Proposal Reviews

#85: INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources

Hydrologic Research Center

Initial Selection Panel Review	
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Initial Selection Panel Review:

CALFED Bay-Delta 2002 ERP PSP
Initial Selection Panel Review

Proposal Number: 85

Applicant Organization: Hydrologic Research Center

Proposal Title: INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources

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	**X**
Consider as Directed Action	**-**
Not Recommended	**-**

Amount: **$600,000**

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

The proposed cost share is under consideration by the NOAA OPG where an identical proposal was submitted. The scientific review panel and the selection panel felt this proposal should be funded, but that funding should be contingent upon NOAA funding the projected cost share component of this 5-year project.

Provide a brief explanation of your rating:

This highly-rated research proposal seeks to improve management of the network of reservoirs in the CALFED area by improving the integration of climatic forecast into models used to manage the system. This is not the kind of proposal that is likely to draw a lot of public attention or involvement. Because it is about research to improve water supply, the regional panels felt that it wasnt as high a priority as it might be if it addressed immediate ecological issues within the Delta. At least one panel felt that the project should be undertaken by the water management entities and funded by another program related to water supply reliability. However, the selection panel felt that the strong scientific basis for the project and the possibility of increased and more reliable water supply, coupled with the potential contribution of funds by NOAA, makes it viable for funding by CALFED. Given the costs of water in California, if water supplies are enhanced then the costs are reasonable and the ecological benefits could be substantial if water management can be effectively used for ecological benefits. This project appears to have a high probability of success because of the close ties of the research group to the agencies involved in the water management and demonstrated expertise and success with a similar project. The panel noted that for this project to ultimately succeed the implementation of the results by the water management entities is an essential step.

Research and Restoration Technical Panel Review:

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

Proposal Number: 85

Applicant Organization: Hydrologic Research Center

Proposal Title: INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources

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	**Although the regional panels were lukewarm about this proposal, the science reviews gave it high marks. The external scientific reviewers thought this was a quality proposal, and had high potential to result in a useful management tool, which would ultimately lead to more efficient water management. Funding by CALFED should be dependent upon NOAA funding the cost-share component as well.**
-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?

   The goals of this project are ambitious: to improve management of large reservoir systems based on better integration with climatic forecasting. This goal supports priority MR-4: ensure restoration and water management action through all regions can be sustained under future climatic conditions. The project would build upon past research on Folsom Lake and expand the approach to the CALFED network. The project covers a broad spatial scale, and can lead to a cumulative effects analysis of water management across a multi-reservoir system. The overall justification for funding this project is that improved management of a multi-reservoir system should provide more water for environmental needs.

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?

   Reviewers generally found the proposal to be feasible, under the constraints of this type of modeling which involves uncertainty on several levels. The authors have considerable expertise in this field, which increases the likelihood to succeed. They are using existing models and expanding their scope rather than trying to create a new model. Similar work on Folsom Lake shows that this approach can work.

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 outcome would be a tool for more efficient reservoir operations across the region. The usefulness of the tool depends not only on the performance of the models, but how well the information is relayed to reservoir managers. The system must be easy enough to be employed consistently across the region. The reviewers felt the applicants already had good buy-in from the local decision makers. Several letters of support are indicative of the acceptance of this proposal.

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

   Reviewers agreed that the budget was reasonable, and was adequate if the cost-share funds come through.

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?

   The regional panels ranked this proposal lower (Bay Region - Low, Delta Region - Medium, Sacramento - Low) than the external scientific reviewers (Excellent, Excellent, Excellent and Good). The Bay Region did not feel the proposal was very applicable to their region, and had little connection with Bay restoration efforts. The Delta Region saw little linkage to restoration activities, but acknowledged that increased water availability could translate to improved environmental conditions. The Sacramento Region agreed with the conceptual approach of the projects, but thought the project should be done by the agencies involved with managing these reservoirs. Reviewers were concerned with the uncertainty of the outcome of the modeling efforts.

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?

   Some minor cost discrepancies were noted. Because federal cost-share funds are involved, there was concern that NEPA compliance would be required, which would involve more time to process.

Miscellaneous comments:

None

Bay Regional Review:

Proposal Number: 85

Applicant Organization: Hydrologic Research Center

Proposal Title: INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources

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

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

It was felt that this project has low applicability to the Bay region specifically. Though it has indirect connections to Delta operations, the Bay Panel felt that the utility of the project should be assessed and funded by water operations/supply managers. The principal aim is to ensure better water management but models of this nature are generally not under ERP jurisdiction. It may ultimately have benefit to the ERP as a whole; however, this benefit should be made explicit to receive ERP funds.

