

DWR WATER POLICE
97 JUL 28 PM 1:34

**Expansion of a Decision Support System for
Real-time Water Quality Management
of the Lower San Joaquin River Basin**

— (Other Service: Water Quality)

Submitted to

**CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, CA 95814**

Proposed by

**Carl W. Chen, Ph.D.
Systech Engineering, Inc.
3180 Crow Canyon Pl., Suite 260
San Ramon, CA 94583
510-355-1780 (phone)
510-355-1778 (fax)
systecheng@compuserve.com**

in collaboration with

**San Joaquin River Management Program
Water Quality Subcommittee**

I. Executive Summary

a. Project Description and Primary Biological/Ecological Objectives

The project will expand an existing decision support system (DSS) developed in the San Joaquin River Real-time Water Quality Management Demonstration Project. The system contains models, databases, communication software all integrated in a Windows™ graphical user interface (GUI). The model in the existing DSS simulates discharge and salinity conditions along the main stem of the lower SJR. This project proposes to expand this model in two ways, (1) model domain will be extended upstream to the major storage reservoirs on east side tributaries and downstream from Vernalis to the estuary portion of SJR, and (2) model constituents will be expanded to include dissolved oxygen and streamflow temperature. The communication software will allow water managers to upload their planned operation schedule to a coordinator at DWR and to download model results from the coordinator, all through the Internet. The DSS-SJRB will allow water managers to coordinate their operations, to minimize the violations of SJR water quality objectives at the key compliance point near Vernalis, and to prevent high temperature and low dissolved oxygen situations harmful to fish migration. Working on a moving window of weekly forecasts and updates, the DSS-SJRB will allow the water managers to make adaptive management decisions on their flow release and diversion schedules so that water quality objectives are met and fish migrations are not blocked. The timely decisions may save water released during non-essential times for later release when fish migration occurs.

b. Approach/Tasks/Schedule

The project will build on the results of previous work. The existing GUI will serve as the starting point of development. The model domain will be extended downstream of Vernalis to include the estuary portion of SJR, for which an existing hydrodynamic-water quality simulation model of the City of Stockton will be used. The existing DSS model, an input-output mass balance model of SJR, will be expanded to include heat budget for temperature, and sink and source terms of dissolved oxygen. The database will be expanded to include meteorology, tides at the lower boundary, and also parameters contributing or consuming dissolved oxygen. Application of the DSS-SJRB will be made through the stakeholders' forum organized by DWR.

The project will have 6 tasks: coordination, program development, data compilation and model calibration, beta testing, revision of final product and reporting. Coordination will be made through DWR's SJR Real-time Water Quality Management Program. Program development will include new software to download meteorological data and to provide an automatic interface between the river and estuary models. The hydrology and water quality data will be derived from DWR's California Data Exchange Center and new monitoring programs. The meteorological data will be derived from the California Irrigation Management Information System. The models will be calibrated with hydrology, temperature, dissolved oxygen, and salinity data.

The beta version of DSS-SJRB will be completed in the first year. The second year will be devoted to testing by DWR and SJR stakeholders. Many workshops will be conducted to promote its use. Comments and suggestions for improvement will be solicited from users. The final version will be delivered at the end of the second year.

c. Justification for Project and Funding by CALFED

The delta ecosystem is under stress. Why? Many reservoirs, wetlands, irrigation diversion, and drainage structures have been built. Operational rules for those structures have been developed to maximize the benefit for their original purposes, often at the expense of ecosystem and thus the ecosystem stress. To relieve the stress, it is important to develop operational rules that consider the ecosystem protection. This project will take the first step in that direction by expanding a tool to provide information on the environmental consequences of various water management activities. Such information may be used by water managers to modify and coordinate their operations so that water quality objectives are met and stress to fish migrations are eliminated. For this reason, this project deserves the CALFED funding support.

d. Budget Costs and Third Party Impacts

The project is expected to cost \$350,000, of which 50,000 dollars are allocated to the collaborators. The first year's budget is 200,000 dollars. No negative third party impacts are identified at this time.

e. Applicant Qualifications

The applicant has 30 years experience in water quality modeling. Recently, the applicant developed the DSS GUI under contract with DWR for the SJR Real-time Water Quality Management Demonstration Project. Additionally, the applicant developed an estuary model of the SJR for the City of Stockton, and the Watershed Analysis Risk Management Framework (WARMF), which contains models to simulate hydrology and water quality of the Catawba River Basin in North and South Carolina.

f. Data evaluation

The project will provide an integrated interpretation and presentation of flow and water quality data collected in the San Joaquin River Real-time Water Quality Management Program.

g. Local support

The product of this project will be turned over to DWR and SJR stakeholders for use. During the developmental stage, consultation and coordination meetings will be held with local agencies to receive their input and to ensure their early buy-in of the final product.

II. Title Page

a. Title of Project: Expansion of a Decision Support System for Real-time Water Quality Management of the Lower San Joaquin River Basin (DSS-SJRB)

b. Name of Applicant:

Carl W. Chen, Ph.D.
Systech Engineering, Inc.
3180 Crow Canyon Pl., Suite 260
San Ramon, CA 94583
Phone: 510-355-1780
Fax: 510-355-1778
Email: systecheng@compuserve.com

c. Type of Organization: private engineering corporation

d. Tax Identification Number : 94-2863956; Engineering License CE 20579

e. Contact : same as in b.

f. Collaborators:

Water Quality Subcommittee of San Joaquin River Management Program

Jo Anne Kipps, California Department of Water Resources (San Joaquin)
Earle W. Cummings, California Department of Water Resources
Leslie Grober, Central Valley Regional Water Quality Control Board
Nigel Quinn, US Bureau of Reclamation/Lawrence Berkeley Laboratory

g. RFP Project Group Type: other services - water quality.

III. Project Description

a. Project Description and Approach

The SJR and its tributaries provide important spawning habitats for such anadromous fish as salmon, steelhead trout, striped bass, sturgeon, and American shad. Fish migration to and from SJR can be blocked by poor water quality such as high temperature and low dissolved oxygen concentrations. Influences to SJR water quality includes reservoir releases, wetland releases, irrigation diversions, irrigation drainage, groundwater accretion, waste discharges and meteorological conditions. The premise of this project is that SJR water managers can coordinate their flow releases or diversions in such a way that SJR water quality objectives are met and the blockage of fish migrations does not occur.

The project will develop a decision support system for the San Joaquin River Basin (DSS-SJRB) to facilitate the coordination. The multiple tasking DSS-SJRB will contain *Internet-based communication software for water managers to upload their operational schedules to coordinator at DWR, who will use the DSS-SJRB to retrieve real-time water quality data from various monitoring stations in SJR and to download operational schedules through the Internet.* With the input of real-time water quality data and planned operational schedules, the coordinator can use the models embedded in the DSS-SJRB to forecast discharge, temperature, dissolved oxygen, and salinity in SJR. The results can be posted in a home page or a FTP site of the Internet for all project participants to review. If the predicted water quality meets the water quality objectives and not result in high temperature or low dissolved oxygen, the planned operations can proceed. If not, the coordinator, together with water managers, can use the DSS-SJRB to find alternate release and/or diversion schedules to improve water quality.

The DSS-SJRB will have a Windows™ graphical user interface (GUI) to integrate the model, database, and *communication software.* The *easy-to-use GUI* will facilitate the weekly update of operation schedules to accommodate changing weather conditions, fish migration, reservoir storage, and wetland operations.

The basic design of the DSS-SJRB will follow the GUI developed for the SJR Real-time Water Quality Management Demonstration Project. A number of changes will be made. In order to include the location where low dissolved oxygen and high temperature may occur, the model domain will be extended downstream from Vernalis to the SJR estuary. In order to have a better handle on the relationship between reservoir releases and tributary inflows to the main stem of SJR, the model domain will be extended to include east side tributaries (i.e., Stanislaus River up to New Melones Reservoir, Tuolumne River up to New Don Pedro Reservoir, and Merced River up to Lake McClure).

The model will have two parts: a river model to cover the SJR system upstream of Vernalis and an estuary model to cover the SJR downstream of Vernalis to Stockton ship

channel. The river model will be physically based and have the input-output and mass balance approach used by the SJRIODAY model which was developed by Les Grober of Central Valley Regional Water Quality Control Board. The new river model will include a heat budget for temperature simulations and an algorithm for sinks and sources of dissolved oxygen, used in Systech's dynamic water quality model. The estuary model will be adopted from the simulation model of the City of Stockton, which was developed by Systech. The interface between the two models will automatically be handled by the GUI.

The database for the existing river model provides for real-time simulation of discharge and salinity. Real-time meteorological data will be added to support the heat budget calculations, and other data will also be added to support the simulation of dissolved oxygen. The database for the estuary model also exists for the simulation of other water quality parameters (e.g., biochemical oxygen demand, dissolved oxygen, ammonia, algae, temperature, and dissolved oxygen). Both models have already been calibrated to some extent. The newly assembled models will be tested and calibrated with both existing data as well as new real-time monitoring data to be collected by the SJR Real-time Water Quality Management Program. The DWR's program will also serve as a platform for SJR stakeholders to use the DSS-SJRB.

b. Location and/or geographic boundaries of project.

Figure 1 shows the geographic coverage of SJR model, taken directly from the GUI of the SJR Real-time Water Quality Management Demonstration Project. Figure 2 shows the geographic coverage of the City of Stockton's hydrodynamic-water quality simulation model. The new DSS-SJRB will combine and expand these two models. The geographic coverage will extend upstream to the dams of New Melones Reservoir, New Don Pedro Reservoir, and Lake McClure; to the Lander Avenue Bridge on the SJR; and will include Mud Slough and Salt Slough. The downstream end of the new DSS-SJRB will be Light 18 of the Stockton Ship Channel.

Figure 3 presents the geographic coverage of this proposal and other related proposals of the DWR's San Joaquin River Real-time Water Quality Management Program. The related proposals are submitted to CALFED by a group of individuals and agencies that are coordinating their water quality monitoring and management efforts. The following is a brief description of these proposals.

The San Joaquin River Real-time Water Quality Management Program proposal will use telemetered stream stage and salinity data and computer models to simulate and forecast water quality conditions along the lower SJR. The primary benefit of this project will be to increase the frequency of meeting SJR water quality objectives for salinity. Real-time Water Quality Management of Wetland Drainage Releases proposes to monitor wetland discharges in conjunction with adaptive management actions to reduce the adverse impacts from wetland discharge on lower SJR water quality. Assessment of the Stanislaus River Corridor Below Goodwin Dam proposes to identify the processes that



Figure 1. Geographic Coverage of San Joaquin River Real-time Water Quality Management Program

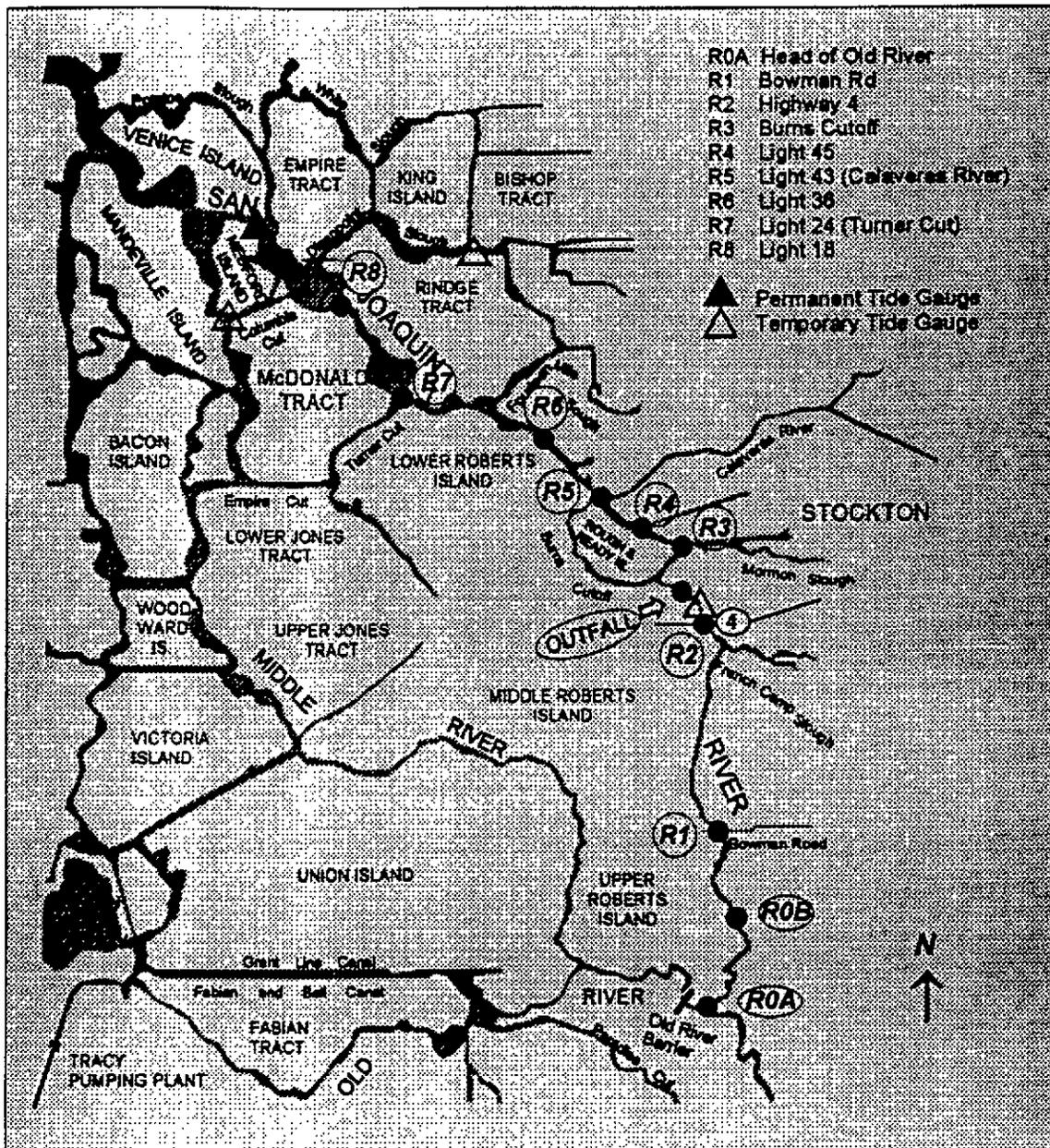


Figure 2. Geographic Coverage of the San Joaquin River Model of the City of Stockton

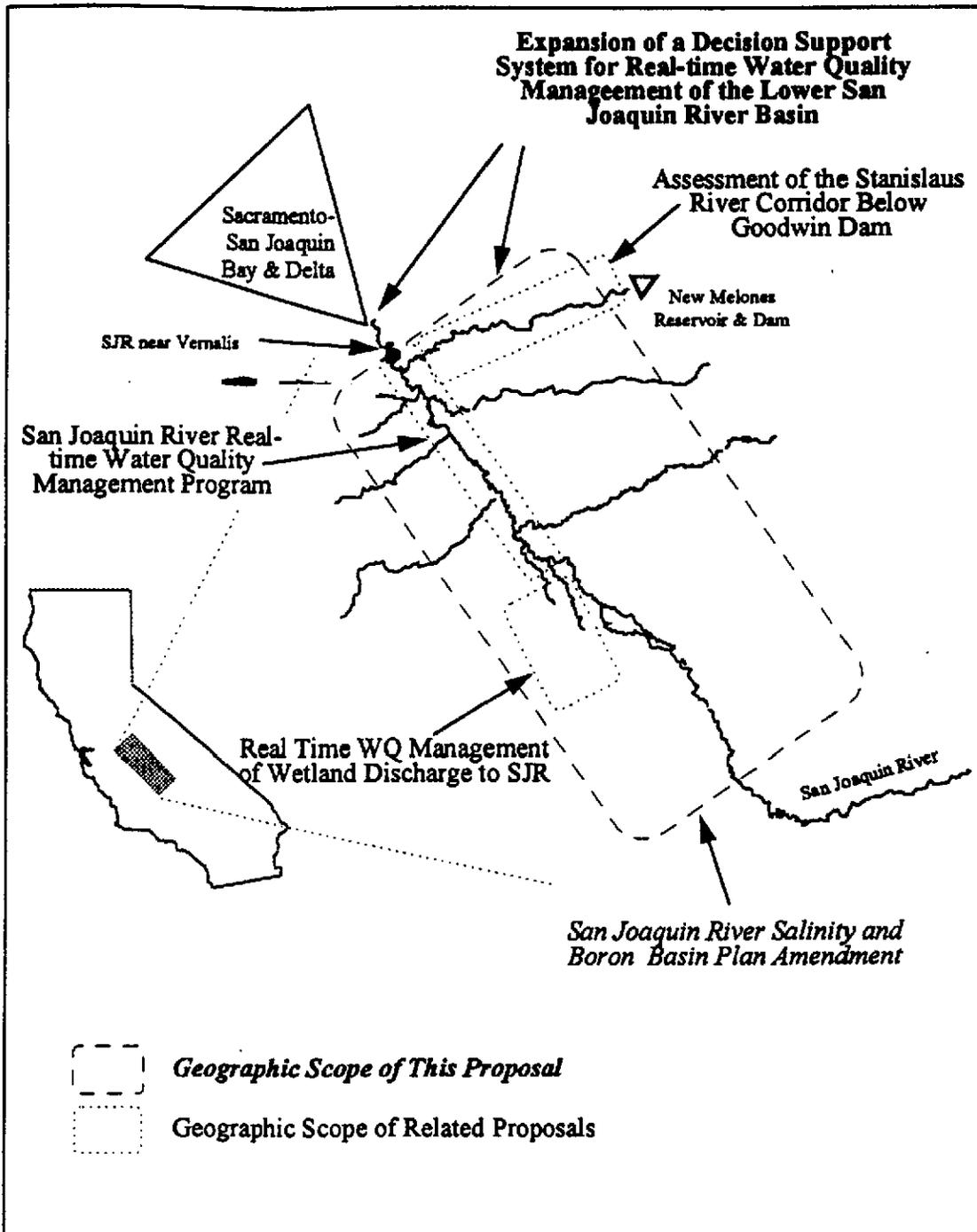


Figure 3. Geographic Scope of This Proposal and Other Related Proposals.

contributed to the river's existing condition, and to evaluate how such conditions affect the adaptive management of fall run chinook salmon. Expansion of a Decision Support System for Real-time Water Quality Management of the Lower San Joaquin River Basin proposes to expand the geographic scope and water quality parameters considered in the San Joaquin River Real-time Water Quality Management Program's current modeling effort. New model parameters include temperature and dissolved oxygen and the new geographic scope includes the east side tributaries upstream to the major reservoirs and downstream to Stockton Ship Channel.

Activities of these individual programs will be coordinated by members of the San Joaquin River Management Program Water Quality Subcommittee. Data will be freely exchanged between the participating agencies and duplication of effort will be minimized.

c. Expected benefits.

The DSS-SJRB will allow SJR water managers (e.g., reservoirs, wetlands, irrigation diversions, and agricultural drainers) to coordinate their efforts to meet the water quality objectives of SJR, and to prevent conditions of high temperature and low dissolved oxygen that may block the migration of anadromous fish. The DSS-SJRB, to be operated on moving windows of weekly forecasts and updates, will provide timely information for managers to make adaptive decisions, accounting for the ever changing conditions in weather, reservoirs, wetlands, croplands, and fish migration. The coordination among water managers may lead to saving of water releases during non-essential time for release at a later time when fish migration occurs.

d. Background and Biological/Technical Justification

With a challenge grant from the Bureau of Reclamation, Systech and its collaborators (i.e., SJRMP Water Quality Subcommittee) have developed a decision support system for SJR real-time water quality management. The existing system has hardware and software components. The hardware component consists of the SJR Water Quality Monitoring Network — selected monitoring stations in the lower SJR basin to measure real-time stage, electrical conductivity, and temperature. The software components contains a Windows™ graphical user interface (GUI), water quality model, database, and Internet-based communication software for water managers to upload their operational schedules to the coordinator at DWR, who then downloads this operational data to run the existing model, and post the results on the Internet for water managers to download. Presently, the retrieval of Network real-time water quality data from monitoring stations is performed outside of the GUI.

Encouraged by the success, the DWR San Joaquin District is submitting a proposal entitled "San Joaquin River Real-time Water Quality Management Program" to CALFED. This proposal includes expanding the hardware to include temperature and conductivity monitoring at more Network stations.

Meanwhile, Systech has developed an estuary hydrodynamic and water quality model of SJR extending from the confluence of Old River to Light 18 of Stockton Ship Channel (Figure 2). The dynamic model tracks the tidal movement of river water back and forth, and the concentrations of such water quality parameters as biochemical oxygen demand, ammonia, temperature, algae, and dissolved oxygen. The model, which has been calibrated and verified with many years' data, has been used to evaluate the impacts of Stockton waste discharges as well as the effects of flows passing the rock (fish) barrier, under the Interim South Delta Program and the 1995 CALFED Accord.

As a part of the effort, Systech recognized the importance of accurate flow predictions on the water quality simulation of SJR. Systech has recommended and the City of Stockton has installed a gaging station near Stockton's outfall. The gaging station will provide real-time flow data to the proposed DSS-SJRB.

It is well known that anadromous fish uses the SJR and its tributaries for spawning habitat. The up-migration of adults and the down-migration of juveniles must pass through the tidal section of the SJR. The fish migration may be blocked in this section by conditions of elevated temperature or depleted dissolved oxygen. For this reason, it is proposed to extend the model downstream of Vernalis and to include temperature and dissolved oxygen in the water quality management objectives. The proposed DSS-SJRB will allow water managers to coordinate their operations to minimize the conditions harmful to fish migration.

e Proposed Scope of Work

The concept and feasibility for SJR real-time water quality management were demonstrated in work by the SJRMP Water Quality Subcommittee. The scope of work in this proposal will include, but not be limited to, the following:

1. Developmental program: add east side tributaries to the main stem of San Joaquin River; add algorithms for temperature and dissolved oxygen simulation; add communication software to download climate data from California Irrigation Management Information System; add communication software to download hydrology and water quality data from California Data Exchange Center; add stochastic synthesizer to forecast weather conditions; add the SJR estuary model; add an automatic interface between the river and estuary models; and, revise the GUI display to cover the entire geographic area for both tidal and non-tidal sections of the SJR.
2. Model calibration: select time period of data for calibration and verification; compile data; show that the models can simulate the observed data, and calculate errors of simulation.

3. **Coordination:** conduct workshops to promote the use of expanded DSS for SJR real-time water quality management, receive suggestions for improvement, and attend meetings to coordinate efforts among the DWR program and related projects.
4. **Beta testing:** transfer the beta version of the program to DWR for beta testing by the coordinator and project participants.
5. **Final product:** revise the final product for delivery to CALFED and DWR.
6. **Reports:** prepare quarterly progress reports, an annual report, and a final report. Monthly invoices will be submitted.

Items 1, 2, 3 and 6 will be done in the first year. Items 3, 4, 5 and 6 will be done in the second year.

f. Monitoring and Data Evaluation.

The project is interrelated with DWR's SJR Real-time Water Quality Management Program. Flow, temperature, dissolved oxygen, and EC (salinity) data collected in DWR's program and its related projects will be used in model calibrations. The flow and water quality data from the City of Stockton will also be used. In addition, the models can be used to evaluate the impacts of best management practices to be implemented on the farms and feed lots in Stanislaus, San Joaquin and Merced counties through the Environmental Quality Improvement Program of the US Natural Resources Conservation Service.

g. Implementability

This project will help stakeholders meet the SJR water quality objectives for salinity. It will also help them prevent conditions of high temperature and low dissolved oxygen that are harmful to fish migration. Implementation requires only operational changes; no structural solution is involved. It requires cooperation among water managers, whose input will be solicited and considered in the development of the proposed DSS-SJRB. There is no question that the proposed DSS-SJRB can be developed and successfully implemented.

IV. Cost and Schedule

a. Budget Costs (2 years).

Task 1. Program Development		
Principal	300 hrs @ 110\$/hr	33,000\$
Engineers	1000 hrs @ 78\$/hr	78,000
Task 2. Data compilation and Model Calibration		
Principal	60 hrs @ 110\$/hr	6,600
Engineers	600 hrs @ 78\$/hr	46,800
Task 3. Coordination Workshops		
Principal	50 hrs @ 110\$/hr	5,500
Engineers	50 hrs @ 78\$/hr	3,900
Contract service		10,000
Task 6. Reports		
Principal	100 hrs @ 110\$/hr	11,000
Engineers	50 hrs @ 78\$/hr	3,900
Miss Expenses		1,300
Total for year 1		<u>200,000\$</u>
Task 3 Coordination workshops		
Principal	150 hrs @ 110\$/hr	16,500
Engineers	150 hrs @ 78\$/hr	11,700
Contract service		25,000
Task 4 Beta Testing		
Engineers	100 hrs @ 78\$/hr	7,800
Contract service		15,000
Task 5 Revisions of Final Product		
Principal	100 hrs @ 110\$/hr	11,000
Engineers	600 hrs @ 78\$/hr	46,800
Task 6 Reports		
Principal	100 hrs @ 110\$/hr	11,000
Engineers	50 hrs @ 78\$/hr	3,900
Miss Expense		1,300
Total Year 2		<u>150,000\$</u>

The contract service is to pay for the collaborators' time and expenses. The billing rates are fully burdened by employee fringe benefit and payroll related taxes, overhead, general administrative cost and fee.

b. Schedule Milestones

12th month - beta version of the proposed DSS-SJRB, complete with calibrated models, database, and communication software.

24th month - technology transfer of the final DSS-SJRB to CALFED and DWR.

c. Third Party Impacts

There are no negative impacts on the third party. To use the product, DWR needs to establish a staff position as the coordinator of operations. The organizational structure and the agreement to cooperation among water managers are being established in San Joaquin River Real-time Water Quality Management Program. When it is successfully implemented, the stakeholders may be able to fulfill their operational goal and at the same time save some water in non-essential period for fish release when needed. It will be a win-win situation for all parties.

V. Applicant Qualifications

Systech Engineering, Inc. is a water resources and environmental engineering company founded in 1983. Its principal has 30 years' experience in hydrodynamic and water quality modeling of lake, river, and estuary. The company has registered as a DBE and SDBE with Caltrans and a small business with the Office of Small and Minority Business. The certifications from both agencies can be found at the end of the proposal. The expiration date for the latter certificate is July 31, 1997. The application for renewal was submitted June 10, 1997. The new certificate is expected any time soon.

Systech is staffed with water resources, chemical, and environmental engineers with strong background in meteorology, hydrology, oceanography, chemistry, biology, mathematics and computer sciences. They are skillful in data acquisition, database management, statistics, modeling, integrated analysis, and decision support systems. They are familiar with environmental regulations and are expert programmers for Windows graphical user interface, GIS, and graphics.

Relevant experience includes the development of the Windows™ GUI for the SJR Real-time Water Quality Management Demonstration Project, funded by a \$250,000 Challenge Grant from the US Bureau of Reclamation. This project will improve the GUI so that water managers may coordinate their efforts to prevent conditions of high temperature and low dissolved oxygen, which may block fish migration.

For the City of Stockton, Systech has developed a hydrodynamic-water quality model to simulate for the estuary section of SJR numerous water quality parameters (i.e., temperature, phosphorus, ammonia, nitrate, algae, biochemical oxygen demand, and dissolved oxygen), as shown in Figure 2. This model has been calibrated and verified with data from 1988 to 1993 and recently with 1996 data as well. At the request of State Water Resource Control Board (for CALFED), this Systech model is now used to

evaluate the water quality impacts of Interim South Delta Program, which proposes to install and operate permanent fish barrier at the Old River Junction. In this project, we propose to incorporate the model and its database into the new decision support system.

Systech has developed a stochastic synthesizer for time series of meteorological data. It is based on replacement sampling of historical records, called boot-strapping technique. The method has successfully been used to forecast time series of weather conditions, which are used in turn by the watershed model to forecast tributary inflows to Lake Sabrina and North Lake in the Bishop Creek Hydro Electric System of Southern California Edison. In this project, we propose to adopt the technique to provide the weekly forecast of climate conditions for the Central Valley.

Systech is a pioneer in watershed management. It has developed the Watershed Analysis Risk Management Framework (WARMF). WARMF is a decision support system that contains a consensus module and an engineering module, integrated in a Windows™ GUI. The consensus module provides a road map to guide stakeholders to make informed decision on a watershed management plan. The engineering module simulates watershed hydrology, nonpoint source loads (cities, farms and feedlots), and water quality of rivers and lakes in response to various management scenarios of point and nonpoint loads. The model, which is readily adaptable to the lower San Joaquin River Basin, performs dynamic flow routing and simulation of temperature, suspended sediment, nutrient series, algae, dissolved oxygen, etc. It is being applied to the Catawba River basin, extending from North Carolina to South Carolina

Systech proposes to assign its president, Carl W. Chen, as principal investigator of the project. He will be supported by the engineering staff of Joel Herr, Wanteng Tsai, and Laura Ziemelis. In addition, the project collaborators will help promote the application of real-time water quality management and beta testing of the program. The collaborators include Jo Anne Kipps and Earle Cummings of DWR, Les Grober of California Regional Water Quality Control Board, and Nigel Quinn of Lawrence Berkeley National Laboratory.

Carl W. Chen received MS and Ph.D. degrees from the University of California, Berkeley. He has 30 years' experience in water quality modeling. With Dr. G.T. Orlob, he pioneered the development of water quality ecological models of Lake Washington and San Francisco Bay. He directed the development of Windows™ GUI for the SRJ Real-time Water Quality Management Demonstration Project, the development of SJR Estuary Model, and the development of weather and flow forecasting system for Bishop Creek Hydro Electric System of Southern California Edison. He is well qualified to lead the project. As principal investigator, he will be actively involved in all tasks. He will lead all coordination workshops, direct the program development and model calibration, supervise program revisions, and prepare reports. He will make sure that the project is on time and within budget.

Joel Herr earned a M.S. degree in Water Resources/ Environmental Engineering from the University of Colorado, Boulder, CO. He has 7 years' experience. He conducted research at the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) at the University of Colorado. He was responsible for developing the Windows™ GUI for the SRJ Real-time Water Quality Management Demonstration Project. He developed the consensus module for watershed management. For this project, he will be involved in the program development of GUI for the proposed DSS-SJRB.

Wanteng Tsai earned his M.S. and Ph.D. degrees in Chemical and Environmental Engineering from Rensselaer Polytechnic Institute, Troy, NY. He has 10 years' experience. Dr. Tsai has worked on the estuary model of SJR. He is currently using it to evaluate the water quality impacts of Interim South Delta Program and the 1995 CALFED Accord. He has applied WQRRS to predict temperature of Pardee and Camanche reservoir releases. In both projects, he downloaded many hydrologic, water quality, and meteorological data from DWR's databases (i.e., California Data Exchange Center, California Irrigation Management Information System, and Interagency Ecological Program). For this project, he will be responsible for databases and estuary model of SJR, and will develop the interface between the river and estuary models.

Laura H. Ziemelis earned a B.S.E. degree in Civil Engineering from the University of Michigan at Ann Arbor and a M.S. degree in Civil Engineering, from the University of Colorado, Boulder. Ms. Ziemelis has 3 years' experience. She conducted research at the Center for Advanced Decision Support for Water and Environmental Systems, where she designed, implemented, and tested engineering methods for PRSYM, a power and reservoir operational model of TVA system. She was involved in the calibration of watershed, river, and reservoir models to the Catawba River Basin. She has published "Consensus Module to Guide Watershed Management Decisions for the Catawba River Basin", a paper presented at the 1997 International Clean Water Conference, March 25-27, 1997, Baltimore, Maryland (with Chen, Griggs, Olmsted, Herr, and Goldstein). For this project, she will be responsible for database, and the development and calibration of river model for SJR.

In addition to its own staff, the project will collaborate with members of SJRMP's Water Quality Subcommittee, who will assist Systech line up potential users of the DSS-SJRB and promote its usage by stakeholders. They will assure that the project direction is consistent with the goal of SJR Real-time Water Quality Management Program. They, particularly Jo Anne Kipps, Nigel Quinn, and Les Grober, will quality assure the program before the beta version is released to water managers for further testing.

To our knowledge, there are no potential conflicts of interest for Systech, its staff, and collaborators to undertake the project.

VI Compliance with Standard Terms and Conditions.

The terms and conditions stipulated in CALFED RFP are agreeable to us. Systech is an equal opportunity employer. The nondiscrimination compliance statement is enclosed.

NONDISCRIMINATION COMPLIANCE STATEMENT

COMPANY NAME

System Engineering, Inc.

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME

Carl W. Chen

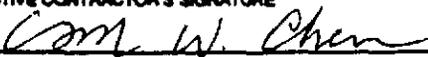
DATE EXECUTED

July 23, 1997

EXECUTED IN THE COUNTY OF

Contra Costa County

PROSPECTIVE CONTRACTOR'S SIGNATURE



PROSPECTIVE CONTRACTOR'S TITLE

President

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME

System Engineering, Inc.

CCCCCCCC TTTT
CCCCCCCC TTTT
CCCC TTTTTTTTTTTTTT
CCCC TTTTTTTTTTTTTT
CCCCCCCC TTTT
CCCCCCCC TTTT TTTT
TTTTTTTT

DEPARTMENT OF TRANSPORTATION
Business Enterprise Program

PO BOX 942874 - MS 79
SACRAMENTO, CA 94274-0001
(916) 227-9599

CALTRANS

Certification Number: CT-005360
Certifying Agency: CALTRANS
Expiration Date: 05-01-1999
Contact Person: CARL CHEN

ASIAN PAC
MALE
CORPORATION

(510) 355-1780

--- * CERTIFIED PROGRAMS ---
DBE SMBE

Attention: CARL CHEN
SYSTECH ENGINEERING, INC.
3180 CROW CANYON PLACE, SUITE 260
SAN RAMON, CA 94583


CERTIFICATION MANAGER, BUSINESS ENTERPRISE PROGRAM

-----Post in Public View-----

CERTIFICATION MUST BE RENEWED 120 DAYS PRIOR TO EXPIRATION DATE.---

It is your responsibility to:

- Apply for Recertification on a Timely Basis.
- Review this notification for accuracy and notify Caltrans in writing of any necessary changes.

-----Preferred WORK LOCATIONS-----

01 ALAMEDA	07 CONTRA COSTA	21 MARIN	28 NAPA
38 SAN FRANCISCO	41 SAN MATEO	43 SANTA CLARA	44 SANTA CRUZ
49 SONOMA			

-----Preferred WORK CATEGORIES and BUSINESS Types-----

C1701 DEVELOP WATER SUPPLY	SE	C2030 EROSION CONTROL	SE
C2065 IRRIGATION SYSTEM	SE	C8700 CONSULTANT	SE
C8707 FEASIBILITY STUDIES	SE	C8710 ENGINEERING	SE
C8720 CIVIL ENGINEERING	SE	C8722 ENVIRONMENTAL ENGINEER	SE
C8730 SAFETY STUDIES	SE		

- * Only certified DBE's may be utilized to meet Federally funded contract goals.
- Only certified SMBE or SWBE's may be utilized to meet State funded contract goals.
- Only certified CFMBE or CFWBE's may be utilized to meet Century Freeway contract goals.

DEPARTMENT OF GENERAL SERVICES

OFFICE OF SMALL AND MINORITY BUSINESS
1531 I STREET, SECOND FLOOR
SACRAMENTO, CA 95814-2016



April 18, 1995

PIN #464980
SYSTECH ENGINEERING INC
3180 CROW CANYON PL #260
SAN RAMON CA 94583

Dear Businessperson:

The Office of Small and Minority Business (OSMB) conditionally approves your firm's small business certification request effective 08-18-94 through 07-31-97. This certification enables your firm to use the 5% bidding preference on state government contracts according to the Small Business Procurement and Contract Act. Reverification of status may occur any time the OSMB deems appropriate. The small business certification is **ONLY** applicable to the following industry group(s) within the designated business type(s):

<u>Business Type(s)</u>	<u>Industry Group(s)</u>	<u>Description</u>
Service:	(iv)	Architects, Engineers and Survey Services
	(xxv)	Misc. Services (NEC)

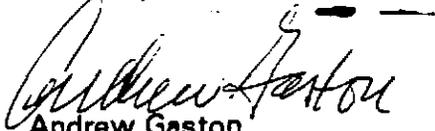
1. Current small business certification status requires:
 - A. **Annual** submission of the following items:
 - Notarized "Affidavit of Income" (AI) form (enclosed) for the applicant and each affiliate in lieu of Federal Tax Returns (FTRs). **The AI must be submitted at the conclusion of each firm's tax year and is only valid for 90 days.** If the FTRs cannot be provided within 90 days, submit a photocopy of a valid Federal Tax Extension for each FTR filed.
 - **SIGNED** FTRs as submitted to the Internal Revenue Service (IRS) for the applicant and each affiliate.
 - B. Written notification of **any** change of address, signed by an owner/officer.
 - C. **ALL** changes in business name, structure or ownership **require** completion of a new Std. 812 (formerly OSMB Form 11).
2. Upon being awarded a state contract, your firm can participate in the Prompt Payment Act Program. Submit the following to the OSMB to receive a rubber stamp:
 - A. A written request to the OSMB for the rubber stamp;

- B. A copy of a current state contract or purchase order soliciting services from the applicant;
- C. A \$15.00 check/money order made payable to the Department of General Services.

A high grade rubber stamp with a corresponding PIN number will be ordered by the OSMB. Once received, the stamp and instructions for its use will be sent.

The OSMB will send a renewal application prior to expiration of your small business certification. Thank you for doing business with the State.

Sincerely,


Andrew Gaston
Programs/Certification Officer
(916) 324-4725

AG:sjc

Enclosures

**Expansion of a Decision Support System for
Real-time Water Quality Management
of the Lower San Joaquin River Basin**

(Other Service: Water Quality)

Submitted to

**CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, CA 95814**

Proposed by

**Carl W. Chen, Ph.D.
Systech Engineering, Inc.
3180 Crow Canyon Pl., Suite 260
San Ramon, CA 94583
510-355-1780 (phone)
510-355-1778 (fax)
systecheng@compuserve.com**

in collaboration with

**San Joaquin River Management Program
Water Quality Subcommittee**