State of California
California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES

Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh

34th Annual Progress Report to the
State Water Resources Control Board in
Accordance with Water Right Decisions 1485 and 1641

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Edmund G. Brown Jr.	**John Laird**	**Mark W. Cowin**
Governor	Secretary for Natural Resources	Director
State of California	California Natural Resources Agency	Department of Water Resources


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Foreword

This is the 34th annual progress report of the California Department of Water Resources' San Francisco Bay-Delta Evaluation Program, which is carried out by the Delta Modeling Section. This report is submitted annually by the section to the California State Water Resources Control Board pursuant to its Water Right Decision 1485, Term 9, which is still active pursuant to its Water Right Decision 1641, Term 8.

This report documents progress in the development and enhancement of the Bay-Delta Office's Delta Modeling Section's computer models and reports the latest findings of studies conducted as part of the program. This report was compiled under the direction of Tara Smith, program manager for the Bay-Delta Evaluation Program.

Online versions of previous annual progress reports are available at:

http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/annualreports.cfm.

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Preface

Chapter 1 Temperature Model Development for CalSim

River water temperature is important for the conservation of fishery habitat. Changes of water delivery or construction around water ways may impact of fish mortality by changing river water temperature. Water temperature is highly relevant to fish mortality and also indirectly influences habitat. Current temperature modeling takes flow output from CalSim and then estimates temperature at points of interest. However, when it violates the downstream temperature requirement, there is no way to adjust outflow or storage to lower the impact.

This chapter documents the work on integrating the Sacramento River Water Quality Model (SRWQM) into CalSim and making reasonably accurate estimates for released water temperature. Through this integration, CalSim can adjust flow or storage to meet river temperature requirements.

Chapter 2 Extension of DSM2 for the South Bay and California Aqueducts and Delta Mendota Canal

This chapter is a summary of the full report that documents work on the DSM2 Aqueduct model: (1) extending the model simulation period from 3 years starting January 1, 2001, to 21 years starting from January 1, 1990; (2) modifying the ways to treat gains and losses of water as a result of seepage, evaporation, rainfall, storm water inflow, meter reading errors, etc.; (3) enhancing the model's capability of calculating water quality by adding two more constituents, dissolved organic carbon (DOC) and Bromide; and (4) incorporating inflows from ground water and storm water.

Chapter 3 DSM2 Version 8.1 Calibration with NAVD88 Datum

A new calibration has been performed for Version 8.1 of DSM2, which incorporates the latest improvements to the DSM2 code. The main differences in DSM2 version 8.1 include: DSM2-Qual model formulation change to improve model; modifications to the DSM2-Hydro program source code that improve channel geometry calculation; datum conversion to NAVD88; and Martinez EC boundary correction. Since these changes affect results both in DSM2 Hydro and Qual, a new calibration is needed. This chapter documents the calibration effort done by adjusting Manning's coefficient values in Hydro and dispersion coefficients in Qual. Further improvements involving other changes, e.g. new bathymetry and grid change, may come in future releases.

Chapter 4 Adding Salmon Route Selection Behavior to DSM2 Particle Tracking Model

DSM2 Particle Tracking Model (PTM) simulates the transport and fate of individual neutrally buoyant particles through the Sacramento – San Joaquin Delta. Since its initial development in 1993, the model has been updated. New features, such as attaching fish-like behaviors to particles, have been added to the model. Although the model itself has been calibrated and validated using a field dye study, the adequacy of the model for simulating fish migration has never been quantitatively evaluated due to the lack of field fish monitoring data. Recent developments in the field monitoring, especially in acoustic telemetry fish tag studies, have made it possible for evaluating the adequacy of applying PTM to simulating fish behaviors. This chapter describes the implementation of fish route selection behavior in PTM and the results of the implementation. The approach for using PTM to simulate fish behaviors and the improvements needed for PTM to better simulate fish behaviors are also discussed.

Chapter 5 Particle Filter for DSM2-PTM

This chapter documents the development of a PTM module feature which simulates directing/blocking particles without affecting flows. One of the major applications of this particle filter is to simulate fish screens and non-physical barriers, which could prevent fish from entering some water area. Another application is to provide an option to keep fish from entering agricultural diversions, seepage to groundwater, and water transfer facilities.

Chapter 6 DSM2-PTM Improvements

This chapter describes bug fixes and related tests of DSM2-PTM, with a focus on convergence tests for different PTM time steps. Bugs discovered are:

1. Missing advection: in the loop through the sub-time steps within one PTM time step, the last sub-time cycle is usually missed. This can delay particle motion and the error accumulated can be significant.
2. First time-step error: PTM reads hydrodynamics information from tide file; the first time-step has an initial calculation error. This leads to erroneous results, when particles are released at the beginning of PTM simulation start time.
3. Time interpolation factor (θ) inconsistence: two different weighting average factors between the current and the previous time step are inconsistent for flow, depth, cross-section area, and stage.
4. Missing dispersion: when a particle arrives at the end of a channel, the random motion in y and z direction is missed for the last sub-time step. This leads to erroneous results, especially in a grid system with many connected channels such as Delta.
5. Error warning for transfer: an error exists in the function that checks flow balance for nodes connecting transfers and reservoirs. This doesn't affect the calculated value but will slow down the module running when the grid has this kind of waterbody combination.

Chapter 7 DSM2-PTM Standard Test Suite Design and Automation

The DSM2-PTM Module is undergoing development for new features and bug fixes. It is essential to have its tests standardized and automated for the changes to the code and input data. This chapter describes the PTM standard test suite design, including several DSM2 test grids, their respective key configuration variables, and design purpose. Scenario runs and plots generation can be batch processed for every version of DSM2-PTM. This batch automation is implemented by Python scripts.