99B-143

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

Proposal Title:
Loss of Mid-Channel Island Habitat in the Delta: Causes and Rates of Erosion

Applicant Name:
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Amount of funding requested: $ 456,781 for 3 years

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

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

Does the proposal address a specified Focused Action? X yes _____ no

What county or counties is the project located in?
Sacramento and San Joaquin

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

- ☐ Sacramento River Mainstem
- ☐ East Side Trib:
- ☐ Sacramento Trib:
- ☐ Suisun Marsh and Bay
- ☐ San Joaquin River Mainstem
- ☐ North Bay/South Bay:
- ☐ San Joaquin Trib:
- ☐ Landscape (entire Bay-Delta watershed)
- ☒ Delta:
- ☐ 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
- ☐ Spring-run chinook salmon
- ☐ Late-fall run chinook salmon
- ☐ Fall-run chinook salmon
- ☐ Delta smelt
- ☐ Longfin smelt
- ☑ Splittail
- ☐ Steelhead trout
- ☐ Green sturgeon
- ☑ Striped bass
- ☑ Migratory birds
- ☐ All chinook species
- ☐ Other:
- ☐ 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:

Vol. 1, pp. 125 ff, 266, 276, 532
Vol. 2, p. 62, 81

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

- ☐ State agency
- ☐ Federal agency
- ☐ Public/Non-profit joint venture
- ☐ Non-profit
- ☐ Local government/district
- ☐ Private party
- ☒ University
- ☐ Other:

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

- ☐ Planning
- ☐ Implementation
- ☐ Monitoring
- ☐ Education
- ☒ 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.

Printed name of applicant University of Southern California

Signature of applicant Lloyd Armstrong

Lloyd Armstrong, Jr., Provost & Sr. Vice Pres. for Acad. Affairs

I-015087

TITLE OF PROJECT:

LOSS OF MIDCHANNEL ISLAND HABITAT IN THE DELTA: CAUSES AND RATES OF EROSION

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TYPE OF ORGANIZATION:

The University of Southern California is a non-profit, tax exempt corporation

TAX IDENTIFICATION NUMBER:

95-1642394

EXECUTIVE SUMMARY

The purpose of the proposed project is to test four scientific hypotheses on three, select midchannel islands in the Sacramento-San Joaquin River Delta. The **hypotheses** are that we can 1) measure rates of morphological changes on the sample islands; 2) quantify island margin erosion rates seasonally and annually; 3) measure surface elevation changes on similar time scales; and 4) attribute relative magnitudes of island margin erosion to causative processes. These hypotheses can be tested through the successful completion of two Tasks. **Task 1** is to determine the bio-geomorphic status of three midchannel islands. This will be done through detailed topographical and habitat surveys, and subsequent monitoring of erosion/accretion stations to assess rates of change over the three year study period. **Task 2** is to identify sources and magnitude of erosive processes. This will be done by detailed measurement of water surface fluctuations over a period of about one year using a pressure transducer system. This type of time-series data collection scheme will allow differentiation between different erosion mechanism like wind waves versus boat wakes. These data, coupled with a Delta wind wave model (developed at USC), the DWRSIM current model, and an ongoing boat traffic model (in development at USC), will allow the energy arriving at island margins to be partitioned according to likely source.

Ecosystem benefits can be gained by restoration projects that sustain and enhance related fundamental ecological structures and processes. Midchannel islands provide shallow water habitat of great value to native fish populations by creating vital environments for spawning, rearing, refuge and a healthy shallow water food web all vital to different essential life-cycle stages. In addition, midchannel islands represent remnants of ancient marshes of the delta that include supra-tidal or riparian habitat of great use to both resident and native bird populations. The midchannel islands vary greatly in character and physiography. The nature of habitat provided by midchannel islands can vary according to the island morphology and dynamics. Therefore, coherent restoration strategies require an understanding of current and evolving island habitat and morphology. Restoration of critical marsh and shallow water habitat on and adjacent to the islands is critical to successful restoration at the ecosystem scale. The results of our proposed study will provide needed information gained from process-based studies. Linking ecosystem health of midchannel islands to physical processes is fundamental to our research plan. The results will be transmitted directly to restoration and management agencies and will be of critical value in the actual design and engineering of restoration and protection measures for midchannel islands. Seasonal changes in erosional processes identified in this study could be used in adaptive management approaches to midchannel island erosion.

This project is directly **linked** to the existing CALFED BREACH study (Simenstad, PI) via the participation of Dr. Denise Reed. This project will also link

directly with the ongoing levee erosion (Sherman and Bauer, PI's) and boat traffic (Wilson, PI) studies. The levee erosion project involves field work and experimentation on a continuing basis, and it allows logistical and administrative **cost sharing** with this project, estimated at about $40,000 per year. There is an additional cost share from USC totaling approximately $100,000 over the life of the project.

This project has several fundamental links to the CALFED Ecosystem Restoration Program Plan, as described in the January 1999 Draft. Restoration of midchannel islands is described specifically in Vol. 1, p. 125 ff. Enhanced midchannel island habitat should benefit directly several of the species identified in the ERP, including Special Status Plant Species (Vol. 1, p. 266) Aquatic Habitat Species (Vol. 1, p. 276), and several of the terrestrial species listed. Results of the project should result in management actions designed to reduce or alter Disturbance from human activities (such as recreational boating) as described in Vol. 1, p. 532. Similar issues are addressed in Volume 2 of the Plan, especially on p. 55, p. 60 (note here the reference to these islands as the last remaining 'original native delta habitats'), p. 62, and p. 81, among others.

PROJECT DESCRIPTION

PROPOSED SCOPE OF WORK:

The Delta contains numerous midchannel islands that comprise critical aquatic and terrestrial habitats. In many parts of the Delta, the island habitats are remnants of quasi-natural systems, and those habitats are completely different from those of the adjacent levees and agricultural lands. The sustainability of midchannel island habitat is dependent on the maintenance of their horizontal boundaries in the face of erosive forces, and their surface elevation in the face of secular and cyclical water level changes. The protection and restoration of midchannel islands has been recognized as a priority topic in the Ecosystem Restoration Program Plan (e.g., Vol. 1, p. 125 ff.), and planning and design work has already been funded. However, there remains minimal information concerning present rates of midchannel island erosion, and the relative magnitude of erosion contributions by the agencies of wind waves, channel flows, tidal currents, and boat wakes. There is also relatively little information concerning rates of vertical surface change, through accretion and/or subsidence. The purpose of this project is to address these information needs through a carefully designed and implemented field experiment, and process-response monitoring program..

Attribution of the causes of midchannel island erosion agencies is critical to the formulation of rational restoration strategies. Because different agencies attack the islands in different manners, an inappropriate erosion response may be largely ineffective. For example, the deployment of floating booms to minimize boat wake and wind wave erosion would have minimal effect on tidally-induced or flow-induced erosion. Unless the ultimate goal is to armor all of the banks on the midchannel islands, and lose access to valuable shallow water habitat for native fish species, the primary erosion agents for particular sites must be identified.

As part of a project to study potential boat wake erosion of Delta levees (funded by the California Department of Boating and Waterways), it has been demonstrated that erosion rates can be partitioned according to responsible processes. This involves both detailed process experimentation and geographical coverage of different erosion environments. This work provides background information and experience necessary to place the proposed work on midchannel islands into a broader Delta context. We propose to attack this problem in two ways. Our first objective is to initiate detailed morphological mapping of three, small midchannel islands. The second objective is to instrument one of these islands to obtain data on hydrodynamic processes to be related to the measured rates of morphological change.

Task 1: Determine the geomorphic status of three midchannel islands.

Three-dimensional maps will be prepared through detailed surveying of island morphology. These maps will provide the baseline information for the assessment of island changes through time. Cross-island survey transects will be conducted to below the low water line, and around island margins. Survey points will be spaced closely around the margins to provide tight control on morphology. Up to 500 survey points per island

will be obtained. The transect data will be supplemented with point data for improved accuracy and precision of geomorphic change from erosion and accretion processes.

Ten erosion stations will be established at or near the waterline on each island. Each station will consist of a set of four erosion pins (2' lengths of 3/8" rebar). Two pins will be installed vertically, and two horizontally. Vertical and horizontal erosion (or accretion) rates for each site are then obtained by averaging the change indicated by the respective pairs of pins. The erosion pin method allows millimeter scale measurements of change. The erosion stations will be placed around the islands at locations with different exposures. For example, stations would be established at updrift and downdrift ends of an island, and on each side of the island. The other six stations would be located according to specific site characteristics, e.g., potential exposure to wind waves or boat wake.

The paradigm for considering surface accumulation processes in tidal marshes (assumed here to represent the surface of the midchannel islands we will be studying) is that the presence of vegetation effectively causes settling of suspended sediments across the marsh surface from tidal flows, and prevents their resuspension. The few studies of this process (e.g., Leonard and Luther 1995, or Wang et al. 1993) show that flows within the marsh are well below the threshold for resuspension. However, waves moving across and through the marsh may be effect agents of resuspension (e.g., Pethick 1992). The marsh vegetative communities on midchannel islands are frequently dense stands of of tule or cattails. These may baffle flows in the same manner as Juncus studied by Leonard and Luther (1995), but the density of midchannel island vegetation is usually lower adjacent the island margins. The effects of wind waves or boat wakes in these areas may lead to the removal of materials from the marsh substrate. Such processes diminish the area of islands and reduce their long-term ability to keep pace with local water level rise.

Studies of marsh surface elevation changes and accretion in the delta (by Reed, as part of the CALFED BREACH study) have, to date, concentrated on well-vegetated, mature marsh surfaces. This study will use the same techniques to document changes in marshsurface elevation in the selected midchannel islands. Up to 12 sites (four per island) will be selected for detailed analysis of surface changes, and to characterize the distribution of midchannel marsh subenvironments. Sediment Erosion Tables, designed to measure sub-millimeter changes in surface elevation will be used as each site. The subenvironments will include:

- Retreating (scarped) marsh margins exposed predominantly to wind waves and tidal currents;
- Retreating (scarped) marsh margins exposed predominantly to boat wakes and tidal currents;
- Marsh margins with low-density tule coverage, not scarped, exposed to wind waves;
- Marsh margins with low-density tule coverage, not scarped, exposed to boat wakes.

Additional measurements of marsh surface elevation near the center of midchannel islands will allow documentation of any accretion or erosion associated with changes in local sediment or organic matter budgets. All of the site specific measurements described above will be made three times per year – in the spring, fall, and mid-summer. The first two sample periods precede and follow the main boating season, and the latter period would be near the height of recreational boating traffic in the Delta.

Task 2: Identify sources and magnitude of erosive processes.

One island will be selected for the installation of a set of four pressure transducers. The pressure transducers will sample water surface fluctuations for ten minutes each hour, at a sample rate of 10 Hz. The instruments will be hardwired to a weatherproofed, data-acquisition installation on the island. The system will obtain power from battery packs and from local generation from a solar and wind generator assembly. A modem and cell phone will be used to transfer the data to the USC computer network. With appropriate maintenance, this system should survive for at least one year, barring extreme high water and island flooding. The resulting data sets will be analyzed to obtain: 1) mean water level changes associated with tides and varying discharge through the system; 2) characteristics of locally-generated wind waves; and 3) characteristics of locally-generated boat wake. Data storage and transmission limitations preclude continuous sampling. However, this sample design should allow identification of the relative energy contributions due to wind and boats. Existing Delta flow models, such as DWRSIM, will be used to estimate tractive forces along island margins.

Estimates of potential boat-wake energy will be matched to boat traffic survey data being collected at USC under contract to the California Department of Boating and Waterways (J.P. Wilson, PI). Estimates of wind wave energy will be matched to a simulation model developed by Yaari (in prep). These independent assessments will provide order-of-magnitude control on measured estimates. Further, comparison of hydrodynamic measurements and simulations with the erosion rates measured during 'Task 1' activities will assist in the apportionment of causality.

There are three project phases. In year one, the emphasis will be on mapping the islands, including the habitat survey, and installing the erosion monitoring stations. The product from this effort will be a set of contour maps of the islands. Near the end of year one, focus will shift to the installation and trouble shooting of the pressure transducer system. In year two, erosion station monitoring will continue, and hydrodynamic data will be acquired and processed. Near the end of year two, the status of the pressure transducer system will be assessed, and a decision made concerning removal or continued measurement. In year three, continued monitoring of erosion stations and removal of the pressure transducer system will occur. There will be a resurvey of habitat. The final project report will include maps of the islands, depictions of erosion rates at the different sites, summary records of the hydrodynamic measurements, estimates of relative magnitudes of erosion resulting from wind waves, boat wakes, and channel and tidal flows, and recommendations for further research.

LOCATION OF THE PROJECT:

The proposed project is designed to be implemented on a set of three neighboring islands, at a location to be determined in phase 1 of the project. Likely locations will be midchannel islands in either Latham or Disappointment Sloughs, although other locales may be selected after detailed reconnaissance. Selection of the sites will be done through consultation with California Departments of Water Resources, Fish and Game, and Boating and Waterways.

ECOLOGICAL/BIOLOGICAL BENEFITS

Ecological/Biological Objectives:

The ecosystem based approach to restoration advocated in the CALFED ERP and Strategic Plan recognizes that species management can be achieved by sustaining and enhancing fundamental ecological structures and processes. Midchannel islands provide shallow water habitat of great value to native fish populations by creating appropriate environments for spawning, rearing and refuge. In addition, those midchannel islands which represent remnant of ancient marshes of the delta include supra-tidal or riparian habitat of great use to both resident and native bird populations.

The midchannel islands vary greatly in character and physiography. Attributes of ecological value such as shallow marginal areas with low-density tule stems and/or submerged aquatic vegetation occur interspersed with cut banks on deep water margins. The nature of habitat provided by midchannel islands can vary according to the island morphology and dynamics. Therefore, coherent restoration strategies require an understanding of current and evolving island habitat and morphology.

Midchannel islands are undergoing erosion and long-term studies show that many are suffering catastrophic erosion (Schmutte, 1999). Restoration of midchannel islands in the Central Delta Habitat Corridor is a focussed action in this PSP. Two anthropocentric factors are recognized as contributing to the erosion: altered sediment regimes and erosion by boat wakes. But the relative contributions of these anthropogenic factors to overall island erosion are not well documented. Despite the occasionally severe erosion, some island margins are still providing valuable shallow water habitat - or at least exhibit potentially valuable ecological structures and processes. This proposal seeks to elucidate the causes and rates of erosion in mid-channel islands such that restoration measures can target the appropriate process to minimize erosion, and so that restoration measures can be implemented to minimize erosion while maintaining the attributes of the islands that are valuable for native species.

This project is designed to focus on island margin and surface changes as they effect shallow water and adjacent habitat. The primary stressor of interest is island margin erosion as a result of several processes. Our hypotheses are 1) that we can measure rates of morphological changes on the sample islands; 2) that we can quantify margin erosion rates seasonally and annually; 3) that we can measure surface elevation changes on similar time scales; and 4) that we can attribute relative magnitudes of island margin erosion to appropriate processes.

The Objectives of this project (as described in Tasks 1 and 2, above, and necessary for the testing of the hypotheses) are:

1. To determine the geomorphic status of several mid-channel islands
2. To identify sources and magnitudes of erosive processes on mid-channel islands

This project will provide data concerning the relative importance of processes contributing to midchannel islands in a manner that is impossible using aerial photography or historical surveys. There have been so many changes to physical processes in the Delta including flow regime, sediment supply, boat wakes, and exposure

to wind waves caused by levee failures and islands flooding, that simply attributing erosion to boat wakes, and implementing restoration measures accordingly, potentially ignores important erosive mechanisms.

The specific questions to be addressed include:

- What is the annual/seasonal magnitude of midchannel island erosion, and what is the intra-and inter-island variability?
- What are the most important processes contributing to midchannel island erosion and how do these vary seasonally? What especially are the relative roles of wind waves and boat wakes?
- Under what physical conditions are shallow vegetated margins developed on midchannel islands?
- Are midchannel islands sustainable vertically under present conditions?

The results of this study will be transmitted directly to restoration and management agencies with interests in the Delta and will be of critical value in the actual design and engineering of restoration and protection measures for midchannel islands. Seasonal changes in erosional processes identified in this study could be used in adaptive management approaches to midchannel island erosion. Such approaches might include seasonal deployment of booms to protect island margins from boat wakes, where the booms are removed during periods of high river-flow to allow beneficial sediment deposition on islands and their shallow margins. The project will be self sustaining to the extent that future management decisions incorporate the findings in efforts to naturally or artificially restore the midchannel island habitats. The project is based on an ecosystem approach, where explicit attention is giving to understanding the fluid processes that impact the habitat necessary to sustain the ecosytem.

Linkages:

This project is directly linked to the existing CALFED BREACH study (Simenstad, PI) via the participation of Dr. Denise Reed. Dr. Reed will employ similar techniques for the measuring marsh surface elevation change and accumulation as in the existing and proposed BREACH study. In addition, the interface between vegetated marsh surfaces and shallow water habitats studied here on the margins of midchannel islands are comparable to the habitats examined by BREACH in breached levee areas of the Delta. The more dynamic or exposed nature of midchannel islands makes this study a natural extension of the physical components of the BREACH study, where physical and physiographic characteristics of shallow water areas are examined with the goal of improving adaptive management approaches to tidal marsh restoration in the Delta.

This project will also link directly with the ongoing levee erosion (Sherman and Bauer, PI's) and boat traffic (Wilson, PI) studies funded by the California Department of Boating and Waterways. The levee erosion project involves field work and experimentation on a continuing basis, and it allows logistical and administrative cost sharing with this project, estimated at about $40,000 per year. Further, results of the boat traffic survey and model will be made available as another tool for estimating potential

boat-wake induced erosion. The objectives of the levee erosion study are quite similar to those of this project, except the focus of interest is the integrity of the levee system.

This project has several fundamental links to the CALFED Ecosystem Restoration Program Plan, as described in the January 1999 Draft. Restoration of midchannel islands is described specifically in Vol. 1, p. 125 ff. Enhanced midchannel island habitat should benefit directly several of the species identified in the ERP, including Special Status Plant Species (Vol. 1, p. 266) Aquatic Habitat Species (Vol. 1, p. 276), and several of the terrestrial species listed. Results of the project should result in management actions designed to reduce or alter Disturbance from human activities (such as recreational boating) as described in Vol. 1, p. 532. Similar issues are addressed in Volume 2 of the Plan, especially on p. 55, p. 60 (note here the reference to these islands as the last remaining 'original native delta habitats'), p. 62, and p. 81, among others.

Improved understanding of mid-channel island dynamics contributes to the overall CALFED goal of improved ecological functions within the Bay-Delta by providing information critical to the successful restoration and maintenance of mid channel island habitat. Also, the CALFED primary objective of reducing the risks posed by levee breaches is assisted by efforts that improve management approaches to midchannel islands - many of which provide critical protection to nearby levees surrounding agricultural areas.

System Wide Ecosystem Benefits:

Midchannel islands occur through the Sacramento-San Joaquin Delta and Suisun Bay where they remain as remnants after levees had been constructed for agriculture or marsh management. This investigation, by focussing on fundamental physical processes such as waves and tidal currents, has applicability across the Delta. The effect of boat wakes, wind waves, or currents will be similar, in process if not in magnitude, from the ancient remnant islands of Lindsey Slough to the multiple small tule islands surrounding Mildred Island. While some of these are exposed to subjected to greater wave fetches than others, e.g., NW Quimby on the eastern margin of Franks Tract, understanding the dynamics of erosion will allow projection of midchannel erosion process across the Delta based upon available wind and tidal current information. Such process-based approaches are critical to successful restoration at the ecosystem scale.

Compatibility with Non-Ecosystem Objectives:

The agents that cause erosion or other alterations of the midchannel islands are also effecting adjacent levee systems. Improved understanding of the magnitude of these processes, and the roles of different energy sources, is fundamental to the development of comprehensive management strategies for both the midchannel islands and the levee system. Any findings that could ultimately reduce the necessity to hard protect (i.e., armor) Delta shorelines will have substantial economic and ecosystem benefits.

TECHNICAL FEASIBILITY AND TIMING

The experience of this science group in assessing levee erosion and habitat change in the Delta has indicated that the methods presented here represent the most reasonable for the environment and the budget. The field team has substantial experience in field mapping and instrument deployment, and there are no novel or experimental protocols being implemented in this project. Other methods of assessing island morphology, such as aerial photography, LIDAR or other airborne sensors are problematic because of the vegetation cover and the changing water levels. More complex instrumentation systems would increase the budget substantially without a proportionate increase in information. To obtain the types of data that we are after in these environments still requires considerable 'in the mud' efforts. The nuances of electronic data acquisition and analysis are well-understood by our group, and pose no technological constraint other than those associated with any remote acquisition project. Data streams will be monitored for continuity, and a rapid-deployment field team will be available on short notice to trouble shoot system failures. The greatest threat to the long-term viability of the project is the occurrence of a flood with discharge sufficient to inundate our electronics. We will attempt to minimize this threat through shelter design, plans for fast-response equipment rescue, and by planning the initial data acquisition period to begin after the annual spring flood. The latter strategy should maximize the time to the next flood.

We are not aware of any compliance or permitting procedures that would impact our schedule or our ability to perform the research as described. We have designed the project to occur on California State Lands, or other lands controlled by the California Resources Agency. It is our intent to initiate the field work component of the project in late Fall, 1999, beginning with site selection and permitting, and conclude in the Fall of 2002 with the production of a project report.

MONITORING AND DATA COLLECTION METHODOLOGY

Biological/Ecological Objectives:

Our hypotheses are 1) that we can measure rates of morphological changes on the sample islands; 2) that we can quantify margin erosion rates seasonally and annually; 3) that we can measure surface elevation changes on similar time scales; and 4) that we can attribute relative magnitudes of island margin erosion to appropriate processes. Testing these hypotheses requires that we first establish the baseline characteristics of the sample islands, and then we monitor geomorphological change and collect data representing local hydrodynamical processes. All phases of the project involve monitoring. Electronic acquisition of hydrodynamic data is largely a year two task.

Monitoring Parameters and Data Collection Approach

Ten erosion stations will be established at or near the waterline on each island. Each station will consist of a set of four erosion pins (2' lengths of 3/8" rebar). Two pins will be installed vertically, and two horizontally. Up to 12 sites (four per island) will be selected for detailed analysis of surface changes (using Sediment Erosion Tables), and to characterize the distribution of midchannel marsh subenvironments. Measurements will occur three times per year, in late Spring, mid-summer, and early Fall. This scheme is designed to bracket the recreational boating season.

Hydrodynamic data will be obtained using of a set of four pressure transducers. Water surface fluctuations will be sampled for ten minutes each hour, at a sample rate of 10 Hz., for a period of up to one year. The sample frequency of 10Hz is desirable because of the short period of Delta wind-waves and boat wake, typically of the order of one second. Our sample rate would still produce ten measurements per wave for those conditions. A modem and cell phone will be used to transfer the data to the USC computer network. With appropriate maintenance, this system should survive for at least one year, barring extreme high water and island flooding. The resulting data sets will be analyzed to obtain: 1) mean water level changes associated with tides and varying discharge through the system; 2) characteristics of locally-generated wind waves; and 3) characteristics of locally-generated boat wake. Data storage and transmission limitations preclude continuous sampling. However, this sample design should allow identification of the relative energy contributions due to wind and boats.

Data Evaluation Approach:

Data reports will be prepared on an annual basis, and will include sample site location maps, updated versions of our island morphology and habitat maps, and data tables and graphs to report margin and surface changes. After the completion of Task 2 data acquisition, a separate report will be prepared, detailing metadata and providing summary statistics and data interpretation. Analytical techniques to identify wind waves vs. boat wake are straightforward due to the periodic nature of the former, and the idiosyncrasy of the latter (in terms of a time series signal). Peer review will occur when results are written up and submitted for publication in the peer-reviewed literature.

Table 2: Monitoring and Data Collection Information

Biological/Ecological Objectives			
Question to be Evaluates	Monitoring Parameters and Data Collection Approach	Data Evaluation Approach	Comments/Data Priority
What is the annual/seasonal magnitude of midchannel island erosion, and what is the intra-and inter-island variability?	Erosion pins and Sediment-Erosion Table -Measured 3x/yr. @ 3 islands	Three islands - 10 sets pins/island, 4 SET/island Data measured directly in field. SAS GLM used to detect changes	Measurements each year bracket recreational boating season Protocols already used in BREACH and CA B&W projects
What are the most important processes contributing to midchannel island erosion and how do these vary seasonally? What especially are the relative roles of wind waves and boat wakes?	Set of four pressure tranducers @ 5 Hz Bursts of 10 min/hr.	Data transfer to USC via cell phone Character of wind waves and boat wakes allows ID after processing	Important dynamic information to detect agents of erosion
Under what physical conditions are shallow vegetated margins developed on midchannel islands?	Surveys (EDM) of island shorelines showing shallow bathymetry Up to 500 points/island	Infer processes on surveyed shorelines based on physical data	Survey once during course of project unless episodic events cause change in shoreline type
Are midchannel islands sustainable vertically under present conditions?	SET, marsh accretion and soil properties	At each SET station. Soil samples used to calculate accumulation of organic and inorganic seds.	Similar protocols to BREACH study

LOCAL INVOLVEMENT

Our proposal incorporates both local regional involvement on several different levels as well as national and international contacts concerning our proposed research in the Delta. Presently Drs. Sherman, Lorang, and Bauer are conducting an ongoing research study on Delta wide erosion with the objective to quantify the relative magnitude of erosion from various factors such as, currents, wind waves and boat wakes. We have completed a manuscript on a field study to quantify erosion due to boat wakes alone. That work will be submitted to an international peer reviewed journal resulting in broad dissemination of our results. During the course of these studies we have been in constant contact with several local marina operators, other local merchants, levee maintenance supervisors and landowners throughout the Delta in the process of completing our fieldwork. We have also made more formal contacts with several individuals (see list) associated with local agencies, as well as more regional offices. These individuals have been informed of our studies and we have had discussions with them about future proposed research. In all cases, erosion and its causes is of concern to everyone, which leads to conversations that center around getting the word out about our findings as they are completed. Erosion relates to issues that are central to many of the stakeholders in the Delta, but not all people are positive about such research, especially with regard to how it may ultimately support potential restrictions on recreational boating. However, getting to the root of the erosion mechanisms – determining which are most important and how wide spread they are through out the Delta -- will greatly influence recovery actions. Such work will ultimately benefit all that have a stake in the Delta, even those who do not support this research.

Contact list

Individual	Affiliation
Diana Jacobs	California Dept. of State Lands
Lauren Burks	California Dept. of State Lands
Ron Flick	California Department of Boating and Waterways
Marsha Brockbank	San Francisco Estuary Project
Laurie Clamurro	Delta Protection Commission
Alexander Krygsman	Port Stockton, Port Director
Bob Jarrett	USGS Denver office (Flood Hydrologist)

I-015100

COSTS

The costs of the proposed projects are detailed in the two tables below. Total project costs are broken down by expenditure category in Table 3, and project costs are broken down by quarter and task in Table 4.

Table 3: Project Costs by Expenditure Category and Year:

PROPOSED BUDGET (10/01/99-09/31/02)	Year 1	Year 2	Year 3	Total	Justification
Salary					
Principal Investigators:					
Bauer	$5,496	$5,771	$6,060	$17,327	.75 mo. p.a.
Sherman	$10,708	$11,244	$11,806	$33,758	1.25 mo. p.a.
Research Associate:					
Lorang	$12,000	$12,600	$17,640	$42,240	4/3/4 mo. p.a.
Research Assistant					
TBD	$12,680	$13,314	$13,980	$39,974	50% time
TDB (no F.B.)	$1,200	$1,200	$1,200	$3,600	hourly wages
TOTAL SALARY	$42,084	$44,129	$50,686	$136,899	
Fringe Benefits @ 32.04%/32.55%/33%	$13,134	$14,006	$16,330	$43,470	excludes hourly wages
Total Salary & Fringe Benefits	$55,218	$58,135	$67,016	$180,369	
Equipment					
Data Acquisition System	$5,750			$5,750	
Materials & Supplies					
Power System	$2,000			$2,000	
Laptop PC	$2,250			$2,250	
Cell Phone	$500			$500	
Environmental Shelter	$1,200			$1,200	
Miscellaneous	$1,500	$1,200	$900	$3,600	e.g., Cable, rebar, tape, film, phone charges
Total	$7,450	$1,200	$900	$9,550	
Travel	$5,500	$5,000	$7,000	$17,500	airfare, car rental, per diem, conference travel
Subcontract	$33,629	$31,274	$32,032	$96,935	University of New Orleans
Total Direct Expenses	$107,547	$95,609	$106,948	$310,104	
Indirect Expenses	$59,162	$40,692	$46,823	$146,677	Includes 1st $25K of subcontract
Year 1 $93,168 @ 63.5% Year 2 $64,335 @ 63.25% Year 3 $74,916 @ 62.5%					Excludes equipment
TOTAL	$166,709	$136,301	$153,771	$456,781	

Note: Non-Federal sponsors fringe benefit rates are used in calculating budget.
Federal sponsors fringe benefit rates is 26%.

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Note that the indirect cost rates used for the budget presented in these Tables are based on the University of Southern California's federally approved rate (63.5%) and the University of New Orleans' federally approved rate of 26%.

Table 4: Project Costs by Task and Quarter

	Quarterly Budget Oct-Dec 99	Quarterly Budget Jan-Mar 00	Quarterly Budget Apr-Jun 00	Quarterly Budget Jul-Sep 00	Total Budget
Task 1	$22,575	$19,241	$33,652	$21,222	$96,690
Task 2	$16,349	$13,933	$24,369	$15,369	$70,019
Total	$38,924	$33,174	$58,021	$36,591	$166,710

	Quarterly Budget Oct-Dec 00	Quarterly Budget Jan-Mar 01	Quarterly Budget Apr-Jun 01	Quarterly Budget Jul-Sep 01	Total Budget
Task 1	$15,446	$15,446	$30,631	$17,531	$79,054
Task 2	$11,186	$11,186	$22,181	$12,695	$57,248
Total	$26,632	$26,632	$52,812	$30,226	$136,302

	Quarterly Budget Oct-Dec 01	Quarterly Budget Jan-Mar 02	Quarterly Budget Apr-Jun 02	Quarterly Budget Jul-Sep 02	Total Budget
Task 1	$18,754	$18,754	$31,020	$20,658	$89,186
Task 2	$13,581	$13,581	$22,463	$14,959	$64,585
Total	$32,335	$32,335	$53,483	$35,617	$153,771

COST SHARING

The Principal Investigators have submitted a proposal to a California State Agency for a project designed to measure and attribute levee erosion for the next three years. The level of support requested for 1999-2000 will be approximately $140,000 per year, and similar support will be requested for each of the two years following. Part of these funds, if obtained will be used to offset the costs of this project. For example, some of the tasks described above will be shared with that project if funded. This refers especially to costs associated with field work and data analysis, and some salary. The survey equipment and pressure transducers (already purchesed from existing contract support) would also be part of the cost sharing. Total cost sharing is estimated to be $40,000 per year. Note however that the state funding is uncertain at this point and is dependent on state budget authorizations and agency management decisions. The ability to perform the tasks described in this proposal is in no way reliant on other sources of funding. The cost sharing benefit is in additional days in the field (we could work 8-10 hrs/day instead of 10-12), and fewer 'donated' days by the scientific personnel. There is also a cost sharing contribution by USC. This totals approximately $100,000 over the three years of the project, and represents the contributions of one month's salary (including fringe benefits and indirect expenses) per year for Drs. Bauer and Sherman. There is a similar type of cost share from the University of New Orleans, totaling approximately $25,000 for the three years.

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APPLICANT QUALIFICATIONS

There are four scientists cooperating on this project: Douglas J. Sherman and Bernard O. Bauer from the University of Southern California, Denise Reed from the University of New Orleans, and Mark Lorang from the University of Oregon. Dr. Sherman is the primary project contact, and will be responsible for overall project management. All these scientists will cooperate on Task 1, with Dr. Reed having primary responsibility for measuring marsh response, and Drs. Bauer, Lorang and Sherman measuring island morphological responses. Task 2 is the responsibility of the latter three. None of these scientists has any conflicts of interest with the CALFED program, or any of the long-term goals of the program.

Dr. Douglas Sherman received his Ph.D. in coastal geomorphology from the University of Toronto in 1983. He is presently a Professor of Geography at the University of Southern California, and Director of the USC Sea Grant Program. His areas of expertise include nearshore processes and sediment transport. For the last three years he has been involved in a research program sponsored by the California Department of Boating and Waterways to study causes and rates of levee erosion in the Delta. This work is ongoing, and complementary to the project proposed herein. Key collaborators in this project have been Drs. Bauer and Lorang. Field work has included a detailed process experiment of sediment suspension by boat wakes, and the establishment and monitoring of a network of 28 erosion pin sites around the Delta.

Dr. Sherman is the author of more than 100 scientific or technical articles and reports, and has administered more than $5 million in contracts and grants. He has published in journals such as *Sedimentology*, *Marine Geology*, *Journal of Coastal Research*, *Earth Surface Processes and Landforms*, *Coastal Engineering*, *Geomorphology*, and the *Journal of Ports, Harbors and Waterways*.

Dr. Bernard Bauer received his Ph.D. in coastal geomorphology from the Johns Hopkins University in 1988 with emphasis on process geomorphology, sediment transport, and wave-current interaction. Some of Dr. Bauer's earlier research was on morphodynamic adjustments in nearshore zones along the coasts of Florida, New York, and Ontario. In a few cases, the focus was specifically on the influence of 'hard' engineering structures, such as groins or revetments, on modifying local hydrodynamics and sediment transport patterns. These projects involved extensive electronic field instrumentation coupled to computer-based data-acquisition systems, as well as standard surveying and sedimentological methods. His research has been published in journals such as *Marine Geology*, *Journal of Coastal Research*, *Progress in Physical Geography*, and *Zeitschrift fur Geomorphologie*.

Dr. Bauer also has extensive field experience in large river systems. He has conducted research on the chronic erosion of channel-margin sand bars in the Colorado River through Grand Canyon. Another project investigated sediment transport and dune migration in a reach of the Green River in Dinosaur National Monument. This research involved sophisticated technologies including high-frequency echo sounders, optical

back-scatterance sensors, and acoustic-doppler velocimeters. The intent was to relate rates of subaqueous dune migration to the spatial and temporal distribution of sediment flux and turbulent fluid motions.

Dr. Denise Reed received her Ph.D. in coastal geomorphology from the University of Cambridge in 1986. Her thesis work examined sediment transport in tidal salt marshes and since 1986 she has worked on coastal marsh studies in the United States. Her work has focussed in Louisiana where she was an Associate Professor at LUMCON until 1998. Her work there on the effects of levees and structures on tidal sedimentation processes has been of great interest to policy makers in coastal restoration. Dr. Reed has also received funding from NOAA, USGS and CALFED (as part of the BREACH study - Simenstad PI) for work on marsh accretion and elevation change on the Atlantic and Pacific coasts of the US. Dr. Reed is presently as Associate Professor at the University of New Orleans. For five years she served as the academic liaison between university researchers in coastal Louisiana and the agencies and managers responsible for implementation of the $40 million per year federal/state coastal restoration program in Louisiana. She is a member of the Coastal and Marine Sector team for the US Global Change Assessment and was an invited participant in the IEP Shallow Water Habitat workshop in summer 1998. Relevant publications have appeared in professional journals such as *Earth Surface Processes and Landforms*, *Marine Geology*, and *Estuaries*.

Dr. Mark Lorang earned his Ph.D. in Oceanography from Oregon State University in 1996. He specialized in wave and beach processes, and landform responses. He has been working at the interface of physical processes and ecology for over ten years. Some of his earlier collaboration was with wildlife biologists examining erosion on channel-islands related to loss of rearing habitat for goslings. River regulation by a power company elevated the water levels leading to increased erosion to the channel islands and displacement of the geese. He was part of a lake ecology team assessing the impacts of shoreline erosion, marsh development and changes to aquatic plant communities. He developed and tested a discharge scheme that would reduce erosion lakewide while benefit downstream fisheries. His plan was adopted by the Federal Regulatory Commission (FERC) as part of a dam re-license plan.

Dr. Lorang has written a guide-book on alternative shore protection methods for the state of Oregon. Most recently he has completed a Post Doctoral fellowship with Drs. Sherman and Bauer at USC where he worked on the levee erosion study. Currently Dr. Lorang is a visiting Asst. Professor in the Geography department at the University of Oregon. He was recently an invited speaker for a special series on the Salmon crisis presenting "Linking flow regimes and sediment transport and Salmonid habitat." Dr. Lorang is collaborating with Dr. Jack Stanford, University of Montana, on a salmon recovery project on the Yakima River in Washington. The focus of the study will be to link flow regimes in a regulated river to sediment transport processes for improving shallow water food webs that support juvenile salmon.