

Up-Migration and Straying of Tuolumne River Salmonids in Response to Fall Attraction Flows and Environmental Factors

Project Information

1. Proposal Title:

Up-migration and straying of Tuolumne River salmonids in response to fall attraction flows and environmental factors

2. Proposal applicants:

Dr. Noah Hume, Stillwater Sciences

3. Corresponding Contact Person:

Dr. Noah Hume
Stillwater Sciences
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510 848-8098 x129
noah@stillwatersci.com

4. Project Keywords:

Anadromous salmonids
Dissolved Oxygen
Estuaries and Estuarine Modeling
Hydrology
Natural Resource Management
River Basin Management
Salmon/Steelhead Biology
Water Quality Assessment & Monitoring
Water Resource Management

5. Type of project:

Research

6. Does the project involve land acquisition, either in fee or through a conservation easement?

No

7. Topic Area:

Natural Flow Regimes

8. Type of applicant:

Private for profit

9. Location - GIS coordinates:

Latitude: 37.7
Longitude: -120.4
Datum: NAD27

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

The project concerns upstream migration of chinook salmon from the mouth of the San Joaquin River (RM 0) to the primary spawning reaches of the Tuolumne, Merced, and Stanislaus Rivers.

10. Location - Ecozone:

13 East San Joaquin Basin

11. Location - County:

Tuolumne, Stanislaus, Merced, San Joaquin

12. Location - City:

Does your project fall within a city jurisdiction?

No

13. Location - Tribal Lands:

Does your project fall on or adjacent to tribal lands?

No

14. Location - Congressional District:

18 and 19

15. Location:

California State Senate District Number: 12

California Assembly District Number: 25

16. How many years of funding are you requesting?

2

17. Requested Funds:

a) Are your overhead rates different depending on whether funds are state or federal?

No

If no, list single overhead rate and total requested funds:

Single Overhead Rate: 142%

Total Requested Funds: \$49,954

b) Do you have cost share partners already identified?

No

c) Do you have potential cost share partners?

Yes. California Department of Fish and Game.

d) Are you specifically seeking non-federal cost share funds through this solicitation?

No

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. Is this proposal for next-phase funding of an ongoing project funded by CALFED?

No

If yes, identify project number(s), title(s) and CALFED program (e.g., ERP, Watershed, WUE, Drinking Water):

Have you previously received funding from CALFED for other projects not listed above?

Yes

If yes, identify project number(s), title(s) and CALFED program.

1998-C16	Developing a Method to Accurately Simulate Entrainment of Fish	ERP
1999-B152	A Mechanistic Approach to Riparian Restoration in the San Joaquin Basin	ERP
2001-C200	Merced River Salmon Habitat Enhancement: Robinson Ranch Site-Revised Phase II	ERP
2001-C208	Tuolumne River Fine Sediment Management Plan	ERP
2001-E201	Hill Slough West Habitat Restoration Demonstration Project, Phase II	ERP

**2001-K218 Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon
and Steelhead Evaluation**

ERP

19. Is this proposal for next-phase funding of an ongoing project funded by CVPIA?

No

If yes, identify project number(s), title(s) and CVPIA program (e.g. AFRP, AFSP, b(1) other).

Have you previously received funding from CVPIA for other projects not listed above?

Yes

If yes, identify project number(s), title(s) and CVPIA program.

CVPIA 11332-0-J017 Tuolumne River Coarse Sediment Management AFRP

CVPIA 11332-9-MO79 Merced River: Ratzlaff Project AFRP

CVPIA 11332-9-MO80 Stanislaus River: 2 Mile Bar AFRP

CVPIA 11332-0-MO09 Stanislaus River: Smolt Survival AFRP

**99-L Ratzlaff Reach: Merced River Corridor Restoration Project Phase II
A-7 (joint w/ DWR) AFRP**

CVPIA 11332-1-GO06 Calaveras Salmonid Limiting Factors Study AFRP

**00-L Feasibility of Long Term Aggregate Source for San Joaquin
D-10 Tributary Channel Restoration Projects AFRP**

**20. Is this proposal for next-phase funding of an ongoing project funded by an entity other than
CALFED or CVPIA?**

No

Please list suggested reviewers for your proposal. (optional)

21. Comments:

Environmental Compliance Checklist:

Up-migration and straying of Tuolumne River salmonids in response to fall attraction flows and environmental factors

1. CEQA or NEPA Compliance

a) Will this project require compliance with CEQA?

No

b) Will this project require compliance with NEPA?

No

c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

This is a research project consisting of review of literature and analysis of available data. The results and recommendations will be published in a white paper. There will be no data collection or activities that affect the environment.

2. If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies). *If not applicable, put "None".*

None

3. Please check which type of CEQA/NEPA documentation is anticipated.

CEQA

-Categorical Exemption

-Negative Declaration or Mitigated Negative Declaration

-EIR

none

NEPA

-Categorical Exclusion

- Environmental Assessment/FONSI

-EIS

none

If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. CEQA/NEPA Process

a) Is the CEQA/NEPA process complete?

N.A.

If the CEQA/NEPA process is not complete, please describe the dates for completing draft and/or final CEQA/NEPA documents.

b) If the CEQA/NEPA document has been completed, please list document name(s):

5. Environmental Permitting and Approvals *(If a permit is not required, leave both Required? and Obtained? check boxes blank.)*

LOCAL PERMITS AND APPROVALS

Conditional use permit

Variance

Subdivision Map Act

Grading Permit

General Plan Amendment

Specific Plan Approval

Rezone

Williamson Act Contract Cancellation

Other

STATE PERMITS AND APPROVALS

Scientific Collecting Permit

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land.

Agency Name:

Permission to access state land.

Agency Name:

Permission to access federal land.

Agency Name:

Permission to access private land.

N/A

6. Comments.

Land Use Checklist

Up-migration and straying of Tuolumne River salmonids in response to fall attraction flows and environmental factors

1. Does the project involve land acquisition, either in fee or through a conservation easement?

No

2. Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?

No

3. Do the actions in the proposal involve physical changes in the land use?

No

If you answered yes to #3, please answer the following questions:

a) How many acres of land will be subject to a land use change under the proposal?

b) Describe what changes will occur on the land involved in the proposal.

c) List current and proposed land use, zoning and general plan designations of the area subject to a land use change under the proposal.

Category	Current	Proposed (if no change, specify "none")
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d) Is the land currently under a Williamson Act contract?

No

e) Is the land mapped as Prime Farmland, Farmland of Statewide Importance, Unique Farmland or Farmland of Local Importance under the California Department of Conservation's Farmland Mapping and Monitoring Program?

No

f) Describe what entity or organization will manage the property and provide operations and maintenance services.

N.A.

4. Comments.

Conflict of Interest Checklist

Up-migration and straying of Tuolumne River salmonids in response to fall attraction flows and environmental factors

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.**
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.**
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.**

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

Dr. Noah Hume, Stillwater Sciences

Subcontractor(s):

Are specific subcontractors identified in this proposal?

Yes

If yes, please list the name(s) and organization(s):

Sarah Hetz, CA Department of Fish and Game, La Grange, California

Helped with proposal development:

Are there persons who helped with proposal development?

Yes

If yes, please list the name(s) and organization(s):

Tim Heyne, CA Department of Fish and Game

Jeff McLain, US Fish and Wildlife Service

Comments:

Budget Summary

Up-migration and straying of Tuolumne River salmonids in response to fall attraction flows and environmental factors

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

See attached Budget Summary Form.

Comments.

Budget Justification

Up-migration and straying of Tuolumne River salmonids in response to fall attraction flows and environmental factors

Direct Labor Hours. Provide estimated hours proposed for each individual.

Employee Hours: Peter Baker 90 Tami Cosio 54 Noah Hume 134 Sharon Kramer 28 Frank Ligon 6
Maureen Mason 62 Wayne Swaney 86

Salary. Provide estimated rate of compensation proposed for each individual.

Employee Rates: Peter Baker \$110.52 Tami Cosio \$46.56 Noah Hume \$114.84 Sharon Kramer \$135.00
Frank Ligon \$170.00 Maureen Mason \$51.60 Wayne Swaney \$87.84

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

Stillwater pays 31% in benefits to employees in all categories.

Travel. Provide purpose and estimate costs for all non-local travel.

All travel is from the Bay Area to Modesto or La Grange and includes the cost of mileage. Travel costs are estimated to total \$400.

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

Estimated break-down of supply costs: Office supplies: \$250 Computing supplies: \$805

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

Sarah Hetz, CA Department of Fish and Game: task to total \$4,500. On site support at CDFG for data entry, and data queries of historical information.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than \$5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

New equipment will not be purchased for the project.

Project Management. Describe the specific costs associated with ensuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentations, response to project specific questions and necessary costs directly associated with specific project oversight.

Data review supervision, coordination with subconsultants, agencies, and the Tuolumne River Technical Advisory Committee, management of data analysis, and project administration are the principal project management activities in Tasks 1, 2, and 3. Task 1 project management costs total \$1,150. Task 2 project management costs total \$1,265. Task 3 project management costs total \$1,955. The project management costs are summarized in Task 4, as \$4,370.

Other Direct Costs. Provide any other direct costs not already covered.

Costs associated with computer systems and networks are included in Other Direct Costs.

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

Stillwater's indirect costs include office expenses (rent, utilities, telephones, computer supplies, data connectivity, etc.), office staff, insurance, legal and accounting costs, proposal expenses and depreciation for capital items such as furniture and office equipment. As no specific place was provided, contractor fee was also included in the Indirect Costs column.

Executive Summary

Up-migration and straying of Tuolumne River salmonids in response to fall attraction flows and environmental factors

In the decades following major dam construction on the Central Valley California rivers, peaks in the annual hydrographs have shifted from late spring to early spring as the majority of spring snowmelt is now impounded for irrigation and consumptive use. This has produced the unanticipated consequence of compressing the available time for spawning, rearing and outmigration of fall run chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*). The use of managed flow pulses near the end of the summer baseflow period has been prescribed for the San Joaquin River tributaries as a means of stimulating early upmigration of returning chinook salmon. The physical and biological mechanisms that underlie the rationale for using fall attraction flows are two-fold. First, homing to the estuary is thought to depend upon chemical olfactory cues specific to each tributary watershed where the salmon reared. Second, upmigration timing appears to be related to an environmental cue that signals the onset of high flows sufficient to provide fish passage to headwater spawning grounds. However, the fall attraction flow prescriptions for the San Joaquin basin appear to be based upon studies of salmon populations from other estuaries with only limited data from the Sacramento San Joaquin Delta (Delta).

The proposed study will examine the relationship of environmental explanatory variables with:

- a) the annual variation in arrival timing of fall run chinook salmon in the lower Tuolumne River, and
- b) the annual proportion of stray coded wire tag (CWT) from the San Joaquin basin that are recovered in Sacramento River tributaries.

Environmental variables will include flow (e.g., tributary-specific, Vernalis), water quality (i.e., DO, Temperature) and regional meteorology (e.g., barometric pressure, tributary rainfall). Annual carcass surveys of the Tuolumne River will be used to indicate the upmigration timing of the San Joaquin basin at large because the Tuolumne River both dominates the annual escapement of San Joaquin basin chinook salmon, and also dominates the fall attraction flow contributions of San Joaquin tributaries in October of each year. CWT recovery of Merced River Fish Facility (MRFF) tag codes released in the San Joaquin basin tributaries (Stanislaus, Tuolumne and Merced Rivers) will be compared to the numbers recovered in the American, Feather and Mokelumne Rivers in the Sacramento River basin. These rivers have been selected on the basis of their consistency in recovery effort and record keeping.

The study will be conducted in cooperation with the Tuolumne River Technical Advisory Committee (TRTAC), and utilize data sources and efforts from California Department of Fish and Game and the U.S. Fish and Wildlife Service's Anadromous Fish Restoration Program (AFRP). The study will consist of a literature review focused upon California's Central Valley and Delta, data collection and summary followed by a data quality review and data analysis. A TRTAC subgroup will be formed to address this issue, taking advantage of local expertise of the committee. Data analysis will center upon arrival times of adults at upstream spawning grounds in response to environmental explanatory variables. A report will be prepared in phases with a preliminary working draft, administrative review draft followed by the final report.

A. PROJECT DESCRIPTION: PROJECT GOALS AND SCOPE OF WORK

A.1 Problem Statement

There are significant challenges to the restoration and enhancement of salmonid fisheries of the San Joaquin basin tributaries and a number of measures have been adopted to improve the survival of migratory life stages of chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*) through the southern Sacramento-San Joaquin River Delta (Delta). The basin-wide Vernalis Adaptive Management Protocol (VAMP) is intended to identify flows sufficient to reduce direct entrainment in the Delta pumps and also to reduce exposure of juveniles to predation. Although a number of ongoing studies have also been undertaken that track juvenile outmigration in response to managed spring pulse flows, less attention has been given to the effectiveness of fall attraction, or “pulse” flows to stimulate adult upstream migration. The proposed study will examine the effectiveness of fall attraction flows by exploring the relationship of environmental explanatory variables with the annual variation in arrival timing of fall run chinook salmon and the variation in the annual proportion of stray San Joaquin fish recovered in Sacramento River tributaries.

The chinook runs of the Stanislaus, Tuolumne, and Merced Rivers are perhaps the southernmost in the species range and summer water temperatures appear to be among the primary factors determining the life-history strategies of these populations as well as those of steelhead. Permanent upstream fish passage impairment dates back to dams constructed in the 19th century, eliminating access to cold-water refugia above the present dams. For chinook and steelhead this has had the unanticipated effect of reducing the time window available for spawning because:

- High water temperatures in the Delta, the San Joaquin River, and lower reaches of the tributaries usually prevent young salmon from migrating out of the tributaries much after May.
- High water temperatures in the lower and middle reaches of the tributaries limit the effectiveness of life-history strategies which require over-summering by adults or juveniles.
- High water temperatures in the lower reaches of the tributaries usually prevent adult returns from spawning much before October.

In the Delta, fall-run chinook salmon typically begin arriving from the Pacific Ocean in September, migrating upstream slowly and entering the San Joaquin tributaries between late October and continuing to migrate into the rivers through December (CDFG Annual reports). To address the temperature limitations above, short pulses (e.g. ~2 days) of high flows have been prescribed for most of the San Joaquin River tributaries in early October to stimulate fall-run chinook salmon to start migrating from the Delta to the tributaries. However, it appears the use of attraction flows is based upon studies from other river and estuaries, with only limited validation of their usefulness in the Delta. In addition, the source of fall attraction flow water is often taken from baseline flows or during other times of the year. The justification for this flow allocation must be thoroughly understood to justify these changes in the future.

Mechanisms. Studies in estuaries that support salmon migrations have shown that homing from the ocean is related to olfactory cues that are specific to the water and sediment chemistry of each tributary (Hasler et al. 1978; Oshima et. al. 1969). The mechanism used to explain the onset of upstream migration is that fish, whereas the fish appear to wait for the onset of flows for passage of physical barriers (e.g., waterfalls and log jams). Although this strategy has not been well documented for chinook salmon in large floodplain rivers, studies of Atlantic salmon (*Salmo salar*) have shown returning adults will wait in the estuary until there is a stormflow “fresht” (Heggberget et al. 1988, Thorstad and

Heggberget 1998; Smith and Laughton 1994 as cited in Hogasen 1998). Since fall attraction flows produce little if any changes in river stage or velocity in the Delta, this suggests the up-migration timing of San Joaquin basin salmonids may be stimulated by an environmental cue or trigger.

A number of non-flow signals have been linked to upstream migration in other rivers, such as water quality (e.g., temperature, turbidity, DO)(Alabaster 1989), or rapid barometric pressure changes (Smith 1985 as cited in Hogasen 1998). In one of the only direct studies of San Joaquin basin salmonids (Hallock et. al. 1970), CDFG biologists attached sonic tags to adult salmon entering the Delta in four successive years (1964-1967) and monitored their subsequent movements with a network of monitoring stations. Water quality barriers related to temperature and DO barriers (i.e., Stockton ship channel) were cited as primary controllers of upstream migration.

Dissolved Oxygen concerns are not a new problem for the lower San Joaquin River. Since 1968, the California Department of Water Resources has measured low DO levels (< 5mg/L) in the Stockton Ship Channel during the late summer and early fall, when the San Joaquin River inflows are low. Because depressed DO may block upstream migration of salmon (Alabaster 1989, Kjelson et. al. 1981), causing physiological stress and reduced growth rates (USEPA 1997), a stakeholder group was formed to make a Total Maximum Daily Load (TMDL) determination for oxygen depleting substances in the San Joaquin River. The SJR DO TMDL Steering Committee (2000) has recently made recommendations for nutrient controls, monitoring and modeling studies. Recognizing that dilution flows are an unacceptable means of water quality protection (CVRWQCB 1995), preliminary results indicate that the high flow requirements for increasing DO above the 5-6 mg/L water quality objective (WQO) for migrating salmon would be higher than the current fall attraction flow levels (Chen et al. 2003).

A.2 Justification

As regional efforts to meet the WQO for DO continue through nutrient controls in the lower San Joaquin River, it is important to consider the importance of the allocation of limited water to aquatic beneficial uses including fisheries such as chinook, but also for the species recovery of threatened central valley steelhead. In addition to the elimination of spawning habitat upstream of the present dams, water development projects in the San Joaquin basin have altered flow timing, reducing spring flows below natural levels and increasing fall flows. However, these impoundments have also created the opportunity to increase summer flows to improve conditions for over-summering salmonids. In the lower Tuolumne River, conditions for over-summering and early arriving salmonids related directly to instream flows (Aceituno 1990; USFWS 1995) that formed much of the basis of the present day flow allocation (FERC 1996). Although dam operators have some operational flexibility in the re-allocation of water between base flow and pulse flow periods, improving instream conditions may require flow reductions and re-allocation of water from other times of the year. To better inform the process of flow timing and allocation, this proposal addresses the link between environmental conditions to the timing of the onset of fall migration of salmonids in the San Joaquin River basin.

A.3 Approach

This proposal seeks to summarize existing data and available literature to form the basis of an analysis of environmental conditions (i.e. flow, temp, DO, meteorology) in the Delta at Stockton and Vernalis that may be used as explanatory variables of immigration timing of adults arriving in the lower Tuolumne River, California. Because of the Tuolumne dominates the annual escapement of San Joaquin basin chinook salmon, Tuolumne River carcass surveys will be used to indicate the upmigration timing of the San Joaquin basin at large. In addition, we will examine straying by the CWT recovery of MRFF

tag codes released and recovered in San Joaquin basin tributaries (Stanislaus, Tuolumne and Merced Rivers) as well as those recovered in the American, Feather and Mokelumne Rivers in the Sacramento River basin. These rivers have been selected on the basis of their consistency in recovery effort and record keeping. Below we outline several tasks to examine the effectiveness of fall attraction flows in the control of arrival timing of fall run chinook salmon as well as the annual proportion of stray fish recovered in Sacramento River tributaries:

Task 1 – Compile Existing Literature and Data. We will conduct a literature review of studies conducted on the Tuolumne and other San Joaquin River tributaries that relate to homing, straying and the timing of upstream migration in response to river flows. CDFG spawner surveys and CWT recoveries will be summarized electronically in cooperation with CDFG and using data from the Pacific States Marine Fisheries Commission’s Regional Mark Information System (RMIS). The summarized CWT data will be subject to a QA/QC review in cooperation with DCFG that will examine the duration of spawning surveys and completeness of data records. We will collect river discharge, temperature, and meteorological records (i.e., USGS, CDEC) for years in which spawner and CWT data is available. We will coordinate with the Central Valley Regional Water Quality Control Board and SJR DO TMDL Steering Committee to obtain available DO, flow and meteorological records as well as communicate data and findings of this study. We will also coordinate with the current California State Energy Resources Conservation and Development Commission funded pulse flow being formed to examine state-wide ecological impacts of pulse flow releases on California stream systems regulated for hydropower production.

Deliverable – Literature will be summarized as an annotated bibliography to be used in Task 3 report. Spawner and CWT summaries will be submitted electronically and as hard copies at the end of year One and included as Appendices to Task 3 report.

Task 2 – Data Analysis. Data analysis will center upon arrival times of adult salmonids at upstream spawning grounds in response to environmental explanatory variables (i.e., flow, temp, DO, meteorology). Because of the significant travel times between the Delta and the Tuolumne River spawning grounds (i.e., weeks), a number of time lag periods may be used to identify plausible correlations. Depending on years in which straying data of MRFF salmon arriving at Sacramento River tributaries (i.e., American, Feather, and Mokelumne Rivers), these analyses will be repeated as explanatory variables for adult straying.

Deliverable – Data Analysis results will be included in Task 3 Report.

Task 3 – Report. A report will be prepared in phases with a preliminary working draft following the initial annotated bibliography (Task 1). The working draft will be revised after review by the Tuolumne River Technical Advisory Committee. An administrative draft will be submitted for comment from selected peer reviewers, the USFWS AFRP, and CALFED.

Deliverable – Electronic submittal of formatted report (e.g., MS Word, MS Excel, or Adobe Acrobat).

Task 4 – Project Management. This task will provide data review supervision, coordination with subconsultants, agencies, and the Tuolumne River Technical Advisory Committee, management of data analysis, and project administration. This task does not include time for presentation of results, but will include annual project reports presenting findings and addressing project progress.

Deliverable – One annual progress report. Electronic submittal of formatted report (e.g., MS Word, MS Excel, or Adobe Acrobat).

A.4 Feasibility

We believe that the proposed project will be able to validate the hypotheses underlying the use of attraction flow for upmigration of San Joaquin basin salmonids from existing data. Although the evaluation of straying data from CWT recoveries will be dependent on the availability of existing data and cooperation of CDFG staff, both CDFG and USFWS AFRP staff are familiar with this project and are supportive of the proposal. In addition to our statistical and modeling capabilities, Stillwater Sciences staff is well familiarized with the biology and literature of Central Valley salmonids as well as the CDFG methodologies for CWT and spawner surveys. Stillwater Sciences also has a good working relationship with the TRTAC members which will facilitate the review process of the Task 3 report.

A.5 Performance Measures

The proposal is intended as an exploratory white paper including recommendations for the design of future experimental or observational studies. Project performance will be based upon successfully testing two relevant hypotheses from CALFED's Comprehensive Monitoring, Assessment, and Research Program (CMARP) for chinook salmon and steelhead in the Central Valley Rivers (CALFED 1998):

1. Adult salmon time their upstream migration into the rivers to coincide primarily with major storm events (e.g., sharp declines in barometric pressure, air or water temperatures) rather than in direct response to high flows.
2. Low dissolved oxygen levels (<5 ppm) in the mainstem San Joaquin River near Stockton in mid-October delay upstream migrating adult chinook salmon on their way to spawn in the San Joaquin tributaries.

The methods and results of this project will be internally and externally peer-reviewed. Comments received from peer-reviewers will be submitted to CALFED as a performance measure.

A.6 Data Handling and Storage

This project will result in the collection and development of data and information, and will build on previously obtained data. References will be annotated and reviewed. All data collected will undergo standard CDFG QA/QC procedures before the originals are archived. Data summaries will be stored in hard copy and electronically with routine (nightly) back up of data in accordance with Stillwater Sciences IT procedures.

A.7 Expected Products/Outcomes

The major product of this project is the report described in Task 3, Section A.3 of this proposal. This report will be prepared in consultation with the TRTAC, and will be peer reviewed by individuals at the USFWS AFRP, and CALFED. It is intended that the results of this study will inform basin-wide policy decisions such as VAMP, the ongoing San Joaquin River DO TMDL process, and future discussions on seasonal flow allocations in the San Joaquin River tributaries. It is intended that the results of this study will be presented at a future CALFED Science conference (or other) and submitted to the IEP newsletter or other peer reviewed journal.

A.8 Work Schedule

Work can proceed within two weeks of the authorization of funds. Assuming a project start date of June 1, 2003, preliminary data collection will be completed by December 1, 2003, the working draft by April 1, 2004, the administrative draft by June 1, 2004, and the final report by December 1, 2004.

B APPLICABILITY TO CALFED ERP AND SCIENCE PROGRAMS GOALS AND IMPLEMENTATION PLAN AND CVPIA PRIORITIES

B.1 ERP, Science Program and CVPIA Priorities

This project directly addresses several restoration priorities identified in Section 3 of the PSP, including Priorities SJ-3, SJ-4, and SJ-6. These PSP restoration priorities describe the need for improving habitat and understanding of species requirements for chinook salmon and steelhead. Specifically, SJ-6 calls for additional studies and evaluations of flows on ecosystem processes and habitat conditions.

This project responds directly to the CALFED Science Program goal of advancing our understanding of physical processes governing ecosystem and biological response. This project also contributes to the CALFED Science Program goal of advancing the scientific basis for regulatory activities since many of the current flow schedules were established on the basis of negotiated settlements rather than experimental evaluation.

B.2 Relationship to Other Ecosystem Restoration Projects

This project will align closely with the California State Energy Resources Conservation and Development Commission funded pulse flow evaluation project (Agreement No. 500-01-044 with UC Davis). The UC-Davis project has a wider scope than salmonid-specific flow allocation and is intended to assess impacts of pulse flow releases on California stream systems regulated for hydropower production, recreational use and other beneficial uses. There is a strong synergy between the information requirements and products of these two projects and close communication will be a benefit to all involved.

CALFED has provided funding for gravel augmentation projects on the Stanislaus and Tuolumne Rivers, and numerous other gravel injection projects will be required to achieve CALFED restoration goals. CALFED has already provided funding for several large-scale channel-floodplain projects that relate to spawning conditions in the past few years, including:

- Merced River Salmon Habitat Enhancement, Ratzlaff Reach (ERP-99-B05)
- Merced River Salmon Habitat Enhancement, Robinson Ranch Site (ERP-01-N06)
- Tuolumne River Fine Sediment Management Plan (ERP-01-C208)

Because of its influence on arrival timing of fall-run chinook salmon, this project may have indirect relationship with these ecosystem restoration projects with goals that relate to improving spawning success in the San Joaquin River tributaries.

B.3 Requests for Next-phase Funding

N/A

B.4 Previous Recipients of CALFED Program or CVPIA Funding

Previous funding awarded to the applicants from the CALFED or CVPIA programs are described in detail in Table 1.

B.5 System-wide Ecosystem Benefits

Understanding the relative impacts of instream flow measures for the enhancement of Central Valley salmon populations is essential to put in the context of physical habitat rehabilitation measures being undertaken by CALFED. Further, understanding the relationship of adult straying to current flow schedules will be important to the management of tributary sub-populations as well as hatchery operations. System wide, this project may yield ecosystem benefits by providing the scientific basis for the re-allocation of water to times of year when it is more critical for the survival of resident and migratory life-stages of Central Valley salmonids.

B.6 Additional Information for Proposals Containing Land Acquisition

N/A

QUALIFICATIONS

The project will be mainly conducted by Stillwater Sciences with some assistance from CDFG. Stillwater Sciences will be the contractee and point of contact for CALFED.

Stillwater Sciences is a firm of biological, ecological, and geological scientists. The company specializes in developing new scientific approaches and technologies for problem-solving in aquatic and terrestrial systems and has extensive experience and in-house ability in GIS applications to environmental analyses. Its founding members have over fifty years of experience in aquatic ecology and fisheries biology. Recent projects include impact assessment and restoration of rivers affected by hydroelectric dams, timber harvest, and irrigation in California and the Pacific Northwest.

Noah Hume, Ph.D., PE. is an applied aquatic ecologist with 18 years experience in aquatic ecology and engineering, spanning water quality, water supply and treatment. In addition to evaluation and analysis of smolt survival studies of CWT fish on the Tuolumne River, he has been actively involved in water quality evaluations of the San Joaquin River and a cooperative habitat assessment methodology development (*i.e.*, USFWS, NMFS, CDFG, DWR, USACE) for Sacramento River salmon runs, splittail and Delta smelt.

Mr. Frank Ligon is an aquatic ecologist and geomorphologist with over 20 years of experience in examining the role of fluvial processes and morphology in the ecology of stream fish, invertebrates, and plant communities. He has successfully managed several complex, long-term projects involving watershed analysis, salmon ecology and restoration, geomorphology and riverine ecosystem restoration.

Sharon Kramer, Ph.D., is a senior aquatic ecologist with over 20 years experience in the Pacific Northwest, Central California, Australia and Hawaii. Dr. Kramer is a recognized expert on Pacific Salmon and the ESA, and has been actively involved in numerous Delta and San Joaquin River projects. Dr. Kramer's extensive experience includes watershed analysis, habitat conservation planning (HCPs), biological assessments, and developing monitoring and adaptive management strategies.

Peter Baker, Ph.D., is a research biologist/statistician with over 15 years experience applying mathematics and statistics to aquatic ecology. Dr. Baker is responsible for maintenance and continued development of the EACH simulation model for San Joaquin chinook salmon populations. Currently Dr. Baker is evaluation the effects of CALFED’s ongoing restoration projects on population dynamics of key fish species.

D COST

D.1 Budget

Please see the attached budget summary form.

D.2 Cost-sharing

In addition to direct funding of seasonal CDFG worker for data entry and data collection, CDFG will provide “in-kind” cost sharing through completing QA/QC reviews of the data developed for this project.

E LOCAL INVOLVEMENT

N/A

F COMPLIANCE WITH STANDARD TERMS AND CONDITIONS

Stillwater Sciences will sign contracts as prime contractor with CDFG as subcontractor.

G LITERATURE CITED

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