Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility

Project Information

1. **Proposal Title:**

   Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility

2. **Proposal applicants:**

   Cedric Tadokoro, HDR Engineering, Inc.

3. **Corresponding Contact Person:**

   Cedric Tadokoro
   HDR Engineering, Inc.
   271 Turn Pike Drive Folsom, CA 95630
   916 351-3800
   ctadokor@hdrinc.com

4. **Project Keywords:**

   Hydraulic Engineering
   Hydrodynamics
   Modeling

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: 37.3

   Longitude: -121

   Datum:

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

The Delta region.

10. **Location - Ecozone:**

    1.1 North Delta, 1.2 East Delta, 1.3 South Delta, 1.4 Central and West Delta

11. **Location - County:**

    Sacramento, 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:**

    California, 11

15. **Location:**

    California State Senate District Number: 5

    California Assembly District Number: 17

16. **How many years of funding are you requesting?**

    1

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: 0.9

    Total Requested Funds: 185822

    b) Do you have cost share partners <u>already identified</u>?

No

c) Do you have potential cost share partners?

No

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

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

No

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

No

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

No

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

Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility

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.

      Hydraulic analysis and modeling project.

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

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

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

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR
   Xnone

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   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?

      Not Applicable

   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.
Landowner Name:

6. **Comments.**

Land Use Checklist

Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility

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 no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   Research only.

4. **Comments.**

Conflict of Interest Checklist

<u>Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility</u>

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):

Cedric Tadokoro, HDR Engineering, Inc.

Subcontractor(s):

Are specific subcontractors identified in this proposal? No

Helped with proposal development:

Are there persons who helped with proposal development?

No

Comments:

Budget Summary

Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility

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.

Federal Funds

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Obtain Model	108	2681	1180	27	54	0	0	1284	5226.0	2400	7626.00
2	Background Study	160	3441	1514	14	6	0	0	1902	6877.0	3152	10029.00
3	Run/Calibrate	450	12782	5624	0	17	0	0	5349	23772.0	11225	34997.00
4	Coordination	382	7824	3443	41	14	0	0	4541	15863.0	7229	23092.00
5	Pilot Model	372	7733	3403	0	14	0	0	4422	15572.0	7126	22698.00
6	Evaluate Questions	1072	21349	9373	82	40	0	0	12743	43587.0	19824	63411.00
7	Workshop	148	3228	1420	14	6	0	0	1759	6427.0	2950	9377.00
8	Project Management	108	6460	2842	0	0	0	0	0	9302.0	5272	14574.00
		2800	65498.00	28799.00	178.00	151.00	0.00	0.00	32000.00	126626.00	59178.00	185804.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grand Total=185804.00

Comments.

Budget Justification

Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility

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

Tom Cannon 304 Cedric Tadokoro 1416 Intern 848 Accounting 8 Reprographics 60 Clerical 64 Ken Myers 100

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

Tom Cannon - $45.67 Cedric Tadokoro - $21.25 Intern - $15.00 Ken Myers - $63.00 Accounting - $20.00 Repro - $22.00 Clerical - $16.00

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

44%

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

n/a

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

Office $150

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.

$0

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.

$0

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

108 Hours - $14,575

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

$0

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.

Discounted Standard Federal Overhead Rate

Executive Summary

Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility

HDR Engineering proposes to conduct hydraulic analyses for the Delta using existing DWR hydraulic modeling capabilities commonly referred to as the DWR Particle Tracking Model (Model). The proposed project is a research project that focuses on employing existing modeling tools to address the effects of CALFED Program Record of Decision (ROD) actions. We propose to use the model to address specific questions that have come up as part of the CALFED assessment process involving the Delta Entrainment Effects Fish Team, the Delta Cross Channel Through Delta Facility Team, Delta Cross Channel Project Work Team, and the North Delta Fish Facilities Technical Team. These groups are responsible for evaluating the potential effects of CALFED alternatives identified in the ROD. We propose to work closely with DWRs Delta Modeling Section and CALFED assessment teams to evaluate the utility of the Model in addressing questions and to make recommendations where necessary to upgrade modeling tools. Project Objectives include: § Employ existing particle tracking models in the CALFED agencies inventory toward questions on Delta hydrodynamics that have been posed by CALFED program assessment teams. § Determine the effectiveness and accuracy of the PTM in addressing the questions. § Determine what further modeling tools may be necessary to address questions. § Build upon Particle Tracking Model Program Work Team (PWT) past applications (e.g., DSM-2 and DWR PTM). Employment of a PTM will help to reduce uncertainties as to how water particles transport through the Delta and how such transport is affected by new facilities or changes to Delta operations and existing facilities (e.g., the DCC).

Proposal

HDR Engineering, Inc.

Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility

Cedric Tadokoro, HDR Engineering, Inc.

Employing a Particle Tracking Model to Simulate Delta Hydrodynamics of Future Delta Infrastructure such as the Through Delta Facility

A. Project Description: Project Goals and Scope of Work

HDR

HDR Engineering Inc. (HDR) proposes to conduct hydraulic analyses for the Delta using existing DWR hydraulic modeling capabilities commonly referred to as the "DWR Particle Tracking Model" (PTM). We propose to use the PTM to address specific questions that have come up as part of the CALFED process involving the Delta Entrainment Effects Fish Team (DEFT), the Delta Cross Channel – Through Delta Team (DCCTDF) team, Delta Cross Channel Project Work Team, and the North Delta Fish Facilities Technical Team (NDFFTT). These groups are responsible for evaluating the potential effects of actions included in the CALFED alternative identified in the CALFED Program Record of Decision (ROD). We propose to use the model to address specific questions, to evaluate how effective the model is in addressing the questions, and to make recommendations for future model development to improve the capability to address such questions. We propose to work closely with DWR's Delta Modeling Section, the DCCTDF, the NDFFTT, and DEFT to evaluate the utility of the PTM in addressing the questions and to make recommendations where necessary to upgrade or use other tools to address questions.

1. Problem

The CALFED ROD identifies several Delta actions to meet program goals that involve changes to Delta infrastructure and hydrodynamics, which in turn may affect ecological processes driven by Delta hydrodynamics. Chief among these potential modifications is a Through Delta Facility (TDF) that would increase the cross-Delta flow of Sacramento River water to the South Delta pumping plants. Evaluation of the potential effects of these potential actions is a CALFED goal over the next several years. At present there are limited tools to evaluate potential effects – one potential tool is what has been referred to as the PTM. Existing CALFED Program teams including the DCCTDF, DEFT, and NDFFTT need information on the potential effects to Delta hydrodynamics to effectively evaluate effects of biological resources from new infrastructure and changes in Delta operations outlined in the ROD. Further application and understanding of the capability of the PTM may help to better predict the effects of a TDF and other new infrastructure and related changes in water project operations. Development of particle tracking models has been on hold in recent years as agency modeling resources have been drawn away to other priorities. The proposed project will provide staff resources to not only support existing needs for this resource, but to identify existing and future PTM needs for the CALFED program.

- **Identify limits of the existing Particle Tracking Model for providing critical information on the effects of potential projects on Delta hydrodynamics**
- **• Identify and develop further applications and capabilities of the model to better predict the effects of new infrastructure and related changes in water project operations**
- **Provide staff resources to support existing modeling needs and identify modeling needs and solutions for the CALFED program in the future**

The PTM simulates the fate and transport of individual "particles" traveling throughout the Sacramento-San Joaquin Delta. The theoretical formulation was developed by Gilbert Bogle, a consultant of DWR's Water Engineering and Modeling with additional development and application being accomplished by Tara Smith, also of DWR. The model utilizes velocity, flow and depth output from a one-dimensional hydrodynamic model

(DSM2). (Time intervals for these hydrodynamic values can vary but are on the order of 15 minutes or 1 hour.) Hydrodynamic input into the model include inflows at the various rivers, pumping, agricultural return and diversions, and stage at Martinez. The Delta's geometry is modeled as a network of channel segments connected together by junctions and the particles move throughout the network of channel segments under the influence of flows and random mixing effects. See Figure 1 of the delta system grid model grid.

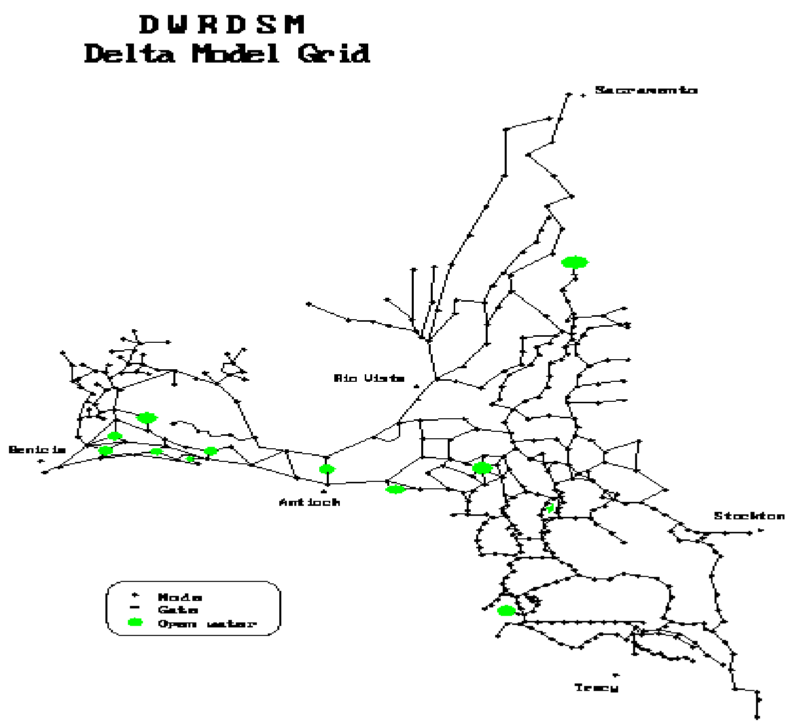


Figure 1: Delta geometry grid in DWR's DSM II model.

The PTM dispersive characteristics were calibrated and presented by Ryan Wilbur as a part of his Masters Thesis, 2000.

Aaron Miller of the DWR's PTM Project Work Team conducted a study utilizing the DSM II PTM to study Delta Smelt. The study compared simulated smelt distribution with collected data. The study also showed distribution in the delta when particles were given partial behavior in the form of predetermining position in the water column either permanently or diurnally.

In a similar fish modeling study, Jamie Anderson, also on the DWR Delta modeling team, created a particle-tracking model called SAMTRAK, to simulate the growth, migration, and mortality of juvenile winter run Chinook salmon. The SAMTRAK model utilized the Resources Management Associates (RMA) model suite as the core of her model. RMA-2 was used to simulate the hydrodynamics of the delta. Results were used as inputs to RMA-11, which simulated water quality in terms of temperature and salinity, the two primary physical conditions impacting juvenile salmonids. The particles in the model simulated populations of salmonids, which over time acquired swimming behavior simulating growth. Model runs were conducted for various water years that included from drought to very wet water years. Model results showed the spatial and temporal distribution of juveniles throughout the early portion of their life cycles. The model also estimated the mortality of eggs and juveniles due to various water quality conditions as well as loss of salmonids to pumping facilities in the CVP, SWP, and peripheral agricultural withdraws.

Each of the past particle modeling simulations addressed particular questions relating to fish migration and distribution throughout the delta under various hydrodynamic and water quality conditions. The smelt model compared simulated distribution to actual collected data as well as spatial distribution based on vertical position. The SAMTRAK model added behavior characteristics to also determine spatial and temporal distribution while adding an additional component of mortality and loss.

We propose to expand on those modeling developments, using the DWR DSM-II and PMT models to address particular questions being addressed by CALFED technical teams involved in evaluating effects of existing and future water management in the Delta. While previous model studies were conducted to test the effectiveness of the modeling process, this project would actually address actual pressing questions assigned to these teams.

Project Goal: The goal of the project is to provide more insight to the potential effects on Delta hydrodynamics from a TDF and other new infrastructure, and to provide for further development of PTM tools for Bay-Delta ecosystem assessment applications.

Project Objectives: The following are the objectives of the proposed project:

- Employ existing particle tracking models in the CALFED agencies' inventory toward questions on Delta hydrodynamics that have been posed by CALFED program assessment teams.
- Determine the effectiveness and accuracy of the PTM in addressing the questions.
- Determine what further modeling tools may be necessary to address questions.
- Build upon Particle Tracking Model Program Work Team (PWT) past applications (e.g., DSM-2 and DWR PTM).

2. Justification (including conceptual model, hypotheses and selection of project type)

The DSM II and PMT have already been developed by DWR including a geometric grid of the delta system. The models have been tested and calibrated, and successively demonstrated simulation of the hydrodynamics of the delta channels. With respect to neutrally buoyant particles, the primary driver of distribution is the hydrodynamics, as well as the water quality conditions, to a lesser degree. The status degree of runoff and release flowing down the Sacramento River and other primary rivers affect not only the distribution of particles but also determine salinity gradient throughout the delta. Various management practices have been shown to change the hydrodynamics, and consequently have increased mortality of various fish species. For example, runoff associated with a wet year would push the salt gradient toward San Pablo and San Francisco Bays but this effect could be negated or drastically affected by vigorous pumping or diversions at the CVP or SWP in the southern delta. It is believed that the

DSM II and PMT would accurately reveal these flow behaviors. With the hydrodynamics and water quality conditions accurately simulated, it is believed that the spatial and temporal distribution of neutrally buoyant particles would also be properly represented.

Project Type:
The proposed project is a research project that focuses on employing existing modeling tools to address major questions as the effects of ROD actions.

Questions/Conceptual Models:

Conceptual Model/Question #1: Primary Question: How would employment of a TDF at Hood affect Delta hydrodynamics and particle movement under different operating and hydrology conditions? Secondary Questions: How would a TDF affect particle transport downstream in the Sacramento River from Hood? Would transport above Hood be affected? How would particle behavior change at the Delta Cross Channel (DCC) and Georgianna Slough (GS) under different operating and hydrology conditions? How would the probabilities of particles being entrained into South Delta pumping plants change with a TDF?

Conceptual Model/Question #2: Primary Question: How do different project operations and hydrological conditions affect particle transport in the Delta? Secondary Questions: How would particle movement be affected by changes to Delta channel configuration (e.g., closure of Frank's Track; setback levees in the Mokelumne forks; etc.). How do particles behave under different operating and hydrological conditions such as when QWEST is negative? How would particle transport change under different operational configurations of the DCC? How fast do water particles transport from various points in the Delta to the South Delta pumping plants? What are the probabilities of a water particle being drawn to the South Delta pumping plants or reaching the Bay under various operations and hydrological conditions?

Uncertainties:
Employment of a PTM will help to reduce uncertainties as to how water particles transport through the Delta and how such transport is affected by new facilities or changes to Delta operations and existing facilities (e.g., DCC).

3. Approach

Task 1 – Obtain model components and get model up and running. Model components are available on DWR model web site. Project team will coordinate with DWR Delta Modeling Section on use and application of model.

Task 2 – Obtain records of existing model runs and review and summarize.

Task 3 – Evaluate model subroutines including existing Delta spatial channel distribution network. Calibrate model behavior with available information.

Task 4 – Coordinate with CALFED technical teams to obtain questions to address with the Model. Teams include DCCTCF, NDFFTT, and DEFT.

Task 5 – Conduct a pilot test of the model by choosing a representative question. Conduct review of model output, including content and format, and gain input from teams as to adequacy and completeness of information needs and presentation format.

Task 6 – Use model to address full array of questions; provide input to teams

Task 7 - Conduct workshop to interested parties as a collaboration of individual questions addressed and discussed between parties.

Detail SubTasks For CALFED Particle Tracking Model Project

Task	Description	Duration
1.0	**Obtain model components and get model up and running. Model components are available on DWR model web site. Project team will coordinate with DWR Delta Modeling Section on use and application of model.**	
1.1	Obtain model from DWR and components. Familiarize with information on the website	
1.1.1	Obtain model from DWR	0.5 days
1.1.2	Read and understand information on the website	1 day
1.1.3	Meeting with DWR understand level of involvement, details, etc.	0.5 days
1.2	Run Model	
1.2.1	Understand boundary conditions	1 day
1.2.2	Run DSM II model	1 day
1.2.3	Run Particle Tracking model	1 day
1.3	Write up of findings of geometry network	1 day
1.4	Task completion meeting	0.5 days
	Sub-total: Task 1	6.5 days
2.0	**Obtain records of existing model runs and review and summarize**	
2.1	Obtain records of existing model runs	
2.1.1	Obtain existing studies from website	0.5 day
2.1.2	Library search	1 day
2.2	Study existing studies	5 days
3.3	Write up summary of existing studies	5 days
3.4	Task completion meeting	0.5 days
	Sub-total: Task 2	12.0 days
3.0	**Evaluate model subroutines including existing Delta spatial channel distribution network. Calibrate model behavior with available information.**	
3.1	Evaluate capability of model including inherent subroutines	1 day
3.2	Evaluate and understand modeled hydrodynamics	2 days
3.3	Obtain actual delta hydrodynamics data	2 days
3.4	Compare hydrodynamics between simulated and actual	5 days
3.5	Calibrate hydrodynamics	5 days
3.6	Calibrate salinity advection/dispersion coefficients	10 days
3.7	Written summary of subroutines, hydrodynamics, and salinity behavior	5 days
3.8	Task completion meeting	0.5 days
	Sub-total: Task 3	12.0 days
4.0	**Coordinate with CALFED technical teams to obtain questions to address with the Model. Teams include DCCTCF, NDFFTT, and DEFT.**	
4.1	Prepare presentation of model and capabilities and past studies	5 days
4.2	Coordinate with agencies to set up meeting. Prepare letters, phone calls, etc.	1 day
4.3	Present model to participating agencies.	0.5 days
4.4	Obtain questions PTM is to answer (1 day ea.)	3 day

Task			Description	Duration
	4.5		Study & Evaluate DCCTCF question(s)	5 days
	4.6		Study & Evaluate NDFFTT question(s)	5 days
	4.7		Study & Evaluate DEFT question	5 days
	4.8		Written summary of each question and how PTM can address each question. Advantages and short comings.	5 days
	4.9		Word processing of written summary, distribute to agencies	1 day
	4.10		Receive comments from written summaries and make appropriate adjustments	3 days
	4.11		Task completion meeting	0.5 days
			Sub-total: Task 4	34.0 days
5.0			**Conduct a pilot test of the model by choosing a representative question. Conduct review of model output, including content and format, and gain input from teams as to adequacy and completeness of information needs and presentation format**	
	5.1		Evaluate questions and decide on representative question for pilot study	1 day
	5.2		Obtain data for pilot study	
		5.2.1	Website search for data	1 day
		5.2.2	Contact agency(s) for appropriate data	2 day
		5.2.3	Library search for data/published papers	1 day
	5.3		Process data for inputting into model	2 days
	5.4		Run model	0.5 day
	5.5		Compare model to existing data	3 days
	5.6		Minor calibration changes	1 day
	5.7		Run particle tracking model to hydrodynamic results	0.5 days
	5.8		Check out put for validity	2 days
	5.9		Make adjustments where necessary	2 days
	5.10		Written summary of pilot study	5 days
	5.11		Word processing and printing of report, send out to agencies	1 day
	5.12		Receive comments, incorporate changes, document particular areas of interest	3 days
	5.13		Task completion meeting	0.5 days
			Sub-Total: Task 5	25.5 days
6.0			**Use model to address full array of questions; provide input to teams**	
	6.1		Evaluate and understand question/background study	5 days
	6.2		Obtain hydrodynamic boundary conditions	3 days
	6.3		Process input data	5 days
	6.4		Run model and calibrate	10 days
	6.5		Evaluate model results	5 days
	6.6		Written draft summary of model results	5 days
	6.7		Word processing and printing draft report	1 day
	6.8		Prepare meeting with specific agency that question is being answered	1 day
	6.9		QA/QC	2 days
	6.10		Meeting with agency present draft report	0.5 days
	6.11		Make appropriate changes/re-run model if necessary, complete final draft	5 days
	6.12-23		Conduct process for 2nd and 3rd agency & question	85 days
	6.24		Task completion meeting	1 day
			Sub-Total: Task 6	128.5 days
7			**Conduct workshop to interested parties as a collaboration of individual questions addressed and discussed between parties**	
	7.1		Prepare presentation for workshop	5 days

Task	Description	Duration
7.2	Conduct workshop: final presentation & collaboration period between agencies	1 day
7.3	Receive final comments from agencies and make final changes for final draft and distribute	3 days
	Task completion meeting	0.5 days
	Sub-Total: Task 7	9.5 days
	Final Number of Days	224 days

4. Feasibility

The proposed project would allow agencies to address certain questions that would be difficult to investigate due to various reasons. The agency could be short of qualified trained personnel or resources to physically obtain field data and then to analyze the results. Certain scenarios could also be addressed that would require special weather conditions, of which planning is limited, for example, extreme wet or dry conditions. In these and many other situations, a model would allow a satisfactory evaluation of an issue that may investigation but could not be made due to aforementioned conditions. A model would present a significant cost-savings to individual as well as agencies collectively.

With the model, the work would be conducted in-house with the need for outside permits. Additional data that maybe necessary would be provided by either DWR for their model or the respective agency whom their question is being investigated. Project completion would be limited to efficient collaboration between agencies and also the difficulty and complexity of a particular question or questions.

5. Performance Measures

The validity of the hydrodynamics of the DSM II and PMT model have been shown in the Ryan Wilbur’s thesis, but will be re-verified. The modeled hydrodynamics would be tested and calibrated to actual data collected throughout the delta. A general check of the results would also be made with comparing result from the RMA models. Effectiveness of the model to address the questions will be handled by the individual agencies expertise to understanding the dynamics of their particular question.

6. Data Handling and Storage

The results of the individual studies would be managed by each participating agency. They will each obtain model inputs, outputs, and analyzed results for the pilot study and their particular question.

7. Expected Products/Outcomes

Model results would be presented in the form of technical memorandums (TM’s) and reports, depending on the degree of evaluation. The calibration and model process would be presented as a TM. This TM would include shortcomings of the model as well as particular strengths experienced. Each of the questions addressed by the model would be a TM or report, depending on the complexity of the question. When possible, related topics and subject matter would be pooled and addressed collectively. A workshop involving the interested parties would follow as a project wrap-up.

8. Work Schedule

Task Number	Start Date	Completion Date
1: Obtain model and coordinate with DWR	September 2, 2002	September 12, 2002
Task 2 – Evaluate model and background	September 13, 2002	September 27, 2002
Task 3 – Evaluate model and network	September 30, 2002	November 8, 2002
Task 4 – Obtain questions from CALFED agencies	November 11, 2002	January 10, 2003
Task 5 – Pilot Study	January 13, 2003	February 28, 2003
Task 6 – Study questions	March 3, 2003	June 20, 2003
Task 7 - Conduct workshop and post-project review	June 23, 2003	July 11, 2003

The payment schedule for each task would be invoiced monthly for each task minus 10% that is invoiced later after completion of the task. For example, project management would be invoiced for 1/36th of the contract amount for that task each month minus 10% of the total to be withheld until completion of the task, which in the case of project management would be the last deliverable.

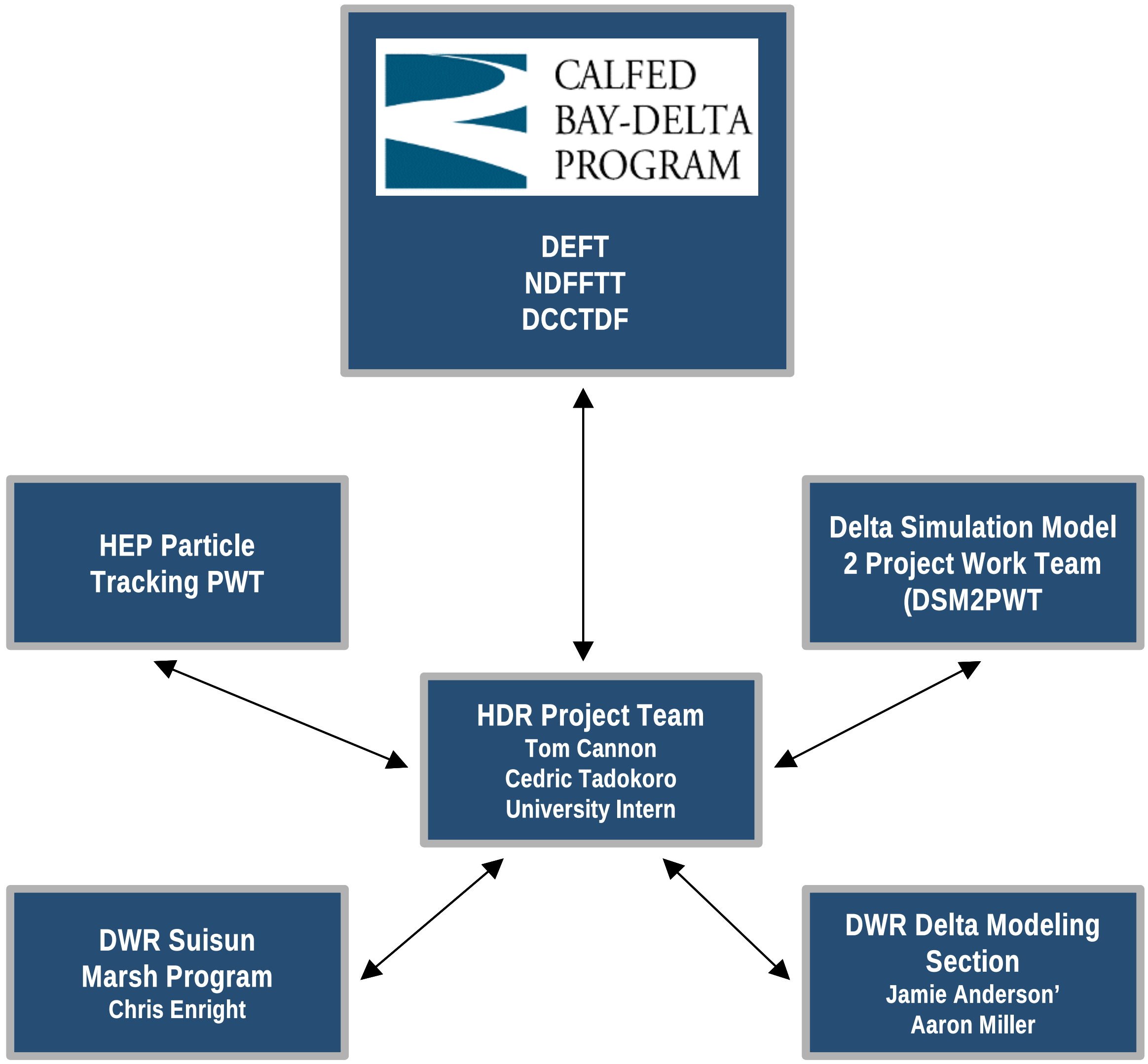
B. Applicability to CALFED ERP and Science Program Goals and Implementation Plan and CVPIA Priorities

1. ERP, Science Program and CVPIA Priorities.

The Particle Tracking Model will be used to improve our understanding of how water moves in the Delta under various water management and natural flow conditions. This information is helpful in minimizing diversion effects on fish (Strategic Goal 1, At-risk species). The model will be especially valuable in relating the affects on water movement from changes in Delta Cross Channel operation or the application of a Through Delta Facility.

2. Relationship to Other Ecosystem Restoration Projects.

The project team will work closely with other CALFED and Interagency Ecological Program (IEP) modeling and assessment teams. CALFED Program teams including DEFT, NDFFTT, and DCCTDF will provide questions and evaluation of model predictions and outputs. IEP PWT's will provide review and technical support and expertise. DWR Suisun Marsh Program and Delta Modeling Section provide staff who have been involved in the past and present in the use of the PT Model, who have agreed to provide technical review and support for the modeling.



C. Qualifications

Tom Cannon is proposed as the project manager on the project team. Mr. Cannon has a B.S. in fisheries and masters in biology and biostatistics. He is a aquatic ecologist with extensive experience in Delta diversion effects on fish. He has been a key participant in the CALFED program since its inception in 1995, having contributed to the Ecosystem Restoration Program Plan, the Multi-species Conservation Strategy, EIR/EIS, Upper Yuba River Studies Program, and Stage 1 Implementation Plan. He has been a consultant to CALFED's Delta Entrainment Effects on Fish Team (DEFT) and the Delta Cross Channel – Through Delta Facility (DCCTDF) team. He was project manager for entrainment effects assessments for PG&E's Delta power plants.

Cedric Tadokoro is a water resources engineer at HDR Engineering, Inc. Projects include hydrologic studies, spillway analysis, and design of flood control channels. Models used are HEC-RAS and HEC-HMS. He previously was a research assistant for the University of California, Davis, Civil Engineering and Environmental Modeling Group. He previously conducted modeling research on the Sacramento River and Sacramento-San Joaquin River Delta hydrodynamics and water quality using the RMA-2 model was used to simulate hydrodynamics and RMA-11 was used to simulate the salinity and temperature components. He assisted in completing applications of the model, which consisted of a dissertation from Dr. Jamie Anderson, "Modeling Impacts of Multiple Stresses on Aquatic Ecosystems: Case Study of Juvenile Chinook Salmon in the Sacramento River (2000)" and a M.S. thesis by Curtis Loeb on the hydrodynamics and water quality effects due to various delta management plans including the Isolated Facility, the Through Delta Facility, and the dredging of Old River.

D. Cost

Please see electronic form.

E. Local Involvement

Non-applicable.

F. Compliance with Standard Terms and Conditions

HDR agrees to the Terms and Conditions with the exception of the following suggested modification to Item 11 identified with underlining.

11. . Indemnification: The Grantee agrees to indemnify, defend, and save harmless the CALFED agencies, the State of California, the Resources Agency, the Department of Water Resources, and the National Fish and Wildlife Foundation and their officers, agents, and employees from any and all claims and losses accruing or resulting to any or all contractors, subcontractors, material persons, laborers, and any other person, firm, or corporation furnishing or supplying work services, materials, or supplies in connection with the performance of this contract, and resulting from the negligence of the Grantee, and from any and all claims and losses accruing or resulting to any person, firm, or corporation who may be injured or damaged by the Grantee in the negligent performance of this Agreement.

G. Literature Cited

Anderson, Jamie. "Modeling Impact of Multiple Stresses on Aquatic Ecosystems: Case Study of Juvenile Chinook Salmon in the Sacramento River System." University of California, Davis, Ph. D. dissertation. 2000.

Orlob, Gerald et al. "Simulation of Historical Hydrodynamics and Water Quality Conditions in the Sacramento River-San Francisco Bay-Delta System." Water Resources and Environmental Modeling Group, Civil and Environmental Engineering, University of California-Davis. Report written for the Center for Environmental Health Research Report #00-6. June 2000

Meeting Minutes. Particle Tracking Project Work Team Meeting, April 11, 2000. California Department of Water Resources.

M. Weinberg, C. A. Lawrence, J. D. Anderson, J. R. Randall, L. W. Botsford, C. J. Loeb, C. S. Tadokoro, G. Orlob, and P. Sabatier. In Press. Biological and Economic Implications of Sacramento Watershed Management Options. University of California, Davis, California.

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