | 8,217 |
| 1993 | 0 | 0 | 0 |
| 1994 | 6,727 | 4,012 | 10,739 |
| 1995 | 0 | 0 | 0 |
| 1996 | 7,319 | 3,459 | 10,778 |
| 1997 | 9,522 | 3,438 | 12,960 |

[1] (Acre Feet)

and lower initial rates compared to the combined releases described above, but follow the same principles.

### 2.6.4 Emergency Winter Operations

The Cachuma Project was constructed for conservation purposes, thus no space is reserved for flood control purposes. The space created by normal conservation operations provides incidental flood benefits. Historically, operations of Lake Cachuma have followed the adopted "rule curve" during large storm events. Under normal operations at Bradbury Dam, flow entering Lake Cachuma is stored until the reservoir elevation exceeds 750 feet MSL. Above that elevation, the reservoir spillway gates are opened to release the inflow as a direct function of the lake elevation above 750 feet (Figure 2-15). The effect of this type of operation on routing a storm through a full reservoir is to decrease peak outflow by a few percent compared to peak inflow, and to delay the peak by 2.5 to 3 hours. Since the "rule curve" (which stipulates gate opening as a function of lake elevation) is actually an envelope, past operations have recognized that some additional reduction of peak flow occurs if the reservoir is allowed to rise to the maximum level allowed (within the envelope) during peak inflow. Past operations apparently took advantage of this flexibility during very large storms.

### 2.6.5 State Water Deliveries

The full entitlement of South Coast participants totals 13,500 AFY (Table 2-21). ID#1, which is not a South Coast participant and does not put any of its entitlement into Cachuma, has a total entitlement of 2,000 AFY. 1,500 AFY of that belongs to Solvang, over which the two entities (Solvang and ID#1) are currently in litigation. Right now ID#1 has discretionary use of 500 AFY.

ID#1 gets SWP water in exchange for its Cachuma Project entitlement through a mechanism called the ID#1 exchange. The South Coast SWP participants are obligated to exchange SWP water for ID#1's Cachuma Project entitlement on a yearly basis. This benefits ID#1 by exchanging treated water for untreated water and the South Coast SWP participants by saving on pumping costs and Warren Act storage charges. This exchange amounts to 2,580 AFY.

In September 1997, SWP water deliveries were started to ID#1, followed by deliveries to Lake Cachuma in November 1997. A total of 1,502 AF was delivered in November and December 1997. The Lake Cachuma spill that began on February 3, 1998, stopped State Water deliveries into Lake Cachuma (deliveries are not made when the lake is spilling or expected to spill). Deliveries are also not made concurrently with downstream water rights releases. To date, CCWA has not delivered water to Lake Cachuma concurrently with downstream water rights releases and thus no discharge of State Water directly to the river has occurred. When such a release is planned, it will be conducted in accordance with the constraints, (both temperature and proportion) described in Section 3.2.3.

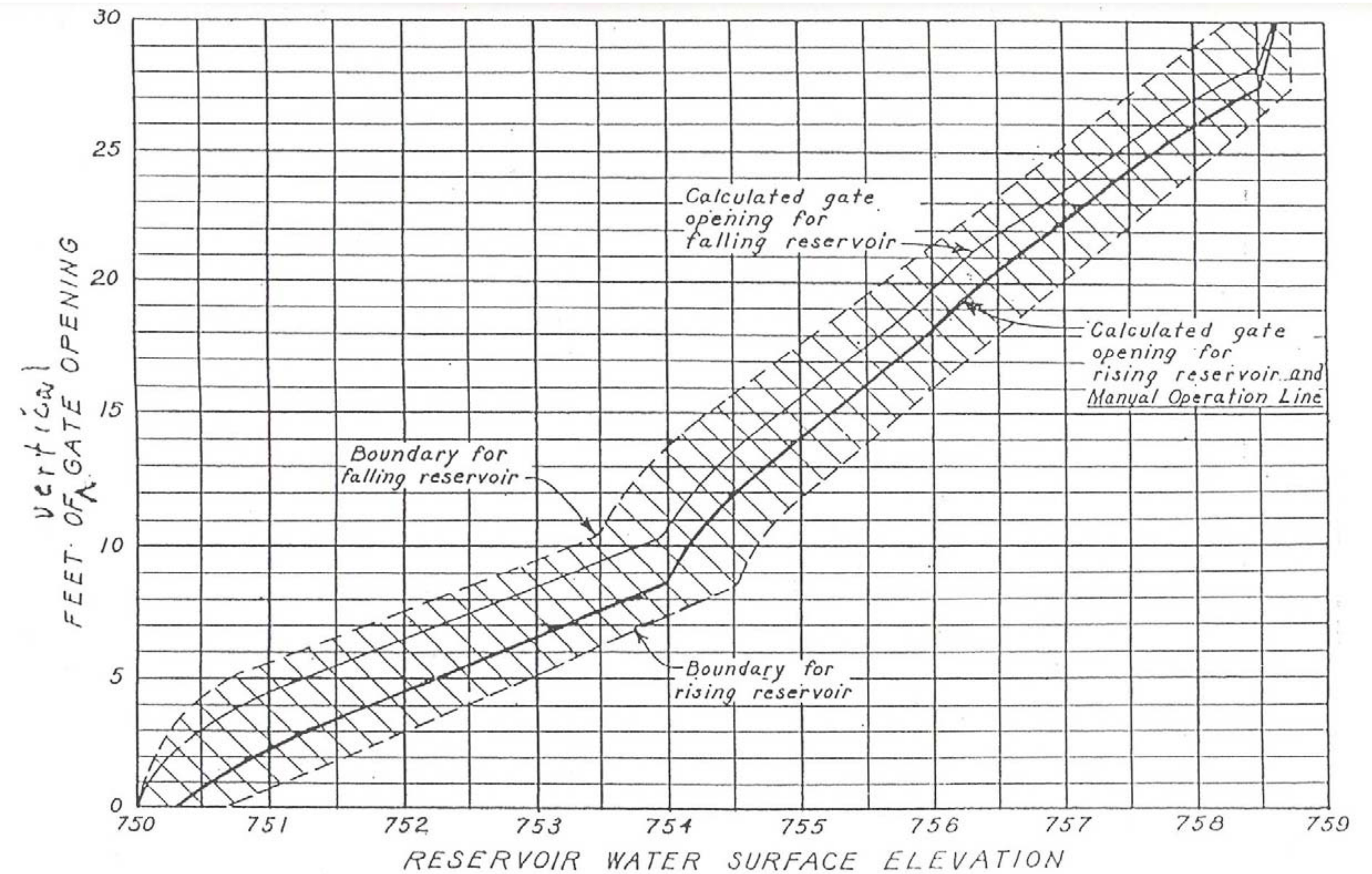



**Figure 2-16. Rule Curve for Operation of Lake Cachuma During Spill Events (Provided by the Santa Barbara County Flood Control and Water Conservation District and Water Agency).**

**Table 2-21. State Water Project Entitlement for Member Units**

| Party | | Total Entitlement for State Water (acre-feet per year) |
|---|---|---|
| South Coast Participants | | |
| | Carpinteria Valley WD | 2,000 |
| | Goleta WD | 4,500 |
| | Montecito WD | 3,000 |
| | Santa Barbara | 3,000 |
| Santa Ynez Valley Participants | | |
| | Improvement District #1 | 2,000 |

The Member Units have requested deliveries ranging from 5,780 AF in 1999 to 6,835 AF in 2002. Requested deliveries vary by month with the greatest demand occurring from June through August. The requested delivery to the Member Units at full entitlement is 15,125 APY (13,750 AFY contract entitlement plus 1,375 drought buffer entitlement). A schedule of requested deliveries through 2002 and at full entitlement is provided in Table 2-22.

## Table 2-22. State Water Delivery Schedule[2]

| Year[1] | W.T | Total |
|---|---|---|
| 1999 | Requested Delivery | 5,780 |
| | ID #1 Exchanges | -2,945 |
| | Scheduled Delivery in Lake Cachuma | 2,835 |
| 2000 | Requested Delivery | 6,305 |
| | ID #1 Exchanges | -2,580 |
| | Scheduled Delivery in Lake Cachuma | 3,725 |
| 2001 | Requested Delivery | 6,670 |
| | ID #1 Exchanges | -2,580 |
| | Scheduled Delivery in Lake Cachuma | 4,090 |
| 2002 | Requested Delivery | 6,835 |
| | ID #1 Exchanges | -2,580 |
| | Scheduled Delivery in Lake Cachuma | 4,255 |
| Annual Delivery at Full Entitlement | Requested Delivery | 15,125 |
| | ID #1 Exchanges | -2,580 |
| | Scheduled Delivery in Lake Cachuma | 12,545 |

(Unconstrained Flow Case, By Turnout in Acre Feet)

[1] Delivery Information for 1999 through 2002 is based on project participant's updated delivery request submitted in Sept. 1998.

[2] "Unconstrained" delivery amounts are not limited to each project participant's share of CCWA total delivery capacity; peak demands exceeding the project participant's share of total capacity is accommodated in the unconstrained delivery case.

Source: CCWA

The action being evaluated in this Biological Assessment includes the existing project operations described in Section 2.6, modification to these operations as presented below, and a number of mitigation measures to address potential impacts from Cachuma operations, as well as conservation measures intended to protect and enhance habitat conditions for steelhead. This section first reviews changes in the proposed operations of the Cachuma Project necessary to achieve the mitigation measures that are part of the proposed action. This section then outlines the proposed mitigation measures including conjunctive operations of water releases for both downstream water rights and enhancement of fish habitat in the mainstem Santa Ynez River as mitigation for any project effects on steelhead. In addition, several conservation measures have been designed to protect and enhance steelhead habitat on Reclamation property at Hilton Creek, as well as on tributaries that provide the majority of the spawning and rearing habitat available to anadromous steelhead. The U.S. Bureau of Reclamation and the Cachuma Member Units have reviewed the Proposed Operations and the associated conservation measures to protect steelhead, and fully endorse and support their implementation, as does Reclamation. The Santa Ynez River Conservation District supports the elements of proposed operations applicable to its functions, namely the conjunctive use of the downstream water rights releases with the Fish Reserve Account as presented below to benefit rainbow trout/steelhead habitat in the Santa Ynez River and Hilton Creek. Elements of the Proposed Operation and its associated conservation measures are briefly discussed below.

## 3.1 PROPOSED RESERVOIR OPERATIONS

The significant changes to reservoir operations (from the baseline condition) include the addition of a 1.8 foot surcharge during spill years and a formal, permanent Fish Reserve Account to provide water for the protection of aquatic resources downstream of Bradbury Dam (described in Section 3.2 below).

### 3.1.1 WATER SUPPLY AND WATER STORAGE

Cachuma Project Members will continue the baseline-level draft of 25,714 AF per year from the Project for water supply (see Section 4.3 for discussion of higher shortages). Water storage levels in the reservoir should be similar to past levels with the exception of a 1.8 feet higher starting level during spill years. The addition of the Fish Reserve Account will mean greater fluctuation to lake levels, although those fluctuations will occur over months and years and will likely not be noticeable to the casual observer.

### 3.1.2 DOWNSTREAM WATER RIGHTS RELEASES

Under the Proposed Operations downstream water rights releases occur in a manner similar to the baseline operation. Because of the target flows for fish, smaller downstream releases to replenish the upper Santa Ynez riparian groundwater basin will likely not be needed in most years. The other main difference will be a formal ramping policy for the transition between downstream water rights releases and fish releases to minimize the potential for stranding.

### 3.1.3 Emergency Winter Operations

In very wet winters, such as 1998, the normally available space may be filled early in the winter and increase the likelihood of large, potentially damaging runoff events in the subsequent months. During these winters, modified operations can provide substantial health and safety benefits to the area downstream of Bradbury Dam. After the 1998 storms, the Reclamation, Member Units, Santa Barbara County Flood Control and Water Conservation District, the City of Lompoc, and the SYRWCD entered into discussions to formulate a program defining these operational modifications. As an outcome of these discussions, the Santa Barbara County Public Works Department Water Agency prepared a report of modified storm operations for Bradbury Dam (SBCPWD 1998). The report summarizes operational changes to be implemented in the appropriate conditions to protect downstream health and safety.

The modified operations move water through the release works (and past the flow sensitive areas downstream) before or after the anticipated peak reservoir inflow. Three operation changes may be employed individually or in concert:

1. pre-storm reservoir drawdown of up to several feet, or "precautionary releases";

2. release of storm inflows up to a calculated maximum flow while holding reservoir below normal operational level, termed "prereleases"; and

3. after lake reaches above-full condition, hold spillway gates to achieve extra reservoir surcharge, "gateholding".

The first two operational changes move water through the reservoir before the peak inflow; the third holds water in the reservoir for release after peak inflow. Each of these techniques is discussed below.

#### 3.1.3.1 Reservoir Drawdown Below Elevation 750 Feet. (Precautionary Releases)

Temporary evacuation of water to lower the lake elevation a few feet provides storage for initial detention of runoff from the expected storm. This allows subsequent runoff to occupy that space thus keeping reservoir water level from rising as much during the early part of the storm. Used in concert with releases of initial storm runoff ("pre-releases"), maximum lake level rise during the storm runoff event (thus gate opening) can be reduced.

#### 3.1.3.2 Early Releases of Storm Inflow From Rainfall in Upper Watershed (Pre-Releases)

The concept of this second procedure is routing early storm runoff more quickly through the reservoir so as to reduce the maximum lake level during peak storm inflow, thus reducing peak storm release. This operational modification releases water at a rate greater than the historic rule curve during early phases of storm runoff and must be limited by accurate knowledge of downstream channel capacity and flow conditions. Since the release rate is determined from measurements of actual rainfall, there is no risk to water supply from this modification.

#### 3.1.3.3 Temporary Surcharge (Gateholding)

Gate design and operation at Bradbury Dam allow surcharge of the reservoir. That means that the reservoir level can be controlled so that water level could be raised above the normal operation level at any gate opening (release rate) without overtopping the release works or embankment. This allows releases to be held significantly below inflow during the period of peak inflow. In conjunction with lake level lowering and early runoff releases, gateholding will maximize the size of the reduction of downstream flow. Since this operational modification occurs during a spill condition, there is no risk to water supply.

#### 3.1.3.4 Integration of Operational Modifications

The three elements of modified operations discussed above exhibit synergy; they are more effective in reducing peak outflow when used together during the same storm than if used only singly or two together. Physically, these modifications reduce peak downstream flows by temporarily storing peak inflow in the reservoir and releasing it at a reduced rate. Precautionary releases and release of early storm inflow make additional storage available by moving water through the reservoir before the peak storm inflow. This is accomplished by releasing water before and at greater rates than required by the original rule curve. Gateholding reduces and retards releases during peak inflow. Each of these techniques performed alone will reduce peak storm release. However, performed together, the reduction of peak release is greater than simply adding the expected effects together, because each technique allows the subsequent operation to start at a lower lake level. These operations will not affect the total volume of storm flow passing through the system, only its temporal distribution for a few days.

#### 3.1.3.5 Factors Considered for Operational Decisions

To protect water supply and to be certain that modified operations do not add to peak downstream flows, several important factors are evaluated as part of and during the modified operations. These factors are:

- quantitative precipitation forecasts (QPF) for each storm.
- watershed conditions, particularly remaining watershed runoff.

- downstream tributary response to precipitation (both predicted and actual).

During two large storm events in February 1998, the historic operation of Bradbury Dam (Lake Cachuma) was modified to reduce downstream flow in the Santa Ynez River through a combination of these three changes to the "normal operations". The results of these modifications indicate that peak storm flows can be reduced up to 40 percent compared to the existing standard operations, thereby reducing coincidental flood damage downstream of Lake Cachuma.

Analysis of historic flow and precipitation data indicate that significant flows above Lake Cachuma needing this sort of modification occur relatively frequently (Table 3-1), but are not regular events. Since the dam began storing water in November 1952, there have been 14 storms during which the emergency winter operations would have been implemented. In seven of these storms, there was sufficient storage space in the reservoir to detain the bulk of the runoff and thereby reduce flooding downstream of the dam. In the remaining seven storm events (11 percent of years), the modified operations could have substantially reduced flood peaks, thereby reducing the potential damage downstream.

These modified operations are possible because of advancements in technology, including rainfall and streamflow monitoring capability as well as a flood routing model developed by the Santa Barbara County Flood Control and Water Conservation District.

Modified operations will be considered during storm events where the predicted magnitude of inflow to Lake Cachuma exceeds 15,000 to 20,000 cfs. Actual implementation will depend on a variety of factors as previously discussed.

At the conclusion of a large spill event such as those described above, the recession of spills from Cachuma Reservoir can be ramped down gradually based on the projected inflow to the reservoir. The recession hydrograph of inflow to Cachuma Reservoir is relatively predictable and can be used in the reservoir operation to regulate the spill. Under the proposed operation, the surcharge storage space should be utilized to ramp down the spills while creating the surcharge. For example, storage surcharge and ramp-down may begin at a discharge rate of approximately 300 cfs. Based on projected recession hydrograph of inflow, the storage and release from the surcharge can be used to regulate the ramping of spills down to about 30 or 50 cfs.

**Table 3-1. Significant Flow Events in the Santa Ynez River at Los Laureles and Solvang Gages, 1952-Present.**

**Storms That Produced Flows Exceeding 20,000 cfs**

| Year | Date | Los Laureles (above Cachuma) | Solvang (below Cachuma) |
|---|---|---|---|
| 1966 | December 6 | X | |
| 1969 | January 21 | X | |
| 1969 | January 25-26 | X | X |
| 1969 | February 24-25 | X | X |
| 1978 | February 10 | X | |
| 1978 | March 4 | X | X |
| 1983 | March 1-2 | X | X |
| 1992 | February 12 | X | |
| 1995 | January 10 | X | X |
| 1995 | January 24-25 | X | |
| 1995 | March 11 | X | |
| 1998 | February 1-2 | X | X |
| 1998 | February 6-7 | X | |
| 1998 | February 23-24 | X | X |

### 3.1.4 MAINTENANCE ACTIVITIES

Various maintenance operations must be conducted at regular intervals to ensure that the Cachuma Project can operate as designed and meet its obligations to the Member Units and the downstream accounts. These maintenance activities include:

- Inspect and test annually High Pressure Gate Assembly with Hydraulic Hoist located at Outlet Works Gate Chamber. Operate gates one at a time from full close to full open. Performed only when two hollow jet valves & butterfly value are closed.
- Annually test the two 30" hollow jet valves. Test from full closed to full open only when conduit is drained.
- Annually test 10" butterfly valve. Test from full close to full open only when conduit is drained.
- Annually lubricate fittings on machinery deck and trunnion.
- Test and calibrate meters
- Inspect trunnion anchor block four times per year (March, June, Sept, Dec)
- Weekly operate and test radial gate motors during spill release.
- Radial gates are left in open position until spill conditions then are operated/tested according to spill release.

These maintenance activities will not result in discharge to the river, except during spills.

Reclamation will sustain the low-flow crossing and will upgrade it as needed for future projects. Any upgrading would only occur between June and December and include sediment controls. This action would consist of placing washed small cobble (4 to 6 inches) in the Santa Ynez River. If needed for a specific project, vaulted culverts compatible with NMFS standards for culverts would be installed. Filter fences would be installed to trap displaced sediment during this operation.

## 3.2 CONJUNCTIVE OPERATION OF WATER RIGHTS RELEASES WITH FISH RESERVE ACCOUNT RELEASES

### 3.2.1 SURCHARGE

The storage capacity in Lake Cachuma can be increased by surcharging the reservoir. The additional water stored will be dedicated to the Fish Reserve Account for fish and habitat enhancement purposes. In the past, Reclamation has surcharged Lake Cachuma to 0.75 feet above elevation 750.0 feet, yielding approximately 2,000 AF of additional storage in Lake Cachuma in years when the reservoir spills.

Last fall, Reclamation investigated the feasibility surcharging the reservoir to 1.8 feet and 3.0 feet (Reclamation 1998b). This would involve installing taller flashboards on each of the four spillway radial gates at Bradbury Dam. The radial gates arms are structurally adequate to accommodate either flashboard scenario. However, the 3.0-foot surcharge level may have significant negative potential impacts on the operations of the local state park. The extent of these impacts will be evaluated in the Santa Ynez River Fish Management Plan. As a surcharge level of 1.8 feet can be implemented, it is included in the Biological Assessment as a proposed action. The cost of fabrication and installation of a flashboard system is estimated to be $30,000 per gate for a 1.8-foot flashboard (approximately $120,000 total).

A surcharge of 1.8 feet at the end of the runoff season in a spill year will provide additional conservation storage of about 5,500 AF above the reservoir full level (above water surface elevation of 750.0 feet). Operations modeling for the 1918 to 1993 period of record indicates that this level of surcharge will likely occur in 25 out of 75 years (33 percent of years).

### 3.2.2 FISH RESERVE ACCOUNT AND CONJUNCTIVE RELEASE

#### 3.2.2.1 Fish Reserve Account

As a part of the Proposed Operations, a dedicated volume of water will be made available within Lake Cachuma for purposes of environmental protection and enhancement. The Fish Reserve Account will be allocated and administered under the direction of the SYRTAC. As with other components, the Fish Reserve Account will be adaptively managed to reflect annual and inter-annual variations in hydrologic conditions. For the purpose of establishing the Fish Reserve Account in Lake Cachuma, Reclamation will surcharge of the reservoir as described above. All of this surcharge will be allocated to the Fish Reserve Account. Water provided to the Fish Reserve Account in years when the reservoir does not spill will come from the Member Units in normal and dry years.

Criteria for Allocation, Storage and Carryover

The amount of water allocated to the Fish Reserve Account will vary according to water year type and storage in the reservoir. This is done to take advantage of greater water supplies when available. In years of higher flow the mouth of the estuary will open and steelhead will be able to migrate up the mainstem. In years of lower flow, the mouth may not open and migration up the mainstem may not be possible, but fish holding over from previous years must be sustained. By having a variable allocation to the Fish Reserve Account, more water is available when it will support the most steelhead, and less water is available when fish numbers are low. This allows the water to provide the most benefit, while conserving water when it will provide less benefit. In those years when precipitation and runoff results in spill from Bradbury Dam, the Fish Reserve Account will be allocated 5,500 AF of water. In those years when Bradbury Dam does not spill but storage is greater than 120,000 AF, the Fish Reserve Account will be allocated 2,000 AF. During years in which storage is less than 120,000 AF, annual allocations to the Fish Reserve Account will experience minor shortages on a pro-rata basis with the

Member Units and the account will be allocated less than 2,000 AF. These shortages would generally range from 3 to 10 percent, based on historic operations. When the Project water in storage has receded to less that 30,000 AF in the reservoir, the allocation and release of Fish Reserve Account will be limited to the amount of water required for refreshing the Stilling Basin and the Long Pool, or about 30 AF per month.

The annual allocation of water to the Fish Reserve Account that would be made under the proposed plan is provided for the years 1918 to 1993 based on output from the Santa Ynez River model (Figure 3-1). These runs show that allocations to the Fish Reserve Account would be as follows:

| Allocation | Number of Years | Percentage of Years |
|---|---|---|
| 5,500 AF | 25 | 33.3 |
| 2,000 AF | 28 | 37.3 |
| Pro-rated with Member Units | 21 | 28.0 |
| Flushing releases only | 1 | 1.3 |

Fish Reserve Account water stored in Lake Cachuma will not experience evaporation or seepage losses. The unused portion of the Fish Reserve Account will be carried over to the next year. In the event of a spill, the Fish Reserve Account will be deemed to spill and the account will receive a new allocation of up to 5,500 AF, depending on the level of surcharge available. If only a partial surcharge is possible (not the complete 1.8 feet) then the account would receive either 2,000 AF or the surcharge amount, whichever is greater. Simulations with the Santa Ynez River model indicate that when the reservoir spills, the surcharge space is always completely filled, although in theory a partial surcharge is possible.

#### 3.2.2.2 Plan For Conjunctive Operation

Releases are made from Bradbury Dam to meet downstream water rights requirements (WR 89-18). These releases are typically made during the late spring and/or summer and early fall, using flow patterns designed to recharge the groundwater basin between Bradbury Dam and Lompoc Narrows and the Lompoc groundwater basin. In wet years, downstream water rights releases are generally not made because the aquifers have been sufficiently recharged by the heavy winter rains.

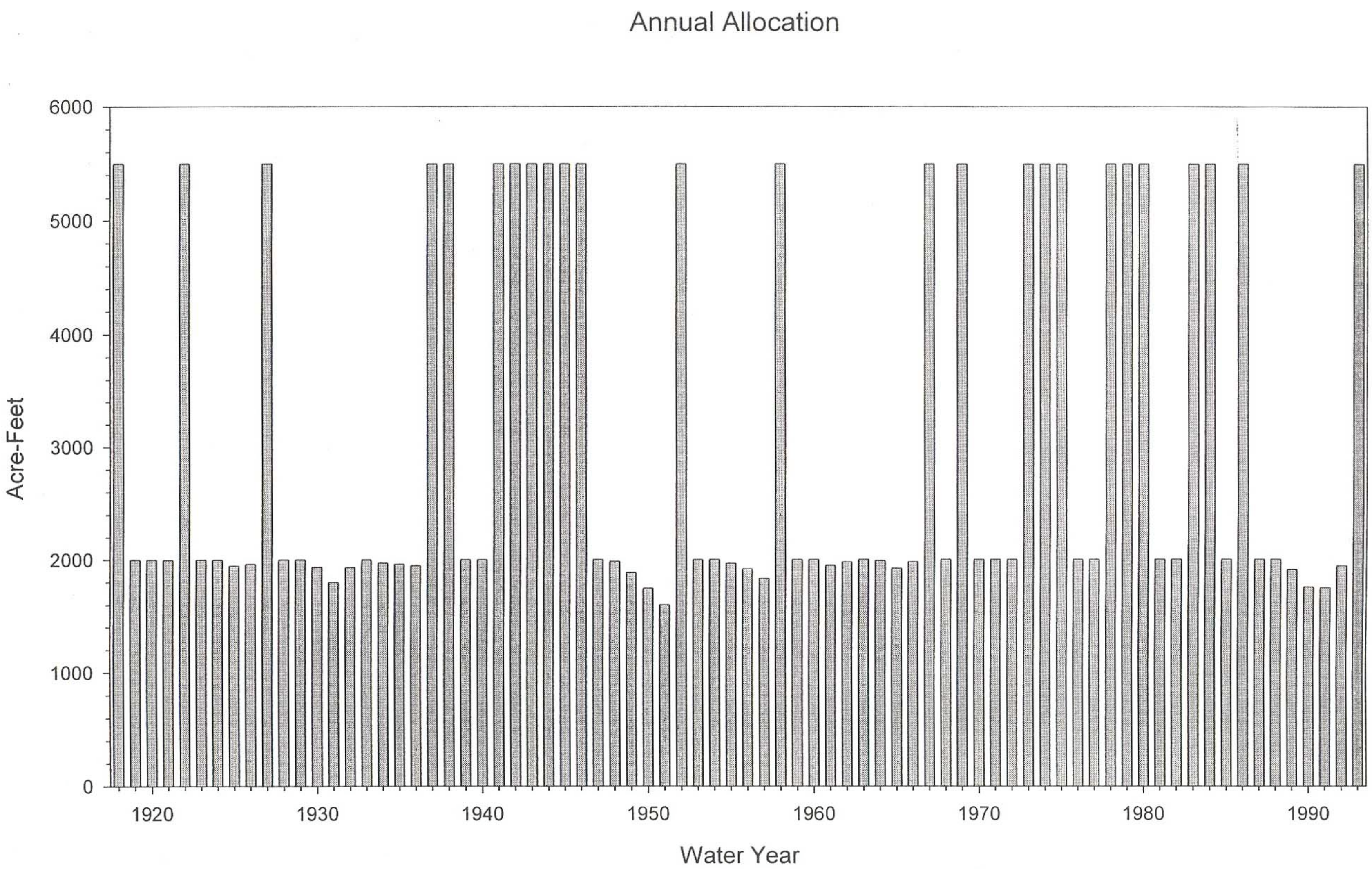



**Figure 3-1. Fish Reserve Account allocation under the proposed operations, 1918-1993.**

The objective of conjunctive operation of the downstream water rights releases in combination with releases from the Fish Reserve Account is to extend the period of time each year when instream flows improve fisheries habitat for over-summering and juvenile rearing within the mainstem river and Hilton Creek. First priority for flow enhancement will be given to Hilton Creek (as described in Section 3.3.1). The reach from the Hilton Creek confluence to Highway 154, will receive second priority. The third priority will be the area between Bradbury Dam and the Hilton Creek confluence, including the Stilling Basin and Long Pool, and fourth priority is given to the mainstem downstream from Highway 154 to the Solvang area.

These priorities have been established based on the quality of existing habitat, the results of extensive water temperature monitoring and modeling (Sections 2.3.1.1 and 2.3.1.2), and the likelihood for successful protection and improvement of steelhead populations. Temperature monitoring and modeling suggest that improved temperature conditions will not extend beyond the Highway 154 Bridge.

These priorities will need to be evaluated on the basis of antecedant conditions. The ability to manage the combined releases from Bradbury Dam to the mainstem varies substantially among years in response to variation in factors such as precipitation and runoff, reservoir storage, and downstream need. Releases will be adaptively managed based on variation in conditions, constraints, and need. Releases from the Fish Reserve Account will be made in a manner to augment natural flow and water rights releases to maintain the target flows identified. For example, in wet years, when steelhead are able to migrate upstream and spawn in Hilton Creek, high priority will be given to providing rearing flows throughout the year within Hilton Creek to support that production until the following year when those fish would likely move out of the system. In the second year of a drought, when adult steelhead have not spawned in Hilton Creek for two years, priority might be given to maintaining mainstem habitat. This will be evaluated based on the number of steelhead remaining in Hilton Creek, the water supply available to maintain fish habitat, water quality conditions in the creek, and the likely schedule for releases to downstream water users. Because priorities must shift in response to in situ conditions, releases from the Fish Reserve Account will be managed on an adaptive basis. The biological sub-committee of the SYRTAC will have the responsibility for making decisions about how the Fish Reserve Account will be used. A description of how these decisions would be reached is provided in Section 3.2.4.

During winter runoff seasons, natural flow from tributaries generally provides instream flow in the mainstem of the Santa Ynez River. In wet years, instream flows continue into early summer. In addition, spills from Lake Cachuma tend to enhance and prolong the instream flows in the mainstem in wet years.

Under the proposed conjunctive operation, releases will be made to maintain target flows between the dam and Highway 154 Bridge based on lake level elevations and the amount of water in the Fish Reserve Account at the beginning of each month. Releases of up to 10 cfs will be made from the supplemental watering system for Hilton Creek to meet these targets. These releases will be made both to Hilton Creek and/or the Stilling

Basin. In years when the lake spills and when the storage in Lake Cachuma is above 120,000 AF, a target flow of 10.0 cfs at Highway 154 Bridge will be maintained when possible, when no water rights release is underway. When the lake does not spill and the storage in Lake Cachuma exceeds 120,000 AF, then a target flow of 5 cfs will be maintained where possible. When lake storage recedes below 120,000 AF, the target flow at Highway 154 Bridge will be 2.5cfs. In the event storage recedes to less than 30,000 AF, releases at Bradbury Dam for the purpose of fish habitat will be limited to pulsed flows to refresh the Stilling Basin and the Long Pool below Bradbury Dam. Such releases will be limited to about 30 AF per month or as needed.

Analysis of historical hydrology indicates that it will be possible to meet these target flows under most conditions. Figure 3-2 shows the daily exceedance flow for the Santa Ynez River at Highway 154 based on simulations of the Santa Ynez River model from 1918 to 1993. Flow at Highway 154 would exceed 2.5 cfs about 98 percent of the time, 5 cfs about 78 percent of the time, and 10 cfs about 41 percent of the time. Some of this flow persists downstream as far as the Alisal reach during most years (Figure 3-3). Table 3-2 shows the minimum daily flow that would be observed during each year from 1942 through 1993 under the proposed conjunctive use operation based on daily simulations from the Santa Ynez River model. This table shows that the minimum daily flow during any year at Highway 154 would be less than 2.5 cfs during three years (1951, 1952 and 1991), all of which occur at the end of prolonged droughts. During these years, pulse flows will be made to preserve refuge habitat.

The Fish Reserve Account will not be debited during water rights releases. This conjunctive operation will occur through coordination among Reclamation, the SYRTAC, and SYRWCD, has committed to participate in conjunctive use operations.

Ramping

The duration and rate (including initial rate) of water right releases will vary, depending on whether water is released for the purpose of recharging only the above Narrows area or both above and below Narrows areas together. For example, combined releases for the above and below Narrows areas may begin at the rate of 135-150 cfs and are maintained at a steady rate for about 12-15 days before it is gradually decreased to lower flow rates. During the initial period of 12-15 days, the flow moves at the rate of less than three miles per day (or less than 0.2 ft/sec). At a given location, the flow would gradually ramp up as the recharge rate decreases further upstream. As the recharge rate decreases in the river bed, the release rate is also gradually reduced. Changes in release rates are generally attenuated in the river. In essence, the release rates are maintained at such rates that water would disappear in the lower reaches of the Santa Ynez River channel. The reduced releases could extend two to three months and then would be gradually ramped down to match scheduled releases from the Fish Reserve Account. Whereas, releases for the above Narrows areas are made for shorter durations and lower initial rates compared to the above releases, but follow the same principles.

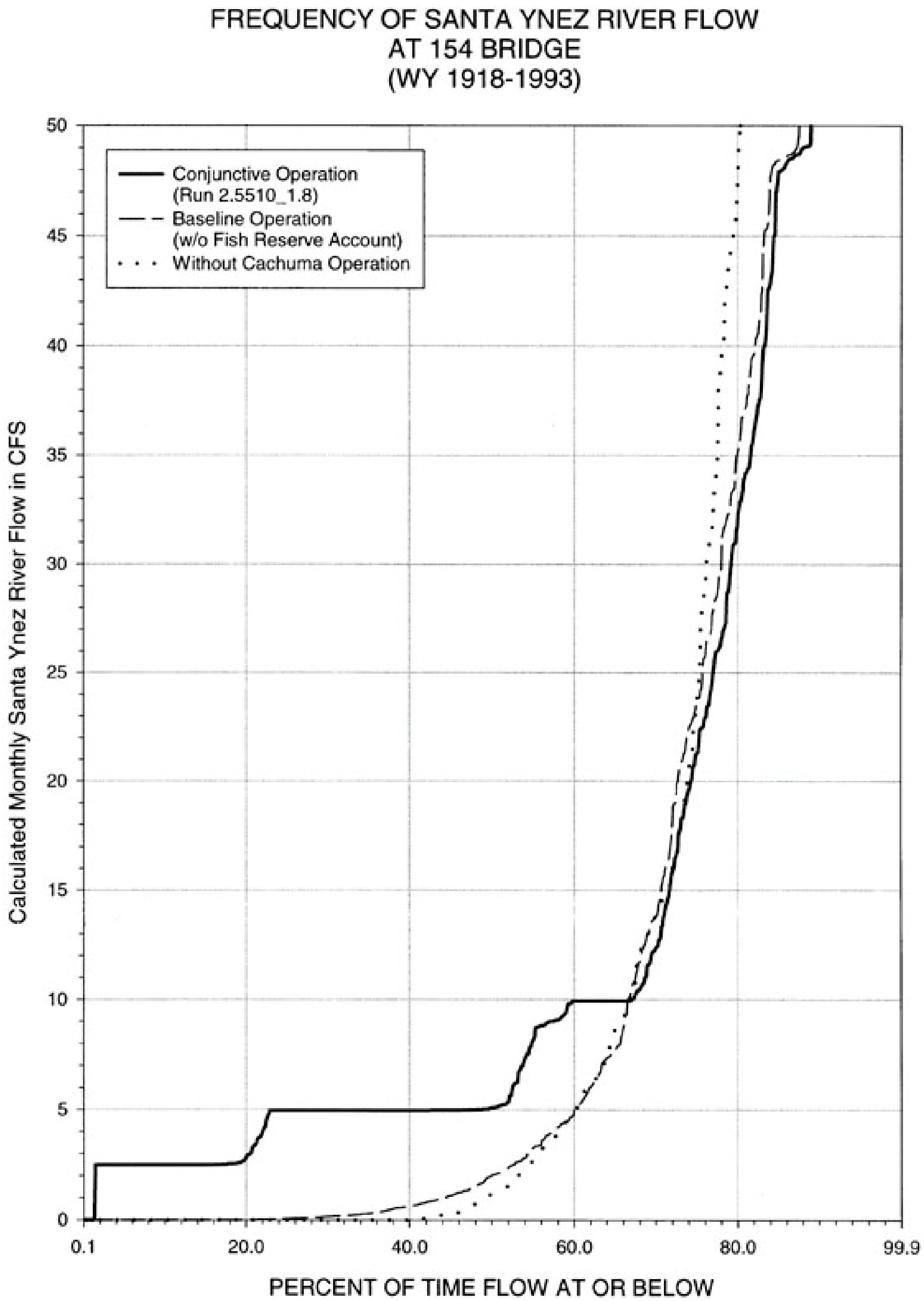



**Figure 3-2. Flow at Highway 154 Under Proposed Operations.**

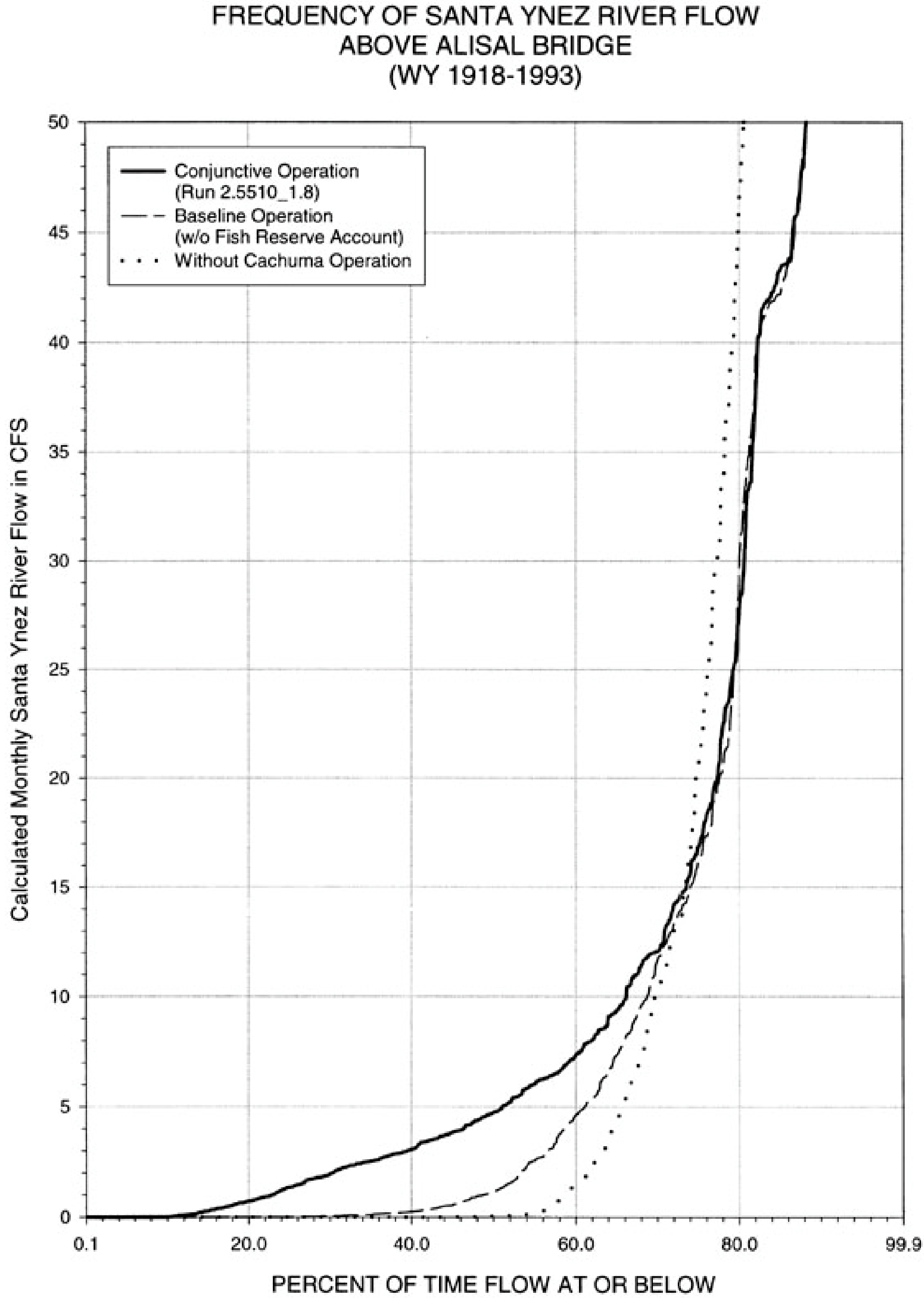



**Figure 3-3. Flow at Alisal Reach Under Proposed Operations.**

## Table 3-2. Minimum Daily Flow Under Proposed Operations, Water Years 1942-1993

| Water Year | Location: Below Hilton Creek (cfs) | Location: Highway 154 Bridge (cfs) | Location: Alisal Bridge (cfs) | Water Year | Location: Below Hilton Creek (cfs) | Location: Highway 154 Bridge (cfs) | Location: Alisal Bridge (cfs) |
|---|---|---|---|---|---|---|---|
| 1942 | 5 | 5 | 2.9 | 1970 | 5 | 5 | 0.9 |
| 1943 | 6 | 5 | 0.6 | 1971 | 3.6 | 5 | 2 |
| 1944 | 4.3 | 5 | 0.9 | 1972 | 3.2 | 5 | 0.1 |
| 1945 | 5 | 5 | 0.5 | 1973 | 4.3 | 4 | 0.1 |
| 1946 | 3.8 | 5 | 2.2 | 1974 | 5 | 5 | 2.6 |
| 1947 | 5.4 | 5 | 2.2 | 1975 | 5 | 5 | 0.8 |
| 1948 | 4.9 | 4 | 0 | 1976 | 4.3 | 5 | 0.3 |
| 1949 | 4 | 4 | 0 | 1977 | 4.9 | 4 | 0 |
| 1950 | 3 | 4 | 0 | 1978 | 4.9 | 4 | 0 |
| 1951 | 0 | 0 | 0 | 1979 | 4 | 4 | 0 |
| 1952 | 0.1 | 0 | 0 | 1980 | 5 | 5 | 1.3 |
| 1953 | 5 | 5 | 1.3 | 1981 | 5 | 5 | 0.6 |
| 1954 | 4 | 5 | 1.4 | 1982 | 3.8 | 5 | 2.1 |
| 1955 | 3.3 | 4 | 0.5 | 1983 | 5 | 5 | 1.8 |
| 1956 | 3.1 | 4 | 0.1 | 1984 | 4.7 | 5 | 2.9 |
| 1957 | 4 | 4 | 0.3 | 1985 | 3.8 | 5 | 2.1 |
| 1958 | 3.3 | 4 | 0.5 | 1986 | 4.3 | 5 | 1.3 |
| 1959 | 4.8 | 5 | 0.7 | 1987 | 3.6 | 5 | 0.7 |
| 1960 | 4.5 | 4 | 0.2 | 1988 | 4.3 | 5 | 0.3 |
| 1961 | 5 | 4 | 0 | 1989 | 4.8 | 4 | 0.5 |
| 1962 | 4 | 4 | 0 | 1990 | 5.1 | 4 | 0 |
| 1963 | 4.1 | 5 | 0.5 | 1991 | 0.1 | 0 | 0 |
| 1964 | 5.1 | 4 | 0 | 1992 | 4 | 4 | 0.1 |
| 1965 | 3.4 | 4 | 0 | 1993 | 5.6 | 5 | 1.5 |
| 1966 | 4 | 4 | 0 | | | | |
| 1967 | 5 | 5 | 1.8 | | | | |
| 1968 | 4.6 | 5 | 1 | | | | |
| 1969 | 5.8 | 5 | 1.8 | | | | |

Operation of water rights releases, in conjunction with releases from the Fish Reserve Account, will be managed to avoid stranding of rainbow trout/steelhead and other fish species. Since 1994, water rights releases have been ramped down voluntarily at the and, termination of the releases in accordance with recommendations of the Biological Subcommittee of the SYRTAC. Water rights releases were ramped down to about 5 cfs streamflow. This practice will be continued under this Plan as outlined in Table 3-3. A schedule for ramping flows upward is unnecessary as the travel time of water in the river will attenuate the rate of increase as described above.

In general, managed releases provide opportunities for improved maintenance of fisheries habitat over longer periods of time than have occurred in the past several decades. These releases can be made from the Bradbury Dam outlet and/or via the Hilton Creek supplemental water supply facility. The benefits are discussed in Sections 4.1.1 and 4.2.1. These can include increased amount of aquatic habitat, improved dissolved oxygen conditions from flushing of accumulated algae, and generally reduced water temperatures in reaches close to Bradbury Dam. Using an adaptive management strategy, conjunctive operation of water releases will be made to improve habitat conditions and build the rainbow trout/steelhead population during wet years, while using limited water supplies to maintain the rainbow trout/steelhead population and other fishery resources in dry years.

<u>Accounting and Flow Measurements</u>

Reclamation will be responsible for tracking the releases of water from the various accounts during each year. The allocation of water to the Fish Reserve Account during different year types is described above. The determination of the Fish Reserve Account allocation for each year will be made on April 1 of that year. This allocation will depend on spill and storage conditions as previously described. Accounting of flows to different accounts within Lake Cachuma is made by Reclamation based on releases made at the dam. During routine releases from Lake Cachuma, water will be drawn from various accounts (above Narrows, below Narrows and Fish Reserve Account) as described under conjunctive operation. The Fish Reserve Account will not be debited when scheduled fish water releases coincide with downstream water rights releases. Figure 3-4 shows the annual releases from the Fish Reserve Account based on the Santa Ynez River model runs form 1918 to 1993. The average release from Fish Reserve Account is approximately 2,350 AF under the proposed operations.

