Summary Information

California State University, Chico

Sacramento River Riparian Monitoring and Assessment Project

Amount sought: $3,222,967

Duration: 36 months

Lead investigator: Dr. David Wood, California State University, Chico−Research Foundation

Short Description

This project will measure a range of physical and biological indicators for ERP and AFRP−funded projects within the Sacramento River Ecological Management Zone (Red Bluff to Colusa) and compare them to previous conditions and reference systems in order to test whether restoration actions have been successful in improving riparian forest conditions and forest interactions with aquatic processes. Because local and regional perceptions of restoration can affect the implementation and effectiveness of ecosystem improvements, we will also test the effects of these restoration efforts on human attitudes towards ecosystem restoration.

Executive Summary

Sacramento River Riparian Monitoring and Assessment Program

The riparian corridor between Red Bluff and Colusa is one of the richest and most diverse habitats remaining in California. Since about 1850 this reach has undergone a number of hydrologic, geomorphic, and environmental changes. These changes are caused by dams and diversions, flood control and regulation, bank protection, pollution, hydraulic mining, gravel mining, urbanization, removal of riparian vegetation, agriculture, and logging. These activities can disrupt the equilibrium of river ecosystem in complex ways with consequent ecological and physical changes (See Ecosystem Restoration Conceptual Model developed for this proposal package). This has lead to significant restoration investments by CALFED, many of which have unknown or un−measured benefits. We propose to measure a range of physical and biological indicators for ERP and AFRP−funded projects within the Sacramento River Ecological Management Zone (Red Bluff to Colusa) and compare them to previous conditions and reference systems in order to test whether restoration actions have been successful in improving riparian forest conditions and forest interactions with aquatic

processes. Because local and regional perceptions of restoration can affect the implementation and effectiveness of ecosystem improvements, we will also test the effects of these restoration efforts on human attitudes towards ecosystem restoration.

We will provide several products to the ERP critical to understanding restoration effectiveness and informing the future evaluation of restoration actions. 1) Evaluation of effectiveness of restoration at particular sites and across the study area in achieving specific project goals and CALFED goals. 2) A Sacramento River Ecological Management Zone Monitoring Plan, including key environmental and social indicators for measuring restoration project and program success. 3) Inclusive and collaborative processes for designing evaluation approaches, primarily through the Sacramento River Conservation Area Forum. 4) Publications and a conference describing the approaches, the findings and recommendations for future restoration success.

As a result of its altered hydrology, competing demands, and reduced latitude to meander, the post Shasta Dam Sacramento River riparian system requires the implementation of adaptive management to achieve sustainable ecosystem processes and function. ERP, AFRP and CVPIA actions to restore the dynamic interactions among riparian forest, the active channel, and the floodplain along the Sacramento River will improve habitat for fish and wildlife. Fish benefit from complex riparian areas that become flooded at high flows, slow floodwaters down, and provide refugia for young and juvenile fish. Salmon reproduction and species like the bank swalow will be aided by restoration of both riparian forests and the dynamic interactions between forest and channel/floodplain. Populations of species of management concern like the Valley Elderberry Longhorn Beetle and the Yellow−billed cuckoo will benefit from the restoration of native riparian forest habitat. Our project will evaluate the extent to which the ERP and AFRP−funded projects have brought about these improvements.

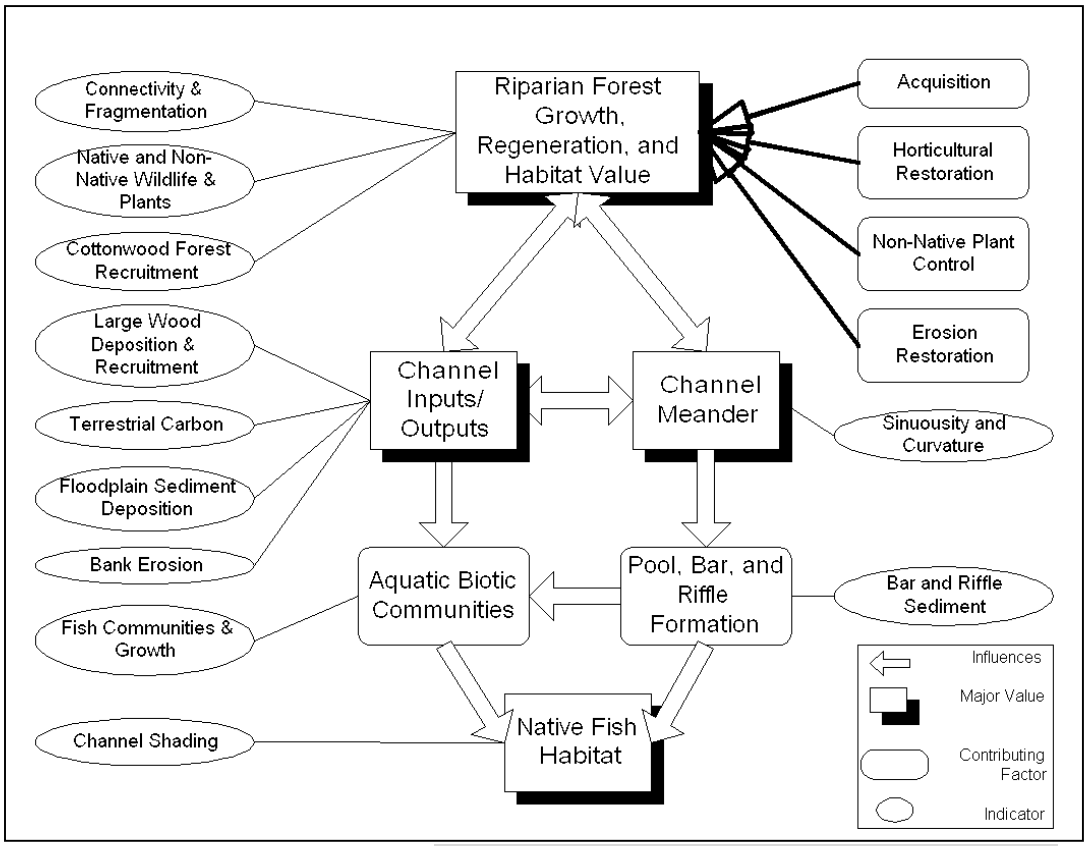
Sacramento River Riparian Monitoring and Assessment Project

A. Project Description:

1. Problem, Goals, and Objectives

The goal of this project is to evaluate for the Ecosystem Restoration Program whether the habitat and populations of certain endangered and other at-risk species are recovering, whether the ecological processes are being rehabilitated, protected and restored, and whether the impacts from non-natives invasive species are being reduced for ERP and AFRP-funded project sites within the Sacramento River Ecological Management Zone. This level of information is critical for the evaluation of species of concern (i.e., Valley elderberry longhorn beetle, salmon, etc.), not to mention assessing the overall success of ERP within this area of Sacramento River Ecological Management Zone. Currently the only information that ERP has is basic information on whether or not their projects are being implemented as described in the contract, while lacking essential ecosystem performance and condition information.

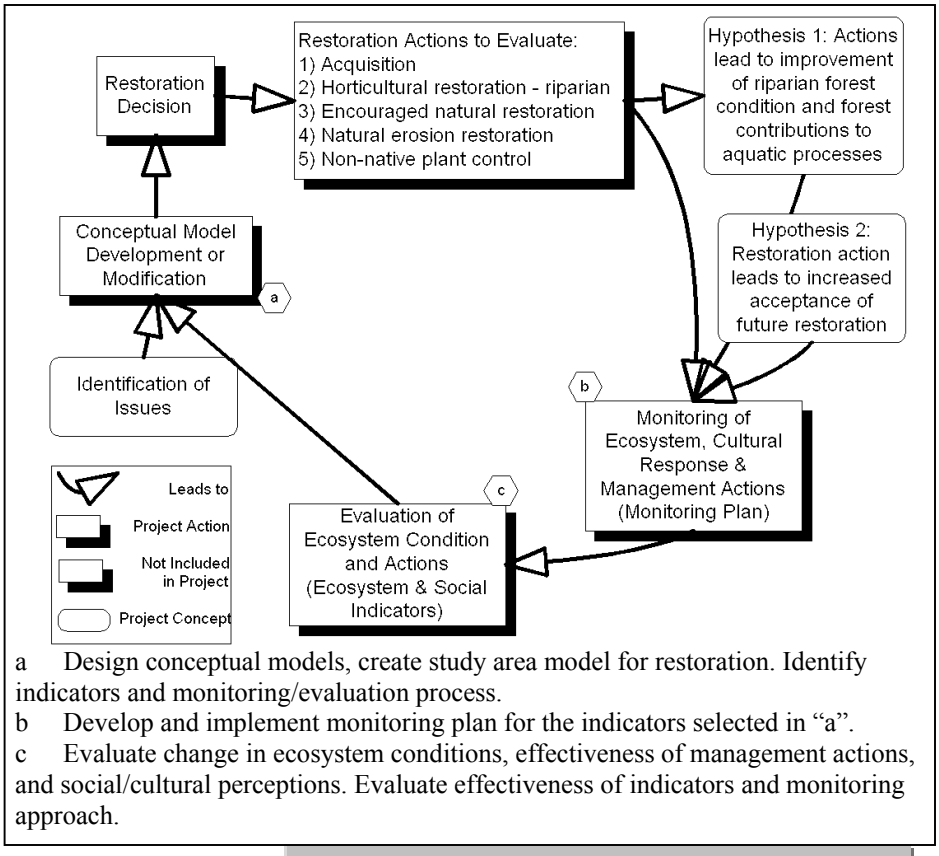
This region lacks a comprehensive monitoring program, which is needed to evaluate the effectiveness of multiple restoration actions within the Sacramento River Ecological Management Zone. We will work with others active in the Zone (e.g., River Partners and The Nature Conservancy) to develop standardized monitoring approaches and indicators for evaluating restoration success. In addition, there is a lack of information on whether similar projects are (1) achieving the goals outlined in their project descriptions, and (2) cumulatively are meeting the intent of the ERP milestones and goals. We propose an integrated monitoring program to evaluate the success of riparian restoration projects in restoring riparian and channel habitat and processes, as well as the dynamic interaction between riparian forest, the active channel and the floodplain. We propose a three-stage approach. In year 1 we will compile existing data and solicit expert input through technical advisory committees to refine our proposed restoration evaluation monitoring methods and metrics. Through this process we will identify gaps in existing data and prioritize indicators for monitoring, which will begin in year 1. During year 2 we will proceed with environmental data collection to evaluate success of restoration. In the latter half of year 3 we will critically analyze the data and use the data to evaluate the performance of CALFED-funded restoration actions, make recommendations about how to improve restoration efforts, and inform the adaptive management process.



Ecosystem Restoration Conceptual Model

2. Justification

The ecosystem conceptual model for the Sacramento River riparian corridor showing the relationships among actions, responding ecosystem functions, and indicators of response is shown above. Arrows indicate influence. In addition, we will incorporate our effectiveness monitoring and evaluation into the ERP adaptive management cycle, as shown in the figure to the right entitled "Restoration Program Effectiveness Conceptual Model".



a Design conceptual models, create study area model for restoration. Identify indicators and monitoring/evaluation process.
b Develop and implement monitoring plan for the indicators selected in "a".
c Evaluate change in ecosystem conditions, effectiveness of management actions, and social/cultural perceptions. Evaluate effectiveness of indicators and monitoring approach.

Restoration Effectiveness Conceptual Model

We have two primary hypotheses which we will test in this project: 1) ERP and AFRP-funded restoration actions in the Sacramento River Ecological Management Zone have resulted in measurable positive changes in ecological rate processes and attributes. 2) The ERP and AFRP-funded restoration actions have resulted in increased support for ecosystem restoration in local and regional communities and users.

We will focus on the dynamic interactions between riparian forest processes and the channel and floodplain. This dynamic zone is not well understood and the impacts of large-scale horticultural, acquisition, and flow restoration actions are not known. Aspects of the system are better understood in isolation because of recent CALFED-funded projects (e.g., cottonwood recruitment response to flow regimes and channel migration) and will provide the basis for this integrated study. Successful restoration of the dynamic fluxes between the terrestrial and aquatic environments will be a hallmark of programmatic success and will benefit salmon, Valley Elderberry Longhorn Beetle (VELB), the Yellow Billed Cuckoo, bank swallows, and other species of concern.

3. Previously Funded Monitoring

In Attachment 1 we provide a map of the area showing the projects in the study area to be evaluated across the restoration continuum (i.e., from restored public lands to private lands under easements). In addition, in Attachment 1 we provide a table summary of each action, including the location, current status (highlighting accomplishments to date) and a timeline for completion. Also noted are any outstanding implementation issues.

In coordination with past project proponents and with funding secured under this PSP we will provide the Ecosystem Restoration Program (ERP) with a full description of the problem that the previous restoration action(s) addressed. We will work with the project directors to identify the project goals, objectives and hypothesis if one was previously identified. Collectively we will determine the measurable elements from each objective so that progress towards them can be assessed. Our review of the previously funded programs will define the analytical and statistical methods used to quantify and assess the projects, their current status, any links to a conceptual models and performance measures that

they propose to evaluate and their accomplishments to date. We will collect monitoring information they have generated, their conclusions and, determine if previously-funded monitoring aspects of these studies have been completed. We will note any outstanding regulatory or implementation issues, the funds remaining from prior grants to complete them, and will layout a timeline for their completion.

4. Approach and Scope of Work
(NB: Detailed protocols for each subtask are contained in Attachment 2)

Project Summary

The Sacramento River is the largest, most complex, productive and regulated meandering river system in California. It is managed for the often-conflicting needs of public safety, water supply and quality, navigation, and the environment. Historic estimates show that over 500,000 acres of rich riparian forests have been depleted to approximately 5% of that area. California Indians have cultivated the landscape for thousands of years (Stevens 2003, 2004), including a remaining handful of continuously tended sites remain along the Sacramento River, which have been identified as extremely important cultural resources by local tribes. The CALFED ERP targets for the Sacramento River Ecological Management Zone (EMZ) between Red Bluff and Colusa include;

- Protection of the associated riparian forest,
- Maintaining flows that emulate the natural hydrology and seasonal patterns for maintenance of the limited existing riparian corridor,
- Managing and restoring a functioning ecosystem that provides a mosaic of varying riparian forest age classes.

This project will result in an integrated evaluation of the effectiveness of ERP and AFRP-funded projects in providing positive ecosystem responses and social acceptance of restoration projects in the Sacramento River Ecological Management Zone (Red Bluff to Colusa). The project focuses on the dynamic zone between the active channel and the riparian forest/floodplain. We will measure contributions from the channel to the floodplain and riparian areas and from these areas back to the channel because these dynamic exchanges are key to the health of the ecosystem and therefore the performance of ERP and AFRP within the Sacramento River Ecological Management Zone. We will center our attention on parcels acquired and/or restored with ERP and AFRP funding and compare attributes of these sites with historic or previous conditions (when known) and un-restored sites.

We will describe a monitoring approach and panel of environmental and social indicators for continued monitoring and evaluation of the performance of the restoration sites and program. This plan will be developed by our team of scientists, resource agency personnel and the various stakeholders identified through our Outreach Plan being developed by the Sacramento River Conservation Area Forum (SRCAF) to support future ERP decision-making. This approach and these indicators will be an important source of information for the development of the proposed "Ecosystem Restoration Program Strategic Plan" for the Sacramento River Ecological Management Zone. For the monitoring plan, we will first collect and identify existing monitoring methods and findings in the study area (during year 1). We will describe this plan in the context of the monitoring of channel and riparian forest processes that we will be measuring concurrently. During the second year, we will complete a feedback loop between the formulation of the monitoring plan and the collection of new monitoring data to inform the selection of particular approaches. We will also interact with monitoring teams in the Sacramento River riparian corridor (if funded), as well as the proposed Cosumnes River/Yolo Bypass monitoring study proposed by UC Davis scientists and others. In the third year, we will evaluate the choice of particular methods and metrics based on the findings of the monitoring studies. Using this information we will develop a final proposed monitoring plan. For draft and final versions of the plan, we will rely on the expert input of the Sacramento River Conservation Area Forum.

A key component of this project will be the development and description of a panel of environmental indicators that reflect the attributes (e.g., riparian gallery forest) and rate processes (e.g., rate of large wood recruitment into the channel) of the restoration area. These indicators will be chosen based on cost-effectiveness and their reflection of the natural processes of concern. The development of the indicators will take place in coordination with other proposed and actual indicator systems, such as the proposed Cosumnes River/Yolo Bypass study (UC Davis et al.) and the Bay Institutes recent collaborative work in the Delta region (Pawley, personal communication). Accompanying the environmental indicators will be set of social indicators that will be used to evaluate the performance of ERP and AFRP funded projects in increasing support for restoration in the Conservation Area. They will be selected so that they can reflect local and regional perceptions and can be measured periodically in order to gauge the continuing perception of communities neighboring the Conservation Area.

The culmination of this project will be an overall evaluation of the effectiveness of acquisition and restoration actions taken over the last 9 years by ERP and AFRP. During each task listed above, the condition of the specific indicator will be evaluated relative to a previous condition or another standard from the scientific literature. For certain metrics, the distribution of sampling and analysis will allow for evaluation uniformly throughout the study area (e.g., fragmentation analysis), for other metrics, the sampling will be limited to a sub-set of restoration sites, allowing for the evaluation of the types of restoration site and action. For certain metrics and locations, there will be insufficient historic information to provide a "pre- and post-" restoration evaluation. In those cases, the information collected will serve as the baseline for a continuing monitoring program.

TASK 1: Project Management (Administrative and Technical)

SUBTASK 1.1: OVERSEE TECHNICAL ASPECTS OF ENTIRE PROJECT AND COORDINATE WITH PROJECT DIRECTOR (WOOD, SHILLING)

A) Members of each scientific area meet to provide interface among all technical areas of project.

An important component of the project is the integrated nature of the studies, which measure different aspects of the ecosystem. Communication among the project researchers is essential to maintain project cohesion. In the first year we will have two large groups meetings of all those involved in the monitoring effort to coordinate and solicit feedback on proposed monitoring protocols. We will have additional meetings of the different subgroups to solicit technical input on specific subsets of monitoring parameters. After collecting data in year 2, we will reconvene the different subgroups and the larger group to evaluate the success of restoration and revise monitoring protocols.

B) Provide descriptions of findings to the project team, other monitoring teams, and CALFED.

Communication within the team and between the team and other monitoring programs is essential to both leverage limited resources and to provide rapid sharing of information to allow adaptive monitoring responses among monitoring programs and with CALFED.

SUBTASK 1.2: PROJECT ADMINISTRATION (COOPER-CARTER)

A) Develop all subcontract agreements, invoicing processes, quarterly and final reports

Timely administration of all contractual and invoicing needs is critical to the successful completion of deliverables. Quarterly and Final report records are essential to keep program participants updated on our progress and for reporting on findings.

TASK 2: Monitoring Riparian Forest Processes

SUBTASK 2.1: MAPPING AND ANALYSIS OF RIPARIAN LAND USE AND COVER (NELSON, SHILLING)

A) Update existing (1999) map of vegetation, land use, and ownership in the Sacramento River Ecological Management Zone (Red Bluff to Verona).

Since the early 1990's, over 5,000 acres of the upper Sacramento River Ecological Management Zone (Colusa to Red Bluff) has either been purchased or has come under state and federal resource agency easements. As a result, many thousands of acres of land have been purchased with the intent of being restored to their natural state. One simple performance measure of the effectiveness of these programs is to spatially measure change along the SRCA through a comprehensive mapping program.

We will begin our comprehensive monitoring effort in the Sacramento River Ecological Management Zone with a revision of the land cover map. Once this has occurred, it will be possible to run various ecological modeling programs, analyze forest growth, and model responses to and from the river ecosystem. As monitoring begins on the river, we will incorporate certain quantitative information into a comprehensive GIS. We will use this approach as a simple way to share information with agencies and institutions doing work on the region using the Riparian Corridor GIS. Through our Information Dissemination Plan we will develop a comprehensive information sharing strategy clearly identifying all of the organizations that could assist us in disseminating this data.

Aerial color photography will be conducted during several specific times of the growing season when leaves are present in the riparian forest, the digital images ortho-rectified, and images made available as TIFF files. Orthophotos will pass U.S.G.S. Map Accuracy Standards and be projected into UTM-meters (Universal Transverse Mercator) and NAD 83. Images will be "heads-up" digitized and saved as a SHP file. Metadata will also be generated describing the maps and mapping process. Metadata are invaluable to others who may want to use the data in monitoring or other efforts. Monitoring data collected through this proposal will be entered into a Sacramento River database that would be available to other researchers. The GIC would be responsible for database upkeep and information distribution. All data and metadata creation and updating will meet Federal Geographic Data Subcommittee guidelines (http://www.fgdc.gov).

B) Evaluate fragmentation and connectivity among habitat blocks/patches in the Conservation Area.

Mapping land cover in the SRCA is only one step in the monitoring and evaluation effort. Data analysis provides a series of clues to what has been going on in areas where restoration has been occurring. Modeling programs like FRAGSTATS and Patch Analyst (ESRI) include metrics that provide information about the degree of fragmentation in the riparian forest and across the landscape, quantifying landscape patterns, and providing a way to look at abrupt discontinuities (boundaries) that interfere with critical ecological processes necessary for wildlife and plant populations and ecosystem health. We will use FRAGSTATS to analyze fragmentation and connectivity in the restored, remnant, and un-restored riparian forest. These fragmentation metrics will be important and cost-effective indicators of project and program performance by site and across the entire study area.

SUBTASK 2.2: MEASURE RIPARIAN FOREST ATTRIBUTES AND PROCESSES ACROSS THE CONSERVATION AREA (WOOD, HOLL, MORGAN)

We propose to monitor and analyze the following commonly-measured vegetation metrics (Holl & Cairns 2002) vegetation structure and cover of native and exotic species as indicators of success of the Calfed ERP goal of "restoring functional upland and riparian habitats". We will first use existing data sets from Wood (Wood 2003a,b,c), Holl (Holl & Crone 2004), Golet (unpublished data of TNC),

Efseaff (unpublished data of River Partners), and Cepello (unpublished data of DWR) to identify data gaps in our understanding of whether current restoration practices are successful in restoring vegetation communities. We will then gather selected additional data to fill those gaps and expand our ecological and geographic scope. The result will be a comprehensive monitoring of vegetation metrics in both restoration sites and remnant forests over a range of spatial and temporal scales.

A) Continue established monitoring of forest community structure and composition in restored and remnant riparian forest patches across the Conservation Area.

Vegetation structure: Woody vegetation structure has long been demonstrated to be an important indicator of habitat quality for birds (Karr 1968, McDonnell & Stiles 1983, Small et al. 1999) and forest regeneration (Mueller-Dombois & Ellenberg 1974). More recently, flooded forest habitats have been shown to be important for growth and survival of native fishes that are a primary target of CALFED ERP efforts (Sommer et al. 2001, Ribeiro et al. 2004). Horticultural restoration as currently practiced (Alpert et al. 1999) provides the raw material (i.e. planted native woody species), but forest community structure must develop *in situ* in response to ecological factors. Wood (2003c) has previously collected vegetation data in 106 permanent 20 × 30 m plots at six TNC restoration sites, along with soil stratigraphy data. In addition, Wood (2003a) has monitored cottonwood and willow recruitment along newly formed point bars, and Wood (2003b) has collected community structure data from 20 permanent plots in remnant forest to document reference conditions for restoration (cf. Stephenson 1999). The proposed project will quantitatively monitor the development of forest community structure, using existing methods, in additional restoration sites to cover a greater range of soil type, elevation, land use history, and landscape configuration. These data can then be used in habitat models for birds and other wildlife (Small et al. 1999).

Native species cover: One of the main goals of horticultural restoration is to increase native species cover, and thus biodiversity, of both woody and herbaceous species. Many native species are important in determining wildlife value of these restored sites (Small et al. 1999) and may also have cultural importance (Stevens 2003). Holl and Crone (2004) collected data on both native and exotic herbaceous vegetation cover in 553, 1 × 1 m quadrats along a systematic grid at a total of 15 restored sites in 2000. In this proposal, we intend to increase the geographic coverage of our sampling and to evaluate the effect of more recent restoration efforts that incorporate a wider diversity of overstory species and actively plant native understory species. By combining these data with the mapping efforts described above we will be able to identify potential local and landscape environmental factors influencing restoration success, also providing guidance on future restoration efforts. For example, Holl & Crone (2004) found that increasing overstory cover and reducing exotic cover were much more important than proximity to forest for unassisted establishment of native understory species.

Exotic species cover: Reducing exotic species cover is a goal of the Calfed ERP because exotics compete with native species and impair ecosystem function (Zavaleta et al. 2001), and because farmers have concerns about the spread of exotic weeds and other pests from restoration sites onto agricultural lands. Some noxious invasive species have colonized restoration sites (e.g. *Arundo donax, Centaurea solstitialis*; Wood 2003b). The additional sampling described above will substantially increase the database on the diversity and extent of exotic species in restoration sites and to determine whether this diversity and extent is changing over time.

SUBTASK 2.3: MONITOR TERRESTRIAL ARTHROPODS (HUNT)

We will sample native and non-native (e.g., Argentine ants) arthropod assemblages within at least 3 categorical habitat types (young and old restoration sites, and remnant riparian forests) along the Sacramento River. Existing (Hunt, 2004) and new pitfall trap data will be used. There will be a five year gap (2001 to 2006) between the old and new data sets, allowing for analyses of response to habitat change. The collection of new pitfall trap data is vital to allow this analysis. In addition to analyzing

pitfall trap data for response to habitat type, existing and new data pitfall trap data can be analyzed in other ways (e.g. native versus nonnative species, and trophic groups). A morphospecies (or Recognizable Taxonomic Unit; RTU) approach makes Malaise traps and Burlese funnels feasible with limited time and funding, and will provide insight into how different arthropod assemblages are responding to habitat restoration. All trap samples (pitfall, Malaise, Berlese) will be sorted to RTU's and abundances recorded. Trap data from all collection methods will be entered into a relational database.

SUBTASK 2.4: MEASURE COTTONWOOD RECRUITMENT (MORGAN, CEPELLO)

B) Measure and characterize current rates of cottonwood recruitment

Several western North-American studies have recognized flow-related declines in the extent and health of riparian cottonwood ecosystems (Rood and Mahoney 1990, Bradley et al. 1991, Braatne et al 1996, Mahoney and Rood 1998) and furthermore, flow alterations could affect every stage of the cottonwood recruitment process. The cottonwood species is an indicator of ecosystem health and riparian forest condition, and, therefore, in addition to vegetation community sampling we will do detailed measured of cottonwood recruitment as a focal species. This subtask will describe specific growth attributes of this primary successional riparian phreatophyte in response to current hydrology. This study will assess progress towards meeting selected CALFED ERP goals that include restoration of ecological processes and improving essential terrestrial habitats within the Sacramento River EMZ and complements the ERP funded effort 167DA with The Nature Conservancy (2002). Data developed through this monitoring project will be useful in planning individual floodplain restoration site projects. The ERP Riparian and Riverine Aquatic Habitats Programmatic Action 1C, Restoration Target 1 states the need to "implement a study to determine appropriate conditions for the germination and establishment of riparian woody plants along the river". Data provided from this study will help describe flow regime components critical to the sustainability of cottonwood forests and conditions for establishment. Multiple years of data will also add to development of methodologies for measuring regeneration success in a large complex alluvial river system.

Understanding the efficacy of natural forest regeneration within the context of large-scale restoration within the Sacramento River Ecological Management Zone will provide perspective on ERP's conservation strategy and potential for long-term success. A critical component for the identification of flow prescriptions suitable for ecosystem restoration includes requirements for natural recruitment of riparian vegetation. The overall objectives are to develop field methodology, standardized monitoring study protocols, and document observations of cottonwood regeneration for three years. Data provided from this study will help identify flow regime conditions required by cottonwood seedlings for establishment along the Sacramento River consistent with the CALFED White Paper (2000a). This hydrogeomorphic and phenological study will be located within the EMZ between Red Bluff and Colusa (Attachment 1) and addresses the conceptual model for cottonwood establishment presented in the CALFED White Paper.

This monitoring project will continue efforts towards understanding critical unknowns for Sacramento River Fremont cottonwood establishment conditions such as timing, length, and viability of seed release, bank elevations corresponding to seedling desiccation and scour, maximum seedling root growth, survivable rate of water table decline, soil moisture and texture characteristics, and field conditions of water table dynamics.

TASK 3: Monitor Channel Processes

In 1992, the United States Fish and Wildlife Service identified woody debris as a critical component to Shaded Riverine Aquatic Cover (SRA), a Resource Category 1 habitat on the Sacramento River (USFWS 1992). Over the last 30 years, large woody debris (LWD) has been described in

fisheries, ecological, and fluvial geomorphological literature as an important indicator of river geomorphic process, function, habitat creation, and overall systemic health (Gurnell et al. 2002). Woody debris also directly impacts navigation, water safety, and infrastructure. While published studies have attempted to track the input, movement, and residence time of large woody debris in river systems, research is limited on systems as large as the Sacramento River.

Input of LWD can be related to three distinct historic sources on the Sacramento River; riparian forests and orchards along the mainstem, the upper watershed (above Shasta Dam), and tributaries below Shasta Dam. Construction of the Shasta Dam in 1943 cut off LWD input from the upper watershed. Operations to remove wood from Lake Shasta for navigation purposes confirm the loss of a substantial large woody debris contribution to the river below Shasta Dam. Little is known about the influence of LWD inputs from tributaries of the Sacramento River, however, personal accounts confirm large volumes of wood transported into the valley from tributaries like Big Chico, Cottonwood, Cow, Deer, and Mill Creeks during high flow events. Due to bank erosion, LWD input to the Sacramento River, specifically between Red Bluff and Colusa (Figure 1), is dominated by the recruitment of riparian forest and orchard trees along the mainstem. Land use changes, bank protection, levees, and declines in riparian forest along the river further restrict the historic input sources available for LWD recruitment.

Research shows that the essential role riparian forests play in river ecosystems continues long after the trees have died. Woody debris on the margins of the channel are critical habitat for threatened and endangered salmonids, providing hydraulic diversity, shade, cover, and access to food sources. Channel morphology and sedimentation are influenced by in-stream debris, while debris on the floodplain (both fallen and deposited) is an important component of forest diversity. Once a tree begins its journey down the Sacramento River, it may act in one or more of these roles at different times, at multiple locations, along the way.

Several CALFED Ecosystem Restoration Plan (ERP) activities have the potential to directly affect the amount of LWD in the Sacramento River and, as additional land is acquired and restored, this potential will increase in the future. According to CALFED Milestone 60, over 5,800 acres have been restored, or will be restored, in pursuit of the ERP action to *Complete protection and restoration of the Sacramento River meander corridor as part of the Sacramento River Conservation Area/SB 1086 program, including easement or purchase of an additional 15,000 acres, revegetation, and restoration of stream meander function by the end of Stage1* (CALFED 2004, CALFED 2000a). In addition to land use changes, CALFED has identified multiple Restoration Targets and Programmatic Actions for ecological processes in the Sacramento River Ecological Management Zone (EMZ), which have the potential to increase the amount of woody debris in the Sacramento River (CALFED 2000b). These processes include stream meander, natural floodplain and flood processes, and habitats (riparian and riverine aquatic habitats and freshwater fish habitat and essential fish habitat). Understanding the importance, flux, and trends of woody debris is essential for adaptive management of the Sacramento River, as it is an indicator of all the these processes, and for addressing stakeholder concerns.

SUBTASK 3.1: MEASURE AND CHARACTERIZE RECRUITMENT OF LARGE WOODY DEBRIS DUE TO CHANNEL BANK MIGRATION (LARSEN, HENDERSON)

A) Measure and characterize current rates and spatial extent of large woody debris recruitment due to channel bank migration. This task will produce comprehensive estimates of recent rates and spatial patterns of large woody debris recruitment due to channel migration and measure current tree stem sizes on existing near-channel cut bank surfaces to quantify the amount of woody debris recruitment per area of land reworked.

B) Measure and characterize historic (background) rates and spatial extent of large woody debris recruitment due to channel bank migration. This analysis establishes historic background rates and locations of large woody debris input into the Sacramento River channel and serves as the baseline for subsequent analyses.

Understanding erosion patterns is key to predicting large woody debris recruitment within the riparian corridor of the Sacramento River. We will conduct a study of rates and spatial patterns of historic erosion. This will include calculating rates of erosion at both the bend and entire reach scale, documenting the spatial patterns of erosion, and identifying the fluvial process that created the erosion (avulsions vs. migration). Using historic channel mapping of channel features, based on a mapping classification system by Greco et al. (2003a), we will calculate rates of area reworked for time increments between 1937 and 1997 in the reach of the Sacramento River between Red Bluff and Colusa. This part of the subtask will coordinate with past and proposed work by DWR. Historic land cover will be analyzed by DWR. Tributary input will also be considered (in coordination with DWR estimates of a known tributary.). Stem density and size for each larger vegetation class will be quantified. Using these data, we will back-calculate the amount of recruitment from 1937 up to the present using past channel and vegetation (1937-present).

C) Model and characterize future rates and spatial extent of large woody debris recruitment due to channel bank migration. Using an existing meander migration model, we will estimate future rates and spatial patterns of large woody debris recruitment due to channel migration.

Using centerline and channel feature data described in (A) and (B), we will use an existing meander migration model (Johanneson and Parker 1989, Larsen 1995, Larsen and Greco, 2002) to forecast channel migration along the reach of the Sacramento River between Red Bluff and Colusa for 25, 50 and 100 year time increments. Based on predictions of vegetation development in that time, we will forecast rates and spatial locations of large woody debris recruitment due to channel migration. Forecasts of ecological processes using this meander migration model have recently been done (Larsen and Greco 2002, Larsen et al. 2004a, Larsen et al. 2004b.) Forecasts and model development may be used to consider the impact of future channel management alternatives on the rate and spatial pattern of large woody debris recruitment.

D) Coordinate and support ongoing efforts of DWR.

DWR will provide aerial photo interpretation, which will then be used by our project. Subject to the analytic findings, DWR field work will validate and check analytic findings in subtask 3.1. Joint cooperative studies will be adaptively managed with DWR personnel.

SUBTASK 3.2: MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF SYSTEMIC HEALTH (HENDERSON, CEPELLO)

A) Measure and Characterize Large Woody Debris Distribution, Input, and Transport rates.
Measure and characterize the current loading and distribution of LWD in the Sacramento River Ecological Management Zone. In order to measure flux of LWD in the Sacramento River EMZ, the annual load of LWD, both in the channel and in the floodplain will be quantified in the field over 3 water years. The field measurements will be compared to LWD located on high resolution aerial photography to test the feasibility of using remote sensing to monitor LWD flux in the future. GPS locations will be imported into the Sacramento River Geographic Information System (GIS) for analysis. The following specific LWD monitoring actions will be conducted:

- Track and map the movement of 25 pieces of LWD in the Sacramento River Ecological Management Zone.
- Quantify and measure shaded riverine aquatic (SRA) cover in the Sacramento River Ecological Management Zone.

- Analyze tributary input of LWD (loading) to the Sacramento River Ecological Management Zone.

B) Analyze Historic Land Cover Mapping of the Sacramento River Ecological Management Zone.

In collaboration with Eric Larsen at UC Davis, historic land cover mapping will be collected, analyzed, and summarized to measure and characterize historic large woody debris input potential by vegetation category. The following specific mapping actions will be conducted:

- Analyze existing historic land cover and vegetation datasets and digitize data.
- Interpret historical aerial photography to identify land use on LWD input sites.
- Provide field support element in the creation and validation of LWD input categories of land use.

SUBTASK 3.3: MEANDER HISTORY, BANK EROSION, AND FLOODPLAIN DEPOSITION (BUER, CEPELLO)

Change in riparian ecosystem processes result in a reduction in the rate of bank erosion and overbank sediment deposition. Other physical changes resulting from the influence of stressors include changes in meander rates, bank composition, river channel gradient, depth, width and sediment transport. Many of these changes in turn have reduced riparian vegetation, water quality, hydrologic diversity, and fish and wildlife resources.

Study Location, Goals and Objectives This section proposes to conduct field geomorphic studies, monitoring, and analyses of meander history, bank erosion and floodplain deposition at, or adjacent to CALFED ERP and AFRP funded land acquisitions along the Sacramento River between Red Bluff and Colusa (Figure X). This reach lies within the Sacramento River Management Zones' Ecological Management Unit 2, Red Bluff Diversion Dam to Chico Landing EMU (RM 243 to RM 194) and Unit 3, the Chico Landing to Colusa EMU (RM 194 to RM 143). River depth sonar surveys adjacent to naturally eroding banks of the acquisition properties will also be conducted as part of the study. These field measurements will be coordinated with the mapping and modeling studies by Larsen, subtask 3.1B.

Indicators - Measures of Performance This proposal is consistent with the CALFED ERP goals of Restoration Target 1: the Riverine and Aquatic Habitats programmatic Action 1C, "to preserve and improve the existing stream meander belt in the Sacramento River by purchase in fee or through easements of riparian lands in the meander zone". For the purposes of this study the following indictors of change within the river system within the meander zone will be examined and monitored:

- channel lateral meander and bank erosion rates - rates similar to those pre-Shasta
- vertical changes to channel and floodplain cross-sections – deposition on floodplain, channel cross-section geometry does not exhibit narrowing/deepening over time
- vertical changes to depths adjacent to natural versus rip-rapped banks – depths adjacent to unprotected banks shallower than adjacent to protected banks
- changes to gravels at point bars downstream of naturally eroding versus rip-rapped banks – gravels on point bars downstream of natural banks less armored than those downstream of protected banks

Approach

1) Mapping of eroding banks adjacent to ERP and AFRP-funded land acquisitions.
2) Measure bank erosion during winter and summer flows.
3) Monitor channel and floodplain sediment deposition at established cross-sections.
4) Bathymetric surveys adjacent to eroding and rip-rapped banks adjacent to and not adjacent to acquired lands.
5) Gravel sampling at top of point bars to determine spawning gravel quality and bar formation adjacent to acquired lands.

SUBTASK 3.4: CALCULATE CHANNEL MORPHOLOGY METRICS (LARSEN)

A) Measure and characterize historic (background) and current channel morphology metrics.

This analysis step establishes historic background and current magnitude and locations of channel morphology metrics on the Sacramento River channel that serves as the baseline for forecasting future conditions.

Using historic channel mapping of channel features, based on a mapping classification system by Greco et al. (2003a), we will use GIS analysis to calculate channel morphology metrics for 7 time periods between 1904 and 1997 in the reach of the Sacramento River between Red Bluff and Colusa (as in Task 1).

Channel morphology metrics will be computed based on GIS derived data and other analytical tools (MATLAB). Examples of two key metrics are channel sinuosity and channel radius of curvature. These metrics can be used to examine vegetation communities and patterns association with these metrics. The metrics also include metrics concerning morphology of oxbow lake formation.

B) Measure and characterize future channel morphology metrics.

Using an existing meander migration model, we will estimate future magnitudes and spatial patterns of channel metrics that will develop subsequent to future channel migration. Using channel migration forecasts described in subtask 3.1, we will predict changes in channel morphology metrics for 25, 50 and 100-year time increments.

SUBTASK 3.5: MONITOR AND EVALUATE AQUATIC BIOTA ACROSS THE RESTORATION SPECTRUM (MARCHETTI)

The flood plain and riparian forests of large rivers are known to be important in the life history of both fish and aquatic invertebrates (Junk et al. 1989, Bayley 1995, Benke et al. 2000, Benke 2001, Sommer et al. 2001a, b., Limm & Marchetti 2005). We propose to monitor the use of restored flooded riparian areas by fish and aquatic invertebrates and assess the ecological function of riparian restoration efforts. This work will build on data collected and methods developed by Limm and Marchetti (2005) in the upper Sacramento River. Salmon play a key role in riverine systems as they are top predators and provide a vital input of marine derived nutrients to the system when they expire. Previous work has suggested that the juvenile stage of the salmonid lifecycle is an appropriate arena for restoration and management actions (Sommer et al. 2001a, Limm and Marchetti 2005). Large riverine systems contain a biologically diverse aquatic community including a suite of native non-game species that are often neglected in targeted restoration efforts. The fish and aquatic invertebrate studies will provide the tools to monitor the in-stream effects of terrestrial riparian restoration.

A) Monitor salmonid growth and rearing habitat in restored flooded areas.

We will determine daily growth rates of juvenile fall run Chinook salmon across a chronosequence of restoration sites using otolith microstructure daily incremental growth rate analysis (Neilson & Geen 1982, Campana & Neilson 1985, Campana & Thorrold 2001, Limm and Marchetti 2005). In addition, we will examine mechanisms responsible for changes in growth, by characterizing the diet of the juvenile salmon and assess feeding selectivity (Sommer et al. 2001, Limm & Marchetti 2005). We will also quantify the relative abundance of aquatic marcroinvertebrates (food items) that exist across the chronosequence of habitats. We hypothesize that aquatic macroinvertebrate abundance will be higher in mature restored habitat than in young restored and agricultural habitats.

B) Monitor other native fish habitat-use in restored areas.

In conjunction with salmonid collection we will examine the extent and abundance of native non-game fish populations across the chronosequence of restoration sites, which will allow us to assess whether restoration efforts that affect target taxa (salmonids) also effect native fish community

interactions. It has been shown that increased flooding can positively affect native non-game fishes (Sommer et al. 2001a, Marchetti & Moyle 2001) and that riparian restoration efforts may also prove beneficial. We hypothesize that native non-game fishes will be more abundant and diverse in mature restored habitat than in young restored and agricultural habitats.

TASK 4: Engaging the Public

SUBTASK 4.1 PUBLIC OUTREACH AND INFORMATION DISSEMINATION

A) Develop an Information Dissemination Plan

The Sacramento River Conservation Area Forum, along with the PAC will develop an Information Dissemination Plan that will serve to guide this program in an effort to involve, educate and inform the various stakeholders.

TASK 5: Developing Monitoring and Indicator Framework

For this task, we will convene a Program Advisory Committee (PAC). The PAC will be made up of scientists, resource agency personnel, the Sacramento River Conservation Area Forum representing landowner concerns, various past funded project managers and environmental stakeholders. The PAC's academic experts will have experience on the Sacramento River and expertise in directing an effort to further investigate the specific ecosystem health indicators identified in this application. The PAC will be broken down into subcommittees. These subcommittees will focus their effort on sets of specific individual indicators to develop agreed upon monitoring protocols. These subcommittees may need to expand their individual membership to others with needed expertise to address unforeseen questions. The recommendations of these individual subcommittees will be compiled and submitted to the broader PAC for further study.

At the end of the first year we will provide a complete, collaborative, peer reviewed scientifically-based monitoring program for a major stretch of the Sacramento River. This program can serve as a demonstration project for other reaches of the River and other major monitoring efforts. During the first year, and once the plan is complete, we will use these protocols to evaluate the past restoration programs. These past programs will give us the opportunity to determine if the protocols generate the amount and type of information deemed important to the Ecosystem Restoration Program, CVPIA and CALFED's other various subcommittees. Further refinement of the protocols and indicators will probably be necessary after restoration effectiveness monitoring has been conducted in order to meet the needs of the various organizations and effectively describe changing ecosystem processes.

SUBTASK 5.1: DEVELOP A MONITORING FRAMEWORK AND PLAN FOR EVALUATING THE EFFECTIVENESS OF RESTORATION IN THE SACRAMENTO RIVER ECOLOGICAL MANAGEMENT ZONE. (SHILLING, WOOD, HOLL, MARCHETTI, CEPELLO, LARSEN)

A) Collect monitoring protocols appropriate for evaluating ecosystem condition and response to restoration.

We will add to previous work done in connection with CMARP and similar efforts and collect contemporary protocols and approaches for monitoring ecosystem processes and attributes, similar to the approach taken with the California Watershed Assessment Manual and other programs (Shilling et al., 2004; Berkes 1999; Berkes et al. 1995; CERP Public Outreach Program Management Plan 2001; Holling et al. 1995; Holling 1986; Holling 1978). We will contact and work with researchers on the proposed project and who are part of other potential ERP-funded monitoring programs (e.g., TNC/UCD and River Partners on the Sacramento River, UC Davis on the Cosumnes River and Yolo Bypass) to

collect monitoring approaches. Approaches and specific protocols will be classified according to major disciplines, referenced to the scientific literature, and linked to the data eventually collected using the approaches. This work will be linked to the ecosystem indicator work in task 6.

B) Develop a monitoring plan for the Sacramento River Ecological Management Zone in coordination with the Sacramento River Conservation Area Forum.

Once we have collected together a candidate list of monitoring approaches for evaluating restoration in the ecosystem, we will develop a plan including these methods with the SRCAF. The SRCAF is a stakeholder group including landowners and agencies and is the appropriate venue for vetting evaluation methods for this area.

We will work closely with SRCAF staff and stakeholders to develop a monitoring plan for evaluating restoration effectiveness. We will build on previous work of CMARP, the CALFED EIR/EIS, CALFED Environmental Justice 2004 Performance Measures ,and the SRCAF Handbook. The monitoring plan will include A) mechanics – descriptions of the protocols, the link between the protocols and indicators, the link between the monitored indicator and the specific management actions; B) costs – the potential cost of the actions as a function of sampling intensity; and C) statistics-based sampling intensity – the suggested frequency of the monitoring activity, the suggested spatial distribution of sites, the required sample size. This work is linked to the development of environmental indicators in Task 5.2.

SUBTASK 5.2: DEVELOP ENVIRONMENTAL & SOCIAL INDICATORS TO MEASURE CHANGE IN THE SURROUNDING HUMAN COMMUNITIES IN RESPONSE TO THE RESTORATION PROGRAM. (SHILLING, LUBELL, STEVENS, BUCKLEY)

Environmental indicators are measures of the condition or function of components of an ecosystem intended to provide focused and cost-effective evaluations of overall ecosystem change and human impacts. Examples of the use of indicators in large-scale land and water-use planning include the Willamette River Basin (Baker et al., 2004) and the Chesapeake Bay Program (http://www.cbp.org). There have been several primary methods developed in the scientific literature for ecosystem-scale evaluations: 1) water quality-based indices founded on concentrations of particular contaminants and physical properties (e.g., EPA Water Quality Index and Oregon Water Quality Index, Cude 2001); 2) indices of biotic integrity based on diversity, condition, and extent of aquatic invertebrate and fish populations and appropriate habitat; 3) multi-metric environmental indicator score-cards for bay-estuarine systems with large-scale restoration programs (e.g., Bay Institute's scorecard for San Francisco Bay and the Chesapeake Bay Program's scorecard for the Chesapeake Bay)); 4) integration of public outreach with restoration planning and adaptive assessment with the Florida Everglades Restoration Plan (DERP PMP 2001; Brody et al. 2003; Light and Holling 1994) and 5) integration of indigenous traditional resource management, restoration and conservation biology (Berkes et al. 2000; Berkes 1999; Blackburn and Anderson 1993; Peakcock and Turner 2000Turner et al. 2000)..

A sustainable ecosystem restoration program requires political support from local and regional stakeholders. Local and regional stakeholders are the people who use the ecosystem attributes or processes, often engage in specific restoration activities, are the subjects of government regulations, and can use their political voice to influence subsequent policies. When stakeholders perceive the restoration program as effective and legitimate, they are more likely to participate in long-term stewardship. When stakeholders do not support a restoration program, they will resist policy implementation and use their political power to undermine future efforts.

There are several interrelated social indicators that are signals of overall political support. Previous research has shown these indicators to be positively related to participation in watershed

restoration activities (Lubell 2003; 2004; Leach and Sabatier 2003). Ultimately, the goal of the Calfed ERP is to improve the water and ecosystem quality of the regions for the humans who live in the region. Therefore, evaluating human responses to restoration actions is critical to evaluating success and to implementing future restoration efforts. CALFED has used the Sacramento River Conservation Area Forum (Forum) as a model of how to do integration with local communities; this is the legacy of the SB1086 program, which predated CALFED. The goal in development of instruments for monitoring social indicators is to provide objective input to the Forum on whether they and the ERP are achieving their goals/ objectives for landowner support, education, agency coordination, corridor planning/ management, and community support, which thus tie directly into CALFED targets, actions and milestones for the Sacramento River.

- Perceived water quality problems
- Perceived restoration benefits
- Perceived restoration costs
- Ecosystem knowledge
- Participation in restoration activities

CALFED's ERP evaluation of restoration effectiveness will be well-informed by a set of scientifically-valid and tested indicators of ecosystem condition. In addition, by using combined environmental and social indicators sets, ERP could take advantage of more dimensions for evaluating restoration, increasing reliability of future restoration decisions (e.g., Gomez-Sal et al., 2003).

A) Collect a range of environmental indicators appropriate for this system.

There is a well-established encyclopedia of ecological, geomorphological, hydrological, and management indicators and performance measures contained within previous CALFED and the scientific literature. However, to be useful for system and program evaluation and decision-making, these indicators should be related to the specific place, a monitoring plan, and categories of management decisions. Indicators will be in two main categories – attributes of the system (e.g., populations, plant community composition, fragmentation) and flux in the system (e.g., rate of large wood recruitment into the channel, rate of cottonwood seedling recruitment).

Examples of indicator sets and considerations for our project are:

1) Terrestrial and aquatic animal species that are indicators of species richness and diversity, as well as habitat disturbance (Houghton, 2004; Nally and Fleishman, 2004)

2) Riparian forest structure, integrity, and disturbance as indicated by selected native and non-native plant species and guilds (Moffatt and McLachlan, 2004).

3) Limited indicator-sets of biodiversity composition and habitat structure (e.g., connectivity) indicating ecosystem responses to land-use scenarios (Zebisch et al., 2004).

4) Ecosystem management indicators used to understand the capacity of local jurisdictions to contribute to and participate in restoration (Brody et al., 2003)

We will work with our project team and other investigators working in the riparian corridor and at the Bay Institute (Dr. Anitra Pawley) to focus on environmental indicators that cost-effectively describe ecosystem condition and function. Specifically, we will take all existing proposed and potential indicators and develop a full panel of indicators. These will then be subjected to the following tests – functional duplication with other indicators, current and likely future availability of data, cost-effectiveness relative to other indicators, broad acceptance and understanding of the significance of the indicator among technical practitioners, utility in measuring both ecosystem condition and change in condition in response to management action.

B) Collect and test a range of indicators of social response to ecosystem restoration.

This subtask will provide a tested set of indicators of how well ERP, AFRP, and other restoration programs are accepted by neighboring communities and the types of opportunities and barriers to the involvement and acceptance of these communities.

We propose to collect a combination of survey and personal interview data from the populations of stakeholders immediately neighboring and periodically using and benefiting from the riparian corridor (e.g., landowners in the riparian corridor, local community users of the Sacramento River, native Americans). Our best guess at the number of landowners in the riparian corridor is 700. We will add respondents who use the river but do not live in the corridor, and underrepresented populations. We anticipate a total sample of approximately 1500 people. We will begin with personal interviews to better understand the views of relevant types of stakeholders, and then incorporate those interviews into analytical narratives about the restoration projects, as well as a quantitative survey instrument. The quantitative survey instrument will use a variety of survey question formats to measure each of the indicators mentioned above.

We will integrate the social indicators with the research design of the ecosystem indicators. This will be accomplished by geographic stratification of the survey population according to the different categories of restoration activities that have occurred in the Sacramento River watershed. For example, we will compare stakeholders who live and/or use reaches of the river that have restoration projects to reaches of the watershed without restoration projects. In the absence of longitudinal data, the comparative analyses can be used to establish the social effects of various types of restoration activities. Furthermore, this initial data collect effort can be used as a baseline set of social indicators for measuring change with a future study.

TASK 6: Restoration Effectiveness Evaluation (Wood, Holl, Shilling, Larsen, Cepello, Buer, Lubell)

In this project and for this task, we will conduct two scales of evaluation of restoration effectiveness: 1) change in an ecosystem or social indicator in response to ERP or AFRP-funded action at a specific site and 2) change in overall ecosystem condition and social perceptions in response to types of actions (e.g., horticultural restoration on newly-acquired lands). We will have a panel of indicators proposed in this project and other projects proposed in the study area (e.g., Sacramento River Partners project), from which we will select the indicators described in task 5.

For each indicator at each site, we will statistically compare the values measured to values from the scientific literature and previous studies in the conservation area (methods described in Attachment 2, Task 6). For overall condition evaluation, we will provide a summary of evaluations per indicator and site, categorized by restoration action type. The restoration action types are: a) previously-owned public lands with extensive restoration, b) public lands with no restoration, c) newly-acquired lands with restoration, d) newly-acquired lands with no restoration, e) private lands with easements and restoration, and f) private lands with no easements or restoration. These evaluations will be the raw information for indicator score-card approaches proposed in the CALFED solution area (e.g., Bay Institute's approach) that are currently under development (Pawley, personal communication). Examples of the indicators and what would constitute a "good" or "bad" condition score are given in the narrative descriptions of tasks 2, 3, and 5. In our reporting on monitoring and evaluation, we will also make recommendations about improving future restoration approaches based on these evaluations.

5. Feasibility

Given our past experience with this type of work and in this geographic location we feel that there will be no problem completing this work in the time allotted. We do not feel that weather conditions will have much of an effect on our ability to fulfill the needs of this program. We have the

full cooperation with the program managers for almost all of the past funded actions that we will be studying. We have set aside funds to pay their staff to assist us in gathering information. There are no contingencies or requirements that we need to work around or that we are dependent on. The only environmental compliance or permitting issues that we will contend with is the US Fish & Wildlife Service and Department of Fish and Game Collection Permits. We have successfully applied for these permits before and do not anticipate any problems in obtaining more.

If we are to seek access to private property, we will provide written permission from the property owner. The majority of the monitoring location activities will be performed on The Nature Conservancy, federal, state and other public lands.

Other stakeholders that we will coordinate with include the Sacramento Valley Landowners Association, Regional Tribal organizations, Northern California Water Association, various fishing guide companies, county government offices, city government offices, several Irrigation Districts, Resource Conservation Districts, pumping plants, flood control facilities, Family Water Alliance, the Mill Creek Conservancy, the Deer Creek Conservancy, and regional environmental organizations. The Sacramento River Conservation Area Forum will be the organization responsible for conducting all of our outreach to these various organizations. A full Information Dissemination Plan will be developed and implemented by their office. For further information see Section (7) Data Handling, Storage, and Dissemination.

6. Expected Outcomes and Products

The products and deliverables are described in detail by subtask in Attachment X. A brief list follows:

- Development of Technical Advisory Committee
- Agreed upon ecosystem indicators and Monitoring Plan
- Subcommittees developed specific to the scientific needs of these individual indicator areas
- Monitoring protocol recommendations from each subcommittee
- PAC input and revisions to draft monitoring protocols.
- Monitoring of previously funded restoration actions.
- Evaluation of restoration effectiveness based on several independent environmental indicators
- Evaluation of programmatic effectiveness based on social indicators
- Conference entitled “The Land and People of the Sacramento River”

7. Data Handling, Storage, and Dissemination

The Sacramento River Conservation Area Forum office and staff will be the primary contacts for the information that is generated through this program. The development of this program is in direct response to the needs of the Forum and its staff. This program will allow the Forum members to gain a better understanding of river processes, the current and past state of the River and will allow the Forum a greater ability to guide the restoration and management process. The SRCA staff will be making presentations, disseminate reports, and will share the data generated with agency, local government and stakeholders interested in the Sacramento River.

In addition, the CSU, Chico Geographic Information Center will become a repository for much of the mapping information that is generated. Information will be posted on their Sacramento River Web site. Information that is gathered will be shared with other Sacramento River efforts such as the Sacramento River Watershed Program, the Sacramento River Portal, the Sacramento River Discovery Center, local watershed conservancy groups, agency personnel, local government agencies and others.

We anticipate that the research from this program will generate scientific findings that will be shared with the research community through publications and presentations. We will participate in the annual CALFED Science conference, the California Watershed Conference, Ecological Society of America Conference, and others technical conferences and symposia.

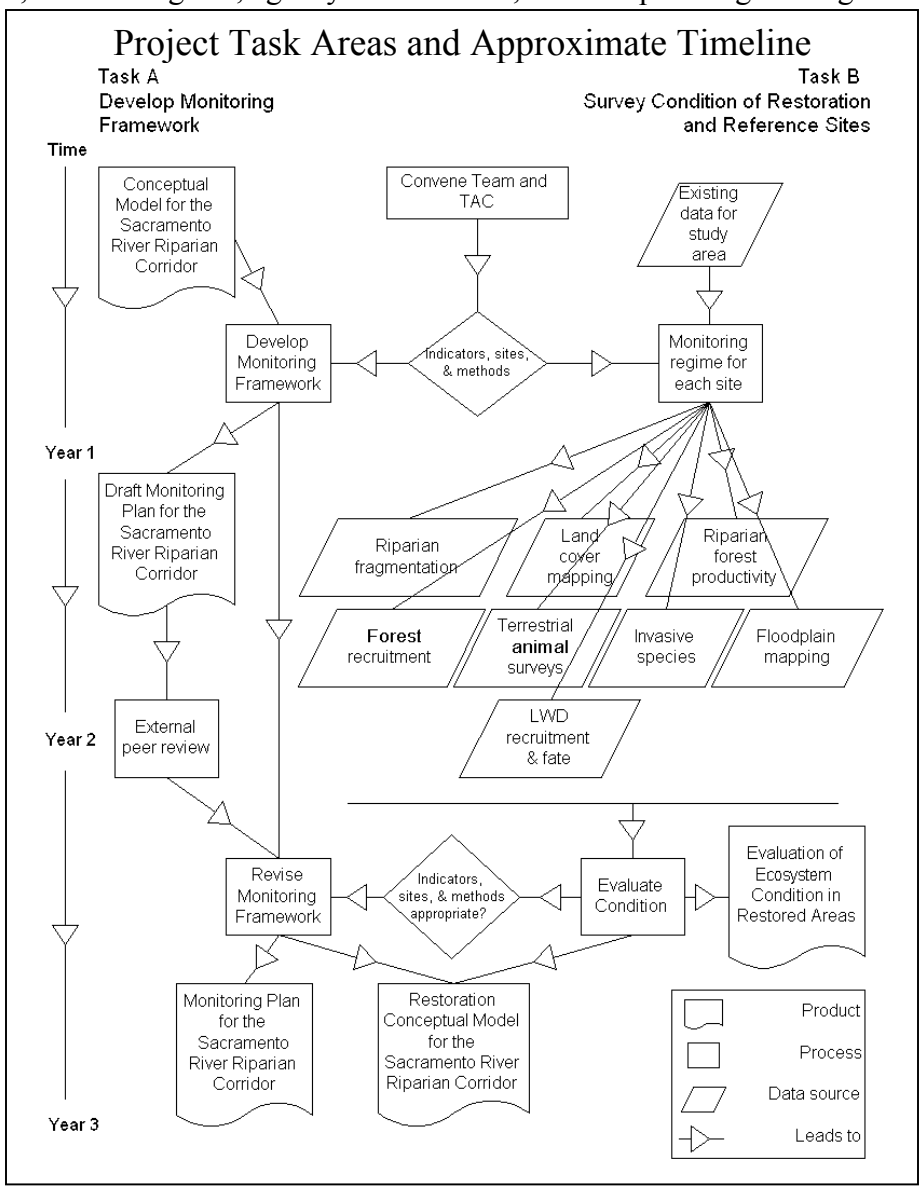
This program will integrate the findings of this program with the other monitoring programs on the Sacramento River. Programs such as the Sacramento River Watershed Program and the Sacramento River Portal will assist us with dissemination of information while the Sacramento River Conservation Area Forum will be the main conduit for reports and data storage. The Forum will also interface with endangered species recovery programs. We will maintain a high level of coordination with long-term monitoring programs such as the Interagency Ecological Program, the CVPIA's Comprehensive Assessment and Monitoring Program, and the Surface Water Ambient Monitoring Program.

8. Public Involvement and Outreach

The mission statement for the Sacramento River Conservation Area Forum is to "bring communities, individuals, organizations and agencies together along the Sacramento River to make resource management and restoration efforts more effective an sensitive to the needs of local communities. The Forum supports restoration done well, and serves as a forum for sharing, a facilitator of solutions, and a partner for projects that protect both eth natural values of the Sacramento River and the communities it runs through." Providing an instrument for monitoring social indicators, providing input to the Sacramento River Conservation Area Forum on whether they are achieving their goals/ objectives for landowner support, education goals, agency coordination, corridor planning/ management, and community support

(1) Sacramento River Conservation Area Forum will provide project review and will help the CRF disseminate information and conduct public outreach. Through the TAC, the SRCAF will review and comment on project studies to provide guidance for technical merit and consistency with the Handbook. SRCAF will include project information and reports in its public information program and coordinate with the CRF in conducting public workshops and outreach efforts. The SRCAF will facilitate use of its Project Tracking information for establishing a database for project monitoring.

(2) Staff and program costs for SRCAF responsibilities will be partially funded through this grant if these job duties are deemed appropriate by the SRCAF Board. It will be at



the SRCAF board discretion to fulfill these CALFED grant responsibilities with existing staff, a new staff person or they may determine that these commitments are not appropriate for their organization. These determinations will be made during the contract negotiations by a formal Board vote which was not possible during the grant proposal timeframe.

9. Work Schedule

The timeline submitted online identifies the duration (in months) of each task in our scope of work. We provide an annual time line that identifies when the work in each task will be accomplished (reflected in the figure above). On the attachment we have clearly indicated the tasks that are inseparable as well as tasks that can be funded incrementally through color coding. The true value of this program will be in the development of the long-term monitoring plan with environmental and social indicators. This will give the evaluation of the restoration actions a monitoring and evaluation system through which to determine both short term and long term effectiveness. This system will also provide newly proposed projects with monitoring approaches with which they can coordinate their assessments. The monitoring and evaluation system will be designed to produce both individual results and results that can be compared across like actions for a broader evaluation.

B. Applicability to CALFED Bay-Delta Program ERP Goals, the ERP Draft Stage 1 Implementation Plan, and CVPIA Priorities.

The three agencies responsible for implementing the ERP developed a process used to review progress toward each milestone. From this process a "Single Blueprint" concept for restoration and species recovery was developed to provide a unified and cooperative approach to restoration. The goal of the Single Blueprint is to ensure coordination and integration, not only within the CALFED Program, but between all resource management, conservation, and regulatory activities affecting the Bay-Delta system. As can be seen in the Attached Map (X), there are several restoration actions within the Sacramento River Ecological Management Zone from Red Bluff to Colusa. It is our goal to use this program to provide the needed framework through which to monitor and assess the results of these many actions, further adding another layer of valuable information to this "Single Blueprint" concept. The resulting framework that is developed through this program will be highly integrated with the milestones assessment approach. Through this integration the development of the Monitoring Framework will also be linked to other important ERP initiatives such as the *ERP Project Evaluation Phase 2 Report (Look Back Exercise)* and the *CALFED ERP Milestones: Parsing and Rationales document (Parsing Document)*. We view the Monitoring Framework as the third level to this initial two level process. The first level, the contract review gives us information on whether the stated objectives and actions of the existing contracts address ERP milestones. The second level, verification from field personnel determines if the contracted work is taking place or was completed. The Framework provides the third tier; did the restoration actions result in meeting milestone goals?

Additionally, this monitoring proposal specifically addresses many of the ERP Science Program goals and CVPIA priorities. This program was developed in conjunction with the SRCAF and within the guidelines of the Sacramento River Conservation Area handbook (Sacramento River Advisory Council 2000) to develop the monitoring activities outlined in this proposal. By monitoring existing restoration programs in the Sacramento River Ecological Management Zone, this project will help to evaluate and direct future river management with a much greater level of knowledge than is currently available. The evaluation of the restored stream meander corridor between Red Bluff and Colusa (PSP SR-1) will provide the Forum and the ERP with valuable information about the success of past projects while also allowing PAC participants to develop a much needed monitoring framework for the evaluation of future actions. This program will monitor the past projects ability to improve and connect important habitat for at-risk and declining riparian and aquatic species (ERP Goals 1 and 4) and will

evaluate past restoration actions designed to enhance the natural processes such as erosion and deposition (channel meander). Part of this monitoring program will determine if these actions helped to increase spawning gravel, an important factor in anadromous fish reproduction success and whether they provided in-stream complexity in the form of large woody debris that falls into the river as these areas erode (PSP SR-2 and SR-4, Goal 2).

Some of the people on our program team feel that the "Milestone" document is rather narrow in scope. It includes an assessment of the one Target for the Sacramento River Ecological Management Zone to be completed during Stage 1. We feel that we should be evaluating all CALFED projects against all relevant Targets for the study area. Many the projects contribute to, or have the potential to contribute to, meeting one or many of CALFED's Targets for the Sacramento River Ecological Management Zone. This would then allow us to monitor for system changes.

CVPIA Priorities: The proposed project addresses the following CVPIA goals and Anadromous Fish Restoration Program (AFRP) objectives:
1. Protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California;
2. Improve habitat for all life stages of anadromous fish by providing flows of suitable quality, quantity, and timing, and improved physical habitat; and
3. Involve partners in the implementation and evaluation of restoration actions.

Restoring complex riparian habitat along the Sacramento River will improve habitat for fish and wildlife. Fish benefit from complex riparian areas that become flooded at high flows, slow floodwaters down, and provide refugia for young and juvenile fish (Sommer et al. 2001). Salmon reproduction will be aided by restoration of both riparian forests and the dynamic interactions between forest and channel/floodplain. Valley Elderberry Longhorn Beetle will benefit from the restoration of native habitat and the exclusion of non-native species (such as Argentine ants). Yellow-billed cuckoo will benefit from reduced habitat fragmentation and increased mature forest distribution and complexity. Bank swallows will benefit from eroding banks along active channels. Our project will evaluate the performance of the ERP-funded projects to bring about these improvements.

2. **Relationship to Other Ecosystem Restoration Actions, Monitoring Programs, or System-wide Ecosystem**

This program was developed in direct response to the needs expressed by the SRCAF. SRCAF determined that in order for their organization to organize and coordinate the management of the Conservation Area that further information about the past restoration actions was needed, more up to date mapping should be supported and a framework through which to assess future projects was critical.

This program is being coordinated with two other PSP applications being submitted by The Nature Conservancy and the Sacramento River Partners. These other proposals are organizing in-depth research efforts that will compliment and extend the knowledge that will be gained through the funding of this program. This program will provide the monitoring framework through which the prior actions and future restoration programs will be evaluated. This framework will be developed in conjunction with and in coordination with the existing activities of the Department of Fish and Game, the Sacramento River Wildlife Refuge (specifically the Sacramento River National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment, July 2004) and SFEI-RMP. Additionally, there are a couple of water quality monitoring programs that we will be coordinating with; SRWP and SWAMP. We intend to design this program so that the results will be easily integrated with those of other long-term monitoring efforts. Programs such as the Interagency Ecological Program, the CVPIA's Comprehensive Assessment and Monitoring Program, the Surface Water Ambient Monitoring Program, along with US F&WS endangered species recovery programs will be consulted prior to the development of the Framework to ensure successful coordination with these programs.

C. QUALIFICATIONS (For specific qualifications please see Attachment 3)

Project Management broken up into two areas;

Administrative manager; Kristin Carter, MA*

Technical managers; Dave Wood, PhD*
Fraser Shilling, PhD*

Outreach Coordination; Burt Bundy*
Sacramento River
Conservation Area Forum

Geomorphology
Matt Kondolf, PhD*

Geographic Information
Chuck Nelson*
Fraser Shilling, PhD*

Fish
Michael Marchetti, PhD*

Riparian Habitat
David Wood, PhD*
Karen Holl, PhD*
John Hunt, MS*

Channel/Floodplain
Eric Larsen, Ph.D*
Koll Buer, P.E.*
Stacy Cepello, DWR*
Adam Henderson*

Social Indicators
Mark Lubbell, PhD*
Michelle Stevens, PhD, DWR
Mark Buckley, MS
Fraser Shilling, PhD*

Agency Partners
Stacy Cepello, DWR*
Margie Graham, Ph.D., DWR
Patricia Bratcher, DFG
Dan Burmester, DFG
Tricia Parker, USF&WS

*Currently involved in Sacramento River research

Subcontractors

DWR; UC, Davis; UC, Santa Cruz; UC, Berkeley; Sacramento River Conservation Area Forum

- All of our subcontractors were chosen because of their vast experience on the Sacramento River and within their area of expertise.
- There are no potential problems regarding the principal participants' availability to complete their work within the projected timeline.

D. Cost.

1. **Budget**

See Budget Forms.

2. **Cost sharing**

The Department of Water Resources has internal funding that will be used as match. These matching funds are approved and will be formally committed to this program within 30 days after being notified that our proposal has been approved by ERP.

3. **Long-term funding strategy**

Our long-term strategy is to use this project to develop a monitoring framework, plan, and set of indicators with broad buy-in in order to standardize monitoring approaches. This will facilitate the inclusion of the standard approaches in new restoration projects and provide a more cost-effective evaluation of success, compared to a post-hoc approach. Indicator systems that are shown to reflect ecosystem condition will also make subsequent monitoring cheaper and thus easier to include in subsequent restoration projects.

Compliance with Standard Terms and Conditions.

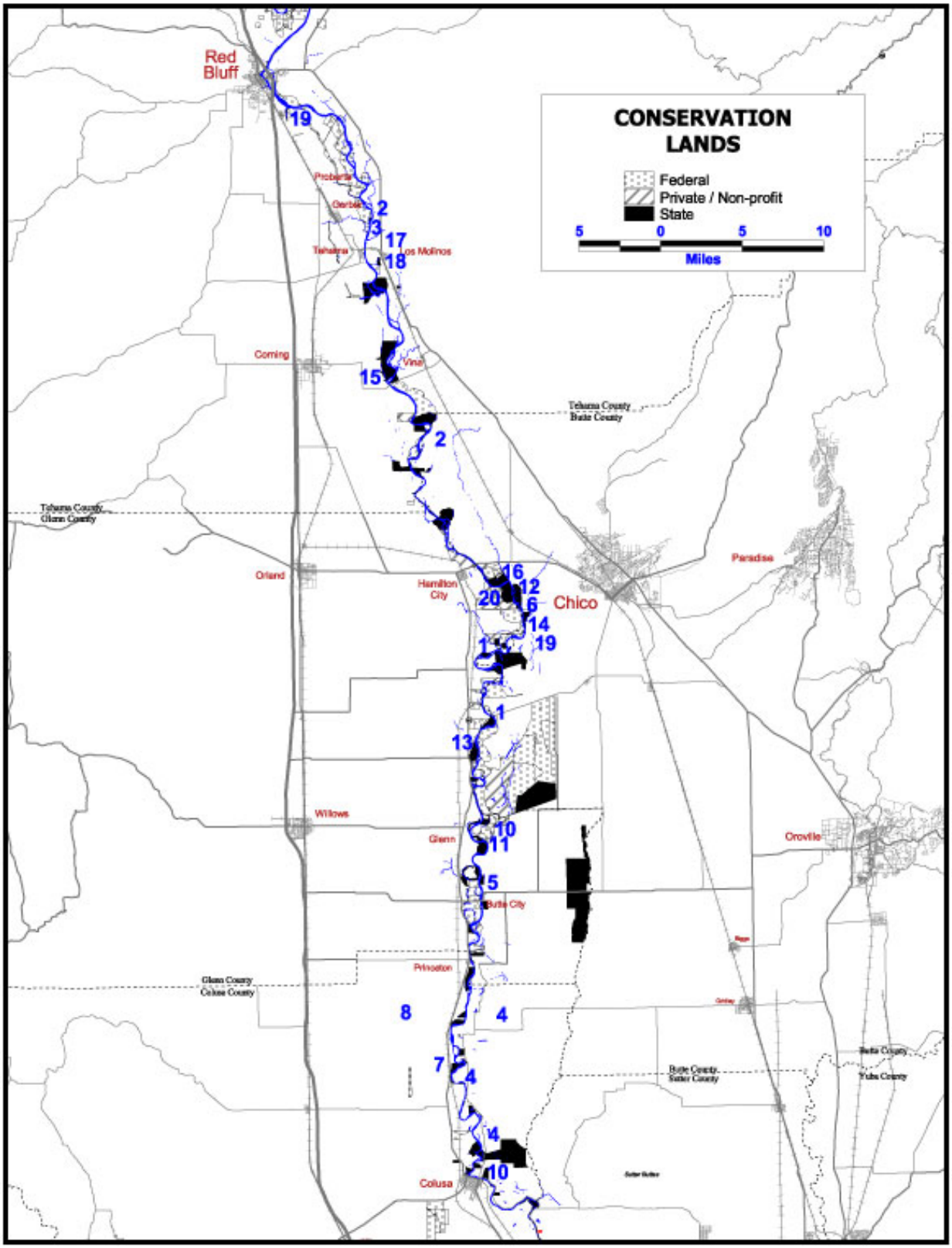
We are willing and able to comply with the terms of standard ERP grant agreements, as described in this PSP's attachment 4. We have carefully reviewed and understand the standard grant agreement terms.

Literature Cited.

Please see Attachment 5

Nonprofit Verification. Proof of nonprofit status of the CSU Chico Research Foundation is attachment 6.

Attachment 1



Potential project monitoring sites.

Project Title/Map location #	CALFED Program/ CVPIA Project	Term	Progress and Accomplishments	Status
Map Location #1 Ecosystem and Natural Process Restoration on the Sacramento River: Floodplain Acquisition and Management	CALFED 97-NO2 ERP	1/1/98-12/31/01	Four properties along the Sacramento River totaling approximately 1,628 acres have been purchased (Kaiser, Dead Man's Reach, Gunnhill, RX Ranch). Task orders are in progress to fund portions of the purchase of two additional properties: 238-acre Ward property purchased in April 2001, and 77-acre Clendenning property under option and anticipated to close in September. Start up stewardship activities are underway, including preliminary hydrologic and geomorphic modeling that will help identify short and long-term conservation and management actions for these properties.	The Clendenning property will complete the acquisition terms of this grant. Restoration of 3 of the purchased properties is the subject of a 2002 CALFED proposal. A request was recently approved by CALFED for an extension of the term date and the shifting of funds under the agreement from Task 1 (direct acquisition costs) to Task 3 (Startup Stewardship) in order to complete the management and monitoring plans called for under Task 3.
Map Location #2 Ecosystem and Natural Process Restoration on the Sacramento River: Active Restoration of Riparian Forest	CALFED 97-NO3 ERP	12/1/98-6/30/02	Site preparation and planting of two sites (River Vista and Flynn) to riparian habitat totaling 264 acres is complete. Ecosystem response studies conducted for 2 field seasons, annual reports filed.	Restoration terms of this grant are completed; monitoring is currently in progress. Maintenance will be complete fall of 2001.
Map Location #3 Ecosystem and Natural Process Restoration on the Sacramento River: A Meander Belt Implementation Project	CALFED 97-NO4 ERP	2/25/98-12/1/01	The 94+ acre Flynn property and adjacent levee were purchased in December 1998. The levee was subsequently removed; as a result this site now supports one of the largest bank swallow colonies recorded on the Sacramento River. Restoration was implemented under CALFED 97-NO3 and 97-NO4.	Acquisition and restoration terms of this grant are complete; monitoring is currently in progress. Maintenance will be complete in the fall of 2001.
Map Location #4 Floodplain Acquisition, Management and Monitoring on the Sacramento River	CALFED 98-F18, FWS Agreement #11420-9-J074 ERP	7/20/99-6/30/02	Funding was awarded for the acquisition portion of this grant. The 104+ acre Jensen property located in Colusa County was purchased in July 2000. This property is located within the setback levees of the Sacramento River Flood Control Project. Two additional properties, totaling 183+ acres will be wholly or partially funded under this agreement upon official approval of the agency, including: the 129 acre Boeger property scheduled to close by December, and 54 acre Hays property purchased in May 2001.	The Boeger and Hays properties will complete this acquisition grant. Additional CVPIA funding has been obligated to complete the purchase of the Boeger property.

Potential monitoring sites

Project Title/Map location #	CALFED Program/ CVPIA Project	Term	Progress and Accomplishments	Status
Map Location #5 Floodplain Acquisition and Sub-Reach/Site Specific Management Planning: Sacramento River (Red Bluff to Colusa)	CALFED 2000-F03, FWS Agreement #11420-1-J001 ERP	6/1/01-5/31/03	Funding was awarded to implement the Sub-reach/Site Specific Planning portion of this proposal. Four tasks are currently in progress to develop comprehensive conservation and management strategies for multiple benefits and uses of the river floodplain. Under Task 1 data collection is in progress, and the Beehive Bend Hydraulic analysis has been completed for RM 167-172. Under Task 2, a Socioeconomic Assessment for the riparian corridor of the SRCA between Red Bluff and Colusa is in progress with involvement from SRCA, stakeholders and local governments. Under Task 3 a newsletter went out to all stakeholders; stakeholder meetings have been conducted; updates are regularly provided to the SRCA.	During the first year of this 3-year grant, all tasks were initiated and are making good progress. A report to be developed under Task 4 will outline future conservation and management actions for the Beehive Bend sub-reach based on information developed within Tasks 1 – 3.
Map Location #6 Restoration of the Confluence Area of the Sacramento River, Big Chico and Mud Creeks	ERP-02-P16-D	1/1/04-12/31/06	Funding was awarded to complete Phase II of a four-phase project to protect and restore 311 acres of flood-prone, ecologically significant land located within the Sacramento River Conservation Area at the confluence of the Sacramento River, Big Chico and Mud Creeks. This includes the purchase of 2 properties and baseline assessments, restoration design, preparation of management plans and outreach for these and one other property. The appraisal for the ? -acre Nicolaus property has been approved by DGS. An appraisal for the ? acre Nock property is currently under review.	The Nicolaus property should be under option in November. Planning for baseline assessment work is underway and will take place summer 2005.

(continued next page)

Potential monitoring sites. (continued)

Map Location #7 Subreach Planning for the Sacramento River: River Mile 144-164	ERP-02-P27	4/15/04-4/14/07	Funding was awarded to collaboratively conduct planning with the Sacramento River Conservation Area Forum (SRCAF) for the subreach of the Sacramento River between Princeton and Colusa. This comprehensive approach to restoration planning includes a high level of stakeholder involvement will develop the tools and information needed to make informed land use decisions regarding the effects of restoration actions that are uniquely designed to correspond to local conditions. A Steering Committee has been formed, an MOA signed with SRCAF, and an Advisory Committee formed. Subcontracts have been let for a facilitator, for baseline assessment work, and to conduct a local landowner survey.	Initial meeting of Advisory Workgroup to be held November 3, 2004. Priority landowner questions will be identified. The landowner survey, initial newsletter and other outreach programs will be initiated. Baseline assessment work will continue, and the subreach background report currently being prepared will be finalized the next quarter.
Map Location #8 Collaborative Approach to Quantifying Ecosystem Flow Regime Needs for the Sacramento River	ERP-02D-P61	9/10/04-9/9/07	Partial funding was awarded to quantify ecosystem flow regime needs for the Sacramento River between Red Bluff and Colusa utilizing a collaborative workshop process, targeted field investigations, quantitative computer modeling, and a decision analysis tool to formulate linkages between the flow regime and ecosystem components. This agreement was only recently signed and work has just been initiated.	
Map Location #9 Sacramento River Restoration: Chico Landing Sub-Reach (RM 178-206)	ERP-02D-P65	TBD	Partial funding was awarded to conduct restoration planning and research on three sites within the Chico Landing Sub-reach in preparation for future restoration, and on a set of reference sites that were previously restored by Contractor 5-13 years ago. The agreement for this work is currently being finalized.	The Recipient Agreement should be signed in early November. CBDA is the lead agency for CEQA compliance under the agreement and an Initial Study has already been initiated.
Map Location #10 Acquisition of Southam Orchard Properties for Preservation of Riparian Habitat	CVPIA grant, BuRec Agreement #00FG200173 b(1)"other"	9/12/00-9/30/02	A portion of the grant was applied to the purchase of the 76+-acre Southam property, purchased in July 2000. The remainder of the funding was applied to the purchase of the 238-acre Ward property purchased in April 2001.	The grant is complete. Additional funding was used to purchase these properties. CVPIA (AFRP) and private funding was used to complete the purchase of Southam. CALFED 97-NO2 and private funding was used to complete the Ward purchase.

Table 6. (continued)

Map Location #11 Hartley Island Acquisition	CVPIA grant, FWS Agreement #1448-11332-7-G017 AFRP	8/14/97-9/30/01	Funding was used toward the purchase of two parcels on Hartley Island, including the 321-acre Sandgren parcel. The remaining funds available were applied to the purchase of the 76+-acre Southam parcel.	The grant is complete.
Map Location #12 Singh Walnut Orchard	CVPIA grant, FWS Agreement #11332-0-G014 AFRP	9/18/00-12/31/01	Completed tasks for this pre-acquisition and planning grant includes: pre-acquisition due diligence and signed option for Singh property, baseline assessment, and local stakeholder meeting conducted to discuss restoration plans.	A report will be submitted fall 2001 that outlines baseline and ecological considerations with restoration alternatives. This will complete the terms of this grant. Acquisition and restoration of this property is the subject of a 2002 CALFED proposal.
Map Location #13 Sacramento River Basin-Acquire a riparian easement on Millar Farms Inc., Glenn County.	AFRP # 1998-11 Sacramento National Wildlife Refuge Complex	1998-	Restore native riparian vegetation to approximately 122 acres along the Sacramento in order to provide shaded riverine habitat for all stages of salmonids	Easement acquired
Map Location #14 Peterson Property acquisition and restoration	AFRP # 1996-03 California State Parks, Bidwell-Sacramento River SP	2003-07	Acquire and restore the riparian sections of the Peterson Property. It encompasses 58.5 acres and is adjacent to the Sacramento River and is bordered on the inland side by Big Chico and Mud creeks.	The Peterson addition (58 acres) became part of Bidwell-Sacramento River State Park in FY98. Over the next two to three years, exotic plants will be removed and the vegetative management plan will be implemented (depending on available restoration funds and resources).
Map Location #15 Acquire a riparian easement on New Clairvaux Abby property on Deer Creek.	AFRP #2003-07 Ducks Unlimited		Important piece of property at mouth (valley floor)of Deer Creek	Very slow process.
Map Location #16 Sacramento River Basin-Pine Creek Orchards property restoration.	AFRP #1996-10 Sacramento River National Wildlife Refuge	1996-	The restoration will be accomplished through cooperative efforts between the previous landowner, the Nature Conservancy (TNC), Department of Water Resource (DWR), the U.S. Army Corps of Engineers, CVPIA, and the Sacramento River NWR (Refuge). The restoration will involve the removal of almond and walnut trees, the preparation of seed	420 acres of agricultural lands located between the Sacramento River and Pine Creek were acquired in FY97 as an addition to the Sacramento River National Wildlife Refuge. A restoration plan is completed and 288 acres of mixed riparian forest have been planted through FY99. Project is over 50% completed.

			beds, and the planting of native riparian vegetation to include trees and shrubs.	
Map Location #17 Acquire a riparian easement on the Porter property on Deer Creek.	CVPIA TNC Refuge	1999	Place protective corridor around lower section of Deer Creek	Easement sale anticipated in 2000.
Map Location #18 Acquire a riparian easement on the Birkes property.	AFRP #1998-13 TNC	1998	These additional acres are in the riparian zone and support native vegetation. This property is in a residential zone and located adjacent to fall-run Chinook salmon spawning habitat and a critical migration corridor for spring- and fall-run Chinook salmon and steelhead.	The acquisition of a 3.48 acre parcel known as the Birkes property was completed in1999. Although this was a Fee Title acquisition, the CVPIA dollars were used for the cost to establish an easement on this property. The remainder of the property will be resold by The Nature Conservancy. Since acquisition, this easement, through accretion, has increased another six acres.
Map Location #19 Acquire a riparian easement on the Dana property.	AFRP #1998-03 TNC	1998	The proposed grant will be used to protect 9.48 acres of riparian lands in the middle reach of Mill Creek through the purchase of a conservation easement.	The acquisition of a 9.48 acre parcel known as the Dana property was completed in 1999
Map Location #20 Acquire a riparian easement on the Klinesteker property.on Mill Creek.	AFRP #1999-02 TNC	1999	The proposed grant will partially fund the purchase of a conservation easement to protect the riparian portion of the Klinesteker property located on Mill Creek. The easement for Klinesteker will permit the existing residential use to continue in a manner compatible with riparian habitat protection and enhancement, but will limit further subdivision and development.	Although partially funded by the AFRP, the acquisition management process of this property was retained by the Habitat Conservation Branch of the Sacramento Fish and Wildlife office who were coordinating and contracting the purchases through The Nature Conservancy. The acquisition process is still ongoing
Map Location #21 Acquire a riparian easement on the Latimer property along Mill Creek.	AFRP # 1998-02 TNC	1999	The proposed grant will be used to protect 1,629 acres of riparian lands in the middle reach of Mill Creek through the purchase of a conservation easement.	The acquisition of the Latimer property, a 1692 acre easement with approximately 5 miles of stream frontage, was completed in 1999.
Map Location #22 Lake Red Bluff Riparian Area Restoration &	ERP-99-N04 California Conservation Corps	2001	Restoration	Agreement executed 4/4/00

Education Support Project				
Map Location #23 Hamilton City Ecosystem Restoration and Flood Damage Reduction	ERP-02-C05-D	2001	Feasibility Study and Environmental Impact Report on a project to increase flood protection and restore the Sacramento River floodplain near Hamilton City which involve constructing a setback lvee, removing an existing levee and restoring 1500 ac of native veg	Final report released July, 2004

Attachment 2

Detailed Methods by Subtask

TASK 2: Monitoring Riparian Forest Processes

SUBTASK 2.1: MAPPING AND ANALYSIS OF RIPARIAN LAND USE AND COVER

A significant amount has been invested into riparian and channel restoration over the last ten years by the ERP and AFRP. As an integral part of a restoration evaluation program new maps of the riparian cover and channel need to be generated and compared to previous efforts. Riparian vegetation in the Sacramento River Ecological Management Zone (Colusa to Red Bluff) was mapped in the mid-1990's (1994-96) and again in 1999 by CSU Chico. The 1999 vegetation classes included exotics like *Arundo donax* (Giant Cane), Tamarisk, and blackberry scrub. Maps of vegetation polygons for both projects were digitized and are available as GIS (Geographical Information Systems) SHP files.

Aerial photography will be conducted in the proposed study during specific portions of the growing season when leaves are present in the riparian forest. Previous efforts have used film products but this effort will rely on digital products, which can be easily processed and readily reproduced. True color is the chosen sensor and nominal scales need to be in the 1"=600' to 1"=1000' range to yield satisfactory results and allow enlargement for future monitoring efforts.

The Geographical Information Center at California State University, Chico (GIC) will be in charge of ortho-rectification of the digital images and for the initial riparian mapping efforts. Images will be delivered to the GIC as TIFF files. The GIC will use orthophoto software to three dimensionally rectify the images and prepare them for interpretation. Orthophotos will pass U.S.G.S. Map Accuracy Standards. Pixel resolution will be one foot.

Digital orthophotos will be projected into UTM-meters (Universal Transverse Mercator) and NAD 83. Images will be brought into ESRI's ArcGIS software and vegetation will be "heads-up" digitized and saved as a SHP file.

Our previous efforts have yielded riparian categories that were based on classifications used in similar mapping efforts. These were modified to reflect what could be interpreted directly from aerials with minimal ground-truthing. Additional classification included adding categories that recognize exotics like Giant Cane, Blackberry, Eucalyptus and Tamarisk species that are currently causing major problems all along the Sacramento and major tributaries.

In this effort, we will be using California Native Plant Society's (CNPS) Vegetation Rapid Assessment Protocol method of vegetation and habitat sampling (VRAP). CNPS has adopted the rapid assessment method to update the location, distribution, species composition, and disturbance information of vegetation types as identified in the first edition of *A Manual of California Vegetation* (MCV), a CNPS publication. Other agencies, such as California State Parks, the Department of Fish and Game, and the U.S. Forest Service, are also adopting this method for documenting vegetation patterns.

By using VRAP, biologists and resource managers can gain a broad ecological perspective, as the full range in ecological variation across broad landscapes can be reflected in the vegetation assessments. For example, changes in environmental elements (such as geology, aspect, topographic position) or physical processes (fire, flooding, erosion, and other natural or human-made disturbances) can influence the distribution of plants or patterning of vegetation, which are documented in the rapid assessments. In turn, these vegetation patterns can influence the distribution of animals across the landscape.

The quantitative vegetation data recorded in the rapid assessments can be described with standard classification techniques and descriptions, and they can be depicted in maps across any landscape. Categories can be cross-walked to existing efforts. Additional information recorded in these assessments, such as disturbance history and anthropogenic impacts, can serve to define habitat quality and integrity for plant and animal distributions. Because this method provides an important means for representing the full array of biological diversity as well as habitat integrity in an area, it can also be an effective and efficient tool for conducting natural resource planning.

Metadata will also be generated describing the mapping process. Metadata is invaluable to others who may want to use the data in monitoring or other efforts. Rapid assessment field data forms will also be made available.

In addition, there needs to be a central databank where information on the river is housed. As part of our Sacramento River Recreational and Public Access Guide, the GIC compiled the most up to date set of parcel maps available on the river. It has been checked by all of the government and non profit agencies and is continually updated as agency comments arrive. We also have developed the best complete riparian base data on the river.

The parcel database and the channel and vegetation mapping would provide the cornerstone to the remaining monitoring efforts. All information collected will be entered into a Sacramento River database that would be available to other researchers. The GIC would be responsible for database upkeep and information distribution.

Calculating fragmentation is possible with modeling programs such as FRAGSTATS that measure the degree of fragmentation of a landscape (McGarigal and Marks, 1995; McGarigal et al., 2002). The products of these models are indices of the degree to which a landscape and its processes have been fragmented. The fragmentation analysis model FRAGSTATS assumes that the landscape can be broken up into discreet patches of distinct types—often based on vegetation communities and human land-use types. A patch in this context means a piece of landscape that is surrounded by other landscape that is either different (e.g., a patch of oak woodlands in a grassland) or separated by an artificial structure (e.g., a road). FRAGSTATS calculates a suite of metrics based on the following principles: patch size distribution and density; patch shape complexity; patch core area; isolation/proximity to other patches; contrast between patch types; dispersion of patches; contagion and interspersion; subdivision (i.e. fragmentation) of patch type; and connectivity among patches of the same type (McGarigal, 2002; McGarigal et al., 2002). These indices are calculated at three levels of organization: (1) individual patches, (2) classes of patches (e.g. vegetation types), and (3) the landscape as a whole. These metrics are calculated independent of distributions of things like species population, as opposed to population models (e.g., Hanski, 2001), which calculate a degree of fragmentation based on species population distributions. The benefit of using analyses based on landscape pattern analysis is that results can be easily generalized over large extents wherever spatial data for land cover exists.

Other related efforts: Negotiations are currently underway to use this project as a demonstration project in an effort to collect multi-band spectral data. A new company has recently started up in the northern Sacramento Valley that has the capacity to collect information at over 545 nm spectral range between 400 and 1000 nms. Information collected would include visible, infrared (vegetation), thermal band (vegetation stress, soil moisture, stream discharge, turbidity, chlorophyll, benthic cover underwater), LIDAR (for precise elevations through forest understory) and cameras with large zooming capabilities and laser pointing. The spectrographic imager generates multiple value-added products from the same set of image data and can be used in applications including environmental monitoring, forestry, and water quality applications. Data can be collected under low light conditions and under clouds. All collected information would be geo-referenced with on board GPS linked to positional satellites allowing centimeter accuracy.

SUBTASK 2.2: MEASURE RIPARIAN VEGETATION ATTRIBUTES AND PROCESSES ACROSS THE CONSERVATION AREA

1) Establish 20 × 30 m permanent vegetation sampling plots in restoration sites not currently being studied, including grassland restoration sites. Collect vegetation, community structure, and environmental data in accordance with ongoing studies. Site locations and sampling intensity to be determined after the PAC reports.

2) Resurvey vegetation, using previously established methods, at a subset of the sites previously studied as well as more recently restored sites to determine whether native vegetation cover and composition is recovering over time and exotic species cover is decreasing. We will analyze these data as a function of a number of local (e.g. soil stratigraphy, time since restoration, composition of species planted at the site) and landscape (e.g. percent forest in the surrounding landscape, distance to river) variables following the analytical methods used in Holl & Crone (2004).

SUBTASK 2.3: MONITOR TERRESTRIAL ARTHROPODS

Because of their diversity and abundance in riparian forests, sampling and analysis of arthropod communities offers a powerful tool for use in examining effects of management actions and success in attaining management goals. As a result of new approaches to sample sorting and data management, sampling of terrestrial arthropods is becoming an increasingly useful and valuable method for measuring ecosystem change (Hunt 2004; Kremen et al. 1993; Sieren & Fischer 2002). Arthropods are also important food sources for aquatic organisms and, therefore, link terrestrial and aquatic habitat. Databases from well-designed studies sampling terrestrial arthropods provides information on assemblage patterns at multiple spatial (e.g. between habitats and ecosystem-wide), temporal (e.g. annual, seasonal and monthly), and taxonomic (e.g. order, family, species) scales. This approach has been successfully applied along the Sacramento River riparian corridor in preliminary studies by Hunt (2004) to examine broad-spectrum change in riparian forest communities in response to horticultural riparian forest restoration efforts. In these studies, it was found that several species of beetles appeared to be strongly associated with, or restricted to, remnant riparian forests (e.g. *Pterostichus lustrans* [Family: Carabidae], *Nyctoporis sponsa* [Family: Tenebrionidae], *N. aequicollis* and *N. crestata*).

Three sampling methods (pitfall traps, Malaise traps and Burlese funnels) outlined below will be employed to sample ground-dwelling and flying arthropod assemblages within 3 categorical habitat types (young and old restoration sites, and remnant riparian forests) along the Sacramento River. Preliminary sampling for new methods (Malaise traps and Burlese funnels) will be conducted during the first year of the study. Focused sampling will be conducted during the second year, and synthesis of information will be conducted during the final year of the project.

A) Measure ground-dwelling beetle diversity using pitfall traps

In previous studies, trap abundance of several beetle species was significantly related to forest type (i.e. young restoration, old restoration, and/or remnant riparian sites). The beetle species *Pterostichus lustrans* (Coleoptera: Carabidae) and three species within the genus *Nyctoporis* (Coleoptera: Tenebrionidae) may serve as good indicators of remnant riparian forest. These taxa proved to be good indicators of forest type in recent work by Hunt (unpublished thesis).

Pitfall traps consist of small plastic cups buried with the lip flush to the ground. Surface-active arthropods moving about the ground enter the trap and fall into a reservoir of preservative in the bottom of the trap. This collecting technique provides useful information on relative intraspecific abundances for these species. Pitfall trapping will be carried out, following methods outlined by Scudder (1996), at a total of 9 sites (3 sites within each of the 3 categorical habitat type). Sampling will be conducted on a bi-monthly basis from March through October for one year. Each trap array will contain 12 traps (9 primary sampling traps and 3 “replacement” traps in the event of trap disturbance) in a 3 x 4 grid and

will be set in the interior of each categorical habitat type to reduce edge effects. Approximately 648 traps will be collected during the sample year (9 traps x 9 sites x 8 months).

B) Measure "in-flight" insect diversity using Malaise traps

Indicators will be chosen from the assemblages found in early sampling. A taxonomic group that is diverse and abundant in malaise traps will be selected for data analysis. This "target taxon" will be examined for patterns in species-level responses (i.e. relative intraspecific abundances) to land-use type. Likely groups are the Ichneumonidae and Braconidae (Hymenoptera).

Malaise traps are "flight intercept" traps which sample aerial arthropods by directing them into a suspended collection bottle containing a small amount of preservative. Malaise trapping will be conducted on a monthly basis from March through October for one year. Two Malaise traps will be set out at all 9 sites, and will be checked regularly during the trapping period as collection bottles can fill rapidly, depending on season and habitat type. Particular groups, such as wasps (Hymenoptera) or flies (Diptera) may be targeted for analysis, depending on trap composition during preliminary sampling. Beetles (Coleoptera) will also be targeted for comparison with previous data sets developed by Hunt (2004).

C) Measure spatial distribution of insect taxa using Burlese funnel sampling:

Using Burlese funnels will provide spatial information (e.g. numbers of individuals per unit area) regarding species not typically collected in pitfall sampling. This method will likely yield important information pertaining to taxa not sampled using other methods.

Berlese funnels, which sample relatively small, sedentary soil and litter arthropods, will be conducted annually on a monthly basis from March through October for one year. Berlese funnel sampling will be done at all 9 sites. Since Berlese samples require complete removal of a standardized amount of soil or litter, a grid will be used, sampling randomly from a fixed number of squares on each sampling cycle. Small, relatively inactive soil arthropods targeted by Berlese funnels will complement surface-active arthropods sampled with pitfall traps. Because Berlese funnels sample a fixed area, they will provide spatial information (e.g. numbers of individuals per species per unit area) which will complement data gathered by pitfall and Malaise sampling. Beetles (Coleoptera) will also be targeted for comparison with previous data sets developed by Hunt (2004).

D) Monitor Argentine ant distribution

The invasive exotic Argentine ant has been implicated in the decline of the federally threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). The Argentine ant will be targeted for monitoring as an invasive species of concern. Ant assemblages (i.e., all species) will be monitored as well, but not to serve explicitly as indicators. Timed biannual collecting-searches for ant species within each sampling area will be conducted. These data will be combined with presence/absence data for ant species collected during pitfall, malaise, and Burlese sampling. This data will provide critical information about the distribution of this species within the Sacramento River Ecological Management Zone, as well as information about the distribution of other terrestrial arthropod communities along the Sacramento River, in relation to this species.

Argentine ant monitoring will consist of timed searches and collecting within the 9 established sampling sites in combination with data gathered from pitfall and Malaise traps and Burlese funnels.

Data Storage and Analysis

Development of collection and specimen database:

Specimens of all target taxa will be sorted by Recognizable Taxonomic Unit (RTU) into a physical specimen collection, from which the collection database will be developed. Data incorporated into the database may include, but is not limited to: collection method, collection date, sample site, trap, and RTU, as well as related information for sample sites (including information on site characteristics)

and taxonomy (e.g. order, family, subfamily, genus, and species). Taxonomic work will be carried out continuously during the course of the study and will include use of both taxonomic texts as well as exchange of information with regional collections and comparison of specimens with collections throughout northern California.

Mean monthly trap abundances of all target taxa (species and RTUs) will be compared across habitat type (young and old restoration, and remnant riparian) using either a one-way analysis of variance (ANOVA) or a Kruskal-Wallis (KW) nonparametric test. Pair-wise comparisons will be performed using either a Tukey test (for ANOVA) or a Nemenyi test (for KW; Zar 1999). Indicator species analysis (producing an indicator value or IV) using PCOrd (McCune and Mefford 1999) will also be performed using monthly means across habitat type. A Monte Carlo test will be performed to calculate the significance of IV's.

Statistical methods for community data will follow procedures recommended by McCune and Grace (2002). A ranked multi-response permutation procedure (MRPP) in PCOrd (McCune and Mefford 1999) will be used to test for the effect of habitat type on community composition. Cluster analysis will be performed using group-average linking of Bray-Curtis values with the program BioPro (McAleece et al. 1998). Ordinations will be performed using nonmetric multidimensional scaling (NMS) with PCOrd or similar method. A Monte Carlo test using 50 randomizations of the data will be performed to test the probability of acquiring the calculated stress value by chance.

SUBTASK 2.4: MEASURE AND CHARACTERIZE CURRENT RATES OF COTTONWOOD RECRUITMENT

Various approaches exist to understand the processes involved in cottonwood recruitment including dendrochronological, greenhouse, and field studies. Western North American investigators have compared dates of tree establishment with historical stream flow events (Everitt 1968, Bradley and Smith 1986, Stromberg et al. 1991, Scott et al. 1997, Merigliano 1998, Roberts et al. 2001). Various researchers have studied water table decline, cottonwood survival and root growth in controlled lab conditions (Rood and Mahoney 1990, Mahoney and Rood 1991and 1992, Amlin and Rood 2002, Seglequist et al. 1993, Hughes et al. 2000, Kranjcec et al. 1998, Horton and Clark 2001, Cederborg 2003). Studies of seedling survival requirements in the natural setting exist for areas of Canada, Utah, and Arizona (Rood and Mahoney 2000, Horton et al. 2001, Cooper et al. 2003, Kalischuk et al. 2001, Stromberg et al. 1996). Mahoney and Rood (1998) describe the "recruitment box" conditions for cottonwood survival in Alberta Canada, a general physical and hydrological model that other researchers have adjusted to their region. A small amount of cottonwood research exists for other areas of California (McBride and Strahan 1984, Stella et al. in press, 2003 and 2004). The bulk of the cottonwood studies are for other regions and for much smaller river systems with smaller stage changes.

Sacramento River cottonwood research contributions include dendrochronology (Roberts et al. 2001), greenhouse cultivation (Cederborg 2003), and effects of hydrologic alterations (Snowden, 2002). The field-based approach of this study involves simultaneously collecting data on vegetation, site hydrology, geomorphology, and soils. This project includes conducting direct field seedling demographic and survivorship observations coupled with Global Positioning System (GPS) and Geographical Information System (GIS) technologies. The study also includes topographic and bathymetric surveys. Determinations of stream and alluvial water table dynamics will use scientific gauging devices.

The funding of this proposal will allow for the continuation and expansion of a previous, long-term cottonwood monitoring effort by the Department of Water Resources (2004) that will aid in development of a "recruitment box" model for Sacramento River cottonwood establishment. This will inform future restoration decision-making. Three study sites in the Sacramento River EMZ will consist

of identical monitoring devices and protocols. All data will be analyzed, reports written, and an article will be submitted for publication.

Approach

At each site, physical and hydrogeomorphic field conditions will be measured, including: A) stream stage and water table relationships, B) stage and discharge relationships, C) and regional weather data, D) annual topographic and bathymetric survey. In addition, at each site, water table dynamics and cottonwood survival will be measured using: A) permanent cross-sectional belt transects, B) root growth rates and correlations to ground water fluctuations, and C) soil texture and moisture content. Finally, cottonwood seed release phenology will be determined.

A) Physical and Hydrogeomorphic Conditions Affecting Seedling Recruitment

Stream stage and water table relationships

Stage recording gauges and shallow groundwater wells with pressure transducers will be installed to analyze the stream and alluvial groundwater dynamics at each site. Additionally, as elevation and horizontal distance increase, hyporheic groundwater dynamics are not well understood.

Stage and discharge relationships

DWR's GPS acoustic Doppler capable boat will create discharge at each site and will be related to stage data. River stage and discharge relationships will be made and correlated to the ERP Restoration Target 2 "to maintain base flows of 6,000 to 8,000 cfs during the fall" (CALFED 2000b). Seasonal aspects of the discharge hydrograph can affect all aspects of cottonwood phenology, therefore understanding the entire annual hydrograph at each site is necessary.

Site-Specific Weather data

Ambient air temperature and relative humidity will be monitored at all sites and applied to seed release characteristics from the mature trees and seedling germination and survival.

Annual topographic and bathymetric surveys

Annual topographic and bathymetric surveys along permanent transects will measure point bar topographical changes and channel movement. Surveys aid in seedling analysis by documenting locations and elevations of scour and deposition over multiple years. These surveys will identify seedling survival elevations above base flow.

B) Water Table Dynamics and Cottonwood Survival

Permanent cross-sectional belt transects

Permanent cross-sectional belt transects will be established at each of three study locations perpendicular to the channel. Along the transects, 20 cm X 50 cm (0.1 m^2) quadrats will be censused along recruitment bands for densities and characteristics of cottonwood germinants throughout seed release and the growing season time period. Seedling establishment date, survival and mortality will be documented.

Root growth rates and correlations to ground water fluctuations

Sample germinants will be excavated periodically to measure root lengths. Water table elevations and fluctuations will be correlated with seedling survival, mortality and elevation. Roots will be measured at the end of the season for maximum first year rooting length data.

Soil analysis

Surface soils within the seedling zone will be evaluated for texture and moisture content. Acceptable methods of visual, dry sieving and hydrometer methods will be used.

C) Cottonwood phenology, seed release quantification and climatic conditions

Temperature, relative humidity, precipitation, and flow data will be used to determine controlling factors for seed release and seedling survival. Using the working protocol of Stella et al. 2004, seed release will be quantified. Timing of seed release will be documented by observing the capsules of female trees in the field at three Sacramento River study locations. Quantification of seed rain (seeds/m^2/day) will begin with seed release and extend until all noticeable capsules have opened. Seed viability throughout seed release will also be analyzed.

TASK 3: Monitoring Channel Processes

SUBTASK 3.1: MEASURE AND CHARACTERIZE RECRUITMENT OF LARGE WOODY DEBRIS DUE TO CHANNEL BANK MIGRATION

A) Measure and characterize current rates and spatial extent of recruitment of large woody debris due to channel bank migration.

Volumetric rates of large woody debris recruitment due to channel migration depends on the density and size of trees in the eroded areas. We will survey existing remnant vegetation and orchards to catalog tree species, density and size (height and DBH) to estimate rates of recruitment due to bank erosion. Site vegetation data will be scaled-up to the entire middle section of the Sacramento River by cross-walking site-specific surveyed vegetation data to vegetation classifications from remote sensing for the entire reach. Recent channel position data exist for 1997 and 1999 (see Greco et al. 2003; CSUS 1999).We will add the 2005 channel (from data collection proposed in a related ERP proposal). The 2005 dataset of channel positions would be useful to quantify current channel migration patterns. The method we will use is to spatially combine channel centerline data for each year in a GIS to calculate the area eroded per bend per time interval (Fremier 2003, Greco et al. in prep). The GIS-script (programmed by the LASR Lab, UC Davis) can also capture the fluvial processes that erodes the cutbank, i.e. continuous migration (bank retreat) and channel abandonment (avulsion events). Mapping land erosion processes as proposed here has been previously used successfully for ecological as well as geomorphic analyses (Fremier 2003, Micheli et al. 2004, Larsen et al. 2004a, Larsen et al. 2004b, Larsen et al. 2004c).

For estimating the volumetric rate of recruitment, we will survey existing remnant vegetation and orchards to catalog tree species, stem density and size (height and DBH) to estimate rates of recruitment due to bank erosion. We will establish 20m x 50m plots on characteristic areas related to cutbanks. Plots will be located using a stratified random methodology (Muller-Dubois and Ellenberg nnnn). The study area will be stratified by age of the floodplain (Fremier 2003) and existing remotely-sensed vegetation data (CSUC 1999). Within each plot, tree stem density, height, and DBH will be measured for every tree. From these measurements, a volume of wood, per unit area can be estimated for specified vegetation classes.

Site vegetation data will be scaled-up to the entire middle section of the Sacramento River by cross-walking site-specific surveyed vegetation data to vegetation classifications, including species and canopy height, from remote sensing for the entire reach.

Channel migration from 1997 (or 1999) until 2005 will be determined from channel centerlines digitized from rectified aerial photos. Mapping land erosion processes as proposed here has been previously used successfully for ecological as well as geomorphic analyses (Fremier 2003, Micheli et al. 2004, Larsen et al. 2004a, Larsen et al. 2004b, Larsen et al. 2004c).

Vegetation classes will be identified in each of the areas of land eroded (distinct GIS polygons). The product of the area and the volume (of wood) per unit area will estimate the volume of wood recruited due to bank erosion in each polygon of area eroded.

B) Measure and characterize historic (background) rates and spatial extent of large woody debris recruitment due to channel bank migration.

Using historic channel mapping of channel features, based on a mapping classification system by Greco et al. (2003a), we will calculate rates of area reworked for time increments between between 1937 and 1997 in the reach of the Sacramento River between Red Bluff and Colusa. (Rates of area reworked between 1937 and 1997 is also currently proposed for an existing funded study under a TNC ecological flows grant. If completed there, it will be used in this study.)

Areas eroded between 1937 and 1997 will be related to the volume of wood recruited in a method similar to 3.1 (A). Historic land cover data, which has already been collected, will be correlated spatially with areas eroded in order to calculate volumes (and rates) of LWD recruited.

C) Model and characterize future rates and spatial extent of large woody debris recruitment due to channel bank migration.

Using centerline and channel feature data described in (A) and (B), we will use an existing meander migration model (Johanneson and Parker 1989, Larsen 1995, Larsen and Greco 2002) to forecast channel migration along the reach of the Sacramento River between Red Bluff and Colusa for 25, 50 and 100 year time increments. Model use and calibration have been described in Larsen and Greco 2002. Polygons of areas eroded will be predicted, and spatially linked with vegetation data which will be characterized as done in section 3.1(A).

SUBTASK 3.2: MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF SYSTEMIC HEALTH

LWD will be located, mapped, and described, both in channel and on the floodplain, using Global Positioning Systems (GPS) and established protocols established by the Department of Water Resources. Similar methods have been used by the Department of Water Resources on the Feather River, CA and recently on the Upper Missouri River (Angradi et al. 2004, DWR 2003). This survey will be conducted annually and flux will be monitored over three water years. Amount, spatial distribution, and location of the LWD on the Sacramento River will be documented in the field and compared to LWD located on high resolution aerial photography to test the feasibility of using remote sensing to monitor LWD flux in the future. GPS locations will be imported into the Sacramento River Geographic Information System (GIS) for further analysis.

Track and map the movement of 25 pieces of LWD in the Sacramento River Ecological Management Zone. Annual transportation rates of 25 pieces of LWD will be quantified, for each of 3 water years, using radio transmitters, with priority given to LWD originating from properties either restored by, or acquired with, CALFED funds. This methodology was established by the Department of Water Resources on the Sacramento River (DWR 2004c, Henderson 2003).

Quantify and Measure Shaded Riverine Aquatic Cover in the Sacramento River Ecological Management Zone. SRA will be measured and monitored annually for 3 years, using bank survey techniques established by the Department of Water Resources (DWR 2004a, DWR 2004b). Bank surveys will document both natural and riprapped banks, as well as attributes of SRA by definition (USFWS 1992).

Analyze tributary input of LWD to the Sacramento River Ecological Management Zone. The influence of LWD input from tributaries is unknown; however, this source is potentially significant to the total woody debris load of the Sacramento River. In order to measure flux of LWD in the

Sacramento River EMZ, tributary inputs need to be estimated. Significant tributaries will be evaluated in terms of access, potential for reliable estimates, and usefulness as representative watersheds. A study team will select a single representative watershed and quantify the LWD input to the mainstem during the first season with flows adequate to mobilize LWD. Loading will be estimated from direct observation, standard statistical sampling, and tagging techniques.

Historic land cover maps will be collected, analyzed, and summarized to measure and characterize historic large woody debris input potential by vegetation category. The following specific mapping actions will be conducted:

Analyze existing historic land cover and vegetation datasets. Cross walk categories will be created to feed into LWD input framework. Existing paper maps will be digitized and entered into the Sacramento River GIS and existing digital data will be evaluated and compiled.

Interpret historical aerial photography to identify land use on LWD input sites. Historical photography sets will be used to identify input land use types in areas identified by Eric Larsen. The UC Davis LASR lab houses a vast historical Sacramento River aerial photograph collection, most of which has been scanned and stored by DWR, Northern District. These photos will be rectified and land use will be digitized based on the LWD input protocol on sites identified by historic migration.

Provide field support element in the creation and validation of LWD input categories of land use. Input categories will be based on land use and the amount of LWD available by land use type. Field measurements will inform the availability of LWD per land use type and will be used to create input categories. Field measurements will also calibrate and validate historic aerial photography interpretation.

SUBTASK 3.3: MEANDER HISTORY, BANK EROSION, AND FLOODPLAIN DEPOSITION

1) Mapping of eroding banks (Figure 1 – bank structure component of channel structure) - DWR conducted a study at ten bank erosion monitoring sites in 1986 within the 58-mile study reach between Red Bluff and Colusa. An additional six sites were surveyed in 1988. The sites are resurveyed biannually. Each site was mapped and a plate prepared showing the geology, vegetation, hydrology, and bank erosion for the period. For this project, DWR will map erosion sites adjacent to the land acquisitions in the two EMU's between Red Bluff and Colusa. Field determinations of geologic contacts will be placed on a scaled profile of each eroding bank using standard mapping techniques.

2) Bank erosion monitoring (Figure 1 – channel structure and migration) - DWR's Geology Section has been monitoring from ten to sixteen bank erosion sites on the Sacramento River in the two EMU's between Red Bluff and Colusa since 1986. For this study, bank erosion sites will be revisited and compared to previous work to estimate rates of erosion. They will be conducted biannually to differentiate between winter erosion (brief, high discharge events) and summer erosion (sustained moderate discharge possibly undercutting toes of banks). Data to be collected includes vertical and horizontal coordinates along each bank edge at a resolution adequate to define and compare among bank edges over time.

3) Monitor changes to floodplain and channel (Figure 1 – flooding and floodplain formation and management) – In a previous study by DWR, change in floodplain deposition was examined with ten cross-sections sites surveyed between 1986 and 1988 that re-established historic profiles done by the U. S. Geological Survey (USGS) between 1976 and 1980 and the U.S. Corps of Engineers between 1917 and 1923.. The cross sections extend from one side of the flood plain or centerline of a project levee, across the floodplain, across the Sacramento River to the opposing side of the floodplain or project levee. That study showed that at five sites showed that channel fill in excess of 25 feet is common over

a fifty year period. The floodplain far away from the river, deposition of two to five feet was not uncommon. The other five cross-sections showed that the same amount of deposition is not uncommon within a 10-year interval. Two major storm events occurred during this time interval, one in March 1983 and the other in February 1986. After these floods, floodplain deposition was observed in a number of places. Deposition varied from zero inches to over 2 feet, with an average of several (3-6) inches within the flooded area. For this task, DWR will return to monitor the ten USGS cross-sections across the active channel and adjacent floodplains in the two EMU's between Red Bluff and Colusa allowing a comparison to the previous study. This task will include channel bathymetry and GPS surveys to re-establish the old cross-sections. Data to be collected includes vertical and horizontal coordinates of original reference benchmarks and along each topographic profile.

4) Bathymetric surveys adjacent to eroding versus rip-rapped banks (Figure 1 – native fish habitat) - Thalweg depths were measured opposite 30 eroding banks between Red Bluff and Ord Ferry by DWR between 1986 and 1988. Depths were obtained by using a sonar depth-finding instrument mounted on the back of a jet boat. Individual surveys were started at the downstream end of the site and continuous soundings recorded as the boat followed a sinusoidal path across the thalweg adjacent to each bank. The resultant strip chart recordings were analyzed and an average thalweg depth for each site was obtained. The same procedure was used for measuring thalweg depths opposite 37 riprapped sites between Red Bluff and Ord Ferry. Data analysis shows that the mean thalweg along riprapped banks average 6 feet deeper than comparable eroding banks. The average thalweg depth for riprap has a mean of 15.8 feet, ranging from a minimum of 8 feet to a maximum of 23 feet. The average thalweg depth for eroding banks has a mean of 10.0 feet, ranging from a minimum of 5 feet to a maximum of 18 feet. Under this proposal, DWR will perform similar work for the eroding banks adjacent to land acquisitions. These will be compared with depths adjacent to rip-rapped banks in the general area to verify that land acquisitions will maintain channel depths more appropriate for salmon habitat than those opposite rip-rapped banks. Data to be collected will be GPS coordinates and depths to thalwegs opposite eroding and rip-rapped banks in the vicinity of land acquisitions.

5) Gravel sampling at the top of point bars downstream of eroding versus rip-rapped banks (Figure 1 – native fish habitat, bar and riffle formation) – For this study, representative areas at the head of point bars within the study area will be analyzed using bulk gravel sampling and surface sampling techniques to determine the surface and substrate quality of salmonid spawning gravel. Gradation curves for each site will be prepared and compared to similar investigations done in the past. Trend lines showing the changes in gravel size distribution will be prepared. Develop and compare the mathematical relation between the two bank types and point bars and gravel samples.

QA/QC

The surveys will be performed by staff trained in the use of standard survey techniques and GPS equipment. Quality assurance of the data will be maintained by cross-checking and calibrating GPS surveys with known benchmark coordinates and by the use of staff knowledgable with past surveys.

SUBTASK 3.4: CALCULATE CHANNEL MORPHOLOGY METRICS

A) Measure and characterize historic (background) and current channel morphology metrics.

Background channel morphology metrics for 7 time periods between 1904 and 1997 in the reach of the Sacramento River between Red Bluff and Colusa have been proposed for an existing funded study under a TNC ecological flows grant, and, if completed in that study, will be used for this study. Using historic channel mapping of channel features, based on a mapping classification system by Greco et al. (2003a), we will calculate channel morphology metrics for the 2005 channel. The classification system

utilizes a main channel for use in delineating a centerline for the river reach. Centerline data are used for calculating various channel metrics (e.g. sinuosity and radius of curvature). The historic centerline data are available as described in Task 3.1.

Channel morphology metrics will be computed based on GIS derived data and other analytical tools (MATLAB). The same tools can be used to estimate oxbow lake creation (e.g. Larsen et al 2004b).

B) Measure and characterize future channel morphology metrics.

Using the predicted channel locations from task 3.1, and the tools described in 3.4A, we will predict changes in channel morphology metrics for 25, 50 and 100-year time increments.

SUBTASK 3.5: MONITOR AND EVALUATE AQUATIC BIOTA ACROSS THE RESTORATION SPECTRUM

A. Juvenile Salmonid Growth Rates in Restored Off-channel Habitat

Based on our previous work (Limm & Marchetti 2005), we propose to examine growth and habitat use of juvenile Chinook salmon in restored flooded riparian vegetation. Previous work in the artificial habitat of the Yolo Bypass (Sommer et al. 2001a, 2001b) suggests that slow-water floodplain habitat, improves juvenile Chinook salmon growth and survival. We hypothesize that slow-water habitats in mature vegetatively restored areas will provide improved growth and rearing for Chinook salmon over young restored and predominately agricultural habitats.

We will determine daily growth rates of juvenile fall run Chinook salmon using otolith microstructure daily incremental growth rate analysis (Neilson & Geen 1982, Campana & Neilson 1985, Campana & Thorrold 2001, Limm and Marchetti 2005). Over a three-year period, during winter floods, fish will be collected in inundated restoration areas across a chronosequence of restoration sites along the Sacramento river (including fully agricultural sites). Fish will be collected with hand seines and otoliths will be removed. Juvenile salmonid growth rates will be determined by measuring the width of daily growth rings on the otoliths.

In addition, we will examine mechanisms responsible for changes in growth, by characterizing the diet of the juvenile salmon and assess feeding selectivity (Sommer et al. 2001, Limm & Marchetti 2005). This will involve removing the stomachs from the juvenile salmon and quantitatively examining their diets (Limm & Marchetti 2005). To examine diet selectivity of salmon (and therefore reasons for changes in growth) we will quantify the relative abundance of aquatic marcroinvertebrates (food items) that exist across the chronosequence of habitats. This will involve quantitative collection of aquatic macroinvertebrates contemporaneously with the juvenile salmon collection using plankton nets (Limm and Marchetti 2005). An index of diet selectivity will be calculated for each fish.

B. Non-salmonid Fish Use of Restored Off-channel Habitat

We will examine the extent and abundance of native non-game fish populations across the chronosequence of restoration sites. This will allow us to assess whether restoration efforts that effect target taxa (salmonids) also effect native fish community interactions. This work will be conducted by setting up a series of hand seining and backpack electroshocking transects at each of the sites within the chronosequence of restoration efforts. Fish will be collected, identified, weighed, measured and returned to the habitat. From this data we will be able to compare the non-salmonid fish communities across the chronosequence of sites in terms of both numbers and biomass.

TASK 5: Developing Monitoring and Indicator Framework

SUBTASK 5.2: DEVELOP A PALETTE OF ENVIRONMENTAL AND SOCIAL INDICATORS TO MEASURE CHANGE IN THE ECOSYSTEM AND SURROUNDING HUMAN COMMUNITIES IN RESPONSE TO THE RESTORATION PROGRAM.

A) Social Indicators

There are a variety of types of responses and indicators of social reactions to ecosystem restoration projects that can be used to understand and encourage local and regional support for restoration:

- Perceived water quality problems: Stakeholders who believe that water quality problems exist are more likely to accept policies geared towards solving those problems.
- Perceived restoration benefits: Stakeholders who believe that existing restoration efforts have been successful and cost-effective will support the project.
- Perceived restoration costs: Stakeholders who believe that restoration efforts have economic costs for landowners or other users will be less likely to support the project.
- Trust: Stakeholders who trust involved government agencies, and other resource users, are more likely to accept restoration policies.
- Ecosystem knowledge: Stakeholders who have a better understanding of ecological relationships in the watershed are more likely to understand the relevance of restoration activities.
- Participation in restoration activities: To the extent the restoration project provides opportunities for public participation, either in the planning processes or in project implementation,

These indicators are interrelated, and when they are all moving in a positive direction, it is a signal that the overall system of social and political institutions is functioning well, and may provide long-term sustainability.

Previous research has shown the following indicators to be positively related to participation in watershed restoration activities (Lubell 2003; 2004; Leach and Sabatier 2003): a) Perceived water quality problems; b) Perceived restoration benefits; c) Perceived restoration costs; d) Trust involved government agencies; e) Knowledge of the ecosystem; f) Participation in restoration activities; and g) needs of local farming/ agricultural community. Each of these indicators is in principle measurable through social science survey techniques. We will begin with gathering existing survey information to better understand the views of relevant types of stakeholders, and then incorporate those interviews into a quantitative survey instrument. The quantitative survey instrument will use a variety of survey question formats to measure each of the indicators mentioned above. Our best guess at the number of landowners in the riparian corridor is 700. We will add respondents who use the river but do not live in the corridor, and underrepresented populations. We anticipate a total sample of approximately 1500 people

We will differentiate the areas of concern for farmers, both benefits and costs. The reported areas of negative impact concerns to farmers include in descending order of importance according to initial surveys are: weeds, vertebrate pests, invertebrate pests, endangered species recruitment, flooding, and trespassing. The reported benefits in order of importance are: fish and game, pest predation, pollination, and scenery. Through interviews, we will further investigate the specific nature of positive and negative impacts in terms of their perceived sources, characteristics, effects, ranges, prevention and mitigation.

More detailed ethnographic interviews will be conducted with knowledgeable individuals in the watershed, and these narratives will be presented in both written form and through a local conference to other stakeholders in the watershed (Berkes et al. 2000; Blackburn and Anderson 1993; Egan et al.

2001; CERP Everglades Public Outreach Program Management Plan 2001; Light and Holling 1994; Stevens, 2004; Stevens 2003; Stevens 1995; Turner et al. 2000). We anticipate at least 20 individual oral histories will be collected to evaluate local knowledge of farmers and landowners with long-term memories and observations of changes in the Sacramento River ecosystem, as well as knowledgeable members of local California Indian tribal communities. This detailed local knowledge will provide information for emerging conceptual models of ecological restoration, including a mechanism to monitor social perceptions of the Sacramento River ecosystem and the value of restoration practices to local stakeholders. Monitoring social acceptance or concerns with restoration and land use management practices provides an adaptive assessment feedback loop, providing a mechanism to address local concerns and problem situations. The Forum has established committees to address landowner concerns; the survey instrument and oral histories provide an objective evaluation instrument. Historic fidelity and cultural integrity are closely linked; a critical element to restoration planning is including a critical range of variability in key ecological and cultural features. From an environmental justice perspective, the California Indian Basketweavers Association (CIBA) has put a high priority on obtaining access to plant materials and tending sites and restoration of these sites can be evaluted. Other key under-represented cultural groups will also be interviewed in terms of their perception of restoration projects along the river. From a working landscape perspective, local knowledge of farmers in the region provides a great deal of perspective for restoration and land management decisions.

Approaches:

- Social Adaptive Management protocol developed to be used to provide an objective social science feedback loop for both CALFED and the Sacramento River Conservation Area Forum on the relationship between environmental and social indicators for restoration projects.
- Analytical narratives based on personal interviews, with information synthesized on the relationship of peoples perceptions of the restoration projects and land use on the river, with publications available in both refereed journal literature and in language more accessible to the general public. Develop survey instrument, distribute survey, analyze and publish results.
- Develop survey instrument, distribute survey, analyze and publish results.
- Hold conference on "The Land and People of the Sacramento River" for the general puplic and stakeholders, to present both oral history and survey data on social implications and history of restoration and land management on the Sacramento River.

TASK 6: Restoration Effectiveness Evaluation

Evaluation of effectiveness will include statistical analyses. Statistical tests for site-specific and overall condition evaluation include the ones described in the text for each monitoring subtask and include the Chi-Square test for categorical data, the Student t-test for normally-distributed scalar data between sites and between times, Hotelling's t-test for comparing vector data (among indicators). For non-normally-distributed data, transformations including log-transformation and "Box-Cox" transformation may be done. For more than two time points, Multiple Analysis of Variance (MANOVA) will be used for multiple indicators and ANOVA for a single indicator. Where there are sufficient data for trends analysis we will look at each individual parameter and use Seasonal-Kendall (Hirsch et al. 1982; Hirsch and Slack 1984; Esterby 1996) or Seasonal Wilcoxon-Mann-Whitney step trend (Crawford et al. 1983) analyses to determine if there is a statistically significant upward or downward trend in the indicator, or no significant trend. These non-parametric tests allow for detection of significant trends in environmental parameter data in the presence of seasonal or inter-annual variance, and can be adjusted to account for variations in other factors (e.g., flow) and serial autocorrelation. Depending on the results of these tests, each parameter series in each project area will be classified as degraded, improved, or unchanged over the time period.

Attachment 3

Scientist Qualifications

CSU, Chico

Lead Project Scientist

David Wood

David M. Wood has degrees from U.C. Davis (B.A. Zoology 1975), California State University Fresno (M.A. Biology 1982) and the University of Washington (Ph.D. Botany 1987). He was a postdoctoral research associate at the Institute of Ecosystem Studies in Millbrook, NY from 1987 to 1988. He then joined the faculty of Wheaton College in Norton, MA as an assistant professor from 1988 to 1990. In 1990 he joined the faculty at California State University Chico where he is now a full professor (homepage: http://www.csuchico.edu/~dmwood). Dr. Wood's research interests are centered in community and ecosystem ecology, with special interests in riparian ecology, ecological succession and ecosystem recovery from disturbance. Dr. Wood has conducted field research on Mount St. Helens (ongoing since 1982), eastern deciduous forest in New York (completed), and the Sacramento River (ongoing since 1998). He has graduated 11 Masters Degree students, seven of whom conducted their research on riparian ecology (C. Bracken, B McAlexander, D. Peterson, D. Efseaff, M. Quinn, B. Borders, J. Hunt). He has 14 refereed publications, has authored 2 book reviews, and is coauthor on 4 book chapters. Dr. Wood has received grants from several agencies and organizations including The Nature Conservancy and the National Science Foundation.

Project Administrative Lead

Kristin Cooper Carter

As the former director of the Environmental Resource Program at CSU, Chico she assisted in the management of all environmental projects on the university campus. These projects included, faculty research studies, watershed management plans, up-dates to city general plans, feasibility studies and habitat land management plans. She was the primary interface for all state and federal agencies, such as Department of Water Resources, CalTrans, the Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation and others.

She has also been a consultant for several local government offices such as; the City of Chico, Red Bluff and the County of Glenn. She was a founding board member of the Sacramento River Partners and has worked closely with other nonprofits such as the Nature Conservancy and the Sacramento River Preservation Trust. Carter's experience in local habitat restoration includes three projects on Deer Creek, two on Brickyard Creek, with newly developed projects on Reeds Creek and Red Bank Creek.

Carter is also currently assisting the landowners of Tehama County in developing a watershed management program for Red Bank and Reeds Creek. Carter oversees biological resource analysis, assists in developing mitigation strategies and recommendations for offsetting project effects on botanical, wildlife, and watershed resources. She also prepares environmental documents and permits for all of the aforementioned projects.

Charles Nelson

Chuck Nelson has been the Director of the Geographical Information Center since it was formed in 1995 and also managed its predecessor, the Center for Planning and Geographical Research. He has an M.A. in Geography. Mr. Nelson has been involved in numerous remote sensing, GIS and digital mapping efforts in Northern and Central California and specializes in resource and local government GIS applications. His involvement in the Sacramento River Stream Corridor Protection Program was the first large-scale effort to classify and map riparian vegetation on the entire Sacramento River mainstem and valley tributary streams. Chuck has worked for the university for over 30 years and has

taught cartography, map reading and airphoto interpretation classes as an adjunct research professor of geography.

Michael Marchetti

Michael P. Marchetti has degrees from Bucknell University (B.A Biology/B.A.Chemistry 1990) and the University of California, Davis (M.S. Ecology and Ph.D. Ecology 1994 & 1999) and was a post doctoral researcher at University of California, Davis (1999-2000). Currently he is an assistant professor at California State University, Chico. Dr. Marchetti has 15 years experience working on stream ecosystems in California, primarily in the Central Valley. His research interests include native fish ecology, larval fish ecology, aquatic conservation biology, restoration biology, neurobiology of salmonids and multivariate statistical techniques applied to stream ecology. Dr. Marchetti is currently teaches ichthyology, limnology, conservation biology and community ecology courses at CSUC. He has an active research lab with 8 graduate students and 4 undergraduates working on a diverse array of ecological projects in the upper Sacramento River Watershed. Dr. Marchetti has authored or co-authored 17 peer reviewed scientific papers and book chapters.

John Hunt

John W. Hunt has a degree from California State University, Chico (M.S. Biology 2004). He has worked as a field technician and biologist since 1991. He has conducted and participated in field investigations throughout California, ranging from examination of nitrogen mineralization rates in response to riparian habitat restoration efforts to rare plant and wildlife surveys. He has surveyed taxa ranging from terrestrial invertebrates to small mammal and bird communities to raptors and mid-sized forest carnivores. John has authored and co-authored several riparian habitat restoration plans for The Nature Conservancy's Sacramento River Project and The California Department of Fish and Game. John's primary interests are in the design and implementation of surveys which examine ecosystem response to management actions and the application of this information to future land management decisions. John is currently an ecologist and project manager for the Bidwell Environmental Institute.

Scott Chamberlain

Scott A. Chamberlain has a degree from California State University Chico (B.S. Biology 2003). During undergraduate work he completed a National Science Foundation internship looking at passerine foraging in riparian forests along the Sacramento River. He worked closely with John Hunt on riparian beetle assemblages in riparian forests along the Sacramento River. Scott has worked under Dr. Wood on three separate projects along the Sacramento River, all involving vegetation. In 2003 Scott conducted a valley elderberry longhorn beetle survey along the Sacramento River at horticultural restoration sites. His most recent riparian work was creating a restoration plan for a Tehama County creek weed removal demonstration site. Scott currently works for Dittes and Guardino Consulting, conducting rare plant surveys and preparing facets of the South Sacramento County Habitat Conservation Plan. He is also a board member on the Friends of Bidwell Park board of directors, a non-profit park advocacy organization. Scott's main career and research interests are centered on ecology, specifically entomological ecology. He is currently working on two publications, one with Dr. Schlising on a native California geophyte and one with John Hunt and Dr. Wood on surface-active beetle response to horticultural restoration along the Sacramento River.

Sacramento River Conservation Area Forum

Burt Bundy, Manager

Mr. Bundy and his wife have a small commercial cattle and catfish operation at their home in Los Molinos where he has lived for over 50 years. Burt is President of the Mill Creek Conservancy, a local watershed group that has facilitated conservation easements, habitat restoration and in-stream

anadromous fish monitoring. He is also a member of the State Reclamation Board and a fellow of the California Agricultural Leadership Program.

As a Tehama County Supervisor in 1986, he was one of the original members of the Sacramento River Fisheries and Riparian Habitat Advisory Council (SB1086). He is currently the Manager of the Sacramento River Conservation Area Forum, a nonprofit resource planning organization that has grown out of the SB1086 program and helps coordinate activities along the Sacramento River.

Department of Water Resources

Koll Buer

Koll Buer is a Senior Engineering Geologist at the Department of Water Resources, Northern District, specializing in stream geomorphology and engineering geology. He has a Masters degree in Geology and is a Registered Geologist and Certified Engineering Geologist in the State of California. His experience includes 28 years with the Department of Water Resources managing State Water Project reservoir, FERC, Sacramento River bank erosion, conjunctive use, surface water pollution, environmental restoration, and watershed identifying education and relevant experience as well as contributions (e.g., completed projects, published reports on the same topic) consistent with their roles and responsibilities in the proposed projects. management studies. He also has conducted studies and developed detailed knowledge of the Sacramento, Feather, Trinity, Klamath, Shasta, Fall, Stanislaus, Tuolumne, Merced, Santa Ynez, Big Sur, and Eel rivers and their respective watersheds. He was a member of the Department of Conservation's Instream Gravel Mining Coordination Committee, formulating policy for State reclamation law. He is a member of the Senate Bill 1086 Riparian Habitat TAC Subcommittee for ten years, providing scientific guidance for Sacramento River ecosystem management. He is a member of the Cottonwood Creek Watershed Group Technical Advisory Committee.

Stacy Cepello

Stacy Cepello is a Senior Environmental Scientist and Chief of the Environmental Services Section of the California Department of Water Resources, Northern District. In the past 24 years he has conducted numerous studies for the Department and is the principal author of several reports and technical papers. His primary focus is the restoration of the riverine-riparian ecosystem of the Sacramento River. Presently, he is manager of the Sacramento River Fisheries and Riparian Habitat Restoration Programs and the Mill and Deer Creeks Water Exchange Program. For the past 18 years, he has provided technical assistance to the (SB 1086) Sacramento River Advisory Council, and now the Sacramento River Conservation Area Forum.

Mr. Cepello received his B.A. in Biology from the University of California, Santa Cruz and his M.S. in Biological Sciences from California State University, Chico. In 1997-98, he attended the University of California, Davis as a Visiting Scholar in the Natural Resources Fellowship Program.

Michelle Stevens

Dr. Stevens holds a PhD. in Ecology from the University of California, Davis, and Masters degree from the University of Wisconsin, Madison. Currently she is a project manager/ restoration ecologist for the California Department of Water Resources Flood Protection Corridor Program, is adjunct faculty at San Francisco University, as well as developing an NGP for restoration of the Mesopotamian Marsh restoration in southern Iraq. She has over 20 years experience in wetland and riparian research, environmental science and policy, watershed management, public outreach and ecological restoration. Dr. Stevens has published refereed journal articles, over 100 restoration reports, plans and government documents, and six books on wetland and restoration ecology. As an ethnoecologist, she works with California Indian cultures and Marsh Dweller cultures from southern Iraq, conducting oral histories and ethnographic interviews on restoration and land use management practices. Her dissertation (The

Ethnoecology and Autecology of White Root (*Carex barbarae*): Implications for Restoration) won the Barbara Lawrence Award from the Society of Ethnobiology in 1999. Dr. Stevens major field of interest is to evaluate the cultural and ecological relationships from applying Traditional Resource Management and Traditional Ecological Knowledge and to historical ecology, restoration and design, and adaptive management. As Project Manager for Eden Again/ Iraq Foundation, and now associated with Iraq-AWARE project with University of Miami, she is promoting eco-cultural restoration of the Mesopotamian Marshes in southern Iraq and building capacity with Iraqi academic institutions.

Tara Morgan

Tara Morgan has a degree from California State University, Chico (B.A. Geography 2000) and is currently working towards her second (M.S. Environmental Science 2005). Her emphasis is in hydrology and plant ecology. Currently she is a graduate student assistant in the Environmental Services Section, Division of Planning and Local Assistance, Northern District, State of California Department of Water Resources. Her main research interest is in riparian ecophysiology including water dependency, water relations and restoration. She has been the project coordinator for the 2002-2004 cottonwood field monitoring study and has organized and conducted weekly field monitoring data collection activities. She is a GIS professional with a lot of experience in using aerial photography, applying GIS and GPS to watershed analysis applications and environmental monitoring. She has assisted in multiple restoration/revegetation projects and scientific research projects on the Sacramento River and its tributaries.

Adam Henderson

Adam Henderson has two degrees from California State University, Chico (B.A. Geography 1995, M.A. Geography 2003). Currently he is an Environmental Scientist in the Environmental Services Section, Division of Planning and Local Assistance, Northern District, State of California Department of Water Resources. His research includes tracking large woody debris in the Sacramento River and managing bank surveys to document revetment and habit qualities on the Sacramento River. Adam has extensive experience in aerial photo interpretation, applying GIS and GPS technologies to environmental monitoring, LWD processes, assisting multiple scientific research efforts on the Sacramento River, and vegetation interpretation.

UC Davis

Eric Larsen

Dr. Larsen serves as a science advisor for many public agencies and private groups. These groups include the California Tahoe Conservancy, the California Department of Water Resources, the National Audubon Society, The Water Heritage Trust (San Francisco), the Water Research Institute (Blue Hill, Maine), a work group of State and Federal Agencies advising the UC Army Corps of Engineers on their Sacramento River Bank Protection Program, and a multi-agency technical advisory group for Sacramento River Off-stream Storage (North of Delta Off-stream Storage), a 2-billion dollar State of California project. Additionally, he has worked with the Putah Creek Council in an informal advisor role on stream issues. He has served as the lead geomorphologist in the restoration of the Upper Truckee River.

