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DEPARTMENT OF GEOLOGY

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July 2, 1998

CALFED Bay-Delta Program
1416 9th St., Suite 1155
Sacramento, CA 95814

Dear CALFED Bay-Delta Program:

Please find enclosed 10 copies of the proposal entitled: Geomorphic and habitat model for visualization and feasibility assessment of setback levees, submitted for the ERPP. Final copies of signed data sheets and attachments are being forwarded to you under separate cover by the University of California, Davis Office of Research.

Thank you for your consideration of this proposal.

Sincerely,

A handwritten signature in black ink, appearing to read "Jeffrey Mount".

Jeffrey Mount
Professor and Chair

Attachment H

COVER SHEET (PAGE 1 of 2)

May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

Geomorphic and habitat model for demonstration and feasibility
Proposal Title: assessment of setback levees: Lower Sacramento River
Applicant Name: Dr. Jeffrey Mount
Mailing Address: Department of Geology, UC Davis, One Shields Avenue, Davis, CA 95616
Telephone: 530-752-7092
Fax: 530-752-0951

Amount of funding requested: \$ 220,430.00 for 1 years

Indicate the Topic for which you are applying (check only one box). Note that this is an important decision: see page ___ of the Proposal Solicitation Package for more information.

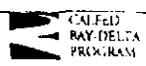
- Fish Passage Assessment
Floodplain and Habitat Restoration
Fish Harvest
Watershed Planning/Implementation
Fish Screen Evaluations - Alternatives and Biological Priorities
Fish Passage Improvements
Gravel Restoration
Species Life History Studies
Education

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

- Sacramento River Mainstem
Delta
Suisun Marsh and Bay
San Joaquin River Mainstem
Landscape (entire Bay-Delta watershed)
Sacramento Tributary:
East Side Delta Tributary:
San Joaquin Tributary:
Other:
North Bay:

Indicate the primary species which the proposal addresses (check no more than two boxes):

- 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
Spring-run chinook salmon
Fall-run chinook salmon
Longfin smelt
Steelhead trout
Striped bass



COVER SHEET (PAGE 2 of 2)

May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

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 type="checkbox"/> Monitoring | <input type="checkbox"/> Education |
| <input checked="" 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 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 II.K) 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.



(Signature of Applicant)

II. Executive Summary

a. Project title: Geomorphic and habitat model for demonstration and feasibility assessment of setback levees: lower Sacramento River.

Applicants: Dr. Jeffrey F. Mount, Dr. Eric W. Larsen, and Steven E. Greco

b. Project description and primary biological/ecological objectives: Setback levees have been supported as an approach to multi-objective floodplain management on the Sacramento and San Joaquin Rivers, and are commonly recommended as a way to restore geomorphic and ecosystem function in riverine habitats. However, the habitat benefits of setback levees, as weighed against the costs, have yet to be conclusively demonstrated to agency personnel and the public. This project seeks funding to develop a coupled geomorphic and habitat model that allows simulation and demonstration of the response of riverine systems to levee removal and setback. The prototype of this model will be applied to selected close-leveed reaches of the lower Sacramento River and will be evaluated by local stakeholders and decisionmakers.

The levee setback simulations will be based upon two models that are currently in development for the Sacramento River. The first model is a physics-based meander migration model that predicts channel evolution in response to measured or estimated hydraulic and geologic conditions. The second is an empirical model of the response of riparian forest and floodplain vegetation to channel dynamics and floodplain inundation. These two models will be coupled and used to simulate channel and habitat changes in response to levee setbacks.

When applied to various levee setback designs, the coupled geomorphic/habitat model can be used to demonstrate and estimate spatial and temporal changes in key habitats. These simulations will inform decisions on appropriate magnitude of setbacks, ecosystem benefits, and potential third party benefits and impacts such as compatible land uses, placement of infrastructure, water quality impacts, and economic impacts. Additionally, the visualizations that will be developed for CALFED and collaborating partners in this project will demonstrate the evolution and growth of riverine habitats in response to levee setbacks and renewed channel migration, and add to the public understanding of promoting natural processes as a means of restoration.

c. Approach/tasks/schedule: This project involves four tasks to be completed within one year of the start date. UC Davis researchers and staff, in collaboration with project partners, will complete all tasks. The California Department of Water Resources and the U.S. Army Corps of Engineers have agreed to supply hydrologic, geologic, land use, and topographic information. Initial hydrologic modeling of levee setbacks will be conducted by DWR. The Nature Conservancy will participate in public presentations and stakeholder evaluations.

Task 1: Upgrade of existing meander migration model, First and Second Quarters

Task 2: Upgrade and coding of riparian forest and floodplain vegetation model, First and Second Quarters

Task 3: Coupling of meander migration model and vegetation model, Third Quarter

Task 4: Model simulations, stakeholder presentations and evaluations, stakeholder evaluations, and preparation of final report and recommendations for CALFED, Fourth Quarter.

d. Justification for project and funding by CALFED: As noted in the CALFED ERPP, the conservation and improvement of ecosystems within the Sacramento River Basin involves restoring channel dynamics and the links between the channel and its floodplain. This project will provide the tool to allow CALFED and other decisionmakers the method to evaluate the magnitude and type of habitat that is likely to be created if levees are set back and geomorphic processes are restored. In addition, this tool can be used for public demonstration of the value and implications of setback levees and the restoration of geomorphic and ecosystem function, and aid in designing setbacks that minimize third party impact.

e. Budget costs and third-party impacts: This project seeks \$217,426 for an intensive, one-year project. Most of the cost is salaries and overhead for a programmer analyst, post-graduate researcher, and research scientist.

Task 1: Upgrade of existing meander migration model	60,983
Task 2: Upgrade vegetation model	62,234
Task 3: Coupling of meander and vegetation model	44,308
Task 4: Simulations, stakeholder meetings and final report	<u>52,905</u>
Total	\$220,430

No negative third party impacts are anticipated with this proposed project. The model and demonstration tool will be utilized by a broad range of stakeholders and agencies, including CALFED, in the understanding and analysis of levee setbacks.

f. Applicant qualifications:

Jeffrey F. Mount, Ph.D. (1980), Professor and Chair, Department of Geology, University of California, Davis. Director, UD Davis Center for Integrated Watershed Science and Management. Area of emphasis: sedimentology, fluvial processes, flood management.

Eric W. Larsen, Ph.D. (1995), Assistant Research Scientist, Department of Geology, University of California, Davis. Area of emphasis: fluvial geomorphology, riverine restoration, river mechanics and sediment transport.

Steven E. Greco, M.S. (1993), Ph.D. Candidate, Ecology (expected 1998). Area of emphasis: riparian ecosystems and landscape ecology, geographic information systems, ecological modeling.

g. Monitoring and data evaluation: Although no significant monitoring or data evaluation will be conducted, data and project evaluation will occur through coordination with a multi-agency advisory committee, and peer and agency review.

h. Local support/coordination with other programs/compatibility with CALFED

objectives: This project is a multi-agency partnership that depends upon close coordination between UC Davis, The Nature Conservancy, ACOE Comprehensive Study Group, DWR and USFWS. Members of each agency will participate in an advisory team to direct the development of the model and guide simulations, providing for consistency and coordination with other floodplain management programs. Additionally, the project will interact directly with the on-going California Interagency Floodplain Management Coordination Group and the ACOE Sacramento and San Joaquin Comprehensive Study.

III. Title Page

**Geomorphic and Habitat Model for Demonstration and Feasibility Assessment
of Setback Levees: Lower Sacramento River.**

Jeffrey F. Mount

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Type of organization and tax status: Institution of higher education/exempt

Tax identification number: 94-6036494-W

In coordination and cooperation with:

**The Nature Conservancy
California Department of Water Resources
U.S. Army Corps of Engineers Comprehensive Study Group
US Fish and Wildlife Service**

IV. Project Description

Project description and approach

Levees have played a vital role in flood management and water supply within the Central Valley and the Bay-Delta region for the past 150 years. In reviews of flood management following the Mississippi River floods of 1993 and the 1997 New Year's floods of the Central Valley, multiple public and private entities have noted that close levees--those levees which confine river flows to a narrow floodway adjacent to river channels--are often in conflict with multi-objective floodplain management goals. Setback levees, which expand the area of the floodway, increase flood conveyance and storage, and reduce maintenance costs, have been discussed as an alternative to close levees in some regions of the Central Valley. Additionally, setback levees have been identified within the ERPP and at CALFED meetings and hearings as a potential method for restoring ecosystem function within riparian habitats in the lower Sacramento and San Joaquin rivers.

While there is broad, but not unanimous advocacy for setback levees within the Sacramento and San Joaquin Basin, the ecosystem and flood management benefits of such an approach have been largely assumed, but not proven. Although currently a topic of consideration by the California Interagency Floodplain Management Coordination Group, no rigorous evaluations have been completed demonstrating that the considerable costs associated with setback levees are matched by the reductions in flood damages and the quantity and quality of habitat generated.

Currently, two key unknowns limit our ability to design setback levees and to accurately assess their benefits for ecosystem restoration and flood management. The first unknown entails the geomorphic response of a river to setbacks. When close levees are removed or set back, rivers will respond through development of a new, dynamic channel planform that reflects newly-imposed hydrologic and geologic conditions (Brookes, 1989; Mount, 1995, 1997). Predicting the evolution of this planform through time is key to the determination of the design and placement of the setbacks and their performance in large floods. The second unknown revolves around the habitat changes that accompany restoration of a dynamic channel system. Channel migration and the magnitude and frequency of floodplain inundation will control the spatial and temporal evolution of linked aquatic, riparian, floodplain and wetland habitats. The amount and type of new habitat created will play a key role in assessing the benefit of levee setback designs. In addition, it will determine what types of land use practices are likely to be compatible with setbacks. To date, two fundamental questions--*how will the river change*, and *how will the habitat respond*--limit our ability to accurately assess levee setbacks.

The goal of this project is to develop a demonstration and modeling tool that will support evaluation of the response of single-channel meandering rivers to various levee setback configurations. When completed, this tool can be used by decisionmakers and designers to estimate short- and long-term change in channel planform and associated riparian, floodplain and wetland habitat. In addition, the computer visualizations associated with this model can be used as a demonstration tool for private and public stakeholders to illustrate geomorphic processes and habitat change in response to levee setbacks.

This intensive, one-year project will involve coupling two existing models: a physics-based meander migration model developed for the Sacramento River by Dr. Eric Larsen, and an empirical riparian forest/floodplain habitat model for the Sacramento

River developed by Steven Greco. The model will be GIS-based and interactive, with on-screen adjustments in the parameters that control the patterns and rates of channel change. The output from the coupled geomorphic/habitat models will be displayed using three-dimensional visualization software ideal for demonstration purposes.

In order to evaluate the utility of the geomorphic/habitat model and to develop visualizations for demonstration purposes, we will conduct initial modeling runs on selected close-leveed reaches of the Sacramento River between Chico Landing and Knights Landing. We will model the potential channel and habitat response of the river to changes in hydrology and physical conditions associated with levee setbacks. The model will also be used to illustrate the impacts of changing land use types and infrastructure, such as irrigation diversions, bridges and revetment, on channel planform and habitat evolution. This proposal is envisioned as the first phase requirement for a more comprehensive study to assess the potential benefits and impacts to third parties that would be required for implementing setback levees.

Proposed scope of work

Task 1: Upgrade and calibration of existing meander migration model to include levee and infrastructure placements (First and Second Quarter)

With DWR and USFWS funding, Dr. Eric Larsen has developed a numerical model of meander migration for several reaches of the Sacramento River between Colusa and Red Bluff. The model, which combines a model for the velocity flow field (Johannesson and Parker, 1989) and bank erosion (Ikeda et al., 1981), has been successful in predicting channel migration (Larsen et al., 1997; Larsen and Mount, in review). The model requires input values for the channel planform and five variables that represent the hydrology and hydraulic characteristics of the channel: characteristic discharge, width, depth, slope and median particle size. The model currently uses optimization methods to calibrate the hydraulic roughness and the bank erosion rate, although these parameters can be estimated. The model currently runs on a Pentium-based PC in MATLAB.

In order to couple this meander migration model to the dynamic riparian vegetation model, several upgrades must take place. Prototype computer code has been developed that allows the incorporation of riprap, levees and other hard points, such as irrigation diversions and bridges, within the model runs. This prototype code requires installation and testing within the model. In addition, further testing of the model on the Sacramento River between Colusa and Red Bluff is needed to enhance our ability to predict the role of geologic and land use controls on bank erosion coefficients in the absence of the data necessary for optimization analysis.

The MATLAB-based meander migration model will be presented to CALFED personnel and reviewed by the advisory group at the end of the second quarter.

Task 2: Upgrade, code and calibrate riparian forest and floodplain vegetation model to incorporate levee design, DEMs and hydrodynamic models (First and Second Quarter)

With DWR and USFWS funding, Steven Greco has been developing a model for riparian forest and floodplain ecosystem habitat change in response to channel changes and floodplain inundation along the Sacramento River between Colusa and Red Bluff (Greco, in prep.). Based on extensive field study and analysis of historical photos and datasets, he has constructed an empirical model that predicts vegetation succession.

Elements of this model, which operates in ArcView and runs on a Pentium-based PC, were presented to the 1997 CALFED Bay-Delta Program Category III Technical Committee.

In order to incorporate and effectively use the empirical riparian and floodplain vegetation model, coding must be completed and upgraded to include digital elevation models (DEMs) and hydrodynamic modeling. Although channel migration plays a key role in the evolution of riparian and floodplain habitat, the frequency and magnitude of floodplain inundation plays an equally important role. The various levee setback options to be considered in the second phase of this study will have a significant impact on the depth, extent and frequency of modeled floods. ACOE and DWR have agreed to provide the hydrodynamic modeling information and DEMs to eventually be incorporated in the geomorphic/habitat model.

The ArcView-based vegetation model will be presented to CALFED personnel and reviewed by the advisory group at the end of the second quarter.

Task 3: Couple meander migration and riparian forest and floodplain vegetation model; develop AMAP simulations and demonstration tool (Third Quarter)

In order to develop an interactive visualization tool that models and demonstrates the response of a river to levee setbacks, we will couple the meander migration model and the riparian vegetation models, with output displayed using a visualization package. Three programs will be linked, including ArcView, MATLAB, and AMAP. ArcView and MATLAB are widely used for analysis and presentation of spatially-based data and for programming. UC Davis currently maintains site licenses, and considerable expertise, for both programs. The output from ArcView and MATLAB will be displayed using the AMAP program. AMAP is a three-dimensional terrain and vegetation model that is capable of simulating landscapes using random seeding of trees within polygons. Additionally, the AMAP program allows depiction of growth of patches of vegetation and changes in landscapes, and incorporates custom fly-through and digital animations that can be output into common formats (such as Quicktime).

Task 4: Prepare model simulations, hold stakeholder demonstrations, provide report and recommendations (Fourth Quarter)

Following completion of the prototype geomorphic/habitat model, we will develop a suite of model runs that illustrate the potential impacts of various levee setbacks within selected reaches of the lower Sacramento between Chico Landing and Knights Landing. Selection of these reaches will depend upon existing conditions and available hydrologic and habitat information. The Department of Water Resources has agreed to supply information for this study and to assist in the modeling. We will work closely with DWR, ACOE, USFWS, and TNC to select sites that best illustrate the impacts of levee setbacks.

The suite of model runs will be assembled into a collection of digital animations that can be used for public presentations that demonstrate and discuss the impacts of levee setbacks. These animations will be in a format that can be used with a Pentium-based laptop PC.

In order to test the model's ability to enhance public understanding of natural processes and functions as a means of restoration, we will hold two stakeholder meetings. Interested participants from both the public and private sector will be invited to view the model and discuss questions and issues relative to the demonstration tool and its application. A summary of these meetings will be included in the final report.

At the end of this project, and in consultation with project collaborators, we will present to CALFED a final report that includes an assessment and copy of the prototype geomorphic/habitat model, including selected model simulation runs. The report will focus on issues that should be addressed, using the model, in design and evaluation of levee setbacks.

Location and/or geographic boundaries of project

This project is not intended to specifically address a geographic area, but rather to have broad application as a demonstration and modeling tool for levee setback considerations throughout the CALFED region of interest. The demonstration of the model will be based on selected close-leveed reaches within the Sacramento River Zone along the edges of the Colusa and Butte Basins. The modeling and assessments will demonstrate levee setback scenarios along the Sacramento River between Chico Landing and the Fremont Weir (river miles 188.6 to 84.0).

Expected benefits

As noted above, the assessment of the benefits and costs of levee setback design hinge upon being able to determine the channel and habitat response to levee changes. When applied, the geomorphic/habitat model proposed here will provide an important tool for addressing and demonstrating a series of local and watershed-scale issues. Some of the questions that will be supported by the model include:

- setback design to optimize habitat formation, flood reduction, reduction of levee maintenance and reduction of costs and impacts to local land use activities
- quantitative determination of potential short- and long-term changes in aquatic, riparian, wetland and floodplain habitat
- magnitude of planform change and impact of infrastructure
- local and regional changes in flood stage associated with levee setback options, including changes in stage associated with changes in habitat and land use
- cumulative water quality changes associated with increased wetland, riparian and floodplain habitat
- economic analysis of setbacks on farm-based economies, including identification of farming practices that are compatible with setback levees
- economic analysis of the value of changes in habitat, water quality, levee maintenance and construction

It is anticipated that this model will directly assist the California Interagency Floodplain Management Coordination Group's on-going effort to develop an economic model for alternative and non-structural floodplain management.

As the May 1998 CALFED ERPP Proposal Solicitation Package accurately points out, there is limited public understanding of the benefits associated with restoration of geomorphic function in riverine settings and the links between rivers and their floodplains. One of the benefits of this project will stem from the computer simulations that will allow CALFED and agency personnel the opportunity to demonstrate the long-term changes and habitat benefits associated with channel restoration. The simulations developed for the prototype model will be in easy-to-use format and will run on a Pentium-based laptop PC. Additionally, the variables that control channel planform

change will be adjustable using on-screen buttons in MATLAB, allowing presenters to illustrate the influence of hydrologic and land use changes on rivers.

Background and ecological/biological/technical justification

As the CALFED ERPP notes, the health of riparian ecosystems and associated aquatic communities is tied directly to the maintenance of geomorphic processes. Riparian plant communities that remain within the alluvial floodplains of the Sacramento are dynamic, with adaptations to cycles of flooding, erosion and deposition. The fish and wildlife species that depend upon these communities are adapted to take advantage of disturbances and cycles within these habitats. Studies within and outside of the basin indicate that fish biomass is positively correlated with flooding onto the floodplain (Roux and Copp, 1996; Bayley and Peter, 1989; Ward and Stanford, 1989), and avian diversity is tied to riparian forest diversity and cover (Hehnke and Stone, 1978).

Land use practices have dramatically reduced the historical extent of riparian, wetland and floodplain habitat of the Sacramento River over the past century (Roberts, Howe, and Major, 1977; Katibah et al., 1984; Scott and Marquiss, 1984). The decline has taken place in several forms: loss of riparian forests through land conversion, separation of the links between the aquatic and terrestrial zones, and water management or land use practices that reduce or eliminate disturbance and geomorphic function.

The loss of riparian habitat and geomorphic function within the Sacramento River watershed has been driven, in part, by the methods used to reduce flood damages within the basin. The extensive close levees that line the lower Sacramento and its tributaries have contributed to the decline in habitat, and the associated decline in species richness. The following list of stressors affecting priority species, such as winter-run, spring-run, and fall-run Chinook salmon, Sacramento splittail, steelhead, white sturgeon, and migratory birds, are associated with close levees (based on CALFED 1997 Integration Panel and geographic technical teams as listed in the ERPP May 1998 Proposal Solicitation Package):

- **Hydrologic Isolation of Floodplain or Marshplain**
- **Physical Isolation of Floodplain or Marshplain**
- **Elimination of Fine Sediment Replenishment**
- **Alteration of Channel Form**
- **Prevention of Channel Meander**
- **Isolation or Elimination of Sidechannel Tributaries**
- **Reduction of Gravel Recruitment**
- **Channel Aggradation Due to Fine Sediments**
- **Loss of Existing Riparian Zone or Lack of Regeneration Potential**
- **Increased Water Temperature**

The model developed for this project will specifically address a wide range of objectives described in the ERPP, including **restoration of hydraulic conditions** (ERPP v. 1, p.27), **meander migration** (ERPP v. 1, p.27, p. 284), **floodplain function** (ERPP v. 1, p. 45), and **riparian habitat** (ERPP v. 1, p. 110). Aquatic species of concern that will be addressed by this model include **splittail** (ERPP v. 1, p. 144), **white sturgeon** (ERPP v. 1, p. 148), four races of **Sacramento chinook salmon** (ERPP v. 1, p. 153), **steelhead** (ERPP v. 1, p. 160), and **resident fishes** (ERPP v. 1, p. 172). Avian populations that are tied to floodplain and riparian habitat will be addressed by this model (ERPP v. 1, pgs. 260, 262, 264), including Swainson's

hawk (ERPP, v. 1, p. 232), yellow-billed cuckoo (ERPP v. 1, p. 242), and bank swallow (ERPP v. 1, p. 245). Habitat and levee-maintenance issues addressed by this model will assist in efforts to maintain the Valley elderberry longhorn beetle (ERPP v. 1, p. 268).

As shown, the restoration of geomorphic function and the links between channel and floodplain that are likely to accompany the development of setback levees meets a broad range of CALFED ERPP objectives and AFRP objectives for priority species. However, as noted in the project description of this proposal, to date we have lacked sufficient technological resources to quantitatively evaluate levee setback benefits, and costs, and how well they meet these ecosystem objectives. Additionally, this information is essential in identifying third party impacts and benefits. The project described in this proposal is an important first step.

Monitoring and data evaluation

This project does not entail monitoring or data evaluation. However, when applied, the GIS-based model being produced for this project will form a useful tool for evaluating and monitoring large-scale restoration projects associated with levee setbacks or channel modifications.

Implementability

The development of the model will be closely coordinated with the two on-going floodplain management programs currently being conducted by the ACOE and EPA. Professor Mount is currently participating in the ACOE study as part of the Joint Technical Support Group, and as a member of the University of California Water Resources Center advisory panel offering technical support to the California Interagency Floodplain Management Coordination Group.

In addition to direct coordination with the floodplain management task forces, the collaborators on this project will constitute an advisory group that will meet bi-monthly with the project team. During these meetings progress on the model will be reviewed and, when appropriate, demonstrated. Additionally, the group will meet to evaluate the potential usage of the model and participate in the development of the report recommendations.

Since the construction of this model does not involve design or implementation of any restoration projects, we have not sought local support. We will, however, hold two stakeholder meetings to test the demonstration capacity of the model. At the conclusion of this project, the model simulations will be made available for presentation by public and private groups.

COSTS AND SCHEDULE TO IMPLEMENT PROPOSED PROJECT

Budget Costs

Project Task	Direct Labor Months	Direct Salary and Benefits (@ 23%)	Overhead (44.5% on all direct costs)	Service Contracts	Material and Acquisition Contracts	Misc. and Other Direct Costs	Total Cost (inc. overhead)
Task 1: Upgrade of existing meander migration model	Res. Sci @ 4.0 Prog Analyst @ 4.0	36,403	18,780	na	Photo printing 2800	Supplies, travel 3000	60,983
Task 2: Upgrade and code existing riparian and floodplain veg model	PGR V @ 6.0 Prog Analyst @ 4.0	37,269	19,165	na	Photo printing 2800	Supplies, travel 3000	62,234
Task 3: Couple models and develop AMAP visualizations	Res Sci @ 1.0 PGR V @ 3.0 Prog Analyst @ 2.0	19,163	13,645	na	AMAP Software Purchase 10,000	Supplies, travel 1500	44,308
Task 4: Prepare model simulations stakeholder presentations and CALFED recommendations	Prof II @ 1.0 Res Sci @ 1.0 PGR V @ 3.0 Prog Analyst @ 2.0	33,113	16,292	na	Report reproduction drafting 2500	Supplies, travel 1,000	52,905
TOTAL	24.0	125,948	67,882	0	18,100	8,500	\$220,430

The UC Davis Center for Integrated Watershed Science and Management will supply office space, computers, system support, site licenses, and administrative support. In addition, the University will support the salary of the project director during the academic year.

Schedule Milestones

- Task 1: The upgrade of meander migration model will be initiated in the First Quarter and be completed by the end of the Second Quarter.
- Task 2: The upgrade and coding of the riparian and floodplain vegetation model will begin in the First Quarter and be completed by the Second Quarter.
- Task 3: Coupling of meander migration model and riparian and floodplain vegetation model will be completed during the Third Quarter.
- Task 4: Model simulations will be constructed and final report with recommendations and stakeholder comments will be prepared for CALFED during the Fourth Quarter.

Third Party Impacts

No negative third party impacts are anticipated with this proposed project. The model and demonstration tool will be utilized by a broad range of stakeholders and agencies, including CALFED, in the analysis of levee setback scenarios and assessment of third party impacts.

APPLICANT QUALIFICATIONS

The plan of work will be conducted in laboratories at the University of California, Davis currently under the direction of Dr. Jeffrey Mount. These labs are equipped with several PC-based workstations and have access to other computing environments over the campus network. Dr. Jeffrey Mount will direct the project and the preparation of demonstration simulations and the final report. Personnel from The Nature Conservancy will assist in stakeholder meetings that evaluate the model demonstrations. Dr. Eric Larsen will direct the upgrade of the meander migration model. Steven Greco will direct the upgrade of the vegetation model and the development of AMAP simulations. Larsen and Greco will collaborate on the coupling of the model. A full-time Programmer Analyst will be assigned to this project to assist all tasks.

Jeffrey F. Mount received his B.A. in Geology from UC Santa Barbara (1976), and his M.A. (1978) and Ph.D. (1980) in Earth Science from UC Santa Cruz. 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 sedimentation and stratigraphy, 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. He is the author of *California Rivers and Streams: The Conflict between Fluvial Process and Land Use*, 1995 (UC Press).

During his 17 years at UC Davis he has supervised more than 20 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-Principal Investigator on four 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.

Eric W. Larsen received his Ph.D. in 1995 from the Environmental Water Resources Division of the Civil Engineering program at UC Berkeley. Prior to receiving his degree he worked extensively as a consultant in the field of geomorphology and river restoration. From 1997 to the present he has been an Assistant Research Geomorphologist in the Department of Geology, UC Davis. His current research

interests include application of continuum mechanics to channel migration in meandering rivers. Based on this research, he has constructed the meander migration model that will form the basis of this study. In addition his research applies the mechanics of sediment transport and flow hydraulics to the development of quantitative techniques for evaluating the impacts of geomorphic change on riverine habitat suitability. On-going projects in the Sierra Nevada and Coast Ranges are focused on establishing and modeling the links between runoff/sediment supply in watersheds and the evolution of stream channels. This work applies quantitative geomorphic models to evaluating habitat conditions for a range of threatened and endangered riparian species.

Dr. Larsen is currently involved in multiple collaborative research projects that directly involve graduate students. These include joint projects on: channel dynamics of the Sacramento River (USFWS); quantitative evaluation of channel adjustments to changing sediment supply (UC Center for Water and Wildlands Research); links between stream dynamics and groundwater tables (U.S. Bureau of Reclamation); and geomorphic controls on habitat conditions in mountain streams (California Department of Parks and Recreation).

Steven E. Greco received his B.S. in Landscape Architecture in 1987 and his M.S. in Ecology in 1993. He is currently a Ph.D. candidate in Ecology at UC Davis, with degree completion expected in September 1998. He has a broad research interests in landscape ecology and GIS-based ecosystem analysis. His current research is on riparian forest and floodplain habitat dynamics in response to historic and present flooding regimes. This research attempts to model ecosystem changes on the Sacramento River, miles 220-226, as a function of hydrodynamic patterns from 1945 to present. The model, which will be applicable to the Sacramento River between the Delta and Red Bluff, currently emphasizes habitat suitability for avian species of concern.

Steven Greco has extensive experience in GIS-based ecosystem research. He has served as an ecologist and GIS analyst for the University of California Natural Reserve System where he developed a desktop GIS for analysis of California gnatcatcher habitat. He applied his GIS expertise in the Sierra Nevada Ecosystem Project (SNEP), where he participated in the design and assembly of an extensive ARC/INFO database on natural and cultural features and ecosystem processes in the Sierra Nevada. He has also served as an ecologist and GIS analyst for the Sacramento River Riparian Forest Conservation Project, California Department of Water Resources (DWR), Northern District, and the University of California, Davis. This project is an on-going interagency effort to collect information regarding the conservation and restoration of riparian forests along the Sacramento River and is a continuation of the SB 1086 Program.

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IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
3310 El Camino Avenue, Suite 130
Sacramento, California 95821-6340

June 26, 1998

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

Subject: Lower Sacramento River Geomorphic and Habitat Model for Setback Levees

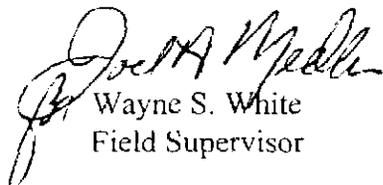
Dear Dr. Mount:

Recently you brought to our attention your plans to develop a geomorphic and habitat model to evaluate the benefits and feasibility for setting back levees along the Sacramento River, between Chico Landing and Knights Landing. The goal of your project is to develop modeling tools to help evaluate habitat and flood reduction benefits of setting levees back from current positions. The models would estimate changes in river channel and floodplain morphology in response to different levee setback configurations, and associated responses of floodplain habitats.

Your proposal has considerable potential to benefit fish and wildlife resources, and is consistent with the Fish and Wildlife Service's mission and with federal guidance on floodplain management. Setback levees offer significant benefits to fish and wildlife resources which have been heavily impacted by flood protection systems, such as found on the Sacramento River, which rely heavily on channel-confining levees and bank protection to prevent river meander. Our agency advocates the use of setbacks and other alternatives, e.g., instead of reliance on bank protection on the Sacramento River system, but implementation has been rare. The lack of tools to evaluate setback levee benefits has been a significant constraint on their implementation.

We would be willing to collaborate by providing technical assistance to your project, in coordination with our involvement in the Corps of Engineers' Sacramento and San Joaquin River Basins Comprehensive Study, which your proposed project complements well. Should you have any questions, please call Gary Falxa or Doug Weinrich of my staff at (916) 979-2107.

Sincerely,


Wayne S. White
Field Supervisor



Northern California Area Office
1330 21st Street, Suite 103
Sacramento, California 95814

International Headquarters
Arlington, Virginia
TEL 703 841-5300

TEL 916 449-2850
FAX 916 448-3469

July 1, 1998

Lester Snow, Executive Director
CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, California 95814

Dear Mr. Snow:

The Nature Conservancy would like to express strong support for the CALFED funding proposal being submitted by Dr. Jeffrey Mount, Dr. Eric Larsen, and Steven Greco entitled "Geomorphic and Habitat Model for Demonstration and Feasibility Assessment of Setback Levees: Lower Sacramento River". This project seeks funding to develop a coupled geomorphic and habitat model that allows demonstration and simulation of the response of riverine systems to levee removal and setback. The prototype of this model will be applied to selected close-leveed reaches of the lower Sacramento River.

This is a crucial time for flood management planning for rivers in the Central Valley, including the Sacramento River. The opportunity exists through various programs focused on floodplain management to consider alternatives that allow for multi-objective floodplain management, including ecosystem restoration. This project will provide the tool to allow CALFED and other decision makers to evaluate channel migration, and the magnitude and type of habitat that is likely to be restored if levees are set back. The channel migration and resulting habitat benefits need to be quantified for both design, cost-benefit, and third party analysis before projects can be carefully planned.

In talking with local stakeholders about setback levees, The Nature Conservancy has recognized the need for a demonstration and educational tool inform these discussions. The Nature Conservancy plans to participate in the implementation of this proposal through involvement on the advisory committee and in stakeholder meetings.

Sincerely,

A handwritten signature in cursive script that reads "Marlyce Myers".

Marlyce Myers
Project Manager

Agreement No. _____

Exhibit _____

**STANDARD CLAUSES -
INTERAGENCY AGREEMENTS**

Audit Clause. For contracts in excess of \$10,000, the contracting parties shall be subject to the examination and audit of the State Auditor for a period of three years after final payment under the contract. (Government Code Section 8546.7).

Availability of Funds. Work to be performed under this contract is subject to availability of Category III funds through the State's normal budget process.

Interagency Payment Clause. For services provided under this agreement, charges will be computed in accordance with State Administrative Manual Section 8752.

Termination Clause. Either State agency may terminate this contract upon 30 days advance written notice. The State agency providing the services shall be reimbursed for all reasonable expenses incurred up to the date of termination.

U.S. Department of the Interior

**Certifications Regarding Debarment, Suspension and
Other Responsibility Matters, Drug-Free Workplace
Requirements and Lobbying**

Persons signing this form should refer to the regulations referenced below for complete instructions:

Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions - The prospective primary participant further agrees by submitting this proposal that it will include the clause titled, "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transaction," provided by the department or agency entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions. See below for language to be used or use this form for certification and sign. (See Appendix A of Subpart D of 43 CFR Part 12.)

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions - (See Appendix B of Subpart D of 43 CFR Part 12.)

Certification Regarding Drug-Free Workplace Requirements - Alternate I. (Grantees Other Than Individuals) and Alternate II. (Grantees Who are Individuals) - (See Appendix C of Subpart D of 43 CFR Part 12)

Signature on this form provides for compliance with certification requirements under 43 CFR Parts 12 and 18. The certifications shall be treated as a material representation of fact upon which reliance will be placed when the Department of the Interior determines to award the covered transaction, grant, cooperative agreement or loan.

PART A: Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions

CHECK ___ IF THIS CERTIFICATION IS FOR A PRIMARY COVERED TRANSACTION AND IS APPLICABLE

- (1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:
 - (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by any Federal department or agency;
 - (b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 - (c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and
 - (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.
- (2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

PART B: Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions

CHECK ___ IF THIS CERTIFICATION IS FOR A LOWER TIER COVERED TRANSACTION AND IS APPLICABLE

- (1) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
- (2) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

DI-2010
 June 1996
 (This form replaces DI-1983, DI-1984,
 DI-1988, DI-1989 and DI-1993)

~~PART C: Certification Regarding Drug-Free Workplace Requirements~~

~~CHECK ___ IF THIS CERTIFICATION IS FOR AN APPLICANT WHO IS NOT AN INDIVIDUAL.~~

Alternate I. (Grantees Other Than Individuals)

A. The grantee certifies that it will or continue to provide a drug-free workplace by:

- (a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;
- (b) Establishing an ongoing drug-free awareness program to inform employees about--
 - (1) The dangers of drug abuse in the workplace;
 - (2) The grantee's policy of maintaining a drug-free workplace;
 - (3) Any available drug counseling, rehabilitation, and employee assistance programs; and
 - (4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;
- (c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);
- (d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will --
 - (1) Abide by the terms of the statement; and
 - (2) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;
- (e) Notifying the agency in writing, within ten calendar days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification numbers(s) of each affected grant;
- (f) Taking one of the following actions, within 30 calendar days of receiving notice under subparagraph (d)(2), with respect to any employee who is so convicted --
 - (1) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
 - (2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;
- (g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a) (b), (c), (d), (e) and (f).

B. The grantee may insert in the space provided below the site(s) for the performance of work done in connection with the specific grant:

Place of Performance (Street address, city, county, state, zip code)

Check ___ if there are workplaces on file that are not identified here.

~~PART D: Certification Regarding Drug-Free Workplace Requirements~~

~~CHECK ___ IF THIS CERTIFICATION IS FOR AN APPLICANT WHO IS AN INDIVIDUAL.~~

Alternate II. (Grantees Who Are Individuals)

- (a) The grantee certifies that, as a condition of the grant, he or she will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity with the grant;
- (b) If convicted of a criminal drug offense resulting from a violation occurring during the conduct of any grant activity, he or she will report the conviction, in writing, within 10 calendar days of the conviction, to the grant officer or other designee, unless the Federal agency designates a central point for the receipt of such notices. When notice is made to such a central point, it shall include the identification number(s) of each affected grant.

DI-2010
June 1998
(This form replaces DI-1963, DI-1964,
DI-1966, DI-1968 and DI-1969)

**PART E: Certification Regarding Lobbying
Certification for Contracts, Grants, Loans, and Cooperative Agreements**

*CHECK IF CERTIFICATION IS FOR THE AWARD OF ANY OF THE FOLLOWING AND
THE AMOUNT EXCEEDS \$100,000: A FEDERAL GRANT OR COOPERATIVE AGREEMENT;
SUBCONTRACT, OR SUBGRANT UNDER THE GRANT OR COOPERATIVE AGREEMENT.*

*CHECK IF CERTIFICATION IS FOR THE AWARD OF A FEDERAL
LOAN EXCEEDING THE AMOUNT OF \$150,000, OR A SUBGRANT OR
SUBCONTRACT EXCEEDING \$100,000, UNDER THE LOAN.*

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

As the authorized certifying official, I hereby certify that the above specified certifications are true.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL

TYPED NAME AND TITLE

DATE

DI-2010
June 1996
(This form replaces DI-1962, DI-1964,
DI-1965, DI-1966 and DI-1967)