1. Is the project feasible based on local constraints?

   -Yes **X**No

   How?

   N/A. Feasiblity based on local constraints is difficult to assess. Research appears feasible; however, it is unclear exactly how this project interfaces with existing reservoir models (USBR and DWR) and how it will improve on these models. Also, Bay regional issues are not a factor here.

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

   -Yes **X**No

   How?

   N/A for bay region. Not very applicable to the Bay region, but more applicable to water management of the CALFED Delta region. In the proposal stated applicability is: MR 4: Ensure restoration and water management action through all regions can be sustained under future climatic conditions. However, though funding this proposal might increase our understanding of the system, it does not ensure restored water to fisheries, etc. There are indirect ERP linkages through an improved ability to forecast reservoir releases via a long range decision model. However, the applicability to Bay region restoration is not as direct as that in the Sacramento River region and the Delta. The Bureau letter of support mentions the lack of water due to stricter environmental regulations and the need for better modeling to ensure improved decisions for releases. These releases are generally directed at in-stream conditions and Delta take issues.

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

   -Yes **X**No

   How?

   No, connection with Bay restoration seemed minimal. Support of participating federal, state and local agencies is expressed through letters of support, but these groups, USBR and SAFCA are not directly involved in Bay area restoration.

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

   -Yes **X**No

   How?

   At this point, no. Local bay agencies, stakeholder representatives are not represented, but could be through the proposed workshops.

Other Comments:

Because the proposed research is mainly aimed at improved reservoir management by taking climate change scenarios into account, it seems that this project is linked more closely to the Bulletin 160 program and general reservoir management (CALFED water supply reliability) and therefore should seek most of its funds from these programs.

Delta Regional Review:

Proposal Number: 85

Proposal Title: INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources

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

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

This application isn't closely tied to Delta region priorities. There is no assurance additional water made available by improving the reservoirs' management would be used for restoration purposes.

1. Is the project feasible based on local constraints?

   XYes **-**No

   How?

   o Products are mathematical models that will be developed to improve operation of four CVP and SWP reservoirs - Folsom on the American River, Oroville on the Feather River, Shasta on the Sacramento River and Trinity on the Trinity River.

   o Products will assess relative benefits associated with reservoir operation following INFORM standards versus standard reservoir operations. Benefits will be described in terms of flow releases, flood protection, hydroelectric power generation and compliance with environmental flow criteria.

   o Products are dependent on utilization of existing data and on information provided by state and Federal water management agencies. The proposal proponents indicate they will have sufficient access to these data and information. Considerable coordination with the relevant agencies has already occurred, and future coordination and cooperation is anticipated.

   o No CEQA or NEPA documents will be required to complete the proposal.

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

   -Yes **X**No

   How?

   o The linkage is limited and somewhat indirect. The linkage is with ERP Draft Stage 1 Delta and East Side Tributaries Restoration Priority #7 Protect at risk species in the Delta using water management and regulatory approaches), although none of the three priority groups of studies identified in Restoration Priority #7 applies to the proposal.

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

   -Yes **X**No

   How?

   o There is no specific reference in the proposal to any linkage with restoration activities in either the Delta and East Side Tributaries Region or the Multi-Region Bay-Delta Areas.

   o Implied benefits could result from increased efficiency in reservoir water management if these water savings would translate to increased water availability for environmental purposes.

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

   XYes **-**No

   How?

   o Local involvement is focused on water project operators (Department of Water Resources and Bureau of Reclamation), the National Weather Service and Sacramento Area Flood Control Association (SAFCA). Close coordination with the U.S. Army Corps of Engineers (COE) will occur through useage of the COE data bases.

   o No local government, landowner environment, agriculture or municipal/industrial special interests have been involved.

   o No public outreach program is identified.

   o Letters of support for this proposal are included from the Bureau of Reclamation in Sacramento and from SAFCA.

Other Comments:

Better coordination of this study with the Corps' comp study could improve understanding of ways to integrate reservoir operation with floodplain restoration.

Sacramento Regional Review:

Proposal Number: 85

Applicant Organization: Hydrologic Research Center

Proposal Title: INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources

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

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

Generally speaking, the review panel felt that this project could be useful but should be done by the agencies involved with managing these reservoirs. The uncertainty associated with proposed outcomes on such a project seemed high.

1. Is the project feasible based on local constraints?

   XYes **-**No

   How?

   The design of the integrated forecast-control system was first used by Georgakakos et al. (1998) successfully for the assessment of benefits of climate information for the management of Saylorville reservoir on the upper Des moines River. Prior to that study, a system with fully coupled hydrologic-forecast and reservoir-control components but without GCM information processors was designed and was applied to the Des Moines River basin resulting in superior performance to that of operational practices for all the objectives of management. The authors of this proposal have demonstrated statistically that using GCM information yields significantly more reliable inflow volume forecasts for Folsom Lake. The authors of this study found that with the benefit of reliable forecasts, an increase of the minimum downstream flow constraint by 50% will not significantly impact other reservoir objectives while providing more water for downstream uses which is important for environmental restoration projects downstream.

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

   XYes **-**No

   How?

   A specific priority, MR-4, (Ensure restoration and water management actions through all regions can be sustained under future climatic conditions) in the ERP 2002 PSP, supports the objectives of this proposal.

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?

INFORM (HRC, GWRI) has been meeting regularly with USBR Planning Div., NWS CNRFC, NOAA OGP, USBR Central Valley Ops., California Dept. of Water Resources, Sacramento Flood Warning Service, and Sacramento Area Flood Control Agency. Letters of support for this research are provided by some, if not all of these agencies.

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

XYes **-**No

How?

This project has significant support from participating federal, state and local agencies. They state that staff from several federal and state Agencies have been attending informational meetings on INFORM during the last two years (about 30-40 scientists and engineers). They have also established a close collaboration with staff from operational forecast and management agencies associated with the targeted reservoirs.

However, there have been no public meetings for to include local people and there do not appear to have any planned. This project is a heavy research oriented effort run by well-published scientists from both Hydrologic Research Center and Georgia Water Resources Institute.

Other Comments:

Conceptually it appears to be the type of research that could significantly contribute to more efficient and coordinated management of four large reservoirs to meet water supply, hydroelectric energy production, flood control, and environmental restoration needs beyond the traditional methods presently employed. The research objectives are proposed to be accomplished by integrating the use of GCM-conditioned forecasts with the operational rule-based management component. From a technical viewpoint, it was difficult to determine if this proposal was capable of achieving its objectives.

External Scientific: #1

Research and Restoration External Scientific Review Form

Proposal Number: **85**

Applicant Organization: **Hydrologic Research Center**

Proposal Title: **INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources**

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:

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**
XExcellent	**The proposal will accelerate the use of climate information by water managers, and, if successful, will help managers meet competing objectives. The PI's have demonstrated in other regions that the economic benefits of climate information are much, much higher than the costs of utilizing that information. The PI's have a clear set of objectives, and the capabilities to successfully complete each research task. Decision-makers are involved as collaborators in this project--the project is constructed so as to be useful to them. The PI's have had several meetings with decision-makers, and letters of support are included in the appendix.**
-Good	
-Poor	

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

   The proposal is easy to read and understand. The PI's have a clear set of objectives, and the capabilities to successfully complete each research task. The concept is important. Recently, we have seen significant advances in our ability to predict future climate (caused in part by increased understanding of the causes and impacts of ENSO), but these improved climate predictions are rarely used to improve water management. The proposal will accelerate the use of climate information by water managers, and, if successful, will help managers meet

competing objectives.

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 builds on an extensive bank of existing knowledge. I like the fact that the PI's plan to use the operational models of cooperating agencies in all instances, and instead focus on the linkages between these models--working on the steps that are necessary for probabilistic climate information to be used routinely by water managers. The research steps are clearly articulated, and are feasible.

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?

   Decision-makers are involved as collaborators in this project--the project is constructed so as to be useful to them. The PI's have had several meetings with decision-makers, and letters of support are included in the appendix. The novel information that will facilitate widespread use of climate information by water managers is quantifying the economic value of climate forecasts in water management applications. Also, by following GCM forecasts all the way through to management benefits, the investigators will provide a prototype framework for which other investigators can work on improving individual components. The entire approach appears to be well designed.

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 appears to be technically feasible. Because the project many different elements, some aspects of the methodology were discussed rather briefly. Having siad this, however, the PI's have an impressive track-record, and the likelihood for success of this project is very high.