<u>Measurement of Target Flows</u>

Habitat maintenance flow targets have been established at the Highway 154 bridge, where there was formerly a USGS gaging station. The gaging station at Highway 154 has been discontinued and Reclamation does not currently have access to this site. There is another flow gage on Reclamation property approximately 0.7 miles below Bradbury Dam. There is an adequate historical record in common between these two locations to

**Table 3-3. Ramp-down Schedule for Downstream Water Rights Releases.**

| Type of Release | Water Release (cfs) | Duration |
|---|---|---|
| **WR 89-18** | 150 | -- |
| | 90 | 1 day |
| | 60 | 1 day |
| | 30 | 2 days |
| | 20 | 2 days |
| | 15 | 2 days |
| **Fish Reserve Account** | 10 | 2 days or ongoing |
| (releases may begin | 5 | 2 days or ongoing |
| depending on water year type) | 2.5 | 2 days or ongoing |

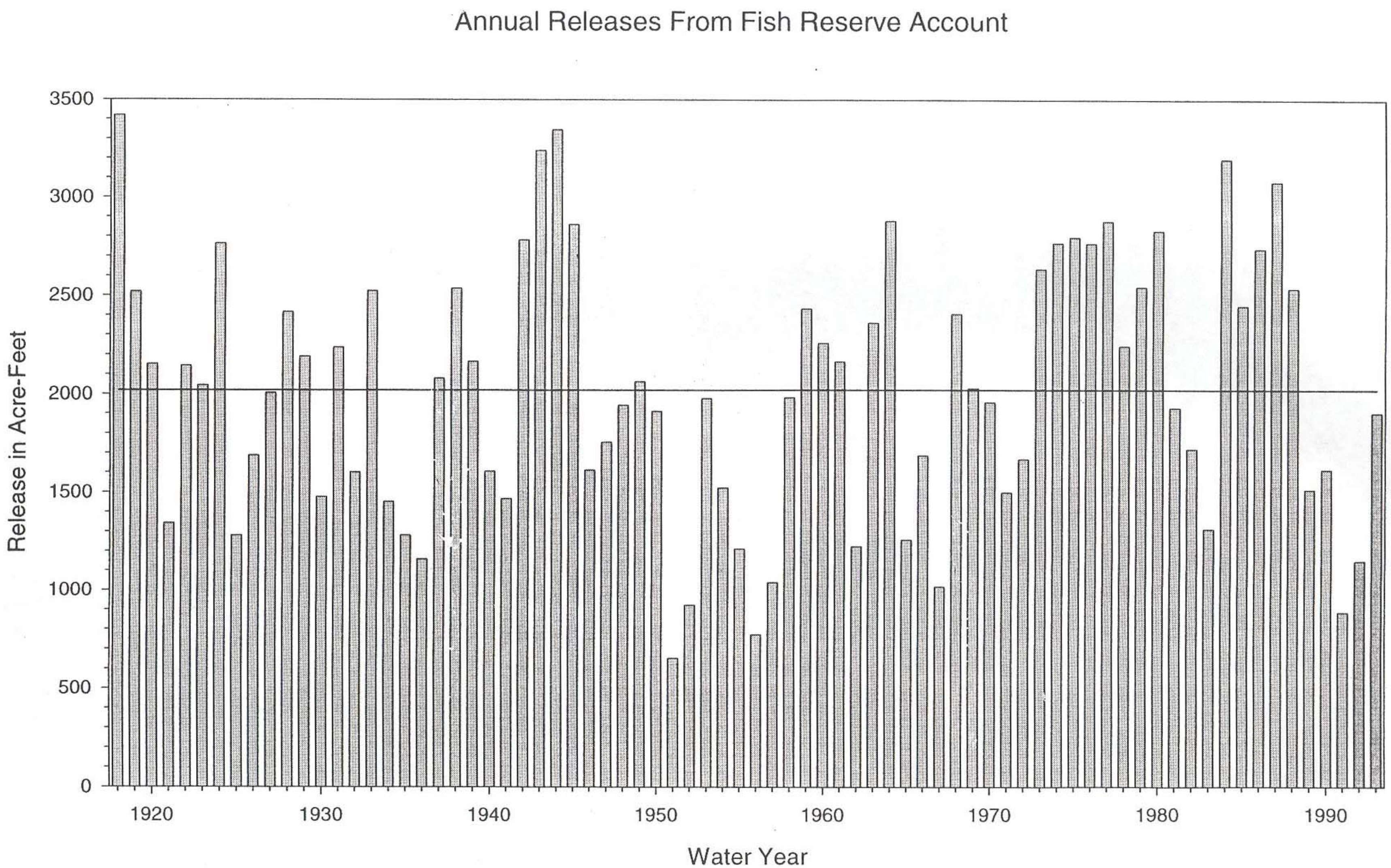



**Figure 3-4. Annual Releases from Fish Reserve Account.**

establish a reliable empirical relationship between the flows at these two locations. This relationship will be used in conjunction with the existing gage on Reclamation property to monitor flow levels at Highway 154.

### 3.2.3 CCWA Water Release

CCWA will make deliveries to Lake Cachuma and ID#1, as described in Section 2.6.5. When there are no downstream releases from Lake Cachuma through the outlet works at Bradbury Dam, the Santa Ynez Pumping Facility will directly pump SWP water into Lake Cachuma. If it is necessary to make deliveries simultaneously with downstream water rights releases, delivery will be made to the Stilling Basin in lieu of Cachuma water. The SYRTAC has requested and CCWA has agreed not to make deliveries to the reservoir when downstream releases are being made to avoid SWP water being delivered to the river. Based on current demand and the capacity of the CCWA facility, it appears that deliveries during this period can be avoided at this time. However, as demand for SWP water increases to the maximum entitlement of 14,500 AF per year, it is likely that releases to the river will be made.

In the unlikely event that SWP water must be released to the Stilling Basin, this release would be subject to specific temperature and mixing requirements to avoid potential impacts to steelhead. The release of SWP water into the Santa Ynez River may have the potential to affect steelhead trout because this water may be warmer than Project water and may contribute to thermal loading in the system. In addition, DFG raised concerns that releases to the river containing SWP water may cause an imprinting problem for young steelhead, which could affect their ability to home in on the Santa Ynez River as adults returning from the ocean. Imprinting would not be a problem, however, since any SWP water releases made to the river in the course of WR 89-18 releases would normally be made in the summer months, not during the juvenile outmigration season. The potential temperature and imprinting impacts were addressed in informal consultation with NMFS, FWS, and DFG for CCWA deliveries in 1997 and in an Environmental Assessment prepared for the CCWA Project (Reclamation 1994).

Specific guidelines for the release of SWP water to the Santa Ynez River were developed in consultation with NMFS and DFG to eliminate the potential effects of these releases, and will be included in the upcoming Habitat Conservation Plan (B. Brennan, CCWA, pers. comm. 1999). When Reclamation is releasing water from the dam outlet works (releases of more than 10 to 15 cfs) and CCWA is delivering SWP water, to the lake, CCWA water will be diverted to the river as part of the downstream release because the inlet works of CCWA and the outlet works for Bradbury Dam share the same conduit. When releases of less than 10 cfs are to be made, these will occur from the Hilton Creek water supply system, via the Hilton Creek channel and/or the Stilling Basin release point. When this occurs, CCWA deliveries would not be interrupted. During periods when CCWA is delivering water simultaneously with releases from Bradbury Dam, CCWA will blend its SWP water with released Cachuma water in a proportion to meet the temperature target as agreed upon by NMFS and DFG (B. Brennan, CCWA, pers. comm. 1999). Specifically, CCWA will ensure that the water entering the Stilling Basin will have a temperature of 18$^{o}$C or less. CCWA will calculate how much water it can pump while still meeting the temperature target.

When releases from Lake Cachuma and CCWA deliveries into Lake Cachuma are simultaneously scheduled, CCWA will contact and notify the CDFG, USFWS, and NMFS that SWP water will be entering the Santa Ynez River. CCWA staff will ensure that water temperature constraints are rigidly enforced.

Temperature confirmation for both lake and SWP water will be undertaken daily. Reclamation staff currently take daily temperature readings of the lake release water. Reclamation staff will also monitor the temperature of the river downstream of the Stilling Basin daily when releases are made. Raw and treated SWP water temperatures are taken by CCWA at the Polonio Pass Water Treatment Plant every four hours, providing advance warning of any changes in water temperature entering the pipeline. Weekly water temperatures are also taken at each tank and turnout along the pipeline route. CCWA's experience thus far indicates that water temperature increases approximately 1$^{o}$C along the length of the SWP Water Pipeline. CCWA staff will take daily SWP water temperature readings at the Santa Ynez Pumping Facility when downstream releases are occurring and will be responsible for analyzing all pertinent temperature data. CCWA staff will immediately suspend pumping when the temperature of the mixed water exceeds 18$^{o}$C.

Since it is not possible for CCWA to pump less than 5 or 6 cfs, CCWA cannot contribute to any downstream releases from the outlet works of less than 10 to 12 cfs (50 percent SWP water). The Hilton Creek supplemental water supply will provide the release mechanism for flows lower than 10 cfs.

Discharges of pumped SWP water to the river below Bradbury Dam coincidental with scheduled releases of downstream water rights from Lake Cachuma will be treated in lieu of releases for a portion of downstream water rights account water scheduled for release from Lake Cachuma. In essence, there is an exchange of SWP water for a portion of downstream water rights account water scheduled for release.

Pumped SWP water will be measured by a meter installed by the CCWA immediately downstream of the Santa Ynez Pumping Facility. Water released from Lake Cachuma is measured by the Reclamation venturi meter on the outlet works at Bradbury Dam. In addition, CCWA has installed an ultrasonic meter on the Reclamation outlet works at Bradbury Dam which measures the flows in either direction (releases from Lake Cachuma or SWP water pumped into Lake Cachuma). The sum of the pumped SWP water measured immediately downstream of the Santa Ynez Pumping Facility and water released from Lake Cachuma measured by the Reclamation venturi meter or the CCWA ultrasonic meter should represent the amount of water released for downstream water rights releases.

CCWA is obligated to deliver water into Lake Cachuma every month, if possible. Because of downstream water rights releases, Fish Reserve Account releases (during 1998 only), and/or reservoir spill, CCWA may be unable to match delivery requests on a month by month basis. CCWA intends to complete the annual deliveries by the end of each calendar year. During periods when no water is being released from the outlet works of the dam, CCWA will, after consultation with the dam tender, deliver the requested entitlement water along with any undelivered water from previous months into Lake Cachuma, if possible.

### 3.2.4 Decision Criteria for Conjunctive Releases

The goal of the conjunctive use of the downstream water rights releases and the Fish Reserve Account is to provide habitat in Hilton Creek and the mainstem Santa Ynez River. The amounts of water available for this purpose will vary with hydrologic conditions in the basin. Factors that influence the amount of water in the Fish Reserve Account and the Above and Below Narrows accounts are discussed in Section 3.2.2. Factors that influence the amount of water to be used conjunctively include the reservoir level, the amount of surcharge (if any), downstream tributary flows, the dewatered storage in the groundwater aquifers of the lower river, and the amount of inflow and spill from the reservoir.

Under the Fisheries MOU, the Bio-Subcommittee of the SYRTAC has the responsibility for allocating the Fish Reserve Account and working with the downstream water rights holders to provide for fish habitat. The guideline that the Bio-Subcommittee will use to allocate water from the Fish Reserve Account will be to provide a steady base flow for habitat maintenance through the summer and fall months when possible. Winter and spring flows have varied naturally according to rainfall and runoff patterns.

The Bio-Subcommittee has also established priorities for habitat to be supported by conjunctive use. When flow conditions in the basin are such that coastal rainbow trout have spawned in Hilton Creek, that becomes the highest priority. The mainstem river from Hilton Creek to Highway 154 is second priority, mainstem from the dam to Hilton Creek will be third priority, and the reach of river from Highway 154 downstream to Alisal is fourth priority. In wet years, when the reservoir has surcharged and there is natural flow in the tributaries, habitat will be maintained at varying levels in Hilton Creek, in the mainstem to Highway 154 and in the mainstem from Highway 154 to Alisal. In normal and dry years, the Fish Reserve Account will be used to support habitat in Hilton Creek and in the reach upstream of Highway 154. In critically dry years, at the end of prolonged droughts, the Fish Reserve Account water may be limited. In these years, the water will be used to maintain the habitat in refuge pools located in the upper portion of Highway 154 reach (i.e., the Long Pool) using pulsed flows.

Augmenting the natural flows in Hilton Creek to support spawning and rearing habitat is a high priority for the conjunctive use operations. Flow in Hilton Creek will be supplemented to provide from 1.5 to 5 cfs in Hilton Creek and in the mainstem Santa Ynez River. The amount of water will depend on water in the Fish Reserve Account and the season of the year. In April and May, if adult fish are in Hilton Creek, flow will be maintained at a slightly higher level than during the rearing period. In the fall, flows in the creek will be reduced, following the pattern of a natural hydrograph. The amount of flow provided during these periods will be determined based on the amount of water in the account and the natural flow in Hilton Creek. In years when the natural runoff has been insufficient to provide passage conditions in the mainstem river up to Hilton Creek, Fish Reserve Account releases will be made to provide rearing habitat in Hilton Creek.

There are two release outlets into Hilton Creek. The Bio-Subcommittee expects to make releases primarily from the upper release point in most years. In dry years, if flow is being lost to the alluvial reach upstream of the lower release point, then releases will be shifted to the lower release point to increase the amount of water in lower Hilton Creek. Water temperature will also play a role in the selection of release points. When air temperatures are above normal, water releases to Hilton may be moved to the lower release point if we find that significantly cooler water temperatures can be maintained in lower Hilton Creek by using the lower release point, which would reduce heating caused by exposure to solar radiation. During the first years of operation, flow and temperature data will be collected to determine the influence of the release points on water temperatures and water quantity in lower Hilton Creek.

Maintaining habitat in the reach from Hilton Creek downstream to Highway 154, and to Alisal Bridge in wet years, is also an important feature of the conjunctive use operations. Flows in the mainstem will be augmented by releases to Hilton Creek and in some cases by releases to the Stilling Basin (through the third release outlet). In years when the reservoir surcharges, half of the water for augmentation will be released to Hilton Creek (up to 5 cfs) and the other half will be released to the Stilling Basin (up to 5 cfs). Thus, if there is no natural flow in the mainstem upstream of Highway 154 and 10 cfs is available to support habitat, flow in the mainstem from the stilling basin to the confluence of Hilton Creek will be approximately 5-8 cfs and the flow in Hilton Creek will be about 3-5 cfs. At the confluence of Hilton Creek, the flow will be approximately 10 cfs. In normal and dry years, when combined releases are 5 cfs or less, water will be allocated primarily to supplement flows in Hilton Creek and in the mainstem downstream of the Hilton Creek confluence.

## 3.3 CONSERVATION MEASURES TO PROTECT STEELHEAD

### 3.3.1 HILTON CREEK

Hilton Creek is a small stream located just downstream of Bradbury Dam that goes dry in early summer. SYRTAC studies have documented the migration of adult steelhead into Hilton Creek, spawning activity, and successful reproduction (SYRTAC 1995, 1997, 1998). Usually, however, the fry are lost when the stream dries up and they are stranded or forced to move downstream to the mainstem Santa Ynez River, where their vulnerability to predation is increased.

Modifications to improve fisheries habitat within Hilton Creek are a high priority. The reach of Hilton Creek to be enhanced is located on lands owned and controlled by Reclamation, and hence implementation of habitat improvement measures can be made without requiring access to private lands or authorization and approvals by agencies outside of those involved in the direct implementation of these conservation measures. Because Hilton Creek is within the jurisdictional authority of Reclamation and the Member Units, and because it naturally supports good steelhead habitat, Reclamation and the Member Units believe that it provides an excellent opportunity to provide significant benefits to steelhead through a variety of enhancement measures (Figure 3-5). These measures include:

- Stream flow augmentation from Lake Cachuma.
- Construction of an extension channel (up to 1,500 feet long) at the lower end of Hilton Creek.

- Construction of upstream passage facilities at a partial barrier at the chute pool.

- General habitat enhancements within the existing channel of Hilton Creek.

#### 3.3.1.1 Supplemental Watering System

<u>Facilities</u>

Because of Hilton Creek's proximity to Bradbury Dam, it is possible to augment creek flow with water from the reservoir. The feasibility of this approach was demonstrated in 1997, when a temporary watering system successfully provided water from Lake Cachuma to Hilton Creek (released in the bedrock chute just above the chute pool) from early summer through the end of December. Reclamation and the Member Units are currently completing the installation of a permanent supplemental watering system that will be able to provide suitable water in most years. This system will incorporate: (1) a basic facility with pipelines to make releases at three different locations (currently being completed), (2) pumps to ensure reliable water deliveries at lower lake elevations, and (3) an adjustable intake pipe to obtain cool water deep in Lake Cachuma. Releases can be made at three sites: two in Hilton Creek and one to the Stilling Basin (Figure 3-5).

The upper release site in Hilton Creek is located near the Reclamation property boundary at elevation 680 feet, approximately 2,980 feet upstream of the Santa Ynez River. The lower release site is located just above the chute pool, approximately 1,380 feet upstream of the river at elevation 645 feet. The pipeline has a total capacity of 10 cfs. This capacity could be obtained through simultaneous releases at all three release sites. At each release point, an energy dissipation/aeration structure would maintain dissolved oxygen concentrations near saturation.

The permanent watering system will operate differently at various lake levels. When lake surface is at elevation higher than 719 feet, the system will operate by gravity (Figure 3-6). At lake elevation 750 feet, the system was designed to deliver 10 cfs total with all three release points open, and 8.85 cfs from the upper and lower release points combined. At lake elevation 720 feet, the system is expected to deliver via gravity-feed 8.26 cfs total with all three release points open, and 7 cfs from the upper and lower release points combined.

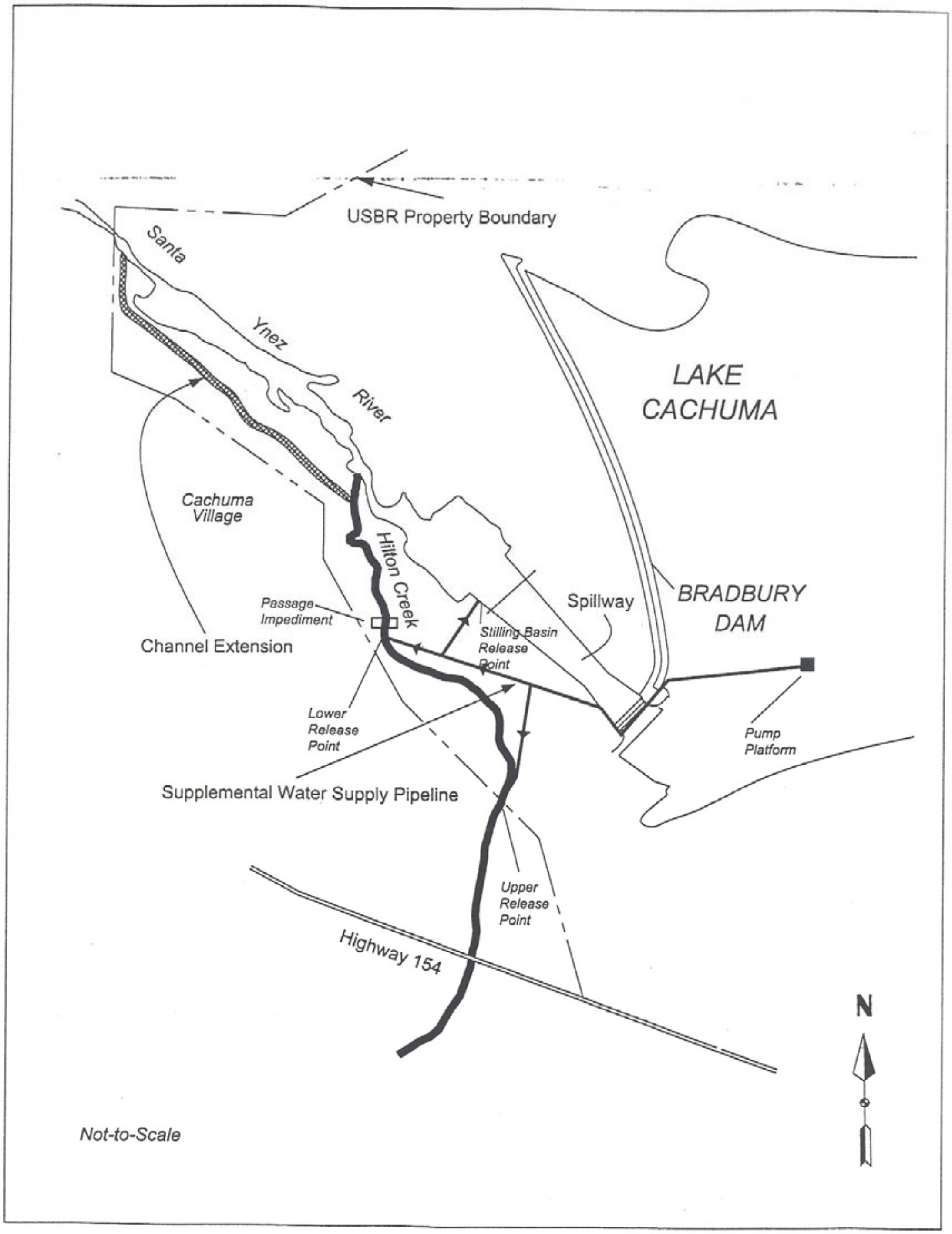



**Figure 3-5. Conservation measures at Hilton Creek**

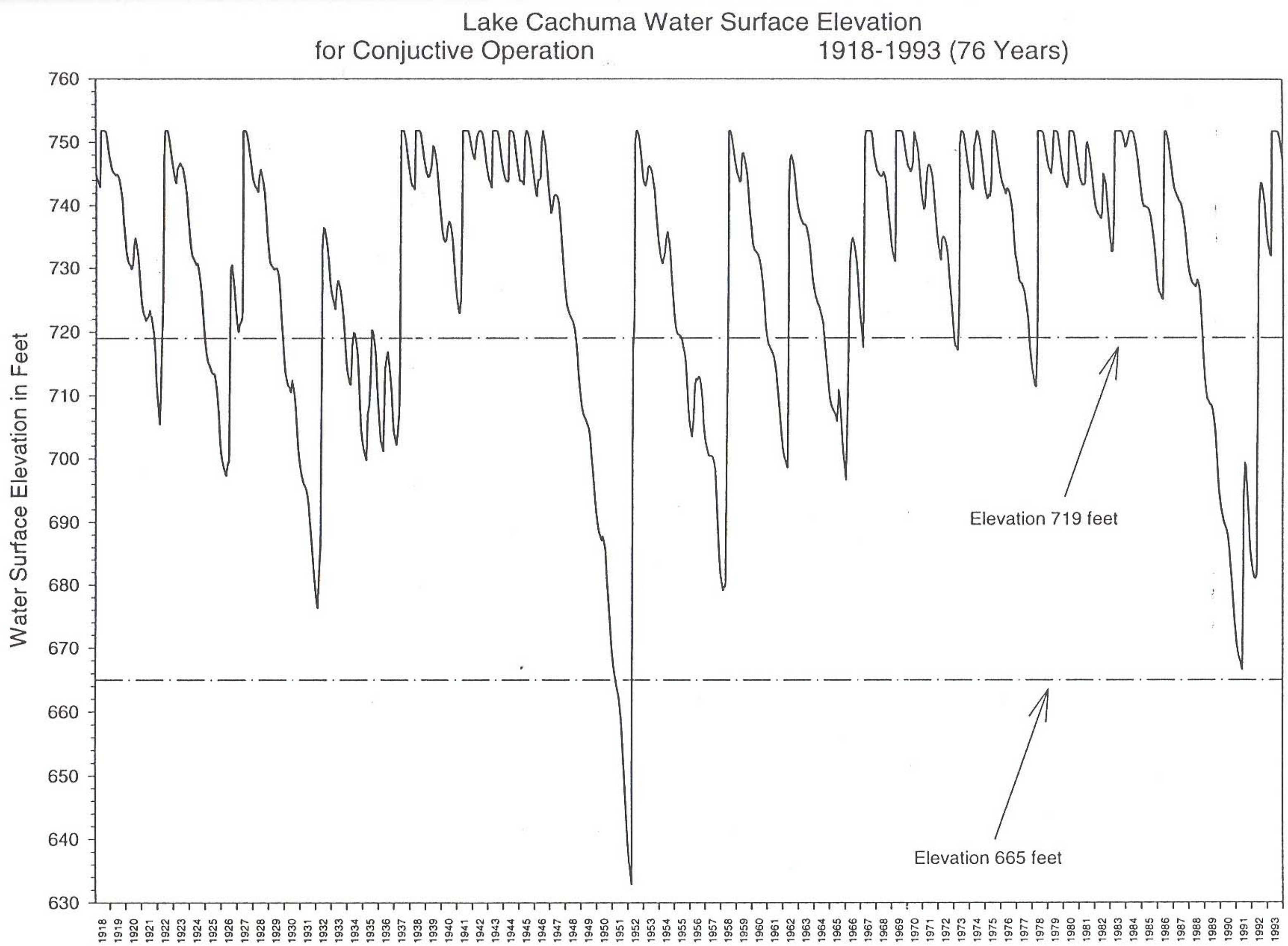



**Figure 3-6. Lake Cachuma Water surface elevation modeled under Conjunctive Operations**

Projects of lake levels under proposed operations (in November, when levels are lowest) indicate that the gravity-fed system would make deliveries 65 percent of the time (Figure 3-7). The planned installation of a pump will allow water deliveries down to lake surface elevations of 665 feet, which will increase the frequency of operation to 98 percent of the time (Figure 3-7). The pump is expected to be able to deliver 10 cfs total with all three release points open, and 8.85 cfs from the upper and lower release points combined. Although the pump system can operate at lower lake elevations, an electrical power supply is required to run the pump. Having both the gravity-flow and pump systems will ensure consistent water deliveries to Hilton Creek. The foregoing is based on the design criteria for the Hilton Creek watering system. The actual release levels may vary somewhat from those stated.

The pumping system would consist of two 50-horsepower vertical turbine pumps, two 12-inch isolation valves, and appurtenance installed on a floating platform anchored in Lake Cachuma at least 1,000 feet from the dam. The discharge pipeline would be a flexible High Density Polyethylene pipe (HDPE). The HDPE pipe would run from the platform to the dam, across the top of the spillway, and be connected with the headworks of Reclamation's distribution pipeline at the side of the spillway. The pumps would be powered by electricity from power lines at the dam. A stand-by generator would be housed in a storage shed on the shoreline to run the pumps in case of power outage.

Steelhead/rainbow trout require cool water. Lake Cachuma is thermally stratified during spring and summer, with warm water near the surface (the epilimnion layer) and cold water at deeper levels (the hypolimnion). Vertical thermal profiles measured during the summer indicate that water should be obtained from a minimum depth of 65 feet (20 meters) below the lake's surface in order to obtain water measuring 18°C or cooler (SYRTAC 1997). The planned gravity system will have a variable intake line (snorkel) at 700 feet elevation which could extend to 650 feet elevation or lower.

The proposed pumping project would include a floating platform with a 20-inch diameter, 65-foot PVC intake pipe mounted below. This intake configuration would allow cool water to be taken from variable elevations, depending on the lake surface elevation and the depth of the hypolimnion.

The cost for installing the pump, platform, and intake pipe is estimated at $286,500. The cost for operating and maintaining the pump is estimated at $33,800 per year.

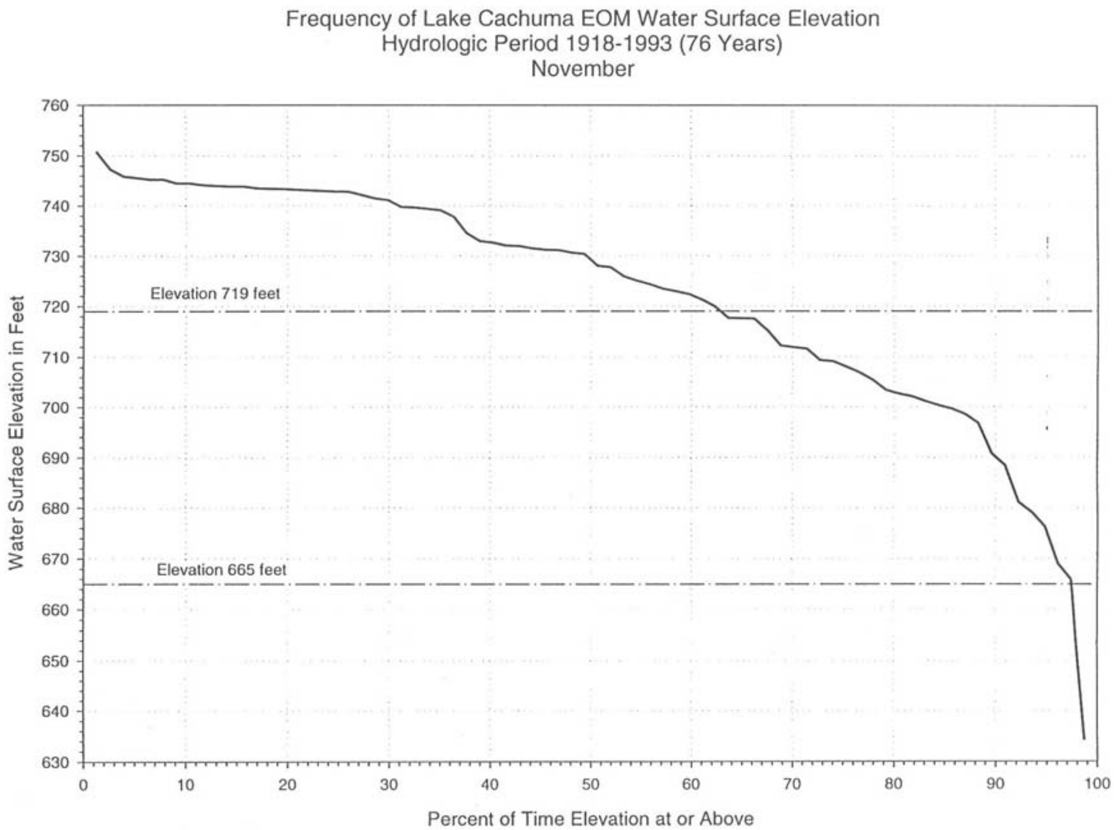



**Figure 3-7. Simulated Frequency of Lake Cachuma Water Surface Elevation in November for the Hydrologic Period 1918-1993.**

Operations

Releases into Hilton Creek will be 5 cfs or less depending on the water year type, natural flow in Hilton Creek, and the amount of water stored in the lake. Some or all of the releases made to maintain flows at the Highway 154 Bridge (see Conjunctive Operations) will be made via Hilton Creek. When the storage in Lake Cachuma is more than 120,000 AF at the beginning of the month, releases will be made to maintain a target flow of 5 cfs at the Highway 154 Bridge. If storage is less than 120,000 AF at the beginning of that month, release flows will be made to attempt to maintain a target flow of 2.5 cfs at the same location. In a year when the reservoir spills, releases will be made with the goal of maintaining a 10 cfs target flow at Highway 154 Bridge, with up to 5 cfs supplied via Hilton Creek and up to 5 cfs released to the Stilling Basin. At each release point, an energy dissipation/aeration structure will maintain dissolved oxygen concentrations near saturation. Up to 5 cfs of the releases made to support mainstem habitat or for downstream water rights (30 to 150 cfs to the mainstem; see Conjunctive Operations) will be made via Hilton Creek.

The fixed intake to the proposed Hilton Creek gravity flow system was designated by Reclamation to be at 700 feet lake elevation and deliveries taking place at lake elevations above 719 feet. That is comparable to about 111,600 AF of storage in Lake Cachuma. During drought situations, when the elevation of Lake Cachuma declines below 665 feet (2 percent of years), the watering system will not be able to deliver water to Hilton Creek. Migrating steelhead, however, are not expected to reach Hilton Creek in drought years. When such a situation occurs, a fish rescue would be performed in Hilton Creek (assuming any steelhead spawned within that year) and water releases for fish maintenance purposes would be limited to refreshing flows to the Stilling Basin and the Long Pool below Bradbury Dam. These releases would be limited to about 30 AF per month or as needed.

The water delivery system has been designed, and will be operated, to meet temperature and dissolved oxygen criteria appropriate for steelhead/rainbow trout. The two release points provide greater flexibility in adjusting the amount of water delivered to the different reaches of the creek. During operation of the temporary watering system in 1997, where water deliveries were made at the lower release point, water quality conditions were suitable throughout the lower Hilton Creek. Water released at the upper release point could experience greater warming as it travels through the channel, or it may temporarily go subsurface at the open alluvial area before rising again at the bedrock chute. If this is a problem, releases could be shifted to the lower release point. Monitoring of water temperature, flows, and dissolved oxygen will be conducted in order to adjust operations of the two release points as necessary. The releases to Hilton Creek within and among years will be adaptively managed by the SYRTAC. Management will be based on a number of factors including, but not limited to, presence of spawning adult steelhead/rainbow trout, presence of rearing juveniles, reservoir storage, Fish Reserve Account allocations, and water temperature at the intake depth in Lake Cachuma. One operational scenario that could be used for a wet year, when there is good winter runoff and migrating adults can ascend Hilton Creek to spawn, will make releases to Hilton

Creek (1 to 5 cfs) in the spring or early summer once naturalflows recede to about 3 to 5 cfs in order to maintain rearing habitat for the resulting young-of-the-year through the summer or as long as possible, given the amount of water available in the Fish Reserve Account In extremely dry years, when no adult rainbow trout/steelhead can enter Hilton Creek to spawn and when the Fish Reserve is minimal, releases may be limited to pulsed flows to refresh any existing pools or may not be made at all. A fish rescue operation will be conducted in those situations when water is not available to prevent stranding or exposure to harmful habitat conditions (as described below in Section 3.3.2). Monitoring of Hilton Creek by an experienced fishery biologist will provide the data necessary to make management decisions about flow releases.

#### 3.3.1.2 Channel Extension

Reclamation and the Member Units plan to leverage the benefits of the supplemental watering system by creating an additional stream channel that can also be watered to provide habitat. The lower reach of the Hilton Creek channel will be modified to provide additional fishery habitat within an extension approximately 1,500 feet long (Figure 3-8) (Stetson Engineers and Hanson Environmental 1997). The channel extension will be constructed on Reclamation property and will approximately parallel the Santa Ynez River before joining the river at the Long Pool. The channel extension will be designed and constructed to include a series of pools, riffles, and a sinuous thalweg. The channel itself will be built to accommodate flows of up to 15 cfs. The upstream end of the extension channel will include a flow control structure to prevent flood damage to habitat.

The SYRTAC is currently evaluating two possible alignments for the channel extension across the Santa Ynez River floodplain. One possible alignment uses a portion of a relic overflow channel with a riparian corridor of mature sycamore near the southwest Reclamation property line. This alignment has the advantage of already having a well-developed riparian canopy. The second possible alignment being studied is closer to mainstem Santa Ynez River and would be constructed across the alluvial floodplain. Site-specific information on percolation and expected groundwater conditions will be collected in summer 1999 prior to finalizing the channel alignment and design.

The selection of the alignment will depend on groundwater levels and potential seepage loss. The soil along the Hilton Creek channel extension is alluvial, and the seepage rate is expected to be high. To maintain the flow in the channel, it may be necessary to use zone B material in constructing the channel. This will be more easily accomplished along the second alignment. The channel bed would be made of a 6-inch layer of zone B material (impervious or low hydraulic conductivity material). Layers of sand, gravel, and cobble would be placed on top of the channel bed material, to a depth of about 1 foot, to prevent channel bed erosion. The extent of channel lining that may be necessary to prevent seepage and the planting design for supplemental streamside vegetation to provide shading will be planned at the same time.

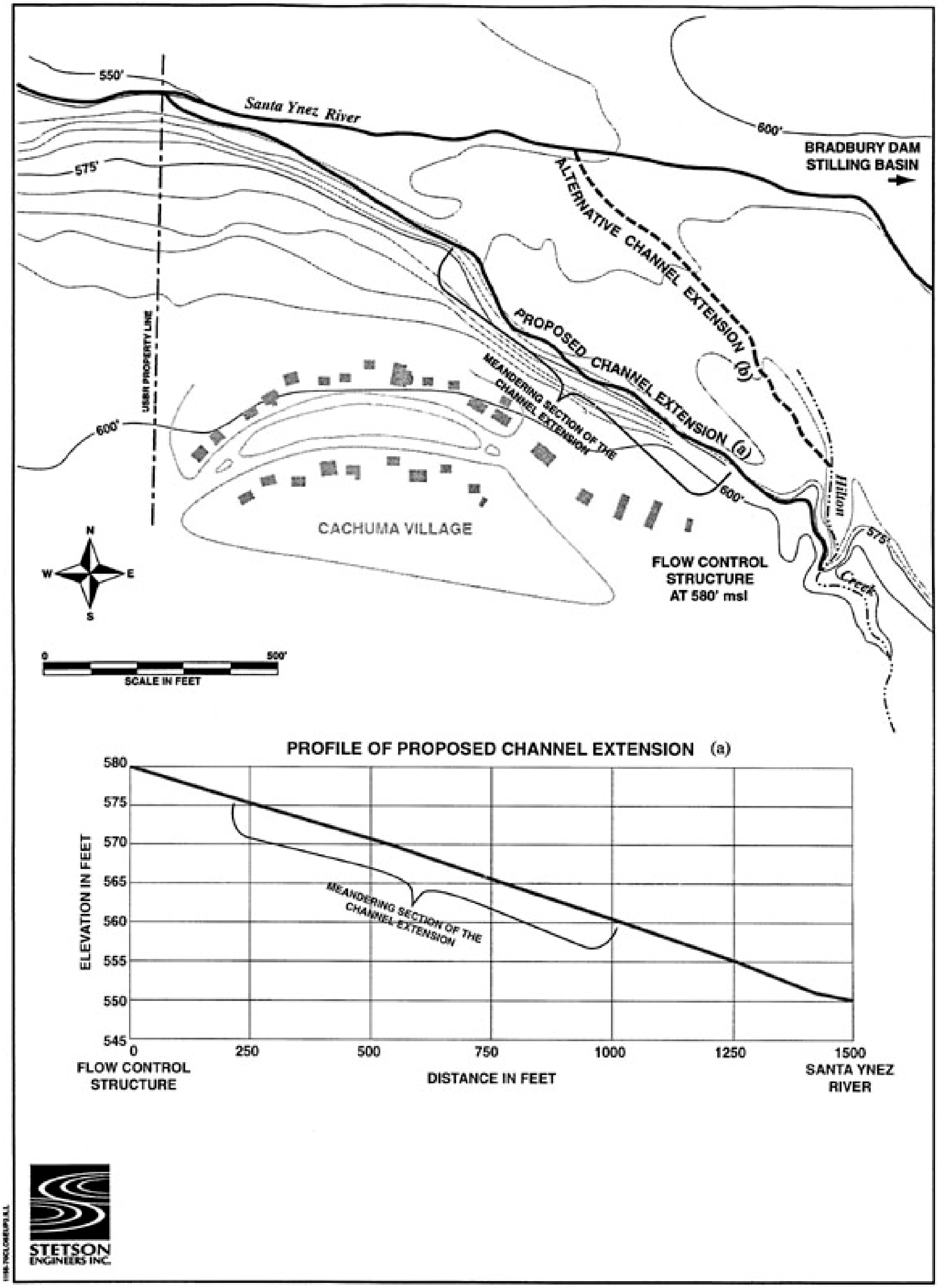



**Figure 3-8. Hilton Creek Channel Extension.**

The channel extension will serve as the low-flow channel. Flows will typically be 2.5 to 5 cfs, but the channel will be constructed to accommodate flows up to 15 cfs. The channel that was cut in Hilton Creek by the 1998 storms will continue to serve as the overflow channel to convey Hilton Creek flow into the Santa Ynez River during large rainstorms. During winter high flows, migrating adult steelhead/rainbow trout will be able to enter Hilton Creek through either this high flow channel or the channel extension.

The flow control structure will consist of two parts: (1) a submerged boulder weir to direct low summer flow and releases into the channel extension and (2) a limiter log structure to prevent high flows from entering the extension. A low boulder weir will be constructed across Hilton Creek 20 feet downstream of the head of the channel extension to create a back water. Under normal operations, this structure will direct the rearing flows in Hilton Creek to the channel extension. High storm flows will pass over the boulder weir within the natural course of the creek to accommodate the migration of steelhead/rainbow trout from the mainstem of the Santa Ynez River to Hilton Creek. Riprap or boulders will be placed to stabilize the stream bed near the mouth of the extension. High streamflow will be prevented from entering the Hilton Creek extension by use of a limiter log at its upstream entrance (Limiter log structures have been successfully used in restoration of Lee Vining Creek, Mono County; W. Trihey, pers. comm.) This type of flow control structure is constructed of natural materials (boulders and logs) but performs as a fixed plate orifice.

The stream bed and banks will be constructed of large boulders, available at the site, for a distance of two channel widths. Approximately one fourth the distance into this armored section one or more large logs will be placed across the channel, limiting the cross sectional area between the bottom of the log and the armored streambed and stream banks. The cross sectional area would be calculated to pass no more than 10 cfs beneath the limiter log without pressure flow developing. The cross section will be large enough to accommodate adult steelhead migrating upstream through the channel extension into Hilton Creek.

The Hilton Creek channel extension will be constructed using boulders, woody debris, suitable gravel and vegetation to create high value stream habitat. Boulders will be placed in the channel to increase shelter areas for steelhead and meandering of the stream flow. Riparian vegetation will be planted along the channel to provide shading and reduce increases in water temperature. Willow cuttings from nearby plants will be used, in addition to other appropriate native riparian species such as sycamore, cottonwood, and oak. A drip irrigation system will be installed to establish the plantings. Placement of boulders and planting of riparian vegetation will be consistent with the DFG's *California Stream Habitat Restoration Manual*, Section VII (Flosi et al. 1998). The final design of the channel extension will be subject to approval by DFG and NMFS.

The channel extension will be monitored to assess its performance and determine the need for any maintenance activities. Following a high flow year, it may be necessary to repair the channel where it meets the Santa Ynez. Sediment transport through the channel extension is expected to be minimal, since high flows will be directed to the current Hilton channel. Habitat monitoring will be used to determine if sediment

supplementation or removal of fine sediments may be necessary in following years. The success of riparian plantings will also be assessed and corrective measures taken.

Estimated cost for construction of the proposed Hilton Creek channel extension is about \$150,000 or approximately \$100 per linear foot. Additional costs will also be associated with preparation of environmental documentation and permitting, plans and specifications for channel construction, and the initial cost for establishing and maintaining riparian vegetation, as well as routine channel maintenance. The total cost for implementing the channel extension, not considering maintenance, is approximately \$200,000 to \$250,000.

#### 3.3.1.3 Passage Facilities

A rocky cascade and bedrock chute are potential passage impediments for migrating steelhead. The cascade is approximately 7 feet high and located just above the chute pool, about 1,380 feet upstream from the confluence with the river. The bedrock chute immediately above the cascade is about 100 feet long. Passage can be difficult at this location during large flows because of high velocity.

Providing passage around a partial barrier to steelhead migration at the chute pool will improve fish access to approximately 2,800 feet of stream channel up to the culvert at the Highway 154 crossing, which is a complete passage barrier. The habitat immediately above the chute pool consists of 400 feet of poor habitat (100 feet of bedrock chute and then about 300 feet of open channel), followed by 2,400 feet of good quality habitat up to the culvert. Discussions with George Heise (DFG) suggest that a suitable solution would consist of concrete weirs installed at the rocky cascade to create step pools, and boulder baffles installed in the bedrock chute to create low-velocity resting sites.

Passage over the cascade will be improved by installing five cast-in-place concrete weirs that will fill during high flow events and create step pools that fish can negotiate (Figure 3-9). Prior to the construction design, impacts of high flood flows and sedimentation on the proposed structures would be evaluated. The weirs will span the width of the channel and will be 8-inches thick. The top of the weir closest to the cascade will be about 1-foot above top of the cascade to drown the crest of the cascade and create a pool for fish to jump into, since the channel immediately above the cascade is a bedrock chute. Ideally, the weirs would be spaced about 20 to 30 feet apart. However, site-specific information will be collected to determine the exact location and height of each weir.

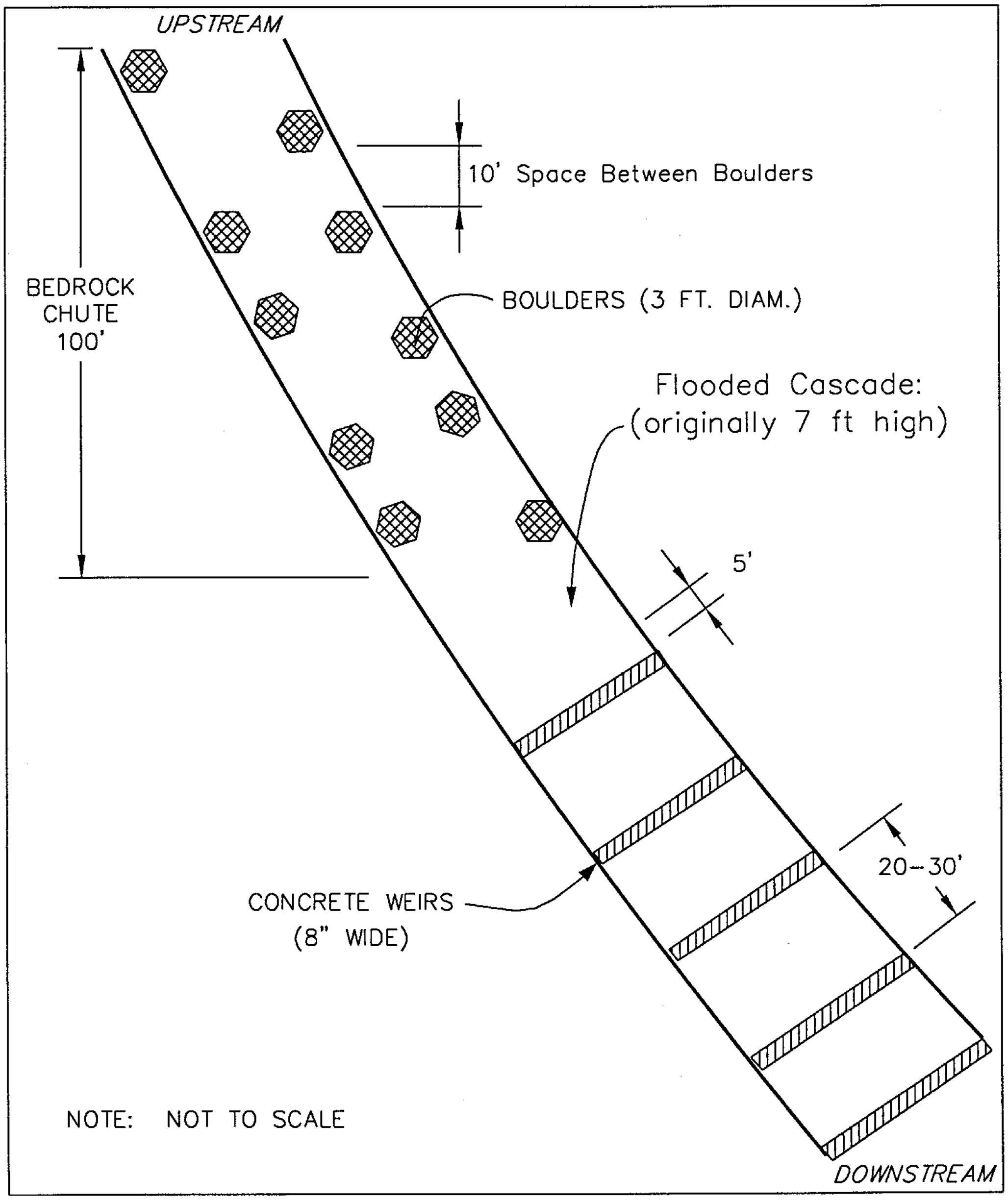



**Figure 3-9. Conceptual diagram of fish passage enhancement in Hilton Creek**

Passage in the 100-foot long bedrock chute immediately upstream from the cascade will be improved by strategic placement of large boulders aligned to create a pool chute flow pattern which would slow down and deepen average stream flow conditions in this area. Large boulders (about 30-inches in diameter) will be placed approximately 10 feet apart on average throughout the chute. The boulders would be anchored to the underlying bedrock using one or more rebar pins and expanding epoxy cement. The competence of the bedrock to hold a pin would be assessed prior to installation. Each boulder would block about 30 to 40 percent of the channel cross section. A hydraulic analysis of the channel and proper placement and anchoring of boulders would be performed as a part of developing the construction plans.

The final design will be developed in consultation with fish passage experts from CDFG and NMFS in a manner consistent with the DFG's *California Stream Habitat Restoration Manual* and the ESA.

#### 3.3.1.4 Physical Habitat Enhancement

In addition to the measures above, other habitat modifications will include, but not be limited to, improvements to riparian vegetation (this may be limited by existing soil and bedrock conditions), improvements to instream pool and riffle habitat to create additional spawning and over-summering areas, and spawning gravel augmentation.

### 3.3.2 FISH RESCUE

While the supplemental water supply system will provide flow to Hilton Creek in most years, in dry or critically dry years or in years when lake level falls to near 665 feet, it would not be feasible to provide streamflow throughout the summer and fall months. As the season progresses, flow decreases, water temperatures increase, and dissolved oxygen levels may drop to stressful or harmful levels. In the past, fish have been restricted to isolated pools as flows in Hilton Creek declined. In these pools, rainbow trout/steelhead were vulnerable to predation by both fish and birds; desiccation, and exposure to elevated water temperatures (in a number of instances exceeding acute lethal temperature thresholds for steelhead). Under these circumstances, it may become imperative to move fish residing in Hilton Creek to more suitable habitat if they are to survive. This type of operation is referred to as a fish rescue.

Hydrologic analysis indicates that a fish rescue operation will likely be necessary in approximately 2 percent of all water years. During most of these years, however, it is likely that the river mouth would not open during the winter, and thus there would be no spawning in Hilton Creek by anadromous steelhead, although resident rainbow trout may still spawn there. Additionally, juvenile steelhead from the previous year may still reside in the stream, if there has not been enough flow to cue them to emigrate. Fish rescue operations have been successfully conducted in Hilton Creek in 1995 and 1998. In June 1998, about 831 young-of-the-year rainbow trout/steelhead and 3 adults were successfully moved from Hilton Creek to the mainstem Santa Ynez River above the Long Pool (676 fish) and San Miguelito Creek (153 young-of-the-year). During 1998, specific protocols were developed for determining when fish rescue operations would be instigated. These protocols may not be appropriate for all years, but 1998 provided a template for coordination and cooperation between the SYRTAC, DFG and NMFS which will make similar efforts in the future successful.

The fish rescue plan for Hilton Creek has two parts: (1) monitoring to determine whether and when a fish rescue should be initiated; and (2) the protocols for capture and transfer of fish. Monitoring of flow levels and water temperatures within Hilton Creek will provide the primary information on when a fish rescue operation should be considered. If flow seems likely to become substantially diminished or temperature approaches stressful levels, then the project biologist will consult with the SYRTAC, DFG and NMFS to determine if a fish rescue should be implemented. Once the potential need for a fish rescue has been identified, the creek will be monitored daily for signs of additional stress.

One of the conditions necessary for a successful fish rescue operation is the availability of a suitable place to relocate the fish. If it seems likely that a fish rescue operation will be necessary, the project biologist will investigate likely relocation areas to determine if they have conditions (adequate streamflow, temperature) which are favorable to steelhead. If a suitable relocation area is available, a survey of fry/juvenile density will be performed, to determine if there is any available space for more fish. Potential relocation sites include the Long Pool and mainstem just below Bradbury Dam, and certain tributary reaches.

To minimize predation losses of relocated young-of-the-year rainbow trout/steelhead, warmwater fish (largemouth, bass, smallmouth bass, and bullheads) may be removed from the receiving site if they are abundant. These fish can increase the mortality rates of young rainbow trout/steelhead both directly through predation, and indirectly by forcing young fish to occupy less suitable areas where they may have slower growth rates, lower fitness, or be exposed to other predators. Predator removal could provide localized benefits to native fish in the mainstem pools although these benefits will be temporary because of recolonization from other areas (other stream reaches and/or Lake Cachuma). Predator removal will be most valuable as refuge pools become isolated during the summer.

Predators will be selectively removed from key pools using physical capture methods. The primary methods would be fyke nets (also called box traps) in larger pools and runs, and seines in smaller pools. Captured native fishes will be returned to the stream. The operations will be conducted by fishery biologists or volunteers directly supervised by a fishery biologist.

Once a suitable location is found, the fish rescue could proceed using protocols similar to those used in 1998, although specific details will need to be decided on a case by case basis, as conditions may change. Operations will occur in the morning when the stream is coolest and will cease when water temperatures exceeds 18°C. Fish will be captured using seines and nets as much as possible, and held and transported in chilled aerated water. The temperature of transport and release water will be equalized prior to release.

Fish rescue and predator control operation will be undertaken on a case-by-case basis in consultation with NMFS and DFG. Fish rescue operations could also be conducted in other stream reaches that are drying and/or have stressful temperatures that are not on Reclamation property. The decision to conduct fish rescues in these areas will be made on a case-by-case basis based on the landowner's permission and in consultation with the resource agencies.

### 3.3.3 CONSERVATION EASEMENTS: HABITAT PROTECTION AND ENHANCEMENT

The tributaries on the south side of the watershed have good potential as fish habitat because these streams generally have perennial flow through the summer, at least in their upper reaches. Habitat quality can range from good quality in upper reaches (i.e. perennial flow, good canopy cover, suitable water quality) to poor just above the confluence with the mainstem Santa Ynez River (i.e., intermittent or no flow in summer, little canopy cover). Conservation measures directed at tributary habitat will focus on protecting habitat that is already in good condition and enhancing habitat that is in fair condition. Efforts will not be expended on poor quality habitat where conditions cannot be feasibly improved.

All tributaries in the lower basin, except lower Hilton Creek, are on private property. Therefore, voluntary participation by the landowner will be necessary for implementation of protective and enhancement measures along these streams. The Member Units will obtain conservation easements from landowners to protect property and to implement and monitor appropriate enhancement actions. Priority areas for seeking conservation easements will be identified according to the persistence of flows, suitability of habitat (or potential for enhancement), and absence of downstream passage barriers.

Several landowners have approached the Member Units about establishing conservation easements. The Public Education and Outreach Program (Section 3.3.6) will complement this action by educating landowners about "fish friendly" land management practices and encouraging others to participate in conservation easements.

#### 3.3.3.1 Habitat Protection

Habitat protection will focus on obtaining conservation easements from private landowners along stream corridors. A conservation easement is a legal agreement between a landowner and a non-profit group or government agency, such as Reclamation and the COMB. Conservation easements will entail purchasing the rights to manage a strip of property along streams from the property owner. The owner retains ownership of the property, but is paid for loss of use. In exchange, Reclamation and the Member Units would be able to implement fish conservation measures within the easement, as described in the following section.

In most agreements, landowners allow certain activities to be performed on their property in exchange for monetary or other benefits. Conservation easements can be effective at fostering habitat improvement, both where land use is negatively affecting riparian and aquatic habitat or where frequent access to the stream is required for the maintenance of projects. Conservation easements can foster natural recovery of habitat over time, as well as enhance the success of active intervention through other actions, such as planting riparian vegetation.

Reclamation and the Member Units will also work with landowners to develop land use practices that protect steelhead and their habitat without adversely affecting the operation of the landowners' property. Such practices may include exclusionary fencing to keep cattle from the stream or out of riparian vegetation, creation of catchment ponds to settle fine sediments and other materials from runoff waters before they enter the stream, streambank protection, and vegetative buffer strips.

Reclamation and the Member Units expect to obtain conservation easements on several properties in the El Jaro Creek drainage, which will protect about 6 to 8 miles of upper El Jaro Creek and about 1 mile of Ytias Creek, a tributary of El Jaro Creek. The landowners and the COMB are entering into contracts to pursue investigations and negotiations for conservation easements. The estimated cost of obtaining easements for 100-foot wide corridors around these reaches may range from $400,000 to $800,000.

The general process for establishing conservation easements starts with discussions between the landowner and Reclamation/COMB. Field surveys will be conducted to evaluate the potential of the stream as steelhead habitat and to assess land use practices that may affect the stream. An action plan will be developed from this information, which will outline site-specific habitat enhancement measures and land use practices. An appraisal will be done by an independent appraiser familiar with assessing property values for conservation easements. The landowner and Reclamation/COMB will determine the terms and conditions for sale or lease of the conservation easement, which will be funded by Reclamation/COMB and transferred to an approved land trust organization, such as the Santa Barbara County Land Trust. The Member Units will then implement the habitat enhancement actions outlined in the action plan and conduct monitoring to adaptively manage the conservation easement.

#### 3.3.3.2 Habitat Enhancement

Habitat improvements might include structural modifications to instream habitat such as the creation of additional pool and riffle areas and augmentation of spawning gravel. Boulders and large woody debris could be used to create additional habitat features within selected reaches of the mainstem and the tributaries. Access to private lands and the results of field fisheries surveys and habitat typing, in combination with results of water temperature monitoring, will be used as a basis for identifying specific locations for habitat protection and improvement.

<u>Addition of Instream Structures</u>

Physical modifications of the channel through addition of instream structures would be used to create more oversummering pool habitat. Habitat complexity has been positively correlated with fish density. Methods for physical enhancement include: (1) improving the quality of pools by increasing cover and complexity, and (2) increasing the amount of pool habitat by increasing depths in existing pools or scouring new pools.

The first step of a pool enhancement program will be to identify areas where opportunities exist for enhancement measures to be successfully implemented. Surveys will be conducted of existing permanent pools to determine their habitat characteristics, as well as to identify additional areas where pools could be created that would likely persist. Site selection would take into account accessibility, channel hydraulics, geomorphology (e.g. bankful width, depth, gradient, sinuosity, sediment load, and substrate size), streamflow regime, and availability of structural materials. Sites with relatively stable stream bed, stable banks, and woody riparian vegetation will afford the greatest opportunities, while sites with steep streambanks, non-cohesive sandy soils, little riparian vegetation, and high stream gradients present greater challenges to the successful use of instream structures.

Once suitable sites have been identified, a conceptual enhancement plan can be developed. A feasibility analysis will be performed to evaluate factors such as continued site accessibility, structural stability, cost, and longevity prior to developing final engineering plans for the proposed enhancements. Although the instream habitat improvements will be designed to withstand damage due to flood flows to the maximum extent practicable, periodic maintenance will be required to correct problems such as unsuitable scouring of cover structures or infilling of pools with excess sediment.

Cover elements in pools may be naturally formed by overhanging riparian vegetation, undercut banks, exposed root wads or logs. Structures typically added to pools to enhance cover include logs, root wads, boulders and cobbles. These structures will need to be secured to stable locations to prevent wash-out. Boulders and cobbles can be placed into pools to create interstitial spaces that provide cover. Consideration should be given to using boulders and cobbles that are large enough to minimize entrainment and transport during high flows. This may require somewhat larger bed materials than those which are currently found in the river.

Pool depth can also be increased by installing instream structures to increase scour, by direct excavation, and/or by manipulating channel geomorphology. Instream structures such as log and boulder weirs, deflectors, and/or digger logs could be used to constrict the channel, increase flow velocities, and thereby scour pools. The objective being to promote self-maintaining pools and to create back-water conditions during periods of low-flow.

<u>Riparian Enhancement</u>

Riparian zones perform a number of vital functions that affect the quality of aquatic habitats, as well as provide habitat for terrestrial plants and animals (Spence et al. 1996). Fallen leaves and branches are an important source of food for aquatic macroinvertebrates and nutrients for aquatic vegetation, while fallen terrestrial insects are valuable prey for fish. The roots of riparian vegetation maintain bank structure and provide cover via undercut banks. Overhanging branches also provide cover. The riparian canopy can reduce water temperatures by shading the stream. Large woody debris that falls into the stream further increases cover and creates areas of scour which increase water depth. Riparian vegetation can also reduce water velocities and create refuge areas of relatively low velocity during storm flows.

Propagation of native riparian vegetation can improve stream habitat through the mechanisms described. The Plan will enhance and restore riparian vegetation at specific pools along the Santa Ynez River. This type of restoration effort is relatively inexpensive and easy to perform, as long as permission can be obtained from landowners to access these areas to plant vegetation or conduct other enhancement activities and to protect new plants. Planting or enhancement of riparian vegetation may be useful at sites where the canopy cover is low and the stream channel is not too wide. Where possible, deep-rooted vegetation such as sycamore or cottonwood would be preferable to shallow-rooted vegetation such as willow. The species of vegetation selected for propagation can have a measurable effect on streamflow. The enhancement or expansion of streamside vegetation will likely increase water loss due to transpiration within the stream corridor, although this would be balanced by decreases in evaporation due to improved shading.

### 3.3.4 TRIBUTARY PASSAGE BARRIER MODIFICATION

Under current conditions, manmade and natural structures may impede steelhead movements in the tributaries of the lower Santa Ynez River, especially under low and moderate streamflows. Since habitat availability may be a primary factor limiting the steelhead populations in the watershed, it is imperative to improve accessibility to existing aquatic habitat by modifying or removing impassable barriers. These efforts will serve to expand the available habitat for spawning and rearing steelhead; thereby expanding the carrying capacity of the lower river.

The tributaries of primary interest are Salsipuedes-El Jaro, Hilton, and Quiota Creeks, since they have perennial flow, at least in their upper reaches, and can support spawning and rearing. Passage enhancement measures for the cascade and bedrock chute in Hilton Creek are described above in Section 3.3.1.3. Impediments on the other tributaries are manmade barriers such road crossings, bridges, and culverts (Table 3-4).

Access to habitat within Salsipuedes and El Jaro Creeks by anadromous steelhead is limited by two low flow passage barriers, associated with bridges or road crossings (SYRTAC data). These barriers were thought to impede the passage of both adult and juvenile fish primarily during periods of low flow. The Highway 1 Bridge #51-95 on lower Salsipuedes Creek is located about 3.6 miles upstream from the Santa Ynez River. This bridge has a 3 to 4 foot drop from the concrete apron into a pool downstream of the bridge. Pool depth may not be sufficient to allow fish to negotiate the apron. CalTrans is nearing completion on the Highway 1 modernization project. Reclamation and the Member Units will review the stream crossing recommendations to determine their compatibility with rainbow trout/steelhead and will make recommendations, as appropriate, to CalTrans.

Road crossings, such as those in Quiota and El Jaro Creeks, can also be an impediment to fish movement. El Jaro Creek has a road crossing and concrete apron about 1/3-mile upstream of the confluence. It is an old ford on a private, unused road, with a 3-foot drop below. Refugio Road crosses Quiota Creek many times beginning about 1.3 miles upstream from the mainstem Santa Ynez River. All nine crossings are shallow-water Arizona crossings, with concrete beds and, at several sites, a 2 to 3-foot drop downstream of the concrete apron. Refugio Road is maintained by the County of Santa Barbara.

**Table 3-4. Passage Impediments on Tributaries**

| Creek | Location of Impediment | Structure | Type of Impediment | Jurisdiction |
|---|---|---|---|---|
| Salsipuedes | 3.6 miles above Santa Ynez River | Bridge crossing on Highway 1 | Low-flow passage barrier | State road |
| El Jaro | 1/3 mile above Salsipuedes confluence | Road crossing | Low-flow passage barrier | Abandoned private road |
| Quiota | 1.3 to 1.6 miles above Santa Ynez River and beyond | 9 Road crossings | Low-flow and high-flow passage barriers | County road |
| Hilton | 1,300 feet above Santa Ynez River | Rocky cascade & bedrock chute | High-flow passage barrier | Reclamation |
| | Below Highway 154 | Concrete culvert | Velocity barrier | State road |

Arizona 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. Modifying the depth of flow across these crossings would reduce their utility at some flow levels making travel inconvenient.

The County of Santa Barbara and Member Units will team together to develop more fish-friendly crossings, as the County makes plans to repair several of these crossings.

Surveys of other potential passage impediments and barriers will be conducted to determine the benefits and feasibility of modifying them to enhance fish passage. For example, there is a culvert on Nojoqui Creek that may be an impediment about 3.5 miles upstream of the Santa Ynez River, but further assessment is required (SYRTAC data). Box culverts under state and county roads can impede migration. 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 boulder 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 the culvert could be replaced with a bridge or arch culvert.

Preliminary engineering designs will be developed for low to moderate flow fish passage facilities in consultation with the bioengineering staffs of the NMFS and DFG. The preliminary engineering designs for fish passage facilities will be used as a basis for estimating costs for final design and construction, the range of flow conditions for which the passage facilities would provide benefit, identification of permitting requirements and preparation of environmental documentation, and requirements for access to private lands for the construction of fish passage facilities.

### 3.3.5 Pool Habitat Management

Results of the 1993-1998 fisheries investigations have demonstrated the importance of existing deeper water pool habitats within the mainstem as refugia for rainbow trout/ steelhead during low flow summer conditions. Pools are known to support rainbow trout/ steelhead throughout the management reach. These pools are particularly important for larger fish (>6 inches), but less so for small fish since smaller fish are easily preyed upon by introduced predatory fish species. Factors which may impair production in these pools include high temperatures, low dissolved oxygen content, lack of structure, and presence of predators.

Water quality in these pools will be maintained via conjunctive operation of water releases, as discussed above in Section 3.2. In addition to water releases, non-flow related measures may be taken to improve the quality of pool habitat on Reclamation property. Habitat improvements could include structural modifications to instream habitat such as augmentation of spawning gravel or installation of boulders and large woody debris to provide cover. To the extent that willing private landowners can be located, these improvements may be made elsewhere as well.

### 3.3.6 Public Education and Outreach Program

Reclamation and the participating agencies will develop a Public Education and Outreach Program to explain the activities related to the protection and enhancement of steelhead populations and their habitat, as well as other sensitive resources in the lower Santa Ynez

River system. It will describe the programs designed to maintain or restore steelhead, and solicit volunteer actions from private property owners to improve steelhead habitat in the mainstem of the river and its tributaries downstream of Bradbury Dam. The Member Units will finance the program activities, and coordinate comments and suggestions received from the public.

Because the majority of land in and along the lower Santa Ynez River is privately owned, the Public Education and Outreach Program will stress the voluntary part of the Plan. It will be broad-based but will particularly target riparian landowners, keeping them informed of river-related activities designed to help maintain and restore steelhead, and soliciting their voluntary participation in habitat improvement programs. These programs may include riparian planting, spawning gravel augmentation, passage barrier removal, creation of additional habitat features, "fish friendly" land management practices, and other measures to benefit steelhead and other aquatic resources. This information program will emphasize sections of the river and tributaries under the control or management of the landowners, but will also draw upon the successes from Reclamation property and from other watersheds, as well. The Public Education and Outreach Program will provide technical assistance for implementing these measures and will fund or co-fund these type of enhancements.

Public involvement activities will be initiated in order to keep the public informed of the progress of the conservation measures undertaken to protect and restore steelhead and its habitat. These activities will include the following outreach activities:

- Annual public workshops to invite suggestions from the public on reasonable conservation measures for steelhead, and to keep them informed of the progress of the restoration effort. The first of these meetings was held in June, 1998, to solicit input on management alternatives being considered for an overall fish management plan.

- Issuance of periodic news releases to the *Santa Barbara News Press*, the *Lompoc Record*, and the *Santa Ynez Valley News* to ensure that program successes are relayed to the news media.

- Establishment of a free "800" phone message line with regular updated messages concerning the progress of instream habitat improvements and the effect of those improvements on the various life stages of the steelhead. The public will also have the opportunity to leave messages.

- Issuance of annual newsletters summarizing the previous year's enhancement activities on the Santa Ynez River and its tributaries, habitat conditions, fish populations, successes, failures, future milestones, and schedule of upcoming events. They might also include a "highlight" piece on related topics, such as: voluntary measures undertaken by landowners that have aided in creating additional habitat or improving existing habitat; successful, cooperative fish programs between landowners and public agencies; ability of cattle and fish to successfully coexist along the river; the cost of the steelhead restoration measures; sources of funding and technical assistance available to landowners to implement habitat improvement measures.

- Establishment of a web page with updated messages and photographs, along with information who to contact with comments, questions, or suggestions.

- Seasonal field trips led by project biologists to give interested landowners a real-life perspective on the enhancements that are being made in the river and the benefits they provide to the steelhead.

- Establishment of an expert speaker's group to provide informed speakers to local organizations. This group might also include local landowners who have initiated innovative measures to help restore steelhead habitat.

- Annual "Steelhead Restoration" slide shows at local bookstores advertised through fliers posted in local shops and restaurants.

The Public Education and Outreach Program will be developed on an adaptive management basis; activities that are successful will be continued, and improvements to the Program will be continually sought.

This section summarizes potential effects (adverse and beneficial) on protected species of ongoing operations, proposed modifications and conservation measures as described in Section 3.0. Section 4.1 reviews the effects of conjunctive use operations on steelhead downstream of Bradbury Dam and then looks at the environmental effects of the proposed operations upstream of the dam in Lake Cachuma. Section 4.2 evaluates the effects of other conservation measures, including the improvements to Hilton Creek, conservation easements and the other measures described in Section 3.0. Section 4.3 describes the effects of the proposed operations on the Member Units and downstream water rights. The cumulative effects of the proposed operations and conservation measures with foreseeable future developments in the Santa Ynez River basin are described in Section 4.4.

The Biological Assessment includes consideration of protected species inhabiting the watershed downstream of Bradbury Dam, with particular emphasis on steelhead, as well as those inhabiting the Santa Ynez River watershed upstream of Bradbury Dam. The effects of various elements of the proposed plan on species other than steelhead were addressed in the Biological Assessment prepared by Reclamation along with the Contract Renewal EIS/EIR (Woodward-Clyde *et al.* 1995).

## 4.1 CONJUNCTIVE OPERATION OF WATER RIGHTS RELEASES WITH FISH RESERVE ACCOUNT RELEASES

### 4.1.1 STEELHEAD

#### 4.1.1.1 Conjunctive Use

This section evaluates the effects of the releases to be made under the proposed project operations relative to the existing operations on the number of passage opportunities and the availability of mainstem steelhead spawning and rearing habitat. This evaluation includes the reaches of the Santa Ynez River downstream of Bradbury Dam (the upstream limit of steelhead) that may support steelhead. This analysis also looks at the streamflow conditions that would have been present at these locations if Bradbury Dam did not store water, and all inflow was passed through the reservoir. The analysis is based on the flows that would be present at specified locations along the river during wet, normal, and dry water year types. The three water year types are represented by the 20, 50 and 80 percent exceedance flows under the three operating conditions: Historic, Baseline, and Proposed.

- The “Historic” condition represents the habitat conditions prior to the construction of Bradbury Dam.

- The “Baseline” operations represent the operation of the project inclusive of State Board Decision WR 89-18. There is no Fish Reserve Account. The project stores water and makes deliveries to the Member Units and releases to satisfy the requirements of downstream users.

- The “Proposed” operations include modification to the project to include the Fish Reserve Account for the maintenance and enhancement of aquatic habitats and species downstream of the reservoir and conjunctive use of downstream releases to supplement the Fish Reserve Account.

The conjunctive use of Downstream Water Rights Releases and the Fish Reserve Account is described in Section 3.2.2. These analyses do not include the effects of other proposed conservation measures, such as the improvements to Hilton Creek. The proposed conservation measures provide additional benefits beyond those described in this section, and are described in Section 4.2.

Summary of Effects of Conjunctive Use

The effects of the Proposed Operations on steelhead were evaluated with respect to the potential effects on three lifestages: passage, mainstem spawning and mainstem rearing.

- **Passage** - The Proposed Operations have very little effect on passage opportunities relative to the Baseline operations (Section 4.1.1.2). The Proposed Operations may provide a very small benefit in that there is a slight decrease in the percentage of years in which passage is impaired, but this decrease is so slight, it is likely negligible. The Historic condition provides more passage opportunities than either the Proposed or Baseline operations because water is not stored behind Bradbury Dam, but flows directly to the sea. The benefit of this additional passage is likely lost during late summer rearing, however.

- **Spawning Habitat -** The Proposed operations provide substantially more mainstem spawning habitat in all three reaches between Bradbury Dam and Alisal Road in most water year types than the Baseline operations (Section 4.1.1.3). The Baseline operations provide slightly more spawning habitat in wet years, but this is offset by the substantially lower amount of habitat it provides in normal and dry years, particularly in the Refugio and Alisal reaches. The Historic condition provides more spawning habitat in wet and normal years than the Proposed operations, but less habitat in dry years, especially in the Refugio and Alisal reaches.

- **Rearing Habitat -** The Proposed operations result in a substantial amount of additional rearing habitat (Section 4.1.1.4) being available relative to the Baseline operation during all seasons in dry and normal years, and in July through December in wet years. In the first half of a wet year, the Proposed operation provides a similar amount of rearing habitat to the Baseline operation. These results were common to all three reaches. The Historic condition provids more rearing habitat than the Proposed Operations from January through June in normal and wet years, but provides substantially less rearing habitat in the latter half of these years. This was particularly true of the Alisal reach, where the proportion of pool habitat was lower than in the more upstream reaches.

The additional rearing habitat provided by the Proposed Operations relative to the Baseline operations, in combination with the persistence of this habitat throughout the year, even under dry conditions, provides a substantial benefit to steelhead over both Baseline Operations and Historic Conditions. Young-of-year rearing habitat was identified as a major limiting factor in the Contract Renewal EIS/EIR (Woodward-Clyde Consultants, et al. 1995). Proposed operations provide many times the amount of rearing habitat than either of the other two conditions and provide a similar number of passage opportunities and more spawning habitat than the Baseline Operations. Because of this, the Proposed Operations are judged to provide a net benefit to steelhead over the Baseline Operations.

Taken from the view of the entire steelhead life cycle, the proposed operations provide substantial benefit to steelhead versus the baseline and the Historic Condition. Although the Historic Condition provides more passage opportunities, greater spawning habitat, (except in dry years), and more rearing habitat in the early part of the year, these benefits are likely lost in the latter portion of the year, when rearing habitat is reduced below the level provided under the Proposed Operations. During the first part of the year, temperatures are relatively cool and, therefore, the metabolism of rainbow trout/steelhead would be slower. These fish tend to reside in pools during the winter months and feeding is reduced, therefore habitat needs are less. In the April through June period, juvenile fish may be smolting and moving downstream to the ocean when flows permit. Young-of-year fish, where present (they are emerging from the gravels during this time) are small and require less space. As the fish grow, they require more space and this may lead to a habitat bottleneck in the late summer or early fall as the amount of space required by each fish increases, while the amount of space available decreases. The greater availability of rearing habitat in the late summer and early fall under the proposed operations likely provides a substantial benefit to the steelhead population relative to the Historic Condition in this portion of the river.

The perennial flows in the river under the Proposed Operations would likely result in the increased growth of willows and other riparian plant species. The increased growth of riparian plants would likely provide additional cover for steelhead and thus increase the carrying capacity of the river. The increased riparian growth may also shade the stream and help promote cooler water temperatures and reduce evaporation. Increased riparian growth may remove water from the stream through increased rates of evapo-transpiration, but this is not likely to be of a magnitude that would adversely affect the steelhead population. It also may require periodic maintenance for flood control purposes which would result in some disturbance to the rearing habitat and additional cost to the flood control district. Best management practices fore vegetation removal would be followed to avoid adverse effects to steelhead.

Passage

The passage evaluation is based on the results of the passage study performed by the SYRTAC (1999b) as described in Section 2.4.1.2. This analysis uses a minimum passage criterion of 8 feet of contiguous channel width with a depth of 0.6 feet. This criterion was selected based on the passage analysis performed by the SYRTAC (1999b) and observation of flows at which adult steelhead/rainbow trout were observed in Salsipuedes Creek during the 1999 migration season (SYRTAC data). An evaluation was performed of the frequency with which the minimum flows identified would be available, for periods of 1, 3, 5, and 10 consecutive days between January 1 and April 30. These periods are intended to represent the amount of time it might take an adult steelhead to migrate upstream to spawning areas. Of course a steelhead may hold over somewhere along the river if it does not reach a suitable spawning area within this time, but assuming that migration takes place during a single event, it provides a conservative estimate of the passage opportunity. A second analysis examined what percentage of years would provide a given number of passage opportunities based on daily flows. Passage opportunities were analyzed at four locations along the river, represented by passage transects identified by DFG during the SYTAC studies: Lompoc Narrows, Cargasachi, Alisal, and Refugio. Sequential passage past these areas are presumed to provide steelhead access to suitable spawning habitat in Salsipuedes/El Jaro, Alisal, Quiota, and the mainstem below the dam and Hilton Creek, respectively.

Prior to a steelhead migrating upstream in the river itself, it must first be able to enter the river from the ocean. As discussed previously, the mouth of the Santa Ynez River is frequently closed by the presence of a sandbar. This bar forms during the summer when flows are low and wave energy is also low. It is breached in the winter by a combination of higher river flows and greater wave energy (although either of these elements may be able to breach the bar by themselves). No information is available regarding the frequency with which the bar is broken or what flows might be required to accomplish this. Flow from Salsipuedes Creek appears to be sufficient to breach the bar before flows come up in the mainstream. The bar has occasionally been opened manually, but this is not a regular practice. The passage analysis that follows presumes that steelhead have already gained access to the river.

The SYRTAC passage analysis (1999b) indicates that passage past the Lompoc Narrows requires the most flow, while passage past Refugio requires the least amount of flow.

Figures 4-1 and 4-2, respectively, show the percentage of years when a given number of three day and one day passage opportunities are available. From these plots, it is apparent that the Proposed and Baseline operations provide a similar number of passage opportunities. For both the 3 day and 1 day opportunities, the Proposed Operations provide slightly more passage opportunities than Baseline Operations, but this difference is only a few percent.

The Historic Condition results in better passage conditions than under either operations. It has the lowest percentage of years with no passage opportunities under all conditions at all locations. It also has the highest percentage of years with more than 7 passage opportunities at all locations.

As discussed in the summary, the decreased number of passage opportunities under the proposed condition when compared to the Historic Condition are likely offset by increased rearing habitat in the summer and fall. Additionally, attempting to make flow releases to provide additional passage opportunities during dry years (when they are most limited) would substantially decrease the amount of water available for other uses, including maintenance of rearing habitat. Much of the water released from the dam, would likely percolate into the groundwater and there is no assurance that additional passage opportunities would be provided.

<u>Spawning Habitat</u>

The spawning habitat analysis (in this section) and rearing habitat analysis (in the next section) are both based on the habitat studies performed by the SYRTAC (1999a), as described in Section 2.4.1.2. This analysis focuses on the upper part of the mainstem from Alisal Bridge to Bradbury Dam because the river below the Alisal reach does not appear to support rainbow trout/steelhead. The average top width versus flow relationship was generated by weighting the top width of each habitat type by its relative proportion in each reach. The average top width was converted to acres of habitat by multiplying the average top width by the length of habitat in each reach. For the spawning analysis, usable habitat was limited to riffles and runs. Flow exceedance curves were developed from the daily flows generated from the Santa Ynez River model for three locations: (1) below the confluence of Hilton Creek, (2) at Highway 154, and (3) at Alisal Bridge based on model simulations including a 52-year period of record (1941-1993). The spawning analysis examined the January 1 through March 31 period.

The Proposed Operations will provide markedly more spawning habitat than would be available under Baseline Operations (Table 4-1). They also provide more spawning habitat than Historic Conditions in dry years and similar amounts in normal and wet years. Under the Proposed Operations, for all three reaches, a similar amount of spawning habitat is available regardless of the year type.

In the reach from Bradbury Dam to 154, the Proposed Operations markedly increase the amount of spawning habitat available in dry and normal years under Baseline Operations (1465 and 142 percent increases respectively) and provides similar habitat values in wet years. When compared to the Historic Conditions, the Proposed Operations improve conditions for spawning in dry years (42 percent increase) and provides 10 percent less habitat in normal years and 20 percent less in wet years.

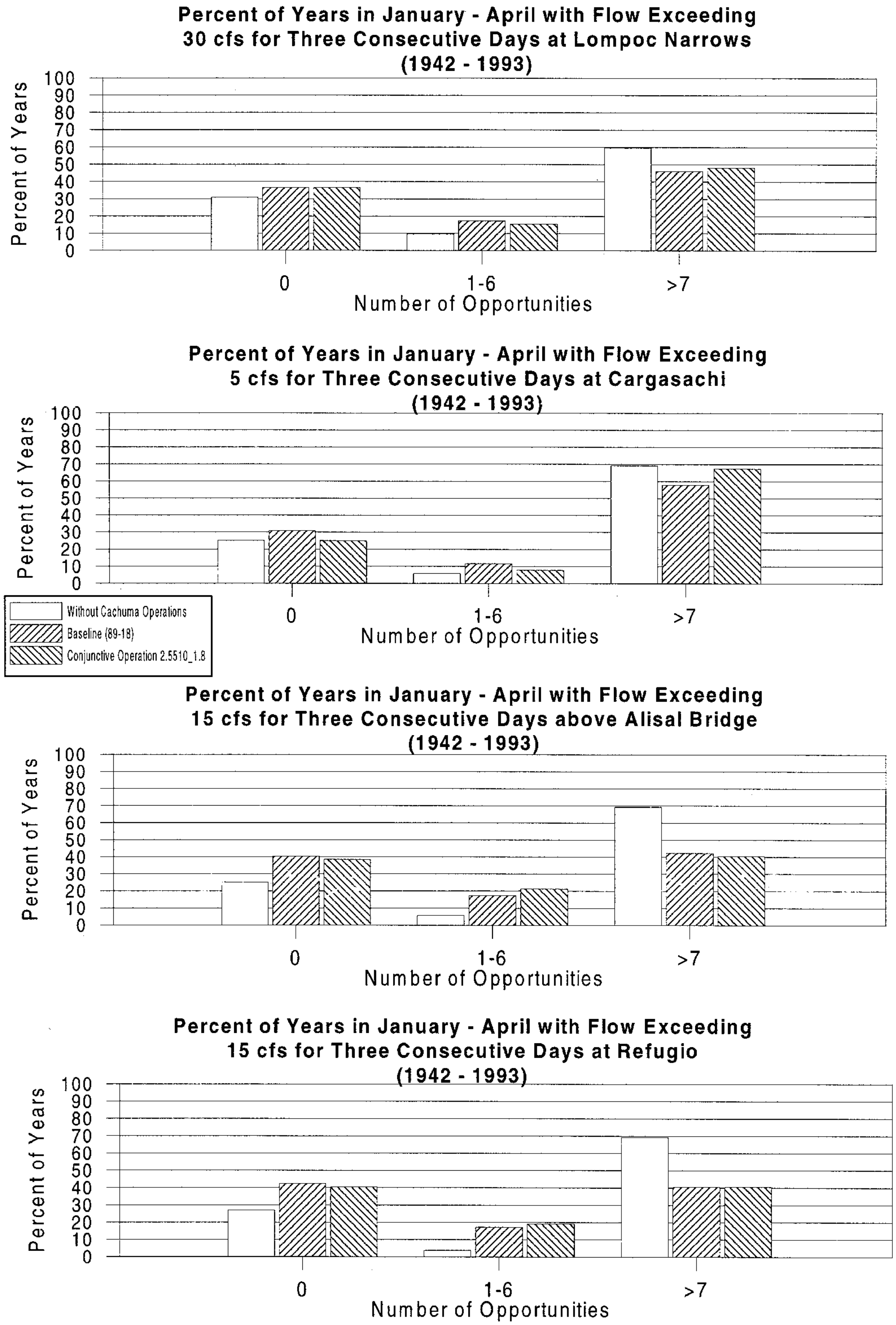



**Figure 4-1. Number of 3-Day Passage Opportunities in the Santa Ynez River.**

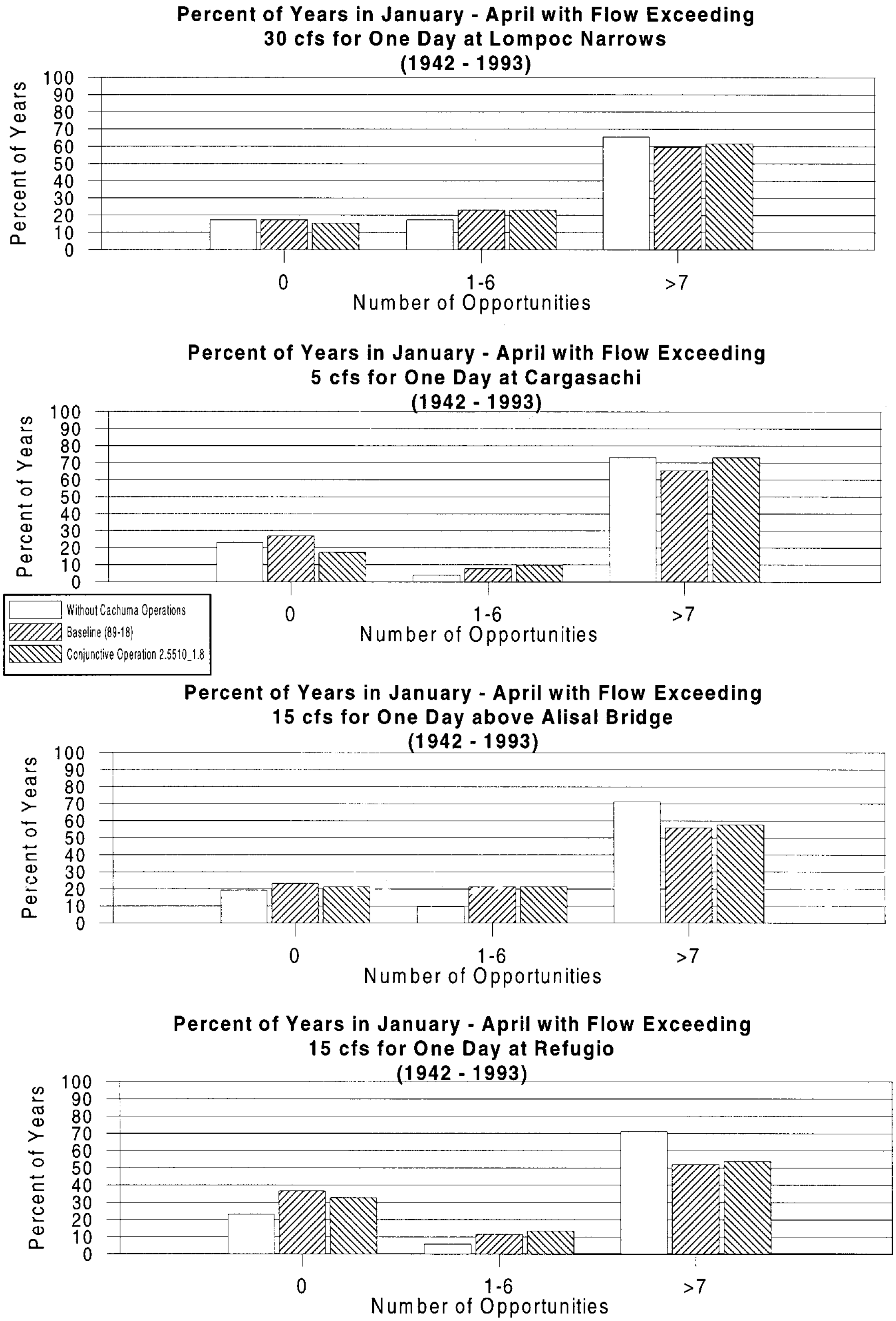



**Figure 4-2. Number of 1-Day Passage Opportunities in the Santa Ynez River.**

**Table 4-1. Flow and Available Spawning Habitat Under Different Operation Scenarios.**

| Condition | Dry Years 80% exceedance | | | Normal Years 50% exceedance | | | Wet Years 20 % exceedance | | |
|---|---|---|---|---|---|---|---|---|---|
| | Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) | Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) | Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) |
| **Bradbury Dam to Highway 154** | | | | | | | | | |
| Historic | 1.2 | 3.2 | 42 | 18.1 | 6.2 | -10 | 157.7 | 7.7[3] | -21 |
| Baseline | 0.2 | 0.3 | 1465 | 0.9 | 2.3 | 141 | 21.3 | 6.2 | -3 |
| Proposed | 2.5 | 4.5 | - | 5.0 | 5.6 | - | 14.7 | 6.1 | - |
| **Highway 154 to Refugio Road** | | | | | | | | | |
| Historic | 0.3 | 0.4 | 640 | 17.4 | 4.0 | -14 | 157.1 | 5.1[3] | -19 |
| Baseline | 0.0 | 0.0 | +++[2] | 0.8 | 1.5 | 125 | 28.6 | 4.3 | -3 |
| Proposed | 2.6 | 3.2 | - | 5.0 | 3.4 | - | 22.9 | 4.1 | - |
| **Refugio Road to Alisal Bridge** | | | | | | | | | |
| Historic | 0.0 | 0.0 | +++[2] | 14.0 | 8.4 | -16 | 161.6 | 11.4[3] | -15 |
| Baseline | 0.0 | 0.0 | +++[2] | 1.1 | 4.4 | 59 | 38.7 | 9.7 | 0 |
| Proposed | 1.3 | 5.3 | - | 3.9 | 7.0 | - | 39.4 | 9.7 | - |

[1] Based on change in habitat area
[2] Percentage increase could not be calculated because there was no available spawning habitat under the reference condition
[3] estimated habitat, flows exceed predictive reliability of habitat-flow relationship.

In the reach from Hwy 154 to Refugio Road, Proposed Operations also show substantial increases in habitat over either the Baseline Operations or Historic Conditions; from 0 or 0.4 acres to 3.2 acres. In wet years, the Proposed Operations provide a two-fold increase over Baseline Conditions and 14 percent less habitat than under Historic Conditions. In wet years, the Proposed Operations provide less spawning habitat than Historic Conditions (19 percent less) but nearly the same as Baseline Operations.

For the reach from Refugio Road to Alisal Road, a comparison of spawning habitat under Proposed Operations to that available under Baseline Operations and Historic Conditions shows the same results as those discussed for the Refugio Reach.

Proposed Operations improve spawning habitat availability over Baseline Operations in most years. Compared to historical conditions, the Proposed Operations will provide more habitat in dry years. However, during these years passage may be poor and adults may not be able to reach the spawning areas near Bradbury Dam. The SYRTAC has reported adults oversummering in the long pool and the stilling basin ( S. Engblom, Pers. Comm.). Adults already in the system would benefit from increased spawning habitat. Proposed Operations provide from 10 - 14 percent less habitat in normal years and 20 percent less habitat in wet years than Historic Conditions. Substantial production of steelhead/rainbow trout has been observed in the Santa Ynez River in wet years like 1995 and 1998 (see Table 2-18). In these wet years there appears to be sufficient spawning success to fully utilize the available rearing habitat. Conditions such as those experienced in 1995 and 1998 will continue to occur under Proposed Operations. Thus, it appears that reductions in spawning habitat in the mainstem caused by storing water in Lake Cachuma are not likely to cause jeopardy to Southern California steelhead.

These decreases in spawning habitat would not be expected to substantially reduce populations in the Santa Ynez River as rearing habitat is the primary limiting factor for rainbow trout/steelhead in the Santa Ynez River. Improvements to rearing habitat under Proposed Operations are expected to result in an overall increase in production.

Rearing Habitat

Young steelhead remain in freshwater for a year or more and summer habitat in warm climates is often in short supply. Steelhead also require cool water temperatures and summer conditions in Santa Ynez Valley can warm water temperatures above levels suitable for young steelhead. Historically, the reach of the Santa Ynez Rive downstream of Bradbury Dam either dried up in the summer or supported very low streamflow levels. One of the main objectives of the conjunctive use of the downstream water rights and the Fish Reserve Account was to provide year round rearing habitat for young rainbow trout/steelhead. The Proposed Operations substantially improve rearing conditions in the mainstem Santa Ynez River downstream of Bradbury Dam when compared to either the Baseline Operations or the Historic Conditions.

The effect of the Proposed Operations on rearing habitat was analyzed using the habitat studies performed by the SYRTAC (1999a), as described in Section 2.4.1.2. This analysis focuses on the upper part of the mainstem from Alisal Bridge to Bradbury Dam because the river below the Alisal reach does not appear to support rainbow trout/steelhead. Despite many snorkel surveys since 1995 (SYRTAC 1997, 1998), only one rainbow trout/steelhead has been observed below this reach. This adult fish was found below Buellton in a pool at Santa Rosa Park in 1998, an extremely wet year (SYRTAC data).

For purposes of this analysis, the average top width vs. flow relationship was generated by weighting the top width of each habitat type by its relative proportion in each reach. The average top width was converted to acres of habitat by multiplying the average top width by the length of habitat in each reach. It was assumed that only pool habitats remained when flow was zero and all other habitat types provided no habitat. This likely results in an overestimate of habitat under zero flow conditions as the pools likely shrink by an unknown amount in both in length and width and an unknown number of pools would likely dry up completely. Regardless of this overestimate, the analysis does provide a basis for making a comparison between the Baseline and Proposed operations, as both are evaluated under the same assumptions.

Flow exceedance curves were developed from the daily flows generated from the Santa Ynez River model for three locations: (1) below the confluence of Hilton Creek, (2) at Highway 154, and (3) at Alisal Bridge based on model simulations including a 52-year period of record (1941-1993). Four seasons were used in the rearing habitat analysis: (1) January 1 through March 31, (2) April 1 through June 30, (3) July 1 through September 30, and (4) October 1 through December 31.

The reach from the dam to 154 is the primary rearing habitat since water temperatures are most often suitable in this reach due to the cool water releases from Lake Cachuma and the confined nature of the channel. Proposed Operations will increase habitat availability by in summer and fall by 46 to 79 percent when compared to Baseline Operations and Historic Conditions (Table 4-2). Similar increases in habitat are noted for normal years. During winter and spring in wet years and normal year, habitat availability is slightly less (-2 to -12 percent) under Proposed Operations, as water is being stored for releases later in the summer and fall.

An additional change that occurs in this reach is that under Baseline Operations and Historic Conditions, most of the available rearing habitat was in isolated pools in the thalweg of the river. With the additional flow from the conjunctive use, the pools are connected by flowing water and riffles and runs are also present increasing the diversity of the habitats available and providing addition benefits to the aquatic ecosystem with increased production of aquatic insects, additional growth of riparian vegetation. The development of these features, food supply and cover increase the value of the habitat to rainbow trout/steelhead.

