Appendix D

Draft Battle Creek Salmon and Steelhead Restoration Project Adaptive Management Plan

DRAFT
BATTLE CREEK SALMON AND STEELHEAD RESTORATION PROJECT

ADAPTIVE MANAGEMENT PLAN

U.S. Bureau of Reclamation

Pacific Gas and Electric Company

National Marine Fisheries Service

U.S. Fish and Wildlife Service

California Department of Fish and Game

September 2001

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ADAPTIVE MANAGEMENT PLAN

Prepared for the

U.S. Bureau of Reclamation

Pacific Gas and Electric Company

National Marine Fisheries Service

U.S. Fish and Wildlife Service

California Department of Fish and Game

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September 2001

This version incorporates all comments received through September 5, 2001.

PREFACE

Battle Creek has historically been regarded as a uniquely important salmon-producing watershed because of the large numbers and broad diversity of chinook salmon and steelhead that have historically used this stream. The importance of restoring the fish habitat and populations within Battle Creek has long been recognized, but the urgency of the ongoing Battle Creek Salmon and Steelhead Restoration Project (Restoration Project) is heightened by the fact that this watershed is home to winter-run chinook salmon, spring-run chinook salmon, and steelhead, all of which are in danger of or threatened with extinction as defined by the federal Endangered Species Act (ESA). Furthermore, Battle Creek provides the only remaining accessible habitat in the Sacramento River watershed, other than the Sacramento River itself, that may be suitable for populations of winter-run chinook salmon.

The primary goal of the Restoration Project is to restore and enhance about 42 miles of anadromous fish habitat in Battle Creek and an additional 6 miles of habitat in its tributaries while minimizing the loss of renewable energy produced by the Battle Creek Hydroelectric Project. The Restoration Project has been the result of a long planning process that culminated in a Memorandum of Understanding (MOU) between the Resource Agencies and Pacific Gas and Electric Company (PG&E). An integral part of the MOU was the direction to develop and implement an adaptive management program to monitor the effectiveness of restoration actions taken and make further adjustments to Hydroelectric Project facilities and/or operations as appropriate in pursuit of the primary goal of the Restoration Project.

Therefore, this document is the strategic plan agreed upon by the Resource Agencies and PG&E. Its goal is to implement specific actions to protect, restore, enhance, and monitor salmonid habitat at the Hydroelectric Project to guard against false attraction of chinook salmon and steelhead, and to ensure that these fish in all life stages are able to fully access and beneficially use available habitat, thereby maximizing natural production and the full use of ecosystem carrying capacity. While this Adaptive Management Plan (AMP) was written primarily to conform to provisions of the MOU, it is also recognized that this AMP may assist the Federal Energy Regulatory Commission (FERC) regulating license compliance and may be incorporated as part of, or at least linked to, other Battle Creek watershed and statewide resource management efforts. Because this plan is intended specifically to apply to the Restoration Project and is not a general watershed management plan, its objectives and protocols must be evaluated in light of these stated purposes.

At the core of this plan (Section III) are 11 objectives incorporating scientific information gathering with adaptive management decision making, all within the context of federal and state policy and MOU provisions. These objectives are framed by a discussion (Section II) of the organization of the adaptive management program including management structure, roles, responsibilities, and funding mechanisms. Section IV describes how this adaptive management program will link to other resource management efforts. Protocols for implementing this plan are discussed in Section V. Finally, the Executive Summary gives the reader an abridged, but comprehensive overview of all elements of this plan.

NOTES TO THE READER

This AMP assigns specific meanings and definitions to some common words or proper nouns. Words used in the text that represent specific meanings as defined within this plan are indicated by capitalizing the first letter of each word. Definitions for these words can be found beginning on page 17.

Table 1. A list of acronyms used within this report.

AFRP	Anadromous Fish Restoration Program
AMF	Adaptive Management Fund
AMP	Adaptive Management Plan
AMPT	Adaptive Management Policy Team
AMTT	Adaptive Management Technical Team
BA	Biological assessment
BCWC	Battle Creek Watershed Conservancy
BCWG	Battle Creek Working Group
BLM	United States Bureau of Land Management
CALFED	CALFED Bay-Delta Program
CAMP	Comprehensive Assessment and Monitoring Program
CDFG	California Department of Fish and Game
CDWR	California Department of Water Resources
CED	California Energy Commission
CEQA	California Environmental Quality Act
CMARP	Comprehensive Monitoring, Assessment, and Research Program
CNFH	Coleman National Fish Hatchery
CRR	Cohort replacement rate
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
EPA	Environmental Protection Agency
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
GPS	Global positioning system
IFIM	Instream flow incremental methodology
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
PG&E	Pacific Gas and Electric Company
POC	Point of Contact
Restoration Plan	Battle Creek Salmon and Steelhead Restoration Plan
Restoration Project	Battle Creek Salmon and Steelhead Restoration Project
TNC	The Nature Conservancy
USBR	United States Bureau of Reclamation
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WAF	Water Acquisition Fund

EXECUTIVE SUMMARY

The Restoration Project is a joint effort between PG&E, the National Marine Fisheries Service (NMFS), California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (USFWS), and U.S. Bureau of Reclamation (USBR) to restore salmon and steelhead runs in the Battle Creek watershed while maintaining the renewable energy production of the Battle Creek Hydroelectric Project (FERC Project No. 1121). An MOU was adopted in June 1999 stating the intent of the MOU parties to engage in a restoration effort that would modify the facilities and operations of FERC Project No. 1121. The objectives of the Restoration Project are (1) the restoration of self-sustaining populations of chinook salmon and steelhead and their habitat in the Battle Creek watershed, (2) up-front certainty regarding specific restoration components, (3) timely implementation and completion of restoration activities, and (4) joint development and implementation of a long-term AMP with dedicated funding sources to ensure the continued success of restoration efforts under this partnership.

The MOU identifies Adaptive Management as an important component of the Restoration Project (Figure 1). Adaptive Management uses extensive monitoring to identify problems, examine possible solutions for meeting the biological objectives, and if needed, allow changes to Contemporary strategies and actions within established limits to try to achieve the objectives and desired results. The Adaptive Management concept was formalized in this AMP developed by the PG&E, NMFS, USFWS, and CDFG (collectively known herein as the "Parties"). Funding for implementation of the AMP is provided by the CALFED Monitoring Fund, the Water Acquisition Fund (WAF), the Adaptive Management Fund (AMF), and Licensee (Pacific Gas and Electric Company).

The AMP describes policy regarding the management of Restoration Project-related fish populations, habitat, and passage when the MOU does not specifically address a policy issue. However, in cases where the language in the AMP may conflict with the MOU, policy regarding these topics will be set by the MOU. The MOU prevails in any discrepancy between policy specified in the AMP and that set by the MOU.

The AMP was developed by Consensus between the Parties under the Adaptive Management Policy Team (AMPT) and the Adaptive Management Technical Team (AMTT). The AMPT consists of management-level representation from each of the Resource Agencies and the Licensee and is authorized to make all final decisions regarding the implementation of the AMP and to provide policy direction and dispute resolution on issues forwarded to it by the AMTT. The AMTT consists of technical experts from each of the Resource Agencies and the Licensee and is responsible for the development and implementation of the AMP portion of the Restoration Project when it has been approved by FERC. Definitions are provided in the AMP to minimize confusion and to simplify the text. Words or phrases defined in the AMP appear capitalized within this plan.

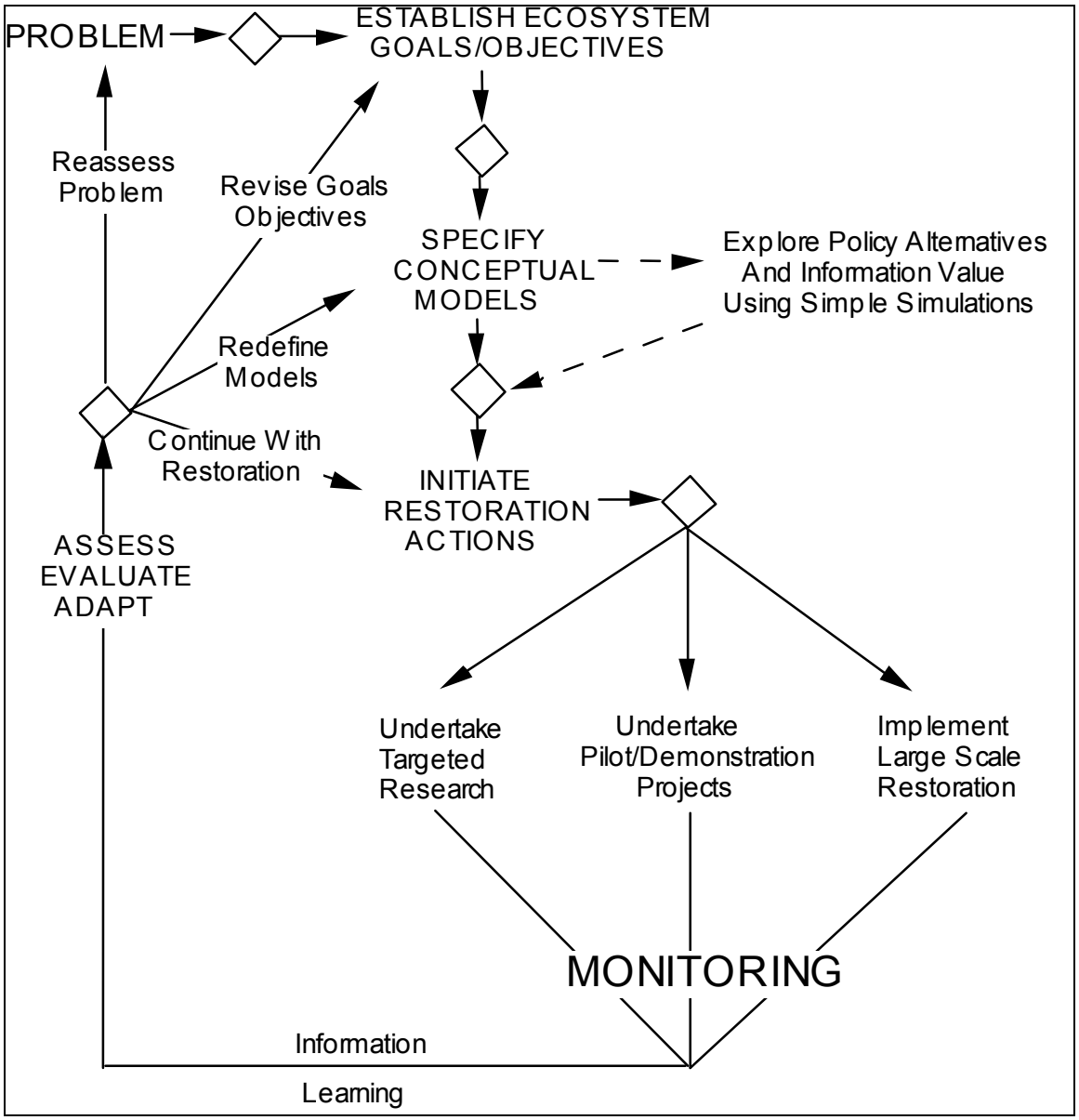

Figure 1 CALFED schematic of adaptive management.

Roles and responsibilities of the Parties pertaining to the AMP portion of the Restoration Project are listed in detail. The Licensee has agreed to a number of physical and operational changes and additions to FERC Project No. 1121 and has agreed to assume 90 percent of the initially forecast costs associated with the loss of power generation as well as other future costs. These include, but are not limited to, cost overruns for which the Licensee is responsible, future authorized facilities modifications or increased instream flows in the event the WAF and AMF are depleted, internal costs associated with providing expertise in the AMP process, and the loss of power associated with meeting instream flow releases and Ramping Rate requirements. Upon completion of facility start-up and testing, Licensee is responsible for the operation, maintenance, replacement, and successful operation of all physical modifications to its facilities under

the MOU. Licensee is also responsible for all facility and other monitoring required by the FERC license amendment for FERC Project No. 1121. NMFS responsibilities are those it determines consistent with its mandate under the ESA. NMFS also has the responsibility of defining recovery goals for salmon species listed under the ESA. Together the USFWS and CDFG agree to support the prescribed instream flows and Ramping Rates described in the MOU, or agreed upon through the Adaptive Management in the next relicensing proceeding for FERC Project No. 1121. USFWS and CDFG are also jointly responsible for conducting or funding a variety of monitoring, data collection and assessment, and report preparations associated with various fish population objectives. In addition, all Parties will be responsible for providing at least one representative to the AMPT and the AMTT and assuming all responsibilities and costs associated with these positions. All Parties will be individually responsible for any costs associated with their involvement in any FERC dispute resolution proceedings.

Sources of funding for the implementation of the AMP identified to date are the CALFED Monitoring Fund, the WAF, the AMF, and the Licensee. The CALFED Monitoring Fund of $1,000,000 is intended for monitoring costs associated with the Restoration Project. The WAF is a federal fund of $3,000,000 administered by the Resource Agencies per AMP protocols and intended for the sole purpose of acquiring additional instream flow releases in Battle Creek recommended under the AMP for a ten year period following the initial prescribed instream flow releases. The AMF of $3,000,000 is for the purpose of funding possible future changes to the Restoration Project developed under the AMP. The AMF is to be limited to actions under the Restoration Project directly associated with FERC Project No. 1121, and is expressly not available for funding of monitoring or construction cost overruns. In the event of the exhaustion or termination of the WAF, the AMF may be used to secure additional instream flow releases developed under the AMP. In the event of exhaustion of the WAF and AMF, the Licensee has committed up to a total of $6,000,000 for all Adaptive Management actions for Authorized Modifications to project facilities and/or flow operations which are determined to be necessary under Adaptive Management.

The Adaptive Management objectives outlined in the AMP focus on management of hydroelectric operations within the Restoration Project to facilitate habitat changes beneficial to salmon and steelhead. There is expected to be a corresponding increase in salmon and steelhead populations as a result of these management actions. Measuring such increases is practical for larger populations such as steelhead and fall-run chinook salmon, but proving statistically significant responses to fish populations currently at extremely low levels, such as winter-run chinook, may not be possible. Therefore, trigger events leading to Adaptive Management actions will not be based solely on populations data, but will also rely on measurements indicating habitat conditions. The AMP objectives do not include or exclude existing or potential future propagation and/or supplementation activities, nor do they consider “active” experimentation to elucidate relationships between management actions and ecological processes, nor do they address the possibility of future development within Battle Creek.

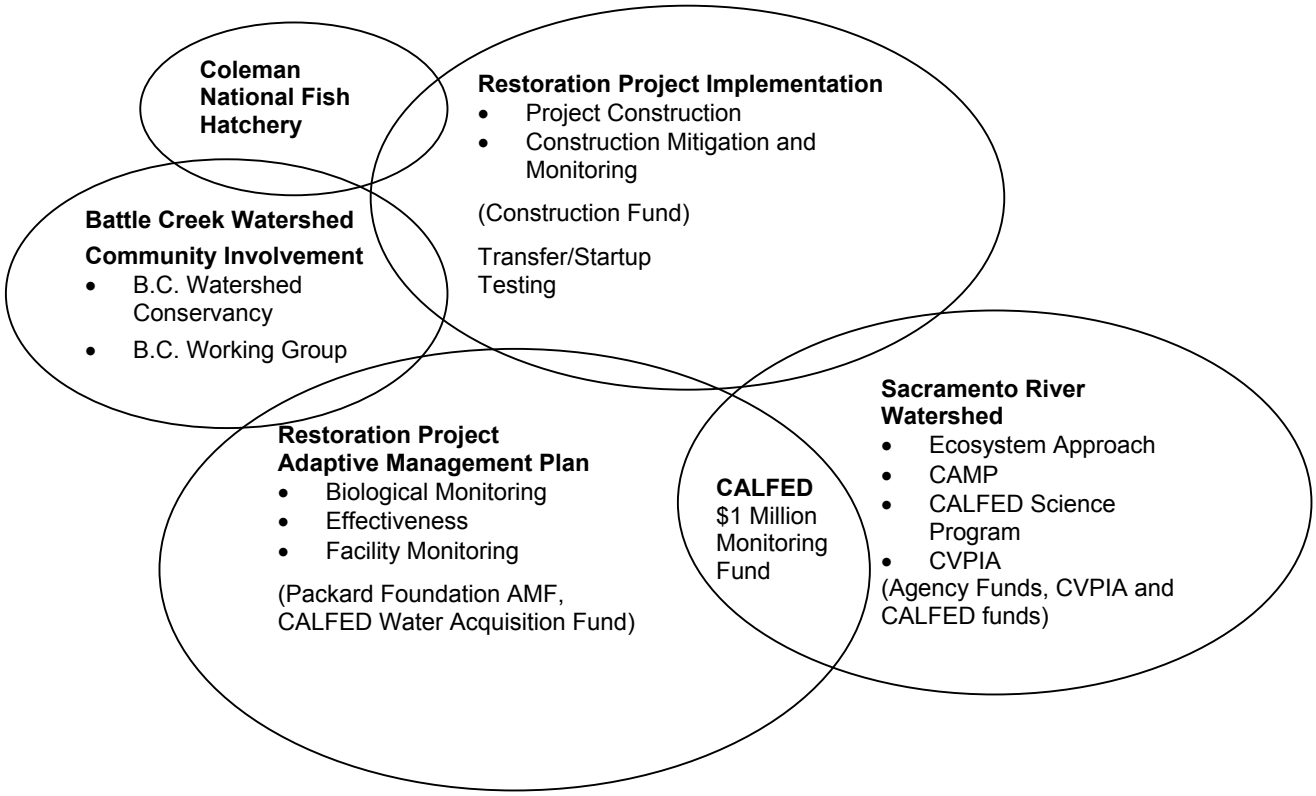

Figure 2. Institutional and funding relationships described in the Battle Creek Adaptive Management Plan with related watershed restoration programs and community involvement.

Although many anticipated limiting factors as well as many unanticipated circumstances have been outlined in the AMP, the plan acknowledges that not all events are predictable and, invariably, surprising circumstances will arise. However, it is the nature of Adaptive Management to design studies and management programs to adapt to unforeseen circumstances. Also, many unanticipated factors may be outside the scope of the Restoration Project. Just how an AMP responds to new circumstances is governed by a stepwise scientific process beginning with hypothesis testing of objectives through monitoring and data assessment. A timeline identifies the duration and order of monitoring activities and includes trigger events indicating that an Adaptive Management response is necessary. Adaptive Management responses would be evaluated to determine if the objective is being met and current actions should continue or if new actions are needed to meet the objectives. Adaptive Management responses could include any major or minor changes to the hydroelectric facility or the natural features of the Restoration Project. Responses to a trigger event will have limits identified by the FERC license amendment. Adaptive Management responses falling outside of those allowed by the FERC license amendment provisions would need to be addressed through established FERC processes. Key to the Adaptive Management process is a reporting regime consistent with the ability to design and evaluate responses to Adaptive Management actions.

The AMP objectives for the restoration of salmon and steelhead focus on improvements in population dynamics, improvements to the habitat, and improvements designed to ensure safe passage of adults and juveniles. The population objectives are (1) ensure successful salmon and steelhead spawning and juvenile production, (2) restore and recover the assemblage of anadromous salmonids (i.e., winter-run, spring-run, steelhead) that inhabit the stream's cooler reaches during the dry season, (3) restore and recover the assemblage of anadromous salmonids (i.e., fall-run, late-fall-run) that enter the stream as adults in the wet season and spawn upon arrival, and (4) ensure salmon and steelhead fully utilize available habitat in a manner that benefits all life stages, thereby maximizing natural production and full utilization of the ecosystem carrying capacity. Objectives focusing on improving the habitat of salmon and steelhead are (1) maximize habitat quantity through changes in instream flow, (2) maximize habitat quantity by ensuring safe water temperatures, (3) minimize false attraction and harmful fluctuation in thermal and flow regimes resulting from planned outages or detectable leaks from the hydroelectric project, and (4) minimize the stranding and isolation of salmon and steelhead resulting from variations in flow regimes caused by hydroelectric project operations. Objectives for the safe and reliable passage of salmon and steelhead are (1) provide upstream passage of adults at dams, (2) provide downstream passage of juveniles at dams, and (3) provide upstream passage of adults to their appropriate habitat over natural obstacles while ensuring appropriate levels of spatial separation between runs.

To determine if the population objectives of the AMP are being met, assessments of population size, trends in productivity, population substructure, and population diversity must be compared to corresponding guidelines set forth by NMFS. The AMP has adopted NMFS definitions of "viable populations" as the intermediate population goal and identifies the maximization of salmon and steelhead production and full utilization of carrying capacity as the final goal. The fish passage objectives are intended to assist in restoring natural process of dispersal and the habitat objectives will work to restore natural ecological variation associated with the natural function of the ecosystem. Further threats to population diversity not covered by the AMP objectives will be addressed through the AMP "linkages."

The AMP is just one aspect of the Restoration Project and is closely linked with the other elements of the Restoration Project. Other programs within the Restoration Project cover some aspects of restoration not covered in the AMP such as facility operations and maintenance. The AMP is also linked to non-project restoration programs affecting salmon and steelhead populations both within and outside the Battle Creek watershed.

The implementation of the AMP is governed by a set of protocols. Adaptive Management activities on private land will be conducted in a manner that respects landowners' rights and privacy and that minimizes disturbances and risks to private lands. Protocols governing data management are consistent with guidelines established by Comprehensive Monitoring, Assessment, and Research Program (CMARP) and the

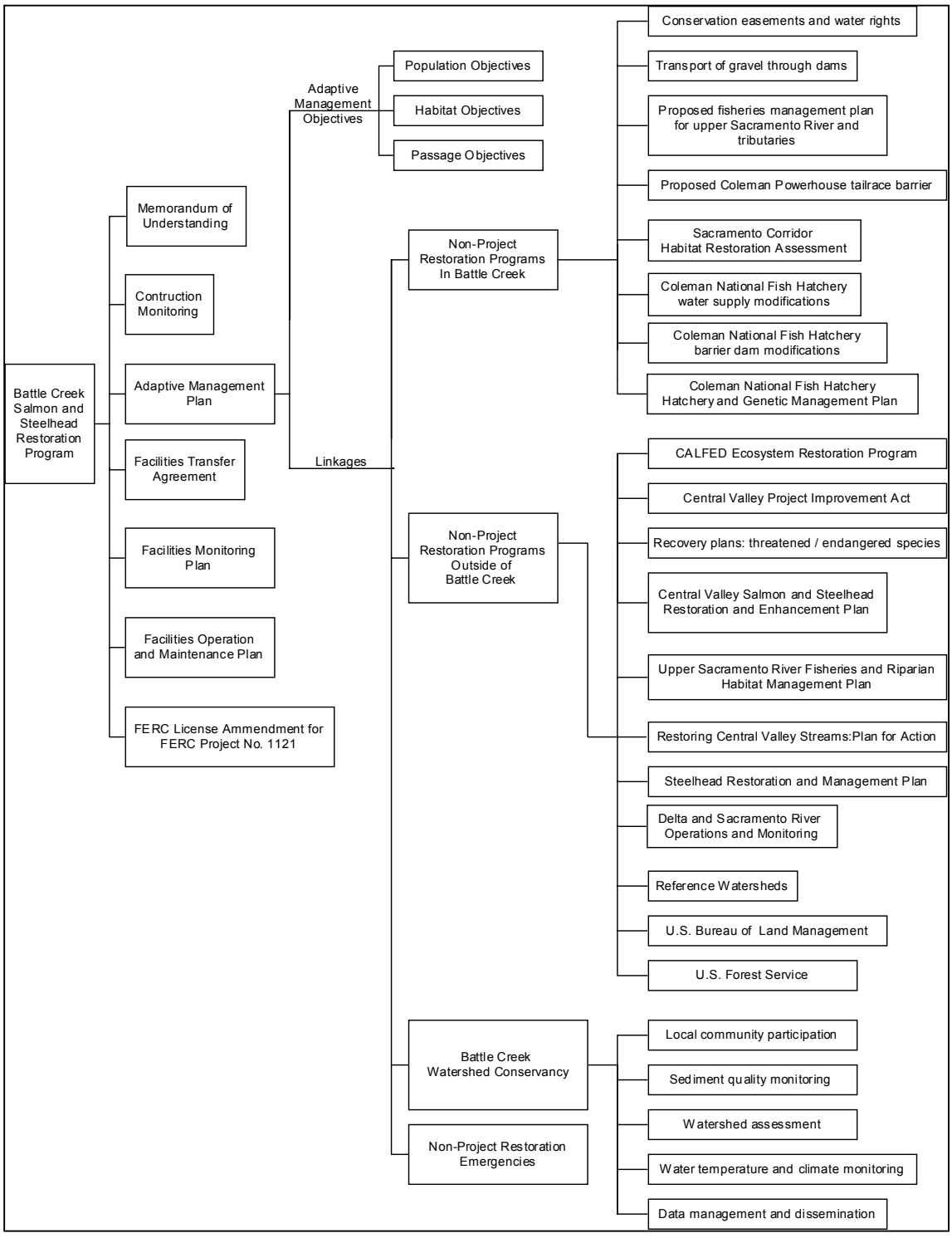

Figure 3. Schematic of the relationship of the Adaptive Management Plan and Adaptive Management objectives with other Restoration Project and non-project restoration activities that may affect salmon and steelhead in Battle Creek.

Environmental Protection Agency (EPA). Data and information will be made available to the public by dissemination to the appropriate agency information storage systems and an information system operated and maintained by the Battle Creek Watershed Conservancy (BCWC).

Meetings of the AMTT will be scheduled four times per year including an annual meeting in March, when possible Adaptive Management actions will be considered. The AMPT will meet at least annually in late March. These March meetings of the AMTT and AMPT are scheduled to finalize annual reports in time for funding agency deadlines. Ad hoc meetings may be scheduled by the AMTT or AMPT to address emergencies without advanced public notice, but such meetings will only consider the emergency at hand. All meetings will be open to the public, and all scheduled meetings will be announced to the public. Protocols also specify meeting announcement requirements, voting rules, report writing, Adaptive Management responses, proposal ranking, modification of Adaptive Management objectives, and dispute resolution.

The appendices contain tables, lists, and documentation useful to the understanding of the AMP. Monitoring activities and FERC license articles affected by Adaptive Management are all included in the appendices. The Literature Cited section contains the source material for all the references cited in the AMP.

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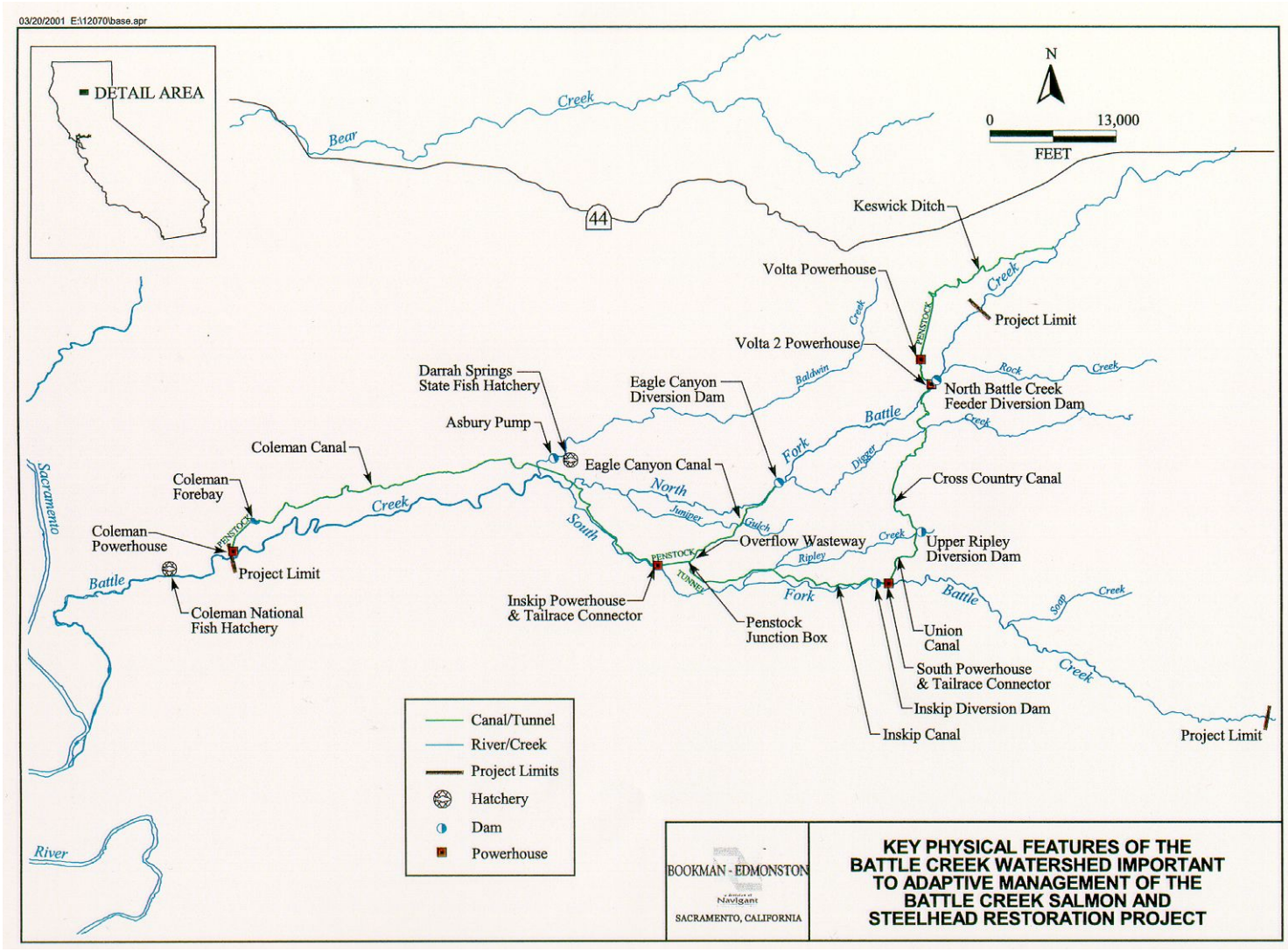

Location Map: Battle Creek Salmon and Steelhead Restoration Project

I. INTRODUCTION

I.A. Setting

Battle Creek is a tributary of the Sacramento River located in Tehama and Shasta Counties. This cold, spring-fed stream has exceptionally high flows during the dry season, making it important habitat for anadromous fish. Battle Creek may be the only remaining stream other than the main stem of the Sacramento River that can successfully sustain breeding populations of steelhead and all four runs of chinook salmon. Battle Creek is also unique and biologically important because its numerous cold-water springs provides habitat opportunities during drought years for winter-run chinook salmon.[1]

Pacific Gas and Electric Company (PG&E) owns and operates several hydroelectric power diversion facilities on the North and South Forks of Battle Creek, including Coleman Division Dam, Inskip Diversion Dam, South Diversion Dam, Wildcat Diversion Dam, Eagle Canyon Diversion Dam, and North Battle Creek Feeder Diversion Dam, and dams on Ripley Creek, Soap Creek, and Baldwin Creek. PG&E controls the majority of the flows in the anadromous fish reaches of the Battle Creek watershed.[2]

I.B. Document History and Purpose

In June 1999, PG&E, National Marine Fisheries Service (NMFS), California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (USFWS), and U.S. Bureau of Reclamation (USBR) entered into a Memorandum of Understanding (MOU) that signaled the intent of these MOU parties to pursue a salmon and steelhead restoration effort on Battle Creek that would modify the facilities and operations of PG&E's Battle Creek Hydroelectric Project (Federal Energy Regulatory Commission [FERC] Project No. 1121). Consequently, a federal-state interagency program known as the CALFED Bay-Delta Program (CALFED) provided $28 million in directed funding for the planning and implementation commitments of the Resource Agencies' portions of any approved project elements resulting from the proposed Battle Creek Salmon and Steelhead Restoration Project (Restoration Project).[3]

The MOU parties agreed that Adaptive Management is an integral component of the Restoration Project. Adaptive Management is a process that (1) uses monitoring and research to identify and define problems; (2) examines various alternative strategies and actions for meeting measurable biological goals and objectives; and (3) if necessary, makes timely adjustments to strategies and actions based upon best scientific and commercial information available.[4]

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[1] MOU 1.1
[2] MOU 1.2
[3] Notice of Preparation Project Background
[4] MOU 9.0

The primary reason for using an Adaptive Management process is to allow for changes in the restoration strategies or actions that may be necessary to achieve the long-term goals and/or biological objectives of the Restoration Project and to ensure the likelihood of the survival and recovery of naturally-spawning chinook salmon and steelhead. Using Adaptive Management, restoration activities conducted under the Restoration Project will be monitored and analyzed to determine if they are producing the desired results (i.e., properly functioning habitats).[4]

To formalize the use of Adaptive Management in the Restoration Project, an Adaptive Management Plan (AMP) was developed by PG&E, the NMFS, USFWS, and CDFG (collectively known herein as "Parties"). Biological goals are the broad guiding principles for the AMP and are the rationale behind the minimization and mitigation strategies and/or actions. Specific biological objectives are the measurable targets for achieving the biological goals. The goal of the AMP is to implement specific actions to protect, restore, enhance, and monitor salmonid habitat at FERC Project No. 1121 to guard against false attraction of adult migrants and ensure that chinook salmon and steelhead are able to fully access and utilize available habitat in a manner that benefits all life stages and thereby maximizes natural production, fully utilizing ecosystem carrying capacity.[5]

As implementation of the Restoration Project proceeds, results will be monitored and assessed. If the anticipated goals and objectives are not being achieved, then adjustments in the restoration strategy or actions will be considered through the AMP, which has been developed consistent with the relevant CALFED guidelines. A Water Acquisition Fund (WAF), Adaptive Management Fund (AMF), and Licensee Commitment are elements of Adaptive Management which will provide funding for potential changes to Restoration Project actions that result from application of the AMP.[4]

The AMP will be submitted by PG&E to the FERC at the time that PG&E files its license amendment application pursuant to the MOU. The Parties acknowledge that implementation of the AMP could later involve proposals for changes in operations, project facilities, and possible decommissioning of some additional FERC Project No. 1121 facilities to improve biological effectiveness and habitat values for chinook salmon or steelhead.[6]

The AMP is designed to be consistent with and fulfill the goals and objectives of the Restoration Project. The primary goal of the Restoration Project is to restore and enhance approximately 42 miles of anadromous fish habitat in Battle Creek plus an additional 6 miles of habitat in its tributaries while minimizing the loss of clean (emission-free), renewable energy produced by the Battle Creek Hydroelectric Project. The primary objective of the Restoration Project is to provide increased habitat and reliable upstream and downstream migration routes for salmonids. Reliable migration

[5] MOU 9.1.A.2.(a). Ecosystem carrying capacity is not specifically defined in the MOU or AMP. Rather, the use of that term in this document conforms to the sense of the definition of "maximum carrying capacity" in Odum (1983), which says that theoretical maximum carrying capacity is reached when no further increase in the size of a population occurs because maintenance energy costs balance available energy.
[6] MOU 9.1

routes for salmonids refers not only to safe passage but also includes measures that allow returning adult salmonids to find their natal streams by minimizing the false attraction of North Fork fish to the South Fork of Battle Creek. Current hydroelectric project operations result in the transfer of most of the natural flow of the North Fork to the South Fork, which could cause false attraction of returning adult migrants born in the North Fork to the South Fork.

The MOU described the following goals, or benefits, of the Restoration Project: restoration of self-sustaining populations of chinook salmon and steelhead and their habitat in the Battle Creek watershed through a voluntary partnership with state and federal agencies, the Packard Foundation, and PG&E;[7] up-front certainty regarding specific restoration components;[8] timely implementation and completion of restoration activities;[9] and joint development and implementation of a long-term AMP with dedicated funding sources to ensure the continued success of restoration efforts under this partnership.[10] Furthermore, implementation of the Restoration Project will be consistent with the following restoration directives and programs:

- Central Valley Project Improvement Act (Public Law 102-575 Section 3401 et seq. [CVPIA]) Anadromous Fish Restoration Program (AFRP);
- State Salmon, Steelhead Trout, and Anadromous Fisheries Program Act (State Senate Bill 2261, 1990) Central Valley Salmon and Steelhead Restoration and Enhancement Plan;
- NMFS Recovery Plan for Sacramento River Winter-Run Chinook Salmon;
- CALFED Ecosystem Restoration Program (ERP);
- Upper Sacramento River Fisheries and Riparian Habitat Management Plan (State Senate Bill 1086, 1989);
- Restoring Central Valley Streams- A Plan for Action (1993); and
- Steelhead Restoration and Management Plan for California (1996).[11]

I.C. Document Organization

This document was written to provide a complete understanding of the adaptive management process as applied to the Restoration Project and to serve as a procedural and planning reference tool for Contemporary managers of the Restoration Project and Battle Creek fisheries. However, it was not written to be a "stand-alone" document in that it does not include all background and reference documentation; rather, it depends directly on key supporting documents including, primarily, the Battle Creek Salmon and Steelhead Restoration Plan (Restoration Plan), the CALFED Ecosystem Restoration Plan (CALFED 1999), and the Facility Monitoring Plan, which is currently being prepared per the MOU for matters of regulatory compliance. Users of this document who are

[7] MOU 1.4.A
[8] MOU 1.4.B
[9] MOU 1.4.C
[10] MOU 1.4.D
[11] MOU 1.7

interested in learning more about the foundation of the Restoration Project and related actions, the initial steps in the adaptive management process used to develop this plan, or historical details of the restoration planning process are invited to read the Restoration Plan (Ward and Kier 1999a), MOU, and several other restoration plans that include Battle Creek (CALFED 1999; Ward and Kier 1999b; USFWS 1997; Bernard et al. 1996; CDFG 1996, 1993, 1990; USRFRHAC 1989; CACSST 1988; Hallock 1987). Users of this document who are interested in learning more about the current and proposed activities at Coleman National Fish Hatchery (CNFH) are encouraged to peruse the Biological Assessment (BA), which describes and assesses impacts of current or proposed operations of the CNFH and Livingston Stone National Fish Hatchery on listed populations of anadromous salmonids in the Central Valley under the Endangered Species Act (ESA) (USFWS 2001a).

This AMP is divided into four major sections. The first section, Organization, describes the structure of the Adaptive Management technical and policy teams, the roles and responsibilities of the Parties to the MOU, Adaptive Management funding, and the term of the AMP. The following two technical chapters implicitly recognize the fact that many factors, including the Restoration Project and factors outside of the control of the Restoration Project, will affect the eventual restoration of salmon and steelhead in Battle Creek. Therefore, the section titled Adaptive Management Objectives describes specific Adaptive Management objectives pertaining to the future Adaptive Management of Restoration Project elements, and the scientific methodology associated with Adaptive Management of salmon and steelhead populations, habitat, and passage directly affected by the Restoration Project. Linkages with Other Programs describes the linkages between the Adaptive Management of Restoration Project elements and other state and federal restoration programs and directives not directly related to the Restoration Project or with other Restoration Project planning that is not related to Adaptive Management. The Protocols section describes procedural rules that will govern the Adaptive Management process. Finally, the AMP includes appendices that list AMP and monitoring activities; objectives and concepts that have been considered and rejected for inclusion in the AMP; proposed FERC license articles affected by Adaptive Management; and the literature cited in this document.

The AMP sets policy regarding the management of Restoration Project-related fish populations, habitat, and passage when the MOU does not specifically address a policy issue. However, in cases where the language in the AMP may conflict with the MOU, policy regarding these topics will be set by the MOU. The MOU prevails in any discrepancy between policy specified in the AMP and that set by the MOU.

I.D. Adaptive Management Process

The intent of the adaptive management process is to permit the power of scientific problem solving (experimentation) to be built into management actions in a way that develops better resource management systems (Healey 2001; Walters 1986). The adaptive management process proceeds from definition of a management problem to the modeling of system dynamics and anticipated responses to management options. From

an evaluation of anticipated system response, adaptive management then proceeds to the implementation of specific management option(s) in ways that allow system response to be detected. Finally, monitoring is based on the hypothesized system dynamics and reassessment of the problem, while management actions follow from the results of monitoring (Figure 1; Healey 2001).

The concept of adaptive management is evolving. Presently, there are two overall approaches recognized: active and passive. In general, the active approach applies several proposed management options separated by time or location as a means to discriminate among competing hypotheses of system dynamics. Conversely, the passive approach implements the single most promising management option and monitors its effectiveness versus anticipated results.

In the case of the Restoration Project, a number of actions are being implemented simultaneously as the initial starting point, including instream flow increases, release of cold spring water to streams, passage facility improvements, elimination of potential sources of false attraction to migrating adult fish, and isolation of hydroelectric project water fluctuations from the natural stream reaches. Following the application of this initial array of actions, passive adaptive management will be the tool used to monitor effects of the Restoration Project and to apply further modifications where warranted.

The following subsections briefly explain the six steps in passive adaptive management (Table 2), how those steps were carried out in the development of this AMP, and where the reader may find more information about those steps.

Table 2. The six steps of passive adaptive management identified by the CALFED Independent Science Board (Healey 2001).

1. Review the available information to define the problem as precisely as possible.
2. Develop plausible solutions to the management problem. Describe these in terms of conceptual models of system behavior and its response to possible management interventions.
3. Subject these solutions to some form of structured analysis (simulation modeling is a useful analytic tool) to determine which offers the greatest promise of success.
4. Specify criteria (indicators, measures) of success or failure of the most promising solution
5. Implement the most promising solution and monitor the system response according to the criteria developed in Step 4.
6. Adjust the design of the solution from time to time according to the results of monitoring in an attempt to make it work better.

I.D.1. Step 1: Review of Available Information

The first step in formalized passive adaptive management is to review existing information in order to define the management problem as precisely as possible (Table 2; Healey 2001). In the case of Battle Creek, the management problem, at its grossest level, was how to restore currently-depressed numbers of anadromous salmonids, in a watershed that historically was one of the most diverse and productive salmon and steelhead streams in the Sacramento River.

The gross-level fishery management problem, low numbers of anadromous salmonids in Battle Creek, was more clearly defined through several restoration planning documents that were based on Contemporary best available science. For example, Hallock (1987) recommended that a salmon restoration plan be developed for Battle Creek upstream of the CNFH. He felt that the major factor suppressing salmon populations was decreased instream flows caused by the PG&E hydroelectric project and that restoration of stream flows could support populations of between 6,000 and 10,000 fall-run salmon, 2,500 spring-run salmon, and 1,000 steelhead. The hydroelectric project can divert up to 97 percent of the natural base-flow of the stream and all the major cold-water springs.

The Upper Sacramento Fisheries and Riparian Habitat Advisory Council, established in 1986 by California Senate Bill 1086, generated a fisheries and riparian habitat management plan which also cited hydroelectric development, and the operation of the CNFH, as the two primary causes for low populations of naturally reproducing salmon and steelhead in Battle Creek. This plan called for:

- Increased and stabilized instream flows downstream of hydroelectric project diversions;
- Installation of fish screens at project diversions;
- Modification of the practice of removing gravel from behind project dams;
- Releasing a portion of salmon and steelhead runs, including a continuation of the practice of releasing excess fall chinook salmon, to Battle Creek upstream from the CNFH;
- Completion of habitat studies;
- The development of a specific anadromous fish management plan for Battle Creek and the CNFH.

During the late 1980s, a comprehensive fisheries investigation was performed on Battle Creek. Component studies of this investigation provided much of the scientific foundation for subsequent restoration planning. The several components of the fisheries investigation included studies of (1) instream flow (TRPA 1998a), (2) species habitat criteria, (3) fish passage barriers (TRPA 1998b), (4) water temperature (TRPA 1998c, 1998d), (5) fish species abundance (TRPA 1998e), (6) hydrology, (7) sediment and gravel recruitment, and (8) hatchery interactions.

In the early 1990s, another plan was developed to restore and enhance salmon and steelhead in the Central Valley (CDFG 1990). This plan also called for increased instream flows and effective fish screens on Battle Creek. The final recommendations of the California Advisory Committee on Salmon and Steelhead Trout were adopted in Senate Bill 2261, passed in 1988, which in turn led to the development of "A Plan for Action" (CDFG 1993). This document called for increased stream flows, improving fish passage at Eagle Canyon Dam, installation of fish screens at agricultural and hydroelectric project diversions, passage of fall chinook salmon above the CNFH to spawn naturally in Battle Creek, and preparation and implementation of a comprehensive

plan to restore winter and spring chinook salmon and steelhead to Battle Creek. One offshoot of the "Plan for Action" was the development of the Steelhead Restoration and Management Plan for California, including Battle Creek (CDFG 1996).

The most definitive attempt to define management problems in Battle Creek began in 1997 with a CalFed Category III contract for development of a comprehensive technical plan to guide implementation of restoration planning efforts and receive advice from interested and affected parties. This effort was completed under the supervision of the Battle Creek Working Group (BCWG)[12] and culminated in the Restoration Plan and an addendum (Ward and Kier 1999a, 1999b). These two documents summarized instream habitat studies that used best available science in the 1980s (TRPA 1998a, 1998b, 1998c, 1998d, 1998e) and the existing conditions in Battle Creek in the late 1990s including discussions of geology and hydrology, fish populations, selected stream-dependent plants and animals, the history of the Battle Creek watershed including hydroelectric project and hatchery operations that contributed to the decline of Battle Creek's anadromous salmonids, Sacramento River fisheries management and environmental factors, and summaries of past and contemporary restoration efforts. The "Technical Plan" section of the Restoration Plan described goals, objectives, and models for the restoration of ecosystem processes in Battle Creek and documented an analysis of anadromous fish habitat in Battle Creek including, among many others, perceived limiting factors such as instream flow, water temperature, removal of cold-water spring flow, fish passage problems at dams and natural features, and false attraction resulting from hydroelectric project operations. These two documents also examined perceived limiting factors associated with the operations of the CNFH. All limiting factor analyses within these two reports were based on explicit and implicit conceptual models consistent with the formal adaptive management process.

The Restoration Plan (Ward and Kier 1999a) provided detailed recommendations regarding Battle Creek's hydroelectric-related management problems and, to a lesser extent, watershed activities and CNFH management options. Potential solutions for Battle Creek's fishery management problems included actions supporting salmonid restoration in the Battle Creek uplands, in Battle Creek upstream of anadromous fish habitat, and within anadromous fish habitat of Battle Creek; a list of evaluations and studies necessary for salmonid restoration to decrease uncertainty involved in solution identification; and monitoring that would be necessary to ensure that any restoration projects were successful.

The conclusion of the initial "problem definition" step of adaptive management, reached during a long period of restoration planning, resulted in rather precise definitions of the management problem. The gross-level problem of "how to restore anadromous fish" was refined to a list of problem areas that needed to be improved for fish restoration (Ward and Kier 1999a), including:

[12] The BCWG was established by interested and affected parties associated with implementation of the CVPIA to develop an implementation plan for Battle Creek that is effective and has community acceptance It included representatives of at least 18 agencies and stakeholders. All of the Adaptive Management Parties, including PG&E, USFWS, CDFG, NMFS, and USBR, were represented in the BCWG.

- Insufficient instream flows below PG&E diversion dams limits fish production;
- Removal of inflow from major cold-water springs to stream reaches reduces the amount of cold-water habitat at low elevations;
- Water allocated to fish restoration is at risk of future reallocation to off-stream uses;
- Ramping procedures below diversion dams did not meet the intent of state and federal endangered species laws;
- False attraction of anadromous salmonids from the North Fork to the South Fork leads to unstable population structure and loss of production in the more drought-tolerant North Fork and potentially leads to fish mortality;
- Fish passage facilities at dams did not provide safe passage of adult and juvenile salmonids;
- False attraction of anadromous salmonids to the Coleman Powerhouse tailrace potentially causes fish mortality and/or loss of production;
- Natural barriers at Panther Creek on the South Fork limit the habitat available to anadromous salmonids, according to a 1983 assessment of fish passage barriers, but not according to recent observations (CDFG 2001a, 2001b) that indicate the feature is not a barrier at high flow;
- Fish passage barriers and low amounts of spawning gravels in a one-half mile reach of Baldwin Creek limit steelhead production;
- Fish pathogens flow from salmon habitat to the CNFH's primary water supply on Coleman Canal via hydroelectric project diversions and water conveyance systems and might impact the CNFH during times when its ozonation system is inoperative (the ozonation system became operational in 2000; USFWS 1998); and
- A lack of institutional controls and automated mechanisms prevent fish entrainment and fluctuating instream flows.

Many other items were excluded from the list because they were not seen as limiting factors or key components of the management problem. These include:

- Gravel recruitment processes are not disturbed,
- No gravel mining exists in the watershed,
- Gravel routing at diversion dams has been addressed by operational procedures,
- Riparian community structure is healthy,
- Upland land use is isolated from stream channels,
- Channel geomorphology is not impaired because diversions do not significantly impact channel maintenance flows, and

- Exotic fish species would be restricted in range, abundance and impact under restored flow conditions,

Also excluded from the problem definition, because they were addressed by other ongoing management efforts, were such factors outside the Battle Creek watershed as:

- Water diversions impacts in the Sacramento River,
- Sacramento/San Joaquin Delta conditions,
- Commercial and sport fishing, and
- Oceanographic conditions.

Finally, the Restoration Plan and its addendum, "Maximizing Compatibility between Coleman National Fish Hatchery Operations, Management of Lower Battle Creek, and Salmon and Steelhead Restoration" (Ward and Kier 1999b), indicated that there was a great deal of uncertainty that Contemporary operations at the CNFH would be fully compatible (as characterized by USFWS 1994) with timely recovery of salmon and steelhead in the restored habitat. The USFWS is currently engaged in an ongoing CNFH Reevaluation Process aimed at identifying potential conflicts between existing hatchery operations and the restoration program and evaluating potential alternative operational strategies to ensure that the CNFH does not impede the restoration of natural salmon and steelhead populations in Battle Creek. Problem definition and solution identification at the CNFH adequate for formal adaptive management were not completed in these reports.

Following completion of these restoration planning documents, PG&E, NMFS, CDFG, USFWS, and USBR undertook a series of negotiations consistent with the formal adaptive management process to further identify solutions to Battle Creek's management problems. The MOU, adopted in June 1999, stated the intent of these MOU parties to engage in a restoration effort that would modify the facilities and operations of FERC Project No. 1121. The objectives of the Restoration Project are (1) the restoration of self-sustaining populations of chinook salmon and steelhead and their habitat in the Battle Creek watershed, (2) up-front certainty regarding specific restoration components, (3) timely implementation and completion of restoration activities, and (4) joint development and implementation of a long-term AMP with dedicated funding sources to ensure the continued success of restoration efforts under this partnership.

Restoration and monitoring activities currently under way or planned for Battle Creek are guided by the goals, objectives, and strategies developed in the AFRP Plan (USFWS 2001b). To facilitate restoration of natural salmonid populations in Battle Creek, the CNFH's operations need to be made compatible with the AFRP guided recovery process (USFWS 1994, 1998). Major changes under way at the CNFH include modifications to the hatchery's barrier weir and upstream ladder, improvements to or screening of the water intakes, and construction of an ozone water treatment plant (USFWS 2000a).

I.D.2. Step 2: Solution Identification and Development of Conceptual Models

The second step in formalized passive adaptive management is to develop plausible solutions to the management problem and describe these in terms of conceptual models of system behavior and likely responses to possible management interventions (Table 2; Healey 2001). In the case of Battle Creek, the initial, grossest-level solution identification was conducted by a subgroup of the BCWG that did not include PG&E. In January 1998, this subgroup released the working paper "A Time For Action," which was intended to catalyze the planning process by suggesting a list of possible restoration actions (BCWG 1998). Biological, socioeconomical, and political analyses were then conducted in response to this working paper, including the description of alternative solutions in terms of conceptual models of system behavior.

The overarching conceptual model employed in Battle Creek was the development of a classification system that anticipated the maximum potential restored fish habitat by stream reach and species. Each stream reach within the project-affected portion of the Battle Creek watershed was categorized by professional judgment using a system of five grades based on such attributes as potentially restorable temperature regime, cold-water accretions from springs, physical habitat characteristics, species life history, length of stream reach, stream gradient, reach elevation, and past observations in similar watersheds.[13] This overarching conceptual model was supported by the use of reference streams (e.g., Mill and Deer Creeks, Little Sacramento and McCloud Rivers) and the importance of abundant cold-water spring resources.

This overarching conceptual model was then strengthened by the use of more specific, biological models of key stream reach attributes such as instream flow and potentially usable fish habitat, spawning gravel surveys, water temperature, natural fish passage barriers, and fish passage at diversion dams. Instream flow and available fish habitat were modeled by TRPA (1998a) using the instream flow incremental methodology (IFIM), which described the relationship between instream flow and the quantity of fish habitat in each reach of the project-affected area for several fish species and lifestages. This instream flow model was interpreted using an limiting life stage model that assessed the relative importance of habitat for three life stages of chinook salmon, including fry, juvenile, and spawning, through the use of a mathematical model that determined, for each reach, which type of habitat limited production under varying flow regimes. Water temperatures, under possible alternative solutions to the management problem, were modeled using the SNTEMP model (Tu 2001; TRPA 1998c, 1998d) to ensure that thermal regimes would approximate those found in other streams supporting spring-run chinook. Natural fish passage barriers were analyzed by field measurements and the use of a model that helped determine at which flow a potential barrier would become impassable to migrating chinook and steelhead. Fish passage at diversion dams was considered in light of state and federal standards for fish ladders and criteria for fish screens that have been established to maximize the effectiveness of fish

[13] The concept of Reference Watersheds was developed to "ground-truth" the stream classification system and is used frequently throughout the Adaptive Management process to assess conceptual models, to screen solutions, and to develop criteria for measuring the success of the identified solution.

ladders and screens to salmon and steelhead. Furthermore, the cost of fish passage facility modifications was compared with diversion dam decommissioning. Finally, economic models of power production were used to estimate economic impacts of various restoration efforts.

I.D.3. Step 3: Solution Screening

The third step in formalized passive adaptive management is to subject alternative solutions to some form of structured analysis (e.g., simulation modeling) to determine which offers the greatest promise of success (Table 2; Healey 2001). In the Battle Creek case, the BCWG employed various technical models and a series of four formal policy-level screening mechanisms.

The overarching screening mechanism employed in Battle Creek was the concept of ecosystem function. As mandated by CVPIA and CALFED legislation, all possible solutions were screened to ensure that measures undertaken for the benefit of salmon and steelhead would address ecosystem functions or processes (Ward and Kier 1999a).

Alternative solutions were also screened by the policy concept of "stream-dependent economic values" to ensure that possible solutions would minimize the economic impact of fish restoration on the Battle Creek Hydroelectric Project and to ensure the project's viability; not change any consumptive water rights within the Battle Creek watershed and not impact existing agriculture; and provide benefits to commercial fisheries and recreational industries including fishing clubs and guide services by providing more fish to catch.

Another policy concept, "Maximum Potential Restoration," was used to screen solutions. Technical models used in identifying solutions considered ecological characteristics (e.g., habitat descriptions, species prioritization, and temperature regimes) that would be achieved under "maximum potential restoration" or terms similar to "reliable," "complete," or "full" restoration. In general, these tools are used to set targets for what could be achieved if every identified problem affecting anadromous salmonids could be eliminated. Due to the reality of limited restoration funds, the stated goal of balancing restoration with stream-dependent economic values, and other sociopolitical realities, the BCWG acknowledged that not all possible restoration actions would be implemented as a result of the Restoration Plan. However, they felt these compromises would be best addressed in the recommendations and subsequent restoration actions, rather than to bias the tools used to evaluate the potential for restoration. Therefore, tools used in solution identification generally considered the maximum potential for restoration. An ancillary policy concept was that significant amounts of public monies were identified for the Restoration Project, creating an expectation that the actions would be highly certain and reliable compared to normal regulatory processes.

Finally, three policy-level "Biological Principles" were used by the USFWS, NMFS, CDFG, and USBR to screen solutions: biological effectiveness, restoring natural processes, and biological certainty. Solutions were required to incorporate the most biologically effective remedies that provide the highest certainty to successfully restore

ecosystem functions and self-sustaining populations of native fish in a timely manner. However, hatchery programs to supplement fish populations were not considered because such programs are only one possible element of a recovery planning process led by NMFS that is still under way. Solutions were required to incorporate measures that mimic the hydrologic conditions under which Battle Creek anadromous fish resources evolved by increasing base flows and eliminating the mixing of North Fork and South Fork waters. These solutions were to include the removal of diversions at major springs (e.g., in Eagle Canyon and Soap Creek) and the removal of low-elevation dams that fish must pass to reach cold water (e.g., Wildcat and Coleman Diversion Dams). Solutions were required to provide maximum long-term effectiveness by minimizing long-term dependence on the integrity of man-made restoration actions and the cooperation of future project owners and operators.

Technical-level models were used for screening purposes in many applications (see Ward and Kier 1999a for a complete discussion of all technical analyses used by the BCWG). For example, the IFIM instream model and the limiting life-stage model were used to screen alternatives. In particular, the Biological Team of the BCWG spent nearly a year screening countless alternative instream flow regimes to arrive at a flow regime (named "biologically optimum flows"[14]) that they forecast would typically provide at least 95 percent of the maximum weighted useable area[15] for the priority species and limiting life-history stage present at that time. In some cases, other considerations took precedence over adherence to the 95 percent of maximum weighted useable area. These considerations included ensuring adequate flows for adult salmon migration at natural barriers, balancing overlapping life stages and species, preventing redd dewatering, considering the amount of inflow available at the upstream end of each reach, providing water to preserve the structural integrity of the South Canal,[16] and assuming that accretions within the Keswick Reach upstream of the anadromous salmonid habitat would provide the necessary flows in the lower portion of this reach.

Another example of the use of conceptual model to screen solutions was the release of major cold water springs to the stream and the application of the SNTEMP water temperature model to ensure that summer water temperatures were suitable for winter-run and spring-run chinook salmon under the "biologically optimum" flow regime.

The result of the solution identification process was a suite of proposed changes to the facilities and operations of the Battle Creek Hydroelectric Project (Table 3). This

[14] The BCWG prefaced the use of the term "biologically-optimum." That name was not intended to imply that these flows are "perfect" or that they provide the maximum potential amount of habitat. Rather, the term identified restored flows that were derived from the best Contemporary methodology for determining instream flows, that would minimize the take of habitat for listed species pursuant to Section 2081.0 of the California Fish and Game Code, and that would carefully balance overlapping ecological needs while recognizing the stated goal of maintaining stream-dependent economic values.

[15] Pursuant to Section 2081.0 of the California Fish and Game Code, the taking of species, listed under the California Endangered Species Act, or their habitat, should be "minimized or fully mitigated." In this case, releasing flows that provided 95 percent of the maximum weighted useable area was considered to "minimize" the take of habitat for listed species.

[16] The MOU, written after these analyses, called for decommissioning of this canal.

project solution is referred to in this document as the "Restoration Project" and is supported by and described in detail in the June 1999 MOU signed by the NMFS, USBR, USFWS, CDFG, and PG&E.

Table 3
Components of the Battle Creek Salmon and Steelhead Restoration Project

Site Name	Component
North Battle Creek Feeder Diversion	55 cfs fish screen Fish ladder
Eagle Canyon Diversion	70 cfs fish screen Fish ladder
Wildcat Diversion	Dan and appurtenant facilities removed
South Diversion	Dan and appurtenant facilities removed
Inskip Diversion and South Powerhouse	220 cfs fish screen Fish ladder South Powerhouse and Inskip Canal connector
Coleman Diversion and Inskip Powerhouse	Dam removed 340 cfs fish screen Fish ladder
Lower Ripley Creek Diversion	Dan and appurtenant facilities removed
Soap Creek Diversion	Dan and appurtenant facilities removed

Finally, many of the goals and objectives of both the CALFED ERP and the CVPIA AFRP were included within the MOU The CVPIA is a federal statute jointly implemented by the USBR and USFWS. Its goals are consistent with CALFED's ERP. The CVPIA authorizes a number of projects and programs that contribute to the purposes of the Act and that are consistent with the restoration approach identified in the record of decision for CALFED. In Battle Creek, both CVPIA and CALFED plans, goals, funds, and projects have been utilized to benefit the ecosystem (CALFED 2001).

I.D.4. Step 4: Specification of Criteria of Success

The fourth step in formalized passive adaptive management is to specify criteria of success or failure of the most promising management solution (Table 2; Healey 2001). To make Adaptive Management scientifically feasible in the restoration of Battle Creek, consideration of the "success or failure of the Restoration Project" was divided among a series of individual objectives that closely correspond to the detailed description of the management problem as discussed above. Therefore, the success or failure of the Restoration Project will be measured against many indicators and criteria as described in detail within the eleven Adaptive Management objectives (see page 33).

Criteria vary among the different Adaptive Management objectives and are quite diverse. For example, Salmon and Steelhead Population Objective 1 (Spawning and Juvenile Production; page 43) uses the following metrics and criteria to gauge the success or failure of obtaining this objective:

Fish Population Objective 1 Metrics:

- Estimates of juvenile outmigrant production upstream of the CNFH and at the terminus of each fork of the creek;
- Estimates of adult and jack population sizes and distribution;
- Evaluations of physical and biological conditions within habitats by reach;

Fish Population Objective 1 Criteria:

- Estimates of juvenile outmigrant production will be compared to (1) expected production levels based on adult spawning populations, (2) production levels in Reference Watersheds, and (3) relevant ecological factors.

On the other hand, Salmon and Steelhead Habitat Objective 2 (Water Temperature, page 49) uses the following metrics and criteria to gauge the success or failure of obtaining this objective:

Habitat Objective 2 Metrics:

- Climatic conditions within the South Fork watershed;
- Longitudinal water temperature regime of stream;
- Flow at springs to which CDFG has conservation water rights;

Habitat Objective 2 Criteria:

- Observed water temperature regimes will be compared to water temperatures predicted by the best available Contemporary water temperature models at target points within the stream.

Please refer to individual population, habitat, and fish passage objectives for a complete understanding of the diverse criteria that will be used to gauge the success of the Restoration Project.

I.D.5. Step 5: Solution Implementation

The fifth step in formalized passive adaptive management is to implement the most promising solution and monitor the system response according to the criteria developed in Step 4 (Table 2; Healey 2001). The MOU among the MOU Parties described in detail what was considered to be the most promising solution. The USBR has proposed the suite of actions outlined in the MOU as the "preferred alternative" and may implement this solution, pending analysis in a formal NEPA/CEQA project selection process and pending receipt of necessary construction permits. A suite of monitoring studies and reporting protocols will be the basis for implementing this AMP (see Section VI, Appendix Listing AMP Monitoring Activities).

I.D.6. Step 6: Adaptive Responses

The sixth step in formalized passive adaptive management is to adjust the design of the solution from time to time according to the results of monitoring in an attempt to make it work better (Table 2; Healey 2001). As described in more detail below (see

page 31), adaptive responses are an integral feature of this AMP. The solution, as implemented in the form of the Restoration Project and considered under the structure of the eleven Adaptive Management objectives, will be evaluated to determine if each objective is being met and whether current actions should continue or if new actions are needed to meet the objectives. Adaptive Management responses could include any major or minor changes to the hydroelectric facility or the natural features of the Restoration Project. Adaptive Management responses have limits identified by the FERC license amendment. Adaptive Management responses falling outside those allowed by the FERC license amendment provisions would need to be addressed through established FERC processes.

I.E. Experimentation

Adaptive management is strongly rooted in scientific experimentation. By specifically designing experiments into management actions, conclusions can be drawn that help develop better resource management decision making. Experimentation in Battle Creek is embodied in three ways, where experimentation (1) has been a component of adaptive management problem definition and solution development, (2) is embodied in the overall Adaptive Management program as envisioned in this document, and (3) may be conducted as part of individual Adaptive Management objectives considered under this plan within the established protocols.

I.E.1. Experimentation in Problem Definition and Solution Development

Some early management actions functioned as experiments that helped to develop better resource management decision making in Battle Creek although they were not specifically designed as adaptive management experiments. For instance, during the period from 1985 to 1989, fall-run chinook were intentionally allowed passage over the CNFH barrier dam, below which they had historically been restricted, and instream flows were increased in the area accessible to these fish to assess their use of the habitat upstream of the CNFH. The major conclusions of this experiment were findings that fall-run chinook would use habitat as far upstream as the Inskip reach and that the presence of fall-run chinook in the water supply upstream of the CNFH contributed to subsequent disease outbreaks at the hatchery. This experimentation contributed to the development of improved disease control systems at the CNFH and contributed to the design of new water conveyance facilities that will partially isolate the CNFH water supply as part of the Restoration Project.

A similar management initiative in the late 1990s has also led to adaptive changes in the management of Battle Creek, specifically the development of new instream flow prescriptions as part of the Restoration Project. In 1995, a partnership between PG&E, state and federal fisheries agencies, and restoration funding sources (CVPIA and Category III) initiated increases in instream flows at half of the hydroelectric diversions affecting salmon and steelhead within Battle Creek while maintaining FERC-required minimum instream flows at the remainder of the diversions. Physical (e.g., water temperature, fish passage at natural barriers) and biological responses (e.g., fish

distribution) to these flow changes have been monitored and resulting observations have been incorporated into subsequent restoration planning.

I.E.2. Experimentation in the Overall Adaptive Management Effort

This AMP does not specify conducting individual experiments at this time. The intent of the MOU parties was to spend, if necessary, the limited funds available for Adaptive Management on implementing specific remedies to unforeseen shortcomings in the Restoration Project, rather than committing these funds to experimentation for goals other than those specific to the Restoration Project. The Adaptive Management Parties recognize the uncertainty surrounding our understanding of ecological processes and, specifically, about how salmon and steelhead populations will respond to initial Restoration Project actions. However, the Parties recognize that clear-cut population level responses may take decades to be manifested and trust in the considerable existing knowledge of the aquatic ecosystems of Battle Creek as well as the protocols for adaptive responses discussed in this AMP.

Collectively, the Restoration Project and the objectives set forth within this AMP constitute a long-term experiment in restoration. Theories of experimental design suggest that maximizing the difference between the treatment and control provides the best opportunity for identifying a response. In Battle Creek, the difference between the experimental control (existing conditions under the current FERC license) and the experimental treatment (Restoration Project actions) are so large that a response to these measures should become evident, provided that freshwater habitat conditions in the hydroelectric project reaches indeed limit fish production. For example, existing conditions under the current FERC license are typified by hydroelectric diversions with inadequate fish passage and instream flows that are very low for the target species' life stage needs, while the Restoration Project provides for removal of diversion dams, installation of state-of-the-art fish ladders and screens, protection against false attraction, release of major cold-water springs, and instream flow levels on the order of 10 to 29 times greater than existing conditions. Furthermore, the Restoration Project was specifically designed to minimize the uncertainty that is normally explored through experimentation. For example, installation of tailrace connectors should virtually eliminate the current transbasin water diversions that could otherwise lead to false attraction and confound the relationships between fish production and the other Restoration Project actions. Dam removals and increasing instream flows to levels approaching natural conditions are other examples of minimizing uncertainty.

Should the population objectives not be realized as a result of the Restoration Project and this AMP, then adaptive management suggests that other management actions be considered. Fortunately, the time scales of salmon and steelhead restoration (dictated by ecological processes like the population dynamics of small populations and cycles in oceanographic productivity) match up with the time scales of hydroelectric project relicensing. Another opportunity, outside of this AMP, to implement broad-scale changes to the hydroelectric project will be available in 2026 when the project is scheduled for relicensing and this AMP expires.

I.E.3. Experimentation Within Component Objectives

Though not specifically considered at this time, smaller-scale experiments may be a key tool for eliminating future uncertainty in the case that Adaptive Management responses are triggered by unforeseen future conditions. Several component objectives within this AMP specify that diagnostic studies will be performed in the case that planned management actions fail to achieve the intended objectives. Nothing in this AMP suggests that these diagnostic studies could not take the form of experimentation, provided they are feasible, practical, reasonable, prudent, acceptable to the local community, conform to required protocols, and fall within response limits that are specified in criteria that bound potential adaptive management responses.

I.F. Definitions

Adaptive Management means an approach that allows for changes to the Restoration Project that may be necessary in light of new scientific information regarding the biological effectiveness of the restoration measures.[17]

Adaptive Management Fund means the fund described in Section II.C.3.

Authorized Modifications means changes to project facilities and/or flow operations that are determined to be necessary per Adaptive Management protocols.

Battle Creek Watershed Conservancy (BCWC) means an organization of landowners from the Battle Creek watershed created as a means of discussing matters of concern to local landowners, including education, watershed land and water use, solid waste management, exotic vegetation control, and fire safety, and as a means of sharing information among watershed residents about the salmon and steelhead restoration plans under development by state and federal agencies.

Battle Creek Working Group means a stakeholder and agency group comprised of nearly 20 organizations interested in restoration of salmon and steelhead to Battle Creek (see Ward and Kier 1999a for a list of member organizations).

Battle Creek Hydroelectric Project, FERC Project No. 1121 or **FERC Project No. 1121** means the hydroelectric development as described in the license issued by FERC on August 13, 1976, and as subsequently amended.

Consensus means the unanimous agreement among the Parties.[18]

Contemporary means current or modern. This word is generally used to refer to existing or future criteria that will be used to judge the success of restoration actions. When new criteria are created to replace old criteria, the use of "Contemporary" refers to the new criteria.

[17] MOU 2.1
[18] MOU 2.7

Emergency Responses are adaptive management responses that must be dealt with promptly (e.g., situations that create unsafe conditions or unduly threaten salmon or steelhead populations or individuals). Emergency Responses that require a change to hydroelectric project facilities and/or flow operations that exceed a value of $100,000, adjusted for inflation from the date of this agreement, must be approved by the AMPT; otherwise they may be approved by the AMTT. The AMPT will treat the dollar amount listed in this paragraph as a flexible guideline, and will evaluate these numbers and revise them as necessary as part of the yearly report. Any member of the AMPT may propose an adjustment to these spending guidelines for any action.

Fail-Safe Fish Ladder means features inherent in the design of the ladder that ensure the structure will continue to operate to facilitate the safe passage of fish under the same performance criteria as designed under anticipated possible sources of failure.[19]

Fail-Safe Fish Screen means a fish screen that is designed to automatically shut off the water diversion whenever the fish screen fails to meet design or performance criteria until the fish screen is functioning again.[20]

Licensee means either PG&E or any lessee or successor owner of FERC Project No. 1121.

Licensee's Commitment means a total spending cap on the part of the Licensee for expenses necessary under Adaptive Management. As more specifically identified in Section II.C.4. in the event of exhaustion of the WAF and AMF, Licensee acknowledges and agrees that it will pay up to a total of $6,000,000 for all Authorized Modifications to FERC Project No. 1121 facilities and/or flow operations that are determined to be necessary under Adaptive Management.

Major Responses are defined as non-emergency changes to hydroelectric project facilities and/or flow operations that exceed a value of $25,000, adjusted for inflation from the date of this agreement. The AMPT will treat the dollar amount listed in this paragraph as a flexible guideline, and will evaluate these numbers and revise them as necessary as part of the yearly report. Any member of the AMPT may propose an adjustment to these spending guidelines for any action.

Minor Responses are defined as non-emergency changes to hydroelectric project facilities and/or flow operations that are less than a value of $25,000, adjusted for inflation from the date of this agreement. The AMPT will treat the dollar amount listed in this paragraph as a flexible guideline, and will evaluate these numbers and revise them as necessary as part of the yearly report. Any member of the AMPT may propose an adjustment to these spending guidelines for any action.

Parties means PG&E (or any lessee or successor), NMFS, USFWS, and CDFG.[21]

[19] MOU 2.10
[20] MOU 2.11

PG&E means "the Pacific Gas and Electric Company,"[22] the utility regulated by the California Public Utility Commission that owned the Battle Creek Hydroelectric Project (FERC Project No. 1121) at the time this document was prepared. (The term "PG&E" as used in the MOU and the use of PG&E is continued in this document for the ease of the reader.) "PG&E" and "Licensee" refers to the Pacific Gas and Electric Company or any lessee or successor owner of FERC Project No. 1121.

Ramping Rates means moderating the rate of change of stream stage decrease in Battle Creek resulting from the operation of FERC Project No. 1121.[23]

Reference Watersheds means the Deer, Mill, and Butte Creek watersheds and any other watersheds resembling Battle Creek in geology, morphology, hydrology, and fish species diversity and distribution, that are located in proximity to Battle Creek.

Resource Agencies means the CDFG, NMFS, and USFWS.[24]

Restoration Project means all measures set forth in the Agreement in Principle (MOU Attachment 1) as further developed in the MOU and having the purpose of restoring chinook salmon and steelhead habitat associated with FERC Project No. 1121, within the Restoration Project Area.[25]

Restoration Project Area means the areas in and around the following PG&E facilities: Coleman Diversion Dam, Inskip Diversion Dam, South Diversion Dam, Wildcat Diversion Dam, Eagle Canyon Diversion Dam, North Battle Creek Feeder Diversion Dam, and Asbury Pump Diversion Dam; Battle Creek, North Fork Battle Creek and South Fork Battle Creek, up to the natural barriers at 14 miles and 19 miles above the confluence, respectively; and Eagle Canyon Springs, Soap Creek (and Bluff Springs), Baldwin Creek, Lower Ripley Creek, and each of their adjacent water bodies.[26]

Viable Salmonid Population means an independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame. Other processes contributing to extinction risk (catastrophes and large-scale environmental variation) are also important considerations, but by their nature, they need to be assessed at the larger temporal and spatial scales represented by evolutionarily significant units or other entire collections of populations.[69]

Water Acquisition, funded by WAF, AMF, Licensee, and others, means the non-consumptive release of water from use in FERC Project No. 1121 to the natural stream channel as instream flows. Payments for additional water acquisition during the first ten

[21] The Parties, as used in this document, differs from the MOU parties in that it does not include the USBR, whose only role in Adaptive Management is to maintain the WAF account and disburse monies at the request of the AMPT through the USFWS.
[22] Part of MOU 2.14
[23] MOU 2.16
[24] MOU 2.17
[25] MOU 2.18
[26] MOU 2.19

years of the Restoration Project are made from the WAF in arrears annually to the Licensee. For additional water that will continue to be released beyond the ten-year life of the WAF, a lump-sum payment computed on the net present value of the ongoing water release will be paid at the end of the tenth year. Water acquisition does not impact the consumptive use of water downstream from the Restoration Project Area.

II. ORGANIZATION

As required by the MOU, the AMP was developed through the Consensus process by the Resource Agencies and Licensee. Interested persons were invited to attend any meeting, contribute to discussions and provide suggestions regarding development of the AMP. Specific notice, in addition to any general notice, of any such meetings was sent to (1) the BCWC; (2) CALFED; and (3) any person who requested such notification.[27]

II.A. Structure

The basic organizational structure of the Adaptive Management effort consists of the Adaptive Management Policy Team[28] (AMPT) and the Adaptive Management Technical Team[29] (AMTT).

II.A.1. Adaptive Management Policy Team

The AMPT is a management-level cooperative group that makes all final decisions regarding the implementation of the Adaptive Management component of the Restoration Project. The AMPT has a representative from each of the Resource Agencies and Licensee. The members of the AMPT are familiar with Adaptive Management methodologies adopted by CALFED.

The AMPT provides policy direction and resolves any disputes forwarded by the AMTT through Consensus. In the event that the AMPT is unable to reach Consensus within 30 days, dispute resolution procedures, described herein, shall be followed.[30]

II.A.2. Adaptive Management Technical Team

Voting members of the AMTT include a representative from each of the Resource Agencies and Licensee with appropriate training and experience to effectively address the technical aspects of implementing the AMP.[31] While each Party will have only one voting member, more than one individual from each Party will likely serve on the AMTT during the term of the AMP in order to effectively address the technical aspects of AMP implementation.

[27] MOU 9.1.A.1.
[28] MOU 9.1.B.1
[29] MOU 9.1.B.
[30] MOU 9.1.B.1
[31] MOU 9.1.B.2

The AMTT has developed the AMP for approval by the AMPT and will implement the Adaptive Management component of the Restoration Project upon approval by FERC. The Chairperson of the AMTT will rotate regularly as agreed upon by the AMTT.[32]

II.B. Roles and Responsibilities

The MOU lists the roles and responsibilities for each party to the MOU pertaining to the overall Restoration Project as well as the those roles and responsibilities for Adaptive Management. The following sections of this AMP list only those roles and responsibilities that pertain to Adaptive Management. See the MOU for a more complete list. The AMP sets policy regarding roles and responsibilities when not specifically addressed by the MOU. However, in cases where the language in the AMP may conflict with the MOU, roles and responsibilities will be set by the MOU. The MOU prevails in any discrepancy between the AMP and the MOU.

II.B.1. Licensee

A. As more fully described below, Licensee has agreed to a number of physical and operational changes and additions to FERC Project No. 1121, as well as the assumption of a number of future costs. Licensee, however, recognizes that these costs may exceed those estimates and agrees it is responsible for all cost overruns for Restoration Project components which are identified as funded by Licensee in Table 3 of MOU Attachment 1. This amount includes Licensee's participation in a portion of the biological and environmental monitoring more fully described in MOU Section 7.3. In addition to other financial obligations documented in the MOU and Facilities Monitoring Plan, Licensee's financial participation in the Adaptive Management elements of the Restoration Project will consist of absorption of the loss of forgone power as a consequence of Ramping Rate requirements described in MOU Attachment 2. In the event of exhaustion of the WAF and AMF, Licensee acknowledges and agrees that it will pay up to a total of $6,000,000 for all Authorized Modifications to FERC Project No. 1121 facilities and/or flow operations which are determined to be necessary under Adaptive Management. No aspect of this commitment relieves the Licensee from legal responsibilities. Nothing in the AMP is intended to bind or prejudice the Resource Agencies, or otherwise limit their respective authorities, in the performance of their responsibilities under this AMP, the MOU, and other applicable federal and state laws.[33]

B. Licensee will pay all of its internal costs associated with the FERC license amendment required to implement the Restoration Project. Licensee will also participate in and provide limited internal technical and fishery expertise, at its

[32] MOU 9.1.B.2
[33] MOU 6.1A

expense, to assist with the biological and environmental monitoring efforts described in Section 7.3 and will cooperate/work with the Resource Agencies conducting analyses, reviewing results, and identifying potential Adaptive Management actions for the Restoration Project.[34]

C. Licensee will provide the prescribed instream flow releases and Ramping Rates identified in MOU Attachments 1 and 2, and any agreed-upon future changes to these prescribed instream flow releases or Ramping Rates resulting from the AMP until the end of the current FERC license and any subsequent annual licenses. The Parties acknowledge that this commitment to provide the prescribed instream flow releases and Ramping Rates is subject to change by FERC in the license amendment process and at the expiration of the current license term in 2026.[35]

D. Licensee's water diversion rights associated with all dams to be decommissioned in the Restoration Project Area pursuant to the MOU shall be transferred to CDFG. CDFG agrees that the water rights transferred by Licensee to CDFG shall not be used by CDFG or any successor in interest, assignee, or designee to increase prescribed instream flow releases above the amounts developed pursuant to the AMP, nor shall they be used adversely against remaining FERC Project No. 1121 upstream or downstream diversions, until such time as the FERC license is abandoned, whereupon the limitation regarding transferred water rights will no longer apply. Licensee agrees that its riparian rights associated with lands within the Restoration Project Area shall not be used by Licensee or any successor in interest, assignee, or designee to decrease prescribed instream flow releases below the amounts developed pursuant to the AMP. Licensee agrees that any deed transferring such riparian land or rights shall contain the above restriction in use of the riparian rights.[36]

E. Licensee is responsible for the operation, maintenance, and replacement of all physical modifications to its facilities under this MOU on Battle Creek due to normal wear and tear, catastrophic damage, and any other type of damage, and will ensure that the new fish screen and ladder facilities meet the Fail-Safe criteria. Installation costs of facilities installed under the AMF protocols are excepted. Licensee's responsibilities under this section begin once the facility start-up and acceptance testing is successfully completed by USBR and Licensee. At that point, Licensee shall accept and take over the facilities.[37]

F. Licensee shall be responsible for all monitoring required by FERC through the FERC license amendment for FERC Project No. 1121. Licensee will also participate in and provide limited internal technical and fishery expertise, at its expense, to assist with the biological and environmental monitoring efforts

[34] MOU 6.1.B
[35] MOU 6.1.D
[36] MOU 6.1.E
[37] MOU 6.1.G

described in MOU Section 7.3, which are the responsibility of the Resource Agencies. Licensee shall be responsible for all of the facility monitoring more particularly described in the Facilities Monitoring Plan.[38]

G. Licensee shall provide at least one representative to the AMPT and one representative to the AMTT. Licensee's representatives to these two teams shall be responsible, for one year out of every four as outlined in the Protocols section, for the chairmanship of these teams on a rotating basis with the other Parties. These chairmanships includes the responsibility of publishing the annual Adaptive Management report.

H. Licensee will be responsible for assuming its costs for any FERC dispute resolution proceedings.[39]

I. As described more fully below in descriptions of individual Adaptive Management objectives, Licensee shall conduct and/or fund facilities monitoring consistent with the Facilities Monitoring Plan, including recording the timing and estimated amounts of water intentionally released from the canal gates and spill channels; conduct and/or fund the facilities monitoring, and operation and maintenance of hydroelectric project facilities; conduct and/or fund adult counts at fish ladders in the initial three-year period of operation; repair or replace fish counting equipment in fish ladders in the initial three-year period of operation. Pursuant to Adaptive Management protocols, if salmon and steelhead populations are insufficient to affirm ladder effectiveness under continuous duty, then Licensee may conduct and/or fund adult counts at fish ladders for a longer period of time as agreed upon by the Parties. All data collected as part of Adaptive Management monitoring will conform to data management protocols in Section V.B.

II.B.2. NMFS

A. In the next relicensing proceeding for FERC Project No. 1121, to the extent NMFS determines that these provisions are consistent with the biological opinion rendered for the proposed Restoration Project and its responsibilities under the ESA to conserve threatened and endangered species and their habitats,[40] the NMFS agrees to support the continuation of the prescribed instream flow releases described in MOU Attachment 1 and Ramping Rates resulting from adaptive management.[41]

B. NMFS agrees to support, to the extent NMFS determines that these provisions are consistent with the biological opinion rendered for the proposed Restoration Project and its responsibilities under the ESA to conserve

[38] MOU 6.1.M
[39] MOU 14.0
[40] MOU 6.3.B
[41] MOU 6.3.B.3

threatened and endangered species and their habitats, any changes to instream flow releases or Ramping Rates resulting from Adaptive Management, subject to applicable law, and to support incorporating Battle Creek monitoring needs into appropriate CVPIA, CALFED, and other monitoring programs.[42]

C. NMFS shall provide at least one representative to the AMPT and one representative to the AMTT. NMFS's representatives to these two teams shall be responsible, for one year out of every four as outlined in the Protocols section, for the chairmanship of these teams on a rotating basis with the other Parties. These chairmanships includes the responsibility of publishing the annual Adaptive Management report.

D. NMFS will be responsible for assuming its costs for any FERC dispute resolution proceedings.[43]

E. As described more fully below in descriptions of individual Adaptive Management objectives, NMFS, in cooperation with USFWS and CDFG, may conduct and/or fund or seek funding from sources other than the Licensee for any necessary unfunded element of Adaptive Management. All data collected as part of Adaptive Management monitoring will conform to data management protocols in Section V.B.

F. NMFS will define recovery goals for anadromous salmonid species in Battle Creek listed under the ESA. These include species currently listed (i.e., winter-run chinook salmon, spring-run chinook salmon, and steelhead) as well as any other anadromous fish species that may be listed under the ESA at any time during the term of the AMP.

II.B.3. USFWS

A. In the next relicensing proceeding for FERC Project No. 1121, USFWS agrees to support the continuation of the prescribed instream flow releases described in MOU Attachment 1 and Ramping Rates resulting from adaptive management.[44]

B. USFWS agrees to support any changes to instream flow releases or Ramping Rates resulting from Adaptive Management, subject to applicable law, and to support incorporating Battle Creek monitoring needs into appropriate CVPIA, CALFED, and other monitoring programs.[45]

C. USFWS shall provide at least one representative to the AMPT and one representative to the AMTT. USFWS's representatives to these two teams shall be responsible, for one year out of every four as outlined in the Protocols

[42] MOU 6.3.C
[43] MOU 14.0
[44] MOU 6.4.B.3
[45] MOU 6.4.C

section, for the chairmanship of these teams on a rotating basis with the other Parties. These chairmanships includes the responsibility of publishing the annual Adaptive Management report.

D. USFWS will be responsible for assuming its costs for any FERC dispute resolution proceedings.[46]

E. As described more fully below in descriptions of individual Adaptive Management objectives, USFWS, in cooperation with CDFG and NMFS, shall conduct and/or fund or seek funding from sources other than the Licensee for monitoring and data assessments including those associated with all fish population objectives; data collection and report preparation associated with Habitat Objective 1; water temperature and climatic data collection associated with Habitat Objective 2; relevant biological monitoring and measurement of any known release or discharge from the hydropower water conveyance system that elicits a response from salmon or steelhead associated with Habitat Objective 3; incidental monitoring and the diagnostic Ramping Rate assessment associated with Habitat Objective 4; biological monitoring using ladder counts after the ladder is deemed effective associated with Passage Objective 1; the repair or replacement of fish counting equipment in fish ladders after the initial three-year period of operation; and monitoring activities associated with Passage Objective 3. All data collected as part of Adaptive Management monitoring will conform to data management protocols in Section V.B.

II.B.4. CDFG

A. In the next relicensing proceeding for FERC Project No. 1121, CDFG agrees to support the continuation of the prescribed instream flow releases described in MOU Attachment 1 and Ramping Rates resulting from adaptive management.[47]

B. CDFG agrees to support any changes to instream flow releases or Ramping Rates resulting from Adaptive Management, subject to applicable law, and to support incorporating Battle Creek monitoring needs into appropriate CVPIA, CALFED, and other monitoring programs.[48]

C. CDFG shall provide at least one representative to the AMPT and one representative to the AMTT. CDFG's representatives to these two teams shall be responsible, for one year out of every four as outlined in the Protocols section, for the chairmanship of these teams on a rotating basis with the other Parties. These chairmanships includes the responsibility of publishing the annual Adaptive Management report.

[46] MOU 14.0
[47] MOU 6.5.C.3
[48] MOU 6.5.D

D. CDFG will be responsible for assuming its costs for any FERC dispute resolution proceedings.[49]

E. As described more fully below in descriptions of individual Adaptive Management objectives, CDFG, in cooperation with USFWS and NMFS, shall conduct and/or fund or seek funding from sources other than the Licensee for monitoring and data assessments including those associated with all fish population objectives; data collection and report preparation associated with Habitat Objective 1; water temperature and climatic data collection associated with Habitat Objective 2; relevant biological monitoring and measurement of any known release or discharge from the hydropower water conveyance system that elicits a response from salmon or steelhead associated with Habitat Objective 3; incidental monitoring and the diagnostic Ramping Rate assessment associated with Habitat Objective 4; biological monitoring using ladder counts after the ladder is deemed effective associated with Passage Objective 1; the repair or replacement of fish counting equipment in fish ladders after the initial three-year period of operation; monitoring activities associated with Passage Objective 3; modification of natural fish passage barriers. All data collected as part of adaptive Management Monitoring will conform to data management protocols in Section V.B.

II.C. Funding

Funding for provisions of this AMP will come from several sources including a WAF and AMF, both initially described in the MOU, cost sharing by the Parties, and solicitations from other funding sources. No provisions in the MOU or the following sections on funding are intended to limit the ability of the Parties, or third-party donors, from augmenting the Adaptive Management budget to continue to implement actions supported by AMP protocols.

II.C.1. CALFED Monitoring Fund

As part of the original grant for the Restoration Project, CALFED included $1,000,000 for monitoring activities. This money will be used to fund monitoring needs that are not funded by other sources.

II.C.2. Water Acquisition Fund

An important component of the Restoration Project will be the WAF. The purpose of the WAF is to establish a ready source of money which may be needed for future purchases of additional instream flow releases in Battle Creek that may be recommended under the AMP during the ten-year period following the initiation of prescribed instream flow releases listed in MOU Attachment 1. The WAF shall be used solely for purposes of purchasing additional environmentally-beneficial instream flow

[49] MOU 14.0

releases pursuant to the protocols developed by the Resource Agencies and Licensee. The Parties acknowledge that if additional instream flow releases are determined by the Resource Agencies to be required pursuant to the protocols described in MOU Section 9.2 A 3, the ESA, or other applicable law, and (1) the ten-year period described above has elapsed and/or (2) there are not sufficient funds in the WAF or the AMF to pay for such additional instream flow releases, then Licensee shall be responsible for the cost of such instream flow releases up to the maximum commitment of $6 million for changes in operation and modifications to facilities.[50]

The WAF account will be funded with federal funds described in Section 10.2 of the MOU and administered by the Resource Agencies following consultation with appropriate interested parties. USBR shall commit $3,000,000 of such funds to an account or subaccount for the WAF within four months of CALFED approval of federal funds described in MOU Section 10.2. Account disbursement instructions will be developed jointly by the Resource Agencies and Licensee. USFWS shall request disbursements from the WAF in writing, based on the account disbursement instructions.[51]

Protocols to identify environmentally beneficial flow changes for anadromous salmonids under the AMP, to be funded from the WAF, are detailed in a subsequent section of this plan.

During the ten-year effective period of the WAF, payment to Licensee for consensually agreed to or FERC-approved increased flow releases, and interim instream flow releases which have been taken pending FERC action, will be made in arrears annually. After January 1 following the expiration of the WAF, all uncommitted funds will revert to CALFED, or as otherwise provided by law. During the last year of the WAF, and to the extent that adequate moneys remain in the WAF, funds for agreed to prescribed instream flow releases which will be delivered after expiration of the WAF will be paid to Licensee in one lump-sum based on the net present value of foregone energy for the period inclusive of the realized increased prescribed instream flow releases and expiration date of the current FERC license.

The method of valuation of any additional environmentally beneficial prescribed instream flow releases for the purpose of compensation from the WAF shall be similar to that used for estimating the net present value of foregone power in MOU Attachment 1. The annual in arrears payments described above will be calculated by computing the additional energy foregone on a daily basis over the prior year due to increased prescribed instream flow releases multiplied by the weighted daily energy price published by the California Power Exchange for northern California, or equivalent. The lump-sum payment described above will be determined based on the average annual additional foregone energy associated with increased prescribed instream flow releases for a typical

[50] Based on MOU 9.2.A.1 and subsequent discussions.
[51] MOU 9.2.A.2

water year (e.g., water year 1989). The net present value payment will be based on the appropriate power values, escalation factor, and discount rate.[52]

Section 9.2.A.4 of the MOU provides for the calculation of a net present value payment from Adaptive Management funds at the end of year 10 for continuing additional instream flows determined necessary under Adaptive Management protocols. This section, however, left undetermined the actual power values; escalation factors, and discount rate to be used in such a calculation. These variables were left undetermined because the Adaptive Management Parties recognized that the conditions under which these variables were defined during negotiations were likely to change (perhaps significantly) between the finalization of the MOU and the end of the ten-year effective period of the WAF.

Residential and industrial demand, available supply, and available access via transmission and distribution systems will impact future power values. The future power values used in MOU negotiations were based on projections of the California energy market by the California Energy Commission (CEC). If the CEC is still developing similar projections when the WAF is accessed for the year 10 lump-sum net present value payment, their estimates will be used. In the event that the CEC no longer exists, or they no longer develop such projections, an impartial set of projections will need to be used. The first preference is to use projections developed by another State of California agency that has responsibility for developing published projections. If no such agency exists, the Parties will agree to an appropriate substitute through Adaptive Management decision-making protocols.

The previous paragraph assumes that the hydroelectric project will be participating in a deregulated energy market. In the event that the hydroelectric project is regulated by the California Public Utilities Commission, replacement power value and discount rate appropriate to the regulated utility status would be used by the Parties in arriving at a lump-sum net present value payment.

Escalation (or inflation) factors will be agreed upon by the Parties through Adaptive Management decision-making protocols.

During negotiation of the MOU, the electric generation industry in California was transitioning from a regulated industry to a deregulated industry. At the end of the ten-year effective period of the WAF, when funds for agreed to prescribed instream flow releases will be paid to Licensee in one lump-sum, the electric generation industry may be completely deregulated. The discount rate used was based on PG&E's weighted average cost of capital. This discount rate was justified due to PG&E's regulated utility status, more specifically, the cost-of-service regulation of its hydroelectric generation assets. The Licensee may or may not have this status at the end of the ten-year effective period of the WAF. As a fully deregulated industry, the appropriate discount rate would be based on the expected return by the Licensee in the deregulated industry. It is not clear what such a discount rate will be at the end of the ten-year period.

[52] MOU 9.2.A.4

Keeping the previous paragraph in mind, the discount rate should be applicable to the Licensee and agreed upon by the Parties through Adaptive Management decision-making protocols.

II.C.3. Adaptive Management Fund

Another component of the Restoration Project will be the AMF to implement actions developed under the AMP. The Parties agree that the purpose of the AMF is to provide a readily available source of money to be used for possible future changes in the Restoration Project. The AMF shall be used only for Restoration Project purposes directly associated with FERC Project No. 1121 including compensation for prescribed instream flow release increases after the exhaustion or termination of the WAF. The AMF shall be administered pursuant to the AMP protocols. The AMF shall not be used to fund monitoring or construction cost overruns.[53]

The AMF, in the amount of $3,000,000, will be made available to Licensee and the Resource Agencies by the Packard Foundation, to fund those actions developed pursuant to the AMP. The Packard Foundation shall deposit the $3,000,000 in an interest-bearing account managed by The Nature Conservancy (TNC) pursuant to a separate agreement to be developed jointly by the Resource Agencies, Licensee, and TNC. Account disbursement instruction will be developed jointly by the Resource Agencies, the Packard Foundation, and Licensee.

The Parties agree that (1) interest on the moneys in the AMF will accrue to the account and shall be applied to changes in the Restoration Project adopted pursuant to the Adaptive Management protocols and (2) all uncommitted funds in the AMF will revert to the Packard Foundation at the end of the current term of the license for FERC Project No. 1121. USFWS shall request disbursement from the AMF in writing, based on the protocols identified below.[54]

Protocols to designate environmentally beneficial Adaptive Management actions to be funded from the AMF pursuant to the AMP, are detailed in a subsequent section of this plan.

For funding prescribed instream flow increases, the protocols will be the same as for the WAF described in MOU Section 9.2 A 3. For funding facility modification, the protocols will be the same as that described in MOU Section 9.2 A 3, with two exceptions: (1) no interim action will be implemented prior to any required FERC approval of a license amendment or other necessary action by FERC and (2) for all actions resolved by FERC, in which Licensee is in the minority opinion (opposing a proposed action expenditure), the AMF will contribute 60 percent of any resulting facility modification cost; in the case of Licensee being in the majority opinion (in support of a

[53] MOU 9.2.B.1
[54] MOU 9.2.B.2

proposed action expenditure), the AMF will contribute 100 percent of any resulting facility modifications.[55]

II.C.4. Licensee Commitment

The principles of Adaptive Management include agreed-upon measures to ensure resources are not expended on an open-ended process of change that is out of proportion with the specified goal. While this level of detail was not addressed in the MOU, in the development of this AMP measures were more specifically defined, resulting in a funding commitment on the part of the Licensee in the amount of $6 million for continuation of Adaptive Management actions after exhaustion of the WAF and AMP. In aggregate, the funding commitments will provide up to $12 million for Adaptive Management actions over the life of the Restoration Project.

In the event of exhaustion of the WAF and AMF, Licensee acknowledges and agrees that it will pay up to a total of $6,000,000 for all Authorized Modifications to FERC Project No. 1121 facilities and/or flow operations which are determined to be necessary under Adaptive Management.[56] No aspect of this commitment relieves the Licensee from legal responsibilities. Nothing in the AMP is intended to bind or prejudice the Resource Agencies, or otherwise limit their respective authorities, in the performance of their responsibilities under this AMP, the MOU, and other applicable federal and state laws.[57]

This commitment is intended to provide a readily available source of money to be used for possible future changes in the Restoration Project.[58] This commitment shall be used only for Restoration Project purposes directly associated with FERC Project No. 1121 including compensation for prescribed instream flow release increases after the exhaustion or termination of the WAF and after the exhaustion or termination of the AMF.[59] This commitment shall be administered pursuant to the AMP protocols and shall not be used to fund monitoring or construction cost overruns.[60] Furthermore, this commitment may fund future purchases of additional instream flow releases in Battle Creek which may be recommended under the AMP.[61]

II.D. Term

The term of the AMP will begin when the FERC license amendment for the Restoration Project is granted, will coincide with the implementation of restoration actions, and will continue through the current FERC license. In addition, the AMP also

[55] MOU 9.2.B.3
[56] Parallels MOU 6.1.A
[57] MOU 5.7
[58] Parallels MOU 9.2.A.1
[59] Parallels MOU 9.2.B.1
[60] Parallels MOU 9.2.B.1
[61] Parallels MOU 9.2.A.1

includes more specific end points for some objectives, monitoring approaches, or responses.

II.D.1. Water Acquisition Fund

The WAF is available as a ready source of money for future purchases of additional instream flow releases in Battle Creek during the ten-year period following the initiation of prescribed instream flow releases listed in Attachment 1 of the MOU. After January 1 following the expiration of the WAF, all uncommitted funds will revert to CALFED, or as otherwise provided by law.[62]

II.D.2. Adaptive Management Fund

Provisions for establishment and administration of the interest-bearing AMF account became effective December 1, 2000, with the execution of an agreement between TNC and the MOU parties. The AMF account will be established 30 days after receipt of a final FERC Order approving the FERC license amendment that reflects the provisions of the Restoration Project and Adaptive Management. To the extent it is not exhausted, this fund will remain in effect from that point through and including June 30, 2026, or any earlier date upon which the FERC License for FERC Project No. 1121 expires or is revoked, unless earlier terminated pursuant to the agreement between TNC and the MOU parties regarding the AMF.[63]

II.D.3. FERC License

The license for the Battle Creek Hydroelectric Project, FERC Project No. 1121 was issued by FERC on August 13, 1976, and is scheduled to expire on July 31, 2026, unless extended by FERC.[64]

III. ADAPTIVE MANAGEMENT OBJECTIVES

This technical chapter of the AMP describes specific Adaptive Management objectives pertaining to the future Adaptive Management of Restoration Project elements, and the scientific methodology associated with Adaptive Management of salmon and steelhead populations, habitat, and passage directly affected by the Restoration Project.

The focus of AMP objectives is on the management of salmon and steelhead habitat, and in particular, on hydroelectric project facilities and natural habitat features affected by hydroelectric project operations within the Restoration Project area. Although the Restoration Project Area includes the north and south forks of Battle Creek

[62] Mimics MOU 9.2.A
[63] Per the May 7, 2000 agreement between TNC and the MOU Parties regarding the AMF.
[64] Mimics MOU 2.4 and MOU 15.0

upstream to the natural water falls,[65] no elements of the Restoration Project (i.e., neither facilities or operations of the FERC Project No. 1121 modified as part of the Restoration Project) will exist upstream of Inskip and North Battle Creek Feeder Diversion Dams. Therefore, adaptive management actions upstream of Inskip Dam and North Battle Feeder Dam will be limited to modification of any natural barriers that may occur up to, but not including, the absolute barriers to anadromous fish passage at the falls on each fork (river mile 18.85 on the South Fork and river mile 13.48 on the North Fork).[65]

Central to the AMP focus on management of habitat is an implicit expectation that salmon and steelhead populations will respond affirmatively to positive changes in their habitat. During the term of the AMP, Restoration Project elements will change fish habitat with the intention of improving that habitat for chinook salmon and steelhead. The AMTT expects to be able to measure significant responses to these habitat changes from the larger populations of salmonids like steelhead and fall-run chinook salmon. However, statistically significant responses to these habitat changes in populations of fish that are currently at extremely low levels, such as winter-run chinook salmon, may not be measurable at least until the populations of these scarce fish grow. This is due to the small number of these fish, limited natural recovery rates, and the limitations of scientific and statistical tools. The ability to adaptively manage habitat features of Battle Creek based on measurements of scarce populations of winter-run chinook, and possibly spring-run chinook, will be severely constrained until such a time that populations levels of these species increase substantially. Adaptive Management actions will not be triggered by biological measurements of scarce species alone; rather, habitat trigger events will need to support the biological indicators. Currently there is not sufficient predictive capability to determine when full recovery of listed species may occur.

The AMP objectives are sufficiently flexible to respond to implementation of approved programs which may change the time scales that apply to fisheries monitoring. However, the AMP objectives do not include artificial propagation and/or supplementation and do not incorporate potential future fisheries management plans that could implement various kinds of artificial propagation and/or supplementation programs, because such programs are outside the scope of the Restoration Project. Likewise, the AMP objectives do not exclude artificial propagation and/or supplementation, activities that may be specified in future fisheries management plans. The AMP objective also do not address the possibility of future development within Battle Creek.

Eleven objectives were identified pertaining to the Adaptive Management of salmon and steelhead populations, habitat, and passage affected by the Restoration Project (Table 4). These objectives were developed primarily from MOU language and pertain to all reasonable and foreseeable interactions between modifications to FERC Project No. 1121 facilities and operations, and salmon and steelhead populations.

[65] MOU 2.19. The barriers which determine the upstream distribution of anadromous salmonids in Battle Creek at river mile 13.48 on the North Fork of Battle Creek and at river mile 18.85 on the South Fork will not be modified as part of this AMP.

The nature of adaptive management, by definition, is to design studies and management programs that can be adapted to uncertain or unforeseen circumstances. A well-designed adaptive management plan anticipates as many circumstances as possible before designing monitoring and data assessment approaches. Within the eleven objectives, circumstances or issues that were anticipated include potential limiting factors such as water temperature, habitat quantity based on instream flow, natural barriers, fish passage at diversion dams, problems with facility design or operation, and many more. However, this AMP recognizes that not all future limiting factors could be anticipated. Therefore, many of the objectives refer to future unanticipated factors which could conceivably include things such as institutional changes (e.g., changes to the ESA or other laws), new natural resource management directives (e.g., artificial propagation or supplementation programs), newly understood ecological phenomena (e.g., global climate change), or land and water use changes (e.g., suburbanification of the uplands). Some unanticipated factors may fall outside of the Restoration Project (e.g., toxic spills) and would be addressed through linkages to other programs or directives, while others might be shown to be related to the hydroelectric project or shortcomings in the Restoration Project that could arguably be included under these adaptive management

Table 4. Adaptive Management objectives of the Battle Creek Salmon and Steelhead Restoration Project.

Salmon and Steelhead Populations
1. Ensure successful salmon and steelhead spawning and juvenile production.
2. Restore and recover the assemblage of anadromous salmonids (i.e., winter-run, spring-run, steelhead) that inhabit the stream's cooler reaches during the dry season
3. Restore and recover the assemblage of anadromous salmonids (i.e., fall-run, late-fall-run) that enter the stream as adults in the wet season and spawn upon arrival.
4. Ensure salmon and steelhead fully utilize available habitat in a manner that benefits all life stages thereby maximizing natural production and full utilization of ecosystem carrying capacity
Salmon and Steelhead Habitat Objectives
1. Maximize usable habitat quantity – volume.
2. Maximize usable habitat quantity – water temperature.
3. Minimize false attraction and harmful fluctuation in thermal and flow regimes due to planned outages or detectable leaks from the hydroelectric project
4. Minimize stranding or isolation of salmon and steelhead due to variations in flow regimes caused by hydroelectric project operations.
Salmon and Steelhead Passage Objectives
1. Provide reliable upstream passage of salmon and steelhead adults at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams per Contemporary engineering criteria and/or standards/guidelines.
2. Provide reliable downstream passage of juveniles at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams per Contemporary criteria after the transfer of facilities to Licensee.
3. Provide reliable upstream passage of adult salmon and steelhead to their appropriate habitat over natural obstacles within the Restoration Project area while maintaining an appropriate level of spatial separation among the runs.

objectives (e.g., possible oligotrophication problems in Battle Creek[66]). While this discussion of possible unanticipated factors may seem speculative or fanciful, past experience with adaptive management has shown that the actual factors that are eventually encountered will likely be even more surprising.

Adaptive Management used in this plan could more technically be defined as "passive" adaptive management, where changes in management are made in response to monitoring results, versus an "active" type of adaptive management where specific experiments are conducted in order to learn about ecological processes. Due to the existing knowledge regarding the aquatic ecosystems in Battle Creek, no specific experiments are contemplated. For example, this AMP does not consider experimental changes in instream flow designed to elucidate relationships between flow and salmonid habitat use.

III.A. Objective Table Format

In the following description of objectives and in the accompanying flow chart (Figure 4), the **bold-faced** terms refer to components of the Adaptive Management objective that will be discussed in more detail in the following sections and specifically within the tables detailing each objective.

For each **objective**, the Adaptive Management process will follow a stepwise scientific process beginning with a testable hypothesis which would indicate whether an objective is being met. **Hypotheses** conform to formal adaptive management criteria in that they are statements of cause and effect; are possible answers to a fishery management problem; are a potential description of how the world works; connect the actual management actions with expected outcomes, and are focused and testable (Healey 2001). The scientific methods used to test the hypothesis are identified in this plan as the **monitoring and data assessment approach** and are comprised of established and routine procedures, surveys, analysis, and modeling. These scientific methods will comply with all Contemporary standard methods and reporting practices that are adopted by CALFED and Resource Agencies as they are developed, with provisions for updating methods based on Contemporary scientific norms that are likely to change during the term of the AMP. The AMP will not propose studies that would compromise the recovery of salmon and steelhead. An implementation schedule, or **timeline**, lists the duration and order of monitoring activities for each objective, and includes trigger events and end points. **Trigger events** are circumstances indicating that an adaptive response should be taken and **end points** are a goal and/or circumstance indicating that an objective has been attained and indicating that monitoring and data assessment is no longer needed under the AMP for that objective. Some objectives may not have end points and will require monitoring and data assessment for entire term of the AMP.

[66] The importance of marine-derived nutrients in salmon ecosystems and the possible ramifications to restoration efforts of cultural oligotrophication in streams like Battle Creek, where large numbers of salmon carcasses have been excluded for decades by the hydroelectric project, have been emerging in the awareness of fisheries researchers and managers in the past decade (e.g., see Gresh et al. in *Fisheries* 25(1), and Stockner et al. in *Fisheries* 25(5)).

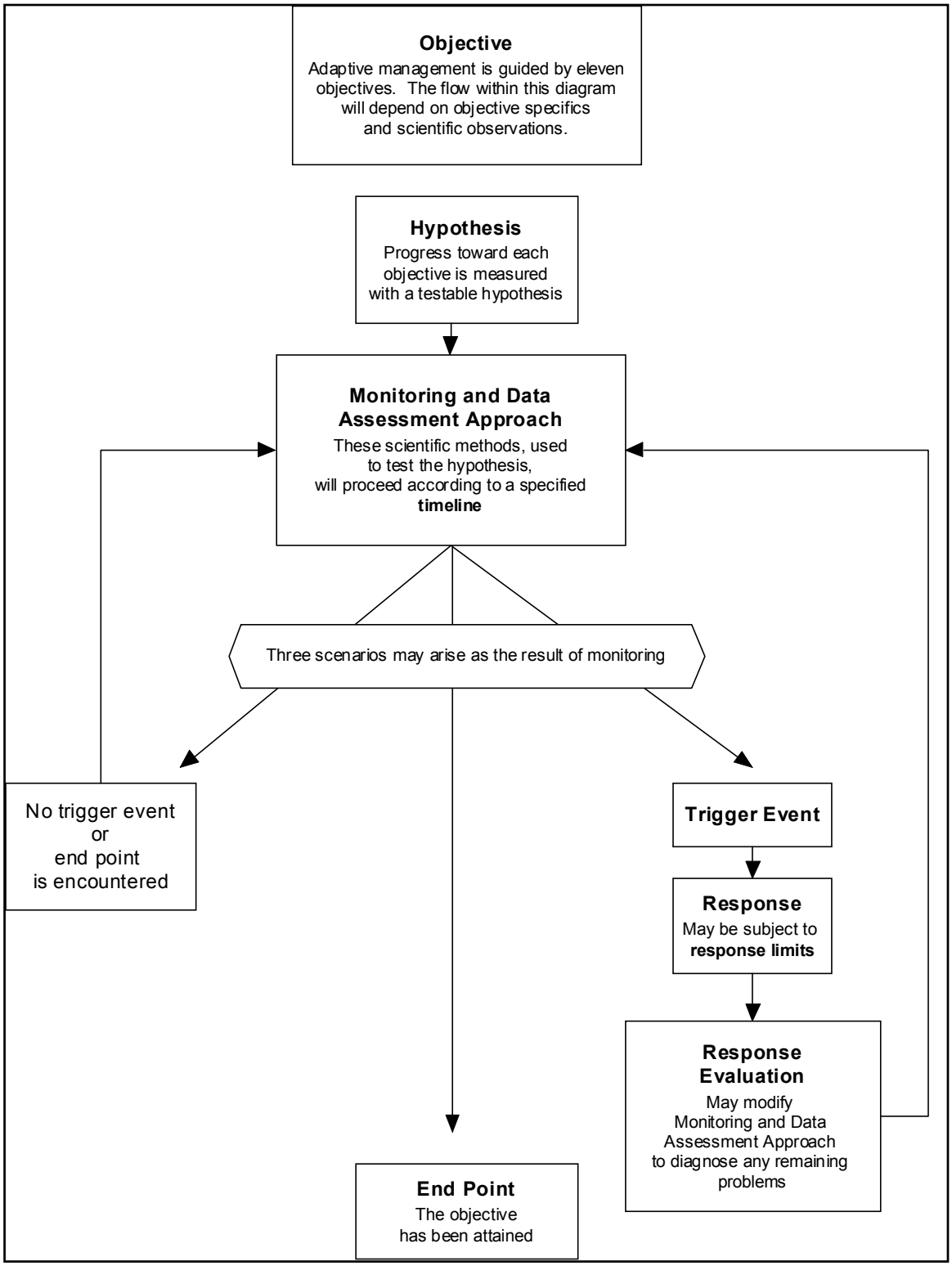

Figure 4. Flow chart depicting components of all adaptive management objectives and the general relationships between the various components.

If an objective is not being met and a trigger event occurs, then an adaptive **response** would be required, which could involve further diagnostic studies or modification of the hydroelectric project facilities or operations, or changes to natural features of the Restoration Project Area, designed to bring the system closer to achieving the objective. All responses must be feasible, practical, reasonable, prudent, and acceptable to the local community, though this does not preclude potentially major modifications to project facilities or operations. However, each response has **response limits** which describe the absolute scope of actions that can be taken in response to a trigger event.

Response limits are useful for long-term planning. However, response limits determined by complex processes, like the estimation of the future instream flow needs of salmon and steelhead, are impossible to predict because of unforeseeable changes in the policies or methodologies that will be used to determine them. Also, any changes in minimum flows need to be implemented through Consensus among the Parties and it is impossible to prejudge what that Consensus decision would be. Likewise, response limits may be confounded by conflicts between project goals and unforeseeable trigger events.

In general, response limits under the AMP will be determined by Consensus, guided by principles of feasibility, practicality, reasonability, prudence, local community acceptance, and will conform to limits identified by the FERC license amendment. Possible adaptive responses which fall outside of the FERC license amendment provisions, including major changes in project facilities such as new dams or dam removal, would require further decisions through established FERC processes. In addition, nothing in this AMP is intended to bind or prejudice the Resource Agencies, or otherwise limit their respective authorities, in the performance of their responsibilities under applicable federal and state laws.[67]

All adaptive responses will be evaluated by **response evaluations** and outcomes of those adaptive responses will be compared to the objective. If the objective has been met, then the original monitoring and data assessment approach will be resumed. If the objective is still not met, the monitoring and data assessment approach may be modified to diagnose the problem.

An important component of the adaptive management process will be **reporting** which includes emergency reporting procedures, regular periodic reporting, and final long-term reporting as described in subsequent sections. An annual adaptive management report will summarize all data collected under these monitoring and data assessment approaches and will present analyses required within each objective. Certified raw data, and reports, generated under these objectives will be updated to appropriate agency and publicly accessible/locally endorsed and maintained information systems using database standards consistent with CMARP, Comprehensive Assessment and Monitoring Program (CAMP), and Environmental Protection Agency (EPA).

[67] MOU 5.7

Finally, the **responsibility/funding** for each adaptive management objective specifies who will fund studies, responses, and reporting.

III.B. Population Objectives

The first four adaptive management objectives specifically address fish populations in an effort to measure the progress toward the AMP goal of restoring chinook salmon and steelhead populations to the point they are viable and fully utilizing ecosystem carrying capacity. To do this, accurate assessments of the population size, trends in productivity, population substructure, and population diversity will be critical, though this plan focuses primarily on quantifying population size and trends in productivity. Recovery goals must ensure that natural populations are large enough to avert the risks associated with small population size. Accordingly, both the natural cohort replacement rate (CRR) (i.e., trends in productivity) and spawner abundance must be evaluated. This is because a high replacement rate with few parent spawners does not necessarily indicate recovery of the population. Conversely, an abundant spawning population may not indicate a recovered population if the CRR was negative (i.e., a declining population).[68] In order to quantify and gauge the progress toward these goals, the AMP has adopted NMFS definitions of "viable populations"[69] as the intermediate population target and full utilization of ecosystem carrying capacity as the eventual goal for each species of chinook salmon and steelhead.

III.B.1. Population Size

Small populations face a host of risks intrinsic to their low abundance; conversely, large populations exhibit a greater degree of resilience. A large part of the science of conservation biology involves understanding and predicting the effects of population size.[69] NMFS has published guidelines for viable population size (Table 5). A population must meet <u>all</u> of the viable population guidelines to be considered viable.[69]

[68] The CRR is a parameter used to describe the number of future spawners produced by each existing spawner. This spawner-to-spawner ratio is defined as the number of naturally produced and naturally spawning adults in one generation divided by the number of naturally spawning adults (regardless of parentage) in the previous generation. As such, the ratio describes the rate at which each subsequent generation, or cohort, replaces the previous one and can be described as a natural cohort replacement rate (NMFS 1997).

[69] As defined in NMFS, Draft Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units, January 6, 2000 (NMFS 2000), " **Viable salmonid population** is an independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame. Other processes contributing to extinction risk (catastrophes and large-scale environmental variation) are also important considerations, but by their nature they need to be assessed at the larger temporal and spatial scales represented by evolutionarily significant units or other entire collections of populations."

Table 5. NMFS viable population size guidelines.[69]

1. A population should be large enough to survive environmental variation of magnitudes observed in the past.
2. A population must have sufficient abundance for any compensatory density dependent processes that affect the population to provide resilience to environmental and anthropogenic perturbation.
3. A population should be sufficiently large to maintain its genetic diversity over the long term.
4. A population should be sufficiently abundant to provide important ecological functions in all the environments it occupies.
5. Population status evaluations should take uncertainty about abundance into account.

The ability to accurately estimate adult and juvenile population sizes, and the validity of inferences drawn from those estimates, may be confounded by small population sizes and/or large variation in population size and distribution. Conclusions drawn from population estimations will take into account all statistical assumptions and limitations.

These NMFS guidelines for viable population size were considered when designing all four adaptive management population objectives and should be met through the implementation of these objectives.

III.B.2. Trends in Productivity

Trends in abundance reflect changes in factors that drive a population's dynamics and thus determine its abundance. Changes in environmental conditions, including ecological interactions, can influence a population's intrinsic productivity or the environment's ability to support a population (or both), and thus alter the underlying population dynamic over time. Such changes may result from random environmental variation over a wide range of temporal scales (environmental stochasticity). In this section, however, we are most concerned with trends in abundance that reflect systematic changes in a population's dynamics. Therefore changes in abundance caused by environmental stochasticity are treated as "noise" that, although important for estimating the population's extinction risk, acts to obscure persistent trends. [69] Again, NMFS has published trends and productivity guidelines (Table 6).

Table 6. NMFS trends and productivity guidelines.[69]

1. A population's natural productivity should be sufficient to maintain its abundance above the viable level.
2. A Viable Salmonid Population that includes naturally spawning hatchery fish should exhibit sufficient productivity from naturally-produced spawners to maintain population abundance at or above viability thresholds in the absence of hatchery subsidy.
3. A Viable Salmonid Population should exhibit sufficient productivity during freshwater life-history stages to maintain its abundance at or above viable thresholds—even during poor ocean conditions.
4. A Viable Salmonid Population should not exhibit sustained declines in abundance that span multiple generations and affect multiple brood-year cycles.
5. A Viable Salmonid Population should not exhibit trends in traits that portend productivity declines.
6. Population status evaluations should take into account uncertainty about trends and productivity.

Trends in productivity will be monitored to assess the achievement of the AMP population objectives. To accomplish this, specific actions will be undertaken to monitor CRR. The CRR is a parameter used to describe the number of future spawners produced by each spawner. This spawner-to-spawner ratio is defined as the number of naturally produced and naturally spawning adults in one generation divided by the number of naturally spawning adults (regardless of parentage) in the previous generation. As such, the ratio describes the rate at which each subsequent generation, or cohort, replaces the previous one, and can be described as a natural CRR. When this rate is 1.0, the subsequent cohort exactly replaces the parental cohort and the population is in equilibrium, neither increasing or decreasing. When the rate is less than 1.0, subsequent cohorts fail to fully replace their parents and abundance declines. If the ratio is greater than 1.0, there is a net increase in the number of fish surviving to reproduce naturally in each generation and abundance increases.[70]

For winter-run chinook, this parameter varies from year to year, but, in the Sacramento River, values of less than 1.0 were observed in the past, as expected in a decreasing population. In Battle Creek, environmental and habitat conditions will have to be improved enough to rebuild the population and to observe CRR values greater than 1.0. CRR must then remain at least near 1.0 for a period of time of high abundance to consider the species viable.[70]

When estimating the value of CRRs, the true value will not be known. Hence, a certain number of samples will be needed to obtain an adequate precision. For example, to adequately estimate CRR for winter-run chinook in the Sacramento River, NMFS determined that nine samples are necessary, which requires 13 years of observation of spawner abundance because the maximum spawning age is 4 years (NMFS 1997). In Battle Creek, the sampling period is unknown because the population estimation precision is unknown. However, guidance on this issue will likely be forthcoming upon completion of NMFS' viable salmonid population definition process.

[70] NMFS Proposed recovery plan for the Sacramento River Winter-run chinook salmon. p IV-2.

These NMFS guidelines for trends and productivity were considered when designing all four adaptive management population objectives and should be met through the implementation of these objectives.

III.B.3. Population Substructure

When evaluating population viability, it is important to take within-population spatial structure needs into account for two main reasons: (1) because there is a time lag between changes in spatial structure and species-level effects, overall extinction risk at the 100-year time scale may be affected in ways not readily apparent from short-term observations of abundance and productivity; and (2) population structure affects evolutionary processes and may therefore alter a population's ability to respond to environmental change.[70] The first reason applies to the important conservation goal of restoring Battle Creek as a hedge against the extinction of winter-run chinook, and the second reason is important because many habitats in which Battle Creek fish live will not be specifically managed by AMP objectives (e.g., land use in the upper watershed, Sacramento-San Joaquin Delta). The attention given in the AMP to sub-watershed production estimates (i.e., within the two forks of Battle Creek), as well as the false attraction and reach-by-reach habitat protection measures, were designed to meet the NMFS guidelines for spatial structure (Table 7).

Table 7. NMFS spatial structure guidelines.[69]

1. Habitat patches should not be destroyed faster than they are naturally created.
2. Natural rates of straying among subpopulations should not be substantially increased or decreased by human actions.
3. Maintain some habitat patches that appear to be suitable or marginally suitable, but currently contain no fish.
4. Source subpopulations should be maintained.
5. Analyses of population spatial processes should take uncertainty into account.

III.B.4. Population Diversity

Several salmonid traits exhibit considerable diversity within and among populations, and this variation has important effects on population viability (Appendix A.7). Some of these varying traits are anadromy, morphology, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, physiology and molecular genetic characteristics. Of these traits, some (such as DNA or protein sequence variation) are completely genetically based, whereas others (such as nearly all morphological, behavioral, and life-history traits) usually vary as a result of a combination of genetic and environmental factors.

In a spatially and temporally varying environment, there are three general reasons why diversity is important for species and population viability. First, diversity allows a species to use a wider array of environments than they could without it. For example,

varying adult run and spawn timing allows several salmonid species to use a greater variety of spawning habitats than would be possible without this diversity. Second, diversity protects a species against short-term spatial and temporal changes in the environment. Fish with different characteristics have different likelihoods of persisting, depending on local environmental conditions. Therefore, the more diverse a population is, the more likely it is that some individuals would survive and reproduce in the face of environmental variation. Third, genetic diversity provides the raw material for surviving long-term environmental changes. Salmonids regularly face cyclic or directional changes in their freshwater, estuarine, and ocean environments due to natural and human causes, and genetic diversity allows them to adapt to these changes.[71]

The AMP passage objectives take great steps towards restoring the natural process of dispersal throughout the Battle Creek watershed while AMP habitat objectives are intended to aid in the restoration the ecosystem function, essentially those natural processes that cause ecological variation (Table 8). Other human-caused factors have been previously identified in the Battle Creek watershed (e.g., see Ward and Kier 1999b for a summary of concerns) that affect population diversity, including traits such as run timing, age structure, size, fecundity, behavior, and molecular genetic characteristics, include the operation of the CNFH barrier dam, hatchery selection of spawning fish, use of Sacramento River winter-run chinook in Battle Creek, and superimposition by hatchery fish on wild fish redds. Factors from outside of the Battle Creek watershed also affect these population diversity traits including operations of water diversions (e.g., Red Bluff Diversion Dams, delta pumps), commercial and sport fisheries, and temperature control in the Sacramento River (NOAA 1994; CDFG 1998). These activities which may threaten population diversity will be addressed through the AMP linkages.

Table 8. NMFS diversity guidelines.[69]

1.	Human-caused factors such as habitat changes, harvest pressures, artificial propagation, and exotic species introduction should not substantially alter traits such as run timing, age structure, size, fecundity, morphology, behavior, and molecular genetic characteristics.
2.	Natural processes of dispersal should be maintained. Human-cased factors should not substantially alter the rate of gene flow among populations.
3.	Natural processes that cause ecological variation should be maintained.
4.	Population status evaluations should take uncertainty about requisite levels of diversity into account.

III.B.5. Carrying Capacity

Carrying capacity represents a population size that the resources of the environment can maintain without large fluctuations. As populations fully utilize their environment, competition between the same species for resources (intraspecific competition) acts to equalize the birth and death rates, thus stabilizing the population. Carrying capacity changes. For instance, the carrying capacity of Battle Creek for

[71] NMFS Proposed recovery plan for the Sacramento River Winter-run chinook salmon. p IV-20-21.

anadromous salmonids in the post-restoration state is expected to be much higher than the current depressed carrying capacity.

The natural environment must be able to support large enough populations to reduce radical fluctuations associated with small populations (demographic stochasticity) and environmental variation. Current salmon and steelhead populations, particularly winter- and spring-run chinook, are small enough to be susceptible to extinction as a result of random events tied to reproduction. Therefore, the objectives of this AMP are to increase habitat volume and quality, and fish access to habitat, so that salmon and steelhead populations increase to a size where risks from random variation associated with demographics and the environment are minimized. With the implementation of the Restoration Project, the CRR average is expected to rise above 1.0 for consecutive generations to rebuild salmon and steelhead populations. As populations begin to reach carrying capacity, the CRR trend will begin to decline and stabilize near 1.0. If the three-year running CRR average falls below 1.0 and the viable populations standard has not been met, then the limiting factors will be identified and addressed by the AMP.

Carrying capacity is reached when the CRR has stabilized for several generations at 1.0 after many generations of a CRR greater than 1.0. It is possible that the carrying capacity could be reached but the populations remain below the "viable population" levels or estimated maximum natural production levels, or the viable population standard could be met, but be below the carrying capacity. Thus, in evaluating carrying capacity and viable populations, it is important to consider condition of the habitat, absolute population size, and the CRR. Furthermore, naturally caused fluctuations in populations, and the long period of time that CRR must average 1.0, confound the ability to determine when populations are at carrying capacity.

No formal estimates of carrying capacity have been generated for Battle Creek, either in its pre-restoration or post-restoration states. The Restoration Project is expected to increase the carrying capacity of the watershed, though the methods to precisely determine carrying capacity are limited at this time. The AMTT will work to identify when salmon and steelhead are fully utilizing the restored habitat of Battle Creek. The AMTT may use USFWS (1995; Table 9) as guidance. USFWS (1995) predicted population sizes of chinook salmon and steelhead in Battle Creek after implementing restoration measures that were less comprehensive than those proposed under the Restoration Project.

Table 9. Predicted population sizes of chinook salmon and steelhead in Battle Creek after implementing restoration measures outlined in USFWS (1995).

Battle Creek Anadromous Fish Populations	Numbers of Adult Fish
Winter-run chinook salmon	2,500
Spring-run chinook salmon	2,500
Fall-run chinook salmon	4,500
Late-fall-run chinook salmon	4,500
Steelhead	5,700
Total	**19,700**

POPULATION OBJECTIVE 1

Ensure successful salmon and steelhead spawning and juvenile production.

HYPOTHESIS: Implementation of instream flow levels and facilities modifications specified in the description of the Restoration Project, implementation of the Facilities Monitoring Plan, and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities will ensure that juvenile salmon and steelhead production is within the expected level given the number of spawning adults and relevant ecological factors.

MONITORING AND DATA ASSESSMENT APPROACH: (1) Establish pre-project estimates of juvenile production using outmigrant traps at the terminus of the Restoration Project Area upstream of CNFH[72]; (2) Estimate adult and jack population sizes and distribution using adult counts at fish ladders, carcass counts, snorkel surveys, and/or redd surveys; (3) Estimate juvenile production using an out-migrant trap at the terminus of the Restoration Project Area upstream of CNFH; (4) Estimate juvenile production using outmigrant traps at the terminus of each fork during years and seasons as needed, when adult population levels are sufficient to produce statistically detectable numbers of juvenile outmigrants[73]; (5) Evaluate physical and biological conditions within habitats by reach; (6) Compare juvenile production, by fork and mainstem reach, with production expected from previous spawning populations, in those areas, in light of relevant ecological factors; (7) Compare juvenile production, by fork and mainstem reach, with production observed in Reference Watersheds.

TIMELINE: (1) Each monitoring and data assessment approach applies separately for each run of salmon and steelhead to reflect the diversity of life histories[74]; (2) Sample juvenile production when adult population levels are sufficient to produce statistically detectable numbers of juvenile outmigrants; (3) Sample, when feasible, juvenile production during all periods of juvenile movement; (4) Sample juvenile production especially during drought.

TRIGGER EVENT: Juvenile production not within expected range given the number of spawning adult salmon and steelhead and relevant ecological factors. For example, if a year-class failure occurs in Battle Creek but not in Reference Watersheds.

RESPONSE: (1) If the limiting factor is flow-related, then the response would be that set forth in Habitat Objective 1; (2) If the limiting factor is water temperature-related, then the response would be that set forth in Habitat Objective 2; (3) If the limiting factor is unidentifiable after testing hypotheses from all habitat and passage objectives, then identify unanticipated limiting factors and work to eliminate those factors that are controllable and related to the Restoration Project.[75]

RESPONSE LIMITS: (1) If the limiting factor is identified by testing hypotheses from any of the habitat and passage objectives, then the response limits would be based on the appropriate objective; (2) If the limiting factor is not associated with any of the objectives, but is controllable and related to the Restoration Project, then the response limit will be any action deemed feasible, practical, reasonable, prudent, acceptable to the local community, and consistent with MOU and FERC protocols, provided that Consensus has been reached among the Parties.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: (1) There is no end point for juvenile production monitoring at the terminus of the Restoration Project Area upstream of the CNFH; (2) There is no end point for estimating adult and jack population sizes; (3) Trapping on the forks will continue until the AMTT decides it is no longer necessary (i.e., the hypothesis is met during a reasonable number of years of extreme water conditions); (4) Comparisons of actual versus expected juvenile production, and comparisons with Reference Watersheds are terminated when Population Objective 4 has been reached and juvenile production is within the expected range.

REPORTING: Per standard data management and reporting procedures described in Sections V.B. and V.C.3.

RESPONSIBILITY/FUNDING: (1) Licensee will conduct and/or fund, up to the Licensee's Commitment, adult counts at fish ladders in the initial three-year period of operation. Pursuant to adaptive management protocols, if salmon and steelhead populations are insufficient to affirm ladder effectiveness under continuous duty, then Licensee will conduct and/or fund adult counts at fish ladders for a longer period of time to be determined by mutual agreement per protocols. (2) Resource Agencies will, subject to available funds, conduct and/or fund or seek funding for other monitoring and data assessments.

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[72] Establishing pre-project estimates of production are important to prove the results of the Restoration Project, as a foundation for adaptive management, and to comply with CAMP protocols. Pre-project production estimates would be made under the present interim flow agreement and present screw-trapping and snorkeling surveys. Some limited data collected during the period of FERC-required flows exist.

[73] Monitoring in both forks is important because of different habitats, limiting factors, and management actions/facilities within each fork.

[74] See Ward and Kier (1999a) for life history information.

[75] The response to factors that are controllable but not related to the Restoration Project will depend on the appropriate agency initiatives identified in the "Linkages" section of this report. Identification of uncontrollable factors could lead to a reassessment of "relevant ecological factors."

POPULATION OBJECTIVE 2

Restore and recover the assemblage of anadromous salmonids (i.e., winter-run, spring-run, steelhead) that inhabit the stream's cooler reaches during the dry season

HYPOTHESIS: Implementation of instream flow levels and facilities modifications specified in the description of the Restoration Project, implementation of the Facilities Monitoring Plan, and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities will ensure that populations of spring-run, winter-run and steelhead are at Viable Population Levels.

MONITORING AND DATA ASSESSMENT APPROACH: (1) Estimate adult and jack population sizes using adult counts at fish ladders, carcass counts, snorkel surveys, and/or redd surveys; (2) Estimate juvenile production using out-migrant traps within the Restoration Project Area; (3) Calculate, analyze, and monitor CRR according to protocols; (4) After population levels are sufficient to reliably calculate CRR, compare 3-year running average CRR with expected CRR; (5) Compare trends in CRR with limiting factors from outside the Restoration Project area using the linked monitoring in the Sacramento River system; (6) Compare trends in CRR with Reference Watersheds.

TIMELINE: (1) Each monitoring and data assessment approach applies separately for each run of salmon and steelhead to reflect the diversity of life histories; (2) Estimates of adult population size and juvenile production will be made throughout the term of the AMP or until this Objective is met; (3) CRR protocols suggest that calculation and analysis of CRR will continue for a minimum of 13 years plus three years and will likely extend for at least the term of the AMP.

TRIGGER EVENT: The three-year running average CRR falls below 1.0 after CRR can be reliably calculated according to CRR protocols above, and trends in CRR differ from CRR trends in Reference Watersheds.

RESPONSE: (1) If the limiting factor is flow-related, then the response would be that set forth in Habitat Objective 1; (2) If the limiting factor is water temperature-related, then the response would be that set forth in Habitat Objective 2; (3) If the limiting factor is unidentifiable after testing hypotheses from all habitat and passage objectives, then identify unanticipated limiting factors and work to eliminate those factors that are controllable and related to the Restoration Project.[76]

RESPONSE LIMITS: (1) If the limiting factor is identified by testing hypotheses from any of the habitat and passage objectives, then the response limits would be based on the appropriate objective; (2) If the limiting factor is not associated with any of the objectives, but is controllable and related to the Restoration Project, then the response limit will be any action deemed feasible, practical, reasonable, prudent, acceptable to the local community, and consistent with MOU and FERC protocols, provided that Consensus has been reached among the Parties.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: Continue these monitoring and data assessment approaches, separately for each run of salmon and steelhead, until populations reach Viable Population Levels.

REPORTING: Per standard data management and reporting procedures described in Sections V.B. and V.C.3.

RESPONSIBILITY/FUNDING: (1) Licensee will conduct and/or fund, up to the Licensee's Commitment, adult counts at fish ladders in the initial three-year period of operation. Pursuant to adaptive management protocols, if salmon and steelhead populations are insufficient to affirm ladder effectiveness under continuous duty, then Licensee will conduct and/or fund adult counts at fish ladders for a longer period of time to be determined by mutual agreement per protocols. (2) Resource Agencies will, subject to available funds, conduct and/or fund or seek funding for other monitoring and data assessments. (3) NMFS will define recovery goals for anadromous salmonid species in Battle Creek listed under the ESA at any time during the term of the AMP.

[76] The response to factors that are controllable but not related to the Restoration Project will depend on the appropriate agency initiatives identified in the "Linkages" section of this report. Identification of uncontrollable factors could lead to a reassessment of "relevant ecological factors."

POPULATION OBJECTIVE 3

Restore and recover the assemblage of anadromous salmonids (i.e., fall-run, late-fall-run) that enter the stream as adults in the wet season and spawn upon arrival.

HYPOTHESIS: Implementation of instream flow levels and facilities modifications specified in the description of the Restoration Project, implementation of the Facilities Monitoring Plan, and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities will ensure that populations of fall-run and late-fall-run are at Viable Population Levels.

MONITORING AND DATA ASSESSMENT APPROACH: (1) Estimate adult and jack population sizes and distribution using adult counts at fish ladders, carcass counts, snorkel surveys, and/or redd surveys; (2) Estimate juvenile production using out-migrant traps within the Restoration Project Area; (3) Calculate, analyze, and monitor CRR according to protocols; (4) After population levels are sufficient to reliably calculate CRR, compare 3-year running average CRR with expected CRR; (5) Compare trends in CRR with limiting factors from outside the Restoration Project area using the linked monitoring in the Sacramento River system; (6) Compare trends in CRR with Reference Watersheds.

TIMELINE: (1) Each monitoring and data assessment approach applies separately for each run of salmon to reflect the diversity of life histories; (2) Estimation of adult population size and juvenile production will be made throughout the term of the AMP or until this Objective is met; (3) CRR protocols suggest that calculation and analysis of CRR will continue for a minimum of 13 years plus three years and will likely extend for at least the term of the AMP.

TRIGGER EVENT: The three-year running average CRR falls below 1.0 after CRR can be reliably calculated according to CRR protocols above and trends in CRR differ from CRR trends in Reference Watersheds.

RESPONSE: (1) If the limiting factor is flow-related, then the response would be that set forth in Habitat Objective 1; (2) If the limiting factor is water temperature-related, then the response would be that set forth in Habitat Objective 2; (3) If the limiting factor is unidentifiable after testing hypotheses from all habitat and passage objectives, then identify unanticipated limiting factors and work to eliminate those factors that are controllable and related to the Restoration Project.[77]

RESPONSE LIMITS: (1) If the limiting factor is identified by testing hypotheses from any of the habitat and passage objectives, then the response limits would be based on the appropriate objective; (2) If the limiting factor is not associated with any of the objectives, but is controllable and related to the Restoration Project, then the response limit will be any action deemed feasible, practical, reasonable, prudent, acceptable to the local community, and consistent with MOU and FERC protocols, provided that Consensus has been reached among the Parties.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: Continue these monitoring and data assessment approaches, separately for each run of salmon and steelhead, until populations reach Viable Population Levels.

REPORTING: Per standard data management and reporting procedures described in Sections V.B. and V.C.3.

RESPONSIBILITY/FUNDING: (1) Licensee will conduct and/or fund, up to the Licensee's Commitment, adult counts at fish ladders in the initial three-year period of operation. Pursuant to adaptive management protocols, if salmon and steelhead populations are insufficient to affirm ladder effectiveness under continuous duty, then Licensee will conduct and/or fund adult counts at fish ladders for a longer period of time to be determined by mutual agreement per protocols. (2) Resource Agencies will, subject to available funds, conduct and/or fund or seek funding for other monitoring and data assessments. (3) NMFS will define recovery goals for anadromous salmonid species in Battle Creek listed under the ESA including species that may not be listed at the time the AMP was originally drafted.

[77] The response to factors that are controllable but not related to the Restoration Project will depend on the appropriate agency initiatives identified in the "Linkages" section of this report. Identification of uncontrollable factors could lead to a reassessment of "relevant ecological factors."

POPULATION OBJECTIVE 4

Ensure salmon and steelhead fully utilize available habitat in a manner that benefits all life stages, thereby maximizing natural production and full utilization of ecosystem carrying capacity.

HYPOTHESIS: Implementation of instream flow levels and facilities modifications specified in the description of the Restoration Project, implementation of the Facilities Monitoring Plan, and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities will ensure that, once populations of anadromous salmonids are at Viable Population Levels, the natural production of populations of anadromous salmonids within the Restoration Project Area is maximized based on full utilization of habitat and ecosystem carrying capacity.

MONITORING AND DATA ASSESSMENT APPROACH: (1) Perform monitoring for this objective once each population of anadromous salmonid reaches Viable Population Levels; (2) Estimate adult and jack population sizes using adult counts at fish ladders, carcass counts, snorkel surveys, and/or redd surveys; (3) Estimate juvenile production using out-migrant traps and other Contemporary sampling techniques within the Restoration Project Area; (4) Define the carrying capacity of each species and life stage of salmon and steelhead and compare populations with expectations of carrying capacity; (5) Determine if natural production in the Restoration Project Area is maximized; (6) Calculate, analyze, and monitor CRR according to protocols; (7) Compare 3-year running average CRR with expected CRR; (8) Compare long-term CRR trend for a decade and compare with a consistent value of 1.0.

TIMELINE: (1) Each monitoring and data assessment approach applies separately for each species of salmon or steelhead to reflect the diversity of life histories; (2) Estimation of adult population size and juvenile production will be made throughout the term of the AMP or until this Objective is met; (3) CRR protocols suggest that calculation and analysis of CRR will continue for a minimum of 13 years plus 3 years and will likely extend for at least the term of the AMP.

TRIGGER EVENT: (1) The three-year running average CRR falls below 1.0 after Viable Populations Levels have been reached, and long-term trends in CRR differ from CRR trends in Reference Watersheds; (2) CRR reach a consistent value of 1.0 for several generations but the populations size(s) are less than the expected carrying capacity; (3) Natural production of any species or life history stage in the Restoration Project Area is less than expected levels of production.

RESPONSE: If CRR falls below 1.0 and long-term trends differ from Reference Watersheds, or if CRR stabilizes at 1.0 but the populations sizes are lower than expected, or if natural production of any species or life history stage is less than expected, then identify unanticipated limiting factors, and either work to eliminate those factors that are controllable, related to the Restoration Project, and within response limits, or refine estimates of expected carrying capacity.

RESPONSE LIMITS: (1) If the limiting factor is identified by testing hypotheses from any of the habitat and passage objectives, then the response limits would be based on the appropriate objective; (2) If the limiting factor is not associated with any of the objectives, but is controllable and related to the Restoration Project, then the response limit will be any action deemed feasible, practical, reasonable, prudent, acceptable to the local community, and consistent with MOU and FERC protocols, provided that Consensus has been reached among the Parties.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: Continue these monitoring and data assessment approaches, separately for each run of salmon and steelhead, until natural production within the Restoration Project Area is maximized and ecosystem carrying capacity is fully utilized.

REPORTING: Per standard data management and reporting procedures described in Sections V.B. and V.C.3.

RESPONSIBILITY/FUNDING: (1) Licensee will conduct and/or fund, up to the Licensee's Commitment, adult counts at fish ladders in the initial three-year period of operation. Pursuant to adaptive management protocols, if salmon and steelhead populations are insufficient to affirm ladder effectiveness under continuous duty, then Licensee will conduct and/or fund adult counts at fish ladders for a longer period of time to be determined by mutual agreement per protocols. (2) Resource Agencies will, subject to available funds, conduct and/or fund or seek funding for other monitoring and data assessments.

III.C. Habitat Objectives

Four adaptive management objectives specifically address fish habitat in an effort to measure the progress toward the AMP goal of restoring chinook salmon and steelhead populations to the point they are viable and fully utilizing ecosystem carrying capacity. All four of these objectives are designed, in part, to adaptively manage the flows prescribed by the MOU. These flows were determined through careful analysis and Consensus, and are considered the best scientific estimate of biologically optimum flows. Hence, these flows are at an excellent level for salmon and steelhead restoration, are likely better for restoration than flows set through a strictly regulatory process, are considered to be insurance against future uncertainty, and are not intended to be adjusted experimentally.

As noted in the discussion of response limits above, response limits for the instream flows needs of salmon and steelhead are impossible to predict because of unforeseeable changes in the policies or methodologies that will be used to determine them, because of potential conflicts between project goals and unforeseeable trigger events, and because it is impossible to prejudge Consensus in future decision making. Therefore, any adaptive management instream flow levels response will be made provided that Consensus is reached among the Parties, to the extent funding is available from the WAF, AMF, Licensee commitment, and other Adaptive Management funds. If Consensus is not met, minimum instream flow changes will be determined via the dispute resolution process (see Section V.F.).

Field observations were conducted per MOU Attachment 2 to determine the feasibility for establishing a threshold criteria of flow and stage above which Ramping Rates will not be required in Battle Creek. Field observations by fisheries biologists from CDFG and PG&E and by a USBR contractor were conducted in the spring of 2000 (CDFG 2001). Initially, areas of potential stranding habitat were identified by aerial surveys of the North and South Forks of Battle Creek in the Restoration Project Area. Several sites with significant potential for fish stranding due to flow fluctuations (e.g., large, low-gradient, in-channel gravel bars or bedrock areas, or side-channels, that could be de-watered during flow changes) were identified on the South Fork, while such sites were relatively rare on the North Fork.

A test flow change was analyzed at one South Fork site with relatively high stranding potential. Based on field observations, it was determined that ramping-related fish stranding would be avoided at flows greater than 460 cfs. These flows fill the South Fork channel sufficiently to inundate all potential stranding habitat. Rapid instream flow reductions at flows less than 460 cfs may dewater potential stranding habitat. Therefore, Ramping Rate criteria developed in this AMP would apply in the South Fork at flows less than 460 cfs, but would not apply at flows greater than this threshold.

At the time of this AMP's publication, field observations of the relationship between flow changes and potential stranding habitat in the North Fork had not been completed. However, the general channel morphology of the North Fork, consisting of

steep-sided canyon walls, indicates that a threshold flow for initiating a Ramping Rate would be much less than that of the South Fork, which flows in a less incised canyon.

HABITAT OBJECTIVE 1

Maximize usable habitat quantity – volume.

HYPOTHESIS: Implementation of instream flow levels specified in the description of the Restoration Project and implementation of any adaptive responses affecting instream flows will provide at least 95 percent of maximum usable habitat quantity for critical life stages among priority species.

MONITORING AND DATA ASSESSMENT APPROACH: (1) Compare observations with expected habitat use once there is enough salmon and steelhead to use available areas; (2) Observe and record anadromous salmonid habitat use during the course of other monitoring studies; (3) Apply any appropriate advancements or refinements that significantly reduce uncertainty in flow/habitat relationships; (4) examine flow monitoring measurements taken immediately below each dam for the Facilities Monitoring Plan.

TIMELINE: (1) Apply appropriate, significant advancements in instream flow analysis as they become available; (2) Apply appropriate habitat use data as it is accumulated.

TRIGGER EVENT: (1) Significant advancements or refinements arise that reduce uncertainty in flow/habitat relationships and indicate that changes to instream flows are needed; (2) Observed habitat use is not consistent with expected habitat use at a time when there are enough salmon and steelhead to get a reliable data set.

RESPONSE: (1) Incorporate significant advancements or refinements into existing or new instream flow models, (2) If observations of habitat use are not consistent with expected habitat use, then conduct a verification study of anadromous salmonid habitat use according to Contemporary protocols; (3) If suggested by the verification study, then develop new habitat suitability criteria; (4) Recommend changing instream flows as appropriate consistent with MOU and FERC protocols.

RESPONSE LIMITS: All minimum instream flow changes deemed feasible, practical, reasonable, prudent, acceptable to the local community, and consistent with MOU and FERC protocols, will be implemented, provided that Consensus has been reached among the Parties and dedicated funding is available. If Consensus has not been reached, then minimum flow changes will be determined through the dispute resolution process.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: None.

REPORTING: Per standard data management and reporting procedures described in Sections V.B. and V.C.3.

RESPONSIBILITY/FUNDING: Resource Agencies will, subject to available funds, conduct and/or fund or seek funding for data collection and report preparation. Other programs (e.g., CVPIA and CALFED) would be solicited to fund additional diagnostic assessment tools to design a proper response (e.g., instream flow modeling). Water acquisition would be funded by the WAF, and AMF upon exhaustion of WAF. If both funds are exhausted and Consensus is reached, the Licensee funds water acquisition up to the Licensee's commitment. If both funds are exhausted and Consensus is not reached, funding of minimum instream flows will be determined through the dispute resolution process, up to the Licensee's commitment.

HABITAT OBJECTIVE 2

Maximize usable habitat quantity – water temperature.

HYPOTHESIS: Implementation of instream flow levels and facilities modifications specified in the description of the Restoration Project and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities will provide instream water temperatures that are suitable for critical life stages among species at appropriate stream reaches.

MONITORING AND DATA ASSESSMENT APPROACH: (1) Monitor climatic conditions within the South Fork watershed by establishing an appropriate weather station to support water temperature modeling efforts; (2) Monitor longitudinal water temperature regime of stream to determine attainability of water temperature goals[78] for each stream reach; (3) CDFG will monitor any springs to which it has conservation water rights; (4) Compare longitudinal water temperature regime with target points within the stream; (5) Compare monitoring results with predictions from the best available Contemporary water temperature models applied to appropriate stream reaches.

TIMELINE: (1) Monitor climatic and longitudinal water temperature regime for at least five years for system-wide water temperature monitoring including at least at least one year of dry/hot conditions; (2) Maintain key water temperature monitoring stations at appropriate locations for the term of the AMP.

TRIGGER EVENT: Water temperature goals are not attained in specific reaches under climatic conditions when attainment is expected.

RESPONSE: (1) Apply the best available Contemporary water temperature model to determine if water temperature goals could be met and/or exceeded under different climatic conditions by changing instream flows or spring releases from hydroelectric project water collection facilities; (2) If so indicated by the model, develop a rule-based plan[79] for short-term changes in the flows to reduce water temperatures to target ranges during hot weather,[80] and perform a verification test of project operations according to the rule-based plan to determine if water temperature goals could be achieved; (3) Acquire water and/or spring releases from hydroelectric project water collection facilities to increase instream flows as needed.

RESPONSE LIMITS: All instream flow changes for water temperature adjustment deemed feasible, practical, reasonable, prudent, acceptable to the local community, and consistent with MOU and FERC protocols, will be implemented, provided that Consensus has been reached among the Parties and dedicated funding is available. If Consensus has not been reached, then instream flow changes for water temperature adjustment will be determined through the dispute resolution process.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: (1) Monitoring the longitudinal water temperature regime would end after the AMTT determines the attainability of water temperature goals for each stream reach; (2) Prescriptive actions under the rule-based plan for selected water temperature target points would remain in effect for the term of the AMP; (3) There is no end point for key water temperature monitoring stations.

REPORTING: Per standard data management and reporting procedures described in Sections V.B. and V.C.3. The annual adaptive management report will summarize all data collected under these monitoring and data assessment approaches and will present analyses required herein during the development of the rule-based plan and during implementation of the rule-based plan. Periodic updates of summarized raw data will be made to match the frequency of meetings of the AMTT.

RESPONSIBILITY/FUNDING: Resource Agencies will, subject to available funds, conduct and/or fund or seek funding sources other than Licensee for water temperature and climatic data collection. Other programs (e.g., CVPIA and CALFED) would be solicited to fund additional diagnostic assessment tools to design a proper response (e.g., water temperature modeling). Water acquisition would be funded by the WAF, and AMF upon exhaustion of WAF. If both funds are exhausted and Consensus is reached, the Licensee funds water acquisition up to the Licensee's commitment. If both funds are exhausted and Consensus is not reached, funding of water acquisition will be determined through the dispute resolution process, up to the Licensee's commitment.

[78] Specific temperature goals for each reach based on temperature criteria and geographic prioritization are described in the *Battle Creek Salmon and Steelhead Restoration Plan*. The post-Restoration Project operations will be monitored to examine attainability under different controllable factors.

[79] The rule-based plan would provide hydroelectric project operators with a predictive model that would allow them to adjust flow for the next day based on the current day's observed water temperatures and other variables. This rule-based plan will consider geographical limits and/or the attainability of temperature criteria, it will contain an allowance for deviations from criteria, and it will contain enough flexibility to cope with contingencies. This rule-based plan would be developed based on established temperature protocols such as the NMFS draft temperature guidelines.

HABITAT OBJECTIVE 3

Minimize false attraction and harmful fluctuation in thermal and flow regimes due to planned outages or detectable leaks from the hydroelectric project.[81]

HYPOTHESIS: Implementation of facilities modifications specified in the description of the Restoration Project, implementation of the Facilities Monitoring Plan, and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities will ensure that water discharges from the powerhouse tailrace connectors or water conveyance system are confined to times and amounts that avoid false attraction or biologically significant changes to thermal and chemical regimes.[82]

MONITORING AND DATA ASSESSMENT APPROACH: (1) During the course of other monitoring studies, determine if salmon or steelhead appear to be responding to leakage from powerhouse tailrace connectors or discharges from the water conveyance system; (2) If salmon or steelhead appear to be responding to leakage from powerhouse tailrace connectors or discharges from the water conveyance system, (a) measure leakage or discharges, (b) compare volume of leakage or discharge to streamflow at all times it is known to occur, (c) determine if the discharge measurably alters the thermal or chemical regimes of the South Fork of Battle Creek.[82]

TIMELINE: Continue monitoring and data assessment approaches for the term of the AMP.

TRIGGER EVENT: (1) Direct evidence of an adverse fish response to leakages or discharges from the hydroelectric project is observed; (2) Facilities monitoring identifies and estimates significant intentional or unintentional release from the powerhouse tailrace connectors or discharge from the water conveyance system to the South Fork.

RESPONSE: Restore isolation of water in the powerhouse tailrace connectors and/or water conveyance system from the South Fork of Battle Creek.

RESPONSE LIMITS: Restore isolation to the extent that it is practical and feasible by Contemporary engineering practices for water conveyance structures provided that actions do not threaten the safety of the water conveyance system and dedicated funding is available.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: None

REPORTING: Per the Facilities Monitoring Plan. Per standard data management procedures described in Section V.B.

RESPONSIBILITY/FUNDING: Installation costs of new/additional facilities required to meet Contemporary criteria or modification of existing facilities to avoid fish injury or mortality would be paid by AMF protocols. However, in the event that the AMF is exhausted, the Licensee will pay up to the Licensee's Commitment for Authorized Modifications to project facilities which are determined to be necessary under adaptive management. (1) Licensee conducts and/or funds the facilities monitoring consistent with the Facilities Monitoring Plan, including recording the timing and estimated amounts of water released from the canal gates and spill channels during known releases from the conveyance system; (2) Resource Agencies will, subject to available funds, conduct and/or fund or seek funding sources other than the Licensee for relevant biological monitoring and measurement of any unintentional leakage or discharge that elicits a response from salmon or steelhead.

[80] There may be a need to balance temperature control with other habitat effects of flow changes, but based on action priorities developed herein, temperature control may take priority over other habitat effects.

[81] Planned outages from the powerhouse tailrace connectors or water conveyance system to the South Fork will occur during the period from February 1 through April 30, as specified in the MOU, and will be monitored per the Facilities Monitoring Plan. Forced outages are not covered under this AMP because they are assumed to occur infrequently and under emergency situations, and produce discharges of relatively short duration. In the event that these assumptions are not met, this objective could be modified to include forced outages. Emergencies are addressed in the AMP protocol section.

[82] "Chemical" in this sense refers to chemical constituents of stream water at detectable levels that may be used by migrating salmonids for homing or spawning area recognition.

HABITAT OBJECTIVE 4

Minimize stranding or isolation of salmon and steelhead due to variations in flow regimes caused by hydroelectric project operations.

HYPOTHESIS: Implementation of facilities modifications specified in the description of the Restoration Project, implementation of the Facilities Monitoring Plan, and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities will ensure that following forced or scheduled outages where the available diversion flow has been released to the natural stream channel, variations in flow regimes do not strand salmon and steelhead or isolate them from their habitat when diversions are resumed.

MONITORING AND DATA ASSESSMENT APPROACH: (1) In the course of other monitoring studies, evaluate, in the South Fork, threshold flow levels above which ramping-rates may differ from 0.1 feet/hour[83]; (2) In the North Fork, conduct a diagnostic study of ramping thresholds to determine the flow level above which ramping rates may differ from 0.1 foot/hour; (3) Collect evidence of fish stranding during the course of other monitoring studies; (4) Monitor Ramping Rates and threshold flow levels during scheduled outages at appropriate sites to ascertain their effectiveness to avoid stranding and/or isolating anadromous fish from their preferred habitat[84]; (5) Monitor natural flow fluctuations not caused by project operations to ascertain their effect on stranding and/or isolating anadromous salmonids; (6) Compare the stranding effects of project-induced ramping and natural flow fluctuations.

TIMELINE: (1) The diagnostic study of threshold flows in the North Fork will be completed the first time flow conditions are appropriate and may occur as early as spring 2001; (2) Evidence of fish stranding will be collected through the term of the AMP, (3) Monitoring of Ramping Rates will be conducted during scheduled outages; (4) Monitoring of natural flow fluctuations will be conducted the first time flow conditions are appropriate and may occur as early as spring 2001; (5) Comparisons of project-induced ramping and natural flow fluctuations will be completed as soon as flow conditions permit.

TRIGGER EVENT: Biologically significant salmon and steelhead stranding or isolation, caused by project-induced ramping and natural flow fluctuations, is observed.

RESPONSE: Conduct a diagnostic assessment of ramping effects on anadromous salmonids at the 0.1 foot/hour rate specified in the MOU, or slower, that determines the relationship between stranding/ isolation and Ramping Rates using statistically valid techniques. The assessment would recommend a more appropriate Ramping Rate.

RESPONSE LIMITS: All instream flow changes for ramping deemed feasible, practical, reasonable, prudent, acceptable to the local community, and consistent with MOU and FERC protocols, will be implemented, provided that Consensus has been reached among the Parties. If Consensus has not been reached, then instream flow changes for ramping will be determined through the dispute resolution process.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: Ramping Rate is finalized base on diagnostic assessment Ramping Rate study or response evaluation.

REPORTING: Results from the Ramping Rate study will be incorporated into the annual Adaptive Management report. Other reporting and data management per standard data management and reporting procedures described in Sections V.B. and V.C.3.

RESPONSIBILITY/FUNDING: (1) Resource Agencies will, subject to available funds, conduct and/or fund or seek funding for incidental monitoring and the diagnostic Ramping Rate assessment; (2) Licensee will fund, up to the Licensee's Commitment, costs associated with more restrictive Ramping Rates, consistent with WAF and AMF protocols.[85]

[83] CDFG (2001) determined that 460 cfs is an adequate threshold flow below which ramping rates should be applied for the protection of salmon and steelhead downstream of Inskip Dam (and above which ramping rates need not be applied) following the implementation of the Restoration Project.
[84] MOU Section 9.1A.2.(c)
[85] MOU Section 6.1.D and MOU Attachment 2

III.D. Passage Objectives

Three Adaptive Management objectives specifically address fish passage in an effort to measure the progress toward the AMP goal of restoring chinook salmon and steelhead populations to the point they are viable and fully utilizing ecosystem carrying capacity. All three of these objectives are designed to adaptively manage the fish passage provisions in the MOU and facilities constructed as part of the Restoration Project. These facilities represent state-of-the-art designs based on considerable fish passage engineering and biological experience. Hence, these fish passage facilities and provisions are an excellent start for salmon and steelhead restoration, are considered to be insurance against future uncertainty, and are not intended to be adjusted experimentally.

PASSAGE OBJECTIVE 1

Provide reliable upstream passage of salmon and steelhead adults at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams per Contemporary engineering standards/guidelines.

HYPOTHESIS: Implementation of facilities modifications specified in the description of the Restoration Project, implementation of the Facilities Monitoring Plan, and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities will ensure unimpeded passage of adult salmon and steelhead at fish ladders relative to Contemporary standards/guidelines.

MONITORING AND DATA ASSESSMENT APPROACH: (1) Use video or electronic counters in ladders to count anadromous salmonids; (2) Compare ladder counts with spawner distribution and predicted habitat use; (3) In the course of other studies, look for direct evidence of fish injury related to upstream passage at fish ladders; (4) Study fish passage at each ladder with a group of tagged test fish and/or radio tracking; (5) Monitor the possible unintended downstream-return of upstream-migrating fish ("fall back") over or through diversion dams using tagged fish and/or radio tracking studies; (6) Make underwater observations for congregations of adults below the dam and compare to ladder counts; (7) Monitor key hydraulic parameters continuously for Fail-Safe capabilities according to long-term Operations and Maintenance Plan and Facility Monitoring Plan.

TIMELINE: (1) Monitor video or electronic counters for three years. Pursuant to adaptive management protocols, if salmon and steelhead populations are insufficient to affirm ladder effectiveness under continuous duty, then video or electronic counting will be continued for a longer period of time by agreement of the Parties to be determined per protocols; (2) Conduct continuous monitoring of key hydraulic parameters for the term of the AMP.

TRIGGER EVENT: (1) Standards/guidelines, or Contemporary criteria, are changed and an evaluation of the existing ladder, according to Contemporary testing protocol, demonstrates a significant exceedence from the standards/guidelines/criteria; (2) Operations and maintenance activities indicate that facilities are not performing as designed; (3) Contemporary standards/guidelines, or future criteria, are not met, and/or there is direct evidence of impaired fish passage[86]; (4) Direct evidence of salmon or steelhead injury from passage through fish ladders is observed; (5) Absence of spawning adults of species expected to distribute themselves in the higher elevation reaches of the stream, based on all observational data at times when there are sufficient populations of salmon and steelhead to observe, are observed for at least three years when no other barriers are identified.

RESPONSE: (1) If triggered by a change in standards/guidelines/criteria, refer matter to AMPT to determine response; (2) If triggered by a failure to perform as designed, then diagnose if there is direct evidence of impaired fish passage or injury; (3) If no direct evidence of impaired fish passage or injury, request a variance; (4) If triggered by unexpected spawner distribution (as defined in trigger event) then diagnose problem with appropriate tools such as tagged test fish or a radio tracking study; (5) If triggered by direct evidence of impaired fish passage or injury associated with fish ladders, then diagnose reason for the problem and modify or replace fish ladder or components.

RESPONSE LIMITS: All actions deemed feasible, practical, reasonable, prudent, acceptable to the local community, and consistent with MOU and FERC protocols, will be implemented, provided that Consensus has been reached among the Parties and dedicated funding is available. If Consensus has not been reached, then appropriate actions will be determined through the dispute resolution process. Major project changes in facilities (e.g., new dam site, dam removal, major facility changes) would be subject to the FERC decision-making process.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: Conclude ladder effectiveness monitoring after three years with sufficient salmon and steelhead populations and no identified fish passage problems at particular fish ladder. Continue operations and maintenance monitoring for the term of the AMP. Salmon and steelhead counts at the ladder may continue as needed for basin wide biological studies.

REPORTING: Per standard data management and reporting procedures described in Sections V.B. and V.C.3.

RESPONSIBILITY/FUNDING: After transfer of facility from USBR to Licensee, Licensee assumes all costs for ladder repairs and replacements due to normal wear and tear, catastrophic damage, and any other type of damage, and will ensure that the ladders meet Fail-Safe criteria. Installation costs of new/additional facilities required to meet Contemporary criteria or modification of existing facilities to avoid fish injury or mortality would be paid by AMF protocols. However, in the event that the AMF is exhausted, the Licensee will pay up to the Licensee's Commitment for Authorized Modifications to project facilities and operations which are determined to be necessary under adaptive management. The following responsibilities also apply after transfer of the facility from USBR to Licensee. (1) Licensee will conduct and/or fund, up to the Licensee's Commitment, monitoring to ensure the effectiveness and continued reliable operation of ladders pursuant to the Facilities Monitoring Plan; (2) Continued monitoring specified as part of the adaptive management process would be funded according to adaptive management protocols; (3) Resource Agencies will, subject to available funds, conduct and/or fund or seek funding for biological monitoring using ladder counts after the ladder is deemed effective.

[86] Direct evidence of impaired fish passage could include, but is not limited to, persistent or repeated plugging of the ladder with debris or persistent, abnormally high concentrations of salmon and steelhead below dams combined with low ladder counts.

PASSAGE OBJECTIVE 2

Provide reliable downstream passage of juveniles at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams per Contemporary criteria after the transfer of facilities to Licensee.

HYPOTHESIS: Implementation of facilities modifications specified in the description of the Restoration Project, implementation of the Facilities Monitoring Plan, and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities, will ensure that hydraulic parameters at fish screens meet Contemporary criteria at all times.

MONITORING AND DATA ASSESSMENT APPROACH: (1) Use Contemporary NMFS criteria[87] or subsequent NMFS approved criteria. As per p 73490 in NMFS "4d Rule"; (2) Biological effectiveness of the screen relies on meeting Contemporary fish screen criteria as it has been affirmed to protect fish from injury and entrainment in applicable studies; (3) Measure, at various stream and diversion flows, hydraulic parameters such as approach and sweeping velocities, (4) Calculate flow rates for screen sections to verify approach and sweeping velocities; (5) Monitor key hydraulic parameters such as water surface elevation on both sides of fish screens continuously for Fail-Safe capabilities according to long-term Operations and Maintenance Plan and Facility Monitoring Plan; (6) Conduct visual observations of canals, during the course of other studies and especially at times when canals are dewatered, to check for possible entrainment.

TIMELINE: (1) Measure all relevant hydraulic parameters such as such as approach and sweeping velocities and water surface elevations at startup, and other appropriate times and flows as the facility ages, per the long-term Operations and Maintenance Plan; (2) Conduct continuous monitoring of water surface elevation on both sides of the fish screen for the term of the AMP.

TRIGGER EVENT: (1) Contemporary fish screen criteria is changed and an evaluation of the existing screen, according to Contemporary testing protocol, demonstrates a significant exceedence from the criteria;
(2) Operations and maintenance activities indicate that facilities are not performing as designed;
(3) Contemporary criteria is not met, and/or there is evidence of fish entrainment or injury.

RESPONSE: (1) If triggered by a change in NMFS criteria, refer matter to AMPT to determine response;
(2) If triggered by a failure to perform as designed, then diagnose whether facility provides injury-free downstream passage of juvenile salmon and steelhead; (3) If facility provides injury-free downstream passage of juvenile salmon and steelhead, request a variance; (4) If evidence of fish entrainment or injury, then diagnose reason for the problem and modify or replace fish screens or components.

RESPONSE LIMITS: All actions deemed feasible, practical, reasonable, prudent, acceptable to the local community, and consistent with MOU and FERC protocols, will be implemented, provided that Consensus has been reached among the Parties and dedicated funding is available. If Consensus has not been reached, then appropriate actions will be determined through the dispute resolution process. Major project changes in facilities (e.g., new dam site, dam removal, major facility changes) would be subject to the FERC decision-making process.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: None.

REPORTING: Per standard data management and reporting procedures described in Sections V.B. and V.C.3.

RESPONSIBILITY/FUNDING: The responsibility and funding of monitoring of key hydraulic parameters will be assigned in the Facilities Monitoring Plan. After transfer of facility from USBR to Licensee, Licensee assumes all costs for screen repairs and replacements due to normal wear and tear, catastrophic damage, and any other type of damage, and will ensure that the screens meet Fail-Safe criteria. Installation costs of new/additional facilities required to meet Contemporary criteria or modification of existing facilities to avoid fish injury or mortality would be paid by AMF protocols. However, in the event that the AMF is exhausted, the Licensee will pay up to the Licensee's Commitment for Authorized Modifications to project facilities and operations which are determined to be necessary under adaptive management.

[87] For example, the Contemporary fish screening criteria used to generate this plan were adopted from NMFS Southwest Region "Fish Screening Criteria For Anadromous Salmonids, January 1997."

PASSAGE OBJECTIVE 3

Provide reliable upstream passage of adult salmon and steelhead to their appropriate habitat over natural obstacles within the Restoration Project area while maintaining an appropriate level of spatial separation among the runs.

HYPOTHESIS: Implementation of instream flow levels and facilities modifications specified in the description of the Restoration Project, implementation of the Facilities Monitoring Plan, and implementation of any adaptive responses affecting instream flows or hydroelectric project facilities will ensure that natural instream barriers do not impede upstream migration of adult salmon and steelhead at prescribed flows and normal wet season flow regimes.

MONITORING AND DATA ASSESSMENT APPROACH: (1) Inspect potential barriers during annual surveys including photographic documentation and description; (2) Compare spawner distribution relative to suspected barriers; (3) Compare observed spawner distribution relative to expected spawner distribution for a particular species; (4) Use Contemporary methodologies that consider flow regime to identify actual barriers[88]; and (5) Employ additional diagnostic studies as needed (e.g., radio tracking) if observed spawning differs relative to expected spawning distribution but no specific barrier is identified.

TIMELINE: Conduct continuous monitoring of natural potential barriers for the term of the AMP.

TRIGGER EVENT: An obstacle in the Restoration Project area is found to be unduly impeding adult salmon or steelhead migration under a range of flows including the prescribed instream flows.

RESPONSE: (1) Modify barrier, giving priority to those barriers that block large portions of a species' preferred habitat, while maintaining an appropriate level of spatial separation among the runs[89]; (2) If barrier cannot be modified either in the short term or long term, acquire water to change instream flows, if appropriate, to levels that allow passage over natural barriers for the necessary times only.

RESPONSE LIMITS: All instream flow changes for salmon and steelhead passage deemed feasible, practical, reasonable, prudent, acceptable to the local community, and that are consistent with MOU and FERC protocols, will be implemented, provided that Consensus has been reached among the Parties. If Consensus has not been reached, then instream flow increases for salmon and steelhead passage will be determined through the dispute resolution process. If appropriate level of barrier modification is not feasible, then flow changes would be set to levels that allow passage over natural barriers for the necessary times only. Long-term and medium-term instream flow increases over the estimated flows for maximum usable habitat will provide not less than 90 percent of the maximum usable habitat. Short-term, pulsed instream flows may be set to higher levels that provide less than 90 percent of the maximum useable habitat for short periods of time.

RESPONSE EVALUATION: Per standard response evaluation described above.

END POINT: None

REPORTING: Per standard data management and reporting procedures described in Sections V.B. and V.C.3.

RESPONSIBILITY/FUNDING: (1) Resource Agencies will, subject to available funds, conduct and/or fund or seek funding sources other than the Licensee for monitoring activities; (2) Resource Agencies will, subject to available funds, conduct and/or fund or seek funding sources other than the AMF or the Licensee for modification of barriers; (3) Water acquisition for increased instream flows downstream of Inskip, North Battle Creek Feeder, and Eagle Canyon diversion dams to facilitate fish passage will be funded by the WAF, AMF, Licensee up to the Licensee's Commitment, and/or others.

[88] For example, TRPA (1989) methodologies for barrier determination were used to generate this plan.

89 Natural barriers within streams can provide many important ecosystem functions including restricting the movement of introduced fishes, acting as selective factors in the natural evolution of species, and separating subpopulations of native fishes. For example, sympatric races of chinook salmon generally segregate themselves by spawning at different times or in different locations within a stream. This spatial segregation is usually determined through interactions between flow and natural barriers. Removing some barriers could disrupt the natural factors controlling this natural segregation. For example, the spawning timing of spring-run chinook and fall-run chinook may overlap. However, spring-run typically migrate to spawning grounds at higher flows and may more easily pass obstacles at those flows. Spring-run chinook could be put in unnatural contact with fall-run chinook if barriers were removed which normally stop fall-run during the low flow season. Because of the many benefits of natural barriers, caution and careful analysis will characterize any decisions to remove natural barriers under Adaptive Management.

IV. LINKAGES WITH OTHER PROGRAMS

This technical chapter describes the linkages between the adaptive management of Restoration Project elements and state, federal, and private restoration programs and directives not directly related to the Restoration Project or with other Restoration Project planning that is not related to adaptive management. Table 10 provides a list of all the linkages discussed in this section.

Table 10. Linkages between the Adaptive Management of the Battle Creek Restoration Project and other planning or restoration programs and directives.

Restoration Project Planning	
Memorandum of Understanding	Construction Monitoring
Facilities Transfer Agreement	Facilities Monitoring Plan
Operations and Maintenance Plan	
Non-Project Restoration Programs In Battle Creek	
Conservation easements and conservation water rights	
Proposed fisheries management plan for the upper Sacramento River and tributaries	
Sacramento Corridor Habitat Restoration Assessment	
Proposed Coleman Powerhouse tailrace barrier construction	
Coleman National Fish Hatchery, water-supply intake modifications	
Coleman National Fish Hatchery, barrier dam modifications	
Coleman National Fish Hatchery, Hatchery and Genetic Management Plan	
Non-Project Restoration Programs Outside of Battle Creek	
CALFED Ecosystem Restoration Program.	
Comprehensive Monitoring, Assessment, and Research Program/CALFED Science Program	
Central Valley Project Improvement Act	
Anadromous Fish Restoration Program	
Comprehensive Assessment and Monitoring Program	
Recovery plans for threatened or endangered salmonids	
Central Valley Salmon and Steelhead Restoration and Enhancement Plan	
Upper Sacramento River Fisheries and Riparian Habitat Management Plan	
Restoring Central Valley Streams—A Plan for Action	
Steelhead Restoration and Management Plan for California.	
Delta and Sacramento River operations and monitoring	
Reference Watersheds	
U.S. Bureau of Land Management	
U.S. Forest Service	
Battle Creek Watershed Conservancy	
Local community participation	Sediment quality monitoring
Watershed assessment	Water temperature and climate monitoring
Data management and dissemination	
Non-Project Restoration Emergencies	
For example, hazardous spills/toxic leaks	

IV.A. Restoration Project Planning

This section details other planning elements of the Restoration Project to which the AMP is linked.

IV.A.1. Memorandum of Understanding

In June 1999, PG&E, NMFS, CDFG, USFWS, and USBR entered into an MOU that signaled the intent of these parties to pursue a salmon and steelhead restoration effort on Battle Creek that would modify the facilities and operations FERC Project No 1121. As stated throughout this document, the AMP is a direct product of the MOU. In addition to the AMP and its elements, the MOU also described all elements of the Restoration Project including physical changes to the hydroelectric project facilities and operation; definitions; purposes; roles and responsibilities; contingencies and limitations; planning, permitting, and construction activities; funding; provisions for lease or sale of FERC Project No. 1121; environmental liabilities; dispute resolution; term; and termination. While the AMP includes many of these same elements, questions about these elements, especially when they do not pertain to adaptive management, should rely on wording in the MOU or the amended FERC license for this project. In other words, the MOU prevails in any discrepancy between policy specified in the AMP and that set by the MOU.

IV.A.2. Construction Monitoring

USBR agrees to perform all construction monitoring and reporting as part of construction of the Restoration Project as described in MOU Sections 6.2 and 8.4. Funding for the construction monitoring will be derived only from the federal funding as identified in MOU Section 10.2, and USBR does not agree to spend any additional, federal money to perform such construction monitoring. Construction monitoring includes those parameters required by the permits developed pursuant to the Clean Water Act, and mitigation actions adopted pursuant to California Environmental Quality Act (CEQA), National Environmental Policy Act (NEPA), ESA, and related FERC requirements.[90]

IV.A.3. Facilities Transfer Agreement

USBR agrees to perform all start-up and acceptance testing and prepare the necessary documents and reports, up to and until Licensee and USBR jointly determine that the constructed facilities' operation meets the design criteria. Completion inspections for each construction contract will be performed by both USBR and Licensee and certifications of approval will be issued jointly by USBR and Licensee. If construction of a particular Restoration Project feature does not meet with the satisfaction of either party, a checklist of needed work prior to the certification of completion will be

[90] MOU 7.1.A

prepared and agreed to by both parties. Upon mutual agreement of the parties, a completed portion of the construction contract or a Restoration Project feature may be turned over to Licensee for operation and maintenance.

Start-up and acceptance testing for both screens and ladders will include, but is not limited to, measurements of velocity and flow collected from each component of the structure at several stage heights to evaluate actual hydraulic performance and reliability over the full range of operating conditions as compared to the design specifications.[91]

IV.A.4 Facilities Monitoring Plan

Licensee, in consultation with the Resource Agencies, shall prepare a detailed facility monitoring plan to be submitted to FERC as part of the license amendment application. Licensee shall perform and assume the costs for the following facility monitoring:

A. At the various outlet and spillway works for North Battle Creek Feeder, Eagle Canyon, Inskip, and Asbury Pump (Baldwin Creek) Diversion Dams, operate properly calibrated remote sensing devices that continuously measure and record total flow and the fluctuation of stage immediately below each dam during all operations for the purpose of verification of FERC license compliance. All flow and stage recording methodologies shall be approved by FERC;

B. At the fish ladders at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams, operate properly calibrated remote sensing devices that continuously monitor water surface elevations at the top and bottom of the ladder to identify debris problems. In addition, continuously operate a calibrated automated fish counter or an underwater video camera to document fish movement through the ladder during the initial three-year period of operation, or as otherwise agreed upon by the Parties; and

C. At the fish screens at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams, operate properly calibrated remote sensing devices that continuously monitor water surface elevation differences on the inlet and outlet side of screens to identify plugging.[92]

IV.A.5 Operations and Maintenance Plan

USBR will work with Licensee as part of the design effort to create a Operations and Maintenance Plan that will be turned over to the Licensee at the time the restoration facilities are transferred from USBR to Licensee. The Operations and Maintenance Plan will include designers' operation criteria that give standards for safety and performance

[91] MOU 7.1.B
[92] MOU 7.2

limits for the new restoration facilities and a manual of standard operating procedures that explains how to operate the new restoration facilities.

IV.B. Non-Project Restoration Programs in Battle Creek

IV.B.1. Conservation Easements and Conservation Water Rights

TNC has established one conservation easement within the Battle Creek watershed as of October 2000 and is talking with several other landowners at this time about possibly acquiring others. The intended goals of this project are to limit future impacts of landscape fragmentation, instream physical disturbance, and the addition of new wells and septic systems; and to preserve high quality riparian habitat adjacent to wildlife compatible agriculture. TNC hypothesizes that the purchase of conservation easements in a watershed with at-risk native species will help maintain and enhance functional riparian habitat and stream-bank conditions, and will help minimize threats which stem from extensive human impacts, including water use.

TNC believes that the next important step in protecting salmon and steelhead along Battle Creek is protecting the relatively pristine riparian habitat along the stream from degradation and preventing the loss or degradation of its cold spring water by well development. In this project, TNC, working in partnership with the BCWC, plans to acquire conservation easement interests from willing landowners on resource-rich Battle Creek properties with potential for future development in order to provide conservation protection of natural processes while maintaining land in private agricultural use and ownership. It is intended that the terms of the easements will help ensure protection of the riparian habitat, will help prevent excessive water extraction and use, and will help ensure connectivity of the stream to the surrounding land, but may vary slightly to fit a particular property.

The U.S. Bureau of Land Management (BLM) has also acquired conservation easements on two properties in lower Battle Creek including land along the mouth of the stream. The purpose of these easements, acquired in October 2000, is to conduct riparian restoration activities along Battle Creek and the Sacramento River and to maintain the agricultural nature of these properties. BLM will be developing a conservation plan for these properties and anticipates implementing restoration activities during the next 15 to 20 years. While BLM is not actively seeking other conservation easements or land acquisitions in the Battle Creek watershed at this time, they will entertain proposals by willing sellers for new acquisitions or easements in the future.[93] The BCWC and local landowners have predicted that BLM land acquisition would increase public access to Battle Creek and likely heighten human impacts on sensitive populations of salmon and steelhead (R. Lee and B. McCampbell, presentations to the BCWG, 1998).

CDFG is currently exploring opportunities to obtain from willing sellers, conservation water rights from cold water sources. These conservation water rights

[93] Kelly Williams, BLM, pers. comm. 10/17/00.

would allow the natural flow of cold water from springs or seeps into the natural Battle Creek stream channel.

IV.B.2. U.S. Forest Service

All U.S. Forest Service (USFS) lands in the watershed are located in the upper Battle Creek watershed, upstream of the Restoration Project Area and outside the area that will be adaptively managed. However, the upper watershed is important in that its condition can potentially influence the quality of aquatic habitat in downstream reaches. The Lassen National Forest has been conducting a few limited programs in the upper Battle Creek watershed related to stream restoration and fuels assessment. These have included several road restoration measures such as culvert replacement, which are intended to reduce sediment delivery to the stream. In the summer of 2000, the USFS assessed wildfire fuels and aquatic/riparian habitat in the Battle Creek watershed under a contract with BCWC. Results of this assessment are expected in 2002.[94]

IV.B.3. Proposed Comprehensive Fisheries Management Plan for the Upper Sacramento River and Tributaries

CDFG is beginning to draft a comprehensive fisheries management plan for the upper Sacramento River and tributaries in 2001. The objective of this plan is to take a watershed-wide, fisheries management-based view at production potential and population levels of all races of anadromous salmonids. Specific goals will be set for each upper Sacramento River tributary that will integrate the production potential of each stream, as well as the main river, from a system perspective. Perennial anadromous salmonid-producing tributaries that will be addressed in this plan include Clear, Cow, Cottonwood, Battle, Deer, Mill, and Antelope Creeks, while other streams that occasionally produce anadromous salmonids in good water years include Sulfur, Churn, and Bear Creeks. Questions regarding Battle Creek will be developed during this open planning process.

IV.B.4. Sacramento Corridor Habitat Restoration Assessment

The California Department of Water Resources (CDWR) will conduct, in cooperation with BLM, CDFG, TNC, a study of the geomorphic and riparian interactions occurring on an alluvial reach of the Sacramento River between the mouth of Cow Creek and Jelly's Ferry bridge (RM 280-267), including lower Battle Creek and Anderson Creek, to determine restoration possibilities for the integrated complex that includes lands owned and managed by the BLM, lands with conservation easements held by BLM, and other possible acquisitions by fee and/or conservation easements from willing sellers within this reach. This work will establish the existing conditions in the river reach for quantifiable attributes that could be monitored to evaluate the effects of land use improvements.

[94] Susan Chapelle, USFS, pers. comm. 6/28/00

IV.B.5. Coleman National Fish Hatchery Water-Supply Intake Modifications

The CNFH's water-supply intakes do not currently meet federal and state guidelines for the protection of salmonids at water diversions. A process to improve the intakes has been initiated by the USFWS.

Planning efforts have identified various intake alternatives to meet specific fish protection and flow requirements. The USFWS believes that the recommended alternative best meets the CNFH's needs, while also meeting the goals of the Restoration Project. Public involvement, as part of the environmental compliance and permitting activities, began in June 2000 under Phase I of the project. A draft Environmental Assessment/Initial Study will be prepared by the USBR. Permitting, design, and construction are anticipated to take three years to complete. Funds for construction are being sought.

Direct impacts from the construction of these modifications, as well as existing entrainment risks that might continue as late as 2003, may affect existing populations of fish in Battle Creek. These modifications are expected to benefit fish in the Restoration Project Area by eliminating any entrainment risks associated with the hatchery water-supply intakes and would protect the progeny of any adult fish that are allowed access to the Restoration Project Area as a result of the latter.

IV.B.6. Proposed Coleman Powerhouse Tailrace Barrier Construction

The AFRP identified the lack of a tailrace barrier downstream of the Coleman Powerhouse as a high-priority action item because of harmful false attraction of anadromous salmonids to powerhouse tailrace water (USFWS 1997). This action item has been linked to proposed modifications to the CNFH water-supply intakes and appears in each alternative being considered. The outcome of this analysis may determine the eventual action to be taken.

The multi-agency interim intake improvement subgroup (of the BCWG) has proposed installing a temporary fish rack as an interim solution to this problem. Problems with obtaining access to the site have delayed installation of the fish rack though a transfer of ownership from a private individual to the BLM should free up access to the site. Barrier construction is included as part of the CNFH Intake Improvements.

IV.B.7. Modifications to the Coleman National Fish Hatchery Barrier Dam

The barrier dam at CNFH is used primarily to collect fall-run chinook, late-fall-run chinook, and steelhead broodstock for the hatchery. The USFWS is presently funded by a 1999 CALFED grant to (1) more effectively block fall-run and late-fall-run chinook passage and (2) improve the upstream fish ladder to meet the same Contemporary criteria that will be applied to the improved hydro power facility ladders. The USFWS is

working with the USBR to determine the final design and future operations of this facility through the NEPA process.

Fish trapping facilities at this ladder will play an important part in several adaptive management objectives. Adult anadromous salmonids returning to the Restoration Project Area will be captured and sampled for such information as populations estimates, run-timing, stock, size, and condition. Future activities to monitor upstream migration of adults into the restored portion of the Battle Creek watershed can be modeled after monitoring conducted at this site by the USFWS office in Red Bluff since 1995 (USFWS 1996).

IV.B.8. Coleman National Fish Hatchery Biological Assessment and Associated Biological Opinion

The USFWS has recently completed a draft BA describing fish propagation programs at CNFH and assessing potential impacts resulting from those artificial propagation programs to naturally-produced salmonids. The primary purpose of the BA is to provide a single, comprehensive source of information to assess CNFH impacts, primarily to listed fish populations, resulting from artificial production programs. When finalized in the spring of 2001, the BA will be submitted to NMFS as part of the evaluation and permitting process required under ESA. NMFS will use the BA to generate a Biological Opinion, which will assess whether the proposed artificial production programs impart deleterious genetic or ecological effects on listed natural populations. If the BA is approved, the USFWS will enter into Section 7 consultation with NMFS to ensure proper implementation and systematic monitoring and reporting of results/effects.

The organizational structure of the BA follows the highly-detailed format of the NMFS's Hatchery and Genetic Management Plan. Furthermore, the BA is structured in a manner that incorporates and addresses comments and concerns generated through public and stakeholder participation in the CNFH reevaluation process (USFWS 2000b). The primary goal of the CNFH reevaluation process is to objectively review all aspects of hatchery facilities and operations, to ensure the integration with the AFRP-guided restoration efforts in Battle Creek. This broad-based reevaluation process is in addition to the ongoing hatchery evaluation program conducted by the USFWS's Red Bluff Fish and Wildlife Office (e.g., biological investigations and hatchery permitting BAs and enhancement permits). The four major components of the reevaluation process are:

- Compilation and analysis of historical hatchery operations and evaluation work;
- Determination of mitigation responsibilities;
- Analyzing potential impacts of current and proposed production programs on listed stocks of anadromous salmonids; and,

- Generating and analyzing potential management alternatives to minimize hatchery impacts on naturally-produced salmonid populations and compiling and analyzing historical hatchery operations and evaluation work.

Through the CNFH reevaluation process and the BA, the USFWS will address concerns regarding hatchery programs and activities that could potentially impact restoration of naturally-produced populations of anadromous salmonids in Battle Creek. Potential modifications to hatchery activities that are being examined through the CNFH reevaluation process, along with the adaptive management of hatchery operations, will be designed to minimize potentially negative impacts of hatchery activities to naturally-produced salmonid populations. Modifications to hatchery activities or facilities that may result from the CNFH reevaluation process may necessitate reinitiation of consultation with NMFS and amending or revising the BA for the CNFH.

IV.C. Non-Project Restoration Programs Outside Battle Creek

IV.C.1. CALFED Ecosystem Restoration Program

The Restoration Project is funded in large part by monies allocated as part of the implementation phase of CALFED's ERP. The ERP is organized into a matrix of visions that identify what the ERP will accomplish with its stated objectives, targets, and programmatic actions for an ecological process, habitat, species or species group, stressor, or geographical unit. The vision statements included in the ERP provide technical background to increase understanding of the ecosystem and its elements.[95] In light of the contribution of CALFED monies to the Restoration Project, ERP visions that are relevant to the Restoration Project, in terms of species or processes, are presented in Table 11. The adaptive management actions that will meet ERP visions will be identified.

[95] CALFED ERP Volume 1 page 1

Table 11. CALFED Ecosystem Restoration Program visions for ecosystem elements and how the Restoration Project and Adaptive Management Plan achieve these visions.

Element	ERP Vision	Achievement Method
Central Valley Streamflows	The ERP vision for Central Valley streamflows is to protect and enhance the ecological functions that are achieved through the physical and biological processes that operate within the stream channel and associated riparian and floodplain areas in order to contribute to the recovery of species and the overall health of the Bay-Delta.	The Restoration Project will substantially increase stream flows to meet the needs of ERP priority 1 fish species, chinook salmon and steelhead. The AMP contains protocols for changing these stream flows if necessary to increase chinook salmon and steelhead populations, chinook salmon and steelhead habitat, or assist chinook salmon and steelhead passage.
Stream Meander	The ERP vision for stream meander is to conserve and reestablish areas of active stream meander, where feasible, by implementing stream conservation programs, setting levees back, and reestablishing natural sediment supply to restore riverine and floodplain habitats for fish, wildlife, and plant communities.	By removing several diversion dams from Battle Creek, the Restoration Project will aid in the reestablishment of active stream meanders to the extent that Battle Creek and its tributaries meander naturally. Furthermore, agreements between Licensee and CDFG regarding enhancing the natural sediment supply and sediment routing in Battle Creek have been formalized in the past and will be pursued in the future.
Natural Floodplains and Flood Processes	The ERP vision for natural floodplains and flood processes is to conserve existing and intact floodplains and modify or remove barriers to over-bank flooding to reestablish aquatic, wetland, and riparian floodplain habitats.	By removing several diversion dams from Battle Creek, the Restoration Project will aid in the reestablishment of natural floodplains and flood processes, even though the FERC Project No. 1121 has historically had a relatively minor effect on natural flood flows.
Coarse Sediment Supply	The ERP vision for coarse sediment supply is to provide a sustained supply of alluvial sediments that are transported by rivers and streams and distributed to river bed deposits, floodplains, channel bars, riffles, shallow shoals, and mudflats, throughout the Sacramento-San Joaquin Valley, Delta, and Bay regions. This would contribute to habitat structure, function, and foodweb production throughout the ecosystem.	By removing several diversion dams from Battle Creek, the Restoration Project will prevent the loss of naturally-supplied sediment that can be stored in reservoir impoundments or removed from the system by reservoir dredging operations.
Central Valley Stream Temperatures	The ERP vision for Central Valley stream temperatures is to restore natural seasonal patterns of water temperature in streams, rivers, and the Delta to benefit aquatic species by protecting and improving ecological processes that regulate water	The Restoration Project will substantially increase instream flows, increase spring releases from hydroelectric project water collection facilities, and remove interbasin transfers of water to restore natural seasonal patterns of water temperatures in Battle Creek by protecting and improving ecological processes that regulate water. Furthermore, the AMP contains protocols for changing these stream flows if necessary to meet appropriate water temperature criteria.
Riparian and Riverine Aquatic	The ERP vision for riparian and riverine aquatic habitats is to increase their area and protect and improve their quality.	By removing several diversion dams from Battle Creek, increasing instream flows, and increasing cold water spring releases

Element	ERP Vision	Achievement Method
Habitats	Achieving this vision will assist in the recovery of special-status fish and wildlife populations and provide high-quality habitat for other fish and wildlife dependent on the Bay-Delta. The ERP vision includes restoring native riparian communities ranging from valley oak woodland associated with higher, less frequently inundated floodplain elevations to willow scrub associated with low, frequently inundated floodplain elevation sites such as stream banks, point bars, and in-channel bars.	from hydroelectric project water collection facilities, the Restoration Project will improve riparian and riverine aquatic habitats. It is believed that higher instream flows will aid in the distribution of seeds from riparian plant species and elevate the dry-season water table in the riparian area fostering an expansion of riparian communities such as willow scrub.
Freshwater Fish Habitats	The ERP vision for freshwater fish habitats is to protect existing habitat from degradation or loss, to restore degraded habitats, and restore areas to a more natural state. Freshwater fish habitat will be increased to assist in the recovery of special-status plant, fish, and wildlife populations. Restoration will provide high-quality habitat for other fish and wildlife dependent on the Bay-Delta.	By removing several diversion dams from Battle Creek, increasing instream flows, and providing improved fish passage facilities, the Restoration Project will restore degraded freshwater fish habitats to assist in the recovery of special-status plant, fish, and wildlife populations.
Essential Fish Habitats	The ERP vision for essential fish habitats is to maintain and improve the quality of existing habitats and to restore former habitats in order to support self-sustaining populations of chinook salmon.	By removing several diversion dams from Battle Creek, increasing instream flows, increasing cold water spring releases from hydroelectric project water collection facilities, and providing improved fish passage facilities, the Restoration Project will restore degraded freshwater fish habitats to assist in the recovery of self-sustaining populations of four races of chinook salmon.
Winter-Run Chinook Salmon	The ERP vision for winter-run chinook salmon is to recover this state- and federally-listed endangered species, achieve naturally spawning population levels that support and maintain ocean commercial and ocean and inland recreational fisheries, and that fully uses existing and restored habitats. This vision will contribute to the overall species diversity and richness of the Bay-Delta system and reduce conflict between protection for this species and other beneficial uses of water and land in the Central Valley.	By removing several diversion dams from Battle Creek, increasing instream flows, increasing flows from cold water springs, and providing improved fish passage facilities, the Restoration Project will restore degraded freshwater fish habitats to assist in the recovery of self-sustaining populations of winter-run chinook salmon. Fish passage facilities and prescribed minimum instream flows were determined in large part based on the needs of winter-run chinook salmon. Furthermore, the AMP contains protocols for changing these stream flows if necessary to specifically meet the habitat needs of winter-run chinook salmon.
Spring-Run Chinook Salmon	The ERP vision for spring-run chinook salmon is to recover this state- and federally-listed threatened species under the ESA, achieve naturally spawning population levels that support and maintain ocean commercial and ocean and inland	By removing several diversion dams from Battle Creek, increasing instream flows, increasing flows from cold water springs, and providing improved fish passage facilities, the Restoration Project will restore degraded freshwater fish habitats to

Element	ERP Vision	Achievement Method
	recreational fisheries, and that fully use existing and restored habitats. This vision will contribute to the overall species diversity and richness of the Bay-Delta system and reduce conflict between protection for this species and other beneficial uses of water and land in the Central Valley.	assist in the recovery of self-sustaining populations of spring-run chinook salmon. Fish passage facilities and prescribed minimum instream flows were determined in large part based on the needs of spring-run chinook salmon. Furthermore, the AMP contains protocols for changing these stream flows if necessary to specifically meet the habitat needs of spring-run chinook salmon.
Late-Fall-Run Chinook Salmon	The ERP vision for late-fall-run chinook salmon is to recover this stock which is presently a candidate for listing under the ESA (it is included in the fall-run chinook salmon evolutionarily significant unit), achieve naturally spawning population levels that support and maintain ocean commercial and ocean and inland recreational fisheries, and that fully use existing and restored habitats. This vision will contribute to the overall species diversity and richness of the Bay-Delta system and reduce conflict between protection for this species and other beneficial uses of water and land in the Central Valley.	By removing several diversion dams from Battle Creek, increasing instream flows, and providing improved fish passage facilities, the Restoration Project will restore degraded freshwater fish habitats to assist in the recovery of self-sustaining populations of late-fall-run chinook salmon. Fish passage facilities and prescribed minimum instream flows were determined in large part based on the needs of late-fall-run chinook salmon. Furthermore, the AMP contains protocols for changing these stream flows if necessary to specifically meet the habitat needs of late-fall-run chinook salmon.
Fall-Run Chinook Salmon	The ERP vision for the fall-run chinook salmon evolutionarily significant unit is to recover all stocks presently a candidate for listing under the ESA achieve naturally spawning population levels that support and maintain ocean commercial and ocean and inland recreational fisheries, and that fully use existing and restored habitats. This vision will contribute to the overall species diversity and richness of the Bay-Delta system and reduce conflict between protection for this species and other beneficial uses of water and land in the Central Valley.	By removing several diversion dams from Battle Creek, increasing instream flows, and providing improved fish passage facilities, the Restoration Project will restore degraded freshwater fish habitats to assist in the recovery of self-sustaining populations of fall-run chinook salmon. Fish passage facilities and prescribed minimum instream flows were determined in consideration of the needs of fall-run chinook salmon. Furthermore, the AMP contains protocols for changing these stream flows if necessary to specifically meet the habitat needs of fall-run chinook salmon.
Steelhead Trout	The ERP vision for Central Valley steelhead trout is to recover this species listed as threatened under the ESA and achieve naturally spawning populations of sufficient size to support inland recreational fishing and that fully uses existing and restored habitat areas.	By removing several diversion dams from Battle Creek, increasing instream flows, and providing improved fish passage facilities, the Restoration Project will restore degraded freshwater fish habitats to assist in the recovery of self-sustaining populations of steelhead. Fish passage facilities and prescribed minimum instream flows were determined in large part based on the needs of steelhead. Furthermore, the AMP contains protocols for changing these stream flows if necessary to specifically meet the habitat needs of steelhead.

Element	ERP Vision	Achievement Method
Anadromous Lampreys	The ERP vision for anadromous lampreys is to maintain and restore population distribution and abundance to higher levels than at present. The ERP vision is also to better understand life history and identify factors which influence abundance. Better knowledge of these species and restoration would ensure their long-term population sustainability.	By removing several diversion dams from Battle Creek, increasing instream flows, and providing improved fish passage facilities, the Restoration Project will restore degraded freshwater fish habitats to assist in the recovery of self-sustaining populations of anadromous lamprey. Furthermore, monitoring approaches within the AMP will contribute to gaining a better understanding of the life history identify factors which influence the abundance of anadromous lamprey.
Native Resident Fish Species	The ERP vision for resident fish species is to maintain and restore the distribution and abundance of native species, such as Sacramento blackfish, hardhead, and tule perch to contribute to the overall species richness and diversity. Achieving this vision will reduce conflict between protection for this species and other beneficial uses of land and water in the Bay-Delta.	By removing several diversion dams from Battle Creek, increasing instream flows, and providing improved fish passage facilities, the Restoration Project will restore degraded freshwater fish habitats and should assist the restoration of the distribution and abundance of native fish species in Battle Creek.

IV.C.1.a. Comprehensive Monitoring, Assessment, and Research Program/ CALFED Science Program

In 1998, CALFED approved and funded a joint San Francisco Estuary Institute, Interagency Ecological Program, U.S. Geological Survey proposal to develop a Comprehensive Monitoring, Assessment, and Research Program (CMARP) for CALFED and its member agencies. The proposed CMARP addresses eight CALFED program elements and actions to be implemented over the next 30 years including long-term levee protection, water quality, ecosystem restoration, water use efficiency, water transfer framework, watershed management coordination, and delta conveyance and storage.

One of the primary goals of CMARP has been the design and implementation of a monitoring program with several modules that overlap with the Restoration Project in Battle Creek. Compliance monitoring provides information needed to determine if activities are meeting permit or other regulatory requirements. Model verification monitoring provides information to evaluate management alternatives, e.g., for adaptive management. Trend monitoring helps identify long-term changes occurring as a result of human and natural factors. The following have been components of the CMARP monitoring program: an inventory of existing monitoring programs, the development of specific monitoring elements, the development of a process for data management, and the development of a process for data assessment and reporting.

CMARP (soon to be renamed CALFED Science Program) is currently developing aquatic and terrestrial baseline monitoring programs to provide information needed by CALFED managers and scientists to follow trends in key indicators of the status and trends of Bay/Delta and Central Valley ecosystems and several sensitive plant and

animals. Geographically, the recommended aquatic resources baseline program will extend from the bases of the major dams through the Bay/Delta and into the near-shore ocean. The program will include ecosystem processes as well as specific elements directed to listed and special status fish species such as chinook salmon, steelhead, delta smelt, splittail, and green and white sturgeon.

The foundation of the proposed baseline will be built on many of the existing monitoring efforts being conducted under the auspices of CVPIA, CAMP, the Interagency Ecological Program, the Sacramento Watershed Group, the San Francisco Estuary Institute's Regional Monitoring Program, and agency-funded tributary monitoring on the Feather, American, and Tuolumne Rivers and on Battle, Deer, Mill, and Butte Creeks. The monitoring program report will identify data gaps and recommend new elements to fill those gaps.

The recommended plan was to be sent to CALFED with the goal of identifying and agreeing on the program elements at a later date. If CALFED approves the plan, the monitoring program will go into effect during the fall of 2001, with the new elements funded as money becomes available through the budget process. The report will contain chapters on data management (recommend use of the IEP Bay/Delta and tributaries data base), communications/coordination among the program participants, and data conversion and information transfer to decision makers.

Monitoring and data assessment results from the Battle Creek adaptive management program will be shared with CMARP/CALFED Science Program. Data collections and analyses as part of the AMP will be coordinated with the larger aims of CMARP/CALFED Science Program.

IV.C.2. Central Valley Project Improvement Act

The Central Valley Project Improvement Act of 1992 (H.R. 429 "Reclamation Projects Authorization and Adjustments Act of 1992: Title XXXIV—Central Valley Project Improvement Act") was enacted to provide funds for fisheries restoration. The CVPIA mandated changes in Central Valley Project (CVP) management in order to protect, restore, and enhance fish and wildlife habitat. In particular, the act stated "The mitigation for fish and wildlife losses incurred as a result of construction, operation, or maintenance of the CVP shall be based on the replacement of ecologically equivalent habitat" and that first priority shall be given to "measures which protect and restore natural channel and riparian habitat values."

IV.C.2.a. Anadromous Fish Restoration Program

To meet provisions of this act, the USFWS developed the AFRP (USFWS 1997), which identified 12 actions that would help restore anadromous fish to Battle Creek, including increasing instream flows past PG&E's hydropower diversions and installing effective fish screens and ladders. Additionally, the CVPIA has sought to minimize fish losses incurred as a result of operations or maintenance of any element of the CVP,

including the CNFH in Battle Creek, and specifies that habitat replacement, rather than hatchery production, is the preferred means of mitigating for unavoidable losses.

Of the 12 proposed actions listed in the AFRP, five have been implemented, three are elements of the Restoration Project, and four are yet to be implemented (AFRP Implementation Plan available at http://www2.delta.dfg.ca.gov/afrp/). The outstanding AFRP elements include improved management of the barrier dam for salmon passage now that a disease-safe water supply has become available to the CNFH, screening the Coleman Powerhouse tailrace and the CNFH water-supply intakes, and developing a comprehensive restoration plan for Battle Creek that integrates CNFH operations. These four proposed actions should be completed through the programs listed in the above section entitled "Non-Project Restoration Programs in Battle Creek."

IV.C.2.b. Comprehensive Assessment and Monitoring Program

The CAMP was also established in response to the CVPIA. A section of the CVPIA directed the Secretary of the Interior to develop a program to evaluate the effectiveness of actions designed to ensure that by the year 2002, the natural production of anadromous fish in Central Valley streams is sustainable, on a long-term basis, at levels not less than twice the average levels attained during 1967-1991. The anadromous species included in CAMP are fall-run chinook salmon, late fall-run chinook salmon, winter-run chinook salmon, spring-run chinook salmon, steelhead trout, American shad, striped bass, white sturgeon, and green sturgeon. The categories of anadromous fish restoration actions evaluated by CAMP for their effectiveness in doubling natural production are habitat restoration, water management, fish screens, and structural modifications.

CAMP assesses both the cumulative and relative effectiveness of restoration actions on anadromous fish production. The cumulative effectiveness of restoration actions is evaluated by monitoring adult production of each species and comparing the estimated natural adult production to the target natural adult production (i.e., the anadromous fish doubling goals). The relative effectiveness of restoration actions is evaluated by monitoring juvenile abundance of chinook salmon in relation to when and where restoration actions are implemented. Adult and juvenile data collected for CAMP are compiled regularly and made available on the Internet and in published reports.

CAMP monitoring focuses on estimating juvenile production and counts of adults. While CAMP does fund some monitoring projects, it primarily acts as a guide to other studies by maintaining protocols for fisheries research that allow for the development of a Central Valley-wide understanding of anadromous fish restoration. Applicable data collected as part of the Restoration Project and adaptive management will follow CAMP protocols to facilitate the understanding of the Restoration Project contribution to reaching CVPIA goals.

IV.C.3. Recovery Plans for Threatened or Endangered Salmonids

NMFS prepared a recovery plan for winter-run chinook salmon which identified and set priorities for actions necessary to ultimately restore the Sacramento River winter-run chinook salmon as a naturally sustaining population throughout its present range. More immediately, the plan identified actions to prevent any further erosion of the population's viability and its genetic integrity. The recovery plan also included a description of site-specific management actions necessary for recovery, objective, measurable criteria, which when met, will allow delisting of the species, and estimates of the time and cost to carry out the recommended recovery measures. Finally, the recovery plan specified Battle Creek as a site for the potential restoration of self-sustaining populations of winter-run chinook salmon.

NMFS is currently in the process of preparing a recovery plan for steelhead and is planning to prepare a recovery plan for spring-run chinook salmon. The recovery plan for spring-run chinook salmon would likely be prepared jointly with CDFG. Much of these plans would likely be based on CALFED's EIS/EIR, its Multi-Species Conservation Plan, and the Ecosystem Restoration Plan. No timeline has been set for the completion of these plans.

These recovery plans would link to the Restoration Project by setting numerical goals for viable population levels for three of the species targeted for restoration. These documents would likely not include any binding mandates or prescriptions to be specifically implemented in Battle Creek.

IV.C.4. Central Valley Salmon and Steelhead Restoration and Enhancement Plan

In the early 1990s, the Central Valley Salmon and Steelhead Restoration and Enhancement Plan was developed to restore and enhance salmon and steelhead in the Central Valley (CDFG 1990). This plan called for increased instream flows and effective fish screens on Battle Creek. The implementation of the Restoration Project will meet all the recommendations in this plan that were specific to Battle Creek.

IV.C.5. Upper Sacramento River Fisheries and Riparian Habitat Management Plan

The Upper Sacramento River Fisheries and Riparian Habitat Advisory Council's 1989 Plan singled out Battle Creek as a key watershed for restoration. Goals of this plan will be achieved with the implementation of the Restoration Project and the AMP.

IV.C.6. Restoring Central Valley Streams—A Plan for Action

CDFG's (1993) "Restoring Central Valley Streams—A Plan for Action" focused on the potential for restoring winter-run and spring-run chinook salmon and steelhead to Battle Creek by the preparation and implementation of a comprehensive restoration plan

for anadromous fish in Battle Creek, increasing instream flows, and revised management of the barrier dam at CNFH. The planning recommendations of "A Plan for Action" have already been achieved with the development of the Restoration Plan (Ward and Kier 1999a) and the MOU. Implementation of the Restoration Project and the AMP will meet "A Plan for Action's" goals of increasing instream flows. Finally, the goal of revising management of the barrier dam will be based on USFWS' Hatchery and Genetic Management Plan for the CNFH and CDFG's proposed comprehensive fisheries management plan for the upper Sacramento River and tributaries.

IV.C.7. Steelhead Restoration and Management Plan for California

The Steelhead Restoration and Management Plan was prepared by CDFG in 1996 as a follow-up to its "A Plan for Action" stemming from the final recommendations of the California Advisory Committee on Salmon and Steelhead Trout. Several of the actions identified in this document that pertained to the Battle Creek watershed will be implemented through the Restoration Project.

IV.C.8. Delta and Sacramento River Operations and Monitoring

Water diversions from the Sacramento River downstream of Battle Creek, including Red Bluff Diversion Dam and about 300 others, have been identified as causing problems for fish passage (CDFG 1990). Especially harmful for fish populations from the upper Sacramento River Basin are the many unscreened water diversions which can entrain juvenile and adult fish (CDFG 1990). Perhaps the most commonly cited factor negatively affecting populations of salmon and steelhead from Sacramento River tributaries such as Battle Creek is the operation of water pumping plants by state and federal agencies, as well as smaller water diversions, within the Sacramento/San Joaquin Bay-Delta (CDFG 1990). These pumps cause problems with the magnitude and direction of flow, tidal cycles, fish entrainment, salinity and water quality, and fish migration (CDFG 1990).

Seeking solutions to the resource problems in the Bay-Delta, state and federal agencies signed a Framework Agreement in June of 1994 that provided increased coordination and communication for environmental protection and water supply dependability. The Framework Agreement laid the foundation for the Bay-Delta Accord and the CALFED Bay-Delta Program. A programmatic environmental impact statement was released in June 2000 which detailed specific actions regarding how water supply operations will be coordinated with endangered species protections and water quality, and which developed long-term solutions to fish and wildlife, water supply reliability and flood control, and water quality problems in the Bay-Delta.

The well-intended steps proposed in these planning documents may have beneficial affects on fish populations from Battle Creek and should aid the Restoration Project in restoring anadromous fish to Battle Creek. However, it is possible that diversions in the Bay-Delta and Sacramento River will continue to harm fish populations from Upper Sacramento River tributaries. If that happens, salmon and steelhead

restoration in Battle Creek could be confounded. The adaptive management studies in the AMP have been designed to identify those impacts on Battle Creek fish caused by the hydroelectric project and to tell when factors from outside the watershed are at play. However, the AMP will not be able to rectify extra-watershed limiting factors.

IV.C.9. Reference Watersheds

Monitoring relevant to this AMP is routinely conducted in the Deer, Mill, and Butte Creek Reference Watersheds. With some variations in specific methodologies, population estimates of adult fall-run and spring-run chinook salmon, and estimates of juvenile chinook salmon production, are generated annually in each of these watersheds. From these estimates, CRRs are routinely calculated. Other fish population data either recently collected or anticipated in the near future includes genetic sampling of spring-run and fall-run chinook, life history details of juvenile chinook, and age/growth information from otolith sampling.

Fish habitat is monitored in these streams, especially in the high-elevation habitat of spring-run chinook. Also, water temperature and water quality monitoring is routinely conducted in Deer, Mill, and Butte Creeks.

The monitoring of adult counts and juvenile production are both part of long-term state and federal programs that are expected to continue well into the future. However, other fish population data has received directed funding that may not be available in the future. Data about fish populations, habitat, and water temperature/quality collected in these Reference Watersheds will be directly compared with similar data from Battle Creek as a means of measuring attainment of several objectives within the AMP.

IV.D. Battle Creek Watershed Conservancy

IV.D.1. Potential Local Community Participation

In general, the stream systems of the upper watershed are in good health; fisheries, water, and land management activities occurring in these streams have had little impact on the potential to restore anadromous salmonids to the lower Battle Creek watershed. While several fisheries, land, and water management actions in the upper watershed affect resident populations of fish, these effects are usually localized and attenuated by the time Battle Creek flows into anadromous fish habitat. Some of these actions include fish stocking in streams and reservoirs of the upper watershed for recreational fishing, timber harvest on private and public lands primarily in the headwaters areas, cattle grazing in or near riparian ecosystems, and hydroelectric power development (Ward and Kier 1999a).

Nonetheless, several possible land use activities that could affect restoration of salmon and steelhead have been identified. Agricultural use of surface waters may affect anadromous fish habitat if water quality and temperature are impacted. Catastrophic wild fires in the uplands surrounding the anadromous fish habitat of Battle Creek could

devegetate vast areas of land exposing significant amounts of soil to erosive processes which might then carry sediment to fish habitat in Battle Creek (Wissmar et al. 1994; see Spence et al. 1996 for a review of the effects of wildfires on salmonids). Chemical fire retardants needed to suppress wild fires have also been identified as impacting water quality and killing fish (Norris and Webb 1989).

Furthermore, current trends throughout the American West indicate that as the economics within Battle Creek shift and as more people seek land in rural areas, it is likely that large land holdings will be subdivided and sold to multiple owners (Rudzitis 1996; Power 1996) leading to more complicated political and land management scenarios which will likely impact the ability to restore or maintain salmon and steelhead populations. The present land use and ownership patterns have been identified by CDFG as the best for the restoration of anadromous fish populations compared with the identified alternatives (CDFG 1997).

Neither the AMP nor any single agency initiative will be addressing any of these issues despite the fact that land use, and the attitudes toward restoration held by local landowners, will play a critical role in the restoration of anadromous salmonids to Battle Creek. The BCWC, in as much as it is motivated and funded to do so, will be the organization most suited to protecting Battle Creek and its fish populations from deleterious land use practices, primarily through education, outreach, physical projects, and monitoring.

Perhaps most importantly, the BCWC is best suited to foster long-term acceptance of the Restoration Project by the local community, which will be a critical component to the success of adaptive management and the Restoration Project. The perception of the Restoration Project by local community members ranges from "it's a government imposed burden" to "it's a worthy project that we want to help." If the BCWC and the MOU parties can work together to successfully implement the Restoration Project, then the challenge will be to give members of the local community a reason to embrace the Restoration Project. The BCWC has suggested that if the local community is encouraged to participate in adaptive management monitoring and data management, then community acceptance, a sense of ownership in the outcome of the project, and the eventual success of the Restoration Project is far more assured than if the Restoration Project excludes local input and salmonid restoration is seen as something to be actively resisted.

As a private organization with no statutory responsibility, the BCWC will have no responsibility to enforce provisions or policy associated with the Restoration Project. However, it may assist in a preventative role, helping to identify potential problems between land owners and Restoration Project policy, and helping to ameliorate these problems through technical assistance, assistance in getting grant money for on-the-ground work, and through liaison with the agencies. For example, landowners are often reluctant to consult with agencies charged with enforcement since they feel there is a chance they may be punished. The BCWC can continue to act as a go-between in such cases, with the result that the issue is addressed and a problem solved.

IV.D.2. Suggested Monitoring Tasks

Inasmuch as it is motivated and funded to do so, the BCWC, with participation from local schools, may be the organization most suited to monitoring certain aspects of the watershed that either fall within, or are complementary to, this AMP. The BCWC hopes the Parties will encourage their participation in the following activities.

IV.D.2.a. Sediment Quality Monitoring

One of the most easily measured symptoms of deleterious land use practices would be an increase in sedimentation within Battle Creek. The BCWC could partner with local schools to initiate sediment quality monitoring. Through relatively simple scientific sampling regimes, young residents of the watershed could provide an early-warning system for the health of the Battle Creek uplands while learning about and forming a connection with the unique populations of salmon and steelhead that will be restored in their watershed.

IV.D.2.b. Ongoing Watershed Assessment

Sediment quality monitoring is useful in detecting erosion problems after they occur. The BCWC feels that a locally developed, long-term, watershed assessment program would be able to prevent erosion problems before they occur or, at least, before they affect stream habitat in the Restoration Project Area. By working with private landowners in the upper watershed, the BCWC could help landowners implement appropriate land-use practices that would protect against ecological impacts and would prevent the need for future regulatory actions.

IV.D.2.c. Water Temperature and Climate Monitoring

Water temperature and climate monitoring are included within this AMP and are activities that might be done efficiently and cost-effectively by the BCWC. Depending on interest by the BCWC, it may be possible for the Resource Agencies to train and fund the BCWC to collect this critical information. Some private landowners may not allow access to Battle Creek for monitoring by Resource Agency personnel, but would be much happier to allow a member of the community on their property. In these situations, it is possible that key adaptive management monitoring elements, like temperature monitoring, would only be feasible with the support and participation of the local community.

IV.D.2.d. Data Management and Dissemination

The BCWC operates and maintains an information system in which data collected as part of the Restoration Project can be stored and/or disseminated. This existing system affords the BCWC and local community members the ability to monitor changes in the watershed as well as assess the effects of those changes on the fish populations and habitat in the Restoration Project Area. This system complements and, in many respects,

outperforms agency-maintained databases which are designed more for Central Valley-wide applications, rather than the fine-scaled effects most important to adaptive management. The BCWC foresees using this information system as a critical way to assist in the adaptive management process.

IV.E. Non-Restoration Project Emergencies

Emergencies in the Battle Creek watershed that could affect the restoration of salmon and steelhead, but that are not directly related to the Restoration Project (e.g., hazardous spills or toxic leaks), would be addressed by standard, official channels. The AMTT would be available to consult with the interested parties as to the possible impacts these types of emergencies may have on the fish or habitat in the Restoration Project.

V. PROTOCOLS

V.A. Adaptive Management Activities on Private Land

Extensive field investigations will be conducted by the Parties to implement the objectives of the AMP. Much of this work may be conducted on private land or access to sampling sites may require travel across private land. To respect landowner rights, all adaptive management activities on private land will follow these protocols.

A Shasta or Tehama County representative of either CDFG or USFWS will coordinate all adaptive management field activities undertaken by the Parties or their agents by serving as, or designating, a Point of Contact (POC). The activities coordinated by the POC may include, but are not limited to, field surveys, site visits, and construction work associated with adaptive responses. The POC will work with Field Coordinators designated by each of the Parties. The POC will serve as the primary contact person for the public and will coordinate and be responsible for the maintenance and renegotiation of landowner agreements and right-of-way easements established by the USBR during Restoration Project initiation. A standard landowner agreement and easement form will be developed by the AMTT with the help of the BCWC that could be modified in any way to meet individual landowner needs. The POC will develop Contemporary communications tools such as a telephone “hotline” and/or web site to provide timely and complete information to landowners and other parties interested in adaptive management activities.

Field Coordinators will be responsible for coordinating all field investigations and adaptive management activities conducted by the members or agents of their respective agency. Field Coordinators will also assist the POC by interfacing with the public. For instance, they will be responsible for notifying landowners of activities on individual private lands.

A seasonal schedule of all adaptive management activities conducted by any of the Parties or their agents will be maintained by the POC. This schedule, and any

updates, will be distributed by the POC to all Field Coordinators, affected landowners, hydroelectric project operators designated by the Licensee, appropriate CDFG and NMFS wardens or enforcement officers, representatives of the BCWC, CALFED, and any person requesting such notification.[96] Day-to-day changes in field scheduling approved by Field Coordinators will be communicated by Field Coordinators directly to the POC, affected landowners, hydroelectric project operators designated by the Licensee, and appropriate CDFG and NMFS wardens or enforcement officers.

The POC will accompany all field personnel at least during the initial field surveys each year. The POC's presence during subsequent surveys will be decided at the time of those later surveys.

Adaptive Management activities will only be performed within the Restoration Project Area. All field personnel must adhere to the following guidelines when performing Adaptive Management activities in Battle Creek:

(1) Minimize the number of field trips into the Battle Creek watershed by combining monitoring activities and coordinating schedules with other agencies/field teams.

(2) Field work activities must be conducted safely. For example, field personnel will always work in teams of two or more. In case of any emergency, contact the Licensee's designated emergency number or hydroelectric project operator.

(3) Field personnel will honor and respect all landowner agreements or right-of-way easements and should carpool as much as possible to minimize disturbance to the landowners and their property.

(4) All road gates will be left the way they are found (i.e., if a gate is found open, it will be left open; if a gate is found closed, it will be left closed after passing through, regardless of the duration of activities within the gated area.

(5) Roads will not be damaged by driving on them when they are too wet or soft. Field personnel will walk when roads are wet, and will photograph and document any road damage that may occur and report the incident to the Field Coordinator. If field personnel find a road with existing soil disturbance (e.g., rutting, erosion, etc.), it will not be used and it will be documented and reported to the POC by the Field Coordinator.

(6) All agency personnel going into the field must carry official photo identification (e.g., valid driver's license) and must freely offer it to any property owner or employee who requests it.

(7) Field personnel will be required to sign entry logs at or near the point of entry for each site if required by property owners.

[96] From MOU 9.A.1

(8) All field supplies brought into a site must also be removed including field equipment (except long-term monitoring equipment approved by affected landowners), personal belongings, or garbage.

(9) Fire damage is a real and serious concern. Field crews will check with the Field Coordinator for the current fire hazard status before performing fieldwork. Field crews will avoid motorized vehicular access during periods of extreme fire hazard as determined by the Field Coordinator. There will be no smoking at any time on any private property. Vehicles should have a fire extinguisher and a shovel. No vehicles will be parked where grass or other vegetation might contact the underside of the vehicle. Evidence of fires possibly triggered by field personnel (e.g., burning odors, smoke) will be investigated immediately and reported if necessary.

(10) Field personnel have no right to recreational or personal use of any private property. Pets are not to be taken into the field and onto private property. Only personnel authorized by Field Coordinators may accompany field crews on any private property.

(11) Field personnel will record only data that meets the purpose of the visit. Incidental observations will not be recorded or shared with the public, but may be shared with the landowner upon request at any time. Field personnel will not discuss specifics of data collected from private properties with anyone outside of the staff designated by the AMP data management protocols.

V.B. Data Management

It will be the responsibility of any Party collecting and/or funding the collection of data as part of Adaptive Management monitoring to ensure that the following data management protocols are carried out. All data collected as part of Adaptive Management monitoring will be:

- Collected according to scientifically sound protocols developed by the agencies collecting or funding data collection;
- Collected following AMP protocols for data collection on private lands;
- Validated using scientifically sound quality assurance and quality control procedures before being released to the public or other agencies, or used in decision making;
- Include information consistent with CMARP, EPA, or other Contemporary standards;
- Stored and/or disseminated in an appropriate agency information system that is publicly accessible which provides for public distribution of information; and
- Transmitted to the BCWC for storage and/or dissemination in an information system operated and maintained by the BCWC and will include metadata and

narrative descriptions of the goals, objectives, methodology of data collection, and a description of the limitations on the use of the data.

Contemporary CMARP and EPA data collection standards encourage the collection of the following information: date; time; station code; GPS (global positioning system) coordinates; species; length; length criteria; marks or tags; life stage; plus count; live/dead; effort information; trapping efficiency; basic water quality data such as temperature, turbidity, flow; and metadata. Adaptive Management data collection and storage standards may change to meet any changes in Contemporary standards.

V.C. Process

V.C.1. Meeting Schedule

Regular meetings of the AMTT will be scheduled four times per year to allow data collection scheduling in accordance with fish life-history requirements and funds management. In addition to considerations of grant scheduling and funding, each regular meeting will address any possible adaptive management actions that need to be taken immediately. All regularly scheduled meetings of the AMTT will be open to the public.

At an AMTT meeting to be held in **October**, summary reports will be presented by each Party responsible for collecting data in the preceding field season. These data reports will be used to prioritize any possible adaptive management responses and will be the foundation for the preparation of a draft annual report. The draft annual report will be presented and discussed at a meeting to be held in **January**. The draft annual report will be presented and discussed at an annual stakeholders meeting in **February**. The final annual report will be presented and discussed at a regular meeting in **March**. At this time, the annual report will be ready for submittal to AMPT. Field study and data collection will also be coordinated at the March meeting.

All regularly scheduled meetings of the AMPT will be open to the public. The AMPT will meet regularly, at least once per year. The annual meeting will be held in **late March** and consist of two purposes. The first purpose will be primarily directed at budget review, funds management, and approval of the annual adaptive management report in time to meet funding agency deadlines. The second purpose will be to provide updates to stakeholders and for public presentation and comment of the annual report. This meeting will be formally announced to the public according to the specific public announcement protocols.

Ad hoc meetings of either the AMTT or AMPT may be scheduled as needed, following the specified adaptive management decision making protocols. Ad hoc meetings called in response to emergency conditions may be conducted in person or with the aid of telecommunications, as determined at the time of the emergency by either the AMTT and/or AMPT. Advance public notice requirements specified for regular meetings of the AMPT need not be implemented for ad hoc meetings of the AMPT in the case of emergencies. Ad hoc meetings of the AMPT scheduled for a specific emergency and not announced with a formal public notice, will consider only issues pertinent to the

emergency at hand and will not make decisions on issues normally addressed at regular meetings. All ad hoc meetings of the AMTT and AMPT will be open to the public.

V.C.2. Meeting Process

Annual meetings of the AMPT and regularly scheduled AMTT meetings will be formally announced to all Parties, the BCWC, CALFED, and any person requesting such notification.[97] Chairpersons of the AMPT and AMTT will provide certified notice of regularly scheduled meetings at least one month in advance to Party representatives of their respective team and representatives of the BCWC, CALFED, and any person requesting such notification.[97] Members of each team then have one week to respond with suggestions for the meeting agenda, which will be circulated by the Chairperson to representatives of each Party and representatives of the BCWC, CALFED, and any person requesting such notification.[97]

The annual AMPT meeting and ad hoc meetings of the AMPT that are not scheduled in direct response to an emergency will be formally announced to the public. The scheduled meeting location and time and the meeting agenda will be published a minimum of three times, at least two weeks before scheduled meetings, in major newspapers or other Contemporary standard media in Shasta and Tehama Counties. Interested persons may attend any meeting, contribute to discussions, and provide suggestions regarding implementation of the AMP.[98]

At least one representative from each of the Parties will be required to attend regularly scheduled and ad-hoc meetings announced according to the aforementioned process or to provide a proxy. A proxy may be transmitted electronically if followed by a document meeting Contemporary formal documentation standards adopted by the AMPT. To ensure that absenteeism does not impede the decision-making process, if a Party or Parties is not represented in person or by proxy at regularly scheduled and ad-hoc meetings announced according to the aforementioned process, and unless a written proxy from the absent party conforming to Contemporary formal documentation standards is received by the Chairperson of the meeting within two weeks, then the dispute resolution process will be triggered.

The Chairs of the AMPT and AMTT will be held by a representative of one of the Parties. Each Chair will rotate annually among the four Parties such that no Party will be the Chair of one team more than once in any four-year period. Furthermore, the Chair for the AMTT will always represent a different Party than the Chair for the AMPT so that the Chairpersons of the AMTT and the AMPT are never representatives of the same Party at any given time.[99] A Chairperson-elect will be appointed for each team to succeed the Chairperson at the expiration of the Chairperson's one-year term. This appointment must consider the Chairperson rotation protocols set forth in this paragraph.

[97] MOU 9.A.1
[98] MOU 9.A.1
[99] Sense of MOU 9.B.1 and 2

All decisions made by the AMTT and AMPT will be made by voting representatives of each Party at regularly scheduled or ad hoc meetings according to the aforementioned notification and absentee rules. All decisions made by the AMTT must be made by Consensus or will be referred to the AMPT. All decisions made by the AMPT will conform to the following possible outcomes:

- A 4-to-0 vote (Consensus) carries the motion;
- A 3-to-1 vote triggers dispute resolution protocols;
- A 2-to-2 vote leads to further discussion.
- A 3-to-0 vote (absenteeism or abstention) triggers dispute resolution.

V.C.3. Reporting

An adaptive management report will be prepared each year by the AMTT and approved by the AMPT. This annual report will document monitoring and data assessment approaches and results from the previous year, identify any possible trigger events that occurred which require an adaptive response, propose the adaptive response to be taken, report on results of adaptive responses taken since the most recent report, and evaluate spending guidelines involved in categorizing major, minor, and emergency responses. This report may also include any other diagnostic studies conducted as part of adaptive responses. Documentation of monitoring and data assessment approaches and other diagnostic studies will be achieved by compiling field study reports prepared by the Parties that conducted or funded individual field studies. The compilation of these field study reports, as well as preparation of report sections identifying trigger events and adaptive responses, will be conducting under the joint oversight of the AMTT and AMPT Chairpersons or their designates. The annual adaptive management report will be presented at the annual meeting of the AMPT, to the BCWC, BCWG, and other stakeholders.

V.C.4. Adaptive Response Process

After a trigger event has occurred, one of three types of adaptive responses will follow: Major, Minor, or Emergency Responses. Major Responses are defined as non-emergency changes to hydroelectric project facilities and/or flow operations that exceed a value of $25,000, adjusted for inflation from the date of this agreement. Minor Responses are defined as non-emergency changes to hydroelectric project facilities and/or flow operations that are less than a value of $25,000, adjusted for inflation from the date of this agreement. Emergency Responses are adaptive management responses that must be dealt with promptly (e.g., situations that create unsafe conditions or unduly threaten salmon or steelhead populations or individuals). Emergency Responses that require a change to hydroelectric project facilities and/or flow operations that exceed a value of $100,000, adjusted for inflation from the date of this agreement, must be approved by the AMPT; otherwise they may be approved by the AMTT. The AMPT will treat the dollar amounts listed in this paragraph as flexible guidelines, and will evaluate these numbers and revise them as necessary as part of the yearly report. Any member of

the AMPT may propose an adjustment to these spending guidelines for any action. Adaptive Management responses from any of these three categories may be required to conform to decision-making processes such as the Federal Power Act, NEPA, CEQA, or Clean Water Act protocols and any other appropriate state or federal law.

Major Responses will be proposed in the annual report and will be proposed for funding according to response prioritization protocols described below. Responses that would be appropriately funded by the WAF or AMF would be approved at a regular AMPT meeting and the USFWS would then request disbursement of the money from USBR according to USBR protocols. Responses that would be funded by other agencies will be described in a proposal formatted per Contemporary guidelines of the targeted funding agency and will include, as a minimum, justification and alternatives, expected benefit, and the priority of species to be affected by the proposal. These response proposals would be submitted after their approval by the AMPT in late March, at the earliest opportunity for funding by target funding agencies.

Minor Responses will be considered and may be approved at the next regularly scheduled or ad hoc meeting of the AMTT or AMPT. Emergency Responses may be considered and approved at ad hoc meetings of the AMTT and/or AMPT, depending on the magnitude of the change required, as specified above.

V.C.5. Prioritizing Response Proposals

All adaptive responses proposed by the AMTT will be prioritized by the AMPT according to adaptive management objectives specified in this document (Table 4) and Contemporary objectives developed through the adaptive management process, fisheries management strategies, effectiveness, and species and ecologically based action priorities. Balancing adaptive management objectives, fisheries management strategies, effectiveness, and action priorities may be very complicated and will not likely be a mere mechanical exercise that could be captured in a flow diagram.

Several criteria will be considered in prioritizing adaptive management responses. These criteria are not necessarily ranked, because conflicts between criteria may need to be balanced or integrated.

- Responses that promote conservation strategies, such as those promoted by federal and state endangered species laws, will take precedence over those proposals that only promote production strategies such as those embodied in the CVPIA's goal to double natural production of anadromous fish.
- The Contemporary status of salmon or steelhead populations according to federal or state endangered species laws will help determine prioritization of proposals. For example, responses benefiting species listed as endangered will take precedence over those affecting threatened, candidate, or unlisted species.
- Contemporary federal endangered species designations will take precedence over Contemporary state designations.

- Alternative response proposals that balance the needs of more than one species will take priority over response proposals focused on individual species even if otherwise equally ranked.
- Biological effectiveness will be considered when ranking response proposals. Those proposals having the maximum long-term benefit will outweigh those having only short-term benefits.
- Cost-effectiveness will be considered when ranking response proposals.
- The effect of actions on the local community and on the maintenance of renewable energy production will be considered in prioritizing adaptive management responses.
- Species and ecological action priorities will be used to rank responses. Responses that promote the recovery of an entire population will take precedence over those that only ensure year-class success. Responses providing either of these types of benefits would outweigh those providing only protection of individuals. Finally, response proposals benefiting adult salmon or steelhead would outweigh those benefiting only juveniles.
- Although adaptive responses are generally designed to benefit salmon and steelhead populations, environmental/ecological consequences will be considered as well; the function of ecosystem processes should not be compromised to benefit only a single species.
- Responses must be technically and administratively feasible.

V.C.6. Budget Review

At the yearly scheduled AMPT meeting, budget reports will be received from cooperating funding sources including TNC and any agencies contributing to adaptive management funding. These budget reports will be used to identify fundable adaptive management tasks.

V.D. Monitoring and Data Assessment

Extensive data sets will be collected and diverse analyses will be performed in the course of implementing monitoring and data assessment under this AMP. Contemporary scientific standards, guidelines, and protocols will followed for all study design, data collection, and analysis. Furthermore, monitoring and data assessment methodologies will be standardized to the maximum extent possible with Central Valley-wide monitoring and research efforts including CAMP, CMARP, and EPA protocols.

During the course of AMP implementation, circumstances may arise that suggest changes to existing monitoring and data assessment approaches. These may include the need to refine existing approaches, budget shortfalls, emergencies, or the identification of unanticipated monitoring needs.

Refinements of existing approaches may be proposed by the AMTT if the AMTT identifies problems with existing approaches. If the proposed refinement to a monitoring and/or data assessment approach requires no additional funding and has no programmatic consequences, then the proposed refinement may be implemented upon a Consensus decision by the AMTT. If a proposed refinement has either funding or programmatic consequences, or was proposed in response to changes in overall management approach, then the AMPT would be required to approve the proposal by Consensus before the proposed change is implemented.

Two other circumstances may arise that would require a special proposal by the AMTT to the AMPT. If any budget shortfalls are encountered in the course of implementing adaptive management monitoring and/or data assessments, the AMTT would prepare, in a timely fashion, a special proposal to the AMPT. The AMPT would then meet to discuss, and possibly approve, either changes in funding or changes to the monitoring and data assessment approach, at either the AMPT's annual meeting or an ad hoc meeting.

Similarly, if an emergency arises that suggests urgent changes to monitoring and/or data assessment approaches, or require changes to AMP flow and/or facilities elements, the AMTT will convene an emergency meeting, diagnose the problem, and submit a special proposal to the AMPT. The AMPT would then consider convening an emergency meeting where it would discuss, and possibly approve, either changes in funding or changes to the monitoring and data assessment approach.

The AMP does not propose specific diagnostic studies, but adaptive management objectives included in the AMP do recognize the potential need for diagnostic studies to pinpoint possible shortcomings in proposed restoration actions and to assist adaptive management. Potential diagnostic studies identified in the AMP include diagnoses of potential fish barriers, possible problems at fish ladders, assessment of ramping effects on anadromous salmonids at the 0.1 foot/hour Ramping Rate, water temperature modeling, and instream flow modeling. It is possible that other diagnostic studies may be required during the term of this plan. If the AMTT determines that any diagnostic study is needed to refine an adaptive management approach or to determine the appropriate response to a trigger event, the AMTT will prepare a proposal for the consideration of the AMPT. No work will be initiated on diagnostic studies without the approval and direction of the AMPT.

V.E. Funds Management

All decisions about funds management will be made by the AMPT at regularly scheduled meetings formally announced to the BCWC, CALFED, any person requesting such notification, and the public following the protocols listed herein. All Parties of the AMPT will jointly and aggressively pursue additional sources of funds at times when funding needs can be predetermined. The AMPT will work to conserve the CALFED Monitoring Fund to be used primarily as an emergency funding mechanism. Disbursement of money from this fund will be allocated evenly over the term of the

AMP, with a budget of approximately $50,000 available per year to meet emergency needs. The balance of the fund is intended to provide a prudent reserve for unanticipated monitoring/emergencies.

V.F. Dispute Resolution

The MOU provides for a dispute resolution procedure that applies in the event any one of the Parties believes there is an issue regarding the interpretation of, or compliance with, any provision of the MOU including this AMP (other than an issue involving determining protocols for funding prescribed instream flow release increases utilizing the WAF or the AMF[100]), or to resolve failure to reach consensus. Disputes involving protocols for funding prescribed instream flow release increases utilizing the WAF or the AMF[101] will be addressed later in this section. The following dispute resolution process conducted to resolve a dispute about one or more adaptive management elements[102] is in no way intended to alter or terminate the obligations of the Parties to carry out any other adaptive management element identified within this AMP which is not specifically in dispute. The disputing Parties agree to devote such time, resources, and attention to the Adaptive Management process as needed to attempt to resolve the dispute at the earliest time possible.

V.F.1. Disputing Party—Licensee

In the event that such an issue arises, where the Licensee is the disputing Party, the Licensee shall provide written notice of that issue to each of the other Parties. The Parties will then meet within 30 days of the written notice in an effort to resolve the issue. If resolution is not achieved within 14 days of the meeting, Licensee and the Resource Agencies (collectively) will each choose a person, and together, those two persons will choose a single third party who will act as mediator. Choosing a mediator is the sole role of both individuals. The Licensee and Resource Agencies will bear the cost, respectively, of the person they chose to select the mediator. Licensee and the Resource Agencies shall make their respective choice within 14 days from the date of any determination that resolution has not been achieved, and the third-party mediator shall be chosen no later than 45 days from such date of determination that resolution has not been achieved. The third-party mediator shall mediate the dispute during the next 60 days after their selection. The cost of the mediator shall be born equally by the Licensee and Resource Agencies. Any of these times may be extended or shortened by mutual agreement of the Licensee and Resource Agencies or as necessary to conform to the procedure of an agency or other entity with jurisdiction over the dispute. If resolution through non-binding mediation is still not achieved, the Resource Agencies and Licensee shall petition FERC to resolve the subject dispute for those actions within FERC's jurisdiction. Any such petition shall include the administrative record of the mediation process. Resource Agencies and Licensee will be responsible for assuming their respective costs for any

[100] MOU 14.0
[101] MOU 14.0
[102] Adaptive management elements include but are not limited to objectives, monitoring and data assessment approaches, trigger events, responses, end points, or roles and responsibilities.

such FERC process. For those issues falling outside the scope of FERC's jurisdiction, where any one of the Parties fails to achieve resolution through the dispute resolution process described above, then any one of the Parties may seek any available appropriate administrative and/or judicial remedies.[103]

V.F.2. Disputing Party—Resource Agency

In the event that such an issue arises in which one of the Resource Agencies is the disputing Party, the disputing Resource Agency shall provide written notice of that issue to each of the other Parties. The Parties will then meet within 30 days of the written notice in an effort to resolve the issue. If resolution is not achieved within 14 days of the meeting, the disputing Resource Agency and the other Parties (collectively) will each choose a person, and together, those two persons will choose a single third party who will act as mediator. Choosing a mediator is the sole role of both individuals. The disputing Resource Agency and other Parties will bear the cost, respectively, of the person they chose to select the mediator. The disputing Resource Agency and other Parties shall make their respective choice within 14 days from the date of any determination that resolution has not been achieved, and the third-party mediator shall be chosen no later than 45 days from such date of determination that resolution has not been achieved. The third-party mediator shall mediate the dispute during the next 60 days after their selection. The cost of the mediator shall be born equally by the disputing Resource Agency and other Parties. Any of these times may be extended or shortened by mutual agreement of the disputing Resource Agency and other Parties or as necessary to conform to the procedure of an agency or other entity with jurisdiction over the dispute. If resolution through non-binding mediation is still not achieved, the disputing Resource Agency and other Parties shall petition FERC to resolve the subject dispute for those actions within FERC's jurisdiction. Any such petition shall include the administrative record of the mediation process. The disputing Resource Agency and other Parties will be responsible for assuming their respective costs for any such FERC process. For those issues falling outside the scope of FERC's jurisdiction, where any one of the Parties fails to achieve resolution through the dispute resolution process described above, then any one of the Parties may seek any available appropriate administrative and/or judicial remedies.[104]

V.F.3. Water Acquisition Fund

If Consensus regarding flow changes is not achieved by the AMTT or AMPT, Licensee and the Resource Agencies (collectively), each will choose a person, and together those two persons will choose a single third party who will act as mediator. Each Party shall make its choice within 14 days from the date of any determination that Consensus has not been achieved, and the third-party mediator shall be chosen by those Parties no later than 45 days from such date of determination that Consensus has not been achieved. These times may be extended by mutual agreement of the Resources Agencies

[103] MOU 14.0
[104] MOU 14.0

and Licensee. If Consensus through mediation is still not achieved, the Resource Agencies and Licensee reserve their right to petition FERC to resolve the subject action. Resource Agencies and Licensee will be responsible for assuming their respective costs for any FERC process.

However, in the interim, instream flow releases determined to be necessary by the Resource Agencies through the aforementioned protocols will be provided by Licensee until there is either Consensus or FERC approval of the additional instream flow releases. WAF moneys shall be used to implement consensually agreed-to or FERC-approved actions and interim actions that have been taken pending FERC action.[105]

V.F.4. Adaptive Management Fund

For disputes arising regarding the funding of prescribed instream flow increases, the protocols will be the same as for the WAF described above. For disputes arising regarding funding facility modifications, the protocols will the same as for the WAF described above, with two exceptions: (1) no interim action will be implemented prior to any required FERC approval of a license amendment or other necessary action by FERC; and (2) for all actions resolved by FERC, in which Licensee is in the minority opinion (opposing a proposed action expenditure), the AMF will contribute 60 percent of any resulting facility modification cost; in the case of Licensee being in the majority opinion (in support of a proposed action expenditure), the AMF will contribute 100 percent of any resulting facility modification cost.

[105] MOU 9.2.A.3

VI. APPENDIX LISTING AMP MONITORING ACTIVITIES

Appendix Table 1. Adaptive Management monitoring field studies and analysis.

Adaptive Management Monitoring Tasks	Task Type	Objective	Responsibility	Timeline	Estimated Annual Cost
Estimate adult and jack population sizes using Coleman barrier weir.	field study	POP-1, POP-2, POP-3, POP-4	Resource Agencies	13 – 16 years minimum	**A** $50,000
– Compare 3 year-running average CRR with expected CRR when populations allow	analysis	POP-2, POP-3, POP-4	Resource Agencies	13 – 16 years minimum	included in A
– Evaluate CRR trends in light of limiting factors in the Sacramento River system	analysis	POP-2, POP-3	Resource Agencies	13 – 16 years minimum	included in A
– Compare CRR to Reference Watersheds	analysis	POP-2, POP-3	Resource Agencies	13 – 16 years minimum	included in A
– Compare CRR 10-year trend to CRR value of 1.0	analysis	POP-4	Resource Agencies	Term of AMP	included in A
Count adult and jack anadromous salmonids using video and electronic methods at ladders	field study	PASS-1	Licensee[106]	3 years or longer per AMP protocols	proprietary information
Estimate adult and jack anadromous salmonid sub-population sizes and distribution by reach using counting facilities at new fish ladders, after PASS-1 is done.	field study	POP-1	Resource Agencies[106]	After Licensee's responsibility ends until no longer needed	$30,000
Estimate juvenile production when adult populations are large enough to produce detectable numbers of outmigrants	field study	POP-1, POP-2, POP-3, POP-4	Resource Agencies	Term of AMP	**B** $250,000
– Compare juvenile production to expected production from previous spawners and ecological factors	analysis	POP-1	Resource Agencies	Term of AMP	included in B
– Compare juvenile production to production observed in Reference Watersheds	analysis	POP-1	Resource Agencies	Term of AMP	included in B
Estimate pre-project juvenile production	field study	POP-1	Resource Agencies	1998-2002	$250,000

[106] Pursuant to the MOU as explained in Passage Objective 1 and the Facilities Monitoring Plan, the Licensee is expected to operate video and electronic counting equipment to count adult and jack anadromous salmonids for the first three years, or longer per AMP protocols, after the transfer of facilities from USBR to PG&E. The Resource Agencies will take over these fish counting responsibilities to satisfy Population Objective 1 at the end of the Licensee's obligation.

Adaptive Management Monitoring Tasks	Task Type	Objective	Responsibility	Timeline	Estimated Annual Cost
Estimate juvenile production at the terminus of each fork when adult populations are large enough to produce detectable numbers of outmigrants	field study	POP-1	Resource Agencies	5 years, 2002-2007	$100,000
Estimate adult and jack distribution using carcass counts, snorkel surveys, and /or redd surveys	field study	POP-1, POP-2, POP-3, POP-4, PASS-1, PASS-3	Resource Agencies	Term of AMP	**C** $155,000
– Evaluate physical and biological habitat conditions for each reach	field study	POP-1	Resource Agencies	Term of AMP	included in C
– Observe and record habitat use, and compare observed habitat use to expected habitat use	field study	HAB-1	Resource Agencies	Term of AMP	included in C
– Gauge salmon or steelhead response to tailrace leaks or discharge of water	field study	HAB-3	Resource Agencies	Term of AMP	included in C
– Monitor Ramping Rates and threshold flow levels for effects on stranding or isolating	field study	HAB-4	Resource Agencies	During scheduled outages 2002-2007	included in C
– Monitor fish stranding	field study	HAB-4	Resource Agencies	Term of AMP	included in C
– Monitor natural flow fluctuations for affects on stranding and isolating	field study	HAB-4	Resource Agencies	Conducted in 2000-2007	included in C
– Compare stranding and isolating effects of natural flow fluctuations and project induced ramping	analysis	HAB-4	Resource Agencies	Completed 2007	included in C
– Inspect potential barriers during annual surveys	field study	PASS-3	Resource Agencies	Term of AMP	included in C
– Compare spawner distribution relative to suspected barriers	analysis	PASS-3	Resource Agencies	Term of AMP	included in C
– Compare ladder counts with spawning distribution and predicted habitat use.	analysis	PASS-1, POP-1	Resource Agencies	Term of AMP	Included in C
– Compare observed spawner distribution relative to expected spawner distribution for a particular species	analysis	PASS-3	Resource Agencies	Term of AMP	included in C
– Document fish injury caused by fish ladders	field study	PASS-1	Resource Agencies	Term of AMP	included in C
– Observe adult congregations below dam and compare to ladder counts	field study	PASS-1	Resource Agencies	Term of AMP	included in C

Adaptive Management Monitoring Tasks	Task Type	Objective	Responsibility	Timeline	Estimated Annual Cost
Use Contemporary methodologies that consider flow regime to identify actual barriers	field study	PASS-3	Resource Agencies	contingent on need	contingent on need
Diagnose threshold flow on the North Fork at which Ramping Rates differ from 0.1 foot/hour	field study	HAB-4	Resource Agencies	During scheduled outages 2001-2003	$10,000
Monitor longitudinal water temperature regime	field study	HAB-2, POP-1	Resource Agencies	5 years minimum	$20,000
Monitor cold water from Bluff Springs	field study	HAB-2	Resource Agencies	Term of AMP	none
Monitor water temperature at target points within stream	field study	HAB-2, POP-1	Resource Agencies	Term of AMP	$5,000
Monitor climatic conditions	field study	HAB-2, POP-1	Resource Agencies	5 years minimum	$13,000 first year and $3,000 thereafter
Monitor leaks and discharge for indications that it alters the South Fork thermal or chemical regime	field study	HAB-3	Licensee	Term of AMP	proprietary information
Compare leakage or discharge to stream flow rates	analysis	HAB-3	Licensee	Term of AMP	proprietary information
Monitor hydraulic parameters at fish ladders for Fail-Safe capabilities	field study	PASS-1	Licensee	Term of AMP	proprietary information
Measure and compare hydraulic parameters at fish screens for calculated and measured diversion rates	field study	PASS-2	Licensee	Measure as relevant throughout the OMP	proprietary information
Monitor key hydraulic parameters at fish screens for Fail-Safe capabilities	field study	PASS-2	Licensee	Continuously throughout AMP	proprietary information
Observe canals for entrainment during other activities and when dewatered	field study	PASS-2	Licensee	Continuously throughout AMP	proprietary information

Appendix Table 2. Possible adaptive management diagnostic analysis and field studies (the need for these will be determined through AMP monitoring and protocols)

Possible Adaptive Management Diagnostic Studies	Task Type	Objective	Responsibility	Timeline	Estimated Annual Cost
Water temperature modeling	diagnostic analysis	HAB-2	Resource Agencies	5 years	unknown
Apply advancements in flow/habitat relationships	diagnostic analysis	HAB-1	Resource Agencies, Licensee	To be determined	unknown
Study fish passage at ladders with tagged test fish	diagnostic field study	PASS-1	Resource Agencies	Term of AMP	unknown
Monitor fallback with tagged test fish	diagnostic field study	PASS-1	Resource Agencies	Term of AMP	unknown
Conduct a diagnostic study of ramping thresholds in the North Fork to determine the flow level above which ramping rates may differ from 0.1 foot/hour.	diagnostic field study	HAB-4	Resource Agencies	Term of AMP	unknown

VII. APPENDIX OF PROPOSED FERC LICENSE ARTICLES AFFECTED BY ADAPTIVE MANAGEMENT

This appendix will list the text of proposed FERC license articles that pertain to FERC Project No. 1121 facilities or operations that will be affected by provisions in the AMP. Contents of this appendix will be prepared in time to be included in the Draft EIR/EIS and draft license amendment.

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