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?

   I guess the ultimate measure for success of this project is if the water management agencies begin to make routine use of climate information. This is not clearly stated. The PI's do have objective criteria for measuring (1) the saccuracy of the climate forecast, (2) the skill of the hydrologic forecast, and (3) management benefits.

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 product from this research is the use of climate information to meet multiple management objectives. This has high economic value--value that will be quantified in the course 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 PI's are all highly respected scientists in their own right--I have no doubt that they have the capabilities and experience to successfully complete this project. Their infrastructure and support is adequate.

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

   The budget is reasonable. If NOAA-OGP kick in some funds, then CALFED will get considerable bang for their buck. The PI's have demonstrated in other regions that the economic benefits of climate information are much, much higher than the costs of utilizing that information (such as in the model development proposed by the PI's).

Miscellaneous comments:

None.

External Scientific: #2

Research and Restoration External Scientific Review Form

Proposal Number: **85**

Applicant Organization: **Hydrologic Research Center**

Proposal Title: **INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources**

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:

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**
XExcellent	**This is a large, complex project that involves many entities and will require considerable coordination among the players. The project outlines the tasks in a reasonable manner to achieve their goals. There is a risk involved if the modeling efforts do not result in better forecasting, but the financial risks are spread across several agencies, and to develop a novel approach some risk is unavoidable.**
-Good	
-Poor	

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

   1) Excellent The goals of this project are ambitious: to improve management of large, multi-objective reservoir systems based on better integration with climatic forecasting. This goal supports priority MR-4: ensure restoration and water management action through all regions can be sustained under future climatic conditions. The project would build upon past research on Folsom Lake and expand the approach to the Calfed network.

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?

1) Excellent The conceptual model for the project is clearly stated in the proposal. It would begin with the use of climate information from Global Climate Models, downscale the information to the spatial scale of the reservoir catchment, generate forecasts through ensemble forecasting, generate trade-off options among competing objectives, and through simulations, come up with preferable management schedules. The proposal would consider forecast uncertainty from the Global Climate Models and decision support models for decisions regarding reservoir releases and power generation.

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) Excellent This approach has already been used at Folsom Lake, with encouraging results. If this project is successful, the information will be useful to decision makers and would provide for more efficient use of water throughout the region. It is a novel approach in that the study would assess the cumulative effects' of water management decisions on a large spatial scale. Also, the hierarchical approach (short range, mid range and long range models) is a desirable feature of this proposal.

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?

   3) Good The equipment, models and expertise are in place to run the proposed simulations. Several papers have been published in respectable journals that discuss elements of this proposal, the tasks as outlined are well thought out and the work schedule seems reasonable. However, NOAA Office of Global Programs is listed as a potential cost share partner of $450,000. If that funding does not materialize, the project could not be completed. Some tasks identified (Task 1.2 and 1.3) will use Folsom Lake as a test case, and it is stated that those approaches will be extended to other sites if the models work. It is not stated what happens if the Folsom Lake test cases do not work.

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?

   3) Good The performance measure is how well the models work to forecast flows. Reliability scores were generated for Folsom Lake inflows, based on observed and forecast values. The same measure could be applied to the models at all the reservoir sites. Specific performance measures for each task are not listed.

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?

   4) Very Good The main product of the project would be a decision tool to increase the accuracy of forecasting flows in a complex reservoir system. The benefit of this project to the resources and communities is a more efficient use of water, based on an evaluation of trade-offs of competing needs and the prediction of volumes and timing of runoff. Improved reservoir

operations should result.

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?

   1) Excellent The authors have worked in this field for many years, and have many publications on related subjects in rigorous, peer-reviewed journals. Letters of support from cooperating agencies illustrate confidence in the authors' abilities to carry out this work

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

   1) Excellent. The proposal is requesting $200,000 per year for three years. This is a reasonable cost, considering the time involved by the principal investigators to complete this model.

Miscellaneous comments:

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External Scientific: #3

Research and Restoration External Scientific Review Form

Proposal Number: **85**

Applicant Organization: **Hydrologic Research Center**

Proposal Title: **INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources**

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:

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**
XExcellent	**This proposal is ambitious and the challenges will be signficant. The applicants are well qualified to undertake the project, but as with any research project, unknowns abound. The product from the project will be of great interest to many parties, most specifically the large federal or state agencies that manage these reservoirs. I have some doubts that integrated management will succeed even if the project demonstrates benefits because of institutional and territorial interests. However, if downscaling of GCM's and the inclusion of climate indicators is shown to work even on the single reservoirs operations, that may cause that technique to be adopted, and that alone could yield major benefits in these very large, multi-year storage reservoirs.**
-Good	
-Poor	

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

   The goals, objectives, and hypotheses are stated in the Exec Summary, and in sections 2 through 5. The concept of linking major reservoir systems to provide a unified water managment strategy is important, and with the advances in global climate modeling, the concept is timely. This type of work is just beginning in terms of coupling GCMs with

large-basin hydrologic models, and to attempt to incorporate the operational characteristics of large reservoirs is an important step forward.

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 a clear advance relative to existing knowledge. Section 5.2 clearly outlines the major components of the conceptual model, and provides some examples of the different aspects as they are being tested in other parts of the country. The underlying basis for the proposed work is not described in extreme detail, but adequate references are supplied, and researchers familiar with the area would have no trouble understanding what is being proposed. The project is midway between a pilot and a full-scale implementation. It has been tried as a pilot on one of the four reservoirs, and it is proposed to be expanded to include the four major reservoirs in the river basin and to evaluate and research the interactions between them.

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 appears to have a thorough sense of design and integration, and in that it tiers off the pilot project, it should meet the objectives. The results will be very interesting, and if the project succeeds, may add to the base of knowledge. I expect that novel approaches will be required to codify the operations at the various reservoirs into uniform sets of rules that can be quantified into objective functions. The results from the 5-year study will be of great interest to decision-makers either because it will demonstrate what level of benefit might be obtained from integrated operations of four major reservoirs, or it will demonstrate that the complexity is such that the goal of integated management is not yet achievable.

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 reasonably well documented, and it appears that it is technically feasible. The authors have extensive experience in this field, and have demonstrated the ability of solve complex systems problems in past research. There are several sections in Section 5.4, Main Research Tasks, where the phrase ".... then the other sites if Folsom works" is used. This type of problem is characteristically difficult to fully specify. The authors will have to employ considerable creativity to overcome the complexity of the system. The likelihood of success is difficult to quantify because simplifications that may have to be made may jeopardize the analytical capability of the product. The authors have a good track record with past efforts, so the likelihood of success is certainly better than 50%. The scale of the project (4 reservoirs) is probably large but is required to address the river basin macro scale objective.

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 project includes numerous assessment tasks to evaluate the relative success of the decision support system compared to the historic operational regime. The combined assessment program is not as well specified, but a similar protocol could be used to determine if benefits

from integrated operations are occurring. This is not a restoration project, and does not include monitoring, but instead compares historic actual operations versus simulated operations given then-current operational information versus "perfect" operational outcomes.

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 principal product is the integrated management evaluation, combined with possible benefits from demonstrating that GCMs can produce improved reservoir operatons and benefits from improving communications between the major players in the reservoir operations business. If significant benefits are identified through simulation of historical operations, then it will be clear that a similar GCM-based integrated managment protocol and methodology should be developed to promote integrated managment of the reservoirs.

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 applicants appear to be well qualified to pursue this line of inquiry. All three co-PI's have extensive publications and experience in this line of research. Although there is not extensive information on the infrastructure associated with the two reseach centers, past performance suggests that they efficiently support research programs.

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

   The budget appears reasonable. The salaries do not appear excessive, and the overhead rates are not out of line with what is commonly charged. The multi-source funding appears to be in place and to leverage the CalFed dollars. While the total for the 5-year program is large, the scope and challenges of the project is similarly large.

Miscellaneous comments:

There are certainly tribal lands contained in the catchements that supply the major reservoirs that are modeled (Section 13 of the Project Information header page), but the project has no effect on those lands.

I always have concerns as to what happens on projects like this that are depending on funds from multiple sources. What if one of the sources fails to produce the "promised" funding? Does that lack of funding jeopardize the likelihood of success on the total project?

External Scientific: #4

Research and Restoration External Scientific Review Form

Proposal Number: **85**

Applicant Organization: **Hydrologic Research Center**

Proposal Title: **INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources**

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:

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	**The proposal is very complex and could be improved perhaps by decreasing its scope to an application and test for a longer initial period at two major reservoirs. The test needs to include weather/watershed runoff forecasts. Sufficient funding to help the researchers conduct technology training to operators is an important initial element.**
XGood	
-Poor	

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

   The primary objective of this proposal, as I see it, is really technology transfer from the academic world to actual water project management. This would take advantage of such weather forecasting skills as can be demonstrated in developing probabilistic watershed runoff in different detail for three ranges of time projections into the future. The goal of such a forecast-control framework is improved operation of several major test case reservoirs, seeking to demonstrate less flood control spill and more power and water supply benefits.

