Proposal Reviews

#42: Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries

Central Valley Regional Water Quality Control Board

Initial Selection Panel Review	
Research and Restoration Technical Panel Review	
Sacramento Regional Review	
External Scientific Review	#1 #2 #3 #4
Environmental Compliance	
Budget	

Initial Selection Panel Review:

CALFED Bay-Delta 2002 ERP PSP
Initial Selection Panel Review

Proposal Number: 42

Applicant Organization: Central Valley Regional Water Quality Control Board

Proposal Title: Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries

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	**-**
In Part	**-**
With Conditions	**-**
Consider as Directed Action	**-**
Not Recommended	**X**

Amount: **$0**

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

None

Provide a brief explanation of your rating:

This proposed project would apply a bioassessment approach to identify and rank stressors affecting aquatic biota in surface waters of the Sacramento River watershed. A probability-based sampling framework would be applied to the selection of sampling sites, to the sampling of biota, and to habitat measurements. Biological sampling would focus on aquatic macroinvertebrates, periphyton, and fish. Statistical analyses would be used to identify stressor metrics that could be applied by managers to identify areas in greatest need of restoration.

External scientific reviewers generally agreed that stressor metrics linked to biological measurements are needed. Otherwise, the technical reviews of the proposal were mixed, and support for the proposal was weak. Most reviewers believed that the project, as proposed, was overly ambitious and should be scaled down and focused. Moreover, reviewers expressed skepticism, based on technical and logistical concerns, that project goals could be achieved. Some aspects of the project were not sufficiently described in the proposal and merit more detailed discussion, particularly in a proposal of this magnitude. It is not clear whether the ecological benefits would justify the high cost ($3.65 million) of the proposed project. The regional reviewer expressed doubt that the information provided would measurably enhance species recovery efforts.

Research and Restoration Technical Panel Review:

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

Proposal Number: 42

Applicant Organization: Central Valley Regional Water Quality Control Board

Proposal Title: Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries

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**
-Superior	**Several of the reviewers considered the project to be overly ambitious and recommended that it would benefit from substantial scaling back and focusing.**
-Above average	
XAdequate	
-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?

   The goals, objectives and hypotheses are fairly clearly stated. The need for stressor specific metrics is clearly justified, however there were differing opinions as to the clarity of the conceptual model

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 project is very ambitious. Three of the external scientific reviews expressed doubts about the likelihood that the project could reach its goals. The reviews identified problems with the identification of reference sites (due to random site selection), lack of information on how impaired sites will be distinguished from unimpaired sites. Other concerns were with

the choice of statistical methods to be used (potential for misinterpretation of multivariate results). There was little discussion of how the accuracy and precision of the metrics would be determined and some concern that the design would not allow partitioning of natural- and anthropogenic sources of variation. It was pointed out that many stressors have similar effects on biological attributes making difficult to identify stressor-specific metrics. Overall the process of metric identification was very vague as was description of how the metrics would be evalueated.

There were no major problems identified with regard to the capabilities of the team.

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?

   The project is likely to contribute pertinent data on biological attributes in the region of study and their spatial variation.

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

   This 3year project has a total budget of $3,653,287. It is a relatively expensive project. One of the reviewers recommended that it be scaled down to about 1 mil. Another reviewer suggested that the team receive more funding to expand the scope.

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?

   Sacramento Regional Review gave a low ranking. This review stated that there is already considerable information on effects of stressors on salmonids and other listed fishes in the Sacramento River and that the scope of the project is so broad as to limit its usefulness. Also suggested that more local involvement would be desirable.

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 Environmental Compliance checklist does not reflect discussion of anticipated/applicable permits. Unclear whether CESA Section 2080.1 consistency determination and corresponding CEQA & NEPA documentation. State Lands Commission approval required. No problems indicated in Budget review.

Miscellaneous comments:

One of the external reviewers expressed need for greater emphasis on data handling to ensure that no backlogs are allowed to occur in organism identification and data entry. Also indicated the importance of making the data publicly available.

Sacramento Regional Review:

Proposal Number: 42

Applicant Organization: Central Valley Regional Water Quality Control Board

Proposal Title: Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries

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

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

Determining biological stressors for salmonids and other listed species of fish is an important mission. But, there already is considerable information available on the subject for the Sacramento River and its tributaries. The scope of the project is ambitious, as is the funding request. There are concerns that the scope of the project is so broad that it would not provide information that would be needed to promote species recovery.

1. Is the project feasible based on local constraints?

   XYes **-**No

   How?

   Parties would need to gain access to river in order to conduct study.

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

   XYes **-**No

   How?

   It pursues multi-region and Sacramento region priorities.

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?

   There has been considerable research done on stressors that the study can be linked to.

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

   XYes **-**No

How?

Could benefit from additional local involvement from the regulated community. But, the inclusion of the Regional Water Quality Control Board is a good start.

Other Comments:

The proposal would benefit from a more directed focus to a specific area, coordination with other monitoring and ecosystem programs, increased coordination with local entities, and a smaller scale.

External Scientific: #1

Research and Restoration External Scientific Review Form

Proposal Number: **42**

Applicant Organization: **Central Valley Regional Water Quality Control Board**

Proposal Title: **Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries**

Conflict of Interest Statements:
I have no financial interest in this proposal.
XCorrect
-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):

I have no connection to this proposal. I worked with Robert Holmes at the State Water Resources Control Board. Robert and Lori Webber currently have contracts with my laboratory. Michael Johnson and I have worked together and he currently has a subcontract with my laboratory. These relationships have not affected my objective review of this proposal.

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	**OverallIt is very important that bioassessments be incorporated into the procedures applied to monitoring and assessing aquatic ecosystem biological integrity and health in California. For reasons stated in other sections of this review, I cannot conclude that this is an excellent proposal. However, I do recommend that these investigators be funded to perform a bioassessment project. My ideal would be for this group to scale back goals and objectives (as well as budget) to those indicated in the Feasibility and Cost/Benefit sections of this review.**
XGood	
-Poor	

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

   Goals, objectives, and hypothesesWhile the title of the proposal is rather misleading, goals, objectives, and hypotheses are fairly clearly stated. However, throughout the text of the proposal several goals and objectives are added to or expanded from the summary on page

3.

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?

   JustificationThere can be little doubt regarding the need for accomplishing the goals and objectives stated in this proposal. The question is how much effort and time will be required to achieve these ambitious goals and objectives.

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?

   1.Approach to the goals/objectives of estimating the current condition of biological assemblages in the Sacramento River Watershed and determining the extent to which waters of the Sacramento River Watershed support their designated aquatic life beneficial uses.

   Up to a point the approach proposed by the investigators for meeting this goal is sound. Useful information is likely to be provided by this component of the proposed study. The investigators propose to designate/classify regions within the Sacramento River Watershed (SRW) based on physical, chemical, and biological information (the authors indicate that this activity is to limit the effects of natural biological variation on interpretation and application of metrics and indicessee below). The investigation of stressors is then to occur within these regions. I do not see this activity included in the Tasks. Task 5 indicates that there will be probabilistic/ random selection of sites. It is not clear how reference sites/conditions will be selected/identified within each of the regional water bodies. It is difficult to understand how there can be a reference site/conditions in each of the regional groupings given that sites are to be selected by the EMAP probabilistic/random approach. This approach is not likely to yield a reference site in all or any of the regional waterbody groups. To determine biological condition and assess whether sites within these regional groupings are meeting designated beneficial uses there must be a reference site/condition to serve as a benchmark (for comparison to all other sites). The authors indicate that reference conditions for the proposed project are to come from an ongoing investigation. It is not clear how data from this ongoing study will be translated/converted into reference sites/conditions for each of the regional waterbody classifications in the proposed project.

   The investigators do not describe procedures/approach for determining (1) the biological condition of a site and (2) whether a site meets designated beneficial uses. Clearly, a benchmark/reference site or conditions that represents the designated beneficial uses (i.e., un-impaired biological conditions--metrics and indices) will be needed in each of the regional waterbody groupings. Other sites have to be compared to the standard/benchmark. Further, the authors do not describe the procedures for making this comparisonthat is, how to determine of whether a site is impaired or not (meets or does not meet designated beneficial uses). Multivariate statistics appear to be a primary analysis procedure in the proposed study. However, multivariate statistics do not discriminate impacted sites/biological condition, they provide potential associations among variables. The authors do not identify the procedures (statistical or otherwise) that will be used to distinguish/identify impaired from un-impaired sites (those that meet or dont meet designated beneficial uses). This is a very significant issue and will be highly controversial. This issue relates to the question of the ecological relevance of the selected/measured biological metrics and indices. What represents and how do we measure/determine good and bad biological condition?; also, what amount of difference is

necessary to differentiate good from bad? How does one confidently know when a site is impacted (meeting or not meeting designated beneficial uses)? How much divergence from reference conditions constitutes an ecologically relevant effect (certainly understanding natural variation will play into this issuesee below)? The authors do not describe an approach for addressing this issue or making these decisions. This issue also relates to distinguishing (and ranking) potential stressors. How is it to be determined that a potential stressor has ecologically relevant effects on biological metrics and indices? It seems that the ecological significance of bioassessment metrics and indices should relate to magnitude, geographic extent, and duration of anthropogenic effects, as well as reversibility and potential for recovery. This proposal does not address this.

Reliability of bioassessment dataBecause management decisions and/or regulatory actions may be based on bioassessment information, I am surprised that this proposal fails to address accuracy and precision of such data. Accurate assessments of stream biological data are difficult because natural biological variability cannot be controlled. Moreover, the accuracy of bioassessments cannot be objectively verified. Thus, there is a question of obtaining reliable, ecologically relevant, and comparable bioassessment data. Again, because data from this project could be used for management decisions and/or regulatory purposes, I believe that the investigators must establish some bioassessment data quality objectives that define requirements for precision, bias, and sensitivity (detection limits). To understand the sensitivity of a metric or index, a thorough knowledge of natural temporal and spatial variation is essential (see below). Reliability and quality of data generated in this or any other project depends on data quality objectives. Without reliable/high quality bioassessment data predicting biological condition of an aquatic ecosystem or the effects of anthropogenic stressors on the biota of that ecosystem has a high degree of uncertainty. It is incorrect to assume that all bioassessment data are accurate, precise, and sensitive enough to establish/define biological condition or to predict the effects of anthropogenic stressors.

2. Approach to the goal/objective of distinguishing and minimizing the effects of natural biological variation on interpretation and application of bioassessment data.

The approach proposed by the authors cannot be completely successful in achieving this goal. If this project is to be successful, natural (temporal and spatial) variation of biological attributes must be distinguished/partitioned out from anthropogenic-caused variations. Achieving this segregation is no simple feat and generally requires considerable effort and time (to understand the extensive temporal variation in biological attributes). Further, bioassessment in the SRW is in its infancythere is little information and background with which to work. Thus, the ambitious goal stated above cannot be achieved in the proposed project. This is a short-term project (3 years) with limited sites per region, but can contribute to some understanding of spatial variation. The one time sampling at each of the sites precludes any understanding of the contribution of natural temporal (seasonal and year-to-year) variation biological metrics and indices.

While the authors recognize that natural variation of biological attributes confound/limit interpretation and applications of bioassesment data, their approach for minimizing its effects is incomplete. The investigators propose to deal with natural variation by classifying regional waterbodies into relatively homogenous groups with respect to biological, physical, and chemical conditions. The proposed approach may minimize the effects of spatial variation in biological attributes, but does not partition out significant effects of natural temporal variation on interpretation of bioassessment data. Furthermore, the classification system proposed is applicable only to reference sites, not to sites impaired by anthropogenic stressors. As indicated above, it is not clear how reference conditions/sites are to be established in each of the regional waterbody groupings (especially since site selection is probabilistic/random). This procedure of

selecting sites seriously jeopardizes obtaining homogenous reference sites in each and all of the regional waterbody groupings.

To be reliable predictors of biological condition anthropogenic stressors in aquatic ecosystems, biological metrics cannot be characterized by high natural temporal or spatial variability. It seems that this project may begin to provide some insight into the spatial variation of biological metrics and indices in the SRW. However, there should be considerable caution applied to using metrics and indices to predict anthropogenic stressors (and rank them) without a more complete understanding of the natural variation in those metrics. Metrics and indices that are characterized by high natural variability are not reliable predictors of biological condition or of anthropogenic stressors. Abundance and density metrics are far from ideal metrics for determining biological condition or distinguishing potential anthropogenic stressors because these parameters show a high degree of natural variations through seasons and time (also spatially). The approach, duration, and scope of this project severely limit distinguishing biological variation due to natural and anthropogenic causes. This, in turn, limits the ability to predict biological condition/meeting of beneficial uses and to distinguish/predict potential stressors.

According to Karr and Chu (1999, p. 45), Too many existing studies confound patterns of human influence with natural variation over time. We must be very cautious about analytical/statistical procedures that mix the effects of natural and anthropogenic-caused variation on aquatic communities.

Karr, J.R. and E.W. Chu 1999. Restoring Life in Running Waters: Better Biological Monitoring. Island Press, Washington, D.C.

3.Approach to the goals of developing stressor-specific biological metrics and indices and producing a relative ranking of the major stressors that affect biological integrity in the SRW.

Discrimination of potential anthropogenic stressors/causes that affect biological communities is highly dependent on study design. Task 3 may identify many potential stressors, but, in addition to the limitations to the proposed approaches summarized above, the proposed field design precludes achieving the above goals. Specifically, the EMAP probabilistic/random selection of sampling sites is inappropriate for distinguishing stressors. According to Barbour et al. (1999), as well as Karr and Chu (1999), probabilistic selection of sites can provide information on the status/biological condition in a watershed, but is not intended to identify stressors that impact aquatic biota. For the correlation procedures (to be used in this project) to be effective in distinguishing potential stressors a gradient (dose-response) of each stressor is absolutely necessary. Random selection of sampling sites almost certainly will not provide gradients of the multiple stressors in the SRW. There are only 40 sites in each of the two SRW regions to be investigated. These sites are to be classified/divided into regional subgroups. Because of the random selection of sites, it is not likely that each of the regional subgroups will have stressor gradients or enough sites to establish a correlative association between metrics and anthropogenic stressors.

Karr and Chu (1999, p. 40) state that, sampling and analysis should focus on multiple sites within similar environments, across the range from minimal to severe human disturbances. By so doing, it would be possible to evaluate biological responses to a changing dose of a single human influence. With the EMAP probabilistic/random selection of sites, habitat limitations (and possibly flow) will almost certainly be distinguished (using the multivariate analyses proposed) as the probable major stressors (cause of variation in biological data). That is, habitat factors/limitations will dwarf other potential stressors, making it difficult to distinguish them.

This is especially true since sites are not to be selected based on potential stressor gradients as Karr and Chu suggest. The point that I am making here is very clearly illustrated by the study by Brown and May (2000) on the Sacramento San Joaquin Watersheds. In this investigation, habitat variables smothered all other variables. If this proposed project is to distinguish other potential stressors, site selection must be such as to minimize habitat limitations. An alternative for this project would be to back-off of the overly ambitious goal of ranking of anthropogenic stressors and focus on habitat limitations and flowthis would be more likely to be successful.

Barbour et al. (1999, p. 3.7) conclude that, If the goal of an assessment is to evaluate the effects of water chemistry degradation, comparable physical habitat should be sampled at all stations, otherwise, the differences in biology attributable to a degraded habitat will be difficult to separate from those resulting from chemical pollution water quality degradation. While this statement relates to the project approach limitations stated above, it also relates to the development of stressor-specific metrics and indices. Furthermore, chemical pollutants analyses are not associated with this project. Reliance on pollutant data (chemical concentrations in water and sediment) collected sporadically in the past and/or at locations other than the sites to be studied in this proposed project is inappropriate. Chemical use data in the watershed may indicate potential stressors, but is far from specific identification of impacts on biological metrics or indices (no cause-and-effect established). This provides further reason for scaling back the scope, goals, and objectives of this project.

Few stressor-specific metrics have been developed in other areas of the U.S., even in states or regions that have been involved in bioassessments 10 or more years. This is probably due to the fact that many stressors have the same or similar effects on biological attributes. Given the limitations to project approaches/design indicated in this and the above sections, this is another goal that I recommend eliminating. It is certainly not likely to be achieved.

Scientists in the central valley have been attempting to specifically identify stressors to fish populations for many, many years. While it appears that flow, alien species, and over-fishing are stressors on some fish populations, little is known on other anthropogenic stressors. Further, I am not aware of a relative ranking of stressors on fish populations. Given this knowledge, it is unlikely that a limited scope, three-year project can achieve the goal of ranking anthropogenic stressors for fish, periphyton, and benthic macroinvertebrates. Further, it would seem that ranking stressors must involve quantitative evaluation of magnitude, duration,, and geographic extent of anthropogenic impacts. This project is not equipped to address these parameters.

Multivariate statistical analyses appear to be a central component of data analysis in the proposed project. These procedures have strengths and limitations. Karr and Chu (1999, p. 146) propose that, Multivariate analyses were developed for finding patterns, not assessing impacts. We believe that misinterpretation is more common with multivariate than with the multimetric approach. Principle components analysis (PCA-a multivariate tool to be applied in the proposed project) assumes that data follow a multivariate normal distribution; this is in fact rare in biological monitoring. Further, PCA defines statistically orthogonal factors that may or may not be independent biologically. Therefore, interpretation of PCA can be very complicated as related to discerning anthropogenic stressors. Multivariate techniques frequently fail to discriminate among important sources of variability. Multivariate matices often mix temporal and spatial sampling data. Multivariate analyses assume that statistical description of maximum variance identifies the signal/stressor most meaningful to biological integrity. However, because multivariate methods reduce the dimensionality of the original data by extracting or loading the maximum variance on successive axes, they lose biological information at each step of analysis. A key limitation of multivariate analyses is reliance on mathematical/statistical properties of data and the structure of the covariance matrix rather than on biological/ecological knowledge.

While this project is likely to contribute useful information on the existing biological conditions (especially if modifications indicated above are made in procedures/approaches) in the in the SRW, bioassessments are not known for specific identification of stressors (i.e., establishing cause-effect relationships). Management and regulatory actions should be based on sound cause-effect relationships. If these investigators intend to specifically and conclusively identify stressors to aquatic biota in the SRW or anywhere else, other procedures will have to be added to the bioassessment methods described in this proposal.

Karr and Chu (1999, p. 45) state that, When a range of factors (different human influences on different environmental types) is lumped into a single analysis, it becomes almost impossible to understand the causes or consequences of human versus natural event. I believe that this proposal suffers from attempting to investigate and provide answers to far too many questions in a restricted period of time. Further, the approaches/procedures the authors propose for answering several questions and achieving many of the proposed goals and objectives are inappropriate.

Throughout their book Karr and Chu (1999) conclude that the objective of biological monitoring is to detect human-caused deviation from baseline biological integrity. While it is essential to understand natural variation in biological communities, it is only anthropogenic impacts on aquatic communities that management and regulatory actions have the potential to alter. Karr and Chu, among many others, make it very clear that there is a continuous degradation of aquatic ecosystem biological integrity in the U.S. and that the cause of this degradation is anthropogenic activities. Therefore, is seems essential that CalFed preferentially fund studies that can conclusively establish the anthropogenic causes of degradation to aquatic ecosystem health/integrity.

Barbour et al. 1999. Rapid bioassessment protocols for use in wadeable streams and rivers. U.S. EPA Office of Water, Washington, D.C. EPA 841-B-99-002.

Brown, L.R. and J.T. May 2000. Macroinvertebrate assemblages on woody debris and their relations with environmental variables in the lower Sacramento and San Joaquin River drainages, California. Environ. Monitor. Assess. 64: 311-329.

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?

FeasibilityThis is an overly ambitious proposal/project that must be scaled back and focused. The feasibility of this project achieving the stated goals and objectives is covered in the Approach section of this review. To summarize, it is likely that the proposed project will contribute pertinent data on biological condition in two regions of the SRW (if concerns expressed in this review are accommodated into project design). The proposed project is also likely to yield useful information on natural spatial biological variation (which is essential to understanding anthropogenic impacts on aquatic communities) in two regions of the SRW. It is highly unlikely that the proposed project can achieve the stated goals of (1) determining the extent to which waters of the SRW support their designated beneficial uses, (2) distinguishing and minimizing the effects of natural biological variation on interpretations and application of bioassessment data, (3) developing stressor-specific biological metrics and indices for the SRW, and (4) producing a relative ranking of the major stressors that affect biological integrity in the SRW. These four goals/objectives cannot be accomplished because of (a) study design/procedures and approach, (b) achieving these ambitious goals will require considerably more than three years, (c) including more sites that are sampled repeatedly, and (d) including procedures that specifically identify anthropogenic stressors.

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 MeasuresAn external science review panel that examines the success of the project in accomplishing proposed goals and objectives would be a valuable addition to the proposed performance measures.

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?

   Value of ProductsWhile I am extremely skeptical that all of the goals and objectives of this proposal can be achieved, I am confident that valuable information will come out of the proposed project (if it is scaled back and revised to consider the concerns and recommendations advanced in the Approach and Feasibility sections of this review).

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?

   CapabilitiesThe investigators on this proposal are a very talented, capable, and resourceful group. If they scale back the scope, goals, and objectives of this proposed project, modify their approaches, and take into consideration the concerns and recommendations summarized in this review valuable information can be produced.

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

   Cost/BenefitI cannot endorse the high budget for the proposed project given that several of the goals and objectives cannot be accomplished in the three-year time frame or with the procedures/approaches proposed. I propose that a budget of approximately 1 to 1.2 million would be sufficient to achieve the goals/objectives that can be attained: contributing to an understanding of (1) biological condition/integrity and (2) natural spatial variation in the two regions of the SRW.

Miscellaneous comments:

External Scientific: #2

Research and Restoration External Scientific Review Form

Proposal Number: **42**

Applicant Organization: **Central Valley Regional Water Quality Control Board**

Proposal Title: **Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries**

Conflict of Interest Statements:
I have no financial interest in this proposal.
XCorrect
-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:

<u>Excellent:</u> outstanding in all respects;
<u>Good:</u> quality but some deficiencies;
<u>Poor:</u> serious deficiencies.

Overall Evaluation Summary Rating	**Provide a brief explanation of your summary rating**
-Excellent	**Although the topic addressed is extremely important and the project has a number of strengths, I feel that the approach (particularly with regard to metric development) is too vague to warrant an 'excellent' rating.**
XGood	
-Poor	

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

   The primary goal of this project is to is to determine the extent to which regional waters support their designated beneficial uses for aquatic life. The primary objectives are to identify and develop regional biological stressor specific metrics and determine relative magnitudes of each major stressor. The hypotheses described are either trivial (1) or unclear (2). The conceptual model (Figure 1) is not particularly helpful and I find the description of 'metrics' too vague.

2. **<u>Justification.</u>** 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 overall concept of defining water quality on the basis of biological attributes (corrected for differences in physical and chemical attributes of a system) is an attractive approach and one that is being increasingly embraced in other parts of the world (e.g., European Union Water Framework Directive). The topic of study is well justified, but how the applicants will go about achieving their ultimate goals is less 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 reasoning behind the approach seems somewhat circular. For example the idea is to use biological attributes to determine that specific stressors are acting on a system. However, the first step in the approach is to classify water bodies into homogeneous types with regard to physical, chemical and biological attributes. It is unclear how natural variability can be separated from stressor effects without a priori knowledge that specific stressors are having an impact (and hence little need for a metric).

   The description and justification of sampling approach relies heavily on reference to EMAP procedures. The process of stressor identification is only very briefly described (p. 5). It is stated that univariate and multivariat statistical analyses will be used to aid in identification of biological classes of waterbodies and examine linkage of potential stressors. This can be a complex and potentially difficult to interpret aspect of the study.

   According to Figure 2, the process of index development involves aggregating several so-called 'core metrics' to a single dimensionless index. There have been concerns with approaches of this kind because much information is lost and it may not offer significant advantages in terms of stressor identification.

   Because there will only be one sampling season for each of the two regions it will not be possible to examine interannual variability within or among 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 statement on feasibility in the project description is not very convincing.

   It should be possible within the timeframe allowed to achieve an estimate of the natural variability in biological systems in different classes of water body and this is an important step. I am not convinced by the project description that the approach will lead to the development of 'stressor specific biological metrics'. Furthermore that the objective is to develop such indicators for macroinvertebrates, fish and periphyton is rather ambitious.

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 will partly be indicated by various QA/QC procedures for the measurements made. A technical advisory group will meet annually to discuss project status. Quarterly CALFED reports and peer-reviewed publications are also indicated as performance measures.

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 applicants intend to provide a 'measurement tool' to assess the ecological integrity of water bodies in the two regions of study. I am not convinced that they will be able to produce such a product given the scope and timeframe of the project.

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 project team appears to have the necessary expertise to conduct the proposed project. A variety of institutions is involved and it appears that the necessary infrastructure/support is available.

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

   This 3 year project has a total budget of $3,653,287. It is a very expensive and very ambitious project.

Miscellaneous comments:

Presumably there will be no problem collecting the necessary permits as described on p. 7?

External Scientific: #3

Research and Restoration External Scientific Review Form

Proposal Number: **42**

Applicant Organization: **Central Valley Regional Water Quality Control Board**

Proposal Title: **Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries**

Conflict of Interest Statements:
I have no financial interest in this proposal.
XCorrect
-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:

<u>Excellent:</u> outstanding in all respects;
<u>Good:</u> quality but some deficiencies;
<u>Poor:</u> serious deficiencies.

Overall Evaluation Summary Rating	**Provide a brief explanation of your summary rating**
XExcellent	**The program appears well planned, meets important and topical goals and will provide an excellent ecological database for use in further analyses. The team assembled has the necessary range of skills to successfully address the goals and has a record of success. The only concern is whether the team asked for sufficient funds to conduct the needed work on enough sites with examination of enough species in a short enough time period within the season to get the optimum data. I would encourage the awarding body to consider asking the authors to slightly expand the cost of the summer phases of the work to allow a more intense analysis.**
-Good	
-Poor	

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

   The goals objectives are very clearly stated. I would have preferred to see the term "relative significance of" used in place of "magnitude of" (stressors). Under the "central focus" the authors might like to point out that they are looking at "natural variability within EACH OF two ecoregions".. The hypotheses are correctly stated but the use of the term "biological classifications" may be open to confusion. If terminology such as " characteristic local

aquatic assemblages" were used along with "each characteristic..assemblage reflects the cumulative influence of the stressors at that point in a predictable manner" thehypotheses might be clearer. The concept of stressor identification and its potential use for aquatic habitat classifaction and monitoring and use to guide stewardship and mitigation activities offers an important tool for managing agricultural watersheds and is needed as soon as possible.

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 clearly necessary since the available data would not permit these valuable analyses; it appears that no other programs will generate equivalent data (see below). The conceptual model is very clear and reverses a previous impression that all stressors were anthropogenic. The conceptual model and justification is also congruent with the goals, objectives and hypothesis. The explanation of the application of the "adaptive management" cycle was persuasive. A case could be made that the study has been underscoped; this full implementation still runs the risk of not covering sufficient species, sites and a suitably short period of time to minimize natural differences between sites at sampling and thus risks losing some comparative power. I would suggest that the funding body consider increasing the scope slightly to permit more work to achieved in a slightly shorter summer "sampling" season in both years. The current rationale for the selection of 40 sites appears to based on convenience rather than an assessment of the likely needed for "N" samples from "X" sites. Data and experience exists for other studies and other states that would help assess the realism of using 40 sites to address this goal.

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 study appears to be carefully thought through and well designed and will generate data of potentially very high value to this and other programs; this data will not exist anywhere else in the cohesive format necessary to permit this type of assessment. The findings will be novel and probably locally specific and should be useful for regulators provided that they are used in a "weight of evidence" environment rather than for using some metric to "draw a line" in the sand (see the comment re the inclusion of regulatory scientists on the advisory committee). Irrespective of the final outcome, the project will be of value to regulators and decision makers since raw data will be obtained that will be usable to address and calibrate many important regulatory issues.

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 study design is comprehensive and achievable; useful data will be accumulated. However, realistically the desire to develop "stressor specific" metrics may be overly optimistic but I am convinced that the study should generate metrics with "a strong correlation to one (or combinations) of stressor(s)". See the comment above regarding whether it would be appropriate to expand the scale of the summer activities slightly to increase the numbers of sites sampled and decrease the sampling period. A fundamental underlying assumption is that the two currently defined ecoregions are sufficiently different to justify making two (temporally) independent programs. Early in the program, research into existing data on the two ecosystems should be conducted to ensure that the planned separation across years is the optimum way of investigating variability in the Sacramento Watershed

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?

   At the data level, the inclusion of a QA/QC program was excellent. Given the lack of existing data in this area, it is difficult to adequately specify performance measures in advance. With the addition of a more detailed timeline, the "performance" of the study will be fairly easily monitored. Because of the research nature of the development of metrics from the data, it is less easy to specify performance criteria. In the justification section, the adaptive management approach was mentioned and this principle should be applied during the program (especially to incorporate learning from year 1 into year 2)

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 - the project will produce a plethora of currently unavailable data which will be of immense potential value irrespective of the analyses - hence a definitive plan on making the raw data available in advance of interpretation by the study team would be beneficial. The interpretation will provide a new dimension of information on the state of the aquatic ecosystems across the Sacramento watershed. The exercise in examining the potential impacts of potential stressors in a cumulative effects assessment approach will be instructive both from a Sacramento Watershed standpoint as well as developing aspects of the science of ecological monitoring

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 work experience of these reseachers appears to provide a well knit team that should be able to address the planned program. In the light of the comments above, it might be beneficial to add some field staff in order to allow a shorter summer sampling period. The selection of cited literature and cross reference to other studies and data sources in the text indicated the sound and thorough background of the study proposers in this area Not knowing the PI's personally, I cannot comment usefully on their track records although it was noticeable that they did not cite many of their own papers in the literature review. Fortunately the demands of a program like this do not require large amounts of esoteric infrastructure; instead great efficiency in handling large amounts of field data is essential and can lead to backlogs. Therefore, as with many government research programs, I would like to see more emphasis in the proposal on ensuring that the progression is timely and that no backlogs are allowed to occur in organism identification and data entry. A time line needs to be agreed for making all the raw data available for public/government use rather than waiting for publications.

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

   The budget appears generally sensible - however, it was difficult to understand the time estimate for identifying random sites (2000 hours per 40 sites - 6+ mandays per site). It appears that truly random site selection would offer few advantages and a stratified random approach to ensure appropriate representation from various "types" of sites will be critical given the restricted number of sites. See comments above that by having more people working on more sites over a shorter period in the summer, the study might be made even more powerful.

Miscellaneous comments:

I would like to see specific reference made to cooperation with the NAWQA ecological analyses and monitoring data - should be easy to do given the USGS advisors. Given the difficulties associated with the translation of field ecology data into usable regulatory metrics, it would be useful to appoint technically expert regulators to some of the advisory roles to ensure that scientists entrusted with making use of regulatory data for decision making (e.g. CDPR) have a chance to influence the study and the development of metrics. I saw no mention of quantifying suspended solids as a potential stressor - this should be specifically included. Given that (Landsat?) 30 m resolution land use data will be used, the selection of a 50 m riparian corridor seems strange. Experience shows it is better to make the buffer distance something like 2.5 pixels wide. Moreover, the length of the riparian corridor to be considered above the sampling point should be specified as well as the distance to patch borders. However, given the small number of sampling sites, a strong case could be made for using aerial imagery (1 -2 m resolution) to better understand riparian area influences. My recommendation would be to consider separately 1) "watershed above the sampling point" 2)the individual fields to either side of the water body (one fields with) and 3)the latter after considering the influence of the riparian areas. It appears that insufficient description was given to how the "expected presence or absence of stressors" according to the GIS in task 3 will be validated on the ground - perhaps that is part of the reason that the estimate of time for step 5 is so high. It will be essential to confirm that the 40 selected sites actually represent what the GIS tools predict. An important aspect that was not mentioned and requires inclusion is to include consideration of how the potential stressors co-occur(e.g. sediment or DO being flushed through when flow augmentation /release occurs). A sound understanding of this will be needed for decisions on the confidence of whether a stressor specific metric has been identified

External Scientific: #4

Research and Restoration External Scientific Review Form

Proposal Number: **42**

Applicant Organization: **Central Valley Regional Water Quality Control Board**

Proposal Title: **Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries**

Conflict of Interest Statements:
I have no financial interest in this proposal.
XCorrect
-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:

<u>Excellent:</u> outstanding in all respects;
<u>Good:</u> quality but some deficiencies;
<u>Poor:</u> serious deficiencies.

Overall Evaluation Summary Rating	**Provide a brief explanation of your summary rating**
-Excellent	**This is an overly ambitious study that would benefit from some further thought, including a more careful analysis of potential stressors and how they could be assessed. The group proposes to measure many parameters and then use multivariate statistics to assess what are the significant stressors. A more clearly focused approach based on greater understanding of underlying ecological processes seems likely to result in more interpretable results.**
-Good	
XPoor	

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

   The goal of this proposal is to identify potential stressors for aquatic life in the Sacramento River watershed and to identify stressor-specific metrics based on sampling of fishes, invertebrates and periphyton. The proposed metrics will include those responsive to flow manipulations. Although this is a noble goal, I am not convinced the work proposed will achieve this goal. The hypotheses being tested (p.3) are extremely vague and of little value.

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 conceptual model underlying this proposal (Figure 1) is extremely vague and strikes me as overly ambitious. The site selection procedure is the probabilistic sampling protocol of EMAP. The approach to stressor identification appears to be gathering a great deal of potentially relevant data and entering it into a multivariate analysis that then identifies the major stressors. This does not strike me as particularly well conceived. The proposal incorporates little existing knowledge of biological metrics in the region, basically dismissing existing data as scattered and of little value because of the lack of establishment of reference conditions. It appears that currently funded research is beginning to identify these reference conditions, which is a worthwhile beginning.

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?

   As mentioned above, I am not impressed with the approach being used to identify stressors. I also am concerned about the approach to sampling. A one-day invasion of four people at 40 sites over a six month period does not adequately account for seasonal variability in these assemblages. What does existing information on life history characteristics of target populations tell us about feasibility of that approach. Sampling many sites over a six month period appears to be particularly a problem for invertebrates and periphyton. I question whether it is worth the considerable expense to attempt to include periphyton in this project. The emergence pattern of the aquatic insects will result in very different assemblages at the beginning (April) and end (September) of the field season.

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 site selection approach is poorly documented. They say they will use EMAP procedure for site selection. Other than being probabilistic sampling in polygons, what does that mean? How is river network structure incorporated into the sampling design? How are sites stratified? A clearer, more thorough explanation of site selection is essential to be able to evaluate the ability of this approach to extrapolate findings to the broader landscape.

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 measures appear to be primarily quarterly reports. No indication of how they are going to evaluate the success of the metrics proposed.

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?

I question whether products of value will result. The reasons for my concern have been outlined above.

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 individuals appear to have the taxonomic skills to accomplish the project. It is less obvious that they have the statistical skills and ability to integrate at the level of the landscape.

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

   The group might be wiser to attempt something on a somewhat smaller scale that would demonstrate the feasibility of this approach.

Miscellaneous comments:

Environmental Compliance:

Proposal Number: 42

Applicant Organization: Central Valley Regional Water Quality Control Board

Proposal Title: Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries

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

   -Yes **X**No

   If no, please explain:

   The Environmental Compliance checklist does not reflect the discussion of anticipated/ applicable permits on page 7. It is unclear on page 7 whether the project applicant has already obtained a CESA Section 2080.1 consistency determination, as well as the corresponding CEQA and NEPA documentation.

   State Lands Commission approval required.

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

   XYes **-**No

   If no, please explain:

   If CEQA, NEPA documentation, and CESA 2080.1 compliance can be completed within the scheduled 90 days.

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

   -Yes **X**No

   If yes, please explain:

Other Comments:

Budget:

Proposal Number: 42

Applicant Organization: Central Valley Regional Water Quality Control Board

Proposal Title: Development of Aquatic Biological Stressor Metrics for the Sacramento River Watershed and Tributaries

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

   XYes -No

   If no, please explain:

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

   XYes -No

   If no, please explain:

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

   XYes -No

   If no, please explain:

4. Are appropriate project management costs clearly identified?

   XYes -No

   If no, please explain:

   listed as project administration

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

   XYes -No

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

6. Does the budget justification adequately explain major expenses?

   XYes -No

If no, please explain:

7. Are there other budget issues that warrant consideration?

   -Yes **X**No

   If yes, please explain:

Other Comments: