

99B-190

4.5 PSP Cover Sheet (Attach to the front of each proposal)

Proposal Title: Linked Hydrogeomorphic-Ecosystem Models to Support Adaptive Management: Cosumnes-Mokelumne Paired Basin Project
 Applicant Name: Dr. Jeffrey Mount Director, Center for Integrated Watershed Science and
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Amount of funding requested: \$ 1,946,167 ^{ok} for 3 years

Indicate the Topic for which you are applying (check only one box).

- Fish Passage/Fish Screens
- Habitat Restoration
- Local Watershed Stewardship
- Water Quality
- Introduced Species
- Fish Management/Hatchery
- Environmental Education

Does the proposal address a specified Focused Action? yes no

What county or counties is the project located in? Sacramento, San Joaquin, El Dorado, Amador

Indicate the geographic area of your proposal (check only one box):

- Sacramento River Mainstem
- Sacramento Trib: _____
- San Joaquin River Mainstem
- San Joaquin Trib: _____
- Delta: _____
- East Side Trib: Cosumnes/Mokelumne
- Suisun Marsh and Bay
- North Bay/South Bay: _____
- Landscape (entire Bay-Delta watershed)
- Other: _____

Indicate the primary species which the proposal addresses (check all that apply):

- San Joaquin and East-side Delta tributaries fall-run chinook salmon
- Winter-run chinook salmon
- Late-fall run chinook salmon
- Delta smelt
- Splittail
- Green sturgeon
- Migratory birds
- Other: _____
- Spring-run chinook salmon
- Fall-run chinook salmon
- Longfin smelt
- Steelhead trout
- Striped bass
- All chinook species
- All anadromous salmonids

Specify the ERP strategic objective and target (s) that the project addresses. Include page numbers from January 1999 version of ERP Volume I and II:

Riparian and Riverine Aquatic Habitats, Targets 1&3 (pg 378-9); Central Valley Stream Flows, Target 1 (pg 371); Natural Floodplain and Flood Processes, Target 1 (pg375); Coarse Sediment Supply Targets 1&3, (pg 374); Freshwater Fish Habitat and Essential Fish Habitat, Target 1 (pg379); Contaminants, Target 1 (pg382); Central Valley Stream Temperatures, Target 1 (pg 376); Strategic Plan Objectives (pg43,80-81 Vol.I)

Indicate the type of applicant (check only one box):

- | | |
|--|---|
| <input type="checkbox"/> State agency | <input type="checkbox"/> Federal agency |
| <input type="checkbox"/> Public/Non-profit joint venture | <input type="checkbox"/> Non-profit |
| <input type="checkbox"/> Local government/district | <input type="checkbox"/> Private party |
| <input checked="" type="checkbox"/> University | <input type="checkbox"/> Other: _____ |

Indicate the type of project (check only one box):

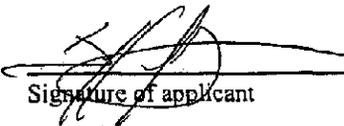
- | | |
|--|---|
| <input type="checkbox"/> Planning | <input type="checkbox"/> Implementation |
| <input checked="" type="checkbox"/> Monitoring | <input type="checkbox"/> Education |
| <input type="checkbox"/> Research | |

By signing below, the applicant declares the following:

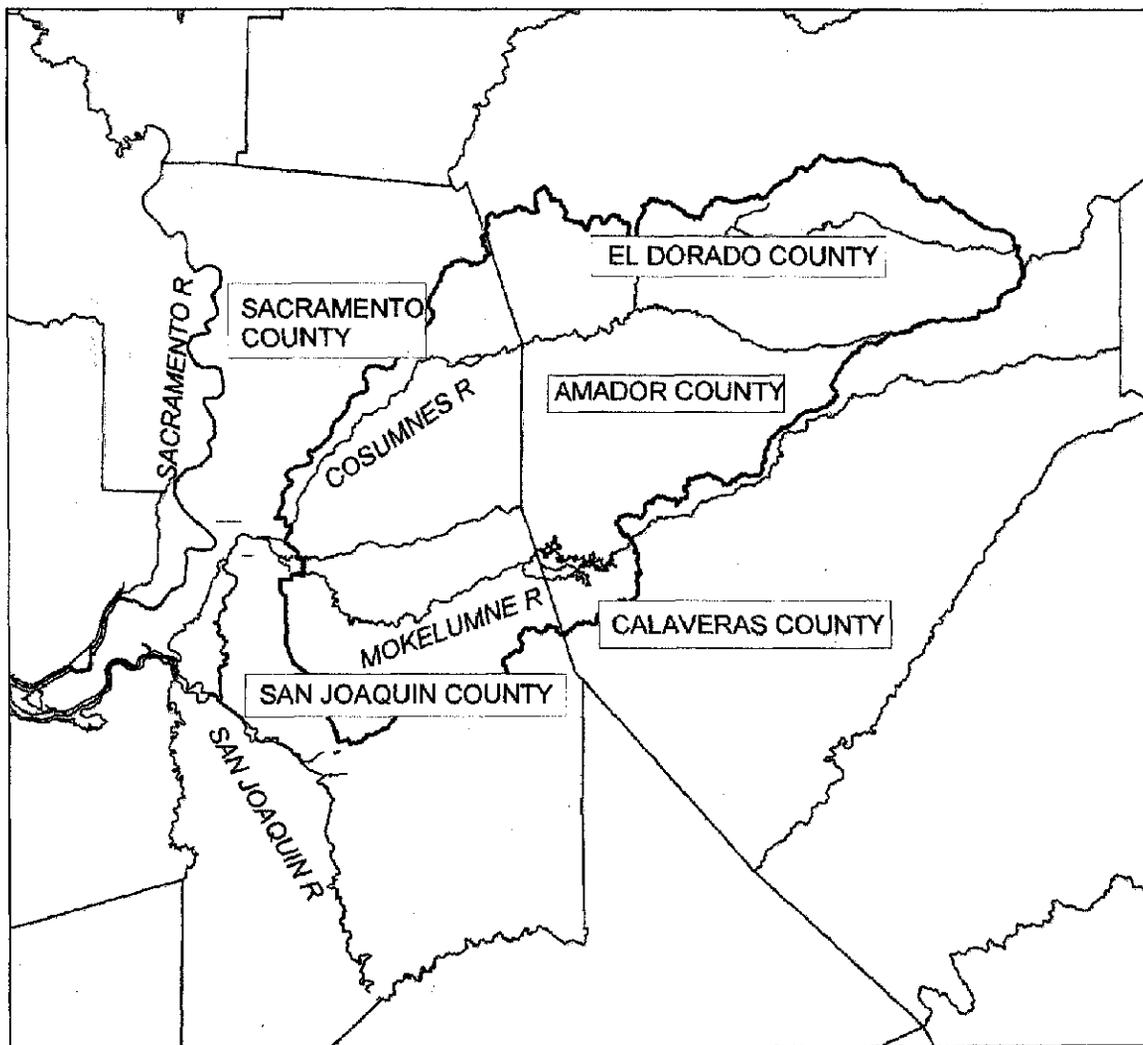
- 1.) The truthfulness of all representations in their proposal;
- 2.) The individual signing the form is entitled to submit the application on behalf of the applicant (if the applicant is an entity or organization); and
- 3.) The person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section 2.4) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

Dr. Jeffrey Mount

Printed name of applicant


Signature of applicant

Cosumnes River and Mokelumne River Watersheds



20 0 20 40 Kilometers



Information Center for the Environment, UCD
Data Provided by: Teale Data Center, CA DFG, and CDF
(Watershed Boundaries are available from ICE)

**Linked hydrogeomorphic-ecosystem models to support adaptive management:
Cosumnes-Mokelumne Paired Basin Project**

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Dr. James Quinn, Information Center for the Environment
Dr. Levent Kavvas, Civil and Environmental Engineering
Dr. Graham Fogg, Land, Air, and Water Resources
Dr. Gregory Pasternack, Land, Air, and Water Resources
Dr. Geoffrey Schladow, Civil and Environmental Engineering
Dr. Theodore Grosholz, Environmental Sciences and Policy
Dr. Mark Schwartz, Environmental Sciences and Policy
Dr. Randy Dahlgren, Land, Air, and Water Resources

Type of organization and tax status:

Institution of higher education / tax exempt
Tax identification number: 94-6036494-W

II. Executive Summary

The University of California, Davis Center for Integrated Watershed Science and Management (CIWSM), in partnership and collaboration with foundation, agency and university partners, propose to develop a demonstration monitoring and assessment program for the CALFED Cosumnes and Mokelumne River Ecological Management Units. The *Cosumnes Consortium* will focus upon on-going and planned restoration efforts within the Cosumnes and Mokelumne Watersheds with the intent of providing technical and informational support for restoration planning and design, developing new analytical tools and information systems that support implementation of CALFED's ERP, Watershed Management, Water Quality and Levee Integrity Programs, and providing baseline studies and targeted research for long-term biologic and hydrogeomorphic monitoring in support of CMARP.