Dr. Larsen has taught workshops on a variety of subjects for groups, including the Yolo County Resource Conservation District, the California State Water Resources Control board, the California Department of Water Resources, and the California State Parks system. Some of the topics that he has presented include “Quantative Principles of Fluvial Geomorphology for Land Management and Restoration” and “Controls on River Processes: Formative Discharge”. He has also organized a cooperative research program between a UC Davis research project and the Rudolf Steiner High School

in Fair Oaks, California. This allows for the high school students to participate in field work on the Yuba River and learn about fluvial processes. He has given numerous talks and presentations to state and federal agencies.

Many of Dr. Larsen's research projects serve to help with practical questions posed by State agencies. He serves as an advisor to a group of State of California agencies, including CALFED and the Department of Water Resources. He has served as a reviewer of proposals submitted to CALFED for funding.

Fraser Shilling

Dr. Fraser Shilling is the project lead for the California Watershed Assessment Manual project, funded by the Resources Agency and CALFED (http://cwam.ucdavis.edu). He has worked with many watershed groups and technical advisory committees in developing monitoring and assessment plans, and evaluating watershed conditions throughout the state. He is currently involved in ERP-funded work (through Department of Health Services) in the Delta and tributaries to evaluate and mitigate the impacts of mercury to human and wildlife health. He is also designing a geographic information system-based approach to supporting decisions for habitat restoration and water supply solutions in the LA River watershed.

Dr. Shilling received his Ph.D. from the University of Southern California in Biological Sciences and has published over 20 peer-reviewed articles in scientific journals and as stand-alone reports. He has received grants and contracts from non-governmental organizations, land trusts, local agencies, state agencies, and federal agencies.

Mark Lubell

Mark Lubell has degrees from U.C. San Diego (B.A. Political Science/Mass Communications, 1993) and State University of New York at Stony Brook (Ph.D. Political Science 1998). He was an assistant professor of political science at Florida State University before coming to UC Davis in 2001, where he is currently an assistant professor of environmental policy in the Department of Environmental Science and Policy. Dr. Lubell's research interests focus on environmental policy, with specific projects in watershed management, resolution of environmental conflicts, and environmental attitudes. Dr. Lubell has published 12 referred journal articles and several book chapters, as well as being a primary editor on *Swimming Upstream: Collaborative Approaches to Watershed Management* (forthcoming MIT Press, 2005). Dr. Lubell has received research grants from the National Science Foundation, the Russell Sage Foundation, and the US EPA.

UC Santa Cruz

KAREN DAVIS HOLL

Stanford University, B.S. Biology with honors, 1989
Virginia Polytechnic Institute and State University, Ph.D., NSF pre-doctoral fellow, 1994
Stanford University, Dept. of Energy Global Change Post-Doctoral Fellow 1994-1996

Appointments

2002-present, Pepper-Giberson Endowed Chair in Environmental Studies
2001-present, Associate Professor of Environ. Studies, University of California, Santa Cruz
1995-2001, Assistant Professor of Environmental Studies, University of California, Santa Cruz

Research Interests

Restoration ecology, Landscape ecology, Grassland ecology, Riparian ecology, Tropical ecology

Selected Publications

Moffatt, K. C., E. E. Crone, K. D. Holl, R. W. Schlorff, and B. A. Garrison. In press. Importance of hydrologic and landscape heterogeneity for restoring Bank Swallow (*Riparia riparia*) colonies along the Sacramento River, California. *Restoration Ecology*.
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Holl, K. D. 2002. The effect of coal surface mine revegetation practices on long-term vegetation recovery. *Journal of Applied Ecology* 39: 960-970.
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MacMahon, J. A. and K. D. Holl. 2001. Ecological restoration: a key to conservation biology's future. Pages 245-269 in *Research Priorities in Conservation Biology*, ed. M. E. Soulé and G. Orians. Island Press: Washington, DC.
Holl, K. D., M. E. Loik, E. H. V. Lin, and I. A. Samuels. 2000. Restoration of tropical rain forest in abandoned pastures in Costa Rica: overcoming barriers to dispersal and establishment. *Restoration Ecology* 8:339-349.
Holl, K. D. 1999. Factors limiting tropical moist forest regeneration in agricultural land: seed rain, seed germination, microclimate and soil. *Biotropica* 31:229-242.

Selected Grants

2005-2008. Calfed. Factors affecting native understory species establishment in restored forest on the Sacramento River, $171,000. (subcontract on grant to The Nature Conservancy).
2004-ongoing. Earthwatch Institute. Tropical forest restoration in Costa Rica, $16,000.
2003-2005. U.S. Department of Agriculture. Impact of restoration on orchard pest species in an agricultural-restoration land use mosaic, $75,000. Lead PI: Elizabeth Crone.
2000-2002. National Science Foundation. Biocomplexity Incubation Grant. Linking hydrological and biological processes in restoring riparian forest ecosystems, $92,000. Co-PIs: Elizabeth Crone, Matt Kondolf, Nadav Nur.
2000-2001. University of California, Multicampus Research Initiative. Linking large-scale hydrological and biological processes in restoring riparian forest ecosystems, $12,000.
1999-2002. United States Department of Agriculture. The role of cattle grazing in conserving grassland biodiversity, $125,000.
1999-2002. National Center for Ecological Analysis and Synthesis. Restoration in a landscape context. $8366. Co PIs: Elizabeth Crone and Cheryl Schultz.

Mark Buckley

Education 2000–present **University of California-Santa Cruz**

Dissertation Research: creating and using empirical, behavioral and survey methods for applying game theory to conflicts over environmental policy implementation.
M.A., Ph.D Candidate (2003), Environmental Studies Department.

National Science Foundation Dissertation Improvement Grant in Economics ($10,000, 2004)
Research Grant from STEPS Institute for Innovation in Environmental Research (UC, wrote proposal, $28,000 total, my share ~$20,000, 2004).
Provost Fellowship ($31,000, 2000).
Department Summer Grant ($1500 each year, 2000-2004) and other small grants.
Complete Ph.D coursework in microeconomics, also econometrics, aquatic toxicology, public policy, biology, and hydrogeology.
1994–1998 **Davidson College** Davidson, NC
B.A., Economics.
Omicron Delta Epsilon National Economic Honor Society, ETS Major Field Achievement Test in Economics, 99th percentile.
Extensive courses in Biology.
1999 **University of North Carolina-Chapel Hill**
Continuing Studies (Chemistry).
1997 **School for Field Studies** Queensland, Australia
Conservation Biology, Rainforest Ecology, and Ecological Economics.
1998-2000
Advanced courses in Microsoft Excel, Microsoft Access, Visual Basic, and Visual Basic for Excel.

Attachment 4

Standards Terms Language

Applicants agree to comply with the terms of standard ERP grant agreements, as describe in current PSP attachment with one exception. In Exhibit A, Scope of Work, III Project Officials, it states that the Project Director shall have full authority to act on behalf of the Grantee. Note that Project Directors at CSU, Chico do not have the authority to contractually bind the CSU, Chico Research Foundation (the applicant/grantee). Dr. Katie Milo, Vice Provost for Research, has this authority.

Attachment 5

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Project Summary

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TASK 2: Monitoring Riparian Forest Processes

SUBTASK 2.1: MAPPING AND ANALYSIS OF RIPARIAN LAND USE AND COVER

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SUBTASK 2.2: MEASURE RIPARIAN VEGETATION ATTRIBUTES AND PROCESSES ACROSS THE CONSERVATION AREA

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SUBTASK 2.3: MONITOR TERRESTRIAL ARTHROPODS

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TASK 3: Monitoring Channel Processes

SUBTASK 3.1: MEASURE AND CHARACTERIZE RECRUITMENT OF LARGE WOODY DEBRIS DUE TO CHANNEL BANK MIGRATION

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SUBTASK 3.3: CALCULATE CHANNEL MORPHOLOGY METRICS

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SUBTASK 3.4: MONITOR AND EVALUATE AQUATIC BIOTA ACROSS THE RESTORATION SPECTRUM

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TASK 5: Developing Monitoring and Indicator Framework

SUBTASK 5.1: THROUGH AN INCLUSIVE PROCESS, DEVELOP A MONITORING FRAMEWORK AND PLAN FOR EVALUATING THE EFFECTIVENESS OF RESTORATION IN THE SACRAMENTO RIVER RIPARIAN CORRIDOR.

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Attachment 6

INTERNAL REVENUE SERV.
DISTRICT DIRECTOR
P. O. BOX 2508
CINCINNATI, OH 45201

DEPARTMENT OF THE TREASURY

Date: AUG 5 1987

THE CSU CHICO RESEARCH FOUNDATION
C/O RICHARD JACKSON
FIRST & NORMAL STS
CHICO, CA 95929-0246

Employer Identification Number:
68-0386518
DLN:
17053105054007
Contact Person:
D. A. DOWNING
Contact Telephone Number:
(513) 241-5199
Accounting Period Ending:
June 30
Form 990 Required:
Yes
Addendum Applies:
Yes

Dear Applicant:

Based on information supplied, and assuming your operations will be as stated in your application for recognition of exemption, we have determined you are exempt from federal income tax under section 501(a) of the Internal Revenue Code as an organization described in section 501(c)(3).

We have further determined that you are not a private foundation within the meaning of section 509(a) of the Code, because you are an organization described in section 509(a)(3).

If your sources of support, or your purposes, character, or method of operation change, please let us know so we can consider the effect of the change on your exempt status and foundation status. In the case of an amendment to your organizational document or bylaws, please send us a copy of the amended document or bylaws. Also, you should inform us of all changes in your name or address.

As of January 1, 1984, you are liable for taxes under the Federal Insurance Contributions Act (social security taxes) on remuneration of $100 or more you pay to each of your employees during a calendar year. You are not liable for the tax imposed under the Federal Unemployment Tax Act (FUTA).

Since you are not a private foundation, you are not subject to the excise taxes under Chapter 42 of the Code. However, you are not automatically exempt from other federal excise taxes. If you have any questions about excise, employment, or other federal taxes, please let us know.

Grantors and contributors may rely on this determination unless the Internal Revenue Service publishes notice to the contrary. However, if you lose your section 509(a)(1) status, a grantor or contributor may not rely on this determination if he or she was in part responsible for, or was aware of, the act or failure to act, or the substantial or material change on the part of the organization that resulted in your loss of such status, or if he or she acquired knowledge that the Internal Revenue Service had given notice that you would no longer be classified as a section 509(a)(1) organization.

Donors may deduct contributions to you as provided in section 170 of the

Letter 947 (DO/CG)

cont'd

THE CSU CHICO RESEARCH FOUNDATION

Code. Bequests, legacies, devises, transfers, or gifts to you or for your use are deductible for federal estate and gift tax purposes if they meet the applicable provisions of Code sections 2055, 2106, and 2522.

Contribution deductions are allowable to donors only to the extent that their contributions are gifts, with no consideration received. Ticket purchases and similar payments in conjunction with fundraising events may not necessarily qualify as deductible contributions, depending on the circumstances. See Revenue Ruling 67-246, published in Cumulative Bulletin 1967-2, on page 104, which sets forth guidelines regarding the deductibility, as charitable contributions, of payments made by taxpayers for admission to or other participation in fundraising activities for charity.

In the heading of this letter we have indicated whether you must file Form 990, Return of Organization Exempt From Income Tax. If Yes is indicated, you are required to file Form 990 only if your gross receipts each year are normally more than $25,000. However, if you receive a Form 990 package in the mail, please file the return even if you do not exceed the gross receipts test. If you are not required to file, simply attach the label provided, check the box in the heading to indicate that your annual gross receipts are normally $25,000 or less, and sign the return.

If a return is required, it must be filed by the 15th day of the fifth month after the end of your annual accounting period. A penalty of $10 a day is charged when a return is filed late, unless there is reasonable cause for the delay. However, the maximum penalty charged cannot exceed $5,000 or 5 percent of your gross receipts for the year, whichever is less. This penalty may also be charged if a return is not complete, so please be sure your return is complete before you file it.

You are not required to file federal income tax returns unless you are subject to the tax on unrelated business income under section 511 of the Code. If you are subject to this tax, you must file an income tax return on Form 990-T, Exempt Organization Business Income Tax Return. In this letter we are not determining whether any of your present or proposed activities are unrelated trade or business as defined in section 513 of the Code.

You need an employer identification number even if you have no employees. If an employer identification number was not entered on your application, a number will be assigned to you and you will be advised of it. Please use that number on all returns you file and in all correspondence with the Internal Revenue Service.

This determination is based on evidence that your funds are dedicated to the purposes listed in section 501(c)(3) of the Code. To assure your continued exemption, you should keep records to show that funds are expended only for those purposes. If you distribute funds to other organizations, your records should show whether they are exempt under section 501(c)(3). In cases where the recipient organization is not exempt under section 501(c)(3), there should be evidence that the funds will remain dedicated to the required

cont'd

purposes and that they will be used for those purposes by the recipient.

Since you have not indicated that you intend to finance your activities with the proceeds of tax exempt bond financing, in this letter, we have not determined the effect of such financing on your tax exempt status.

If we have indicated in the heading of this letter that an addendum applies, the enclosed addendum is an integral part of this letter.

Because this letter could help resolve any questions about your exempt status and foundation status, you should keep it in your permanent records.

We have sent a copy of this letter to your representative as indicated in your power of attorney.

If you have any questions, please contact the person whose name and telephone number are shown in the heading of this letter.

Sincerely yours,

District Director

Tasks And Deliverables

Sacramento River Riparian Monitoring and Assessment Project

Task ID	Task Name	Start Month	End Month	Deliverables
Management	Project Management	1	36	**i) Finalized subcontracts ii) Invoice reports iii) Quarterly and final project reports and invoices**
Management	**OVERSEE TECHNICAL ASPECTS OF ENTIRE PROJECT AND COORDINATE WITH PROJECT DIRECTOR**	**1**	**36**	**i) Quarterly technical reports to CALFED and other monitoring programs in the region.**
Monitoring Riparian Forest Processes	**MAPPING AND ANALYSIS OF RIPARIAN LAND USE AND COVER**	**1**	**36**	**i) 2005 riparian corridor map showing ownership type (e.g., public, restored), dominant plant communities, surrounding land uses, and human infrastructure (e.g., roads). ii) Vector (polygon) and raster (grid) spatial datasets for updated vegetation and land use/ownership type available for download from project Web site. iii) Digital aerials will be made available for download or purchase (at cost to copy). iv) Maps and tables of fragmentation metrics by plant community, ownership type, and parcel. v) Report on fragmentation/connectivity analysis including**

				correlation of metrics with restoration continuum class (e.g., public ownership and non-restored) and other potential explanatory variables.
Monitoring Riparian Forest Processes	MEASURE RIPARIAN VEGETATION ATTRIBUTES AND PROCESSES ACROSS THE CONSERVATION AREA	1	36	i) A comprehensive analysis of native and non-native vegetation metrics in both restoration sites and remnant forests over a range of spatial and temporal scales. ii) A detailed vegetation monitoring plan to be used in future riparian forest evaluation efforts. iii) At least one scientific publication based on this work.
Monitoring Riparian Forest Processes	MONITOR TERRESTRIAL ARTHROPODS	1	36	i) Physical specimen collection, with taxonomic clarification as detailed as possible. ii)Relational database as well as taxonomically and geographically specific datasets. iii) Scientific publication(s) based on the proposed research.
Monitoring Riparian Forest Processes	MEASURE COTTONWOOD RECRUITMENT	1	36	i) A current map and accompanying table quantifying erosion, and rates and locations of large woody debris recruitment from bank erosion and fluvial process. The product will be a continuous surface spatially showing rates of recruitment due to bank

				erosion (GIS raster dataset) and a table of both erosion and rates of wood recruitment per time interval at each river bend. ii) Publishable scientific report describing recruitment rates and explanatory variables.
Monitoring Channel Processes	MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF SYSTEMIC HEALTH	1	36	i) A current map and accompanying table quantifying erosion, and rates and locations of large woody debris recruitment from bank erosion and fluvial process. The product will be a continuous surface spatially showing rates of recruitment due to bank erosion (GIS raster dataset) and a table of both erosion and rates of wood recruitment per time interval at each river bend. ii) Report describing the methodology and results.
Monitoring Channel Processes	MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF SYSTEMIC HEALTH	1	36	i) Map and digital GIS shapefile quantifying 3 years of LWD load flux on the Sacramento River ii) Report documenting the mapping methods and summarizing results. Results will include quantified LWD densities analyzed by location determined by river mile, reach, left and right bank,

				floodplain, aquatic/terrestrial interface, in channel, and the annual variability of those relationships. iii) Quantification of transport rates of LWD on the Sacramento River, integrating GPS and GIS technologies. Transportation rates and distances will be documented, along with annual hydrographs at multiple gauging stations in the EMZ. These data and findings will be published in a report and an article will be submitted to a referred journal. iv) Report and detailed maps and GIS shapefiles documenting total amounts of SRA, revetment, and SRA attributes will also be produced for the entire study reach, specific to properties either restored by, or acquired with, CALFED funds. v) Report describing tributary input of LWD to Sacramento River. vi) Maps and GIS shapefiles of existing land use/vegetation mapping efforts available to analyze historic LWD inputs. These data will be integrated into modeling efforts in subtask 3.1. vii) GIS shapefiles,

				created by digitizing land use mapped from historical photography. These data will be integrated into modeling efforts in subtask 3.1.
Monitoring Channel Processes	**MEANDER HISTORY, BANK EROSION, AND FLOODPLAIN DEPOSITION**	**1**	**36**	**i) Annual progress reports that summarize field work accomplished and present data collected along with a brief initial analysis. ii) The final report will supplement the existing DWR bank and channel survey data at the land acquisition sites with new bank mapping, bank erosion and floodplain profile data. iii) The mapping will consist of 11?X 17?plates drafted in AutoCad at an appropriate scale. The bank erosion plates will be updated with survey data from 1994 ?2007. iv) Floodplain profiles from the 1994 report will be updated. v) Charts and tables summarizing channel meander, bank erosion, and vertical changes to the channel and floodplains.**
Monitoring Channel Processes	**CALCULATE CHANNEL MORPHOLOGY METRICS**	**1**	**36**	**i) Spatial data (GIS shapefile) and report describing the methodology and results. ii) Reports summarizing the analyses and findings of future channel morphology metrics**
Monitoring Channel	**MONITOR AND EVALUATE**	**1**	**36**	**i) Report examining the growth rates of juvenile**

Processes	**AQUATIC BIOTA ACROSS THE RESTORATION SPECTRUM**			**chinook salmon across the restoration spectrum comparing growth in mature restored areas, newly restored areas and predominantly agricultural areas. ii) Report examining the abundance and distribution of aquatic macroinvertebrates across the restoration spectrum iii) Report examining the diets of juvenile chinook salmon across the restoration spectrum. iv) Report detailing the abundance and distribution of non−salmonid fishes across the restoration spectrum.**
Engaging the Public	**PUBLIC OUTREACH AND INFORMATION DISSEMINATION**	**1**	**36**	**i) Develop Information Dissemination Plan ii) Upon completion of social and environmental oral histories and surveys, have a conference on "The People and Ecology of the Sacramento River" for general public and stakeholders**
Developing Monitoring and Indicator Framework	**THROUGH AN INCLUSIVE PROCESS, DEVELOP A MONITORING FRAMEWORK AND PLAN FOR EVALUATING THE EFFECTIVENESS OF RESTORATION IN THE**	**1**	**36**	**i) Categorized lists of approaches in a written report and on the project website. ii) Draft monitoring plan iii) Final monitoring plan in response to SRCAF and other feedback on draft plan**

	SACRAMENTO RIVER RIPARIAN CORRIDOR			
Developing Monitoring and Indicator Framework	DEVELOP A PALETTE OF ENVIRONMENTAL AND SOCIAL INDICATORS TO MEASURE CHANGE IN THE ECOSYSTEM AND SURROUNDING HUMAN COMMUNITIES IN RESPONSE TO THE RESTORATION PROGRAM	1	36	i) Focused list of environmental and social indicators and report describing rationale for indicators. ii) Analytical narratives based on personal interviews. iii) Mail survey instrument and analysis. iv) Comparison of indicator−based evaluations of restoration perceptions along the restoration gradient v) "The People and Ecology of the Sacramento River" conference to present the oral history and survey information to the general public and local stakeholders
Restoration Effectiveness Evaluation	iNDICATOR EVALUATION RELATIVE TO PREVIOUS CONDITIONS (12 MONTHS)	1	36	i) Report describing the monitoring−based evaluation of ecosystem attributes and rate processes at each restoration study site ii) Report describing 1) the overall riparian/channel ecosystem processes and the contribution of ERP and AFRP−funded restoration actions to ecosyctem condition and 2) the program effectiveness in encouraging neighboring communtiy support for existng and future restoration iii) Tabular presentation of attribute and rate process indicator

				conditions relative to standards/references
		1	**36**	
		1	**36**	

Comments

If you have comments about budget justification that do not fit elsewhere, enter them here.

Budget Summary

Project Totals

Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
$1,527,202	$333,525	$71,116	$123,987	$42,000	$31,100	$0	$16,815	$2,145,745	$1,077,222	$3,222,967

Do you have cost share partners already identified?
Yes.

If yes, list partners and amount contributed by each:

For each year of the project the California Department of Fish and Game will contribute 160 hours of staff time for two environmental scientists for a total of $13,526/year including 19.8% administrative overhead for a three-year total of $40,579.

For each year of the project the California Department of Water Resources will commit $28,000 in salaries and wages in Statewide Planning Funds as well as $35,000 per year in salaries and wages in North of Delta Offstream Storage Investigation funds. DWR's cost share for three years totals $189,000

TOTAL COMMITTED COST SHARE = $229,579

Do you have potential cost share partners?
Yes.

If yes, list partners and amount contributed by each:

There are several agencies and other various stakeholders who will be involved in the develoment and review of this program who will not be directly compensated for their participation. We will

acquire cost share verification forms for their time throughout the life of this grant.

Are you specifically seeking non−federal cost share funds through this solicitation?
No.

Sacramento River Riparian Monitoring and Assessment Project

Sacramento River Riparian Monitoring and Assessment Project

Year 1 (Months 1 To 12)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
Management: project management (12 months)	**20281**	**8490**	**3000**	**4700**	**9000**	**0**	**0**	**0**	$45,471	**45294**	$90,765
Management: OVERSEE TECHNICAL ASPECTS OF ENTIRE PROJECT AND COORDINATE WITH PROJECT DIRECTOR (12 months)	**22845**	**8926**	**3075**	**4725**	**9000**	**0**	**0**	**0**	$48,571	**9714**	$58,285
Monitoring Riparian Forest Processes: MAPPING AND ANALYSIS OF	**44570**	**15590**	**1750**	**10167**	**0**	**0**	**0**	**0**	$72,077	**15015**	$87,092

RIPARIAN LAND USE AND COVER (12 months)											
Monitoring Riparian Forest Processes: MEASURE RIPARIAN VEGETATION ATTRIBUTES AND PROCESSES ACROSS THE CONSERVATION AREA (12 months)	**18113**	**1823**	**713**	**75**	**0**	**0**	**0**	**0**	$20,724	**4145**	$24,869
Monitoring Riparian Forest Processes: MONITOR TERRESTRIAL ARTHROPODS (12 months)	**27656**	**5430**	**4000**	**2000**	**0**	**0**	**0**	**0**	$39,086	**7817**	$46,903
Monitoring Riparian Forest Processes: MEASURE COTTONWOOD RECRUITMENT (12 months)	**74448**	**8165**	**0**	**0**	**0**	**17900**	**0**	**0**	$100,513	**85615**	$186,128
Monitoring Channel Processes: MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF	**25200**	**8820**	**0**	**0**	**0**	**6500**	**0**	**0**	$40,520	**28845**	$69,365

SYSTEMIC HEALTH (12 months)											
Monitoring Channel Processes: MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF SYSTEMIC HEALTH (12 months)	**111994**	**8820**	**1500**	**14240**	**0**	**0**	**0**	**0**	$136,554	**49352**	$185,906
Monitoring Channel Processes: MEANDER HISTORY, BANK EROSION, AND FLOODPLAIN DEPOSITION (12 months)	**11946**	**0**	**750**	**772**	**0**	**0**	**0**	**0**	$13,468	**2694**	$16,162
Monitoring Channel Processes: CALCULATE CHANNEL MORPHOLOGY METRICS (12 months)	**53141**	**16474**	**0**	**1500**	**0**	**6700**	**0**	**0**	$77,815	**63030**	$140,845
Monitoring Channel Processes: MONITOR AND EVALUATE AQUATIC BIOTA ACROSS THE RESTORATION	**12018**	**1515**	**1000**	**400**	**0**	**0**	**0**	**0**	$14,933	**2987**	$17,920

SPECTRUM (12 months)											
Engaging the Public: PUBLIC OUTREACH AND INFORMATION DISSEMINATION (12 months)	**17842**	**6967**	**2000**	**1760**	**0**	**0**	**0**	**0**	$28,569	**5714**	$34,283
Developing Monitoring and Indicator Framework: THROUGH AN INCLUSIVE PROCESS, DEVELOP A MONITORING FRAMEWORK AND PLAN FOR EVALUATING THE EFFECTIVENESS OF RESTORATION IN THE SACRAMENTO RIVER RIPARIAN CORRIDOR (12 months)	**22140**	**0**	**500**	**1333**	**0**	**0**	**0**	**0**	$23,973	**5993**	$29,966
Developing Monitoring and Indicator Framework: DEVELOP A PALETTE OF ENVIRONMENTAL AND SOCIAL INDICATORS TO MEASURE CHANGE IN THE ECOSYSTEM AND SURROUNDING	**58170**	**8284**	**2720**	**16815**	**0**	**0**	**0**	**0**	$85,989	**38367**	$124,356

HUMAN COMMUNITIES IN RESPONSE TO THE RESTORATION PROGRAM (12 months)											
Restoration Effectiveness Evaluation: iNDICATOR EVALUATION RELATIVE TO PREVIOUS CONDITIONS (12 MONTHS) (12 months)	**17963**	**753**	**513**	**2191**	**0**	**0**	**0**	**0**	$21,420	**4802**	$26,222
Totals	**$538,327**	**$100,057**	**$21,521**	**$60,678**	**$18,000**	**$31,100**	**$0**	**$0**	**$769,683**	**$369,384**	**$1,139,067**

Year 2 (Months 13 To 24)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
Management: project management (12 months)	**12480**	**4618**	**3000**	**4700**	**6000**	**0**	**0**	**0**	$30,798	**42360**	$73,158
Management: OVERSEE TECHNICAL ASPECTS OF ENTIRE PROJECT	**15173**	**5075**	**3500**	**4800**	**6000**	**0**	**0**	**0**	$34,548	**7834**	$42,382

AND COORDINATE WITH PROJECT DIRECTOR (12 months)											
Monitoring Riparian Forest Processes: MAPPING AND ANALYSIS OF RIPARIAN LAND USE AND COVER (12 months)	**26070**	**6345**	**1250**	**2167**	**0**	**0**	**0**	**0**	$35,832	**7766**	$43,598
Monitoring Riparian Forest Processes: MEASURE RIPARIAN VEGETATION ATTRIBUTES AND PROCESSES ACROSS THE CONSERVATION AREA (12 months)	**27353**	**4473**	**2125**	**575**	**0**	**0**	**0**	**0**	$34,526	**7628**	$42,154
Monitoring Riparian Forest Processes: MONITOR TERRESTRIAL ARTHROPODS (12 months)	**28280**	**6103**	**4000**	**1000**	**0**	**0**	**0**	**0**	$39,383	**7877**	$47,260
Monitoring Riparian Forest Processes: MEASURE COTTONWOOD RECRUITMENT	**67428**	**23600**	**0**	**0**	**0**	**0**	**0**	**0**	$91,028	**77542**	$168,570

(12 months)											
Monitoring Channel Processes: MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF SYSTEMIC HEALTH (12 months)	**25200**	**8820**	**0**	**0**	**0**	**0**	**0**	**0**	$34,020	**28980**	$63,000
Monitoring Channel Processes: MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF SYSTEMIC HEALTH (12 months)	**78076**	**8820**	**1700**	**7944**	**0**	**0**	**0**	**0**	$96,540	**43135**	$139,675
Monitoring Channel Processes: MEANDER HISTORY, BANK EROSION, AND FLOODPLAIN DEPOSITION (12 months)	**7968**	**0**	**800**	**311**	**0**	**0**	**0**	**0**	$9,079	**2142**	$11,221
Monitoring Channel Processes: CALCULATE CHANNEL MORPHOLOGY	**53141**	**16474**	**0**	**0**	**0**	**0**	**0**	**0**	$69,615	**56597**	$126,212

METRICS (12 months)											
Monitoring Channel Processes: MONITOR AND EVALUATE AQUATIC BIOTA ACROSS THE RESTORATION SPECTRUM (12 months)	**23179**	**7564**	**1000**	**400**	**0**	**0**	**0**	**0**	$32,143	**6429**	$38,572
Engaging the Public: PUBLIC OUTREACH AND INFORMATION DISSEMINATION (12 months)	**20918**	**8607**	**2000**	**1100**	**0**	**0**	**0**	**0**	$32,625	**6525**	$39,150
Developing Monitoring and Indicator Framework: THROUGH AN INCLUSIVE PROCESS, DEVELOP A MONITORING FRAMEWORK AND PLAN FOR EVALUATING THE EFFECTIVENESS OF RESTORATION IN THE SACRAMENTO RIVER RIPARIAN CORRIDOR (12 months)	**22140**	**0**	**500**	**1333**	**0**	**0**	**0**	**0**	$23,973	**5993**	$29,966
Developing Monitoring	**72570**	**13324**	**5440**	**16815**	**0**	**0**	**0**	**0**	$108,149	**50724**	$158,873

and Indicator Framework: DEVELOP A PALETTE OF ENVIRONMENTAL AND SOCIAL INDICATORS TO MEASURE CHANGE IN THE ECOSYSTEM AND SURROUNDING HUMAN COMMUNITIES IN RESPONSE TO THE RESTORATION PROGRAM (12 months)											
Restoration Effectiveness Evaluation: iNDICATOR EVALUATION RELATIVE TO PREVIOUS CONDITIONS (12 MONTHS) (12 months)	**22650**	**1847**	**1125**	**892**	**0**	**0**	**0**	**0**	$26,514	**6143**	$32,657
Totals	**$502,626**	**$115,670**	**$26,440**	**$42,037**	**$12,000**	**$0**	**$0**	**$0**	**$698,773**	**$357,675**	**$1,056,448**

Year 3 (Months 25 To 36)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights	Other Direct Costs	Direct Total	Indirect Costs	Total

							Of Way				
Management: project management (12 months)	**17056**	**6652**	**3000**	**4700**	**6000**	**0**	**0**	**0**	$37,408	**43682**	$81,090
Management: OVERSEE TECHNICAL ASPECTS OF ENTIRE PROJECT AND COORDINATE WITH PROJECT DIRECTOR (12 months)	**17056**	**6652**	**3000**	**4700**	**6000**	**0**	**0**	**0**	$37,408	**7482**	$44,890
Monitoring Riparian Forest Processes: MAPPING AND ANALYSIS OF RIPARIAN LAND USE AND COVER (12 months)	**27070**	**7225**	**1250**	**2167**	**0**	**0**	**0**	**0**	$37,712	**8142**	$45,854
Monitoring Riparian Forest Processes: MEASURE RIPARIAN VEGETATION ATTRIBUTES AND PROCESSES ACROSS THE CONSERVATION AREA (12 months)	**9024**	**1203**	**1815**	**75**	**0**	**0**	**0**	**0**	$12,117	**2741**	$14,858
Monitoring Riparian Forest Processes:	**43568**	**8434**	**4000**	**1000**	**0**	**0**	**0**	**0**	$57,002	**11400**	$68,402

MONITOR TERRESTRIAL ARTHROPODS (12 months)											
Monitoring Riparian Forest Processes: MEASURE COTTONWOOD RECRUITMENT (12 months)	**67428**	**23600**	**0**	**0**	**0**	**0**	**0**	**0**	$91,028	**77542**	$168,570
Monitoring Channel Processes: MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF SYSTEMIC HEALTH (12 months)	**25200**	**8820**	**0**	**0**	**0**	**0**	**0**	**0**	$34,020	**28982**	$63,002
Monitoring Channel Processes: MONITORING LARGE WOODY DEBRIS FLUX AS AN OVERALL INDICATOR OF SYSTEMIC HEALTH (12 months)	**61117**	**8820**	**1300**	**5296**	**0**	**0**	**0**	**0**	$76,533	**37484**	$114,017
Monitoring Channel Processes: MEANDER HISTORY, BANK	**5978**	**0**	**700**	**209**	**0**	**0**	**0**	**0**	$6,887	**1377**	$8,264

EROSION, AND FLOODPLAIN DEPOSITION (12 months)											
Monitoring Channel Processes: CALCULATE CHANNEL MORPHOLOGY METRICS (12 months)	**53141**	**16474**	**0**	**0**	**0**	**0**	**0**	**0**	$69,615	**56550**	$126,165
Monitoring Channel Processes: MONITOR AND EVALUATE AQUATIC BIOTA ACROSS THE RESTORATION SPECTRUM (12 months)	**30670**	**7667**	**1000**	**200**	**0**	**0**	**0**	**0**	$39,537	**7907**	$47,444
Engaging the Public: PUBLIC OUTREACH AND INFORMATION DISSEMINATION (12 months)	**19655**	**8461**	**1400**	**900**	**0**	**0**	**0**	**0**	$30,416	**6083**	$36,499
Developing Monitoring and Indicator Framework: THROUGH AN INCLUSIVE PROCESS, DEVELOP A MONITORING FRAMEWORK AND	**22140**	**0**	**500**	**1333**	**0**	**0**	**0**	**0**	$23,973	**5993**	$29,966

PLAN FOR EVALUATING THE EFFECTIVENESS OF RESTORATION IN THE SACRAMENTO RIVER RIPARIAN CORRIDOR (12 months)											
Developing Monitoring and Indicator Framework: DEVELOP A PALETTE OF ENVIRONMENTAL AND SOCIAL INDICATORS TO MEASURE CHANGE IN THE ECOSYSTEM AND SURROUNDING HUMAN COMMUNITIES IN RESPONSE TO THE RESTORATION PROGRAM (12 months)	**72570**	**13324**	**4080**	**0**	**0**	**0**	**0**	**16815**	$106,789	**50724**	$157,513
Restoration Effectiveness Evaluation: iNDICATOR EVALUATION RELATIVE TO PREVIOUS CONDITIONS (12	**14576**	**466**	**1110**	**692**	**0**	**0**	**0**	**0**	$16,844	**4074**	$20,918

MONTHS) (12 months)											
Totals	**$486,249**	**$117,798**	**$23,155**	**$21,272**	**$12,000**	**$0**	**$0**	**$16,815**	**$677,289**	**$350,163**	**$1,027,452**

Budget Justification

Sacramento River Riparian Monitoring and Assessment Project

Labor

YEAR 1 Project Management Labor 1.1 Cooper Carter – 50% Total 1.1 $20,281 1.2 Cooper Carter 0.5 $20,281 1.2 Wood – oversee technical aspects 0.25 $2,565 Total 1.2 $22,845

Riparian Processes 2.1 Nelson $33,500 2.1 Schilling 25% $11,070 Total 2.1 $44,570 2.2 Holl 0.75 $12,984 2.2 Wood 0.5 $5,129 Total 2.2 $18,113 2.3 Hunt Total 2.3 $27,656 2.4 Morgan(DWR)Cottonwood Total 2.4 $74,448

Channel Processes 3.1 Henderson Lg/Woody/DWR Total 3.1 $25,200 3.2 Henderson 0.5 $25,200 3.2 Larsen 0.9 $84,794 3.2 Kondolf 1 $2,000 Total 3.2 $111,994 3.3 Larsen 0.1 $9,946 3.3 Kondolf $2,000 Total 3.3 $11,946 3.4 Koll Buer (DWR) Total 3.4 $53,141 3.5 Marchetti Total 3.5 $12,018 Public Involvement 4.1 Bundy 1 $17,842 Monitoring and Indicator Framework 5.1 Schilling – 50% Total 5.1 $22,140 5.2 Lubell/student time 100% 1 $36,570 5.2 Stevens 1 1 $21,600 Total 5.2 $58,170 Restoration Effectiveness Evaluation 6.1 Shilling 0.25 25% $11,070 6.1 Holl 0.25 $4,328 6.1 Wood 0.25 $2,565 Total 6.1 $17,963 Total Project Costs $550,344

YEAR 2 Project Management Labor 1.1 Cooper Carter 50% Total 1.1 $12,480 1.2 Cooper Carter $12,480 1.2 Wood – ovesee technical aspects $2,693 Total 1.2 $15,173

Riparian Processes 2.1 Nelson $15,000 2.1 Schilling $11,070 Total 2.1 $26,070 2.2 Holl $12,581 2.2 Wood $14,772 Total 2.2 $27,353 2.3 Hunt – 100% Total 2.3 $28,280 2.4 Morgan (DWR) (Cottonwood) Total 2.4 $67,428 Channel Processes 3.1 Henderson Lg Woody DWR Total 3.1 $25,200 3.2 Henderson $25,200 3.2 Larsen $50,876 3.2 Kondolf $2,500 Total 3.2 $78,076 3.3 Larsen $5,968 3.3 Kondolf $2,000 Total 3.3 $7,968

3.4 Buer – Morphology DWR Total 4.3 $53,141 3.5 Marchetti –

100% Total 3.5 $23,179 Public Involvement 4.1 Bundy Total 4.1 $20,918 Monitoring and Indicator Framework 5.1 Schilling – 100% Total 5.1 $22,140 5.2 Lubell – 100% $36,570 5.2 Stevens – 100% $36,000 Total 5.2 $72,570

Restoration Effectiveness Evaluation Schilling $11,070 Holl $4,194 Wood $7,386 Total 6.1 $22,650 Total Project Costs $502,626

YEAR 3 Project Management Labor

1.1 Cooper Carter $17,056 1.2 Cooper Carter $17,056 Total 1.2 $17,056

Riparian Processes 2.1 Nelson $16,000 2.1 Schilling 0.25 $11,070 Total 2.1 $27,070 2.2 Holl 0.75 $6,038 2.2 Wood 0.5 $2,987 Total 2.1 $9,024 2.3 Hunt $43,568 2.4 Morgan (DWR) $67,428 Channel Processes 3.1 Henderson Large Woody Debris 0.5 $25,200 3.2 Henderson 0.5 $25,200 3.2 Larsen 0.9 $33,917 3.2 Kondolf 0.5 $2,000 Total 3.2 $61,117 3.3 Larsen 0.1 $3,978 3.3 Kondolf 0.5 $2,000 Total 3.3 $5,978 3.4 Buer – Morphology DWR $53,141 3.5 Marchetti $30,670 Public Involvement 4.1 Bundy $19,655 Monitoring and Indicator Framework 5.1 Schilling 0.5 $22,140 5.2 Lubell $36,570 5.2 Stevens $36,000 Total 5.2 $72,570 Restoration Effectiveness Evaluation 6.1 Shilling 0.25 $11,070 6.1 Holl 0.25 $2,013 6.1 Wood 0.25 $1,493 Total 6.1 $14,576 Total Project Costs $486,249

Benefits

Benefit rates vary depending upon subcontracting agency.

For the CSU, Chico, the UC's and DWR the average fringe benefit rate for faculty and staff is in 30–35%

Travel

YEAR 1 $22,519 YEAR 2 $26,439 YEAR 3 $23,154

Supplies And Expendables

YEAR 1 $61,078 YEAR 2 $42,037 YEAR 3 $21,272

Services And Consultants

YEAR 1 $18,000 YEAR 2 $12,000 YEAR 3 $12,000 All of these costs are to pay for TNC, Sacramento River Partners, Refuge, agenecy, etc staff time to participate in the review of their past funded projects. This funding will also be used to hire subcontractors with specific expertise that may be needed during the implementation of this program.

Equipment

YEAR 1 $31,100– Transmitters – $6,500 Surveying and GPS – $6,700 Recorders and Sensors – $17,900

YEAR 2 $0 YEAR 3 $0

YEAR 2 $

Lands And Rights Of Way

$0

Other Direct Costs

$16,815 – Survey costs

Indirect Costs/Overhead

Indirect costs for CSU, Chico costs are calculated at the standard rate of 20% total direct costs for all personnel and other funds requested by CSU, Chico. Indirect taken by CSU, Chico on subcontractors' costs is calculated according to federal regulations that allow indirect to be taken on the first $25,000 of any subcontract for more than $25,000 and 20% of total costs on any subcontract less than $25,000. These

indirect costs are added to the indirect costs associated with Administration in the first section of each year’s budget.

Comments

Environmental Compliance

Sacramento River Riparian Monitoring and Assessment Project

CEQA Compliance

Which type of CEQA documentation do you anticipate?
X none
− negative declaration or mitigated negative declaration
− EIR
− categorical exemption

If you are using a categorical exemption, choose all of the applicable classes below.
− Class 1. Operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of use beyond that existing at the time of the lead agency's determination. The types of "existing facilities" itemized above are not intended to be all−inclusive of the types of projects which might fall within Class 1. The key consideration is whether the project involves negligible or no expansion of an existing use.
− Class 2. Replacement or reconstruction of existing structures and facilities where the new structure will be located on the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced.
− Class 3. Construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure. The numbers of structures described in this section are the maximum allowable on any legal parcel, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.
− Class 4. Minor public or private alterations in the condition of land, water, and/or vegetation which do not involve removal of healthy, mature, scenic trees except for forestry or agricultural purposes, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.
− Class 6. Basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies. These may be strictly for information gathering purposes, or as part of a study leading to an action which a public agency has not

yet approved, adopted, or funded.
− Class 11. Construction, or placement of minor structures accessory to (appurtenant to) existing commercial, industrial, or institutional facilities, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.

Identify the lead agency.

Is the CEQA environmental impact assessment complete?

If the CEQA environmental impact assessment process is complete, provide the following information about the resulting document.

Document Name
State Clearinghouse Number

If the CEQA environmental impact assessment process is not complete, describe the plan for completing draft and/or final CEQA documents.

NEPA Compliance

Which type of NEPA documentation do you anticipate?
X none
− environmental assessment/FONSI
− EIS
− categorical exclusion

Identify the lead agency or agencies.

If the NEPA environmental impact assessment process is complete, provide the name of the resulting document.

If the NEPA environmental impact assessment process is not complete, describe the plan for completing draft and/or final NEPA documents.

Successful applicants must tier their project's permitting from the CALFED Record of

Decision and attachments providing programmatic guidance on complying with the state and federal endangered species acts, the Coastal Zone Management Act, and sections 404 and 401 of the Clean Water Act.

Please indicate what permits or other approvals may be required for the activities contained in your proposal and also which have already been obtained. Please check all that apply. If a permit is *not* required, leave both Required? and Obtained? check boxes blank.

Local Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
conditional Use Permit	–	–	
variance	–	–	
Subdivision Map Act	–	–	
grading Permit	–	–	
general Plan Amendment	–	–	
specific Plan Approval	–	–	
rezone	–	–	
Williamson Act Contract Cancellation	–	–	
other	–	–	

State Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
scientific Collecting Permit	X	–	
CESA Compliance: 2081	–	–	
CESA Complance: NCCP	–	–	
1602	–	–	
CWA 401 Certification	–	–	
Bay Conservation And Development Commission Permit	–	–	
reclamation Board Approval	–	–	
Delta Protection Commission Notification	–	–	
state Lands Commission Lease Or Permit	–	–	
action Specific Implementation Plan	–	–	

other	–	–	

Federal Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
ESA Compliance Section 7 Consultation	–	–	
ESA Compliance Section 10 Permit	–	–	
Rivers And Harbors Act	–	–	
CWA 404	–	–	
other	–	–	

Permission To Access Property	Required?	Obtained?	Permit Number (If Applicable)
permission To Access City, County Or Other Local Agency Land Agency Name The Nature Conservancy	X	–	
permission To Access State Land Agency Name California Department Of Fish And Game, California Department Of Parks And Recreation	X	–	
permission To Access Federal Land Agency Name US Fish And Wildlife, U.S. Bureau Of Reclamation	X	–	
permission To Access Private Land Landowner Name Various Landowners Identified On Our Maps And Description.	X	–	

If you have comments about any of these questions, enter them here.

Land Use

Sacramento River Riparian Monitoring and Assessment Project

Does the project involve land acquisition, either in fee or through easements, to secure sites for monitoring?
X No.
– Yes.

How many acres will be acquired by fee?

How many acres will be acquired by easement?

Describe the entity or organization that will manage the property and provide operations and maintenance services.

Is there an existing plan describing how the land and water will be managed?
– No.
– Yes.

Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?
– No.
X Yes.

Describe briefly the provisions made to secure this access.

We have a comprehensive list of all the landowners, both private and agency. We will contact each landowner prior to conducting any work. Additionally, we will send out written notices prior to the start of the program introducing the work that will be done and providing each landowner with the name and phone number of contact people that can address their questions and concerns.

Do the actions in the proposal involve physical changes in the current land use?
X No.
– Yes.

Describe the current zoning, including the zoning designation and the principal permitted uses permitted in the zone.

Describe the general plan land use element designation, including the purpose and uses allowed in the designation.

Describe relevant provisions in other general plan elements affecting the site, if any.

Is the land mapped as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance under the California Department of Conservation's Farmland Mapping and Monitoring Program?
– No.
X Yes.

Land Designation	Acres	Currently In Production?
Prime Farmland	4071	–
Farmland Of Statewide Importance	77	X
Unique Farmland	674	–
Farmland Of Local Importance	37	–

Is the land affected by the project currently in an agricultural preserve established under the Williamson Act?
X No.
– Yes.

Is the land affected by the project currently under a Williamson Act contract?
X No.
– Yes.

Why is the land use proposed consistent with the contract's terms?

Describe any additional comments you have about the projects land use.