

# **Proposal Reviews**

## **#18: Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach**

California Department of Fish and Game

**Final Selection Panel Review**

**Initial Selection Panel Review**

**Research and Restoration Technical Panel Review**

**Bay Regional Review**

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## Final Selection Panel Review:

### CALFED Bay-Delta 2002 ERP PSP Final Selection Panel Review

**Proposal Number:** 18

**Applicant Organization:** California Department of Fish and Game

**Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

Please provide an overall evaluation rating.

Fund	
As Is	X
In Part	-
With Conditions	-
Consider as Directed Action	-
Not Recommended	-

Amount:    **\$3,881,215.46**

Conditions, if any, of approval (if there are no conditions, please put "None"):

**None**

Provide a brief explanation of your rating:

**Comments from the ABAG CALFED Task Force, the San Francisco Estuary Project, and the Clean Estuary Partnership endorsed this project, while asking for close coordination between mercury monitoring and wetland restoration and for more attention to public education about the public health impacts of mercury-contaminated sportfish. In much of the Bay-Delta ecosystem, sediments are contaminated with mercury from historic mining activities or other sources. This contamination's impacts in the Bay-Delta system are widespread. The Selection Panel is also aware that wetlands are sites of active methylmercury production. In response to these contaminant issues, CALFED is organizing a workshop to develop an integrated science strategy to address questions pertaining to potential linkages between wetland-restoration activities, the production of methylmercury, and contamination of aquatic biota, fish, and wildlife, which can influence human exposure to methylmercury.**

**In response to the Clean Estuary Partnership's comments regarding improving mercury source assessments, the Selection Panel also recommends that this project's Task 2C (Conduct sub-watershed studies of tributaries or source regions...) include estimation of episodic inputs of mercury to the San Joaquin River in the vicinity of Mud Slough, which receives mercury originating from the New Idria Mercury Mine via the Panoche Fan.**

## Initial Selection Panel Review:

### CALFED Bay-Delta 2002 ERP PSP Initial Selection Panel Review

**Proposal Number:** 18

**Applicant Organization:** California Department of Fish and Game

**Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

Please provide an overall evaluation rating.

#### Explanation of Recommendation Categories: Fund

- **As Is** (a proposal recommended for funding as proposed)
- **In Part** (a proposal for which partial funding is recommended for selected project phases or components)
- **With Conditions** (a proposal for which funds are recommended if the applicant contractually agrees to meet the specified conditions)

**Consider as Directed Action in Annual Workplan** (a proposal addressing a high priority action that requires some revision followed by additional review prior to being recommended for funding)

**Not Recommended** (a proposal not currently recommended for funding-after revision may be considered in the future)

#### Note on "Amount":

For proposals recommended as Fund As Is, Fund In Part or Fund With Conditions, the dollar amount is the amount recommended by the Selection Panel.

For proposals recommended as Consider as Directed Action in Annual Workplan, the dollar amount is the amount requested by the applicant(s).

Fund	
As Is	X
In Part	-
With Conditions	-
Consider as Directed Action	-
Not Recommended	-

Amount:    **\$3,881,215**

Conditions, if any, of approval (if there are no conditions, please put "None"):

None

Provide a brief explanation of your rating:

**The Selection Panel views quantification of the relative importance of external and internal sources of methylmercury as a critical first step toward identifying and focusing potential management approaches related to methylmercury contamination of aquatic biological resources within the Bay-Delta ecosystem. The centerpiece of this project is a mass-balance approach for total mercury and methylmercury in the Delta. The project also includes an array of supporting studies that will examine important fluxes and transformations of mercury in the ecosystem. (The investigators present preliminary information suggesting that riverine inputs are a major source of methylmercury to the Delta and that the influxes are greatest during periods of high flow.) The project will also examine inputs of mercury in atmospheric deposition and will indirectly assess internal production of methylmercury within the Delta (e.g., fluxes of methylmercury across the sediment-water interface).**

**This project received a High ranking from the Bay and Sacramento regions, and a Low ranking from the Delta and San Joaquin regions. Despite the mixed regional support, the Selection Panel believes that this project will provide information of considerable utility to managers. This process-level study will be conducted at the ecosystem scale, is hypothesis driven, and addresses three regional and one multi-regional priorities. The investigators are knowledgeable and experienced. The project goals are ambitious, but most reviewers considered the likelihood of successful completion to be very good. The Panel expects that uncertainties in estimates of some fluxes (input and outputs) in the mass balance will be large; however, information on uncertainties can be useful for focusing future work, as appropriate and desirable.**

**The Selection Panel concurs with the following two recommendations by the external scientific reviewers:**

**Recommendation 1 - The investigators should modify the proposed temporal allocation of sampling effort to one that is more closely linked to the hydrograph, when influxes of total and methyl mercury to the Delta are greatest (monthly sampling intervals were proposed). In other words, sampling frequency should be increased during periods of high inflow from the tributaries, when influxes of total and methyl mercury to the Delta are expected to be greatest.**

**Recommendation 2 - The investigators should seek to collaborate with scientists involved with direct measurement of mercury methylation and demethylation in aquatic sediments and wetland areas in the Delta. Such collaborative work would strengthen the interpretation of information on sources, sinks, and fluxes of methylmercury in the ecosystem.**

**The Selection Panel also encourages the principal investigators to develop an analytical capability for low-level determinations of total mercury and methylmercury in dilute media, to reduce the costs of contractual analyses in mercury investigations.**

# Research and Restoration Technical Panel Review:

## CALFED Bay-Delta 2002 ERP PSP Research and Restoration Technical Panel Review Form

**Proposal Number:** 18

**Applicant Organization:** California Department of Fish and Game

**Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

**Review:**

**Please provide an overall evaluation summary rating:**

**Superior:** outstanding in all respects;

**Above Average:** Quality proposal, medium or high regional value, and no significant administrative concerns;

**Adequate:** No serious deficiencies, no significant regional impediments, and no significant administrative concerns;

**Not Recommended:** Serious deficiencies, significant regional impediments or significant administrative concerns.

Overall Evaluation Summary Rating	Provide a brief explanation of your summary rating
XSuperior	<b>This is the most thorough of any of the mercury projects submitted to the CALFED review panel. The PIs certainly have experience in the study area and have identified key areas to focus their research. The mass-balance approach is scientifically defensible and the process level work, coupled with an atmospheric deposition study result in a top-notch research project. It directly addresses many CALFED priority issues. Reviewers suggest directing some costs associated with consulting firms to graduate student/postdoc involvement in the project.</b>
-Above average	
-Adequate	
-Not recommended	

1. **Goals and Justification.** Does the proposal present a clear statement of goals, objectives and hypotheses? Does the proposal present a clear justification and conceptual model for the project?

