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Draft Anadromous Fish Restoration Plan

A Plan to Increase Natural Production of Anadromous Fish in the Central Valley of California

December 6, 1995

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DRAFT ANADROMOUS FISH RESTORATION PLAN

A PLAN TO INCREASE NATURAL PRODUCTION OF ANADROMOUS FISH IN THE CENTRAL VALLEY OF CALIFORNIA

Prepared for the Secretary of the Interior by the
United States Fish and Wildlife Service with assistance from
the Anadromous Fish Restoration Program Core Group
under authority of the Central Valley Project Improvement Act.

December 6, 1995

PREFACE

The Central Valley Project Improvement Act (CVPIA) directs the Secretary of the Interior to develop and implement "a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991" (Section 3406(b)(1)). This document is the plan for the program being developed to satisfy this directive. The program is known as the Anadromous Fish Restoration Program (AFRP).

This plan describes criteria used to make an initial determination of reasonableness of the restoration actions being considered for inclusion in this plan. These criteria included consideration of potential adverse economic and social impacts, public sentiment, the magnitude of benefits, the certainty that an action will achieve the projected benefits, and the authority established by existing laws and regulations. Public comments were, and will continue to be, particularly valuable in addressing reasonableness.

The restoration plan provides a list of actions considered by the USFWS to be reasonable, and identifies those that are underway or likely to be implemented in 1996. The plan also describes a process to implement actions. Implementation will be a lengthy process and substantial progress toward doubling production will take time. Because doubling natural production would require actions that may be considered unreasonable, the program will likely fall short of doubling production of some species and races of anadromous fish.

The AFRP will use all the authority and resources provided by the CVPIA to restore anadromous fish and will rely heavily on local involvement and partnerships with property owners, watershed workgroups, public and private organizations, county and local governments, and state and federal agencies. The AFRP will coordinate restoration efforts with those by other groups, such as CDFG, Category III of the Bay-Delta Agreement, and the CALFED Bay-Delta Program. Successful implementation of this restoration plan will depend on the continued participation of the public and interested parties and support of involved state and federal agencies.

ACKNOWLEDGMENTS

The Anadromous Fish Restoration Plan is the responsibility of the USFWS as the lead agency for the AFRP. The USFWS thanks the AFRP's Core Group, including Randy Brown of the California Department of Water Resources, Jim Bybee of the National Marine Fisheries Service, Susan Hatfield and Bruce Herbold of the Environmental Protection Agency, Ken Lentz of the United States Bureau of Reclamation, and Terry Mills of the California Department of Fish and Game, and Technical Teams. However,

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this plan does not commit any Core Group members' agency to implement any of the actions noted herein. The USFWS thanks the staffs at the Central Valley Fish and Wildlife Restoration Program, including Roger Dunn, Roger Guinee, Andy Hamilton, Jim McKevitt, and Larry Puckett; and the Sacramento-San Joaquin Estuary Fishery Resource Office, including Pat Brandes, Dan Castleberry, Kathy Corbin, John Icanberry, Marty Kjelson, Yvette Leatherman, Sam Lohr, Rick Morat, Gary Rensink, and John Wullschleger; for their contributions toward completion of this plan. The USFWS also thanks the many public and private organizations and individuals that took time to help prepare this plan by attending public workshops, meeting on a local watershed or interest level, or writing or calling to voice their concerns.

SUMMARY

On October 30, 1992 President Bush signed into law the Reclamation Projects Authorization and Adjustment Act (Public Law 102-575), including Title XXXIV, the Central Valley Project Improvement Act (CVPIA). The CVPIA amends the authorization of the Department of the Interior's Central Valley Project (CVP) to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic uses, and fish and wildlife enhancement as a purpose equal to power generation.

Section 3406(b)(1) of the CVPIA directs the Secretary of the Interior (Secretary) "to develop and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991". This restoration plan was developed to work toward the above goal. This program is known as the Anadromous Fish Restoration Program (AFRP).

The six anadromous fish species identified for restoration efforts under the AFRP are chinook salmon, steelhead, striped bass, American shad, white sturgeon, and green sturgeon. Populations of these fish have declined to such low levels that several species or races may be in danger of extinction. At present, winter-run chinook salmon are listed as endangered under the federal Endangered Species Act, and all other races of chinook salmon and steelhead have been petitioned for listing.

Doubling natural production will require many efforts, some of which may be unreasonable. Because the AFRP will include only reasonable efforts, it will likely fall short of doubling production of some species and races of anadromous fish. However, the AFRP is a major opportunity for the U.S. Fish and Wildlife Service (USFWS) and U.S. Bureau of Reclamation (USBR) to collaborate with other agencies, organizations and the public to increase natural production of anadromous fish in the Central Valley. In large part, this will be accomplished by augmenting and assisting restoration efforts conducted by local watershed workgroups, the California Department of Fish and Game (CDFG), and others.

Six objectives are important in achieving the program goal:

- Improve stream habitat for all life stages of anadromous fish through improved flows, water quality, and physical structure;
- Improve survival rates by reducing or eliminating entrainment of juveniles at diversions;
- Improve adult escapement rates by modifying barriers that impede migration;
- Develop fish population and habitat data to facilitate evaluation of restoration actions;

- Integrate habitat restoration efforts with harvest and hatchery management; and
- Involve partners in the implementation and evaluation of restoration actions.

The AFRP will employ methods that include partnerships, local involvement, public support, adaptive management, and flexibility to implement actions. Of particular importance is the formation of partnerships, without which the program goal cannot be achieved. The USFWS and USBR will involve the public as much as possible in planning and implementing restoration actions.

Actions included in this plan came from recommendations to the USFWS, the AFRP Working Paper, CDFG's documents "Restoring Central Valley Streams: A Plan for Action" and "Status of Implementation", and the Bay-Delta Agreement's Category III process.

An important provision of the CVPIA is that the AFRP "makes all reasonable efforts" to double natural production. To select reasonable actions, the AFRP considered potential adverse economic and social impacts, public sentiment, the magnitude of benefits, the certainty that an action will achieve the projected benefits, and the authority established by existing laws and regulations.

The tools available to the Secretary to achieve the goal of the AFRP include all sections of the CVPIA and cooperation with entities that have the authority, interests, or resources to facilitate restoration.

Because resources are limited, an attempt will be made to implement high-priority actions first. To establish priority, watersheds were prioritized, then types of actions were prioritized within each watershed. Watershed priority considered capacity for improvement, presence of special status species, and the ability of the Secretary to facilitate restoration. Action priority considered the contribution to increasing production and restoring natural habitat. These priorities will guide efforts of the AFRP, but will not prevent collaboration on actions developed by partners independent of these priorities.

The AFRP will use adaptive management to address uncertainty about the effects of restoration actions. Adaptive management involves monitoring initial actions to evaluate their effectiveness, then using the information to modify the actions to improve their benefits. Monitoring is needed to obtain data on anadromous fish production and habitats to evaluate the effects of restoration actions. Adaptive management is essential to making the most efficient use of scarce resources.

A total of 176 actions and 109 evaluations are identified. Of these, 57 actions and 30 evaluations have high potential for implementation during FY 1996.

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INTRODUCTION

Congress directed the Secretary of the Interior (Secretary) to develop and implement a program which makes all reasonable efforts to restore and enhance anadromous fish habitat in the rivers and streams of California's Central Valley (excluding the San Joaquin River upstream of Mendota Pool), with the overall target of doubling the natural production of anadromous fish relative to the average levels attained during 1967-1991 (Section 3046(b)(1) of the Central Valley Project Improvement Act (CVPIA); Public Law 102-575). The Secretary directed the U.S. Fish and Wildlife Service (USFWS) and the U.S. Bureau of Reclamation (USBR) to jointly implement the CVPIA, including Section 3406(b)(1), which has become known as the Anadromous Fish Restoration Program (AFRP). The six anadromous fish species identified for restoration efforts under the AFRP are chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), striped bass (*Morone saxatilis*), American shad (*Alosa sapidissima*), white sturgeon (*Acipenser transmontanus*), and green sturgeon (*A. medirostris*). This restoration plan presents the goals, objectives, and strategies of the AFRP; describes processes the program will use to identify, develop, select, and implement restoration actions; and lists actions and evaluations initially determined reasonable to implement in the near future.

PROBLEM

Since settlement of the Central Valley in the mid-1800s, populations of native anadromous fishes (i.e., chinook salmon, steelhead, white sturgeon, and green sturgeon) have declined dramatically. Declines have been so dramatic that several species may be in danger of extinction. At present, winter-run chinook salmon are listed as endangered under the federal Endangered Species Act, and all other races of chinook salmon and steelhead have been petitioned for listing.

American shad and striped bass were introduced into the Sacramento-San Joaquin system in the 1870s. Both species supported valuable sport and commercial fisheries throughout much of this century, but California Department of Fish and Game (CDFG) data indicate that populations have declined since the mid-1960s.

Habitat degradation is the primary cause of these declines. Hydraulic mining for gold was the first human activity that resulted in large-scale habitat degradation due to sedimentation and diversion of water in many Central Valley streams. Hydraulic mining was prohibited in 1894, but habitat degradation has continued. Habitat quantity and quality have declined due to construction of levees and barriers to migration, modification of natural hydrologic regimes by dams and water diversions, elevated water temperatures, and water pollution. Although the effects of habitat degradation on fish populations were evident by the 1930s, rates of decline for most anadromous fish species increased following completion of the major water project facilities.

Other factors that may have adversely affected natural stocks of anadromous fish include overharvest, hatchery production, and introduction of competitors, predators and diseases. Fish populations may also vary due to natural events. Droughts and poor ocean conditions, such as El Niño, may reduce populations. However, populations in healthy habitats typically recover within a few years after natural events. The decline of fish populations has continued through cycles of beneficial and adverse natural conditions, indicating the need to improve habitat.

VISION

The AFRP is an opportunity for the USFWS and USBR to collaborate with other agencies, organizations and the public to increase natural production of anadromous fish in the Central Valley by augmenting and assisting restoration presently conducted by local watershed workgroups, the CDFG, and others. Purposes of the CVPIA (Section 3402) relevant to the AFRP are:

- To protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley;
- To address impacts of the Central Valley Project (CVP) on fish, wildlife, and associated habitats;
- To improve the operational flexibility of the CVP;
- To contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay and Sacramento-San Joaquin Delta Estuary; and
- To achieve a reasonable balance among competing demands for the use of CVP water, including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors.

GOALS

The goal of the AFRP, as stated in section 3406(b)(1) of the CVPIA, is to "develop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991".

During the first phase of this program, the USFWS released the Working Paper on Restoration Needs (USFWS 1995), which included estimates of target levels of long-term, average production for four races of chinook salmon, steelhead, striped bass, American shad, and white and green sturgeon. Production is defined in Appendix A as the number of fish recruited to the adult population, including those harvested. Estimates of target production levels are summarized in Table 1.

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Table 1. Target production levels for anadromous fish in Central Valley rivers and streams.

Species	Target
Chinook salmon, all races[a]	990,000
Fall run	750,000
Late-fall run	68,000
Winter run	110,000
Spring run	68,000
Steelhead[b]	13,000
Striped bass[c]	2,500,000
American shad[d]	4,300
White sturgeon	11,000
Green sturgeon	2,000

[a] Appendix B lists production targets for each race of chinook salmon for each of the streams in the Central Valley. Because of rounding errors, targets for individual races of chinook salmon do not add up to the target for all races.
[b] Production target for steelhead spawning upstream of Red Bluff Diversion Dam.
[c] Production target for striped bass is expressed as the abundance of adult striped bass.
[d] Production target for American shad is expressed as the juvenile index as derived from the CDFG fall midwater trawl in the Delta.

The Working Paper also included a list of restoration actions, that, if implemented, would likely result in at least doubling the natural production of anadromous fish. The Working Paper did not consider whether the actions were reasonable.

Since the Working Paper was released, the USFWS has received comments that some of the actions are not reasonable. To address these comments, the USFWS has adopted an incremental approach. Initially, restoration will be restricted to actions that the USFWS and USBR are authorized to implement under the CVPIA or other reasonable actions identified and supported by the public. Doubling production by implementing a

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reasonable set of actions is far less certain than if all the actions were implemented, but it may still be possible to double production for some species and streams. For example, doubling production of fall-run chinook salmon in a small tributary of the upper Sacramento River may be relatively easy, whereas doubling production of striped bass will likely be difficult because all life history stages depend on the Delta, where effective action may be considered unreasonable.

We will only know for sure whether production can be doubled after it has been doubled. This is partly why monitoring and evaluating are important throughout the implementation process. Implementation of additional actions will depend on results of implementing initial actions and on the ability of the USFWS and USBR to work with the public to develop and implement solutions to the problems that limit natural production.

OBJECTIVES

Six general objectives need to be met to achieve the program goal:

- Improve stream habitat for all life stages of anadromous fish through improved flows, water quality, and physical habitat;
- Improve survival rates by reducing or eliminating entrainment of juveniles at diversions;
- Improve adult escapement rates by modifying barriers that impede migration;
- Develop fish population and habitat data to facilitate evaluation of restoration actions;
- Integrate habitat restoration efforts with harvest and hatchery management; and
- Involve partners in the implemention and evaluation of restoration actions.

STRATEGIES

Fishery managers must address complex biological, economic, social, and technological issues to substantially restore natural production of anadromous fish in the Central Valley. Restoration will be costly and require changing the way aquatic resources and habitats are managed. Because the challenge is great, the AFRP requires solid strategies to select and implement effective restoration actions.

The AFRP strategies consist of two components, implementation *principles* and an implementation *approach*. Implementation principles are the tenets guiding selection and prioritization of actions. The implementation approach describes essential qualities of restoration actions and how they may be implemented.

Implementation principles

Restoration actions will be selected and prioritized based on the magnitude of the contribution to doubling natural production, the status of target species and races, and on Section 3406(b)(1)(A) of the CVPIA, which directs the AFRP to give first priority to:

- Measures which protect and restore natural channel and riparian habitat values through habitat restoration actions;
- Modifications to Central Valley Project operations; and
- Implementation of the supporting measures mandated by subsection 3406(b) of the CVPIA.

These principles are discussed below.

Contribution to natural production

Placing priority on actions that result in large increases in natural production by addressing primary limiting factors will most efficiently contribute to meeting target production levels.

Species status

Placing priority on actions that benefit species and races with the greatest need for restoration will help maintain the genetic diversity of anadromous fish in the Central Valley. Maintaining genetic diversity will help ensure that natural production will be sustainable on a long-term basis.

Winter-run chinook salmon are listed as endangered under the federal Endangered Species Act. Spring-run, late-fall-run, and fall-run chinook salmon in the Sacramento River and Delta tributaries, fall-run chinook salmon in the San Joaquin basin, and steelhead are potential candidates for threatened or endangered status (NMFS 1994 and 1995). White sturgeon, green sturgeon, striped bass and American shad have suffered recent declines.

Restoring natural habitat values

Restoring habitat values promotes natural processes regulating the geomorphic characteristics, nutrient dynamics, and production capabilities of streams. These processes ultimately influence the ability of both the physical and biological components of the ecosystem to resist declines in habitat structure or production and to recover after a perturbation, thus contributing to long-term sustainability of natural production.

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Modifying CVP operations

Placing priority on modifying CVP operations will directly help minimize impacts on fish, wildlife, and associated habitats; help balance competing demands for the use of CVP water, including the requirements of fish and wildlife; and will focus restoration efforts where the Secretary has the authority to be most effective.

Implementing supporting measures in the CVPIA

Placing priority on implementing the supporting measures mandated by subsection 3406(b) of the CVPIA focuses restoration efforts where the Secretary has the authority to be most effective.

The implementation principles can be used to compare actions that address a common limiting factor as well as to compare actions that address different limiting factors within a watershed. In applying these principles, the AFRP will support actions that contribute to increasing the natural production of anadromous fish through restoration of natural habitat values before supporting actions that increase production by other means.

Implementation approach

The AFRP approach to making reasonable efforts to double natural production of anadromous fish will include partnerships, local involvement, public support, adaptive management, and flexibility.

Partnerships

A single entity cannot double natural production of anadromous fish throughout the Central Valley. Partnerships are needed. Voluntary collaborations to achieve mutual goals and objectives will accelerate accomplishments, increase available resources, reduce duplication, encourage innovative solutions, improve communication, and increase public involvement and support through shared authority and ownership of restoration actions. The AFRP will seek partners to facilitate restoration.

Local involvement

The AFRP will encourage local citizens and groups to share or take the lead in implementing restoration actions. Influences on anadromous fish production in specific watersheds are often related to local water management and land use, which are typically controlled by local individuals and groups. Local people may have innovative approaches to solving problems, and may be able to implement those solutions most efficiently. This approach is consistent with "California's Coordinated Regional Strategy

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to Conserve Biological Diversity" (MOU 1991), in which 26 state and federal agencies emphasize regional solutions to regional problems.

The AFRP will encourage local involvement by joining with existing local restoration groups and supporting the formation of new groups.

Public support

Public support is both a product and a prerequisite of partnerships and local involvement. Public sentiment is an indicator of perceived economic and social effects and the reasonableness of restoration actions. Public support for an action will facilitate implementation and attract partners for future actions. The AFRP will seek opportunities for the public to assist in planning and implementing restoration actions.

Adaptive management

The AFRP will employ adaptive management to increase the effectiveness of restoration actions and to address scientific uncertainty. Adaptive management is an approach that allows resource managers to learn from past experiences through formal experiment or by altering actions based on their performance.

Flexibility

Implementation of restoration actions needs to be flexible so that unforseen opportunities can be pursued if they meet the intent of the CVPIA. For example, the AFRP could purchase land from a willing seller if the purchase satisfies a long-term objective, even though the action was not in this plan or was considered a low priority.

IMPLEMENTATION PROCESS

The USFWS and USBR believe that implementing actions through partnership will be the most effective means for success. Partnership development will take time and should take place in the local watershed, with all the interested and involved parties working together. Examples of local watershed partnerships successfully operating in the Central Valley are the Mill Creek Watershed and Deer Creek conservancies. Guidelines for forming local resource conservation partnerships are contained in the "California Coordinated Resource Management and Planning Handbook" (CCRMP 1990).

A local partnership needing CVPIA resources to implement habitat restoration actions consistent with the AFRP should send a request to the Program Manager of the USFWS's Central Valley Fish and Wildlife Restoration Program (CVFWRP) at the address listed in

Appendix C. The USFWS and USBR expect to follow the implementation process discussed below.

SOURCES OF ACTIONS

Actions considered for implementation came from a number of sources. For example, actions have come from the recommendations to the USFWS, the AFRP Working Paper, CDFG's documents titled "Restoring Central Valley Streams: A Plan for Action" (Reynolds et al. 1993) and subsequent "Status of Implementation" report (Mills 1995), and Category III of the Bay-Delta Agreement's list of actions (found on the World Wide Web at http://www.delta.dfg.ca.gov/data/category3/cat3home.html). In addition, USFWS and USBR will continue to consider actions they receive and to solicit action recommendations to address specific problems. Recommendations should be submitted to the Program Manager of the CVFWRP at the address listed in Appendix C, using a format similar to that described in Appendix D.

SELECTING ACTIONS

For any action to be supported by the AFRP, that action must improve natural production of anadromous fish, and must be consistent with the provisions and intent of the CVPIA, as they appear in the CVPIA and in the AFRP Position Paper (Appendix A). Chief among these provisions is that the AFRP "makes all reasonable efforts" to double natural production. The following section describes a process and criteria to determine reasonable efforts.

Process and criteria to determine reasonable actions

The phrase "reasonable efforts" is interpreted to mean actions that will not result in unreasonable costs or impacts. In addition, what is reasonable depends upon the magnitude of benefits, the certainty that an action will achieve the projected benefits, and the authority established by existing laws and regulations.

This section describes the process and presents some evaluation criteria to be used to identify reasonable restoration actions (Figure 1). This will help potential partners initially identify actions that can be implemented to make progress toward doubling natural production of anadromous fish. This process is not meant to replace National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) processes nor to circumvent existing laws and regulations for those actions to which they apply. Many actions initially considered reasonable by criteria in Figure 1 will be subject to NEPA, CEQA or other processes.

Figure 1 displays the multi-step process used to identify reasonable restoration actions. Each of the steps is explained below:

1) Proposed actions must contribute to doubling natural production of anadromous fish, and must be consistent with the provisions and intent of the CVPIA. The basis for applying this criterion is described within the CVPIA and the AFRP Position Paper (Appendix A).

2) Review of scientific and technical information should be separate from consideration of economic and social impacts. AFRP participants should develop and adopt objective criteria that can be used to determine whether the existing information is adequate to proceed with further evaluation and implementation.

3) Reasonable actions must comply with existing laws and regulations. This is affirmed in Section 3406(b), which directs the Secretary of the Interior to "operate the CVP to meet all obligations under state and federal law". Restoration actions that address limiting factors not related to the CVP will also be expected to comply with existing laws and regulations.

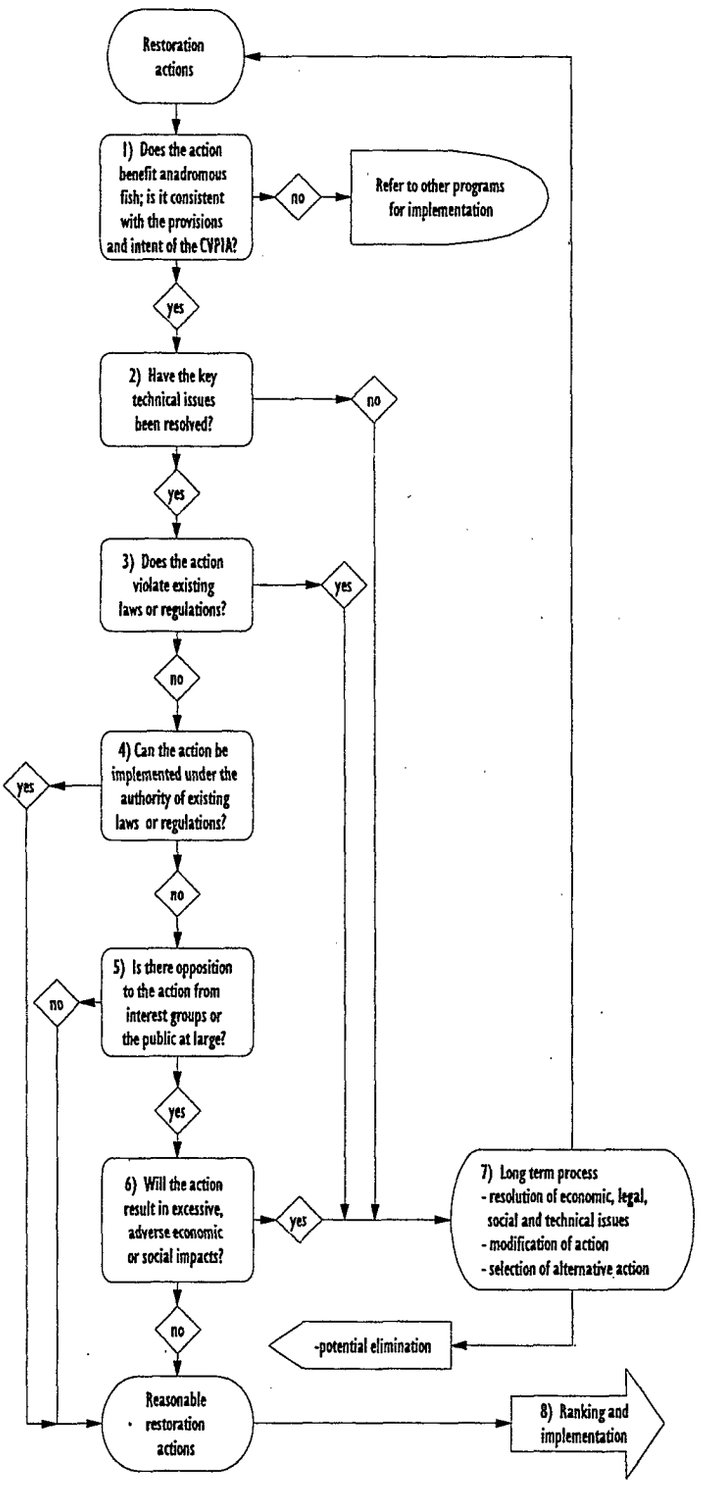

Figure 1. Process and criteria to identify reasonable restoration actions for implementation under the Anadromous Fish Restoration Program (see explanation in text).

4) Actions that are implementable under the authority of existing environmental laws will be considered reasonable. Existing laws were enacted by elected representatives and should reflect what society as a whole believes is reasonable. Existing regulations are assumed to have been developed with the benefit of public review and comment. Within the constraints of a specific law or regulation, it may still be necessary to exercise discretionary flexibility to ensure that actions are implemented in a reasonable manner. Actions that cannot be implemented under the authority of existing laws or regulations will require partners willing to implement the action.

5) Actions that are not strongly opposed by individuals, interest groups or the public at large will be considered reasonable. Lack of strong opposition probably indicates adverse impacts will be minimal. Opposition will be gaged through public meetings, letters received, and through NEPA or CEQA public involvement processes.

6) Actions that do not result in excessive economic or social impacts will be considered reasonable, especially if those actions are supported by the partners most directly affected by the action. Economic and social impacts should be verifiable and should be determined by standard methods agreed to in advance by all participants. Methods established for application under NEPA and CEQA processes will be used as appropriate.

7) Actions that are not identified as reasonable will be deferred for future consideration. These actions could be modified and reevaluated, replaced with alternate actions with similar benefits, or eliminated from consideration. In some cases, actions may become reasonable as a result of changing social and economic factors. Alternate or revised actions will be subjected to the same reasonableness screening process as the original actions.

8) Actions identified as reasonable will be prioritized and implemented, contingent upon available funding and other resources.

Criteria to prioritize reasonable actions

Because resources are not sufficient to implement all reasonable actions simultaneously, an attempt will be made to implement high-priority items first. Priorities will be used to focus initial efforts. Monitoring will provide information to help in reevaluating priority for remaining actions. However, the implementation schedule should be flexible so the AFRP can take advantage of unique opportunities, even if it results in implementing actions that are not the highest priority.

Prioritization criteria primarily include biological considerations, which are derived from the implementation principles described in the strategies section of this plan. In the

following sections, watersheds are prioritized, followed by a list of criteria to prioritize types of actions within each watershed.

Watershed priority

Watersheds are prioritized based on a combination of biological and non-biological factors. Biological factors include the production capacity within each watershed and the presence of species and races of anadromous fish with special status. Information used to prioritize watersheds are summarized in Appendix E.

Watersheds with a high capacity to increase fish production, relative to production during the baseline period, are assigned priority over those watersheds with a lower capacity to increase production. Thus, higher priority is generally placed on watersheds with severely degraded habitat than those with less severely degraded habitat.

Watersheds that support, or have the potential to support species or races of special status are assigned priority over those watersheds that do not.

A non-biological consideration is the ability of the Secretary to facilitate restoration. Because the CVPIA directs the AFRP to address effects of the CVP on anadromous fish and habitat, and provides more tools to the USFWS and USBR to implement restoration actions for such streams and facilities than elsewhere, streams with CVP facilities or flows controlled primarily by the CVP are considered high priority.

The highest priority for restoration is assigned to the Sacramento-San Joaquin Delta because it is highly degraded and all anadromous fish in the Central Valley must pass through it as both juveniles and adults.

A second high priority is assigned to the upper Sacramento River because it provides habitat for endangered winter-run chinook salmon, is the primary area for production of most species and races, and is strongly influenced by operation of the CVP.

A third high priority is assigned to tributaries of the upper Sacramento River, especially Clear, Battle, Butte, Deer, and Mill creeks. These streams have high potential for production of spring-run chinook salmon and steelhead, and for promoting genetic diversity.

A fourth high priority is assigned to the tributaries of the San Joaquin River, because fall-run chinook salmon there may be distinct from fall run in the Sacramento River, production of San Joaquin fall-run chinook salmon often falls to very low levels, and the tributaries are highly degraded.

Action priority

Criteria to prioritize actions within a watershed involve determining primary limiting factors to fish production. Limiting factors have been identified in the Working Paper (USFWS 1995) and through substantial comments and data supplied by various groups.

All AFRP actions address limiting factors. In general, actions score high if they promote natural channel and riparian habitat values and natural processes, such as those affecting stream flow, water temperature, water quality, and riparian areas. Actions score medium if they affect emigration or access to streams, such as sites of entrainment into diversions and migration barriers. Depending on the watershed, factors associated with fish access to habitat, rather than habitat quality, may be identified as the primary limiting factors. In these instances, actions relating to fish passage may be assigned high priority. Actions score low if they do not directly affect habitat, such as hatchery practices, harvest regulations, and law enforcement.

IMPLEMENTING ACTIONS

Tools for implementing actions

Tools in the CVPIA

Tools available to the Secretary for achieving the goal of the AFRP include implementing all sections of the CVPIA. Sections 3406(b)(1)(B) through (21) of the CVPIA authorize and direct the Secretary, in consultation with other state and federal agencies, Indian tribes, and affected interests, to take specific actions. These actions are briefly described below. Details are provided in the CVPIA.

3406(b)(1)(B) - Modify CVP operations based on recommendations of USFWS after consultation with CDFG.

3406(b)(2) - Manage 800,000 acre-feet of CVP yield for fish, wildlife, and habitat restoration purposes after consultation with USBR and CDWR and in cooperation with CDFG.

3406(b)(3) - Acquire water to supplement the quantity of water dedicated for fish and wildlife water needs under (b)(2), including modifications of CVP operations; water banking; conservation; transfers; conjunctive use; and temporary and permanent land fallowing, including purchase, lease, and option of water, water rights, and associated agricultural land.

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3406(b)(4) - Mitigate for Tracy Pumping Plant operations.

3406(b)(5) - Mitigate for Contra Costa Canal Pumping Plant operations.

3406(b)(6) - Install temperature control device at Shasta Dam.

3406(b)(7) - Meet flow standards that apply to CVP.

3406(b)(8) - Use pulse flows to increase migratory fish survival.

3406(b)(9) - Eliminate fish losses due to flow fluctuations of the CVP.

3406(b)(10) - Minimize fish passage problems at Red Bluff Diversion Dam.

3406(b)(11) - Implement Coleman National Fish Hatchery Plan and modify Keswick Dam Fish Trap.

3406(b)(12) - Provide increased flows and improve fish passage and restore habitat in Clear Creek.

3406(b)(13) - Replenish spawning gravel and restore riparian habitat below Shasta, Folsom, and New Melones reservoirs.

3406(b)(14) - Install new control structures at the Delta Cross Channel and Georgiana Slough.

3406(b)(15) - Construct, in cooperation with the State and in consultation with local interests, a seasonally operated barrier at head of Old River.

3406(b)(16) - In cooperation with independent entities and the State, monitor fish and wildlife resources in the Central Valley.

3406(b)(17) - Resolve fish passage and stranding problems at Anderson-Cottonwood Irrigation District Diversion Dam.

3406(b)(18) - If requested by the State, assist efforts to restore the striped bass fishery in the Bay-Delta estuary.

3406(b)(19) - Reevaluate carryover storage criteria for reservoirs on the Sacramento and Trinity Rivers.

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3406(b)(20) - Participate with the State and other federal agencies in the implementation of the on-going program to mitigate for the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant.

3406(b)(21) - Assist the State in efforts to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions.

In addition to these actions, Section 3406(e)(1 through 6) directs the Secretary to investigate and provide recommendations on the feasibility, cost, and desirability of implementing the actions listed below.

3406(e)(1) - Measures to maintain suitable temperatures for anadromous fish survival by controlling or relocating the discharge of irrigation return flows and sewage effluent, and by restoring riparian forests.

3406(e)(2) - Opportunities for additional hatchery production to mitigate the impacts of water development and operations on, or enhance efforts to increase Central Valley fisheries; Provided, That additional hatchery production shall only be used to supplement or to re-establish natural production while avoiding adverse effects on remaining wild stocks.

3406(e)(3) - Measures to eliminate barriers to upstream and downstream migration of salmonids.

3406(e)(4) - Installation and operation of temperature control devices at Trinity Dam and Reservoir.

3406(e)(5) - Measures to assist in the successful migration of anadromous fish at the Delta Cross Channel and Georgiana Slough.

3406(e)(6) - Other measures to protect, restore, and enhance natural production of salmon and steelhead in tributary streams of the Sacramento and San Joaquin Rivers.

Finally, Section 3406(g) of the CVPIA directs the Secretary to develop models and data to evaluate the ecologic and hydrologic effects of existing and alternate operations of public and private water facilities and systems to improve scientific understanding and enable the Secretary to fulfill requirements of the CVPIA.

The CVPIA establishes the "Central Valley Project Restoration Fund" and gives the Secretary the authority to use the fund "...to carry out the habitat restoration,

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improvement and acquisition (from willing sellers) provisions..." of the CVPIA (Section 3407), including the actions listed above. Funding priorities for use of the Restoration Fund are being developed and will be described in a report to Congress in early 1996 pursuant to sections 3407(a) and (f) of the CVPIA.

Restoration actions using the tools listed above will be implemented by the USFWS and USBR to contribute to doubling production of anadromous fishes. Each of these tools is being managed separately under the coordination of the Program Manager for the CVFWRP. Managers of these tools will use this plan as a guide to help establish priorities and identify actions. Specific actions will be selected according to the overall strategies stated in the Introduction to this restoration plan. These managers will ensure that actions conducted pursuant to the CVPIA will be coordinated with and complementary to ongoing restoration actions of other groups in the Central Valley and Bay-Delta, such as CDFG, Category III of the Bay-Delta Agreement, mitigation agreements, and ad hoc groups such as the Spring-Run Chinook Salmon Workgroup.

Actions not directly addressed by tools in the CVPIA will be managed by the AFRP Program Manager (address listed in Appendix C), and their implementation will depend on partnership with local watershed workgroups and other agencies, especially the CDFG.

Several tools may contribute to goals other than increasing natural production of anadromous fish. For example, 3406(b)(18) and (e)(2) may include artificial production, or other contributions to total production, such as pen rearing of salvaged striped bass, that would not directly contribute to natural production (see the AFRP Position Paper in Appendix A for definition of natural production). In fact, some fishery interests believe that artificial production is needed to supplement reasonable habitat restoration actions to stabilize or increase total production of fall-run chinook salmon in the San Joaquin tributaries and striped bass. While the AFRP can not directly support artificial production and pen rearing, it will coordinate its efforts with these and similar efforts conducted under other subsections of the CVPIA to achieve the greatest benefit for fish and wildlife.

Tools limited to use on CVP-controlled streams - Tools available to the Secretary to implement actions on streams and the Delta where flows are controlled primarily by CVP structures are greater than the tools available on streams where flows are not controlled by CVP structures. For example, modification of CVP operations (Section 3406(b)(1)(B)) and use of the 800,000 acre-feet (Section 3406(b)(2)) are limited to CVP-controlled streams and the Delta. The CVP-controlled streams include the Sacramento, American, Stanislaus, and San Joaquin rivers and Clear Creek. (Restoration of anadromous fish habitat on the San Joaquin River is limited to the section downstream of

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Mendota Pool.) In addition, the CVP controls exports at the Tracy Pumping Plant, located in the south Delta.

A process for the long-term management of the 800,000 acre-feet (af) of CVP yield dedicated for fish and wildlife and habitat restoration by Section 3406(b)(2) of the CVPIA has not yet been developed. However, draft interim guidelines have been reviewed by the public and comments solicited by the USFWS and USBR. Guidelines for management of the 800,000 af are being developed. Proposed rules and regulations for managing the dedicated yield as part of a long-term planning process will be drafted and made available for public review and comment in 1996.

During 1993-1995, the approach contained in the white paper (December 1994 letter of agreement between the USFWS and USBR) was used to manage the 800,000 af, wherein the USFWS submitted annual habitat and flow objectives to the USBR for implementation in the Sacramento, American, and Stanislaus rivers, and the Delta. These objectives were developed annually in coordination with CDFG and USBR and considered the projected hydrologic conditions.

Pursuant to CVPIA, USBR used the following management strategies to meet the habitat and flow objectives: modification of project operations; management of the 800,000 af of CVP yield; acquisition of water for fish and wildlife purposes; and use of water from other sources which do not conflict with fulfillment of the Secretary's contractual obligations to provide CVP water for other authorized purposes (Section 3406(b)(1)(B)). The USBR used a portion of the dedicated water to help meet objectives for Delta outflow, cross channel gate closure, and export curtailment in the Delta.

Cooperation with others

In most streams of the Central Valley, the Secretary does not have direct authority to implement actions to restore anadromous fish production because flows are not controlled by CVP facilities. Streams not controlled by the CVP include Battle, Mill, Deer, Butte, Elder, and Thomes creeks and Feather, Yuba, Bear, Cosumnes, Mokelumne, Calaveras, Tuolumne and Merced rivers, as well as a portion of the Delta. Private land owners, public and private irrigation districts, utilities, the State Water Project, municipalities, and industry manage facilities and flows on these streams. To assist in restoration of these streams, the Secretary will need the cooperation of others. Cooperation through partnerships of the USFWS, USBR, and other entities that have the authority, interests, or resources to facilitate restoration, will provide a tool to implement actions in this restoration plan. The USFWS and USBR encourage potential partners to enter into voluntary relationships with the agencies to conduct restoration actions.

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Mechanisms under which the USFWS and USBR can establish cooperative relationships are discussed in "Conservation Partnerships: A Field Guide to Public-Private Partnering for Natural Resource Conservation" (MIEB 1993). Selection of the appropriate mechanism will depend on the role of the USFWS or USBR in relation to the partners. Figure 2 is a guide for selecting mechanisms, which are briefly explained below:

- Interagency agreements--used when one agency is providing payments, goods or services to another agency. For federal agencies, the Economy Act allows for this if an efficiency gain can be realized.

- Procurement arrangements--used when an agency pays to receive a direct benefit. It is treated as a procurement action.

- Memoranda of understanding--most commonly used to establish partnerships and document specific responsibilities; signatories agree to work toward mutual goals, perform joint work, or share research results, but no obligation of funds may be included.

- Grants--allow the USFWS and USBR to transfer money, property, services or anything of value to an outside group for a project of mutual interest where substantial agency involvement is not anticipated.

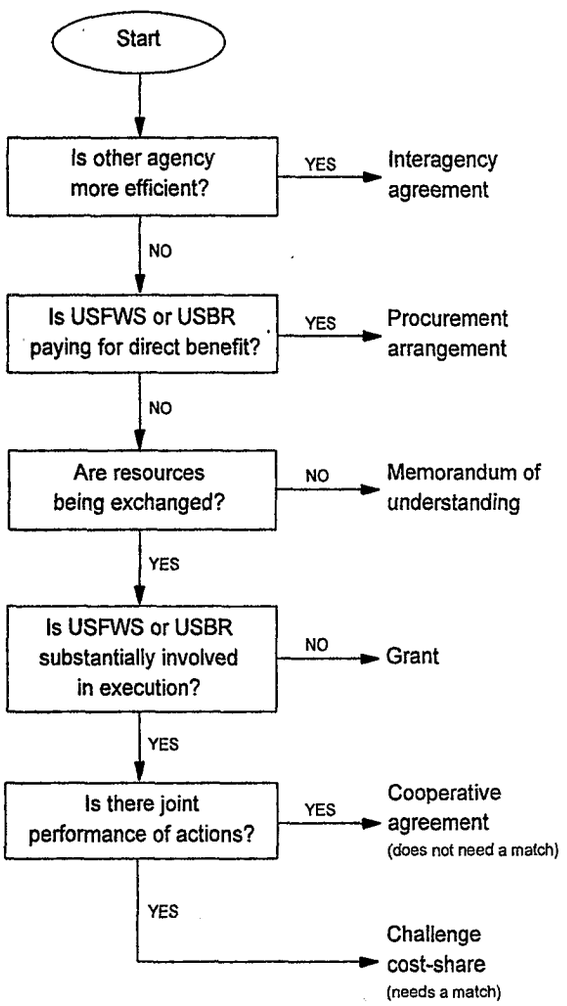

Figure 2. Mechanisms for working together (adapted from MIEB 1993).

- Cooperative agreements --allow the USFWS and USBR transfer money, property, services or anything of value to an outside group for a project of mutual interest where substantial agency involvement is anticipated.

- Challenge cost-sharing--allow the USFWS and USBR and other federal agencies to receive funds and requires recipients to match this money with non-federal funds, labor, materials, equipment or land and water, typically of one-to-one.

Through these mechanisms, the USFWS and USBR can make agreements and direct funds, including a portion of the Restoration Fund, or services to partners. The partners could then implement specific restoration actions. The CVPIA (Section 3407(e)) provides the Secretary with the flexibility to use several of the mechanisms for working together to fund non-federal partners by stating:

> "If the Secretary determines that the State of California or an agency or subdivision thereof, an Indian tribe, or a non-profit entity concerned with restoration, protection, or enhancement of fish, wildlife, habitat, or environmental values is able to assist in implementing any action authorized by this title in an efficient, timely, and cost effective manner, the Secretary is authorized to provide funding to such entity on such terms and conditions as he deems necessary to assist in implementing the identified action."

Funds dispersed through this section are subject to cost-share requirements contained in other sections of the CVPIA. Potential partners and possible mechanisms for working together are:

Local agencies and groups--Watershed workgroups, conservation groups, water districts, non-profit groups, and individual property owners can help implement restoration actions. Agreements can be reached with these groups, or funds and services can be directed to them through memoranda of understanding, grants, cooperative agreements, and challenge cost-sharing. In areas where there is local support but no watershed workgroups, the USFWS and USBR may provide funds and help for forming one. Information on forming and supporting local watershed workgroups is contained in the "California Coordinated Resource Management and Planning Handbook" (CCRMP 1990). In addition, the USFWS and USBR are developing a grant program, Project Double, designed to allow small groups to participate in restoration actions.

State agencies--The CDFG, CDWR, Reclamation Board, SWRCB, and other state agencies have expertise, abilities, experience, and are willing to assist in implementing many restoration actions. The USFWS and USBR can enter into procurement arrangements, memoranda of understanding, grants, and cooperative agreements with state agencies.

Other federal agencies--The Natural Resources Conservation Service, U.S. Forest Service, Bureau of Land Management, NMFS, U.S. Geologic Survey, National Biological Service, U.S. Army Corps of Engineers, Western Area Power Administration and other federal agencies likely have specific expertise and abilities, and are willing to help implement specific actions. Through interagency and procurement arrangements, the USFWS and USBR can enter into agreements with other federal agencies to provide funding or services for development, review and implementation of restoration actions.

MONITORING AND EVALUATION

Monitoring, using standardized and validated methods, is essential to obtain data on anadromous fish production and associated habitats to facilitate an evaluation of the effects of restoration actions. When possible, data collection should begin before specific restoration actions are implemented so that an adequate baseline is established. Data collected after implementation of actions can then be compared to the baseline. These data are essential for evaluating the contribution of actions to doubling natural production.

Most data used to establish the AFRP doubling targets were derived from sampling programs conducted by the CDFG (Mills and Fisher 1994). These programs consisted primarily of carcass counts, angler surveys, and ocean harvest records of salmonids; adult and juvenile population estimates and angler surveys of striped bass; an index of juvenile abundance of American shad; and adult population estimates of both white sturgeon and green sturgeon. These data represent the most complete data set on anadromous fish in most Central Valley streams and the Bay-Delta. The AFRP recommends that these programs continue and that efforts be made to refine methods and integrate the CDFG monitoring with that needed by the AFRP. This would reduce duplication and effectively allocate funding by both entities for monitoring throughout the Central Valley.

AFRP and CDFG monitoring will also be integrated with existing programs such as the Interagency Ecological Program (IEP) and others initiated to comply with mitigation requirements for specific projects. An oversight committee or forum is needed to coordinate activities of all those involved and to ensure that efforts are complementary, encourage an open exchange of information, and establish a repository or clearinghouse for data. An additional function of such a group would be to help direct monitoring activities by identifying deficiencies in the current data base. The IEP is an appropriate entity for coordinating monitoring in the Bay-Delta and for managing all data. An IEP project work team or similar forum, which would include experts in various watersheds, should be established to provide oversight for Central Valley streams.

A diverse array of data will be required to fully evaluate restoration actions in the Central Valley and the Bay-Delta. The AFRP proposes a hierarchical approach to monitoring, from fine to coarse spatial and temporal scales (e.g., action-specific, watershed-specific, and system-wide scales, and short- versus long-term temporal scales). Monitoring at all scales is needed so that restoration can be adaptively modified and refined.

Action-specific

Monitoring the effects of specific restoration actions should facilitate evaluation at the finest spatial, and possibly temporal resolution. This could be a short-term process,

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intended to determine the immediate effectiveness of restoration actions. For example, the effectiveness of a fish screen, the revegetation of a restored streambank, and the effects of an operational change on flow and temperature would all be monitored. Results of action-specific evaluations will contribute to an evaluation of the overall success of Section 3406(b) of the CVPIA (described below).

Restoration actions implemented pursuant to Section 3406(b) of the CVPIA will include a plan to assess the effectiveness of each action. Ensuring that each action includes monitoring will be the responsibility of the AFRP, designated agencies, and partners.

Watershed-specific

The purpose of monitoring at the watershed level would be to evaluate the cumulative effects of all restoration actions within a single watershed. Data collected specifically for a watershed may span a short or long period, and should address the overall results of multiple actions. For example, monitoring at the watershed level could answer whether there has been an improvement in the abundance, timing, health and distribution of juvenile anadromous fish, or in selected habitat variables. The primary monitoring objective will be to use indices of abundance and survival of juvenile life history stages and estimates of adult production to evaluate the effectiveness of restoration actions in specific watersheds. Results of watershed-specific evaluations will also contribute to an evaluation of the overall success.

Systemwide and long-term

The long-term effects of restoration actions need to be assessed throughout the Central Valley and Bay-Delta. For example, the primary biological measure may be production of adult fish, but it could also include measures of abundance at adult or juvenile life stages. Production of adult fish should be monitored in all watersheds.

Systemwide monitoring needs to include hatchery-produced fish, primarily chinook salmon and steelhead. All or a constant fraction of hatchery salmonids released from Central Valley hatcheries should be uniquely marked according to site of origin and site and date of release. This would allow managers to differentiate between wild and hatchery fish spawning in streams, clarify the distribution of hatchery fish in the system, determine their relative contribution to commercial and sport harvest, and evaluate factors affecting fish survival. Specific studies should be designed to determine how hatchery fish interact with naturally produced fish so that the effects of hatchery practices on population genetics and dynamics can be evaluated.

Other components of the Central Valley ecosystem that will be monitored include long-term changes in characteristics of stream channels, riparian areas, and water quality.

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Additional sampling of fish assemblages could be incorporated into sampling protocols, and the resulting data used to evaluate fish community responses to restoration actions through time.

Section 3406(b)(16) of the CVPIA directs the Secretary to "establish in cooperation with independent entities and the State of California, a comprehensive assessment program to monitor fish and wildlife resources in the Central Valley to assess the biological results and effectiveness of actions implemented pursuant to this subsection." The Comprehensive Assessment and Monitoring Program (CAMP) was initiated pursuant to Section 3406(b)(16) and will assist in directing future monitoring activities. A draft conceptual plan prepared for CAMP uses a watershed-specific approach for evaluating long-term trends in anadromous fish. Therefore, CAMP will not address action- or site-specific monitoring. It will rely on information from other monitoring programs to provide the basis for evaluating the overall success of restoration actions. Because the AFRP restoration targets are based on natural production of adult anadromous fish, CAMP will emphasize this attribute in selected watersheds. However, measures of hatchery production and harvest will be needed to determine success toward doubling natural production of anadromous fish.

DEALING WITH SCIENTIFIC UNCERTAINTY

Resource management decisions are made with varying degrees of scientific uncertainty. Primary contributing factors are the variability of biological processes and the physical conditions on which they depend. Moreover, the large geographic range and long life-span of anadromous fish restrict the ability of resource managers to employ many control and replicate groups in studies, as is common in other fields of science (Hilborn and Ludwig 1993). It is impossible to gather enough data to describe processes, evaluate important variables, and predict results of management actions with a high degree of certainty. Thus, analyses are subject to multiple interpretations, and management decisions must rely on professional judgement and uncertain data.

By acknowledging scientific uncertainty in making decisions, resource managers engage in risk assessment. Managers must balance the certainty of a predicted effect of a management action with the need to act. An extreme example is the certainty of effects resulting from acting to recover winter-run chinook salmon in the Sacramento River compared with the probable results of not acting, continued decline and likely extinction of the race. However, managers must also consider the human dimension as part of the system in making decisions (Ludwig et al. 1993). That is, they must assess the relationship between human activities and the resource, such as potential economic and social effects of management actions.

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A responsive approach to address scientific uncertainty about the effects of restoration actions is to employ adaptive management. This approach can be separated into three phases:

- Implement initial actions, based on available data and professional judgement.
- Second, monitor initial actions to evaluate their effectiveness.
- Third, modify actions, if necessary, to improve their benefits.

Actions in the AFRP restoration plan are intended to fit the first phase of adaptive management. To address the second phase, every action should be monitored so its effectiveness can be assessed. An additional benefit is reduced uncertainty of an action's effects on anadromous fish and their habitats. Many actions supported by the AFRP are evaluations of potential problems affecting anadromous fish, which provide insight into restoration opportunities by reducing scientific uncertainty. The third phase will be addressed through annual evaluations and continued interaction with interest groups.

Evaluations are important for contested issues, especially where uncertainty surrounding an issue prevents progress toward restoration. The AFRP will encourage those involved in such issues to agree in advance to take specific actions contingent upon the results of evaluations.

The levels of certainty used in developing this restoration plan are reasonable to support the recommended actions. Considering the status of listed and potentially listed species and races of anadromous fish and the substantial declines in others, there is a real urgency for action to reverse these trends. In addition, delays to restore some anadromous fish stocks may ultimately reduce future management options.

The USFWS and USBR will continue to use the best available scientific information to make and implement management decisions. In the biological sciences and in managing natural ecosystems, uncertainty is often substantial and cannot be eliminated. With imprecise and incomplete information inherent in the science, professional judgement will continue to be employed to make the best possible recommendations.

PUBLIC INVOLVEMENT

Introduction

Section 3406(b)(1) of the CVPIA presents two great challenges. First, Congress directed the Secretary to determine actions that are reasonable to implement. Second, the Secretary's authority is limited. This limitation emphasizes the need for voluntary partnerships to restore natural production in the Central Valley. Even for actions that the Secretary is authorized to take, partnerships are important if the actions are to be

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performed efficiently. Public support and local involvement are integral parts of the plan's strategies and implementation.

The USFWS and USBR are committed to involving the public as much as possible in planning and implementing restoration actions.

Approach

There are two levels of public involvement for the AFRP. The first level is programmatic, and involves planning a comprehensive program. At this level, all areas of the Central Valley are included. The second level is action-specific and involves implementing specific actions in individual watersheds.

Programmatic public involvement activities to date

CVPIA signed by President Bush.	October 1992
Draft Plan of Action for the Central Valley Anadromous Fish Restoration Program released.	August 1993
Coalition of senior fish experts from the USFWS, USBR, NMFS, USEPA, CDFG, and CDWR formed the Core Group to direct the development of the AFRP.	October 1993
Public workshops held in Oakland, Fort Bragg, Sacramento, Fresno, and Red Bluff to introduce the AFRP and to discuss the draft Plan of Action.	October-November 1993
Core Group formed eight technical teams consisting of experts from state and federal agencies, private industry and academia to develop actions deemed necessary to double natural production of anadromous fish populations.	March 1994
Final Plan of Action for the Central Valley Anadromous Fish Restoration Program released.	May 1994
Public workshop held in Sacramento to discuss the final Plan of Action.	May 1994
Draft Position Paper for Development of the Anadromous Fish Restoration Program released.	July 1994

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Public workshop held in Sacramento to discuss the draft Position Paper.	July 1994
Central Valley Anadromous Sport Fish Annual Run-size, Harvest, and Population Estimates, 1967 through 1991, Third Draft, released by CDFG.	August 1994
Public workshop held in Stockton to discuss CDFG's Central Valley Anadromous Sport Fish Annual Run-size, Harvest, and Population Estimates.	October 1994
Working Paper on Restoration Needs released.	May 1995
Public workshops held in Oakland, Redding, Sacramento, Modesto, and Monterey to discuss the Working Paper on Restoration Needs; opportunity extended to public to comment orally or in writing on Working Paper.	June 1995
AFRP staff attended over 30 technical workshops and meetings to discuss the Working Paper and development of the draft Anadromous Fish Restoration Plan.	May-November 1995
Draft Anadromous Fish Restoration Plan released.	December 1995

Future public involvement opportunities

Programmatic

Public review of the draft Anadromous Fish Restoration Plan.	December 1995-January 1996
Public workshops to receive comments on draft Anadromous Fish Restoration Plan	January 1996
Final Anadromous Fish Restoration Plan to be released.	Spring 1996

Action-specific

Implementation of specific actions in the Anadromous Fish Restoration Plan, including partnership formation, planning, environmental documentation, and permitting.	Ongoing

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Public involvement mechanisms

Public participation is critical to successful development of the final plan. The following are public involvement mechanisms established to facilitate public input to the AFRP:

- Draft report review- Allows the public to contribute to report development.
- Final reports- Document progress to a plan and offer the public a road map for implementation.
- Press releases- Announce significant events and the opportunity for involvement.
- Letters to interested parties- Provide information.
- Workshops and meetings- Offer an informal setting for public input and dialogue and learning to occur both for the AFRP and the attending public.
- Educational materials- Provide summary or pertinent information about anadromous fish and the AFRP.
- Records of comments and responses- Summarize comments and AFRP responses.
- Environmental documentation- NEPA and CEQA compliance affords structured public involvement in scoping and review.
- Permitting- If required, regulatory permitting affords the public structured public involvement.
- Grapevine- Toll-free and automated information line that provides information on meeting schedules, report releases, workshop announcements, etc. To reach this service, dial (800) 742-9474 or (916) 979-2330 and dial extension 542 after the recorded message begins.
- Internet home page- Provides up-to-date information on the AFRP and access to USFWS public release files. The Internet address is:

  http://www.delta.dfg.ca.gov/usfws/afrp/afrp.html

- Long-term monitoring and evaluation reports- Afford public the opportunity to receive and comment on information on implementation.
- Mailing lists- Will be maintained and updated as requested.

- Action implementation partnerships- The implementation program for specific actions will seek to effect public involvement in the form of action-oriented partnerships, preferably local watershed workgroups.

ACTIONS AND EVALUATIONS

The actions and evaluations that follow came from several sources, including the AFRP Working Paper, public and private organizations, and individual contributors. They were subjected to the process to determine reasonable actions described earlier in this document. Some actions from the Working Paper were determined to be unreasonable or in need of further evaluation, and are not included here. Some of those actions were replaced, while others were changed to evaluations rather than actions. With some actions, the language and intent were changed, perhaps reducing their potential biological benefit, to make them reasonable but still maintaining their contribution to increasing natural production of anadromous fish. Others were combined.

Actions and evaluations are categorized by stream or geographic area. Streams are categorized by basin, starting with the Sacramento River basin, moving to the lower Sacramento River and Delta tributaries, then to the San Joaquin basin, and finally the Delta. Within each basin, streams are organized geographically, generally starting upstream and moving downstream. Separate lists of actions and evaluations are presented Central Valley-wide and for the ocean. Evaluations are generally activities that will help define or contribute to actions for future implementation. Results of all actions will be monitored and evaluated.

Under each stream or geographic area, actions and evaluations appear in separate tables. The tables consist of four columns. The first column describes the action or evaluation in one or two brief sentences. The second column lists the potential involved parties, including local watershed workgroups, and public and private organizations expected to be involved in implementation. The third column presents the CVPIA tools. The last column lists the priority for the action or evaluation in relation to others in the watershed.

Actions and evaluations with an arrow (➧) preceding their description in the first column have high potential for implementation prior to the end of fiscal year (FY) 1996. These are actions that the USFWS and USBR, partners, or individual sponsors have indicated they are implementing or could begin to implement in FY96. In most cases, considerable design and engineering work, feasibility studies, environmental compliance documentation, or contract administration will be required prior to on-site activity.

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It is important to note that the number of actions that can be implemented in FY96 will be constrained by the resources available from the USFWS, USBR, and potential partners. The Restoration Fund, along with additional agency and other partnership funds, will support implementation of the AFRP restoration actions (See Appendix F for a brief summary of CVPIA resources available in FY96 for implementation of restoration actions).

Direct benefits to fish may not be observed in FY96 even though implementation has begun. In addition, costs to implement, operate and maintain a specific action often are greater than envisioned. Hence, it is likely that the number of actions implemented may be fewer than desired. Greater accomplishments may be possible through cost sharing with partners.

A total of 176 actions and 109 evaluations are identified. Of these, 57 actions and 30 evaluations have high potential for implementation during FY96.

Annual implementation plans will be developed based on this list of actions and other reasonable actions from the AFRP or partners. Following review of the AFRP in 1997, the AFRP will develop a three-to-five year implementation plan.

SACRAMENTO RIVER BASIN

Upper mainstem Sacramento River

<table>
<tr><th>Action</th><th>Involved parties</th><th>Tools</th><th>Priority</th></tr>
<tr><td>1. Implement a river flow regulation plan that balances carryover storage needs with instream flow needs consistent with the 1993 biological opinion for winter-run chinook salmon based on runoff and storage conditions, including the following minimum recommended flows at Keswick and Red Bluff Diversion Dams.

Recommended minimum Sacramento River flows (cfs) at Keswick Dam for October 1 to April 30 based on October 1 carryover storage in Shasta Reservoir and critically dry runoff conditions (driest decile runoff of 2.5 maf) to produce a target April 30 Shasta Reservoir storage of 3.0-3.2 maf for temperature control.

<table>
<tr><th>Carryover storage (maf)</th><th>Keswick release (cfs)</th></tr>
<tr><td>1.9 to 2.1</td><td>3,250</td></tr>
<tr><td>2.2</td><td>3,500</td></tr>
<tr><td>2.3</td><td>3,750</td></tr>
<tr><td>2.4</td><td>4,000</td></tr>
<tr><td>2.5</td><td>4,250</td></tr>
<tr><td>2.6</td><td>4,500</td></tr>
<tr><td>2.7</td><td>4,750</td></tr>
<tr><td>2.8</td><td>5,000</td></tr>
<tr><td>2.9</td><td>5,250</td></tr>
<tr><td>3</td><td>5,500</td></tr>
</table>
</td><td>USFWS, USBR, NMFS, CDFG</td><td>3406(b)(1)(B), 3406(b)(2), 3406(b)(3)</td><td>High</td></tr>
</table>

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Action	Involved parties	Tools	Priority
◗2. Implement a schedule for flow changes that avoids, to the extent controllable, dewatering redds and isolating or stranding juvenile anadromous salmonids, consistent with SWRCB Order 90-5.	USFWS, USBR, CDFG, SWRCB, NMFS	3406(b)(9)	High
◗3. Continue to maintain water temperatures at or below 56°F from Keswick Dam to Bend Bridge to the extent controllable, consistent with the 1993 biological opinion for winter-run chinook salmon and with SWRCB Order 90-5.	USFWS, USBR, CDFG, SWRCB, NMFS	3406(b)(1)(B), 3406(b)(6)	High
◗4. Continue to raise RBDD gates for a minimum duration from September 15 to May 15 to protect adult and juvenile chinook salmon migrations, consistent with the 1993 biological opinion for winter-run chinook salmon and with SWRCB Order 90-5, and accommodate water delivery using appropriate pumping facilities.	USFWS, USBR, SWRCB, NMFS, CDFG	3406(b)(6), 3406(b)(10)	High[1]
◗5. Construct an escape channel for trapped adult chinook salmon and steelhead from the Keswick Dam stilling basin to the Sacramento River, as designed by NMFS and USBR.	USFWS, USBR, NMFS, CDFG	3406(b)(11)	Medium

[1] Although Action 4 addresses fish passage, it was assigned high priority because it significantly increases fish productivity. These findings are based on unpublished data and reports located in the Northern Central Valley Fish and Wildlife Office, USFWS, Red Bluff, California (Rich Johnson, personal communication 1995).

Action	Involved parties	Tools	Priority
◗6. Continue to implement the Anadromous Fish Screen Program.[2]	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
◗7. Implement structural and operational modifications to the Glenn-Colusa Irrigation District's (GCID) water diversion facility to minimize impingement and entrainment of juvenile salmon.	GCID, USFWS, USBR, CDFG, NMFS, CDWR	3406(b)(20)	Medium
8. Remedy water quality problems from toxic discharges associated with Iron Mountain Mine and water quality problems associated with metal sludges in Keswick Reservoir, consistent with the Comprehensive Environmental Response, Compensation, and Liability Act and the Clean Water Act.	EPA, SWRCB USFWS, USBR, NMFS, CDFG		High
9. Pursue opportunities to create a meander belt from Keswick Dam to Chico Landing to recruit gravel and large woody debris, to moderate temperatures and to enhance nutrient input.	Sacramento River Advisory Council (SRAC), CDFG, COE, USFWS, USBR, CDWR, NMFS	3406(b)(1)(B), 3406(b)(13)	High

[2] Priorities for screening are being determined by the Anadromous Fish Screen Program.

Action	Involved parties	Tools	Priority
◗10. Implement operational modifications to Anderson-Cottonwood Irrigation District's (ACID) diversion dam to eliminate passage and stranding problems for chinook salmon and steelhead adults and early life stages and toxic discharges from the canal and structural modifications to improve the strength of the fish screens.	ACID, USFWS, USBR, CDFG, RWQCB, NMFS	3406(b)(17)	Medium
◗11. Develop and implement a program for restoring and replenishing spawning gravel, where appropriate, in the Sacramento River.	CDFG, USFWS, USBR, NMFS, CDWR	3406(b)(13)	High

Evaluation	Involved parties	Tools	Priority
◗1. Continue study to refine a river regulation program that balances fish habitats with the flow regime and addresses temperatures, flushing flows, attraction flows, emigration, channel and riparian corridor maintenance.	USFWS, USBR, CDFG, SWRCB, NMFS	3406(e)(1)	High
◗2. Evaluate opportunities to incorporate flows to restore riparian vegetation from Keswick Dam to Chico Landing that are consistent with the overall river regulation plan.	USFWS, USBR, NMFS, CDFG, SRAC	3406(b)(13), 3406(e)(1)	High
◗3. Continue the evaluation to identify solutions to passage at RBDD, including measures to improve passage whenever the RBDD gates are closed.	USFWS, USBR, CDFG, Tehama Colusa Canal Authority, NMFS	3406(b)(10)	High

Evaluation	Involved parties	Tools	Priority
⧫4. Evaluate the contribution of large woody debris and boulders in the upper mainstem Sacramento River to salmonid production and rearing habitat quality.	CDFG, USFWS, USBR, CDFG, RWQCB, NMFS	3406(e)(6)	Medium[3]
5. Identify opportunities for restoring riparian forests in channelized sections of the upper mainstem Sacramento River that are appropriate with flood control and other water management constraints.	SRAC, The Nature Conservancy (TNC), CDFG, COE, USFWS, USBR, CDWR, NMFS	3406(b)(13)	High
⧫6. Identify and attempt to maintain adequate flows for white sturgeon and green sturgeon from February to May for spawning, emigration, egg incubation and rearing, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	USFWS, USBR, NMFS, CDFG	3406(b)(1)(B), 3406(b)(2), 3406(b)(3)	High
⧫7. Identify and attempt to maintain adequate flows from April to June for spawning, incubation, and rearing of American shad, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	USFWS, USBR, NMFS, CDFG	3406(b)(1)(B), 3406(b)(2), 3406(b)(3)	High

[3]Although Action 4 contributes to natural habitat, it was assigned medium priority because of a lack of evidence of benefits to fish production.

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Evaluation	Involved parties	Tools	Priority
▶8. Identify and implement measures that will maintain mean daily water temperatures between 61°F and 65°F for at lease one month between April 1 and June 30 for American shad spawning, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	USFWS, USBR, NMFS, CDFG	3406(b)(2), 3406(b)(3)	High
9. Identify the extent of entrainment of juvenile sturgeon at diversions and pumps and minimize entrainment, if substantial.	USFWS, USBR, CDFG, NMFS		Medium
10. Identify green sturgeon spawning sites and evaluate the availability and use by adult sturgeon.	USFWS, USBR, CDFG, NMFS		High
11. Determine the effects of poaching and fishing on the number of spawning sturgeon.	USFWS, USBR, CDFG, NMFS		Low

Upper Sacramento River tributaries

Clear Creek

Action	Involved parties	Tools	Priority
◗1. Release 200 cfs October 1 to June 1 from Whiskeytown Dam for spring-, fall- and late fall-run chinook salmon spawning, egg incubation, emigration, gravel restoration, spring flushing and channel maintenance; release 150 cfs, or less, from July through September to maintain ≤ 60°F temperatures in stream sections utilized by spring-run chinook salmon. Both releases should be within the average total annual unimpaired flows to the Clear Creek watershed.	CDFG, USFWS, USBR, SWRCB	3406(b)(12)	High
◗2. Halt further habitat degradation and restore channel conditions from the effects of past gravel mining.	CDFG, USFWS, USBR, Bureau of Land Management (BLM), NRCS	3406(b)(12)	High
3. Provide fish passage facilities at McCormick-Saeltzer Dam and remove sediment from behind the dam.	McCormick-Saeltzer Dam owners, CDFG, USFWS, USBR, NRCS	3406(b)(12)	Medium

Action	Involved parties	Tools	Priority
4. Develop an erosion control and stream corridor protection program to prevent habitat degradation due to sedimentation and urbanization.	CDFG, USFWS, USBR, NRCS, BLM, Resource Conservation District (RCD)	3406(b)(12)	High
◗5. Replenish gravel and restore gravel recruitment blocked by Whiskeytown Dam.	CDFG, USFWS, USBR	3406(b)(13)	High

Evaluation	Involved parties	Tools	Priority
◗1. Attempt reestablishment of steelhead and spring-run chinook salmon. If life stages are present, provide flows within five miles below Whiskeytown Dam from June 1 to November 1 to provide necessary temperatures for juvenile rearing (≤ 65°F), holding of prespawning adults (≤ 60°F), and for egg incubation (≤ 56°F) (see Central Valley-wide Evaluation 8).	CDFG, USFWS, USBR	3406(b)(1)(B), 3406(b)(7), 3406(b)(12)	High

Cow Creek

Action	Involved parties	Tools	Priority
1. Obtain agreements to provide flows for suitable passage and spawning for fall-run chinook salmon adults and adequate summer rearing habitat for juvenile steelhead.	Diverters, CDFG, USFWS, USBR, SWRCB	3406(b)(3)	High

Action	Involved parties	Tools	Priority
2. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
3. Improve passage at agricultural diversion dams.	Diverters, CDFG, USFWS, USBR		Medium
4. Fence select riparian corridors within the watershed to exclude livestock.	NRCS, Landowners, CDFG, USFWS, USBR		High

Bear Creek

Action	Involved parties	Tools	Priority
1. Restore instream flows to allow suitable passage of juvenile and adult chinook salmon and steelhead during spring and early fall.	Diverters, CDFG, USFWS, USBR	3406(b)(3)	High

Action	Involved parties	Tools	Priority
2. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium

Cottonwood Creek

Action	Involved parties	Tools	Priority
1. Establish limits on instream gravel mining operations by working with state and local agencies to protect spawning gravel and enhance recruitment of spawning gravel to the Sacramento River in the valley sections of Cottonwood Creek.	Corps of Engineers (COE), Shasta and Tehama counties, California Division of Mines, CDFG, USFWS, USBR		High
2. Restore the stream channel to prevent ACID Siphon from becoming a barrier to migration of spring- and fall-run chinook salmon and steelhead.	ACID, Gravel miners, USFWS, USBR		Medium
3. Eliminate adult fall-run chinook stranding by stopping attraction flows in Crowley Gulch or by constructing a barrier at the mouth of Crowley Gulch.	ACID, CDFG, USFWS, USBR		Medium

Action	Involved parties	Tools	Priority
4. Facilitate watershed protection and restoration to reduce water temperatures and siltation to improve holding, spawning, and rearing habitats for salmonids.	Landowners, CDFG, USFWS, USBR		High

Battle Creek

Action	Involved parties	Tools	Priority
1. Continue to allow adult winter- and spring-run chinook salmon passage above the Coleman National Fish Hatchery (CNFH) weir. After a disease-safe water supply becomes available to the CNFH, allow passage of fall- and late-fall-run chinook salmon and steelhead above the CNFH weir. In the interim, prevent anadromous fish from entering the main hatchery water supply by blocking fish ladders at Wildcat Canyon, Eagle Canyon, and Coleman diversion dams.	CDFG, USFWS, USBR	3406(b)(11)	High[4]

[4]Although Action 1 addresses fish passage, it was assigned high priority because a disease-safe water supply to CNFH substantially enhances production of anadromous salmonids by allowing them unrestricted access to the upper reaches of Battle Creek.

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Action	Involved parties	Tools	Priority
◗2. Increase flows past PG&E's hydropower diversions in two phases to provide adequate holding, spawning and rearing habitat for anadromous salmonids.	CDFG, PG&E, USFWS, USBR, NMFS, FERC	3406(b)(3)	High

Diversion	Months	Flow (cfs)
Keswick ditch[b]	All year	30
North Battle Creek feeder [b]	September-November January-April May-August	40 40 30
Eagle Canyon [a]	May-November December-April	30 50
Wildcat [a]	May-November December-April	30 50
South [b]	May-November December-April	20 30
Inskip [b]	May-November December-April	30 40
Coleman [a]	September-April May-August	50 30

[a]First phase flows required to support winter- and spring-run chinook salmon between the Coleman Powerhouse and Eagle Canyon Diversion Dams while a disease-safe water supply is being developed for CNFH.
[b]Second phase flows required to support fall-run chinook salmon and steelhead above the CNFH weir, Coleman Powerhouse and Eagle Canyon Diversion Dams, after a disease-safe water supply is available to CNFH.

Action	Involved parties	Tools	Priority
◗3. Construct barrier racks at the Gover Diversion dam and waste gates from the Gover Canal to prevent adult chinook salmon from entering Gover Diversion.	Gover Diversion Dam owners, CDFG, USFWS, USBR		Medium
4. Screen Orwick Diversion to prevent entrainment of juvenile salmonids and straying of adult chinook salmon.	Orwick Diversion Dam owners, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
5. Screen tailrace of Coleman Powerhouse to eliminate attraction of adult chinook salmon and steelhead into an area with little spawning habitat and great potential for entrainment into the CNFH water supply.	CDFG, PG&E, USBR, USFWS		Medium
6. Construct fish screens on all PG&E diversions after both phases of upstream flow actions (see Action 1) are completed and fish ladders on Coleman Powerhouse and Eagle Canyon Diversion Dams are opened.	PG&E, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
7. Improve fish passage in Eagle Canyon by modifying a bedrock ledge and boulders that are potential barriers to adult salmonids.	CDFG, USFWS, USBR		Medium

Evaluation	Involved parties	Tools	Priority
◗1. Evaluate the effectiveness of fish ladders at PG&E diversions.	CDFG, PG&E, USFWS, USBR	3406(e)(3)	Medium

Evaluation	Involved parties	Tools	Priority
2. Evaluate the feasibility of establishing a naturally spawning population of winter-run chinook salmon.	CDFG, USFWS, USBR	3406(e)(6)	High[5]
3. Evaluate alternatives for providing a disease-safe water supply to CNFH so that winter-, spring- and fall-run chinook salmon and steelhead would have access to an additional 41 miles of Battle Creek habitat.	USFWS, USBR, CDFG, NMFS	3406(b)(11), 3406(e)(6)	High

Paynes Creek

Action	Involved parties	Tools	Priority
1. Improve instream flows to improve spawning, rearing and migration opportunities for fall-run chinook salmon.	Diverters, CDFG, BLM, USFWS, USBR	3406(b)(3)	High
2. Restore and enhance spawning gravel.	CDFG, BLM, USFWS, USBR		High

[5] Although action priority criteria do not directly address endangered species, Action 2 was rated high because restoration of winter-run chinook salmon requires high priority restoration actions, flow enhancement and habitat and water quality improvements.

Antelope Creek

Action	Involved parties	Tools	Priority
1. Improve instream flows to allow passage of juvenile and adult spring-, fall- and late-fall-run chinook salmon.	Diverters, CDFG, USFWS, USBR, USFS	3406(b)(3)	High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the creation of a more defined stream channel to facilitate fish passage by minimizing water infiltration into the streambed and maintaining flows to the Sacramento River.	Landowners, CDFG, USFWS, USBR	3406(e)(3)	Medium

Elder Creek

Action	Involved parties	Tools	Priority
1. Work with Tehama County to develop an erosion control ordinance to minimize sediment input into Elder Creek.	Tehama County, CDFG, USFWS, USBR		High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the feasibility of constructing a fish passage structure over the Corning Canal Siphon.	CDFG, USFWS, USBR	3406(e)(3)	Medium

Mill Creek

Action	Involved parties	Tools	Priority
1. Continue to provide instream flows in the valley reach of Mill Creek to facilitate the passage of adult and juvenile spring-, fall- and late-fall-run chinook salmon and steelhead.	Mill Creek Watershed Conservancy (MCWC), Landowners, CDFG, USFWS, USBR, CDWR	3406(b)(3)	High
2. Preserve the habitat productivity of upper Mill Creek through cooperative watershed management.	CDFG, MCWC, USFWS, USBR		High
3. Improve spawning habitats in lower Mill Creek for fall- and late-fall-run chinook salmon.	CDFG, MCWC, USFWS, USBR		High
4. Maintain and restore the riparian habitat along the lower reaches of Mill Creek.	City and county agencies, Chico State University, CDFG, USFWS, USBR		High

Evaluation	Involved parties	Tools	Priority
1. Develop a permanent solution for fish passage at Clough Dam.	Diverters, MCWC, Los Molinos Municipal Water District, CDFG, CDWR, USFWS, USBR	3406(e)(3)	Medium

Thomes Creek

Action	Involved parties	Tools	Priority
1. Modify gravel mining methods to reduce their effects on salmonid spawning habitats.	Gravel miners, Tehama County Planning Commission, CDFG, CDWR, USFWS, USBR		High
2. Employ the most ecologically sound timber extraction practices by implementing the Forest Plan on federal lands within the drainage.	Landowners, USFWS, USBR, USFS		High

Action	Involved parties	Tools	Priority
3. Modify and employ the most ecologically sound grazing practices by implementing the Forest Plan on federal lands within the drainage.	Landowners, USFS, USFWS, USBR		High
4. Reduce use of seasonal diversion dams that may be barriers to migrating chinook salmon and steelhead.	Henleyville and Paskenta diversion dam operators, CDFG, USFWS, USBR		Medium

Evaluation	Involved parties	Tools	Priority
1. Identify and evaluate restoring highly erodible watershed areas.	CDFG, USFWS, USBR	3406(e)(6)	High
2. Monitor water quality throughout the creek and identify limiting conditions for salmon.	CDFG, USFWS, USBR		High
3. Develop a release strategy for the Tehama-Colusa Canal into Thomes Creek to maintain flows from October to May if sufficient water is available from diversions at Red Bluff.	Tehama-Colusa Canal Authority, CDFG, USFWS, USBR	3406(e)(1)	High

Deer Creek

Action	Involved parties	Tools	Priority
1. Improve instream flows in the lower ten miles of Deer Creek to ensure passage of adult and juvenile spring- and fall-run chinook salmon and steelhead over three diversion dams.	Deer Creek Conservancy, CDFG, USFWS, USBR	3406(b)(3)	High
2. Protect and restore chinook salmon and steelhead habitat in upper Deer Creek.	Deer Creek Conservancy, CDFG, USFWS, USBR		High
3. Improve spawning habitats in lower Deer Creek for fall- and late-fall-run chinook salmon.	Deer Creek Conservancy, CDFG, USFWS, USBR		High
4. Negotiate long-term agreements to maintain and restore riparian habitats along the lower reaches of Deer Creek.	Landowners, Deer Creek Conservancy, CDFG, USFWS, USBR		High

Action	Involved parties	Tools	Priority
5. Plan and coordinate required flood management activities with least damage to the fishery resources and riparian habitats of lower Deer Creek.	Tehama County Flood Control, Deer Creek Conservancy, COE, CDFG, USFWS, USBR		High

Stony Creek

Evaluation	Involved parties	Tools	Priority
1. Determine the feasibility of restoring anadromous salmonids by evaluating water releases from Black Butte Dam, water exchanges with the Tehama-Colusa Canal, interim and long-term water diversion solutions at Red Bluff Diversion Dam, water quality improvements, spawning gravel protection and restoration, riparian habitat protection and restoration, creek channel creation, and passage improvements water diversions.	Stony Creek Task Force, CDFG, COE, USFWS, USBR	3406(e)(1), 3406(e)(3), 3406(e)(6)	High

Big Chico Creek

Action	Involved parties	Tools	Priority
◗1. Relocate and screen the M&T Ranch diversion.	M&T Ranch owners, Western Canal Water District (WCWD), USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
2. Repair the Iron Canyon fish ladder.	CDFG, USFWS, USBR		Medium
3. Replenish spawning gravel in reaches modified for flood control.	Chico Parks Department, CDFG, USFWS, USBR		High
4. Repair the Lindo Channel weir and fishway at the Lindo Channel box culvert at the Five-Mile Diversion.	Chico Parks Department, CDFG, CDWR, COE, USFWS, USBR		Medium

Action	Involved parties	Tools	Priority
5. Improve cleaning procedures at One-Mile Pool.	City of Chico, CDFG, USFWS, USBR		High
◆6. Protect spring-run chinook salmon summer holding pools by obtaining from willing sellers titles or conservation easements on lands adjacent to the pools.	Landowners, CDFG, USFWS, USBR		High
7. Cooperate with local landowners to encourage revegetation of denuded stream reaches and establish a protected riparian strip.	Landowners, CDFG, USFWS, USBR		High

Evaluation	Involved parties	Tools	Priority
◆1. Evaluate the water management operations between Big Chico Creek and Lindo Channel.	City of Chico, CDFG, CDWR, USFWS, USBR	3406(e)(6)	Medium
2. Evaluate the replenishment of gravel in the flood-diversion reach of Mud Creek.	Butte County, CDFG, CDWR, USFWS, USBR	3406(e)(6)	High

Butte Creek

Action	Involved parties	Tools	Priority
◗1. Obtain additional instream flows from Parrott-Phelan Diversion.	Diverters, CDFG, USFWS, USBR	3406(b)(3)	High
2. Maintain a minimum 40 cfs instream flow below Centerville Diversion Dam.	CDFG, PG&E, USFWS, USBR	3406(b)(3)	High
◗3. Purchase existing water rights from willing sellers.	Diverters, CDFG, USFWS, USBR, SWRCB	3406(b)(3)	High
◗4. Build a new high water volume fish ladder at Durham Mutual Dam.	Diverters, CDFG, TNC, USFWS, USBR		Medium
◗5. Install fish screens on both diversions at Durham Mutual Dam.	Diverters, TNC, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium

Action	Involved parties	Tools	Priority
◗6. Remove the Western Canal Dam and construct the Western Canal Siphon. If the dam is not removed and siphon not constructed, support CDFG's efforts to build a new high water volume fish ladder and to install fish screens on both diversions at the Western Canal Dam.	Western Canal Water District (WCWD),TNC CDFG, USBR, USFWS	3406(b)(21)	High[6]
◗7. Remove McPherrin and McGowan dams and provide an alternate source of water as part of the Western Canal Dam removal and siphon construction. If McPherrin and McGowan dams are not removed and alternate sources of water are not supplied as part of the WCWD dam removal and siphon construction, support CDFG's efforts to build new high water volume fish ladders at both dams and to install fish screens on both diversions.	Diverters, WCWD, CDFG, USBR, USFWS	3406(b)(3), 3406(b)(21)	High[7]
◗8. Acquire water rights as a part of the Western Canal Siphon project.	WCWD, CDFG, SWRCB, USBR	3406(b)(3)	High

[6]Although Action 6 addresses fish passage, it was assigned a high priority because the removal of the Western Canal Dam and construction of the Western Canal Siphon returns the stream to natural conditions and enhances anadromous salmonid access to spawning habitats.

[7]Although Action 7 addresses fish passage, it was assigned high priority because the removal of McPherrin and McGowan dams returns the stream channel to natural conditions and enhances anadromous salmonid access to spawning habitats.

Action	Involved parties	Tools	Priority
9. Adjudicate water rights and provide water master service for the entire creek; enforce or initiate legal action on diverters who are violating water right allocations.	Diverters, CDFG, CDWR, SWRCB, USFWS, USBR		High
◗10. Build a new high water volume fish ladder at Adams Dam.	Diverters, CDFG, USFWS, USBR		Medium
◗11. Install fish screens on both diversions at Adams Dam.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
◗12. Build a new high water volume fish ladder at Gorrill Dam.	Diverters, CDFG, USFWS, USBR		Medium
◗13. Install fish screens on both diversions at Gorrill Dam.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
14. Establish operational criteria for Sanborn Slough Bifurcation.	Diverters, CDFG, USFWS, USBR		Medium

Action	Involved parties	Tools	Priority
15. Establish operational criteria for the East Barrow pit and West Barrow pit.	Diverters, CDFG, USFWS, USBR		Medium
16. Establish operational criteria for Nelson Slough.	Diverters, CDFG, USFWS, USBR		Medium
17. Install a fish screen at White Mallard Dam.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
18. Eliminate chinook salmon stranding at White Mallard Duck Club outfall.	Diverters, CDFG, USFWS, USBR		Medium
19. Rebuild and maintain existing culvert and riser at Drumheller Slough outfall.	Diverters, CDFG, USFWS, USBR		Medium
◗20. Install fish screens on Little Dry Creek pumps.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
◗21. Increase enforcement of fishing regulations.	CDFG, USFWS, USBR		Low

Action	Involved parties	Tools	Priority
22. Install a high water volume fish ladder at White Mallard Dam.	Diverters, CDFG, USFWS, USBR		Medium
23. Develop and enforce land use plans that create buffer zones between the creek and urban development.	City and county government agencies, Conservation groups, CDFG, USFWS, USBR	3406(e)(6)	High

Evaluation	Involved parties	Tools	Priority
1. Develop and evaluate operational criteria and potential modifications to Butte Slough outfall.	Diverters, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
2. Evaluate alternatives or build a new high water volume fish ladder at East-West Diversion Weir.	Diverters, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
3. Evaluate operational alternatives and establish operational criteria for Sutter Bypass Weir #2.	Diverters, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium

Evaluation	Involved parties	Tools	Priority
4. Evaluate operational alternatives and establish operational criteria for Sutter Bypass Weir #1.	Diverters, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
5. Evaluate alternatives to help fish passage, including the installation of a fish screen, at Sanborn Slough Bifurcation Structure.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(e)(3)	Medium
6. Evaluate alternatives to help fish passage, including the installation of fish screens, within Sutter Bypass where necessary.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(e)(3)	Medium
7. Evaluate operational alternatives and establish operational criteria for Sutter Bypass Weir #5.	Diverters, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
8. Evaluate alternatives to help fish passage, including the installation of a high water volume fish ladder, on Sutter Bypass Weir #2.	Water users, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
9. Evaluate alternatives to help fish passage, including the installation of a high water volume fish ladder, on Sutter Bypass Weir #1.	Water users, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium

Evaluation	Involved parties	Tools	Priority
10. Evaluate alternatives to help fish passage, including the installation of a high water volume fish ladder, on Sutter Bypass Weir #5.	Water users, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
11. Evaluate alternatives to help fish passage, including the installation of a high water volume fish ladder, on Sutter Bypass Weir #3.	Water users, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
12. Evaluate enhancement of fish passage at a natural barrier below the Centerville Diversion Dam.	PG&E, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
◗13. Evaluate fish passage enhancement at PG&E Diversion Dams and other barriers above Centerville Diversion Dam.	PG&E, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
◗14. Develop a watershed management program.	Private land owners, Butte Creek Conservancy, CDFG, USFWS, USBR		High

Colusa Basin Drain (westside tributaries)

Evaluation	Involved parties	Tools	Priority
1. Investigate the feasibility of restoring the access of anadromous fish to westside tributaries through development of defined migrational routes, sufficient flows, and adequate water temperatures.	CDFG, USFWS, USBR	3406(e)(1), 3406(e)(6)	High
2. If restoring the access of anadromous fish to westside tributaries shows little potential, evaluate the installation of an adult exclusion device at the Knights Landing outfall for Colusa Basin Drain.	CDFG, USFWS, USBR	3406(e)(1), 3406(e)(6)	Medium

Miscellaneous small tributaries

Evaluation	Involved parties	Tools	Priority
◗1. Encourage the restoration of small tributaries by evaluating the feasibility of screening or relocating diversions, switching to alternative sources of water for upstream diversions, restoring and maintaining a protected riparian strip, enforcing dumping ordinances, removing toxic materials, replacing bridge and ford combinations with bridges or larger culverts and installing siphons to prevent truncation of small streams at irrigation canals.	CDFG, USFWS, USBR	3406(e)(6)	High
◗2. Evaluate the contribution of small Sacramento River tributaries as rearing areas for juvenile winter-, spring-, fall- and late-fall-run chinook salmon and steelhead.	CDFG, USFWS, USBR, Chico State University	3406(e)(6)	High

LOWER SACRAMENTO RIVER AND DELTA TRIBUTARIES

Feather River

Action	Involved parties	Tools	Priority
◗1. Improve flows for all life history stages of fall- and spring-run chinook salmon and steelhead.	CDWR, CDFG, USFWS, USBR	3406(b)(3)	High
2. Improve flows for American shad migration, spawning, incubation and rearing from April to June, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	Diverters, CDWR, CDFG, USFWS, USBR	3406(b)(3)	High
◗3. Develop and utilize a temperature model as a tool for river management.	CDWR		High

Evaluation	Involved parties	Tools	Priority
◗1. Evaluate the response of spawning salmonids to increased flows in the low-flow channel.	CDWR, CDFG		High
◗2. Evaluate the quality of spawning gravel in areas used by chinook salmon, and if indicated, consider gravel renovation or supplementation to enhance substrate quality.	CDWR		High
◗3. Evaluate the distribution of Feather River Fish Hatchery chinook salmon in Central Valley stocks and determine the genetic integrity of Feather River spring-run chinook salmon.	CDWR, CDFG		Low

Evaluation	Involved parties	Tools	Priority
4. Identify and attempt to maintain adequate flows and temperatures for white sturgeon and green sturgeon migration, spawning, incubation and rearing from February to May, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	CDFG, CDWR		High
5. Identify and remove physical and water quality barriers that impede access for white sturgeon and green sturgeon to spawning habitat or facilitate passage around these barriers.	CDFG, CDWR		Medium
6. Identify the extent of white sturgeon and green sturgeon entrainment at diversions and pumps and reduce or eliminate entrainment if found to be substantial.	CDFG, CDWR		Medium
7. Identify white sturgeon and green sturgeon spawning sites and evaluate the availability and use by adult sturgeon of spawning habitat.	CDFG, CDWR		High
8. Determine the effects of poaching and fishing on the number of spawning white sturgeon and green sturgeon.	CDFG		Low
9. Identify and implement actions that maintain mean daily water temperatures between 61°F and 65°F for at least one month from April 1 to June 30 for American shad spawning, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	CDFG, CDWR		High

Yuba River

Action	Involved parties	Tools	Priority
1. Improve flows for all life history stages of chinook salmon and steelhead.	Yuba County Water Agency (YCWA), SWRCB, CDFG, USFWS, USBR	3406(b)(3)	High
2. Improve flows for American shad migration, spawning, incubation and rearing from April to June, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	YCWA, SWRCB, CDFG, USFWS, USBR	3406(b)(3)	High
3. Reduce and control flow fluctuations to avoid and minimize adverse effects to juvenile salmonids.	YCWA, PG&E, SWRCB, CDFG		High
4. Maintain adequate instream flows for temperature control.	YCWA, CDFG, USFWS, USBR	3406(b)(3)	High
5. Improve efficiency of screening devices at Hallwood-Cordua and Brophy-South Yuba water diversions, and construct screens at the Browns Valley water diversion and other unscreened diversions.	Diverters, SWRCB, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium

Action	Involved parties	Tools	Priority
6. Construct or improve fish bypasses at Hallwood-Cordua and Brophy-South Yuba water diversions.	Diverters, SWRCB, USFWS, USBR, NMFS, CDFG, CDWR		Medium
7. Facilitate passage of spawning adult salmonids by maintaining appropriate flows through the fish ladders, or by modifying the fish ladders at Daguerre Point Dam.	YCWA, CDFG, COE, USFWS, USBR	3406(b)(3)	Medium
8. Purchase streambank conservation easements to improve salmonid habitat and instream cover.	Landowners, YCWA, BLM, USFWS, USBR		High
9. Increase river patrols in areas where poaching is a concern.	CDFG		Low
10. Facilitate passage of juvenile salmonids by modifying the dam face of Daguerre Point Dam.	YCWA, CDFG, COE		Medium
11. Operate reservoirs to provide adequate water temperatures for anadromous fish.	Yuba River Water Temperature Advisory Committee, SWRCB		High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the effectiveness of pulse flows to facilitate successful juvenile salmonid emigration.	YCWA, CDFG, USFWS, USBR	3406(e)(6)	High
2. Evaluate whether enhancement of water temperature control via shutter configuration and present management of the cold water pool at New Bullards Bar Dam is effective, and modify the water release outlets at Englebright Dam if it is effective.	YCWA, CDFG, PG&E, USFWS, USBR	3406(e)(6)	High
3. Identify and attempt to implement actions that will maintain mean daily water temperatures between 61°F and 65°F for at least one month from April 1 to June 30 for American shad, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	YCWA, CDFG, USFWS, USBR	3406(g)	High
4. Evaluate the benefits of restoring stream channel and riparian habitats of the Yuba River, including the creation of side channels for spawning and rearing habitats for salmonids.	YCWA, CDFG, USFWS	3406(e)(6)	High

Bear River

Action	Involved parties	Tools	Priority
1. Improve flows for all life history stages of chinook salmon and steelhead.	South Sutter Water District (SSWD), SWRCB, CDFG, USFWS, USBR	3406(b)(3)	High
2. Provide adequate water temperatures for all life-stages of chinook salmon and steelhead.	SSWD, SWRCB, CDFG		High
3. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
4. Negotiate removal or modification of the culvert crossing at Patterson Sand and Gravel and other physical and chemical barriers impeding anadromous fish migration.	Patterson Sand and Gravel, CDFG, USFWS, USBR		Medium

Evaluation	Involved parties	Tools	Priority
1. Complete an Instream Flow Incremental Methodology study to contribute to the understanding of the flows needed to protect all life stages of salmonids.	SSWD, CDFG, USFWS, USBR		High

Evaluation	Involved parties	Tools	Priority
2. Evaluate the extent that white sturgeon and green sturgeon use the Bear River for spawning and rearing.	CDFG, USFWS		High
3. Monitor water quality, particularly at agricultural return outfalls, and evaluate potential effects on anadromous fish.	Diverters, CDFG		High
4. Evaluate the extent that poaching or fishing reduces the numbers of adult sturgeon.	CDFG, USFWS		Low

American River

<table>
<tr><th>Action</th><th>Involved parties</th><th>Tools</th><th>Priority</th></tr>
<tr><td>1. Develop and implement a river regulation plan that meets the following flow objectives by modifying CVP operations, using (b)(2) water, and acquiring water from willing sellers as needed.
<table>
<tr><th rowspan="2">Month</th><th colspan="4">American River minimum flow objectives[a] (cfs)</th></tr>
<tr><th>Wet[b]</th><th>Above and below normal</th><th>Dry and critical</th><th>Critical relaxation</th></tr>
<tr><td>October</td><td>2,500</td><td>2,000</td><td>1,750</td><td>800</td></tr>
<tr><td>November-February</td><td>2,500</td><td>2,000</td><td>1,750</td><td>1,200</td></tr>
<tr><td>March-May</td><td>4,500</td><td>3,000</td><td>2,000</td><td>1,500</td></tr>
<tr><td>June</td><td>4,500</td><td>3,000</td><td>2,000</td><td>500</td></tr>
<tr><td>July</td><td>2,500</td><td>2,500</td><td>1,500</td><td>500</td></tr>
<tr><td>August</td><td>2,500</td><td>2,000</td><td>1,000</td><td>500</td></tr>
<tr><td>September</td><td>2,500</td><td>1,500</td><td>500</td><td>500</td></tr>
</table>
[a] A multi-agency and interested party management team should be formed to review and adjust flows in consideration of carryover storage and hydrologic conditions as needed to provide for the long-term needs of anadromous fish. Flow objectives should be met for the entire reach of the American River downstream of Nimbus Dam.
[b] Year types should be based on an American River index, or on consideration of carryover storage and hydrologic conditions in the American River watershed.</td><td>Sacramento Area Water Forum (SAWF), CDFG, USBR, USFWS</td><td>3406(b)(1)(B), 3406(b)(2), 3406(b)(3)</td><td>High</td></tr>
</table>

Action	Involved parties	Tools	Priority
2. Develop a long-term water allocation plan for the American River watershed.	SAWF, CDFG, Other water users, USFWS, USBR	3406(b)(1)(B), 3406(b)(2), 3406(b)(3)	High
◗3. Reduce and control flow fluctuations to avoid and minimize adverse effects on juvenile salmonids.	USFWS, USBR, CDFG	3406(b)(9)	High
◗4. Reconfigure Folsom Dam shutters for improved management of Folsom Reservoir's cold water pool and better control over the temperature of water released downstream.	USFWS, USBR, CDFG	3406(b)(1)(B)	High
5. Replenish spawning gravel and restore existing spawning grounds.	USFWS, USBR, CDFG	3406(b)(13)	High
6. Improve the fish screen at Fairbairn Water Treatment Plant.	City of Sacramento, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
7. Modify the timing and rate of water diverted from the river annually to reduce entrainment losses of juvenile salmonids.	City of Sacramento, Other water users, CDFG, USFWS, USBR	3406(b)(1)(B)	Medium

Action	Involved parties	Tools	Priority
8. Develop a riparian corridor management plan to improve and protect riparian habitat and instream cover.	County of Sacramento, Sacramento Area Flood Control Association (SAFCA), COE, USFWS, USBR, CDFG	3406(b)(13)	High
9. Terminate current programs that remove woody debris from the river channel.	County of Sacramento, City of Sacramento, SAFCA, COE, USFWS, USBR, CDFG		High
10. Conduct river patrols in areas where poaching is a concern.	CDFG		Low
▶11. Increase flows for American shad migration, spawning, incubation and rearing from April to June, by modifying CVP operations, by using dedicated water, and by acquiring water from willing sellers, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	SAWF, USFWS, USBR, CDFG	3406(b)(1)(B), 3406(b)(2), 3406(b)(3)	High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the effectiveness of pulse flows to facilitate successful emigration of juvenile salmonids.	USFWS, USBR, CDFG		High
2. Evaluate and refine a river regulation plan that provides flows to protect all life stages of anadromous fish based on water storage at Folsom Reservoir and predicted hydrologic conditions in the American River watershed.	SAWF, CDFG, USFWS, USBR	3406(g)	High

Mokelumne River

Action	Involved parties	Tools	Priority
1. Improve flows for all life history stages of chinook salmon and steelhead.	East Bay Municipal Utility District (EBMUD), Woodbridge Irrigation District (WID), FERC, CDFG, USFWS	3406(b)(3)	High
2. Replenish gravel suitable for salmonid spawning habitat.	CDFG, EBMUD		High
3. Cleanse spawning gravel of fine sediments and prevent sedimentation of spawning gravel.	CDFG, EBMUD		High

Action	Involved parties	Tools	Priority
4. Reduce and control flow fluctuations to avoid and minimize adverse effects to juvenile salmonids.	CDFG, EBMUD		High
5. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, CDFG, CDWR, USFWS, USBR, NMFS	3406(b)(21)	Medium
6. Maintain suitable water temperatures for all salmonid life stages.	EBMUD, CDFG		High
7. Enhance and maintain the riparian corridor to improve streambank and channel rearing habitat for juvenile salmonids.	Landowners, CDFG		High
8. Establish and enforce water quality standards to provide optimal water quality for all life history stages of salmonids.	CDFG		High
9. Increase river patrols in areas where poaching is a concern.	CDFG		Low
10. Eliminate or restrict gravel mining operations in the Mokelumne River flood plain to prevent damage to potential spawning areas and encroachment of vegetation.	Gravel miners, CDFG		High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the effectiveness of pulse flows to facilitate successful emigration of juvenile salmonids in the spring, and determine the efficacy in all water year types.	EBMUD, CDFG, USFWS, USBR	3406(e)(6)	High

Evaluation	Involved parties	Tools	Priority
2. Evaluate and facilitate passage of spawning adult salmonids in the fall and juvenile salmonids in the spring past Woodbridge Irrigation District Diversion Dam and Lodi Lake.	WID, City of Lodi, EBMUD, CDFG, USFWS	3406(e)(3)	Medium
3. Evaluate the incidence of predation on juvenile salmonids emigrating past Woodbridge Dam, and investigate potential remedial measures if necessary.	WID, EBMUD, CDFG, USFWS, USBR	3406(e)(6)	Medium
4. Evaluate the effects of extending the closure of the fishing season from 31 December to 31 March (and possibly to 1 June) to protect juvenile salmonids and adult steelhead and prevent anglers from wading on redds.	CDFG		Low

Cosumnes River

Action	Involved parties	Tools	Priority
1. Reduce water diversions or augment instream flows during critical periods for salmonids.	Diverters, CDFG, USFWS, USBR	3406(b)(3)	High
2. Pursue opportunities to purchase existing water rights to ensure adequate flows for all life stages of salmonids.	CDFG, The Nature Conservancy (TNC), USFWS, USBR	3406(b)(3)	High

Action	Involved parties	Tools	Priority
3. Enforce Fish and Game Codes that prohibit construction of unlicensed dams.	CDFG		Medium
4. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, CDFG, CDWR, USFWS, USBR, NMFS, TNC	3406(b)(21)	Medium
5. Establish a riparian corridor protection zone.	TNC, Landowners, CDFG		High
6. Rehabilitate damaged areas and remedy incompatible land practices to reduce sedimentation and instream water temperatures.	TNC, Landowners, CDFG		High

Evaluation	Involved parties	Tools	Priority
1. Determine and evaluate instream flow requirements that ensure adequate flows for all life stages of all salmonids.	Diverters, TNC, CDFG, USFWS, USBR	3406(e)(6)	High
2. Evaluate and facilitate passage of adult and juvenile salmonids at existing diversion dams and barriers.	Diverters and dam builders, TNC, CDFG, USBR, USFWS	3406(e)(3)	Medium

Evaluation	Involved parties	Tools	Priority
3. Evaluate the feasibility of restoring and increasing available spawning and rearing habitat for salmonids.	TNC, CDFG, USBR, USFWS	3406(e)(6)	High

Calaveras River

Action	Involved parties	Tools	Priority
1. Improve flows for all life history stages of chinook salmon.	Calaveras County Water District, Stockton East Water District (SEWD), CDFG, COE, USFWS, USBR	3406(b)(3)	High
2. Provide flows of suitable water temperatures for all salmonid life stages.	CDFG, USFWS, USBR	3406(b)(3)	High
3. Facilitate passage of adult and juvenile salmonids at existing diversion dams and barriers.	Diverters, CDFG		Medium

Action	Involved parties	Tools	Priority
4. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, CDFG, CDWR, USFWS, NMFS, USBR	3406(b)(21)	Medium

Evaluation	Involved parties	Tools	Priority
1. Monitor sport fishing and evaluate the need for regulations to protect salmonids.	CDFG		Low

SAN JOAQUIN BASIN

Merced River

Action	Involved parties	Tools	Priority
1. Supplement flows provided pursuant to the Davis-Grunsky Contract Number D-GGR17 and FERC License Number 2179 as needed to improve conditions for all life history stages of chinook salmon.	Merced Irrigation District (MID), Diverters, CDFG, CDWR, USFWS, USBR	3406(b)(3)	High
2. Reduce adverse effects of rapid flow fluctuations.	MID, CDFG, USFWS, USBR		High

Action	Involved parties	Tools	Priority
3. Improve watershed management to restore and protect instream and riparian habitat, including consideration of restoring and replenishing spawning gravel.	Landowners, Merced County, NRCS, CDFG, USFWS, USBR		High
4. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
5. Provide additional law enforcement to reduce illegal take of salmon, stream alteration, and water pollution and to ensure adequate protection for juvenile salmon at pumps and diversions.	CDFG		High
6. Establish a "streamwatch" program to increase public participation in river management.	Public, CDFG, USFWS		Low

Evaluation	Involved parties	Tools	Priority
1. Identify and implement actions to provide suitable water temperatures for all life stages of chinook salmon; establish maximum temperature objectives of 56°F from October 15 to February 15 for incubation and 65°F from April 1 to May 31 for juvenile emigration.	Dam operators, CDFG, USFWS, USBR	3406(g)	High
2. Evaluate and implement actions to reduce predation on juvenile chinook salmon, including actions to isolate "ponded" sections of the river.	CDFG, USFWS, USBR	3406(e)(6)	Medium

Tuolumne River

Action	Involved parties	Tools	Priority
◗1. Implement a flow schedule as specified in the terms of the pending FERC order resulting from the New Don Pedro Project (FERC Proceeding P-2299-024). Supplement FERC agreement flows as needed to improve conditions for all life history stages of chinook salmon.	City and County of San Francisco, Turlock Irrigation District (TID), MID, FERC, USFWS, USBR	3406(b)(3)	High
2. Reduce adverse effects of rapid flow fluctuations.	Diverters, Hydropower operators, CDFG, USFWS, USBR		High
3. Improve watershed management and restore and protect instream and riparian habitat, including consideration of restoring and replenishing spawning gravel.	Landowners, NRCS, CDFG, USFWS, USBR		High
4. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium

Action	Involved parties	Tools	Priority
5. Provide additional law enforcement to reduce illegal take of salmon, stream alteration, and water pollution and to ensure adequate protection for juvenile salmon at pumps and diversions.	CDFG		High
6. Support the Tuolumne River Interpretive Center.	CDFG		Low
7. Establish a "streamwatch" program to increase public participation in river management.	Public, CDFG, USFWS		Low

Evaluation	Involved parties	Tools	Priority
1. Identify and implement actions to provide suitable water temperatures for all life stages of chinook salmon; establish maximum temperature objectives of 56°F from October 15 to February 15 for incubation and 65°F from April 1 to May 31 for juvenile emigration.	Dam operators, CDFG, USFWS, USBR	3406(g)	High
2. Evaluate and implement actions to reduce predation on juvenile chinook salmon, including actions to isolate "ponded" sections of the river.	TID, MID, CDFG, USFWS, USBR	3406(e)(6)	Medium

Stanislaus River

<table>
<tr><th>Action</th><th>Involved parties</th><th>Tools</th><th>Priority</th></tr>
<tr><td>1. Implement an interim river regulation plan that meets the following flow schedule by supplementing the 1987 agreement between USBR and CDFG[a], through reoperation of New Melones Dam, use of (b)(2) water, and acquisition of water from willing sellers as needed.
<table>
<tr><th rowspan="2">Month</th><th colspan="5">Stanislaus River flow schedules (cfs) by year type[b]</th></tr>
<tr><th>Wet</th><th>Above normal</th><th>Below normal</th><th>Dry</th><th>Critical</th></tr>
<tr><td>October</td><td>350</td><td>350</td><td>250</td><td>250</td><td>200</td></tr>
<tr><td>November-March</td><td>400</td><td>350</td><td>300</td><td>275</td><td>250</td></tr>
<tr><td>April</td><td>1,500</td><td>1,500</td><td>300/1500[c]</td><td>300/1500[d]</td><td>300/1500[e]</td></tr>
<tr><td>May</td><td>1,500</td><td>1,500</td><td>1500/300[c]</td><td>1500/300[d]</td><td>1500/300[e]</td></tr>
<tr><td>June</td><td>1,500</td><td>800</td><td>250</td><td>200</td><td>200</td></tr>
<tr><td>July-September</td><td>300</td><td>300</td><td>250</td><td>200</td><td>200</td></tr>
<tr><td>Total (taf)</td><td>468</td><td>410</td><td>313</td><td>257</td><td>247</td></tr>
<tr><td>Baseline (taf)</td><td>1,015</td><td>722</td><td>406</td><td>242</td><td>269</td></tr>
<tr><td>Unimpaired (taf)</td><td>1,772</td><td>1,291</td><td>920</td><td>631</td><td>449</td></tr>
</table>
[a] Existing flow requirements are 98 to 302 taf, based on the 1987 agreement between CDFG and USBR (CDFG and USBR 1987); actual schedule is determined on an annual basis and depends on available yield, carryover storage, and hydrologic conditions.
[b] Year type based on San Joaquin basin 60-20-20 index. Flow schedules are releases from Goodwin Dam.
[c] In a below normal water year, April-May flow would be maintained for 45 days at 1500 cfs and 16 days at 300 cfs.
[d] In a dry water year, April-May flow would be maintained for 30 days at 1500 cfs and 31 days at 300 cfs.
[e] In a critical water year, April-May flow would be maintained at 1500 cfs for 30 days and at 300 cfs for 31 days.</td><td>CDFG, USFWS, USBR, Oakdale Irrigation District, South San Joaquin Irrigation District, Stockton East Water District, Central San Joaquin Water Conservation District</td><td>3406(b)(1)(B), 3046(b)(2), 3406(b)(3)</td><td>High</td></tr>
</table>

Action	Involved parties	Tools	Priority
2. Improve watershed management to restore and protect instream and riparian habitat.	Landowners, CDFG, NRCS, USFWS, USBR		High
3. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
4. Provide additional law enforcement to protect against illegal take of salmon, stream alteration, and water pollution and to ensure adequate screening of pumps and diversions.	CDFG		High

Evaluation	Involved parties	Tools	Priority
1. Identify and implement actions to provide suitable water temperatures for all life stages of chinook salmon, consistent with efforts to maintain adequate flows to provide fish habitat. Establish maximum temperature objectives of 56°F from October 15 to February 15 for incubation and 65°F from April 1 to May 31 for juvenile rearing and emigration.	Dam operators, CDFG, USFWS, USBR	3406(g)	High
2. Evaluate and implement actions to reduce predation on juvenile chinook salmon, including actions to isolate "ponded" sections of the river.	CDFG, USFWS, USBR	3406(e)(6)	Medium
3. Evaluate and refine a river regulation plan that provides adequate flows to protect all life stages of anadromous fish based on water storage at New Melones Reservoir and predicted hydrologic conditions.	USFWS, USBR, CDFG		High

Evaluation	Involved parties	Tools	Priority
4. Develop a carryover storage target for New Melones Reservoir to ensure Vernalis flow standards are met during the 30-day pulse flow period during the third year of a dry or critical period. This will protect at least one of three year classes of chinook salmon during emigration.	USFWS, USBR, CDFG	3406(g)	High
5. Evaluate use of the Stanislaus River by American shad and consider increasing flows and maintaining mean daily water temperatures between 61°F and 65°F from April to June when hydrologic conditions are adequate to minimize adverse effects to water supply operations and in a manner consistent with actions to protect chinook salmon.	Dam operators, CDFG, USFWS, USBR	3406(g)	High

Mainstem San Joaquin River

Action	Involved parties	Tools	Priority
1. Coordinate with CDFG and others to implement a flow schedule that improves conditions for San Joaquin chinook salmon migrating through, or rearing in, the lower San Joaquin River and Sacramento-San Joaquin Delta.	River and tributary water managers and diverters, CDFG, SWRCB, USFWS, USBR	3406(b)(3)	High

Action	Involved parties	Tools	Priority
◗2. Develop and implement an export schedule that will protect San Joaquin chinook salmon migrating through, or rearing in, the Sacramento-San Joaquin Delta.	River and tributary water managers and diverters, CDFG, SWRCB, CDWR, USFWS, USBR	3406(b)(3)	High
3. Develop an equitable, integrated San Joaquin Basin plan that will meet outflow:export objectives identified under Actions 1 and 2.	River and tributary water managers and diverters, CDFG, SWRCB, CDWR, USFWS, USBR		High
◗4. Reduce or eliminate entrainment of juvenile chinook salmon at Banta-Carbona, West Stanislaus, Patterson, and El Soyo diversions by implementing the Anadromous Fish Screen Program in conjunction with other programs.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
5. Reduce or eliminate entrainment of juvenile chinook salmon at smaller riparian pumps and diversions on the mainstem San Joaquin River.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium

Action	Involved parties	Tools	Priority
6. Prohibit the dredging of the Stockton ship channel during critical periods.	CDFG, CDWR, COE		High
7. Establish a basin-wide conjunctive water use program.	River and tributary water managers and diverters, CDFG, CDWR, USBR, USFWS		High
8. Attempt to improve flows for migration of steelhead, consistent with efforts to maintain adequate flows for chinook salmon.	River and tributary water managers and diverters, CDFG, USFWS, USBR	3406(b)(3)	High

Evaluation	Involved parties	Tools	Priority
1. Identify and implement actions to improve watershed management to restore and protect instream and riparian habitat.	Landowners, CDFG		High

Evaluation	Involved parties	Tools	Priority
2. Identify and implement actions to maintain suitable water temperatures or minimize length of exposure to unsuitable water temperatures for all life stages of chinook salmon in the San Joaquin River and Delta.	River and tributary water managers and diverters, CDFG, USFWS, USBR	3406(g)	High
3. Identify and implement actions to reduce predation on juvenile chinook salmon.	CDFG, USFWS		Medium
4. Identify and attempt to maintain adequate flows for migration, spawning, incubation and rearing of white sturgeon and green sturgeon from February to May, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	River and tributary water managers and diverters, CDFG, CDWR		High
5. Identify and attempt to implement actions that will maintain mean daily water temperatures between 61°F and 65°F for at least one month from April 1 to June 30 for American shad, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	CDFG, USFWS, USBR	3406(g)	High

SACRAMENTO-SAN JOAQUIN DELTA

Improvements to aquatic habitat in the Delta are essential to restore the natural production of anadromous fish in the Central Valley because habitat in the Delta is highly degraded and all species and races of fish use the Delta at some stage in their life history.

Recent actions to improve fish habitat in the Delta are described in the 15 December 1994, Principles of Agreement on Bay-Delta Standards between the State of California and the Federal Government (Bay-Delta Agreement) and the SWRCB's Water Quality Control Plan (WQCP)(SWRCB 1995).

Both the Bay-Delta Agreement and WQCP require operational flexibility of state and federal water projects to provide protection for anadromous fish with no additional loss of water supply annually. The WQCP delegates substantial authority, subject to veto by the SWRCB Executive Director, to the Operations Coordination Group (Ops Group). The Ops Group has the responsibility to use the operational flexibility of the State Water Project (SWP) and Central Valley Project (CVP) in such ways that species using the estuary receive more protection than they would have received by strict adherence to WQCP standards.

Operational flexibility allows the Ops Group to meet operational targets that contribute to doubling natural production of anadromous fish, and the Bay-Delta Agreement's criterion to maintain water quality conditions which, together with other measures in the watershed, are sufficient to achieve a doubling of production of chinook salmon. The operational targets listed in the first table below are the AFRP recommendations to the Ops Group. These targets allow variability in the timing and nature of operations to meet requirements in the WQCP and do not involve costs to water supply beyond the Bay-Delta Agreement.

A second table lists supplemental actions that involve changes in operations beyond the authority of the Ops Group that further contribute to meeting the AFRP goal and the Bay-Delta Agreement's criterion. These actions consist of two categories, those requiring water and those not requiring water. Supplemental actions that require water will be limited by the water available through management of 800,000 af of CVP yield (Section 3406(b)(2)) and acquisition of water from willing sellers (Section 3406(b)(3)). Use of these tools will avoid unreasonable effects on water supply.

Supplemental actions not requiring water include screens at diversions, law enforcement, and educational programs. These actions are not under the direct authority of the Ops Group or addressed by the WQCP, however, some actions may be addressed by Category III of the Bay-Delta Agreement.

The following operational targets, supplemental actions, and evaluations are intended to be consistent with and supportive of the CALFED Bay-Delta process.

Operational target	Involved parties	Tools	Priority
◗1. Close Delta Cross Channel (DCC) up to 45 days in the November through January period, when juvenile salmon enter the Delta or flow or turbidity changes trigger salmon migration.	CALFED agencies	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	High[1]
◗2. Make operational changes in flow or export rates, or both, to prevent juvenile chinook salmon from being diverted to the southern Delta when the DCC is closed in the November through January period.	CALFED agencies	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	High
◗3. Maximize DCC closure in the May through June period when Sacramento River chinook salmon are abundant, but keep open when striped bass and other sensitive species are abundant in the lower San Joaquin River.	CALFED agencies	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	High[2]
◗4. Maintain an average export:inflow ratio of no more than 45% during February in dry years by increasing the ratio to ~55% in early February and decreasing the ratio to ~35% in late February, when winter-run chinook salmon smolts are abundant.	CALFED agencies	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	High

[1]Although Operational target 1 addresses fish passage, it was assigned high priority because potential to increase fish production is great.

[2]Although Operational target 3 addresses fish passage, it was assigned high priority because potential to increase fish production is great.

Operational target	Involved parties	Tools	Priority
◗5. Assist the CVP in achieving the operational targets listed above, by filling the CVP portion of San Luis Reservoir in the fall using SWP pump capacity, if available.	CALFED agencies	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	High
◗6. Minimize fish losses and predation at facilities by operating state and federal pumps interchangeably.	CALFED agencies	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	Medium

Supplemental action requiring water	Involved parties	Tools	Priority
◗7. Limit the combined SWP and CVP exports to 1,500 cfs or maintain a Vernalis inflow:total export ratio of 5 to 1 during the April through May pulse flow period.	CALFED agencies	3406(b)(2), 3406(b)(3)	High
8. Limit the combined SWP and CVP exports to 1,500 cfs for more than the 30 days required by the WQCP, when San Joaquin River chinook salmon smolts are abundant, or when large striped bass spawning events occur in the lower San Joaquin River.	CALFED agencies	3406(b)(2), 3406(b)(3)	High
9. Increase the Vernalis pulse flow period to more than the 30 days required by the WQCP, when San Joaquin River chinook salmon smolts are abundant and temperatures are below 68°F. (Do in conjunction with action 8.)	CALFED agencies	3406(b)(2), 3406(b)(3), 3406(b)(8)	High
◗10. Make operational changes in flow or export rates, or both, to prevent juvenile chinook salmon from being diverted to the southern Delta when the DCC is closed in the November through January period.	CALFED agencies	3406(b)(2), 3406(b)(3)	High

Supplemental action requiring water	Involved parties	Tools	Priority
◗11. Reduce exports and increase Delta outflow from April through July to begin restoration of striped bass production.	CALFED agencies	3406(b)(2), 3406(b)(3)	High
12. Construct and operate a seasonal barrier at the head of Old River to improve conditions for chinook salmon migration and survival if evaluation 1 determines that a barrier can be operated to improve conditions for salmon with minimal adverse effects on other Delta species.	CALFED agencies	3406(b)(2), 3406(b)(3), 3406(b)(15)	High[1]
◗13. Maintain at least 13,000 cfs daily flow in the Sacramento River at the I Street Bridge during May. The CVPIA contribution from (b)(2) and (b)(3) water should be used to augment Delta outflow.	CALFED agencies	3406(b)(2), 3406(b)(3)	High
◗14. Supplement Delta outflow for migration and rearing of white sturgeon, green sturgeon, striped bass, and American shad by modifying CVP operations and using water available under the CVPIA (3406(b)(2) and (3)), consistent with actions to protect chinook salmon and steelhead.	USFWS, USBR, CDFG, CDWR	3406(b)(1)(B), 3406(b)(2), 3406(b)(3)	High
15. Minimize to the extent possible riparian diversions in the Delta during the April through May pulse flow period and at other times when anadromous fish are abundant.	Diverters, CALFED agencies	3406(b)(2), 3406(b)(3)	High
16. Develop and implement a program that provides for modified operations and new or improved control structures at the DCC and Georgiana Slough during times when high numbers of striped bass eggs, larvae, and juveniles are in these areas.	CDFG, USFWS, USBR, CDWR	3406(b)(2), 3406(b)(3), 3406(b)(14)	Medium

[1]Although Supplemental action 12 addresses fish passage, it was assigned high priority because potential to increase fish production is great.

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Supplemental action not requiring water	Involved parties	Tools	Priority
17. Implement actions to reduce losses of juvenile anadromous salmonids resulting from unscreened or inadequately screened diversions in the Sacramento-San Joaquin Delta and Suisun Marsh.	Diverters, CDFG, CDWR, USFWS, USBR, NMFS	3406(b)(21)	Medium
18. Provide additional funding for increased enforcement of fishery regulations in the Delta.	CDFG, USFWS, USBR, CDWR		Low
19. Sponsor workshops to review and clarify new scientific information regarding the effects of export pumping.	SWP and CVP contractors, IEP agencies		Low
20. Increase public education efforts and hazardous waste pick-ups to minimize water quality impacts associated with the use of pesticides and other hazardous materials.	Local groups, Regional WRCB, SWRCB, USFWS, USBR		High

Evaluation	Involved parties	Tools	Priority
1. Evaluate whether a barrier at the head of Old River can be operated to improve conditions for chinook salmon migration and survival with minimal adverse effects on other Delta species.	CALFED agencies	3406(b)(15)	High[1]

[1]Although Evaluation 1 addresses fish passage, it was assigned high priority because resulting information is needed before Supplemental action 12 can be implemented.

Evaluation	Involved parties	Tools	Priority
▶2. Evaluate the effects of net reverse flows on juvenile salmonids migrating in the San Joaquin River near the mouth of the Mokelumne River with an intensive monitoring program of marked (radio, sonic, or other tags) and unmarked smolts.	SWP and CVP contractors, IEP agencies, EBMUD	3406(e)(5)	High
3. Evaluate potential benefits and opportunities to increase salmonid production through improved riparian habitats in the Delta.	SWP and CVP contractors, TNC, IEP agencies	3406(e)(1)	High
▶4. Evaluate opportunities to provide modified operations and a new or improved control structure for the DCC and Georgiana Slough or other methods at those locations to assist in the successful migration of anadromous salmonids.	SWP and CVP contractors, IEP agencies	3406(b)(14), 3406(e)(5)	High[2]
▶5. Evaluate alternative water conveyance and storage facilities for the SWP and CVP in the Delta to avoid or minimize adverse effects on anadromous fish.	CALFED Bay-Delta Program, SWP and CVP contractors, IEP agencies	3406(g)	High
6. Evaluate benefits of DCC closure to anadromous fish relative to time of day and tidal stage.	SWP and CVP contractors, IEP agencies	3406(b)(14), 3406(e)(5)	Medium

[2]Although Evaluation 4 addresses fish passage, it was assigned high priority because the potential to increase fish production is great.

Evaluation	Involved parties	Tools	Priority
7. Evaluate opportunities to create tidal shallow-water habitat to increase rearing habitat for anadromous fish in the Delta.	SWP and CVP contractors, TNC, IEP agencies		High
8. Evaluate feasibility of Delta channel barriers and other technologies to improve water quality and to guide migrating fish.	SWP and CVP contractors, IEP agencies		Medium
9. Evaluate riparian restoration opportunities, such as conservation easements, that are coordinated with restoration of rearing habitats and consistent with flood control and other objectives.	Local interests, SWP and CVP contractors, TNC, IEP agencies	3406(g)	High
10. Evaluate opportunities to reduce the number of Delta diversions through land retirement and consolidation of diversion points.	Diverters, Landowners, IEP agencies		Medium
11. Evaluate existing angling regulations to identify options that would increase anadromous fish production.	Angler groups, CDFG		Low
12. Evaluate land retirement as a means of improving water quality and riparian and rearing habitats, and reducing the number of diversions in the Delta.	Diverters, Landowners, IEP agencies	3406(e)(1), 3406(g)	High
13. Evaluate opportunities to develop channel buffer zones to enhance riparian areas and reduce sedimentation.	Landowners, TNC, IEP agencies	3406(g)	High

Evaluation	Involved parties	Tools	Priority
◗14. Evaluate effects of pulse flows on chinook salmon migration.	SWP and CVP contractors, IEP agencies		High
15. Evaluate actions to reduce loss and entrainment of eggs, larvae, and juveniles of anadromous fish by screening or relocating riparian diversions in the Delta.	USFWS, USBR, CDFG, CDWR		Medium
◗16. Evaluate potential measures of Delta hydraulic conditions.	SWP and CVP contractors, IEP agencies	3406(g)	High

CENTRAL VALLEY-WIDE

Action	Involved parties	Tools	Priority
1. Support programs to provide educational outreach to local communities, including programs like Salmonids in the Classroom, Aquatic Wild, and Adopt a Watershed.	Local schools, CDFG, USFWS, NMFS		Low
2. Develop programs to educate the public about anadromous fish issues, such as the effects of poaching.	CDFG, USFWS, NMFS		Low

Evaluation	Involved parties	Tools	Priority
1. Evaluate the need to revise harvest regulations to increase spawning escapement of naturally produced chinook salmon.	CDFG, Pacific Fisheries Management Council (PFMC)		Low
2. Evaluate the potential to modify hatchery procedures to benefit native stocks of salmonids.	CDFG, CDWR, USFWS, USBR	3406(e)(2)	Low
3. Evaluate and avoid potential competitive displacement of naturally produced juvenile salmonids with hatchery-produced juveniles by implementing release strategies for hatchery-produced fish designed to minimize detrimental interactions.	CDFG, CDWR, USFWS, USBR	3406(e)(2)	Low
4. Evaluate and implement specific hatchery spawning protocols and genetic evaluation programs to maintain genetic diversity in hatchery and natural stocks.	CDFG, CDWR, USFWS, USBR	3406(e)(2)	Low
5. Evaluate the transfer of disease between hatchery and natural stocks.	CDFG, CDWR, USFWS, USBR	3406(e)(2)	Low
6. Evaluate effects of trace elements and organic contaminants, especially selenium and PCBs, on the health of adult white sturgeon and green sturgeon, the viability of their gametes, and development of their offspring.	CDFG, USFWS		High
7. Evaluate a program to tag and fin-clip all or a significant portion of hatchery-produced fish as a means of collecting better information regarding harvest rates on hatchery and naturally produced fish and effects of hatchery-produced fish on naturally produced fish.	CDFG, CDWR, USFWS, USBR, NMFS, EBMUD	3406(e)(2)	Low

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Evaluation	Involved parties	Tools	Priority
1. Evaluate the need to revise harvest regulations on both sport and commercial fishers to increase spawning escapement of naturally produced chinook salmon.	PFMC, CDFG		Low
2. Evaluate the effects of sea lion predation on chinook salmon production.	PFMC, CDFG, NMFS, USFWS		Low
3. Evaluate the effects of foreign, open-ocean harvest on Central Valley chinook salmon and steelhead stocks.	PFMC, NMFS, CDFG, USFWS		Low

REFERENCES CITED

California Coordinated Resource Management and Planning. 1990. California Coordinated Resource Management and Planning Handbook. 18 pp.

California State Water Resources Control Board. 1995. Water quality control plan for the San Francisco Bay/Sacramento-San Joaquin Delta estuary. May 1995 (95-1WR). Sacramento, CA.

Hilborn, R., and D. Ludwig. 1993. The limits of applied ecological research. Ecological Applications 3:550-552.

Ludwig, D., R. Hilborn, and C. Walters. 1993. Uncertainty, resource exploitation, and conservation: Lessons from history. Science 260:17.

Management Institute for Environment and Business. 1993. Conservation partnerships: a field guide to public-private partnering for natural resource conservation. Washington, D.C.; National Fish and Wildlife Foundation. 40 pp.

Memorandum of Understanding. 1991. California's coordinated regional strategy to conserve biodiversity: The agreement on biological diversity, September 19, 1991. 6 pp. Washington, D.C.; National Fish and Wildlife Foundation. 40 pp.

Mills, T. J. 1995. Restoring Central Valley streams: A plan for action, status of implementation. California Department of Fish and Game, Inland Fisheries Division. Sacramento, CA.

Mills, T. J., and F. Fisher. 1994. Central Valley anadromous sport fish annual run-size, harvest, and population estimates, 1967 through 1991. August 1994 draft. California Department of Fish and Game, Inland Fisheries Technical Report. Sacramento, CA.

National Marine Fisheries Service. 1994. Listing endangered and threatened species and designating critical habitat: Petition to list steelhead throughout its range in Washington, Oregon, California, and Idaho. Federal Register 59:27527-27528, May 27, 1994.

National Marine Fisheries Service. 1995. Listing endangered and threatened species and designating critical habitat: Petition to list chinook salmon throughout its range in California, Oregon, Washington, and Idaho. Federal Register 60:30263-30264, June 8, 1995.

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Reynolds, F. L., T. J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley streams: A plan for action. California Department of Fish and Game, Inland Fisheries Division. Sacramento, CA.

U.S. Fish and Wildlife Service. 1995. Working paper on restoration needs: Habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Volumes 1-3. May 9, 1995. Prepared for the U.S. fish and Wildlife Service under the direction of the Anadromous Fish Restoration Program Core Group. Stockton, CA.

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APPENDICES

A. AFRP Position Paper

Presented in its entirety below is the "Position Paper for Development of the Central Valley Anadromous Fish Restoration Program". The Position Paper was developed by the AFRP Core Group to guide program development. It was released to the public on July 18, 1994 and was slightly revised and re-released in Volume 2 of the Working Paper on Restoration Needs (USFWS 1995). Only the phone number to request copies has been revised since the last release.

POSITION PAPER FOR DEVELOPMENT OF THE CENTRAL VALLEY ANADROMOUS FISH RESTORATION PROGRAM

INTRODUCTION

The Plan of Action (POA) for the Central Valley Anadromous Fish Restoration Program (Program) identifies the steps necessary to develop the Program (USFWS 1994). One of the steps included the preparation of a Position Paper to be developed by the Core Group. This document is a draft of the Position Paper described in the POA.

This Position Paper is a reference document for use by the Core Group and the technical teams to guide Program development. Because it was impossible to anticipate all issues prior to drafting the Position Paper, this paper will be amended and supplements added as needed. To determine if your copy is current and to request copies of the Position Paper, contact the Public Information Officer, Central Valley Fish and Wildlife Restoration Program, 2800 Cottage Way, Sacramento, California 95825, (916) 979-2760.

The paper is divided into three sections: (1) Program goal and definitions, (2) Intent of Title 34, and (3) Implementation criteria. The first section states the Program goal and develops general definitions for each of the terms used in the Program goal. The second section presents and interprets the intent of Title 34 and reexamines some of the definitions presented in the first section. These first two sections lay the foundation for the last section.

In the last section, implementation criteria are discussed for the 1967-1991 (baseline) period and for the future. Discussions of implementation criteria are separated because the two periods require different criteria. As discussed later in this paper, limitations are imposed by the type or

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quantity of data collected during the baseline period. Future monitoring programs may be designed to avoid these limitations.

PURPOSE OF POSITION PAPER

The purposes of the Position Paper are two-fold: (1) to explain or clarify the Core Group's position on issues related to developing the Program and (2) to document reasons used to develop these positions.

PROGRAM GOAL AND RELATED DEFINITIONS

Title 34 requires that "...natural production of anadromous fish in Central Valley rivers and streams be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991..." (Section 3406[b][1]). Several terms need to be clearly defined before the program can be designed to meet this requirement: natural production, anadromous fish, Central Valley rivers and streams, sustainable, long-term basis, and average levels.

Natural Production

Title 34 defines natural production as: "... fish produced to adulthood without direct human intervention in the spawning, rearing, or migration processes" (Section 3403[h]). To apply this definition, we must develop an understanding of the meaning of each of the components of the definition. Important components that have been identified to date are the following: production, adulthood, and direct human intervention.

Production

Ricker (1958) defined production as "the total elaboration of new body substance in a stock in a unit of time, irrespective of whether or not it survives to the end of that time." Although Ricker's definition includes changes in mass as well as numbers of fish, Title 34 specifies "... fish produced to adulthood..." and therefore production will refer to numbers of fish produced.

Because a fish can only be "...produced to adulthood..." once in its lifetime, an individual fish should not be counted twice. In addition, production should be measured over a discrete time interval. Because all stocks under consideration are seasonal spawners, **a direct and simple approach will be to count the first-time spawners each spawning season.**

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Ricker's definition also states that a fish is counted toward production for the time period over which production is being measured "...irrespective of whether or not it survives to the end of that time". Using Ricker's definition, juvenile fish that did not survive to adulthood would be counted. The definition of natural production in Title 34 specifies "... fish produced to adulthood..." and therefore does not count juvenile fish. On the other hand, Title 34 does not discriminate between adult fish that return to spawn and those taken in recreational and commercial fisheries. Because Ricker's definition includes fish that do not survive to the end of the time period, and because the definition of natural production in Title 34 specifies fish produced to adulthood, **all naturally produced, adult fish shall be counted, including those that are harvested prior to spawning.**

Including harvested fish is consistent with the definition of production in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act. The California Act defines production as "the survival of fish to adulthood as measured by abundance of the recreational and commercial catch together with the return of fish to the states spawning streams." Because both the Federal and State acts have similar purposes and goals, and because implementation of both acts should be coordinated, it is convenient that the definitions of production being implemented for both acts are similar.

Whether or not a fish attains adulthood is key to determining whether or not to count that fish toward the production goal. Adulthood is defined below.

Adulthood

Section 3403(h) includes the phrase "...fish produced to adulthood..." as part of the definition of natural production. Adulthood is not defined within Title 34. Adulthood is generally defined as the state, condition or quality of being fully developed and mature. Applying this definition to fish is complicated by the fact that most fish continue to grow throughout life (i.e., cessation of growth can't be used to indicate full development) and may become sexually mature several times during their lifetime (i.e., although developed gonads can be used to indicate maturity, lack of developed gonads cannot be used to indicate immaturity). Because the presence or absence of external characters can't always be used to identify adult fish, and because sexual maturity (i.e., developed gonads) is a transitory state, fishery managers often use size or age criteria to indicate maturity.

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An adult fish will be defined as one that is capable of reproduction. Ability to reproduce should be based on some external characteristic, such as size. Because Title 34 requires that production be compared between baseline and goal periods, the same criteria for determination of adulthood will be applied to both periods.

Direct Human Intervention

The definition of natural production precludes "...direct human intervention..." in the spawning, rearing, or migration processes of an individual, naturally produced fish. A definition of direct human intervention is key to understanding the definition of natural production. Humans have pervasively intervened in the structure and function of the Sacramento-San Joaquin system. All anadromous fish that spawn in the system have been impacted by this intervention. Indeed, Title 34 has as one of its purposes "...to address impacts of the Central Valley Project on fish, wildlife, and associated habitats..." (Section 3402[b]). But not all human intervention is direct. The word direct is an important component of the phrase "...direct human intervention...".

Direct human intervention is any action taken in the absence of intervening elements. Any form of intervention that requires handling of fish is direct intervention due to a lack of intervening elements. Any action that includes one or more intervening elements would be considered indirect intervention.

Hatchery and artificial propagation, including supplementation and outplanting of eggs or any other life-stage, requires handling of fish by humans during the spawning and rearing processes and therefore are forms of direct intervention. Transporting fish, including truck and barge transport, and fish salvage require capture and handling of fish during the rearing or migration process and therefore are forms of direct intervention. Hatchery and artificial propagation, transport and salvage of fish, or any process that requires handling of any life-stage of fish will be considered direct human intervention.

Title 34 clearly states that fish produced with direct human intervention should not be included in counts of natural production. In developing the Program, we will avoid counting hatchery-produced fish or fish produced with any other form of direct human intervention in counts of natural production. The Core Group has determined that there will be one exception to this rule: the progeny of naturally spawning fish salvaged at the John E. Skinner Delta Fish Protective Facility and the Tracy Fish

Protective Facility, if they reach adulthood, will be counted as naturally produced.

An example of a form of intervention that does not fit the definition of direct intervention is flow manipulation. When we manipulate flow to benefit fish, flow acts as the intervening element. Humans directly alter flows and flows alter fish spawning, rearing, or migration processes. Therefore, flow manipulation is not a direct but an indirect form of intervention. Construction of fish ladders, screens and barriers are forms of indirect intervention because each of these structures act as the intervening element. Reservoir or flow manipulations (including Delta flows and flows to maintain desired stream temperatures), ladders, screens, barriers, and other forms of habitat alteration and enhancement activities will not be considered direct human intervention because each of these is or has an intervening element and does not require handling of fish.

Because the definition of natural production in Title 34 includes the phrase "...produced to adulthood...", fish that are not subject to direct human intervention until after they reach adulthood would still be considered naturally produced. For example, a naturally produced fish that returned to a hatchery and was spawned in the hatchery would be considered naturally produced. Obviously, its progeny would not be considered naturally produced because they were produced in a hatchery. Similarly, naturally produced adult fish whose migration was subject to direct human intervention would still be considered naturally produced, although their progeny would not be considered naturally produced.

Anadromous Fish

Title 34 defines anadromous fish as "...those stocks of salmon (including steelhead), striped bass, sturgeon, and American shad that ascend the Sacramento and San Joaquin rivers and their tributaries and the Sacramento-San Joaquin Delta to reproduce after maturing in San Francisco Bay or the Pacific Ocean" (Section 3403[a]). This definition identifies five groups or species of fish: salmon, steelhead, striped bass, sturgeon, and American shad. The American Fisheries Society recognizes steelhead as the common name for the anadromous form of *Oncorhynchus mykiss* and striped bass and American shad as the common names for *Morone saxatilis* and *Alosa sapidissima* (AFS 1991). Clearly, Title 34 includes these species in the definition of anadromous fish. The names salmon and sturgeon both include multiple species of fish and the meaning of these terms in relation to Program development needs clarification. The term "stocks" in the definition of anadromous fish also needs clarification.

Salmon - Salmon is a common name for at least six species of fish. Five species of salmon have been observed in the Sacramento River: chinook (*O. tshawytscha*), coho (*O. kisutch*), sockeye (*O. nerka*), pink (*O. gorbuscha*), and chum (*O. keta*) salmon (Moyle 1976, Fry 1973). Chinook salmon are common in the Sacramento-San Joaquin system, the other four species are rare. Based on observations of adults during 1949 through 1958, Hallock and Fry (1967) concluded that sockeye, pink, and chum salmon entered the Sacramento River regularly enough to be regarded as very small runs, but that coho salmon were so scarce and irregular that they should be regarded as strays. Juvenile coho salmon were planted in Mill Creek in 1956, 1957, and 1958, but by 1963 coho salmon were almost as scarce as they had been before the introductions (Hallock and Fry 1967). During the baseline period, there is no evidence that coho, sockeye, pink, or chum salmon maintained self-sustaining spawning runs in the Central Valley (Fisher pers. comm.). Because the definition of anadromous fish specifies "...salmon... that ascend the Sacramento and San Joaquin rivers...to reproduce..." and because chinook salmon is the only salmon known to reproduce in the system on a regular basis during the baseline period, the use of the word salmon in the definition will be interpreted to mean chinook salmon.

Sturgeon - Two species of sturgeon are found in the Sacramento-San Joaquin system: white sturgeon (*Acipenser transmontanus*) and green sturgeon (*A. medirostris*) (Moyle 1976). Because both species of sturgeon reproduce in the Sacramento-San Joaquin system, the word sturgeon will be interpreted to include white and green sturgeon.

In summary, **the species of anadromous fish identified by Title 34 that reproduce in the Sacramento-San Joaquin system include chinook salmon, steelhead, striped bass, white sturgeon, green sturgeon, and American shad.** The Program will be designed to double the natural production of the anadromous forms of these six species.

Other anadromous fish - Title 34 does not identify several species of anadromous fish that spawn in Central Valley rivers and streams. These include threespine stickleback, brown trout, and two species of lamprey and smelt (Fry 1973). The Program will not establish restoration goals specific to these species.

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Stocks

For purposes of the Program, **a stock is defined as a group of individuals which are more likely to mate with each other than with individuals not included in the group**. The term stock describes a fish population that spawns in a particular stream, or stream reach, at a particular season and that do not interbreed to a substantial degree with any group spawning in a different place, or in the same place at a different time. This definition does not rely upon absolute reproductive barriers. In fisheries management, stocks are recognized to maintain and improve the genetic basis for management.

Several stocks which meet this definition are already recognized. For example, chinook salmon are divided into several races based on the season during which they enter the rivers to begin their upstream spawning migrations as follows: fall, late-fall, winter, and spring runs. Others stocks which might be recognized in the future will likely become stocks of special concern.

Good evidence exists for salmon and steelhead that these species return to their natal streams to spawn. There is some evidence and little reason not to expect that the same relationship holds for some of the other anadromous species. As stated in the POA for the Program, the objective of the Program will be to double the natural production of all species and races within specific individual streams, and to preserve genetic stocks. If it proves unfeasible to double the natural production of a species or race within a specific stream, the unmet production increment will be transferred to other individual streams in the following order of priority: (1) another stream within the same drainage system, (2) another stream within the larger basin, such as the Sacramento River Basin, and (3) any stream within the Central Valley.

Central Valley Rivers and Streams

For the purposes of the Program, **Central Valley rivers and streams are defined as all rivers, streams, creeks, sloughs and other watercourses, regardless of volume and frequency of flow, that drain into the Sacramento River basin, the San Joaquin River basin downstream of Mendota Pool, or the Sacramento-San Joaquin Delta upstream of Chipps Island.**

Sustainable

Sustainable means capable of being maintained or kept in existence. In Title 34, sustainable refers to natural production, which is defined as "... fish produced to adulthood without direct human intervention...." Elimination of direct human intervention as a legitimate alternative requires reliance on restoration and maintenance of habitat conditions that allow anadromous fish populations to sustain themselves at levels consistent with numeric restoration goals. Therefore, in the context of Title 34, **sustainable is defined as capable of being maintained at target levels without direct human intervention in the spawning, rearing or migration processes.** Production levels specified by numeric goals will be considered sustainable when they are maintained under the entire range of conditions resulting from legal human activities, as superimposed on natural variability inherent in the system. Human activities shall include, but not be limited to, agricultural diversion and discharge, exports, flow manipulation, water pollution, dredge and fill, channel modification and damming.

There is an element of time implicit in sustainability. Therefore, if natural production is to be sustainable, modifications to system operations as well as improved physical habitat and water quality must be provided into the future. Title 34 requires that "...natural production...be sustainable, on a long-term basis" and provides for annual funding without a specified expiration date. The intent of Title 34 is that numeric restoration goals continue to be realized or exceeded in perpetuity.

Long-Term Basis

Long-term will encompass at least several generations of fish (not less than 5) over a variety of hydrologic conditions (to allow for natural variation in production) and will continue indefinitely.

Average Levels

As stated in Title 34, the goal is to sustain natural production "...at levels not less than twice the average levels attained during the period of 1967-1991..." To attach numeric values to this goal, we need to estimate average levels of production. One problem is that average is not a precise statistical term. In statistics, the term average can apply to several measures of central tendency (Langley 1971). The most commonly used measure of central tendency is the arithmetic mean (Lapin 1975). Consequently, the public generally understands average to mean

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arithmetic mean and it is reasonable to assume that this was the intent of the authors of Title 34. Therefore, **the definition of average will be the arithmetic mean.**

INTENT OF TITLE 34

Habitat Restoration

Of the six purposes of Title 34, three are particularly germane to discussion of the intent of Title 34 as it relates to the Program. These three purposes are listed below:

(1) to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California (3402[a]);

(2) to address impacts of the Central Valley Project on fish, wildlife and associated habitats (3402[b]);

(3) to contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (3402[e]);

In addition, Section 3406(b)(1)(A) states that the Program "...shall give first priority to measures which protect and restore natural channel and riparian habitat values through habitat restoration actions, modifications to Central Valley Project operations, and implementation of the supporting measures mandated by this subsection..." Because Title 34 directs that the Program shall emphasize habitat restoration, **emphasis will be placed on restoring habitat.**

Natural versus Hatchery Production

Title 34 requires that "...natural production of anadromous fish in Central Valley rivers and streams be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991..." (Section 3406[b][1]). The requirement that natural production be sustainable on a long-term basis suggests that the intent of Title 34 is for the definition of natural production to extend between generations of fish. Natural production should be self-sustaining. **The Program should not depend on hatchery-produced fish to sustain populations of naturally spawning fish.**

In addition, Title 34 requires investigations of "...opportunities for additional hatchery production to mitigate the impacts of water development and operations on, or enhance efforts to increase Central Valley fisheries; Provided, That additional hatchery production shall only be used to supplement or to re-establish natural production while avoiding adverse effects on remaining wild stocks" (Section 3406[e][2]). This section provides insight into the intent of Title 34 as it relates to the roles of natural and hatchery production and emphasizes avoiding adverse effects of hatchery production on wild (naturally produced) stocks. Under Title 34, **hatchery production should only be used as a last resort to supplement or to re-establish natural production, and then only after investigations on the desirability of developing and implementing additional hatchery production.**

Adverse effects of hatchery production on natural stocks can include reductions in population size caused by competition, predation, disease or other factors (Sholes and Hallock 1979, Waples 1991). A large potential for negative interaction exists when these stocks interbreed (Hindar et al. 1991, Taylor 1991, Waples 1991). The adverse effects of interbreeding increase as hatchery-produced fish become more prevalent in the naturally spawning population. Interbreeding reduces interpopulation diversity and may lead to a reduction in overall productivity and a greater vulnerability to environmental change (Waples 1991). Outbreeding depression may also result from interbreeding. In addition, large populations of hatchery-produced fish that are indistinguishable from naturally produced fish may intensify effects of harvest on naturally produced fish (Wright 1993). The simplest way to avoid adverse effects on naturally produced stocks is to minimize the opportunities for interaction between naturally and hatchery-produced fish. **The Program should be designed to avoid adverse effects of hatchery production on natural stocks.**

Harvest

Title 34 does not directly address harvest. Title 34 defines natural production as: "... fish produced to adulthood..." (Section 3403[h]) and requires that natural production be increased. Inclusion of the term production, and especially production to adulthood, suggests that **Title 34 does not intend for restriction of harvest to be used as a means of achieving Program goals.** As stated in the definition of production, harvested fish should be included in counts of production. Sound harvest management is designed to harvest only excess production, allowing for enough fish to escape harvest to maintain production at the highest level the habitat can support.

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Title 34 requires that natural production be increased. There are two mechanisms by which natural production can be increased: (1) increasing the productivity of the existing habitat, and (2) increasing the amount of habitat. These mechanisms are consistent with the emphasis Title 34 places on habitat restoration. Doubling productivity of existing habitat would provide more offspring from the same number of spawners. If existing spawning habitat is being fully utilized, then increasing the number of spawners by reducing harvest would not increase production. If production of naturally produced fish is doubled and escapement is held to present levels, then harvest of naturally produced fish could more than double.

The second mechanism, doubling the amount of habitat, would accommodate twice the number of spawners. This would also provide twice the number of offspring. Under this scenario, harvest of naturally produced fish could double. Under either mechanism, barring other harvest restrictions, we would expect at least a doubling of harvest of naturally produced fish. To meet the Intent of Title 34, **harvest should be maintained at levels that allow sufficient numbers of naturally produced fish to spawn to meet goals for at least doubling natural production.**

IMPLEMENTATION CRITERIA

As stated earlier, criteria for determination of natural production will conform to the definition of natural production and intent of Title 34, including definitions and interpretations of intent discussed and refined in this Position Paper. Because determination of natural production in the past will require different criteria than in the future, criteria for these time periods will be discussed separately.

Criteria for the baseline period

In the past, data collection efforts have not focused on estimating natural production and existing data may not provide direct estimates of natural production. In order to establish numerical goals for the Program, average levels of natural production must be estimated for the baseline period. Estimates will require assessing existing data and developing criteria to determine which data are germane. Criteria may not strictly conform to the definitions in and intent of Title 34 but are a compromise necessitated by a lack of data on natural production.

As explained in the POA, the Core Group and technical teams are responsible for developing these criteria. Technical teams are asked to develop initial criteria and estimates of average levels of natural production for the baseline period.

Where data are lacking, technical teams will make assumptions to expand existing data, or put existing data in perspective. For example, run-size estimates for American shad exist for only two years. In addition, young American shad abundance has been sampled during the fall emigration each year since 1967, except for 1974 and 1979 (Mills and Fisher, in preparation). The American shad technical team could look at young American shad abundance data to determine if run-size estimates for adults are representative of the abundance of shad for the baseline period. This approach has assumptions (chief among these is that abundance of young American shad can tell us something about average adult run-sizes) which are probably violated to some degree and is only presented as an example of what might be considered. Technical teams will document options considered for estimating natural production in issue papers that will be appended to the Program Plan if not in the text. Data quantity and applicability toward estimating natural production varies between species and drainage. Each technical team will need to address these issues for each species and drainage separately. Criteria for determining natural production during the baseline period will be applicable to existing data.

Because there is a relative wealth of data for chinook salmon and because several Teams deal with chinook salmon, specific criteria are proposed for them. Most of the data necessary to estimate production of each stock of chinook salmon for the baseline period are compiled in Mills and Fisher (1994). The proposed procedure for estimating yearly production of each race of chinook salmon for each stream during the baseline period follows.

In the following explanations and formulas, P is for production, E is for escapement, H is for harvest, and *h* is for the portion of total production not produced naturally. Subscripted letters following the normal letters and prior to the first comma represent different races of chinook salmon as follows: F for fall, L for late-fall, W for winter, S for spring, and C for all races combined. Subscripted letters following the first comma represent the following: O for ocean, D for downstream, I for instream, N for natural, H for hatchery, and T for total. Subscripted letters following the second comma represent the following: CV for Central Valley, SF for San Francisco, M for Monterey, and other letter combinations correspond to specific streams (e.g., AM for American River). Subscripted letters following a third comma refer only to ocean harvest and are C for

commercial and R for recreational. In all cases, a subscripted X acts as a "wildcard" place holder for an unspecified subscript.

1. A portion of production returns to spawn in each stream, both naturally and in the hatchery. Some of these fish are captured before spawning. These fish are counted toward production for the stream in which they spawned or were harvested according to the following:

   a. To determine the total spawning escapement ($E_{X,T,XX}$) for each race in each individual stream, sum the estimated number of each race of chinook salmon returning to spawn naturally ($E_{X,N,XX}$) and in hatcheries ($E_{X,H,XX}$) for each individual stream.

$$E_{X,T,XX} = E_{X,N,XX} + E_{X,H,XX}$$

   b. To determine the portion of production for each race returning to each stream (in-river run-size, $P_{X,I,XX}$), add $E_{X,T,XX}$ to the estimated number of each race of chinook salmon harvested in each stream ($H_{X,I,XX}$). Estimates of $H_{X,I,XX}$ do not exist for all streams and all years. Where estimates are not available or are inadequate, best professional judgement must be used. Technical Teams should document options considered for estimation of $H_{X,I,XX}$ in the Program Plan or in issue papers that will be appended to the Program Plan.

$$P_{X,I,XX} = E_{X,T,XX} + H_{X,I,XX}$$

   c. To determine the total number of each race of chinook salmon returning to the Central Valley ($P_{X,I,CV}$), sum $P_{X,I,XX}$ for all streams in the Central Valley ($\sum P_{X,I,XX}$) .

$$P_{X,I,CV} = \sum P_{X,I,XX}$$

   d. To determine the total number of chinook salmon (all races combined) returning to the Central Valley ($P_{C,I,CV}$), sum $P_{X,I,CV}$ for all races of chinook salmon ($\sum P_{X,I,CV}$) .

$$P_{C,I,CV} = \sum P_{X,I,CV}$$

2. A portion of production is harvested in the ocean and downstream of areas in rivers where the stream responsible for this production is not easily identified. To assign these harvested salmon to individual streams, the total number of salmon falling into this category is summed and subdivided to race and stream,

proportional to the portion of production attributed to each race and returning to each stream, according to the following:

a. To determine the Central Valley component of ocean harvest ($H_{C,O,CV}$), sum commercial catch at San Francisco ($H_{C,O,SF,C}$) and Monterey ($H_{C,O,M,C}$), sum recreational catch at these same ports ($H_{C,O,SF,R} + H_{C,O,M,R}$), and add these together. This estimate of $H_{C,O,CV}$ is based on the Central Valley Index (CVI), where harvest of Central Valley stocks equals landings at major ports south of Point Arena (San Francisco and Monterey). Use of CVI to estimate the Central Valley component of ocean harvest assumes that the number of Central Valley chinook salmon harvested from ports north of San Francisco is balanced by the number of chinook salmon from drainages north of the Central Valley harvested from San Francisco and Monterey. To carry $H_{C,O,CV}$ forward in subsequent calculations, assume that each chinook salmon harvested in the ocean fishery is equivalent to an adult salmon returning to spawn.

$$H_{C,O,CV} = H_{C,O,SF,C} + H_{C,O,M,C} + H_{C,O,SF,R} + H_{C,O,M,R}$$

b. To account for that portion of inland harvest that occurs downstream of streams for which production is being estimated, estimate portion of inland recreational harvest captured downstream of spawning streams ($H_{C,D,CV}$). Information necessary to estimate $H_{C,D,CV}$ may not be available. If an estimate exists, use it. If an estimate of inland harvest for the entire Central Valley exists ($H_{X,I,CV}$), then sum all assignable inland harvest ($\sum H_{X,I,XX}$) and subtract it from $H_{X,I,CV}$ to determine $H_{C,D,CV}$. If other options exist, these should be explored. $H_{C,D,CV}$ could be assumed to be small and therefore left out of the calculations or could be included in $H_{X,I,XX}$, in which case it would already to assigned to an individual stream.

c. To determine ocean and downstream inland harvest for the Central Valley ($H_{C,O+D,CV}$), sum $H_{C,O,CV}$ and $H_{C,D,CV}$.

$$H_{C,O+D,CV} = H_{C,O,CV} + H_{C,D,CV}$$

d. To assign portions of $H_{C,O+D,CV}$ to specific races, subdivide $H_{C,O+D,CV}$ to each race, proportional to the portion of production for each race returning to the entire Central Valley ($P_{X,I,CV}$) to the portion of production for all races combined returning to the entire Central Valley ($P_{X,I,CV}$).

$$H_{X,O+D,CV} = H_{C,O+D,CV} \cdot (P_{X,I,CV}/P_{C,I,CV})$$

e. To assign portions of $H_{X,O+D,CV}$ to specific streams, subdivide $H_{X,O+D,CV}$ to each stream, proportional to the portion of production for that race returning to each stream ($P_{X,I,XX}$) to the portion of production for that race returning to the entire Central Valley ($P_{X,I,CV}$).

$$H_{X,O+D,XX} = H_{X,O+D,CV} \cdot (P_{X,I,XX}/P_{X,I,CV})$$

3. To determine total production for each race and stream ($P_{X,T,XX}$), sum $P_{X,I,XX}$ and $H_{X,O+D,XX}$.

$$P_{X,T,XX} = P_{X,I,XX} + H_{X,O+D,XX}$$

4. A portion of the total production was not produced naturally (*h*). For the baseline period, only hatchery-produced salmon will be considered to be produced by other than natural means. To determine the natural production for each individual stream ($P_{X,N,XX}$), multiply $P_{X,T,XX}$ by (1-*h*). Technical Teams should document options considered and chosen for estimation of *h* in issue papers that will be appended to the Program Plan or in the text for the Program Plan.

$$P_{X,N,XX} = P_{X,T,XX} \cdot (1-h)$$

Numeric restoration goals for chinook salmon in each stream will be calculated as at least double the average of $P_{X,N,XX}$ for each of the years during the baseline period.

Criteria for the future

In the future, opportunities exist to improve estimates of natural production. These range from augmenting historic data collection activities with efforts to estimate the proportion of fish that are naturally produced, to designing new data collection to better account for natural production. The Core Group and technical teams are responsible for designing future monitoring programs.

The Core Group and technical teams have and will identify deficiencies in the baseline data. Future monitoring activities will be designed to address and avoid deficiencies. For example, monitoring programs should focus on estimating production, including harvest, on a consistent and regular basis, preferably yearly, in all of the streams in the Central Valley.

Monitoring programs should also estimate natural production, requiring some means of separating naturally produced fish from fish produced by other than natural means. At the very least, natural production must be discernable from

hatchery production. Several methods can be used to separate naturally produced fish from hatchery-produced fish, including use of scale (Scarnecchia and Wagner 1980) or otolith (Paragamian et al. 1992) characteristics and constant fractional (Hankin 1982) or complete marking of hatchery-produced fish (Wright 1993), including incorporation of genetic markers (Waples 1991), inducement of otolith banding patterns (Volk et al. 1990), and more standard methods such as clipping fins. In addition, recommendations for the future should include managing naturally and hatchery-produced fish separately.

In addition, better estimates of harvest of Central Valley salmon in the ocean and of all anadromous fish in the Bay, Delta, and in each individual river and stream in the Central Valley should be developed. Harvest should be monitored continually.

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CITATIONS FOR POSITION PAPER

American Fisheries Society. 1991. Common and scientific names of fishes from the United States and Canada. Fifth edition. American Fisheries Society Special Publication 20, Bethesda, Maryland. 183 pp.

Fry, D. H., Jr. 1973. Anadromous fishes of California. California Department of Fish and Game. 111 pp.

Hallock, R. J., and D. H. Fry, Jr. 1967. Five species of salmon, *Oncorhynchus*, in the Sacramento River, California. California Fish and Game 53:5-22.

Hankin, D. G. 1982. Estimating escapement of Pacific salmon: marking practices to discriminate wild and hatchery fish. Transactions of the American Fisheries Society 111:286-298.

Hindar, K., N. Ryman, and F. Utter. 1991. Genetic effects of cultured fish on natural fish populations. Canadian Journal of Fisheries and Aquatic Sciences 48:945-957.

Langley, R. 1971. Practical statistics simply explained. Dover Publications, Inc. New York, NY. 399 pp.

Lapin, L. 1975. Statistics: meaning and method. Harcourt Brace Jovanovich, Inc. New York, NY. 591 pp.

Miller, B., R. Reisenbichler, P. Wampler, C. Burley, D. Leith, B. Thorson, and P. Brandes. 1993. Vision action plan on supplementation, Region 1. U.S. Fish and Wildlife Service, Region 1. Portland, OR. 12 pp.

Mills, T. J., and F. Fisher. In prep. Central Valley anadromous sport fish annual run-size, harvest, and population estimates, 1967 through 1991. Second draft. Inland Fisheries Technical Report. California Department of Fish and Game. 62 pp.

Moyle, P. B. 1976. Inland fishes of California. University of California Press. Berkeley, CA. 405 pp.

Paragamian, V. L., E. C. Bowles, and B. Hoelscher. 1992. Use of daily growth increments on otoliths to assess stockings of hatchery-reared kokanees. Transactions of the American Fisheries Society 121:785-791.

Ricker, W. E. 1958. Handbook of computations for biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada 119. 300 pp.

Scarnecchia, D. L., and H. H. Wagner. 1980. Contribution of wild and hatchery-reared coho salmon, *Oncorhynchus kisutch*, to the Oregon sport fishery. Fishery Bulletin 77:617-623.

Sholes, W. H., and R. J. Hallock. 1979. An evaluation of rearing fall-run chinook salmon, *Oncorhynchus tshawytscha*, to yearlings at Feather River Hatchery, with a comparison of returns from hatchery and downstream releases. California Fish and Game 65:239-255.

Sokal, R. R., and F. J. Rohlf. 1969. Biometry. W. H. Freeman and Company, San Francisco, CA. 776 pp.

Taylor, E. B. 1991. A review of local adaptation in Salmonidae, with particular reference to Pacific and Atlantic salmon. Aquaculture 98:185-207.

U.S. Fish and Wildlife Service. 1994. Central Valley Project Improvement Act - Plan of action for the Central Valley Anadromous Fish Restoration Program. U.S. Fish and Wildlife Service, 4001 North Wilson Way, Stockton, California 95205. 14 pp.

Volk, E. C., S. L. Schroder, and K. L. Fresh. 1990. Inducement of unique otolith banding patterns as a practical means to mass-mark juvenile pacific salmon. Transactions of the American Fisheries Society 7:203-215.

Waples, R. S. 1991. Genetic interactions between hatchery and wild salmonids: lessons from the Pacific Northwest. Canadian Journal of Fisheries and Aquatic Sciences 48:124-133.

Wright, S. 1993. Fishery management of wild Pacific salmon stocks to prevent extinctions. Fisheries (Bethesda) 18(5):3-4.

Zar, J. H. 1984. Biostatistical Analysis. Second edition. Prentice-Hall, Inc., Englewood Cliffs, NJ. 718 pp.

B. Production targets for chinook salmon in each stream

Preliminary estimated production targets for chinook salmon. Data for rivers without a race designation are for fall-run chinook salmon.

Race and river	Production targets
All races combined[a]	990,000
Fall run	750,000
Late-fall run	68,000
Winter run	110,000
Spring run	68,000
Sacramento River	
Fall run	230,000
Late-fall run	44,000
Winter run	110,000
Spring run	59,000
Clear Creek	7,100
Cow Creek	4,600
Cottonwood Creek	5,900
Battle Creek	
Fall run	10,000
Late-fall run	550
Paynes Creek	330
Antelope Creek	720
Mill Creek	
Fall run	4,200
Spring run	4,400
Deer Creek	
Fall run	1,500
Spring run	6,500
Miscellaneous creeks	1,100
Butte Creek	
Fall run	1,500
Spring run	2,000
Big Chico Creek	800
Feather River	170,000
Yuba River	66,000
Bear River	450
American River	160,000
Mokelumne River	9,300
Cosumnes River	3,300
Calaveras River	
Winter run	2,200
Stanislaus River	22,000
Tuolumne River	38,000
Merced River	18,000

[a]Targets for each of the races of chinook salmon may not add up to the target for all races combined due to rounding.

C. Contacts and sources of information.

For information on the Anadromous Fish Restoration Program, contact:

Martin A. Kjelson, Program Manager
Anadromous Fish Restoration Program
U.S. Fish and Wildlife Service
Sacramento-San Joaquin Estuary Fishery Resource Office
4001 North Wilson Way
Stockton, CA 95205
(209) 946-6400

For information on the Central Valley Fish and Wildlife Restoration Program, including information on other subsections of the Central Valley Project Improvement Act that contribute to fish and wildlife restoration, contact:

James J. McKevitt, Program Manager
Central Valley Fish and Wildlife Restoration Program
U.S. Fish and Wildlife Service
2800 Cottage Way, Rm E-1831
Sacramento, CA 95825
(209) 979-2760

For information on the California Department of Fish and Game's efforts to restore anadromous fish in the Central Valley, contact:

Terry J. Mills
California Department of Fish and Game
1416 Ninth Street
Sacramento, CA 95814
(916) 653-9642

Copies of "Conservation Partnership: A Field Guide to Public-Private Partnering for Natural Resource Conservation" may be obtained from:

U.S. Fish and Wildlife Service
Office of Training and Education
4401 North Fairfax Drive
Arlington, VA 22203
(703) 358-1711

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or

National Fish and Wildlife Foundation
1120 Connecticut Avenue, NW, Suite 900
Washington, DC 20036
(202) 857-0166

Copies of "California Coordinated Resource Management and Planning Handbook" may be obtained from:

CRMP Coordinator
California Association of Resource Conservation Districts
801 K Street, Suite 1318
Sacramento, CA 95814
(916) 447-7237
FAX (916) 447-2532

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D. Template for organization of detailed information on specific actions

The AFRP has developed a draft template containing the following information for each of the actions listed in the Restoration Plan.

Location: Identifies the drainage including specific location(s) of the action, if applicable.

Action: Action identified in the Anadromous Fish Restoration Plan.

Rank: Rating relative to other actions in the drainage.

Objective: Identifies species or race(s) of anadromous fish primarily affected and problem(s) solved by or intended effect(s) of the action.

Description: Describes the action in detail, including background, context, and reasons for implementing the action.

Monitoring needs: Identifies activities, including variables to observe, needed to evaluate the effectiveness of the action.

Predicted biological benefits: Identifies anticipated biological benefits, preferably in quantitative terms, focusing on anadromous fish or their habitat.

Issues: Identifies factors potentially influencing initiation and completion of the action.

Involved agencies: Lists government agencies involved and describes their roles (e.g., lead or supporting).

Key stakeholders: Lists stakeholders (i.e., individuals, water user groups, conservation groups, and sport and commercial fishing groups affected by the action in a specific drainage).

Deliverables: Lists products (e.g., progress reports or evaluations) completed during implementation.

Schedule: Time frame showing key events (e.g., start-completion dates, time of deliverables, and monitoring needs).

Estimated cost to completion: Total costs from planning to completion, including permits, environmental documentation, and monitoring. Potential for schedule and budget revisions should be identified.

Funding: Annual budget identifying funding sources (e.g., CVPIA, Category III, Four Pumps Mitigation).

Status: Describes stage of development and accomplishments, future activities and milestones, and impediments.

CVPIA implementation tools: Identifies applicable section(s) of the CVPIA.

Manager: Identifies manager designated by the lead agency or group.

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E. Summary of information used to prioritize watersheds.

Table E-1. Production target for chinook salmon, presence of CVP flow control stuctures or facilities, and race or species present in each of the watersheds for which actions are listed in this restoration plan.

River	Chinook salmon production target	CVP influence	Winter run	Spring run	Steelhead	Late-fall run	San Joaquin fall run	Fall run	Green sturgeon	White sturgeon	Striped bass	American shad
Sacramento River	990,000	X	X	X	X	X		X	X	X	X	X
Clear Creek	7,100	X		X	X			X				
Cow Creek	4,600				X			X				
Cottonwood Creek	5,900			X	X	X		X				
Battle Creek	10,550	X	X	X	X	X		X				
Paynes Creek	330				X			X				
Antelope Creek	720			X	X	X		X				
Mill Creek	8,600			X	X	X		X				
Deer Creek	8,000			X	X	X		X				
Misc. creeks	1,100				X			X				
Butte Creek	3,500			X	X	X		X				
Big Chico Creek	800			X	X	X		X				
Feather River	170,000				X			X	X	X	X	X
Yuba River	66,000			X	X			X				X
Bear River	450				X			X	X	X		
American River	160,000	X			X			X			X	X

River	Chinook salmon production target	CVP influence	Winter run	Spring run	Steelhead	Late-fall run	San Joaquin fall run	Fall run	Green sturgeon	White sturgeon	Striped bass	American shad
Mokelumne River	9,300				X			X			X	X
Cosumnes River	3,300							X				
Calaveras River	2,200		X					X				
Merced River	4,500				X	X	X					
Tuolumne River	38,000					X	X					
Stanislaus River	22,000	X			X	X	X				X	X
San Joaquin River	0	X					X		?	X	X	X
Sacramento-San Joaquin Delta	0	X	X	X	X	X	X	X	X	X	X	X

F. Projected funding and water resources for fiscal year 1996.

The CVP Restoration Fund, along with additional agency and other partner funds, if available, will be used to implement the AFRP restoration actions. Preliminary estimates of funds available from the CVP Restoration Fund to the AFRP for actions, evaluations, monitoring and assessment during FY96 total $3 million, increasing to about $8 million for each of the years in FY97 to FY2001. Additional Restoration Fund dollars carried over from previous years are also available to supplement AFRP funds, if needed. In addition, the Restoration Fund provides sufficient flexibility to move funds to areas of greatest need, subject to certain limitations.

Restoration Fund dollars and USBR Energy and Water budget dollars both provide funding for FY96. Other than funds allocated to the AFRP, the most substantial support for actions in the restoration plan comes from the following subsections of section 3406 of the CVPIA: (b)(3)-water acquisition, $23.7 million; (b)(6)-Shasta Temperature Control Device, $16.9 plus $19.5 (USBR) million; (b)(10)-Red Bluff Diversion Dam, $1.5 million (USBR); (b)(13)-gravel restoration, $0.6 million; (b)(20) Glenn-Colusa Irrigation Diversion, $3 million (USBR); and (b)(21) Anadromous Fish Screen Program, $5.75 million (USBR). In addition, Restoration Funds are also available in FY96 for monitoring, assessment, investigations and the development of tools that contribute to the AFRP and include: (b)(16)-Comprehensive Assessment and Monitoring Program, $2.0 million; (e) investigations, $3.0 million; and (g)-modeling efforts, $1.9 million (USBR funds). Additional detailed funding level projections for FY96 to FY2001 are available from the USFWS and USBR.

Flow and habitat objectives and potential use of dedicated 3406(b)(2) water in the Delta and in CVP controlled streams for FY96 are described in the list of actions. The use of dedicated (b)(2) water in the Delta, as well as upstream areas, is not yet fully defined and depends on water-year type. Delta use will be coordinated with the CALFED Operations Group's use of the operational flexibility of the SWRCB's 1995 Water Quality Control Plan. The specific use of (b)(2) water will be provided in the early spring of 1996.

The amount of water available for acquisition under Section 3406(b)(3) to implement actions relative to instream flows, export curtailments and Delta outflows in FY96 will depend on water-year type, fiscal resources and willing sellers. The ultimate goal is acquisition of a long-term or permanent water supply. In FY96, preliminary goals for water acquisition by stream are: Stanislaus River, up to 100,000 af; Tuolomne River, up to 100,000 af; and Merced River, up to 100,000 af. Additional water acquisition in other streams is being considered.

Specific details for FY96 restoration actions following the template described in Appendix D will be developed for the final 1996 implementation plan in early 1996.

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G. List of acronyms and abbreviations.

Acronym or abbreviation	Description
af	acre-feet
AFRP	Anadromous Fish Restoration Program, established by Section 3406(b)(1) of the CVPIA
AFS	American Fisheries Society
(b)(2) water	Water managed pursuant to 3406(b)(2), sometimes referred to as the 800,000 af or dedicated water.
Bay-Delta	San Francisco Bay and Sacramento-San Joaquin Delta Estuary
Bay-Delta Agreement	15 December 1994, Principles of Agreement on Bay-Delta Standards between the State of California and the Federal Government
BLM	Bureau of Land Management
CALFED	A California and federal multi-agency partnership
CALFED agencies	California California Environmental Protection Agency State Water Resources Control Board The Resources Agency Department of Fish and Game Department of Water Resources Federal Department of Commerce National Marine Fisheries Service Department of the Interior Bureau of Reclamation Fish and Wildlife Service Environmental Protection Agency
CAMP	Comprehensive Assessment and Monitoring Program, established by Section 3406(b)(16) of the CVPIA
CCRMP	California Coordinated Resource Management and Planning
CCWD	Calaveras County Water District
CDFG	California Department of Fish and Game
CDWR	California Department of Water Resources
CEQA	California Environmental Quality Act
CNFH	Coleman National Fish Hatchery
COE	Corps of Engineers

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Acronym or abbreviation	Description
Core Group	AFRP Core Group
CSLC	California State Lands Commission
cfs	cubic feet per second
CVFWRP	Central Valley Fish and Wildlife Restoration Program
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DCC	Delta Cross Channel
Delta	Sacramento-San Joaquin Delta
DOI	Department of the Interior
EBMUD	East Bay Municipal Utility District
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
GCID	Glenn-Colusa Irrigation District
IEP	Interagency Ecological Program
IEP agencies	California California Environmental Protection Agency State Water Resources Control Board The Resources Agency Department of Fish and Game Department of Water Resources Federal Department of Commerce National Marine Fisheries Service Department of Defense Army Corps of Engineers Department of the Interior Bureau of Reclamation Fish and Wildlife Service Geological Survey Environmental Protection Agency
maf	million acre-feet
MCWC	Mill Creek Watershed Conservancy

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Acronym or abbreviation	Description
MID	Modesto Irrigation District
MIEB	Management Institute for Environment and Business
MOU	Memorandum of Understanding
NEPA	National Environmental Protection Act
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
PCB	Polychlorinated biphenyl
PEIS	Programmatic Environmental Impact Statement
PFMC	Pacific Fishery Management Council
PG&E	Pacific Gas and Electric
POA	Plan of Action for the Central Valley Anadromous Fish Restoration Program
Position Paper	Position Paper for Development of the Central Valley Anadromous Fish Restoration Program (Appendix A)
RBDD	Red Bluff Diversion Dam
RCD	Resource Conservation District
Restoration Fund	CVP Restoration Fund, established by Section 3407 of the CVPIA
Restoration Plan	AFRP Restoration Plan
RWQCB	Regional Water Quality Control Board
SAFCA	Sacramento Area Flood Control Association
SAWF	Sacramento Area Water Forum
Secretary	Secretary of the Interior
SEWD	Stockton East Water District
SRAC	Sacramento River Advisory Council
SSWD	South Sutter Water District
SWP	State Water Project
SWRCB	State Water Resources Control Board
taf	thousand acre-feet

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Acronym or abbreviation	Description
TCCA	Tehama-Colusa Canal Authority
TID	Turlock Irrigation District
TNC	The Nature Conservancy
USBR	U.S. Bureau of Reclamation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WCWD	Western Canal Water District
WID	Woodbridge Irrigation District
Working Paper	Working Paper on Restoration Needs
WQCP	Water Quality Control Plan
WRCB	Water Resources Control Board
YCWA	Yuba County Water Agency

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