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?

   Potential benefits are large and relate largely to application of an ensemble of forecasts to develop reservoir inflows in different time frames and development of a reasonable operating strategy to use this information. While it is believed significant gains can be made, a demonstration (or a couple of demonstrations) for one or more reservoirs is necessary over several years to test and evaluate how much improvements over present practice there is and the risks associated with a different operational strategy.

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 proposal is to test and demonstrate what is essentially a statistical method of predicting reservoir inflows and evaluating and selecting operational strategy for 4 northern California reservoirs--Folsom, Oroville, Shasta, and Trinity. It may be better to first demonstrate application at Folsom, including the weather forecasting segment of the work, for several years to get a sampling of hydrologic events, then moving on to Oroville reservoir for demonstration before spending much effort on the 4 reservoir system. Trinity reservoir operation is significantly different because storage is about twice average annual inflow and downstream fishery needs (releases) are a significant source of uncertainty.

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?

   Since quite a bit of experimental work along the lines of the proposal has been done at Folsom reservoir, it makes a lot of sense to concentrate first efforts on the American River system while beginning a program of application on the Feather River and Oroville reservoir (assuming CVP and SWP operations people are willing to participate. Currently, reservoir operations staff don't really understand the methodology being proposed, particularly development of reservoir operating strategy, and much more is needed interaction between researchers and operators in practice. I note that the travel budget does include meetings in Sacramento with State and federal staff, but there may need to be even more such contacts.

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?

   Development of probabilistic reservoir inflow forecasts (ensembles) seems further along and will be easier for operators to understand and use, being not that different in concept in principle from current monthly and seasonal runoff forecasts. More interaction of researchers and operators (perhaps also involving Utah State, where the current experimental Folsom operation strategy was developed) is needed to adequately test the suggested approaches (which the applicants recognize). The researchers need to spend some time too in trying to better understand current reservoir operation practice and the constraints involved.

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 primary product is technology transfers from the academic realm to operations practice. The advent of more powerful local computers makes these sophisticated methods possible now. Implementing the proposal is a major undertaking and will require considerable investment in staff time by water management agencies. These researchers are forward-thinking and need to provide the workshops, lectures, and hands-on demonstration of their products during development. There are not usually a lot of opportunities during a water year to actual test decision making with the new methodology; getting a satisfactory test and evaluation could take 3 to 5 years.

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 research team have been working in the general field of operations research for a number of years and have been showing, in a number of instances, signigicant improvements in water project operation strategy. They are definitely quality people and should be able to produce some good results.

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

   Because of the enormous value in even modest improvements in major reservoir power, water supply, and flood control functions, the benefit/cost ratio should be high. If the applicants can get the financial support indicated from NOAA ($ 450,000), the CalFed money sought will be multiplied.

Miscellaneous comments:

The proposal may be too ambitious, although it is well to point ahead to the big picture. Emphasis should go toward developing and evaluating the ensemble weather/watershed runoff forecasting for Folsom and Oroville and evaluating that thoroughly for the first couple of years--realizing that some water years like 2001 and apparently 2002 so far don't provide much opportunity for testing. That may stretch out the time line for the envisioned total project. Another aspect is that a number of environmental spokespersons seem to believe that great improvements in reservoir operation are possible with modest rule changes which will ease our water supply and flood control problems. This reviewer thinks the systems are already quite efficient. Testing out these advanced methods with some actual operational systems would help answer the efficiency question.

Environmental Compliance:

Proposal Number: 85

Applicant Organization: Hydrologic Research Center

Proposal Title: INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources

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

   XYes **-**No

   If no, please explain:

   However, due to federal cost-share funds, the applicant should consult with the USFWS to see if NEPA compliance is 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:

   Unless NEPA compliance requires additional time and funds.

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: 85

Applicant Organization: Hydrologic Research Center

Proposal Title: INFORM - Integrated Forecast and Reservoir Management Demonstration for Northern California Water Resources

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:

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

   -Yes **X**No

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

   There are discrepancies even if you include the cost share funds.

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: