Municipal Water Quality Investigations Program
2008-2009 Work Plan

5/14/08
Final

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Glossary of Acronyms and Terms

AMS	Accelerated Mass Spectrometry
BCP	Budget Change Proposal
BLM	U.S. Bureau of Land Management
BMP	Best Management Practices
Ca	Calcium
CBDA	California Bay Delta Authority
CCWD	Contra Costa Water District
CDEC	California Data Exchange Center
CDPH	California Department of Public Health
CUWA	California Urban Water Agencies
CVP	Central Valley Project
DBP	Disinfection by-product
DCC	Dry Creek Conservancy
DDT	Dichloro-Diphenyl-Trichloroethane (insecticide)
DFG	California Department of Fish and Game
DMC	Delta-Mendota Canal
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DOE	DWR Division of Engineering
DPLA	California Department of Water Resources, Division of Planning and Local Assistance
DSM2	Delta Simulation Model 2
DU	Ducks Unlimited
DWR	California Department of Water Resources
EC	Specific Electric Conductivity
EPA	U.S. Environmental Protection Agency
FSR	Feasibility Status Report, used in information technology planning
FY	Fiscal Year
GC-MS	Gas Chromatography Mass Spectrophotometer
GIS	Geographic Information System
HAA	Haloacetic Acid
HAAFP	Haloacetic Acid Formation Potential
IC	Ion Chromatography, Inorganic Carbon (e.g., dissolved carbon dioxide)
IEP	Interagency Ecological Program
IT	Information Technology
KHP	Potassium hydrogen phthalate

LC-MS Liquid Chromatography Mass Spectrometry
LLNL Lawrence Livermore National Laboratory
MWDSC Metropolitan Water District of Southern California
MGD Million Gallons per Day
MWQI Municipal Water Quality Investigations
Na Sodium
NEMDC Natomas East Main Drainage Canal
NDBA N-nitroso-di-n-butylamine
NDMA N-nitroso-dimethylamine
NDPA N-nitroso-di-n-propylamine
NMEA N-nitroso-methylethylamine
NMOR N-nitrosomorpholine
NPYR N-nitroso-pyrrolidine
NMR Nuclear Magnetic Resonance (analysis)
O&M Department of Water Resources Division of Operations and Maintenance
OC Organic carbon
OCO Operation Controls Office (DWR O&M)
PCB polychlorinated byphenyls
QA/QC Quality Assurance, Quality Control
QC Quality Control
RTD Real time Data
RTDF Real time Data and Forecasting Program
RTDF-CP Real time Data and Forecasting – Comprehensive Program
SBA South Bay Aqueduct
SDIP South Delta Improvement Program
SLDMWA San Luis Delta Mendota Water Authority
SUVA Specific ultraviolet absorbance
SWC State Water Contractors
SWP State Water Project
SWPCA State Water Project Contractors Authority
TBD To Be Determined
TDS Total Dissolved Solids
THM Trihalomethane
THMFP Trihalomethane formation potential
TKN Total Kjeldahl Nitrogen
TMDL Total Maximum Daily Load

TNC The Nature Conservancy

TOC Total (dissolved and suspended particulate) organic carbon

UCD University of California at Davis

UCSB University of California at Santa Barbara

UNO University of New Orleans

USBR U.S. Bureau of Reclamation

USGS United States Geological Survey

UVA *n* Ultraviolet absorbance at wavelength *n*

VAMP Vernalis Adaptive Management Program

WDL California Water Data Library

WWTP Waste Water Treatment Plants

Executive Summary

This is a work plan for work to be performed under the California Department of Water Resources (DWR) Municipal Water Quality Investigations Program (MWQI Program) for the fiscal year 2008/09 (July 1, 2008 to June 30, 2009). The total MWQI Program budget for fiscal year 2008/09 is 3.1 million.

This work is to be performed under an agreement between DWR and 15 member agencies of the State Water Contractors (SWC) who purvey drinking water. Under this agreement, work to be performed is identified and prioritized annually by the MWQI Technical Advisory Committee (MWQI TAC), composed of technical representatives of the participating agencies, DWR and invited members of outside agencies. Recommendation for approval of the annual work plan is provided by "voting members" of the MWQI TAC, which include representatives from the 15 SWC member agencies, and constitutes a commitment of funding to the planned work. Some of the tasks outlined in the annual work plan will be completed using funds from a supplemental account provided under the MWQI Agreement and managed by the State Water Project Contractors Authority (SWPCA). Expenditures using this fund are approved annually by the Specific Projects Committee, which is made-up of representatives from 12 of the 15 participating SWC agencies. Representatives serving on this committee differ from those serving on the MWQI TAC. A description of these tasks and estimated costs for fiscal year 2008-09 is provided as Appendix 1 of this work plan.

This work plan is divided into 6 elements that describe the objectives or tasks of each program element and the deliverables associated with these tasks. For this fiscal year (FY), there are no grant funds tied to other agencies; however, the MWQI Program has partnered on several contracts with other agencies including the San Luis Delta Mendota Water Authority and UC Davis. These are discussed more fully under the appropriate work plan elements as they have a bearing on overall commitments of MWQI Program resources.

One of the basic tenets of the MWQI Program is flexibility to adjust to changing needs, priorities, and resource availability. While the 2008/09 work plan represents the continuation of a number of core and committee-prioritized projects and programs, it also reflects a continuing evolution of

the MWQI Program as guided by the five-year MWQI Strategic Plan and the RTDF-Comprehensive Program (RTDF-CP).

Within the MWQI Program, the RTDF-CP entails the following elements:

1. organizational coordination and collaboration between DWR monitoring and forecasting groups.
2. real time data acquisition for the Delta and SWP through monitoring.
3. enhancement of forecasting and fingerprinting of drinking water quality through use of computer models.
4. centralized information management and dissemination.
5. scientific support studies.
6. emergency response preparedness as related to drinking water quality.
7. organizational coordination and collaboration with outside agencies to enhance real time monitoring activities.

Implementing many of the RTDF-CP goals requires coordination with staff outside of the MWQI unit. In other cases, more staff are needed to effectively handle the workload produced by the RTDF-CP. The 2008/09 work plan represents the first year where all RTDF-CP positions have been filled and priority tasks that were listed in the 2007/08 work plan can now be fully addressed.

Program Accomplishments

Over the course of the 2007/08 FY, MWQI has accomplished a number of goals listed directly in the 2007/08 work plan or which have arisen during the past FY. Accomplishments include:

- All 7 Budget Change Proposal (BCP) positions filled.
- Completion of Natomas East Main Drainage Canal (NEMDC) report for CALFED.
- NEMDC study published in Water Resources Research.
- Completion of Staten Island study and report for CALFED.
- Completion of inorganic carbon removal study.
- Completion of MWQI Biennial Water Quality Report (Oct. 2005-Sept. 2007).
- Beginning installation of carbon analyzer on the DMC at Jones Pumping Plant.

- Consolidation of MWQI and O&M Water Quality real time instrumentation into one building at Banks Pumping Plant with upgraded communication capabilities.
- Completion of Isotope Study. To be submitted for publication to Water Resources Research.
- Real time anion data posted to CDEC and included in weekly MWQI report.
- Completion of DWR/DSM2/CH2MHill Aqueduct Model.
- RTDF3 database in use.
- Server Security Issues resolved
- Coordination between RTDF-CP partners to examine the effects of the Wanger (Delta Smelt) decision on water quality.

PROGRAM PRIORITIES

The following are the priority activities of the MWQI Program for FY 2008/09:

A. Discrete Sample Collection and Analysis – Discrete samples (also referred to as "grab samples") will continue to be collected at Delta locations of interest and subjected to laboratory analysis for water quality parameters of concern.

B. Real Time Data and Forecasting-Comprehensive Program – With the addition of 7 new positions between MWQI, O & M Water Quality, Bay-Delta Modeling and SWP Modeling, the RTDF Comprehensive Program (RTDF-CP) is now fully staffed and priority tasks that were listed in the 2007/08 work plan can now be fully addressed beginning with this 2008/09 work plan. Many of the elements listed in the 2007/08 work plan were a natural outgrowth of the RTDF-CP thus, beginning this year, they have been listed as program elements under the RTDF-CP. These elements and primary goals are:

- **Real Time Monitoring** – *In-situ* water quality monitoring stations at three Delta locations will continue to be maintained. A fourth real time monitoring station, located at the Jones Pumping Plant is anticipated to become operational during this fiscal year. Evaluations and planning for additional *In-situ* sampling parameters and/or new technologies will continue.

- **Water Quality Forecasting** – Mathematical modeling tools will continue to be developed, refined, and employed to enable forecasting of water quality phenomena affecting agencies taking drinking water supplies from the Delta and SWP, and to provide input to operational decisions.

- **Information Management and Dissemination** – Weekly water quality reports will be disseminated by e-mail and Internet to program participants. Web access to data and other information will be expanded and enhanced, to assure information produced by the MWQI Program is delivered to its clients on a timely basis.

- **Science Support** – Scientific investigations of specific water quality phenomena will be conducted to improve the ability to assess, control and manage Delta drinking water supplies to maximize source water quality and minimize treatment cost.

- **Emergency Response** – Delta levee breaks and spills of hazardous materials are examples of unanticipated events that require dedication of MWQI staff to activities such as collection of water quality samples. Response to these events can become of the highest priority during short periods of time.

Within each of these elements, tasks and deliverables are identified along with the estimated completion date and the lead RTDF team member. Many of the work plan elements either incorporate or overlap with many of the high priority action items identified in the 2006 Sanitary Survey.

MISSION STATEMENT

The mission of the Municipal Water Quality Investigations Program (MWQI Program) is to a) support the effective and efficient use of the State Water Project (SWP) as a source water supply used for municipal purposes through monitoring, forecasting, and reporting of SWP water quality; b) provide early warning of changing conditions in source water quality used for municipal purposes; c) provide data and knowledge based support for operational decision-making on the SWP; d) conduct scientific studies of drinking water importance; and e) provide scientific support to DWR, the State Water Contractors, CALFED, and other governmental entities.

MWQI Core Competencies

- Continuous long-term water quality monitoring (grab samples) in the Delta.
- Real time water quality monitoring (automated, high frequency data collection stations) in the Delta.
- Provide science support on Delta and SWP drinking water issues.
- Analysis of Delta drinking water quality monitoring data.
- Primary source of Delta drinking water quality historical data.
- SWP drinking water quality early warning (RTDF-CP).
- SWP drinking water quality forecasting (RTDF-CP).
- Provide drinking water quality support (data, expertise) to CALFED and other agencies.

Customers/Regulators utilizing MWQI Program data

- State government
- DWR's Operations Control Office
- State Water Contractors and Contra Costa Water District
- CALFED
- Central Valley Regional Water Quality Control Board
- CDPH
- US EPA

1 PROGRAM OVERVIEW AND EVOLUTION

In the early 1960's, the U.S. Public Health Service published drinking water criteria that consisted of only a few water quality parameters, as compared to today. These criteria remained largely unchanged for years, as the conventional wisdom of the day held that treatment of surface waters by filtration, and natural filtering of ground water by soils, along with disinfection, rendered these supplies safe for drinking. Then, in the 1970's, improvements in scientific measurement techniques led to discovery of trihalomethanes (THMs) in U.S. drinking waters. Subsequent investigation indicated a possible link with increased incidence of cancer among exposed populations. By this time, the U.S. EPA had been created, and a process was set in motion that resulted in the early 1980's in a new federal regulation controlling THMs in drinking water.

In anticipation of the new regulation, DWR undertook a three-month investigation of organic carbon and bromide sources in Delta drinking water supplies. This study resulted in a preliminary finding that discharges from wastewater treatment plants and drainage from land surfaces contained elevated concentrations of organic carbon precursors of THMs, and that bromide was present in the system in concentrations sufficient to create bromine-containing THMs in treated drinking water. This finding led, to the formation of a panel of recognized independent water quality and health scientists who were asked to evaluate information and make recommendations for further action as needed.

The panel report, published in 1981, found that most Delta water quality data then in existence was produced in support of ecological, rather than human health, concerns. The panel recommended institution of a program of monitoring for constituents of human health significance, namely THM precursors, sodium, and synthetic organic pollutants such as pesticides. In 1982, DWR implemented the Interagency Delta Health Monitoring Program (IDHAMP) in satisfaction of the panel's recommendations. The IDHAMP was created as an interagency effort, and its successor remains so today. Participants have included the U.S. Bureau of Reclamation, City of Stockton, City of Sacramento, Contra Costa Water District, and California Department of Health Services, along with SWC agencies that purvey drinking water.

Early information from the IDHAMP indicated drainage from Delta island peat soils is rich in organic carbon, therefore a separate study, the Delta Island Drainage Investigation (DIDI) was subsequently instituted. The DIDDI was established to develop detailed information on the nature of this carbon source and to identify potential means of mitigating its impact on Delta drinking water supplies.

Meanwhile, advancements in analytical methodology continued, and as these were applied to environmental analysis, new water quality concerns emerged. Among these were presence of DDT and PCB in fish and sediments of the Delta and its watersheds, selenium pollution in the San Joaquin River watershed, arsenic in the watersheds of the Delta and SWP, pesticide pollution by molinate and thiobencarb (rice herbicides) and insecticides such as diazinon, and waterborne pathogenic protozoa (*Giardia, Cryptosporidium*) that resist disinfection. Advancements in the analytical sciences have also led to discovery of previously unidentified disinfection by-products in drinking water supplies. Scientific data on all these and other potential water quality challenges were collected through the IDHAMP Program.

As scientific discoveries were made, there was a greater appreciation of the need for water quality information upon which to base management decisions affecting Delta water supplies. Accordingly, in 1985, the SWC requested DWR to propose a broad-based program that would provide information on known and emerging threats to drinking water quality. In 1986, DWR responded by implementing the MWQI Program, that unified the IDHAMP and DIDI programs. The MWQI Program was founded on the principle that water quality concerns will continue to evolve as scientific understanding progresses, and that the program must be flexible and pro-active in order to address the new water quality challenges that will continually arise.

In search of practical means of eliminating or mitigating sources of undesirable constituents, the MWQI Program has supported numerous scientific investigations into underlying mechanisms of pollution. Years of monitoring effort have established a high quality, long-term base of data documenting the drinking water quality status of the Delta, and the phenomena that cause changes in Delta water quality. Data from the program have been, and continue to be used, extensively in water quality and water supply studies and planning. The continually evolving integration of MWQI's data with forecasting and information dissemination tools have made possible a future in which we will be able to not only better understand the consequences of

changes that occur in the Delta and SWP, but also to anticipate, communicate and, in some measure, control water quality conditions. It is toward this future that the MWQI program is focused.

Past MWQI water quality assessments centered on periodic collection of discrete ("grab") samples followed by their laboratory analysis and retrospective data interpretation. The early years of the program were primarily devoted to surveying the status of THM precursors and other water quality constituents and identifying their sources. Information derived from this work is used for water supply planning. New technology allows remote, near continuous, monitoring of water quality parameters such as organic carbon and bromide, along with instantaneous remote acquisition of the data. Equipment of this type is presently installed and maintained by MWQI at three critical Delta locations. Remote sensing technology allows real time operational decisions to be made that take into account water quality considerations. As water management has become vastly more complex, due to increasing environmental restrictions on water operations, it has become necessary to manage the Delta and SWP to increasingly finer degrees. This new water quality sensing technology offers a tool for better and quicker "tuning" of water operations.

High frequency real time water quality data from multiple remote locations also provides the needed information base to develop computer tools for fingerprinting and forecasting drinking water quality conditions in the Delta and SWP. The geographic domain of DWR's Delta Simulation Model (DSM2) has been extended to include the newly developed DSM2-Aqueduct extension model. This new model includes the California and South Bay Aqueducts. A third model includes the Delta Mendota Canal. With these tools, water quality consequences of Delta and SWP-Central Valley Project operations can be forecasted, with the objective of incorporating this information into water operations decisions for the export facilities as well as downstream purveyor's facilities.

1.1 The Real Time Data Forecasting Comprehensive Program

The MWQI Program and the SWC realized that the tools were available to coordinate real time data acquisition and water quality forecasting to provide water agencies and municipal operators with the information to make operational decisions based on imminent changes in water quality.

What was lacking was a coordinated mechanism to realize this capability. On June 7 and 8, 2006, representatives from SWC agencies who are participants of the MWQI Program, DWR management and staff, and select outside agencies, met to discuss the concept of a Real Time Data and Forecasting Comprehensive Program (RTDF-CP). The meeting focused on identifying the required program elements, possible collaboration and resource sharing opportunities that would allow the RTDF-CP to become reality. It was determined that if MWQI and the SWC were to effectively harness the tools to improve the efficiency of water project operations while protecting and improving drinking water quality, then the RTDF-CP must address the following considerations:

- The Delta and SWP must be more thoroughly instrumented to assure that real time water quality data are available at all critical locations.
- A forecasting system capable of producing water quality simulations and providing early warning and notification on a daily production basis must be developed for the existing SWP water quality forecasting model. Primarily, this entails developing the software mechanisms for efficiently channeling the necessary input data to the model, and producing a report output suitable for use by water managers.
- Coordination among various DWR and SWC organizations must be improved to enable smooth information flow and timely, appropriate action.

To address these needs the RTDF-CP was developed by the MWQI Program. A five-year strategic plan was developed to guide the RTDF-CP. The objectives of the 5-year strategic plan include:

- Create a cooperative organizational structure and identify the coordination and funding required for the RTDF-CP
- Develop and refine a SWP Early Warning System for water quality concerns to include:
    - Water quality monitoring and emerging concerns,
    - Water quality forecasting,
    - Water quality information management and data dissemination,
    - Scientific support studies, and
    - Emergency Response.

As envisioned, water quality sensors in the tributaries to the Delta (mainly Sacramento and San Joaquin rivers) would provide early warning of elevated concentrations of organic carbon, bromide, turbidity, algal growths, and other water quality constituents of concern to drinking water purveyors. Movement and concentrations of these constituents would be predicted using computer forecasting tools, and their actual movements tracked through other monitoring stations in the Delta. Water operations managers could be made aware of the conditions and could make operations decisions designed to mitigate water quality problems while maintaining water deliveries. Agencies using the Delta as a source of drinking water would be notified and status of the situation communicated on an ongoing basis. If elevated concentrations of constituents entered the SWP system, they could be tracked using computer forecasting and remote sensing tools, and drinking water agencies along the system could be notified when the material was expected to appear at their turnouts, and in what concentrations. Drinking water purveyors could alert water treatment plant managers who, in turn, would prepare for chemical addition or other process changes as warranted. Drinking water agencies would provide continuing feedback to SWP operators and water quality managers to enable the full consequences of operations decisions to be understood, and this information would be acted upon to improve the early warning and operational control processes.

Besides the water quality monitoring, forecasting and data dissemination that makes up the "nuts and bolts" behind a real time early warning system, scientific special studies and emergency response elements are also necessary for an early warning system. In the case of special studies, the information collected is an integral part of the real time data collection and forecasting. Special studies are conducted to investigate the origins, fate and transport, and in some cases, loads of current and emerging contaminants of concern. Such studies help to determine where new instruments should be located. Special studies may also investigate seasonal patterns and trends of constituents or examine circulation patterns of contaminants. These studies can also be used to refine modeling assumptions. Special studies can also assess the impacts of increasing urbanization on levels of water quality constituents of concern. In addition, ensuring that Departmental emergency response mechanisms include consideration of drinking water constituents is vital to an early warning system. A mechanism that can quickly notify water purveyors and operators of emergency spills and analytes that aren't modeled or analyzed in real time will always be necessary.

1.2 The RTDF-CP and the MWQI Program

Within the MWQI Program, the RTDF-CP entails the following elements:

1. Coordination and collaboration between DWR monitoring and forecasting groups.
2. Real time data acquisition for the Delta and SWP through remote, high-frequency monitoring.
3. Enhancement of forecasting and fingerprinting of drinking water quality through use of computer models.
4. Centralized information management and dissemination.
5. Scientific support studies.
6. Emergency response preparedness as related to drinking water quality.
7. Coordination and collaboration within DWR and with outside agencies to enhance real time monitoring activities.

Implementing many of the above goals requires coordination with staff outside of the MWQI unit. Within DWR, several units have expertise and responsibilities that are necessary to operate an extensive real time early warning and response system, including: Division of Environmental Services (MWQI Program, Environmental Real Time Monitoring and Support), Division of Operations and Maintenance (Office of Water Quality, Operations Control Office, SWP Field Divisions), Bay Delta Office (Delta Modeling Section), and Division of Planning and Local Assistance (District Offices). In 2006, the SWC began working with the Department to create additional positions needed to ensure that the goals of the RTDF-CP are accomplished. In FY 2007/08 seven new positions were created within the Department and were filled by February 2008. The FY 2008/09 work plan represents the first year where all RTDF-CP positions have been filled and priority tasks, that were listed in the 2007/08 work plan, can now be fully addressed.

DWR divisions that were delegated newly created positions include:

Organization	# of New Positions	New Position Responsibilities
MWQI Program	4	Two positions initially devoted to Emergency Response with 1 transitioning to enhancing and maintaining current RTDF data management system and/or working on special studies. Two positions devoted to field support
Bay-Delta Office	1	This position is devoted to modeling, forecasting and data dissemination.
Office of Control Operations	1	This position is devoted to modeling, forecasting and data dissemination
Operations & Maintenance Water Quality	1	This position is devoted to grab sampling and in-situ instrumentation installation, operation and maintenance in the SWP, and algal concerns

1.3 Accomplishments from the FY 2007/08

Over the course of FY 2007/08, MWQI accomplished a number of goals listed directly in the 2007/08 work plan. Accomplishments include:

- All 7 BCP positions filled
- Completion of NEMDC report for CALFED
- NEMDC study published in Water Resources Research.
- Completion of Staten Island study and report for CALFED
- Completion of the Inorganic Carbon Removal study
- Completion of MWQI Biennial Water Quality Report (Oct. 2005-Sept. 2007)
- Beginning installation of carbon analyzer on the DMC at Jones Pumping Plant
- Consolidation of MWQI and O&M Water Quality real time instrumentation into one building at Banks Pumping Plant with shared data storage and upgraded communication capabilities.
- Completion of Isotope Study. To be submitted for publication to Water Resources Research
- Real time anion data posted to CDEC and included in weekly MWQI report
- Completion of DWR/DSM2/CH2MHill Aqueduct Model

- RTDF3 database in use
- Server Security Issues resolved
- Coordination between RTDF-CP partners to examine the effects of the Wanger (Delta Smelt) decision on water quality

1.4 Work plan Structure

This work plan is divided into 6 elements. These elements are:

Water Quality Assessment
Real Time Water Quality Monitoring
Real Time Forecasting
Real Time Data Dissemination
Special Studies
Emergency Response

Within each of these elements, tasks and deliverables are identified along with the estimated completion date and the lead RTDF team member. Many of the work plan elements either incorporate or overlap with high priority action items identified in the 2006 Sanitary Survey.

2 PROGRAM FUNDING NEEDS

For Fiscal Year 2008/09, the MWQI Program Budget is $3.1M which includes the $200K "set aside" fund managed by the SWPCA.

DWR "SAP" budget breakdown– this is the total dollar amount outlined in the MWQI and SWPCA agreements. The total dollar amount for FY 2008-09 is $3,100,000 ($2,900,000 MWQI baseline budget and $200,000 SWPCA managed fund). $2.9M will be entered into SAP (DWR's accounting system) as the baseline and non-reimbursable portion of the MWQI Program budget. The remaining $200,000 will be managed by SWPCA. These funds will also remain non-reimbursable.

PROGRAM FUNDING SUMMARY

Table 1. Estimated Total MWQI Program Budget for FY 2008-09

Funding Source	Funding FY 2008-09 (Jul. 1, 2008 – Jun. 30, 2009)	Funding CY 2008 (Jul. 1, 2008 - Dec. 31, 2008)	Funding CY 2009 (Jan. 1, 2009 – Jun. 30, 2009)
MWQI baseline funds	$2,900,000.00	$1,450,000.00	$1,450,000.00
SWPCA Funds	$200,000.00	$100,000.00	$100,000.00
Total funding required	$3,100,000.00	$1,550,000.00	$1,550,000.00

Table 2. Program Element Costs FY 2008/09 (MWQI and SWPCA Funds)

Program Element No.	Program Element	Total Funding FY 2008-09 (Jul. 1, 2008 – Jun. 30, 2009)	MWQI Baseline Funding FY 2008-09	SWPCA Funding FY 2008-09
3.1	Water Quality Assessment	$301,562	$291,209	$10,353
4.1	Real Time Water Quality Monitoring	$763,702	$721,761	$41,941
4.2	New Technologies Sub-committee	$104,130	$104,130	$0
4.3	Water Quality Forecasting	$428,601	$428,601	$0
4.4	Information Management and Dissemination	$253,714	$191,314	$62,400
5.1	Urban Sources and Loads	$122,269	$118,128	$4,141
5.2	NDMA	$93,846	$91,776	$2,070
5.3	South Delta Ag Study	$75,800	$73,729	$2,071
5.4	Organic Carbon Long-term Trends	$60,290	$54,290	$6,000
5.5	O'Neill Forebay Circulation	$137,580	$135,509	$2,071
5.6	Organic Carbon Quality Investigation	$56,480	$46,127	$10,353
6.0	Emergency Response	$192,619	$192,619	$0
7.0	Other Water Quality Program-related activities	$140,259	$140,259	$0
8.0	Program Management	$205,361	$146,761	$58,600
9.0	Other Required Program Costs	$163,787	$163,787	$0
Total funding		$3,100,000	$2,900,000	$200,000

Estimated Laboratory Costs

1. Bryte Laboratory will stay on overhead indefinitely.

3 WORK PLAN ELEMENTS

Sections 3-6 delineate the tasks and deliverables associated with MWQI's six program elements. Program elements are:

- Water quality assessment (discrete sample collection and analysis)
- Real time monitoring
- Water quality forecasting
- Information management and dissemination
- Science support
- Emergency response

3.1 Water Quality Assessment

Water quality monitoring has been a key feature of the MWQI Program since its inception in 1982. Data from the program continue to be used extensively by DWR, SWC agencies, numerous other federal, State, and local agencies, and the public, for water supply planning studies. Data from this program are used to identify longer-term trends of water quality changes in the Delta region and in the SWP. Monitoring data also help DWR and other agencies develop research and mitigation measures to reduce contaminants in Delta waters. In collaboration with the DWR Division of Operations and Maintenance (O&M), monitoring data from the Delta and SWP are being used to develop an "early warning" system having the potential to provide advance notice to Delta water users of possible drinking water quality problems.

3.1.1 Discrete Sample Collection and Analysis

In FY 2008/09, monthly grab sampling and data reporting will continue for 11 Delta sites. Table 3 summarizes locations, water quality parameters, and frequencies while Figure 1 presents a map of grab sampling sites for the FY 2008/09 work plan period. Location, frequency, and analytes are generally unchanged from those listed in the FY 2007/08 work plan. Discrete sampling changes made from the FY 2007/08 work plan are:

1. O & M Water Quality will add total phosphorous monitoring to the constituents monitored at the Banks Pumping Plant.

2. Depending on the results obtained from a planned special study (see section 5.2), N-nitrosodimethylamine may be added to the sampling regime at a few key stations in the future.

3. Once the installation of an organic carbon analyzer is in place at the Jones Pumping Plant, organic carbon, bromide and nutrient grab samples will be collected by MWQI field staff. Sampling frequency will be dependent on field staff's schedule of initial station maintenance and training of San Luis Delta Mendota Water Authority (SLDMWA) field staff. Once grab sample collection at this site begins, a total of 12 stations will have grab sample data.

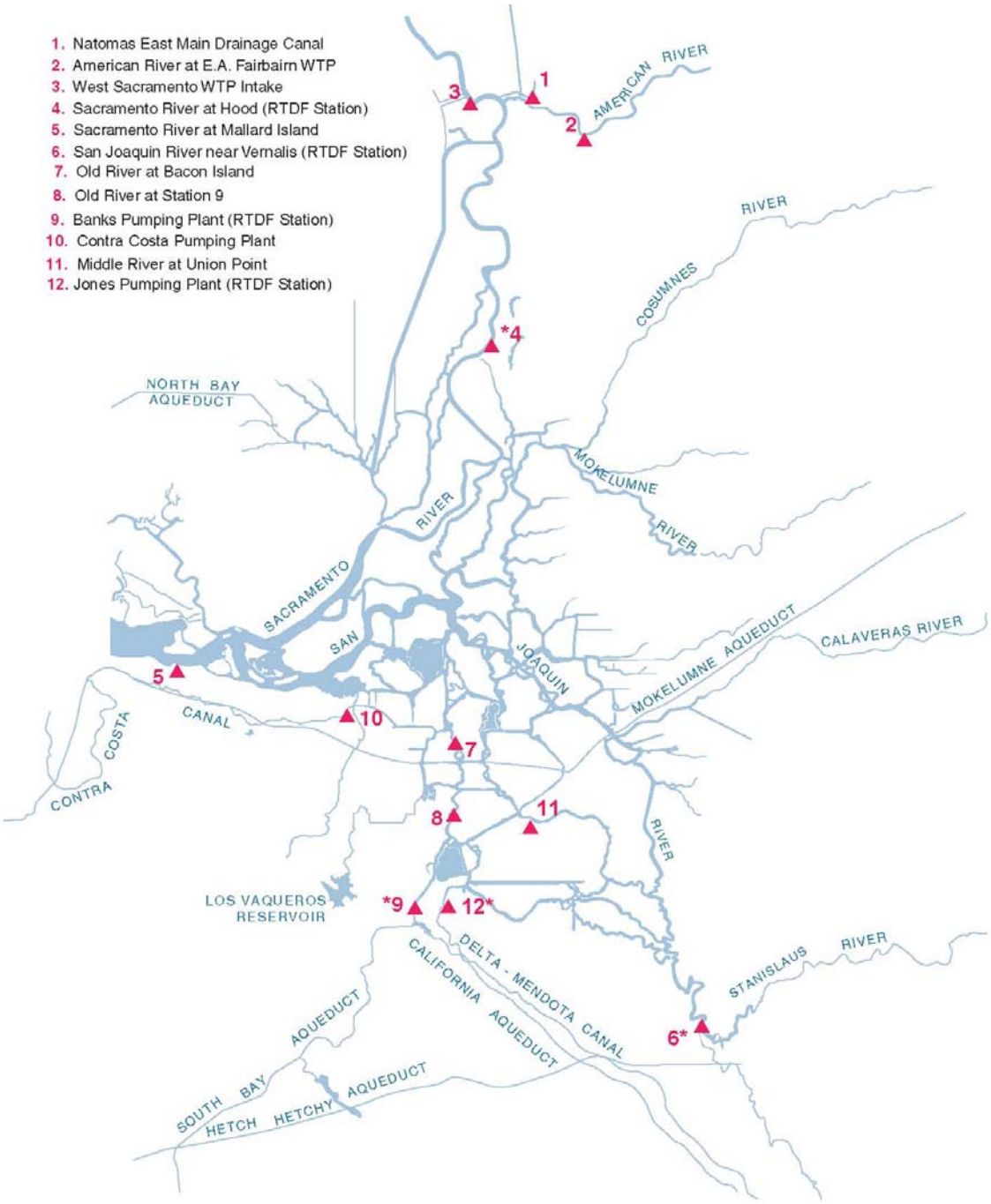
Table 3. MWQI Discrete Sampling: stations, parameters, and frequency

Station #	Stations		Frequency
1	Natomas East Main Drainage Canal (NEMDC)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, bromide, metals	Monthly
2	American River at EA Fairbarin WTP Intake (AMERICAN)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide	Monthly
3	Sacramento River at West Sacramento WTP Intake (SACWSACINT)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide	Monthly
4	Sacramento River at Hood (HOOD)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide	Bi-weekly
5	Sacramento River at Mallard Island (MALLARDIS)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide	Monthly
6	San Joaquin River near Vernalis (VERNALIS)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide	Bi-weekly
7	Old River at Bacon Island (OLDRIVBACISL)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide	Monthly
8	Old River near Byron Tract (STATION09)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide	Monthly
9	‡ Delta P.P. Headworks (BANKS)	Std. Mineral, Turbidity, UVA, TOC, DOC, Bromide, total phosphorous	Bi-weekly
10	Contra Costa Pumping Plant at Rock Slough (CONCOSPP01)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide	Monthly
11	Middle River @ Union Point (MR UNION)	Std. Mineral, Turbidity, UVA, TOC, DOC, Bromide	Monthly
12	Jones Pumping .Plant at DMC Headworks (DMC)	Bromide, nutrients, TOC, DOC	Frequency TBD by installation and training schedules of field staff.

‡ Samples collected by DWR's Operations and Maintenance (O&M)

TBD-To be determined

Figure 1. MWQI Discrete ("Grab") Sampling Locations, FY 2008/09



* denotes stations with MWQI real time monitoring instrumentation.

3.1.2 Discrete Grab Sample Deliverables

Discrete grab sample tasks and deliverables are:

Deliverable	Participants	Estimated Completion Date
Records of monthly and bi-weekly, monitoring data.	MWQI Program	Currently available upon request
Records of periodic calibration of field monitoring equipment	MWQI Program	Currently available upon request
Records demonstrating consistent and timely application of QA/QC procedures	MWQI Program	Currently available upon request
Timely analysis and posting of results to the Water Data Library	MWQI Program	Monthly Available on-line

3.1.3 Budget

Labor costs: Labor hours: 3,885 Labor Cost: $286,209 Other Costs: $5,000 Total Cost: $291,209

4 Real Time Data and Forecasting Comprehensive Program

The geographic scope of the MWQI Program has historically been confined to the Delta. However, the scope of real time monitoring and forecasting effort must, by necessity, encompass the watersheds of the Delta, the SWP, and portions of the federal Central Valley Project that are interconnected to the Delta and SWP. The scope of real time monitoring and forecasting also overlaps various DWR programs, including those of the District offices, the Division of O&M, the Bay-Delta Office, and the Interagency Ecological Program.

A major, but necessary, challenge has been to develop mechanisms to integrate and coordinate among DWR programs and other agencies to achieve effective communications, standardized information formats, provide funding, and periodically review and update programs to meet current needs. The DWR Office of Water Quality was established in recognition of the need for greater linkage among existing DWR water quality programs. Expansion of the Real time Data and Forecasting program illustrates the need and provides a mechanism to realize this coordination and integration. Currently, oversight is being provided by an RTDF Steering Committee with participation from each involved contractor of the SWP. It also includes DWR staff members from the various component divisions.

If a robust real time water quality data and forecasting capability is to be realized, it will require longer-term management commitment and funding from DWR and the SWC. Eventually the RTDF CP will need to reside organizationally where the integration of functions and resources can be best realized. The project tasks proposed for FY 2008/09 rely on an expanded budget and current resources available through the MWQI Program. The work to be done in the coming year using these resources will significantly advance a more comprehensive program.

At a special meeting in February 2008, the RTDF Steering Committee determined the tasks and deliverables for the forecasting and information/data dissemination portion of the Real Time Program. The tasks and deliverables listed in this work plan represent the RTDF Steering Committee's recommendations to the MWQI TAC of the work that needs to be conducted during this and future work plan cycles.

4.1 Real Time Monitoring

As used in this work plan, real time monitoring or in situ monitoring is defined as high frequency or continuous measurement of water quality and flow by remote equipment installed in locations within the Delta, its tributaries, and the SWP. Communication equipment transmits the resulting data to headquarters to be used shortly after measurements are made. This program element is comprised of two parts; a) field operations which ensure the operation and maintenance of all automated sampling equipment, timely transmission of real-time data to users and implementation and documentation of QA/QC of this data, and b) the synthesis of real time data from a variety of federal, State and local agency water quality monitoring programs, rapid data quality control, analysis, and dissemination of results. These results are currently provided as part of the RTDF CP via weekly electronic reports.

Real time results are used to: a) inform operational decisions affecting the Delta and SWP, b) support development of water quality forecasting tools for better managing of SWP water supplies, and c) for water quality and water supply planning studies. In addition to DWR and the SWC, this information is used by many federal, state, and local agencies, and the public.

Real time monitoring activities receive technical advice and guidance from the RTDF Steering Committee, a group of technical experts composed of staff from participating agencies. The RTDF Steering Committee serves as a subcommittee of the MWQI TAC, to which the Steering Committee reports.

Tasks and deliverables in the FY 2007/08 work plan focused on expanding the number and data acquisition or real time analytes, increasing the number of sites monitored and the number of programs providing real time data, and enhancing the vehicle of delivery for data to users (i.e. replacing E-mail reports with an interactive web site and/or database). Examples of the tasks completed or in process under this element from the last work plan include: 1) beginning construction of a new joint use facility at Banks housing both Delta O & M Field Division and MWQI real time monitoring instrumentation which will also include state of the art communications equipment and space for expansion of additional real time monitoring instruments, 2) installation of a new TOC analyzer at the Jones Pumping Plant at the

headworks of the Delta Mendota Canal, 3) the posting and accessibility of anion data on CDEC from the Banks and Vernalis stations and, 4) implementation of the RTDF3 database.

Current objectives for the Real time Monitoring Program include:

- determining baseline concentrations of organic carbon, anions, nutrients and other drinking water quality constituents in Delta and SWP waters.
- determining loads, timing, and quality of carbon, nutrients, anions (i.e. chloride and bromide) entering the Delta from the Sacramento and San Joaquin Rivers, as well as in-Delta sources.
- identifying and quantifying water quality changes caused by land use changes from urbanization and population growth in the Delta and its watersheds, and by actions proposed or taken by CALFED or other entities that affect the Delta environment.
- providing water quality data relevant to SWP contractors and other users of Delta water supplies in a timely manner for decision making.
- providing water quality forecasts that assist SWP and other utilities in advanced planning efforts to optimize management of their water supplies while meeting increasingly stringent drinking water regulations.

Table 4 summarizes station locations, water quality parameters, and automated analyzer equipment used by the MWQI Real time Monitoring Program.

Table 4. MWQI Real time Sampling: station location, parameters, and equipment

Station	Parameters	Equipment
Sacramento River at Hood (HOOD)	TOC, DOC	Shimadzu 4100 – (combustion) Sievers 900 – (oxidation)
San Joaquin River near Vernalis (VERNALIS)	TOC, DOC, bromide, chloride, nitrate, sulfate, fluoride	Shimadzu 4110 – (combustion) Dionex DX 800 – (anions)
Delta P.P. Headworks (BANKS)	TOC, DOC, bromide, chloride, nitrate, sulfate, fluoride	Shimadzu 4100 – (combustion) Dionex DX 800 – (anions)
Upon completion-Delta-Mendota Headwork (Jones Pumping Plant)	TOC, DOC	Shimadzu 4100 – (combustion)

4.1.1 Real Time Monitoring Tasks

The real time monitoring program for FY 2008/09 consists of the following specific tasks:

A. Continue to develop, operate, and maintain QA/QC regimes for all in-situ instruments and continue to identify critical data gaps which could be filled by additional real time instrumentation.

B. Continue operation and improve performance of ion chromatography equipment, and associated remote communications networks at the in-situ monitoring stations at Banks and Vernalis.

C. Continue consolidation of MWQI and O&M WQ instrumentation at Banks into one building. This task includes: a) completing installation of the Shimadzu and training of SLDMWA staff on Shimadzu operation at Jones Pumping Plant and, b) creating a mechanism for data transfer between CVP Jones Pumping Plant to CDEC.

D. Begin installation of real time instrumentation on the DMC at McCabe Road (DMC inlet to O'Neill Forebay) for EC, pH, temperature and turbidity.

E. In cooperation with the O & M San Luis Field Division, begin negotiation and/or installation of a real time monitoring station at San Luis Reservoir.

F. In coordination with staff of O&M, the Interagency Ecological Program (IEP), and the Districts (Division of Planning and Local Assistance (DPLA)) develop necessary

mechanisms to acquire their real time data from existing in-situ water quality monitoring stations at Hood, Banks and Vernalis, and make these data available to Internet users. Eventually, coordinate similarly with outside agencies such as USBR and for different sites within the Delta and SWP for this same purpose.

G. The RTDF Steering Committee will continue to assist with evaluating the need, and plan for, other real time analyzer instrument installations as may be required to fulfill the objectives of the Real time Monitoring Program.

H. Provide readily accessible data and fill in TDS/EC data gaps on pump-in activities.

I. Pursue alternative strategies for efficient and timely debris removal at Vernalis station structure.

4.1.2 Real Time Monitoring Deliverables

(Lead organization(s) are shown in bold)

Deliverable	Associated Task(s)	Participants	Estimated Completion Date
Continued operation of automated stations at Hood, Banks, Vernalis & identify critical data gaps.	A, B	**MWQI Program**	Ongoing
a) Development of SOPs documenting maintenance, operation and quality assurance/quality control of all in-situ equipment. **b)** Work towards standardizing, streamlining, and consolidating DWR's in-situ: equipment, data quality control, and data dissemination.	A	**MWQI Program** **O&M Water Quality** **b) MWQI Program** **O&M Water Quality** DPLA IEP	a) June 2009 b) Ongoing
a) Continue consolidation of MWQI and O&M WQ instrumentation at Banks into one building with shared facilities. **b)** Complete installation and training of SLDMWA staff on Shimadzu operation at Jones Pumping Plant.	C	**a) MWQI Program/ O& M Water Quality, Delta Field Division** b) **MWQI/SLDMWA**	a) May 2008 b) Contract in place June 2008 Installation complete August 2008 Training complete Oct. 2008

c) Pursue data transfer options from Jones Pumping Plant to CDEC.		c) **MWQI/SLDMWA**	c) TBD
Installation of real time monitoring instruments at DMC at McCabe Rd. (inlet to O'Neill Forebay).	D	**O&M Water Quality/SLDMWA** MWQI Program	Dependent on completion of Task C (b) above. Tentative installation Oct. 2008
Pursue installation of San Luis real time monitoring station.	E	**SWPCA** O&M Water Quality	Letter to O&M WQ by May 2008
a). Investigate and document other DWR *in-situ* water quality monitoring programs parameters measured, and data availability **at** Hood, Banks, and Vernalis. **b)**. Investigate and document other DWR in-situ water quality monitoring programs parameters measured, and data availability **upstream** of Hood and Vernalis.	F	**a) MWQI Program** O&M Water Quality DPLA IEP b) **MWQI Program** O&M Water Quality DPLA	a) July 2008 . b) July 2008
Continue to evaluate the need, and planning for, other installations per the RTDF-CP (together with RTDF Steering Committee).	G	**RTDF** MWQI Program	Ongoing
Provide readily accessible data and fill in TDS/EC data gaps on pump-in activities.	H	**O&M WQ**	June 2009
Pursue alternative strategies for debris removal at Vernalis station.	I	**MWQI Program**	June 2009

4.1.3 Budget

Labor costs: Labor hours: 6553 Labor Cost: $481,388 Other Costs: $240,373 Total Cost: $721,761

4.2 "New Technologies" Subcommittee

This subcommittee was created at the June 2006 workshop in Folsom. Specific tasks assigned to the group were discussed and agreed upon by the MWQI TAC members at the workshop. This subcommittee is comprised of members of the RTDF Steering Committee with expertise in monitoring technology and techniques. The subcommittee's purpose is to advise the MWQI TAC and MWQI Program on new technologies that are efficient, cost effective and compatible with the overall desire to expand real time monitoring in the Delta and SWP.

4.2.1 New Technologies Subcommittee Tasks for FY 2008/09

At the February 2008, RTDF special meeting, it was agreed that a prioritization of analytes for real time monitoring was needed. Prioritization of analytes provides direction for the evaluation of new instrumentation and ensures that as new real time stations are added to the RTDF network, instrumentation for the highest priority analytes is installed first. The group agreed that bromide should be ranked as a top priority analyte. The current anion analyzer (DIONEX) in use is labor intensive, has poor technical support, and software that is not easily upgradeable. The RTDF subcommittee tasked the New Technologies subcommittee with locating a better alternative to the DIONEX such that, in the future, bromide/chloride real time instrumentation can be one of the first instruments installed at proposed real time stations. The proposed tasks for the New Technologies subcommittee are:

J. Prioritize constituents of concern for new instrument technologies. In order of tentative priority, the constituents are
    1. Bromide/chloride, EC, and organic carbon
    2. Nitrate/nitrites, total phosphate, orthophosphate, sulfate, and
    3. Ammonia and Total Kjeldahl Nitrogen (TKN)

K. Identify instruments that will more efficiently or economically measure the first priority constituents or a combination of the first and second prioritized constituents.

L. Provide recommendations to RTDF Steering Committee and MWQI-TAC on the purchase of instruments for the 2009/10 work plan (high priority is replacement of DIONEX).

M. Investigate feasibility and relevance of installing Sievers 800 organic carbon instrument at the Vernalis station.

N. Continue investigations into real time monitoring of additional parameters at existing stations (e.g. self-cleaning fluorometers for SWP monitoring stations).

4.2.2 New Technologies Subcommittee Deliverables

Deliverable	Associated Task(s)	Participants	Estimated Completion Date
Prioritize constituents of concern for new instrument technologies.	J	New Technologies Work Group	September 2008
Identify instruments that will more efficiently or economically measure the prioritized constituents.	K	New Technologies Work Group	December 2008
Provide recommendations to RTDF steering committee and MWQI-TAC on the purchase of instruments for the 09/10 work plan (high priority is replacement of DIONEX).	L	New Technologies Work Group	February 2009
Investigate feasibility/relevance of installation of Sievers 800 at Vernalis station.	M	New Technologies Work Group	December 2008
Investigate monitoring instruments for additional parameters at existing stations and/or new stations.	N	New Technologies Work Group	Ongoing

4.2.3 Budget

Labor costs: Labor hours: 851 Labor Cost: $74,130 Other Costs: $30,000 Total Cost: $104,130

4.3 Water Quality Forecasting

While water quality monitoring enables an understanding of current and past water quality conditions, it is generally inadequate to forecast and assess the water quality effects of future, or proposed, changes in the Delta and SWP. To enable future conditions to be forecasted and analyzed, monitoring data will be used in conjunction with mathematical modeling techniques to develop and refine computer simulation tools. Seasonal forecasts should be easier to produce

than weekly forecasts. In the work plan, many of the tasks focus on producing weekly and seasonal salinity (EC and bromide) forecasts for the Delta and the SWP Aqueduct by the end of the 2008/09 fiscal year. Once this is accomplished, the next goal will be to have weekly DOC forecasts for the Delta and the Aqueduct by the end of the 2009/10 fiscal year. Note that as the DSM2 model is improved by upgrades or recalibrations, the most current, vetted, version of the model will be used for forecasting purposes.

To achieve the tasks described below requires the continued collaboration between the various DWR groups responsible for real time data collection and forecasting. These groups include the MWQI Program, O & M's OCO and the Bay Delta Office's Delta Modeling Section. Objectives of this enhanced effort are to better tailor water quality monitoring to modeling needs and to maximize the use of modeling results by water quality managers.

4.3.1 Water Quality Forecasting Tasks

The tasks in this section require many steps. Detailed steps associated with the tasks below are itemized in the deliverables section (section 4.3.2). The tasks under this work plan element are:

A. **Develop capability to simulate historical water quality conditions from 1990 to present.**
   This requires collecting and processing and filling in missing flow data, water quality data, and data on project operations, running the simulation, comparing results to field data, and investigating sources of error in the results.

B. **Develop capability to conduct planning studies of Delta and Aqueduct water quality**
   A planning study requires the generation of boundary conditions and project operations under an assumed hydrology, water demands, institutional constraints, and project operation goals.

C. **Develop capability to produce seasonal forecasts**
   Seasonal forecasts typically extend several months out and require establishing boundary water quality conditions and operations given forecasted system flows.

D. **Develop capability to produce weekly forecasts**
   Producing weekly forecasts requires establishing an accurate description of initial system water quality/fingerprint, capturing relevant recent historical and forecasted data from various sources, and applying some type of quality assessment to this data.

E. **Assess and improve/develop preprocessing tools (computer programs, Python codes, Excel Templates/Macros, etc.) to enable fast, reliable forecasts of EC, DOC, and bromide with DSM2 and the Aqueduct model (i.e. move from manual to automatic processing).**

F. **Assess and improve/develop post-processing tools (computer programs, Python codes, Excel Templates/Macros, etc.) to enable fast, reliable assessment of results from DSM2 and the Aqueduct model (forecasts of EC, DOC, bromide, etc.) for alternative scenarios.**

G. **Enhance forecasting procedures.**

H. **Conduct SWP Particle Tracking Study to assist in validation of the Aqueduct model** (Smart Oranges study).

I. **Staff Training.**

4.3.2 Water Quality Forecasting Deliverables

(Lead organization(s) are shown in bold)

Develop capability to simulate historical water quality conditions from 1990 to present.

This requires collecting and processing and filling in missing flow data, water quality data, and data on project operations, running the simulation, comparing results to field data, and investigating sources of error in the results.

Deliverable	Associated Tasks	Participants	Estimated Completion Date
a) Delta 1) Hydrodynamics 2) EC 3) Bromide 4) DOC 5) Fingerprints **b)** Aqueduct 1) Hydraulics 2) EC 3) Bromide 4) DOC 5) Fingerprints c) Provide mechanism to ensure data gaps are addressed and establish a record keeping method to prevent future gaps .	A	**OCO/Bay-Delta Modeling**	a) 1) completed 2) completed 3) ongoing 4) ongoing 5) completed b) All ongoing c) Ongoing

Develop capability to conduct planning studies of Delta and Aqueduct water quality

A planning study requires the generation of boundary conditions and project operations under an assumed hydrology, water demands, institutional constraints, and project operation goals.

Deliverable	Associated Tasks	Participants	Estimated Completion Date
a) Debug the DSM2 Aqueduct Model under applications of long-term simulations.	B	**Bay-Delta Modeling** OCO	a) April 2008
b) Enable Delta planning studies 1) EC: develop, test, and refine methods to estimate boundary values given assumed upstream flows (quantity and source), land practices, and operations.		**Bay-Delta Modeling**	b) June 2008-Note that for CalSimII studies, EC at Vernalis is already provided.
2) Bromide: develop, test, and refine methods to estimate boundary values given assumed upstream flows (quantity and source), land practices, and operations.		**Bay-Delta Modeling**	June 2008-Note that simulating Delta bromide directly contingent upon a recalibration of DSM2.
3) DOC: develop, test, and refine methods to estimate boundary values given assumed upstream flows (quantity and source), land practices, and operations.		**Bay-Delta Modeling**	TBD- Work underway as part of CALFED drinking water quality program.
c) Enable Aqueduct planning studies 1) For EC, bromide, DOC & fingerprinting: develop, test, and refine methods to estimate boundary values given assumed upstream flows (quantity and source), land practices, and operations.		**Bay-Delta Modeling**	c) TBD

Develop capability to produce seasonal forecasts

Seasonal forecasts typically extend several months out and require establishing boundary water quality conditions and operations given forecasted system flows.

Deliverable	Associated Tasks	Participants	Estimated Completion Date
Enable Delta seasonal forecasts **a)** EC and bromide: develop, test, and refine methods to forecast boundary values given forecasted upstream flows (quantity and source), land practices, and operations.	C	**OCO**	a) June 2008-Note that simulating Delta bromide directly contingent upon a recalibration of DSM2.
b) DOC: develop, test, and refine methods to forecast boundary values given forecasted upstream flows (quantity and source), land practices, and operations.		**OCO/Bay-Delta Modeling**	b) TBD-Dependent on completion of task immediately above
c) Volumetric fingerprints.		**OCO/Bay-Delta Modeling**	c) June 2009

Develop capability to produce weekly forecasts

Producing weekly forecasts requires establishing an accurate description of initial system water quality/fingerprint, capturing relevant recent historical and forecasted data from various sources, and applying some type of quality assessment to this data.

Deliverable	Associated Tasks	Participants	Estimated Completion Date
a) Evaluate CH2MHill's recommendations for adapting DSM2 Aqueduct model to forecasting mode and refine/revise the recommendations as needed. **b)** Troubleshoot and implement revised recommendations to migrate DSM2 Aqueduct Model from planning/seasonal forecast modes to weekly forecast mode. 1. EC 2. bromide 3. DOC 4. fingerprints	D	**OCO/Bay-Delta Modeling** **OCO/Bay-Delta Modeling**	a) October 2008 b) June 2009

Assess and improve/develop preprocessing tools (computer programs, Python codes, Excel Templates/Macros, etc.) to enable fast, reliable forecasts of EC, DOC, and bromide with DSM2 and the Aqueduct model (i.e. move from manual to automatic processing)

Deliverable	Associated Tasks	Participants	Estimated Completion Date
a) Evaluate current methods/procedures/tools for retrieving raw data, quality assurance/ quality checking (QA/QC) of raw data, processing raw data into model input (HEC-DSS) format, and running DSM2 for multiple scenarios. **b)** Identify and list the preprocessing steps, and identify all the required data sources for DSM2 and the Aqueduct model. **c)** Improve/develop better, faster	E	**Bay-Delta Modeling/OCO** **Bay-Delta Modeling/OCO** **Bay-Delta**	a) 2009/10 work plan b) 2009/10 work plan c) 2009/10 work

tools to automatically retrieve raw data from DSM2 (flow, stage, EC, Br, DOC, operations – Clifton Court Forebay, Jones Pumping Plant, South Delta Barriers, Suisun Marsh Control Gates, etc.) and for the Aqueduct model (diversions at the aqueduct turn-outs, flow in and out of O'Neil Forebay to San Luis Reservoir, etc.) from various data sources.		**Modeling/OCO**	plan
d) Improve/develop better, faster tools to automatically process raw data and put those into model input (HEC-DSS) format.		**Bay-Delta Modeling**	d) 2009/10 work plan
e) Improve/develop tools to automatically run the model for multiple scenarios or alternatives.		**Bay-Delta Modeling**	e) 2009/10 work plan

Assess and improve/develop post-processing tools (computer programs, Python codes, Excel Templates/Macros, etc.) to enable fast, reliable assessment of results from DSM2 and the Aqueduct model (forecasts of EC, DOC, and bromide, etc.) for alternative scenarios.

Deliverable	Associated Tasks	Participants	Estimated Completion Date
a) Evaluate current methods/procedures/tools used for DSM2 for retrieving and post processing model results (HEC-DSS format) and putting the results in summary tables, charts, etc. in Excel.	F	**Bay-Delta Modeling/OCO**	a) 2009/10 work plan
b) Identify and list types of tables and graphs that will be useful for assessing the model results and facilitate evaluation of alternative scenarios. (ie improve user friendliness through feedback from the end user on displays and tools).		**Bay-Delta Modeling/OCO** RTDF Steering Committee	b) Ongoing

c) Improve/develop better, faster tools (Excel Macros, etc.) to automatically retrieve model results (flow, stage, EC, Br, DOC, etc.) from the model output (HEC-DSS) format into Excel.		**Bay-Delta Modeling/OCO**	c) 2009/10 work plan
d) Improve/develop better Excel Templates/Macros to automatically generate summary tables, graphs etc. for multiple scenarios to enable assessment of alternatives.		**Bay-Delta Modeling/OCO**	d) 2009/10 work plan
e) Develop animation tools to illustrate Delta water Quality variation with time.		**Bay-Delta Modeling**	e) 2009/10 work plan
f) Enhance presentation of weekly (monthly?) volumetric and constituent “fingerprints” results through development of new visualization tools.		**Bay-Delta Modeling**	f) 09/10 work plan

Enhance forecasting procedures

Deliverable	Associated Tasks	Participants	Estimated Completion Date
a) Improve characterization of initial conditions for EC forecasts: Implement a procedure to allow better interpretation of results with respect to Delta-wide conditions and historical EC patterns and thus improve characterization of initial EC conditions in the Delta.	G	**Bay-Delta Modeling** OCO	a) 2009/10 Work plan-other items will take 1st priority over this task.
b) Improve Delta Island Consumptive Use characterization for forecasting.		**Bay-Delta Modeling/OCO**	b) June 2009
c) Develop a single accepted input stream for historical simulations.		**Bay-Delta Modeling/OCO**	c) 2009/10 work plan
d) Develop method for generating report of historical simulation at some given interval of time, perhaps yearly.		**Bay-Delta Modeling/OCO**	d) 2009/10 work plan

Conduct SWP Particle Tracking Study to assist in validation of the Aqueduct model (Smart Oranges study)

Deliverable	Associated Tasks	Participants	Estimated Completion Date
a) Purchase equipment.	H	**MWQI**	a) April 2008
b) Deploy study.		**MWQI**	b) 1st samples-dependent on pumping, either July 2008,or Aug. 2008 2nd sample-dependent on pumping, latest =s March 2009
c) Provide final report.		**MWQI**	c) June 2009

Staff Training

Deliverable	Associated Tasks	Participants	Estimated Completion Date
a) Have current staff trained to run models for all modes of forecasting and historical simulations.	I	**Bay-Delta Modeling/OCO**	a) June 2009
b) Maintain training as new versions of model become available.		**Bay-Delta Modeling/OCO**	b) Ongoing

4.3.3 Budget

Labor Costs: Labor hours:4,235 Labor Cost: $428,601 Other Costs: $0 Total Cost: $428,601

4.4 Information Management and Dissemination

Within this program element, there are information management and data dissemination tasks associated with grab sample data and with real time data. Grab sample data is stored in the California Water Data Library (WDL) which encompasses DWR programs beyond MWQI. Real time data from MWQI's real time monitoring stations are stored on a MWQI server and posted on DWR's California Data Exchange Center (CDEC) and the MWQI web site. For this component, information management and dissemination tasks are associated with mechanisms that allow real time analytical data and modeled forecasting data to be packaged into a user friendly product for end users. Tasks under this program element include: continued refinement of the California Water Data Library (i.e. fully accessible historical MWQI data, repository for O&M Water Quality and MWQI water quality data, and development of a web interface and interactive map for users), continued development and enhancement of online tools for evaluating and interpreting MWQI water quality data (scientific visualization), development of means to distribute weekly water quality reports via the Internet, and database development for storage and management of RTDF data.

4.4.1 California Water Data Library

Access to historic grab sample data continues to be a priority for MWQI stakeholders and the public. Historic MWQI data are now accessible through an online Water Data Library. The

current web page (http://wdl.water.ca.gov/) interface provides a simple “fill-in-the-blanks” approach for range of dates, types of data, and station names. A simple map is also provided for looking up station locations. This map will continue to be enhanced to allow for multiple means of accessing station information and location. In addition, a new set of web-based data management tools have been released for staff use. This makes it possible for staff to verify sample information and release the results without depending on the database administrators. Planned improvements for the coming year include the addition of Database Administrator functions in the web interface, streamlining routine management of lab error corrections and station documentation. Current support of the web page is performed by DWR staff in the QA/QC Section and DPLA. Enhanced support of the web-based tool will be dependent on hiring proposed new staff at Bryte Laboratory.

With respect to digital report access, the MWQI website is updated as reports are generated in Adobe Acrobat (PDF) format. However, for older, non-computer generated reports, the Berkeley Digital Library Project is no longer maintained. The MWQI website will contain links to older, scanned MWQI reports as scanning efforts make them available.

MWQI staff will continue to respond to special user requests for historic data in formats compatible with user needs.

4.4.2 Water Data Library Tasks

Requested upgrades and improvements to the Water Data Library include:

A. Improve WDL web-based Administrative tool and continue to improve user web interface.
B. Complete entry of all O&M Water Quality data and other Division data sets as requested by the data owners. (Note that all historical MWQI data is already stored in the WDL).
C. Import selected contract lab data into WDL (requested by Northern District and O&M WQ).

4.4.3 Water Data Library Deliverables

(Lead organization(s) are shown in bold)

Deliverable	Associated Tasks	Participants	Estimated Completion Date
Improved web-based Administrative Tools for WDL WQ Module, incremental improvement to user interface.	A	**DPLA** MWQI Program	June 2009
Complete entry of O&M water quality data into WDL.	B	**O&M WQ** DPLA	O & M WQ-June 2009 All other requests subject to availability of staff resources.
Import selected contract lab data into the WDL.	C	O&M WQ Northern District MWQI Program	Depends on staff time constraints and availability of student help.

4.4.4 RTDF Information Management and Dissemination

This element of the work plan integrates and delivers results of the real time monitoring, fingerprinting and forecasting elements of the RTDF-CP. This is generally accomplished through the Weekly water quality reports distributed via an E-mail subscription list to staff of agencies participating in the MWQI Program and to other interested parties. Both current and archived reports are available on the MWQI website. However, as additional needs arise that require real time data and forecasting tools, this information will also be disseminated to stakeholders through e-mail, reports, and meetings. The goals of this program element are:

- to continue to provide real time water quality data and forecasting information to stakeholders and utilities for source water management decisions,
- to continue to review and refine format of real time information based on stakeholder and utility needs,
- to continue to develop a program for acquisition, storage, assessment, and transfer of water quality data and processed information in a near-real time mode,
- to provide continuous, real time postings of relevant autoanalyzer, operations, hydrologic data, and water quality forecasts to stakeholders and utilities via the Internet in a “user friendly” format, and

- to continue updating and enhancing the MWQI Program website.

The previous data management system ("RTDF2") used to generate weekly reports consisted of data retrieval from the California Data Exchange Center (CDEC) by MWQI staff, reviewing the data for accuracy, and summarizing the data in graphical and text forms in the weekly reports. In FY 2007/08, RTDF2 was replaced by RTDF3, consisting of a database platform that automatically receives data from real time stations and/or CDEC as necessary. Using Aquarius software purchased in FY 2007/08, data QC mechanisms will be built into this database to automatically document QA/QC changes and flag questionable data. The final phase of data management under this program element (RTDF4) will link the database with the Internet using a web-based interface. RTDF4 will establish an "on demand" capacity for users to query RTDF data such as TOC, DOC, EC, precipitation, hydrology, anion, and operations data.

Due to the great difficulty of trying to correct problems while the database is in use, it is important for the databases to be well designed from the outset, as opposed to being configured after deployment. It is anticipated that a Database Working Group, composed of DWR staff and Contractor representatives of the MWQI Committee, will need to be formed to oversee technical aspects of data dissemination tool development, especially with respect to RTDF 4. This group will report to the RTDF Steering Committee. This subcommittee will be expected to provide advice and recommendations on the appearance, format, and function of web pages, reports and related media that provide access to the information produced through the project.

4.4.5 RTDF Information Management and Dissemination Tasks

A. Produce weekly water quality reports distributed to users via e-mail and the Internet (MWQI website) and continue to improve user friendliness.
B. Refine RTDF3 and begin development of RTDF 4.
C. Continue to refine the QA/QC process prior to posting on CDEC.
D. Provide timely access to current QA/QC'd SWP operations data i.e. conduct QA/QC on historical data and remove inconsistencies and gaps.
E. Incorporation of new stations real time data into CDEC and weekly report.

4.4.6 RTDF Information Management and Data Dissemination Deliverables

(Lead organization(s) are shown in bold)

Task	Deliverable	Participants	Estimated Completion Date
Weekly water quality reports distributed to users via e-mail and the Internet (MWQI website). **a)** Design and produce a convenient product for use by water quality managers, i.e. one page summary sheets.	A	**MWQI Program** **MWQI Program**/RTDF Steering Committee	Ongoing a) Ongoing
Refine RTDF3 and begin development of RTDF 4.	B	**MWQI Program** Database Development Work group	Ongoing
Continue to refine the QA/QC process prior to posting on CDEC (using Aquarius software). **a)** Define Aquarius QC screening rules. **b)** Automate Aquarius QC screening rules. **c)** Use Aquarius software to develop better, faster tools to QA/QC the retrieved raw data visually/graphically and fill-in missing data by a reliable and automated method.	C	**MWQI Program**	a) April 2008 b) July 2008 c) 2009/10 work plan

Provide timely access to current QA/QC'd SWP operations data i.e. conduct QA/QC on historical data and remove inconsistencies and gaps.	D	**OCO**/Office of Reconciliations & CH2MHIll	Ongoing
Incorporation of new stations real time data into CDEC and weekly report.	E	**MWQI Program**	Ongoing

4.4.7 Budget

Labor Costs: Labor hours: 4138 Labor Cost: $186,314 Other Costs: $5,000 Total Cost: $301,314

5 Science Support (Special Studies)

The many natural and anthropogenic processes that affect drinking water quality in the Delta, its tributaries, and the State Water Project remain poorly understood. To further improve DWR's ability to measure and forecast drinking water quality of water delivered to its customers, MWQI engages in special studies that focus on specific aspects of source waters, contaminant loading, measurement methods and instrumentation, and climate and hydrology. Results of these studies inform subsequent cycles of the MWQI work plan by improving the RTDF and discrete sampling programs.

Strawman proposals of special studies were submitted to the Special Studies subcommittee for discussion and prioritization. Strawman proposals were evaluated on technical merit, how well they met the needs of the MWQI mission, and funding available to conduct the study. Of the 5 proposals recommended for approval, only one incurs equipment costs. Of the remaining proposals, no additional charges are incurred to the program besides what is already allocated in the FY 2008/09 budget to labor. The Special Studies proposals are listed below and discussed in detail in sections.

1. Investigation into the potential for a second MWQI urban load study for FY 2009/10.
2. Sources, fate, and transport of nitrosamines and their precursors in the Sacramento-San Joaquin Delta and the State Water Project.
3. Feasibility of measuring mass loads of TDS, organic carbon, and nutrients discharged from a South Delta Agricultural Island.
4. Investigation of organic carbon and bromide long-term trends and seasonal patterns in the Delta using MWQI long-term historical data.
5. Investigation of O'Neill Forebay water circulation patterns under varying operational conditions.
6. Organic Carbon Quality Investigation - Molecular Characterization of Organic Disinfection By-Product Precursors of Delta Soils

5.1 Urban Sources and Loads Investigation--Lead Investigator: Rachel Barnett

Purpose

As Delta watersheds continue to urbanize, the impacts to drinking water quality from urban runoff is of concern. MWQI has already conducted one intensive urban loading study of the Natomas East Main Drainage Canal (NEMDC) watershed. The study found that, on a daily basis, NEMDC contributed up to 93 percent of the organic carbon load in the Sacramento River at Hood during the wet season. On a monthly basis, NEMDC contributed up to 8.2 percent of the organic carbon load, up to 19 percent of the nitrate plus nitrite load, and up to 14 percent of the orthophosphate load at Hood. These numbers emphasize the level of impacts that urban drainage can have on drinking water quality and the importance of tracking urban loading as the Delta continues to urbanize.

Proposal

The purpose of this study is to investigate where MWQI should focus its efforts for another urban load study in the FY 2009/10. Possible areas of investigation include:

a) examining the impacts from a Southern Sacramento urban watershed (ie. Morrisson Creek).

b) conducting a follow-up study to the previous NEMDC study, with the purpose of determining whether any water quality changes have occurred in the 4 years that have passed between studies and filling in data gaps associated with the first NEMDC study.

c) examining Stockton urban impacts to the San Joaquin River (identifying suitable sample areas).

d) evaluating the effectiveness of mandated in-place Best Management Practices (BMPs) from stormwater permits as they relate to drinking water constituents of concern.

e) quantifying urban runoff from Brentwood and/or Lathrop as their vicinity to the Banks Pumping Plant would have the immediate impact on water quality, and because of their size, no stormwater monitoring has been conducted by the cities.

During this fiscal year, staff will examine the feasibility of the above options (and any others that are uncovered). The goal of this research is to provide the background information required to begin the field work or design of the project. Research conducted will determine the ideal location, feasibility and logistics.

5.1.1 Urban Investigations Tasks

A. Conduct background research and investigate study location, feasibility and logistics.

5.1.2 Urban Investigations Deliverables

Deliverables	Associated Tasks	Participants	Estimated Completion Date
Conduct background research and investigate study locations, feasibility and logistics.	A,	**MWQI Program**	June 2009

5.1.3 Budget

Labor Costs: Labor hours: 1595.5 Labor Cost: $118,128 Other Costs: 0 Total Cost: $118,128

5.2 Sources, Fate, and Transport of Nitrosamines and their Precursors in the Sacramento-San Joaquin Delta and the State Water Project--Lead Investigator: Carol DiGiorgio and MWDSC

Background

Nitrosamines are highly carcinogenic compounds with cancer potentials much higher than that of trihalomethanes (THMs). Historically, nitrosamine concerns have centered on food products. More recently, interest has focused on drinking water—especially effluent-impacted supplies, as surface waters used for drinking water that are downstream of wastewater treatment plants (WWTPs) may contain the carcinogenic compounds themselves, or the precursors necessary to form nitrosamines. Depending on the level of nitrification and/or the use of advanced physical/chemical treatment at a WWTP, the discharge can be a major source of nitrosamines and/or their precursors. Treated wastewater used for groundwater recharge has been shown to

contain N-nitrosodimethylamine (NDMA) at elevated levels (cited in Mitch and others, 2003). In an effluent-dominated river in Colorado, elevated levels of nitrosamines (i.e., NDMA and N-nitrosomorpholine [NMOR]) and nitrosamine precursors have been detected (Krasner and others, 2005). There is also evidence that some nitrogenous pesticides may react with chlorine or chloramines to form nitrosamines (for example, diuron) (Chen and Young, 2007). In addition, certain nitrosamines (e.g., NDMA) can be a chloramination by-product created during the drinking water disinfection process. If certain organic nitrogen precursors are present, drinking water facilities that have switched from chlorine to chloramines, to reduce THM formation in their distribution system, may find themselves in the untenable position of having reduced THMs only to have created more toxic nitrosamines.

Because it was first detected in drinking water wells, much of the attention has been directed at NDMA. However, as more information has become available, the California Department of Public Health has set notification levels of 10 ng/L each for NDMA, N-nitrosodiethylamine (NDEA), and N-nitroso-di-n-propylamine (NDPA), with a Public Health Goal for NDMA of 3 ng/L (http://www.cdph.ca.gov/certlic/drinkingwater/Pages/NDMAhistory.aspx, accessed 12/29/07). The EPA's Unregulated Contaminant Monitoring Rule 2 (UCMR2) has also listed 6 nitrosamines, NDEA, NDMA, NDPA, N-nitroso-di-n-butylamine (NDBA), N-nitroso-methylethylamine (NMEA), and N-nitroso-pyrrolidine (NPYR), as contaminants to be monitored during 2008-2010 to support the Agency's determination of whether to regulate these contaminants in the interest of protecting public health (http://www.epa.gov/safewater/ucmr/ucmr2/basicinformation.html#list, accessed 12/29/07). Early indications suggest that nitrosamines will become the next set of contaminants regulated in treated drinking water by the EPA (Bruce Macler, EPA Region 9, Pers. Comm., Oct. 2007).

The largest municipal discharger to the Delta is the Sacramento Regional WWTP, with an average annual dry weather flow of 160 MGD. Depending on its treatment practices, Sacramento Regional WWTP may be a source to the Sacramento River of both nitrosamines and nitrosamine precursors. With the plant's discharge site located a few miles upstream of a potential peripheral canal location at Hood, understanding what concentrations of nitrosamines and/or nitrosamine precursors are present at this site is critical. The next largest WWTP discharge in the Delta is located in Stockton. Although discharge from this facility (36.7 MGD

average annual dry weather flow) would not affect the water quality of a peripheral canal structure, water quality at the Banks Pumping Plant could be affected. Therefore, regardless of whether a dual conveyance, a through Delta conveyance or a peripheral canal is ultimately decided upon, understanding water quality contributions from both of these WWTPs to nitrosamines and nitrosamine precursors are important to the drinking water community that receives its water from the SWP.

The potential of agricultural inputs of nitrosamine precursors (e.g., from diuron) also needs to be examined. The Delta receives pesticide and herbicide inputs from the Sacramento and San Joaquin River's watersheds, as well as supporting an average annual farming industry of over $2.1 billion within the Delta itself (http://www.delta.ca.gov/pdf/Sacto-SanJoaqin_fact.pdf, accessed 12/29/07). Moreover, diuron is the third most heavily used herbicide in California.

Project Objective

Because of their extreme toxicity, their likely potential to become regulated in the future, and the fact that no assessment of the occurrence of nitrosamines or the nitrosamine formation potential of Delta waters has ever been undertaken, MWQI proposes a cost share special study with Metropolitan Water District of Southern California that would 1) identify and quantify some of the potential sources of nitrosamines and their precursors at a number of key points in the Delta (i.e., sample upstream and downstream of potential point sources), and 2) examine the fate and transport of nitrosamines (which can undergo photolysis depending on the depth of the photic zone) and their precursors (which can be biodegraded to some extent in a river) in the Delta. The study proposed would be a 2-year study, so that trends and seasonal patterns could be assessed. Because this is a cost share study, no large expenditures are anticipated for this study.

Literature Cited

Chen, W.-H., and T.M. Young. 2007. Potential transformation by-product and associated risk of diuron in the disinfection process. Presented at the 233rd American Chemical Society national meeting, Chicago, Ill.

Krasner, S.W., P. Westerhoff, B. Chen, G. Amy, and S. Nam. 2005. Contribution of wastewater to DBP formation: case study of an effluent-impacted river. In the proceedings of the 2005

American Water Works Association (AWWA) Water Quality Technology Conference. Denver, Colo.: AWWA.

Mitch, W. A., J. O. Sharp, R. Rhodes Trussell, R. L. Valentine, L. Alvarez-Cohen, and D. L. Sedlak. 2003. N-Nitrosodimethylamine (NDMA) as a drinking water contaminant: a review. Environmental Engineering Science (20)5: 389-404.

5.2.1 NDMA Tasks/Sample Design

To accomplish the project objectives, MWQI would sample quarterly, for 2 years, beginning in July 2008, from 7 sites (i.e., total of 8 sampling events). The sites sampled would be:

1. West Sacramento Drinking Water Intake: This sampling site would serve as the sampling point upstream of Sacramento Regional WWTP. Samples collected at this point would also capture most of the agricultural drainage impacts from the Sacramento River watershed.
2. Sacramento River at Hood: This sampling site would serve as the sampling point downstream of Sacramento Regional WWTP and is also one of the potential sites of a peripheral canal.
3. San Joaquin River at Mossdale: This sampling site would serve as the sampling point upstream of Stockton's WWTP.
4. San Joaquin River at Holt: This sampling site would serve as the sampling point downstream of Stockton's WWTP.
5. San Joaquin River at Vernalis: This sampling site would capture most of the agricultural drainage impacts from the San Joaquin river watershed.
6. Banks Pumping Plant: This sampling site integrates all of the Delta and riverine influences to the headworks of the SWP's California Aqueduct.
7. Twitchell Island ag drain: This sampling site would represent the in-Delta agricultural drainage inputs from a high-carbon peat island.

Three of these sites are already part of MWQI's discrete sampling program.

Along with standard field measurements, samples would be analyzed by Bryte Laboratory for total organic carbon, dissolved organic carbon, diuron, TKN, ammonia, nitrates + nitrites, total phosphate, UVA-254, THMFP, and HAAFP. A subset of each sample would be split and sent to Metropolitan Water District of Southern California (MWDSC)'s chemistry laboratory, where samples would be analyzed for eight nitrosamines (all nitrosamines with notification levels and all those listed in the UCMR2, as well as NMOR and N-nitrosopiperidine [NPIP]) and nitrosamine formation potential testing. If time and funding permit, MWDSC would also analyze for the anticonvulsants primidone and carbamazepine, as well as caffeine, as conservative tracers of WWTP influences. This will help determine whether the sources of the nitrosamine precursors are from treated wastewater or other sources.

5.2.2 NDMA Deliverables

Deliverables	Participants	Estimated Completion Date
Quarterly sampling at 7 sites in the Sacramento-San Joaquin Delta	MWQI staff MWQI Field Group	July 2010
Analysis of all samples as indicated above by both DWR and MWDSC	Bryte Laboratory MWDSC Laboratory	August 2010
Final Report	MWQI staff MWDSC staff	December 2010
Paper for Publication	MWQI staff MWDSC staff	Submitted March 2011

5.2.3 Budget.

DWR MWQI and MWDSC have agreed to a cost-sharing arrangement for this study.

Labor Costs: Labor hours: 1144 Labor Cost: $ 91,347 Other Costs: $429.00 Total Cost: $91,776

5.3 Feasibility of Estimating Mass Loads of TDS, Organic Carbon, and Nutrients Discharged from a South Delta Agricultural Island--Lead Investigator: Carol DiGiorgio

Background

DWR's Delta Island Consumptive Use Model (DICU) estimates agricultural diversions and return volumes and assigns these volumes and water quality concentrations to nodes in DWR's Delta Simulation Model (DSM2). In estimating the water quality of the agricultural drainage, DICU relies on earlier work conducted by Marvin Jung. Using data collected from Delta island drainage channels approximately 20 years ago, Jung divided the Delta into 3 subregions. In each subregion, a monthly median EC and DOC value was calculated. These 36 data values (3 regions x 12 months), accessed in a lookup table by DICU, are assumed by DICU to represent the monthly water quality discharged from all agricultural islands in each given region. While this approach is fairly robust, MWQI's recently completed Staten Island study found, in some months, that DICU underestimates Staten Island DOC loads by as much as 2 orders of magnitude. In south Delta channels, measured EC can be much higher than that assumed in agriculture drainage by DICU in its lookup table. This situation seems most pronounced when San Joaquin River inflow is low. During periods of low flow in the South Delta, there is less circulation of channel water and agriculture drainage can become a more significant contributor of channel water quality. The Delta Modeling Section reports that DSM2 simulations of EC in the south Delta channels during low flow periods are consistently lower than field-measured EC. Measured EC in Old River at Tracy Road, for example, can be as much as three times higher than DSM2 simulated values. This suggests that our understanding of the timing and quality of South Delta agricultural discharges needs improvement. With the completion of the Staten Island study, there has been some discussion between MWQI and the Delta Modeling Section of applying the information gained to refine DICU's water quality estimates from drainage from Delta peat islands. A better understanding of the quantity and quality of South Delta agricultural discharges would benefit Delta modeling efforts in general, and improve DWR's ability to predict water quality at the Banks pumping plant and other municipal intakes.

Objectives

Unlike Staten Island, where access onto the island was secured by the Nature Conservancy, there is no guarantee that DWR would be allowed to conduct a study on either Union Island or Fabian Tract (the Delta Modeling Section has indicated that these are 2 areas of interest). The purpose of this study is to determine if any landowners in these areas would allow access onto their property for flowmeter installation and weekly sampling. If an appropriate landowner could not be located, then it is likely that MWQI could not move forward with this study. If cooperative landowners can be identified, MWQI could work with the Delta Modeling Section to determine if the pump locations would satisfy modeling needs. If this is the case, it is anticipated that MWQI would begin the installation of flowmeters in the spring of 2009 with the study to run for 2 years, to capture seasonal variability.

Sample Design

This study could only be conducted if a cooperative landowner could be located. The monitoring site would need access to power and drainage water would have to have the potential to influence water quality in the South Delta. It is anticipated that the sampling design would be similar to the one followed for Staten Island. If all criteria could be met, MWQI could begin the installation of flowmeters in the spring of 2009. In addition to flow, it is anticipated that the analytes measured would be TDS, organic carbon, and nutrients, along with standard field measurements of EC, turbidity, DO and temperature. Flow and concentration data would allow loading calculations and give accurate measurements of seasonal discharges.

5.3.1 Feasibility Study of Loads from a South Delta Island Tasks

A. Contact landowners on Union Island or Fabian Tract and determine willingness to participate in a water quality study.
B. If cooperative landowners can be identified, confer with Bay-Delta modelers on the appropriateness of proposed sample locations.
C. If an appropriate site(s) can be located, install flowmeters.
D. Begin collecting flow and weekly data for 2 year study.

5.3.2 Feasibility Study of Loads from a South Delta Island Deliverables

Deliverables	Task	Participants	Estimated Completion Date
Determine if there are willing landowners for a study. If so confirm with Bay-Delta modelers on site appropriateness	A,B	**MWQI**	October 2008
If an appropriate site is located, install flowmeters	C	**MWQI Field Group**	January 2009
Begin flow measurements and weekly sample collection. Sampling to begin approximately 3/09.	D	**MWQI staff MWQI/Field Group**	March 2011

5.3.3 Budget

MWQI labor is already covered within the MWQI budget. It is anticipated that the flowmeter equipment that was used on Staten Island would be reused if a study could be conducted in the South Delta.

Labor Costs: Labor hours: 966 Labor Cost: $ 73,729 Other Costs: 0 Total Cost: $ 73,729

5.4 Investigation of Organic Carbon and Bromide Long erm Trends and Seasonal Patterns in the Delta using MWQI Historical Data--Lead Investigator: Theodore Swift, Joe Christen

Background

Extensive investigations have revealed that organic carbon (DOC and TOC) and bromide concentrations in Delta and SWP waters can have a significant influence on drinking water supplies when they react chemically to form unwanted disinfection by-products (DBPs). Informal analysis of the MWQI long-term monitoring program has raised questions about the possibility of long-term trends (whether unchanging or decreasing) of organic carbon (OC) in the tributary rivers and at the Banks Pumping Plant at the head of the State Water Project (SWP) (B. Bergamaschi, USGS, unpublished analysis of MWQI data; E. Archibald and R. Woodard, pers. comm.). However, large seasonal variability, and interannual wet year versus dry year variation reduce the statistical power of simple linear regressions. Studies are starting to appear in the scientific literature in which OC loading appears to be increasing, perhaps due to mechanisms tied to global climate change or changes in land use. Further, an analysis of water quality in the SWP concluded that the long-term trends were most likely due to changes in reservoir releases and SWP operational decisions rather than, changes in OC loading from the tributary watersheds (DWR, 2005).

Information gained from the study is expected to help (i) improve understanding of the seasonality and presence or absence of long-term trends in organic carbon and bromide loading into the Sacramento-San Joaquin River Delta, (ii) provide general rules of thumb that can be applied to seasonal and annual water quality forecasting, and (iii) improve cultural practices for source water protection. The findings may also be useful for forecasting organic carbon transport and fate in the Delta water quality changes in response to Delta management practices, and the proposed conversion of Delta lands into wetland habitats.

Project Objectives

Existing grab sample and high-frequency real time monitoring program data for DOC, TOC, and bromide from the Sacramento River at Hood, the San Joaquin River at Vernalis, and the Banks Pumping Plant will be collected from existing databases. River discharge and pumping rate data

will also be collected from existing databases. The data will be examined for accuracy and completeness (QC). Time series analysis methods will be applied to the data (e.g., seasonal Kendall test for trend, principal component analysis) to detect the presence of, and if present quantify, seasonal and interannual patterns in the data. With knowledge of tributary flows and SWP operations, likely explanations for the observed patterns will be developed and tested against the observed data. A manuscript in journal article format will be prepared for review and comment, and submitted to a peer-reviewed journal for publication.

Literature Cited

DWR. 2005. Factors Affecting Total Organic Carbon and Trihalomethane Formation Potential in Exports from the South Sacramento-San Joaquin Delta and Down the California Aqueduct.

5.4.1 Organic Carbon and Bromide Long Term Trends Tasks

Specific tasks for FY 2008/09 are:

A. Collect and examine available TOC, DOC, and bromide data for the Sacramento and San Joaquin Rivers and Banks Pumping Plant.
B. Perform time-series analysis.
C. Draft a journal article for submission to a peer-reviewed water resources journal, and solicit internal and external comments.
D. Submit revised journal manuscript for publication in a peer-reviewed journal.

5.4.2 Organic carbon and Bromide Long Term Trends Deliverables

Deliverables	Associated Tasks	Participants	Estimated Completion Date
Data acquisition & QC complete	A	**MWQI Program**	August 2008
Complete time-series analysis	B	**MWQI Program**	Nov 2008
Draft peer-reviewed journal article completed	C	**MWQI Program**	Dec 2008
Peer-reviewed journal article submitted	D	**MWQI Program**	Feb 2009

5.4.3 Budget

Labor Costs: MWQI labor is already covered within the MWQI budget.

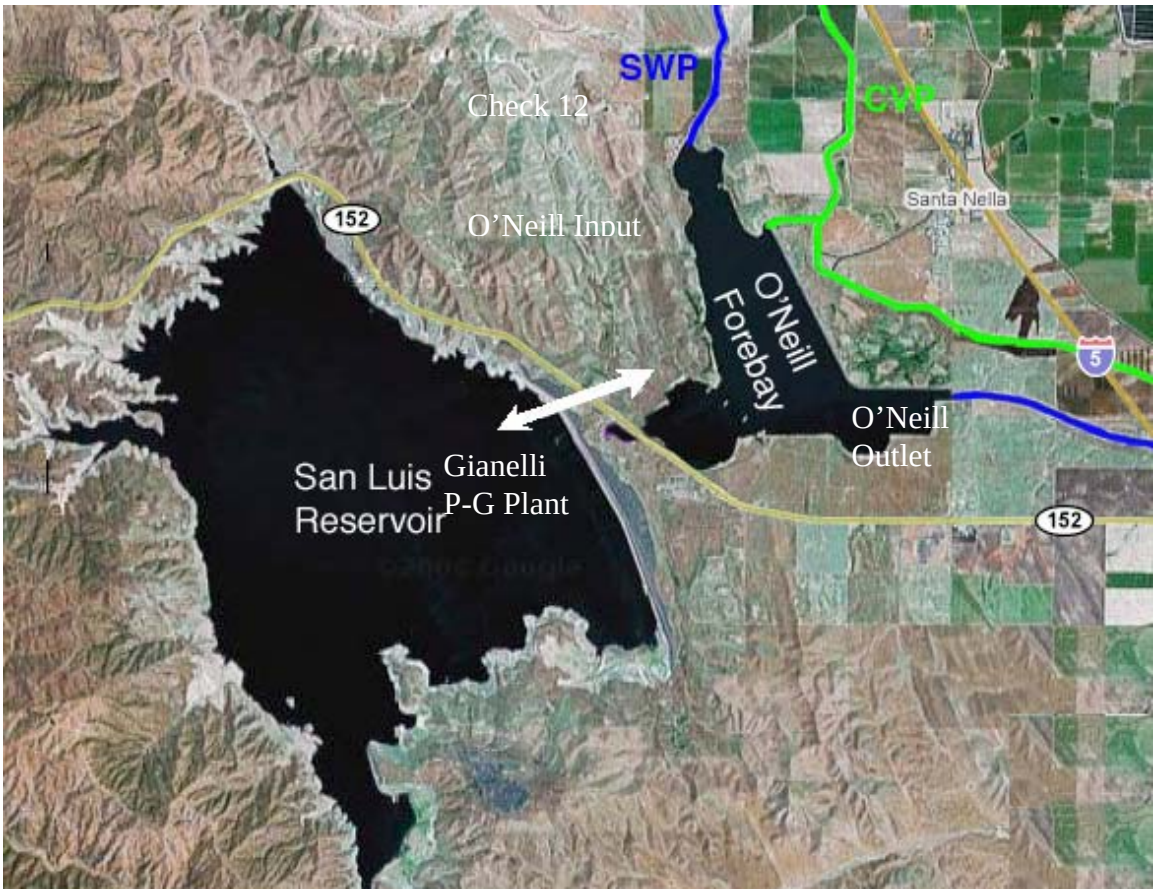
Labor hours: 678 Labor Cost: $54,290 Other Costs: $0 Total Cost: $54,290

5.5 Investigation of O'Neill Forebay water circulation--Lead Investigator: Ron Melcer

Purpose

Water from the State Water Project (SWP) and federal Central Valley Project (CVP) are pumped into O'Neill Forebay at the foot of Sisk Dam and San Luis Reservoir (Figure 2). The SWP and CVP waters are generally of differing water quality, containing different concentrations of bromide and other dissolved salts, organic carbon, and other constituents of concern. Water from the SWP enters O'Neill at its north end, at SWP Check 12. Water from the CVP enters O'Neill on the east side, at CVP O'Neill Intake. Depending on flow and pumping conditions at Gianelli Pumping-Generating Plant, the two waters may be transported south into the joint-use aqueduct at O'Neill outlet, or flow through a channel on the west side to Gianelli and thence into San Luis Reservoir. Observations suggest that the waters do not appreciably mix in O'Neill and, specifically, that CVP water tends to hug the east shore of O'Neill and travel directly to O'Neill Outlet. The behavior of the water flows has important implications for water quality modeling and forecasting. Information gained from the study is expected to help (i) better understand water flow patterns in O'Neill Forebay under a range of conditions, (ii) support more accurate numerical modeling of the O'Neill Forebay region of the DSM2 Aqueduct Extension model, and (iii) improve forecasting of water quality characteristics in subsequent parts of the State Water Project.

Figure 2. Movement of SWP water into O'Neill Forebay

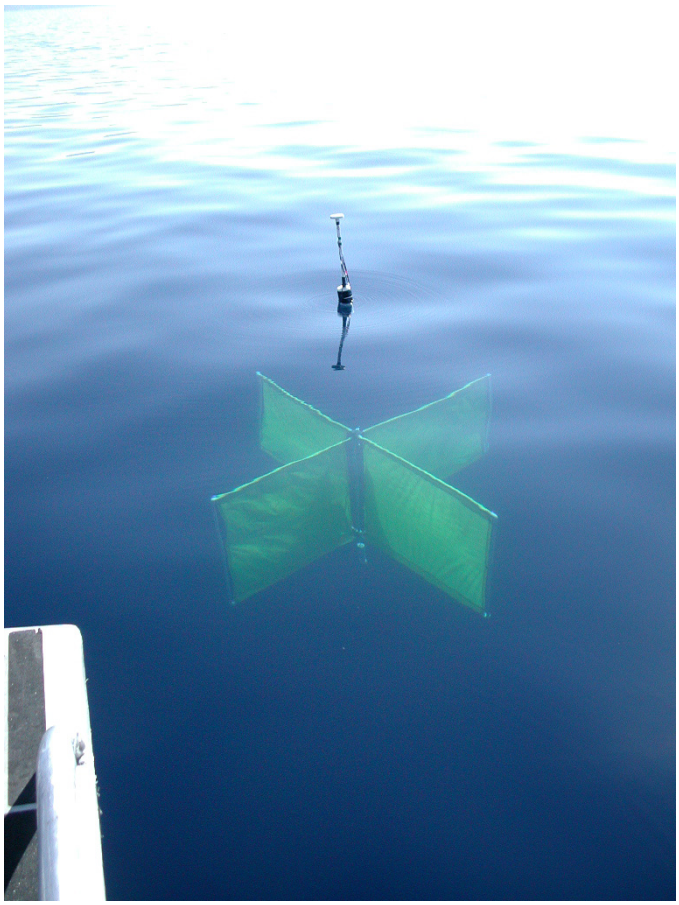


CVP water enters at O'Neill Input. The waters may not mix on their way to O'Neill Outlet.

Objectives

Passively-drifting drogues are a proven tool in lake and ocean circulation studies (e.g., Austin and Atkinson 2004; Figure 3). A submerged "kite" moves with the water at a chosen depth, carrying a surface sensor along with it. In this application, the surface buoy would contain a small, battery-powered GPS receiver and logger. The logger would periodically record the drogue's location for later recovery and downloading.

Figure 3. Example of a drifter surface buoy with a GPS location logger



Buoy is attached to drogue by short stainless steel cable. Each yellow panel is 1 m square. Drifters used in this study may be much smaller. (example picture taken on Lake Tahoe, CA-NV).

Literature Cited

Austin, Jay and Sten Atkinson. 2004. The design and testing of small, low-cost GPS-tracked surface drifters. Estuaries and Coasts 27(6): 1026-1029.

5.5.1 O'Neill Forebay Circulation Tasks

Specific tasks for FY 2008-09 are:

A. Purchase miniature logging GPS receivers and materials to construct drifters.
B. Assemble and test drifters.
C. Perform a series of field investigations at O'Neill Forebay under the widest available range of pumping and flow conditions, designed to quantify the flow patterns of water entering the Forebay from the SWP and CVP.
D. Analyze the field observations from Task C and document findings in DWR report.
E. Consolidate DWR report into format suitable for peer-reviewed publication.

5.5.2 O'Neill Forebay Circulation Deliverables

Deliverables	Associated Tasks	Participants	Estimated Completion Date
Equipment purchase complete	A	**MWQI Program**	Sept 2008
Equipment assembly & testing	B	**MWQI Program**	Oct 2008
Field studies at O'Neill Forebay	C	**MWQI Program**	Dependent on pumping. Nov 2008 - May 2009, with potential sampling in July 09 based on Wanger effects on summer pumping.
Data Analysis and preparation of report	D	**MWQI Program**	Dec 2008 – June 2009
Preparation of peer-reviewed manuscript for publication	E	**MWQI Program**	May 2009 – July 2009

5.5.3 Budget

Labor Costs: Labor hours: 1559.5 Labor Cost: $125,509 Other Costs: $10,000 Total Cost: $135,509

5.6 Organic Carbon Quality Investigation - Molecular Characterization of Organic Disinfection By-Product Precursors of Delta Soils--Lead Investigator: Theodore Swift

Purpose

Previous investigation has revealed that qualitative characteristics of organic carbon in Delta and SWP waters are variable, and have a significant influence on their ability to enter drinking water supplies and react chemically to form disinfection by-products (DBPs). Information gained from this study is expected to help (i) enable current treatment strategies to be improved, and (ii) develop new organic carbon reduction strategies. The findings may also be useful for forecasting organic carbon transport and fate in the Delta, water quality changes in response to Delta management practices, and the proposed conversion of Delta lands into wetland habitats.

Study Proposal Description

A SWC funded, two-year collaborative study between MWQI and UC Davis ended in December 2003. The study resulted in two proceeding papers and three peer-reviewed manuscripts (see references).

From the two-year study, MWQI staff learned that: (1) under natural leaching or runoff conditions, only a small percentage of organic carbon from Delta soils may be released to Delta water; (2) as salt concentrations increase in leachates or runoff waters, organic carbon concentrations decreased; the magnitude of decrease is cation-dependent. Divalent Ca decreased concentrations of organic carbon more than monovalent Na; (3) strong acids and alkaline solutions appeared to transform natural organic carbon, and thus were not suitable for organic carbon extraction or concentration and fractionation using resin-based methods for the purposes of characterizing DBP precursors; instead, non-destructive or minimally destructive methods should be used; (4) the majority of reactive organic carbon, or DBP precursors, appeared to be associated with soluble organic carbon (<0.025 μm in diameter). However, many interesting questions remained unanswered.

The 2003 study collected soil samples down to 10 feet deep, but examined only the topsoil layer. The leaching potential of organic carbon from different soil depths and the DBP formation potential of extractable organic carbon by electrolytes of conductivity values mimicking those of natural leaching and runoff conditions needs to be examined. MWQI staff learned that less than 1.5% of soil organic carbon may be released during short-term extraction studies, but the total quantities of organic carbon under simulated long-term leaching conditions remained unknown. Particulate organic carbon with particle sizes between 1.2 and 0.45 μm in diameter contributes little to DBP production. It was organic carbon of smaller particle size, or the soluble organic carbon (<0.025 μm), that are most reactive to form DBPs (Chow et al., 2005b). The chemical and molecular nature of this fraction from soil extracts and representative Delta locations needs to be investigated.

Additional research may help further understand the quality of organic carbon in the Delta to enable SWP contractors to improve or adjust current treatment strategies for targeted precursor removal. Improved understanding of carbon quality in relation to leaching and DBP formation

potential is critical to the success of these modeling efforts. Whereas current water quality modeling tools treat organic carbon as a conservative constituent, information derived from this study may enable models to account for qualitative differences in organic carbon from different sources.

This ongoing study characterizes the chemical and spectral properties of DBP precursors in soluble organic carbon isolates of water and soil extracts. The study is a follow-up of the two-year MWQI-UC Davis collaborative study that ended in December 2003. The earlier study explored non-destructive electrolytes for extraction and a filtration method for fractionation of the bulk soil extractable organic carbon into four filtered isolates consisting of the following separation and operational organic carbon fraction definitions:

* Particulate organic carbon (POC) less than 1.2 µm i;

* Colloidal organic carbon (COC) less than 0.45 µm;

* Fine colloidal organic carbon (FCOC) less than 0.1 µm;

* Soluble organic carbon (SOC) less than 0.025 µm.

The present study focused on characterization of the chemical properties of the organic carbon DBP precursors.

Characterization approach:

In this ongoing collaborative study with UC Davis, MWQI staff are fractionating the bulk organic carbon by size. The precursor-rich fraction are fractionated by functional group or polarity using liquid chromatography (LC) for exclusions and purification of targeted isolates of organic carbon. These tasks are accomplished in-house at MWQI's West Sacramento facility. At UC Davis, the isolates are being characterized by spectroscopic techniques such as scanning ultraviolet-visible spectroscopy (UV-vis), infrared (IR), gas chromatography and LC in tandem with mass spectrometry (GC-MS and LC-MS).

Literature Cited

Chow, A. T., Fengmao Guo, Suduan Gao, Richard S. Breuer. 2005a. Size and XAD Fractionations of Trihalomethane Precursors from Soils. Chemosphere, 62(2006) 1636-1646.

Chow, A. T., Fengmao Guo, Suduan Gao, Richard S. Breuer. 2005b. Fractionation and disinfection byproduct reactivity of water- and alkaline-extractable soil organic carbon, Journal of Environmental Quality, Vol 35(1):1-404 (2005).

Chow, A. T., Fengmao Guo, Suduan Gao, and Richard S. Breuer. 2005c. Trihalomethane Formation Potential of Filter Isolates of Electrolyte-extractable Soil Organic Carbon. Journal of Environmental Quality, Vol 34(6):2005-2017 (2005).

Zhu,Ye, K. Yanagihara, Fengmao Guo, and Qing X. Li. 2000. Pressurized fluid extraction for quantitative recovery of chloroacetanilide and nitrogen heterocyclic herbicides in soil. Journal of Agric. and Food Chem. 48: 4097-4102.

5.6.1 Tasks for Molecular Characterization of Organic Carbon DBP from Delta Soils

A. Complete experimental data acquisition.

B. Prepare 2 draft manuscripts for submission to a peer-reviewed journal.

C. Submit manuscript to 2 peer reviewed journals.

5.6.2 Deliverables for Molecular Characterization of Organic Carbon DBP from Delta Soils

Deliverables	Associated Tasks	Participants	Estimated Completion Date
Experimental data acquisition complete	A, B	**MWQI Program** UC Davis	June 2008
Prepare 2 draft manuscripts for submission to peer reviewed journals	C	**MWQI Program** UC Davis	September 2008
Final peer-reviewed journal submitted	N/A FY 08-09	**MWQI Program** UC Davis	November 2008

5.6.3 Budget

Labor Costs: Labor hours: 939 Labor Cost: $39,526 Other Costs: $6,601 Total Cost: $46,127

6 Emergency Response Activities

6.1 Background

Although a component of the RTDF-CP, this element is broken out separately because its scope goes beyond the program and includes tasks identified in the 2006 Sanitary Survey. The goals of this element are to 1) develop and encourage policies to define the role of drinking water quality in DWR's Emergency Response (ER) actions, 2) incorporate drinking water quality components, (including monitoring and involving the MWQI Program), into DWR's established ER plans, and 3) improve dissemination of drinking water quality information between DWR and other stakeholders (i.e. State Water Contractors, Department of Public Health, Office of Spill Prevention Response, etc.) during emergency events.

The MWQI Program is uniquely qualified to participate in these types of emergency events because staff

- possess the field, analytical, and hydrologic expertise required in these types of events to address organic carbon loading, salinity increase, taste and odor incidents, and testing for the presence of a variety of contaminants.
- maintain instrumentation situated in key areas of the Delta and at Banks and are trained to use this equipment.
- have well-established relationships with modelers from the DWR Bay-Delta Office through the RTDF-CP. Any new data generated as a result of an emergency event will be in a format that is useable in the models (i.e. DSM2, Aqueduct model).
- have prior experience (i.e., Jones Tract levee failure) in meeting emergency water quality challenges, and can rapidly develop and implement a monitoring plan in response to an emergency situation in a remote location.
- have integrated to varying degrees with other water quality monitoring groups in DWR (i.e. O&M, Environmental Monitoring Program, Central District) and can help facilitate a cooperative effort.

6.1.1 Emergency Response Tasks

A. Prepare a report that reviews all existing DWR emergency response policies, plans, and processes. The report will identify 1) current role of drinking water quality in DWR

Emergency Response policies, 2) how drinking water quality monitoring (including the MWQI Program) could be incorporated into DWR ER plans and processes, and 3) how dissemination of drinking water quality information could be improved between DWR and other stakeholders during emergency events.

B. Meet with SWPCA, and MWQI SWP contractors to discuss report recommendations for achieving goals (1-3) in task A above.

C. In anticipation of a greater involvement in DWR ER, MWQI will engage in preparedness activities in order to develop a framework that will guide the MWQI Program during emergency events. Steps to implement this task include:

- Identifying MWQI water quality staff that could participate in related emergency response events.
- Development of an ER Action Plan for MWQI that will guide the program during emergency events (this includes developing an emergency response equipment and monitoring list, and a fully equipped emergency response kit for field personnel to use during emergency response).
- Provide training and equipment to staff for emergency response preparedness.
- Assist in revising DWR and outside agency ER plans and processes to include drinking water quality representation.
- Assist in development of DWR policies to define the role of water quality in emergency situations.

D. As necessary, participate in emergency response meetings (i.e. CUWA emergency spill workgroup)

6.1.2 Emergency Response Deliverables

Deliverable	Associated Tasks	Participants	Estimated Completion Date
Identify and review all DWR emergency response plans and processes that should consider potential drinking water quality impacts during an emergency.	A	**MWQI Program** O&M WQ O&M Field Divisions DPLA	June 2008
Meeting to determine mechanism to reach report goals.	B	**SWPCA** MWQI Program	July 2008
Identify water quality staff and material resources for responding to various emergency scenarios.	C	MWQI Program O&M WQ	Ongoing
Participate in emergency response meetings (i.e. CUWA emergency spill taskforce).	D	**MWQI program**	Ongoing

6.1.3 Budget

Labor Costs: Labor hours: 2210 Labor Cost: $192,619 Other Costs: $0 Total Cost: $192,619

7 Other Water Quality Program-Related Activities

MWQI management and staff will continue to attend meetings of the following groups as necessary to provide technical input and stay current on issues and activities that could affect drinking water. These groups may include;

CALFED Drinking Water Program
CALFED Water Quality Subcommittee
Central Valley Regional Board's Drinking Water Policy Work Group
CUWA Sewage Spills Work Group
Delta Sustainability Activities
Bay-Delta Conservation Plan
Pelagic Organism Decline Workgroup
Central Valley Salinity Management Plan
San Joaquin River Basin Monitoring Partnership
South Bay Aqueduct Task Force (quarterly meetings)
State Water Resources Control Board
Delta Conveyance
DWR and other agency climate change activities
Special Aquatic Species Workgroups or Meetings (Delta Smelt, Splittail Smelt, Salmon, etc.)

As necessary, MWQI management and staff will also attend meetings associated with storm water and wastewater treatment plant discharge permit renewals and will review EIR/EIS documents for projects with the potential to affect drinking water quality in the Sacramento-San Joaquin Delta.

MWQI will continue to coordinate its activities in these areas with the MWQI SWC members as it has done in the past and work with SWPCA to facilitate workshops as called for in the 2006 Sanitary Survey Action Plan.

MWQI will achieve this through the tasks detailed in this and future work plans and participation in both internal and public forums that are focused on drinking water quality issues.

7.1 Budget

Labor Costs: Labor hours: 1609 Labor Cost: $140,259 Other Costs: $0 Total Cost: $140,259

8 Program Management

Specific MWQI management tasks for FY 2008-09 for this program element include:

A. Conduct monthly program status teleconferences for members of the MWQI TAC. Provide appropriate program and budget updates during these calls.

B. Coordinate up to two comprehensive program conferences for MWQI participants during the fiscal year, one of which may include a Delta or SWP facility tour for new program participants.

C. Along with MWQI staff, participate in technical meetings of the RTDF Steering Committee; New Technologies work group and such other subcommittees or working groups as may be formed from time to time to address specific issues that arise.

D. Along with MWQI staff, attend various technical and management meetings, conference and workshops related to drinking water quality issues.

E. Along with MWQI staff, attend relevant CALFED meetings and various workshops including the CALFED Science Conference

F. Ensure MWQI TAC members continue to receive all draft materials, and members of that committee continue to have the opportunity to participate in any technical meetings of interest.

G. Develop the FY 2009-10 MWQI Program Work Plan

H. Develop MWQI Program budget for FY 2009-10 including identifying needs for the SWPCA Fund.

I. Coordinate implementation of the RTDF-CP

J. Monitor progress on MWQI program elements outlined in work plans.

K. Address personnel and safety related issues for MWQI Program.

8.1 Budget

Labor Costs: Labor hours: 1684 Labor Cost: $143,761 Other Costs: $3,000 Total Cost: $146,761

9 Other Required Program Costs

Description of costs

There are numerous program costs both in terms of labor, supplies, equipment and services that are charged to the MWQI Program through SAP, but are not necessarily linked to specific program elements. These are costs that are often divided between all branches in the Division of Environmental Services. These costs often result from Department-required, job related or career advancement activities and tasks. Examples of miscellaneous labor costs include staff time to:

- Attend training
- Attend conferences, workshops, meetings
- Develop and track contracts, purchase orders, training requests, travel expense claims
- Facility maintenance (West Sacramento Field Unit)
- Accommodate other high priority Departmental programs and outside programs with data collection and analysis as directed by management
- Dealing with Personnel items
- Writing memos
- Time entry/approval
- Budgeting and other SAP-related tasks

Examples of miscellaneous costs associated with supplies, equipment, general facility maintenance and services include:

- IT support (DWR IT personnel maintaining staff computers, servers)
- IT hardware and software (purchasing staff computers, mandatory software)
- Office equipment maintenance (copy and fax machines)
- Office supplies
- Janitorial services
- Moving and general facility services
- Staff training (required and job related)
- Travel costs for meetings, conferences

- Registration costs for mandatory conferences (Environmental Scientists workshop)
- Out-of-State travel costs for conferences, meetings, workshops
- Vehicle maintenance, operation, fuel
- Uniform allowance (shoes, sun glasses)

9.1 Budget

Labor Costs: Labor hours: 1363 Labor Cost: $121,287 Other Costs: $42,500 Total Cost: $163,787

Laboratory Costs: None.

10 Challenges and Opportunities

The following is a description of challenges and opportunities associated with management of the MWQI Program.

DWR Staffing

During FY 2007/08, all vacant staff positions, as well as, the 7 new BCP positions were filled within the MWQI Program and for the RTDF-CP. The challenge of retention and future recruitment still remains especially in light of salary discrepancies for State scientists.

DWR Overhead Rates

Overhead rates for the Department continue to rise steadily with each new fiscal year. Hourly rates for permanent staff currently used in this work plan may not accurately reflect predicted increases for FY 2008/09. As overhead rates increase and the scopes of the MWQI Program and RTDF-CP broaden, adjustments to the overall program budget may need to be made on an annual cycle.

SWPCA Fund

The establishment and use of the SWPCA fund for the MWQI Program has been a great success. The use of the SWPCA fund to acquire students, contractors for small jobs, and to purchase certain items has mitigated some of the impact of the personnel and purchasing delays in DWR. In addition, the reduced time needed to contract for students and consultants has increased the responsiveness and flexibility of the program. In the use of the fund, staff seeks the most cost effective alternative. Multiple sources are contacted, and the most qualified and economical product or consultant is hired. Use of the SWPCA fund is expected to continue. During fiscal year 2006/07 the Specific Projects Committee was formed to assist in managing these funds. This committee functions under the SWPCA and meets at least once per year to approve expenditures for the MWQI Program using these funds.

Journal Submissions

With the time and financial investment that has been dedicated to the MWQI program, it is important to create validated and referenced studies. The MWQI program will continue to use the DWR reports/publications process, but more emphasis will be put on publishing in scientific journals. This insures that the professional effort expended by the MWQI scientists is showcased in a peer-respected venue. Additionally this elevates the individual staff in their own professional career. With the evolution of more scientific entities in the CALFED process, MWQI findings need to be presented on equal footing with other drinking water research project results.

Appendix 1 MWQI Program costs for FY 2008/09 using SWPCA Funds

Program Element	Title	Contracted Labor Costs	Other Costs	Total
3.1 Discrete WQ sampling	Student Assistant 1	$10,353	$0	$10,353
4.1 Real time WQ sampling	Student Assistant 2	$20,705	$0	$20,705
4.4 RTDF Info Mgmt & Dissemination	Data Mgmt. Consultant	$62,400	$0	$62,400
5.1 Urban Loads	Student Assistant 1	$4,141	$0	$4,141
5.2 NDMA Sampling	Student Assistant 1	$2,071	$0	$2,070
5.3 South Delta Ag Island Study	Student Assistant 1	$2,071	$0	$2,071
5.4 OC Long-term Trend	OC loads consultant	$6,000	$0	$6,000
5.5 O'Neill Forebay Circulation	Student Assistant 1	$2,071	$0	$2,071
5.6 OC Quality Study	Student Assistant 3	$10,353	$0	$10,353
8.0 Program Management Special Studies discretionary funds (potentially earmarked for other costs associated with program element 4.1)		$55,600 $21,235	$3,000.00	$58,600 $21,235
TOTAL COSTS		**$197,000**	**$3,000**	**$200,000**

Contracts required for FY 2008-09 include:

1. Consultant to assist with development of RTDF-CP data management structure for up to **$62,400**
2. Organic carbon loading consultant (Jim Sickman) -**$6,000**
3. CSUS Hornet Foundation for student assistants for **$51,765**
4. John Coburn's time – **$55,600**

Specific tasks to be implemented using SWPCA Funds

Program Element 3.1: Water Quality Assessment

a. Continue to employ student assistant for miscellaneous tasks. Annual cost for a student will be approximately **$10,353** and will utilize a new contract between the SWPCA and the CSUS Hornet Foundation.

Program Element 4.1 Real time monitoring

b. Continue to employ student assistant for miscellaneous tasks. Annual cost for a student will be approximately **$20,705** and will utilize a new contract between the SWPCA and the CSUS Hornet Foundation.

Program Element 4.4 RTDF-CP Information Dissemination

c. Consultant's time to assist with continuing progress on implementation of the RTDF-3 database, development of the RTDF4 database, updating of the MWQI Website, assist field staff with remote data relay and assist with all areas of data management including Water Data Library. Salary related to this task is **$62,400**.

Program Element 5.1 Urban Loads and Sources

d. Student assistant time to assist with various tasks under this program element. Salary for this element is **$4,141.**

Program Element 5.2 NDMA Sampling

e. Student assistant time to assist with various tasks under this program element. Salary for this element is **$2,071.**

Program Element 5.3 South Delta Ag Island Study

f. Student assistant time to assist with various tasks under this program element. Salary for this element is **$2,071.**

Program Element 5.4 OC Long-term Trend Analysis

g. Consultant for special assignments such as assistance with publishing a manuscript on dissolved organic carbon trends in the Delta or a paper on the contribution of Staten Island and urban runoff to nutrient loads. Salary related to this task is **$6,000.**

Program Element 5.5 O'Neill Forebay Circulation

h. Student assistant time to assist with various tasks under this program element. Salary for this element is **$2,071.**

Program Element 5.6 Organic Carbon Quality Study.

i. Student assistant time to assist with various tasks under this program element. Salary for this element is **$10,353.**

Program Element 8: Program Management

j. Costs for semi-annual MWQI offsite meetings. Costs may include rental fees for facility, AV equipment and for technical assistance, refreshments, deposit for reserving dates and other miscellaneous meeting package elements. Estimated cost for offsite meeting is **$3,000.**
k. MWQI Technical Consultant to provide technical expertise on program tasks related to water quality assessment, RTDF-related activities, special studies, and serving as a member of the MWQI Technical Advisory Committee. Salary for FY 2007-08 is **$55,600**.

Appendix 2 Strategic Five Year Plan

During 2006-07, the five-year strategic plan for the MWQI Program was updated and approved and adopted by the MWQI Technical Advisory Committee. This strategic plan will serve as the basis for the MWQI Program for completing development of program work plans for 2008-2009, and subsequent years. The plan that was approved is reproduced below.

MWQI Mission Statement

The mission of the MWQI Program is to collect and disseminate timely information to enable drinking water supplies taken from the Sacramento-San Joaquin Delta to be economically treated to produce safe and palatable drinking water. Information produced through this program will be used for:

1. Identifying and evaluating sources of drinking water contaminants.
2. Assisting MWQI Program participants in achieving their water quality objectives, meeting regulatory requirements, and planning for the future.
3. Supporting Delta and SWP water supply operations and assessing the water quality consequences of these operations.
4. Augmenting, in a cost-effective manner, the efforts of State and federal agencies mandated to monitor, protect, and improve drinking water.
5. Assessing impacts of actions by the California Bay Delta Authority and other entities on Delta and SWP drinking water quality.
6. Participating in public regulatory and funding processes to disseminate drinking water quality information and to assist in efforts to protect and improve drinking water sources.

OBJECTIVES FOR THE FIVE-YEAR PLAN

ORGANIZATIONAL STRUCTURE, COORDINATION AND FUNDING

- Develop an organizational structure that ensures staffing requirements for the MWQI Program are met on a timely basis through the retention of highly qualified personnel that have the expertise to meet MWQI Program objectives.
- Develop and implement the Real Time Data and Forecasting-Comprehensive Program (RTDF-CP) which will encompass tasks identified by the State Water Contractors, MWQI staff, other DWR units, outside agencies as high priority and achievable through cooperative effort.
- Work with the State Water Contractors to identify tasks that can most efficiently be performed through cooperative agreement, and participate in cooperative implementation of such tasks. These tasks will be described in detail and planned for on an annual basis in the RTDF-CP strategic plan.

- Work with the State Water Contractors to identify funding needs that will enable the MWQI Program to be adequately implemented, and to participate in acquiring, allocating, and accounting for, funds to accomplish needed work both directly, and through cooperative agreement.
- Coordinate MWQI Program activities with those of other DWR units under the RTDF-CP to enhance productivity, minimize duplication and overlap, and ensure effective coordination and communication among these units to enable joint implementation of water quality assessment and forecasting activities affecting the Delta and SWP as a whole.

DEVELOPMENT AND REFINEMENT OF A SWP "EARLY WARNING SYSTEM" FOR WATER QUALITY CONCERNS

- In conjunction with the Division of Operations and Maintenance and as one of the primary objectives of the RTDF-CP, develop and refine a "SWP Water Quality Early Warning" system that will alert MWQI Program participants of likely drinking water quality problems in a timely manner to enable preventative or corrective actions to be taken to avoid consumer impacts.
- Develop efficient communications among DWR units and MWQI Program participants to ensure early warning information is transmitted, received, and acted upon as appropriate.
- Tasks identified under the "Water Quality Monitoring", "Information Management and Dissemination", "Water Quality Forecasting", "Scientific Support" and "Emergency Response" program elements support the development of this early warning system.

WATER QUALITY MONITORING AND EMERGING CONCERNS

- Monitor water quality parameters relevant to drinking water at key locations in the Sacramento-San Joaquin Delta through periodic collection of discrete samples and their analysis by field and laboratory instruments, according to accepted methods.
- Maintain existing *in-situ* multi-parameter water quality monitoring stations on the Sacramento River at Hood, H.O. Banks Delta Pumping Plant Headworks, and San Joaquin River near Vernalis.
- As part of RTDF-CP work cooperatively with the State Water Contractors, other DWR units, and other agencies, to identify additional key locations in the Delta, its tributaries, and the State Water Project where additional *in-situ* water quality assessment equipment is needed. Work cooperatively with others to acquire needed permits, plan for and perform construction, acquire monitoring and communications equipment, bring new stations into operation, and assure the quality of data produced.
- Perform water quality assessments and evaluations to identify drinking water quality consequences of physical or operational changes in the Delta, its watersheds, and the State Water Project.
- With participation of the State Water Contractors, other MWQI Program participants, and DWR modelers, produce annual re-evaluations of the discrete and *in-situ* monitoring programs to identify and recommend needed changes to eliminate critical data gaps, provide valid data for the DSM2 model, improve program efficiency and minimize monitoring costs.

- Ensure timely and appropriate quality assurance/quality control of water quality and related information produced by the MWQI program. Take timely and effective action to identify and correct QA/QC problems. Include equipment/instrument maintenance and calibration as part of the annual QA/QC process.
- As part of the RTDF-CP work with other DWR units towards standardization of QA/QC procedures, especially for new stations.
- Continue to explore new and improved technologies for acquiring real time water quality data. Utilize new technology where possible to minimize monitoring costs and data gaps and to move towards standardization of monitoring methodology.
- Plan for emerging constituents of concern such as "Taste and Odor" issues that have been increasing with time. Respond to these emerging concerns in a timely manner as part of the RTDF-CP.
- As part of the RTDF-CP develop a comprehensive program of monitoring, early warning, and management for algal growths in the Delta and SWP having the potential for causing taste and odor in treated drinking water taken through the SWP. Governance of this program will be through a steering committee composed of DWR staff from relevant organizational units, and State Water Contractor representatives of affected agencies.

Information Management and Dissemination

- Provide timely analysis, interpretation, and dissemination of monitoring information to MWQI program participants and other identified stakeholders on key constituents of concern. Analyze and present monitoring results to program participants and in public proceedings.
- Continue to develop and refine capability for MWQI Program participants to rapidly acquire real time and other drinking water quality data and supporting information through the internet in user-friendly formats.
- Produce annual data and/or interpretative reports documenting program findings, as shall be determined by the MWQI Committee.
- Continue production of weekly water quality reports, with continuing improvements, as may be directed by the MWQI Committee.
- Provide technical assistance to MWQI Program participants in acquiring needed water quality data and supporting information.
- Research and develop new and innovative means of communicating MWQI Program work products to program participants and other interested parties.
- Encourage and promote actions by regulatory agencies necessary to ensure a high-quality and reliable water supply by disseminating information derived from the MWQI Program.
- Advocate drinking water quality protection by tracking new projects in the Central Valley, including operational planning activities, by alerting MWQI Program participants to projects having the potential to affect the quality of drinking water supplies taken through the Delta, reviewing and commenting on environmental documents, and participating in pubic hearings and workshops.

- Maintain awareness of findings from international, national, and regional research activities that have a bearing on the ability to meet future drinking water regulations, factor these findings into analyses of Delta water quality conditions and facilities options as appropriate, and communicate these findings to MWQI Program participants.

WATER QUALITY FORECASTING

- Complete development of, and implement, extension of the DSM2 Delta model to include the State Water Project.
- Produce timely water quality forecasts for SWP Contractors. MWQI Program staff will support DWR modeling efforts by providing water quality expertise needed to improve Delta models, coordinating closely with modelers to collect data to support model development, and to improve the ability to interpret and apply model outputs.
- Pending full implementation of the extended DSM2 model, evaluate other existing models for the potential of providing interim water quality forecasts to SWP Contractors.

SCIENTIFIC SUPPORT STUDIES

- In cooperation with MWQI Program participants and as part of the RTDF-CP, identify the need for, and implement, detailed studies to examine specific phenomena that affect, or may in the future affect, Delta drinking water quality. These studies may be generally classified as follows:
  - Detailed evaluations of problem areas or conditions identified as a result of monitoring activities.
  - Evaluations of drinking water quality consequences of proposed physical or operational modifications in the Delta and its tributaries, its inflows, internal flow patterns, or outflows.
  - Prediction of the drinking water quality consequences of population growth patterns.
  - Detailed evaluations of natural processes that have the potential to affect the quality of Delta drinking water sources.
  - Detailed evaluations of point and non-point pollutant discharges to the Delta (including tributaries to the Delta).

  Studies will be selected for implementation based on their significance to the quality of drinking water supplies taken through the Delta, and likelihood of being able to apply the information to attain higher quality of Delta drinking water sources. Outside expertise will be enlisted where necessary and feasible to conduct or collaborate on scientific studies.

EMERGENCY RESPONSE

- Identify, to the extent possible, ahead of time specific concerns regarding these events and what constituents would need to be assessed.
- Develop scenarios for different emergency events using models to determine which areas in the Delta pose most significant DWQ issues
- Develop emergency response plans ahead of time (follow SIMS template), identifying funding and staffing needs, all participating groups and their roles

- Work with other DWR units (i.e. Div of Flood Management) to develop emergency response plans
- Encourage DWR Executive to treat these events similar to flood events
- Perform water quality assessments and evaluations in response to emergency situations, such as Delta levee breaks, supplying timely water quality information to emergency decision makers and public health authorities.
- During emergency circumstances, work cooperatively with emergency managers and rapidly communicate results of emergency water quality assessments the MWQI Program may be tasked to perform.