**This proposal presents clear goals and objectives, and unlike many proposals reviewed, is hypothesis-driven. The investigators present clear objectives that are in many facets, logical extensions of previous work in the Bay-Delta region. It is because of the previous work that they can identify specific foci for study and eliminate much of the monitoring that is present as the initial basis of many other studies. The proposal designs a mass-balance approach for looking at major fluxes and transformations of Hg in the system. The portion of the project dealing with internal processes strengthens the ability for application to other systems. The entire proposal is centered on the mass balance and the design is consistent with this approach.**

Key questions for management of Hg in the Bay-Delta area are: 1. What are the main sources of Hg legacy of mining activities, historically polluted sediments or atmospheric deposition.; 2. What sources are more likely to be methylated?; 3. What is the distribution of methylation activity in the Bay? The study is well-justified, due in large part to the existing knowledge that has been gathered by the principal investigators associated with the project. That is clear from the supplementary material. The preliminary work by this group has identified a major concept that may have been missed by other proposals reviewed that riverborne methyl Hg is a major source of MeHg delivered to the delta and that high flow conditions are the most important delivery period. From a conceptual model standpoint, they have already identified both the timing and the importance of the major MeHg flux. They attempt to both refine the estimates of riverine inputs and at the same time, achieve a better understanding of processes affecting MeHg delivered via rivers and delineate other MeHg inputs and pathways within the delta and estuary. The PIs also suggest that atmospheric inputs to the system may be important and propose a three-site network to estimate flux. This is an area of research that other proposals do not investigate and one that is essential for inputs to an anthropogenically-influenced environment like the Bay-Delta.

2. **Likelihood of Success (Approach, Feasibility, Capabilities and Performance Measures).** Is the project likely to succeed based on the approach, feasibility and project team capabilities? Are the proposed performance measures adequate for measuring the project's success?

The approach outlined by the PIs will yield significant results for understanding Hg cycling in the system. In some cases, it appears that the approach is too ambitious for the number of investigators involved, but it is at least worth attempting. The PIs, based on their experience in the study system, will know where best to redirect efforts.

The mass loading study from freshwaters is a key to the study. The PIs should reconsider monthly sampling and better design a monitoring scheme that would be based more directly on the hydrograph. For instance, if they were to compare melt periods to events to baseflow periods, they could better concentrate sampling. It would also be worthwhile to delineate watershed processes by following a hydrograph on a particular storm. This might allow for identification of processes affecting release of MeHg from the watershed. Similarly, Task 2A might be better designed for watersheds with USGS gaging stations. This will allow better choice of sampling times based on the hydrograph.

This is one of the few studies in the region to consider atmospheric deposition as a key source to the system. While the PIs suggest that loading of HgT from the atmosphere may be low, its timing and rates, especially episodic events, may be important. The current approach of the MDN network is inadequate for this type of study and the implementation of three sampling stations would be a key. Little is also known about deposition and partitioning of atmospheric methyl Hg and this information will be novel for a region such as this. Some previous work has alluded to oceanic sources of dimethyl Hg and this study would prove a valuable tracer of its end product, MeHg.

It would bolster the project significantly if the PIs were to partner with an individual that directly measures rates of methylation and demethylation. Bulk MeHg and HgT levels in sediments do little to identify a process and the authors may show that by benthic flux chamber work. Elevated MeHg in sediments may not mean that there was active methylation if the source was deposition from riverine particles. Perhaps installation of some type of sediment trapping device could further help a mass balance for a given site.

The PIs plan to estimate fluxes of Hg across both the air-water and sediment-water interface. These flux terms are probably the most important measures of this mass balance study. While the PIs propose to use both a flux chamber and concentration gradients to measure air-water fluxes, it appears that they are focusing mainly on flux chambers to address sediment-water fluxes. Two reviewers caution against too much dependency of the chambers for assessment of this important mass balance component and suggest that this approach may underestimate flux.

An innovative addition is the integration of a hydrodynamic model. This is definitely a novel technique to be used for Hg transport and deposition in flowing systems. The predictive capabilities of such a model are value-added for this project.

While this is a quite ambitious project, all reviewers have confidence that the PIs can achieve the major goals of the study.

3. **Outcomes and Products.** Will the project advance the state of scientific knowledge in general and/or make an important contribution to the state of knowledge of the Bay-Delta Watershed? For restoration proposals, is the project likely to contribute to ecosystem restoration or species recoveries in a significant way? Will the project produce products useful to decision-makers and scientists?

As a research project, this project should deliver high-quality data that can certainly be used effectively for management of this ecosystem. From a restoration standpoint, the tasks specifically centered on wetland Hg cycling are most pertinent. The mass balance approach is a sound, defensible approach to understanding the dynamics of this system.

4. **Cost/Benefit Comments.** Is the budget reasonable and adequate for the work proposed?

The cost of this project appears to be high. Two reviewers strongly encourage in-house capabilities rather than consulting firms for analyses. Perhaps more graduate students can be used in this project. It seems that if research is the hallmark of this project, then it is not wise to have such a high percentage of the funding be directed at a consulting firm. Many times, research will take turns that are contrary to per sample costs of consulting laboratories. Reviewer split on the cost/benefits of the atmospheric deposition sections, 3 favoring, 1 against.

5. **Regional Review.** How did the regional panel(s) rank the proposal (High, Medium, Low)? Did the regional panel(s) identify significant benefits (regional priorities, linkages with other activities, local involvement) or impediments (local constraints, conflicts with other activities, lack of local involvement) to this proposal? What were they?

**Bay Regional Review - HIGH** Mercury is a key pollutant of the estuary. Methylation may be an important problem facing tidal wetland restoration projects. This is a well thought-out integrative approach to analyzing mercury fluxes and sinks in the estuary that builds on past work for CALFED.

**Delta Regional Review - LOW** Project is unfocussed and not feasible as presented. PIs are continuing field sampling techniques that they have done for several years. Mass balance of Hg around the Delta may be possible, but with some limitations not identified by PIs (i.e. Delta outflow is hard to gauge). Integrated linkage is not thought out and does not consider key Hg transport mechanisms. Proposed model is inappropriate for tasks identified. The PIs are continuing efforts that they began in a CALFED directed action. There are no direct links to other restoration projects, but this really is an information-gathering project and, as such, would inform regional planning efforts and other studies of Hg in the area. PIs seem unaware of

relevant and more focused proposals that overlap with this one. This is a diffuse and unfocused proposal. Project proposes a lot of diverse and interesting studies, some of which seem important to the overall Hg picture for the Delta. But this kind of project should be done within a well-defined framework.

**San Joaquin Regional Review- LOW** Ranked low because - esp task 2 - is anticipated to be a small component of the subject problem. Tables in paper show wetlands to be bigger contributors, but proposal inappropriately focuses on SLD instead. Oversight by low DO steering committee, and coordinated with GBP managers

**Sacramento Regional Review-HIGH** Of all the mercury proposals this one seemed to be the one most useful to the region for planning future restoration projects so that they would not exacerbate the methyl mercury problem. In general, the panel still defers to the technical panels as to how all the mercury proposals fit together and fit with ongoing mercury activities.

6. **Administrative Review.** Were there significant concerns about the proposal with regard to the prior performance, environmental compliance and budget administrative reviews? What were they?

The process of data collection and/or analysis does not provide sufficiently detail to adequately assess what, if any, physical impacts this proposal would have on the environment, including any anticipated take of listed species, and land access permission.

The project description lacks sufficient detail to enable adequate identification of any outstanding regulatory issues. No time or funds are allocated for environmental compliance in the proposal.

An inadequate project description inhibits identifying any possible outstanding regulatory issues.

**Miscellaneous comments:**

None



## Bay Regional Review:

**Proposal Number:** 18

**Applicant Organization:** California Department of Fish and Game

**Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

Overall Ranking:    -Low    -Medium    **XHigh**

Provide a brief summary explanation of the committee's ranking:

**Mercury is a key pollutant of the estuary. Methylation may be an important problem facing tidal wetland restoration projects. This is a well thought-out integrative approach to analyzing mercury fluxes and sinks in the estuary that builds on past work for CALFED.**

1. Is the project feasible based on local constraints?

**XYes -No**

How?

**The CALFED Mercury project is already doing the work. There appear to be no local constraints.**

2. Does the project pursue the restoration priorities applicable to the region as outlined in the PSP?

**XYes -No**

How?

**Yes, ERP stage 1 implem. plan goal 6, sediment and water quality MR-5 that restoration not be threatened by degraded environment. BR-5 restoration of shallow water habitats.**

3. Is the project adequately linked with other restoration activities in the region, such as ongoing implementation projects and regional planning efforts?

**XYes -No**

How?

**This project will provide data to assess and support restoration activities in the region in regards to mercury.**

4. Does the project adequately involve local people and institutions?

**XYes -No**

How?

**Local researchers are involved and data will be available.**

Other Comments:

**The team thought this to be one of the most promising, and certainly the most extensive, of the various mercury proposals.**

## **Delta Regional Review:**

**Proposal Number:** 18

**Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

Overall Ranking:    ☒Low    ☐Medium    ☐High

Provide a brief summary explanation of the committee's ranking:

**Project is unfocussed and not feasible as presented.**

1. Is the project feasible based on local constraints?

☐Yes ☒No

How?

**PIs are continuing field sampling techniques that they have done for several years. Mass balance of Hg around the Delta may be possible, but with some limitations not identified by PIs (i.e. Delta outflow is hard to gauge). Integrated linkage is not thought out and does not consider key Hg transport mechanisms. Proposed model is inappropriate for tasks identified.**

2. Does the project pursue the restoration priorities applicable to the region as outlined in the PSP?

☒Yes ☐No

How?

**Hg contamination is of priority concern in the PSP.**

3. Is the project adequately linked with other restoration activities in the region, such as ongoing implementation projects and regional planning efforts?

☒Yes ☐No

How?

**The PIs are continuing efforts that they began in a CALFED directed action. There are no direct links to other restoration projects, but this really is an information-gathering project and, as such, would inform regional planning efforts and other studies of Hg in the area. PIs seem unaware of relevant and more focussed proposals that overlap with this one.**

4. Does the project adequately involve local people and institutions?

☐Yes ☒No

How?

**No local people and institutions are identified except that the CVRWQCB will be a contractor.**

Other Comments:

**This is a diffuse and unfocussed proposal. Project proposes a lot of diverse and interesting studies, some of which seem important to the overall Hg picture for the Delta. But this kind of project should be done within a well-defined framework.**

## San Joaquin Regional Review:

**Proposal Number:** 18

**Applicant Organization:** California Department of Fish and Game

**Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

Overall Ranking:    **X**Low    -Medium    -High

Provide a brief summary explanation of the committee's ranking:

**Ranked low because - esp task 2 - is anticipated to be a small component of the subject problem. Tables in paper show wetlands to be bigger contributors, but proposal inappropriately focusses on SLD instead.**

1. Is the project feasible based on local constraints?

**X**Yes -No

How?

**Yes, but not well focussed**

2. Does the project pursue the restoration priorities applicable to the region as outlined in the PSP?

**X**Yes -No

How?

**SJ-5, MR-5: reduction of impact of irrigation drainage**

3. Is the project adequately linked with other restoration activities in the region, such as ongoing implementation projects and regional planning efforts?

**X**Yes -No

How?

**Related to low DO investigation and TMDL development; also to Se, salinity and B control**

4. Does the project adequately involve local people and institutions?

**X**Yes -No

How?

**Oversight by low DO steering committee, adn coordinated with GBP managers**

Other Comments:

**None.**

## **Sacramento Regional Review:**

**Proposal Number:** 18

**Applicant Organization:** California Department of Fish and Game

**Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

Overall Ranking:    -Low    -Medium    **XHigh**

Provide a brief summary explanation of the committee's ranking:

**Of all the mercury proposals this one seemed to be the one most useful to the region for planning future restoration projects so that they would not exacerbate the methyl mercury problem.**

**In general, the panel still defers to the technical panels as to how all the mercury proposals fit together and fit with ongoing mercury activities.**

1. Is the project feasible based on local constraints?

**XYes -No**

How?

**They are not proposing to use any techniques that are new or unproven.**

2. Does the project pursue the restoration priorities applicable to the region as outlined in the PSP?

**XYes -No**

How?

**Mercury studies are addressed in restoration priority 7 for the Sacramento region and 5 for the multi region.**

3. Is the project adequately linked with other restoration activities in the region, such as ongoing implementation projects and regional planning efforts?

**XYes -No**

How?

**The scientific review committee specifically address this an an area that would require additional research. This research proposal is also coordinated with several other proposals submitted for this round of CALFED grants.**

4. Does the project adequately involve local people and institutions?

-Yes ☒No

How?

**They have not coordinated with any of the local watershed groups although they have coordinated with the mercury working group at the regional level.**

Other Comments:

**We do have some concern about the stated hypothesis and would request that the science panel review this closely.**



## External Scientific: #1

### Research and Restoration External Scientific Review Form

Proposal Number: **18**

Applicant Organization: **California Department of Fish and Game**

Proposal Title: **Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach**

#### Conflict of Interest Statements:

I have no financial interest in this proposal.

**X**Correct

-Incorrect

In the blank below please explain any connection to proposal, to applicant, co-applicant or subcontractor or to submitting institution (write "none" if no connection):

**None**

#### Review:

**Please provide an overall evaluation summary rating:**

**Excellent: outstanding in all respects;**

**Good: quality but some deficiencies;**

**Poor: serious deficiencies.**

Overall Evaluation Summary Rating	Provide a brief explanation of your summary rating
<b>X</b> Excellent	<b>My rating is mostly based on the importance of the research problem, and the impressive track-record of the PI's involved in this project. I am not an expert in this field, and thus cannot comment on the technical feasibility of the project.</b>
-Good	
-Poor	

1. **Goals.** Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the concept timely and important?

**The research problem is an important one. Elevated concentrations of Hg represent as hazard to fish eating birds and mammals. It also poses a human health risk principally through the consumption of mercury-contaminated fish. The hypotheses and objectives of the proposal are well described, and the PI's have a good track record of work in the region.**

2. **Justification.** Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

**The proposed research is a continuation of an existing CALFED grant, and will build upon knowledge the PI's have already gained in the region. The research on Monomethyl Mercury Photo Demethylation builds on recent results in northwestern Ontario. I have very limited experience on this topic, but the project appears to be feasible, and full-scale implementation is justified.**

3. **Approach.** Is the approach well designed and appropriate for meeting the objectives of the project? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology or approaches? Will the information ultimately be useful to decision-makers?

**In a general sense, information from the project that is likely to be most useful to decision-makers is identifying hot-spots of mercury concentrations. Other uses of this research for decision-makers include (1) assessment if sediment disturbance and remediation efforts exacerbate toxicity problems, (2) assessment of the importance of wetland sites for methylmercury production, and (3) assessment of how operational manipulations of the Delta Cross Channel, the export pumps and barriers, independently or in combination, affect the transport of pollutants. The investigations will be conducted at wetlands study sites and remediation sites.**

4. **Feasibility.** Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives?

**The approach is well documented. Based on the track-record of the PI's, and their experience with the research methods proposed in this study, it appears that the project will be successful. I am not an expert in this field, and thus cannot comment on the technical feasibility of the project.**

5. **Project-Specific Performance Measures.** Does the project include appropriate performance measures to measure success relative to the project's goals and objectives? Is there enough detail as to how the performance measures will be quantified? For restoration projects, are monitoring plans explicit and detailed enough to determine if performance measures will be adequately assessed?

**Performance measure are mostly academic (e.g., publishing in high-quality peer-reviewed journals). This seems appropriate given the technical focus of the proposal.**

6. **Products.** Are products of value likely from the project? Specifically for restoration projects, are products of value also likely from the monitoring component? Are interpretative outcomes likely from the project?

**The quantitative geochemical mass balance model is the major product of this research effort. It appears that this model, and all the pieces of information used to develop it, will be useful to decision-makers in the region.**

7. **Capabilities.** What is the track record of applicants in terms of past projects? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

**The investigators appear to have the tools and experience to successfully complete this research.**

8. **Cost/Benefit Comments.** Is the budget reasonable and adequate for the work proposed?

**The budget appears reasonable.**

**Miscellaneous comments:**

**None.**

## External Scientific: #2

### Research and Restoration External Scientific Review Form

Proposal Number: **18**

Applicant Organization: **California Department of Fish and Game**

Proposal Title: **Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach**

#### Conflict of Interest Statements:

I have no financial interest in this proposal.

**X**Correct

-Incorrect

In the blank below please explain any connection to proposal, to applicant, co-applicant or subcontractor or to submitting institution (write "none" if no connection):

**None**

#### Review:

**Please provide an overall evaluation summary rating:**

**Excellent: outstanding in all respects;**

**Good: quality but some deficiencies;**

**Poor: serious deficiencies.**

Overall Evaluation Summary Rating	Provide a brief explanation of your summary rating
<b>X</b> Excellent	<b>This proposal meets a key need for CALFED with regard to mercury in the ecosystem. The proposal would be conducted by a team with a now proven ability to take on the task. The overall approach a biogeochemical (e.g. process-based) budget for mercury and methylmercury in the San Francisco Bay/Delta is sound and proven in other ecosystems. The study would not examine every process that needs study, but provides a system-wide, integrated approach. The study will generate ecosystem-level budgets and information on methylmercury production at the habitat level. Understanding spatial and temporal distributions in this very complex ecosystem is a necessary part of any attempt to understand Hg and MeHg cycling, and this project should continue to provide more of that information.</b>
-Good	
-Poor	

1. **Goals.** Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the concept timely and important?

**This is a proposal for continuation of a CALFED-funded study of Hg cycling in the Bay/Delta region. Stephenson, Gill et al are one part of ongoing CALFED Hg study. Their portion of the project has focused on Hg/MeHg budgets throughout the ecosystem, with an emphasis on Hg and MeHg distributions in the Bay/Delta. They have also done some initial**

characterization of fluxes within the system.

The project goal is continue to develop a Hg and MeHg budget for San Francisco Bay Delta and its tributaries. The approach is to develop the budget within a biogeochemical mass-balance framework, meaning that internal processes as well as sources and sinks will be examined. More specifically, the PIs propose to extend their preliminary ecosystem-level Hg/MeHg budgets through more intensive sampling in time and space, and through additional characterization of biogeochemical process, and to characterize habitat types that are prone to MeHg accumulation (especially within the Delta) and estimate loadings from these areas.

The goals are clearly stated, consistent within the proposal and consistent with this groups ongoing work. This overall goals are extremely responsive to ERP priorities in general, and in specific for various delta and tributary habitats.

2. **Justification.** Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

In this reviewers opinion, the key questions for Hg management in the Bay/Delta are: 1. What is the main source of Hg to the Bay Delta historically polluted sediments, new releases from mine tailings or atmospheric deposition? 2. What is the main source of Hg for methylation? 3. What is the distribution of methylation activity within the Bay, Delta and tributaries?

Understanding sources provides the most obvious management option for Hg.

Understanding what types of habitats support methylation may be useful to the design of restoration programs, particularly wetland and upland restoration.

This study should provide basic information on all of the above key issues. Construction of a Hg/MeHg budget for the system, including some understanding of internal cycling, should be one of two or three key pieces of the next phase of a mercury strategy for San Francisco Bay/Delta.

The study is therefore very well justified. It is a well thought-out extension of this groups ongoing work. Understanding spatial and temporal distributions in this very complex ecosystem is a necessary part of any attempt to understand Hg and MeHg cycling,

There is a conceptual model in the proposal, stated as a series of hypothesis. Hypotheses as stated are based on findings to date, and are somewhat narrow. Broader hypotheses about sources and sinks are warranted. Some of the hypotheses may be a bit premature. However, the project objectives and justification are made quite clear.

3. **Approach.** Is the approach well designed and appropriate for meeting the objectives of the project? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology or approaches? Will the information ultimately be useful to decision-makers?

The mass balance geochemical framework remains entirely appropriate for answering key questions about Hg in this ecosystem. This groups work to date has provide a good start on this. They are beginning to identify hot spots of methylation, and beginning to construct input/output budgets that are the necessary first step in identifying sources of both Hg and MeHg. Tributaries appear to be an important source of MeHg to the Bay/Delta. Sediment data suggest that the Delta is an area of high MeHg production, since there are areas within the delta that have very high fractions of the existing Hg in MeHg form. However, water column data dont support this MeHg is relatively low in Delta surface waters. While sources and sinks are beginning to be understood,

a basic understanding of the most important Hg and MeHg sources in the ecosystem has not yet been achieved. The San Francisco Bay/Delta complex is probably the most hydrologically complex system for which a Hg/MeHg biogeochemical budget has been attempted. More work is clearly needed.

The ongoing CALFED mercury study has been subject to review of an expert advisory team since its inception. The approach chosen for the proposed extension of this project appears extremely responsive to review team advice (as given in Appendix C).

Examination of MeHg concentrations in and loadings from key habitat types, as proposed here, provides the most important, integrative way of assessing where MeHg is formed in this system.

The focus of the biogeochemical cycling studies will be in the Delta. Information collected in the first two years of work, and info from other ecosystems supports freshwater wetlands as important locations for methylation. The team seems to have moved their focus out of the estuary, and I wonder if this may be premature. Potential MeHg sources outside the delta have not been examined much to date. Some of the tributary studies proposed here will help identify where MeHg is being produced in the tributaries. Are salt marshes producing MeHg? Only very limited info on the estuary is available just a transect down the middle. Is MeHg getting produced and bioaccumulated around the edges of the estuary?

Further comments on the approach taken within each task are below in the misc. comments section. With minor exceptions, each task is appropriate to the goals of the study and to the needs of CALFED, and each task is being approached in a scientifically sound way.

4. **Feasibility.** Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives?

The technical feasibility is very high. With the exception of 1 or 2 subtasks, all of the sampling and analysis methods are well developed, and are in use by a number of investigators including this team. The scope of the ecosystem is intimidating, but the group understands the importance of spatial and temporal distributions within the system, and is beginning to get a handle on it. The group is having a hard time pinning down the importance of sediments as source of Hg and MeHg to overlying waters, but this is a notoriously difficult task.

5. **Project-Specific Performance Measures.** Does the project include appropriate performance measures to measure success relative to the project's goals and objectives? Is there enough detail as to how the performance measures will be quantified? For restoration projects, are monitoring plans explicit and detailed enough to determine if performance measures will be adequately assessed?

**Yes, and the team has a history of producing data syntheses and reports in a reasonably timely way.**

6. **Products.** Are products of value likely from the project? Specifically for restoration projects, are products of value also likely from the monitoring component? Are interpretative outcomes likely from the project?

**Yes, see comments on justification.**

7. **Capabilities.** What is the track record of applicants in terms of past projects? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

**One member of this team brought long experience in Hg biogeochemistry, while others brought general geochemical expertise, and/or expertise in this ecosystem. The team has been reasonably successful in meeting their objectives and in providing information of value to CALFED in their first two year of study. Both the TAMU group and the Moss Landing group produce high quality Hg/MeHg data.**

8. **Cost/Benefit Comments.** Is the budget reasonable and adequate for the work proposed?

**The funding request is quite large. The team should be able to accomplish a good bit with this level of funding.**

**This is a large amount of \$ for CALFED to commit without first putting in place a mercury research strategy (due later this year). Funding Hg projects at this level and at this time may commit CALFED to a certain course that will be hard to change. Nevertheless, the work proposed here would probably be a basic part of any Hg research strategy.**

**Miscellaneous comments:**

**Comments on each task:**

- 2. Fluvial sources of Hg and MeHg - very important to budgets. The large number of upstream stations will provide detailed information on sources of both Hg and MeHg to and within each of the major tributaries. Added detail for key watersheds is great, a really important first step in making management decisions. Sediment transport is missing from both the conceptual model and the sampling and modeling designs.**
- 3. Atmospheric Deposition team proposes the addition of three new deposition sites, in addition to the MDN site already operating in the area. Also a key piece of the mass balance/source study. Distribution of sites seems appropriate, filling in the blanks to provide inland deposition data to supplement the San Jose MDN site. Encourage CALFED to fund RGM monitoring from the start thru the purchase of the Tekran RGM system.**
- 4. Distribution of MeHg and MeHg sediment/water flux in the Delta. A. Map distribution of Hg and MeHg in delta sediments and soils. Team proposes to examine 4 sites in the delta in detail, with intensive sampling thru time, plus a large set of sample sites examined less frequently. Sites will be chosen based on habitat types, as is appropriate. This sub-task has a high chance of generating useful information about what types of habitat support higher levels of net methylation. Sediment Hg/MeHg concentrations provide an integrated picture of MeHg production, and a good surrogate for net methylation. Expansion of this work to include marsh habitats in addition to open water habitats is very important. B. Benthic chambers. Extreme variability, high cost, and the general underestimation of flux using chambers make this sub-task less likely to succeed. If this sub-task goes forward, addition of sites within different marsh habitats, and the addition of diel measurement flux (as proposed) are important. Despite the expertise of the team taking on these measurements, this is the weakest section of the proposal and the least likely to provide important management/restoration info to CALFED**

**5. Process-oriented studies, with a focus on the Delta**

**A. Photodemethylation.** B. Incorporation of Hg/MeHg data into a hydrodynamic model for the delta to better test the hypotheses that the Delta is a net MeHg sink. There is a disconnect in the current available data for net MeHg production and accumulation in the Delta. This, plus additional data collection, is a reasonable approach to help resolve the issue.

**C. Assessment of MeHg production in Delta wetlands,** including loading assessment from different habitat types and study of the relationship between sediment biogeochemistry and MeHg levels. This task will provide another key piece of the Hg/MeHg budget for the Bay/Delta, including information on source of MeHg and the distribution of methylation activity.

**D. Air water exchange of DGM.** Combines measures of DGM in situ with water/air DGM flux. Used with photodemethylation estimates, this will provide a rough value for Hg evasion in the system in space and time. Hg evasion is an extremely variable number, and realistic estimates will require diel measurements of DGM flux over multiple seasons.

**6. Integrate data into a GIS system for display and analysis.** Important to interpretation and usefulness to managers.



## External Scientific: #3

### Research and Restoration External Scientific Review Form

Proposal Number: **18**

Applicant Organization: **California Department of Fish and Game**

Proposal Title: **Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach**

#### Conflict of Interest Statements:

I have no financial interest in this proposal.

**X**Correct

-Incorrect

In the blank below please explain any connection to proposal, to applicant, co-applicant or subcontractor or to submitting institution (write "none" if no connection):

**none**

#### Review:

**Please provide an overall evaluation summary rating:**

**Excellent: outstanding in all respects;**

**Good: quality but some deficiencies;**

**Poor: serious deficiencies.**

Overall Evaluation Summary Rating	Provide a brief explanation of your summary rating
<b>X</b> Excellent	<b>This project is timely and the PIs have developed a sound approach to study Hg cycling in the Bay-Delta. The objectives are ambitious and could be scaled back a bit and still make a sound project. I hope that the PIs will consider dropping the consulting firm in favor of added graduate student participation. This is a unique opportunity to provide funding for research in a real world problem and the inquisitive minds of both additional post-docs and graduate students at Moss Landing and Texas A&amp;M would certainly strengthen the proposed work.</b>
-Good	
-Poor	

1. **Goals.** Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the concept timely and important?

**This proposal presents clear goals and objectives, and unlike many proposals reviewed, is hypothesis-driven. The investigators present clear objectives that are in many facets, logical extensions of previous work in the Bay-Delta region. It is because of the previous work that they can identify specific foci for study and eliminate much of the monitoring that is present as the initial basis of many other studies. The proposal designs a mass-balance approach for looking at major fluxes and transformations of Hg in the system. The entire proposal is centered around the mass balance and the design is consistent with this approach.**

2. **Justification.** Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

The study is well-justified, due in large part to the existing knowledge that has been gathered by the principal investigators associated with the project. That is clear from the supplementary material. The preliminary work by this group has identified a major concept that may have been missed by other proposals reviewed that riverborne methyl Hg is the major source of MeHg delivered to the delta and that high flow conditions are the most important delivery period. From a conceptual model standpoint, they have already identified both the timing and the importance of the major MeHg flux. They attempt to both refine the estimates of riverine inputs and at the same time, achieve a better understanding of processes affecting MeHg delivered via rivers and delineate other MeHg inputs and pathways within the delta and estuary. The PIs also suggest that atmospheric inputs to the system may be important and propose a three-site network to estimate flux. This is an area of research that other proposals do not investigate and one that is essential for inputs to an anthropogenically-influenced environment like the Bay-Delta.

3. **Approach.** Is the approach well designed and appropriate for meeting the objectives of the project? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology or approaches? Will the information ultimately be useful to decision-makers?

The approach outlined by the PIs will yield significant results for understanding Hg cycling in the system. In some cases, it appears that the approach is too ambitious for the number of investigators involved, but it is at least worth attempting. The PIs, based on their experience in the study system, will know where best to redirect efforts.

The mass loading study from freshwaters is a key to the study. I would hope that the PIs would reconsider monthly sampling and better design a monitoring scheme that would be based more directly on the hydrograph. For instance, if they were to compare melt periods to events to baseflow periods, they could better concentrate sampling. It would also be worthwhile to delineate watershed processes by following a hydrograph on a particular storm. This might allow for identification of processes affecting release of MeHg from the watershed. Similarly, Task 2A might be better designed for watersheds with USGS gaging stations. This will allow better choice of sampling times based on the hydrograph.

This is one of the few studies in the region to consider atmospheric deposition as a key source to the system. While the PIs suggest that loading of HgT from the atmosphere may be low, its timing and rates, especially episodic events, may be important. The current approach of the MDN network is inadequate for this type of study and the implementation of three sampling stations would be a key. Little is also known about deposition and partitioning of atmospheric methyl Hg and this information will be novel for a region such as this. Some previous work has alluded to oceanic sources of dimethyl Hg and this study would prove a valuable tracer of its end product, MeHg.

One of the weaknesses of the proposal lies in Task 4A. It would bolster the project significantly if the PIs were to partner with an individual that directly measures rates of methylation and demethylation. Bulk MeHg and HgT levels in sediments do little to identify a process and the authors may show that by benthic flux chamber work. Elevated MeHg in sediments may not mean that there was active methylation if the source was deposition from riverine particles. Perhaps installation of some type of sediment trapping device could further help a mass balance for a given site.

**I was quite impressed by the integration of a hydrodynamic model in Task 5B. This is definitely a novel technique to be used for hg transport and deposition in flowing systems. The predictive capabilities of such a model are value-added for this project.**

**The authors also provide innovative approaches to estimating fluxes of Hg across both the air-water and sediment-water interface. These flux terms are probably the most important measures of this mass balance study. While the PIs propose to use both a flux chamber and concentration gradients to measure air-water fluxes, it appears that they are focusing mainly on flux chambers to address sediment-water fluxes. They should additionally compare sediment pore water gradients and even use a mass-balance in a small, constrained backwater to verify chamber results. This would allow for assessment of chamber affects on measured fluxes. I caution against too much automation of the chambers. Allowing divers to visually inspect chambers certainly strengthens the data that is produced.**

4. **Feasibility.** Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives?

**While this is a quite ambitious project, I have confidence that the PIs can achieve most of the major goals of the study. In order to fully characterize seasonal influence on flow and MeHg transport, it is important to have a field team that is able to perform event-based sampling. The atmospheric work could also be treated in a similar manner. Restructuring some of the efforts to achieve these tasks may be warranted. Defining some of the major topic areas around personnel would have helped. For instance, "A graduate Student at Texas A&M will be responsible for a study of ....."**

5. **Project-Specific Performance Measures.** Does the project include appropriate performance measures to measure success relative to the project's goals and objectives? Is there enough detail as to how the performance measures will be quantified? For restoration projects, are monitoring plans explicit and detailed enough to determine if performance measures will be adequately assessed?

**The section of the proposal dealing with performance measures is brief, but that is the nature of a research project. The plan suggested by the authors of adherence to a sampling plan, QA protocols and external peer review should help the program achieve success.**

6. **Products.** Are products of value likely from the project? Specifically for restoration projects, are products of value also likely from the monitoring component? Are interpretative outcomes likely from the project?

**As a research project, this project should deliver high-quality data that can certainly be used effectively for management of this ecosystem. From a restoration standpoint, the tasks specifically centered around wetland Hg cycling are most pertinent. The mass balance approach is a sound, defensible approach to understanding the dynamics of this system.**

7. **Capabilities.** What is the track record of applicants in terms of past projects? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

**I have no doubt that the assembled team is well-qualified to perform the tasks outlined and deliver management concerns usable products to better understand Hg in the Bay-Delta region. One can be assured that top-notch peer-reviewed research articles will evolve from this work, based on the track record of two of the PIs.**

8. **Cost/Benefit Comments.** Is the budget reasonable and adequate for the work proposed?

**The cost of this project appears to be extremely high. I question the cost of some of the major subcontracts, especially the costs to Battelle Northwest. Couldnt more graduate students be used in this project? I can count about five different focus areas that would make excellent projects on a first-class project. It seems that if research is the hallmark of this project, then it is not wise to have such a high percentage of the funding be directed at a consulting firm. Many times, research will take turns that are contrary to per sample costs of consulting laboratories.**

**Miscellaneous comments:**

## External Scientific: #4

### Research and Restoration External Scientific Review Form

Proposal Number: **18**

Applicant Organization: **California Department of Fish and Game**

Proposal Title: **Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach**

#### Conflict of Interest Statements:

I have no financial interest in this proposal.

**X**Correct

-Incorrect

In the blank below please explain any connection to proposal, to applicant, co-applicant or subcontractor or to submitting institution (write "none" if no connection):

**none**

#### Review:

**Please provide an overall evaluation summary rating:**

**Excellent: outstanding in all respects;**

**Good: quality but some deficiencies;**

**Poor: serious deficiencies.**

Overall Evaluation Summary Rating	Provide a brief explanation of your summary rating
-Excellent	<b>This proposal has many outstanding qualities, but the primary goal to achieve an understanding of transport, fate, and cycling of Hg and MMHg in this large system is simply not feasible at this time. Valuable insight concerning loads of MMHg and Hg to the Delta will be gained from this project. Also, the proposed benthic flux chamber work and photodemethylation work is excellent and innovative.</b>
XGood	
-Poor	

1. **Goals.** Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the concept timely and important?

**The goals are lofty, but clearly stated. The primary goal of the project--to understand transport, cycling, and fate of Hg and MMHg in the Delta-- is a very ambitious and likely unreachable goal in only 3 more years of study. Mass budgets for single lakes and wetlands typically take years to construct and then only a partial understanding is gained.**

**There are several parts of the proposal that are timely and innovative. Much of the proposal is only important if one wishes to attempt to model this particular system. Determining loadings of MMHg and Hg to the Delta are very important determinations, but only**

applicable to this system. Detailed, process-oriented work in some of the subwatersheds may be applicable to other systems. Clearly, the understanding of MMHg cycling limits our ability to model aquatic systems, especially a large system like this one. I feel process-oriented studies are more appropriate at this time in this system; and this proposal contains some very good process-oriented work.

2. **Justification.** Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Yes, the study is justified as it is unclear what subwatersheds are responsible for the bulk of Hg and MMHg loads to the Delta. MMHg production and loss within the Delta are also poorly understood, but are poorly understood in all aquatic systems.

In most of the tasks listed in the proposal it is clear why the task is important to the overall objective of the proposal.

The questions addressed in this project clearly justify it as a research project.

3. **Approach.** Is the approach well designed and appropriate for meeting the objectives of the project? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology or approaches? Will the information ultimately be useful to decision-makers?

The approach is well-designed, but the size of the system will make modeling efforts very difficult and in my opinion, not real meaningful. The results will add to the knowledge base of Hg and MMHg cycling in this system, but will a complete understanding of the system be achieved? - No. Individual lakes and wetlands have been extensively studied and models developed, but there is still significant uncertainty and poor predictive capabilities due to a general lack of understanding of the MMHg cycle, in particular.

The authors of the proposal are proposing to collect appropriate data to constrain, but not construct mass budgets in the system. The applicability of any model will be diminished by a general lack of understanding of MMHg cycling under for example, differing flow regimes. The work being proposed is designed to answer key questions about Hg and MMHg cycling in the system, but when the project is done there will still be great uncertainty in modeling MMHg in this system. Significant progress will be made, but by no means will complete understanding be achieved. For example, what is the loss of Hg and MMHg via sedimentation in the system? How does this vary year-to-year? This is one example of a difficult question that could not be answered with much certainty.

Novel information will be collected from the benthic flux chambers, in particular. Flux of MMHg from the sediments relative to photodemethylation will also be of interest to the mercury field.

I do not like the approach in Task 4A. Collecting sediment Hg and MMHg from different habitats, looking for high concentrations, and then trying to explain them is not appropriate scientific work. What is the hypothesis? Sampling 28 sites 2 times per year when it is unknown how sediment concentration varies at one site over an entire year is not appropriate. Task 5B and Task 5C2 also lack hypotheses. For example, in Task 5B, a model is not needed to develop hypotheses on losses of MMHg. MMHg is either being degraded or lost via sedimentation.

The atmospheric deposition studies are also of limited value in this system. Hg and MMHg from wet deposition are certainly minor in this system. The Mercury Deposition Network also has a couple of sites in California. Measurement of reactive gaseous mercury would be interesting, but applying a few measurements at a limited number of sites would result in a poor estimation, at best, for RGM dry deposition to the Delta. Certainly, we need a better understanding of RGM, but it is more appropriate for an experimental research proposal, not just a sidelight in this one.

The information should be useful to decision-makers. In particular the loadings to the Delta will be better quantified and should indicate major sources. The modeling on the other hand will likely be of little use.

4. **Feasibility.** Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives?

The approach is well-documented and valuable data will be collected. I have doubts of whether a meaningful predictive model can be constructed due to a lack of understanding of key elements of MMHg cycling. This project will collect valuable data and will further our understanding of MMHg cycling, but will not produce enough understanding to produce a predictive model.

The project will be successful in determining loads of Hg and MMHg to the Delta. A complete understanding of the controls on these loads will not be achieved, but identification of sources will be an important outcome of this study. I doubt whether significant resources should go towards constructing a model given our lack of understanding of key components in the MMHg and Hg cycle.

This is a large scale project consistent with the objectives. There are basically three components to the project: a mass budget component, a process-oriented component, and a model component.

5. **Project-Specific Performance Measures.** Does the project include appropriate performance measures to measure success relative to the project's goals and objectives? Is there enough detail as to how the performance measures will be quantified? For restoration projects, are monitoring plans explicit and detailed enough to determine if performance measures will be adequately assessed?

Yes, appropriate performance measures are in place to track the success of the field sampling and analytical measurements. However, the performance of a predictive model can only be calibrated against collected data. Even with the large scope of this project, I doubt that the model will have much meaning under changing environmental conditions in the Delta and its large watershed.

6. **Products.** Are products of value likely from the project? Specifically for restoration projects, are products of value also likely from the monitoring component? Are interpretative outcomes likely from the project?

Yes, valuable products will come from this project. A complete understanding of MMHg and Hg cycling is not one of them. Valuable information will be gained on loads to the system and on the process of sediment-water exchange and photodemthylation.

7. **Capabilities.** What is the track record of applicants in terms of past projects? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

**Dr Gary Gill is a highly respected mercury scientist and his work with benthic chambers is recognized as truly outstanding. The other researchers are also capable of completing this work. This project appears to have a lot of administrative support.**

8. **Cost/Benefit Comments.** Is the budget reasonable and adequate for the work proposed?

**This is a high-cost proposal but I think the costs are reasonable given the broad scope of the work. I don't think the information gained from the atmospheric modeling is worth the 400,000+ in the budget. I think the most appropriate items in the budget are the mass loading, the benthic flux chamber work, the photodemethylation work, and the wetland export studies, although I cannot pick the costs out individually for each component.**

**Miscellaneous comments:**

**none**



## External Scientific: #5

### Research and Restoration External Scientific Review Form

Proposal Number: **18**

Applicant Organization: **California Department of Fish and Game**

Proposal Title: **Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach**

#### Conflict of Interest Statements:

I have no financial interest in this proposal.

**X**Correct

-Incorrect

In the blank below please explain any connection to proposal, to applicant, co-applicant or subcontractor or to submitting institution (write "none" if no connection):

**none**

#### Review:

**Please provide an overall evaluation summary rating:**

**Excellent: outstanding in all respects;**

**Good: quality but some deficiencies;**

**Poor: serious deficiencies.**

Overall Evaluation Summary Rating	Provide a brief explanation of your summary rating
<b>X</b> Excellent	<b>Overall, I thought the proposal asked the right questions, and was positioned well between monitoring, process study, and modeling aspects. It focuses on a mass balance and use of experimentation to fill current gaps in knowledge. Particularly useful will be relationships between sediment type and MeHg production, as determined by flux chambers. I believe that this work will address specific concerns related to the Delta, and be transferable to other systems. I give it the highest rating.</b>
-Good	
-Poor	

1. **Goals.** Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the concept timely and important?

**The stated goals and hypotheses of this proposal were clearly stated, in a systematic fashion. The research activities proposed tied in directly with each goal, and was consistent throughout. Overall, the objectives addressed specific questions about mercury cycling in the Delta system, but it was obvious that by including process-level work, the authors were looking to make the findings applicable to other aquatic systems. This is a very positive feature. This proposal includes a nice variety of monitoring, modeling, instrument development, and process work, and the issues (particularly demethylation and sediment**

contributions) are very timely.

2. **Justification.** Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

**The proposal was well justified. Clearly, there are major Hg issues in the Delta region, with tremendous uncertainties related to mass balances and bioavailability. The authors have integrated their objectives and hypotheses well into gaps in our understanding--many of which were identified by their present CALFED project. Questions such as the relative role of deposition, sediment fluxes, and demethylation on Hg content are major issues in every natural water system.**

3. **Approach.** Is the approach well designed and appropriate for meeting the objectives of the project? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology or approaches? Will the information ultimately be useful to decision-makers?

**The approach is composed of a nice balance between monitoring, experimentation, and modeling. The proposal includes both spatial and temporal monitoring of selected regions, which, when coordinated with other CALFED studies examining biota, will prove valuable in connecting sources and processes with biota bioaccumulation. Incorporation of a hydrodynamic model will help explain advective or time-related processes under a number of different scenarios. Experimental techniques including flux chambers and photodemethylation incubations will quantify as yet unknown fluxes. I believe that there is a high likelihood that these studies will result in findings that are applicable to the Delta system, as well as many other natural waters. The authors are using facilities, personnel, and techniques that are proven in the Delta system. The main drawback that I see is that biota sampling is not planned on a large scale, such that geochemical/modeling findings will have to be conjoined with other studies that are focusing on the food web. It would be nice to see some in situ incubation studies involving invertebrates or small fish included with site-specific monitoring and experimentation.**

4. **Feasibility.** Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives?

**I believe that there is a high likelihood of success, given the expertise of the authors, and their familiarity with the system. The proposal is adequately cited, and the rationale for each task is well supported. Aside from a few sediment flux and demethylation techniques, all methods are fairly well standardized and internally consistent. The authors have implemented a QAPP for QA/QC protocols. The scale of this proposal is admittedly large, and with a large budget. I doubt that an successful mass balance can be achieved from a small study, however, given all of the source and sink terms involved.**

5. **Project-Specific Performance Measures.** Does the project include appropriate performance measures to measure success relative to the project's goals and objectives? Is there enough detail as to how the performance measures will be quantified? For restoration projects, are monitoring plans explicit and detailed enough to determine if performance measures will be adequately assessed?

**The performance measures were adequate, and based upon quarterly/annual reports, QA/QC criteria based upon a QAPP, and both internal and external peer review. The authors did not go into any great detail about these measures, but it is likely not a concern based upon their prior work.**

6. **Products.** Are products of value likely from the project? Specifically for restoration projects, are products of value also likely from the monitoring component? Are interpretative outcomes likely from the project?

**This proposal will likely supply data specific to the Delta system that will aid in identifying areas where enhanced bioaccumulation is occurring, and what the biogeochemical controls are. Besides spatial and temporal data, rate constants will be determined relative to sediment, soil, or landscape type that will likely be applicable to other aquatic systems (via GIS and modeling). This work will likely fill in many of the research gaps identified by CALFED for the region, including the role of sediments, deposition, and specific tributaries and watersheds in supply of Hg and MeHg to the Delta.**

7. **Capabilities.** What is the track record of applicants in terms of past projects? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

**The authors are experts in their fields, and have demonstrated proficiency in their current CALFED research. As this is a continuation project, there is a high likelihood of having the lab/field facilities in place at the start of funding.**

8. **Cost/Benefit Comments.** Is the budget reasonable and adequate for the work proposed?

**The proposal is ambitious, as well as the budget. Given the size and complexity of the Delta system, I think that the budget is reasonable. Having in-house analysis of MeHg would be desirable, rather than expensive consulting. The equipment requests are well suited for the study, particularly the purchase of instrumentation for atmospheric work.**

**Miscellaneous comments:**

**I believe that this proposal will tie in well with existing work, particularly if they can coordinate with a group that is focusing on bioaccumulation.**

## **Prior Performance/Next Phase Funding:**

**New Proposal Number:** 18

**New Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

1. Prior CALFED project numbers, titles, and programs: *(list only projects for which you are the contract manager)*

**CALFED #99-B06, USBR #99-FC-20-0241 - San Jose State University Foundation - Assessment of Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed**

**CALFED #98-B30, USBR #99-FC-20-0061 - California Department of Fish and Game - Salmonids in the Classroom Project**

2. Prior CVPIA project numbers, titles, and programs: *(list only projects for which you are the contract manager)*

**N/A**

3. Have negotiations about contracts or contract amendments with this applicant proceeded smoothly, without persistent difficulties related to standard contract terms and conditions?

**-Yes -No XN/A**

If no, please explain any difficulties:

4. Are the status, progress, and accomplishments of the applicant's current CALFED or CVPIA project(s) accurately stated?

**-Yes -No XN/A**

If no, please explain any inaccuracies:

5. Is the applicant's progress towards these project(s)' milestones and outcomes to date satisfactory?

**-Yes -No XN/A**

If no, please explain deficiencies:

6. Is the applicant's reporting, records keeping, and financial management of these projects satisfactory?

**-Yes -No XN/A**

If no, please explain deficiencies:

7. Will the project(s) be ready for next phase funding in 2002, based on its current progress and expenditure rates?

-Yes -No **X**N/A

If no, please explain:

Other Comments:

**While I administer CALFED Agreement 99-B06 with the San Jose State University Foundation, I have no direct knowledge of CDFGs performance on that project.**

**CALFED Agreement 98-B30 was an educational project with CDFG and has no relation to this proposal.**

## Environmental Compliance:

**Proposal Number:** 18

**Applicant Organization:** California Department of Fish and Game

**Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

1. Are the legal or regulatory issues that affect the proposal identified adequately in the proposal?

-Yes **X**No

If no, please explain:

**The process of data collection and/or analysis does not provide sufficiently detail to adequately assess what, if any, physical impacts this proposal would have on the environment, including any anticipated take of listed species, and land access permission.**

2. Does the project's timeline and budget reflect adequate planning to address legal and regulatory issues that affect the proposal?

-Yes **X**No

If no, please explain:

**The project description lacks sufficient detail to enable adequate identification of any outstanding regulatory issues. No time or funds are allocated for environmental compliance in the proposal.**

3. Do the legal and regulatory issues that affect the proposal significantly impair the project's feasibility?

**X**Yes -No

If yes, please explain:

**An inadequate project description inhibits identifying any possible outstanding regulatory issues.**

Other Comments:

## **Budget:**

**Proposal Number:** 18

**Applicant Organization:** California Department of Fish and Game

**Proposal Title:** Transport, Cycling, and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries--An Integrated Mass Balance Assessment Approach

1. Does the proposal include a detailed budget for each year of requested support?

☒Yes ☐No

If no, please explain:

2. Does the proposal include a detailed budget for each task identified?

☒Yes ☐No

If no, please explain:

3. Does the proposal clearly state the type of expenses encompassed in indirect rates or overhead costs?

☒Yes ☐No

If no, please explain:

4. Are appropriate project management costs clearly identified?

☒Yes ☐No

If no, please explain:

5. Do the total funds requested (Form I, Question 17A) equal the combined total annual costs in the budget summary?

☐Yes ☒No

If no, please explain (for example, are costs to be reimbursed by cost share funds included in the budget summary).

**Requested amount and Grand Total off by .03.**

6. Does the budget justification adequately explain major expenses?

☒Yes ☐No

If no, please explain:

7. Are there other budget issues that warrant consideration?

-Yes ☒No

If yes, please explain:

Other Comments: