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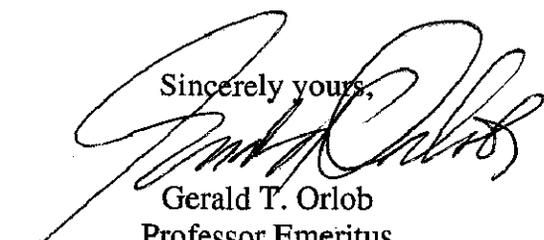
Ms. Kate Hansel
CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Dear Ms. Hansel,

Enclosed please find an original plus nine copies of an inquiry proposal titled, "Impacts of Multiple Stresses on Aquatic Habitat in the Sacramento River System." I will appreciate your evaluation of this inquiry proposal for consistency with the mission of the CALFED Bay-Delta Program.

If you have any questions, please call me at (916) 752-1424, or you may reach me via e-mail at gtorlob@ucdavis.edu. I look forward to receiving your reply.

Sincerely yours,


Gerald T. Orlob
Professor Emeritus
Civil and Environmental Engineering

Inquiry Proposal

**IMPACTS OF MULTIPLE STRESSES ON WATER QUALITY
IN THE SACRAMENTO RIVER SYSTEM:
TEMPERATURE AND HEAVY METALS**

Gerald T. Orlob and Ian P. King, Principal Investigators
Department of Civil and Environmental Engineering
University of California, Davis, CA 95616

A. Project Description

Aquatic habitat and in-stream water quality in the Sacramento River have been severely affected by development and management of water resources in the upper regions of the watershed. Reservoir operations in the Shasta - Trinity Division of the Central Valley Project (CVP) have been managed in attempts to meet temperature targets in the Sacramento River below Keswick Dam. However, during the hot summer and early fall months and especially during unusually dry years, water temperatures may exceed levels tolerated by more sensitive aquatic species present in the river, particularly during spawning of winter-run chinook salmon. These species may be exposed to conditions of elevated water temperatures during critical periods in their life cycle. Such conditions may be exacerbated during dry hydrologic years when increased demands on water resources exist. In addition to stresses related to elevated in-stream temperatures, these sensitive aquatic species may also experience a high risk of exposure to elevated concentrations of contaminants, particularly heavy metals, discharged with acidic mine drainage into Keswick Reservoir and carried in either dissolved or bound form to the Sacramento River throughout the year.

Primary Ecological Objectives

The primary ecological objectives of the proposed study are to provide estimates of anticipated ranges of water temperature and heavy metal concentrations, e.g. copper, that in combination may impose stress greater than either single stressor alone. This objective will be achieved through field observations combined with hydrodynamic and water quality modeling of Keswick Reservoir and the Sacramento River downstream to the confluence with the Feather River near Verona. These stressors will be quantified at various locations throughout the study reach and at times when heightened sensitivity of indigenous aquatic species, e.g., juvenile salmonids, makes them more susceptible to harm.

B. Project Approach and Schedule

The suggested project will combine field measurement and modeling components to provide analytical tools to facilitate efficient management and control of temperatures and acid mine drainage discharges to the Sacramento River. Meeting the above stated objectives will require completion of certain specific tasks, outlined as follows:

1. Assembly and review of relevant data and information. Available physical, chemical, water quality and meteorological data will be gathered for analysis, and evaluated for model application. Data gaps and deficiencies will be identified.
2. Field Monitoring. A field program will be implemented to obtain more detailed descriptions of water temperatures in the Sacramento River at selected locations, particularly in the critical reach between Keswick Dam and Red Bluff Diversion Dam.

3. Model Development. Hydrodynamic and water quality models of the Sacramento River and Keswick Reservoir have been developed in other projects and are available for use in more detailed studies of temperature and heavy metal transport in the system. The models will be adapted and refined to reflect additional information gained during the field monitoring program.
4. Model Calibration, Verification and Sensitivity Analysis. This phase of the study must be performed to ensure acceptable representation of the system by the models.
5. Model Application. A range of reservoir operation, contaminant discharge and meteorological conditions will be examined to quantify resulting water quality conditions in the Sacramento River, particularly coincident occurrences of combined stressors.
6. Documentation. A detailed report will be presented to discuss findings and describe the analyses of water temperature and metal concentration ranges expected at ecologically sensitive locations under given operation and contaminant loading conditions.

Schedule

It is anticipated that the study will be completed within two years from the date of project inception. The period of study will span two summers, allowing for sufficient gathering of field data during periods when elevated water temperatures are most likely to impose stress on the ecosystem.

C. Project Justification for CALFED Funding

This project meets the objectives of the CALFED Program to evaluate effects of combined stresses on aquatic habitat and in-stream water temperatures as they affect priority species of concern (i.e., winter- and spring-run chinook salmon) in the Sacramento River.

D. Budget Costs and Third Party Impacts

The estimated cost of the proposed project is \$150,000 for a two year period. No third party impacts are anticipated as a result of work conducted on this project.

E. Applicant Qualifications

Dr. Orlob, Professor Emeritus and Dr. King, Professor, in the Department of Civil and Environmental Engineering at the University of California, Davis, have extensive research and project experience in development and application of systems analysis techniques, especially mathematical models of surface water systems, for water quality management. Most recently, their research has focused on temperature control in northern California river systems including the Sacramento, Trinity, Feather, Shasta, and Klamath rivers and the Sacramento-San Joaquin Delta. They guide a team of doctoral and masters students experienced in field techniques and application of hydrodynamic and water quality models to riverine, lake, reservoir, and estuarine surface water systems.

F. Monitoring and Data Evaluation

Please see tasks outlined in Section B.

G. Local Support

The proposed project will greatly benefit from field monitoring equipment and expertise acquired during on-going projects at UC Davis. In addition, the investigators anticipate continued collaboration with the California Department of Fish and Game for limited field assistance, and other state and federal agencies for field data available for the Sacramento River watershed.