DRAFT STEELHEAD RESTORATION ACTION PLAN FOR THE ALAMEDA CREEK WATERSHED

prepared for the

Alameda Creek
Fisheries Restoration Workgroup

by

Center for Ecosystem Management and Restoration

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1. Executive Summary

Alameda Creek has the largest watershed of all local streams tributary to the San Francisco Estuary. The size of the drainage, the protected status of large portions of the upper basin areas, and the presence of native fishes make the watershed a high priority for restoration. Alameda Creek has the potential to contribute significantly to restoring steelhead trout populations in South Bay streams and in the greater Central California Coast region.

The possibility of restoring steelhead to Alameda Creek has been the topic of sporadic discussion and study for over 50 years, and historical fish ladders in the watershed attest to concern for these fish even earlier. Task forces were formed in 1983 and 1987 to address the issue, but disbanded without seeing through to completion their recommended restoration actions. In 1996, Central Coast steelhead were listed as threatened pursuant to the federal Endangered Species Act. To coordinate renewed efforts to restore these fish, the Alameda Creek Fisheries Restoration Workgroup (Workgroup) was formed in early 1999. Led by the efforts and financial support of the Alameda County Flood Control and Water Conservation District (ACFCWCD), the Workgroup benefits from the active participation of Alameda County Water District (ACWD), the Alameda Creek Alliance (a citizen's group), the California State Coastal Conservancy (SCC), the California Department of Fish and Game, the East Bay Regional Park District, the National Marine Fisheries Service, the San Francisco Public Utilities Commission (SFPUC), the U.S. Army Corps of Engineers (Corps) and the Zone 7 Water Agency. The Workgroup has met regularly since its inception and has adopted a statement of goals and objectives to guide its activities.

With funding from the ACFCWCD and the SCC, the Workgroup published a report entitled *An Assessment of the Potential for Restoring a Viable Steelhead Trout Population in the Alameda Creek Watershed* (hereafter, *Assessment*) in February, 2000. The *Assessment* found that suitable habitat exists in the watershed to support steelhead spawning and rearing, but that in-migration was completely prevented by the presence of several barriers in the lower portion of the watershed. It concluded that making these barriers passable was essential to steelhead restoration in Alameda Creek, and made recommendations to address migration and other steelhead restoration issues in the watershed.

This *Restoration Action Plan* (hereafter, *Plan*), developed through a grant from the California Department of Fish and Game, uses the recommendations contained in the *Assessment* as a starting point and presents a plan of action to effect restoration. The *Plan* identifies the need to implement nine passage barrier modification projects, seven fish screens or sets of fish screens at water diversion points, instream flow provisions for four reaches of Alameda Creek, proposed riparian corridor improvements and a steelhead supplementation program. Implementation of these actions should be sufficient to restore a viable steelhead run in the watershed. A monitoring program is also needed to track the success of the restoration actions and to inform future management decisions.

Planning for modification of the major barriers in the lower watershed barriers is underway through the Corps' §1135 Process, a federal restoration program for aquatic ecosystems affected by flood control projects. The §1135 Process will incorporate several key fish passage projects in the section of Alameda Creek channelized for flood control, including their planning, design, funding and construction. The process is being undertaken by the Corps in cooperation with ACFCWD and ACWD, with the Corps having recently completed the Preliminary Restoration Plan for the project. Also, the SFPUC is sponsoring removal of two obsolete Alameda Creek dams in Niles Canyon east of Fremont. The SFPUC has dedicated funds for project implementation, applied for major additional grant support and initiated the environmental review process for these projects. An additional barrier modification project is being planned by the Pacific Gas & Electric company at a site where a natural gas pipeline crosses the creek.

With these barrier problems addressed, habitat in two key reaches (i.e., Niles Canyon and Upper Alameda Creek) will become accessible to steelhead, presumably in late 2005. Another potentially important reach with spawning and rearing habitat in the upper Arroyo Mocho drainage can be made available through additional passage projects at two small barriers. These three reaches are approximately 5 miles each, for a total of 15 miles of stream with potential salmonid habitat, not including possible habitat in creeks tributary to these areas. (Combined, these reaches were estimated in 1987 to be capable of supporting a steelhead run of 1,000 individuals.)

Availability of steelhead spawning and rearing habitat in the Alameda Creek watershed, as well as adequate conditions for out-migration, will depend on providing instream flows. The presence of multiple water agencies and water storage facilities on the creek and its tributaries suggests the need for a coordinated planning effort to determine the various flow requirements for the system. Negotiations leading to flow schedules for various Alameda Creek reaches should be commenced soon in order to be completed the year before the system is opened to in-migrating steelhead.

An implementation schedule is provided that assumes advancement of all actions in the *Plan* in concert with the proposed completion date for construction of the §1135 Process projects in fall of 2005. For example, development of the steelhead supplementation program, including related studies, permitting, funding and operations must be in place to allow for fish to be released and mature prior to recruitment into a potential run in late 2005. The Workgroup is committed to cooperating with its member organizations and others involved in restoration activities to acquire the necessary funding, permits and agreements to complete all the projects put forth in the *Plan* within this time frame.

A preliminary cost estimate for this steelhead restoration program, based on information collected to prepare this *Plan*, suggests that the capital cost for implementing all actions identified here will require roughly $14-15 million. Costs will be born by project sponsors including the Corps, ACFCWD, ACWD, SFPUC and others, and will be supplemented by funds available through grant programs, donations, and in-kind and volunteer services. About $[**needed from project sponsors**] million toward the cost of implementing identified actions has been committed or applied for as of the time of writing. Because of the public trust nature of the steelhead resource and the importance of Alameda Creek to regional restoration, the Workgroup hopes to attract sufficient financial support from a diverse array of sources to ensure that the entire program of activities is implemented and given the opportunity to succeed.

2. Introduction

Alameda Creek Fisheries Restoration Workgroup

The Workgroup has been meeting since 1999 to cooperatively address issues related to restoring Alameda Creek watershed fisheries. The goal of the Workgroup is to restore a self-sustaining population of native steelhead trout (*Oncorhynchus mykiss*) to the Alameda Creek watershed, while recognizing the need for the watershed to support other beneficial uses such as municipal water supply and flood control. To achieve this goal, the Workgroup has adopted the following objectives:

1) Prepare a scientifically-authoritative (e.g., peer-reviewed) assessment of the feasibility of restoring steelhead in the Alameda Creek watershed.
2) Based upon the outcome of the assessment, identify local partners to submit an application for restoration funding to the U.S. Army Corps of Engineers (Corps) pursuant to §1135 of the Water Resources Development Act of 1986.
3) Prepare and submit grant applications to the California Coastal Conservancy and the California Department of Fish and Game for planning funds.
4) Identify a population of native rainbow trout in the upper reaches of the watershed that would be a suitable stock to use for reestablishing a steelhead run.
5) Prepare a *Restoration Action Plan* that identifies and schedules priority restoration actions necessary to achieve the Workgroup's goal, including cost estimates for key projects.
6) Conduct coordinated environmental review for planning and projects related to steelhead restoration.
7) Implement the *Restoration Action Plan*.
8) Monitor and report on the results of *Restoration Action Plan* implementation.

With adoption of the *Plan* by the Workgroup, five of the group's objectives will have been achieved and the group will next complete the process of conducting environmental review of restoration activities.

The Workgroup has agreed that its goal is more likely to be achieved if the following principles are used to guide its work:

1) Our deliberations will include all stakeholders who wish to participate, including public agencies, private businesses, non-governmental organizations, private landowners, and other concerned citizens.
2) Our goal will be most easily accomplished if thoughtful and innovative approaches are taken to minimize the water cost of restoration to municipal water suppliers in the watershed, and to consider both the quantity and quality of waters used.
3) Only native fish, to the extent these can be identified and obtained, will be used in the restoration process.
4) Steelhead restoration efforts will not be undertaken that are likely to adversely affect populations of other native fish species.

5) We recognize that under historical conditions adequate steelhead migration flows were not present in all years, and stream flows established to support steelhead and other aquatic species will be based, in part, on available water supplies.
6) We recognize that due to habitat alterations and water diversions the ability of the watershed to support steelhead has been significantly reduced, and it is appropriate to use the water storage and delivery system, when feasible, to support restoration and conservation of the steelhead population.
7) Restoration of steelhead trout in Alameda Creek benefits the entire Central Coast Steelhead ESU, and it is therefore appropriate to pursue grant funds and water allocations from private, regional, state and federal sources to supplement support by local taxpayers and ratepayers.
8) We recognize that restoration of aquatic and riparian habitat on private land is essential to steelhead restoration, and that this is best achieved by thoughtful collaboration with interested private landowners using conservation easements and other legal and financial instruments for assistance.
9) Plans for restoration of steelhead trout in the watershed should be guided and re-evaluated through adaptive management as information is obtained from early studies and monitoring of restoration actions.
10) Restoration proposals and reports should be subject to open, independent scientific review before adoption and approval.

To date, Workgroup meetings have allowed for a wide range of interests and ideas to be incorporated into planning while maintaining substantial progress in the overall restoration process. Minutes of the meetings are kept that document both the information generated by Workgroup members for consideration in planning and the manner in which specific proposals are developed. These minutes are available for public review at all times (www.cemar.org/alamedacreek). Future restoration related activities will inevitably produce controversy due to cost considerations, legal obligations or other issues. Continued involvement in the Workgroup by current members is the mechanism most likely to produce outcomes that benefit steelhead and sustain other beneficial uses in the Alameda Creek watershed.

Steelhead Restoration Plan (Purpose, Goals and Objectives)

The goal of the *Plan* is to present a coordinated schedule for implementing the restoration actions necessary to restore steelhead to Alameda Creek, including cost estimates for key projects and a program for monitoring the results of plan implementation. In order to achieve this goal, the *Plan* has the following objectives:

1) Provide a comprehensive description of actions required to restore steelhead to the Alameda Creek watershed, including a schedule that indicates the contingent relationships among actions.
2) Provide a comprehensive description of restoration actions that could serve as a mechanism for the National Marine Fisheries Service (NMFS) to conduct a coordinated review of Endangered Species Act (ESA) compliance.
3) Review other on-going and planned activities in the watershed (i.e. water supply plans, flood control projects, watershed management planning, etc.) to identify how these might influence

steelhead restoration, and what options are available for coordination to insure consistency with steelhead restoration.
4) Assess the implication of restoration actions for existing beneficial uses of Alameda Creek (i.e., water supply, flood control, recreation).
5) For each restoration action, identify location, responsible entities, possible funding/technical support partners, priority, implementation schedule, estimated cost, required permits/approvals.
6) Describe a process for securing legally-protected minimum instream flows for anadromous fish, while recognizing that under historical conditions flows adequate for completion of the anadromous life-cycle were not present every year.

Section 3 of the *Plan* describes the planning context for steelhead restoration in Alameda Creek, including physical and biological attributes of the watershed, and plans and policies related to beneficial uses in the watershed. This next section provides details of the restoration actions necessary to reestablish a viable steelhead run in the creek. Section 4 also details alternatives to several fish passage related projects. Project sponsors, permitting, implementation schedules and estimated costs are discussed in Section 5. The *Plan* concludes with a section that discusses describing both a conceptual monitoring program for the restoration plan and additional studies to inform the restoration process.

3. Alameda Creek Watershed

Physical Setting and Resource Use

This section reviews information essential to the discussion of steelhead restoration in the Alameda Creek watershed. More detailed consideration of physical setting factors may be found in the *Assessment* and in water district planning documents referenced in this *Plan*.

For the purposes of the *Plan*, main stem Alameda Creek consists of four reaches listed in an upstream direction: 1) Flood Control Channel, 2) Niles Canyon, 3) Sunol Valley, and 4) Upper Alameda Creek (Figure 1, **not included in this draft**). A major tributary, Arroyo de la Laguna, is also considered throughout this document. Important characteristics of the reaches are as follows:

Flood Control Channel. This reach consists of River Mile (RM) 0 (elevation 0) to RM 11.9 (elevation 45 feet). These lower 12 miles of Alameda Creek are channelized for flood control purposes, and development has occurred immediately adjacent to the channel levees. Artificial structures in the channel include the ACWD Lower, Middle and Upper Inflatable Dams, and the BART weir. ACWD diversions (seven) also occur here.

Niles Canyon. This area begins at RM 11.9 above the Flood Control Channel and extends upstream to about RM 17.1 (elevation 225 feet), approximately the location of a benchmark (#225) on the USGS topgraphic sheet (Niles, CA quad). This reach is constrained on both sides by steep canyon walls and urbanization is relatively light. In-stream structures found within Niles Canyon include the USGS weir, Niles Dam and Sunol Dam. Stonybrook Creek enters Alameda Creek within this reach, while the reach ends below the confluence with Arroyo de la Laguna.

Sunol Valley. This reach is low-gradient, comprising only an 80-foot elevation change between RM 17.1 and RM 22.2. The channel is wide and braided in places, having long sections with very shallow flow under lower flow regimes. The Sunol Valley is broad, but is bordered in parts by steep slopes. Major land uses include gravel mining and horticulture. The geology of the area allows for a large amount of infiltration of creek flow into the substrate in this reach, a condition which has implications for determining instream flows for steelhead restoration.

Arroyo de la Laguna joins Alameda Creek at the lower end of this reach, and San Antonio Creek, Pirate Creek and Welch Creek are additional notable tributaries in the upstream direction, though San Antonio Reservoir impounds local runoff from that catchment. A Pacific Gas and Electric (PG&E) gasline crossing and an unnamed weir upstream of the gravel pits are potential barriers to fish passage. The reach ends above the Welch Creek confluence where the valley narrows substantially.

Upper Alameda Creek. Alameda Creek is confined in a narrow channel within steep canyon walls throughout most of this reach, which extends to the headwaters. Property in the upper catchment is managed primarily as protected watershed and park, and therefore includes very little intensive land use. Grazing occurs on large portions of the upper watershed. Alameda Creek is indicated as intermittent on the USGS topographic map (Mt. Day quad.) at about RM 42.4 (elevation 2,340 feet).

Important Upper Alameda Creek tributaries include Welch Creek, Indian Joe Creek, Leyden Creek, Calaveras Creek (confluence at RM 26.7) and Valpe Creek (confluence at RM 39.5). Calaveras Dam leads to minimal flow into Alameda Creek from Calaveras Creek or its major tributary, Arroyo Hondo. The Alameda Creek Diversion Dam (ACDD) on main stem Alameda Creek (RM 29.9) diverts the majority of Upper Alameda Creek flows through a tunnel into Calaveras Reservoir. Both ACDD and Calaveras Dam have experienced periods of spills historically. Calaveras spills occur, on average, every five to six years (SFWD 1995).

Arroyo de la Laguna. The Arroyo de la Laguna area includes significant urban areas including the Cities of Dublin, Pleasanton and Livermore as well as upper watershed areas with low levels of development. Two tributaries to Arroyo de la Laguna are considered in this *Plan*, Arroyo del Valle and Arroyo Mocho. Runoff from the upper portion of the Arroyo Valle catchment is impounded by Lake del Valle, while the Arroyo Mocho watershed is unregulated.

Water Resources Development. According to State Water Resources Control Board (SWRCB) analyses, Alameda Creek flows at the confluence with the San Francisco Bay are 72 percent "impaired" (SWRCB 2001). This figure represents the ratio of the estimated appropriation (demand) under existing water rights to estimated Alameda Creek flows (supply). According to the SWRCB, the level of impairment (demand/supply) of Alameda Creek flows at the top of Niles Canyon is about 58 percent (SWRCB 2001). While SWRCB impairment calculations are not available for the watershed area tributary to Sunol Valley, a screening-level estimate is approximately 86 percent impaired (SFWD 1995). According to the SWRCB, approximately 90 percent of potentially available flows to Arroyo de la Laguna are designated for water supply purposes (SWRCB 2001). The entire Alameda Creek watershed is considered "fully appropriated" and no further applications for diversion are being considered (DWR 2002).

Average "natural flow" (i.e., discharge through creeks before water development) in several Alameda Creek catchments have been estimated and are listed in Table 2-1 (COE 1978; SFWD 1995).

Table 2-1. Estimated unimpeded streamflows for Alameda Creek catchments.

Catchment	Natural Flow (acre-feet/yr)
San Antonio Creek	7,200
Calaveras Creek	36,000
Alameda Creek above ACDD	12,000
Other local above Sunol	4,500
Alameda Creek above Sunol	59,700
Arroyo Valle	25,000

In drought years, the total "natural flow" from the catchment tributary to Alameda Creek above Sunol is estimated to be about 12,000 acre feet per annum (afa) (SFWD 1995).

The intensity of water resources development in the Alameda Creek watershed leads to conditions of little streamflow remaining in the natural watercourses. For example, minimal flow occurs in San Antonio Creek below San Antonio Reservoir, while in normal years flow in Calaveras Creek immediately below Calaveras Dam amounts to about 0.5 cubic feet per second (cfs) (SFWD 1995). Water in the main stem Alameda Creek below the ACDD depends on the amount of diversion into Calaveras Reservoir. On average, 9,200 afa of Alameda Creek flow goes to the reservoir while about 2,800 afa spills into Alameda Creek below the diversion facility (SFWD 1995). Flow below del Valle Dam averages [**coming from DWR**].

Biological Setting

The fisheries resources of Alameda Creek have been described in the *Assessment* and elsewhere, and will not be reviewed in depth here. Rather, this section presents information concerning steelhead and other biological resources in the watershed that is essential in the current planning context.

Native fishes historically occurring in the upper Alameda Creek watershed include: Pacific lamprey (*Lampetra tridentata*); rainbow trout (*O. mykiss*); California roach (*Lavinia symmetricus*); prickly sculpin (*Cottus asper*); Sacramento sucker (*Catostomus occidentalis*) (occassional); Sacramento pikeminnow (*Pytchocheilus grandis*); threespine stickleback (*Gasterosteus aculeatus*); riffle sculpin (*Cottus gulosus*) (likely uncommon, now extirpated); and hitch (*Lavinia exilcauda*). Some evidence exists that coho salmon (*O. kisutch*) and chinook salmon (*O. tshawytscha*) used the watershed as well, though the extent of this use is not known (TNC 1999). Additionally, five non-native fish species have been documented in the upper Alameda Creek watershed, with most of these likely introduced from Calaveras and San Antonio Reservoirs (TNC 1999). Eight of the nine native fish species historically found continue to occupy habitat in upper Alameda Creek (TNC 1999).

O. mykiss has been documented in various parts of main stem Alameda Creek, and in Arroyo de la Laguna and its main tributaries, Stonybrook Creek, Calaveras Creek, Arroyo Hondo and numerous other smaller tributaries (SFWD 1994; ACFRW 2000). Genetic studies have documented that *O. mykiss* collected from several tributaries to Alameda Creek consist of stock from the Central California Coast Evolutionarily Significant Unit (ESU) and are not of hatchery origin (Nielsen and Fountain 1999). In addition, adult steelhead have been documented in the Flood Control Channel during water years 1998-2002. Trap and haul efforts and artificial propagation may have allowed some steelhead offspring to be produced from individuals collected during this period. Information concerning historical *O. mykiss* abundance, including the size of historical steelhead runs in the Alameda Creek watershed, is not available.

Of particular importance to current restoration planning are self-sustaining *O. mykiss* populations in streams of the San Antonio Creek and Calaveras Creek watersheds above the reservoirs. These populations may be derived from coastal steelhead isolated by dam construction and could comprise the source of *O. mykiss* released into the Alameda Creek system to "jump start" the system's steelhead run. Self-sustaining populations are also known to occur in Stonybrook Creek, Arroyo Mocho, Welch Creek and other Alameda Creek watershed tributaries (ACFRW 2000). Propagation-related projects are discussed in Section 4 of this *Plan*.

Other biological resources in the Alameda Creek watershed are of interest to the current planning context as they may benefit from restoration activities including riparian and riverine habitat improvements. In particular, three vegetative communities immediately adjacent to main stem Alameda Creek are currently considered sensitive or rare because of limited distribution locally or regionally (SFPUC 1998). Each of these communities may provide habitat for special status animal species as follows:

- Valley Oak Woodland. Black-shouldered kite, sharp-shinned hawk, Cooper's hawk, pallid bat, ringtail, California tiger salamander.
- Riparian Forest (Coast live oak and white alder). Black-shouldered kite, sharp-shinned hawk, Cooper's hawk, pallid bat, ringtail, northwestern pond turtle, California red-legged frog, foothill yellow-legged frog.
- Sycamore Alluvial Woodland. Alameda whipsnake, northwestern pond turtle, California red-legged frog, foothill yellow-legged frog, black-shouldered kite, sharp shinned hawk, Cooper's hawk (SFWD 1994).

Steelhead Habitat Conditions

Aquatic habitat characteristics within the Alameda Creek watershed are described in numerous previously-prepared reports. This section summarizes salient features of the various planning areas of Alameda Creek in terms of quality as steelhead habitat. For a more detailed discussion, the reader is referred to the *Assessment* and to the documents cited in the following discussion.

Flood Control Channel. Large portions of the Flood Control Channel have a trapezoidal cross section with rip rap banks and fine-grained sediment bottoms. Low vegetation occurs in some areas but is generally controlled in order to maintain flood-carrying capacity. While a low-flow channel exists in parts of the channel, it is often indistinct with lower level discharge occupying a shallow, wide profile. Artificial pools are formed upstream of the three ACWD inflatable dams when they are in use. In general, this reach of Alameda Creek consists of a highly simplified system without natural features such as pool/riffle sequences and is considered to offer primarily migratory habitat even after the implementation of future restoration projects.

Niles Canyon. Currently, habitat conditions in the Niles Canyon reach appear suitable for both *O. mykiss* spawning and rearing except that summer water temperatures may be limiting (ACFRW 2000). Under "natural" conditions of low summer stream flows, Niles Canyon likely would resemble other regional systems with most habitat in shaded pools supported by cool subsurface flows. The presence of dams in the upper watershed provides the opportunity to augment summer flows in the reach, though such flows are not anticipated in this *Plan*.   Flows can be delivered through Niles Canyon by releases into Vallecitos Creek of State Water Project (SWP) water purchased by ACWD and delivered via the South Bay Aqueduct (SBA). SBA releases may have both harmful and beneficial impacts on the quality of aquatic habitat and its ability to support *O. mykiss*. SBA flows may be relatively warm but may create atypical fast-water habitat that allows trout to obtain sufficient food to withstand the warmer temperature (ACFRW 2000).

In 1987, EBRPD staff estimated the potential size of the steelhead run that could be supported in various Alameda Creek reaches based on several key assumptions including:

- instream flows provided allowing for 10 cfs to pass through the Flood Control Channel through about May 15;
- reservoir releases made for habitat enhancement;
- conversion factors relating habitat use and stream length to adult steelhead return, developed for the Carmel River system (due to hydrologic similarity), applicable; and
- riparian corridor improvements implemented (EBRPD 1987).

This *Plan* does not attempt to analyze these assumptions, nor does it defend the run size estimates offered in the EBRPD correspondence reporting this work. However, as this information comprises a rare interpretation of the steelhead restoration goal embraced by the Workgroup, run size estimates are reported here for each of three reaches: Niles Canyon, Upper Alameda Creek and the Arroyo Mocho portion of the Arroyo de la Laguna catchment. EBRPD estimated that mainstem Alameda Creek in the Niles Canyon reach could support a steelhead run of about 348 individuals (EBRPD 1987). It should be noted that 5.5 miles of Niles Canyon habitat were assumed to be available for steelhead rearing in producing this estimate. Earlier EBRPD surveys found that without instream flow provisions, about two miles of "good" rearing habitat occurred in Niles Canyon (EBRPD 1983).

As Stonybrook Creek supports multiple year classes of rainbow trout, it is assumed to offer potential steelhead habitat between its confluence with Alameda Creek and the first crossing of Palomares Road. Sinbad Creek supported steelhead historically, and parts of this tributary may function as steelhead habitat, though the fact that *O. mykiss* has not persisted in the drainage suggests that this habitat may be marginal.

Sunol Valley. At lower flows, this reach presents passage problems for steelhead. Substrate is suitable for spawning in parts of the reach, but steelhead rearing would not be expected to occur here often due to the high potential for dewatering and the general lack of suitable habitat characteristics such as in-stream cover and shading (ACFRW 2000).

The San Antonio Reservoir complex blocks fish migration between Alameda Creek and the upper San Antonio Creek watershed. As the catchment is relatively small and dry, the stream may have supported only limited perennial habitat and steelhead use before reservoir construction (Smith 1998). Under current conditions, insufficient flows occur to support steelhead spawning or rearing below the dam.

Pirate Creek and Welch Creek have been shown to support multiple year classes of *O. mykiss* in recent surveys. The upstream extent of potential spawning and rearing habitat in Pirate Creek has not been identified, while natural migration barriers in Welch Creek (approximately 0.3 miles above its confluence with Alameda Creek) probably preclude access to the middle and upper reaches of the tributary. The lower reach of Welch Creek is considered potential steelhead habitat.

Upper Alameda Creek. This reach contains areas suitable for steelhead spawning and rearing, though summer water availability and temperature are considered limiting factors (SFWD 1993c)}. Conditions in the 4.5 miles of Alameda Creek between Sunol Valley and the Calaveras Creek confluence are influenced by both Calaveras Dam and ACDD, while the 3.2 miles between this confluence and ACDD are influenced only by ACDD. Above ACDD, Alameda Creek is free-flowing through about 12.5 miles to the headwaters, though the dam represents a complete barrier to fish passage.

O. mykiss appears to be self-sustaining in the area below ACDD under current conditions based on the presence of multiple age classes encountered in several recent surveys. However, overall use of the reach may be limited by difficult passage conditions in the Little Yosemite area (ACFRW 2000). Summer flow is very low and the stream channel is dry in some places, but pools provide perennial habitat areas. *O. mykiss* has also been collected below Calaveras Dam in several surveys in the 1970's and 1980's, as well as in other tributaries (SFWD 1995). An estimate (based on assumptions described above) of the steelhead run that could be supported on mainstem Alameda Creek between SVWTP and Little Yosemite is 317 individuals (EBRPD 1987).

Above ACDD, similar conditions exist and multiple year classes of rainbow trout have been found in recent surveys (ACFRW 2000). Few pools that could provide dry season habitat are likely available in main stem Alameda Creek upstream of the Valpe Creek confluence, although Valpe Creek itself appears to provide habitat for a self-sustaining rainbow trout population in the upper watershed. Upper Alameda Creek areas with multiple year classes of *O. mykiss* may provide steelhead habitat if migratory conditions are made favorable in the future. Diversions from the watershed above ACDD are limited to grazing-related withdrawals and private wells.

Arroyo de la Laguna. Like lower Alameda Creek, the majority of the lower Arroyo de la Laguna watershed probably constitutes only migratory habitat for steelhead due to natural and created channel conditions. The lowermost sections of the reach, however, do offer some potential to serve as suitable seasonal steelhead habitat (USEPA 1999). Steelhead migration between the main stem Alameda Creek and upper portions of the Arroyo de la Laguna tributary watersheds involves extensive low gradient channels, and natural variations in winter and spring flow conditions may have resulted in restricted steelhead passage in some years even prior to water project developments in the area (Smith 1998).

Arroyo Valle below the dam contains some suitable spawning gravels in its lowermost stretches, though it is probably poor habitat for steelhead due to lack of suitable riparian habitat and potentially high summer water temperatures (ACFRW 2000). Aquatic habitat conditions are controlled by releases from the reservoir, which are managed for groundwater percolation.

Upstream reaches of Arroyo Mocho offer habitat suitable for steelhead if migratory passage is provided at barriers in the lower watershed. Self-sustaining populations of *O. mykiss* have been documented within Arroyo Mocho as far downstream as the USGS gaging station near the del Valle Road turnoff. Hydrologic conditions in upper portions of the Arroyo Mocho catchment are relatively pristine and habitat conditions are similar to those in other headwater areas of the Alameda Creek watershed (i.e., created by low-baseflow, subsurface input-dominated flow regimes). Flow in upper Arroyo Mocho is believed to be perennial, even in severe drought years [Smith, 1999]. Using assumptions described above, EBRPD estimated that Arroyo Mocho could support a steelhead run of about 317 individuals (EBRPD 1987).

Existing Plans and Policies

As part of this *Plan*, local agencies with management responsibilities concerning Alameda Creek were queried for plans and policies relating to their future activities in the watershed. We reviewed these documents and summarized sections pertinent to the current planning effort for steelhead restoration. While other government organizations (e.g., city and county governments) have jurisdiction over lands in the watershed, the plans and policies of the ACFCWCD, ACWD, California Department of Water Resources (DWR), SFPUC and Zone 7 were considered to most directly affect planning for steelhead restoration.

ACFCWCD. ACFCWCD is currently conducting a multi-year investigation regarding sediment transport in the lower Flood Control Channel. Sediment sampling is being performed by the USGS in various portions of the Alameda Creek watershed with the goal of determining the sources of sediment loads being deposited in the Flood Control Channel. The USGS contract includes daily sampling stations in Alameda Creek near the SVWTP, in Arroyo de la Laguna near the Pleasanton Ridge Park entrance and at the USGS Niles Gauging Station. In addition, there are five grab sample stations scattered throughout the Livermore Valley basin.

Information concerning sediment sources is of considerable interest due to the cost of desilting, and may be used to develop a management plan to reduce the sediment transport at or near the source. In addition to reducing flood flow carrying capacity, erosion and sedimentation in the watershed degrade wildlife habitat. ACFCWCD's goal is to work cooperatively with other entities responsible for flood control and land management to address sedimentation-related problems in lower Alameda Creek. Future investigations will also examine the upstream migration of sediment from the Bay. This phenomenon may be a major factor in the deposition dynamics in the lower part of the creek.

The district has just completed the last year of a four-year desilting project in the Flood Control Channel at an average cost of over $1 million per year. This project may need to be repeated about every ten years, depending on runoff levels in the future. The next portion of the channel that will require desilting is from Ardenwood Blvd. to the Bay. The schedule for this work has not been determined at this time, as environmental and permitting issues are very complicated due to ESA-listed species concerns and jurisdiction of multiple regulatory agencies. However, ACFCWCD has completed a study showing that, at current sedimentation rates, Alameda Creek flows would overtop levees at about 30,000 cfs in the lower section (an area of little or no development). As the highest flow of record is around 29,000 cfs, this effect is not considered urgent (ACFCWCD 2002).

ACFCWCD is also pursuing a levee relocation project at the mouth of Alameda Creek. This project has the potential to create extensive habitat accessible to migratory salmonids.

ACWD. ACWD's *Urban Water Management Plan 2001-2005* characterizes the agency's water supply, demand management and operational alternatives under existing and projected future conditions. Elements of the plan pertaining to steelhead restoration planning in Alameda Creek include existing sources of supply and water supply strategy.

Runoff from the Alameda Creek watershed comprises about 15% of ACWD's distribution system water supply and is used primarily for recharging the aquifers of the Niles Cone Groundwater Basin. This supply is used to meet groundwater system needs including private groundwater pumping, Aquifer Recharge Program[1] pumping and water needed to balance groundwater outflow from the aquifer system to San Francisco Bay (ACWD 2001).

ACWD also receives water supply from DWR's Lake del Valle facility that typically comprises [**needed from ACWD**] percent of total supply. This water can be diverted into treatment plants or into Alameda Creek (via the Vallecitos Takeoff or Arroyo del Valle and Arroyo de la Laguna) for use in groundwater recharge.

ACWD expects that water demand will increase in the service area in the future, but does not project additional supply through local recharge or del Valle water sources (that affect Alameda Creek) under average hydrologic conditions. In critically dry years, ACWD projects the need to increase supply from local recharge by about 1.7 percent to meet demand for the year 2015 and beyond. It should be noted, however, that projected demand exceeds projected supply for all ACWD planning horizons (i.e., 2005, 2010, etc.) under critically dry year conditions (ACWD 2001).

DWR: Lake del Valle. DWR constructed this facility "primarily for the purposes of flood control, recreation, and for providing regulatory flows in the South Bay Aqueduct" (DWR 1997). Since 1969, through series of agreements between DWR and ACWD and Zone 7, local water has been stored for "later release for subsequent beneficial use" by the water districts under their SWRCB permits. The disposition of stored local inflow is determined by the districts and can be: (1) released into Arroyo del Valle; (2) released into the South Bay Aqueduct; (3) exchanged for an equivalent amount of South Bay Aqueduct water; or (4) any combination of (1) through

[1] ACWD is conducting an on-going program, the Aquifer Recharge Program (ARP), which replaces saline groundwater in the local aquifer system with fresh water via the District's groundwater recharge facilities.

(3) (DWR 1997). Under the current agreement, DWR is allowed use of local inflow at times when the districts cannot use all or part of this supply.

[**local inflow management summary needed from DWR**]

SFPUC. The SFPUC published the *Draft Alameda Watershed Management Plan* (AWMP) in 1998, the primary goal of which is to maintain and improve water quality. Two secondary goals with relevance in the current planning context are described below.

First, the AWMP includes a secondary goal to "preserve and enhance the ecological and cultural resources of the watershed." This goal is to be achieved in part through policies:
- W2. Protect, conserve, and enhance existing native wildlife populations and their habitat.
- W3. Protect, conserve, and enhance ecosystems that provide important wildlife habitat values.
- W6. Maintain the integrity of the watershed creeks to retain their value as riparian ecosystems and wildlife corridors.
- W11. Achieve appropriate compliance, when watershed activities and operations affect regulated and legally protected species, by implementing comprehensive wildlife protection programs (such as habitat conservation plans), obtaining appropriate permits, and establishing conservation easements.

The AWMP contains additional wildlife-related policies focusing on aquatic resources:
1. AR1. Conserve, protect, and enhance the biodiversity, genetic integrity, and habitat of the watershed's aquatic resources.
2. AR2. Protect special status species and adhere to applicable State and Federal management regulations.
3. AR4. Promote healthy, diverse riparian and wetland vegetation to provide shade and cover necessary for fish spawning, rearing, and feeding areas.
4. AR8. Manage the watershed's aquatic resources in cooperation with State, Federal, and local agencies, as well as scientific institutions.
5. AR9. Cooperate with stream management organizations to protect and enhance aquatic habitat of streams in the hydrologic watershed.

An additional secondary goal is to maximize water supply, implemented in part by the SFPUC policy to "minimize the release of water that cannot be recaptured (Policy WS9)."

Several actions proposed in the AWMP also have relevance to steelhead habitat restoration:
- Action wil9. The SFPUC proposed developing a comprehensive, multi-species Habitat Conservation Plan (HCP) for species of concern in the watershed, including steelhead trout. The HCP would contain a "habitat enhancement strategy…based on scientifically sound information"
- Action aqu6. A Sediment Transport Study is proposed to identify stream segments with excessive bank erosion or channel sedimentation that are contributing risk to aquatic resources.
- Action aqu7. Information from the Sediment Transport Study is to be used to rehabilitate stream sections.

- Action aqu8. This action provides for establishing and conducting long-term stream corridor monitoring to evaluate the effectiveness of protection measures and rehabilitation projects.
- Action fis8. The SFPUC is to conduct annual surveys of fish populations and habitat conditions in conjunction with water quality monitoring in representative habitat sites.

The Grazing Element of the AWMP was prepared to provide strategies to appropriately manage grazing in the watershed, and provides actions intended to realize "the beneficial aspects related to fire management…without jeopardizing water quality/quantity and biological resources" (SFPUC 1998). The most important components of this element in terms of potential steelhead habitat are considered to be stocking levels and riparian area management as addressed by:
Action gra1. Animal Unit Months reduced by at least 40 percent of pre-1991 stocking levels.
Action gra8. Implement improvements for the Lower Alameda Creek Watershed Protection Area.

The SFPUC plans to develop quarry pits adjacent to Alameda Creek in Sunol Valley for water storage and recreation. The Sunol Valley Resources Management Element of the AWMP calls for completing mining by about the year 2035 in area SMP-32 (north of I-680) and creating a water storage pit with 16,100 af capacity. South of I-680, plans indicate development of either a 47,100 af water storage pit complex after mining is completed in 2021 or a 38,800 af capacity complex available sometime after 2014 (SFPUC 1998). Water diverted to the quarry pits would be derived from [**needed from SFPUC**] and would constitute about [**needed from SFPUC**] afa.

The Alameda Creek Water Resources Study (ACWRS), completed in 1995 for the SFPUC, included recommendations related to fisheries enhancement, Sunol Valley groundwater management, reservoir operations and beneficial uses of Sunol Valley. One opportunity presented in the ACWRS is to supply water releases for fisheries (i.e., fish flows) from Calaveras Reservoir. Introducing these flows "could provide improved fisheries and riparian vegetation condtions [in Calaveras Creek below the dam and in main stem Alameda Creek below the Calaveras Creek confluence] while still being used for San Francisco Water Department supply, if recaptured at a downstream location" (SFWD 1995).

The ACWRS concludes that the primary requirements for improving fisheries in this reach are summer stream temperatures and early spring spawning flows (SFWD 1995). It recommended a flow management plan (discussed in Section 4 of this *Plan*) to enhance habitat for the native fish assemblage, using a combination of unregulated Alameda Creek runoff and Calaveras releases. The study also found that streamside fencing throughout Alameda Creek would improve riparian habitat conditions by preventing cattle access.

Zone 7. This water agency published an Urban Water Management Plan addressing operations, as well as water supply and demand, in 2000. Elements of the plan germane to the restoration of steelhead in the Alameda Creek watershed are summarized in the following. Additional information regarding Zone 7 water resources management is provided from environmental review documentation of Zone 7's Water Supply Planning Program (Zone 7 1999).

Zone 7 reached its maximum original State Water Project (SWP) annual entitlement of 46,000 af in 1997. Subsequent acquisitions have raised the maximum to 68,000 afa with plans to increase this amount to 78,000 afa. Due to constraints on deliveries, SWP yield to Zone 7 is likely to be about 51,400 afa on average, or about 76% of the 68,000 afa entitlement (Zone 7 2000). Additional future yield from SWP sources is not a Zone 7 planning assumption.

Zone 7 plans to store runoff in a "Chain of Lakes" created by abandoned gravel quarries in the Livermore-Amador Valley in the future. Diversion from Arroyo Mocho is expected as early as 2003 (Zone 7 2000). Zone 7 holds water rights for flows in Arroyo del Valle and typically receives about 8,000 afa of Lake del Valle storage. Yield from this source is estimated to increase in the future to 9,300 AF/year through the year 2020 based on modeling of runoff data and future Zone 7 demand (Zone 7 2000).

For planning purposes, the population in Zone 7's service area has been estimated to increase by over 18% between the years 2000 and 2005 (Zone 7 2000). By 2020, population is expected to increase in the area by 50% over the year 2000 level. Corresponding increases in water demand are projected to rise from 60,800 afa in the year 2000 to 66,900 afa by 2005 (10 percent increase) and to 100,800 afa in 2020 (approximately 66 percent increase from year 2000 demand) (Zone 7 2000). In 1999, Zone 7 estimated that 2020 demand would exceed sustainable supply by approximately 39,800 af.

Zone 7 is also responsible for mitigating risks of flooding in its service area and has undertaken channelization projects on sections of Arroyo de la Laguna, Arroyo Valle and Arroyo Mocho. Zone 7 is currently planning [**flood control projects needed from Zone 7**]. Zone 7 has no flood control funding mechanism other than money from their water sales.

4. Restoration Projects

The section of the *Plan* defines the activities for establishing a viable steelhead run in Alameda Creek. Details of these actions and investigations are provided including conceptual design (where available) or other project description, cost estimates, implementation timelines, permit requirements and responsible agencies. The actions described in the *Plan* are exclusively those deemed essential to establishing a viable steelhead run in the Alameda Creek watershed. Numerous activities contributing to habitat restoration may be envisioned for various portions of the watershed that are not included in the present discussion since they go beyond the scope of this document.

The Restoration Projects section also includes discussion of various alternatives to the projects under consideration. This information was generated largely during two meetings of an Alternatives Subgroup of the Workgroup and includes: descriptions of the alternatives, consideration of the extent to which alternatives achieve project objectives, preliminary evaluation of environmental impacts, and a screening level analysis of the feasility of each alternative.

Passage Projects

Providing migration passage is necessary for the success of steelhead restoration in the Alameda Creek watershed. Passage barriers and impedances are organized based on their position in the watershed in a downstream-to-upstream direction, with barriers on tributaries discussed subsequently.

Barrier Modifications/Removals

The following projects are of three types, fishway installations, barrier modifications and barrier removals, each of which will provide passage opportunities for migratory fish. Modifications will be designed for a range of flows acceptable to regulatory staff in terms of their "efficiency," or ability to successfully pass fish. Fishway projects will similarly include operating conditions that provide acceptable fish passage efficiency. These conditions will include such factors as the period(s) of operation, discharge through the fishway, and maintenance and security provisions.

ACWD Lower Inflatable Dam. This barrier consists of a 7-to-9 foot high dam and sill. To improve passage during low flow conditions, a small curb (6 inches high) could be constructed to concentrate flow to one side of the channel, along with roughening the surface of the concrete apron. Concentrating flow to the right bank could help form a channel to guide fish to the fishway or roughened sill area.

Instream flows below this dam can vary from several thousand cfs to near zero. Since instream flow requirements have yet to be established, a fishway would need to operate over this wide range of flows. Two fishways housed in one structure could be used: 1) a false weir Alaska Steeppass ladder to operate when flows are between about 5-25 cfs, and 2) a vertical slot fishway to operate when flows are above 25 cfs. This ladder would require a screened water supply of 5 cfs, which could be attained from the adjacent pool or from nearby recharge ponds.

The vertical slot fishway is a self-regulated design that could be operated over a range of water levels according to the inflatable dam height. When the dam is inflated, the ladder would be relatively maintenance free. However, the entrance pool might collect sediment from high flow events and need to be periodically flushed or manually cleared. Flow through this ladder would vary from 25 to 40 cfs, with auxiliary water from the reconfigured bypass used for additional attraction if necessary. Juvenile passage over the Lower Dam could occur safely through the ladder, the existing auxiliary bypass, or over the low height inflatable dam.

Alternately, the Lower Inflatable Dam could be removed. The service life of this facility is estimated to be [**needed from ACWD**], at which point it would require replacement. Removal would involve loss of an estimated [**needed from ACWD**] afa of water supply to ACWD achieved by a combination of channel percolation and diversion to ponds. The existing pond (T-1) does not fill a significant recharge area and therefore could be filled from a pipeline from the Kaiser Pond or through a pumped intake that would not rely on having sufficient water depth in the Lower Inflatable Dam pool.

BART Weir and Middle Inflatable Dam. While the BART weir and the ACWD Middle Inflatable Dam are considered together in this section, it should be noted that various options for providing passage through this barrier complex have been examined by the Workgroup, including options that modify the BART weir alone and others. Further discussion of these alternatives is provided later in Section 4 of this *Plan*.

The concrete apron of the BART weir is an impassable fish barrier due to its steep slope and the high sheeting velocities that occur over its surface. A conceptual design for a fishway at the

BART weir has been developed for use in applying for funding from the Corps. The following information summarizes the conceptual plan's project design.

The proposed fishway would allow fish passage between the area downstream of the drop structure to the pool upstream of the Middle Inflatable Dam. It would operate regardless of whether the dam is inflated or deflated. This design eliminates the need for two separate ladders and the possibility of fish falling back over the BART weir’s sloping apron.

The lower portion of the ladder would consist of a vertical slot fishway for fish passage when the Middle Inflatable Dam is deflated. This dam is generally deflated during higher flow events when water depth in the channel can fluctuate significantly. The vertical slot design would accommodate this fluctuation and regulate the flow in the fishway. To ensure adequate submergence and minimum ladder flows when the dam is deflated, a two foot high curb placed across the channel and downstream of the ladder exit would be necessary. This curb would consist of a fixed concrete lip located just downstream of the Middle Inflatable Dam. This feature could also consist of fully or partially adjustable weir elements if necessary for flood control or sedimentation issues.

In the conceptual design, the fishway entrance is located as close to the apron base as possible. The side channel entrance would be submerged for proper fishway function. This would be accomplished by creating a pool from the backwater created by the Lower Inflatable Dam or by constructing a notched sill at the end of the energy dissipater. When the backwater from the Lower Inflatable Dam is not available, flows down the channel would be concentrated to the right bank of the channel in a newly formed armored channel. This channel would be cut into the existing grouted stone area under the BART bridge to direct fish to the fishway entrance.

The proposed design affords the least channel constriction at the top of the drop structure of options considered. It also can be constructed without compromising the structural integrity of the adjacent retaining walls and bridge footings.

When the Middle Inflatable Dam is inflated, the pool depth upstream of the dam increases up to 11 feet over the channel invert. Under this condition, the upper ladder section consisting of a pool and weir fishway would be opened and the lower vertical slot exit would be closed. A pool and weir design would be used here because the pooled water surface does not fluctuate much, allowing for closer regulation of fishway flows. Automatic overflow gates would be installed to allow for some water surface fluctuation. Since this portion of the fishway would only operate when the Middle Inflatable Dam is inflated, the ladder should remain relatively free of sediment and debris.

Upper Inflatable Dam. The Upper Inflatable Dam is a 13-foot high structure when fully inflated. Unlike the other ACWD inflatable dams in the channel, the Upper Inflatable Dam experiences overflow concentrated in the center of the channel. Since a fishway is more practically located on the channel bank, providing attraction flows will be important. A notched concrete sill would be constructed to guide fish to the ladder entrance.

A pool and weir ladder is proposed for installation in the right channel embankment of the Upper Inflatable Dam. Automatic overflow gates would regulate ladder flows and accommodate up to three feet of fluctuation in the pool level. The ladder would gain elevation before passing through a rectangular channel section adjacent to the dam crest. Since a wall specifically designed to incorporate a ladder exists in the abutment, dam operations should not be disrupted during fishway construction.

Niles and Sunol Dams. The SFPUC has two inactive concrete dams, Niles and Sunol, on main stem Alameda Creek. The SFPUC has budgeted $1.25 million and has applied for the remaining funds required to remove these dams, as they constitute major barriers to steelhead migration. Both dams have fish ladders that are non-functional. Niles Dam, located at RM 11.9, is approximately 6 ft high and is believed to impede passage at conservatively estimated flows of up to 500 cfs (SFPUC 2001). Sunol Dam is approximately 8 ft high by 25 ft wide and acts as a passage barrier even at higher flows.

A study concerning the impacts of the dam removals project recommended that sediment trapped behind Niles Dam be allowed to disperse throughout the system after dam removal, while Sunol Dam sediments were recommended for removal prior to dam decommissioning (SFPUC 2000). Removal of Niles Dam will allow access to about five miles of aquatic habitat between Niles Dam and Sunol Dam, while removing Sunol Dam will garner an additional estimated 2.5 miles of stream habitat up to the next barrier at the PG&E gasline crossing at RM 18.6.

PG&E Gasline Crossing. This structure is a sloping, articulated concrete mat protecting a 36-inch diameter natural gas pipeline. The mat covers an area of about 10 feet elevation gain over approximately 30 feet of channel length and creates conditions of shallow flow at all but high discharges. PG&E is investigating options to modify its pipeline crossing structure. The preferred alternative appears to be addition of a series of 7-8 added cross sections of mat material to raise the channel adjacent to the existing structure. Successful mitigation would provide steelhead access to at least Little Yosemite (RM 27.2) in the Upper Alameda Creek reach if suitable migration flows are available.

Alameda Creek Diversion Dam. Provision of fish passage at ACDD would provide access to about 8.5 miles of relatively pristine habitat for spawning and rearing. During the winter of 2001-2002, Alameda Creek flows were spilled at ACDD during an engineering investigation of Calaveras Dam. However, fish passage at the facility is not presently available and would require decommissioning the dam or constructing a large-scale fishway. ACDD is significant to current water supply infrastructure but discussions are ongoing about alternative water supply operations that would allow the structure to be removed.

Arroyo Mocho Drop Structure. This barrier is one of only two believed to significantly limit steelhead access to potential spawning and rearing habitat in Arroyo Mocho. It consists of a three-four foot high concrete channel stabilizing structure and associated concrete apron. It appears to be owned by the City of Livermore and could be modified by adding downstream structures or fishways.

Arroyo Mocho Road Crossing. This concrete apron presents a migratory barrier due to the shallow, high velocity flow conditions it appears to create and a substantial (6-10 foot) drop created by erosion in the channel (ACFRW 2000). The road crossing appears to be on privately-owned land, though the road provides controlled access to a water supply line servicing the Lawrence Livermore National Laboratory (LLNL). LLNL is in the initial phases of investigating options for providing fish passage at the site. The road crossing could be modified by adding downstream structures or fishways.

<u>Fish screen installations</u>

Overview. Seven fish screens or sets of fish screens may be constructed on ACWD facilities with the potential to entrain steelhead. The screen installation locations are: Pit T-1; Shinn Pond Diversion 1,2, ; Shinn Pond Diversion 1,2,3; Kaiser Pond Diversion; B Pond Diversion; B Pond Pumps; and Alameda Creek Pipeline Intake. These screens have been described in a conceptual design report used as the basis for a submittal to the Corps for funding support (ACFCWCD, ACWD 2001). The conceptual design is summarized in the following.

The fish screens proposed for ACWD diversions are designed to meet the most current fish screen criteria established by the NMFS and California Department of Fish and Game (DFG) for steelhead fry. Consultation on final design criteria would be obtained from NMFS and DFG prior to the final design of facilities. For conceptual design purposes, the screen size is governed by the approach velocity (over the gross screen area) criteria of 0.33 feet per second for continuously cleaned screens. Profile bar screens are proposed due to their structural qualities and ease of cleaning. The maximum screen slot openings for profile bar would be 1.75 mm and would comprise at least 27 percent of the open area.

Screens would be automatically cleaned when in use with either a brush cleaner or air burst system (except on pump intakes where air entrainment is generally unacceptable). To standardize design features for maintenance purposes, two screen facility types are proposed. An inclined flat plate fish screen with a wiper brush is proposed for use at the larger gravity diversions (i.e., diversion rates greater than 50 cfs). For pump screens and smaller gravity diversions, a retrievable cylindrical fish screen with a brush cleaner would be used.

Pit T-1 Diversion. This facility has a maximum diversion rate of 30 cfs. A cylindrical fish screen arrangement can be installed at this location, but water depths may limit the clearances needed for the screens (a minimum of one foot above and below the screens are needed). The existing trashrack structure would be removed, and the opening would be covered with a plate and pipe stub that will connect to a cylindrical fish screen manifold. Four screens will be connected to the manifold that would be retrievable during flood and maintenance events. Screens would be continually cleaned during diversion using brushes.

Shinn Pond Diversion 1,2. This is a 200 cfs diversion. The existing trash rack and the supporting structure would be removed, and an enlarged inclined flat plate intake screen would be installed. A wider screen support structure would be constructed that would protrude several feet into the channel. This design would permit the installation of flow distribution baffling to allow uniform velocities across the screen face. The structure would have smooth transitions to the banks. The existing pipe and gate would continue to function normally.

Shinn Pond Diversion 1,2,3. At this 225-cfs diversion, the existing trash rack and the supporting structure would be removed, and an enlarged inclined flat plate intake screen would be installed. A wider screen support structure would be constructed that would protrude several feet into the channel. This design would permit the installation of flow distribution baffling to allow uniform velocities across the screen face. The structure will have smooth transitions to the banks. The existing pipe and gate would continue to function normally.

Kaiser Pond Diversion. The rate of diversion at this facility can reach 50 cfs. Either a flat plate, inclined fish screen or a cylindrical fish screen arrangement can be installed at this location and constructed as described above.

B Pond Diversion. This gravity facility diverts at a rate up to 20 cfs. The existing trashrack structure would be removed, and the opening would be covered with a plate and pipe stub that would connect to a cylindrical fish screen manifold. The two screens and manifold would be retrievable so they can be removed during flood events and for maintenance purposes. Screens would be continually cleaned during diversion using brushes.

B Pond Pumps. This facility consists of three individual three cfs pumps for a maximum diversion rate approaching ten cfs. Each pump intake would be retrofitted to fit into a larger diameter pipe “sock.” Attached to this pipe would be a submerged, retrievable, cylindrical fish screen. Each screen would be cleaned with an automatic brush system.

Alameda Creek Pipeline Intake. The intake rate can reach 150 cfs at this facility. The existing trash rack and the supporting structure would be removed, and an enlarged inclined flat plate intake screen would be installed. A wider screen support structure would be constructed that would protrude several feet into the channel. This design would permit the installation of flow distribution baffling to allow uniform velocities across the screen face. The structure would have smooth transitions to the banks. The existing pipe and gate will continue to function normally.

<u>Alternatives</u>

The Workgroup has examined various alternatives related to fish passage through the Flood Control Channel portion of Alameda Creek. An Alternatives Subgroup was created that "brainstormed" options for the purposes of documentation and providing analysis for future planning. The subgroup attempted to use principles typically employed by passage engineers, and took advantage of the presence of staff from DFG and NMFS by encouraging them to provide their thoughts and comments.

In general, barriers to migratory fish are believed to be mitigated by the following approaches, with the first being the most desirable:

- remove barrier
- modify channel bed to provide passage by reducing the required height of the barrier
- focus upon altering barrier during the "hydrologic windows" when fish move
- construct fishway

The subgroup applied this prioritization structure and screening criteria (i.e., ability to achieve Workgroup objectives, environmental impacts and feasibility) to various alternatives as described below. Alternatives to the BART weir ladder are considered first, followed by alternatives for fish passage at other Flood Control Channel barriers.

BART Weir Fish Passage Alternatives

Re-Graded Channel. Under this alternative, the existing drop structure would be removed and the channel reconstructed to achieve the necessary grade change over a longer upstream-downstream section of the flood control channel. The design would need to account for potential pier scour concerns at the BART and train supports, and would likely involve reconstructing the footings of at least one set of supports. Re-grading the channel could be combined with a consolidation of ACWD diversions at the upper inflatable dam and removal of the middle inflatable dam. This would require additional capacity at diversions at the upper inflatable dam, including a second (or larger) pipe to bring diverted water to the percolation ponds west of the Hayward fault. This consolidation would have the benefit of removing existing diversions that require screening. It would include substantial cost for the new pipe.

The length of the channel to be re-graded would be determined based on the criterion of achieving an overall slope of three percent or less throughout the reach. A low-flow channel would have to be established within the channel cross section. In addition to channel stability and water supply issues, this alternative could create potentially significant flooding and sedimentation effects. Costs associated with this approach are unknown but are likely to be substantial based on the scale of the various project elements. Further evaluation of this alternative is recommended as described in Section 6 of the *Plan*.

Modify Channel Bed Downstream. In the Alameda Creek flood control channel, modifying the channel bed to lower the effective height of the BART weir as a barrier could involve constructing a series of bank-to-bank steps downstream of the weir that would be capable of passing migratory fish by virtue of their low individual heights. Alternately, a longer, continuous channel slope could be constructed with a goal of three percent maximum grade. Either of these options would entail substantial cost and would present the technical difficulty of providing a low flow channel. Also, channel modification would not remove the need for a fishway on the middle ACWD inflatable dam or water supply consolidation as described in the preceding alternative.

Downstream modification would involve raising levee heights adjacent to the affected section to maintain flood flow carrying capacity. Hydrologic modeling would be required to determine the length of the re-graded channel section needed to achieve desired water velocities for both fish passage and flood protection.

Modify Barrier for Passage. The BART weir cannot be modified on a seasonal basis to allow for fish passage.

Bypass Channel. This alternative would provide fish passage past the drop structure and middle ACWD inflatable dam by means of a channel constructed outside the boundaries of the existing flood control channel. A Bypass Channel alternative has the potential to fulfill the project objectives of providing fish passage while maintaining existing flood control and water supply functions.

The Bypass Channel alternative presents technical difficulties of ensuring that fish enter the bypass channel as opposed to using the flood control channel. A conceptual location and preliminary design specifications also would be necessary to evaluate the feasibility of this alternative in terms of site suitability. Existing land uses adjacent to the flood control channel could present constraints to implementing this alternative.

Construct Fishway. The conceptual fishway design proposed to the Corps represents an attempt to respond to the critical criteria of variable stream discharge conditions and fish passage efficiency. Passage efficiency is commonly adversely affected by a fishway filling with sediment or debris, or by insufficient or inadequately designed attraction flows. Fishways must be able to provide for upstream and downstream migration at high and low discharge levels for both adult fish and smolts.

Design flows for fishways are based on the flow conditions occurring in the target stream. These flows may be represented graphically by a flow-duration curve that plots stream discharge against the percentage of time flows exceed given discharge levels. For example, in a perennial stream, a level of 0 cfs discharge is exceeded 100 percent of the time, while greater flows are less commonly exceeded. Fishways are often designed to provide fish passage under conditions that are exceeded five percent of the time by large flood flows (although regulatory agency policy regarding this issue is under review and is tending to favor designs that incorporate fewer instances of inadequate passage provision). Flow conditions that are exceeded 50 percent of the time are typically used to indicate the low flow design criterion.

To operate efficiently, fishways must carry sufficient flow to attract fish into the (downstream) entrance. Typically, ten percent of the total discharge of a stream is considered the minimum flow necessary to attract upstream migrating fish into a fishway. Such flows can be a portion or all of the instream flow directed into the fishway, or can incorporate "auxiliary" water. In the latter case, supplemental water supplies from a stream diversion or other source are introduced into the fishway for the purposes of attraction.

Attraction flows are often the limiting factor to the efficiency of fish passage through a fishway. In response to this concern, fish ladders are sometimes necessary in multiple locations in the channel cross section, such as on opposite banks or in the center of the stream. In Alameda Creek, construction of multiple fishways at the BART weir is highly problematic due to cost and loss of flood carrying capacity.

Specific fishway design criteria applicable to the BART weir and ACWD Middle Inflatable Dam include the following:

- the fishway must incorporate two (upstream) exits to allow for fish passage when the inflatable dam is either inflated or deflated; and
- the fishway must carry all of the Alameda Creek flow under low flow conditions.

The fishway design included in the Corps submittal represents the consensus of several design engineers regarding an acceptable approach to the specific situation found at the BART weir/Middle Inflatable Dam in the Alameda Creek flood control channel. Also, the project site appears to accommodate the maintenance requirements for this type of ladder well.

A variation on the set of fishways and screens proposed in the Corps submittal has also been proposed. Under this scenario, fish exiting the BART weir/Middle Inflatable Dam fishway would pass into a small (25-35 cfs) flume constructed to lead to the area above the upper inflatable dam. Under this approach, fish would pass the barrier complex by entering one ladder system rather than two, potentially reducing migration delays. The connecting channel would incorporate small drops within the channel that would make up the 13-foot grade difference between the Middle and Upper Inflatable Dam facilities. In this configuration, a fishway exit would be provided upstream of the Upper Inflatable Dam as well as one just upstream of the Middle Inflatable Dam. The intermediate exit would be operated if the Middle Inflatable Dam was inflated and the Upper Inflatable Dam were deflated.

Other Flood Control Channel Barrier Alternatives

Remove Rubber Dams. This alternative would consist of removing the Middle and Upper ACWD Inflatable Dams and providing new water supply mechanisms such as new pumping facilities and pipelines or an alternate water supply and associated delivery structures. Currently, the Upper ACWD dam impoundment provides a desirable resource (due to large hydrologic head) that allows for operational flexibility and produces large volumes of groundwater storage through recharge. The middle dam also produces substantial water supply through groundwater recharge.

This alternative would achieve the project objective of providing fish passage at the existing dams and would benefit potential future steelhead populations by reducing migration delays and predation pressures represented by impoundments. ACWD facilities at each of these sites are critical to current operations, however, and this alternative would entail large costs associated with developing replacement water supplies. Based on the projected costs and water supply implications of this alternative, it was not considered a feasible alternative to be carried into future planning efforts.

Modify Rubber Dam Operations. Under this alternative ACWD inflatable dams would be operated to provide fish passage during migration periods, and an alternative water supply mechanism(s) would be developed (e.g., new pipelines, intake facilities, alternate water supply, etc.). It should be noted that while some information is available concerning steelhead migration periods in Alameda Creek and elsewhere, extreme variability in the timing of such events is known to exist. Therefore, establishing fixed periods of dam deflation to allow fish passage is likely to occur in a context of trade-offs between foregone water diversion opportunities and incidental "take" of steelhead. In dry years in particular, conflicts between fish passage and water supply would be expected. Some modifications to existing inflatable dam operations may be required even with construction of fishways at the middle and upper ACWD dams.

This alternative would adversely affect a project objective of maintaining the water supply function of the Alameda Creek flood control channel. Environmental effects of this alternative would depend on the effectiveness of operational changes in relation to the timing of steelhead migration. During periods of dam deflation, the size of upstream impoundments would be substantially reduced, resulting in beneficial environmental effects related to reducing possible migration delays and predation opportunities. The economic viability of this alternative would depend on the method of providing water to ACWD to replace diversions foregone by modified operations. It is estimated that additional facilities required under this alternative would be substantially more expensive than the cost of constructing fish ladders at the Middle and Upper ACWD dams. Such facilities could include pipes or other conveyance structures to alternate water storage locations, associated pumps, and other types of water supply facilities.

Replace Rubber Dams with Rock Weirs or Multiple Inflatable Dams. This alternative attempts to achieve fish passage by constructing multiple "stepped" weirs or dams, thus reducing the elevation change between upstream and downstream portions of the creek on either side of each structure. The alternative could achieve the goals of providing fish passage and maintaining multiple uses of the Alameda Creek channel (i.e., flood control and water supply). The replacement alternative essentially comprises creating a bank-to-bank pool and weir fishway.

A replacement alternative would cause less desirable fish passage conditions in terms of attraction flows than either construction of fishways or operational modifications. Also, this proposed design could cause migratory delays and/or increased predation opportunities. The replacement alternative also would involve substantial additions to ACWD facilities at costs estimated to be greater than costs of fishways or other alternatives.

Trap and Haul. This alternative would involve adopting a program to collect steelhead migrants for transportation past the passage barriers in the Alameda Creek flood control channel. Such a program likely would be undertaken through a Memorandum of Understanding (MOU) with NMFS and DFG. The Trap and Haul alternative would include: (1) constructing facilities to trap migrating steelhead; (2) designating a party to collect and transport trapped fish; and (3) maintaining facilities and providing security (to prevent poaching).

Based on preliminary discussions with representatives from NMFS and DFG, this alternative is undesirable due to potentially significant environmental effects. Trap and Haul efforts typically collect a low percentage of migrating fish. Also, potential steelhead mortality from entrainment in diversion structures would continue to be a risk under this alternative. Overall, Trap and Haul is considered to be a "last resort" alternative.

No Project (No Action). This alternative assumes that no project altering existing conditions for steelhead passage in the Alameda Creek flood control channel is approved. Under this alternative, passage for in-migrating steehead would continue to be blocked by the drop structure, and adult steelhead would not reach upstream areas identified as providing potential spawning habitat. Opportunities for increasing the size of the steelhead run in Alameda Creek would be foregone and potential legal liability resulting from ESA "take" and California Fish and Game Code provisions could result.

Habitat Restoration Projects

Instream Habitat Improvements

Flow enhancement in the Alameda Creek watershed has the potential to improve existing migration conditions for steelhead and to increase the amount of spawning and rearing habitat currently available in the restoration area. In particular, providing additional flows in portions of the watershed to assist with out-migration in late spring months was identified in the *Assessment* as an action to increase the likelihood of restoring a viable steelhead population. Developing recommendations for flow enhancement involves the review of "known" information, generating new information, understanding both legal issues and water supply process requirements, and cooperation amongst competing demands. The following discussion reviews existing information regarding instream flows.

Flood Control Channel. As discussed in the *Assessment*, steelhead smolt and kelt spring outmigration may occur when the Upper, Middle and Lower ACWD dams are all deflated due to high discharge conditions. Based on information collected for the *Assessment*, all ACWD dams were deflated for more than 20 percent of the potential out-migration period (~18 days) in 3 years of the 8-year period of record (1991-1998). Also, steelhead may be able to out-migrate on flows that "overtop" the dams, though this occurrence may have adverse effects on the migrating fish. With fishways operational at the ACWD dams, desired out-migration conditions will be in place either when the dams are lowered or the fishways are passing flows according to the schedule determined by agreement with regulatory agencies.

Typically, flow schedules for fish passage are based on an analysis of the frequency of water year "types" and an analysis of risk to the fish population from various operating scenarios (timing and quantity of releases) corresponding to the type of water year. Specifically, lower flow release quantities or shorter release periods may be developed for years with less-than-normal rainfall that allow for a limited amount of risk to be imposed on the population for the sake of achieving beneficial use goals for the water supply. These considerations will be the subject of negotiations determining the future instream flow schedule for Alameda Creek.

Some evidence exists suggesting that peak spawning of *O. mykiss* in the Alameda Creek system may occur early in the known spawning season for California populations(SFWD 1995). Rainbow trout fry have been observed in Alameda Creek reaches in mid-February, and populations above reservoirs have been noted displaying smolt migration characteristics during this month as well (SFWD 2002). Further refinements in defining the out-migration period for a potentially restored steelhead population could reduce the amount of water dedicated for instream use. For example, narrowing the window of a 7 cfs water release from a 92-day period to a 60-day period represents almost 450 af of conserved water (~1275 af versus ~832 af).

Additional analysis is required to produce a strategy for achieving a flow regime compatible with restoring a self-sustaining steelhead population. Factors to be considered in this strategy include:

- Duration and quantification of acceptable out-migration flows in the Flood Control Channel;
- Defining water year "types" (e.g., "normal", "dry", "critically dry", etc.) in terms of rainfall, discharge or other hydrologic factors for the Alameda Creek watershed;
- "Natural" frequency of no passage (drought) conditions;

- Co-ordination with upstream releases;
- Potential cost of foregone diversion to allow for increased passage flows;
- Source of water provided for passage flows; and
- Alternatives to provision of supplemental dry year flows.

Instream flows for Alameda Creek may be determined in discussions between individual water supply agencies and regulatory staff or in a coordinated approach involving multiple water suppliers and other Workgroup members.

Niles Canyon. USGS data indicate that recent seasonal flow patterns in Niles Canyon closely resemble those occurring prior to the development of major water projects in the watershed (ACFRW 2000). As a result, flows to supplement spawning and rearing habitat in this reach, as well as migration in normal years, are not currently proposed. However, based on future evaluation of out-migration flows desired to support a viable steelhead population in Alameda Creek, releases from del Valle, San Antonio or Calaveras Reservoirs, or foregone diversions from Upper Alameda Creek could be used to supplement dry year discharge. Such a strategy would be developed considering the factors listed above for the Flood Control Channel and additional factors related to "transmission losses" and cooperative arrangements between water management agencies and other Workgroup members.

Sunol Valley. Surface flows in this reach of Alameda Creek are believed to cease typically in June, and flow releases are not recommended as part of the *Assessment* or this *Plan* to support spawning or rearing habitat in Sunol Valley. The reach serves as a link between potential upstream habitat areas and Niles Canyon. Water management projects upstream (Calaveras Dam and ACDD) affect flow entering Sunol Valley and thus may be used to supplement local runoff during migration periods as necessary to support a viable steelhead population. The frequency, timing and quantity of potential supplemental flows to this reach should be evaluated based on:

- Defining "normal", "dry" and "critically dry" years in terms of rainfall, discharge or other hydrologic factors for the Alameda Creek watershed;
- "Natural" frequency of no passage (drought) conditions;
- Potential cost of foregone diversion to allow for increased passage flows;
- Source of water provided for passage flows;
- "Transmission losses" through the Sunol Valley; and
- Alternatives to provision of supplemental flows.

Upper Alameda Creek. The *Assessment* indicated that current water management practices produce conditions in some areas, particularly Lower Ohlone, that allow for successful *O. mykiss* production. However, instream flows that would provide basic habitat requirements, especially during the summer, are the critical factor limiting trout populations in this reach (SFWD 1995). Spawning and rearing habitat in main stem Alameda Creek between Sunol Valley and ACDD (~7.7 miles), and Calaveras Creek from the Alameda Creek confluence to Calaveras Reservoir (~0.6 mile) would be improved by supplemental water releases from the diversion facilities.

As part of a previous planning effort, a flow management scenario was developed for the area below the confluence of Alameda Creek and Calaveras Creek (SFWD 1995). The following schedule was intended to provide conditions favorable for "enhanced trout fisheries and maintenance of native nongame fishes."

Table 4-1. Possible fisheries flow management plan for Upper Alameda Creek

Period	5-Day Running Average (cfs)	Minimum Daily (cfs)
November 1 - January 31	5	4.5
February 1 - March 31	20	18
April 1 - October 31	7	6.3

The amount of water represented by this flow schedule assuming no contribution from local runoff is about 6,200 afa (SFWD 1995). These releases were intended to address important habitat restoration needs, especially sufficient flows during the spawning period and acceptable summer water temperatures.

Additional information is needed to understand the relationship between flows in Upper Alameda Creek and potential future steelhead abundance in the reach. Previous discussions regarding instream flows have focused on the need for the type of information provided by the Instream Flow Incremental Methodology (IFIM). The IFIM approach seeks to determine habitat and streamflow relationships for juvenile and adult life stages for target species in stream reaches. Specifically, IFIM indexes water depth, velocity and substrate under a range of flows to determine habitat suitability. The method is data-intensive and costly, requiring input from monitoring data under varying flow conditions (SFWD 1995). Information regarding flow-habitat relationships in Upper Alameda Creek could be produced by alternative analytical methods under agreement with regulatory agency staff.

Providing deep water habitat for adult *O. mykiss* has been cited as a secondary factor limiting restoration (SFWD 1995). Based on the results of IFIM (or other) studies, supplemental flows may be provided in the Upper Alameda Creek reach to enhance this habitat and increase the productivity of the fishery. Providing deep water habitat flows is not a necessary condition to re-establishing a viable steelhead population in the watershed, and may occur after other "critical path" actions (such as barrier removals and instream flows previously described).

Upper Alameda Creek water projects have also resulted in reduced peak flows through the portions of the reach downstream from ACDD and Calaveras Reservoir. Historically, peak flows averaged 120 cfs or more in winter months and "prepared" spawning gravels (by removing fine bed materials) as flows receded in the spring (SFWD 1993c). While other approaches to spawning habitat improvement in Upper Alameda Creek are available, including gravel placement and cleaning, providing periodic flushing flows should be considered a preferred method to be pursued once primary habitat factors have been addressed. Such flows are likely to produce corollary benefits related to instream vegetation control as discussed in the next section.

Arroyo de la Laguna. Current planning efforts are focused on providing steelhead access to all available spawning and rearing habitat areas, especially those in Niles Canyon, Upper Alameda Creek and Arroyo Mocho. Since Arroyo de la Laguna flows can contribute to achieving steelhead passage in Niles Canyon and the Flood Control Channel, water releases from del Valle Reservoir may be considered in future instream flow negotiations. Also, steelhead potentially using Arroyo Mocho or other portions of the Arroyo de la Laguna catchment may suggest modifications to current diversion practices in the future. Lake del Valle releases are not currently managed to provide flow to the Arroyo de la Laguna confluence.

<u>Riparian Corridor Improvements</u>

The condition of riparian areas along Alameda Creek is considered a secondary factor limiting the success of a restored steelhead population (SFWD 1995). Specific actions have been identified that would improve habitat, but are not essential to establishing a viable fishery. The *Alameda Creek Water Resources Study* cited reducing cattle access as important to the health of riparian and riverine areas, and grazing management is proposed in the *Alameda Watershed Management Plan*, along with supplementing flows in Alameda Creek.

A riparian vegetation baseline assessment and a revegetation/restoration report were performed as part of the ACWRS in 1993. The primary goals of the assessment were to characterize the existing riparian vegetation and identify areas "that could pose a significant limitation to the reestablishment of a viable [trout] fishery within the study area" (SFWD 1993a). This area consisted of about 6.5 miles of Calaveras and Alameda Creeks channel from a point just downstream of the Sunol Valley Water Treatment Plant (SVWTP, at about RM 22.3) upstream to Calaveras Dam. The subsequent report examined restoration opportunities to accommodate a reestablished trout fishery and assessed potential costs to revegetate areas disturbed by gravel mining operations.

Overall, riparian vegetation in the study area was found to be in "relatively good condition" with the exceptions of areas impacted by historic reduction in the water supply, gravel mining and cattle grazing. With regard to water supply, diversion practices reducing peak winter flows "have created stagnant pools which accumulate sediments and are then overgrown by cattail (*Typha* sp.) colonies". Additionally, low flows have "created algal blooms in the pools which cover pool surfaces by early summer with dense mats" (SFWD 1993b). These pool areas generally occur between the SVWTP and Calaveras Dam.

The vegetation studies found that mining operations between about RM 19.4 and RM 21.0 "have virtually eliminated all of the original creek habitat" (SFWD 1993a). The study report noted the highest level of disturbance attributable to cattle activity to be from the Rosedale Bridge (about RM 20.8) upstream to the western boundary of Sunol Regional Park (about RM 25.0). In this area, grazing in some portions "has severely reduced vegetative cover and has greatly disturbed the creek banks and bottom" (SFWD 1993a). According to the report, a likelihood exists of "natural revegetation" of the more disturbed areas after cattle are excluded since native vegetation is well-established throughout the creek.

The revegetation studies supported increased water releases for fisheries as a method to improve habitat conditions related to cattails and algal mats in channel pools. High water flows resulting from major storm events were expected to "gradually wash out the sediments which the cattails depend upon," while "shade created by better vegetation along the stream channel would cause the cattails to die out over time." Also, algal mats were predicted to "disappear when water temperatures drop and shade levels rise" (SFWD 1993b). Water releases combined with grazing exclusion were believed to allow for "full revegetation" of large portions of the study area, excluding the areas affected by gravel mining.

Steelhead Run Supplementation

The Workgroup, in consultation with management agency staff and others expert in steelhead population dynamics and genetics, may elect to "jump start" the steelhead run in the Alameda Creek watershed using artificial propagation. This approach would be an alternative to depending solely upon "natural" production by in-migrating adult fish successfully entering the watershed after the implementation of restoration activities. These adults could be "stray" individuals from other drainages (including hatchery-produced fish) or Alameda Creek *O. mykiss* that escaped either before or after project implementation. While escapement information is not available, it is estimated that the number of adults attempting to enter the system currently is extremely low. Over time, Alameda Creek *O. mykiss* escapement would be expected to increase due to improved migratory conditions. However, founding a restored steelhead run from a small initial population may not produce an adequately diverse genetic structure in the run.

Rainbow trout have been documented in locations above Calaveras Reservoir regularly since 1905. The fish in these tributaries are probably part of a landlocked population derived from a coastal steelhead stock that was isolated in the upper part of the drainage by natural process or by the construction of Calaveras Dam (SFWD 1995). This population, and other self-sustaining *O. mykiss* populations in the watershed (such as in tributaries to San Antonio Reservoir) may provide suitable stock for artificial propagation or downstream transportation used to increase the size and genetic diversity of the future steelhead run. Typically, juvenile steelhead are released between March 15 and May 1; their size at release is equivalent to at least 10 fish/pound (CDFG 1998).

SFPUC studies are presently underway to characterize spawning and recruitment of *O. mykiss* in reservoir tributaries that will provide information to inform decision-making regarding future run supplementation. Issues to be resolved regarding supplementation include: source of the fish to be used, method of propagation, life stage of individuals to be used, numbers of fish needed for release, point of release, method of identification (e.g., tagging, clipping), impact on the donor population, duration of effort, permitting and other related topics. The program is likely to involve one of three approaches: collection and movement of juvenile *O. mykiss* downstream, collection of spawning adults for off-site propagation, or collection of spawning adults for on-site propagation. Supplementation activities would likely occur for a minimum of three years.

The California Fish and Game Code prohibits placing or planting live fish without first securing the written permission of the Department (from the DFG Regional Manager). Such permission would be requested based on review of a rearing plan developed for the Alameda Creek steelhead supplementation program. A NMFS permit may also be required to allow handling of the *O. mykiss* identified as the brood stock for the propagation program. The rearing plan would prescribe a five-year operational scenario including evaluation that would be linked to an overall long-term watershed fishery restoration plan.

A cooperative rearing program between a local sponsor and DFG may be eligible for funding, technical advice and "special assistance" from the State of California. The type of program envisioned for Alameda Creek would satisfy the DFG criterion of supporting programs "that grow fish for use in accelerating the restoration/rehabilitation of depleted wild populations in underseeded habitat" (CDFG 1998). Collection of spawning fish for transportation to an off-site facility, such as that operated for the Monterey Bay Salmon and Steelhead Project, for propagation would allow the Workgroup to carry out its supplementation program under an existing (ESA section 10) permit.

5. Restoration Project Implementation

Project Sponsors

The various projects discussed throughout this *Plan* will be implemented mainly by the agencies owning and/or operating the facilities under consideration. Almost all restoration actions described here have designated sponsors actively participating in project planning. The primary agencies consist of ACFCWCD, ACWD, the Corps and SFPUC. Additional projects may be sponsored or supported by other public agencies (e.g., DFG, EBRPD), private entities (e.g., PG&E) and non-governmental organizations. In addition, restoration-related activities likely will continue to be pursued under the aegis of the Workgroup.

Permit Compliance Strategy

Discretionary projects discussed in this *Plan* will be subject to environmental review under NEPA and/or CEQA based on the types of projects, their funding and their permitting requirements. Listed below are regional, state and federal agencies that will likely review and comment on environmental evaluation documents for the lead agencies for such projects as the §1135 project or the SFPUC Sunol and Niles Dam Removal project, or will have permit authority over such projects. All agencies noted here may not have jurisdiction on all projects; additional agency involvement may also be required on projects such as those involving water diversions.

- DFG. Streambed Alteration Agreement. State-listed threatened and endangered species.
- United States Fish and Wildlife Service. Section 7 Consultation. Federal listed threatened and endangered species.
- NMFS. Section 7 consultation for Central California Coastal Steelhead. Critical Habitat for threatened and endangered species.
- United States Environmental Protection Agency. NEPA Compliance. Preparation of legally adequate environmental documents, compliance with water and air quality regulations.
- United States Army Corps of Engineers. Section 10 and 404 of the Clean Water Act. Potential impact on navigable waters of the U.S.
- San Francisco Bay Regional Water Quality Control Board. Section 401 Clean Water Act. Compliance with California State Porter-Cologne Water Quality Control Act.
- State Historic Preservation Office. California Register of Historic Resources. Loss of historically or architecturally significant buildings or structures.
- National Park Service. U.S. Department of Interior – National Register of Historic Places, Historic American Engineering Record and Historic American Building Survey. Compliance with Federal Historic Preservation Act.
- State Lands Commission. Public trust for water related commerce, navigation, fisheries, recreation, open space, and habitat.

Since steelhead are "threatened" under the federal ESA, the actions considered in this *Plan* must also be consistent with procedural requirements set forth for protecting listed species. ESA issues with relevance to the current planning process include critical habitat designations, take prohibitions and others, and are briefly reviewed here. This *Plan* puts forth a program of activities that is "salmon safe" and contributes to overall plans for recovery of steelhead in the Central Coast ESU.

The Alameda Creek watershed areas described in this *Plan* are considered part of the critical habitat for Central Coast steelhead, with the exceptions of the areas above Calaveras Reservoir, San Antonio Reservoir and del Valle Reservoir. Specifically, "all river reaches accessible to listed salmon and steelhead within the range of the ESUs" are subject to ESA requirements, where accessible is defined to include "reaches that can be occupied by any life stage of salmon or steelhead" and inaccessible reaches are "above specified dams" (65CFR7764).

Section 4(d) of the ESA requires NMFS to issue regulations concerning the activities of state and local governments and private citizens to provide for the conservation of listed species. These rules need not prohibit all take, in that there may be an "exception" from the prohibitions on take so long as the take occurs as the result of a program that adequately protects the listed species and its habitat (NMFS 2000). Current Workgroup restoration planning should provide a sufficiently rigorous protection program to relieve sponsoring agencies from ESA liability associated with their on-going water supply, flood control or other activities. The ESA section 4(d) rule also provides a way to permit the "take" of listed fish for a variety of fish propagation purposes, such as those to be pursued to restore a viable steelhead population in the Alameda Creek watershed. Similarly, an activity whose primary purpose is to restore natural or riparian habitat processes or conditions may be exempt from section 4(d) take prohibitions.

After implementation of the proposed restoration actions, only incidental take due to ladder or screen inefficiency, inadvertent stranding, scientific or management studies, or other mechanisms would be expected, and these would be authorized through a section 10 incidental take permit, a section 7 consultation or a limit on the take prohibitions provided by the 4(d) rule. Section 10 permits may be issued for research activities, activities that enhance a species' survival, or to authorize incidental take occurring in the course of an otherwise lawful activity. Such a permit may be appropriate for certain activities considered in this *Plan* for habitat improvement and on-going studies.

Section 7 of the ESA requires that Federal agencies consult with NMFS on activities they authorize, fund or carry out to ensure they are not likely to jeopardize the continued existence of listed species or result in the destruction or modification of their critical habitat (NMFS 2000). By law, section 7 consultation is a cooperative effort involving affected parties engaged in analyzing effects posed by proposed actions on listed species or critical habitat(s) (USFWS, NMFS 1998). Because it would use federal funding, the §1135 process will be subject to a section 7 consultation between NMFS and the Corps that will likely include ACWD and ACFCWCD.

Implementation Schedule

This section describes a proposed implementation schedule for the actions necessary to restore a viable steelhead run in the Alameda Creek watershed. For each action, or set of actions, information regarding implementation is provided in narrative form as well as summarized in Table 5-1 at the end of this document.

§1135 Projects. At the time of publication of this report, this category includes fishways at the BART weir and Middle and Upper ACWD Inflatable Dams and four fish screens at Shinn Pond Diversion 1,2, Kaiser Pond Diversion, B Pond Diversion and Alameda Creek Pipeline Intake. ACFCWCD and ACWD have developed preliminary designs for these projects to be used by the Corps in preparing a Preliminary Restoration Plan. If approved by Corps Headquarters, a Detailed Project Report will be prepared with a target completion date of July 2004. Subsequent steps in the §1135 process include a Project Cooperation Agreement, preparing Plans and Specifications (P&S), and construction. The target completion date for P&S is January 2005. Construction is proposed to occur between July and October, 2005.

Non-§1135 Flood Control Channel Projects. These projects will consist of necessary Flood Control Channel passage mitigations not covered by the §1135 Process. Presently, the group of projects not under Corps review includes the ACWD Lower Inflatable Dam and three ACWD diversions (i.e., Pit T-1 Diversion, Shinn Pond Diversion 1,2,3, B Pond Pumps). The actions at these locations will be those described in the conceptual design (and summarized in Section 4) or alternatives that address both on-going water supply considerations and fish passage in the Flood Control Channel. The implementation schedule for non-§1135 projects will be parallel with that of the §1135 projects.

Niles and Sunol Dam Removal. The SFPUC commissioned a review of the impacts of dam removal at these locations that was published in December, 2000. The SFPUC has budgeted its own resources and applied for additional funding for the project, and has initiated the environmental review process. Permitting and environmental review are expected to be complete in March, 2004. Construction is scheduled to commence in mid-April of 2004.

PG&E Gasline Crossing. No schedule for this project was available at the time of publication of this *Plan*. For planning purposes, the project has been placed on an implementation schedule parallel to the SFPUC's Niles and Sunol Dam Removal projects.

Arroyo Mocho Drop Structure. No schedule for this project was available at the time of publication of this *Plan*. For planning purposes, the project has been placed on an implementation schedule parallel to the SFPUC's Niles and Sunol Dam Removal projects.

Arroyo Mocho Road Crossing. No schedule for this project was available at the time of publication of this *Plan*. For planning purposes, the project has been placed on an implementation schedule parallel to the SFPUC's Niles and Sunol Dam Removal projects.

Instream Habitat Improvements. Provision of instream habitat improvements related to flow should be in place upon completion of passage projects discussed in this *Plan*. For the purposes of this document, flow determinations have been divided into two processes: an outmigration flow schedule affecting the Flood Control Channel, Niles Canyon and Sunol Valley, and a spawning and rearing flow schedule affecting Upper Alameda Creek. The amount of time necessary to negotiate these flow schedules has not been determined. However, it is assumed that outmigration flows will be necessary in spring of 2004 when the steelhead run is "jump started." Spawning and rearing flows in Upper Alameda Creek should be in place for steelhead entering the newly-opened watershed areas in the winter of 2005.

Riparian Corridor Improvements. Cattle should be excluded from Alameda Creek as soon as possible to allow for riparian area recovery prior to the re-introduction of steelhead into the upper watershed. The SFPUC is in the process of planning this activity.

Steelhead Run Supplementation. Further study of this part of the restoration program for Alameda Creek is necessary to establish the time needed to satisfy permitting requirements, identify funding sources, and develop infrastructure and personnel. Planning for a possible run supplementation program should begin as soon as possible to allow for release of reared fish coincident with the completion of the other restoration actions cited in this *Plan*. On-going SFPUC studies of *O. mykiss* in tributaries to San Antonio and Calaveras Reservoirs will inform supplementation planning, and NMFS has expressed interest in providing technical assistance for a supplementation program for the watershed. It is possible that the Workgroup will attempt release of relocated or propagated steelhead stock in the spring of 2004.

Estimated Costs

The total cost implementing the *Plan* cannot be accurately estimated due to the early stage of development of many of the projects identified here. An attempt has been made to summarize cost estimates already prepared and to use "best guess" figures to complete a preliminary cost estimate for planning purposes (Table 5-2, **at the end of the document**). Background information for this process is provided below and subject to further refinement.

A cost estimate was prepared for a combination of two fishways and four fish screen projects that would mitigate passage-related impacts from the BART weir, the Middle and Upper ACWD Inflatable Dams, and the following four ACWD diversions: Upper Shinn Pond Diversion 1,2; Kaiser Pond Diversion; B Pond Diversion; and Alameda Creek Pipeline. The total cost of these projects was $6,750,000. The Corps may include all or some lesser combination of these projects in its restoration process, depending on the results of the Detailed Project Report. Fish passage and protection at water supply facilities not addressed by this funding source (currently including Lower Inflatable Dam, Pit T-1 Diversion, B Pond Pumps, Shinn Pond Diversion 1,2,3) may be addressed through interim operational modifications and/or separate funding opportunities. Specific cost information for restoration actions is provided below.

Lower Inflatable Dam. Total cost of the fishway at this location including engineering, environmental mitigation, construction inspection, contract administration, and contingencies has been estimated at $1,500,000. The cost of the fish screen proposed for this location (Pit T-1 Diversion) would be [**needed from ACWD**]. The cost of removing the Lower Inflatable Dam and abandoning the diversion structure is estimated to be [**needed from ACWD**].

Middle Inflatable Dam and BART Weir. Total cost of the fishway facilities at this location including engineering, environmental mitigation, construction inspection, contract administration, and contingencies is estimated to be $2,900,000. Screens at the Upper Shinn Pond 1,2 Diversion, Upper Shinn Pond 1,2,3 Diversion, and Kaiser Pond Diversion (associated with this dam) are estimated to cost $1,100,000, $[**needed from ACWD**], and $400,000, respectively.

Upper Inflatable Dam. The cost of the fishway at this location is estimated to be $1,400,000. Screens at the B Pond Diversion, B Pond Pumps and the Alameda Creek Pipeline are estimated to cost $150,000, $[**needed from ACWD**] and $800,000, respectively.

Niles and Sunol Dams. The SFPUC's Niles and Sunol Dam removals have been estimated to cost $3,250,000. The SFPUC has budgeted $1,250,000 for environmental review of the projects and has applied for funding to cover remaining project costs.

PG&E Gasline Crossing. A preliminary estimate of the cost of modifying the PG&E gasline crossing in Niles Canyon is $385,000. This estimate is for construction only and does not include costs associated with design, permitting and project oversight [**needed from PG&E**].

Arroyo Mocho Drop Structure. No cost estimate was available for this project at the time of publication of this *Plan*.

Arroyo Mocho Road Crossing. No cost estimate was available for this project at the time of publication of this *Plan*.

Instream Habitat Improvements. The flow schedule and sources of water for adequate passage conditions have not been determined. Similarly, the flow schedule for the Upper Alameda Creek reach has not been determined. Water costs associated with providing migratory and spawning and rearing habitat conditions necessary for restoration of a viable steelhead population cannot therefore be determined at this time.

Riparian Corridor Improvements. The cost of excluding cattle from the 6.5-mile area studied as part of the ACWRS was estimated to be about $136,000 in 1993 dollars, and included 10 years of fence repair costs (SFWD 1993b). At present, this cost may reasonably be expected to be $[**needed from SFPUC**] in 2002. The cost of providing water releases to the restoration area was not included in this estimate though provision of flows was part of the revegetation studies' analysis.

Steelhead Run Supplementation. The costs associated with *O. mykiss* collection, rearing and release are not estimated here as a supplementation plan has not yet been developed.

6. Monitoring and Assessment

Conceptual Monitoring Program

Monitoring various aspects of a potentially-restored steelhead population and its habitat will allow the Workgroup to measure progress toward restoration goals as well as to change on-going procedures to improve their success. The Alameda Creek steelhead restoration process offers a valuable opportunity to compare "pre-project" conditions where anadromous fish do not contribute to the *O. mykiss* population in the watershed to a possible "post-project" state including a viable population of ocean-maturing individuals. The monitoring program itself should be adaptable to accommodate new management objectives or information requirements.

Monitoring proposed in the context of this *Plan* should lead to a reasonable understanding of the factors limiting a future Alameda Creek steelhead population. Suggested actions and parameters for study are based on the Workgroup's understanding of the necessary steps for establishing a viable population and minimizing "take." Other goals, such as maximizing population size, creating a fishery or conducting scientific research could be considered in the future and could entail additional monitoring and assessment activities.

The monitoring program for the Alameda Creek watershed would have two parts: a pre-project assessment and post-project monitoring. For the purposes of this *Plan*, the "project" is the combination of activities that are expected to result in steelhead access to upper watershed areas suitable for completion of the steelhead life cycle. Specifically, these activities include:

- Barrier removals/modifications;
- Fish screen installations;
- Water management for migration;
- Water management for habitat improvement;
- Riparian corridor improvement; and
- Steelhead supplementation

"Project areas" to be monitored consist of the parts of Alameda Creek and its tributaries that will be affected by these activities. For example, the project area affected by providing out-migration flows is the portion of Alameda Creek downstream of the particular water release point. Affected areas are delineated for each monitoring component.

The conceptual monitoring program comprises the following efforts, with post-project monitoring actions ascribed to each of the major restoration activities.

I. <u>Pre-Project Assessment</u>. This goal of this assessment is to describe baseline conditions concerning habitat and channel types, fish species, riparian communities and water quality as appropriate for the various project areas. Much of the information discussed here may be available from previous studies or on-going data collection programs sponsored by ACFCWCD, ACWD, DFG, EBRPD and SFPUC. The factors to be measured and conceptual monitoring locations are as follows:

Flood Control Channel. This reach serves as migratory habitat and should be described in terms of its ability under current conditions to provide steelhead passage. Critical passage areas should be identified to act as surrogates for overall passage conditions in the Flood Control Channel. Stage-discharge relationships should be determined for these sites so that acceptable migration period flow levels can be established, and the flow regime should be recorded. Photographs should be taken of the areas immediately surrounding the barriers to be modified by the project.

Niles Canyon. Portions of this reach may serve as spawning and rearing habitat, indicating that baseline habitat conditions should be assessed. These conditions include:

- Aquatic species, abundance indices, age structure and distribution;
- Channel and habitat types;
- Spawning substrate availability and fine sediment composition; and
- Flow and temperature regimes (CDFG 1998).

Pre-project conditions with respect to the Niles and Sunol Dam Removals project have been characterized in a previous study (SFPUC 2000). Photographs of the areas adjacent to Niles and Sunol Dams should be taken before construction on the project begins.

Protocols for the inventory and sampling procedures listed above are available in DFG's *California Salmonid Stream Habitat Restoration Manual* (1998). Fisheries sampling should be conducted at representative locations to be used in "post-project" monitoring and should record size (length and weight) and condition of individuals. Due to the ESA status of *O. mykiss*, fish sampling should employ non-capture methods whenever possible. These include stream bank (above water) observation and direct (underwater) observation. Macro-invertebrates should be identified to the lowest taxonomic level practicable and enumerated. Temperature data should be assembled covering a minimum one year period to determine seasonal variation and the influence of instream flow.

Sunol Valley. This reach will serve as a migratory corridor during winter and spring months. Therefore, baseline flow regimes should be assessed. Particular focus should be placed on the "surcharge" water necessary to produce channel (surface) flow throughout the reach by recording the flow regime immediately upstream. Photographs of the areas adjacent to the PG&E gasline crossing should be taken, as well as representative photographs or other documentation showing instream and riparian conditions in areas damaged by cattle.

Upper Alameda Creek. Since this area comprises the majority of available spawning and rearing habitat in the watershed, baseline habitat and fishery conditions should be assessed as described above for Niles Canyon. Thus, aquatic organisms including fish and macro-invertebrates should be sampled, and baseline temperature data should be assembled. Again, much of this information will have been produced by on-going SFPUC studies. Also, a 1996 DFG stream inventory was performed for the area between the SVWTP and the Alameda Creek/Calaveras Creek confluence(CDFG 1996). The area to be assessed should include the approximately eight-mile reach between the Sunol Valley and ACDD. Sites representing this reach should be selected and used in later "post-project" sampling. Documentation of areas subject to riparian corridor improvements (e.g., cattle exclusion) should be performed for comparison over time.

Arroyo de la Laguna. The Arroyo Mocho tributary has been identified as providing the best habitat opportunities for a potentially restored steelhead population in the Arroyo de la Laguna catchment. Baseline monitoring consisting of the same methods proposed for Niles Canyon and Upper Alameda Creek should be performed in potential habitat areas of Arroyo Mocho. Also, pre-project conditions should be documented in the areas surrounding the Arroyo Mocho Drop Sructure and the Arroyo Mocho Road Crossing.

II. Post-Project Monitoring. This portion of the monitoring program would track both the effects and performance of restoration actions such as barrier modifications and screen installations, and would evaluate changes to the *O. mykiss* population and habitat from newly-established flow conditions over time.

Flood Control Channel. The completed §1135 projects should be documented with the following information: project locations; "as built" drawings, photos or descriptions; project performance objectives; and costs. "Project Site Completion Forms" should be prepared for each structure and submitted to DFG. Sample forms and instructions for completing the forms are included in the *California Salmonid Stream Habitat Restoration Manual*.

The projects should be evaluated after enduring at least one, but not more than three, winter's high flows (CDFG 1998). Evaluation should be performed by an independent party and is intended to detect and correct conditions requiring modification or maintenance. This effort should be in addition to regular maintenance and reporting arranged by the project sponsors for proper functioning of the fishways and fish screens. Again, a form (i.e., "Individual Structure or Site Form") and instructions for this work are available in the *California Salmonid Stream Habitat Restoration Manual* and should be submitted to DFG when complete.

Information generated by fish counting procedures at fishways would be extremely useful in evaluating the success of the overall restoration program for Alameda Creek steelhead. While protocols for assembling quantitative fish passage data, including monitoring period, counting method (e.g., visual, electronic, sampling, etc.) and others have not been determined, the design of passage structures offers the opportunity to incorporate video monitoring or other convenient measures into the monitoring program. The sampling methodology should be be in place prior to the first "post-project" migration season.

Niles Canyon. The same types of information should be generated for the Niles and Sunol Dam Removals project as for the §1135 projects described above. In addition, post-project monitoring should be performed in the area downstream of Niles Dam to determine the effects on aquatic habitat of sediment mobilized by the dam removal. (Sediment removal prior to dam removal has been recommended for the Sunol Dam project.)

Since Niles Canyon contains potential spawning and rearing habitat for steelhead, the fish community in this reach and the Upper Alameda Creek reach should be assessed during at least a five-year "post-project" monitoring period. Parameters to be measured for this program should include fish population characteristics, summer water temperature, winter and spring flow regimes, and macro-invertebrate communities (i.e., food supply) at selected locations. The fish population should be evaluated in terms of distribution and abundance, age class structure, fish size (i.e., length and weight) and health of individuals. Standardized sampling protocols and locations should be used to allow for comparability of results over time. Again, fish sampling should be non-destructive due to the sensitive status of the target species.

Sunol Valley. The PG&E Gasline Crossing modification project would be documented according to the protocols listed above for other barrier removals/modifications. As this reach represents a potentially important migratory corridor for steelhead, post-project monitoring would focus on the flow regime (i.e., quantity and seasonal occurrence of surface flow) after implementation of an upstream "fish flow" release schedule. Finally, the condition of riparian and instream areas previously impacted by cattle use should be periodically examined to determine the effectiveness of exclusion measures.

Upper Alameda Creek. Post-project monitoring in this reach will track aquatic habitat enhancement resulting from providing instream flows. In particular, over-summer water temperatures should be measured as well as the spawning period flow regime, as these factors have been identified as limiting to the success of a trout fishery in Upper Alameda Creek. Quantifying the amount of spawning habitat available under the initial release schedule will allow comparison with the value predicted by pre-project (IFIM or other) modeling. Releases may then be modified to match restoration targets. Also, the response of riparian areas where cattle have been excluded should be noted in this reach as in the affected portions of Sunol Valley.

Fish population characteristics as described above for the Niles Canyon reach should be determined during a minimum five-year "post-project" monitoring period. These include distribution and abundance, age class structure, size and health of individuals. Macro-invertebrate community sampling will allow tracking of the response of the reach to the newly-established flow regime as well as providing an indication of food availability.

Arroyo de la Laguna. The Arroyo Mocho Drop Structure and Arroyo Mocho Road Crossing projects would be documented according to the protocols listed above for other barrier removals/modifications.

Monitoring associated with each restoration activity in each reach will produce information that should be used to change management actions when needed. This adaptive management strategy will improve both the effectiveness and efficiency of on-going restoration actions, particularly those related to providing flows for habitat improvement. This *Plan* assumes that continued refinement of management efforts will be necessary to realize both natural resources and water supply goals in the watershed.

Other Valuable Future Studies

Re-Graded Channel Conceptual Design/Feasibility Study. Further efforts are needed to evaluate this alternative to installation of a fishway at the BART weir/Middle Inflatable Dam. Preliminary calculations indicate that sufficient length exists within the current channel configuration to allow for re-grading of the channel to meet fish passage goals. A conceptual design and feasibility study of the Re-Graded Channel alternative would allow for a meaningful comparison to the fishway project in terms of cost and effectiveness.

The study's first step would consist of evaluating stable channel design characteristics that allow for fish passage while meeting flood control objectives. A conceptual design would then be developed that addresses channel design objectives including fish passage, slope stability (and pier scour protection), flood carrying capacity and sediment transport. Feasibility analysis would address the ability of the re-graded channel to meet flood protection requirements of the ACFCWCD and pass the required sediment loads. Flood evaluation would be accomplished by modeling the restored channel, with final details of flood modeling developed through consultation with ACFCWCD and other interested parties. Channel velocities and scour depths within the re-graded channel would be analyzed and used to evaluate impacts to the existing pier footings.

Finally, a report would be prepared describing the results of the conceptual design/feasibility study with sufficient detail to allow the USACE to continue the evaluation within the §1135 program. The cost of developing a conceptual design and feasibility study including HEC flood modeling has been estimated to be between $40,000 and $55,000. The study could be completed in approximately four months (FarWest 2002).

Steelhead Passage. Screening-level analyses of potential barriers to steelhead passage have been performed for the Alameda Creek system that identified the barriers proposed for modification in the *Assessment* and further described in this *Plan*. Additional investigation is recommended, however, to fully address passage issues related to both in- and out-migration of steelhead in main stem Alameda Creek and the major tributaries known to contain potential habitat. This study would achieve the following goals:

- Locate critical passage impedances and barriers existing under low flow conditions;
- Identify flow regimes that allow for passage through critical sections;
- Recommend modifications to impedances and barriers in addition to those already described by the Workgroup; and
- Prioritize projects based on potential increases in steelhead spawning and rearing habitat availability.

Potential barriers would be surveyed and evaluated over a series of flow conditions to estimate discharge requirements to achieve steelhead passage. Such estimates would be based on standardized protocols established by DFG and NMFS, as well as information from scientific literature concerning fish passage. Information generated by this study would be used to evaluate the effects of alternative water management operations on steelhead migration.

Based on preliminary estimates, this study could be completed within a period of about one and one-half years cost of approximately [**needed from consultant**]. The study would likely be performed under a joint agreement between ACWD the SFPUC.

Hydrologic/Geomorphologic Analysis. Substantial amounts of data regarding Alameda Creek flows are available from USGS gaging stations, SFPUC records and other sources. However, such information has not necessarily been analyzed or presented in a comprehensive manner consistent with the goals of restoring a steelhead fishery in the watershed. Specifically, a hydrologic analysis is recommended to accompany current planning efforts that would address, at a minimum, the following topics:

- flood-frequency curves at locations with proposed fishway installations to inform design capacity;
- historical spring season stream discharge patterns to inform possible operational modifications at diversion facilities to account for migration;

- identification of potential flow-related passage barriers in main stem Alameda Creek;
- hydrology of "dry year" and "wet year" conditions to address frequency and volume of possible out-migration flow provisions;
- recession rates for hydrologic events analyzed to inform ramping rate schedules for managed flow changes in Alameda Creek;
- annual discharge estimates to inform possible water rights discussions including in-stream flow availability; and
- estimates of upper Alameda Creek watershed flows necessary for fish passage in lower Alameda Creek (i.e., channel and other gains/losses).

A hydrologic analysis would help answer on-going concerns related to flows necessary to develop a self-sustaining steelhead fishery in the watershed while maintaining existing beneficial uses. Such a study could lead to identifying potential water storage and delivery options to satisfy multiple objectives for the watershed.

High winter flows are important for maintaining stream channel characteristics and particularly for maintaining adequate substrate for spawning. As the natural hydrograph of Alameda Creek has been substantially altered by water management in the upper watershed, key stream attributes (e.g., substrate, habitat complexity, etc.) have been changed in ways that may limit the potential productivity of a restored steelhead population. Evaluation of channel-shaping flows should be performed with the goal of maintaining important channel features as part of the proposed hydrologic/geomorphic study for the watershed.

Based on preliminary estimates, this study could be completed within a period of about [**needed from consultant**] at a cost of approximately [**needed from consultant**].

Habitat Opportunities Assessment. Fisheries studies are on-going or expected by ACWD, the Corps and SFPUC to inform restoration planning. These efforts will help characterize the extent and quality of steelhead habitat in the watershed, and will lead to implementation of several key projects listed in this *Plan* as essential to re-establishing a viable steelhead run. Monitoring will further describe the condition of habitat areas into the future.

A comprehensive assessment of the Alameda Creek watershed for steelhead habitat opportunities will not have been performed as part of the process of implementing the actions listed in this *Plan*. Such a study is therefore recommended for Workgroup attention in the future. In particular, lands not owned or managed by Workgroup members, or not previously surveyed in detail, should be assessed to identify additional opportunities for habitat restoration. The initial selection of survey areas should be based on collective knowledge of the watershed possessed by Workgroup members. The owners of land potentially having high-value habitat characteristics should be contacted for interest in cooperating with such surveys.

The *Habitat Opportunities Assessment* would use guidelines outlined in the California Salmonid Stream Restoration Manual (CDFG 1998). Surveys would include standardized habitat inventory and fish sampling methods that could be performed by a variety of trained participants including agency staff, volunteers, Workgroup members and others leading to production of a watershed-scale information database. Survey results would then be analyzed to determine appropriate treatments of upslope, riparian and instream areas to address "key" watershed impacts deleterious to fish populations. A prioritized list of restoration actions would be prepared based on the importance of the activity to the overall restoration process and the cost of implementation.

The cost of this assessment can not be determined at present due to incomplete information about the scope of the surveys. However, professionally performed comprehensive habitat surveys, including data analysis and reporting, may be expected to cost about $2,700 per stream mile. The implementation schedule for the project should be developed after an initial meeting concerning the geographic scope of the evaluation.

Activity Name	2002	2003	2004	2005
Flood Control Channel: §1135 Projects				
Planning and Environmental Review				
Plans, Specifications and Cost Sharing				
Construction				
Flood Control Channel: non-§1135 Projects				
Planning and Environmental Review				
Plans, Specifications and Funding				
Construction				
Niles and Sunol Dam Removal				
Planning and Environmental Review				
Construction				
PG&E Gasline Crossing				
Planning and Environmental Review				
Construction				
Arroyo Mocho Drop Structure				
Planning and Environmental Review				
Construction				
Arroyo Mocho Road Crossing				
Planning and Environmental Review				
Construction				
Outimigration Flow Schedule				
Negotiation				
Implementation				
Spawning and Rearing Flow Schedule				
Negotiation				
Implementation				
Sunol and Upper Alameda Creek Riparian Corridor Improvements				
Planning and Funding				
Construction				
Steelhead Supplementation				
Studies, Planning, Environmental Review, Propagation				
Release				

Table 5-1. Implementation Schedule for Restoration Actions

Table 5-2. Preliminary cost estimates for Alameda Creek steelhead restoration capital investment projects.

Restoration Action	Preliminary Cost Estimate
§1135 Projects	$6,250,000
Non-§1135 Projects	3,650,000
Niles and Sunol Dam Removal	3,250,000
PG&E Gasline Crossing[1]	750,000
Arroyo Mocho Drop Structure[2]	500,000
Arroyo Mocho Road Crossing[2]	500,000
Riparian Corridor Improvements[3]	136,000
Total Cost	$15,036,000

Notes: [1]Based on 1:1 ratio of construction: planning and oversight costs and PG&E construction cost estimate.
[2]Based on anticipated project scale in relation to other *Plan* projects.
[3]Estimate from SFWD 1993b in 1993 dollars.

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Appendix I: Re-Graded Channel Conceptual Design/Feasibility Study Proposal

Further efforts are needed to evaluate the Re-Graded Channel alternative to installation of a fishway at the BART weir/Middle Inflatable Dam. Preliminary calculations indicate that sufficient length exists within the current channel configuration to allow for re-grading of the channel to meet fish passage goals. A conceptual design and feasibility study of the Re-Graded Channel alternative would allow for a meaningful comparison to the fishway project in terms of cost and effectiveness. Major components of the study are described below, as well as a preliminary study cost estimate.

The study's first step would consist of evaluating stable channel design characteristics that allow for fish passage while meeting flood control objectives. The following sources would be used:

> Review of Existing Information. Measurements from previous studies, reports, maps and field surveys would be reviewed and compiled to determine fill volumes required to achieve channel slopes, and locations of critical structures.
> Regional Curves. The Dunne and Leopold regional curve (modified) would be used to determine stable channel dimensions and associated available floodplain within the available right of way.

A conceptual design would then be developed that addresses channel design objectives including fish passage, slope stability (and pier scour protection), flood carrying capacity and sediment transport. The channel re-grading would be accomplished by determining the lowest slope that matches existing grades at the lower and upper ends of the project area and laying out the restored channel that best meets the stable channel design characteristics. The conceptual design would contain the following elements:

- Elevation profile and cross-section drawings of the restored creek channel that meet the design objectives and the stable channel characteristics to the extent possible;
- Plan view of the re-graded channel showing the stable channel and associated floodplain as well as the anticipated channel thalwag;
- Estimates of average channel velocities using the Mannings Equation and assumed channel roughness factors;
- Earthwork quantities and locations of cut and fill;
- Description of stable channel dimensions and a discussion of areas where restoration of stable channel dimensions is not possible and therefore, hardening of the channel banks (through bioengineering or other methods) may be required;
- Evaluation of erosive forces at critical structures such as bridge piers;
- Typical details of proposed channel bank treatments;
- Description, location and typical details for in-stream “fish friendly” channel grade control structures such as rock weirs (at riffle sections) or Newbury weirs;
- Preparation of cost estimate of final design, permitting and channel construction costs; and
- Evaluation of permitting requirements.

Feasibility analysis would address the ability of the re-graded channel to meet flood protection requirements of the ACFCWCD and pass the required sediment loads. Flood evaluation would be accomplished by modeling the restored channel with the latest version of HEC-RAS (version 3.0). Flood control staff and the conceptual design consultant would determine the exact layout and details of the channel HEC-RAS model runs, including flood flows provided by others (developed by HEC-HMS or similar methods). Steady-state flood flow water levels would be developed and mapped to assess if the restored channel would provide sufficient flood protection through the re-graded reach. In addition, the new version of HEC-RAS would allow for the modeling of unsteady-state flow. Final details of flood modeling would be developed through consultation with ACFCWCD and other interested parties.

Pier scour would be evaluated by the routines within HEC-RAS supplemented by analytical evaluations at critical points. Channel velocities and scour depths within the re-graded channel would be analyzed and used to evaluate impacts to the existing pier footings.

The sediment competency evaluation would involve calculation of average channel shear stress using mean channel velocities and determination of the ability of the channel to transport the D50 and D84 of the channel particle size using the Shields curves. Bedload size and material information would be provided from current studies (by the USGS). Sediment analyses above and beyond these methods (such as SAM modeling or HEC-6) could be performed if requested and would be contracted at a later time.

Finally, a report would be prepared describing the results of the conceptual design/feasibility study with sufficient detail to allow the USACE to continue the evaluation within the §1135 program. The cost of developing a conceptual design and feasibility study including HEC flood modeling has been estimated to be between $40,000 and $55,000. The study could be completed in approximately four months (FarWest 2002).