This project takes advantage of the unique hydrologic, ecologic and institutional opportunities that exist within the Cosumnes and Mokelumne watersheds. The Cosumnes watershed, with its relatively intact hydrologic system and extensive restoration programs, affords the opportunity to conduct and evaluate a broad spectrum of restoration experiments that support multiple objectives of CALFED programs. The closely adjacent Mokelumne River, with its highly altered and regulated hydrogeomorphic system, makes it possible to develop and test new restoration methods and to evaluate their effectiveness in direct comparison with a similar, more naturalized system.

This proposal seeks funding of \$1,946,016 for three years to support six core programs. All programs are intended to be collaborative, with direct involvement and contribution from agencies currently conducting restoration, monitoring and research within the basins. For this reason, budget estimates are considered tentative.

The Consortium project has been subdivided into six core programs that support development of predictive models for hydrogeomorphic and ecosystem function in support of a broad range of CALFED ecological/biological objectives. These include:

HYDROLOGY: In order to optimize integration within the Consortium, all empirical, conceptual and predictive models will be tied to a linked surface water/groundwater model in development at UC Davis. The UC Davis Hydrologic Model is physically-based and spatially-distributed, allowing its use over a wide range of watersheds and scales. This model will be used to simulate the impact of historic and projected land use/land cover changes and water management methods on the Bay-Delta. Cost: \$225,027.

GEOMORPHOLOGY: A range of non-traditional flood management measures are currently being considered in the Cosumnes and Mokelumne basins. The primary focus of the geomorphology program is the documentation and simulation of hydrogeomorphic impacts of levee setback and breach designs that optimize both restoration and flood management goals. This request includes partial funding for the development of a dynamic meander migration model, coupled to the hydrologic model. It is anticipated that this work will directly address design of flood management programs throughout the CALFED region. Additional work in the Geomorphology program includes paired basin study of the impact of land use on sediment flux. Cost: \$192,576.

WATER QUALITY: The CIWSM will develop a paired basin water quality and aquatic food resource monitoring and modeling program. The objective of this program is to document

the links between upland watershed processes, water management, and the health and lower trophic level productivity of lowland and Bay-Delta ecosystems. Results from this program will contribute to high priority issues, such as drinking water quality, fluxes of organic materials contributing to halogenation reactions, and development of total maximum daily load (TMDL) criteria for upland watersheds. The paired basin approach affords the unique opportunity to directly assess the relative effects of water retention structures on water quality and food resources in the Delta. Cost: \$300,000.

AQUATIC RESOURCES: the aquatic resources program will focus on a comparison of the successional, naturalized aquatic ecosystems of the Cosumnes Basin with the highly regulated ecosystems of the Mokelumne River. The collaborative sampling program will emphasize three issues: the relations between hydrogeomorphic processes and function of naturalized aquatic ecosystems, adaptive management of successional trajectories in order to enhance native species and reduce nonindigenous species (such as the Chinese Mitten Crab), and assessment of the benefits of restoration efforts within and outside of the basins. Cost: \$407,049

TERRESTRIAL RESOURCES: In order to guide design and implementation of changes in floodplain management, a spatially explicit vegetation patch dynamic model will be developed that allows simulation of riparian response to levee and channel modification, both within the naturalized reaches of the Cosumnes and the close-leveed, dam-regulated reaches of the Mokelumne. This riparian patch dynamic model work will be supported by the development of a GIS-based model of riparian bird habitat. The aim will be to identify landscape features that serve as predictors for high-quality riparian habitat and can be mapped easily at the scale of several watersheds. Cost: 396,498.

DATA ANALYSIS and DISSEMINATION: The UC Davis Information Center for the Environment (ICE) will manage and support the GIS for all core programs in the Consortium. This program will include maintenance of GIS data bases, development of new data layers, GIS support for investigators, and exchange with decisionmakers and stakeholders. The cost of this program during this project is \$318,197. In conjunction with this process, ICE will develop new mapping and analysis tools to support watershed restoration programs in watersheds throughout the CALFED region. These web-based tools will be prototyped in the Cosumnes and Mokelumne basins. Cost: \$106,669.

All six core programs will be directed by UC Davis faculty. Each faculty member is a recognized expert in their field of specialization and have well-established research programs. The CIWSM will coordinate all activities of the project, including preparation of reports for CALFED and presentation of public symposia and workshops. With Packard Foundation Conservation Program support, the CIWSM is able to provide \$250,000 in matching funds for this project. In addition, UC Davis will supply in-kind services including space, faculty salaries, and computing system support.

The foundation of this project is the recognition that baseline studies that will be used to test and validate predictive models will also guide the design and implementation of a long-term monitoring program dedicated to CALFED's adaptive management goals. This will involve extensive coordination between core programs, including choice of georeferenced, replicate monitoring sites that meet multiple monitoring and assessment objectives. This monitoring program will be developed in cooperation with CALFED program personnel and be subjected to rigorous peer review.

III. Project Description

The University of California, Davis Center for Integrated Watershed Science and Management (CIWSM), in collaboration with The Nature Conservancy (TNC), the Cosumnes River Preserve Partners, East Bay Municipal Utility District (EBMUD), and multiple local, state and federal agencies and universities, propose to develop a demonstration monitoring and assessment program for the Cosumnes and Mokelumne Watersheds. This proposal seeks partial funding for three years to support six core programs (Table 1) with a broad range of deliverables (Table 2). All of these programs are intended to be collaborative, with direct involvement and contribution from agencies and universities currently conducting restoration, monitoring and research within the basins. In order to insure coordination between these activities and CALFED's objectives, faculty members at the CIWSM will be paired with agency personnel directly or indirectly linked to CALFED's ERP, Watershed Management Program and CMARP. The CIWSM will manage these partnerships and coordinate research and monitoring activities. All six core programs are linked to the development of predictive models for hydrogeomorphic and ecosystem function that can be tested and validated in support of adaptive management programs in the basin. Space limitations preclude complete descriptions of these programs. Complete descriptions will be submitted for review upon request.

HYDROLOGY (L. Kavvas and G. Fogg): All Consortium models will be tied to a linked surface water/groundwater model in development at UC Davis. Unlike hydrologic models currently available in the basin, the UC Davis Hydrologic Model is physically-based and spatially-distributed, describing hydrologic flow processes over the land surfaces, within the soil root zone, in deeper soils, and in groundwater aquifers. It also describes the dynamic interactions among these component processes. As such, the model can be used to find the optimal locations for the monitoring of both surface and subsurface flow processes and their influence on geomorphic and ecosystem processes. A prototype of the model is currently operational for the Ward Creek basin in Lake Tahoe.

The UC Davis Hydrologic Model offers several advantages. It incorporates explicitly information on soils, topography, vegetation, land use/land cover and geologic features of a watershed into the model's hydrologic predictions, based upon a geographic information system (GIS) incorporated into the model. Therefore, the model can be used over a wide range of watersheds, at different scales and including different features. Additionally, because the model is spatially-distributed within a GIS, Consortium researchers will be able to simulate the hydrologic impacts of various historic and projected land use/land cover changes as well as evaluate the consequences of water use changes. This will form the basis for coupling ecologic models with the physical/chemical models being developed in the project.

CIWSM, in collaboration with agency partners, will integrate this model with existing hydrologic models for the Mokelumne River currently operated by EBMUD. The UC Davis model will be made available for use for the Watershed Management Program, CMARP and ERP.

GEOMORPHOLOGY (J. Mount; G. Pasternack): under the Corps' 905b process, the Cosumnes and Mokelumne basins may be the site of the first areally-extensive effort to restore geomorphic function within the CALFED Bay-Delta region. Current plans envision a mix of traditional and non-traditional flood management options, including possible levee breaches and levee setbacks on both the Cosumnes and Mokelumne Rivers. With seed funding from the Packard Foundation, the CIWSM is currently conducting geomorphic analyses of the lower

Cosumnes River with an emphasis on evaluation of the hydrogeomorphic impacts of levee setback and breach designs that optimize both restoration and flood management goals. This research includes partial funding for the development of a dynamic meander migration model, coupled to the hydrologic model, that will allow simulation of the response of rivers and riparian systems to flood management changes. We seek to expand this work in order to guide design of non-traditional flood management projects throughout the Bay-Delta watershed. An additional goal of this research is to support research on the Floodplain Ecosystem Function Model developed in the Comprehensive Study. It is our objective to work cooperatively with the Corps and the USGS to refine this model by testing it in the Cosumnes and Mokelumne basins.

With cooperation from EBMUD, we are designing a paired basin geomorphic monitoring program that will be used to inform and guide management of coarse- and fine-grained sediment within the lower portions of these basins (ERP vol. II p. 374). We are currently experimenting with several methodologies for assessment of sediment residence times and transport rates within the lower basin. Discussions are currently underway on coupling this work with research with efforts supported by the USFS on sediment transport in the upper basin.

WATER QUALITY (R. Dahlgren): Natural processes and anthropogenic activities in upland watersheds have a tremendous impact on both drinking water and the health and productivity of aquatic communities in the Bay-Delta ecosystem. To develop effective management strategies for restoration of Bay-Delta habitats while preserving high quality drinking water, it is necessary to understand the processes regulating water quality and resource availability at the large watershed scale. The CIWSM will develop a paired basin water quality and aquatic food resource monitoring and modeling program. The objective of this program is to document the links between upland watershed processes, water management, and the health and lower trophic level productivity of lowland and Bay-Delta ecosystems. Results from this program will contribute to high priority issues, such as drinking water quality, fluxes of organic materials contributing to halogenation reactions, and development of total maximum daily load (TMDL) criteria for upland watersheds. The aspects of water quality addressed by this study are listed in Table 3.

Data collection will focus upon the acquisition of process level information on biochemical and physical processes regulating terrestrial nutrient cycling and water quality. Temporal variability in water quality will be examined at the seasonal and storm-event scale (both rising and falling limbs of storm hydrographs). This information will support modeling of terrestrial-aquatic linkages at large watershed scales and, when coupled with the hydrologic model, allow prediction of the impacts of management actions on water quality-food resource relationships. The paired basin approach affords the unique opportunity to directly assess the relative effects of water retention structures on water quality and food resources in the Delta.

AQUATIC RESOURCES (P. Moyle and E. Grosholz): the aquatic resources program will focus on a comparison of the naturalized (i.e., a mix of native and exotic species) aquatic ecosystems of the Cosumnes Basin with the highly regulated ecosystems of the Mokelumne River. The collaborative sampling program will emphasize three issues: the relations between hydrogeomorphic processes and function of naturalized aquatic ecosystems, adaptive management in order to enhance native species and reduce nonindigenous species (such as the Chinese Mitten Crab), and assessment of the benefits of restoration efforts within and outside of the basins.

Three project areas will be addressed, including the upper watersheds, lower river and floodplains (emphasis on flooded habitats), and the McCormack-Williamson Tract. Funding for

work in the McCormack-Williamson Tract is requested in a separate proposal. Upper watershed studies will document the links between ecosystem health (as measured through the Index of Biotic Integrity), native invertebrate diversity and productivity, and standard habitat and water quality variables. Lower watershed and floodplain studies will address a broad range of issues that will directly inform the ERP, including: 1) the impact of regularly flooded lands and newly flooded lands on primary productivity and diversity and abundance of native and non-native invertebrates; 2) development of empirical models that relate the timing and magnitude of floodplain inundation to rearing and survivorship of native fishes, particularly salmon and splittail; and 3) development of restoration methods and flow regulation that enhances native invertebrates and fish and inhibits nonindigenous species.

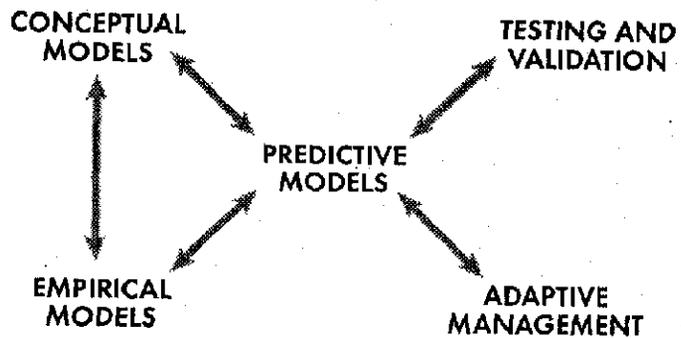
TERRESTRIAL RESOURCES (J. Quinn, M. Schwartz): this program will emphasize the monitoring and assessment of efforts to restore the links between hydrogeomorphic processes and health of riparian reaches of the lower basins. In order to guide design and implementation of changes in floodplain management, a spatially explicit vegetation patch dynamic model will be developed and linked to the physically-based meander migration model. Based on documentation of the historic relationship between patterns of meander migration and vegetation establishment, this model will allow simulation of riparian response to levee and channel modification, both within the naturalized reaches of the Cosumnes and the close-leveed, dam-regulated reaches of the Mokelumne. This work will be used to address elements of the Corps' Floodplain Ecosystem Function Model and will support directly habitat restoration objectives.

This riparian patch dynamic model work will be supported by the development of a GIS-based model of riparian bird habitat. The aim will be to identify landscape features that serve as predictors for high-quality riparian habitat and can be mapped easily at the scale of several watersheds. The Cosumnes River Preserve has been the site for an intensive study of riparian bird populations by the Point Reyes Bird Observatory (PRBO). The project expands this work in collaboration with the UC Davis Information Center for the Environment (ICE). Through field monitoring of bird populations and GIS-based modeling of habitat-species relations, this project will evaluate whether the re-establishment of geomorphic function and enhancement of riparian vegetation conditions results in higher species diversity and abundance. This model will be used to evaluate and guide proposed restoration efforts elsewhere within the CALFED watershed.

DATA ANALYSIS and DISSEMINATION (J. Quinn): The UC Davis Information Center for the Environment will manage and support the GIS for all core programs in the Consortium. With seed money from the Packard Foundation, and support from a range of state and federal agencies, ICE has been pioneering the development of web-based GIS tools that support watershed stakeholder groups and decisionmakers.

Initial efforts of ICE personnel will involve incorporating existing and new data layers and upgrading existing interactive Internet mapping systems (ICEMAPS2). A major thrust of this program will be upgrading the CARES (California Riparian Evaluation System) for the Cosumnes and Mokelumne watersheds. This project will convert CARES for the watersheds from their current low-resolution USGS Hydrologic Unit system to the higher resolution CALWATER Hydrologic Sub-area system. Making the CARES GIS tool more spatially explicit with localized data sets and available through the Internet will allow both agencies and local watershed groups to analyze the watershed for conservation and preservation sites. The model will be tested with riparian and vegetation surveys within the lower basins. Once this system is in place, ICE will expand it to cover other watersheds within the CALFED region.

FRAMEWORK FOR DEVELOPMENT OF MONITORING/RESEARCH PROGRAM



Agencies/Decisionmakers/Stakeholders
Outreach/Education

Table 1

Model/Program	UC Faculty Researchers	Present or Potential Partners
Surface Water-Groundwater	L. Kavvas, G. Fogg	USFWS, USGS, DWR, EBMUD, USFS, USBR, USACE
Hydrogeomorphic Lower and Upper Basin	J. Mount, G. Pasternack	USGS, USFS, EBMUD, NRCS, USACE
Water Quality Lower and Upper Basin	R. Dahlgren, G. Schladow	USGS, DWR, EBMUD, USFS, USFWS, SWRCB, RWQCB
McCormick-Williamson Tract Restoration/Monitoring	G. Schladow, G. Pasternack, P. Moyle, J. Quinn	PRBO, TNC, EBMUD, USACE, DWR, USGS, SFEI, CDFG, USFWS
Aquatic Resources Lower and Upper Basin	P. Moyle, J. Quinn	Preserve Partners, EBMUD, CDFG, USFWS, DWR, Fisheries Society, WCB, SFEI
Riparian and Floodplain Resources Lower and Upper Basin	M. Schwartz, J. Quinn	Preserve Partners, EBMUD, WCB, PRBO, SFEI
GIS/Habitat Assessment/Web Tools	J. Quinn	All partners
Stakeholder Outreach/Agency Coordination	J. Mount	All partners

Table 2: Anticipated Deliverables

Program	Anticipated Deliverables	Time
Program 1: Hydrology.	Report and Program: Linked surface water/groundwater model for the Cosumnes River	24 months
	Report: Hydrologic analysis of management alternatives for enhancing flows to promote Chinook Salmon spawning	24 months
	Report: links between surface flows and groundwater conditions in the Cosumnes River basin: management recommendations	24 months
	Report and Program: Hydrologic and biologic monitoring strategies using a physically-based and spatially-distributed model, Cosumnes and Mokelumne River Basins	36 months
Program 2: Geomorphology	Report: Geomorphic impacts of non-structural floodplain management measures in the Cosumnes River Basin.	12 months
	Report and Program: Meander migration modelling of non-structural floodplain management alternatives.	24 months
	Report: levee setback and breach design for optimization of restoration and flood damage reduction.	28 months
	Report: flow management, coarse sediment flux and restoration of geomorphic function	28 months
	Report: New methods for monitoring sediment and channel impacts of land use change, Cosumnes and Mokelumne River Basins	36 months
Program 3: Water Quality	Report and Programs: Water quality model and calculated yearly loadings in the Cosumnes and Mokelumne basins	20 months
	Report: seasonal flux rates of nutrients and implications for watershed management	24 months
	Report and Programs: Food resource modeling in upland watersheds and the potential links to lowland ecosystems in the CALFED region	24 months
	Report and Programs: Water quality monitoring model for the Cosumnes and Mokelumne Watersheds: nutrients, salts, suspended sediments, pathogens, trace elements, dissolved oxygen and temperature	36 months
	Report and Programs: Water quality monitoring model for the Cosumnes and Mokelumne Watersheds: chlorophyll-a, organic matter, pathogens.	36 months
Program 4: Aquatic Resources	Report: Aquatic resource survey of the lower Cosumnes and Mokelumne Rivers	24 months
	Report: Aquatic resource survey of upper Cosumnes and Mokelumne Rivers	28 months
	Report: Impact of seasonal flooding on native and non-native species, Cosumnes and Mokelumne Rivers.	28 months
	Report: flow management to enhance primary productivity and native invertebrates.	28 months
	Report: management alternatives for reduction in invasive aquatic species	36 months
	Report: Recommended monitoring plan for aquatic species in the Cosumnes and Mokelumne River basins.	36 months

Program 5: Riparian Resources	Report: Baseline inventory of riparian habitats in the lower Mokelumne and Cosumnes Rivers	36 months
	Report: GIS-based avian diversity-habitat relations in the lower Mokelumne and Cosumnes Rivers.	28 months
	Report and program: A spatially-explicit patch dynamic model for riparian restoration	24 months
	Report: Flood management alternatives for the promotion of riparian ecosystems in the lower Mokelumne and Cosumnes Rivers.	36 months
	Report: GIS-based methods for identification of landscape predictors for high quality riparian habitat.	28 months
	Report: Monitoring plan for riparian habitat and avian species with the Cosumnes and Mokelumne Rivers.	36 months
Program 5: Riparian Resources	Report: Baseline inventory of riparian habitats in the lower Mokelumne and Cosumnes Rivers	36 months
	Report: GIS-based avian diversity-habitat relations in the lower Mokelumne and Cosumnes Rivers.	28 months
	Report and program: A spatially-explicit patch dynamic model for riparian restoration	24 months
	Report: Flood management alternatives for the promotion of riparian ecosystems in the lower Mokelumne and Cosumnes Rivers.	36 months
	Report: GIS-based methods for identification of landscape predictors for high quality riparian habitat.	28 months
	Report: Monitoring plan for riparian habitat and avian species with the Cosumnes and Mokelumne Rivers.	36 months
Program 6: Data Analysis and Dissemination	Website: The Cosumnes Consortium	4 months
	Report and Programs: GIS support for multi-objective hydrogeomorphic and biologic monitoring programs in the CALFED region.	24 months
	Report and Program: CARES for the Cosumnes and Mokelumne Watersheds.	30 months
	Report and Program: Application of web-based CARES program and additional decision support tools in CALFED watersheds.	36 months

Table 3. Water quality parameters to be measured in this study.

Temperature	Calcium	Total N
pH	Magnesium	Total dissolved N
Turbidity	Potassium	Mineral N (NH ₄ , NO ₃ , NO ₂)
Electrical conductivity	Sodium	Total P
Suspended sediment	Chloride	Total dissolved P
Chlorophyll-a	Sulfate	Ortho-phosphate
Particulate organic matter	Bicarbonate	Dissolved organic carbon
Dissolved oxygen	Fecal coliform	Cryptosporidium parvo
Trace elements (As, Cu, Zn, etc.)		

IV. Ecological / Biological Benefits

Objectives:

The Cosumnes and Mokelumne basins constitute one of the finest natural laboratories for the study of watershed-scale hydrologic, geomorphic and ecologic relationships within the Bay-Delta watershed. Both basins provide excellent opportunities for the recovery and conservation of at risk native species and the restoration of natural processes. The Goal 1 species that our project would evaluate directly include splittail, Chinook salmon, steelhead trout, Swainson's hawk, greater sandhill crane, bank swallow and possibly western yellow-billed cuckoo. Other Goal 1 species that may benefit from our activities but will not be directly monitored include giant garter snakes and California red-legged frog (PSP pg. 13). With limited urbanization and no significant dams, the Cosumnes River's hydrologic system remains largely intact, affording a unique opportunity for monitoring and evaluation of the impacts of restoration activities on ecosystem and watershed function. Although opportunities to restore salmon spawning habitat may be limited by low flows and natural barriers the Cosumnes provides crucial rearing habitat for Chinook salmon and steelhead (ERP vol. II pg.359). The Mokelumne, with its three large dams and dramatically altered flow regime, provides an ideal comparison that will allow us to parse out the impact of dams from the impacts of levees and other stressors. The Mokelumne also provides an excellent opportunity for restoring spawning habitat for salmon and steelhead (ERP vol.II pg.362).

The Nature Conservancy and EBMUD are the primary management agencies that we are working with in the basins. In 1992, the Nature Conservancy, recognizing that ecosystem health is tied to hydrologic and ecologic processes throughout the watershed, committed to restoring or maintaining a functioning ecosystem on a watershed scale, rather than on a patchwork local scale. The Nature Conservancy's Cosumnes River project has attracted the participation of a range of state, federal, and private partners. The Cosumnes Consortium, which is an alliance between The University of California, Davis and the Cosumnes Preserve Partners will provide multidisciplinary, long term technical support for the Nature Conservancy's restoration efforts and support the information needs of adaptive management in both basins. In the Mokelumne basin EBMUD has signed a Joint Settlement Agreement to protect the anadromous fishery and lower Mokelumne River ecosystem. The Consortium will provide technical support for this agreement.

The Consortium has two main ecological / biological objectives: 1) to improve scientific understanding of hydrologic, geomorphologic and ecologic relationships and 2) to assist in the evaluation of alternative water management strategies. First, this improved understanding of the relationships between physical processes, habitats and species is crucial to the success of future restoration projects. The design of habitat restoration projects is based on a series of assumptions about the impact of various stressors on the at risk native species. These assumptions are largely untested because of the quantity and cross disciplinary nature of the data required. This has led to a high degree of scientific uncertainty about the impact of physical processes on ecosystem health and a resultant lack of success of some restoration projects. The Consortium will collect long term, multidisciplinary, monitoring data which will be used to develop ecologically based models to predict the combination of factors that will maximize ecosystem benefits in ways that are compatible with other water uses. These models will then be used to test these key assumptions and facilitate the conservation and recovery of priority native species in the Cosumnes and Mokelumne basins and throughout the CALFED Bay-Delta watershed. This

approach will allow the investigation of problems for which causes and remedies remain uncertain. For example the surface water / groundwater model that we are creating will allow us to find the most effective ways to restore natural summer and fall base flows on the Cosumnes River and then our aquatic resources monitoring will track the impact of these higher base flows on at risk native species.(p.371-2 ERP vol. II)

The second objective, monitoring of indicators to evaluate alternative management strategies, is linked to an existing Army Core of Engineers(ACOE) project and the Joint Settlement Agreement (JSA) between East Bay Municipal Utility District (EBMUD), US Fish and Wildlife Service (USFWS) and the Department of Fish and Game (DFG). In conjunction with East Bay Municipal Utility District (EBMUD) and the Nature Conservancy (TNC), the Army Core of Engineers (ACOE) has received CALFED funding to implement environmental restoration and flood damage reduction efforts on selected sites in the lower Cosumnes and Mokelumne River basins. The JSA presents target flow releases from Camanche dam and provides money to restore ecosystem health. The ERP states that "these target levels need further review and should be subject to adaptive management and focused research" (p. 373 ERP vol. II). The Consortium will provide baseline data and create the foundation for the implementation of adaptive management in both the Mokelumne and Cosumnes basins. We will collect appropriate baseline data on ecosystem indicators and evaluate the impact of these restoration activities and other stressors within the basins. Since our data will be multidisciplinary we will be able to determine which actions provide multiple benefits to species, habitats, and processes.

The ERP states that "The foundation of the ERP implementation strategy is adaptive management.... Adaptive management relies upon the identification of indicators of ecosystem health, comprehensive monitoring of indicators to measure improvement over time, focused research, and phasing of actions" (ERP vol. I p.6). The first ecological objective described above addresses the directed research aspect of adaptive management. Directed research must be long term and multidisciplinary in nature to answer questions about the system and its components and increase the certainty surrounding the relationship between physical processes and ecosystem health. The second ecological objective addresses the comprehensive monitoring aspect of adaptive management. (ERP vol. I p.6). The Consortium seeks to create a demonstration project on the Cosumnes and Mokelumne River that will provide directed research and monitoring protocols to inform other projects throughout the Bay-Delta watershed.

Our broader hypothesis is that ecosystem health is driven by hydrologic processes and that these processes can be altered to restore native habitats and at risk species in a way that is compatible with other water uses. The individual hypotheses are stated in the project descriptions, but the strength of this project is its multidisciplinary nature.

Linkages:

This project is closely linked to other restoration programs in the Eastside Delta Tributaries Ecological Zone. The University of California, Davis is a partner in the multi-agency effort to restore and protect the Cosumnes River Ecosystem. The Consortium is an integral part of this effort. Early funding for the Consortium was provided by USFWS's Anadromous Fish Restoration Program and the Packard foundation. This CALFED funding would allow us to continue an on going comprehensive monitoring and focused research project on the Cosumnes and expand our activities to the Mokelumne where we would collaborate with ACOE, EBMUD, USFWS, the Department of Water Resources (DWR), and The US Geological Survey (USGS). This project will complement a planned joint TNC-UDC-DWR restoration project on the McCormick Williamson Tract. UCD is also working on cataloging research in the basins through

the California Watershed Projects Inventory so that agency, university and private research efforts can be coordinated. This project aims to facilitate communication, provide easy access for stakeholders, and avoid duplication of research efforts. Table 4 outlines other ongoing research that we have identified.

The 'comments/data priority' section of Table 5 specifies the ERP strategic objectives and targets that the Consortium will address. CALFED's vision for the Eastside Delta Tributaries Ecological Zone is "to improve the values of the rivers and riparian zones as fish and wildlife corridors from the delta to the upland and upstream habitats; restore tidal wetlands; create and maintain permanent freshwater marshes; seasonal wetlands, floodplain habitat, spawning areas for splittail, and rearing, spawning, and foraging habitat for fall-run chinook salmon." (ERP vol. II p.365) The Consortium seeks to play an integral role in this type of restoration by accurately identifying key stressors and providing more sophisticated tools to evaluate ongoing restoration activities. The CALFED implementation strategy calls for an adaptive management approach that is flexible and can respond to new information. The Consortiums work will be central to the success of this kind of approach in the Cosumnes and Mokelumne basins.

System-Wide Ecosystem Benefits:

This is a system-wide synergistic project. The Consortium seeks to create an integrated watershed level research and monitoring program. By creating a demonstration project on the Cosumnes we are hoping to inform restoration efforts throughout the Bay-Delta watershed. The models and monitoring protocol that we create will be broadly applicable and the baseline data that we collect on the Cosumnes can be used in comparison studies of restoration and other stressors throughout the Bay-Delta watershed. The data that we collect and the models that we create will all be made available to the public on the web and through workshops and meetings with agencies and stakeholders.

Compatibility with Non-Ecosystem Objectives:

The project will support, rather than conflict with, other CALFED objectives. For example, accurate, long-term monitoring of aquatic stressors on endangered fish will provide valuable data for improvement of water quality. Hydrologic and geomorphic assessments that help predict the feasibility and success of levee setbacks for floodplain habitat will also support improved levee system integrity; and improved hydrologic models will assist in accurately identifying the relationship between groundwater phenomena and surface water supplies and reliability. In addition the Consortium will be collaborating with the Army Corps of engineers on identifying opportunities for habitat restoration that also provide flood control benefits.

Table 4: Other Current Research in the Basins

Activity	party	Time Frame	Purpose
Mokelumne River Research			
Wildlife Monitoring	EBMUD	1/1/98 - Present	Meet CALFED and FERC relicensing mandate
Water Quality monitoring	EBMUD	1/1/90 - Present	Meet State and Federal Compliance Standards for Water Quality
Setback levee and restoration	Reclamation District	1997 - Present	Habitat restoration
Woodbridge fish screen and passage	Woodbridge Irrigation District	1997 - Present	Increase fish survival
Cosumnes River Research			
Cosumnes River Salmon Barrier Program	Fishery Foundation of California (FFC) and TNC	1/1/99 - 10/15/99	To design and implement measures to eliminate migration barriers and monitor the success of these actions.
Wetlands Creation and Enhancement Program	The Nature Conservancy	1/1/98 - Present	To enhance waterfowl habitat.
Weed Management Project	The Nature Conservancy	1/1/94 - Present	To identify, monitor and control invasive exotic species that threaten native habitats.
Valley Oak Tree Planting	The Nature Conservancy	1/1/89 - Present	To restore gaps in existing Valley Oak riparian forest by active tree planting.
Restoring Natural Flood Regimes on the Floodplain	The Nature Conservancy	1/1/93 - Present	Healthy natural communities require that natural disturbance regimes be preserved.
Native Grassland Restoration	The Nature Conservancy	3/21/99 - Present	Protection and restoration of rare community type, biodiversity, natural process restoration.
Farming for Wildlife Program	The Nature Conservancy	1/1/97 - Present	To model the economic viability of organic farming and wildlife friendly farming.
Inventory of Forest Roads	US Forest Service	1997 - Present	To inventory forest roads

V. Technical Feasibility and Timing

The Consortium is uniquely qualified to create a demonstration project in the Bay-Delta watershed. The Consortium's mission is to develop and implement cutting edge collaborative baseline studies that will form the foundation for a long term monitoring program. We are taking a comprehensive integrated approach to studying the watershed because this is the most effective way to improve understanding of the impact of natural processes on ecological function. There are many areas of scientific uncertainty associated with watershed level restoration. These uncertainties represent a substantial barrier to effective ecosystem restoration and recovery of at risk native species. Investments in the advance of scientific understanding at this early stage in our understanding of watershed level processes will lead to a substantial reduction in money spent on projects that are unlikely to succeed.

As a University our mandate is to develop and disseminate information and to provide knowledge-based services and decision support to decision makers throughout the state. Techniques that we develop and data that we collect will not in anyway be proprietary. On the contrary, part of our goal is to make all of our data available over the web in a GIS format so that other interested groups can benefit from this demonstration project. Agencies, stakeholders, and private consultants will all be able to make use of our data. As the only substantially unregulated river in the western Sierra, the Cosumnes River will yield data that will be particularly valuable to groups studying other similar tributaries. The University is also well situated to facilitate communication between agencies and create a standard format for data presentation.

VII. Local Involvement

The Nature Conservancy provides the local outreach components for the Consortium. The University has sent notice to the Boards of Supervisors of Sacramento, Amador, El Dorado, and San Joaquin Counties

The Cosumnes River Task Force (CRTF), a coordinating body chaired by Sacramento County Supervisor Don Nottole, was consulted in the development of this proposal and informed of its submission. The CRTF comprises the Resource Conservation Districts and Reclamation districts from the North Delta to Rancho Murieta, the Farm Bureau, and major landowners, including the Nature Conservancy. Its goal is to coordinate watershed planning for the Cosumnes, and it will serve as one of the key stakeholders forums for development of the Cosumnes River Feasibility Study by ACOE. Through the CRTF's regular monthly meetings (and more frequent meetings of work groups organized by reaches of the river), we will assure close coordination of this program with CRTF plans and objectives.

The ACOE Feasibility Study will provide another vehicle for assuring local and interagency involvement in the Consortium. The ACOE Project Study Plan should be complete by June 1999. The ACOE process also presents the opportunity for leveraging additional federal funding for the Consortium. It is anticipated that some portions of the proposed research will be supported by this study.

In addition, the Cosumnes Preserve carries out a regular program of outreach to decision makers and community organizations in the greater Sacramento region. Activities in this program include periodic presentation to or participation with the Galt Chamber of Commerce, the North Delta Conservancy, the Delta Protection Commission, service clubs, historical societies, and other groups. These presentations serve to keep key constituencies informed of Preserve activities and to provide the vehicle for further involvement by those who seek it.

VI. Monitoring and Data Collection Methodology

Space limitations preclude a description of all monitoring and data collection methodologies to be employed in this project. Upon request, the CIWSM will provide complete descriptions of methodologies for each program. Summaries are provided in Table 2.

The goal of the monitoring program is to develop sampling and analysis strategies, coupled with modeling, to detect and document linkages between physical processes and ecosystem function within the Cosumnes and Mokelumne watersheds. The project emphasizes the collection of baseline information and development of new analysis tools that will support the implementation of a long-term program for monitoring following completion of the project. Given our current level of understanding of key linkages in ecosystem function, significant components of this monitoring program are expected to be experimental in nature. Additionally, where appropriate, sampling locations and timing will be used to support multiple programs (for example, water quality and primary productivity). This activity will be coordinated by CIWSM and integrated with on-going monitoring programs within the basin.

The Information Center for the Environment (ICE) will provide GIS support and data management to the Consortium. This work is an extension of the GIS data collection and metadata assembly efforts funded originally by the Packard Foundation. ICE will assist consortium members with GIS analysis, digitizing data, mapping, and scanning of air and field photos. As time allows, we will convert hard copy data into digital form. It is important that all sampling programs be georeferenced. ICE will provide GPS training and assistance to consortium members. Data from consortium projects will be incorporated into the Cosumnes River and Mokelumne River Watershed GIS system and made available on the web.

Table 5. Monitoring and Data Collection Information

I) Biological/Ecological Objectives			
Hypothesis/Question to be evaluated	Monitoring Parameter(s) and Data Collection Approach	Data Evaluation Approach	Comments/ Data Priority
HYDROLOGY			
What are the most significant causes of base flow decline in the lower Cosumnes basin?	Physically-based modeling of surface water and groundwater coupled with land use/land cover model	Development of land use/land cover and water use model simulations	Central Valley Streamflows: Target 1 (pg. 371-2)
How can we restore natural summer and fall base flows in the lower Cosumnes basin?	Physically-based modeling of surface water and groundwater coupled with land use/land cover model	Simulations of alternative land/water purchases and changes in groundwater withdrawal, including conjunctive use scenarios.	Central Valley Streamflows: Target 1 (pg. 371-2)
How are terrestrial and aquatic resources	Modeling of seasonal runoff patterns linked to	Coupling of ecologic models and hydrologic	Riparian and Riverine Aquatic Habitats:

impacted by hydrologic processes?	life cycles of target species	models	Targets 1 and 3 (pg 378-9)
GEOMORPHOLOGY			
How will levee setbacks or breaches impact river meanders?	Field evaluation and hydrologic modeling of existing experiments within Preserve. Development of predictive meander migration model.	Simulation of hydrologic and geomorphic impact of various setback and levee breach designs.	Strategic Plan Objective (pg. 43 -vol. I and pg 80-81 vol. I) Natural Floodplain and Flood Processes: Target 1 (pg. 375)
What is the relationship between hydrologic processes and coarse sediment supply?	Field sampling and numerical modeling of coarse sediment transport and response to changes in land use practices.	Extensive replicate georeferenced sampling sites for monitoring change in sediment flux, composition and channel cross section.	Coarse Sediment Supply: Targets 1 and 3 (pg. 374)
Can we develop geomorphic indicators of changing sediment supply due to changing land use?	Use of q^* (Dietrich et al.) as test of changes in transport capacity and sediment supply in selected reaches.	Multiple replicate georeferenced sites for analysis of bedload and surface sediment textures.	Coarse Sediment Supply: Targets 1 and 3 (pg. 374)
How can we change dam releases to provide coarse sediment to the lower Mokelumne?	Comprehensive analysis of coarse sediment resources and flux in lower basin	Calculation of critical thresholds of coarse sediment transport, estimation of flux rates, and measurement based on field experiments.	Coarse Sediment Supply: Targets 1 and 3 (pg. 374)
Are levee breaches sufficient to restore natural meander to the Cosumnes?	Numerical simulation of meander dynamics in response to hydrologic and erosional resistance changes estimated from levee removal	Development and simulation of multiple alternatives to assess hydrogeomorphic changes.	Strategic Plan Objective (pg. 43 -vol. I and pg 80-81 vol. I)
WATER QUALITY			
What are the processes regulating water quality and food resource availability at the watershed scale?	Simultaneous monitoring of water quality parameters and food resources will take place at the established sites throughout the basins.	This data will be used to create a water quality model	Contaminants: Target 1 (pg. 382)

How are aquatic organisms impacted by water quality throughout the basins?	Simultaneous monitoring of water quality parameters and food resources will take place at the established sites throughout the basins.	This data will be used to create a water quality model	Central Valley Stream Temperatures: Target 1 (pg. 376) Contaminants: Target 1 (pg. 382)
Where are the significant sources of nonpoint source contaminants in the Mokelumne basin?	Simultaneous monitoring of water quality parameters and food resources will take place at the established sites throughout the basins.	This data will be used to create a water quality model	Contaminants: Target 1 (pg. 382)
What is the relationship between hydrologic conditions, water quality parameters and food-resources?	Simultaneous monitoring of water quality parameters and food resources will take place at the established sites throughout the basins.	This data will be used to create a water quality model	Contaminants: Target 1 (pg. 382)
AQUATIC RESOURCES			
How do the impacts of altered flow regime and exotic species combine to impact at risk fish species in the basin?	Simultaneous monitoring of hydrologic processes and fish through out the basins.	This data will be used to correlate changes in hydrologic processes with changes in fish assemblage	Freshwater Fish Habitat and Essential Fish Habitat: Target 1 (pg. 379)
How do juvenile salmon use floodplain habitat in the basins?	Simultaneous monitoring of hydrologic processes and fish through out the basins.	This data will be used to correlate changes in hydrologic processes with changes in fish assemblage	Freshwater Fish Habitat and Essential Fish Habitat: Target 1 (pg. 379)
How does the location of roads and ditches impact fish movement?	Simultaneous monitoring of hydrologic processes and fish through out the basins.	This data will be used to correlate changes in hydrologic processes with changes in fish assemblage	Riparian and Riverine Aquatic Habitats: Targets 1 and 3 (pg 378-9) Freshwater Fish Habitat and Essential Fish Habitat: Target 1 (pg. 379)
What physical conditions favor the recruitment of native species over exotics?	Simultaneous monitoring of hydrologic processes and fish through out the basins.	This data will be used to correlate changes in hydrologic processes with changes in fish assemblage	Riparian and Aquatic Habitats: Targets 1 and 3 (pg 378-9) Freshwater Fish Habitat and Essential Fish Habitat: Target 1 (pg. 379)

TERRESTRIAL RESOURCES			
How will riparian vegetation be impacted by proposed levee setbacks?	Historical aerial photos of vegetation response to levee construction and contemporary vegetation surveys.	This data will be used to create an ecological model of levee tree interactions.	Riparian and Riverine Aquatic Habitats: Targets 1 and 3 (pg 378-9) Natural Floodplain and Flood Processes: Target 1 (pg. 375)
How can riparian forests be used to lower stream temperatures?	Simultaneous monitoring of water quality and riparian vegetation through out the basins.	This data will be used to link the vegetation model to hydrologic and water quality models	Central Valley Stream Temperatures: Target 1 (pg. 376)
What is the relationship between physical processes and riparian tree establishment?	Simultaneous monitoring of hydrology, geomorphology and riparian vegetation through out the basins.	This data will be used to link the vegetation model to physical models	Riparian Aquatic Habitats: Targets 1 and 3 (pg 378-9) Natural Floodplain and Flood Processes: Target 1 (pg. 375)
Will proposed restoration activities reduce the adverse effects of invasive riparian plants?	Monitoring of riparian vegetation at disturbed and undisturbed sites through out the basins.	This data will be used to study the relationship between the establishment of exotics and restoration projects.	Invasive Riparian and Marsh Plants: Target 1 (pg. 381)
What is the status of at risk native bird populations in the basins?	Regional sampling of target riparian avian species	Use of biologic indicators of integrity	Vision for Species (pg.370) Habitats (pg. 377-8)
Are restored riparian forests providing habitat benefits for at risk native species?	Regional sampling of CALFED priority riparian avian species-habitat relationships	GIS-based multivariate analysis of bird-habitat relations	Vision for Species (pg.370) Habitats (pg. 377-8)
How do proposed restoration activities impact bird populations?	Development of riparian habitat models.	Simulation of species-habitat impacts of management changes	Vision for Species (pg.370) Habitats (pg. 377-8)
DATA MANAGEMENT			
Where are there potential conservation and restoration sites within the watershed?	We will use GIS, existing data, vegetation surveys and site visits to evaluate riparian areas quality, risk, and species richness	We will evaluate the data with in a GIS model of potential restoration and conservation sites.	Riparian and Riverine Aquatic Habitats: Targets 1 and 3 (pg 378-379)
A GIS database available through the internet will bring substantial data to support decisionmakers and stakeholders.	Data from all the above projects will be compiled to create a comprehensive GIS database.	Stakeholders and decisionmakers will evaluate the data.	Integration with Other Restoration Programs: pg. 86

VIII. Cost - Table 6

Task	Direct Labor Hours	Direct Salary and Benefits	Student Fee	Material and Acquisition	Travel and Boat	Overhead and	Total Cost
HYDROLOGY	Ass. Dev. Eng. 6 mo @ 100%	\$65,221	\$18,112	\$10,500	\$8,000	Overhead: \$17,892 Equipment \$10,100	\$225,027
	GRA - 27 mo@ 50% 9 mo @100% (x 2)	\$71,022					
	UA - 27 mo@ 50%	\$11,571					
	Pran. Analyst- 3 mo @ 100%	\$12,609					
GEOMORPHOLOGY	ARS-18 mo	\$86,285	\$13,720	\$15,000	\$4,500	\$16,260	\$192,576
	GRA - 27 mo@ 50% 9 mo @100%	\$53,802					
	UA - 27 mo@ 50%	\$3,009					
WATER QUALITY	PGR5-36 mo	\$123,961	\$13,720	\$35,860	\$13,500	Overhead: \$23,752 Equipment \$25,000	\$300,000
	GRA - 27 mo@ 50% 9 mo @100%	\$53,803					
	UA - 9 mo	\$10,404					
VEGETATION	GRA - 27 mo@ 50% 9 mo @100%	\$53,803	\$13,720	\$3,700	\$7,000	\$6,450	\$84,673
BIRDS	PGR V- 18 mo @ 25%	\$64,134	PRBO: \$173,764	\$2,845	\$1,005	Overhead: \$12,084 Equipment \$5,133	\$311,825
	PGR II- 10 mo @ 15%	\$31,246					
	Admin. Ass. 6 mo @ 50%	\$21,614					
FISH	PGR VI- 12 mo @ 50%	\$80,228		\$3,000	\$4,800	Overhead \$19,494 Equipment \$8,000	\$222,433
	PGR I- 11 mo @100%	\$96,507					
	UA - 9 mo	\$10,404					
INVERTS	PGR I- 9 mo @100%	\$96,244		\$6,000	\$4,500	Overhead \$16,556 Equipment \$2,500	\$184,616
	PGR I- 11 mo @ 50%	\$58,816					
MAPPING AND ANALYSIS	Pran. Analyst II 1120 hours	\$29,678		\$1,365	\$1,327	Overhead \$9,371 Equipment \$3,588	\$106,669
	Comp Resources 1214 hours	\$26,246					
	Acad Admin 366 hours	\$17,212					
	PGR II	\$17,882					
DATA MANAGEMENT	Pran. Analyst II 513 hours	\$40,755		\$4,095	\$3,981	Overhead \$27,675 Equipment \$13,769	\$318,197
	Comp Resources 2050 hours	\$132,935					
	Acad Admin 276 hours	\$38,745					
	PGR II 1025 hours	\$56,242					
TOTALS		\$1,273,361	\$233,036	\$81,000	\$47,286	\$204,815	\$1,946,016

Table 7 - Quarterly budget

Task	Quarterly Budget Oct Dec 99	Quarterly Budget Jan Mar 00	Quarterly Budget Apr Jun 00	Quarterly Budget Jul Sep 00	Quarterly Budget Oct Dec 00	Quarterly Budget Jan Mar 01	Quarterly Budget Apr Jun 01	Quarterly Budget Jul Sep 01	Quarterly Budget Oct Dec 01	Quarterly Budget Jan Mar 02	Quarterly Budget Apr Jun 02	Quarterly Budget Jul Sep 02	Total Budget
Task 1: HYDROLOGY	26,677	26,677	26,677	26,677	25,012	25,012	25,012	25,012	4,568	4,568	4,568	4,568	225,028
Task 2: GEOMORPHOLOG	15,767	15,767	15,767	15,767	16,046	16,046	16,046	16,046	16,331	16,331	16,331	16,331	192,576
Task 3: WATER QUALITY	28,835	28,835	28,835	28,835	22,914	22,914	22,914	22,914	23,251	23,251	23,251	23,251	300,000
Task 4a: FISH	19,393	19,393	19,393	19,393	17,865	17,865	17,865	17,865	18,350	18,350	18,350	18,350	222,432
Task 4b: INVERTEBRATES	15,801	15,801	15,801	15,801	15,176	15,176	15,176	15,176	15,176	15,176	15,176	15,176	184,615
Task 5a: VEGETATION	7,193	7,193	7,193	7,193	7,092	7,092	7,092	7,092	6,884	6,884	6,884	6,884	84,673
Task 5b: BIRDS	33,750	33,750	33,750	33,750	10,707	10,707	10,707	10,707	33,499	33,499	33,499	33,499	311,824
Task 6: MAPPING AND ANALYSIS	26,667	26,667	26,667	26,667	0	0	0	0	0	0	0	0	106,669
Task 6: DATA MANAGEMENT	28,811	28,811	28,811	28,811	25,369	25,369	25,369	25,369	25,369	25,369	25,369	25,369	318,197
Total	202,895	202,895	202,895	202,895	140,181	140,181	140,181	140,181	143,428	143,428	143,428	143,428	1,946,014

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The tasks outlined above are to a large degree independent and could be funded incrementally. However, one of the major strengths of this project is its interdisciplinary nature and to the extent that the project does not proceed as a whole this aspect is weakened.

IX. Cost Sharing

The CIWSM, in association with The Nature Conservancy and the Cosumnes River Preserve partners, has received Packard Foundation Conservation Program funds to establish the *Cosumnes Consortium*: a coordinated university/agency/foundation partnership dedicated to evaluation and monitoring of ecosystem conservation and restoration efforts, and supporting the information needs of adaptive management in the Cosumnes River watershed. Matching funds will be supplied from the Consortium grant to support activities directly related to the project. Elements of the Geomorphology, Aquatic Resources, and Data Management programs have received seed monies from this grant totaling approximately \$200,000. \$50,000 will be supplied from the Packard grant for this project in order to support project science coordination. Partial support of \$300,000 for hydrologic modeling activities has been granted by the USFWS through the Anadromous Fisheries Restoration Program (AFRP).

In addition to the monies supplied by the Packard Foundation and USFWS, the UC Davis John Muir Institute of the Environment is currently supplying matching funds for a Science Coordinator for the CIWSM. In-kind services supplied by the University of California, Davis include faculty salaries, office space, and technical support.

X. Qualifications

Jeffrey F. Mount received his Ph.D. in Earth Science from UC Santa Cruz in 1980. From 1980 to the present he has been a professor in the Department of Geology at UC Davis. During this time he has conducted research on stratigraphy and sedimentation, with an emphasis on process sedimentology of marine and non-marine depositional systems. His current research interests include: analysis of the hydrogeomorphic evolution of rivers in response to changing land use conditions; geochemical and petrologic identification of anthropogenic sediment sources within the Sacramento River watershed; and mechanics of geomorphic recovery in riverine systems affected by catastrophic sedimentation events.

During his 18 years at UC Davis he has supervised more than 15 graduate students and successfully managed nine large National Science Foundation grants and several American Chemical Society grants. He is currently the Principal Investigator or Co-Principle Investigator on three federally-funded, multidisciplinary grants that focus on watershed issues in the state of California. He serves as a member of several multiagency task forces focusing on floodplain management within the state, is the current Chair of the Department of Geology at UC Davis, and the Director of the UC Davis Center for Integrated Watershed Science and Management.

Peter B. Moyle has been working on the ecology and conservation of native California fishes for about 30 years, subjects on which he has published widely. He has a long-term involvement in instream flow studies and in studies on the ecology and conservation of freshwater and estuarine fishes. His long-term research program on Bay-Delta fishes led to the listing of the Delta smelt as an endangered species. His reward for this activity was to be appointed head to the Delta Native Fishes Recovery Team by the USFWS (completed in 1994) and, recently a member of the science Core

Team for advising the massive CALFED effort to restore the estuary. Dr. Moyle also served as member of the Sierra Nevada Ecosystem Project science team, working on strategies to keep the native aquatic fauna of the Sierra Nevada from sliding further towards extinction. One of his major roles, working with his postdocs and graduate students, is to compile and publish information needed to help make decisions as to whether or not endangered species listing of California native fish species is warranted. His current research focuses on (1) devising watershed-oriented strategies for conservation of the native aquatic fauna, (2) finding ways to reduce the impacts of invasive aquatic species, and (3) documenting the early life histories of stream fishes, probably the most critical and least understood part of their life cycle. He is a professor of fish biology in the Department of Wildlife, Fish, and Conservation Biology, University of California, Davis, where he has been since 1972.

James F. Quinn has degrees from Harvard (A.B. Biology, 1973) and the University of Washington (PhD, Zoology, 1979). He joined the faculty of the University of Pennsylvania in 1979, and moved to the University of California at Davis, where he is now a full professor, in 1981. He has worked on a variety of problems in community ecology and conservation biology, including the effects of habitat fragmentation on species diversity and extinction risk, strategies for inventory and monitoring studies, the design of systems of nature reserves, and estimation of demographic rates for fisheries management, and is the author of more than 60 scholarly publications.

Professor Quinn is a principal investigator for the California Rivers Assessment (CARA), a program to identify and assess the status of critical aquatic resources in California and to provide a database center and access point for environmental data from a variety of collaborating organizations. Professor Quinn also directs the Information Center for the Environment (ICE) at the University of California at Davis. Under his direction, the Center has developed the principal biodiversity databases for U.S. National Parks (NPFauna and NPFlora), UNESCO Biosphere Reserves worldwide (MABFauna and MABFlora) and a variety of public and private lands in California. The Center works closely with over 20 public agencies on monitoring information, databases, and Web services (<http://ice.ucdavis.edu>) involving biodiversity, water quality, and land use, both in California and internationally.

Geoffrey Schladow is an Associate Professor of Water Resources and Environmental Engineering at UC Davis. He received his PhD from the University of Western Australia. Professor Schladow has extensive experience in modeling and measuring flow, sediment and water quality in hydrological systems. His recent research sites include the Sacramento River, Clear Lake, Whiskeytown Reservoir, the Lake Tahoe watershed and the Salton Sea. He is the lead scientist for the modeling and field measurement program directed at the restoration of the 50,000 acre Napa-Sonoma marsh. He is also the Principle Investigator on a multi-institutional proposal directed at intensively monitoring contaminant transport in tidal wetlands. Professor Schladow currently supervises a research group comprised of 1 post-doctoral scientist, 5 PhD and 5 Masters level students.

Gregory Pasternack is an Assistant Professor of Land, Air and Water Resources at UC Davis. He received his PhD from Johns Hopkins University in 1998. He has considerable experience as a fluvial geomorphologist and sediment transport specialist. He recently completed an extensive study of tidal freshwater marsh systems of the Chesapeake Bay. His specialties are in the physical dynamics of tidal freshwater delta evolution, the interactions between marsh plants and

sedimentation patterns, watershed-scale transport and fate of sediment, and the impacts of management on urban river systems.

Edwin Grosholz is an Assistant Specialist in Cooperative Extension in the Department of Environmental Science and Policy at UC Davis. He received his Ph.D. in Zoology from UC Berkeley in 1990. He has been a post-doctoral fellow at Friday Harbor, the Smithsonian Institute and UC Davis, and most recently an Assistant Professor at University of New Hampshire. Dr. Grosholz research emphasizes the ecological and evolutionary impacts of introduced aquatic invertebrates. He has broad experience in evaluating the impacts of nonindigenous crabs as stressors in estuarine communities and their role in altering trophic structure.

Randy Dahlgren's research program examines biogeochemical interactions within and between the atmosphere, hydrosphere, biosphere and geosphere. He received a Ph.D. (1987) in forest soil biogeochemistry from the University of Washington where he examined the effects of Mt. St. Helens tephra on forest ecosystems. As a research associate at Syracuse University, he studied the effects of acidic deposition and clearcutting on water quality at the Hubbard Brook Ecological Forest, New Hampshire. Since joining the Department of Land, Air and Water Resources at UCD (1989), he has completed several water quality studies related to trace elements in agricultural drainage waters, source of nutrients contributing to lake eutrophication, cumulative effects of timber harvest in redwood/Doug fir coastal ecosystems, and rangeland management effects. His current research program in water quality emphasizes nutrients, suspended sediments, pathogens, trace elements and aquatic food resources. He has published 70+ peer-reviewed manuscripts. Dr. Dahlgren is a member of NSF review panels in Environmental Geochemistry and Biogeochemistry and the Water and Watersheds programs, and a panel member for the National Resource Council's Associateship program.

Mark W. Schwartz received a MS in ecology from the University of Minnesota in 1985 and a PhD in Biology from Florida State University in 1990. From 1990 to 1994 he was a research scientist at the Illinois Natural History Survey and was an assistant research scientist at UC Davis from 1994-1998. Dr. Schwartz has conducted research on the effects of disturbance and global change on forest and grassland vegetation in Florida, Illinois, and California. In particular, he has developed experience in forest dynamic models through a demographic monitoring survey of a streamside forest in northern Florida, now in its 12th year. Much of this research on vegetation dynamics has focused on the role of fire as an agent of disturbance in altering vegetation dynamic processes. During his 9 years as a research faculty member Dr. Schwartz has supervised two postdoctoral associates and 10 graduated students. He has also successfully managed over 15 grants from both state and federal granting agencies including National Science Foundation, USDA Forest Service, US Fish and Wildlife Service and The Nature Conservancy. He has edited a book on conservation in fragmented landscapes, is co-author of a textbook on Plant Ecology and has published 28 refereed articles and 26 technical reports, book reviews and proceedings contributions.

April 14, 1999

Dr. Jeffrey Mount
Director, Center for Integrated
Watershed Science and Management
University of California, Davis
Davis, CA 95616

Dear Dr. Mount,

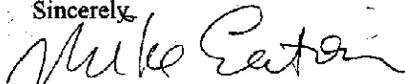
I am writing on behalf of The Nature Conservancy's Cosumnes River Project to express our support for the Watershed Center's proposal to develop a long-term, linked monitoring and assessment program in the Cosumnes and Mokelumne watersheds. The program will provide technical, analytical and informational tools to support adaptive management in the critical East Delta Habitat Corridor which is a priority area for both TNC and CALFED, and which provides critical habitat for priority species.

The proposal is unique in that it is long-term, it is comprehensive and it links biological processes to hydrologic systems. It does not focus on a single species or stressor or process, but rather brings to bear expertise from a variety of disciplines to develop predictive restoration models that reflect the complexity and connectivity of living river systems.

This comprehensive, multi-disciplinary approach is designed to yield results applicable to other Conservancy projects and to a wide array of other restoration efforts in the Bay-Delta. The work that you propose to do will support the Conservancy's stewardship responsibilities on the Cosumnes Preserve and is consistent with the Conservancy's commitment to disseminate the lessons learned from the practice of adaptive management on its ecologically critical holdings.

We look forward to participating in the expanded set of collaborative research opportunities that this program will bring to the Cosumnes-Mokelumne watersheds.

Sincerely,



Mike Eaton
Project Director

February 16, 1999

Jeffrey F. Mount
Director
Center for Integrated Watershed Science and Management
University of California
Davis, CA 95616

Dear Dr. Mount:

The East Bay Municipal Utility District wishes to confirm its interest in mutual collaboration and cooperation with University of California, Davis in the Mokelumne River watershed.

It is our understanding that the University of California, Davis has established the Center for Integrated Watershed Science and Management to highlight and expand the campus role in watershed-related research, teaching and outreach. The Center provides knowledge-based services and decision support to watershed stakeholders and decision-makers, and promotes the development of watershed research partnerships between the University of California, and agencies, foundations, and the private sector.

The District supplies water and provides wastewater treatment for parts of Alameda and Contra Costa counties. The District also owns and manages over 54,000 acres of watershed land in the East Bay and in the Mokelumne River watershed, and has water rights to, and diverts water from the Mokelumne River. The District has entered into a Partnership Agreement with the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (CDFG) to develop joint action plans to protect and enhance the Mokelumne River ecosystem. District activities undertaken with the Center will be coordinated with the partnership.

Collaborative and cooperative efforts of the District and the Center are anticipated to focus on data collection, storage, analysis and dissemination, with an emphasis on the design, implementation and monitoring of ecological rehabilitation in the Mokelumne River basin. We anticipate entering project-specific agreements with the Center as various projects are mutually developed by the Center and the District after coordination

Jeffrey R. Mount
February 16, 1999
Page 2

with the District's partners (USFWS and CDFG). Our mutual cooperative effort will be accomplished in a manner that protects and maintains the Lower Mokelumne River Project as a reliable, high quality water supply for the District, and supports the education mission of the University of California.

One representative each from the Center and the District will be responsible for guiding the cooperative efforts. The District's representative will be James R. Smith, Supervising Fisheries and Wildlife Biologist.

Sincerely,



Dennis M. Diemer
General Manager

DMD:JRS:jrs

Jeffrey J. Mount
February 16, 1999
Page two

Bc: J. B. Lampe
R. C. Nuzum
J. R. Smith



JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

Supervisor Don Nottoli
Chair: Cosumnes River Task Force
700 H Street Suite 2450
Sacramento, Ca 95814

Dear Supervisor Nottoli,

I am writing to inform you that the Center for Integrated Watershed Science and Management of the University of California, Davis, in cooperation with The Nature Conservancy's Cosumnes River Project, is applying for CALFED funds to develop a comprehensive, multi-disciplinary restoration monitoring and assessment program for the Cosumnes and Mokelumne watersheds.

The intent of the program is to provide the technical, analytical and informational tools to support adaptive management in the critical East Delta Habitat Corridor. The project will involve researchers in the fields of geology, hydrology, riparian ecology, water quality and wildlife biology in the development of predictive models that reflect the complexity and connectivity of dynamic river systems. This comprehensive, multidisciplinary approach is designed to yield results applicable to a wide array of restoration efforts in the Bay-Delta.

The Center considers collaboration and communication essential to its mission of improving watershed science and management. We have an on-going collaborative arrangement with The Nature Conservancy and its partners at the Cosumnes Preserve (Bureau of Land Management, Department of Fish and Game, Department of Water Resources, Ducks Unlimited, Sacramento County Parks and Recreation); and through the Conservancy and the East Bay Municipal Utility District have been in contact with a number of local agencies, landowners and representatives of stakeholder groups in the lower Cosumnes/Mokelumne basins. If CALFED should approve this application, the Center will continue to work closely with all of these entities, and will be an active participant in the planned regional coordination project led by the San Joaquin County Council of Governments.

Thank-you for your consideration. A more detailed description of the proposed project is attached. If you have any questions, please contact me or Ellen Mantalica, Watershed Center Coordinator, at (530) 754-9133.

Sincerely,

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Dr. Jeffrey Mount
Director, Center for Integrated Watershed
Science and Management



JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

Sacramento County Board of Supervisors
700 H. Street Suite 2450
Sacramento, CA 95814

Dear Members of the Board,

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Science and Management



JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

Planning Department
Sacramento County
700 H Street
Sacramento, CA 95814

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Dr. Jeffrey Mount
Director, Center for Integrated Watershed
Science and Management



JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

San Joaquin County Board of Supervisors
attn: Board Clerk
222 E. Weber
Stockton, CA 95202

Dear Members of the Board,

I am writing to inform you that the Center for Integrated Watershed Science and Management of the University of California, Davis, in cooperation with The Nature Conservancy's Cosumnes River Project, is applying for CALFED funds to develop a comprehensive, multi-disciplinary restoration monitoring and assessment program for the Cosumnes and Mokelumne watersheds.

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Dr. Jeffrey Mount
Director, Center for Integrated Watershed
Science and Management



JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

Planning Department
San Joaquin County
222 E. Weber Ave
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Dr. Jeffrey Mount
Director, Center for Integrated Watershed
Science and Management



JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

Amador County Board of Supervisors
500 Argonaut Ln.
Jackson, CA 95642

Dear Members of the Board,

I am writing to inform you that the Center for Integrated Watershed Science and Management of the University of California, Davis, in cooperation with The Nature Conservancy's Cosumnes River Project, is applying for CALFED funds to develop a comprehensive, multi-disciplinary restoration monitoring and assessment program for the Cosumnes and Mokelumne watersheds.

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Director, Center for Integrated Watershed
Science and Management



JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

Planning Department
Amador County
500 Argonaut Ln.
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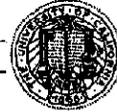
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Dr. Jeffrey Mount
Director, Center for Integrated Watershed
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JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

El Dorado County Board of Supervisors
330 Fair Lane
Placerville, CA 95667

Dear Members of the Board,

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Science and Management



JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

Planning Department
El Dorado County
330 Fair Lane
Placerville, CA 95667

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Dr. Jeffrey Mount
Director, Center for Integrated Watershed
Science and Management



JOHN MUIR INSTITUTE OF THE ENVIRONMENT

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

April 15, 1999

Delta Protection Commission
14215 River Road
P.O. Box 530
Walnut Grove, CA 95690

Dear Commissioners,

I am writing to inform you that the Center for Integrated Watershed Science and Management of the University of California, Davis, in cooperation with The Nature Conservancy's Cosumnes River Project, is applying for CALFED funds to develop a comprehensive, multi-disciplinary restoration monitoring and assessment program for the Cosumnes and Mokelumne watersheds.

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