**Table 4-2. Rearing Habitat Between Bradbury Dam and Highway 154.**

| Quarter | | Dry Years 80% exceedance | | | Normal Years 50% exceedance | | | Wet Years 20 % exceedance | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) | Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) | Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) |
| Jan-Mar | Historic | 1.2 | 36.5 | 12 | 18.1 | 46.3 | -7 | 157.7 | 51.9[2] | -12 |
| | Baseline | 0.2 | 25.3 | 62 | 0.9 | 33.2 | 30 | 21.3 | 46.8 | -2 |
| | Proposed | 2.5 | 41.0 | - | 5.0 | 43.1 | - | 14.7 | 45.7 | - |
| Apr-Jun | Historic | 2.0 | 40.5 | 6 | 13.1 | 45.3 | -4 | 77.0 | 50.4 | -2 |
| | Baseline | 0.6 | 29.8 | 43 | 4.3 | 42.5 | 2 | 56.7 | 49.1 | 1 |
| | Proposed | 4.6 | 42.7 | - | 6.5 | 43.5 | - | 55.3 | 49.4 | - |
| Jul-Sep | Historic | 0.0 | 24.2 | 79 | 0.0 | 24.2 | 85 | 2.6 | 41.1 | 18 |
| | Baseline | 0.6 | 29.8 | 46 | 7.7 | 43.8 | 2 | 43.4 | 48.7 | 0 |
| | Proposed | 6.3 | 43.4 | - | 10.9 | 44.7 | - | 43.3 | 48.7 | - |
| Oct-Dec | Historic | 0.0 | 24.2 | 74 | 0.0 | 24.2 | 79 | 3.2 | 41.7 | 8 |
| | Baseline | 0.0 | 24.2 | 74 | 0.6 | 29.8 | 45 | 6.1 | 43.4 | 4 |
| | Proposed | 3.6 | 42.0 | - | 5.8 | 43.3 | - | 11.8 | 44.9 | - |

[1] Based on change in habitat area
[2] estimated habitat, flows exceed predictive reliability of top width-flow relationship.

The reach from Highway 154 to Refugio Road will provide habitat for steelhead in many years, but not in all, as warm water temperatures may interfere with the quality of rearing conditions for young steelhead. The Proposed Operations provide large increases in habitat in dry years over Baseline Operations and Historic Conditions (300 to almost 800 percent increases). Spring and Summer flows are higher due to the Downstream Water Rights Releases. In normal years, habitat values for summer and fall are also increased by 500 to 800 percent, but rearing habitat is reduced slightly in winter and spring as water is being stored for later release. Wet years the fall base flow is expected to be about 10 cfs in this reach as compared to 1.6 cfs under Historic Conditions and 5.1 cfs under Baseline Operations( Table 4-3).

The reach between Refugio Road and Alisal Road will support rearing habitat in some normal years and in wet years. In normal years, habitat conditions may be suitable for trout if climatic conditions provide suitable water temperatures. Habitat availability for this reach shows very large increases (9932 percent) over Baseline Operations and Historic Conditions (Table 4-4). Although this reach shows large increases in available habitat, water temperatures may be too warm for this reach to provide more than marginal rearing conditions. In wet years, summer water temperatures may also rise to stress levels, but conditions in the cooler portions of the year will provide good rearing opportunities for rainbow trout/steelhead.

Proposed Operations provide 30 and 45 percent more habitat than the Baseline Operations. The Baseline Operations provide more flow and more habitat than the Proposed Operations in the first half of wet years, although the difference in the amount of habitat provided is only about 5 percent.

Flows resulting from the Historic Condition are much greater than either the Proposed or Baseline Operations in the first half of normal and wet years. However, in the later portion of normal years, Historic conditions have severly reduced habitat when flow is zero and habitat is available only in refuge pools.

The Proposed Operations result in about 5 to 14 percent less habitat during the first half of the year, and about 79 to 85 percent more habitat in the latter half of the year than the Historic Condition. In wet years, the Historic Condition retains flow throughout the year, but under Proposed Operations between 8 and 19 percent more habitat is available.

In summary, the proposed operations are anticipated to provide a substantial amount of additional rearing habitat than Baseline or Historic Conditions during the critical summer and fall months. The downstream extent of this habitat will vary depending on hydrologic and meteorological conditions, but habitat quality and quantity in the primary management area above Highway 154 will be improved in most years. In wet years, the reach of suitable habitat will likely extend further downstream. Rearing habitat has been identified by the SYRTAC as one of the primary factors limiting steelhead in the Santa Ynez River. The proposed operations will improve the quantity and quality of this habitat and therefore will provide a substantive benefit to the steelhead population.

**Table 4-3. Rearing Habitat Between Highway 154 and Refugio Road.**

| Quarter | | Dry Years 80% exceedance Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) | Normal Years 50% exceedance Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) | Wet Years 20 % exceedance Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) |
|---|---|---|---|---|---|---|---|---|---|---|
| Jan-Mar | Historic | 0.3 | 2.0 | 317 | 17.4 | 9.5 | -10 | 157.1 | 11.2[2] | -13 |
| | Baseline | 0.0 | 1.0 | 714 | 0.8 | 4.4 | 94 | 28.6 | 9.9 | -2 |
| | Proposed | 2.6 | 8.1 | - | 5.0 | 8.5 | - | 22.9 | 9.7 | - |
| Apr-Jun | Historic | 0.8 | 4.4 | 93 | 12.1 | 9.2 | -7 | 75.3 | 10.8 | -3 |
| | Baseline | 0.1 | 1.0 | 778 | 4.0 | 8.4 | 1 | 51.9 | 10.5 | 0 |
| | Proposed | 4.9 | 8.5 | - | 5.1 | 8.5 | - | 52.9 | 10.5 | - |
| Jul-Sep | Historic | 0.0 | 1.0 | 752 | 0.0 | 1.0 | 803 | 1.6 | 7.9 | 31 |
| | Baseline | 0.1 | 1.0 | 778 | 6.4 | 8.7 | 4 | 39.7 | 10.2 | 1 |
| | Proposed | 4.9 | 8.5 | - | 9.8 | 9.0 | - | 41.8 | 10.3 | - |
| Oct-Dec | Historic | 0.0 | 1.0 | 712 | 0.0 | 1.0 | 752 | 1.4 | 7.4 | 24 |
| | Baseline | 0.0 | 1.0 | 712 | 0.2 | 1.5 | 483 | 5.1 | 8.5 | 6 |
| | Proposed | 2.5 | 8.1 | - | 4.9 | 8.5 | - | 10.6 | 9.1 | - |

[1] Based on change in habitat area
[2] estimated habitat, flows exceed predictive reliability of top width-flow relationship.

**Table 4-4. Rearing Habitat Between Refugio Road and Alisal Road.**

| Quarter | | Dry Years 80% exceedance | | | Normal Years 50% exceedance | | | Wet Years 20 % exceedance | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) | Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) | Flow (cfs) | Habitat Area (acres) | Change under Proposed Conditions[1] (percent) |
| Jan-Mar | Historic | 0.0 | 0.1 | 9165 | 14.0 | 14.3 | -15 | 161.6 | 19.4[2] | -14 |
| | Baseline | 0.0 | 0.1 | 9165 | 1.1 | 7.7 | 57 | 38.7 | 16.6 | 0 |
| | Proposed | 1.3 | 9.3 | - | 3.9 | 12.1 | - | 39.4 | 16.6 | - |
| Apr-Jun | Historic | 0.0 | 0.1 | 10934 | 9.4 | 13.6 | -5 | 77.6 | 18.1 | -6 |
| | Baseline | 0.0 | 0.1 | 10934 | 3.0 | 11.7 | 11 | 44.6 | 16.9 | 0 |
| | Proposed | 1.9 | 11.0 | - | 6.8 | 12.9 | - | 46.0 | 17.0 | - |
| Jul-Sep | Historic | 0.0 | 0.1 | 5329 | 0.0 | 0.1 | 12691 | 0.1 | 0.1 | 26492 |
| | Baseline | 0.0 | 0.1 | 5329 | 2.8 | 11.6 | 11 | 30.2 | 16.0 | -1 |
| | Proposed | 0.8 | 5.4 | - | 6.2 | 12.8 | - | 28.9 | 15.9 | - |
| Oct-Dec | Historic | 0.0 | 0.1 | 0 | 0.0 | 0.1 | 9932 | 0.2 | 0.8 | 1450 |
| | Baseline | 0.0 | 0.1 | 0 | 0.0 | 0.1 | 9932 | 3.6 | 12.0 | 7 |
| | Proposed | 0.0 | 0.1 | - | 1.4 | 10.0 | - | 6.3 | 12.8 | - |

[1] Based on change in habitat area
[2] estimated habitat, flows exceed predictive reliability of top width-flow relationship.

### *Minimum Flows*

The minimum daily flow during a year represents the most severe bottleneck in rearing habitat steelhead will face. Under Proposed Operations at Alisal, minimum daily flows would generally be much lower than at the other two stations, but remain substantially better than the flows present under the Historic Conditions or Baseline Operations. Under the Historic Condition, all sites have little or no flow during a portion of the year, in all year types (Table 4-5). Under the Baseline Operations, a similar situation prevails, although in slightly more than half the years a small amount of flow (<1 cfs) would be present below the Hilton Creek confluence throughout the year. The river would go dry for at least one day in most years at both the Highway 154 and Alisal sites. Under the Proposed Operations, the minimum daily flow would approach zero below Hilton Creek in three years (1951, 1952, and 1991), all occurring at the end of prolonged droughts. During these years dissolved oxygen, temperature and water levels in pools in the upper reaches of the mainstem would be maintained by refreshing flows from the dam (described in Section 3.2). In 75 percent of the years the minimum daily flow that occurred would be in excess of 4 cfs. At Highway 154, the minimum daily flow would exceed 4 cfs in all but the three years discussed above, and would exceed 5 cfs in 57 percent of years.

### 4.1.1.2 Downstream Water Rights Releases

Downstream water right releases are typically made during the summer when the natural flow in the mainstem has ceased to exist. During this period, there are no contributions from tributaries to create a surface flow in the mainstem and tributaries are disconnected from the mainstem.

Water is released for the purpose of recharging only the above Narrows area or above and below Narrows areas together. Accordingly, duration and rate (including initial rate) of releases would vary. For example, the combined release for the above and below Narrows areas may begin at a rate of 135-150 cfs and be maintained at a steady rate for about 12-15 days before it is gradually decreased to lower flow rates. During the initial period of 12-15 days, the flow moves downstream at the rate of less than three miles per day (or less than 0.2 ft/sec). At a given location, the flow would gradually increase as the recharge rate decreases further upstream. As the recharge rate decreases in the riverbed, the release rate is also gradually reduced. In essence, the release rates are maintained such that surface water disappears in the lower reaches of the Santa Ynez River channel. The reduced releases could extend two to three months and then gradually be ramped down to match scheduled releases from the Fish Reserve Account. Releases for the above Narrows areas are made for a shorter duration and at lower initial rates compared to the above releases, but follow the same principles.

Releases will not cease with the gradual ramp-down at the end of the release period. Releases will continue at the rate scheduled from the Fish Reserve Account. Furthermore, the Santa Ynez River would continue to flow at Alisal Bridge for a period

## Table 4-5. Minimum Flow by Water Year.

Minimum Daily Flow in October through September for Various Locations
Water Years 1942 - 1993

| Water Year | Without Cachuma Operations Below Hilton Ck cfs | 154 Bridge cfs | Alisal Bridge cfs | Baseline (89-18) Below Hilton Ck cfs | 154 Bridge cfs | Alisal Bridge cfs | Conjunctive Operation 2.5510_1.8 Below Hilton Ck cfs | 154 Bridge cfs | Alisal Bridge cfs |
|---|---|---|---|---|---|---|---|---|---|
| 1942 | 0 | 0 | 0 | 0.5 | 0.5 | 0.5 | 2 | 5 | 3 |
| 1943 | 0 | 0 | 0 | 0.5 | 0 | 0 | 6 | 5 | 0.5 |
| 1944 | 0 | 0 | 0 | 0.5 | 0 | 0 | 4.5 | 5 | 1 |
| 1945 | 0 | 0 | 0 | 0.5 | 0 | 0 | 2.5 | 5 | 0.5 |
| 1946 | 0 | 0 | 0 | 0.5 | 0 | 0 | 3 | 5 | 2 |
| 1947 | 0 | 0 | 0 | 0 | 0 | 0 | 5.5 | 5 | 2 |
| 1948 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 | 2.5 | 0 |
| 1949 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.5 | 0 |
| 1950 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.5 | 0 |
| 1951 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1952 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1953 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 1.5 |
| 1954 | 0 | 0 | 0 | 0.5 | 0 | 0 | 2 | 5 | 1.5 |
| 1955 | 0 | 0 | 0 | 0 | 0 | 0 | 1.5 | 2.5 | 0 |
| 1956 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.5 | 0 |
| 1957 | 0 | 0 | 0 | 0 | 0 | 0 | 2.5 | 2.5 | 0 |
| 1958 | 0.5 | 0 | 0 | 0 | 0 | 0 | 1 | 2.5 | 0 |
| 1959 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 0.5 |
| 1960 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 | 2.5 | 0 |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 | 2.5 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.5 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 0.5 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 | 2.5 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.5 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.5 | 0 |
| 1967 | 0 | 0 | 0 | 0.5 | 0.5 | 0.5 | 2 | 5 | 2 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 4.5 | 5 | 1 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 5 | 2 |
| 1970 | 0 | 0 | 0 | 0.5 | 0 | 0 | 3 | 5 | 1 |
| 1971 | 0 | 0 | 0 | 0.5 | 0 | 0 | 3.5 | 5 | 2 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2.5 | 0 |
| 1974 | 0 | 0 | 0 | 0.5 | 0 | 0 | 2 | 5 | 2.5 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 1 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 4.5 | 5 | 0.5 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 | 2.5 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.5 | 0 |
| 1979 | 0 | 0 | 0 | 0.5 | 0 | 0 | 2 | 5 | 1.5 |
| 1980 | 0 | 0 | 0 | 0.5 | 0 | 0 | 2.5 | 5 | 0.5 |
| 1981 | 0 | 0 | 0 | 0.5 | 0 | 0 | 2 | 5 | 1 |
| 1982 | 0 | 0 | 0 | 0.5 | 0 | 0 | 2 | 5 | 2 |
| 1983 | 1 | 0.5 | 0 | 0 | 0 | 0 | 2 | 5 | 2 |
| 1984 | 0.5 | 0 | 0 | 1 | 0.5 | 0 | 4.5 | 5 | 3 |
| 1985 | 0 | 0 | 0 | 0.5 | 0 | 0 | 5 | 5 | 1 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 1.5 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 | 5 | 0.5 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 4.5 | 5 | 0.5 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2.5 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 | 2.5 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.5 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2.5 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 5.5 | 5 | 3 |

of time beyond the end of downstream water right releases, because water right releases enhance conveyance in the upper portion of Santa Ynez River.

Although fisheries investigations conducted to date on the lower Santa Ynez River have documented the presence of juvenile and adult rainbow trout/steelhead within the pools and habitat immediately downstream of Bradbury Dam, no data have been collected for use in assessing the response of these fish to releases made for downstream water rights. Based upon results of field studies conducted in other river systems in California, juvenile steelhead and other salmonids have been observed to respond to flow increases and decreases through both a volitional behavioral movement downstream, and through downstream displacement as a result of increased water velocities. On the other hand, juvenile and adult fish have also been observed to remain within a specific stream reach despite increases and decreases in flow. Whether or not juvenile steelhead rearing in the mainstem Santa Ynez River move or are displaced in response to WR 89-18 releases is not known at this time.

Within the lower Santa Ynez River, results of summer and early fall water temperature monitoring (SYRTAC 1997) are consistent with water temperature modeling (Section 2.4.1.2) in showing that suitable habitat for steelhead rearing is limited to the 3-4 mile reach immediately downstream of the dam. Water temperature monitoring during the 1996 downstream water right release (initiated July 18, 1996) showed an increase in downstream temperatures that would be expected to limit the longitudinal distribution of steelhead to the reach of the Santa Ynez River immediately downstream of Bradbury Dam. Based upon the observed longitudinal gradient in water temperature, it is not expected that juvenile or adult steelhead would behaviorally respond to flow changes associated with downstream water right releases by volitionally moving into areas of the river where water temperatures would be unsuitable.

The response of juvenile and adult steelhead to Downstream Water Rights Releases are speculative. However, the depth and complexity of habitat and cover within the Long Pool, Stilling Basin, and mainstem channel between Bradbury Dam and the Highway 154 bridge provide some of the best habitat in the mainstem. This reduces the likelihood that juvenile and adult steelhead would leave this area in response to changes in flow. The lower Santa Ynez River from Bradbury Dam to Highway 154, the principal mainstem reach where juvenile steelhead rearing during summer months may occur, contains habitat conditions (the Stilling Basin, Long Pool and other pools), that provide cover and velocity refuge for juvenile and adult steelhead. The proposed conservation measures include pool habitat management (Section 4.3.2) which are designed to improve habitat conditions and provide additional shelter for juvenile and adult steelhead within mainstem pools on Reclamation property downstream of the dam and perhaps in other areas of the mainstem river on private lands (in cooperation with land owners) that would further reduce the potential effects of increased flows and water velocities on steelhead holding within the mainstem channel. Results of field studies conducted by the SYRTAC (1997) demonstrated that downstream water right releases benefited habitat quality within these pools and the mainstem channel immediately downstream of

Bradbury Dam through the removal of algal accumulations, thereby contributing to an improvement in dissolved oxygen concentrations within the River.

Many of the juvenile and adult rainbow trout/steelhead observed within the Santa Ynez River basin occur in habitats tributary to the mainstem river. Tributaries such as Hilton and Salsipuedes creeks are important rearing and oversummering areas. Fish in these tributaries would not be subject to, or affected by, WR 89-18 water right releases to the mainstem river.

As part of the ongoing fishery monitoring program, additional field surveys and observations will be collected to provide information on movement patterns and the response of rainbow trout/steelhead to WR 89-18 releases. Surveys will be conducted to assess the presence and index of relative abundance of juvenile and adult trout within the area of the Stilling Basin and Long Pool prior to and after WR 89-18 releases. Field surveys will also be conducted during the recession phase of WR 89-18 releases, and after the releases have been completed, to assess fish stranding within pools and other habitats in downstream areas. Results of these field surveys, performed under the guidance of the SYRTAC, will help assess the potential affects of WR 89-18 releases on steelhead and their habitat within the mainstem Santa Ynez River.

Based upon the available information regarding longitudinal temperature gradients within the lower Santa Ynez River, habitat conditions within the reach between Bradbury Dam and Highway 154, and the dynamics and nature of the downstream water right releases, the response of juvenile and adult steelhead remains speculative. Steelhead rearing within the tributaries would be unaffected by water right releases. Improvements in habitat as a result of algal flushing and the associated improvements in dissolved oxygen concentrations, in combination with conservation measures implemented as part of this plan within the Long Pool, Stilling Basin, Hilton Creek and other tributaries, serve to mitigate and compensate for potential for adverse effects associated with potential downstream movement and/or displacement of steelhead in response to water right releases. The Downstream Water Rights Releases also help to maintain fish habitat in the principle management reaches in that to the extent that water rights releases coincide with a scheduled release from the Fish Reserve Account, the Fish Reserve Account is not debited for the release. This water is then available for use at other times when Downstream Water Rights Releases are not being made. Biological monitoring conducted under the guidance of the SYRTAC will provide additional information for use in evaluating the response of steelhead to downstream water right releases and the benefits of habitat enhancement and conservation measures within the mainstem pool habitat (Section 3.3.5) and tributaries (Section 3.3.3) for both juvenile and adult steelhead/rainbow trout.

#### 4.1.1.3 Ramping

The schedule under the proposed Plan for ramping of Downstream Water Rights Releases is described in Section 3.2.2. This schedule was developed to eliminate possible stranding of steelhead or rainbow trout as dam releases are returned to the target flows at Highway 154 at the completion of Downstream Water Rights Releases. The top width to flow relationship presented previously in Figure 2-3 provides the basis for evaluating the effects of ramping. This relationship shows that in all habitat types the top width varies by a maximum of 19 to 25 feet as flows decrease from 50 to 3 cfs. This is about 33 to 45 percent of the total channel width in riffles, which have the most responsive relationship. The proposed ramping schedule would reduce the maximum change in top width to 3 feet in the Highway 154 reach, 4 feet in the Refugio Reach, and 5 feet in the Alisal Reach.

Due to the attenuation of flows, this change in top width would occur over a period of at least several hours, if not several days. Based upon this, the proposed ramping schedule is not anticipated to have any adverse effect on steelhead.

#### 4.1.1.4 Reservoir Surcharge

The effects of the reservoir surcharge are related solely to changes in water surface elevations within Lake Cachuma above Bradbury Dam. Steelhead do not occur in the lake because Bradbury Dam is impassable for migrating fish, and therefore reservoir surcharge will not affect steelhead.

#### 4.1.1.5 CCWA State Water Releases

The SYRTAC has requested that when possible CCWA not deliver water during releases for downstream water rights. This appears to be feasible based on current demands and delivery capacity. In the future, as demand for SWP water on the South Coast increases, delivery of this water may need to occur during Downstream Water Rights Releases. This will result in the State Water being released to the river at the Stilling Basin.

When it becomes necessary to release State Water into the Santa Ynez River, this water will be released in a manner to meet the specific release requirements outlined in the environmental assessment for the CCWA project (Reclamation 1995), and through consultation with resource agencies. The operational criterion was developed specifically to avoid potential adverse impacts on steelhead through adverse temperatures or false imprinting. The temperature monitoring protocol outlined in Section 3.2.3 will ensure that water released will not exceed 18°C and thereby will avoid any adverse temperature effects. Imprinting generally occurs during juvenile outmigration in the spring and no SWP water is expected to be released during out migration. In addition, the amount of water released is restricted to 50 percent of total release for flows less than 45 cfs. Maximum capacity of the Coastal Aqueduct is 22 cfs so the percentage would be less than 50 percent for flows higher than 45 cfs. State Water releases made to the river in the course of WR 89-18 releases would normally be made in the summer months.

### 4.1.2 OTHER SPECIES

#### 4.1.2.1 Conjunctive Use of Water Releases

Water rights releases will provide instream flow between Bradbury Dam and Lompoc during the summer. Fish Reserve Account releases will maintain perennial flow in many years when WR 89-18 releases are not occurring, mainly between the dam and Highway 154 and in some years as far as Alisal Bridge. The proposed flow releases will not propagate flow beyond Lompoc. The proposed operations will not adversely affect species that are not in this area, such as the tidewater goby (lagoon), California tiger salamander (upland pools between Buellton and Santa Ynez), bald eagles (Lake Cachuma), or peregrine falcons (Lake Cachuma and the coast in Vandenburg AFB).

The perennial flow provided under the proposed operations is not anticipated to adversely affect other protected species such as red-legged frog, southwestern willow flycatcher, or least Bell's vireo. None of these species currently occur in the mainstem between the dam and Buellton. If these species expand into this area, they would benefit from the presence of perennial flow and from the increased riparian growth this water will engender. The presence of predatory introduced species, such as bullfrogs, bass, and sunfish, however, make it unlikely that red-legged frogs will be able to successfully colonize this area.

The U. S. Fish and Wildlife Service raised concerns that proposed releases could potentially affect southwestern willow flycatcher, which nests below Buellton and below Lompoc, and least Bell's vireo, which may nest near the confluence with Salsipuedes Creek. It was thought that water releases would increase water levels in the mainstem, thereby flooding riparian nesting habitat (G. Greenwald, USFWS, pers. comm.). Habitat-flow modeling under PHABSIM, however, indicates that depth in the mainstem will not change greatly, even at very high flow levels that are beyond the proposed releases. At Buellton, a flow change from 5 cfs to 200 cfs resulted in a depth change of 1 to 2 feet (stream width 50 to 126 feet wide). Further downstream, the change is less pronounced because the stream channel is wider. At Cargasachi (24 miles below Bradbury Dam, between Buellton and Lompoc), a flow change from 5 cfs to 300 cfs resulted in a depth change of one foot (stream width 159 feet). At Lompoc, a flow change from 5 cfs to 300 cfs resulted in a depth change of only 0.6 foot (stream width about 200-320 feet). Adverse effects on least Bell's vireo are unlikely, given that this species nests 30 to 650 feet away from the nearest edge of water at a height of 3 to 8 feet (Olson and Gray 1989). Overall, it is expected that both bird species will benefit from the riparian growth that the additional water is expected to support.

#### 4.1.2.2 Reservoir Surcharge

The effects of the project operations on species and their habitat upstream of Bradbury Dam are related solely to changes in water surface elevations within the lake. These operations include gateholding during emergency winter operations, surcharging the reservoir to retain additional water for downstream environmental purposes in the dry, summer months, withdrawal of water through the Tecolote Tunnel to meet South Coast demand, and release of water to downstream areas pursuant to WR 89-18 and for environmental purposes through releases from the Fish Reserve Account. The Plan includes surcharging Lake Cachuma by 1.8 feet in years when there is sufficient spill water to do so. Based on simulations of the Santa Ynez River model, surcharging will occur in approximately one out of three years (27 of 75). During these years, water surface elevations would remain above the maximum designed storage level of 750 feet for approximately 1.6 additional months in each year (range one to three months) over existing conditions (Table 4-6).

Sensitive species occurring in the vicinity of Lake Cachuma include the California red-legged frog, bald eagle, and American peregrine falcon. The impacts of surcharging Lake Cachuma on these species and their habitats were evaluated in the Contract Renewal EIS/EIR. Alternative 3B of the EIS/EIR evaluated the effects of surcharging the reservoir by 1.8 feet. The EIS/EIR found that a 1.8-foot surcharge would have no effect on the sensitive species within the lake. Given the rate and timing of lake level changes, none of the sensitive species in or adjacent to the lake are expected to be affected. A specific discussion for each of these species is included below.

Lake Cachuma does not provide good habitat for the California red-legged frog and therefore, this species is unlikely to be impacted. California red-legged frogs are commonly found in creeks, streams and ponds, primarily in areas with pools 2 or 3 feet deep and with dense riparian vegetation. The presence of predatory fish in the lake, in combination with the lack of suitable habitat, make the presence of red-legged frogs unlikely. No red-legged frogs were observed in the lake during surveys conducted in 1994 (Woodward-Clyde Consultants, et al. 1995). The minor changes in water surface elevations due to the proposed operations are unlikely to affect the habitats of this species.

Bald eagles are known to nest near Lake Cachuma and this area supported a breeding pair from 1989 to approximately 1993. These birds prey primarily on fish, although ducks, coots, and southwestern pond turtles are also consumed. Bald eagles prey on fish at the water surface. The minor changes in water surface elevation proposed are unlikely to affect their hunting success or food supply in Lake Cachuma. Water releases from Bradbury Dam will improve aquatic habitat and fish populations in the river, and therefore are likely to enhance the food supply for eagles that may forage below Lake Cachuma.

American peregrine falcons may also be found near Lake Cachuma. These birds, however, prey primarily on other birds, and are unlikely to be affected by surcharging the reservoir.

The arroyo southwestern toad and least Bell's vireo occur upstream of Gibralter Dam and outside of the project area. These species will not be affected by the proposed operations.

**Table 4-6. Duration of Reservoir Surcharge Under Proposed Operations (from Santa Ynez River Model Runs, 1918 to 1993).**

| WATER YEAR | NUMBER OF MONTHS OVER ELEVATION 750 FT | NUMBER OF MONTHS OVER ELEVATION 750 FT WHEN NOT SPILLING |
|---|---|---|
| 1918 | 5 | 1 |
| 1922 | 4 | 1 |
| 1927 | 4 | 1 |
| 1937 | 4 | 1 |
| 1938 | 5 | 1 |
| 1941 | 6 | 1 |
| 1942 | 6 | 3 |
| 1943 | 6 | 2 |
| 1944 | 5 | 2 |
| 1945 | 4 | 2 |
| 1946 | 3 | 1 |
| 1952 | 3 | 1 |
| 1958 | 3 | 1 |
| 1967 | 7 | 2 |
| 1969 | 7 | 2 |
| 1970 | 2 | 2 |
| 1973 | 4 | 2 |
| 1974 | 4 | 2 |
| 1975 | 4 | 2 |
| 1978 | 6 | 2 |
| 1979 | 5 | 2 |
| 1980 | 5 | 1 |
| 1981 | 1 | 1 |
| 1983 | 8 | 2 |
| 1984 | 6 | 3 |
| 1986 | 3 | 1 |
| 1993 | 7 | 2 |

#### 4.1.2.3 CCWA State Water Releases

CCWA releases to the mainstem, if made, are unlikely to affect other protected species such as the red-leged frogs and southwestern willow flycatcher. Neither of these species currently occur in the mainstem between the dam and Highway 154. If these species expand e into this area, they would benefit from the presence of perennial flow and from the increased riparian growth this water will engender. The presence of predatory introduced species, such as bullfrogs, bass, and sunfish make it unlikely that red-legged frogs will be able to successfully colonize this area, however. The proposed operations will not adversely affect species that are not in this area, such as the tidewater goby (lagoon), California tiger salamander (upland pools between Buellton and Santa Ynez), bald eagles (Lake Cachuma), or peregrine falcons (Lake Cachuma and the coast in Vandenburg AFB).

## 4.2 CONSERVATION MEASURES TO PROTECT STEELHEAD

### 4.2.1 HILTON CREEK

#### 4.2.1.1 Steelhead

Previous fisheries studies (SYRTAC 1997) have documented spawning and juvenile rearing in Hilton Creek. Conservation measures in Hilton Creek will benefit steelhead in several ways (Table 4-7). The Plan includes construction of a permanent water delivery system and allocation of water supplies from the Fish Reserve Account to provide reliable supplemental instream flows to Hilton Creek. Flows ranging from approximately 1.5 to 5 cfs would be provided from Lake Cachuma. The water delivery system has been designed, and will be operated, to meet temperature and dissolved oxygen criteria appropriate for steelhead. The management of flows provided to Hilton Creek within and among years will be adaptively managed based on a number of factors including, but not limited to, the presence of spawning adult steelhead, the presence of rearing juveniles, reservoir storage, Fish Reserve Account allocations, and water temperature.

The introduction of a reliable water supply, which can be managed in combination with natural runoff to provide year-round instream flows, will directly benefit steelhead by improving the availability and quality of juvenile rearing habitat, particularly during late spring, summer, and fall. Under current conditions, summer habitat in Hilton Creek is limited to isolated pools. Because streamflow within Hilton Creek is not sustained year-round, juvenile and potentially adult steelhead may be stranded, trapped within isolated pools, or forced to move downstream as natural stream flows recede within Hilton Creek during the late spring and summer. In response to natural flow recession, juvenile steelhead may be forced to migrate downstream into areas such as the Stilling Basin and the Long Pool where vulnerability to predation is increased. Providing year-round streamflow will minimize and avoid these adverse effects on steelhead. The amount of

**Table 4-7. Amount of Habitat and Steelhead Lifestages Affected by Hilton Creek Enhancement Project.**

| Project Element | Steelhead Lifestage Affected | Nature of Effect | Amount of Habitat Affected |
|---|---|---|---|
| Supplemental Watering System | Fry, rearing juveniles, and oversummering adults | Maintain streamflow to support habitat through spring, summer, and fall. | 1,380 feet to lower release<br>2,980 feet to upper release |
| Fish Passage Facilities | Migrating and spawning adults | Enhance access to spawning and rearing habitat above chute pool | 2,800 feet between chute pool and Highway 154 culvert |
| Channel Extension | Fry, rearing juveniles, possibly spawning adults | Create additional stream habitat for summer rearing and possibly spawning by extending lower channel | Up to 1,400 feet<br>(1,500 feet less 100 to 250 feet of current Hilton channel) |

summer habitat expected to be provided by the permanent watering system alone is 1,380 feet up to the lower release point and 2,980 feet up to the upper release point.

The Hilton Creek conveyance facility has been designed as a gravity feed pipeline to provide reliable water supplies that are not dependent upon continuous mechanical pump operation. Under conditions of reduced water storage within Lake Cachuma (whenever reservoir elevation is less than 719 feet), the Hilton Creek water delivery system will need to be operated using a mechanical pump to provide water supplies to the creek. Examination of reservoir operational modeling shows that pump augmentation may be required in approximately 35 percent of years.

Thermal stratification within Lake Cachuma during the spring and summer provides an opportunity to obtain relatively cold water, from below the thermocline, to meet habitat requirements for steelhead within Hilton Creek. Experience with the operational performance of the temporary Hilton Creek watering system during 1997 demonstrated that water quality criteria (e.g., water temperature and dissolved oxygen) can be met in most years.

Water released from Lake Cachuma into Hilton Creek will be exposed to solar radiation in some reaches, potentially elevating water temperatures during conveyance downstream into the Santa Ynez River, particularly during summer months. However, any negative impact of moderate water warming is more than offset by the benefits of having any summer flows in Hilton Creek at all. Furthermore, the water released to Hilton Creek will be cool water from the hypolimnion (18°C or less). Temperature monitoring in summer 1997 during operation of the temporary watering system, which delivered 4 cfs to the lower release point in the bedrock chute, found that average and maximum daily temperatures ranged between 15 to 16°C near the release point and between 15.5 to 17°C at the lower end of Hilton Creek (SYRTAC 1998). Monitoring in 1998 of natural flows at the Reclamation property boundary (the future upper release site) showed a 1 to 2°C increase in temperature compared to temperatures at the chute pool, which is about 1,600 feet downstream of the boundary (SYRTAC data). In general, this warming did not result in temperatures exceeding temperature guidelines (20°C daily average, 25°C daily maximum). This suggests that the effect of slightly increased water temperatures is negligible, especially compared to the benefits of watering Hilton Creek. Monitoring will be conducted to document thermal warming along Hilton Creek in order to adjust operations of the two release points as necessary.

Water conveyed from Lake Cachuma to Hilton Creek will enter the lower Santa Ynez River at the Long Pool and will support additional fisheries habitat in the mainstem downstream from this point. Some limited depletion of the water released will occur due to direct evaporation, evapo-transpiration, and percolation into river deposits during passage down Hilton Creek. Assessment of the potential incremental contribution of thermal warming to the lower Santa Ynez River as a result of sustained instream flows within Hilton Creek during the spring and summer will require additional monitoring and analysis as part of the implementation of the Plan. Based on the volume of the release from 1.5 to 5 cfs and the large volume of the Long Pool, however, the potential for significant temperature increases in the lower Santa Ynez River appears to be minimal.

The management plan includes fish passage facilities at an existing impediment which limits access of adult steelhead to upstream habitat. Construction of fish passage facilities at the cascade and bedrock chute just above the chute pool will benefit steelhead by providing access to an additional 2,400 feet of upstream spawning and/or rearing habitat (2,800 feet from the chute pool to the culvert, less about 100 feet of the bedrock chute and 300 feet of poor habitat). The supplemental watering system will provide water to 1,500 feet of the creek between the chute pool and upper release point. Increased habitat availability is an environmental benefit of the proposed actions. Construction will occur during the summer to minimize short-term impacts on fish in Hilton Creek.

Construction of the Hilton Creek channel extension, including spawning gravels and structural features, is expected to benefit steelhead by increasing the availability of suitable habitat. The channel extension will create up to 1,500 feet of habitat (depending on the alignment chosen). When stream flows are less than 15 cfs, the flow control structure at the head of the channel will direct flows into the channel extension instead of the current channel, which extends about 100 to 200 feet from the proposed head of the channel extension down to the Santa Ynez River. Therefore, the net gain of habitat is up to 1,400 feet, depending on the selected channel alignment.

Water conveyed from Lake Cachuma to Hilton Creek will subsequently be returned to the lower Santa Ynez River at the Long Pool. This will effectively move the confluence of Hilton Creek downstream about 600 to 1,100 feet, depending on the channel alignment selected. This is not expected to significantly affect summer conditions in the Long Pool in comparison with historic conditions, since Hilton Creek does not typically contribute flow to the mainstem after the winter or spring. Use of the Hilton Creek release sites will reduce the amount of water available for release to the mainstem between the stilling basin and the Long Pool (approximately 600 feet of stream channel). However, habitat quality for early lifestages of steelhead will be better in Hilton Creek and the channel extension because predatory warmwater fish would be absent. Releases from the Stilling Basin release site will be used to refresh the mainstem between the Stilling Basin and the outfall of the channel extension. Therefore, operation of the watering system and channel extension will be a net benefit to the steelhead population because it will increase the amount of summer rearing habitat for juveniles.

Some limited depletion of the water released will occur due to evapotranspiration and percolation losses. Percolation losses can be minimized by lining the channel where it crosses permeable alluvium. Thermal gains may be significant through the channel extension if the selected alignment does not provide good canopy cover. To minimize warming, the proposed project will choose an alignment near existing trees and shrubs, where possible, and will plant additional riparian vegetation to shade the channel extension. Construction will be conducted in a dry channel and, therefore, will not impact steelhead residing in the creek or river.

Quantifying the magnitude of the environmental benefit is difficult. Channel modifications in other river systems have resulted in highly variable success, depending on the design features and operation of the system. Furthermore, although the Hilton Creek channel extension will include provisions for bypassing high flows, the frequency and requirements of channel maintenance are unknown.

In general, the conservation measures for Hilton Creek should produce an overall net environmental benefit to steelhead, based upon field observations of spawning and juvenile rearing within Hilton Creek and operational experience with the temporary water delivery system. The modifications to be made in Hilton Creek will directly increase available juvenile rearing and possibly spawning habitat within the Santa Ynez River system. The number of fish rescued from lower Hilton Creek in June 1998 (831 young-of-the-year over approximately 1,200 linear feet) was used to generate a crude estimate of the creek's productivity in wet years. Based on this calculation, the proposed project has the potential to produce up to approximately 2,850 young-of-the-year when winter flows are good (approximately 850 fish for Hilton Creek below the passage impediment, 1,000 fish between the bedrock chute and upper release site, and up to 1,000 fish in the channel extension minus the lowermost 100 to 250 feet of the existing Hilton Creek).

Monitoring will be conducted to evaluate habitat use, spawning success, and juvenile rearing of steelhead within Hilton Creek. Monitoring results will be used to document the expansion of available habitat through the fish passage structure and channel extension, and the incremental contribution of thermal warming from Hilton Creek to habitat conditions in the lower Santa Ynez River.

#### 4.2.1.2 Other Species

In addition to steelhead, sensitive species occurring on the Santa Ynez River downstream of Lake Cachuma include the California red-legged frog and southwestern willow flycatcher. These species have not been reported in the immediate vicinity of Hilton Creek and are therefore not expected to be directly affected by the proposed actions in this area (i.e., such as construction and operation of passage facilities and watering of the channel extension). No adverse impacts to these species are expected.

Although California red-legged frogs and southwestern willow flycatchers are not currently found in the vicinity of Hilton Creek, the proposed project could make this habitat more suitable for these species and, therefore, have a beneficial impact on these species should they establish populations in this area. The California red-legged frog needs water throughout the year, and the southwestern willow flycatcher needs dependable water during its nesting season from May through August. The proposed project will provide a dependable water supply via the permanent watering system through the dry summer months in normal and wet years. These releases will have a beneficial effect on red-legged frogs and other non-listed aquatic species, as well as on steelhead, by providing additional habitat and improving existing habitats through water quality improvements. Sustaining instream flows would also contribute to increased riparian growth that frogs use as cover and that flycatchers nest in and will further improve habitat.

Flow supplementation and physical habitat enhancement at Hilton Creek will not affect other protected species. The other protected species in the lower Santa Ynez River watershed are confined to the area of the lagoon. Project operations will not affect habitat in this portion of the Santa Ynez River and, therefore, there will be no impact to these species. In the middle of the Santa Ynez lower watershed, the California tiger salamander occurs only in upland ponds between the cities of Buellton and Santa Ynez. These ponds are isolated from the river and will not be affected by Hilton Creek operations.

### 4.2.2 Fish Rescue Plan

#### 4.2.2.1 Steelhead

While the supplemental water supply system will provide flow to Hilton Creek in most years, it may be impossible to provide streamflow in critically dry years when lake levels fall to near 660 feet. Under these conditions, fish rescue and predator control operations will be undertaken, if needed, to prevent mortality of rainbow trout/steelhead in the creek. Fish rescue operations may also be conducted in other stream reaches that are drying and/or have stressful temperatures that are not on Reclamation property. The decision to conduct fish rescues in these areas will be made on a case-by-case basis based on the landowner's permission and in consultation with the resource agencies. Predator removal operations may be conducted at a relocation site if surveys indicate that introduced warmwater predators are a potential problem for the size class(es) of rainbow trout/steelhead to be released at that site.

This program will provide a net benefit to the steelhead population by increasing the number of fish that survive through the summer. Under baseline conditions, when flows decrease and only isolated pools remain in Hilton Creek, rainbow trout/steelhead are crowded into pools or stranded in drying reaches. Although some incidental mortality will occur to steelhead as a result of a fish rescue operation, the anticipated level of incidental mortality is lower than the mortality expected if fish rescue operations were not performed. To minimize negative impacts to individual fish from the rescue operations, criteria and protocols for conducting fish rescue operations have been developed through discussions among SYRTAC biologists, including participation by DFG, USFWS, and NMFS.

Monitoring results and adaptive management will be used to determine appropriate release locations for steelhead and other fish species salvaged as part of the fish rescue operations. Relocation sites for fish collected during fish rescue operations will be selected to avoid increasing intra-specific competition with juvenile steelhead already rearing within various areas of the watershed. Trapping and seining to remove predatory fish from relocation sites could affect resident rainbow trout/steelhead that may also be caught. Experienced biologists will be responsible for predator removal operations in order to minimize handling of these fish, which will be immediately returned to the site unharmed.

Overall, a properly designed and managed fish rescue program, as proposed, will provide benefit for steelhead when compared with environmental baseline conditions and the mortality expected to occur to steelhead if rescue operations were not performed.

#### 4.2.2.2 Other Species

The tidewater goby and other sensitive species near the lagoon will not be affected because fish rescue, relocation, and predator removal operations will not occur in this area. The California tiger salamander occurs only in isolated upland ponds between the cities of Buellton and Santa Ynez, which will not be affected by this proposed action.

California red-legged frogs are not present at Hilton Creek, therefore, this species will not be affected by the fish rescue. If a relocation site is selected where red-legged frogs may be present, they would benefit from the removal of introduced warmwater fishes such as bass and bullheads, which can prey on frogs as well as small fish. Increasing the number of rainbow trout/steelhead in an area with red-legged frogs should not affect the frogs as the two species do not prey on or compete with each other.

This proposed action will not affect southwestern willow flycatchers, bald eagles, or peregrine falcons because operations will not occur near known populations and the nature of the actions will not affect these birds or their habitat.

### 4.2.3 Conservation Easements: Habitat Protection and Enhancement

#### 4.2.3.1 Steelhead

Results of fisheries investigations performed by SYRTAC (1997) have shown that habitat conditions are suitable (e.g., perennial flow, acceptable water temperature, etc.) for steelhead spawning and/or rearing within a number of tributaries to the lower Santa Ynez River including Salsipuedes and El Jaro creeks. Steelhead have been observed and collected within these tributary habitats. Habitat conditions within these tributaries, however, could be enhanced and improved for steelhead. Sediment deposition, adjacent land-use practices, minimal riparian shading, and lack of suitable spawning gravels have been identified as areas where habitat improvement may prove beneficial.

These tributaries are largely in areas under private ownership. The BOR/Member Units are currently in discussions with landowners in the El Jaro watershed regarding establishment of conservation easements along stream corridors. These agreements will protect about 6 - 8 miles of El Jaro Creek and about one-mile on Ytias Creek, a small tributary of El Jaro. Development of habitat improvement projects within these tributary areas will include consideration of construction practices and other preventative measures designed to minimize and avoid potential adverse impacts to steelhead habitat (e.g., sediment deposition during construction, etc.) as part of project planning and design.

#### 4.2.3.2 Other Species

Establishment of conservation easements and implementation of habitat enhancement projects in El Jaro Creek and other tributaries will not to adversely affect species that are not in the area, such as the tidewater goby (lagoon), California tiger salamander (upland pools between Buellton and Santa Ynez), southwestern willow flycatcher (dense riparian along the mainstem near Buellton and Lompoc), bald eagles (Lake Cachuma), or peregrine falcons (Lake Cachuma and the coast in Vandenburg AFB). The riparian protection and enhancement measures would benefit flycatchers if their range into the tributaries were expanded.

California red-legged frogs have been reported in Salsipuedes Creek (Woodward-Clyde Assoc. et al. 1995). The proposed action is likely to provide a net benefit to this species, which occurs primarily in areas with pools and dense cover in the riparian corridor. Conservation easements will protect streams from disturbance of riparian vegetation. Depending on the site, enhancement actions will decrease sediment inputs that can fill pools, add instream structures that increase cover and foster deepening of pools, and protect and plant riparian vegetation.

### 4.2.4 Tributary Passage Barrier Modification

#### 4.2.4.1 Steelhead

The SYRTAC proposed project will enhance passage at several fish passage impediments on principal tributaries through the SYRTAC investigations, including several road crossings of Refugio Road on Quiota Creek, a road crossing on El Jaro Creek, two bridge crossings on Salsipuedes Creek, and a cascade and chute area in Hilton Creek (described earlier). Removal of these barriers and impediments to migration has been identified as producing a positive net environmental benefit to steelhead by improving upstream and downstream migration and access to spawning and/or rearing habitat. The incremental effect of these existing fish passage impediments on the steelhead population within the river, however, has not been quantified. No significant adverse effects to steelhead have been identified as a result of barrier removal.

#### 4.2.4.2 Other Species

Modification of passage impediments in Salsipuedes Creek, El Jaro Creek, or Quiota Creek will not adversely affect species that are not in the area, such as the tidewater goby (lagoon), California tiger salamander (upland pools between Buellton and Santa Ynez), southwestern willow flycatcher (dense riparian along the mainstem near Buellton and Lompoc), bald eagles (Lake Cachuma), or peregrine falcons (Lake Cachuma and the coast in Vandenburg AFB).

California red-legged frogs have been documented in Salsipuedes Creek, although it is not known whether they are present at the passage barriers. Surveys will be conducted prior to construction to determine whether frogs are present, and appropriate measures will be taken to minimize short-term impacts from construction. In the long term, red-legged frogs are not likely to be adversely affected by modification or removal of a barrier.

### 4.2.5 Pool Habitat Management

#### 4.2.5.1 Steelhead

Pools within the lower Santa Ynez River provide important habitat for steelhead. Pool habitat is especially important as a refuge for steelhead during summer and fall periods of low instream flow and elevated temperatures (SYRTAC 1997). Opportunities exist to improve structural habitat within pools on Reclamation property, mainly the Stilling Basin and Long Pool. Additional structural elements, such as boulders and large woody debris, can be added to pools to improve rearing conditions for young steelhead and reduce their vulnerability to predation by warmwater fish species (e.g. largemouth bass) known to inhabit existing pools. Although the effectiveness of pool habitat management on the availability and quality of habitat, and the associated improvements in growth and survival of steelhead, cannot be quantified, evaluation of the available information and results of previous habitat and fisheries investigations indicate that these actions will result in a net environmental benefit to steelhead. This type of enhancement will also be implemented on a case-by-case basis on property not owned by the Bureau if willing landowners can be located.

#### 4.2.5.2 Other Species

Enhancement of pool habitat in the mainstem Santa Ynez River near Bradbury Dam will not adversely affect species that are not in the area, such as the tidewater goby (lagoon), California red-legged frogs (habitat near Buellton), California tiger salamander (upland pools between Buellton and Santa Ynez), southwestern willow flycatcher (dense riparian along the mainstem near Buellton and Lompoc), bald eagles (Lake Cachuma), or peregrine falcons (Lake Cachuma and the coast in Vandenburg AFB). The actions will not occur near known populations and the nature of the actions will not affect these species or their habitat.

### 4.2.6 Public Education and Outreach Program

#### 4.2.6.1 Steelhead

Informing and educating the residents of the Santa Ynez River Valley and, in particular, the landowners along the lower Santa Ynez River and its tributaries, is an essential element of the Plan. Increasing public awareness of measures that can and will be implemented on the lower Santa Ynez River and tributaries to protect steelhead and improve habitat conditions, will result in both direct and indirect benefits. Education of local landowners regarding land-use practices and simple management techniques may result in improved habitat conditions within a number of areas of the watershed which are currently under private ownership. Increased education of local landowners may also improve access to privately held areas where additional habitat improvement efforts can be designed and implemented as part of this Plan. As most of the watershed is privately held, even a small improvement in increasing landowner buy-in and participation could provide a substantial benefit to the steelhead population. Increased public awareness of the actions being implemented to also improve habitat conditions for steelhead may also contribute to additional public support and increased funding for habitat improvement projects.

Increasing the awareness of the general public regarding the adverse effects of poaching and recreational angler harvest of adults is expected to contribute to reduced levels of mortality. The public information program will specifically avoid identifying locations within the watershed where adult steelhead may be vulnerable to angler harvest. In other programs, adverse impacts have arisen as a result of identifying, and indirectly promoting, areas where fish are concentrated and therefore vulnerable to angler harvest.

Although it is difficult to quantify the benefits associated with the public information program, it is expected that these actions will contribute to a positive net environmental benefit for steelhead.

#### 4.2.6.2 Other Species

Increasing public awareness of measures that can and will be implemented on the lower Santa Ynez River and tributaries to protect steelhead and improve stream and riparian habitat conditions can indirectly benefit other species that depend on aquatic habitat in the lower mainstem and tributaries, such as the California red-legged frogs and southwestern willow flycatchers. Public education and outreach will have no adverse effect on any listed species.

## 4.3 IMPACTS TO WATER SUPPLY

### 4.3.1 WATER SUPPLY

The Plan will impact the water supply of the Cachuma Project Member Units by creating greater water supply shortages during dry periods. The Fish Reserve Account takes water from Project yield. The Member Units have proposed to address this impact by continuing to draft the Project at the current amount of 25,714 AFY but expect and accept more frequent shortages from the Project and greater shortages during dry periods. The modeling estimates of the Santa Ynez River Hydrology Model indicate that the Plan will produce greater shortages during the critically dry period of approximately 3,600 AF in the worst year of the critical period and a cumulative greater shortage of approximately 10,500 AF occurs during the last five years of the critical period. Smaller shortages would happen during dry periods less severe than the worst historical dry period.

It is important to note that the shortages described above are additional shortages. During dry periods, the Cachuma Project and other local surface water supplies would be expecting substantial shortages under baseline conditions (approximately 4,700 AF). Cachuma Project Member Units have planned to meet those expected baseline condition shortages with SWP water and local groundwater. Under the proposed Plan, the total shortages expected from the Project during the worst year of the critical dry period are estimated at 8,400 AF. Member Units will meet the additional shortages by ordering State Water Project (SWP) water which has an additional marginal cost of approximately $250 per AF, provided that shortages in the SWP do not coincide with critical year shortages in the Cachuma Project. If the Cachuma Project dry periods coincide with SWP shortages, the SWP shortages probably can be made up with other water supplies but at some additional cost. If a future critically dry period is worse than the historical critically dry period or if local demand is significantly greater than current levels, Project Members may have to use desalination which has an estimated marginal cost of $1,200 per AF, plus unknown startup costs.

### 4.3.2 DOWNSTREAM WATER RIGHTS

The Fish Reserve Account and the Downstream Water Rights Releases have been used conjunctively since 1993. Much of the use in prior years has been to meet the investigative needs of the Biology Subcommittee of the SYRTAC. Under the Plan the purpose of Fish Reserve Account releases will be to maintain and restore steelhead. Through use of a greater surcharge the Plan increases the Fish Reserve Account above current levels to allow greater target flows downstream. This will have an ancillary effect of providing additional recharge to upper reaches of the Santa Ynez River groundwater basin which should have the effect of decreasing dewatered storage in the Above Narrows area. This will result in an average reduction in the Above Narrows Account (ANA) and less water released from the ANA. Because the accounts are being used conjunctively, an average reduction in the ANA will not impact downstream water users nor impair the capability of meeting the target flows. The Fish Reserve Account is not expected to have an impact on the Below Narrows Account (BNA) or recharge in the below Narrows area. For the purposes of the ANA and BNA, releases of Fish Reserve Account water are not treated as natural flow in the Santa Ynez River.

A key feature of the Plan is the conjunctive use of the Downstream Water Rights Releases and the Fish Reserve Account. This conjunctive use will allow for greater flexibility for use of the Fish Reserve Account because Downstream Water Rights Releases will provide flows greater than the target flows for substantial periods during most summers. Typically Downstream Water Rights Releases will not be made during spill years, but they are less likely to be needed in those years. During spill years the Fish Reserve Account will receive up to 5,500 AF from the 1.8 feet surcharge and tributaries downstream of Bradbury Dam will more likely have contributing flows. During nonspill years, Downstream Water Rights Releases will be needed to recharge the above Narrows and below Narrows areas and can support the target fish flows.

### 4.3.3 STATE WATER DELIVERIES

With successful operation of the Hilton Creek Watering System, conjunctive use of the Fish Reserve Account and the Downstream Water Rights Releases should not have a significant impact on the delivery of State Water to the Cachuma Project. State Water deliveries should be unimpeded when releases from the Fish Reserve Account and the Downstream Water Rights Releases are 10 cfs or less and 44 cfs or greater. At releases between 10 cfs and 44 cfs, State Water deliveries at amounts less than the maximum of

22 cfs may be possible depending on the mix of the releases using the Hilton Creek Watering System and Bradbury Dam's outlet works. The Central Coast Water Authority should be able to develop a schedule in all years that allows complete delivery of requested State Water to Cachuma Reservoir by the South Coast participants in the State Water Project.

### 4.3.4 Emergency Winter Operations

Emergency winter operations of Bradbury Dam to respond to high reservoir storage and high levels of stormwater runoff have been implemented as part of project operations minimize threats to life and property. These operations will result in increased short-term releases from Bradbury Dam to the lower Santa Ynez River prior to winter storms in an effort to provide additional short-term storage within the reservoir. These operations do not affect the total volume of water moving through the system, only its temporal distribution. Runoff from the storm will then be released more gradually than under current operations. This will have the effect of increasing the duration of storm flows, but decreasing their magnitude. Emergency reservoir operations are expected to be limited in duration to a period of hours or at most, 2 or 3 days. Based upon a review of historical hydrology, reservoir operations, and Santa Ynez River modeling results, it is anticipated that emergency reservoir operations will occur in approximately 3 percent of years.

Emergency reservoir operations will occur only when reservoir storage is high, stormwater runoff is high (15,000 to 20,000 cfs into Lake Cachuma), and naturally-occurring flow within the lower Santa Ynez River is at high levels. During this time, streamflows within the lower Santa Ynez River characteristically fluctuate substantially over the course of hours or days in response to fluctuating precipitation and runoff patterns. Emergency releases from storage are anticipated to occur within the naturally-occurring range of streamflow fluctuations occurring during winter periods. Under these environmental conditions, emergency reservoir operations are not anticipated to adversely affect adult steelhead migration or spawning activity.

### 4.3.5 Maintenance Activities

Routine maintenance activities at Bradbury Dam are not expected to affect steelhead or other protected species. These activities will occur only when water is not being released through the outlet works.

Maintenance of low flow crossing will not occur between January and May. As a result there would be no affect to migrating adults, spawning, egg development or emergening alevins.

During maintenance or upgrade of the low flow crossing, sediment would be loosened from the river substrate and released into the water column. While this effect would likely be minor and temporary, it will be minimized by the installation of filter fences below the work area. Any sediment stirred up will be carried downstream into filter fences, where the mojority of it will settle out. A small amount of sediment may be carried beyond the filter fence but the duration and intensity would be minor. Fish would flee the area and avoid it during the maintenance and/or installation of the culverts. No Steelhead are not expected to be affected as a result of these actions.

### 4.4 CUMULATIVE EFFECTS WITH OTHER ACTIVITIES IN THE BASIN

The potential cumulative effects of the proposed project were assessed in conjunction with other actions that have a reasonable certainty of occurring. These may include the water rights hearings before the SWRCB, flood control activities by the County land use changes and population growth.

The SWRCB will conduct hearings to address issues related to the use of Santa Ynez River water for the Cachuma project, water rights downstream of Bradbury Dam, and the protection of public trust resources in the lower river and Lake Cachuma. The SYRTAC is currently developing the Santa Ynez River Fish Management Plan to provide recommendations to the SWRCB. The Plan is being developed in conjunction with the proposed project and conservation measures in this Biological Assessment. The SWRCB's decision is expected to be consistent with the requirements that NMFS will establish in its Biological Opinion, therefore, the cumulative effects of these two processes on steelhead is expected to be beneficial.

Flood control activities along the mainstem Santa Ynez River are another potential cumulative effect. As reviewed in the Contract Renewal EIS/EIR (Woodward-Clyde Associates et al. 1995), the river channel capacities vary greatly along the Santa Ynez River below Bradbury Dam. With the exception of the 1969 floods, which devastated the Lompoc Valley, river channel capacities have been adequate to pass historic flood flows without damage to urban areas such as Solvang, Buellton, and Lompoc. However, past flood events have caused flooding and erosion to undeveloped and agricultural lands at various locations, as well as damage to numerous bridges including Refugio Road, Alisal, Robinson (Highway 246), Floradale (Lompoc), 13th Street (Vandenberg AFB), and Southern Pacific Railroad bridges.

Flooding of agricultural lands west of the Lompoc Regional Wastewater Treatment Plant is of particular concern. Riparian growth in the channel has been enhanced by the effluent, which has created a flood hazard by reducing the conveyance capacity and water velocities, and increasing sediment deposition. The river channel capacity in this area is currently below 20,000 cfs (Woodward-Clyde Associates et al. 1995). In December 1989 and January 1992, the Santa Barbara County Flood Control District cut the vegetation to temporarily improve conveyance. Flooding of farmlands occurred despite this activity.

The District has expressed concern about the effects of conjunctive releases from Bradbury Dam on riparian vegetation and consequently channel capacity for flood conveyance (Fausett 1997). The proposed project will not increase the flood hazard below Lompoc, which is the area of greatest concern, as no change in flow is anticipated in this release. The presence of perennial flow would, however, potentially stimulate riparian growth in reaches closer to Bradbury Dam. The 1997 vegetation monitoring study concluded that increased vegetation along the low-flow channel at the Highway

154 Bridge is unlikely to be an important factor for flood carrying capacity because channel incision and lack of upstream sediment supply have probably resulted in an increase in channel cross sectional area (Jones & Stokes Associates 1997). No other conclusions were drawn in this report regarding flood flows. While the flood hazard is not as great in the upper mainstem as it is near Lompoc, the County may deem it necessary to cut back some or remove vegetation if growth becomes very dense. The outcome could be a reduction of riparian vegetation to levels similar to pre-project implementation. Therefore, the cumulative effect of the proposed project and flood control activities would be similar to the baseline Cachuma project operations.

Changes in agricultural land use have the potential to affect the project in the future by changing demands for irrigation. The Santa Ynez Watershed contains approximately 576,000 acres. In 1995, 28% (160,500 acres) of these lands were rangelands, 15% (89,200 acres) were wildlands, 9% (53,200 acres) were irrigated crops, including vegetables, flowers and some orchards and vineyards. Less than 1% of the lands (3,600 acres) were dry farmed (e.g. oats, beans) (Natural Resources Conservation Service 1995). One recent development has been the expansion of vineyards in the Santa Ynez Valley. Once they are established, grapevines require an average of 2 AF of water per acre per year, which is less water than required by many vegetables (1.5 AF/acre per year for lettuce to 2.5 AF/acre per year for cauliflower) or alfalfa and irrigated pasture (3.5 to 3.7 AF/acre per year) (University of California Cooperative Extension, Santa Barbara County in Woodward-Clyde Associates et al. 1995). Conversion of existing cropland to vineyards would, therefore, reduce demands for irrigation water, which is primarily supplied from groundwater basins that are recharged by releases from Lake Cachuma. On the other hand, conversion of rangeland to irrigated vineyards could increase demand for irrigation. However, because of high property values in the Santa Ynez Valley, the trend to convert non-irrigated rangelands to vineyards has been slow, compared to other parts of the County, and it is expected that the percentage of rangelands will remain largely unchanged (J. Bechtold, NRCS, pers.comm. 1999).

Finally, population growth and its related development continues to increase, especially in and around the cities of Buellton, Santa Ynez and Lompoc. The Santa Barbara County Planning Department expects to process 700 applications for residential units in the next couple of years. Average water use for a single family dwelling in Santa Barbara in 1998 was 1,100 cubic feet per month. Average water use for a multifamily dwelling for the same period was 600 cubic feet per month. Using these averages, water demand for residences can be expected to increase by 150-200 acre feet per year in the next several years. However, Vandenburg Village, where many of these homes will be built, has requirements that there be no net increase in water use with the project, and therefore the increase in future water demand may not be as great.

An extensive body of scientific information regarding habitat characteristics, fisheries resources, water quality (e.g., water temperature and dissolved oxygen concentrations), hydrology, and reservoir operations has been developed on the lower Santa Ynez River. The best available scientific information was compiled and synthesized from these previous investigations for use by an interdisciplinary team of scientists and engineers to propose changes to project operations and develop reasonable conservation measures as the basis for analyzing and evaluating potential environmental benefits and/or impacts of the Plan to steelhead and other protected species, when compared with environmental baseline conditions. Results of this biological assessment have shown that the Plan will benefit the steelhead population both directly and indirectly by (1) increasing habitat availability and quality, (2) reducing mortality associated with declining water levels or water quality, (3) increased public awareness and support of beneficial actions, and (4) support for voluntary actions to improve habitat on private lands. The conservation measures of the Plan are outlined below:

Habitat improvements will result in a direct increase in the availability and quality of habitat for steelhead. Actions include:

A. Provision of a Fish Reserve Account to provide up to 5,500 acre feet (AF) in years when the reservoir spills, 2,000 AF in years when reservoir storage is more than 120,000 AF, and decreasing it below 2,000 AF on a pro-rata basis with the Member Units in years when storage is less than 100,000 AF. Additionally, the Fish Reserve Account will be able to carry over water from one year to the next. This account provides a dedicated supply of water to be used for improvement of steelhead habitat downstream of Bradbury Dam, including Hilton Creek. Surcharge of the reservoir to 1.8 feet will provide water to the account in years when spill occurs.

B. Conjunctive use of water rights releases and the Fish Reserve Account to extend the period of time each year when instream flows improve habitat for steelhead rearing in Hilton Creek and the mainstem river to provide improved conditions and protection for steelhead. As a part of the proposed conjunctive operation, releases into Hilton Creek and below Bradbury Dam will not be deducted from the Fish Reserve Account when they are scheduled to coincide with water right releases. Instead, they will be accounted for as water right releases for the Above Narrows area. Modifications to reservoir operations will provide sustained target flows via Hilton Creek and/or the mainstem Santa Ynez River of approximately 2.5 to 5 cfs at Highway 154 depending on reservoir elevation, or of approximately 10 cfs at Highway 154 Bridge in years when the dam spills. Releases only will be made in critically dry years to refresh mainstem habitat near Bradbury Dam. Conjunctive use will provide substantially more habitat in the critical late summer months than Baseline or Historic conditions.

C. Modifications to Hilton Creek to provide habitat which has not previously existed through establishment of a reliable water supply meeting specific temperature and dissolved oxygen criteria; providing passage over a partial passage barrier at the chute pool to provide access to approximately 2,400 feet of upstream habitat; and construction of a 1,500-foot long channel extension, designed and managed specifically to provide steelhead spawning and rearing habitat.

D. Protection and enhancement of steelhead spawning and rearing habitat in tributaries through the establishment of conservation easements along approximately 6-8 miles of stream in the El Jaro watershed, and implementation of habitat improvements along those easements, such as riparian planting, structural improvements to instream habitat, and bank stabilization.

E. Removal of fish passage impediments in the tributaries to provide complementary benefits by enhancing the availability and quality of habitat for steelhead spawning and rearing.

F. Structural improvements in mainstem pools to increase the amount of suitable habitat.

G. Public education and outreach will provide direct and indirect benefits to steelhead resulting from increased awareness of local landowners and the public regarding types of actions and land-use practices which will benefit steelhead, and increased awareness and sensitivity regarding impacts to the population resulting from recreational and illegal harvest. This effort is anticipated to provide increased political support for obtaining additional funding for habitat improvement projects on the mainstem and tributaries, and other actions designed to protect and improve steelhead habitat.

## 6.1 INTRODUCTION

The proposed modifications to project operations and the associated proposed conservation measures will be implemented in a phased approach. Those measures that do not require the construction or modification of facilities will be implemented immediately. A schedule for accomplishing those measures requiring the construction of facilities has been established for those that are planned for Reclamation property. And proposed for conservation measures that require the active involvement of other agencies or private landowners will be established in consultation with the landowners, agencies and NMFS.

Funding for the proposed conservation measures is available from Reclamation, the Member Units, the Cachuma Project Contract Renewal Fund, CCWA's Warren Act Trust Fund, and Santa Barbara County. Additional funding will be sought from state and federal sources and private foundations. DF&G has awarded Cachuma Operations and Maintenance Board and Reclamation $50,000 to design and construct the fish passage facilities for Hilton Creek.

This section of the report is organized into subsections that progress from operations and conservation actions which can be implemented immediately, to those that are in the planning stage and will be implemented within the next three to five years. Sections are followed by discussions of the funding mechanisms for the action, how NMFS will be kept apprised of activities undertaken, and the administration of the actions approved in the Biological Opinion.

## 6.2 RESERVOIR OPERATIONS

### 6.2.1 WATER DELIVERIES FROM LAKE CACHUMA

Action. Water deliveries to Member Units and releases from water rights accounts (for downstream water rights) and from the Fish Reserve Account (for target flows) will continue with increased shortages to Member Units during dry cycles.

Schedule. Operations are currently in place with Reclamation making deliveries to contractors and releasing water for downstream interests and fish.

### 6.2.2 EMERGENCY WINTER OPERATIONS

Action. Subject to approval from Reclamation and other interested parties, emergency winter operations may be implemented, if needed, to protect life and property. These operations will produce relatively minor streamflow fluctuations for a few hours during large storm events. These fluctuations will be well within the range of naturally occurring streamflow fluctuations in the lower Santa Ynez River.

Schedule. These operations may be undertaken during large winter storms beginning in 1999-00 if needed.

Biological Benefit. See Section 6.3, Conjunctive Operation, below. Emergency operations are not anticipated to affect steelhead.

## 6.3 CONJUNCTIVE OPERATION OF WATER RIGHTS RELEASES WITH FISH RESERVE ACCOUNT

### 6.3.1 SURCHARGING THE RESERVOIR

Action. In years when the reservoir spills, the reservoir will be surcharged 1.8 feet to store additional water for the Fish Reserve Account. Prior to surcharging, flashboards will be added to the spill gates at Bradbury Dam. This will not require any substantive changes to the gate structure and will be accomplished prior to January 1, 2001.

Schedule. Reclamation will surcharge the reservoir to a level of 0.75 feet if water is available beginning in 1999. Surcharging will be carried out at the new 1.8 foot level in subsequent years when there is sufficient runoff to cause the reservoir to spill beginning in January 2001.

Biological Benefit. Surcharging the reservoir will provide up to 5500 AF of water for the Fish Reserve Account which will be used to enhance rearing and spawning habitat for steelhead. Some of this water will be carried over for use in subsequent dry and normal years.

### 6.3.2 FISH RESERVE ACCOUNT

Action. Reclamation will establish a storage account in the reservoir dedicated to fish needs as follows: 5,500 AF in years when the reservoir spills and 2,000 AF in years when storage exceeds 120,000 AF. In years when reservoir storage is less than 100,000 AF, the fish account shall be allocated 2,000 AF minus the same proportional shortage experienced by the Member Units. The water not used in one year could be carried over to the next year. If the reservoir spills, the Fish Reserve Account will be deemed to spill and the account will be reset to the amount surcharged (up to 5,500 AF). Neither evaporation nor seepage losses will be deducted from this account.

Schedule. The allocation for the Fish Reserve Account will be changed as indicated above as soon as the Biological Opinion is finalized.

Biological Benefit. Water released from Cachuma Reservoir into Hilton Creek or into the Stilling Basin will increase the amount of summer rearing habitat available to steelhead in Hilton Creek and in the Santa Ynez River.

### 6.3.3 Conjunctive Use of the Fish Reserve Account and the Downstream Water Rights Releases

Action. In years when water rights releases are made, the Fish Reserve Account will be used conjunctively with these releases to provide target flows at the Highway 154 Bridge or at the Alisal Bridge during the summer period (May through October). The releases will be made through the outlet works, or the Hilton Creek watering system to provide a target flow of 5 cfs at the Highway 154 Bridge when the storage in Cachuma Reservoir is above 120,000 AF. When storage is less than 100,000 AF, a target flow of 2.5 cfs will be maintained at Highway 154. In years when spills occur, releases will be made to maintain a target flow of 10 cfs at the Alisal Bridge. To the extent that these releases are made through the Hilton Creek watering facility, these releases will be limited to 10 cfs.

Schedule. Conjunctive use of the fish and downstream water rights accounts will begin during the summer of 1999 if water rights releases are made.

Biological Benefit. Conjunctive use of the Fish Reserve Account and downstream water rights releases will provide substantial benefit to steelhead populations through the creation of year-round rearing habitat in Hilton Creek and the mainstem from Hilton Creek to at least Highway 154 in all but critically dry years. Additional habitat will also be provided in the Refugio and Alisal reaches of the mainstem. In wet years, higher flow target levels will provide more habitat than in normal and dry years. This leverages the use of water to provide higher levels of habitat when there will likely be more steelhead in the river, and providing less habitat when there are fewer steelhead in the river and water supplies are lower.

## 6.4 Conservation Actions to Protect Steelhead

### 6.4.1 Supplemental Watering System for Hilton Creek

Action. Reclamation is constructing a supplemental water supply that will provide water directly to Hilton Creek and/or to the Stilling Basin. The supplemental water system will have three delivery points, two in Hilton Creek that can used to maximize habitat availability and minimize thermal loading from solar radiation and one to the Stilling Basin to provide improved water quality conditions when necessary. A second phase of the supplemental watering system is the installation of a pump to allow delivery of water to Hilton Creek at lake elevations below 719 ft. With a pump, water deliveries can be made down to lake elevations of 665 ft.

Schedule. The supplemental water system is currently under construction and will be operational beginning in the summer of 1999. Installation of the pumping facilities is planned for 2002.

Biological Benefit. The supplemental water system will provide a dependable year-round source of cool water to enhance stream habitat for spawning and provide year-round habitat rearing steelhead in lower Hilton Creek, currently an ephemeral stream. The gravity feed system would allow delivery of water to Hilton Creek in 65 percent of the years and the addition of the pump would allow delivery in approximately 98 percent of the years.

### 6.4.2 HILTON CREEK CHANNEL EXTENSION AND FISH PASSAGE PROJECT

Action. Reclamation will design and construct a channel extension for Hilton Creek and will design and construct a fish passage facility at the "chute pool".

Schedule. Reclamation has initiated the planning and design process for these facilities and expects construction and operation in the year 2001.

Biological Benefit. The channel extension will provide an additional 1,500 feet of rearing and spawning habitat for steelhead. The fish passage facility will allow access to an additional 2,400 feet of existing channel.

### 6.4.3 HABITAT ENHANCEMENTS ON RECLAMATION PROPERTY

Action. Reclamation will develop and implement a habitat enhancement plan for their property located downstream from Bradbury Dam. Habitat enhancements are likely to include pool habitat enhancement, placement of cover objects and riparian enhancement.

Schedule. Reclamation is currently reviewing enhancement options and will develop a plan by 2000 with implementation planned for the year 2001. Implementation will closely follow approval of the Plan by NMFS and other state and federal resource agencies.

Biological Benefit. Habitat improvements on Reclamation property will improve the quality of steelhead habitat. Additional shading from riparian enhancement will help protect water temperatures and additional cover objects will reduce predation risks from bass and other predators.

### 6.4.4 FISH RESCUE MEASURES

Action. Steelhead will be collected and moved to perennial habitat if it becomes apparent that habitat conditions are degrading to the point where steelhead could be lost. To enhance survival following transfer to a new site, predatory fish may be removed prior to transferring young rainbow trout/steelhead.

Schedule. Rescue activities will be conducted on a case by case basis as the need arises in consultation NMFS and other state and federal resource agencies (and private landowners, if appropriate) beginning in 1999. Predator control activities may be conducted on a case by case basis at relocation sites to minimize predation in the short term.

Biological Benefit. Fish that would have been lost from the population are provided with access to suitable habitat conditions. Removal of predators from relocation sites will reduce mortality rates of young steelhead while predator populations remain low. This activity is anticipated to have only short-term effects, however, as predator populations may be re-seeded from the lake or other areas of the river.

### 6.4.5 CONSERVATION EASEMENTS AND HABITAT ENHANCEMENT ON TRIBUTARIES

Action:. Reclamation and the member units will pursue the establishment of conservation easements on private lands. The first priority for the establishment of conservation easements will be tributary habitats. Reclamation is in discussion with landowners on El Jaro Creek. As part of the program, Reclamation will consider in consultation with NMFS appropriate actions on the easements to promote the restoration of habitat values that benefit steelhead.

Schedule. Actions on private lands will be implemented within the constraints and schedules established by landowners, permitting processes and funding availability. The easements on El Jaro Creek and its tributaries are under discussion. Reclamation expects to have obtained property appraisals on El Jaro Creek property by fall of 1999 and will engage in contract negotiations at that time. These actions will be funded in part from the Trust and Renewal Funds, CCWA's Warren Act Trust Fund, and in part from additional funding that can be secured.

Biological Benefit. Much of the potential steelhead habitat in the Santa Ynez River basin is located on private lands. Facilitation of habitat enhancements on private property will benefit steelhead in the Santa Ynez River and promote their recovery.

### 6.4.6 PUBLIC EDUCATION AND OUTREACH PROGRAM

Action. Reclamation, the Member Units, and SYRWCD will develop a Public Education and Outreach Program to explain the activities related to protection of steelhead and solicit volunteer action from private property owners to improve steelhead habitat. Reclamation will facilitate habitat enhancement actions on private property by providing information on potential habitat enhancement actions through the Public Education and Outreach Program, by providing technical assistance in designing and implementing the actions and by providing assistance for acquiring public funds such as the NRCS habitat programs or by providing funding for approved activities.

Schedule. Reclamation is proceeding with public workshops to inform the public and solicit public input. Three public meetings have been held to discuss conservation measures. Additional materials are being prepared and future workshops are planned.

Biological Benefit. Much of the promising steelhead habitat in the Santa Ynez River drainage is located on private lands. Providing information on land management actions that are compatible with the enhancement of steelhead habitat will greatly increase the value of the habitat for steelhead. Conducting habitat enhancement actions on private lands with the voluntary participation of landowners will benefit steelhead.

## 6.5 PROGRAM FUNDING

Reclamation is proposing to fund the conservation actions from the Renewal Funds of the Project and from the Warren Act Trust Fund. These funds are presently administered by COMB and overseen by the Trust and Renewal Fund Committee and Advisory Committee. These funds were established in 1996 during the contract renewal process to provide money for enhancement and watershed improvements and come from an assessment on water taken from the Project ($10 per AF) and on use of the reservoir for delivery of State Water ($43 per AF), providing $257,000 to $500,000 per year. The SBCWA is also required under a contract with Member Units to provide $100,000 annually for projects that may include conservation-type activities related to the Cachuma Project. Allocation of these funds for specific projects requires consensus by the County and Member Units, subject to public input. In the future, approximately $300,000 per year will continue to be dedicated to steelhead conservation.

In addition to these funds, Reclamation and the local water agencies are seeking additional funds from other sources, such as the State's Watershed Restoration and Protection Council, DFG's Salmon and Steelhead Restoration Program, and EPA's Watershed Improvement Program to supplement funds available from local sources.

## 6.6 REPORTING

Reclamation will prepare annual progress reports (due March 31) discussing the status of operational and structural elements of the Plan implemented during the previous calendar year and outlining plans for the current calendar year. This report will be provided to NMFS. Status reports on implementation of the conservation actions, identification of potential modifications to Plan elements, and results of ongoing scientific investigations from the lower Santa Ynez River will be included as part of this report.

## 6.7 ADMINISTRATION OF THE PLAN

The scientific direction for the design, development and implementation of the conservation actions, including decisions regarding allocation of the Fish Reserve Account, will be coordinated through the SYRTAC and the Consensus Committee. Overall coordination and administration of Plan activities, including supervision of the design and construction of structural elements of the Plan and securing right-of-way and easements, will be performed by Reclamation and COMB.

We recommend that the Plan, as presented, be incorporated into a biological opinion, issued by the NMFS to Reclamation as part of the Section 7 consultation. This should include incidental take authorization for steelhead as part of Plan activities, including the ongoing scientific monitoring and data collection activities.

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# REVISED SECTION 3 (PROPOSED PROJECT) OF THE BIOLOGICAL ASSESSMENT FOR CACHUMA PROJECT OPERATIONS AND THE LOWER SANTA YNEZ RIVER

*Prepared for:*

**NATIONAL MARINE FISHERIES SERVICE**
Long Beach, CA

*Prepared by:*

**U. S. Bureau of Reclamation**
Fresno, CA

**June 13, 2000**

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The action being evaluated in this Biological Assessment includes the existing project operations described in Section 2.6, modification to these operations as presented below, and a number of measures to address potential impacts from Cachuma operations, as well as conservation measures intended to protect and enhance habitat conditions for steelhead. This section first reviews proposed changes in the operations of the Cachuma Project. This section then outlines the proposed actions including conjunctive operations of water releases for downstream water rights, fish passage, and enhancement of fish habitat in the mainstem Santa Ynez River. Several additional conservation measures have been designed to protect and enhance steelhead habitat on Reclamation property at Hilton Creek, as well as on tributaries that provide the majority of the spawning and rearing habitat available to anadromous steelhead. Reclamation and the Cachuma Member Units have reviewed the Proposed Operations and the associated conservation measures to protect steelhead, and fully endorse and support their implementation. The Santa Ynez River Water Conservation District supports the elements of proposed operations applicable to its functions, namely the conjunctive use of the downstream water rights releases with the Project releases to meet rearing target flows. Elements of the Proposed Operation and conservation measures are discussed below.

## 3.1 PROPOSED RESERVOIR OPERATIONS

The significant changes to reservoir operations (from the baseline condition) include the addition of a surcharge in spill years, rearing target flows in the mainstem, and the establishment of two environmental enhancement accounts (Fish Passage Account and Adaptive Management Account) to provide water for the protection of aquatic resources downstream of Bradbury Dam. Changes have also been made to existing emergency winter storm operations and CCWA delivery operations described below.

### 3.1.1 WATER SUPPLY AND WATER STORAGE

Cachuma Project Members will continue the baseline-level draft of 25,714 acre-feet (AF) per year from the Project for water supply (see Section 4.3 for discussion of higher shortages). Water storage levels in the reservoir should be similar to past levels with the exception of a higher starting level in years where surcharge is possible.

### 3.1.2 DOWNSTREAM WATER RIGHTS RELEASES

Under the Proposed Operations downstream water rights releases occur in a manner similar to the baseline operation. Because of the target flows for fish, smaller downstream releases to replenish the upper segment of the Santa Ynez riparian groundwater basin below the dam will likely not be needed in most years. The other main difference will be a formal ramping policy for the transition between downstream water rights releases and fish releases to minimize the potential for stranding.

### 3.1.3 EMERGENCY WINTER OPERATIONS

In very wet winters, such as 1998, the normally available space in the reservoir may be filled early in the winter and increase the likelihood of large, potentially damaging runoff events in the subsequent months. During these winters, modified operations can provide substantial health and safety benefits to the area downstream of Bradbury Dam. After the 1998 storms, Reclamation, the Member Units, Santa Barbara County Flood Control, the City of Lompoc, and the SYRWCD entered into discussions to formulate a program defining these operational modifications. As an outcome of these discussions, the Santa Barbara County Flood Control and Water Conservation District and Water Agency prepared a report of modified storm operations for Bradbury Dam (SBFCWCDWA 1998). The report summarizes operational changes to be implemented in the appropriate conditions to protect downstream health and safety.

The modified operations provide for releases of water through the spillway gates at Bradbury Dam (and past the areas downstream with flow capacity limitations) before or after the anticipated peak reservoir inflows. Three operation changes may be employed individually or in concert:

1. pre-storm reservoir drawdown of up to several feet, or "precautionary releases";

2. release of storm inflows up to a calculated maximum flow while holding reservoir below normal operational level, termed "pre-releases"; and

3. after lake reaches above-full condition, hold spillway gates to achieve extra reservoir surcharge, "gateholding".

The first two operational changes release water at Bradbury Dam before the peak inflow; the third holds water in the reservoir for release after peak inflow. Each of these techniques is discussed below.

#### 3.1.3.1 Reservoir Drawdown Below Elevation 750 Feet. (Precautionary Releases)

Temporary evacuation of water to lower the lake elevation a few feet provides storage for initial detention of runoff from the expected storm. This allows subsequent runoff to occupy that space thus keeping reservoir water level from rising as much during the early part of the storm. Used in concert with releases of initial storm runoff ("pre-releases"), maximum lake level rise during the storm runoff event (thus gate opening) can be reduced.

#### 3.1.3.2 Early Releases of Storm Inflow From Rainfall in Upper Watershed (Pre-Releases)

The concept of this second procedure is routing early storm runoff more quickly through the reservoir so as to reduce the maximum lake level during peak storm inflow, thus reducing peak storm release. This operational modification releases water at a rate greater than the historic rule curve during early phases of storm runoff and must be limited by accurate knowledge of downstream channel capacity and flow conditions. Since the release rate is determined from measurements of actual rainfall and watershed condition, there is no risk to water supply from this modification.

#### 3.1.3.3 Temporary Surcharge (Gateholding)

Gate design and operation at Bradbury Dam allow surcharge of the reservoir. That means that the reservoir level can be controlled so that water level could be raised above the normal operation level at any gate opening (release rate) without overtopping the release works or embankment. This allows releases to be held significantly below inflow during the period of peak inflow. In conjunction with lake level lowering and early runoff releases, gateholding will maximize the reduction of the downstream flow rate. Since this operational modification occurs during a spill condition, there is no risk to water supply.

#### 3.1.3.4 Integration of Operational Modifications

The three elements of modified operations discussed above exhibit synergy; they are more effective in reducing peak outflow when used together during the same storm than if used only singly or two together. Physically, these modifications reduce peak downstream flows by temporarily storing peak inflow in the reservoir and releasing it at a reduced rate. Precautionary releases and release of early storm inflow make additional storage available by releasing water from the reservoir before the peak storm inflow. This is accomplished by releasing water before and at greater rates than required by the original rule curve. Gateholding reduces and attenuates flood releases during peak inflow. Each of these techniques performed alone will reduce peak storm release. However, performed together, the reduction of peak release is greater than simply adding the expected effects together, because each technique allows the subsequent operation to start at a lower lake level. These operations will not affect the total volume of storm flow passing through the system, only its temporal distribution for a few days.

#### 3.1.3.5 Factors Considered for Operational Decisions

To protect water supply and to be certain that modified operations do not add to peak downstream flows, several important factors are evaluated as part of and during the modified operations. These factors are:

- quantitative precipitation forecasts (QPF) for each storm.
- watershed conditions, particularly remaining watershed runoff.
- downstream tributary response to precipitation (both predicted and actual).

During two large storm events in February 1998, the historic operation of Bradbury Dam (Lake Cachuma) was modified to reduce downstream flow in the Santa Ynez River through a combination of these three changes to the "normal operations". The results of these modifications indicate that peak storm flows can be reduced up to 40 percent compared to the existing standard operations, thereby reducing coincidental flood damage downstream of Lake Cachuma.

Analysis of historic flow and precipitation data indicate that significant flows above Lake Cachuma needing this sort of modification occur relatively frequently (Table 3-1), but are not regular events. Since the dam began storing water in November 1952, there have been 14 storms during which the emergency winter operations would have been implemented. In seven of these

**Table 3-1. Significant Flow Events in the Santa Ynez River at Los Laureles and Solvang Gages, 1952-Present.**

| Storms That Produced Flows Exceeding 20,000 cfs | | | |
|---|---|---|---|
| **Year** | **Date** | **Los Laureles (above Cachuma)** | **Solvang (below Cachuma)** |
| 1966 | December 6 | X | |
| 1969 | January 21 | X | |
| 1969 | January 25-26 | X | X |
| 1969 | February 24-25 | X | X |
| 1978 | February 10 | X | |
| 1978 | March 4 | X | X |
| 1983 | March 1-2 | X | X |
| 1992 | February 12 | X | |
| 1995 | January 10 | X | X |
| 1995 | January 24-25 | X | |
| 1995 | March 11 | X | |
| 1998 | February 1-2 | X | X |
| 1998 | February 6-7 | X | |
| 1998 | February 23-24 | X | X |

storms, there was sufficient storage space in the reservoir to detain the bulk of the runoff and thereby reduce flooding downstream of the dam. In the remaining seven storm events, the modified operations could have substantially reduced flood peaks, thereby reducing the potential damage downstream.

These modified operations are possible because of advancements in technology, including rainfall and stream flow monitoring capability as well as a flood routing model developed by the Santa Barbara County Flood Control and Water Conservation District.

Modified operations will be considered during storm events where the predicted magnitude of inflow to Lake Cachuma exceeds 15,000 to 20,000 cfs. Actual implementation will depend on a variety of factors as previously discussed.

At the conclusion of a large spill event such as those described above, the recession of spills from Cachuma Reservoir can be ramped down gradually based on the projected inflow to the reservoir. The recession hydrograph of inflow to Cachuma Reservoir is relatively predictable and can be used in the reservoir operation to regulate the recession end of a spill. Under the proposed operation, the surcharge storage space should be utilized to ramp down the spills while creating the surcharge. For example, storage surcharge and ramp-down may begin at a discharge rate of approximately 300 cfs. Based on projected recession hydrograph of inflow, the storage and release from the surcharge can be used to regulate the ramping of spills down to about 30 or 50 cfs.

### 3.1.4 Maintenance Activities

Various maintenance operations must be conducted at regular intervals to ensure that the Cachuma Project can operate as designed and meet its obligations to the Member Units and the downstream accounts. These maintenance activities include:

- Inspect and test annually High Pressure Gate Assembly with Hydraulic Hoist located at Outlet Works Gate Chamber. Operate gates one at a time from full close to full open. Performed only when two hollow jet valves & butterfly value are closed.Annually test the two 30" hollow jet valves. Test from full closed to full open only when conduit is drained.

- Annually test 10" butterfly valve. Test from full close to full open only when conduit is drained.

- Annually lubricate fittings on machinery deck and trunnion.

- Test and calibrate meters

- Inspect trunnion anchor block four times per year (March, June, Sept, Dec)

- Weekly operate and test radial gate motors during spill release.

- Radial gates are left in open position until spill conditions then are operated/tested according to spill release.

These maintenance activities will not result in discharge to the river, except during spills.

Reclamation will sustain the low-flow crossing and will upgrade it as needed for future projects. Any upgrading would only occur between June and December and include sediment controls. This action would consist of placing washed small cobble (4 to 6 inches) in the Santa Ynez River. If needed for a specific project, vaulted culverts compatible with NMFS standards for culverts would be installed. Filter fences would be installed to trap displaced sediment during this operation.

## 3.2 FISH ENHANCEMENT OPERATIONS IN THE MAINSTEM

Reclamation is proposing to surcharge Lake Cachuma and use the surcharged water to provide habitat and fish passage enhancement in the lower Santa Ynez River. Implementation of the surcharge requires environmental review and compliance, and construction of flashboards to enable a surcharge. Because implementation of additional surcharge requires facility modifications, Reclamation has developed interim operations to provide increased habitat and passage opportunities.

Interim actions identified to protect and enhance habitat conditions for steelhead within the lower Santa Ynez River have been developed based on results of scientific investigations performed by the Santa Ynez River Technical Advisory Committee (SYRTAC) in combination with extensive hydrologic modeling to evaluate the feasibility and water supply impacts associated with various alternative interim actions. Field fisheries investigations have identified factors such as elevated summer water temperature in affecting habitat quality and availability, particularly for summer steelhead rearing. The investigations have also identified the best available habitat for juvenile steelhead rearing as the reach of the lower Santa Ynez River between Bradbury Dam and Highway 154, and within tributaries such as Hilton Creek. The interim plan of action is designed to protect and enhance these high-value habitat areas using resources and modifications to existing operations under the direct authority of the U.S. Bureau of Reclamation with support of the Santa Ynez River water users.

Based on the SYRTAC investigations a number of instream flow and non-flow actions have been identified that provide fisheries benefit, with specific emphasis on steelhead. Design and construction of the Hilton Creek watering system and the allocation of 2000 acre-feet of water stored in Lake Cachuma (Fish Reserve Account) for use by the SYRTAC for steelhead protection, habitat enhancement, and experimental investigations are examples of actions taken over the past several years to improve conditions on the lower Santa Ynez River for the protection of steelhead.

The proposed interim plan builds on the fishery actions already implemented within the Santa Ynez River to provide the greatest benefits possible to steelhead on a short-term basis within the constraints of reservoir facilities, hydrologic variability within Santa Ynez River watershed, and water supply operations. The fundamental objective of the proposed program of additional interim actions outlined below, in combination with the fishery actions taken to date, is to protect the Santa Ynez River steelhead population at a level sufficient to avoid jeopardy.

Building on the foundation provided by the interim actions, the proposed project will then further enhance instream flow and non-flow actions within the Santa Ynez River as additional facilities (e.g., the facilities necessary to further surcharge Bradbury Dam) and other habitat improvements (e.g., construction of fish passage facilities within the tributaries) are developed as part of the longer term program of steelhead habitat enhancement. The additional facilities and operational flexibility provided through the long-term plan will substantially improve instream flow conditions for various life stages of steelhead in combination with the habitat improvement measures.

Together, these short- and longer-term actions are intended to (1) avoid jeopardy to steelhead, and (2) substantially enhance habitat conditions for steelhead in an effort to promote recovery of the Santa Ynez River steelhead population and its contribution to the Southern California Steelhead Evolutionarily Significant Unit (ESU).

### 3.2.1 SURCHARGE

The storage capacity in Lake Cachuma can be increased by surcharging the reservoir. The additional water stored will be dedicated to reducing the yield impacts of releases for fish habitat enhancement purposes. Currently, Reclamation can surcharge Lake Cachuma to 0.75 feet above elevation 750.0 feet, yielding approximately 2,300 acre-feet of additional storage in Lake Cachuma in years when the reservoir spills. About 5,500 acre-feet of storage is provided by a 1.8 foot surcharge. A surcharge of 3.0 feet would provide additional conservation storage of about 9,200 acre-feet above the reservoir full level (above water surface elevation of 750.0 feet). Operations modeling for the 1918 to 1993 period of record indicates that this level of surcharge would likely occur in 24 out of 75 years (32 percent of years).

For surcharge to occur, the environmental review must be completed, the flashboards must be constructed, and there must be an opportunity to surcharge the reservoir. Reclamation has resolved issues associated with the 1.8 foot surcharge. Surcharging the reservoir to 1.8 feet was evaluated in the EIR/EIS for the Cachuma Reservoir Contract Renewal (Woodward Clyde Consultants 1995). Surcharging the reservoir to a level higher than 1.8 feet (i.e. elevation 753 feet) will require disclosure of potential effects on the human environment, including flooding of some county park facilities, and effects on sensitive resources such as oak trees (NEPA compliance). Reclamation expects to complete resolution of the issues associated with the 3.0 foot surcharge during the five year interim period. Reclamation has already determined that it is feasible, from and engineering perspective, to make the appropriate spillway gate modifications for either the 1.8 or 3.0 foot surcharge (Reclamation 1998b). Evaluation of potential effects on the human environment, under NEPA, for the 3.0 foot surcharge will be evaluated by Reclamation. CEQA review will be accomplished by the EIR currently in process by the State Water Resources Control Board.

The long term operations will occur when the reservoir has surcharged to the 3.0 foot level, thus storing an additional 9,200 acre-feet of water. Reclamation has proposed operations changes to benefit steelhead and their habitats in the interim period. Reclamation anticipates that environmental review and construction required to implement the 3.0 foot surcharge will be in place by 2004 with the implementation of the long-term operations proposal expected in 2005, should the reservoir be surcharged in spring, 2005. Reclamation agrees to re-consult with NMFS if the 3.0 foot surcharge is not approved by the end of 2004.

#### 3.2.1.1 Surcharge Interim Phases

Two interim phases of operations will occur prior to implementation of the longer-term operations proposed above. The two interim periods arise because of the phased approach anticipated for the implementation of the 3.0 foot surcharge. The first set of interim operations has already been partially implemented, and will be fully implemented on the release of the Biological Opinion. The first phase of operations uses a surcharge of 0.75 feet. It will continue until the flashboards are modified and there is sufficient rainfall to surcharge the reservoir to the 1.8 foot level. The second phase interim operations begins when 1.8 feet of surcharge water is available and concludes when the 3.0 foot surcharge is approved and there is sufficient rainfall to surcharge the reservoir to the 3.0 foot level.

Flashboard construction on the Bradbury Dam spillway gates is scheduled for summer 2001. The modifications will accommodate a surcharge up to 3.0 feet making either level of surcharge possible. Environmental review for implementation of the 1.8 foot surcharge has been completed (Woodward Clyde Consultants 1995). Implementation of the 3.0 foot surcharge may require additional actions to be identified through project design and environmental review. We anticipate that several years may be required to complete the environmental documentation for implementation of the 3.0 foot surcharge. When the reservoir spills, it will be surcharged to the maximum level permissible given the status of the environmental review and compliance. Table 3-2 summarize the anticipated implementation schedule for the three phases of proposed operations.

**Table 3-2. Anticipated Implementation Schedule for the Interim and Long Term Proposed Operations**

| Operational Phase | Construction Date | Environmental Review Complete | Implementation Date |
|---|---|---|---|
| Interim Phase 1:<br>0.75 Foot Surcharge | Complete | Complete | Issuance of Biological Opinion |
| Interim Phase 2:<br>1.8 Foot Surcharge | 2001 | Complete | Spring 2002 or 1st spill thereafter |
| Long Term Operations:<br>3.0 Foot Surcharge | 2001 | 2004 | Spring 2005 or 1st spill thereafter |

The existing surcharge capability of Bradbury Dam is 0.75 feet. This level of surcharge provides an additional 2,300 acre feet of storage in Lake Cachuma. With 1.8 feet of surcharge, 5,500 acre-feet of water is stored. Of the 5,500 acre-feet of surcharged water under Phase 2 of the interim operations, 2,500 acre-feet will be allocated to the Fish Passage Account with the remainder used to meet interim target flows at Highway 154.

The interim operations proposed to enhance rearing and passage for steelhead are described in detail in sections below. In addition to the habitat enhanced by water releases, a number of conservation measures will be implemented as described in Section 3.3.

### 3.2.2 CONJUNCTIVE USE AND MAINSTEM REARING TARGET FLOWS

#### 3.2.2.1 Interim Mainstem Rearing Target Flows

During interim operations, rearing target flows will be established in the Santa Ynez River for the purpose of improving mainstem rearing habitat. These target flows will be structured to provide year-round rearing in the Highway 154 reach of the Santa Ynez River. The same rearing target flows will be in effect during both phases of the interim operations (0.75 and 1.8 foot surcharges). Additional water provided by the 1.8 foot surcharge under Phase 2 of the interim operations will be allocated to passage flow supplementation.

Interim target flows will be established at the Highway 154 Bridge. The flow targets will depend on the water year type and the storage in Lake Cachuma on the first of each month. Releases through the Hilton Creek supplemental watering system will be made to meet the flow targets. In years when the lake spills (when the storage in Lake Cachuma is above 120,000 AF) and the spill amount exceeds 23,000 acre-feet, a target flow of 5 cfs at the Highway 154 Bridge will be maintained (when no water rights release is underway). When the lake does not spill, or the spill amount is less than 23,000 acre-feet, and the storage in Lake Cachuma exceeds 120,000 acre-feet, a target flow of 2.5 cfs will be maintained. When lake storage recedes below 120,000 acre-feet, the target flow at the Highway 154 Bridge will be 1.5 cfs.

Reclamation agrees to consult with NMFS in critical drought years to determine what, if any, actions will be taken for mainstem fishery resources. A critical drought year is defined as years when the Project water in storage has receded to less than 30,000 acre-feet in the reservoir. In the historical period analyzed in the Santa Ynez River Hydrologic Model critical drought years have occurred only 2% of the time. Reclamation proposes periodic releases from Bradbury Dam be made to improve water quality in the Stilling Basin and the Long Pool in these critical drought years. Thirty acre-feet per month will be reserved to provide refreshing flows.

Analysis of historical hydrology indicates it will be possible to meet target flows under most conditions. Figure 3-1 shows the daily exceedance flow for the Santa Ynez River at Highway 154 based on simulations of the Santa Ynez River model from 1918 to 1993. Flow at Highway 154 would exceed 1.5 cfs about 98% of the time, 2.5 cfs about 81% of

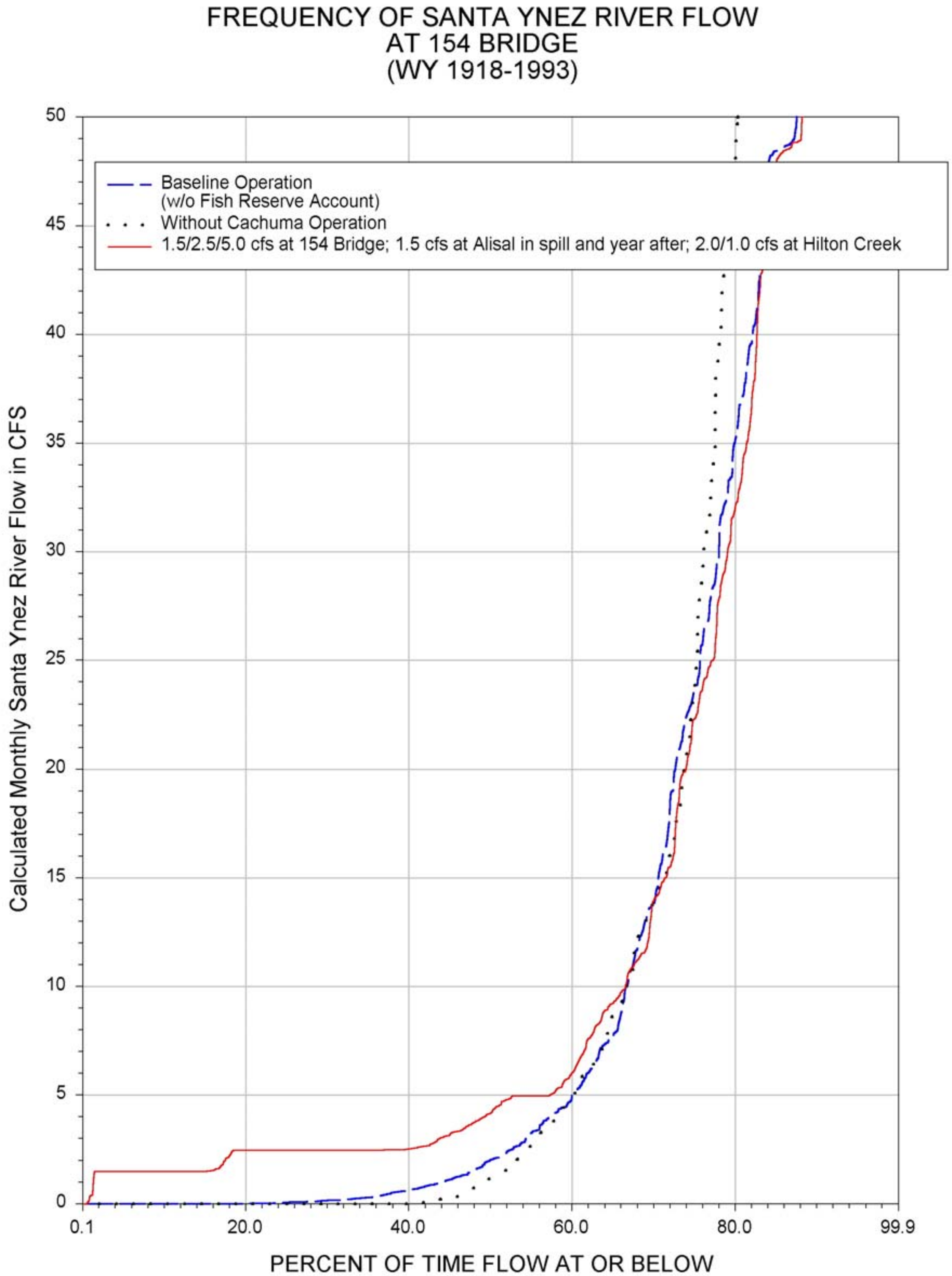


**Figure 3-1. Flow at Highway 154 Under the Proposed Interim Operations**

the time, and 5 cfs about 49% of the time. Some of this flow persists downstream to the Alisal Bridge in most years (Figure 3-2).

#### 3.2.2.2 Long Term Mainstem Rearing Target Flows

As a part of the proposed operations, water will be made available within Lake Cachuma for the purpose of environmental protection and enhancement of habitat downstream of Bradbury Dam. The mainstem target flows have been designed to reflect annual and inter-annual variations in hydrologic conditions. For the purpose of reducing impacts to Project yield, Reclamation will surcharge the reservoir as described above.

Releases are made from Bradbury Dam to meet downstream water rights requirements (WR 89-18). These releases are typically made during the late spring and/or summer and early fall, using flow patterns designed to recharge the groundwater basin. In wet years, downstream water rights releases are generally not made because the aquifers have been sufficiently recharged by the heavy winter rains.

The objective of conjunctive operations is to extend the period of time each year when instream flows improve fisheries habitat for over-summering and juvenile rearing within the mainstem river and Hilton Creek. First priority for flow enhancement will be given to Hilton Creek. The reach from the Hilton Creek confluence to Highway 154, will receive second priority. The third priority will be the area between Bradbury Dam and the Hilton Creek confluence, including the Stilling Basin and Long Pool, and fourth priority is given to the mainstem downstream from Highway 154 to the Solvang area.

These priorities have been established based on the quality of existing habitat, the results of extensive water temperature monitoring and modeling (Sections 2.3.1.1 and 2.3.1.2), and the likelihood for successful protection and improvement of steelhead populations. Temperature monitoring and modeling suggest that improved temperature conditions will not extend beyond the Highway 154 Bridge.

Target flows will be established in the mainstem and will vary in order to provide greater biological benefit. In years of higher flow, the mouth of the estuary will open and steelhead will be able to migrate up the mainstem. Under the proposed target flows, more water is provided in these years. In years of lower flow, the mouth may not open and migration up the mainstem may not be possible, but fish holding over from previous years must be sustained. By having a variable mainstem target flow, more water is available when it will support the most steelhead.

During winter runoff seasons, natural flow from tributaries generally provides instream flow in the mainstem of the Santa Ynez River. In wet years, instream flows continue into early summer. In addition, spills from Lake Cachuma tend to enhance and prolong the instream flows in the mainstem in wet years.

Target flows were established at two locations: at Highway 154 Bridge and at Alisal Bridge. Under the proposed conjunctive operation, releases will be made to maintain target flows based on lake level elevations at the beginning of each month. Releases of

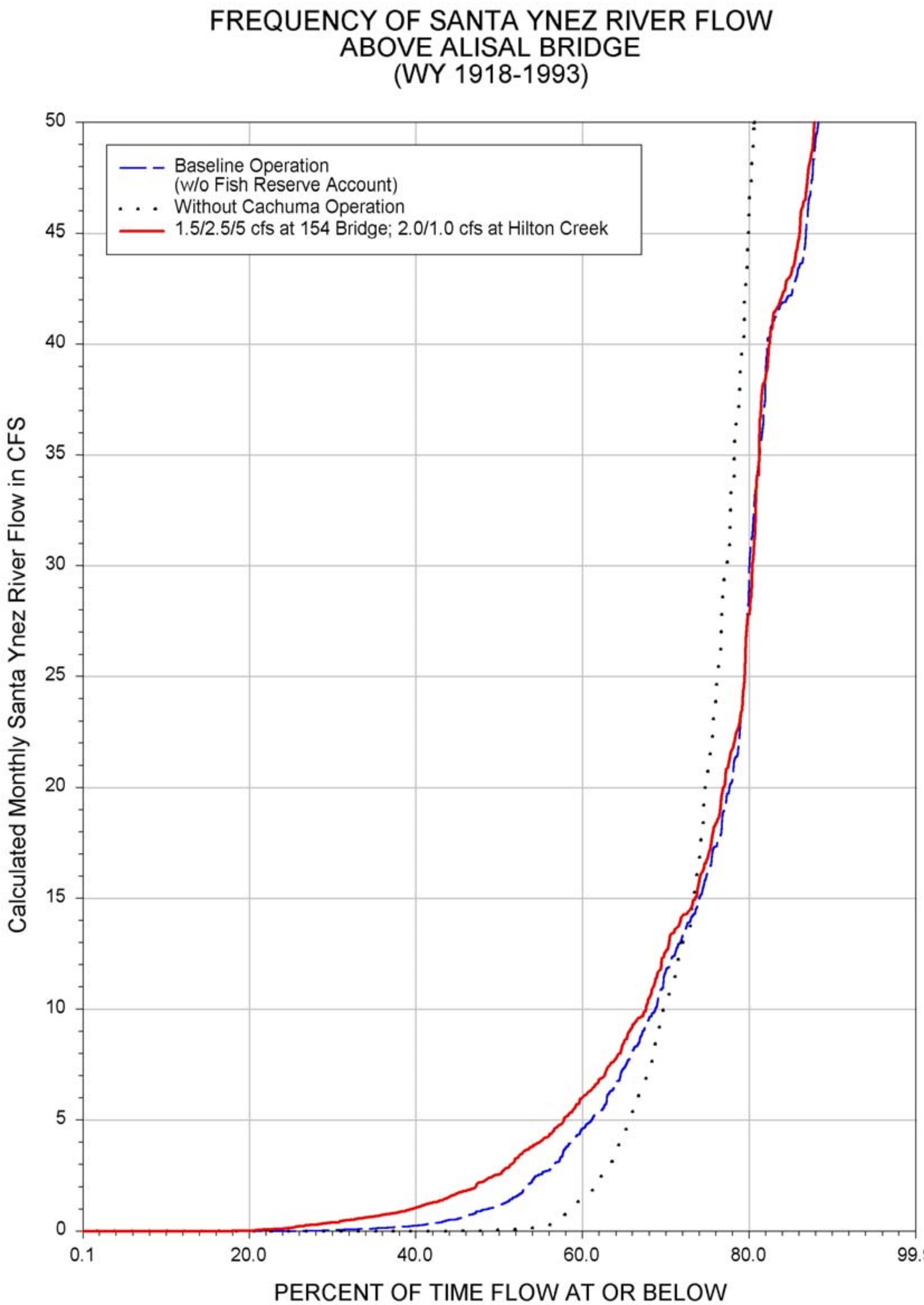


**Figure 3-2. Flow in the Alisal Reach Under the Proposed Interim Operations**

up to 10 cfs will be made from the supplemental watering system for Hilton Creek to meet these targets. These releases will be made both to Hilton Creek and/or the Stilling Basin based upon the criteria described in Section 3.3.1.1. In years when the lake spills (when the storage in Lake Cachuma is above 120,000 acre-feet) and the spill amount exceeds 20,000 acre-feet, a target flow of 10.0 cfs at Highway 154 Bridge will be maintained. When the lake does not spill, or the spill amount is less than 20,000 acre-feet, and the storage in Lake Cachuma exceeds 120,000 acre-feet, then a target flow of 5 cfs will be maintained. When lake storage recedes below 120,000 acre-feet, the target flow at Highway 154 Bridge will be 2.5 cfs.

Reclamation agrees to consult with NMFS in critical drought years to determine what, if any, actions will be taken for mainstem fishery resources. A critical drought year is defined as years when the Project water in storage has receded to less than 30,000 acre-feet in the reservoir. In the historical period analyzed in the Santa Ynez River Hydrologic Model critical drought years have occurred only 2% of the time. Reclamation proposes periodic releases from Bradbury Dam be made to improve water quality in the Stilling Basin and the Long Pool in these critical drought years. Thirty acre-feet per month will be reserved to provide refreshing flows.

In addition to Highway 154 Bridge targets, flow targets will be established at the Alisal Bridge. In years when the Lake Cachuma spill amount exceeds 20,000 acre-feet and steelhead are present in the reach, a target flow of 1.5 cfs will be maintained. A 1.5 cfs target will also be maintained in the year immediately following a spill year (a year with the spill amount exceeding 20,000 acre-feet) if steelhead are present, unless that year is a drought year.

Figure 3-3 shows the annual releases to meet the established mainstem target flows based on the Santa Ynez River model runs form 1918 to 1993. The average release for habitat maintenance is approximately 2,290 acre-feet under the proposed operations. Analysis of historical hydrology indicates that it will be possible to meet these target flows under most conditions. Figure 3-4 shows the daily exceedance flow for the Santa Ynez River at Highway 154 based on simulations of the Santa Ynez River model from 1918 to 1993. Flow at Highway 154 would exceed 2.5 cfs about 98 percent of the time, 5 cfs about 77 percent of the time, and 10 cfs about 39 percent of the time. Based on the capacity of the Hilton Creek supplemental watering system to deliver 10 cfs, the model shows that the 10 cfs target at Highway 154 was not met in its entirety in 34 out of the 185 months the 10 cfs target would have been in place. However, the model demonstrates that in those months where the 10 cfs target was not met, there would have been at least 8.5 cfs at Highway 154. The model showed that the other targets would have been met in all years based on historical watershed conditions.

Some of the flow targeted for Highway 154 persists downstream as far as the Alisal reach during most years (Figure 3-5). Flow at the Alisal Bridge would exceed 1.5 cfs about 75% of the time. Table 3-3 shows the minimum daily flow that would be observed during each year from 1942 through 1993 under the proposed conjunctive use operation based on daily simulations from the Santa Ynez River model. This table shows that the minimum daily flow during any year at Highway 154 would be less than 2.5 cfs during

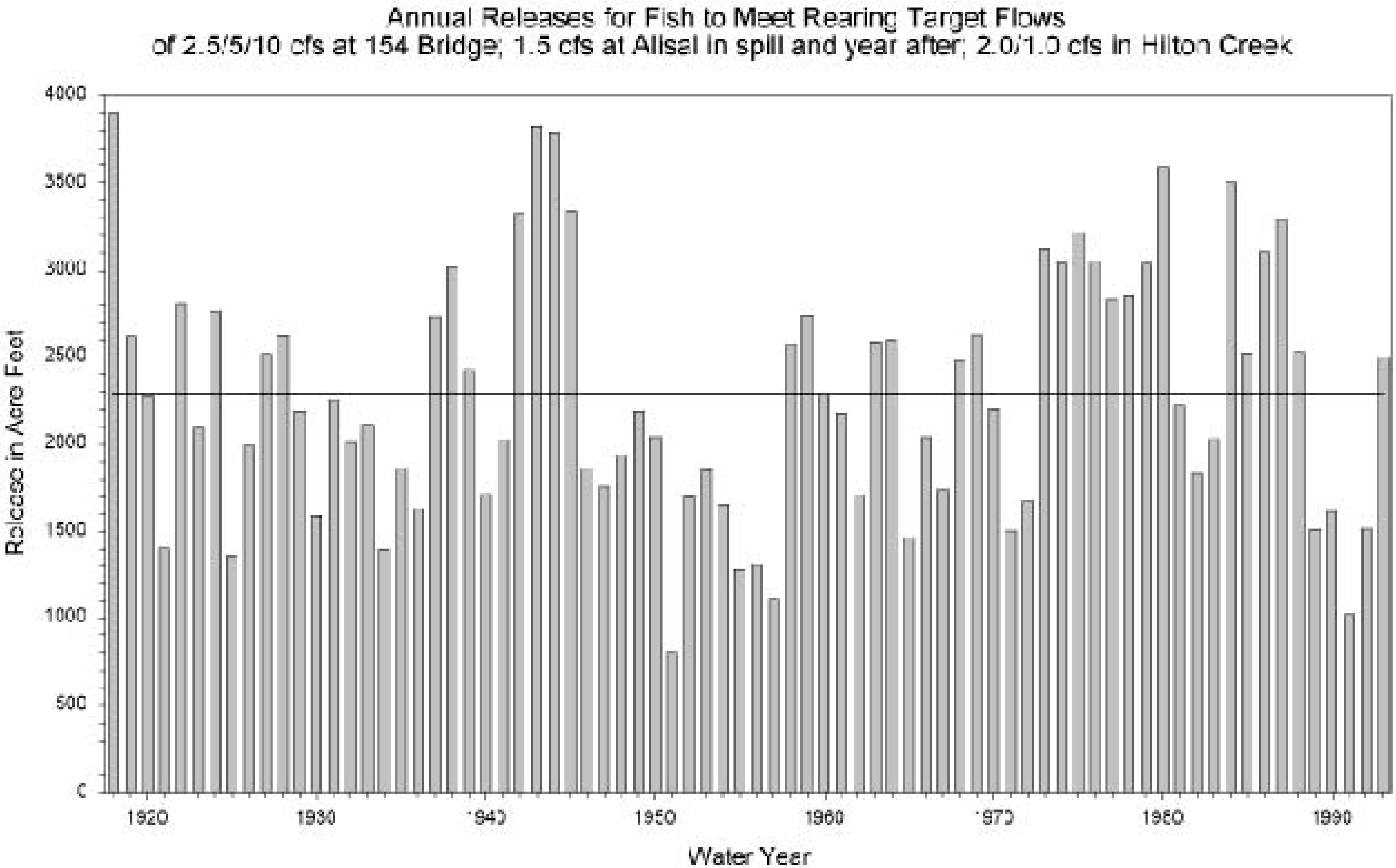


**Figure 3-3. Annual Releases to Meet Long Term Mainstem Rearing Target Flows.**

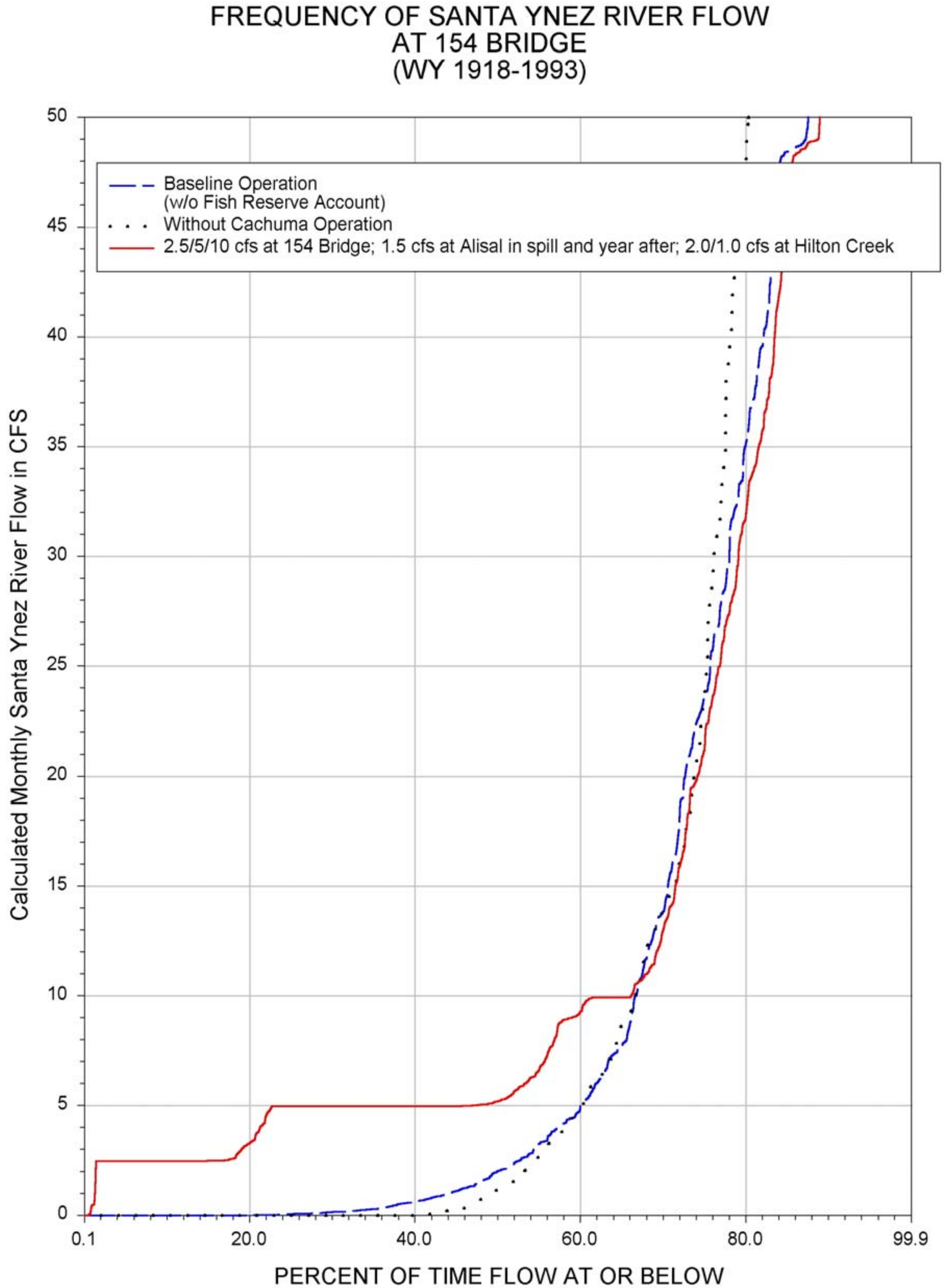


**Figure 3-4. Flow at Highway 154 Under Proposed Long Term Operations.**

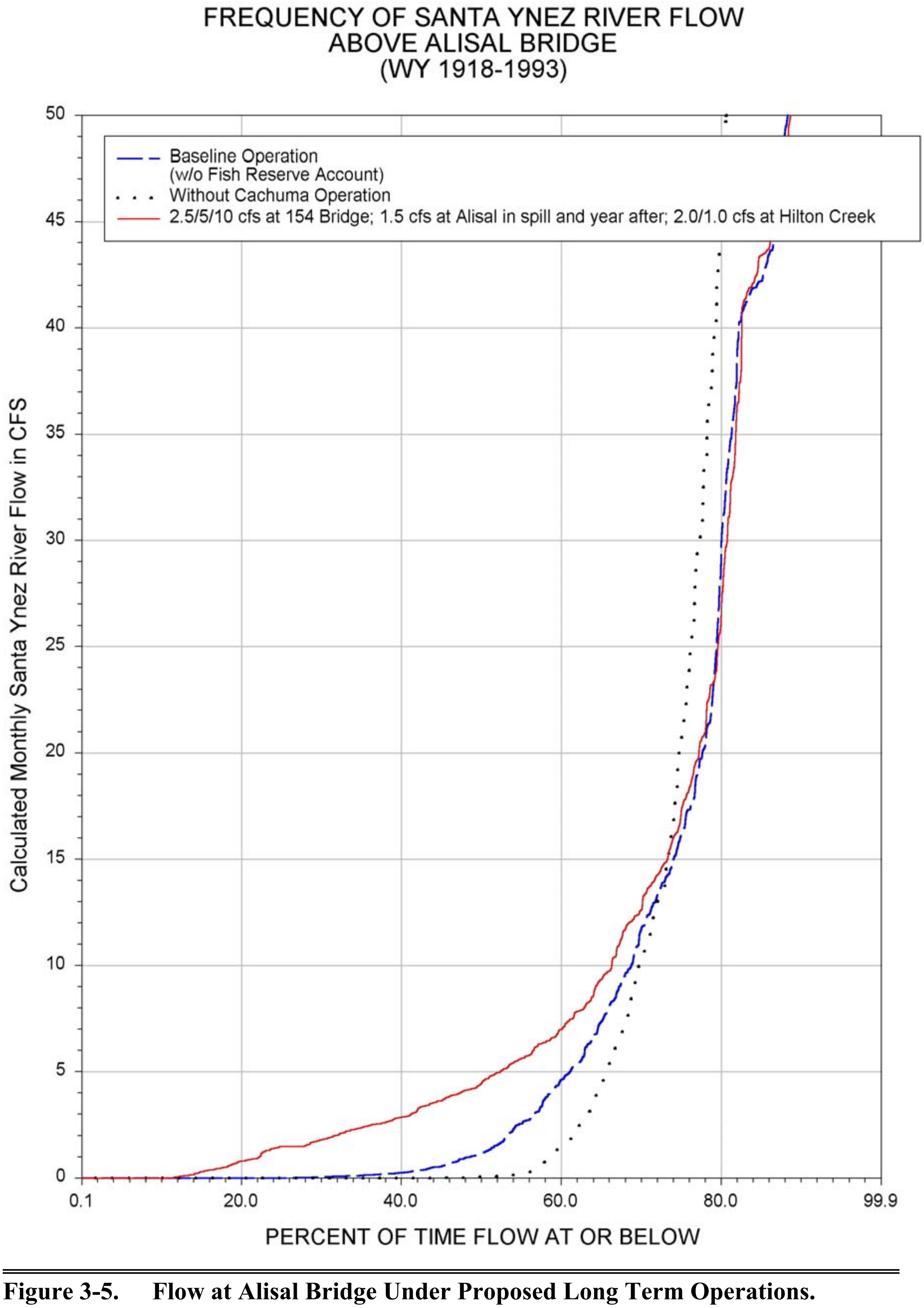


**Figure 3-5. Flow at Alisal Bridge Under Proposed Long Term Operations.**

**Table 3-3. Minimum Daily Flow Under Proposed Long Term Operations, Water Years 1942-1993**

| Water Year | Location Below Hilton Creek (cfs) | Location Highway 154 Bridge (cfs) | Location Alisal Bridge (cfs) | Water Year | Location Below Hilton Creek (cfs) | Location Highway 154 Bridge (cfs) | Location Alisal Bridge (cfs) |
|---|---|---|---|---|---|---|---|
| 1942 | 2 | 5 | 3 | 1970 | 3 | 5 | 1.5 |
| 1943 | 6 | 5 | 0.5 | 1971 | 3.5 | 5 | 2 |
| 1944 | 4.5 | 5 | 1.5 | 1972 | 3 | 5 | 0 |
| 1945 | 2.5 | 5 | 0.5 | 1973 | 2 | 2.5 | 0 |
| 1946 | 2.5 | 5 | 2 | 1974 | 2 | 5 | 2.5 |
| 1947 | 5.5 | 5 | 2 | 1975 | 2 | 5 | 1.5 |
| 1948 | 3.5 | 2.5 | 0 | 1976 | 4.5 | 5 | 0.5 |
| 1949 | 2 | 2.5 | 0 | 1977 | 3.5 | 2.5 | 0 |
| 1950 | 2 | 2.5 | 0 | 1978 | 2 | 2.5 | 0 |
| 1951 | 0 | 0 | 0 | 1979 | 2 | 5 | 1.5 |
| 1952 | 0 | 0 | 0 | 1980 | 2.5 | 5 | 0.5 |
| 1953 | 2 | 5 | 1.5 | 1981 | 2 | 5 | 1 |
| 1954 | 2 | 5 | 1.5 | 1982 | 2 | 5 | 2 |
| 1955 | 2 | 2.5 | 0 | 1983 | 2 | 5 | 2 |
| 1956 | 1 | 2.5 | 0 | 1984 | 4.5 | 5 | 3 |
| 1957 | 2.5 | 2.5 | 0 | 1985 | 5 | 5 | 1 |
| 1958 | 2 | 2.5 | 0 | 1986 | 2 | 5 | 1.5 |
| 1959 | 2 | 5 | 1.5 | 1987 | 3.5 | 5 | 0.5 |
| 1960 | 3.5 | 2.5 | 0 | 1988 | 4.5 | 5 | 0.5 |
| 1961 | 3.5 | 2.5 | 0 | 1989 | 3 | 2.5 | 0 |
| 1962 | 1 | 2.5 | 0 | 1990 | 3.5 | 2.5 | 0 |
| 1963 | 2 | 5 | 0.5 | 1991 | 0 | 0 | 0 |
| 1964 | 3.5 | 2.5 | 0 | 1992 | 2 | 2.5 | 0 |
| 1965 | 2 | 2.5 | 0 | 1993 | 5.5 | 5 | 3 |
| 1966 | 1 | 2.5 | 0 | | | | |
| 1967 | 2 | 5 | 2 | | | | |
| 1968 | 4.5 | 5 | 1.5 | | | | |
| 1969 | 6 | 5 | 2 | | | | |

three water years (1951, 1952 and 1991), all of which occur at the end of prolonged droughts. During these years, releases will likely be made to refresh refuge habitat.

This conjunctive operation will occur through coordination among Reclamation, the SYRTAC, and SYRWCD, which has committed to participate in conjunctive use operations.

#### 3.2.2.3 Ramping

The duration and rate (including initial rate) of water right releases will vary, depending on whether water is released for the purpose of recharging only the above Narrows area or both above and below Narrows areas together. For example, combined releases for the above and below Narrows areas may begin at the rate of 135-150 cfs and are maintained at a steady rate for about 12-15 days before it is gradually decreased to lower flow rates. During the initial period of 12-15 days, the flow moves at the rate of less than three miles per day (or less than 0.2 ft/sec). At a given location, the flow would gradually ramp up as the recharge rate decreases further upstream. As the recharge rate decreases in the river bed, the release rate is also gradually reduced. Changes in release rates are generally attenuated in the river. In essence, the release rates are maintained at such rates that water would disappear in the lower reaches of the Santa Ynez River channel. The reduced releases could extend two to three months and then would be gradually ramped down to match scheduled releases to maintain mainstem rearing flow targets. Releases for the above Narrows areas are made for shorter duration and lower initial rates compared to the above releases, but follow the same principles.

Operation of water rights releases, in conjunction with releases for mainstem target flows, will be managed to avoid stranding of rainbow trout/steelhead and other fish species. Since 1994, water rights releases have been ramped down voluntarily at the termination of the WR 89-18 releases in accordance with recommendations of the Biological Subcommittee of the SYRTAC. Water rights releases were ramped down to about 5 cfs. This practice will be continued under the proposed operations using the ramping schedule outlined in Table 3-4. A schedule for ramping flows upward is unnecessary as the travel time of water in the river will attenuate the rate of increase as described above.

**Table 3-4. Mainstem Ramping Schedule for Downstream Water Rights Releases.**

| Release Rate (cfs) | Ramping Increment (cfs) | Ramping Frequency (no more than once every…) |
|---|---|---|
| > 90 | 25 | 4 hours |
| 90 to 30 | 10 | 4 hours |
| 30 to 10 | 5 | 4 hours |
| 10 to 5 | 2.5 | 4 hours |
| 5 to 3.5 | 1.5 | 4 hours |
| 3.5 to 2.5 | 1 | 4 hours |

In general, managed releases provide opportunities for improved maintenance of fisheries habitat over longer periods of time than have occurred in the past several decades. These releases can be made from the Bradbury Dam outlet (WR 89-18 releases) and/or via the Hilton Creek supplemental water supply facility (WR 89-18 releases and target flow releases). The benefits are discussed in Sections 4.1.1 and 4.2.1. These can include increased amount of aquatic habitat, improved dissolved oxygen conditions from flushing of accumulated algae, and generally reduced water temperatures in reaches close to Bradbury Dam. Conjunctive operation of water releases will be made to improve habitat conditions and build the rainbow trout/steelhead population during wet years, while maintaining the rainbow trout/steelhead population and other fishery resources in dry years.

#### 3.2.2.4 CCWA Water Release

CCWA will make deliveries to Lake Cachuma and ID#1, as described in Section 2.6.5. When there are no downstream releases from Lake Cachuma through the outlet works at Bradbury Dam, the Santa Ynez Pumping Facility will directly pump State Water Project (SWP) water into Lake Cachuma. If it is necessary to make deliveries simultaneously with downstream water rights releases, delivery will be made to the Stilling Basin in lieu of Cachuma water.

When SWP water is released to the Stilling Basin, this release would be subject to specific temperature and mixing requirements to avoid potential impacts to steelhead. The release of SWP water into the Santa Ynez River may have the potential to affect steelhead trout because this water may be warmer than Project water and may contribute to thermal loading in the system. In addition, DFG raised concerns that releases to the river containing SWP water may cause an imprinting problem for young steelhead, which could affect their ability to home in on the Santa Ynez River as adults returning from the ocean. Imprinting would not be a problem, however, since any SWP water releases made to the river in the course of WR 89-18 releases would normally be made in the summer months, not during the juvenile outmigration season. The potential temperature and imprinting impacts were addressed in informal consultation with NMFS, FWS, and DFG for CCWA deliveries in 1997 and in an Environmental Assessment prepared for the CCWA Project (Reclamation 1994).

Specific guidelines for the release of SWP water to the Santa Ynez River were developed in consultation with NMFS and DFG to eliminate the potential effects of these releases, and will be included in the upcoming Habitat Conservation Plan (B. Brennan, CCWA, pers. comm. 1999). When Reclamation is releasing water from the dam outlet works and CCWA is delivering SWP water, to the lake, CCWA water will be diverted to the river as part of the downstream release because the inlet works of CCWA and the outlet works for Bradbury Dam share the same conduit. When releases of less than 10 cfs are to be made, these will occur from the Hilton Creek water supply system, via the Hilton Creek channel and/or the Stilling Basin release point. When this occurs, CCWA deliveries would not be interrupted. During periods when CCWA is delivering water simultaneously with releases from Bradbury Dam, CCWA will blend its SWP water with released Cachuma water in a proportion to meet the temperature target as agreed upon by NMFS and DFG (B. Brennan, CCWA, pers. comm. 1999).

When releases from Lake Cachuma and CCWA deliveries into Lake Cachuma are scheduled simultaneously, CCWA will contact and notify the CDFG, USFWS, and NMFS that SWP water will be entering the Santa Ynez River. CCWA staff will meet the release temperature constraints (release water 18° C or less).

Temperature confirmation for both lake and SWP water will be undertaken daily. Reclamation staff currently take daily temperature readings of the lake release water. Reclamation staff will also monitor the temperature of the river downstream of the Stilling Basin daily when releases are made. Raw and treated SWP water temperatures are taken by CCWA at the Polonio Pass Water Treatment Plant every four hours, providing advance warning of any changes in water temperature entering the pipeline. Weekly water temperatures are also taken at each tank and turnout along the pipeline route. CCWA's experience thus far indicates that water temperature increases approximately 1°C along the length of the SWP Water Pipeline. CCWA staff will take daily SWP water temperature readings at the Santa Ynez Pumping Facility when downstream releases are occurring and will be responsible for analyzing all pertinent temperature data. CCWA staff will immediately suspend pumping when the temperature of the mixed water exceeds 18°C.

Discharges of pumped SWP water to the river below Bradbury Dam coincidental with scheduled releases of downstream water rights from Lake Cachuma will be treated as downstream water rights account water scheduled for release from Lake Cachuma. Pumped SWP water will be measured by a meter installed by the CCWA immediately downstream of the Santa Ynez Pumping Facility. Water released from Lake Cachuma is measured by the Reclamation venturi meter on the outlet works at Bradbury Dam. In addition, CCWA has installed an ultrasonic meter on the Reclamation outlet works at Bradbury Dam which measures the flows in either direction (releases from Lake Cachuma or SWP water pumped into Lake Cachuma). The sum of the pumped SWP water measured immediately downstream of the Santa Ynez Pumping Facility and water released from Lake Cachuma measured by the Reclamation venturi meter or the CCWA ultrasonic meter should represent the amount of water released for downstream water rights releases.

CCWA is obligated to deliver water into Lake Cachuma every month, if possible. Because of downstream water rights releases, Fish Reserve Account releases (during 1998 only), and/or reservoir spill, CCWA may be unable to match delivery requests on a month by month basis. CCWA intends to complete the annual deliveries by the end of each calendar year. During periods when no water is being released from the outlet works of the dam, CCWA will, after consultation with the dam tender, deliver the requested entitlement water along with any undelivered water from previous months into Lake Cachuma, if possible.

### 3.2.3 Passage Flow Supplementation

#### 3.2.3.1 Interim Passage Flow Supplementation

Passage flow supplementation will begin under the second phase of the interim operations, once the reservoir has surcharged to 1.8 feet. A portion of the additional water provided by the 1.8 foot surcharge, 2,500 acre-feet, will be allocated to the Fish Passage Account. Water will be released from the Fish Passage Account in years following the 1.8 foot surcharge event in accordance with the criteria described for long term operations in Section 3.2.3.2.

The quantity and frequency of passage releases under Phase 2 of the interim operations (1.8 feet of surcharge) were calculated using USGS gaged daily stream flows at Solvang for the 40 years of post-Cachuma construction (1958-1998). Passage releases under the interim scenario occur generally one to two years after a year in which the reservoir is surcharged. Table 3-5 tabulates the releases for supplementation of passage by year and shows how releases from the Fish Passage Account would be implemented under this interim proposal. The flow supplementation scenario may be adjusted to provide greater benefit to steelhead.

Analyses based on stream flow records and calculated supplementation releases were undertaken to estimate the total passage days at Solvang in the months of January through May. Passage days with and without supplemented flows are shown for the thirteen years in which supplementation would have occurred (Table 3-6). In these thirteen years, about a third of the years analyzed, 12 additional days of passage per year occur on average. The passage supplementation proposal would thus increase the average number of passage days from a 19 (baseline conditions) to a total of 31 (with supplementation).

#### 3.2.3.2 Long Term Passage Flow Supplementation

Upstream migration is an important event in the steelhead lifecycle. Steelhead, like the other anadromous salmonids, are born in freshwater and live there for generally one or two years before migrating to the sea. While at sea, they grow to sexual maturity and then return to the stream in which they were born to spawn. If passage from the ocean to their spawning grounds is prevented, the steelhead cannot complete its lifecycle and spawn the next generation. When this happens the steelhead may spawn in another stream or wait for another year to spawn. Unlike salmon who die after spawning, steelhead are capable of spawning several times (in different years) under the right conditions (Shapovalov and Taft 1954).

Prior to steelhead migrating upstream in the river itself, they must first be able to enter the river from the ocean. The mouth of the Santa Ynez River is frequently closed by the presence of a sandbar. This bar forms during the summer when flows are low and wave energy is also low. It is breached in the winter by a combination of higher river flows and greater wave energy. Winter runoff from Salsipuedes Creek appears to be sufficient to breach the bar before enough flow is available in the mainstem. No passage flow supplementation will occur until the sand bar has been breached by natural events. The sandbar will be visually inspected each week during the migration season to determine its status and a water level recorder will be installed in the lagoon to monitor ponding conditions (see Section 3.4).

The purpose of the passage flow supplementation is to improve the opportunity for steelhead to migrate from the Santa Ynez lagoon to the tributaries in the Santa Ynez River downstream of Bradbury Dam and to the mainstem reach upstream of the Highway 154 Bridge. The proposed operations provide frequent passage opportunities for migrating steelhead in wet years (spill years). In these years, tributary and mainstem habitat is accessible and of good quality. In dry years, there is a limited number of passage opportunities. Low flows in the tributaries can limit access to tributary habitat and this habitat is of lower quality in these years. In other years, passage opportunities may be limited while tributary habitats are suitable for occupancy. The passage flow supplementation plan proposed here promotes good passage conditions in years

**Table 3-5. Proposed Interim Releases for Passage Supplementation (1958-1998)**

| YEAR | Allocation to Fish Passage Account | Years from Surcharge | Releases from Fish Passage Account | End-of-Year Fish Passage Account Balance |
|---|---|---|---|---|
| 1958 | 2,500 | | 0 | 2,500 |
| 1959 | | 1 | 740 | 1,760 |
| 1960 | | 2 | 1,760 | 0 |
| 1961 | | 3 | 0 | 0 |
| 1962 | 2,500 | | 0 | 2,500 |
| 1963 | | 1 | 2,500 | 0 |
| 1964 | | 2 | 0 | 0 |
| 1965 | | 3 | 0 | 0 |
| 1966 | | 4 | 0 | 0 |
| 1967 | 2,500 | | 0 | 2,500 |
| 1968 | | 1 | 2,500 | 0 |
| 1969 | 2,500 | | 0 | 2,500 |
| 1970 | | 1 | 2,500 | 0 |
| 1971 | | 2 | 0 | 0 |
| 1972 | | 3 | 0 | 0 |
| 1973 | 2,500 | | 0 | 2,500 |
| 1974 | 2,500 | | 0 | 2,500 |
| 1975 | 2,500 | | 909 | 2,500 |
| 1976 | | 1 | 1,811 | 689 |
| 1977 | | 2 | 0 | 689 |
| 1978 | 2,500 | | 0 | 2,500 |
| 1979 | 2,500 | | 0 | 2,500 |
| 1980 | 2,500 | | 0 | 2,500 |
| 1981 | | 1 | 1,170 | 1,330 |
| 1982 | | 2 | 1,330 | 0 |
| 1983 | 2,500 | | 0 | 2,500 |
| 1984 | 2,500 | | 0 | 2,500 |
| 1985 | | 1 | 0 | 2,500 |
| 1986 | | 2 | 957 | 1,543 |
| 1987 | | 3 | 0 | 1,543 |
| 1988 | | 4 | 1,543 | 0 |
| 1989 | | 5 | 0 | 0 |
| 1990 | | 6 | 0 | 0 |
| 1991 | | 7 | 0 | 0 |
| 1992 | | 8 | 0 | 0 |
| 1993 | 2,500 | | 0 | 2,500 |
| 1994 | | 1 | 2,500 | 0 |
| 1995 | 2,500 | | 0 | 2,500 |
| 1996 | | 1 | 2,500 | 0 |
| 1997 | | 2 | 0 | 0 |
| 1998 | 2,500 | | 0 | 2,500 |

**Table 3-6. Passage Days with and without Proposed Interim Passage Supplementation Operations (January through May, 1958-1998)**

| YEAR | Stream flow Record (Baseline) | | | Interim Supplementation Proposal | | |
|---|---|---|---|---|---|---|
| | Hydrologic Year Type[1] | Total # of Passage Days [2] | Indicator of ≥ 14 days | Total # of Passage Days[2] | Days Provided by Proposal | Indicator of ≥ 14 days |
| | | | | | | |
| 1959 | normal | 36 | yes | 36 | 0 | yes |
| 1960 | dry | 9 | no | 21 | 12 | yes |
| 1963 | dry | 9 | no | 30 | 21 | yes |
| 1968 | dry | 12 | no | 35 | 23 | yes |
| 1970 | normal | 11 | no | 29 | 18 | yes |
| 1975 | normal | 78 | yes | 81 | 3 | yes |
| 1976 | dry | 3 | no | 15 | 12 | yes |
| 1981 | normal | 15 | yes | 22 | 7 | yes |
| 1982 | normal | 8 | no | 15 | 7 | yes |
| 1986 | wet | 28 | yes | 33 | 5 | yes |
| 1988 | dry | 2 | no | 14 | 12 | yes |
| 1994 | normal | 8 | no | 27 | 19 | yes |
| 1996 | normal | 27 | yes | 45 | 18 | yes |
| Average | | 19 | | 31 | 12 | |
| Number of years with ≥14 days of passage | | | 5<br>38% | | | 13<br>100% |

[1]A ‘wet’ year is the third of the years analyzed with the greatest inflow into Lake Cachuma, ‘normal’ years were the middle third of years, and ‘dry’ years were the third of years with the lowest inflow into Lake Cachuma.
[2]A ‘passage day’ is defined as flow at the Solvang gage of greater than or equal to 25 cfs.

after steelhead have likely been highly productive in the system. A complete description of the passage supplementation proposal follows.

#### 3.2.3.2.1 Fish Passage Account

For the purpose of supplementing passage flows, Reclamation will create a Fish Passage Account in Cachuma Reservoir. The Fish Passage Account will be filled in years when the reservoir surcharges and released in subsequent years to enhance passage opportunities by augmenting the storm hydrographs. The Fish Passage Account will be allocated the majority of the additional water provided by surcharging over the 1.8 foot surcharge level required to meet the rearing flow targets, or 3,200 acre-feet of water. The Fish Passage Account will be filled when the reservoir is surcharged. Any water captured by the reservoir over elevation 751.8 will be allocated to the Fish Passage Account, up to 3,200 acre-feet of water. The Fish Passage Account water will be released starting in the year after the reservoir surcharges to a level above 1.8 feet, and in subsequent years until there is no more water in the Fish Passage Account.

Fish Passage Account water stored in Lake Cachuma will not diminish by evaporation or seepage losses. Any unused portion of the Fish Passage Account will be carried over to following years until the reservoir surcharges again. In the event of a spill, the Fish Passage Account will be deemed to spill and the account will be reset to a new allocation of 3,200 acre-feet. If only a partial surcharge is possible (not the complete volume between 1.8 and 3.0 feet) then the Fish Passage Account would receive the surcharge amount in excess of the 1.8 foot surcharge, plus any carryover in the account with the total not to exceed 3,200 acre-feet. Simulations with the Santa Ynez River model indicate that when the reservoir spills, the surcharge space between 1.8 and 3.0 feet is always completely filled, although in theory, a partial surcharge is possible.

There is limited data on mainstem fish migration in the Santa Ynez River system and a spotty record of tributary migration. The record is incomplete because of difficulty in installing and maintaining mainstem traps and because of the need to remove traps during storm periods. Because of uncertainty regarding the movement patterns of migrating steelhead, the passage flow supplementation proposal will be adaptively managed. The migrant trapping program will continue and an additional trap will be installed in the Refugio reach to monitor mainstem migrants (see Section 3.4.3). Reclamation will establish an Adaptive Management Committee that will be responsible for adaptively managing the Fish Passage Account releases. These releases will be based on the following passage supplementation regime although modifications may be made based on further biological data, dam operational requirements and, and prior hydrologic events.

#### 3.2.3.2.2 Passage Supplementation Criteria

Releases for fish passage supplementation will be made in years following a surcharge year until all of the water in the Fish Passage Account has been released. Releases will be made to augment storms in January through May. The first storm in January will not be supplemented as it is considered to be a recharge storm and will prime the lower watershed for future releases. If there is a second storm in January, then this storm will be supplemented. All storms in the passage period will be supplemented unless (1) flows at Solvang reach 25 cfs within 7 days from a prior Fish Passage Account release (the second storm will not be supplemented), (2) the Adaptive Management Committee determines that there is a greater biological benefit to not supplement a particular storm, or (3) there is no water left in the Fish Passage Account.

For the purpose of fish passage supplementation, a storm is defined as flows of 25 cfs or more occurring at the Solvang USGS gage. The 25 cfs criteria was selected for three reasons. First, 25 cfs provides passage flow in the Alisal reach and passage at these riffles should indicate that passage is provided over critical riffles upstream to the dam (SYRTAC 1999b). Second, a flow of 25 cfs at Solvang indicates that the tributaries upstream of Solvang (Quiota and Hilton Creeks) are flowing and will provide steelhead access to these habitats. Finally, 92% of the time when there is a flow of 25 cfs or more at the Solvang gage, there is at least 15 cfs flowing in the Santa Ynez River upstream of the confluence with Salsipuedes Creek indicating there is continuity of flow throughout the system. Passage over the critical riffle at the Lompoc Narrows is achieved 92% of the time there is 25 cfs at Solvang indicating passage flows for adult steelhead exist upstream to Bradbury Dam.

The passage flow supplementation will take the form of enhancing the storm hydrograph at the Solvang gage. A decay function for the hydrograph recession at the Los Laureles gage above Cachuma Reservoir has been calculated. Figure 3-6 compares the average storm recession hydrograph for the Los Laureles and Solvang gages. The Solvang gage recedes at a faster rate than the Los Laureles gage primarily because the Solvang gage measures flow from a smaller watershed in the absence of spills at Bradbury Dam. The decay rates begin to diverge at about 150 cfs. The Los Laureles decay function from 150 cfs to 25 cfs takes approximately 14 days. Fourteen days was considered to be a reasonable, continuous passage event for migrating fish. The combination of the divergence, the 14 days of passage flows, and the operational maximum release from the Bradbury Dam outlet works, also 150 cfs, determined the flow trigger for the fish passage releases.

Flow supplementation will begin when the unsupplemented storm hydrograph at Solvang recedes from its peak to 150 cfs. From 150 cfs to 25 cfs, releases will be made from the Fish Passage Account to mimic the Los Laureles decay curve at the Solvang gage. From 25 cfs to baseflow, releases will be made based on the mainstem ramping rate (Table 3-4 above). Figure 3-7 shows how basin input and Fish Passage Account releases would combine to provide additional passage days under this flow supplementation scenario (Example #1). In the event that storm peaks at the Solvang gage are less than 150 cfs but greater than 25 cfs, then releases will be made from Bradbury Dam to supplement not only the decay curve of the storm hydrograph, but also the peak storm discharge. Thus, up to the outlet works capacity of 150 cfs will be released to boost up the peak storm discharge to 150 cfs at Solvang and then the Los Laureles decay function will be applied as stated above. An example of this type of passage supplementation is also shown in Figure 3-7, Example #2. Releases for fish passage supplementation will generally come from the outlet works at Bradbury Dam although a portion of the releases (≤ 10 cfs) may come through the Hilton Creek supplemental watering system.

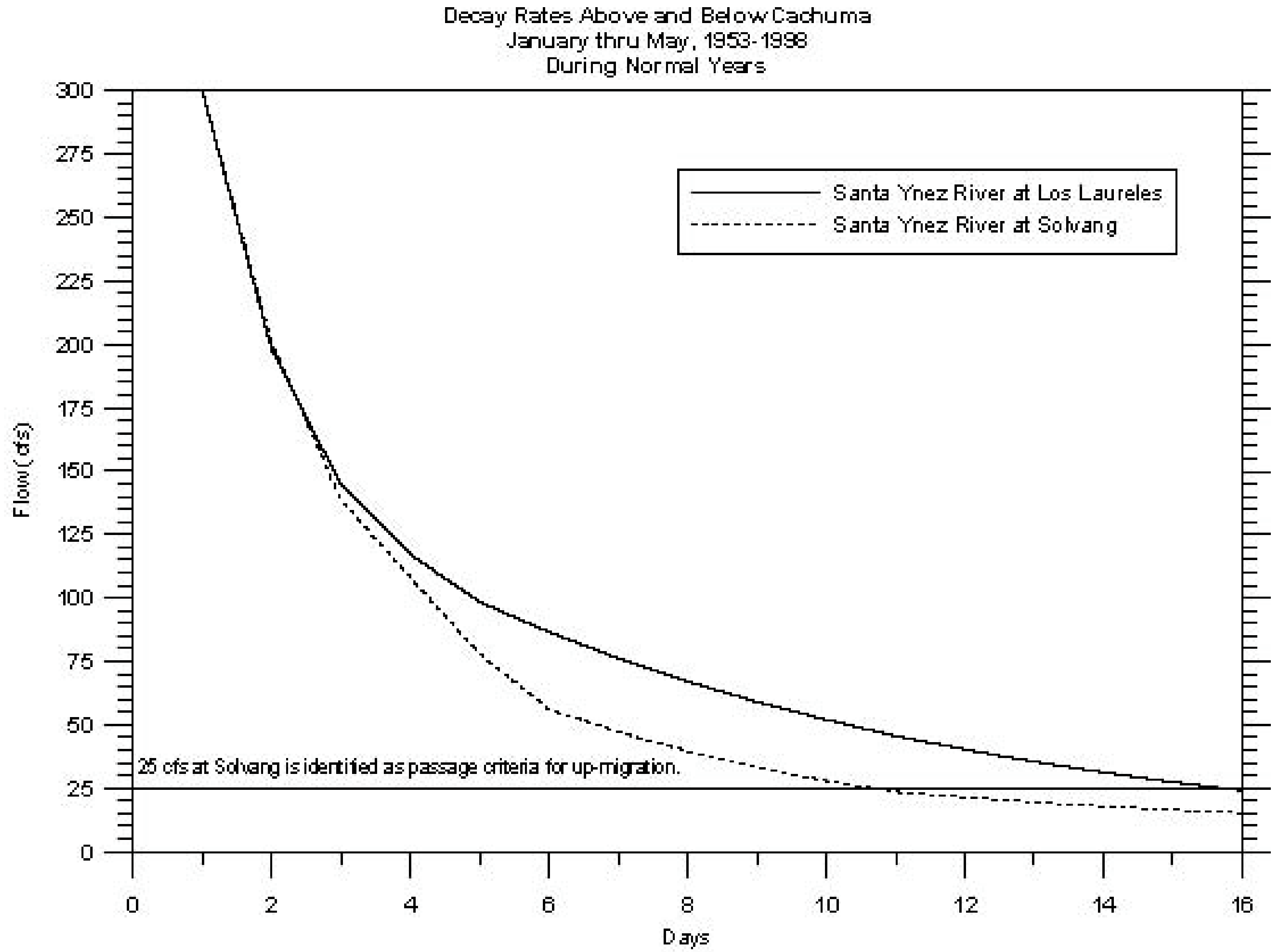


**Figure 3-6. Inflow Decay Rates at the Los Laureles and Solvang Stream flow Gages**

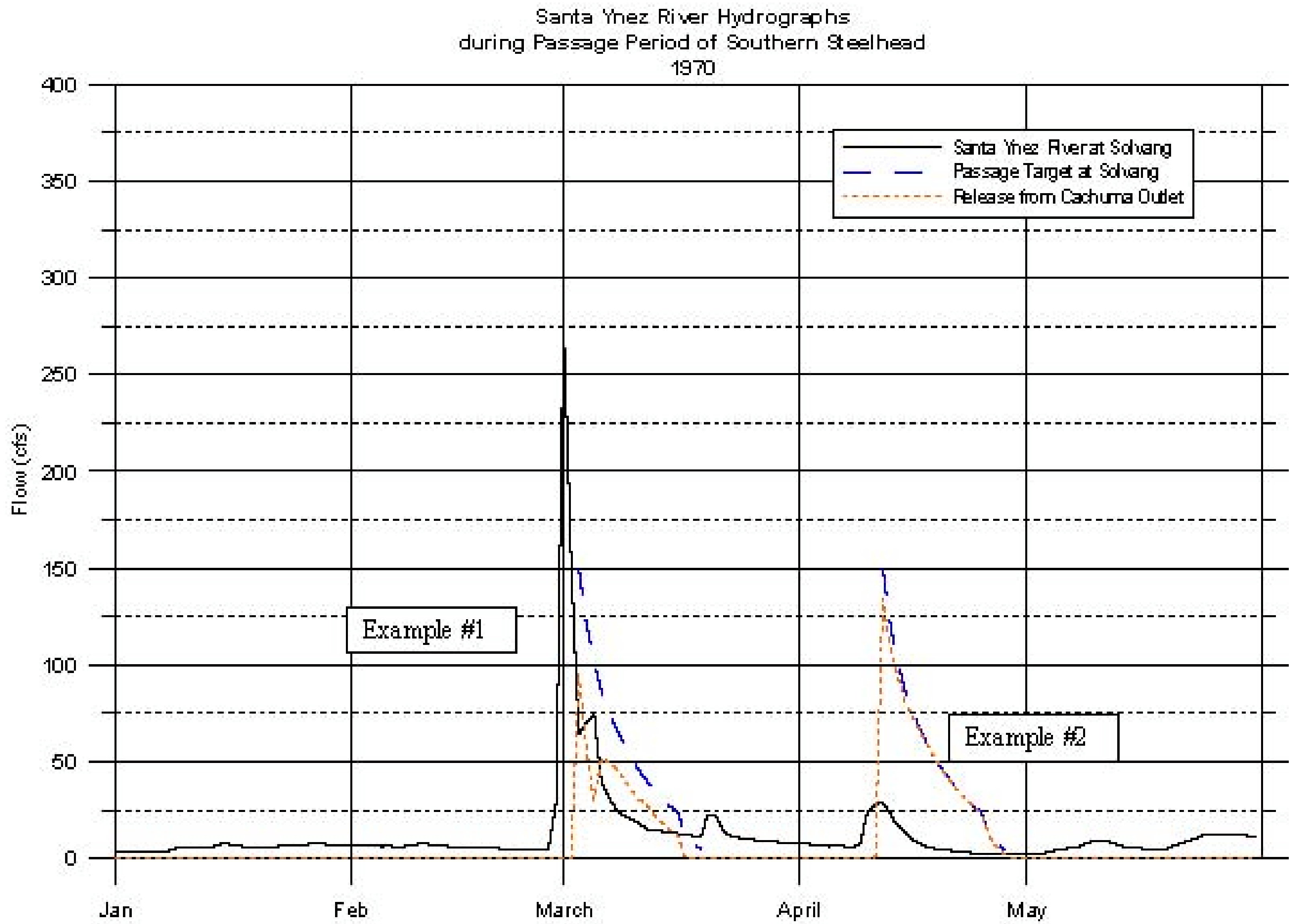


**Figure 3-7. Gaged and Modeled Stream flow at the Solvang Gage with Proposed Passage Supplementation Releases.**

The quantity and frequency of passage releases under the proposal were calculated using USGS gaged daily flows at Solvang for 40 years post-Cachuma construction (1958-1998). Flows required to provide passage supplementation for individual storm events are estimated to range from 300 to 1,800 acre-feet per year. Passage releases would occur starting in the year after the Fish Passage Account is filled by a surcharge event up to, on average, two to three years after the surcharge but could occur up to eight years after the surcharge event. Table 3-7 tabulates the releases for supplementation of passage by year and shows how the operation of the Fish Passage Account (3,200 acre-feet) would be implemented. In those years when the Fish Passage Account is released in a single year, it is generally because there were a number of small storms whose peaks were boosted and then the recession curve applied. Application of the adaptive management program could extend the use of water in these years if the Adaptive Management Committee decides that boosting only a portion of these smaller storms would increase the biological benefit of passage flow supplementation in additional years.

Analyses based on stream flow records and calculated supplementation releases were undertaken to estimate the total passage days at Solvang in the months of January through May, including the passage days resulting from supplementation releases and the passage days resulting from naturally occurring flows. Table 3-8 shows both the total passage days with and without supplementation for the sixteen years in which supplementation would have occurred. In these 16 years, or more than one third of the years analyzed, there were 11 additional days of passage per year on average, increasing the average number of passage days, on average, from 22 (baseline conditions) to 43 (with supplementation). In addition, in these same sixteen years, the number of years in which there was a passage opportunity of 14 or more days increased from 7 to 16 years.

#### 3.2.3.2.3 Adaptive Management of the Fish Passage Account

The protocol set forth above will be used to supplement passage flows and will be monitored closely to provide information to the adaptive management team. However, operating criteria have to be put in place for monitoring peak storm flows at Solvang and concurrent releases at Bradbury Dam for the purpose of implementing the passage flow supplementation.

Based on the results of these experimental releases, the Adaptive Management Committee will manage the Fish Passage Account releases to maximize the biological benefit to steelhead. The Fish Passage Account water will always be used for the purpose of fish passage supplementation. Initially, all storms will be supplemented as described above. As data are gathered on passage releases and fish movement within the system, modifications to the release scenario might be made. Generally modifications within the range of the adaptive management program will be designed to increase the number of storms and years when passage supplementation water will be released to enhance fish migration. Such modifications may include changing the trigger flow level, changing the definition of a storm, and selecting to boost storm peaks that are less than 150 cfs to different levels. Releases in the month of May might also be modified as more out-migrant information is developed. These modifications will likely be similar to those used to extend the water supply availability and might also include extending the tailout for longer periods of time.

## Table 3-7. Proposed Long Term Releases for Passage Supplementation (1958-1998)

| YEAR | Allocation to Fish Passage Account | Years from Surcharge | Releases from Fish Passage Account | End-of-Year Fish Passage Account Balance |
|---|---|---|---|---|
| 1958 | 3,200 | | 0 | 3,200 |
| 1959 | | 1 | 740 | 2,460 |
| 1960 | | 2 | 2,460 | 0 |
| 1961 | | 3 | 0 | 0 |
| 1962 | 3,200 | | 0 | 3,200 |
| 1963 | | 1 | 3,200 | 0 |
| 1964 | | 2 | 0 | 0 |
| 1965 | | 3 | 0 | 0 |
| 1966 | | 4 | 0 | 0 |
| 1967 | 3,200 | | 0 | 3,200 |
| 1968 | | 1 | 3,200 | 0 |
| 1969 | 3,200 | | 0 | 3,200 |
| 1970 | | 1 | 2,813 | 387 |
| 1971 | | 2 | 387 | 0 |
| 1972 | | 3 | 0 | 0 |
| 1973 | 3,200 | | 0 | 3,200 |
| 1974 | 3,200 | | 0 | 3,200 |
| 1975 | 3,200 | | 909 | 3,200 |
| 1976 | | 1 | 1,811 | 1,389 |
| 1977 | | 2 | 0 | 1,389 |
| 1978 | 3,200 | | 0 | 3,200 |
| 1979 | 3,200 | | 0 | 3,200 |
| 1980 | 3,200 | | 0 | 3,200 |
| 1981 | | 1 | 1,170 | 2,030 |
| 1982 | | 2 | 1,298 | 732 |
| 1983 | 3,200 | | 0 | 3,200 |
| 1984 | 3,200 | | 0 | 3,200 |
| 1985 | | 1 | 0 | 3,200 |
| 1986 | | 2 | 957 | 2,243 |
| 1987 | | 3 | 0 | 2,243 |
| 1988 | | 4 | 1,670 | 573 |
| 1989 | | 5 | 0 | 573 |
| 1990 | | 6 | 0 | 573 |
| 1991 | | 7 | 573 | 0 |
| 1992 | | 8 | 0 | 0 |
| 1993 | 3,200 | | 0 | 3,200 |
| 1994 | | 1 | 2,759 | 441 |
| 1995 | 3,200 | | 0 | 3,200 |
| 1996 | | 1 | 2,716 | 484 |
| 1997 | | 2 | 484 | 0 |
| 1998 | 3,200 | | 0 | 3,200 |

**Table 3-8. Passage Days with and without Proposed Long Term Passage Supplementation Operations (January through May, 1958-1998)**

| YEAR | Stream flow Record (Baseline) | | | Interim Supplementation Proposal | | |
|---|---|---|---|---|---|---|
| | Hydrologic Year Type[1] | Total # of Passage Days [2] | Indicator of ≥ 14 days | Total # of Passage Days[2] | Days Provided by Proposal | Indicator of ≥ 14 days |
| 1959 | normal | 36 | Yes | 36 | 0 | Yes |
| 1960 | dry | 9 | No | 26 | 17 | Yes |
| 1963 | dry | 9 | No | 33 | 24 | Yes |
| 1968 | dry | 12 | No | 41 | 29 | Yes |
| 1970 | normal | 11 | No | 30 | 19 | Yes |
| 1971 | normal | 71 | Yes | 72 | 1 | Yes |
| 1975 | normal | 78 | Yes | 81 | 3 | Yes |
| 1976 | dry | 3 | No | 15 | 12 | Yes |
| 1981 | normal | 15 | Yes | 22 | 7 | Yes |
| 1982 | normal | 8 | No | 15 | 7 | Yes |
| 1986 | wet | 28 | Yes | 33 | 5 | Yes |
| 1988 | dry | 2 | No | 14 | 12 | Yes |
| 1991 | normal | 12 | No | 17 | 5 | Yes |
| 1994 | normal | 8 | No | 28 | 20 | Yes |
| 1996 | normal | 27 | Yes | 46 | 19 | Yes |
| 1997 | normal | 28 | Yes | 31 | 3 | Yes |
| Average | | 22 | | 33 | 11 | |
| Number of years with ≥14 days of passage | | | 7<br>44% | | | 16<br>100% |

[1]A 'wet' year is the third of the years analyzed with the greatest inflow into Lake Cachuma, 'normal' years were the middle third of years, and 'dry' years were the third of years with the lowest inflow into Lake Cachuma.
[2]A 'passage day' is defined as flow at the Solvang gage of greater than or equal to 25 cfs.

The decay rate strategy will continue to be applied unless there is data to suggest a more effective release strategy for passage flow supplementation. The data for this type of change will be reviewed by both NMFS and Reclamation biologists.

Early in the year, water in the Fish Passage Account will be used to supplement every storm meeting the requirements. For releases in late April and in May, however, the committee may begin to consider the storage in Cachuma Reservoir and the likelihood of a surcharge in the following year, the balance of the Fish Passage Account, the current and prior storms, and expected baseflow recession levels in deciding whether supplementation is warranted. An example of an adaptively managed scenario is when a series of storms in March and early April provide, consecutively, 60 days of passage flows and 10 days later another storm peaks at 35 cfs. The Adaptive Management Committee may decide that supplementing the 35 cfs storm would not provide much additional benefit to steelhead. The committee may instead decide to reserve the water in the Fish Passage Account for supplementation of storms in May.

### 3.2.4 Adaptive Management Account

The Santa Ynez River system is still under study and new information about many of the operations proposed in this document will be gathered over the course of implementing and monitoring these measures. Many components of the Proposed Operations will be managed by the Adaptive Management Committee established by Reclamation.

Reclamation can foresee potential scenarios where small amounts of additional water could provide a substantial biological benefit in this adaptive management program. These scenarios, however, are based on the convergence of a number of factors that can not be predicted, with any regularity or certainty. For the long-term operation of the project an Adaptive Management Account will be established. In order to capitalize on these occurrences, the Account will contain a quantity of water that the Adaptive Management Committee can use to provide additional benefits to steelhead and their habitat.

The Adaptive Management Account will be filled in years when the reservoir surcharges to the 3.0 foot level. The 3.0 foot surcharge would provide 3,700 acre-feet more water than the 1.8 foot surcharge. Of the additional 3,700 acre-feet provided by the 3.0 foot surcharge, 3,200 acre-feet is allocated to the Fish Passage Account. The remaining surcharged water (500 acre-feet) will be allocated to the Adaptive Management Account. This account will be maintained using the same guidelines as the Fish Passage Account. The Adaptive Management Account will not experience evaporation or seepage losses; the unused portion will be carried over to the next year; and in the event of a spill, the Adaptive Management Account will be deemed to spill and the account will receive a new allocation from the surcharged water.

The Adaptive Management Account will be used at the discretion of the Adaptive Management Committee to increase the biological benefit to steelhead and their habitat as opportunities arise. The account water can be used to increase releases for mainstem rearing, provide additional flows to Hilton Creek, or to provide additional water for passage flow supplementation. For instance, perhaps the last storm of the season was the first week in

May and that storm was supplemented by water from the Fish Passage Account. However, monitoring data from trapping is demonstrating that a number of smolts are attempting to out-migrate but are having difficulty because of low flows in the mainstem. Water from the Adaptive Management Account could be released to provide additional flow for these fish.

#### 3.2.5 Summary of Proposed Fish Enhancement Operations

Table 3-9 summarizes the releases that will be made to enhance fish habitat and fish passage in the mainstem Santa Ynez River below Bradbury Dam. The operations are discussed in detail in the above sections.

### 3.3 Conservation Measures to Protect Steelhead

#### 3.3.1 Hilton Creek

Hilton Creek is a small stream located just downstream of Bradbury Dam that goes dry in early summer. SYRTAC studies have documented the migration of adult steelhead into Hilton Creek, spawning activity, and successful reproduction (SYRTAC 1995, 1997, 1998). Usually, however, the fry are lost when the stream dries up and they are stranded or forced to move downstream to the mainstem Santa Ynez River, where their vulnerability to predation is increased.

Modifications to improve fisheries habitat within Hilton Creek are a high priority. The reach of Hilton Creek to be enhanced is located on lands owned and controlled by Reclamation, and hence implementation of habitat improvement measures can be made without requiring access to private lands or authorization and approvals by agencies outside of those involved in the direct implementation of these conservation measures. Because Hilton Creek is within the jurisdictional authority of Reclamation and the Member Units, and because it naturally supports good steelhead habitat, Reclamation and the Member Units believe that Hilton Creek is an excellent opportunity to provide significant benefits to steelhead through a variety of enhancement measures (Figure 3-8). These measures include:

- Stream flow augmentation from Lake Cachuma.
- Construction of an extension channel (up to 1,500 feet long) at the lower end of Hilton Creek.
- Construction of upstream passage facilities at a partial impediment at the cascade and bedrock chute.
- Construction of upstream passage facilities at a complete impediment at the Highway 154 crossing.
- General habitat enhancements within the existing channel of Hilton Creek.

**Table 3-9. Summary of Proposed Interim and Long Term Operations for Rearing and Passage Enhancement in the Mainstem**

| Project Operations Phase | Proposed Operations for Mainstem Rearing and Passage |
|---|---|
| Interim Phase 1<br>0.75 Foot Surcharge | **Rearing**<br>*Highway 154 Flow Targets*<br>• 5 cfs flow target at Highway 154 in years when the lake spills at least 23,000 AF<br>• 2.5 cfs flow target at Highway 154 in years when the lake does not spill but storage exceeds 120,000 AF or when the lake spills less than 23,000 AF<br>• 1.5 cfs flow target at Highway 154 in years when lake storage recedes below 120,000 AF but greater than 30,000 AF<br>• Releases to refresh the Long Pool and the Stilling Basin may be made (limited to 30 AF per month or as needed) |
| Interim Phase 2<br>1.8 Foot Surcharge | **Rearing**<br>*Highway 154 Flow Targets*<br>• 5 cfs flow target at Highway 154 in years when the lake spills at least 23,000 AF<br>• 2.5 cfs flow target at Highway 154 in years when the lake does not spill but storage exceeds 120,000 AF or when the lake spills less than 23,000 AF<br>• 1.5 cfs flow target at Highway 154 in years when lake storage recedes below 120,000 AF but greater than 30,000 AF<br>• Releases to refresh the Long Pool and the Stilling Basin may be made (limited to 30 AF per month or as needed)<br>**Passage**<br>• 2,500 AF allocation to the Fish Passage Account in surcharge years |
| Long Term Operations<br>3.0 Foot Surcharge | **Rearing**<br>*Highway 154 Flow Targets*<br>• 10 cfs flow target at Highway 154 in years when the lake spills at least 20,000 AF<br>• 5 cfs flow target at Highway 154 in years when the lake does not spill but storage exceeds 120,000 AF or when the lake spills less than 20,000 AF<br>• 2.5 cfs flow target at Highway 154 in years when lake storage recedes below 120,000 AF but greater than 30,000 AF<br>• Releases to refresh the Long Pool and the Stilling Basin may be made (limited to 30 AF per month or as needed)<br>*Alisal Bridge Flow Targets*<br>• 1.5 cfs flow target at the Alisal Bridge in years when the lake spills at least 20,000 AF and steelhead are present in the Alisal reach<br>• 1.5 cfs flow target at the Alisal Bridge in years following a year when the lake spills at least 20,000 AF and steelhead are present in the Alisal reach<br>**Passage**<br>• 3,200 AF allocation to the Fish Passage Account in surcharge years<br>**Adaptive Management Account**<br>• 500 AF allocation to the Adaptive Management Account in surcharge years |

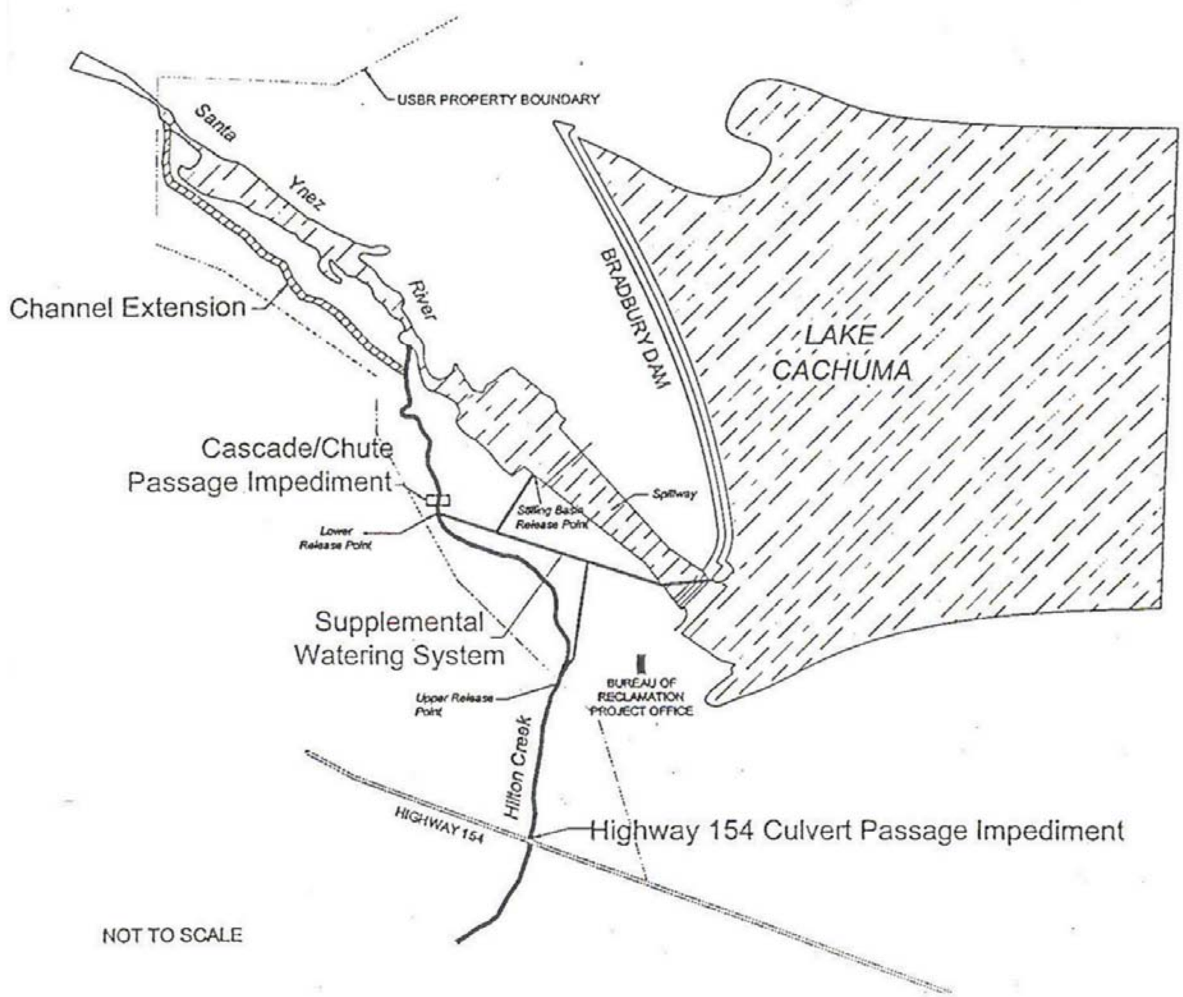


**Figure 3-8. Conservation measures in Hilton Creek.**

#### 3.3.1.1 Supplemental Watering System

Facilities

Because of Hilton Creek's proximity to Bradbury Dam, it is possible to augment creek flow with water from the reservoir. The feasibility of this approach was demonstrated in 1997, when a temporary watering system successfully provided water from Lake Cachuma to Hilton Creek (released in the bedrock chute just above the chute pool) from early summer through the end of December. Reclamation and the Member Units are currently completing the installation of a permanent supplemental watering system that will be able to provide suitable water in most years. This system will incorporate: (1) a basic facility with pipelines to make releases at three different locations (completed), (2) pumps to ensure reliable water deliveries at lower lake elevations, and (3) an adjustable intake pipe to obtain cool water deep in Lake Cachuma. Releases can be made at three sites: two in Hilton Creek and one to the Stilling Basin (Figure 3-8).

The upper release site in Hilton Creek is located near the Reclamation property boundary at elevation 680 feet, approximately 2,980 feet upstream of the Santa Ynez River. The lower release site is located just above the chute pool, approximately 1,380 feet upstream of the river at elevation 645 feet. The pipeline was designed to have a total capacity of 10 cfs. This capacity could be obtained through simultaneous releases at all three release sites. At each release point, an energy dissipation/aeration structure would maintain dissolved oxygen concentrations near saturation.

The capacity of the permanent watering system will vary with lake level. The system will operate by both gravity flow and pumped flow depending on flow targets and lake surface elevation. A secondary, fuel-powered pump system will located on site in the event of a malfunction of the existing pumping system (e.g. a power outage). Having both the gravity-flow and pump systems will ensure consistent water deliveries to Hilton Creek.

Steelhead/rainbow trout require cool water. Lake Cachuma is thermally stratified during spring and summer, with warm water near the surface (the epilimnion layer) and cold water at deeper levels (the hypolimnion). Vertical thermal profiles measured during the summer indicate that water should be obtained from a minimum depth of 65 feet (20 meters) below the lake's surface in order to obtain water measuring 18°C or cooler (SYRTAC 1997). The planned gravity system will have a variable intake line (snorkel) to regulate the depth from which water in Lake Cachuma is drawn.

Operations

Releases into Hilton Creek will be made to maintain flows generally be between 1.5 and 5 cfs depending on the water year type, natural flow in Hilton Creek, and the amount of water stored in the lake. Some or all of the releases made to meet the mainstem target flows (see Section 3.2.2) will be made via Hilton Creek. In addition, a portion of releases made for downstream water rights and for passage flow supplementation may also go through Hilton Creek. At each release point, an energy dissipation/aeration structure will maintain dissolved oxygen concentrations near saturation.

During drought situations, when the elevation of Lake Cachuma declines below 665 feet (2 percent of years), the watering system will not be able to deliver water to Hilton Creek. Migrating steelhead, however, are not expected to reach Hilton Creek in drought years. When such a situation occurs, Reclamation will reconsult with NMFS to determine what, if any, actions should be taken to protect fishery resources in Hilton Creek. A fish rescue would likely be performed in Hilton Creek assuming any steelhead spawned within that year.

A ramping schedule is proposed for Hilton Creek to protect rainbow trout/steelhead. The proposed ramping schedule is shown in Table 3-10. During the first year of the interim period, managed flow changes will be made during daylight hours and the creek will be monitored for stranding during ramping events.

**Table 3-10. Hilton Creek Ramping Schedule**

| Release Rate (cfs) | Ramping Increment (cfs) | Ramping Frequency (no more than once every...) |
|---|---|---|
| 10 to 5 | 1 | 4 hours |
| Less than 5 cfs | 0.5 | 4 hours |

Releases through the water supply system to meet the target flows at the Highway 154 and Alisal Bridges will be managed by the Adaptive Management Committee to maximize the biological benefit to rainbow trout/steelhead. Of the two release points in Hilton Creek, the Adaptive Management Committee expects to make releases primarily from the upper release point in most years. The water delivery system has been designed, and will be operated, to meet temperature and dissolved oxygen criteria appropriate for steelhead/rainbow trout. The two release points provide greater flexibility in adjusting the amount of water delivered to the different reaches of the creek. During operation of the temporary watering system in 1997, where water deliveries were made at the lower release point, water quality conditions were suitable throughout the lower Hilton Creek. Water released at the upper release point could experience greater warming as it travels through the channel, or it may temporarily go subsurface at the open alluvial area before rising again at the bedrock chute. If this is a problem, releases could be shifted to the lower release point. Monitoring of water temperature, flows, dissolved oxygen, and fish use will be conducted in order to adjust operations of the two release points as necessary. The releases to Hilton Creek within and among years will be managed by the Adaptive Management Committee.

Management of both the distribution of water among the release points and the amount of water to be released (i.e. the potential use of the Adaptive Management Account) will be based on a number of factors including, but not limited to, presence of spawning adult steelhead/rainbow trout, presence of rearing juveniles, reservoir storage, water quality (e.g. temperature and dissolved oxygen), system maintenance requirements, the relationship between flow and available habitat, water losses, water temperature at the intake depth in Lake Cachuma, and natural flow in the system.

One operational scenario that could be used for a wet year, when there is good winter runoff and migrating adults can ascend Hilton Creek to spawn, releases might be made to Hilton Creek in the spring or early summer once natural flows recede to about 3 to 5 cfs. The objective is to maintain rearing habitat for the resulting young-of-the-year through the summer. In extremely dry years, when no adult rainbow trout/steelhead can enter Hilton Creek to spawn, releases may be limited to periodic flows to refresh the Stilling Basin and Long Pool. A fish rescue operation will be conducted in those situations when water is not available to prevent stranding or exposure to harmful habitat conditions (as described below in Section 3.3.2).

Monitoring of Hilton Creek will provide the data necessary to make management decisions about flow releases. Flow and temperature data will be collected to determine the influence of the release points on water temperatures and water quantity in lower Hilton Creek. Fish use of the habitat both above and below the lower release point will be studied. The relationship between the quantity and quality of habitat available at different flow levels will be determined. Ramping events will be monitored for potential stranding during the first year of ramping. Monitoring will occur at different flow regimes and release rates to provide a basis for the adaptive management process although the release rates will not be altered for the purpose of these studies.

#### 3.3.1.2 Channel Extension

Reclamation and the Member Units plan to leverage the benefits of the supplemental watering system by creating an additional stream channel that can also be watered to provide habitat. The lower reach of the Hilton Creek channel will be modified to provide additional fishery habitat within an extension approximately 1,500 feet long (Figure 3-9) (Stetson Engineers and Hanson Environmental 1997). The channel extension will be constructed on Reclamation property and will approximately parallel the Santa Ynez River before joining the river at the Long Pool. The channel extension will be designed and constructed to include a series of pools, riffles, and a sinuous thalweg. The channel itself will be built to accommodate flows of up to 15 cfs. The upstream end of the extension channel will include a flow control structure to prevent flood damage to habitat.

The SYRTAC is currently evaluating two possible alignments for the channel extension across the Santa Ynez River floodplain. One possible alignment uses a portion of a relic overflow channel with a riparian corridor of mature sycamore near the southwest Reclamation property line. This alignment has the advantage of already having a well-developed riparian canopy. The second possible alignment being studied is closer to mainstem Santa Ynez River and would be constructed across the alluvial floodplain. Site-specific information on percolation and expected groundwater conditions will be collected during 2000 prior to finalizing the channel alignment and design.

The selection of the alignment will depend on groundwater levels and potential seepage loss. The soil along the Hilton Creek channel extension is alluvial, and the seepage rate may be

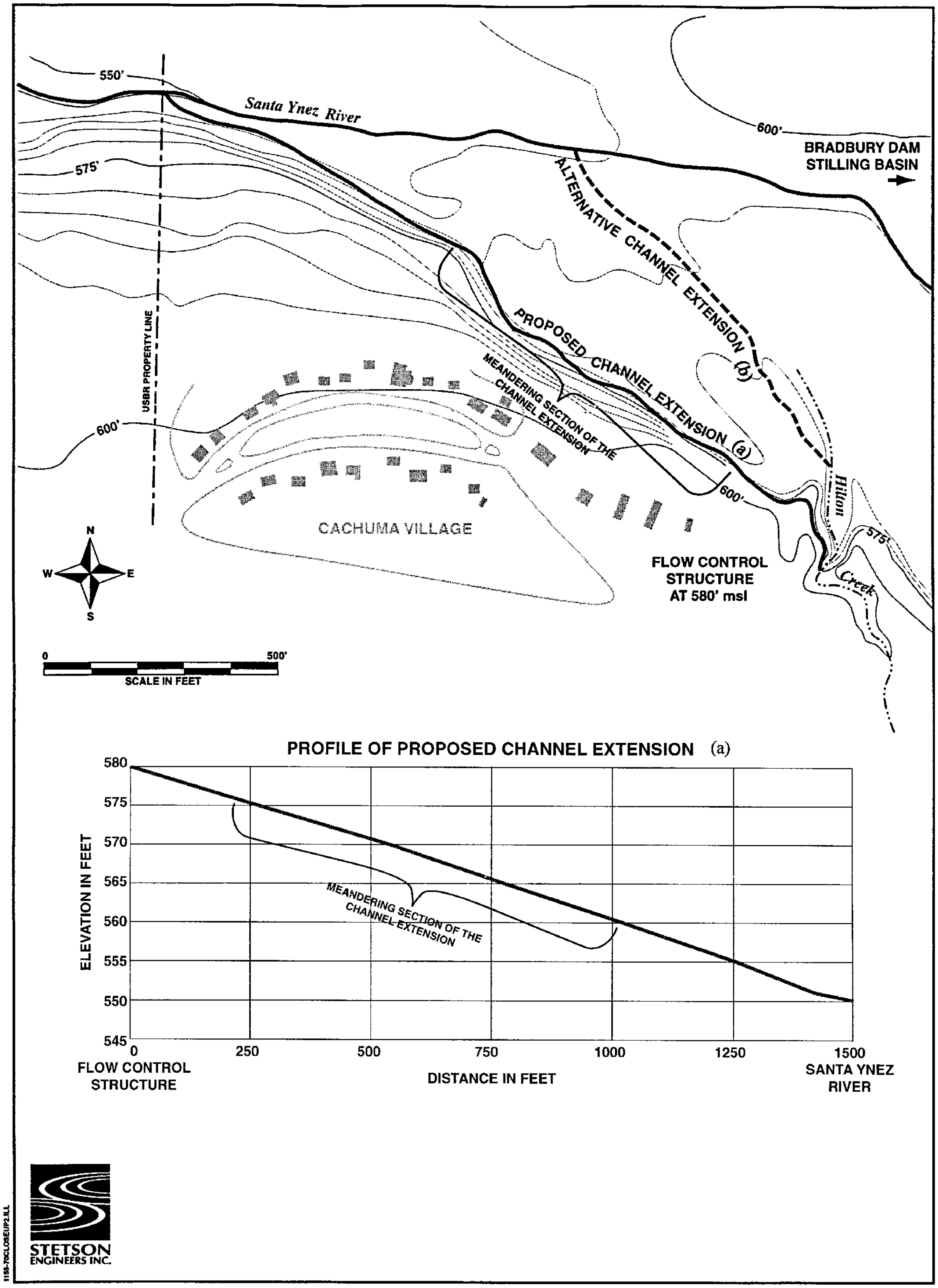


**Figure 3-9. Hilton Creek Channel Extension.**

high. To maintain the flow in the channel, it may be necessary to use zone B material in constructing the channel. This will be more easily accomplished along the second alignment. The channel bed would be made of a 6-inch layer of zone B material (impervious or low hydraulic conductivity material). Layers of sand, gravel, and cobble would be placed on top of the channel bed material, to a depth of about 1 foot, to prevent channel bed erosion. The extent of channel lining that may be necessary to prevent seepage and the planting design for supplemental streamside vegetation to provide shading will be planned at the same time.

The channel extension will serve as the low-flow channel. Flows will typically be 1 to 5 cfs, but the channel will be constructed to accommodate flows up to 15 cfs. The channel that was cut in Hilton Creek by the 1998 storms will continue to serve as the overflow channel to convey Hilton Creek flow into the Santa Ynez River during large rainstorms. During winter high flows, migrating adult steelhead/rainbow trout will be able to enter Hilton Creek through either this high flow channel or the channel extension.

The flow control structure will consist of two parts: (1) a submerged boulder weir to direct low summer flow and releases into the channel extension and (2) a limiter log structure to prevent high flows from entering the extension. A low boulder weir will be constructed across Hilton Creek 20 feet downstream of the head of the channel extension to create a back water. Under normal operations, this structure will direct the rearing flows in Hilton Creek to the channel extension. High storm flows will pass over the boulder weir within the natural course of the creek to accommodate the migration of steelhead/rainbow trout from the mainstem of the Santa Ynez River to Hilton Creek. Riprap or boulders will be placed to stabilize the stream bed near the mouth of the extension. High stream flow will be prevented from entering the Hilton Creek extension by use of a limiter log at its upstream entrance (Limiter log structures have been successfully used in restoration of Lee Vining Creek, Mono County; W. Trihey, pers. comm.) This type of flow control structure is constructed of natural materials (boulders and logs) but performs as a fixed plate orifice.

The stream bed and banks will be constructed of large boulders, available at the site, for a distance of two channel widths. Approximately one fourth the distance into this armored section one or more large logs will be placed across the channel, limiting the cross sectional area between the bottom of the log and the armored streambed and stream banks. The cross sectional area would be calculated to pass no more than 10 cfs beneath the limiter log without pressure flow developing. The cross section will be large enough to accommodate adult steelhead migrating upstream through the channel extension into Hilton Creek.

The Hilton Creek channel extension will be constructed using boulders, woody debris, suitable gravel and vegetation to create high value stream habitat. Boulders will be placed in the channel to increase shelter areas for steelhead and meandering of the stream flow. Riparian vegetation will be planted along the channel to provide shading and reduce increases in water temperature. Willow cuttings from nearby plants will be used, in addition to other appropriate native riparian species such as sycamore, cottonwood, and oak. A drip irrigation system will be installed to establish the plantings. Placement of boulders and planting of riparian vegetation will be consistent with the DFG's *California Stream Habitat Restoration Manual*, Section VII (Flosi et al. 1998). The final design of the channel extension will be subject to approval by DFG and NMFS.

The channel extension will be monitored to assess its performance and determine the need for any maintenance activities. Following a high flow year, it may be necessary to repair the channel where it meets the Santa Ynez. Sediment transport through the channel extension is expected to be minimal, since high flows will be directed to the current Hilton channel. Habitat monitoring will be used to determine if sediment supplementation or removal of fine sediments may be necessary in following years. The success of riparian plantings will also be assessed and corrective measures taken.

#### 3.3.1.3 Passage Facilities at the Cascade and Bedrock Chute

A rocky cascade and bedrock chute are passage impediments for migrating steelhead. The cascade is approximately 7 feet high and located just above the chute pool, about 1,380 feet upstream from the confluence with the river. The bedrock chute immediately above the cascade is about 100 feet long. Passage can be difficult at this location during large flows because of high velocity and at low flows because of the shallow jump pool below the cascade.

Providing passage around a partial impediment to steelhead migration at the chute pool will improve fish access to approximately 2,800 feet of stream channel up to the culvert at the Highway 154 crossing, which is a complete passage barrier. The habitat immediately above the chute pool consists of 400 feet of poor habitat (100 feet of bedrock chute and then about 300 feet of open channel), followed by 2,400 feet of good quality habitat up to the culvert. SYRTAC biologists and engineers have designed structures that will enable fish passage at flows of 5 cfs or more. Passage over the cascade will be improved by installing a weir at the downstream control of the chute pool to effectively decrease the height of the cascade and deepen the jump pool. Passage through the bedrock chute will be facilitated by creating a small resting pool at the top of the cascade and installing a number of channel obstructions to decrease the water velocity and create resting areas for migrating steelhead. Figure 3-10 is a schematic diagram of the proposed improvements. The final design is being developed in consultation with fish passage experts from DFG and NMFS in a manner consistent with the DFG's *California Stream Habitat Restoration Manual* and the ESA.

#### 3.3.1.4 Passage Facilities at the Highway 154 Culvert

Where Highway 154 crosses Hilton Creek, approximately 4,000 feet above the confluence with the Santa Ynez River, there is a culvert that is a complete passage impediment. Providing passage at this impediment and the cascade/chute impediment will make the upper reaches of Hilton Creek available to rainbow trout/steelhead. Anecdotal reports suggest that trout were historically present in upper Hilton Creek above Highway 154 prior to the re-routing of the creek during construction of Bradbury Dam.

Passage at the Highway 154 culvert is difficult at both high and low flows. At high flows the smooth surface inside the culvert can become a velocity barrier. At low flows the culvert and concrete apron can be dry or have very shallow depths that block passage. Further study will be required to develop a plan for making the impediment passable by steelhead. Current discussions suggest that baffles or large boulder could be installed in the culvert to slow the water down. Raising the water surface elevation in the downstream pool would flood the concrete apron allowing fish to pass. Upstream of the culvert is another apron and a debris plug

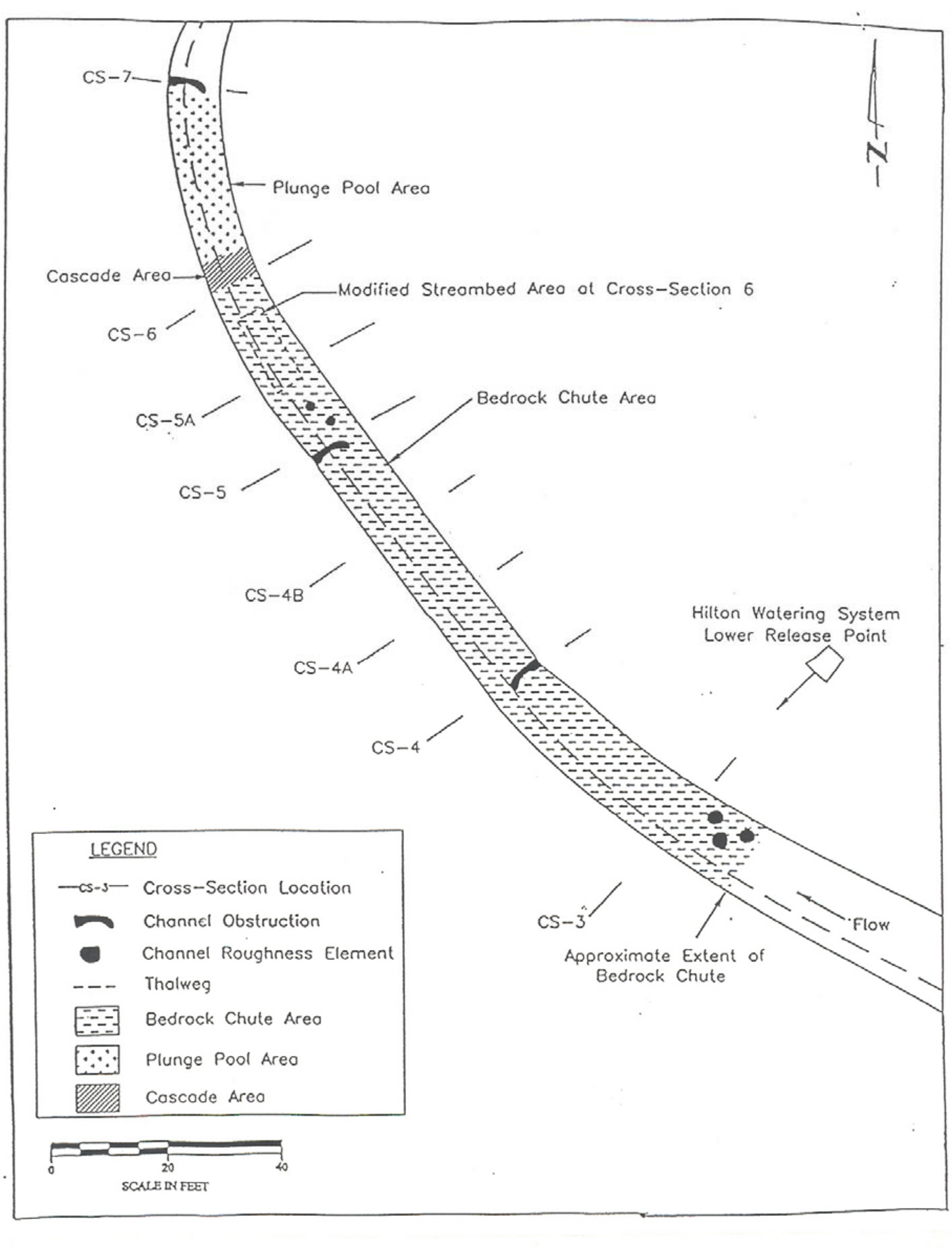


**Figure 3-10. Conceptual diagram of fish passage enhancement at the cascade/chute impediment on Hilton Creek.**

that would also require modifications to allow migrating rainbow trout/steelhead to continue into the upper reaches of Hilton Creek. Project design is limited by the need to work within the 120 foot CalTrans easement for the Highway 154 bridge. Preliminary designs for the culvert modification have been completed and are under review and revision. On-going discussions with CalTrans, DFG, USFWS, NMFS, and SYRTAC scientists will determine the final project design.

#### 3.3.1.5 Physical Habitat Enhancement

In addition to the measures above, other habitat modifications will include, but not be limited to, improvements to riparian vegetation (this may be limited by existing soil and bedrock conditions), improvements to instream pool and riffle habitat to create additional spawning and over-summering areas, and spawning gravel augmentation.

### 3.3.2 FISH RESCUE

While the supplemental water supply system will provide flow to Hilton Creek in most years, in dry or critically dry years or in years when lake level falls to near 665 feet, it would not be feasible to provide stream flow throughout the summer and fall months. As the season progresses, flow decreases, water temperatures increase, and dissolved oxygen levels may drop to stressful or harmful levels. In the past, fish have been restricted to isolated pools as flows in Hilton Creek declined. In these pools, rainbow trout/steelhead were vulnerable to predation by both fish and birds; desiccation, and exposure to elevated water temperatures (in a number of instances exceeding acute lethal temperature thresholds for steelhead). In drought years, Reclamation agrees to consult with NMFS to determine what, if any, actions will be taken to protect downstream fishery resources. Reclamation believes that under these circumstances, it may become imperative to move fish residing in Hilton Creek to more suitable habitat if they are to survive. This type of operation is referred to as a fish rescue.

Hydrologic analysis indicates that a fish rescue operation will likely be necessary in approximately 2 percent of all water years. During most of these years, however, it is likely that the river mouth would not open during the winter, and thus there would be no spawning in Hilton Creek by anadromous steelhead, although resident rainbow trout may still spawn there. Additionally, juvenile steelhead from the previous year may still reside in the stream, if there has not been enough flow to cue them to emigrate. Fish rescue operations have been successfully conducted in Hilton Creek in 1995 and 1998. In June 1998, about 831 young-of-the-year rainbow trout/steelhead and 3 adults were successfully moved from Hilton Creek to the mainstem Santa Ynez River above the Long Pool (676 fish) and San Miguelito Creek (153 young-of-the-year). During 1998, specific protocols were developed for determining when fish rescue operations would be initiated. These protocols may not be appropriate for all years, but 1998 provided a template for coordination and cooperation between the SYRTAC, DFG and NMFS which will make similar efforts in the future successful.

The fish rescue plan for Hilton Creek has two parts: (1) monitoring to determine whether and when a fish rescue should be initiated; and (2) the protocols for capture and transfer of fish. Monitoring of flow levels and water temperatures within Hilton Creek will provide the primary information on when a fish rescue operation should be considered. If flow seems likely to become substantially diminished or temperature approaches stressful levels, then the project biologist will consult with the SYRTAC, DFG and NMFS to determine if a fish rescue should be implemented. Once the potential need for a fish rescue has been identified, the creek will be monitored daily for signs of additional stress.

One of the conditions necessary for a successful fish rescue operation is the availability of a suitable place to relocate the fish. If it seems likely that a fish rescue operation will be necessary, the project biologist will investigate likely relocation areas to determine if they have conditions (adequate stream flow, temperature) which are favorable to steelhead. If a suitable relocation area is available, a survey of fry/juvenile density will be performed, to determine if there is any available space for more fish. Potential relocation sites include the Long Pool and mainstem just below Bradbury Dam, and certain tributary reaches.

To minimize predation losses of relocated young-of-the-year rainbow trout/steelhead, warmwater fish (largemouth, bass, smallmouth bass, and bullheads) may be removed from the receiving site if they are abundant. These fish can increase the mortality rates of young rainbow trout/steelhead both directly through predation, and indirectly by forcing young fish to occupy less suitable areas where they may have slower growth rates, lower fitness, or be exposed to other predators. Predator removal could provide localized benefits to native fish in the mainstem pools although these benefits will be temporary because of recolonization from other areas (other stream reaches and/or Lake Cachuma). Predator removal will be most valuable as refuge pools become isolated during the summer.

Predators will be selectively removed from key pools using physical capture methods. The primary methods would be fyke nets (also called box traps) in larger pools and runs, and seines in smaller pools. Captured native fishes will be returned to the stream. The operations will be conducted by fishery biologists or volunteers directly supervised by a fishery biologist.

Once a suitable location is found, the fish rescue could proceed using protocols similar to those used in 1998, although specific details will need to be decided on a case by case basis, as conditions may change. Operations will occur in the morning when the stream is coolest and will cease when water temperatures exceeds 18°C. Fish will be captured using seines and nets as much as possible, and held and transported in chilled aerated water. The temperature of transport and release water will be equalized prior to release.

Fish rescue and predator control operation will be undertaken on a case-by-case basis in consultation with NMFS and DFG. Fish rescue operations could also be conducted in other stream reaches that are drying and/or have stressful temperatures that are not on Reclamation property. The decision to conduct fish rescues in these areas will be made on a case-by-case basis based on the landowner’s permission and in consultation with the resource agencies.

### 3.3.3 CONSERVATION EASEMENTS: HABITAT PROTECTION AND ENHANCEMENT

The tributaries on the south side of the watershed have good potential as fish habitat because these streams generally have perennial flow through the summer, at least in their upper reaches. Habitat quality can range from good quality in upper reaches (i.e. perennial flow, good canopy cover, suitable water quality) to poor just above the confluence with the mainstem Santa Ynez

River (i.e., intermittent or no flow in summer, little canopy cover). Conservation measures directed at tributary habitat will focus on protecting habitat that is already in good condition and enhancing habitat that is in fair condition. Efforts will not be expended on poor quality habitat where conditions cannot be feasibly improved.

All tributaries in the lower basin, except lower Hilton Creek, are on private property. Therefore, voluntary participation by the landowner will be necessary for implementation of protective and enhancement measures along these streams. The Member Units will obtain conservation easements from landowners to protect property and to implement and monitor appropriate enhancement actions. Priority areas for seeking conservation easements will be identified according to the persistence of flows, suitability of habitat (or potential for enhancement), and absence of downstream passage barriers.

Several landowners have approached the Member Units about establishing conservation easements. The Public Education and Outreach Program (Section 3.3.6) will complement this action by educating landowners about "fish friendly" land management practices and encouraging others to participate in conservation easements.

#### 3.3.3.1 Habitat Protection

Habitat protection will focus on obtaining conservation easements from private landowners along stream corridors. A conservation easement is a legal agreement between a landowner and a non-profit group or government agency, such as Reclamation and the COMB. Conservation easements will entail purchasing the rights to manage a strip of property along streams from the property owner. The owner retains ownership of the property, but is paid for loss of use. In exchange, Reclamation and the Member Units would be able to implement fish conservation measures within the easement, as described in the following section. Conservation easements can either be a permanent purchase of the specified management rights or a long-term lease (typically 20 years) of those rights.

In most agreements, landowners allow certain activities to be performed on their property in exchange for monetary or other benefits. Conservation easements can be effective at fostering habitat improvement, both where land use is negatively affecting riparian and aquatic habitat or where frequent access to the stream is required for the maintenance of projects. Conservation easements can foster natural recovery of habitat over time, as well as enhance the success of active intervention through other actions, such as planting riparian vegetation.

Reclamation and the Member Units will also work with landowners to develop land use practices that protect steelhead and their habitat without adversely affecting the operation of the landowners' property. Such practices may include exclusionary fencing to keep cattle from the stream or out of riparian vegetation, creation of catchment ponds to settle fine sediments and other materials from runoff waters before they enter the stream, streambank protection, and vegetative buffer strips.

The general process for establishing conservation easements starts with discussions between the landowner and Reclamation/COMB. Field surveys will be conducted to evaluate the potential of the stream as steelhead habitat and to assess land use practices that may affect the stream. An action plan will be developed from this information, which will outline site-specific habitat enhancement measures and land use practices. An appraisal will be done by an independent appraiser familiar with assessing property values for conservation easements. The landowner and Reclamation/COMB will determine the terms and conditions for sale or lease of the conservation easement, which will be funded by Reclamation/COMB and transferred to an approved land trust organization, such as the Santa Barbara County Land Trust. The Member Units will then implement the habitat enhancement actions outlined in the action plan and conduct monitoring to adaptively manage the conservation easement.

Reclamation and the Member Units are in discussion to obtain conservation easements on several properties in the El Jaro Creek drainage, which will protect about 10 miles (52,800 ft) of lower El Jaro Creek and its tributaries. The landowners and COMB have entered into contracts to pursue investigations and negotiations for conservation easements. Preliminary surveys of the properties in question demonstrate that the El Jaro Creek habitat is mostly fair quality habitat with some in good condition. There are localized sediment input sources that would be addressed by habitat enhancement projects (see below) once the management agreements are in place. Reducing the sediment input to the stream would improve the habitat quality for spawning and rearing steelhead. Juvenile rainbow trout/steelhead are known to use this habitat to oversummer and adult steelhead have access to this habitat currently (access will be improved by the modification of the impediment at Highway 1). The three landowners have recently met with SYRTAC representatives to discuss the conservation easements and all are very interested in proceeding. Appraisals need to be conducted and the full agreements are expected to be in place by 2003.

#### 3.3.3.2 Habitat Enhancement

Habitat improvements might include structural modifications to instream habitat such as the creation of additional pool and riffle areas and augmentation of spawning gravel. Boulders and large woody debris could be used to create additional habitat features within selected reaches of the mainstem and the tributaries. Access to private lands and the results of field fisheries surveys and habitat typing, in combination with results of water temperature monitoring, will be used as a basis for identifying specific locations for habitat protection and improvement.

For the three properties described above, existing fair steelhead habitat will be enhanced primarily by implementing a number of small bank stabilization projects. Localized livestock management, riparian restoration, and instream enhancements may also be warranted.

<u>Addition of Instream Structures</u>

Physical modifications of the channel through addition of instream structures would be used to create more oversummering pool habitat. Habitat complexity has been positively correlated with fish density. Methods for physical enhancement include: (1) improving the quality of pools by increasing cover and complexity, and (2) increasing the amount of pool habitat by increasing depths in existing pools or scouring new pools.

The first step of a pool enhancement program will be to identify areas where opportunities exist for enhancement measures to be successfully implemented. Surveys will be conducted of existing permanent pools to determine their habitat characteristics, as well as to identify additional areas where pools could be created that would likely persist. Site selection would take into account accessibility, channel hydraulics, geomorphology (e.g. bankfull width, depth, gradient, sinuosity, sediment load, and substrate size), stream flow regime, and availability of structural materials. Sites with relatively stable stream bed, stable banks, and woody riparian vegetation will afford the greatest opportunities, while sites with steep streambanks, non-cohesive sandy soils, little riparian vegetation, and high stream gradients present greater challenges to the successful use of instream structures.

Once suitable sites have been identified, a conceptual enhancement plan can be developed. A feasibility analysis will be performed to evaluate factors such as continued site accessibility, structural stability, cost, and longevity prior to developing final engineering plans for the proposed enhancements. Although the instream habitat improvements will be designed to withstand damage due to flood flows to the maximum extent practicable, periodic maintenance will be required to correct problems such as unsuitable scouring of cover structures or in-filling of pools with excess sediment.

Cover elements in pools may be naturally formed by overhanging riparian vegetation, undercut banks, exposed root wads or logs. Structures typically added to pools to enhance cover include logs, root wads, boulders and cobbles. These structures will need to be secured to stable locations to prevent wash-out. Boulders and cobbles can be placed into pools to create interstitial spaces that provide cover. Consideration should be given to using boulders and cobbles that are large enough to minimize entrainment and transport during high flows. This may require somewhat larger bed materials than those which are currently found in the river.

Pool depth can also be increased by installing instream structures to increase scour, by direct excavation, and/or by manipulating channel geomorphology. Instream structures such as log and boulder weirs, deflectors, and/or digger logs could be used to constrict the channel, increase flow velocities, and thereby scour pools. The objective being to promote self-maintaining pools and to create back-water conditions during periods of low-flow.

Riparian Enhancement

Riparian zones perform a number of vital functions that affect the quality of aquatic habitats, as well as provide habitat for terrestrial plants and animals (Spence et al. 1996). Fallen leaves and branches are an important source of food for aquatic macroinvertebrates and nutrients for aquatic vegetation, while fallen terrestrial insects are valuable prey for fish. The roots of riparian vegetation maintain bank structure and provide cover via undercut banks. Overhanging branches also provide cover. The riparian canopy can reduce water temperatures by shading the stream. Large woody debris that falls into the stream further increases cover and creates areas of scour which increase water depth. Riparian vegetation can also reduce water velocities and create refuge areas of relatively low velocity during storm flows.

Propagation of native riparian vegetation can improve stream habitat through the mechanisms described. The Plan will enhance and restore riparian vegetation at specific pools along the Santa Ynez River. This type of restoration effort is relatively inexpensive and easy to perform, as long as permission can be obtained from landowners to access these areas to plant vegetation or conduct other enhancement activities and to protect new plants. Planting or enhancement of riparian vegetation may be useful at sites where the canopy cover is low and the stream channel is not too wide. Where possible, deep-rooted vegetation such as sycamore or cottonwood would be preferable to shallow-rooted vegetation such as willow. The species of vegetation selected for propagation can have a measurable effect on stream flow. The enhancement or expansion of streamside vegetation will likely increase water loss due to transpiration within the stream corridor, although this would be balanced by decreases in evaporation due to improved shading.

### 3.3.4 Tributary Passage Barrier Modification

Under current conditions, manmade and natural structures may impede steelhead movements in the tributaries of the lower Santa Ynez River, especially under low and moderate stream flows. Since habitat availability may be a primary factor limiting the steelhead populations in the watershed, it is imperative to improve accessibility to existing aquatic habitat by modifying or removing impassable barriers. These efforts will serve to expand the available habitat for spawning and rearing steelhead; thereby expanding the carrying capacity of the lower river.

The tributaries of primary interest are Salsipuedes-El Jaro, Hilton, and Quiota Creeks, since they have perennial flow, at least in their upper reaches, and can support spawning and rearing. Passage enhancement measures for the two passage impediments in Hilton Creek are described above in Section 3.3.1. Impediments on the other tributaries are manmade barriers such road crossings, bridges, and culverts (Table 3-11). All of the impediments listed in Table 3-11 will be modified to provide for fish passage migration assuming access agreements can be reached.

Access to habitat within Salsipuedes and El Jaro Creeks by anadromous steelhead is limited by two low flow passage barriers, associated with bridges or road crossings (SYRTAC data). These barriers are thought to impede the passage of both adult and juvenile fish primarily during periods of low flow. The Highway 1 Bridge #51-95 on lower Salsipuedes Creek is located about 3.6 miles upstream from the Santa Ynez River. This bridge has a 3 to 4 foot drop from the concrete apron into a pool downstream of the bridge. Pool depth may not be sufficient to allow fish to negotiate the apron. Reclamation and the Member Units have received a $25,000 grant to modify the concrete apron to provide low flow passage for migrating steelhead. Preliminary designs for the proposed modification are complete and SYRTAC scientists and engineers will be working to finalize those designs with NMFS and DFG specialists.

Road crossings, such as those in Quiota and El Jaro Creeks, can also be an impediment to fish movement. El Jaro Creek has a road crossing and concrete apron about 1/3-mile upstream of the confluence. It is an old ford on a private, unused road, with a 3-foot drop below. Refugio Road crosses Quiota Creek many times beginning about 1.8 miles upstream from the mainstem Santa Ynez River. All nine crossings are shallow-water Arizona crossings, with concrete beds and, at several sites, a 2 to 3-foot drop downstream of the concrete apron. Refugio Road is maintained by the County of Santa Barbara.

Arizona 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 stream flow, and permit debris and sediment to pass downstream during periods of high stream flow. Generally these crossings require little maintenance to provide access across the stream. However, they often

**Table 3-11. Passage Impediments on Tributaries**

| Creek | Location of Impediment | Structure | Type of Impediment | Jurisdiction |
|---|---|---|---|---|
| Salsipuedes | 3.6 miles above Santa Ynez River | Bridge crossing on Highway 1 | Low-flow passage impediment | State road |
| El Jaro | 1/3 mile above Salsipuedes confluence | Road crossing | Low-flow passage impediment | Abandoned private road |
| Nojoqui | 3.5 miles upstream of Santa Ynez River | Culvert | May be an impediment | |
| Quiota | 1.8 to 3.3 miles above Santa Ynez River | 6 Road crossings | Low-flow and high-flow passage impediments | County road |
| Hilton | 1,380 feet above Santa Ynez River | Rocky cascade & bedrock chute | High-flow passage impediment | Reclamation |
| | Underneath Highway 154 | Concrete culvert | Velocity impediment | State road |

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 stream flow. Steelhead migrating during periods of moderate to high stream flow can jump and swim between the backwater pools until they reach the crossing and swim across it. Modifying the depth of flow across these crossings would reduce their utility at some flow levels making travel inconvenient. The County of Santa Barbara and Member Units will team together to develop more fish-friendly crossings, as the County makes plans to repair three of these crossings.

Surveys of other potential passage impediments and barriers will be conducted to determine the benefits and feasibility of modifying them to enhance fish passage. For example, there is a culvert on Nojoqui Creek that may be an impediment about 3.5 miles upstream of the Santa Ynez River, but further assessment is required (SYRTAC data). Box culverts under state and county roads can impede migration. 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 boulder weirs can often provide adequate backwater during high stream flows 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 the culvert could be replaced with a bridge or arch culvert.

Preliminary engineering designs will be developed for low to moderate flow fish passage facilities in consultation with the bioengineering staffs of the NMFS and DFG. The preliminary engineering designs for fish passage facilities will be used as a basis for estimating costs for final design and construction, the range of flow conditions for which the passage facilities would provide benefit, identification of permitting requirements and preparation of environmental documentation, and requirements for access to private lands for the construction of fish passage facilities.

### 3.3.5 Pool Habitat Management

Results of the 1993-1998 fisheries investigations have demonstrated the importance of existing deeper water pool habitats within the mainstem as refugia for rainbow trout/ steelhead during low flow summer conditions. Pools are known to support rainbow trout/ steelhead throughout the management reach. These pools are particularly important for larger fish (>6 inches), but less so for small fish since smaller fish are easily preyed upon by introduced predatory fish species. Factors which may impair production in these pools include high temperatures, low dissolved oxygen content, lack of structure, and presence of predators.

Water quality in these pools will be maintained via conjunctive operation of water releases, as discussed above in Section 3.2.2. In addition to water releases, non-flow related measures may be taken to improve the habitat complexity of pool habitat on Reclamation property. Habitat improvements could include structural modifications to instream habitat such as augmentation of spawning gravel or installation of boulders and large woody debris to provide cover. To the extent that willing private landowners can be located, these improvements may be made elsewhere as well.

### 3.3.6 Public Education and Outreach Program

Reclamation and the participating agencies will develop a Public Education and Outreach Program to explain the activities related to the protection and enhancement of steelhead populations and their habitat, as well as other sensitive resources in the lower Santa Ynez River system. It will describe the programs designed to maintain or restore steelhead, and solicit volunteer actions from private property owners to improve steelhead habitat in the mainstem of the river and its tributaries downstream of Bradbury Dam. The Member Units will finance the program activities, and coordinate comments and suggestions received from the public.

Because the majority of land in and along the lower Santa Ynez River is privately owned, the Public Education and Outreach Program will stress the voluntary part of the Plan. It will be broad-based but will particularly target riparian landowners, keeping them informed of river-related activities designed to help maintain and restore steelhead, and soliciting their voluntary participation in habitat improvement programs. These programs may include riparian planting, spawning gravel augmentation, passage barrier removal, creation of additional habitat features, "fish friendly" land management practices, and other measures to benefit steelhead and other aquatic resources. This information program will emphasize sections of the river and tributaries under the control or management of the landowners, but will also draw upon the successes from Reclamation property and from other watersheds, as well. The Public Education and Outreach Program will provide technical assistance for implementing these measures and will fund or co-fund these type of enhancements.

Public involvement activities will be initiated in order to keep the public informed of the progress of the conservation measures undertaken to protect and restore steelhead and its habitat. These activities will include the following outreach activities:

- Annual public workshops to invite suggestions from the public on reasonable conservation measures for steelhead, and to keep them informed of the progress of the restoration effort. The first of these meetings was held in June, 1998, to solicit input on management alternatives being considered for an overall fish management plan.

- Issuance of periodic news releases to the *Santa Barbara News Press*, the *Lompoc Record*, and the *Santa Ynez Valley News* to ensure that program successes are relayed to the news media.

- Establishment of a free "800" phone message line with regular updated messages concerning the progress of instream habitat improvements and the effect of those improvements on the various life stages of the steelhead. The public will also have the opportunity to leave messages.

- Issuance of annual newsletters summarizing the previous year's enhancement activities on the Santa Ynez River and its tributaries, habitat conditions, fish populations, successes, failures, future milestones, and schedule of upcoming events. They might also include a "highlight" piece on related topics, such as: voluntary measures undertaken by landowners that have aided in creating additional habitat or improving existing habitat; successful, cooperative fish programs between landowners and public agencies; ability of cattle and fish to successfully coexist along the river; the cost of the steelhead restoration measures; sources of funding and technical assistance available to landowners to implement habitat improvement measures.

- Establishment of a web page with updated messages and photographs, along with information who to contact with comments, questions, or suggestions.

- Seasonal field trips led by project biologists to give interested landowners a real-life perspective on the enhancements that are being made in the river and the benefits they provide to the steelhead.

- Establishment of an expert speaker's group to provide informed speakers to local organizations. This group might also include local landowners who have initiated innovative measures to help restore steelhead habitat.

- Annual "Steelhead Restoration" slide shows at local bookstores advertised through fliers posted in local shops and restaurants.

The Public Education and Outreach Program will be developed on an adaptive management basis; activities that are successful will be continued, and improvements to the Program will be continually sought.

#### 3.3.7 Schedule for Implementation of the Tributary Enhancement Measures

Reclamation has created a schedule that summarizes the anticipated completion date for the proposed tributary enhancement measures (Table 3-12). Given the expected implementation dates for the interim and long-term operations, it is expected that the Hilton Creek fish passage enhancement at the bedrock cascade and chute will be completed during Phase 1 of the interim operations. During Phase 2, seven of the remaining ten tributary enhancement measures will be implemented.

## 3.4 Watershed Monitoring Program

Since 1993, the Santa Ynez River Technical Advisory Committee (SYRTAC) has cooperatively studied the fish, habitat, and hydrology of the SYR. The ultimate goal of the SYRTAC is to develop the information necessary to identify and evaluate potential management actions that will benefit fishery resources in the lower SYR downstream of Bradbury Dam. The participants of the SYRTAC are comprised of Cachuma Member Units (water purveyors), resource agencies

**Table 3-12. Schedule for the Cachuma Project Enhancement Measures**

| Enhancement Measure | Anticipated Implementation |
|---|---|
| Cascade/Chute Fish Passage Enhancement | 2000 |
| Reservoir Surcharge Flashboard Construction | 2001 |
| El Jaro Creek Streambank Stabilization Projects | 2001 |
| Highway 1 at Salsipuedes Creek Fish Passage Enhancement | 2001 |
| Hilton Creek Watering System Pump and Flexible Intake | 2002 |
| Highway 154 Culvert Fish Passage Enhancement | 2002 |
| Conservation Agreements | 2003 |
| Quiota Creek Fish Passage Enhancement | 2003 |
| Hilton Creek Channel Extension | 2004 |
| El Jaro Creek Abandoned Road Fish Passage Enhancement | 2005 |
| Nojoqui Creek Culvert Fish Passage Enhancement | 2005 |
| Habitat Improvements* | 2004, 2005, & 2006 |

*several small scale projects on conservation easements and other tributaries

(California Department of Fish and Game, US Fish and Wildlife Service, Reclamation), and local environmental groups who are interested in the resources of Lake Cachuma and the public trust resources downstream of Bradbury Dam.

In 1997 the SYRTAC drafted a long term study plan to guide the monitoring program in the Lower Santa Ynez River. The monitoring program below is based on this long-term study plan. The original plan is expanded in a number of areas including enhancement project specific monitoring, a multidisciplinary watershed assessment, mainstem migrant trapping, and lagoon water level monitoring.

### 3.4.1 WR 89-18 MONITORING

Monitoring of the ramp-down of the next WR 89-18 release will be conducted to determine the rates of change in stage and wetted width.

METHOD**:** In the first year water rights releases are initiated, a single transect and staff gages will be established at three locations within the mainstem. The locations are as follows:

- Directly downstream of the Stilling Basin
- Directly downstream of the Long Pool
- Approximately 3.5 miles downstream of Bradbury

Transects will be established in run habitats. Once flow decreases are initiated, field personnel will man each transect location, recording measurements every 15 minutes to establish the change in wetted width and depth over time.

The following data will be collected: Time, wetted width, and staff gage depth.

### 3.4.2 WATER QUALITY MONITORING

#### 3.4.2.1 Mainstem and Tributary Thermograph Network

The objective of the monitoring is to evaluate:

- Seasonal patterns of water temperature, in both the mainstem and tributaries downstream of Bradbury Dam
- Diel variations in water temperature
- Longitudinal gradient in water temperatures downstream of Bradbury Dam
- Vertical stratification and evidence of cool water upwelling in selected refuge pools
- Determine water quality suitability for various fish species including steelhead trout

METHOD: There are approximately 14 mainstem thermographs deployed at various locations throughout the mainstem SYR, extending from Bradbury Dam down to the lagoon. The thermograph network will continue at its present level of effort with the core mainstem thermographs located at: Spill Basin (1), Long Pool (2), pool at mile 3.4 (2), pool at mile 6.0 (2), pool at mile 7.8 (2), pool at mile 10.5 (1), run at mile 13.9 (1), run at mile 24 (1), lagoon (2). An additional pool habitat will be picked for a vertical array thermograph monitoring location to increase the level of monitoring in the Alisal Reach. The additional monitoring site will be located at approximately mile 8.0 downstream from Bradbury Dam. Tributary locations include Hilton Creek (2-3), Nojoqui Creek (1), Quiota Creek (1), Salsipuedes Creek (2), El Jaro Creek (1), and San Miguelito Creek (1). Deployment locations are in both run and pool habitats. Run habitats have the thermograph laying on the bottom of the habitat while pool locations generally have a vertical array with the surface connected to a float suspended one foot below the surface and the bottom thermograph laying on the bottom of the habitat.

#### 3.4.2.2 Diurnal Water Quality Monitoring in the Mainstem

During late spring and extending into early fall, the SYR exhibits tremendous algae production in most of its surface waters. During the day when photosynthesis is taking place, algae growth can saturate the water column with dissolved oxygen (DO). Conversely, at night, algae metabolism, bacterial decomposition, and invertebrate respiration can remove significant amounts of DO from overlaying water causing oxygen depletion. Diurnal water quality surveys will continue to be conducted to identify diel fluctuations in DO and to assess the extent which DO concentrations may be limiting refuge habitat.

METHOD: Diurnal water quality surveys will be conducted a minimum of *twice* per month beginning in May and continuing through September. Measurements will be made in consecutive run, riffle, and pool habitats at one-foot intervals throughout the water column. Measurements will be conducted in the core locations that have been monitored since 1997. All mainstem monitoring locations correspond to sites where thermographs are deployed. Additional sites will be chosen in the Alisal Reach for more detailed monitoring. Mainstem monitoring sites are located at: mile 3.4, mile 6.0, mile 7.8, mile 8.0, mile 10.5, and mile 13.9.

The following data will be collected at each monitoring site: time of measurements, depth of measurements, temperature (C), and DO (mg/L).

#### 3.4.2.3 Lake Cachuma Temperature and Dissolved Oxygen Profiles

Lake Cachuma has routinely experienced severe hypolimnetic oxygen depletion during the summer when the lake stratifies. The purpose of the monitoring program is to gather information on:

- Depth of water quality conditions preferable for steelhead in relation to operations of the Hilton Creek watering system
- Depth of anoxic conditions that develop in the lake
- Longitudinal and vertical water quality conditions at the monitoring locations
- A historical data base documenting the timing of stratification and turnover within the lake

METHOD: Reclamation personnel in an aeration study conducted between 1980-1984 measured temperature and dissolved oxygen profiles at three locations within Lake Cachuma. The Reclamation originally chose the study sites to document oxygen depletion at the upper, middle, and lower portions of the reservoir. The SYRTAC monitoring locations duplicate those of the Reclamation to the closest extent possible. All measurements will be taken quarterly throughout the year by boat (with the boat anchored) at one-meter intervals from the surface to the bottom of the lake. Station #1 is located directly upstream of Bradbury Dam at the deepest portion of the lake (lower lake), Station #2 is located within the deep river channel of Tequepis Point (middle lake), and Station #3 is located within the deep river channel directly opposite of the Tecolote Tunnel (upper lake).

Water quality parameters to be measured include: temperate, DO

#### 3.4.2.4 Santa Ynez Lagoon Status and Water Quality Profiles

Water quality measurements will be taken quarterly in the SYR lagoon to monitor seasonal, vertical, and longitudinal patterns. Additionally, the information will be used to assess the habitat suitability for various age classes of steelhead that rear and/or oversummer in the lagoon. Water level in the lagoon and the status of the sandbar at the mouth of the lagoon to pinpoint:

- When does the lagoon open?
- What are the conditions that dictate the opening of the lagoon?
- When does the lagoon close?

METHOD: Sample locations will correspond to sites used in the past SYR studies: lower lagoon at Ocean Park, middle lagoon at $35^{th}$ Street Bridge, upper lagoon at SYR inflow. Water quality profiles will be measured in May, August, November, and February. Measurements will be conducted in the above locations at one-foot intervals from the surface to the bottom. A stage recorder will also be installed directly upstream of the lagoon/ocean interface and will remotely monitor the water surface elevation of the lagoon. Data would be collected remotely within the equipment and downloaded manually once per week to couple the equipment readings with regular visual observations. Relating this information to migrant trapping data can help determine the opportunities steelhead have entering and exiting the SYR watershed.

Parameters to be measured include: temperature, DO, salinity, and conductivity, lagoon water level and status of the sandbar at the mouth of the lagoon (open/closed).

### 3.4.3 FISHERY SURVEYS

#### 3.4.3.1 Tributaries Migrant Trapping

Migrant trapping will be conducted in the tributaries to document the timing and abundance of migrating adult steelhead upstream to spawn, and juvenile smolts migrating downstream to the ocean in relation to flow and water quality conditions. Migrant trapping will be conducted in the following tributaries: Salsipuedes, Hilton, and Nojoqui Creeks, along with any additional tributaries where access may be granted in the future.

METHODS: Both upstream and downstream traps will be deployed in January so that the start of both adult immigration and juvenile emigration will be bracketed. Due to the extreme flashy nature of the watershed, both migrant traps will be removed prior to storm events to prevent trap loss during high flows. Traps will be re-deployed once flows recede to the point where effective trapping can be conducted. Traps will be cleaned of debris and checked daily for migrating fish in the morning. Depending on debris load and stream conditions, traps may be checked multiple times over the course of a day. After traps are checked for fish, field personnel will inspect the traps and panels for scour points or holes, which will be repaired or plugged.

The following data will be collected daily: trap name, time, date, temperature, DO, and staff gage elevation. If any migrating steelhead is captured the following data will be collected: length (mm), scale sample, tissue sample, brief description of migrant, photograph and measured flow. As part of the handling protocol required by NMFS's federal collection permit, water temperatures will be measured prior to handling captured steelhead. If water temperatures are greater than 20 ºC (68 ºF), captured migrants will be enumerated and immediately released without data being collected (size estimated).

In areas where specific construction projects address passage barrier fixes, monitoring will be conducted to evaluate the success of each project. In areas where property access is available, migrant traps will be deployed upstream of passage fixes to determine if upstream migrating adults are able to negotiate through the project sites. If migrant trapping is not possible, success will be determined using bank observations (spawning surveys) or snorkel surveys to verify presence of various age classes of steelhead.

#### 3.4.3.2 Mainstem Migrant Trapping

As an additional component to the regular tributary monitoring, both an upstream and downstream migrant trap will be placed in the mainstem approximately mile 3.5 downstream of Bradbury Dam. The primary purpose of the migrant traps in both the mainstem and tributaries will be:

- Determine the timing, overall numbers, and geographic distribution of steelhead migrating into and out of the SYR watershed
- Evaluate the time it takes for steelhead to migrate to the trap location as related to lagoon opening and closing
- Evaluate the movement of steelhead as it relates to storm events

METHOD: The protocol described under "Tributary Migrant Trapping" will be used for mainstem trapping. Deployment of the mainstem trap will coincide with the lagoon opening to accurately assess the time it takes for migrating steelhead to traverse the mainstem river.

#### 3.4.3.3 Redd Surveys

Redd surveys (spawning surveys) will continue at their present level of effort to determine timing, numbers, geographic distribution, and preferred flow conditions of spawning adults in the mainstem and tributaries of the SYR. Spawning surveys will be conducted bi-monthly beginning in January and continuing through May in each of the mainstem reaches: Highway 154, Refugio, Alisal, and Avenue of the Flags, and in the following tributaries: Hilton, Salsipuedes, El Jaro, Nojoqui, and San Miguelito. Spawning surveys in the mainstem will account for nearly 10 river miles downstream of Bradbury Dam where mainstem spawning conditions can be evaluated.

Once specific passage enhancement projects have been completed, spawning surveys will be conducted upstream of the passage projects to evaluate if adult steelhead are able to negotiate past the instream fixes.

METHODS: In order to accurately describe spawning conditions in the mainstem, an inventory of the known spawning locations will be conducted. Transects will be established across known mainstem spawning areas (as observed during 1999-2000) to determine wetted width and redd location in relation to flow conditions during the spawning season of 2001 and beyond. Redd locations will be monitored throughout the spawning season during various flow regimes to evaluate if flow conditions are affecting the spawning availability (i.e., are known spawning locations above the water line at certain flows). Transects will be broken into quarters and pebble counts (n=50/quarter) will be conducted within each quarter to accurately describe available spawning material at different flows. Spawning gravel embeddedness will also be evaluated. This information coupled with water inflow data into Lake Cachuma and reservoir outflow (decay rates) will be used to determine if water releases, including those proposed to provide for upstream migration, is affecting spawning availability. Since additional water into the river during the spawning season will positively affect steelhead, negative affects will be determined if flow regimes are creating conditions where suitable spawning locations are above the waterline.

When conducting redd surveys, surveyors will proceed in an upstream direction. Once redd excavations or spawning activity is identified, flagging with the date and redd number will be attached to vegetation adjacent to the site. Length and width of the excavation will be measured to the nearest foot. Four depth and velocity measurements will be made at the excavation: one at the head of the excavation, and three across the egg deposition area. Additionally, surveyors will measure the distance to the nearest instream cover likely used by the spawning steelhead including 15-30 random depth and velocity measurements between the excavation site and cover to determine if spawning steelhead are keying in on certain instream cover components and/or instream velocity preferences.

### 3.4.3.4 Snorkel Surveys

Snorkel surveys will be conducted 3 times per year (June, August, and October) in both the mainstem and tributaries. The June survey will take into account baseline conditions (initial fish numbers) prior to the critical summer period by documenting numbers and locations of oversummering steelhead/rainbow trout. The August survey will evaluate instream conditions during the critical time of the year for oversummering steelhead/rainbow trout. The October survey will evaluate the ability of steelhead/rainbow trout to successfully oversummer in both the mainstem and tributaries of the SYR. Cover utilization and upwelling evidence will be recorded for all habitats where steelhead are observed. If upwelling zones are observed, a thermograph array will be deployed in the habitat to monitor water temperature conditions during the critical summer period.

The primary purpose of snorkel surveys is to:

- Determine if successful spawning occurred by observing young of the year

- Determine presence or absence of juvenile and/or adult steelhead rearing over the summer in the mainstem and/or tributaries of the SYR
- Determine geographic distribution of steelhead inhabiting the lower SYR downstream of Bradbury Dam
- Document fish species composition and relative abundance in each location
- Document the success or failure of enhancement and restoration projects by evaluating steelhead use of project areas over time

METHODS: Abundance estimates will be conducted using direct observation techniques. Depending on the size and water clarity of the habitats to be snorkeled, 1 or 2 observers will traverse the habitat a minimum of 2 times with a short 30 minute interval between each pass. The following data will be collected: date, time, habitat number and type, number of each species by size class (3 inch size categories) and pass, length of habitat snorkeled, average width of habitat snorkeled, and duration of each pass.

Mainstem sample locations will include all core locations that have been sampled historically. There are usually between 4-10 pool habitats per reach where under the new monitoring plan, all pools will be sampled. In addition to the pool habitats sampled, adjacent run and riffle habitats to the pool habitat will also be sampled. If conditions are too shallow to allow for snorkeling, bank observations will be conducted instead of direct observations.

Tributaries sample locations will include all core locations that have been sampled historically. Any tributaries that are re-habitat typed will have the core snorkel sites included in them in order to provide a historic perspective with respect to steelhead usage. New tributaries or areas where access may be granted will be habitat typed and a table of random numbers will be used to select pools, riffles, and runs to be sampled.

### 3.4.4 Habitat Monitoring

#### 3.4.4.1 Proper Functioning Condition (PFC)

Reclamation and the SYRTAC will use a consistent repeatable methodology to accurately characterize instream and riparian habitats in both the mainstem and tributaries of the SYR below Bradbury Dam. In discussions with NMFS, Proper Functioning Condition (PFC) was a recommended methodology that could accurately characterize baseline conditions in a consistent, repeatable, quantitative manner that will facilitate evaluation of steelhead habitat conditions and the effects of proposed enhancement and restoration actions.

Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; filter sediments, capture bedload, and aid floodplain development; improve flood-water retention and ground water recharge; develop root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity. The functioning condition of riparian-wetland area is a result of interaction among geology, soil, water, and vegetation (TR 1737-9, 1993).

PFC methodology is an interdisciplinary approach whose team members include watershed specialists, biologists, hydrologists, riparian ecologists, and soil scientists. The goals of instream and riparian habitat inventories is to track the overall condition of habitat in the mainstem and tributaries, track the results of habitat protection and improvement measures, and identify other areas where habitat protection and improvements projects can take place.

A team is currently being assembled for a training workshop scheduled for the first or second week of June 2000. Members of the team will include fisheries biologists, hydrologists, rangeland ecologists and managers, soil scientists, riparian ecologists, and interested landowners. The PFC inventory will be conducted in the lower Santa Ynez River and its tributaries where access is granted. Where access is unavailable, attempts will be made to conduct the PFC analysis from aerial photographs.

#### 3.4.4.2 Habitat Inventory

Utilizing the PFC approach does not negate the need for detailed habitat inventories to determine the distribution, abundance, and quality of mesohabitats (i.e., pool, riffle, and run), and how the various age classes of steelhead/rainbow trout utilize them. Aquatic habitats play an integral role in fisheries management. Their use is critical in predicting such things as the impacts of habitat alterations, potential fish production, and probable limiting factors. Habitat measurements also make it possible to classify aquatic habitats into similar groups so that research and management results may be generalized.

The purpose of the habitat typing will be to:

- Track changes in overall habitat distribution in various reaches of the SYR and tributaries
- Identify snorkel survey locations to monitor distribution, abundance, and survival of oversummering steelhead/rainbow trout

METHOD: Mainstem and tributary habitats will be inventoried every 2-3 years to monitor changes in overall mesohabitat distribution (i.e., the number of pools, riffles and runs). If significant storm events occur that alter the habitat composition along specific study reaches, then the habitats will be inventoried again that year. Habitat typing will use a Level III classification as described in the California Department of Fish and Game *Salmonid Stream Habitat Restoration Manual*. Habitat types will be identified by riffle, run, and pool (scour and dammed), and glide.

- Riffles are characterized by turbulent flow with a typical coarser substrate than units directly upstream or downstream. Substrate is usually cobble dominated, some of which may be partially exposed

- Runs are fast water areas with shallow gradient, typically with a substrate ranging in size from gravel to cobble with no major flow obstructions. Runs are usually deeper than riffles and appear to have little or no turbulent flow.

- Scour pools are characterized by areas of sediment removal, slow water velocities and a highly variable substrate with the greatest depth typically at the head or middle of the pool. Dammed pools are characterized by the material causing the impoundment. These pools are typically deepest at the tail of the pool and have more fines than scour pools and fill with sediment at a more rapid rate

- Glides are characterized by a uniform channel bottom, low to moderate flow velocities, and little or no turbulent flow. Substrates are usually cobble, gravel, and sand.

Additional information that will be collected includes: habitat unit length, width, depth, maximum depth, residual pool depth, percent instream shelter, percent total canopy, right and left bank dominate vegetation types, and any relevant comments with respect to landmarks, landslides, barriers, or changes in channel substrate.

#### 3.4.4.3 Hilton Creek Habitat Monitoring

Information will be gathered to determine the quantity of available habitat for steelhead/rainbow trout in Hilton Creek as it relates to flow. In order to accurately characterize the available habitat, transects will be installed every 100 feet through the lower 1300 feet of Hilton Creek (downstream of the cascade/chute passage impediment). A minimum of 5-10 depth and velocity measurements will taken across the transect to establish a profile of the wetted channel. Transect measurements will be taken at approximately one cfs flow intervals from 1 cfs to 10 cfs to provide the data necessary to evaluate the habitat availability. This study will take advantage of natural and supplemented changes in flow rate to determine the flow vs. habitat relationships. Flow from the Hilton Creek watering system will not be specifically modulated for this study.

The following data will be collected: flow, habitat type, wetted width, and a minimum of 5 depth and velocity measurements across each transect.

### 3.4.5 TRIBUTARY ENHANCEMENT PROJECT SPECIFIC MONITORING

A number of enhancement projects are proposed on the tributaries in the lower Santa Ynez River system. Project specific monitoring plans will be individually developed for each of these projects as they are implemented. The monitoring plans will include study of the following elements:

- ability of fish to migrate through fish passage modifications;
- fish use of habitat upstream and downstream of fish passage structures;
- fish use of habitats created, protected, or enhanced;
- hydrological monitoring to determine that fish passage structures are functioning according to design; and
- monitoring and maintenance of tributary enhancement project sites.

### 3.4.6 TARGET FLOW COMPLIANCE MONITORING

Habitat maintenance flow targets have been established at the Highway 154 bridge, where there was formerly a USGS gaging station. The gaging station at Highway 154 has been discontinued and Reclamation does not currently have access to this site. Reclamation is currently exploring a few options for monitoring Highway 154 target flow compliance. Reclamation is examining the possibility of installing a gage at Highway 154. Another option is using the flow record of the discontinued USGS gage and create an empirical relationship between the flows at this gage, and flows at an existing gage on Reclamation property approximately 0.7 miles below Bradbury Dam. The empirical relationship may be used in conjunction with the existing gage on Reclamation property to monitor flow levels at Highway 154. In addition, a gage will be installed in the lower reach of Hilton Creek to monitor flows in this tributary. Finally, flows in the Alisal reach will be monitored by the USGS Solvang gage.