Chapter 2

Purpose and Need, Project Description, and Project Background

This chapter states the purpose of and need for the Restoration Project, describes the Restoration Project, and provides Restoration Project background information.

NEPA requires that an EIS include the underlying purpose and need for the proposed action because this statement explains why the federal agency and project proponents are undertaking the proposed action and what objectives they intend to achieve. The statement of purpose and need is also used to determine the appropriate range of alternatives to be evaluated in the EIS. CEQA requires that an EIR include the project objectives because the statement of objectives is important in helping the lead agency develop a reasonable range of alternatives to evaluate in the EIR and will aid the decision makers in preparing findings and a statement of overriding considerations, if necessary.

Background information includes a timeline and summary of events leading to the development of the Restoration Project, discussion of the significance of Battle Creek, development of a Memorandum of Understanding (MOU), and discussion of the ecological restoration and energy production considerations associated with the Restoration Project.

Purpose and Need

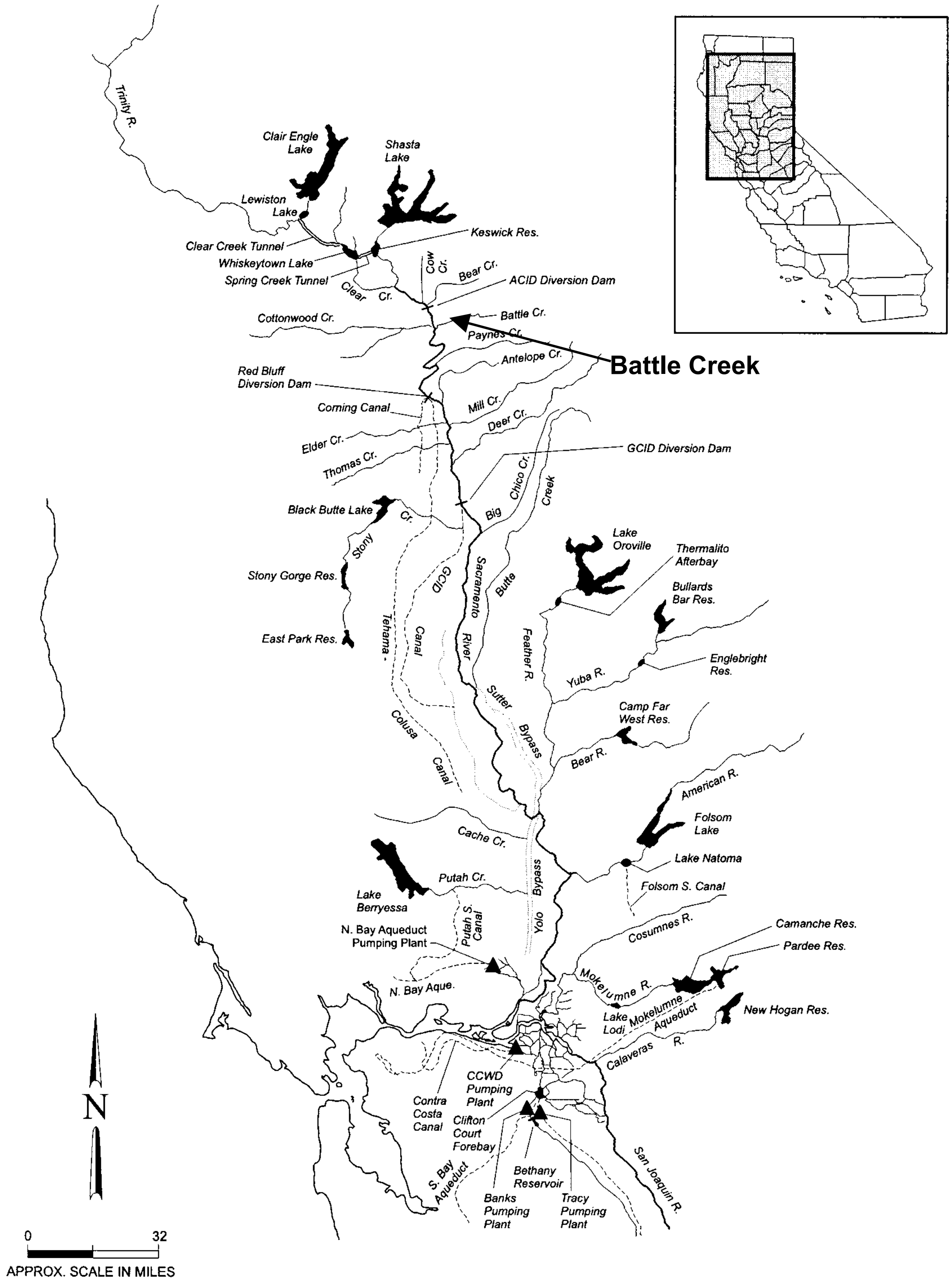
Within the past century, anadromous salmonid fish species in the Sacramento River system have declined because of a number of factors, including the loss and degradation of spawning habitat as a result of changes in hydrologic regimes caused by water management for flood control, irrigation, and hydropower production. In order to preserve and enhance current salmonid populations within the Sacramento River system, habitat restoration efforts are needed. An opportunity to restore uniquely valuable habitat exists in Battle Creek, a tributary to the Sacramento River.

The purpose of the Restoration Project is to restore approximately 42 miles of habitat in Battle Creek and an additional 6 miles of habitat in its tributaries while minimizing the loss of clean and renewable energy produced by the Hydroelectric Project.

The Restoration Project will be accomplished through the modification of Hydroelectric Project facilities and operations, including instream flow releases. Habitat restoration would enable safe passage for naturally produced salmonids and would facilitate their growth and recovery in the Sacramento River and its tributaries. These salmonids include Central Valley spring-run chinook salmon, state- and federally listed as threatened; Sacramento River winter-run chinook salmon, state- and federally listed as endangered; and Central Valley steelhead, federally listed as threatened.

The timely restoration of a drought-resistant, spring-fed system like Battle Creek is especially important to species such as winter-run and spring-run chinook and steelhead, which are dependant on cool water stream habitats. Winter-run chinook is actually obligated to habitats like Battle Creek that have reaches kept constantly cool year-round by springs. Historically, winter-run Chinook salmon populations occurred in the creek, but at present, the only significant population of winter-run chinook occurs in the main stem of the Sacramento River below Shasta Dam (Yoshiyama et. al. 1998). This section is kept cool by releases from the deepest portion of the reservoir. However, periods of extended drought exhaust this cold water reserve, leaving the fish susceptible to reproductive failure. The current population is at risk of total reproductive failure due to lethal water temperatures at least 2 years out of every 100 and partial reproductive failure 1 year out of every 10 (U.S. Bureau of Reclamation 1991). Because it is inevitable that serious drought conditions will again affect Shasta Lake, it is necessary to have drought resistant refugia available in the upper Sacramento River system for populations sensitive to drought conditions like winter-run and spring-run chinook.

The Restoration Project facilitates a timely restoration of the stream compared with waiting until 2026 for the expiration of the existing FERC license of the Battle Creek Hydroelectric project. One of the most valuable aspects of hydropower is that it is renewable through annual snowmelt and rainfall. Hydropower’s fuel, water, is replenished with precipitation. Unlike fossil fuel technologies, hydropower's fuel is reused because it is not consumed in the production of electricity. Hydropower produces no greenhouse gases or other air pollutants. The use of hydropower makes it possible to avoid the additional burning of natural gas or other fossil fuels, which in turn avoids the release of the following air emissions: carbon dioxide, nitrogen oxide, carbon monoxide, and the production of ozone or smog.



Source: Reclamation and USFWS 1999

Figure 2-1
Sacramento River Basin

Project Objectives

Specific project objectives were developed to expand on the purposes of the Restoration Project and to help develop project alternatives. A variety of alternatives that propose various combinations of steps to be taken to improve fish habitat and fish passage (e.g., dam removal, flow increases) are described in this document. The project objectives are consistent with recovery plans for listed anadromous fish species. The alternatives evaluated in this EIS/EIR are consistent with the following specific objectives:

- restore self-sustaining populations of chinook salmon and steelhead by restoring their habitat in the Battle Creek watershed and access to it through a voluntary partnership with state and federal agencies, a third party donor(s), and PG&E;
- establish instream flow releases that restore self-sustaining populations of chinook salmon and steelhead;
- remove selected dams at key locations in the watershed where the hydroelectric values were marginal due to increased instream flow;
- dedicate water diversion rights for instream purposes at dam removal sites;
- construct tailrace connectors and install fail-safe fish screens and fish ladders to provide increased certainty about restoration components;
- restore stream function by structural improvements in the transbasin diversion to provide a stable habitat and guard against false attraction of anadromous fish away from their migratory destinations;
- avoid Restoration Project impacts on species of wildlife and native plants and their habitats to the extent practicable, minimize impacts that are unavoidable, and restore or compensate for impacts;
- minimize loss of clean and renewable energy produced by the Battle Creek Hydroelectric Project;
- implement restoration activities in a timely manner;
- develop and implement a long-term adaptive management plan with dedicated funding sources to ensure the continued success of restoration efforts; and
- avoid impacts on other established water users/third parties.

The Restoration Project is a proactive, cooperative undertaking among the public, interested parties, the BCWG, BCWC, state and federal agencies, and PG&E to help restore the anadromous fishery in the Sacramento River watershed, where funding and restoration potential are uniquely promising.

Project Description

The Restoration Project consists of the portion of the Hydroelectric Project below the natural fish barriers (Figure 2-2). The upper project limit on North Fork Battle Creek is the absolute natural fish barrier above North Battle Creek Feeder Diversion Dam, 14 miles upstream of the confluence. The upper project limit on South Fork Battle Creek is the natural fish barrier above South Diversion Dam. The lower project limit is the confluence of the Coleman Powerhouse tailrace channel and the mainstem of Battle Creek.

Restoration efforts would occur at Hydroelectric Project sites along North Fork and South Fork Battle Creek and their tributaries, including North Battle Creek Feeder, Eagle Canyon, Wildcat, Coleman, Lower Ripley Creek Feeder, Inskip, Soap Creek Feeder, and South Diversion Dams; the Eagle Canyon, Wildcat, Inskip, and South Canals; and the Inskip and South Powerhouses. Complete descriptions of each site, as well as each project alternative, are in Chapter 3 of this EIS/EIR.

The Restoration Project provides the following modifications to the Hydroelectric Project that would achieve the restoration of ecological processes important to anadromous fish.

- Adjustments to Hydroelectric Project operations, including allowing cold spring water to reach natural stream channels, decreasing the amount of water diverted from streams, and decreasing the rate and manner in which water is withdrawn from the stream and returned to the canals and powerhouses following outages.
- Modification of facilities such as fish ladders, fish screens and bypass facilities, diversion dams, and canals and powerhouse discharge facilities.
- Changes in the approach used to manage the Hydroelectric Project to balance hydroelectric energy production with habitat needs, using ecosystem-based management that protects and enhances fish and wildlife resources and other environmental values using adaptive management, reliable facilities, and water rights transfers, among other strategies.

The Restoration Project intends to restore the ecological processes that would allow the recovery of steelhead and chinook salmon populations in Battle Creek and minimize the loss of clean and renewable electricity through modifications to the Hydroelectric Project. The ecological processes in Battle Creek that have been affected to varying degrees by Hydroelectric Project facilities and operations include:

- physical processes that operate within the stream channels, such as streamflow effects on aquatic habitat, coarse sediment routing, and maintenance of subsurface water levels in riparian habitat;
- heating and cooling processes in the streams; and

- biological processes such as fish migration, homing and straying of anadromous salmonids, and fish spawning and rearing.

The alteration of these processes has affected steelhead and salmon populations in a number of ways, including:

- limiting the amount of habitat available for spawning and rearing,
- limiting access to available habitat, and
- causing warmer water temperature above levels tolerable to sensitive life stages of salmon and steelhead and altering the stability of the temperature regime on the South Fork by making the powerhouse operations such a dominant dynamic influence on temperature.

Restoration of these ecological processes is expected to facilitate the recovery of steelhead and winter-, spring-, fall-, and late fall–run chinook salmon because it would provide:

- improved amounts of otherwise production-limiting spawning and rearing habitat;
- unimpeded access of anadromous salmonids to their preferred habitats,
- instream water temperature profiles that are improved and approach the magnitude and thermal continuity of those conditions under which anadromous fish populations have evolved in Battle Creek, and
- unambiguous environmental cues used by salmon and steelhead to navigate that reflect the magnitude and distribution of those conditions under which anadromous fish populations have evolved in Battle Creek.

Project Background

Figure 2-3 presents a timeline and summary of events leading to the development of the Restoration Project. The Restoration Project is supported by and consistent with the following acts, programs, and plans:

- Central Valley Project Improvement Act (CVPIA) (Title 34 of Public Law 102-75, 1992) Anadromous Fish Restoration Program.
- California State Salmon, Steelhead Trout, and Anadromous Fisheries Program Act (California Senate Bill 2261, 1990).
- CALFED Bay-Delta Ecosystem Restoration Program Plan (CALFED 2000b).
- Upper Sacramento River Fisheries and Riparian Habitat Management Plan (California Senate Bill 1086, 1989). *
- Central Valley Salmon and Steelhead Restoration and Enhancement Plan, prepared by the DFG (1990a). *

- Steelhead Restoration Plan and Management Plan for California, prepared by the DFG (1990b). *
- Restoring Central Valley Streams: A Plan for Action, prepared by the DFG (1993b). *
- Proposed Recovery Plan for Sacramento River Winter-Run Chinook Salmon, prepared by NOAA Fisheries (1997b).
- Actions to Restore Central Valley Spring-Run Chinook Salmon, prepared by the DFG (1996f).

The following information is intended to provide an understanding of why Battle Creek is a rare and valuable opportunity to effect significant habitat restoration. It also provides the key considerations used to develop the comprehensive plan identified as the Restoration Project. Further, it provides background on particular attributes of Battle Creek, biological factors pertinent to the anadromous fishery restoration, renewable energy production considerations, and other important aspects associated with the Restoration Project.

Battle Creek Significance

In recent decades, California has experienced a statewide decline in its salmon and steelhead populations, particularly wild stocks. The decline has been attributed to multiple causes, most notably the development of federal, state, municipal, and private water projects to meet growing societal demands. In the Sacramento River drainage, large projects that provide domestic water supplies, irrigation, flood control, and power generation have in some cases irretrievably blocked anadromous fish access to natal streams. Actions to offset permanent stream habitat loss, such as establishing hatchery facilities, have maintained adequate stocks of some species. However, these actions have not been able to mitigate fully the loss of habitat used by species such as winter-run chinook salmon, spring-run chinook salmon, and steelhead that evolved life strategies to make use of the headwaters of major river systems in the Central Valley where natural barriers were absent.

The continuing decline in numbers of several species of chinook salmon and steelhead has resulted in their listing under ESA and CESA as threatened or endangered. Before the species' listing, resource agencies and interest groups were aware of the declines and had initiated efforts aimed at arresting the decline and rebuilding these populations to levels above thresholds of concern set by ESA and CESA. While a number of those efforts broadly address the issues, specific actions significant to the restoration of Battle Creek include the Upper Sacramento River Fisheries and Riparian Habitat Management Plan, the CVPIA, and the ERP of the CALFED Bay-Delta Accord.

* qualified as a comprehensive plan under section 10(a) (2) (A) of the Federal Power Act (FPA)

A common strategy to arrest the decline of the various anadromous salmonid stocks has been to recognize that some habitat has been permanently lost and to focus on finding other suitable habitat that is, or could be, ecologically equivalent, accessible to these species, and that could be restored to offset the permanent losses. In pursuit of that strategy, the use of partnerships among governmental agencies, stakeholders, and the private sector is viewed as the most efficacious and timely means to identify these restoration opportunities and share the costs necessary to bring them to fruition. This approach is the genesis of Battle Creek being identified as an extraordinary opportunity and the initiation of a partnership to effect a comprehensive restoration project for the watershed.

When compared to other upper Sacramento River tributaries, Battle Creek offers an extraordinary restoration opportunity because of its geology, hydrology, habitat suitability for several anadromous species, historical water allocation, and land uses compatible with a restored stream environment. The geology of the Battle Creek watershed, located at the southern end of the Cascades, is primarily volcanic in nature (Figure 2-4). This type of terrain provides deeply incised, shaded, cool stream corridors. Its ruggedness limits the extent of human activities that typically occur around more readily accessible streams. While substantial quantities of water have been diverted for hydroelectric production since the early 1900s, other activities that could have potentially detrimental impacts on the stream and surrounding riparian environment have been effectively precluded by the nature of the terrain.

Perhaps the most important feature of Battle Creek supporting its potential for restoration is its hydrology, which results from the volcanic nature of the drainage. Seasonal precipitation does not rapidly run off the watershed as with streams situated farther south in the Sierra Nevada. Instead, a large portion of the annual water charge percolates through the underlying volcanic strata and emerges throughout the watercourse as cold springs that ensure a relatively high and stable base flow throughout the year. The naturally regulated stable base flow and cold water temperature offer drought resistance not found elsewhere in the present range of anadromous fish and ensure that the watershed can provide refugia for species when they may become distressed in other watersheds more vulnerable to drought conditions. These hydrologic and geologic attributes of Battle Creek are representative of streams permanently blocked by water development projects. In terms of a restoration opportunity, Battle Creek offers the natural habitat conditions conducive to the recovery of species no longer able to access all of their ancestral streams.

In addition to the nature of Battle Creek's hydrology, its geomorphic processes are relatively undisturbed. No large onstream reservoirs impede upstream and outmigration of anadromous fish. Lack of such storage features and the relatively small capacity of the hydroelectric diversions allow seasonally high spill flows to pass through the watershed, providing the necessary flows for gravel and stream channel maintenance in virtually the same manner as has occurred historically. This natural, seasonal rejuvenation of the streambed has maintained Battle Creek's relatively pristine condition, another important factor in its high potential for successful restoration

The suitability of Battle Creek to support the recovery of several anadromous species is exhibited in the type of habitat it offers and the historical use by the listed, naturally occurring anadromous salmonid species in the watershed. Despite the development that has occurred since the early 1900s and the fragmented habitat that exists, remnant populations are still present in the watershed. It is the only upper Sacramento River tributary that has the potential to support winter-run chinook salmon.

The demonstrated persistence of the various anadromous species inhabiting Battle Creek is a key factor in concluding that wild populations could again flourish if habitat improvements are made to better support the various fish life stages. Establishment of an assemblage of several recovered species in Battle Creek would contribute significantly to reversal of the decline of these populations as a whole.

The private ownership of lands bordering Battle Creek is another attribute that would discourage potential human impacts on recovered species. Existing land uses and relatively low consumptive water use are compatible with stream restoration. The terrain itself also precludes development that could have adverse effects. The scale of the Hydroelectric Project is such that modifications to its facilities and operation can be made to meet habitat improvement goals without excessive loss of this renewable resource that is ever more critical to California.

Development of a Memorandum of Understanding

The compatibility of continuing existing land uses and the limited impact on the Hydroelectric Project have facilitated the formation of partnerships supportive of restoration activities throughout the watershed. In particular, the formal partnership among federal and state agencies and PG&E to modify and reoperate the Hydroelectric Project is the key element in the restoration of stream reaches. The collaboration among these partners and the other stakeholders has been the hallmark in the development of the widely supported Restoration Project involving the hydroelectric facilities.

In early 1999 this cooperative effort led to the signing of an Agreement in Principle by Reclamation, NOAA Fisheries, USFWS, DFG, and PG&E to pursue a restoration project for Battle Creek (Appendix D). In mid-1999, the parties signed a detailed, formal MOU in conformance with the Agreement in Principle, allowing the release of $28 million in CALFED funding for the agencies' responsibilities in the partnership. Since the signing of the MOU in 1999, costs have increased to $62 million.[1]

The MOU called for contributions from PG&E in the form of forgone energy generation, pursuit of an amendment to the Hydroelectric Project's FERC

[1] Additional CALFED funding is being sought. If additional funds are not made available for physical implementation of the project, it will be suspended until said additional funds are made available.

license, transfers of certain water rights to the DFG, and a variety of other requirements. Flow determinations for the Restoration Project used in the MOU were initially developed by the BCWG biological technical team. The MOU also provided for the partial funding of adaptive management through a separate third-party funding agreement for an additional $3 million. The plan discussed in the MOU is the Proposed Action alternative, which is being evaluated along with other Action Alternatives in this EIS/EIR.

Social Context

The Restoration Project has been supported in the community and is consistent and compatible with other related restoration initiatives in the watershed. The BCWG has served as a catalyst to explore various actions to carry forth the Restoration Project. The BCWC supports the Restoration Project, pending the appropriate consideration and resolution of other watershed actions, notably, the operation of Coleman National Fish Hatchery.

In addition to the Restoration Project, restoration actions in the watershed include the evaluation of the fish hatchery's operations to ensure their compatibility with recovery efforts for wild anadromous species in Battle Creek above the hatchery; the acquisition of conservation easements along the watershed stream corridors from willing landowners; the development of a Battle Creek Watershed Community Strategy (Appendix B) through CALFED funding; and the watershed restoration measures identified in the Anadromous Fish Restoration Plan (AFRP) associated with the CVPIA. In addition, the Draft Greater Battle Creek Watershed Adaptive Management Framework and Organization has been developed by the stakeholders of the BCWG (Appendix B). The BCWG stakeholders have also developed a draft MOU, the purpose of which is to coordinate the planning, implementation, and evaluation of all fisheries, restoration, and watershed projects among public agencies, nonprofit organizations, and private landowners within the Greater Battle Creek (Appendix B). The stakeholders of the BCWG have also voiced their concerns regarding Battle Creek watershed activities through written correspondence with various agencies (Appendix B).

Coordination of Restoration Project measures with broader local watershed management initiatives and those of a basinwide nature would ensure that restoration of the anadromous fishery in Battle Creek is maintained and would contribute significantly to population recovery goals.

Ecological Restoration Considerations

Consistent with having an ecosystem approach to conservation of salmon and steelhead, the essential goal of salmonid restoration in Battle Creek is to reconnect and improve the important habitat values in the stream system, especially the drought-resistant refugia found in spring-fed reaches. This would allow for the expansion of existing populations of spring-run and winter-run chinook salmon and steelhead native to the upper Sacramento River Basin (Spence et al. 1996). The most important element of this approach is achieving an adequate minimum level of instream flows that would meet the various life stage needs of the anadromous species. Priority should also be given to the release of water from available coldwater springs into the natural channels in preference to release from surface water sources. With partnerships coalescing, stakeholders have pursued an evaluation of habitat needs in Battle Creek to restore the anadromous fishery through various forums. This evaluation focused on minimum instream flow requirements, release of cold spring water to adjacent stream sections, management of those instream flows, upstream and downstream fish passage, restoration of stream function to mimic the natural hydrography in its undeveloped state, and adaptive management to monitor and refine restoration actions. In addition, the availability of significant public funding through the CALFED ERP has allowed for design of restoration project facilities and flows expected to have biological performance exceeding those typically attained in the normal FERC process.

Instream Flow

Because the stream contains a diversity of species and their life stages, substantial effort was directed toward identifying which stream reaches were best suited to the recovery of a particular species. Minimum instream flow schedules were then developed to best serve their life stages through the year.

Recognizing the importance of instream flows for restoration of Battle Creek anadromous fisheries, the USFWS in coordination with state and federal agencies, stakeholders, and interested parties, identified preliminary increases in minimum flows. The preliminary increased minimum flows were developed pursuant to the CVPIA's AFRP and were included in the Revised Draft Restoration Plan for the AFRP (USFWS 1997b). The AFRP's prescription for increased flows considered relationships between streamflow and the physical habitat available to various life stages of anadromous fish for several reaches of Battle Creek (Thomas R. Payne and Associates 1998a) with the objective of providing adequate holding, spawning, and rearing habitat. The AFRP–developed minimum flows were offered as indicators of magnitude needed to optimize anadromous fish production, subject to revision after additional analysis (USFWS 1995a).

In general, these minimum flows were characterized as flows capable of developing 70–75% of the life stage that is potentially most limiting to a population's production in a given stream reach. The AFRP flow schedule did not include releases from the major cold spring water–bearing formations at the Eagle Canyon and Bluff Springs.

Following additional analysis of instream flow data, the BCWG's biological technical team, composed of experts from resource agencies, PG&E, and stakeholders, increased the minimum flows prescribed by the AFRP and incorporated them into the Restoration Project MOU. A substantial body of work directed at quantifying stream habitat, gravel recruitment, passage at natural barriers, and water temperatures was completed in 1998 by Thomas R. Payne and Associates under contract to the DFG with assistance of a technical team composed of PG&E, USFWS, and other participants in the SB 1086 Program (Thomas R. Payne and Associates 1998a, 1998b, 1998c). The information contained in one of those reports, *A 1998 Instream Flow Study: 1 of 8 Components* (Thomas R. Payne and Associates 1998a), formed the scientific basis for evaluating instream flow needs.

The biological technical team also assessed species' needs by using a limiting life stage analysis to determine appropriate minimum flows (Kier Associates 1999b). Simply stated, this approach looks at the potential habitat availability in a particular stream reach and the related flows required to support different life stages such as adult spawning, fry development, and juvenile rearing. The life stage found to be most limiting to fish production in a given stream reach is used to identify the optimal instream flow conditions for that stream, thereby maximizing potential production. The focus of the flow prescription for the limiting life stage was to provide approximately 95% of the estimated habitat that could be created by flow increases. Typically, the two most common life stages competing as a limiting factor were spawning habitat and juvenile rearing habitat. In some reaches, spawning habitat is the limiting factor for production, and in others, juvenile rearing habitat limits production.

In addition to differing life stage flow needs for a single species in a given stream reach, the likely presence of other species added complexity to determining appropriate flows (Kier Associates 1999b). During certain periods of the year, the needs of competing species can conflict. Some accommodation for competing life stages is possible through short-term minimum flow adjustments during transition periods. However, this accommodation involves a compromise between species and cannot be optimal for any species' life stage. Where unavoidable habitat need conflicts occurred, the biological technical team prioritized species based on the availability of their associated habitat in the watershed. This criterion was used to meet species' needs for natural reproduction and to effect their recovery. Because of scarcity of habitat, winter-run chinook salmon was the highest priority followed by spring-run chinook salmon, steelhead, late fall–run chinook salmon, and fall-run chinook salmon.

The greatest divergence of seasonal flow needs occurs between steelhead and the various species of chinook salmon. Because steelhead have greater opportunities available to them for suitable habitat elsewhere in the upper Sacramento River basin, the technical team decided to provide a less-than-optimal flow regime for steelhead. This ensures better habitat conditions for winter-run and/or spring-run chinook salmon. This view was deemed appropriate by the resource agencies, in light of the rather limited habitat opportunities available elsewhere for winter-run and spring-run chinook salmon.

Flow Management

In addition to assessing the optimal flow from a limiting–life stage perspective, the biological technical team recognized the need to manage flows effectively to address concurrent considerations (Kier Associates 1999b). An important consideration that affected the selection of an appropriate minimum flow in some stream reaches was passage over natural barriers. In some cases, ensuring this passage required elevating flows to higher values than those optimal for life stage consideration. Typically, even with this passage accommodation, the minimum flows prescribed by the biological technical team were designed to achieve 95% or more of the biologically optimal restoration flow for a potential limiting life stage.

Water temperature was also an important factor in developing the Restoration Project. The AFRP considered temperature and hydrology in prescribing its minimum instream flows; however, a temperature model for Battle Creek was not available during development of the AFRP Revised Draft Restoration Plan (USFWS 1997b). In response, the biological technical team analyzed water temperature using the SNTEMP Model applied initially by Thomas R. Payne and Associates then refined by PG&E (PG&E 2001a). The model was used primarily to determine which stream reaches might be most sensitive to temperature effects caused by changes in flow. The temperature model can also be used to determine the extent of habitat available for the various life stages under certain meteorological and water year conditions.

Rapid abnormal flow fluctuation in the natural stream channels associated with hydroelectric power system operation has the potential to adversely affect the habitat. Minimizing the occurrence of these fluctuations was addressed through ramping rate and new hydroelectric water conveyance facilities. These tools ensure that both planned maintenance activities and unanticipated power system disruptions would avoid instream flow disturbances to the extent practicable.

Passage

A key consideration in encouraging an increase in restored habitat is ensuring upstream and downstream passage beyond both natural barriers and artificial barriers such as dams. As noted previously, accommodation of natural barrier passage was addressed during the biological team's assessment of minimum instream flow requirements, primarily as a consideration for adult fish migrating upstream to their spawning and holding areas (Kier Associates 1999b). In some cases, these natural barriers would need to be modified to improve passage conditions at prescribed flows. Because the stream is a dynamic environment and floods may create new natural barriers, monitoring for these occurrences should be performed regularly. In these cases, appropriate action would need to be taken either to modify a new barrier or to adjust instream flows to improve passage.

The BCWG fish passage technical team determined that fish passage facilities at the diversion dams would be designed as state-of-the-art installations, incorporating resource agency design criteria/guidelines for ladders and screens and geometries known to provide reliable performance (Kier Associates 1999a). Particular attention in fish ladder design would be directed toward providing attraction flows through the range of instream flows needed by adult fish to move upstream. Ladder configurations known to provide reliable performance in the field also would be used. The ladders would incorporate features to allow flow adjustment during abnormally low water conditions to ensure that effective passage conditions are maintained. Protective structures to minimize the potential for damage during floods would be included. The relatively low height of the dams to be passed via a fish ladder, coupled with the conservative approach to their design, is expected to provide high passage reliability. Removal of select dams would eliminate any concerns about fish passage at those sites.

Preventing the entrainment of outmigrating juvenile fish in Hydroelectric Project water conveyance facilities would be accomplished by installing fish screens at the diversion points (Kier Associates 1999b). As with fish ladders, the fish screens would meet current applicable resource agency criteria and known reliable configurations to allow small fish to continue downstream past water diversion points. Fish screens would be designed to shut off the water diversion automatically whenever the fish screen fails to meet design or performance criteria until the fish screen is functioning again. Similar to the fish ladders, protective structures would be incorporated to prevent damage to the screens during floods.

Restoration of Stream Function

An important feature of the current Hydroelectric Project is the cross-basin transfer of North Fork Battle Creek water to two powerhouses located on South Fork Battle Creek and the subsequent discharge of water into the natural stream channel for recapture at the next downstream diversion point. This mixing of North Fork and South Fork Battle Creek water and infusion of relatively cool powerhouse discharge water at discrete locations into the stream channel deviate from naturally occurring conditions. This unusual situation could negatively affect successful species recovery by interfering with the successful migration of adult salmon and steelhead to their natal streams—a phenomenon known as *false attraction* (Kier Associates 1999b).

One aspect of false attraction is associated with the interbasin transfers of water in the stream. Migrating winter-run and spring-run salmon returning to North Fork Battle Creek may be drawn into the South Fork of Battle Creek as a result of their sensing North Fork Battle Creek water mixed with South Fork Battle Creek flow at the stream confluence. South Fork Battle Creek is considered less desirable during drought to winter-run and spring-run chinook salmon that are natal to the North Fork. North Fork Battle Creek has higher resistance to drought conditions, and it may be important to maintain the fidelity of the fish natal to this fork to ensure survival of the population during adverse conditions affecting streams elsewhere in the Sacramento River drainage. Loss of individuals to South Fork Battle Creek by false attraction at the confluence could compromise population survival during droughts. Guarding against false attraction may keep South Fork Battle Creek from becoming a drain on winter-run and spring-run chinook salmon populations produced in the North Fork, thus leaving this important refugia in the North Fork under-seeded during a drought. Specifically, should false attraction limit the rate and/or size of population growth in the North Fork, fewer returning adults would seed this refugia. The South Fork is very desirable habitat to restore in the Battle Creek watershed because it has the largest capacity to produce salmon outside of drought years, when it has limited capabilities to produce spring-run and winter-run chinook except in the higher elevation reaches.

A second aspect of false attraction has to do with powerhouses discharging relatively large amounts of cool water into the stream at their tailraces (Kier Associates 1999b). Under natural conditions, water temperatures typically become continually cooler as one moves upstream. Migrating adult fish key in on this declining temperature as they seek habitats with water temperatures conducive to successful spawning and rearing of offspring. This natural temperature profile is interrupted where powerhouse discharges enter the stream reaches on South Fork Battle Creek. These localized zones of cooler water may cause adult fish to arrest their upstream movement early and spawn in those zones. Subsequent power system outages or other disruptions that interrupt or alter the normal discharge of the cool powerhouse water could result in stream temperatures rising above maximum threshold temperatures for incubating eggs or fry. Although confined to South Fork Battle Creek, this situation is especially important because the cool natural habitat conditions needed to restore spring-run chinook salmon and steelhead are at the distant upstream reaches of this fork. Artificial water temperature phenomena that interrupt the journey of spawning adults to upstream habitat could compromise the recovery of naturally producing spring-run chinook salmon and steelhead populations in South Fork Battle Creek.

The BCWG biological technical team determined that restoration of stream function to avoid false attraction would be achieved through the construction of conveyance facilities that would avoid the introduction of North Fork Battle Creek water into South Fork Battle Creek. The mixed North Fork and South Fork Battle Creek water contained within the hydroelectric water conveyance system would enter Battle Creek about 5 miles downstream of the forks' confluence, where the waters have already naturally mixed. Tailrace connectors at South and Inskip Powerhouses and a water bypass feature at Inskip Powerhouse would convey the water to Coleman Canal in lieu of discharging it into South Fork Battle Creek. The facilities would address both the false attraction and flow fluctuation issues. The false attraction would be addressed by the isolation of North Fork Battle Creek water from South Fork Battle Creek flow.

Flow fluctuations associated with power system operations would be contained within the Hydroelectric Project's conveyance features rather than causing disruptions in the natural stream channels. The system of power plants and canals on the South Fork is subject to both planned and unplanned outages. During these outages the water that cannot be conveyed through the power plant or the canal is released to the stream at any one of a number of spill outlets either at the dam or at numerous points along the length of the canals. In general, the power system water is released as far downstream as possible to reduce the effects on the stream environment, and routine planned outages are scheduled at the high flow period. The amount of water released from the power system is up to five times the minimum amount released to the stream for fish. This addition of hundreds of cfs of water to the creek during minimum flow conditions has the potential to disrupt the stability of the stream as the power system water is added and then removed after the outage period. The stream function effects are more widespread the closer to the diversion the spill of power system waters occurs.

Adaptive Management

Recognizing that there are likely to be unanticipated influences on fishery restoration or that initial actions may not produce expected results because of unforeseen factors, adaptive management can be an important tool to monitor results and refine the actions being taken. Adaptive management is a formal, science-based, well-defined process that identifies goals, specifies parameters to be monitored, sets protocols for data assessment, proposes trigger points to initiate action, identifies actions to be taken, and continually recycles with the aim of successfully achieving restoration of the fishery. The initial restoration actions would be comprehensive and based on the best scientific information now available. The application of adaptive management principles is an important tool to continually refine those initial actions, based on subsequent acquisition of fishery response data and/or improved scientific information.

A comprehensive draft Adaptive Management Plan (Appendix D) has been developed for the Proposed Action pursuant to the MOU. This document will be dynamic and part of an evolving multi-agency team approach (see Chapter 3 for additional information on the Adaptive Management Plan). Not only does this plan meet the desired criteria for adaptive management, but it also includes dedicated funding sources, notably a sizable third party contribution and funding provided by CALFED to facilitate any additional modifications to the Restoration Project and/or the acquisition of additional water to meet instream needs determined appropriate through the plan's protocols. Similar adaptive management plans would be developed for the other action alternatives.

Power Production Considerations

To minimize the loss of clean, renewable power production from the Hydroelectric Project, careful consideration has been given to power production issues while meeting habitat needs. Key among these are instream flow requirements, maintaining existing system operating flexibility, designing new highly reliable facilities, ensuring that operating and maintenance requirements are reasonable, and achieving regulatory certainty to the extent feasible in light of the sensitivity of the anadromous species inhabiting the watershed. The following sections describe features associated with the Hydroelectric Project, including Hydroelectric Project facilities, water routing, stream diversions, water bypass provisions, facility reliability, operations and maintenance, regulatory certainty, and key elements to consider in order to maintain efficient hydroelectric operations.

Hydroelectric Project Facilities

PG&E's Hydroelectric Project was initially developed in the early 1900s (Figure 2-2). The Hydroelectric Project consists of five powerhouses (Volta 1, Volta 2, South, Inskip, and Coleman), two small upstream storage reservoirs (North Battle Creek and Macumber), three forebays (Grace, Nora, and Coleman), five diversions on North Fork Battle Creek (including the North Battle Creek Feeder, Eagle Canyon, and Wildcat), three diversions on South Fork Battle Creek (South, Inskip, and Coleman), numerous tributary and spring diversions, and a network of some 20 canals, ditches, flumes, tunnels, and pipelines.

Hydroelectric development began on Battle Creek with the construction of the Volta Powerhouse by Keswick Electric Power Company in 1901 (Upper Sacramento River Fisheries and Riparian Habitat Advisory Council (USRFRHAC) 1989). Volta was one of the earliest hydroelectric developments in northern California. The Volta Powerhouse is supplied by two diversions from North Fork Battle Creek. The most upstream diversion is from Al Smith Diversion Dam at North Fork Battle Creek mile 16.5 at an elevation of 3,800 feet. The Al Smith Canal has a capacity of about 64 cubic feet per second (cfs) and ends at Lake Grace at an elevation of 3,480 feet, which serves as a forebay for one of the Volta penstocks. The second diversion is from Keswick Diversion Dam located at approximately North Fork Battle Creek mile 14 at elevation 3,650. The Keswick Canal also has a capacity of 64 cfs and ends at Lake Nora at elevation 3,430, which serves as a forebay for the other Volta penstock. The Volta Powerhouse (9 megawatts [MW]), with a capacity of 120 cfs, is located at elevation 2,240 feet, so the head is about 1,200 feet. There are two small reservoirs located upstream of the Al Smith diversion that provide a small amount of seasonal storage and flow regulation.

The tailwater from the Volta 1 Powerhouse flows in a canal about ¾ of a mile to the Volta 2 Powerhouse located on the north bank of North Fork Battle Creek at elevation 2,082 feet, just downstream of North Battle Creek Feeder Diversion Dam at North Fork Battle Creek mile 9.6. The Volta 2 Powerhouse (1 MW), constructed in 1980, operates with a head of only about 125 feet and has a capacity of 128 cfs. The Volta 2 tailwater flows in a pipe across the North Fork Battle Creek into the Cross Country Canal. The Cross Country Canal has a capacity of 150 cfs that flows about 4 miles to the South Powerhouse located on South Fork Battle Creek.

The South and Inskip Powerhouses were constructed in 1910, and the Coleman Powerhouse was completed in 1911. South Diversion Dam is located at South Fork Battle Creek mile 14.4 at an elevation of 2,030 feet. The South Canal capacity is about 100 cfs, but because Soap Creek (including Bluff Springs) is diverted into South Canal, the maximum diversion from South Diversion Dam is only about 85 cfs. South Canal joins with the Cross Country Canal to form Union Canal, which flows to the South Powerhouse penstock at elevation 1,960 feet. South Powerhouse (7 MW) has a capacity of 190 cfs with an operating head of about 500 feet.

Inskip Diversion Dam is located immediately downstream at South Fork Battle Creek mile 8.0 at an elevation of 1,415 feet. The Inskip Canal has a hydraulic capacity of 222 cfs and generally rediverts the South Powerhouse discharge. A small diversion from Ripley Creek flows into the Inskip Canal. At the Inskip penstock at elevation 1,400 feet, the Inskip Canal is joined by the Eagle Canyon Canal with a capacity of 70 cfs. The Eagle Canyon Canal flow is diverted from the North Fork Battle Creek at Eagle Canyon Diversion Dam located just downstream of Digger Creek at North Fork Battle Creek mile 5.3 at elevation 1,470 feet. The Inskip Powerhouse (8 MW) has a hydraulic capacity of 270 cfs with an operating head of about 380 feet.

Coleman Diversion Dam is located just downstream of the Inskip Powerhouse tailrace at elevation 1,000 feet at South Fork Battle Creek mile 2.5. The Coleman Canal capacity is about 340 cfs and generally rediverts the Inskip Powerhouse discharge. The Wildcat Canal joins the Coleman Canal just east of the confluence of the North Fork and South Fork of Battle Creek. The Wildcat Canal has a capacity of 18 cfs and diverts water from the North Fork Battle Creek at Wildcat Diversion Dam located at elevation 1,070 feet at North Fork Battle Creek mile 2.5. Two diversions on Baldwin Creek join the Coleman Canal. The Pacific Power Canal has a capacity of 15 cfs, and the Asbury pipe has a capacity of 35 cfs but must be pumped about 80 feet in height from Asbury Diversion Dam to the Coleman Canal. The Coleman Canal ends at the Coleman forebay at an elevation of 940 feet. The Coleman Powerhouse (13 MW) is located at elevation 460 feet, with a hydraulic capacity of about 380 cfs and an operating head of about 480 feet.

This system of powerhouses was acquired by PG&E in 1919. The project initially was licensed by the Federal Power Commission in 1932 and was relicensed in 1976 for a period of 50 years. The minimum flow requirement below each of the North Fork Battle Creek diversion dams is 3 cfs. The minimum flow requirement below each of the South Fork Battle Creek diversion dams is 5 cfs.

Hydroelectric Project Water Routing

The Hydroelectric Project diverts water within the Restoration Project area from North Fork and South Fork Battle Creek and several tributaries. Diversions from North Fork Battle Creek are made at North Battle Creek Feeder, Eagle Canyon, and Wildcat Diversion Dams; diversions from South Fork Battle Creek are made at South, Inskip, and Coleman Diversion Dams. Diversions from Battle Creek tributaries include Soap Creek Feeder and Lower Ripley Creek Feeder on Soap Creek and Ripley Creek, respectively. PG&E's vested water rights on Battle Creek and Battle Creek tributaries are presented in Appendix F.

North Fork water is conveyed from its natural drainage and across the upper plateau through a series of tunnels, flumes, and open channels. South Fork water is similarly conveyed, although it remains within its natural drainage. The water from the two forks is ultimately collected into penstocks (large pipes) and dropped down to the South, Inskip, and Coleman Powerhouses situated on the north bank of South Fork Battle Creek and the mainstem of Battle Creek.

After passing through the South and Inskip Powerhouses, the mixed North Fork and South Fork water is discharged into South Fork Battle Creek. The mixed water is then rediverted with additional South Fork water at Inskip and Coleman Diversion Dams, located just below the South and Inskip Powerhouses, respectively. Ultimately, all of this diverted water reaches Coleman Powerhouse, situated farther downstream on the mainstem of Battle Creek, where it is used again to generate electricity.

Occasionally, the powerhouses are shut down because of maintenance, lightning strikes, transmission grid disruptions, or other emergencies. When this occurs, the associated penstock collection facilities at the top of the plateau may be shut off. Diverted water traversing the plateau is then released into penstock bypass channels that enter the natural stream channel and is recaptured at the next downstream diversion dam. With these bypass systems, a shutdown of one powerhouse does not affect the continued operation of downstream powerhouses.

Stream Diversions

As addressed earlier, minimum instream flow requirements are aimed at optimizing habitat conditions to the extent practicable with competing needs in the stream at any given time. Flows in excess of those needed for habitat for priority species fish production are retained for energy production. Flexibility can be provided through adaptive management processes that adjust these flows as appropriate, based on information gained through comprehensive monitoring. Conceivably, this could result in increased or decreased minimum flows based on documented observation of fishery response over time. Additionally, instream flows can be temporarily increased to meet unusual situations, such as rising water temperatures during extreme hot weather conditions. The thoughtful determination of minimum flows, coupled with flexibility, ensures meeting habitat needs while minimizing the loss of renewable energy production.

Water Bypass Provisions

The flexibility of the five powerhouses making up the Hydroelectric Project is essential to maintaining reliability of this energy source and minimizing the loss of production. In order to maintain this flexibility, it would be best if water can be routed around any of the five powerhouses such that a plant being out of service does not affect the others. Attempting to maintain a separation of North Fork and South Fork waters could disrupt this operating flexibility and reliability. However, this disruption would be avoided by routing the South Powerhouse bypass into the proposed South Powerhouse–Inskip Canal connector tunnel and constructing an Inskip Powerhouse water bypass facility. These features would ensure continued flexibility of the energy production of the Hydroelectric Project while meeting biological goals that address false attraction and instream flow stability. In addition, water would be safely routed through these new conduits in the event of a sudden powerhouse shutdown. Otherwise, uncontrolled water would be released from the water conveyance facilities into the South Fork and mainstem of Battle Creek.

Facility Reliability

To maintain energy production, all facilities must be reliable. Robust design and protection from damage are especially important to ensure that the facilities operate as designed for fish passage without disrupting the energy production system. For example, any facility improvements that minimize the amount of water screened at a diversion will increase dependability of the powerhouse's water supply (tailrace connectors). Reliability is addressed through the application of state-of-the-art criteria, actual field experience to the design of the new facilities, and implementation of proactive measures to protect fish screens and fish ladders from damage caused by high flow events or debris in the water.

Operation and Maintenance

Hand in hand with robust designs, reasonable operating and maintenance requirements are critical to ensuring the reliable operation of the energy production system and salmon restoration facilities. The best design of the facilities will take this need and the need for biological reliability into account. The need for reliable operation should also be a consideration when recommending decommissioning and removal of several more remote installations. For the remaining energy production facilities, measures have been incorporated into the design of the facilities to produce cost-effective maintenance and operating requirements, thereby ensuring their reliable operation to meet both habitat and energy production goals.

Regulatory Certainty

The Restoration Project will provide future regulatory certainty. The decline in populations of certain anadromous salmonid species that is the basis of the restoration effort also heightens sensitivity to preserving the remaining stocks and implementing successful measures for species recovery. The operation of facilities to meet human needs in this environment can involve a high degree of regulatory uncertainty. A comprehensive array of measures included as part of the Restoration Project effort substantially reduces that uncertainty with regard to continued reliable energy production from the Hydroelectric Project. By targeting minimum instream flows to achieve 95% or more of potential stream habitat, stabilizing flows and temperature regimes, installing reliable passage measures, constructing water conveyance facilities to restore stream function, removing facilities of marginal value postrestoration, and incorporating adaptive management, all known issues that need to be resolved to effect species recovery would be addressed. These measures would ensure that the hydroelectric facilities could continue to operate with minimal regulatory uncertainty regarding ESA issues pertaining to the anadromous fish species in the watershed.

Enhanced Benefits

The Restoration Project includes a number of other measures (beyond the physical issues discussed above) that would enhance and ensure environmental benefits. Among these are:

- transferring water rights at removed diversion dams to the DFG,
- supporting the dedication of those rights for instream use,
- creating a Water Acquisition Fund to facilitate additional instream flows should the adaptive management process determine that it would be appropriate, and
- using funds from a third party to create an Adaptive Management Fund to accommodate modifications to hydroelectric production facilities or the acquisition of additional water for increased instream flow determined by the Adaptive Management Plan protocols. A total of $6 million is funded for adaptive management through scheduled use of funds derived from a third party and the CALFED water acquisition program.

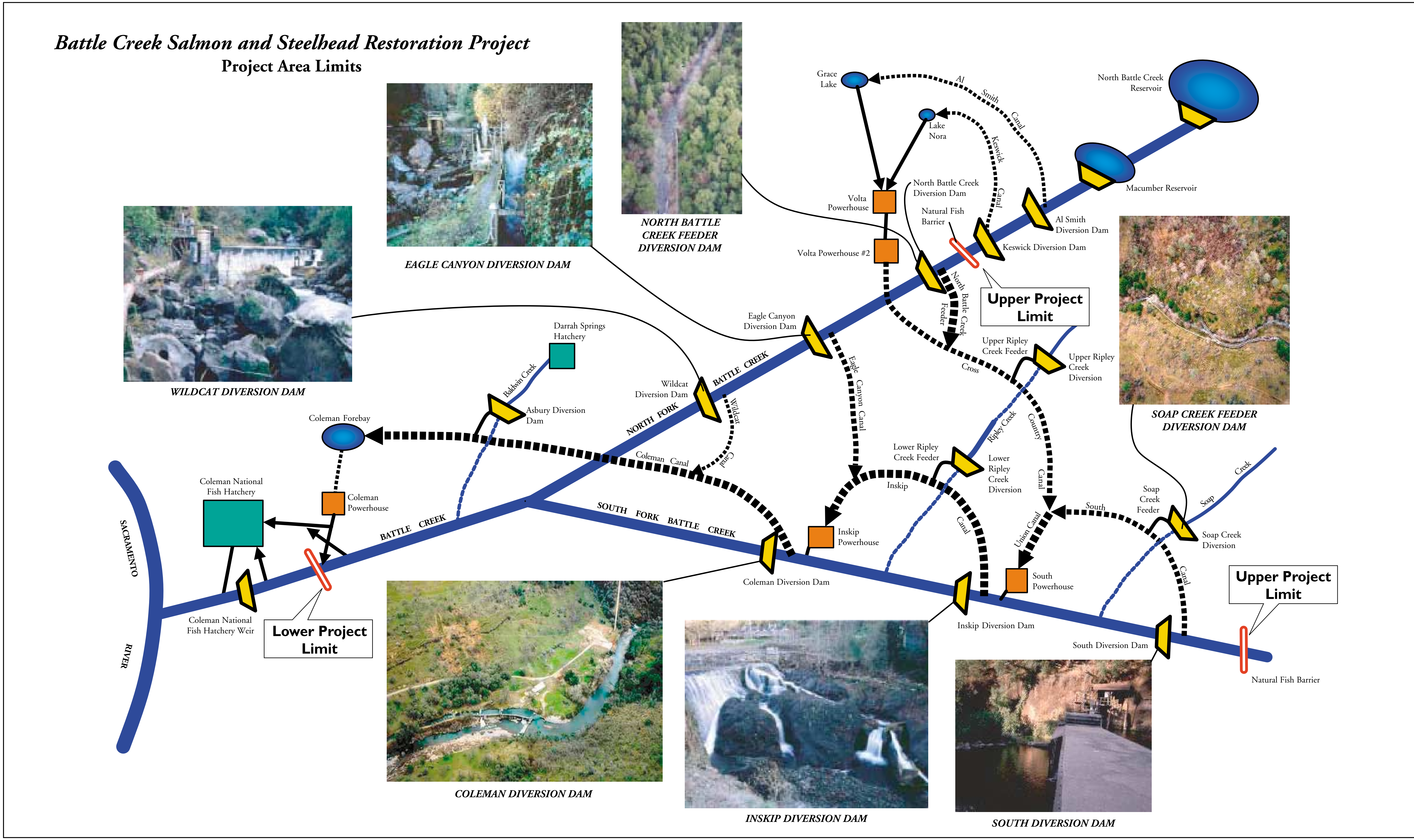


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Figure 2-2
Restoration Project Facilities and Limits

Federal Energy Regulatory Commission issues new Hydroelectric Project License, which contains license article 33 which allows short term drainages in releases below dam for fishery management and requires the Licensee to maintain the following minimum flow releases:

- 150 cfs downstream of Coleman Powerhouse
- 5 cfs in South Fork Battle Creek below the South, Inskip, and Coleman diversions.
- 3 cfs in North Fork Battle Creek below diversions into Al Smith, Keswick, Wildcat, Eagle Canyon, and Cross Country Canals.
- 0.3 cfs from North Battle Creek Reservoir into North Battle Creek Feeder, and from Macumber Reservoir into North Fork Battle Creek.

The California Legislature passes Senate Bill 1086, Upper Sacramento River Fisheries and Riparian Habitat Management Plan, acknowledging that operations of the Coleman National Fish Hatchery and hydroelectric power facilities had contributed to the declining runs of naturally occurring salmon and steelhead (Nielsen 1989).

The Upper Sacramento River Fisheries and Riparian Habitat Advisory Council (Senate Bill 1086) called for increased instream flows and screens at Hydroelectric Project diversions and increased release of salmon and steelhead upstream of Coleman National Fish Hatchery while managing disease risks at the hatchery (Nielsen 1989).

The U.S. Bureau of Reclamation (Reclamation), USFWS, DFG, and PG&E enter into two interim agreements for immediate anadromous fish habitat improvement (Patterson 1996). The key provisions of these agreements include:

- Instream releases at Eagle Canyon and Coleman Diversion Dams increased to 30 cfs, ±5 cfs, target flows or as subsequently modified by mutual agreement.
- Diversion to Wildcat Canal suspended.
- Partial compensation to the Licensee (PG&E) by Reclamation in the form of a water purchase based on value of the forgone energy production. Licensee bears initial loss of 12.5 cfs at Eagle Canyon and Coleman Diversion Dams; Wildcat Canal loss is shared equally.
- Blocking the downstream entrances to the fish passage facilities at Eagle Canyon and Coleman Diversion Dams.

Technical teams from state and federal agencies develop advisory reports for CVPIA program restoration actions that include detailed recommendations to restore Battle Creek that are consistent with past recommendations on flow and passage.

This partnership between PG&E, state and federal fisheries agencies, and restoration funding sources (CVPIA and Category III) allows interim increases in flows at one-half of the hydroelectric diversions affecting salmon and steelhead while a permanent or long-term arrangement can be reached. The basis for this agreement is an article in the FERC license allowing short term changes to the license for fishery management upon mutual agreement between PG&E and DFG.

Completion of the Battle Creek Salmon and Steelhead Restoration Plan – the technical basis for the Battle Creek Salmon and Steelhead Restoration Project.

Reclamation, NOAA Fisheries, USFWS, CDFG, and PG&E sign Agreement in Principle to pursue a restoration project on Battle Creek involving modifications to the Hydroelectric Project.

Reclamation, NOAA Fisheries, USFWS, CDFG, and PG&E sign a Memorandum of Understanding for the Battle Creek Salmon and Steelhead Restoration Project.

Reclamation submits proposal and approves $28 million in directed funding for the Battle Creek Salmon and Steelhead Restoration Project, contingent upon the development of a detailed, formal memorandum of understanding between parties in conformance with the Agreement in Principle and terms of the CALFED funding.

USFWS receives CALFED Ecosystem Restoration Program funding for improving the upstream ladder and barrier weir at the Coleman National Fish Hatchery.

The Battle Creek Watershed Conservancy opposes the Restoration Project in its present form until the Conservancy Board is satisfied that all possible steps will be taken to protect natural [fish] production in Battle Creek, without curtailing hatchery production for the mitigation of the presence of Shasta Dam.

A Four Agency Letter is prepared by Reclamation, USFWS, NOAA Fisheries, and DFG (Four Agency Letter, September 20, 2001) in response to the Battle Creek Watershed Conservancy's concerns over activities of the agencies in the Battle Creek Watershed (Appendix C).

Under the Interim Flow Agreement, USFWS, NOAA Fisheries, and DFG (Letter to PG&E, May 14, 2001) direct PG&E to reduce diversions and close the fish ladders at Eagle Canyon and Coleman Diversion Dams for the 2001 season (Appendix B).

Federal fisheries agency salmon planning effort recommends restoring natural streamflows throughout the Battle Creek system, primarily to meet the requirements for spring-run and winter-run chinook salmon.

Pacific Gas and Electric Company (PG&E) applies for a new license for the existing Battle Creek Hydroelectric Project (FERC License No. 1121).

The U.S. Army Corps of Engineers completed a flood control project on the lower five miles of Battle Creek below the Coleman National Fish Hatchery. Much of the spawning gravel was removed from the stream bed by pushing the gravel into levee-like piles on the bank (O'Brien 1970).

USFWS, PG&E, and DFG cooperate in field trials to assess the potential success of fall-run Chinook salmon spawning in the North Fork, South Fork and main stream of Battle Creek. PG&E increased flows during spawning period.

Battle Creek Fish Passage is identified as a priority in seven restoration plans.

Start of construction

Completion of construction

1962 · 1969 · 1976 · 1979 · 1987 – 1988 · 1989 · 1989 – 1998 · 1995 – 1996 · 1999 · 2001 · 2004 · 2006

1965 · 1970 – 1971 · 1988 · 1990 · 1993 · 1996 · 1997 · 1998 · 2002 · 2003

California Department of Fish and Game (CDFG) statewide fisheries planning effort recommends restoration and utilization of natural salmon spawning area in Battle Creek.

Resource Agency communications at this time reflected, among other things, the beliefs that:

- License flows below Hydroelectric Project diversion dams maintained, but did not enhance, aquatic life (Resource Agency 1971).
- Canal intakes were not screened to avoid loss of resident trout fishery in the canals (Coots and Healey 1966).
- Adequate protection to the anadromous fishery resource was met by reconstruction of the fish ladder at the Coleman Diversion Dam. Further reconstruction of the fish ladders at the other five Hydroelectric Project diversion dams did not appear to be warranted because maintenance of the anadromous fishery was met by eventually reconstructing two-thirds of the fish ladders with steel liners.

California Advisory Committee on Salmon and Steelhead Trout (legislatively authorized in 1970) recommends restoring Battle Creek system.

The CDFG prepares a draft fisheries restoration action item for the Upper Sacramento River Fisheries and Riparian Habitat Management Plan (Senate Bill 1086 Plan) recognizing hatchery operation and hydroelectric power development as combining to drastically reduce natural spawning of Battle Creek salmon and steelhead trout. Short- and long-term solutions recommended by CDFG included continued releases of salmon to Battle Creek upstream of the Coleman National Fish Hatchery, flow augmentations, fisheries studies, development of a Battle Creek anadromous fish restoration plan with the U.S. Fish and Wildlife Service (USFWS), increased diversion bypass flow releases, fish screens at diversions, and improved gravel management.

The CDFG Central Valley basin planning effort for salmon and steelhead (Senate Bill 2261) makes recommendations to restore Battle Creek consistent with those in the 1989 Senate Bill 1086 process.

The Battle Creek Spawning Restoration Project, funded by Proposition 70, protected against bank erosion and channel migration threatening important spawning riffles in lower Battle Creek.

The Inland Fisheries Division of CDFG reported on the successful use of streambank stabilization, gravel loosening, and the replacement of armoring cobbles with clean spawning-sized gravels to improve Battle Creek spawning habitat. CDFG, USFWS, and the National Marine Fisheries Service (NOAA Fisheries) met to develop a conceptual long-term fisheries management plan for Battle Creek upstream of the Coleman National Fish Hatchery.

CDFG Central Valley fisheries restoration "Plan for Action" (advisory to the federal Central Valley Project Improvement Act of 1992 [CVPIA]) makes detailed recommendations to restore Battle Creek consistent with past recommendations on flow and passage.

The CDFG Steelhead Restoration Plan – advisory to the CVPIA of 1992 – recommends increasing the instream flow at Hydroelectric Project diversions and allowing steelhead to ascend above Coleman National Fish Hatchery.

The Pacific Fisheries Management Council passes a resolution to examine the feasibility of reintroducing winter-run chinook salmon into Battle Creek.

Discussions regarding long-term fisheries restoration in Battle Creek begin between PG&E and the resource agencies.

Formation of the Battle Creek Working Group, composed of stakeholder representatives from the state and federal resource agencies and fishery, environmental, local, agricultural, power, and urban stakeholder communities and 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.

NOAA Fisheries Proposed Recovery Plan for the Winter-Run Chinook Salmon recommends conducting a feasibility analysis of reestablishing winter-run salmon populations in Battle Creek.

The USFWS AFRP revised plan for implementing the CVPIA recommends more detailed actions to restore Battle Creek that are consistent with past recommendations on flow and passage.

CALFED awards a Category III contract to Battle Creek Working Group agencies for the development of a comprehensive technical plan to guide implementation and to receive advice from interested and affected parties.

CALFED and CVPIA award a contract to foster the development of a Battle Creek Watershed Conservancy through the joint efforts of the Western Shasta and Tehama Resource Conservation Districts.

The Battle Creek Watershed Conservancy is formed and a newsletter is initiated.

USFWS is awarded CALFED Ecosystem Restoration Project funding for the monitoring of adult and juvenile spring- and winter-run chinook salmon in Battle Creek. Funding is continued in 1998.

The California Department of Water Resources (DWR) receives CALFED Category III funding for studying spawning gravel replacement in the lower reaches of Battle Creek.

The Battle Creek Working Group becomes a technical advisory committee for the technical plan developed under the CALFED Category III grant. Working Group Subcommittees are convened to focus on biology, power loss, and regulatory issues. Presentations are developed on alternative methods of providing flow and passage.

CALFED awards Ecosystem Restoration Program contract with DWR to perform an engineering investigation of anadromous fish passage in upper Battle Creek.

Reclamation is awarded an Ecosystem Restoration Program Grant to investigate costs associated with removing Wildcat, Eagle Canyon, and Coleman Diversion Dams.

Efforts by USFWS to develop a disease-free water supply at Coleman National Fish Hatchery enters its final construction phases.

Reclamation prepared and circulated a Draft Environmental Assessment for the continuance of the temporary flow agreement augmenting streamflow in the lower half of Battle Creek.

The Battle Creek Watershed Conservancy receives CALFED Ecosystem Restoration Program funding for improved Battle Creek watershed stewardship activities.

Under the Interim Flow Agreement, USFWS, NOAA Fisheries, and DFG (Letter to PG&E, March 21, 2001) direct PG&E to reduce diversions and close the fish ladders at Eagle Canyon and Coleman Diversion Dams for the 2002 season (Appendix B).

A Four Agency Letter prepared by Reclamation, USFWS, NOAA Fisheries, and DFG (Four Agency Statement, October 31, 2002) allows for a process of passing adult steelhead above the Coleman National Fish Hatchery barrier weir (Appendix B).

A new Interim Flow Agreement is signed to continue the flow agreements that augment streamflow in the lower half of Battle Creek until December 2004 or the start of instream construction.

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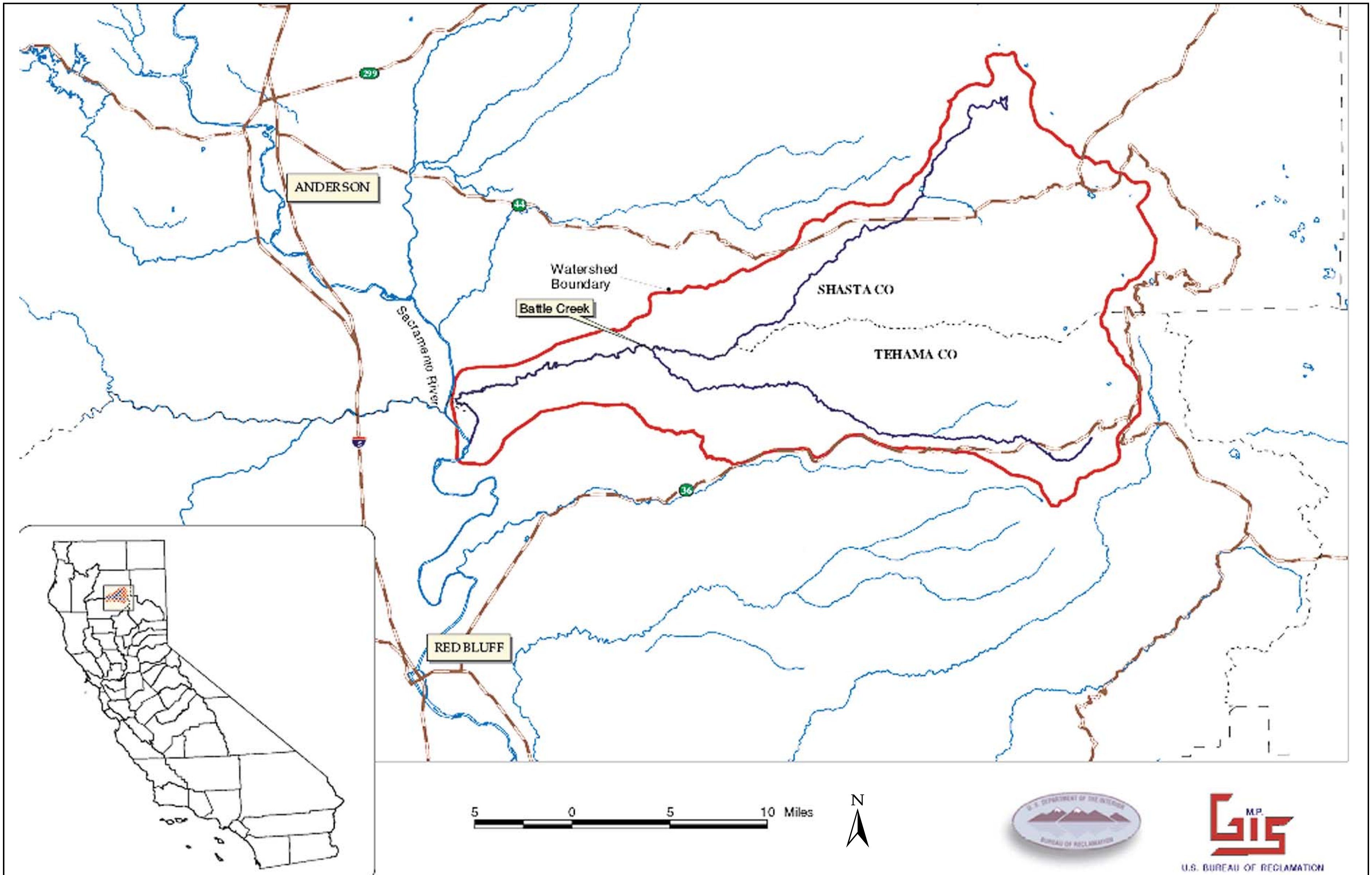
Figure 2-3
Timeline of Important Milestones Associated with Battle Creek Anadromous Fish Restoration



Source: Reclamation 1999a.

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Figure 2-4
Battle Creek Watershed