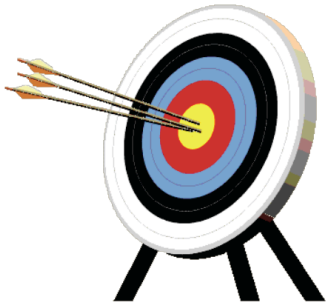
# THE RMP MULTI-YEAR PLAN

# 2012 ANNUAL UPDATE



APPROVED BY STEERING COMMITTEE: 01-24-12

Figure 1. RMP Committees and Workgroups.

## RMP ORIGIN AND PURPOSE

In 1992 the San Francisco Bay Regional Water Board passed Resolution No. 92-043 directing the Executive Officer to send a letter to regulated dischargers requiring them to implement a regional multi-media pollutant monitoring program for water quality (RMP) in San Francisco Bay. The Water Board's regulatory authority to require such a program comes from California Water Code Sections 13267, 13383, 13268 and 13385. The Water Board offered to suspend some effluent and local receiving water monitoring requirements for individual discharges to provide cost savings to implement baseline portions of the RMP, although they recognized that additional resources would be necessary. The Resolution also included a provision that the requirement for a RMP be included in discharger permits. The RMP began in 1993, and over the past 19 years has been a successful and effective partnership of regulatory agencies and the regulated community.

The goal of the RMP is to provide the high quality body of knowledge on estuarine contamination needed for managing water quality in this treasured aquatic ecosystem.

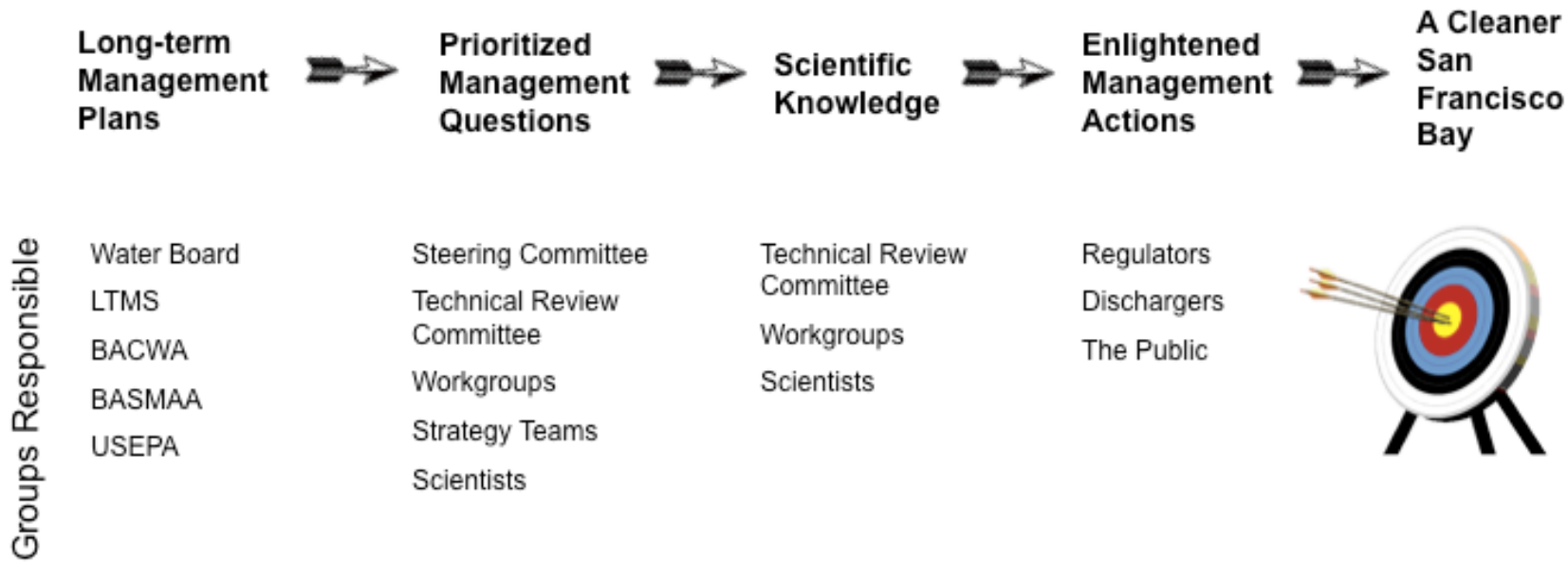
This goal is achieved through a cooperative effort of a wide range of regulators, dischargers, scientists, and environmental advocates. This collaboration has fostered the development of a multifaceted, sophisticated, and efficient program that has demonstrated the capacity for considerable adaptation in response to changing management priorities and advances in scientific understanding.

## RMP PLANNING

This collaboration and adaptation is achieved through the participation of stakeholders and scientists in frequent committee and workgroup meetings. The Steering Committee (Figure 1) consists of representatives from discharger groups (wastewater, stormwater, dredging, industrial) and regulatory agencies (Regional Water Board, USEPA, and U.S. Army Corps of Engineers). The Steering Committee determines the overall budget and allocation of program funds, tracks progress, and provides direction to the Program from a manager's perspective. Oversight of the technical content and quality of the RMP is provided by the Technical Review Committee (TRC), which provides recommendations to the Steering Committee. Five workgroups report to the TRC and address the main technical subject areas covered by the RMP: sources, pathways, and loadings; contaminant fate; exposure and effects; emerging contaminants; and sport fish contamination. An additional workgroup will be established in address the topic of nutrients and to guide development of a nutrient strategy by the Regional Water Board. The workgroups consist of regional scientists and regulators and invited scientists recognized as authorities in their field. The workgroups directly guide planning and implementation of pilot and special studies. RMP "strategy teams" comprise one more layer of planning activity. These stakeholder groups meet as needed to develop long-term RMP study plans for addressing high priority topics. Topics addressed to date include mercury, PCBs, dioxins, small tributary loads, and forecasting.

The annual planning cycle begins with a workshop in October in which the Steering Committee articulates general priorities among the information needs on water quality topics of concern. In the second quarter of the following year the workgroups and strategy teams forward recommendations for study plans to the TRC. At their June meeting, the TRC combines all of this input into a study plan for the following year that is submitted to the Steering Committee. The Steering Committee then considers this recommendation and makes the final decision on the annual workplan.

**Figure 2. Science in support of water quality management.**




The RMP supports management efforts to protect and restore water quality in the Bay. It does this by developing the scientific understanding needed to answer the key questions on priority topics that underpin current and future management policies and actions. RMP stakeholders and scientists work closely together to ensure the linkage of science and management.

In order to fulfill the overarching goal of the RMP, the Program has to be forward-thinking and anticipate what decisions are on the horizon, so that when their time comes, the scientific knowledge needed to inform the decisions is at hand. Consequently, each of the workgroups and teams develops five-year plans for studies to address the highest priority management questions for their subject area. Collectively, the efforts of all these groups represent quite a substantial body of deliberation and planning.

## PURPOSE AND ORGANIZATION OF THIS DOCUMENT

The purpose of this document is to guide efforts and summarize plans developed within the RMP. The intended audience includes representatives of the many organizations who directly participate in the Program. This document will also be useful for individuals who are not directly involved with the RMP but are interested in an overview of the Program and where it is heading.

The organization of this Multi-Year Plan parallels the RMP planning process (Figure 2). Section 1 presents the long-term management plans of the agencies responsible for managing water quality in the Bay and the overarching management questions that guide the Program. The agencies' long-term management plans provide the foundation for RMP planning (page 6). The first step the RMP takes to support these plans, is to distill prioritized lists of management questions that need to be answered in order to turn the plans into effective actions (page 7). The prioritized management questions then serve as a roadmap for scientists on the Technical Review Committee, the workgroups, and the strategy teams to plan and implement scientific studies to address the most urgent information needs. This information sharpens the focus on management actions that will most effectively and efficiently improve water quality in the Bay.

Section 2 provides an overview of the budget of the RMP, including where the funding comes from and how it is allocated among different elements of the Program. This section provides a summary of the priority topics to be addressed by the Program over the next five years.

Section 3 presents the five-year plans developed by the workgroups and strategy teams for specific priority topics: mercury, PCBs, dioxins, emerging contaminants, small tributary loads, exposure and effects, forecasting, nutrients, and status and trends. Led by the stakeholder representatives that participate in these groups, each workgroup and strategy team has developed a specific list of management questions for each topic that the RMP will strive to answer over the next five years. With guidance from the science advisors on the workgroups, plans have been developed to address these questions. These plans include proposed projects and tasks and projected annual budgets. Information synthesis efforts are underway for several of the strategies that will yield recommendations for a next phase of studies. For now, study plans and budget allocations for these strategies are largely labelled as "to be determined". Other pieces of information are also included to provide context for the multi-year plans. First, for each high priority topic, specific management policies or decisions that are anticipated to occur in the next few years are listed. Second, the latest advances in understanding achieved through the RMP and other programs on Bay water quality topics of greatest concern are summarized. Lastly, additional context is provided by listing studies performed within the last two years and studies that are currently underway.

Section 4 describes five-year plans for other elements that are essential to the mission of the RMP: communications, data management, and quality assurance.

## A Living Document

The RMP Multi-Year Plan is updated annually to provide an up-to-date description of the priorities and directions of the Program. An annual Planning Workshop is held in conjunction with the October Steering Committee meeting. A draft Multi-Year Plan is prepared after the workshop, and approved by the Steering Committee at the January meeting.

More detailed descriptions of the elements of the RMP are provided in the annual Program Plan and in the annual Detailed Workplan (both available at **www.sfei.org/rmp/what**).

For additional information on the RMP please visit our website at **www.sfei.org/rmp**.

Please contact Jay Davis, RMP Lead Scientist, at jay@sfei.org with questions or suggestions for improving this document.

**Annual Steering Committee Calendar**

- January
  - Approval of Multi-Year Plan
- April
  - Multi-year Plan: Focus on selected element(s)
  - Plan for Annual Meeting
  - Additional guidance to workgroups
- August
  - Multi-year Plan: mid-year check-in, workshop planning
  - Decision on special studies recommended by the TRC for next year
  - Plan for Annual Meeting
  - Report on SFEI financial audit
  - Brief discussion of fees for year after next
- October
  - Confirm chair(s)
  - Planning Workshop
  - Decision on fees for the year after next
  - Approve Program Plan and detailed budget for next year
  - Decision on Pulse and Annual Meeting topic for next year

Agendas and meeting summaries available at http://www.sfei.org/rmp/sc

## CURRENT AND ANTICIPATED MANAGEMENT DECISIONS, POLICIES, AND ACTIONS BY THE REGULATORY AGENCIES THAT MANAGE BAY WATER QUALITY

| Decisions, Policies, and Actions | Timing |
|---|---|
| *ONGOING AND EXISTING* | |
| *Determination of Permit Limits* | Ongoing |
| *Long-Term Management Strategy for Placement of Dredged Material/Dredged Material Management Office*<br>Regional Sediment Management Strategy | Ongoing |
| *Dredging Permits*<br>Bioaccumulation testing triggers and in-Bay disposal levels | Annual |
| *Biennial 303(d) List and 305(b) Report* | 2012-13<br>2014-15 |
| *Copper*<br>Compare levels to site specific objectives triggers<br>Reevaluation of the site-specific objectives | Annual<br>Triennial (2012) |
| *Cyanide*<br>Antidegradation policy<br>Ambient levels below CTR threshold | Triennial (2012) |
| *Selenium*<br>North Bay Selenium TMDL<br>South Bay Selenium TMDL | 2013-14<br>> 2015 |
| *Dioxins*<br>Review/reissue permit requirements<br>Review 303(d) listings and establish TMDL development plan | 2013-14<br>2013-14 |
| *Mercury*<br>Review existing TMDL and establish plan to revise<br>Revised mercury TMDL and/or implementation Plan | 2013-14<br>2016-18 |
| *PCBs*<br>Review existing TMDL and establish plan to revise<br>Revised PCBs TMDL and/or implementation plan | 2014-15<br>2019-20 |

The RMP contributes to effective management by providing scientific support for current policies and by anticipating and addressing information needs related to future policies and actions.

| Decisions, Policies, and Actions | Timing |
|---|---|
| *NEW AND FUTURE* | |
| *Nutrients*<br>New estuarine numerical endpoints<br>Assessment of ammonia/ammonium | 2012-15<br>2012-14 |
| *Legacy Pesticides (DDT, Dieldrin, Chlordane)*<br>Delist | 2012-13 |
| *Pathogens*<br>Review Bay beaches 303(d) listings and establish TMDL development plan | 2012-13 |
| *Sediment Hot Spots*<br>Review 303(d) listings and establish TMDL development plan | 2012-13 |
| *Chemicals of Emerging Concern*<br>State Water Board policy?<br>Regional Water Board plan or policy | 2012-13<br>2012-13 |
| *Toxicity*<br>Adoption of new state policy on effluent and receiving water toxicity | 2012 |
| *Sediment Quality Objectives*<br>303(d) listings<br>Determination of reasonable potential and permit requirements | 2014-15<br>Annual |

RMP stakeholders have articulated an overarching goal and a tiered framework of management questions that organize and guide RMP studies. The management questions are closely linked to existing and planned regulations.

## RMP GOAL AND MANAGEMENT QUESTIONS

### LEVEL I (CORE) Management Questions

1. Are chemical concentrations in the Estuary potentially at levels of concern and are associated impacts likely?
2. What are the concentrations and masses of contaminants in the Estuary and its segments?
3. What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary?
4. Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased?
5. What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary?

**General Goal of the RMP**

Collect data and communicate information about water quality in the San Francisco Estuary in support of management decisions

| | | | | | |
|---|---|---|---|---|---|
| **LEVEL I (CORE) QUESTIONS** | **QUESTION 1**<br>Levels of concern and associated impacts | **QUESTION 2**<br>Concentrations and masses (spatial distribution) | **QUESTION 3**<br>Sources, pathways, loadings, and processes | **QUESTION 4**<br>Increased or decreased (trends) | **QUESTION 5**<br>Projected concentrations, masses, and impacts |
| **LEVEL II QUESTIONS** | **Q1**<br>Which chemicals have potential for impacts?<br><br>**Q2**<br>What is the potential for impacts due to contamination?<br><br>**Q3**<br>What are appropriate guidelines?<br><br>**Q4**<br>What contaminants are responsible for impacts? | **Q1**<br>Are there particular regions of concern? | **Q1**<br>Which sources, pathways, etc. contribute most to impacts?<br><br>**Q2**<br>Opportunities for management intervention for important pathways?<br><br>**Q3**<br>Effects of management actions on loads? | **Q1**<br>Effects of management actions on concentrations and mass?<br><br>**Q2**<br>Effects of management actions on potential for adverse impacts? | **Q1**<br>Impacts forecast under various management scenarios?<br><br>**Q2**<br>Which contaminants predicted to increase? |

Along with, and consistent with, these general goals, the RMP addresses specific provisions of **NPDES permits** addressing priority information gaps

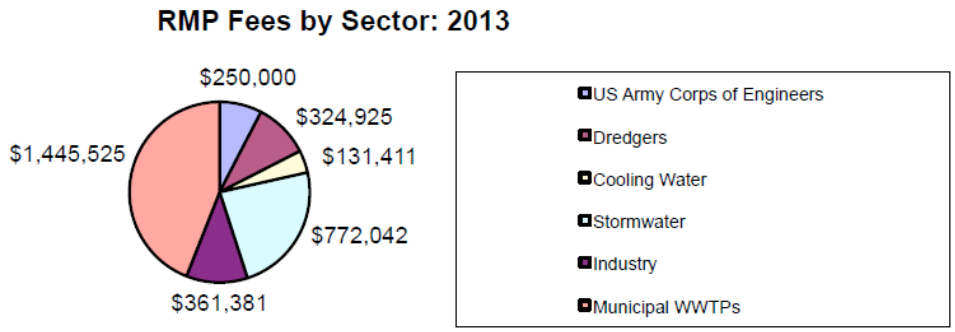
The following **key criteria** are used to evaluate potential RMP elements (in order of priority):

1) addresses NPDES permit requirements
2) supports policies and adaptive implementation
3) addresses scientific information needs

# BUDGET: Revenue - 2013

RMP fees were $2.99 million in 2005 and 2006, increased by 2% per year in 2007-2010, and were $3.24 million for 2010, 2011 and 2012. Fees will increase by 1.5% in 2013, 2% in 2014, and 2% in 2015.

RMP fees for 2013 are divided among the discharger groups as indicated. The proportion contributed by the Army Corps has decreased over the years as their contribution has stayed constant at $250,000 per year since 1993.

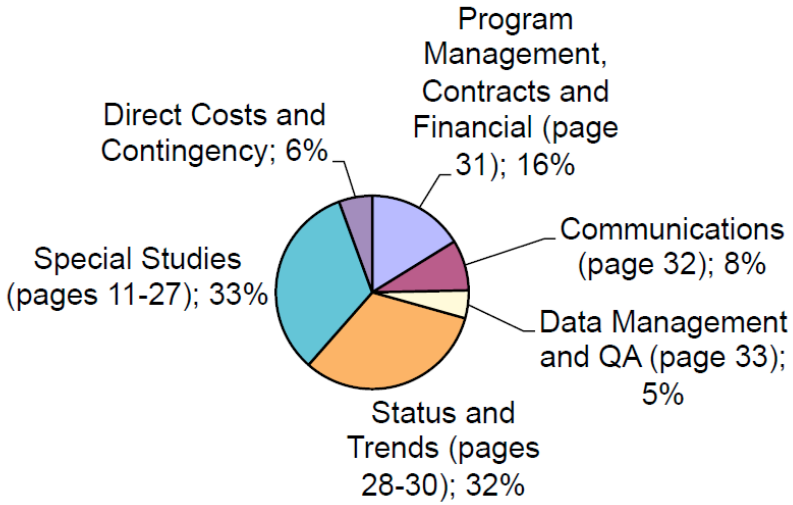



| Year | Jun Bay Area CPI | % CPI Increase | Actual RMP Fee Increase | Basis | Target Fees |
|---|---|---|---|---|---|
| **2005** | 201.2 | | | | $ 2,990,242 |
| **2006** | 209.1 | 3.9% | 0.0% | Fixed % | $ 2,990,242 |
| **2007** | 216.1 | 3.3% | 2.0% | Fixed % | $ 3,050,047 |
| **2008** | 225.2 | 4.2% | 2.0% | Fixed % | $ 3,111,048 |
| **2009** | 225.7 | 0.2% | 2.0% | Fixed % | $ 3,173,269 |
| **2010** | 228.1 | 1.1% | 2.0% | Fixed % | $ 3,236,734 |
| **2011** | 233.6 | 2.4% | 0.0% | Fixed % | $ 3,236,734 |
| **2012** | | | 0.0% | Fixed % | $ 3,236,734 |
| **2013** | | | 1.5% | Fixed % | $ 3,285,285 |
| **2014** | | | 2.0% | Fixed % | $ 3,350,991 |
| **2015** | | | 2.0% | Fixed % | $ 3,418,010 |
| | AVERAGE | 2.5% | | | |
| | | | | | |
| | 16.1% | % INCREASE 2005-2011 | | | 8.2% |
| | | | | | |
| Data from ABAG: http://www.abag.ca.gov/planning/research/cpi.html | | | | | |

RMP fee increases have not kept pace with Bay Area inflation rates. This has contributed to a decrease in the amount of work done per year by the Program.

# BUDGET: Expenses – 2013

| | | |
|---|---|---|
| Program Management, Contracts and Financial (page 31) | $ | 538,125 |
| Communications (page 32) | $ | 281,875 |
| Data Management and QA (page 33) | $ | 155,000 |
| Status and Trends (pages 28-30) | $ | 1,067,900 |
| Special Studies (pages 11-27) | $ | 1,093,540 |
| Direct Costs and Contingency | $ | 185,845 |




A table listing all line items for 2012-2017 is provided in Appendix 1

**Unencumbered Reserve**
An unencumbered reserve of $200,000 is maintained to respond to unanticipated urgent priorities.

**Unencumbered Funds**
Higher than anticipated revenues and elimination or reduction of lower priority elements sometimes leads to accumulation of unencumbered funds (currently $180,000 in addition to the $200,000 unencumbered reserve) that can be used for high priority topics at the discretion of the Steering Committee.

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## RMP SPECIAL STUDIES: 2013-2017

RMP expenditures on special study topics. Figures for 2011 and 2012 are actual amounts. Figures for 2013 and beyond are estimates for planning.

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| **TOPIC** | | | | | | | |
| **Mercury** | $95,000 | $25,000 | $0 | TBD | TBD | TBD | TBD |
| **PCBs** | $53,000 | $0 | $0 | TBD | TBD | TBD | TBD |
| **Dioxins** | $26,000 | $95,500 | $0 | $40,000 | TBD | TBD | TBD |
| **Emerging Contaminants** | $100,000 | $117,000 | $100,000 | TBD | TBD | TBD | TBD |
| **Small Tributaries** | $340,000 | $428,000 | $450,000 | $300,000 | $300,000 | TBD | TBD |
| **Other SPL** | $0 | $0 | $0 | TBD | TBD | TBD | TBD |
| **Exposure and Effects** | $97,000 | $130,000 | $100,000 | TBD | TBD | TBD | TBD |
| **Forecasting** | $0 | $100,000 | $100,000 | $100,000 | TBD | TBD | TBD |
| **Nutrients** | $0 | $140,000 | $230,000 | $300,000 | TBD | TBD | TBD |
| **ANNUAL TOTALS FOR SPECIAL STUDIES** | **$711,000** | **$1,035,500** | **$980,000** | **$740,000** | **$0** | **$0** | **$0** |
| **ANNUAL TOTAL AVAILABLE FOR SPECIAL STUDIES** | $706,194 | $895,434 | $1,093,540 | $1,142,106 | $1,133,319 | $1,171,465 | $1,225,486 |
| **REMAINING** | **-$4,806** | **-$140,066** | **$113,540** | **$402,106** | **$1,133,319** | **$1,171,465** | **$1,225,486** |

TBD – To be determined through synthesis efforts and workgroup discussion.

Special Studies to characterize **small tributary loading** are a high priority for the next three years. **Nutrient** synthesis and monitoring, and **forecasting** of future scenarios for nutrients and other contaminants are also priorities. Next steps for mercury, PCBs, dioxins, emerging contaminants, and effects will be outcomes from information synthesis efforts.

# SMALL TRIBUTARIES LOADING STRATEGY

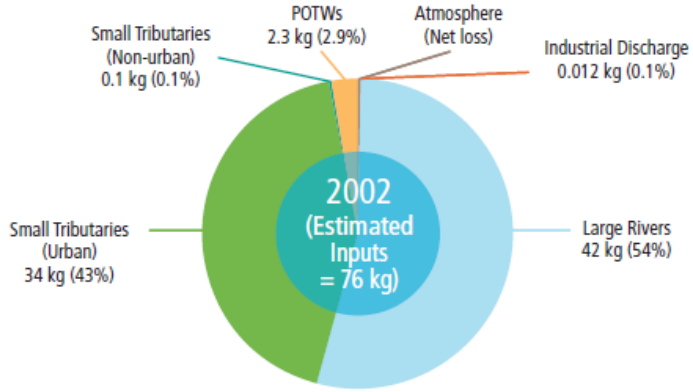
Note: "Small tributary" refers to the rivers, creeks, and storm drains that enter the Bay downstream of Chipps Island.

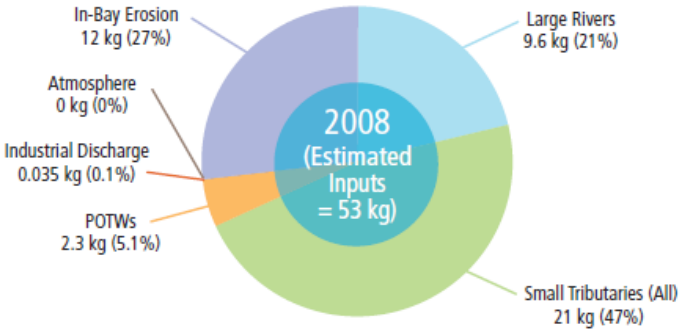
**Relevant Management Policies and Decisions**

- Refine pollutant loading estimates for future TMDLs and management decisions, including mercury and PCB TMDL updates
- Provisions of the Municipal Regional Permit (MRP) in 2010 and beyond
- Which small tributaries are the highest priorities for cleanup?
- What management actions are the best options for small tributaries?

**Recent Noteworthy Findings**

- The proportion of estimated small tributary loads has increased dramatically relative to large river loads for PCBs and mercury as we have obtained more information over the past eight years.
- More intense rainfall in the New Almaden historic mining district mobilizes sediment particles with high mercury concentrations.
- PCBs in the Guadalupe River watershed predominantly originate from urbanized areas in the lower watershed.
- Distinct differences in wet and dry years lead to high variability in mercury loadings to the Bay.
- Area-scaled loadings of many pollutants were similar from the Guadalupe watershed and from a small highly urbanized watershed in Hayward.

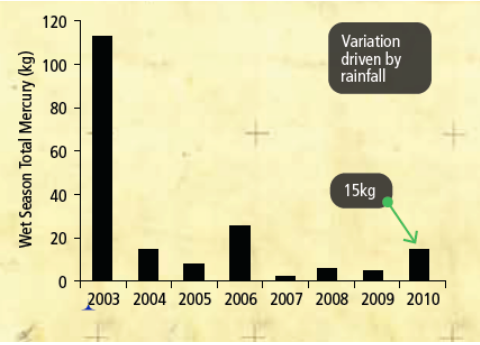



Estimates of PCB loads to the Bay in 2002 and 2008.

**Priority Questions for the Next Five Years**

1. Which are the "high-leverage" small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?
2. What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?
3. How are loads or concentrations of pollutants of concern from small tributaries changing on a decadal scale?
4. What are the projected impacts of management actions on loads or concentrations of pollutants of concern from the high-leverage small tributaries?




Estimates of mercury loads from the Guadalupe River from 2003 to 2010.

# SMALL TRIBUTARIES LOADING STRATEGY

Monitoring loads from representative watersheds will be the major emphasis for the next several years. Monitoring of representative source characterization sites in 2012 and beyond will provide data needed for model development in subsequent years. This work will be closely coordinated with and substantially augmented by MRP monitoring.

Small tributaries loading studies in the RMP from 2011 to 2015. Numbers indicate budget allocations in $1000s.

| Task ID | Funder | Task Description | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| **1** | | **Watershed and Associated Bay Modeling** | | | | | |
| 1A | | Regional Watershed Spreadsheet Model | | | | | |
| 1A.1 | RMP | Phase I – Water, Sediment, PCBs and Mercury | 20 | 20 | | | |
| 1A.1 | BASMAA | Phase I – Sediment | | 28 | 15 | TBD | |
| 1A. 2 | RMP | Phase II – Other Pollutants of Concern | | | 20? | | |
| 1A.2 | BASMAA | Phase II– PBDE, DDT, chlordane, dieldrin | | TBD | TBD | TBD | |
| 1A.3 | RMP | Phase III – Periodic Updates | | | | TBD | TBD |
| 1B | RMP | Coordination with Bay Margins Modeling | | | TBD | TBD | |
| 1C | TBD | HSPF dynamic modeling | | | | | TBD |
| **2** | RMP | **Source Area Monitoring / EMC Development** | 20 | 80 | (80) | TBD | TBD |
| **3** | | **Small Tributaries Monitoring** | | | | | |
| 3.1 | BASMAA | Multi-Year Plan Development | 15 | | | | |
| 3.2 | BASMAA | Standard Operating and Quality Assurance Procedures | 55 | | | | |
| 3A | RMP | Monitor Two Representative Small Tributaries | 300 | 328 | 300 | 300 | TBD |
| 3AB.1 | BASMAA | Monitor Two to Four Representative Small Tributaries or Sites Downstream of Management Actions | 255 | 510 | 480 | (480) | TBD |
| 3AB.2 | BASMAA | Lab Analyses, Quality Assurance, Data Management | 183 | 316 | (320) | (320) | TBD |
| **4** | RMP | **Reporting, Stakeholder Admin, Adaptive Updates** | 41 | | (50 min) | TBD | |
| | BASMAA | **Data Analysis, Communications, Administration** | 45 | 84 | (85 min) | TBD | TBD |
| **RMP Total** | | | **381** | **428** | **TBD** | **TBD** | **TBD** |
| **BASMAA Total** | | **Task 1** | | **28** | **TBD** | **TBD** | **TBD** |
| | | **Tasks 2-4** | **558** | **910** | **TBD** | **TBD** | **TBD** |
| **Total** | | | **934** | **1,366** | **TBD** | **TBD** | **TBD** |

# NUTRIENT STRATEGY

**Relevant Management Policies and Decisions**

**Primary**

- Nutrient numeric endpoints (draft in 2013)
- Evaluate need for revised objectives for DO and ammonia (2013)
- Water quality assessment – impairment listing – 2014, 2016
- NPDES permits (e.g., POTW, MRP) –ongoing
  Data collection – 2012

**Secondary**

- Delta Flows
- Regional Sediment Strategy
- Watershed TMDLs
- Recycled Water Policy and POTW projects

**Recent Advances in Understanding and Priority Information Needs**

- There is a growing body of evidence that suggests the historic resilience of San Francisco Bay to the harmful effects of nutrient enrichment is changing.
- Since the late 1990s, regions of the Bay have experienced significant increases in phytoplankton biomass (30-105% from Suisun to South Bay) and significant declines in DO concentrations (2.0 and 4.0 % in Suisun Bay and South Bay, respectively).
- USGS has found declining suspended sediment in the Bay – however, no data are available for shallow subtidal regions
- There is a need for long-term status and trends monitoring of nutrients and eutrophication
- Bay water quality objectives related to nutrients are limited to un-ionized ammonia and dissolved oxygen
- There are outstanding questions about the role and importance of ammonium with respect to beneficial use impairment

**Priority Questions for the Next Five Years**

1. Is there a problem or are there signs of a problem?
   a. Are anthropogenic nutrients currently, or trending towards, adversely affecting beneficial uses of the Bay?
   b. Are beneficial uses in segments of San Francisco Bay impaired by any form of nutrients?
   c. Are trends spatially the same or different in San Francisco Bay?
2. What are appropriate guidelines for assessing SF Bay's health with respect to nutrients and eutrophication?
3. Which nutrient sources, pathways, (and transformation processes) contribute most to concern?
   a. What is the relative contribution of each loading pathway (POTW, Delta, NPS, etc.) to the Bay overall and the Bay's key sub-systems, and how do these loads vary seasonally?
   b. What is contribution of nutrient regeneration (benthic fluxes) from sediments and denitrification/nitrogen fixation to SF Bay nutrient budgets?
4. What nutrient loads can the Bay assimilate (without impairment of beneficial uses)?
5. What future impairment is predicted for nutrients in the Bay?

# NUTRIENT STRATEGY

**Five-Year Goals for Nutrient Strategy**

1) Document our current understanding of nutrient dynamics in the Bay, highlighting what is known and the crucial questions that need to be answered
2) Implement a monitoring program that supports regular assessments of the Bay, and characterizes/quantifies key internal processes that exert important influence over the Bay's response to nutrient loading
3) Establish guidelines (water quality objectives; i.e., assessment framework) for eutrophication and other adverse effects of nutrient overenrichment, if needed
4) Quantify nutrient loads to and important processes in the Bay
5) Establish a modeling strategy to support decisions regarding nutrient management for the Bay

**The Nutrient Science Strategy for the Bay is a collaborative effort** with major contributions from RMP, USGS, the State and Regional Boards, BACWA, and hopefully others. Funding and oversight are provided by these multiple organizations. Multiagency collaboration is essential to address the information needs for nutrients in the Bay.

Nutrient studies in the Bay from 2011 to 2017. Numbers indicate budget allocations in $1000s.

| Element | Funding Agency | Questions Addressed | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|
| Nutrient Strategy: Program Coordination | RMP | 1-5 | 20 | 10 | | | | | |
| | SWRCB | 1-5 | 15 | 5 | | | | | |
| | BACWA | 1-5 | 10 | 60*** | | | | | |
| Conceptual Model Development and Loads Assessment | RMP | 1-5 | | 100 | TBD | TBD | TBD | TBD | TBD |
| Assessment (NNE) | RMP | | | | TBD | TBD | TBD | TBD | TBD |
| | SFBRWQCB | 2 | | 60*** | 55*** | | | | |
| Monitoring | RMP | 1,3 | 110 | 140** | TBD | TBD | TBD | TBD | TBD |
| | USGS | 1 | 400 | 400 | TBD | TBD | TBD | TBD | TBD |
| | SFBRWQCB | 1 | 100 | 110 | TBD | TBD | TBD | TBD | TBD |
| Modeling* | RMP | 4,5 | | 100*** | 100 | 100 | TBD | TBD | TBD |
| Modeling | BACWA | 4,5 | | | TBD | TBD | TBD | TBD | TBD |
| General Allocation | RMP | | | | 200 | 300 | TBD | TBD | TBD |
| | | **RMP Total** | **130** | **350** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |
| | | **SWRCB Total** | **15** | **70** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |
| | | **SFBRWQCB Total** | **100** | **110** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |
| | | **BACWA Total** | **10** | **60** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |
| | | **USGS Total** | **400** | **400** | **400** | **TBD** | **TBD** | **TBD** | **TBD** |
| | | **Overall Total** | **555** | **880** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |

* joint with RMP Forecasting Strategy ** $110K to USGS, $30K for stormwater loads *** Anticipated TBD – To be determined through synthesis efforts and workgroup discussion.

# FORECASTING (MODELING)

**Relevant Management Policies and Decisions**

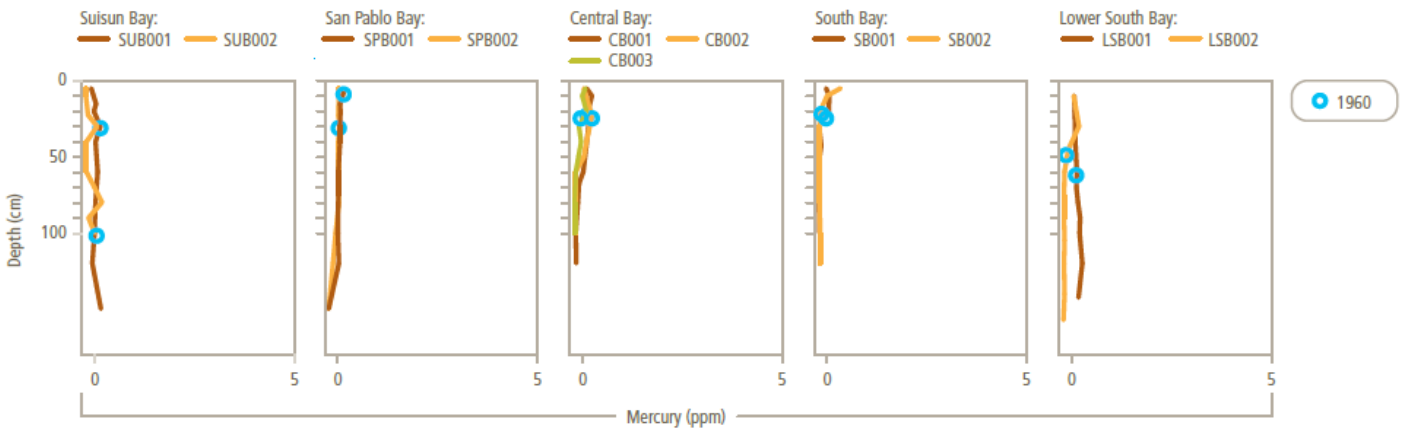
- The next iteration of the mercury and PCBs TMDLs in 2016-2020
- Potential TMDLs for other contaminants
- Priorities for cleaning up small tributaries and contaminated margin sites
- Identifying best options for management actions to reduce impairment

**Recent Noteworthy Findings**

- Sediment cores from open-water sites exhibited total mercury and PCB concentrations in deeper sediments that were generally similar to surface sediments, suggesting diminished concern for prolonged recovery due to erosion of contaminated subsurface material.

**Priority Questions for the Next Five Years**

1) What patterns of exposure are forecast for major segments of the Bay under various management scenarios?
2) What is the contribution of contaminated Bay margins to Bay impairment?
3) What are the projected impacts of Bay margin management actions to Bay recovery?




Depth profiles of total mercury in Bay cores.

# FORECASTING (MODELING)

The ultimate goal of the Forecasting Strategy is to predict recovery of contaminated Bay regions and sites under different management scenarios. Efforts in the next two years will focus on the modeling the open Bay (with an emphasis on nutrients) and developing a strategy for modeling the margins.

**Forecasting studies in the RMP from 2009 to 2017.** Numbers indicate budget allocations in $1000s.

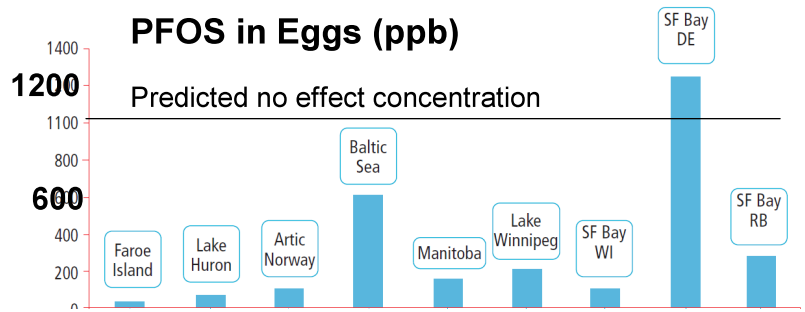
| Element | Funding Agency | Forecasting Questions Addressed | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Margins Conceptual Model | RMP | 1,2,3 | 40 | | | | | | | | |
| Bioaccumulation Conceptual Model | RMP | 1,2,3 | | 40 | | | | | | | |
| Bay Modeling* | RMP | 1,2,3 | | | | 100 | 100 | 100 | TBD | TBD | TBD |
| | BACWA | 1,2,3 | | | | TBD | TBD | TBD | TBD | TBD | TBD |
| Margin Module 1 | RMP | 1,2,3 | | | | | | TBD | TBD | TBD | TBD |
| Margin Module 2 | RMP | 1,2,3 | | | | | | TBD | TBD | TBD | TBD |
| Margin Module 3 | RMP | 1,2,3 | | | | | | TBD | TBD | TBD | TBD |
| **RMP Total** | | | **40** | **40** | **0** | **100** | **100** | **100** | **TBD** | **TBD** | **TBD** |
| **Non-RMP Total** | | | | | **0** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |
| **Overall Total** | | | **40** | **40** | **0** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |

* joint with Nutrient Strategy TBD – To be determined through synthesis efforts and workgroup discussion.

# EMERGING CONTAMINANTS

**Relevant Management Policies and Decisions**

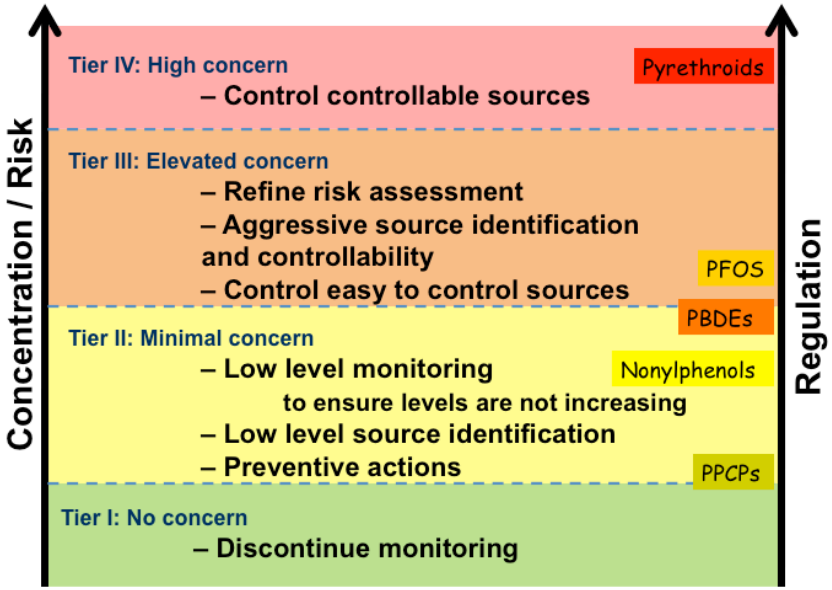
- Water Board plan or policy in 2012-2013
- State Water Board Policy in 2012-2013
- State Board Toxicity Policy
- Narrative water quality objectives prohibiting toxicity and water quality degradation




PFOS in bird eggs, 2006.

**Recent Noteworthy Findings**

- Perfluorinated chemicals in bird eggs are high relative to other locations that have been studied and in South Bay exceed a published health risk threshold.
- Triclosan was detected in sediment at seven out of ten sites with concentrations ranging from 5-10 ppb in the Central and South Bay, and a maximum of 40 ppb. Sediment toxicity thresholds are not available, but these concentrations may be of some concern.
- A screening study of alternative flame retardants generally found low concentrations. Some phosphate-based chemicals are present in sediment at levels comparable to PCBs and PBDEs; work is underway to determine if they accumulate in biota.
- A screening study of pharmaceuticals and personal care products generally found concentrations well below available acute and chronic toxicity thresholds.
- Chlorinated paraffin concentrations in the Bay also are low relative to other ecosystems.
- A small screening study (6 samples from 4 locations) in 2009 found nonylphenol concentrations in small fish ranging from 50 to 420 ppb, similar to other estuaries in California.




**Priority Questions for the Next Five Years**

1. What emerging contaminants have the greatest potential to adversely impact beneficial uses in the Bay?

## EMERGING CONTAMINANTS

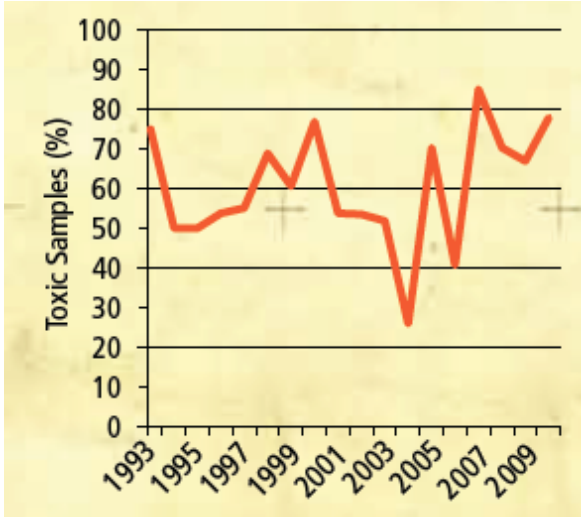
Emerging contaminant studies in the RMP have been augmented substantially by pro bono work and matching funds. A synthesis in 2011 and 2012 will set the stage for a multi-year plan for 2013 and beyond.

**Emerging contaminant studies and monitoring in the RMP from 2008 to 2017.** Numbers indicate budget allocations in $1000s. Matching funds and source indicated in parentheses. CDFO-Canada Department of Fisheries and Oceans; MMC-Marine Mammal Center; NIST-National Institute of Standards and Technology.

| Element | Questions Addressed | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Perfluorinated Compounds | 1 | 35 | 52 | | | 87 | TBD | TBD | TBD | TBD | TBD |
| Alternative Flame Retardants (Duke Univ) | 1 | 48 | | | | | TBD | TBD | TBD | TBD | TBD |
| Chlorinated Paraffins in Biota (CDFO) | 1 | 0 (5) | | | | | | | | | |
| Triclosan in Sediment (USEPA) | 1 | 0 (5) | | | | | TBD | TBD | TBD | TBD | TBD |
| White Paper on ECs in Wastewater | 1 | | 30 | | | | TBD | TBD | TBD | TBD | TBD |
| Nonylphenol in Small Fish (Cal Poly) | 1 | | 0 (2) | | | | TBD | TBD | TBD | TBD | TBD |
| Broadscan Screening of Biota for EC (NIST, SCCWRP, MMC, SDSU) | 1 | | | 55 (75) | 70 (75) | | TBD | TBD | TBD | TBD | TBD |
| AXYS Mussel Study (AXYS) | 1 | | | 27 (33) | | | TBD | TBD | TBD | TBD | TBD |
| AXYS Brominated Dioxins in Sediments and Biota (AXYS) | 1 | | | 0(18) | | | TBD | TBD | TBD | TBD | TBD |
| NOAA Mussel Pilot Study (NOAA, SCCWRP, SWRCB) | 1 | | | 33 (50) | | | TBD | TBD | TBD | TBD | TBD |
| EC Synthesis, Strategy Development | 1 | | | | 30 | 30 | TBD | TBD | TBD | TBD | TBD |
| EC General Allocation | 1 | | | | | | 100 | TBD | TBD | TBD | TBD |
| Nanoparticles (Duke Univ.) | 1 | | | 0 (5) | | TBD | TBD | TBD | TBD | TBD | TBD |
| **RMP Total** | | **83** | **82** | **115** | **100** | **117** | **100** | **TBD** | **TBD** | **TBD** | **TBD** |
| **Non-RMP Total** | | **10** | **2** | **176** | **75** | **0** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |
| **Overall Total** | | **93** | **84** | **291** | **175** | **117** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |

Gray cells – further work on this topic not anticipated

# EXPOSURE AND EFFECTS




Percentage of RMP Sediment Samples Causing Toxicity in Lab Tests.

**Relevant Management Policies and Decisions**

- Implementation of sediment quality objectives
- The next iteration of the mercury TMDL in 2016-2018
- Permitting decisions regarding dredging projects
- Continued implementation of narrative water quality objective prohibiting toxicity

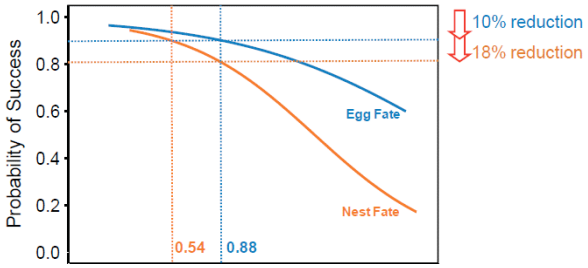
**Recent Noteworthy Findings**

- In every year since RMP sampling began in 1993, 26% or more of sediment samples have been determined to be toxic to one or more test species. The causes of this toxicity remain unidentified.
- Studies have indicated that mercury is impairing hatchability of Forster's tern eggs in San Francisco Bay, but that the reduction of nest success at the TMDL bird egg monitoring target of 0.5 ppm is less than 10%.
- A study examining possible endocrine responses in shiner surfperch and staghorn sculpin found hormonal imbalances that appeared to be related to PCB exposure.

**Priority Questions for the Next Five Years**

**Effects on Benthos**

1. What are the spatial and temporal patterns of impacts of sediment contamination?
2. Which pollutants are responsible for observed impacts?
3. Are the toxicity tests, benthic community assessment approaches, and the overall SQO assessment framework reliable indicators of impacts?




The reduction of Forster's tern nest success afforded by the TMDL bird egg monitoring target of 0.5 ppm is less than 10%.

**Effects on Fish**

4. Are pollutants, individually or in combination, reducing the reproductive ability, growth, and health of sensitive fish populations?
5. What are appropriate thresholds of concern for contaminant concentrations for Bay species?
6. What are cost-effective indicators for monitoring effects of contaminants?

**Effects on Birds**

7. Is there clear evidence of pollutant effects on survival, reproduction, or growth of individual birds?
8. Are pollutants in the Bay adversely affecting bird populations?
9. What are appropriate guidelines for protecting bird populations that are at risk?
10. Do spatial patterns in accumulation indicate particular regions of concern?

## EXPOSURE AND EFFECTS

Exposure and effects effort on benthos and fish in 2011 and 2012 focus on completion of studies from prior years and development of long-term plans. For birds, significant progress has been made in answering the priority questions, and further effects work is not needed at this time.

**Exposure and effects studies and monitoring in the RMP from 2008 to 2014.** Numbers indicate budget allocations in $1000s.

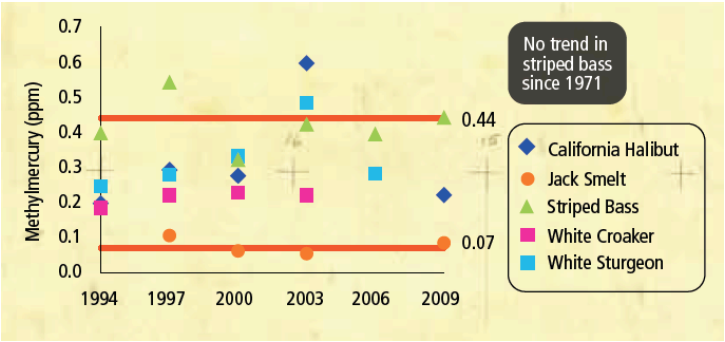
| | Element | Questions Addressed | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Benthos** | Benthic Assessment Tools | 3 | 20 | 25 | 30 | | 50 | TBD | TBD | TBD | TBD | TBD |
| | Causes of Sediment Toxicity: TIEs and LC50 Work | 2 | 10 | 80 | | | | TBD | TBD | TBD | TBD | TBD |
| | Causes of Sediment Toxicity: Molecular TIEs | 2 | | | 60 | | | TBD | TBD | TBD | TBD | TBD |
| | Causes of Sediment Toxicity: Moderate Toxicity Strategy | 2,3 | | | | | 50 | 50 | | | | |
| | USEPA Water Quality Synthesis (National Coastal Condition Assessment) (USEPA) | 1,3 | | | | (100) | (50) | TBD | TBD | TBD | TBD | TBD |
| | Hotspot Followup Study | 1,2,3 | | | | 60 | 30 | TBD | TBD | TBD | TBD | TBD |
| | Reference Site, Benthos Recovery After Dredging | 1 | | | | | | 50 | | | | |
| **Fish** | Endocrine Disruption in Fish | 4,6 | 35 | | | | TBD | TBD | TBD | TBD | TBD | TBD |
| | Effects of PAHs on Flatfish (NOAA) | 4,5,6 | 40 | 50 | | | TBD | TBD | TBD | TBD | TBD | TBD |
| | Effects of Copper on Salmon (NOAA) | 4,5 | | | | 37 | TBD | TBD | TBD | TBD | TBD | TBD |
| **Birds** | Mercury and Selenium Effects on Terns (USGS) | 7,8,9,10 | 75 | 54 | | | | | | | | |
| | PBDEs: Sensitivity in Terns | 8 | | | 48 | | | | | | | |
| **RMP Total** | | | **179** | **209** | **138** | **97** | **130** | **100** | **TBD** | **TBD** | **TBD** | **TBD** |
| **Non-RMP Total** | | | **0** | **0** | **0** | **100** | **50** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |
| **Overall Total** | | | **179** | **209** | **138** | **197** | **180** | **TBD** | **TBD** | **TBD** | **TBD** | **TBD** |

Gray cells – further work on this topic not anticipated

# MERCURY

**Relevant Management Policies and Decisions**

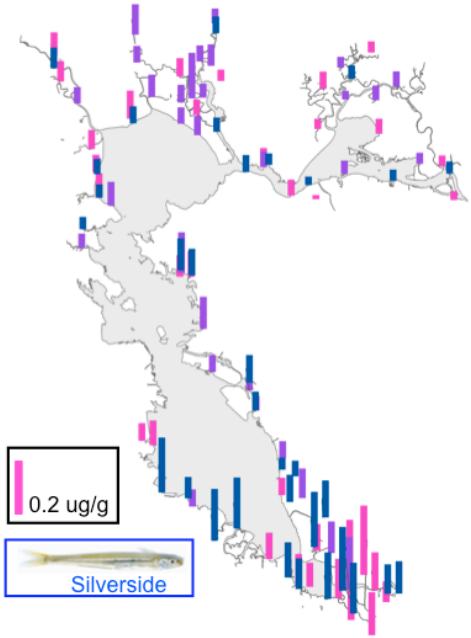
- Review new information and prepare plan to update the current TMDL and implementation plan in 2013-2014
- The next iteration of the TMDL in 2016-2018
- Identifying best options for management actions to reduce mercury impairment




Mercury concentrations (ppm) in sport fish. 0.44 ppm is OEHHA no consumption advisory tissue level (ATL); 0.07 is 2 serving per week ATL. Baywide averages.

**Recent Advances in Understanding**

- The median mercury concentration in striped bass in 2009 was 0.44 ppm, higher than the TMDL target of 0.20 ppm. Concentrations have shown no decline since 1970.
- Monitoring of mercury in small fish indicates that a high proportion (85% in 2008-2010) of samples was above the 0.03 ppm TMDL target for wildlife prey.
- The small fish monitoring also indicates that concentrations are relatively high in the Lower South Bay region.
- Based on mercury concentrations in blood, nearly 60% of all breeding Forster's terns sampled in the Bay are at high risk of toxic effects.
- Sediment cores suggest extensive transport and mixing of past loads and diminished concern for erosion of contaminated subsurface material.
- A mass budget for methylmercury indicates that in-Bay production of methylmercury is about 100 times greater than external loading.
- Source control (principally erosion of mining waste, stormwater, and wastewater) is being pursued but will take many decades to be effective
- Control of internal net methylmercury production may achieve more rapid reductions
- Opportunities for reducing risk by controlling internal production vary by habitat (open Bay, managed pond, tidal marsh)




Mercury concentrations (ppm) in silverside from 2008-2010.

**Priority Questions for the Next Five Years**

1. Where is mercury entering the food web? – *we may have answered this sufficiently – topic for Strategy Team discussion*
2. Which processes, sources, and pathways contribute disproportionately to food web accumulation?
3. What are the best opportunities for management intervention for the most important pollutant sources, pathways, and processes?
4. What are the effects of management actions?
5. Will total mercury reductions result in reduced food web accumulation?

# MERCURY

The Mercury Strategy began with a multi-year suite of studies in 2008. These studies are now being completed. A synthesis in 2011 will set the stage for a new multi-year plan for 2012 and beyond.

**Mercury and methylmercury studies and monitoring in the RMP from 2008 to 2017.** Numbers indicate budget allocations in $1000s.

| General Area | Element | Mercury Questions Addressed | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mercury Strategy | Methylmercury Synthesis | 1,2,3,4,5 | | | | 75 | | | | | | |
| | Food Web Uptake (Small Fish) (Status and Trends) | 1,4 | 150 | 150 | 150 | 20 | TBD | TBD | TBD | TBD | TBD | TBD |
| | High Leverage Pathways (DGTs) | 2 | 58 | 58 | | | TBD | TBD | TBD | TBD | TBD | TBD |
| | High Leverage Pathways (Isotopes) | 2,5 | 40 | 40 | | | TBD | TBD | TBD | TBD | TBD | TBD |
| | Methylmercury Fate Model | 3,4 | | 25 | | | | | | | | |
| **RMP Total** | | | 248 | 273 | 150 | 95 | TBD | TBD | TBD | TBD | TBD | TBD |
| **Non-RMP Total** | | | 0 | 0 | 0 | 0 | TBD | TBD | TBD | TBD | TBD | TBD |
| **Overall Total** | | | 248 | 273 | 150 | 95 | TBD | TBD | TBD | TBD | TBD | TBD |

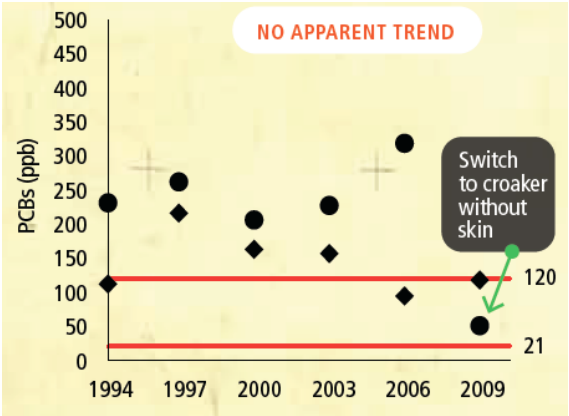
# PCBs

**Relevant Management Policies and Decisions**

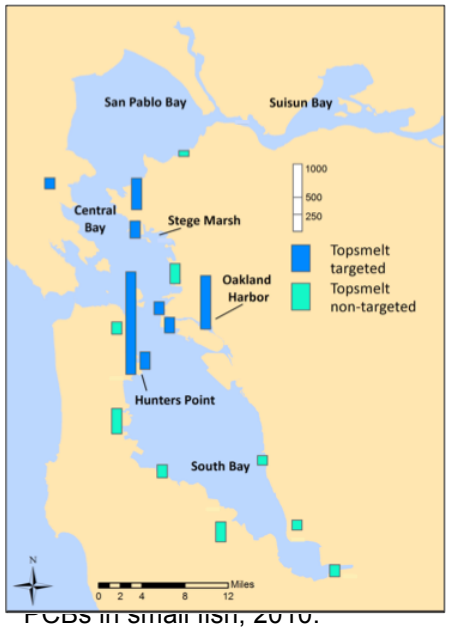
- Review new information and prepare plan to update the current TMDL in 2014-2015
- The next iteration of the PCBs TMDL in 2019-2020
- What management actions are the best options for reducing PCB impairment?

**Recent Noteworthy Findings**

- Sport fish were lower on a wet weight basis in the most recent sampling (2009), though on a lipid weight basis concentrations were comparable to past sampling rounds.
- Risks to fish-eating birds persist. In 2000-2003, 17% of 149 tern eggs were above an effects threshold.
- Small fish accumulate high concentrations of PCBs that correlate with concentrations in sediment.
- Bivalve monitoring continues to indicate declines, with half-lives ranging among stations from 7 to 14 years, and longer half-lives in the South Bay.
- Bay sediment appears to be cleaner than in the 1990s. The Bay-wide average was 7.0 ppb in 2004-2009 compared to 31 ppb in the 1990s. A different sampling design and different methods probably contribute to this apparent decrease.
- Average concentrations in Suisun Bay sediments are lower than in the other Bay segments.
- Bay cores show some areas with higher concentrations at depth, but this is less of a concern than previously thought.
- A new PCB has been identified in effluents and the environment across the U.S. PCB 11 and several other PCBs are inadvertent byproducts in the manufacturing of commonly used pigments. These pigment PCBs are distinct from the Aroclor-derived PCBs that are the subject of the PCBs TMDL.



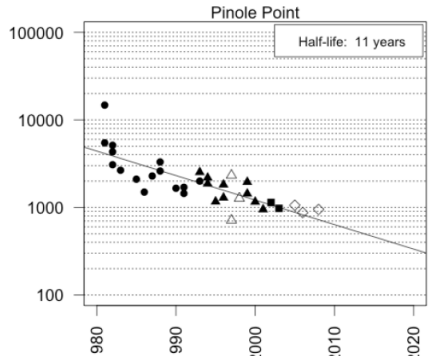

PCB concentrations in sport fish. 120 ppb is OEHHA no consumption advisory tissue level (ATL); 21 is 2 serving per week ATL. Baywide averages. Circles-white croaker, diamonds-shiner surfperch.




PCBs in small fish, 2010.

**Priority Questions for the Next Five Years**

1. What potential for impacts on humans and aquatic life exists due to PCBs?
2. What are appropriate guidelines for protection of beneficial uses?
3. What is the total maximum daily load of PCBs that can be discharged without impairment of beneficial uses?
4. What are the rates of recovery of the Bay, its segments, and in-Bay contaminated sites from PCB contamination?
5. What are the present loads and long-term trends in loading from each of the major pathways?
6. What role do in-Bay contaminated sites play in segment-scale recovery rates?
7. Which small tributaries and contaminated margin sites are the highest priorities for cleanup?
8. What management actions have the greatest potential for accelerating recovery or reducing exposure?
9. What is the most appropriate index for sums of PCBs?




PCB trend in mussels at Pinole Point.

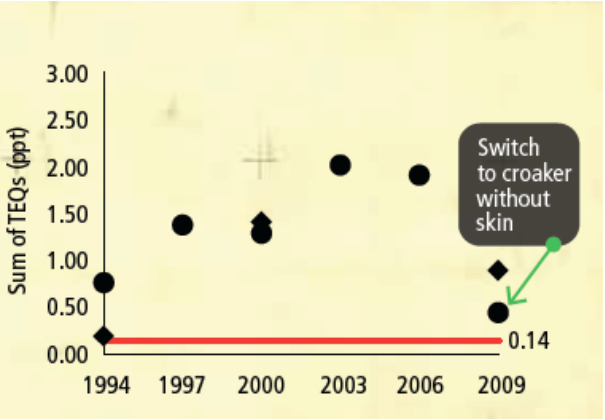
## PCBs

Studies under the PCB Strategy began in 2010. A synthesis in 2011 will set the stage for a multi-year study plan for 2012 and beyond.

**PCB studies and monitoring in the RMP from 2010 to 2017.** Numbers indicate budget allocations in $1000s.

| General Area | Element | PCB Questions Addressed | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| PCB Strategy | Food Web Uptake (Small Fish) | 1,7 | 50 | | TBD | TBD | TBD | TBD | TBD | TBD |
| | PCB Conceptual Model Update | 1,2,3,4,5,6,7,8,9 | | 53 | TBD | TBD | TBD | TBD | TBD | TBD |

# DIOXINS




Dioxin and furan TEQ concentrations (ppt) in white croaker (circles) and shiner surfperch (diamonds). Baywide averages.

**Relevant Management Policies and Decisions**

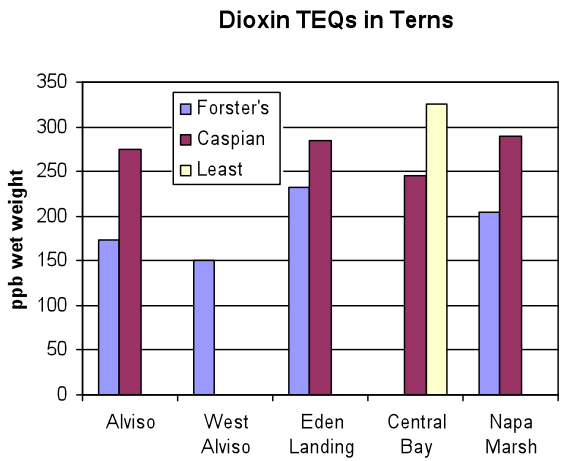
- Reissue permit requirements in 2013-2014
- Review 303(d) listings
- Establish TMDL development plan in 2013-2014

**Recent Noteworthy Findings**

- The key sport fish indicator species (shiner surfperch and white croaker) have been higher than the Water Board screening value of 0.14 ppt and show no sign of decline, but there is a great deal of uncertainty regarding the human health risk associated with dioxins in sport fish.
- Dioxin-toxic equivalents in Least Tern, Caspian Tern, and Forster's Tern eggs are at or above estimated thresholds for adverse effects; risks especially significant in combination with dioxin-like PCBs.
- Few data on dioxins are available on other priority questions – the Dioxin Strategy was developed to address this need.
- Recent wetland cores suggest rapidly declining inputs from local watersheds during recent decades, though additional coring data are needed to support this hypothesis

**Priority Questions for the Next Five Years**

1. Are the beneficial uses of San Francisco Bay impaired by dioxins?
2. What is the spatial pattern of dioxin impairment?
3. What is the dioxin reservoir in Bay sediments and water?
4. Have dioxin loadings/concentrations changed over time?
5. What is the relative contribution of each loading pathway as a source of dioxin impairment in the Bay?
6. What future impairment is predicted for dioxins in the Bay?




Mean concentrations of dioxin and furan TEQs in three tern species, 2000-2003. Mean concentrations for the California Least Tern fall within the effects threshold range. Concentrations within the effects threshold range were observed in some eggs of all species. From Adelsbach and Maurer (2007).

## DIOXINS

Dioxin Strategy studies began in 2008, with a multi-year plan extending through 2012. Synthesis activities are planned for 2013 and 2014 after the data from the earlier studies are available.

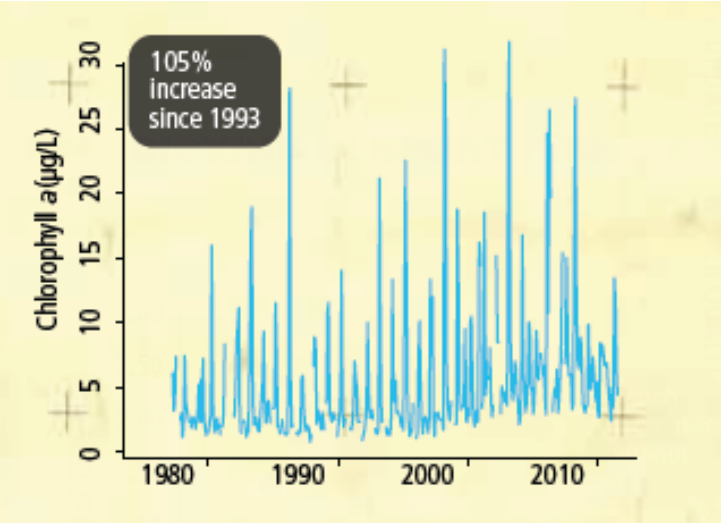
**Dioxin studies and monitoring in the RMP from 2008 to 2017.** Numbers indicate budget allocations in $1000s. Unlike the other contaminants, dioxin costs have generally been itemized explicitly as add-ons to RMP studies.

| General Area | Element | Dioxin Questions Addressed | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dioxin Strategy | Quality Assurance | 1,2,3,4,5,6 | | 14 | | | | | | TBD | TBD | TBD |
| Status and Trends | Sport Fish | 1,2,4 | | 22 | | | | | 24 | TBD | TBD | TBD |
| | Avian Eggs | 1,2,4 | | | | | 13 | | | TBD | TBD | TBD |
| | Surface Sediments | 2,3 | | 58 | 58 | | | TBD | TBD | TBD | TBD | TBD |
| | Water | 2,3 | | 26 | | 26 | | TBD | TBD | TBD | TBD | TBD |
| Loads | Small Tributary Loading | 4,5,6 | | | 65 | | 52 | TBD | TBD | TBD | TBD | TBD |
| | River Loading (THg) | 4,5,6 | | | 34 | | | TBD | TBD | TBD | TBD | TBD |
| Forecast | Sediment Cores | 3,4,6 | | | 57 | | 32 | TBD | TBD | TBD | TBD | TBD |
| | Synthesis: One-Box Model | 3,4,5,6 | | | | | | | 20 | TBD | TBD | TBD |
| | Synthesis: Food Web Model | 5,6 | | | | | | | 20 | TBD | TBD | TBD |
| Loads | Atmospheric Deposition | 5,6 | | | 20 | | | TBD | TBD | TBD | TBD | TBD |
| **RMP Total** | | | 0 | 120 | 234 | 26 | 97 | TBD | TBD | TBD | TBD | TBD |
| **Non-RMP Total** | | | 0 | 0 | 0 | 0 | 0 | TBD | TBD | TBD | TBD | TBD |
| **Overall Total** | | | 0 | 120 | 234 | 26 | 97 | TBD | TBD | TBD | TBD | TBD |

## STATUS AND TRENDS

### Relevant Management Decisions

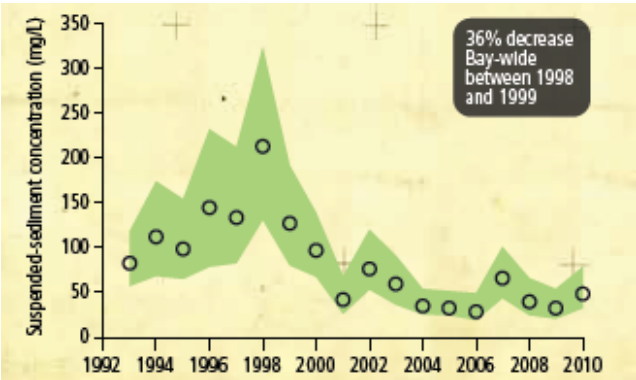
- Revision of Mercury and PCB TMDLs in 2016-2020
- Development of Se TMDL in 2013-2014 (North Bay) and 2015 beyond (South Bay)
- De-listing of legacy pesticides (2012-2013)
- Evaluation of sediment and water quality objectives
    - Copper site-specific objective and cyanide anti-degradation policy
    - 303 (d) listings
    - Reasonable potential analysis
- Dredged material management
    - Defining ambient conditions in Bay (PCBs, Hg, PAHs, etc.)
- Identification of causes of sediment toxicity in the Bay
- Development of and assessment with nutrient numeric endpoints; management of ammonium
- Providing fundamental science to evaluate the health of the Bay and to model the fate and transport of contaminants.




Chorophyll trend in the South Bay.

### Recent Advances in Understanding

- Annual sampling of water and sediment chemistry has documented a general lack of trend in persistent pollutants and spatial patterns that vary by pollutant but are consistent from year to year.
- A sudden decrease in suspended sediment concentrations occurred in 1999.
- Increasing chlorophyll concentrations have been observed in the Bay and are attributed to a variety of possible drivers (e.g., decrease in SSC concentrations and an increase in bivalve predators).
- PBDEs appear to be leveling off (BDE 47) or declining (BDE 209)
- Concentrations of mercury in sediment correlate poorly with methylmercury in sediment (MeHg represents 1% of total Hg).




Suspended sediment trend at a representative station.

### Priority Questions for the Next Five Years

1. Are chemicals at levels of concern?
2. What are the concentrations and masses of priority contaminants?
3. Have concentrations and masses increased or decreased?

# STATUS AND TRENDS

**Status and trends monitoring budget allocations in the RMP from 2012 to 2017.** Allocations are spread evenly over the years, even though the expenditures (see next page) occur intermittently.

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| % increase subcontractors | 0.0% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% |
| **STATUS AND TRENDS TOTAL** | **$1,266,500** | **$1,067,900** | **$1,069,273** | **$1,115,598** | **$1,100,342** | **$1,114,506** |
| Water Chemistry (biennial 22 sites) | | $81,667 | $83,708 | $85,801 | $61,250 | $62,781 |
| Aquatic Toxicity (every five years) | | $2,333 | $2,392 | $2,451 | $1,000 | $1,025 |
| Bivalves (biennial 11 sites) | $45,000 | $30,000 | $30,750 | $31,519 | $32,307 | $33,114 |
| Sediment Chemistry (biennial 47 sites dry/27 wet) | $110,000 | $92,500 | $92,500 | $73,750 | $74,000 | $75,850 |
| Sediment Toxicity (biennial 27 sites dry/27 wet) | $51,000 | $25,750 | $25,750 | $26,394 | $27,054 | $27,730 |
| Sediment Benthos (biennial 27 sites dry/27 wet) | $62,000 | $30,900 | $31,673 | $32,464 | $33,276 | $34,108 |
| Fieldwork and Logistics | $214,000 | $221,000 | $217,500 | $222,938 | $228,511 | $234,224 |
| Suspended Sediment in SF Bay | $250,000 | $250,000 | $250,000 | $250,000 | $250,000 | $250,000 |
| Hydrography and Phytoplankton | $110,000 | $110,000 | $110,000 | $110,000 | $110,000 | $110,000 |
| Fish Contamination Study (triennial) | $87,000 | $0 | $0 | $54,000 | $55,350 | $56,734 |
| Cormorant Eggs (triennial) | $35,000 | $25,000 | $25,625 | $26,266 | $26,922 | $27,595 |
| Forster's Tern Eggs (triennial) | $35,000 | $25,000 | $25,625 | $26,266 | $26,922 | $27,595 |
| Archiving | $17,500 | $8,750 | $8,750 | $8,750 | $8,750 | $8,750 |
| Data Management | $250,000 | $165,000 | $165,000 | $165,000 | $165,000 | $165,000 |

Status and Trends sampling was scaled back significantly in 2012, with a change from annual to biennial sampling of water and sediment. The amount of information gained from annual sampling was diminishing, while needs for special studies to generate information on other topics were increasing. The reduction of Status and Trends effort freed up approximately $400,000 per year for studies on other topics.

# STATUS AND TRENDS

**Anticipated status and trends monitoring expenditures in the RMP from 2013 to 2019, indicating the years in which sampling will actually occur.** Projections are in 2012 dollars.

