HANDOUT #8

Draft

Strategic Plan

2003 - 2008

Trinity River Restoration Program

Restore • Adapt • Improve

Trinity River Restoration Program

Table of Contents

1.0 Program Justification and Mission

1.1 Mission Statement

"The mission of the Trinity River Restoration Program is to restore, enhance, and conserve naturally-spawning anadromous fisheries, native plant communities, and associated wildlife resources of the Trinity River basin in sufficient quantity and quality to ensure long-term sustainability."

1.2 Statutory Authority[1]

Primary justification for the Trinity River Restoration Program (TRRP) is found in Public Law (P.L.) 84-386, Trinity River Division (TRD), Central Valley Project, August 12, 1955, where *"...the Secretary is authorized and directed to adopt appropriate measures to insure the preservation and propagation of fish and wildlife..."* This is further supported in P.L. 98-541, the Trinity River Basin Fish and Wildlife Management Act of 1984, as amended, wherein *"...the Secretary...shall formulate and implement a fish and wildlife management program for the Trinity River Basin designed to restore the fish and wildlife populations in such basin to the levels approximating those which existed immediately before the start of construction...and to maintain such levels."* Most recently, P.L. 102-575, the Central Valley Project Improvement Act, Title 34, reiterated this emphasis where *"...the purposes of this title shall be...to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California."*.

1.3 Program Goals

There are many river restoration programs with varying objectives and different degrees of success. What characterizes the TRRP is its foundation in adaptive environmental assessment and management (AEAM). Although the recommendations of the Trinity River Flow Evaluation (TRFE) report were based on the best available scientific information compiled by respected scientists and peer reviewed by outside experts, the fact remains that alluvial river systems are complex and dynamic. While our understanding of these systems and our predictive capabilities are extensive and improving, some uncertainties still exist.

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[1] The specific authorities for entering into financial assistance agreements, which are an important component of the program, come from several of the same acts. They are listed in Appendix A of the current draft of the Reclamation Financial Assistance Handbook. Specific sections cited are as follows:

- Pseudo Code: 15.BBB – Trinity River Fish and Wildlife Management Act – P.L. 98-541, as amended by P.L. 104-143. Section 4.(i) *Beginning in the fiscal year immediately following the year the restoration effort is completed and annually thereafter, appropriations may be sought in order to monitor, evaluate, and maintain program investments and fish and wildlife populations in the Trinity River Basin for the purpose of achieving long-term fish and wildlife restoration goals.*
- Pseudo-Code: 15.BCC - Central Valley Project Improvement Act - P.L. 102-575, Title 34. Section 3407 (e) *If the Secretary determines that the State of California or an agency or subdivision thereof, an Indian tribe, or a non-profit entity concerned with restoration, protection, or enhancement of fish, wildlife, habitat, or environmental values is able to assist in implementing any action authorized by this title in an efficient, timely, and cost effective manner, the Secretary is authorized to provide funding to such entity on such terms and conditions as he deems necessary to assist in implementing the identified action.* In addition, Section 3408 (a) states that *"The Secretary is authorized and directed to promulgate such regulations and enter into such agreements as may be necessary to implement the intent, purposes, and provisions of this title."*

The purpose of the TRRP is not merely to implement a series of fishery restoration actions, but to make informed decisions and implement management actions in spite of these uncertainties. The AEAM process (refer to Section 6.0) provides a structured mechanism for fine-tuning management recommendations related to flow schedules, sediment management, and channel restoration actions based on experience and comparing predicted results with actual outcomes.

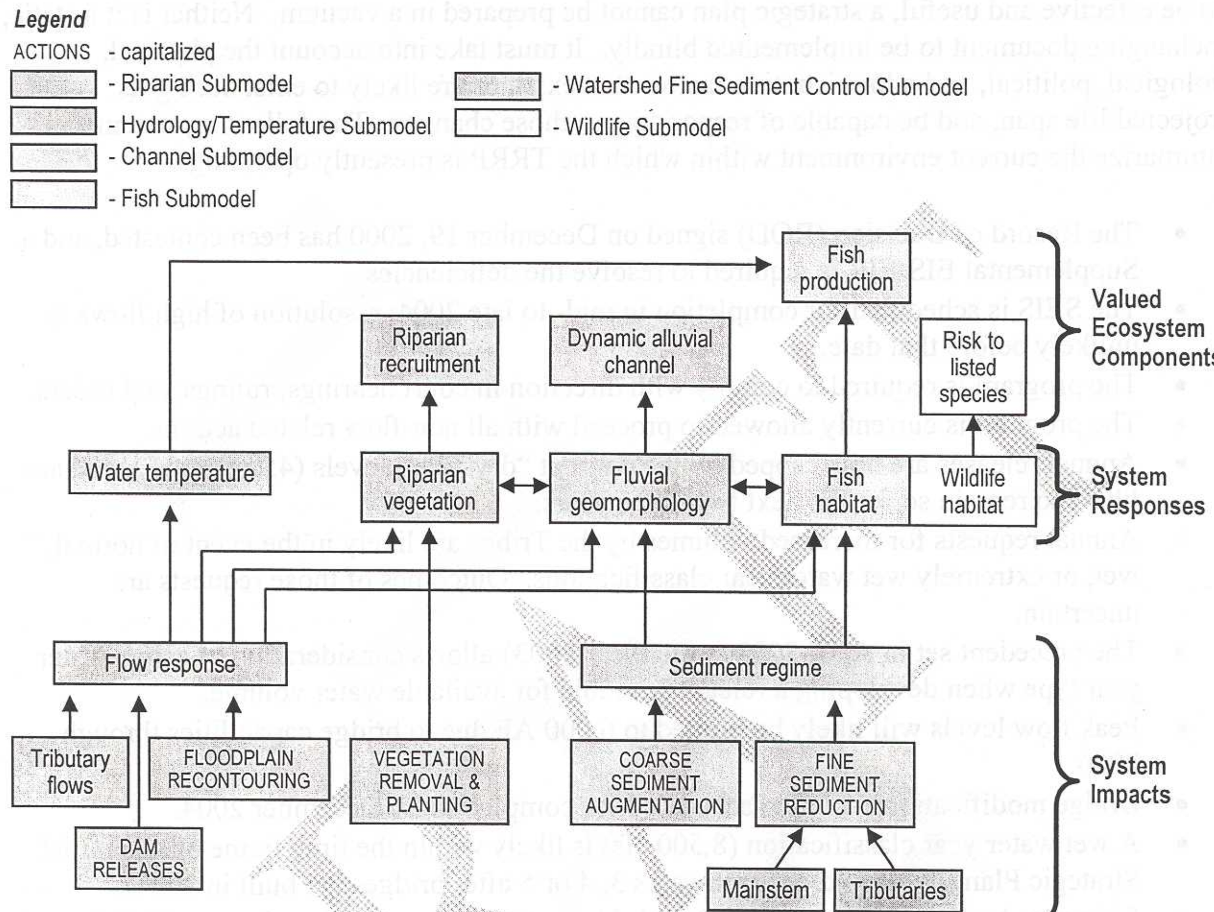
The following goals describe the primary focus of the Trinity River Restoration Program. Together they provide the basic sideboards for future steps in the planning process. There is no explicit priority associated with the order they are presented. None of these goals can be implemented alone; together they represent an integrated approach for restoration.

- Restore natural populations of anadromous fish in the Trinity River basin to levels that existed prior to the construction of Trinity and Lewiston dams, and maintain such levels.
- Restore attributes of a healthy, functional alluvial river system to the Trinity River basin downstream of Lewiston Dam to enhance populations of native fish species.
- Identify opportunities for restoration activities within tributary watersheds that provide direct benefits to mainstem health and function; consider all restoration activities within the context of improved watershed health.
- Provide credible and objective scientific knowledge that furthers our understanding of regulated alluvial river systems for effective adaptive management of the Trinity River.
- Restore and enhance diversity of species, structure, and function of riparian and associated upland plant communities within the historic floodplain to increase the quality of wildlife habitats, and enhance native populations of wildlife species.

A more detailed set of objectives needed to carry out these goals is described in Section 4.0 - Implementation of Program Goals, which will in turn be refined as the Scientific Framework[2] for the program is developed. A draft conceptual model of system impacts, system responses, and valued ecosystem components which will be addressed in the Scientific Framework is shown in Figure 1.3-1.

[2] The Scientific Framework is a comprehensive and systematic methodology that emphasizes learning from the outcomes of carefully designed management actions as a continuing process. With the Strategic Plan providing the basic sideboards, the Framework will lead to the development of a conceptual model of the Trinity River system and its resources. The conceptual model will include the following six features: 1) system sub-models, 2) measurable indicators of progress towards the goals and objectives of each sub-system, 3) an integrated spatial structure for all sub-model, 4) functional physical-biological linkages among the sub-models, 5) chains of hypotheses linking actions to indicators, and 6) critical uncertainties and knowledge gaps.

Figure 1.3-1. Draft conceptual model for Trinity River system.



2.0 Planning Assumptions

To be effective and useful, a strategic plan cannot be prepared in a vacuum. Neither is it a static, unchanging document to be implemented blindly. It must take into account the physical, biological, political, and administrative factors that exist, or are likely to exist during its projected life span, and be capable of responding to those changes. The following statements summarize the current environment within which the TRRP is presently operating.

- The Record of Decision (ROD) signed on December 19, 2000 has been contested, and a Supplemental EIS/EIR is required to resolve the deficiencies.
- The SEIS is scheduled for completion in mid- to late 2004; resolution of high flows is unlikely before that date.
- The program is required to comply with direction in court hearings, rulings, and orders.
- The program is currently allowed to proceed with all non-flow related actions.
- Annual releases are now capped by the court at "dry-year" levels (452,600 AF), and are likely to remain so for the next two-three years.
- Annual requests for increased volumes by the Tribes are likely in the event of normal, wet, or extremely wet water year classifications. Outcomes of those requests are uncertain.
- The precedent set in April 2003 (water year 2003) allows consideration of actual water year type when developing a release schedule for available water volume.
- Peak flow levels will likely be limited to 6,000 AF due to bridge capabilities through 2004.
- Bridge modifications are now scheduled for completion by December 2004.
- A wet water year classification (8,500 cfs) is likely within the time frame of this initial Strategic Plan (i.e., could occur in years 3, 4 or 5 after bridges are built in 2004).
- Litigation by Westlands (or others) on bridges, Cableway gravel project, and fall flow schedule now appears unlikely.
- The Department of the Interior Solicitor's opinion on South Fork Trinity still considered valid by Reclamation and is basis for focusing agency funds on the mainstem.
- The Trinity Adaptive Management Working Group (TAMWG) is now operational and will be actively involved in program and budget priorities.
- The program budget has averaged $10-11 million for the past three years. The ROD and Implementation Plan identified a budget of $12-15 million per year.

3.0 Desired Future Condition

3.1 March 2004: 1-Year Vision – "Setting the Stage"[3]

- The TRRP Strategic Plan (2003-2008) is completed, including preliminary project timelines and funding needs (budgets).

[3] March 2003 was the initiation date of the draft Strategic Plan, and the reference point for 1, 3, and 5 year vision statements.

- Statement of work for the Scientific Framework is complete; contract award ready to initiate; and first round of workshops are scheduled.
- The process for developing and recommending flow release schedules (by water-year type) is well understood and agreed to by all program partners.
- The FY 2005 budget process is based on Strategic Plan priorities and preliminary results of the Scientific Framework, including an emphasis on integrated study design and independent technical reviews.
- The federal financial agreement process is significantly streamlined, with improved response time.
- All vacant TRRP staff positions are filled.
- All NEPA/CEQA documents and permits are complete for all bridges; construction contracts awarded; and all four bridges open to traffic by December 2004 (allowing peak releases of up to 11,000 cfs).
- All affected landowners (including private, state, and federal) are aware of the program and actively participating in project planning and design.
- Support from local communities is visible and increasing.
- Channel rehab site process well understood and applied to pilot site (Hocker Flat).
- Hocker Flat restoration site construction underway.
- Design process for next set of restoration sites underway.
- The Cableway gravel introduction project is complete, with monitoring taking place.
- There is a clear understanding of disease impacts *(Ich)* on Trinity fish and plans are in place to deal with future threats.

3.2 March 2006: 3-Year Vision – "Starting to Implement"

- "Unhindered" implementation of the ROD is taking place.
- A comprehensive AEAM framework and plan is in place, and the second year's recommendations are being implemented.
  - Information gaps have been identified.
  - Additional studies have been identified and proposals solicited.
  - Predictive modeling is routinely used in planning and design.
- A functional information management system and decision support tools (models) are in place and being used.
- An efficient tracking system for all channel rehabilitation sites is in place, including planning, design, implementation, and monitoring.
- Consistent science-based protocols for all elements of restoration process have been developed, including pre assessment – implementation – post assessment components.
- Individual biological site responses at gravel introduction and restoration sites are becoming visible and being documented, e.g., at the Diversion Pool, Cableway, and Hocker Flat sites.
- Construction of all primary channel rehabilitation sites below Canyon Creek is complete.
- A significant portion of the short term gravel introduction program is complete.
- An inventory of high priority tributary restoration sites with direct relevance to main stem restoration activities is complete.

3.3 March 2008: 5-Year Vision – "Seeing the Results"

- The Trinity River is beginning to change its configuration because of flow releases, gravel introduction program, and bank rehabilitation projects.
- There is a 50:50 chance of several large flow events, possible resulting in unexpected changes to the river system.
- Projects have started to link up; holes are filling in and being created; more scour is visible.
- Positive responses to restoration projects will be visible, i.e., increases in overall fish populations.
- Aquatic studies will be producing data and results with sufficient accuracy and precision to demonstrate fish response to restoration projects and to inform adaptive management of flows in a scientifically defensible manner.
- Process-based techniques in defined river segments are being scientifically analyzed, supported, refined; with statistically valid science-based results coming from inter-agency efforts.
- A systematic evaluation of over-all program effectiveness by the Science Advisory Board has been completed.
- New flood plain plantings will show significant growth; flood plain vegetation will be different in species composition.
- The program will be positioned to successfully withstand an audit by National Academy of Science.
- The common perception in Trinity County (and the Central Valley) is that we have made a positive difference in the river and dependent fish populations.

4.0 Implementation of Program Goals *(preliminary and not yet complete)*

This section will detail science-based and river-specific objectives organized around the program goals, linked to the Record of Decision, and incorporating TRFE recommendations (Chapter 8 and Appendix O):

Variable annual flow regime
Mechanical channel rehabilitation
Sediment management
Watershed restoration
Infrastructure improvement
Adaptive environmental assessment and management

Objectives and Outcomes *(measurable progress)*:
Current conditions *(what do we have to work with, what are the information gaps)*:
Strategies *(techniques to help achieve priorities)*:
Hypotheses *(scientific questions to be tested)*:
Tasks *(operational details, link to annual program of work)*:

<u>4.1 - Restore natural populations of anadromous fish in the Trinity River basin to levels that existed prior to the construction of Trinity and Lewiston dams, and maintain such levels.</u>

4.1.1 – Improve habitat conditions in all reaches of the Trinity River and for all life cycles of anadromous fish species.

- Consider late summer/early fall temperature and flow requirements when developing annual flow recommendations.

<u>4.2 - Restore attributes of a healthy, functional alluvial river system to the Trinity River basin downstream of Lewiston Dam to enhance populations of native fish species.</u>

4.2.1 – Design annual flow recommendations to achieve restoration and physical condition objectives outlined in the Trinity River Flow Evaluation Study.

- Determine total water volume based on water-year type.
- Recognize and take into account interim constraints imposed by court rulings.
- Coordinate with Central Valley Operations and others.
- Identify opportunities not initially recognized in the ROD for consideration by the Trinity Management Council.
- Maximize flow-related benefits for rehabilitation sites and sediment management, including frequency considerations.
- Optimize potential biological response for species under consideration when developing and implementing annual flow recommendations.
- Use species-specific biological production and population models, e.g., degree-day model for riparian seed release.
- Establish real-time instrumentation to track environmental conditions.

4.2.2 – Complete necessary infrastructure modifications for wet (8,500 cfs) and extremely wet (11,000 cfs) water-year flows as soon as possible.

- Plan, design, and implement modifications for bridges incapable of passing 8,500 cfs flows (e.g., Salt Flat and Biggers Road) by April 2004.
- Plan, design, and implement modifications for structures susceptible to 8,500 cfs flows (e.g., "little yellow house," Poker Bar roads, and other impacted structures) by April 2004.
- Plan, design, and implement modifications for bridges incapable of passing 11,000 cfs flows (e.g., Poker Bar and Bucktail) by April 2005.
- Plan, design, and implement modifications for houses, roads, and other structures susceptible to 11,000 cfs flows by April 2005.

4.2.3 – Increase geomorphic and hydraulic complexity to provide greater diversity of fish habitats capable of supporting a wide range of life history stages.

- Plan, design, and implement all feasible mechanical channel restoration projects below Canyon Creek until final resolution of flow schedules are resolved.
- Construct projects that encourage channel meanders.
- Increase areas of shallow, low velocity fry and juvenile salmonid rearing habitat.
- Pursue side channel projects anywhere within the upper 40 miles that are sustainable under current and foreseeable flow conditions.

4.2.4 – Minimize fine sediment supply and storage in the mainstem Trinity River.

- Monitor sediment collection ponds for efficiency, storage capacity.
- Maintain capacity of collection ponds through periodic dredging.

4.2.5 – Balance the coarse sediment budget in the mainstem Trinity River.

- Monitor sediment transport and delta conditions by substrate sampling, pool size.
- Develop, refine, and apply a predictive sediment transport model for use in development of annual flow recommendations and implementation of long-term gravel injections.
- Develop a comprehensive gravel management plan that addresses short and long-term gravel supplementation, delta maintenance, cost, and logistics.

4.2.6 – Modify distribution of riparian vegetation to benefit fish and wildlife species.

- Remove riparian vegetation from channel margins.
- Restore riparian vegetation in floodplain areas.

<u>4.3 - Identify opportunities for restoration activities within tributary watersheds that provide direct benefits to mainstem health and function; consider all restoration activities within the context of improved watershed health.</u>

4.3.1 –

4.4 - Provide credible and objective scientific knowledge that furthers our understanding of regulated alluvial river systems for effective adaptive management of the Trinity River.

4.4.1 – Test scientific hypotheses and reduce management uncertainties by implementing flow schedules, channel restoration activities, sediment management, and watershed restoration within the context of predetermined study designs.

- Fully develop and use a "blocking strategy" in the implementation of restoration projects and related monitoring activities.
- Incorporate decision support models in design of restoration projects.
- Develop a scientifically supportable design, construction, monitoring, and evaluation framework for projects below Canyon Creek that recognizes current time constraints.

4.5 - Restore and enhance diversity of species, structure, and function of riparian and associated upland plant communities within the historic floodplain to increase the quality of wildlife habitats, and enhance native populations of wildlife species.

4.5.1 –

5.0 Resource Conditions[4]

5.1 Introduction and Overview

The Trinity River drains a watershed of approximately 2,965 square miles, about one-quarter of which is above Lewiston Dam. Elevations range from 8,888 feet mean sea level (msl) at Sawtooth Mountain in the Trinity Alps to 300 feet msl at the confluence of the Trinity and Klamath Rivers. The climate is Mediterranean with an average precipitation of 62 inches per year; throughout the basin it varies from 30-70 inches annually, which typically occurs as rain in the lower elevations and snow at the higher elevations.

The flood season on the Trinity River usually lasts from October through April, when over 90 percent of the annual precipitation falls. Floods on the Trinity River are somewhat controlled by the dams upstream of Lewiston. The greatest flood recorded for the area occurred in December 1955. Floods have also been recorded for the years 1862, 1926, 1928, 1937, 1940, 1941, 1948, 1950, 1958, 1960, 1963, 1964, 1972, and 1974 (FEMA 1996) and 1997.

Prior to the completion of the Trinity River Division (TRD), flows in the Trinity River were highly variable, ranging from summer flows of 25 cubic feet per second (cfs) to extreme winter events with instantaneous peak flows greater than 100,000 cfs. The maximum flow recorded at Lewiston was 71,600 cfs in 1955. Annual hydrographs typically followed a seasonal pattern of high winter and spring flows followed by low summer and fall flows. Total annual flow volumes at Lewiston ranged from 0.27 to 2.7 million acre feet (maf), with an average of 1.2 maf.

Construction of the TRD began in 1957 and operation of the Lewiston and Carr powerhouses started in April 1964. The TRD consists of a series of dams, tunnels, and power plants that export water from the Trinity River Basin into the Sacramento River Basin. Trinity and Lewiston Dams currently regulate Trinity River flows below River Mile (RM) 112. With a capacity of 2.48 million acre feet (maf), Trinity Reservoir is the largest component of the TRD. Releases from Trinity Reservoir are re-regulated in Lewiston Reservoir prior to release downstream into the Trinity River. Lewiston Reservoir also acts as a forebay for the trans-basin export of water into Whiskeytown Reservoir via the Clear Creek Tunnel. Lewiston Dam marks the upstream limit of anadromous salmonid access.

From 1962 to 1979, the Central Valley Project (CVP) diverted nearly 90 percent of the Trinity River's annual water yield (above Lewiston) into the Sacramento River for agricultural and urban use[5]. After 1979, river releases were increased from 110,000 to 340,000 annual acre feet (afa), such that the diversion percentage was reduced to roughly seventy percent. In recent years (1985-1997), annual exports have decreased to an average of 732,400 AF. Conversely, post-dam Trinity River flows at Lewiston have been as low as 121,500 afa (10 percent of pre-dam levels).

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[4] Unless otherwise stated, material in this section is summarized from the Trinity River Bridges Project Environmental Assessment/Draft Environmental Impact Report, prepared by North State Resources, Inc. for the Trinity River Restoration Program, Bureau of Reclamation, Bureau of Land Management, and Trinity County, 2003.

[5] The percentage of the Trinity River diverted to the Central Valley Project is the percentage of total reservoir release, not the percentage of the inflow that is diverted.

Currently, releases to the Trinity River are flows are capped at dry and critically dry years, as dictated by a federal court decision. In critically dry years, the releases will be limited to 368,500 afa, while in all other year types (dry, normal, wet, and extremely wet), the releases will be limited to 452,600 afa. The original December 19, 2000, Record of Decision (ROD) had provided higher numbers for normal years (646,900 afa), wet years (701,000 afa), and extremely wet years (815,200 afa). Whether these higher numbers will be reinstated depends on the outcome of the NEPA process associated with the Supplemental EIS (SEIS) and ROD. According to the terms of the CVPIA, long-term flows cannot go lower, regardless of any new ROD, than 340,000 afa. Although releases of 340,000 to 452,600 afa represent significant increases compared with the releases made during the period starting in 1965 and ending in 1992, the higher flows still represent what, absent the TRD, would constitute drought conditions within the Trinity River. Based on records of pre-dam flows at Lewiston and post-dam inflow to Trinity Reservoir, 340,000 AF approximates the third lowest flow since 1912.

Following its initial authorization in 1984, the Trinity River Basin Fish and Wildlife Restoration Program conducted a variety of restoration activities in the mainstem Trinity River and its tributaries. Some activities conducted in tributaries include watershed restoration work,.as well as habitat enhancement projects, and dam construction and pool dredging in Grass Valley Creek to decrease the amount of fine sediment entering the mainstem Trinity River. Mainstem restoration activities included gravel placement, pool dredging, and construction of several channel rehabilitation projects (side channels and bank rehabilitation of point bars).

From 1990-1993, 27channel rehabilitation projects were constructed on the mainstem Trinity River between Lewiston Dam and the North Fork, including 18 side-channel projects and nine bank rehabilitation projects (also known as feathered-edge projects). The nine bank rehabilitation projects between Lewiston Dam and the North Fork were constructed by physically removing vegetated sand berms along the bank to restore the channel to a pre-dam configuration, i.e., wider and shallower. Along with promoting formation of alluvial features characteristic of unregulated rivers, channel rehabilitation projects have been shown to increase the amount and diversity of habitat for adult and juvenile salmon and steelhead.

5.2 Physical Resources

River channels are formed by three primary building blocks: various sizes of sediment, varying amounts and stages of vegetation, and varying amounts of water. Individual rivers are composed of a unique combination of these building blocks, which are determined by soils, climate, and geology. Complex interactions between these three components comprise the geomorphic environment and provide a diversity of physical structures, such as point bars and riffle-pool sequences that perform a variety of environmental functions. The resulting geomorphic environment typically supports a unique ecosystem that depends on geomorphic processes to maintain its fundamental structure. A change in one or more of the building blocks will change the geomorphic environment (USFWS et al. 2000a).

Generally, a highly variable hydrology in an alluvial river system will result in a physically complex river that provides substantial ecological benefits. A physically complex river provides a variety of habitats that can be used by different species under a range of flows. Hydrology changes seasonally, daily, and hourly, causing energy inputs to a river to be in constant flux. Varying flows impart varying amounts of energy throughout a river channel and elicit varying responses in the river channel. Flows can mobilize and deposit a wide range of sediment particle sizes (ranging from fine material to large boulders during peak events). This movement and deposition of sediment particles in turn scours and shapes the river channel, creating river bars, pools, and riffles, and can force the main channel to shift its position in the floodplain can be scoured during high flows, leaving open gravel bars and preventing vegetation in the scour zone from maturing.

The construction of the TRD of the CVP replaced the Trinity River's pre-dam hydrology with a greatly reduced, near-constant flow schedule. This reduction in water and associated energy has directly affected the character of the channel. The new, lower flows allowed woody riparian vegetation along the channel to become established and mature. Sediment berms developed along the channel margins. These berms further anchored the sides of the channel and resulted in the loss of many broad, gently sloping point bars, which changed the pool-riffle-run sequences created by alternate bar sequences to a large monotypic-run habitat. The loss of these bars has substantially reduced the complexity and diversity of riparian and riverine habitats (McBain and Trush 1997). These changes in geomorphic processes and channel geomorphology have decreased the quantity and quality of riverine habitats.

A suite of ten attributes was identified in the TRFE Report (USFWS and HVT 1999) and used in the FEIS/EIR (USFWS et al. 2000a) to describe the geomorphic environment and processes of a healthy alluvial river. These attributes provide a foundation for understanding the dynamic equilibrium of the river and developing recommendations to meet restoration objectives, and remain valuable for evaluating potential strategies for improving the fishery within the mainstem Trinity River. The methodology used in the original EIS (USFWS et al. 1999) assumed that if all 10 of these attributes were present, the Trinity River would have the physical characteristics to support a healthy alluvial river ecosystem. These attributes are listed below:

- Attribute 1. Spatially complex channel geomorphology
- Attribute 2. Flows and water quality are predictably unpredictable
- Attribute 3. Frequently mobilized channel-bed surface
- Attribute 4. Periodic channel-bed scour and fill
- Attribute 5. Balanced fine and coarse sediment budgets
- Attribute 6. Periodic channel migration
- Attribute 7. A functional floodplain
- Attribute 8. Infrequent channel resetting floods
- Attribute 9. Self- sustaining diverse riparian plant community
- Attribute 10. Naturally fluctuating groundwater table

The Restoration Program area is subject to the *Water Quality Control Plan for the North Coast Region* (Basin Plan), as amended June 28, 2001 for the North Coast Regional Water Quality Control Board (NCRWQCB). The Basin Plan for the North Coast Region includes all the land area that drains into the Klamath River and North Coast basins. The Trinity River is included in the Klamath Basin, and then further defined into distinct Hydrologic Areas. The Lower Trinity Hydrologic Area is that portion of the watershed that is downstream of Lewiston Reservoir.

The State of California has determined that the Trinity River is impaired in accordance with Section 303 (d) of the Clean Water Act due to excessive sediment. The primary adverse impacts associated with excessive sediment in the Trinity River pertain to the anadromous salmonid fish habitat. The State water quality standards consist of designated uses, water quality criteria to protect the uses, and an antidegradation policy.

The beneficial uses impaired by excessive sediment in the Trinity River are primarily those associated with supporting high quality habitat for fish. Changes in substrate composition have occurred because of increases in fine sediment (from increased watershed erosion and attenuation of sediment-transporting flows) and the reduction of coarse sediment (e.g., gravel) recruitment (due to the dams). Fine sediment fills in spaces between gravels and cobbles, which inhibits the percolation of water through these areas, degrading and reducing available spawning habitats. Sedimentation of spawning areas can inhibit flow (and thus oxygen) to incubating eggs as well as create an impenetrable barrier that prevents salmon sac-fry from emerging from their gravel nest. Accumulation of fine sediments can also decrease the amount of space between gravel and cobble, thereby decreasing the amount of available habitat for over-wintering juvenile coho salmon and steelhead that burrow into the substrate. Sedimentation may also decrease aquatic invertebrate production and diversity, thereby limiting the primary food source for juvenile salmonids.

Two documents address specific elements of water quality in the Trinity River Basin. The NCRWQCB "Interim Action Plan for the Trinity River" is incorporated into the Basin Plan and addresses flow and temperature issues in that portion of the river affected by the TRD of the CVP. The *Trinity River Total Maximum Daily Load for Sediment* (EPA 2001) identifies the total load of sediment that can be delivered to the Trinity River and its tributaries without exceeding water quality standards based on current flow conditions and estimated flows under the ROD.

The TMDL for sediment describes how seasonal variation in considered. Sediment delivery in the Trinity River watershed inherently has considerable annual and seasonal variability. Due to variability in terms of magnitude, timing, duration and frequency, the TMDL and load allocation applies to the sources of sediment and uses a ten-year rolling average.

The TMDL does not allocate flow; however, it does take into account critical conditions for flow, loading and water quality parameters. The control of the streamflow below the TRD has greatly contributed to the impairment of the Trinity River below Lewiston Dam (EPA 2001). The reduction in available coarse sediment upstream of Rush Creek and the significant contribution of fine sediment from Grass Valley Creek have severely affected the sediment flux in the river. These effects are observable as far downstream as the North Fork.

Trinity River water temperatures are also influenced by Trinity and Lewiston Reservoir release temperatures, flow rates, channel geometry, regional meteorology, and tributary flows and temperatures (the effect of Trinity and Lewiston Reservoirs diminishes with distance downstream). Generally speaking, the greater the release volumes from the dams, the less susceptible the river's temperature is to other factors. Trinity Reservoir releases tend to be generally cold (42-4_°F), whereas Lewiston Reservoir, which is much shallower, tends to provide releases that are more affected by ambient temperatures. All releases to the Trinity River emanate from Lewiston Reservoir.

Construction and operation of the TRD also changed the thermal diversity available to Trinity River anadromous salmonids. The dams blocked access to the upstream reaches that are dominated by snowmelt runoff and remain cool throughout the year. Prior to the dam, these areas provided important juvenile rearing and adult holding habitats for salmonids when the majority of the lower mainstem habitats (i.e., below Lewiston) had likely become too warm. The upstream tributaries (dominated by snowmelt) provided increased flows and decreased temperatures during the spring and early summer that aided smolt emigration through much of the mainstem. Because these habitats are now blocked by the TRD, and much of the snowmelt is retained in the TRD reservoirs, it is necessary to artificially maintain cooler temperatures below the dam than those that existed prior to the dam. In other words, the mainstem below the dam must now function thermally like the upstream reaches and tributaries (for anadromous salmonids). Exacerbating the problem is the decrease in geomorphic diversity below the dam. Prior to the TRD, water temperatures in the deep mainstem pools stratified; bottom layers were documented as much as 7 °F cooler than upper layers (Moffett and Smith 1950). The cool temperatures at the bottom of the pools provided important thermal refugia for migrating adult and rearing juvenile salmonids. The altered flow regime and channel geomorphology decreased or eliminated the temperature stratification in pools in the summer/early fall months. Although average post-dam monthly water temperatures at Lewiston are cooler than pre-dam temperatures during June to November, this benefit has not fully compensated for the lost thermal diversity in the system (i.e., above the dams) or for the reduction in stratified pools.

The NCRWQCB has defined temperature objectives that apply to activities in the Trinity River. Temperature standards are effective from July 1 to December 31 for the upper reach between Lewiston Dam and the North Fork Trinity River. Standards for the Trinity River are presented in **Table 5.2-1**. The objectives also stipulate that water released into the Trinity River may be no more than _°F warmer than receiving water temperatures.

TABLE 5.2-1
NCRWQCB TEMPERATURE OBJECTIVES FOR THE TRINITY RIVER

Temperature	Dates	Trinity River Reach
60 F (15.6 C)	July 1 – September 14	Lewiston Dam to Douglas City Bridge
56 F (13.3 C)	September 15 – October 1	Lewiston Dam to Douglas City Bridge
56 F (13.3 C)	October 1 – December 31	Lewiston Dam to confluence with North Fork

5.3 Biological Resources

The primary fish species of interest to the TRRP include the native anadromous salmonids Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), and steelhead (*Oncorhynchus mykiss irideus).* Of the three species, there are two races of Chinook salmon (spring- and fall-run) and three races of steelhead (summer-, fall-, and winter-run), which are differentiated based on the season of migration into the river. Some life history and habitat requirements of these species and the spawning populations within species are presented in **Table 5.3-1**.

TABLE 5.3-1
LIFE HISTORY AND HABITAT NEEDS FOR ANADROMOUS SALMONID FISH IN THE TRINITY RIVER BASIN

Species	Migration	Spawning	Rearing	Rearing Habitat Conditions
Spring-run Chinook	Spring - Summer	September-November	Winter-Spring-Summer	Shallow, slow-moving waters adjacent to higher water velocities for feeding.
Fall-run Chinook	Fall	October-December	Winter-Spring	Shallow, slow-moving waters adjacent to higher water velocities for feeding.
Winter-run Steelhead	Winter	February-April	Year-round	Areas of clean cobble where there is refuge from high velocities; juveniles over-winter for 1-2 or more years.
Summer-run Steelhead	Spring-Summer	December-April	Year-round	Areas of clean cobble where there is refuge from high velocities; juveniles over-winter for 1-2 or more years.
Fall-run Steelhead (includes 'half-pounder' life history)	Late-summer/Fall	December-April	Year-round	Areas of clean cobble where there is refuge from high velocities; juveniles over-winter for 1-2 or more years.
Coho	October-December	November-January	Year-round	Backwater areas of slow water and pool margins; juveniles over-winter 1 year.

Source: Leidy and Leidy 1984; USFWS et al. 2000a

All anadromous species begin their life in fresh water, migrate to the ocean to rear and mature, and return to spawn in fresh water. Although the three species have generally similar life histories they differ in the time of year they migrate and spawn, as well as when egg incubation typically occurs.

Adequate flows, temperatures, water depths and velocities, appropriate spawning and rearing substrates (e.g., riverbed gravels), and availability of instream cover and food are critical for the production of all anadromous salmonids. Spring Chinook salmon and summer steelhead also need long-term adult holding habitat in which pool size and depth, temperature, cover, and proximity to spawning gravel are important requirements. Newly emerged fry and juveniles of all species require rearing habitat with low velocities, open cobble substrate, and cool water temperatures. Emigration of smolts to the ocean and the immigration of spawning adults require adequately timed flows with the appropriate temperature, depth, and velocity.

Native non-salmonid anadromous species found in the Trinity River Basin include green sturgeon (*Acipenser medirostris*), white sturgeon (*Acipenser transmontanus*), and Pacific lamprey (*Lampetra tridentata*). These fish spend their early life stages in fresh water, migrate to the ocean for maturation, and return to their natal stream to spawn. Status information on native non-salmonid anadromous species residing in the Trinity River Basin is very limited. However, the Klamath/Trinity River Basin is known to contain the largest spawning population of green sturgeon in California. In contrast, only small runs of white sturgeon occur.

Resident native fish species found in the Trinity River Basin include game fish such as rainbow trout (*Oncorhynchus mykiss*). Anadromous brown trout were propagated in the Trinity River Salmon and Steelhead Hatchery (TRSSH) until 1977 when this practice was discontinued because of the small numbers and the lack of anadromous characteristics of fish entering the hatchery. Currently, brown trout are largely limited to the upper portions of the river, although some brown trout exhibit anadromous characteristics. Brook trout provide a significant sport fishery in the tributary streams and high elevation lakes of the Trinity River Basin. Its life cycle and habitat requirements are similar to that of brown trout.

For the purposes of this Strategic Plan, listed fish species include taxa that are (1) designated as threatened or endangered by the state or federal governments (i.e., "listed species"); or (2) are proposed or petitioned for federal threatened or endangered status; and/or (3) are state or federal candidates for threatened or endangered status. "Other" special-status fish species are identified by the USFWS as Species of Concern and/or are identified by CDFG as Species of Special Concern and/or California Fully Protected Species.

The SONCC ESU of coho salmon was listed as threatened pursuant to the ESA on April 25, 1997, and has greatest implications for the Restoration Program. This listing includes coho from the Trinity River and Klamath River Basins. Critical habitat for this ESU was designated on May 5, 1999. Critical habitat is designated to include all river reaches accessible to listed coho salmon between Cape Blanco and Punta Gorda. Excluded are areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). In the Trinity River Basin, designated critical habitat for the SONCC ESU coho salmon consists of the water, substrate, and adjacent riparian zone of those estuarine and riverine reaches (including off-channel habitats and accessible tributaries) downstream of Lewiston Dam (CFR Vol. 64, No. 86, May 5, 1999).

The 1983 EIS on the Trinity River Basin Fish and Wildlife Management Program (USFWS 1983) documented the in-river spawner escapement goals and the TRSSH production goals developed by the CDFG. The goals were subsequently adopted by the TRRP as escapement numbers. The in-river goals represent the total number of naturally produced adult spawners (excluding jacks) for the Trinity River Basin below Lewiston Dam and exclude fish caught by the fisheries (**Table 5.3-2**). The hatchery goals represent numbers of adult fish needed by the hatchery, exclusive of fisheries for chinook and coho salmon (an undefined in-river harvest is included in the restoration program goals for steelhead).

TABLE 5.3-2
TRINITY RIVER RESTORATION PROGRAM GOALS

Species	In-river Spawner Goals	Hatchery Goals	Total
Fall-run Chinook	62,000	9,000	71,000
Spring-run Chinook	6,000	3,000	9,000
Coho	1,400	2,100	3,500
Steelhead	40,000	10,000	50,000

Source: USFWS et al. 2000a

In-river spawner escapement is the number of fish returning to spawning grounds, which consists of two subgroups: naturally-produced fish and hatchery-produced fish. However, hatchery-produced fish are not considered to contribute towards the in-river spawner escapement goals of the TRRP, although their offspring do (i.e., if hatchery-produced fish spawn in-river and their offspring survive to return to spawn, these offspring are naturally produced by definition). The best available data indicate that large numbers of hatchery-produced fish spawn in-river. Typically, more fish spawn in-river than are spawned at the hatchery, and relatively fewer in-river eggs survive to return as adults. Assuming that hatchery- and naturally-produced fish are subject to the same environmental conditions after the hatchery releases its fish (typically as smolts), the relatively low returns of naturally-produced fish are indicative of lower survival rates of early fresh water life stages (i.e., eggs, fry, and/or juvenile fish), compared to hatchery-reared fish.

The Trinity River's native plants and animals are adapted to natural river flow patterns and habitat conditions. For example, salmon have adapted to the river's hydrology. Late fall and early winter rainstorms (the peaks in October through December) help draw adult salmon up into the river; winter base flows allow for spawning; and the spring snowmelt (April through June) assists juveniles in their journey to the ocean before the warm, low flows of summer. Plants that live along the river are similarly adapted - winter rainstorms and spring snowmelt floods scour away dormant seedlings and saplings growing too close to the river's edge; seeds released in the spring and early summer sprout higher up on the bank when the water level is high; and seedlings on these higher surfaces are able to grow during the slowly receding spring snowmelt, which has recharged the groundwater table. All of these patterns have implications for restoration activities.

Construction and operation of the TRD, combined with earlier (late 1800's) large-scale gold dredging, and other harmful land management activities, such as poorly planned timber harvest and road construction, have caused major changes in habitat conditions in the Trinity River basin. The Trinity and Lewiston dams block access to 59 miles of Chinook salmon habitat, 109 miles of steelhead habitat, and an undetermined amount of coho salmon habitat (USFWS 1994). Much of this habitat was prime spawning and rearing habitat. In the case of the Chinook, it represented 50 percent of spawning habitat in the basin. As early as 1980, overall decline in spawning habitat was estimated at 80-90 percent (USFWS 1980). Furthermore, elimination of the upstream reaches greatly reduced the diversity of the entire river system, thereby reducing habitat choices for salmonids.

Downstream of Lewiston dam, reduced river flows, increases in fine sediment input, and reductions in coarse sediment recruitment are the primary reasons why channel geomorphology has changed, resulting in the reduced quality, quantity, and suitability of fish habitat and reduced survival of freshwater life stages. The altered channel geomorphology reduced the number and quality of alternate bar sequences. Important salmonid habitats associated with alternate bars include pools that provide cover from predators and cool resting places for juveniles and adults; gravelly riffles where adults typically spawn; open gravel/cobble bars that create shallow, low-velocity zones important for emerging fry; and slack-water habitats for rearing juveniles.

Prior to dam construction the natural hydrograph of the Trinity River was characterized by high winter and spring flows followed by greatly reduced summer flows (with great inter-year variability). Large winter and spring floods maintained multi-age woody riparian vegetation via channel scouring, periodic channel migration, and varying seed distribution during flow recession. The result was a mosaic of early-successional willow-scrub vegetation combined with patches of more mature willow-alder and alder-dominated associations. Pre-dam aerial photographs indicate that approximately 300 acres of diverse riparian vegetation occurred between Lewiston Dam and the North Fork.

Construction of the TRD greatly reduced the magnitude of peak flows, obstructed coarse sediment input from above the dam, and allowed fine sediment to accumulate on channel features that had previously been regularly scoured by flood flows. The result is a more static system that is susceptible to expansion and maturation of woody riparian vegetation. Riparian vegetation has now increased in area by almost 300 percent (to approximately 900 acres) by encroaching into areas that had previously been scoured by flood flows. The expansion and maturation of woody riparian vegetation has had detrimental effects, including the formation of a riparian berm that effectively armors and anchors the riverbanks, thereby preventing the river from meandering within the channel. The establishment of these berms further exacerbates the encroachment and maturation of woody vegetation.

Existing riparian vegetation is most prevalent from the Lewiston Dam to the confluence with the North Fork. This reach includes approximately 330 acres of early-successional willow-dominated vegetation, 170 acres of more mature later-successional alder-dominated vegetation, and 380 acres of willow-alder mix. Between the North Fork and the South Fork, the Trinity River channel is restricted by canyon walls that limit riparian vegetation to a narrow band. In comparison to upstream reaches, peak flows in this reach have been impacted only modestly by dam operations. Between the South Fork and the Klamath River, the Trinity River alternates between confined reaches with little riparian vegetation to alluvial reaches with vegetation similar to pre-dam conditions in the reach between Lewiston Dam and the North Fork.

6.0 Adaptive Environmental Assessment and Management

6.1 The AEAM Process[6]

Adaptive Environmental Assessment and Management (AEAM) gives decision makers the ability to refine previous decisions in light of the continual increase in knowledge and understanding of a river system. This approach relies on teams of scientists, managers, and policy makers jointly identifying and bounding management problems in quantifiable terms. A well-designed AEAM organization: 1) defines goals and objectives in measurable terms; 2) develops hypotheses, builds models, compares alternatives, designs system manipulations and monitoring programs for promising alternatives; 3) proposes modifications to operations that protect, conserve and enhance the resource; 4) implements monitoring and research programs to examine how selected management actions meet resource management objectives; and uses steps 1-4 to further refine ecosystem management to meet the program's stated objectives.

6.2 Research Capabilities

The key organizational component of AEAM is the Technical Modeling and Analysis Group (TMAG), an interdisciplinary team of resource specialists and scientists responsible for conducting and managing complex technical studies and projects, and integrating these products into management objectives and recommendations to be used in restoration activities. The TMAG conducts technical analyses, models projections for achieving restoration objectives, evaluates new designs for comparison with past approaches, and coordinates peer reviews. The TMAG oversees scientific evaluation of and provides design recommendations for rehabilitation projects including: bank rehabilitation, gravel augmentation, riparian re-vegetation, floodplain creation, sediment management, and watershed rehabilitation.

Members of the TMAG integrate multi-disciplinary information and identify alternatives to resolve conflicting ecological management needs. They coordinate with the Rehabilitation and Implementation Group (RIG) and present analyses and recommendations to the Executive Director and the TMC for resolving conflicts and assessing management needs. Specific tasks include short-term research project development and oversight, and long-term trend monitoring development and oversight. This group sets standards and protocols for monitoring information, and ensures effective data management, storage, analysis and distribution. The TMAG solicits technical input and review from stakeholder groups and regulatory agencies. They analyze and submit implementation plans for scientific peer review, as well as coordinate review from the Scientific Advisory Board (SAB). TMAG members recommend design standards and techniques to the RIG for rehabilitation activities and Objective Specific Monitoring. They develop Requests for Proposals (RFPs) and prepare statements of work for technical studies and monitoring.

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[6] Excerpted and summarized from Appendix C – Implementation Plan for the Preferred Alternative of the Trinity River EIS/EIR, December 2000.

6.3 Engineering Capabilities

The Rehabilitation Implementation Group (RIG) is responsible for implementing site-specific planning, design, and construction activities associated with AEAM. These activities include, but are not limited to, collecting planning and design data, evaluating project alternatives, preparing designs, awarding contracts and conducting quality control inspections; managing construction of bridge alterations and replacements, rehabilitation projects, gravel augmentation, riparian revegetation, sediment control, and objective-specific monitoring. This group also performs field investigations and surveys, assures availability of photogrammetry and mapping, and arranges access (rights-of-way) for TRRP activities. The RIG conducts and/or coordinates all necessary environmental permit requirements, including NEPA/CEQA compliance, realty actions, public involvement, and landowner contacts needed for the development of project alternatives, and various access and maintenance agreements.

The RIG works in close cooperation with the TMAG, and presents analyses and recommendations to the Executive Director and TMC for resolving conflicts and assessing management needs. The RIG solicits technical input review from stakeholder groups and regulatory agencies. It prepares project designs in collaboration with the TMAG, including development of technical specifications, plans, and drawings. The group supervises and approves the preparation of service and supply contracts, develops Requests for Proposals (RFPs), prepares statements of work for implementation activities, and provides related assistance to the TMAG. .

6.4 Information Management

An Integrated Information Management System (IIMS) provides a comprehensive logical structure to integrate spatial (geographic) and tabular data along with photographs and graphics to support the AEAM process. The Integrated Information Management System is a tool to support the TMAG and other Trinity River Restoration Program scientists in their endeavors to enhance the understanding of ecosystem functions and environmental processes and in identifying and filling critical information gaps. The IIMS will also facilitate integration and sharing of baseline and monitoring data; serve as a feature location database for monitoring and analysis; provide a tool for ecological and physical modeling; and allow visualization of data and simulations to facilitate sound management decisions.

There are three fundamental components of the Integrated Information Management System: 1) relational databases, 2) geospatial data, and 3) digital archives. Together they will facilitate consolidating, storing, and distributing data gathered and generated as part of Trinity River Restoration Program's monitoring, modeling and research projects.

A GIS-based Information Management System provides the ability to relate diverse datasets in ways that cannot be done on paper maps or with numeric data bases and to analyze information over this large diverse land area. Tracking and illustrating current resource conditions, along with spatial modeling techniques, can help predict probable changes to resources based on different management alternatives, making the IIMS a valuable tool in improving the efficiency and accuracy of decision-making by scientists, managers and policy makers.

6.5 Education and Outreach

Public information, education, and outreach activities are an important part of AEAM, designed to expand public knowledge of the program in order to improve the likelihood of success, acceptance, and support for restoration efforts. The primary objective is to reach local residents, landowners, schools, elected officials, as well as other non-resident stakeholders through such means as newsletters, brochures, open houses, annual accomplishment reports, and portable exhibits. As part of this effort, the multi-agency nature and unique program identity of the TRRP is to be emphasized.

The major benefit of this proposal is a more informed group of stakeholders, who will be better able to participate in public meetings, review draft documents, and provide useful comments to program staff while developing a sense of ownership in program goals, objectives, and actions.

7.0 Project Scheduling and Budget *(Cost estimates and approximate time schedules)*
Shown for illustrative purposes only at this time.

Major Activity Schedule (Partial)

Activity	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
	----SEIS/new ROD-----|					
	|--Science Framework---|					
	|-------------On-going Monitoring and Evaluation---------------------------|					
	|--Bridge Construction Complete ----|					
	|--Gaging Network Upgrade--|					
	----Hocker Flat Pilot----|					
	|-Other Canyon Cr. Designs-|					
		|--Other Canyon Creek Construction---|				
			|-----Other Site Rehab Designs-----|			
				|--Other Site Rehab Construction---|		
	|--Rush Creek Study-|					
		|--Rush Cr. Construction--|				

Multi-Year Budget (Preliminary)

Activity	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
SEIS						
Science Framework						
Monitoring						
Bridge Construction						
Gaging Network						
Hocker Flat Pilot Project						
Channel Rehab Designs						
Channel Rehab Construction						
Watershed Restoration						

APPENDIX A

Summary of Populations, Habitat, Biology, and Range
for Anadromous Salmonids of the Trinity River