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|
| Water Chemistry (biennial 22 sites) | $0 | $55,000 | $0 | $190,000 | $0 | $55,000 | $0 | $190,000 |
| Aquatic Toxicity (every five years) | $0 | $0 | $0 | $7,000 | $0 | $0 | $0 | $0 |
| Bivalves (biennial 11 sites) | $60,000 | $0 | $60,000 | $0 | $60,000 | $0 | $60,000 | $0 |
| Sediment Chemistry (biennial 47 sites dry/27 wet) | $110,000 | $0 | $185,000 | $0 | $110,000 | $0 | $185,000 | $0 |
| Sediment Toxicity (biennial 27 sites dry/27 wet) | $51,500 | $0 | $51,500 | $0 | $51,500 | $0 | $51,500 | $0 |
| Sediment Benthos (biennial 27 sites dry/27 wet) | $61,800 | $0 | $61,800 | $0 | $61,800 | $0 | $61,800 | $0 |
| Fieldwork and Logistics | $214,000 | $221,000 | $214,000 | $221,000 | $214,000 | $221,000 | $214,000 | $221,000 |
| Fish Contamination Study (triennial) | $0 | $0 | $270,000 | $0 | $0 | $0 | $0 | $270,000 |
| Cormorant Eggs (triennial) | $75,000 | $0 | $0 | $75,000 | $0 | $0 | $75,000 | $0 |
| Forster's Tern Eggs (triennial) | $75,000 | $0 | $0 | $75,000 | $0 | $0 | $75,000 | $0 |

# PROGRAM MANAGEMENT

- Includes four general categories of activies
  - Program Management ($255,000)
    - Internal coordination (staff management), coordination with Program participants, external coordination with related groups, Program planning
  - Contract and Financial Management ($160,000)
  - Workgroup and Peer Review Coordination ($110,000)

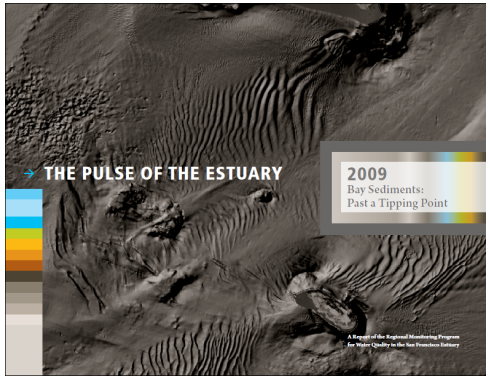
**Program Review**
Periodically, the RMP conducts an overall peer review of the Program as a whole. Two Program Reviews have been conducted to date, in 1997 and in 2003. The timing and scope of Program Reviews are determined by the Steering Committee.

- The RMP has evolved considerably since the 2003 Review, with greatly enhanced planning processes that have made the Program much more forward-looking and thoroughly peer-reviewed.
  - Workgroups have been permanently established to address the major topical areas of the Program.
  - Strategy Teams consisting of stakeholders and local scientists have been formed to identify the highest priority management questions on important topics and to formulate long-term workplans to answer them.
  - The Steering Committee has also taken a more forward-thinking approach, capturing all of the workgroup and strategy team plans in a RMP Master Plan, and in holding an annual planning workshop (beginning in 2010) to provide direction to all of the subcommittees.
  - With carefully considered guidance from stakeholders and peer reviewers, the RMP has prioritized and addressed the topics recommended in the 2003 review, and is continually sharpening its focus on using the resources that are available in an efficient manner to provide the information that is most needed to support TMDLs and other management initiatives.
- The Steering Committee does not consider a Program Review appropriate in 2013 because ongoing review of critical elements is well established. A Review will be conducted after the Master Planning process has become established and when a clear need for an overarching review becomes apparent.

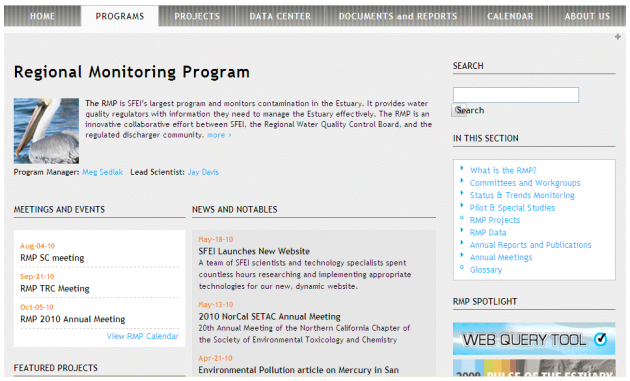
**Peer Review**
Extensive peer review is a key to the cost-effective production of reliable information in the RMP. This peer review is accomplished through the following mechanisms.

- Workgroups. The RMP Workgroups include leading scientists that work with stakeholders to develop workplans. Peer review occurs at all stages of a project: planning, implementation, and reporting.
- Technical Review Committee. Provides general technical oversight of the Program.
- Peer-reviewed Publications. Another layer of peer review occurs when journal publications are prepared. This occurs for most significant RMP studies.

# COMMUNICATIONS




- $275,000 per year (8% of the total budget).
- Includes the Pulse of the Estuary, Annual Meeting, Multi-Year Plan, State of the Estuary report card, RMP web site, Annual Monitoring Results, technical reports, journal publications, newsletter, oral presentations and posters, media outreach.
- These platforms are used to make information from the RMP available to the following target audiences.
  - Primary Audience
    - RMP Participants. Need information to encourage support for the RMP and water quality programs in the Bay. The Pulse, Annual Meeting, Multi-Year Plan, State of the Estuary report card, RMP web site, newsletter, fact sheets, oral presentations, media outreach.
  - Secondary Audiences
    - Other regional managers. Need information to inform their decisions and evaluate effectiveness of their actions. A target audience for all communication products.
    - Regional law and policy makers. Need information to encourage support for water quality programs in the Bay. The Pulse, State of the Estuary report card, media outreach.
    - Regional Scientists. Need to share information to increase understanding of water quality and maintain technical quality of the science. A target audience for all communication products.
    - Media, public outreach specialists, educators. Need information to encourage support for the RMP and water quality programs in the Bay, and to protect their health. The Pulse, Master Plan, State of the Estuary report card, RMP web site, newsletter, fact sheets, media outreach.
    - Managers and scientists from other regions.



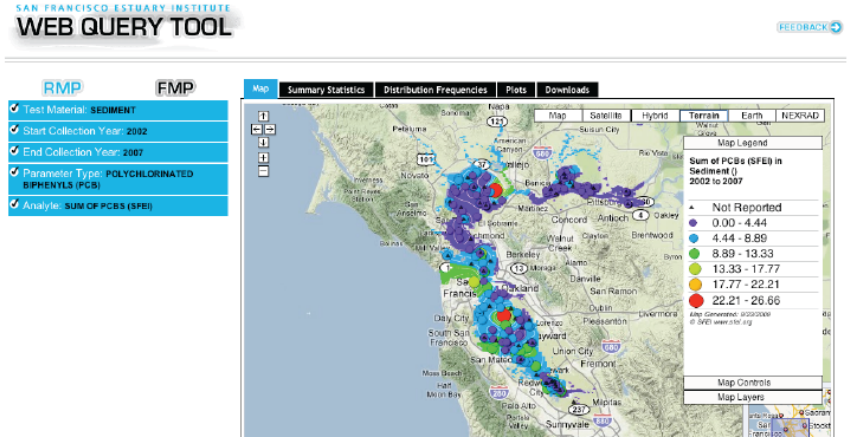

Home page for the RMP web site.

**Highlights for the Next Five Years**

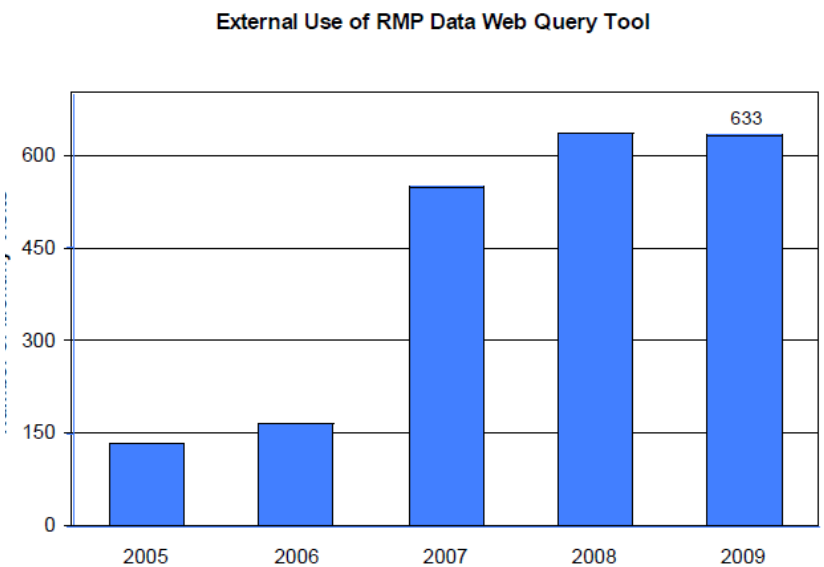
- Stakeholder information needs survey
- Pulse Lite in 2012
- Next Pulse: CECs in 2013
- Closer partnership with SFEP to reach broader audience
- Annual Meeting joint with State of the Estuary in 2013
- Workshops: Modeling, Mercury, Moderate Toxicity
- Continued web site improvement

# DATA MANAGEMENT AND QUALITY ASSURANCE

- **Data Management** ($125,000 per year)
  - The RMP database contains approximately 900,000 records generated since the Program began in 1993.
  - Includes formatting, uploading, and reporting each year's data; managing, maintaining, and improving the RMP database to enable easy access to RMP data through the RMP website; coordination with statewide data management initiatives (i.e., SWAMP and CEDEN); support for quality assurance evaluation, data analysis, and RMP report production.
  - Web-based data access tools include user-defined queries, data download and printing functionality, maps of sampling locations, and visualization tools. Through the user-defined query tool, results can be downloaded into Excel in both a cross-tabulated and flat-file format. Dynamic mapping of concentrations allows users to view spatial distributions across the Estuary, and statistical functions, such as cumulative distribution function plots, provide aggregated summaries.
  - These platforms are used to make information from the RMP available to water quality managers, stakeholders, scientists, and the public.




A data display by the RMP Web Query Tool.




633 users per month used the Web Query Tool in 2009.

- **Quality Assurance** ($30,000 per year)
  - Includes QA review of the data that are submitted by the laboratories. Development and application of the QAPP. Review in comparison to data quality objectives and prior results. Review of congener ratios.
  - Troubleshooting problems with chemical analyses.
  - Occasional special studies to assess sampling methods, analytical methods, or lab performance.

**New Initiatives for the Next Five Years**

- Efficiencies in Data Uploading and Formatting
- Enhancement of Visualization Tools
- Coordination with the Estuary Portal
- Coordination with SFEI Data Access Initiative: “Project Mario”

# RMP AND NON-RMP STUDIES RELATED TO WATER QUALITY IMPACTS OF DREDGING AND DREDGED MATERIAL DISPOSAL

## Notable Activities

- In 2011 the RMP created a web page to provide the latest information on thresholds for bioaccumulation testing and in-Bay disposal (http://www.sfei.org/content/dmmo-ambient-sediment-conditions). These thresholds are based on RMP Status & Trends data.

**Dredging related studies.** Dollar amounts in thousands.

| | Study | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| RMP Status & Trends | S&T Sediment Triad | 260 | 250 | 250 | 250 | | 250 | | 250 | |
| RMP Status & Trends | USGS Suspended Sediment Studies | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| RMP Exposure and Effects | Benthic Assessment Tools | | 30 | | 50 | | | | | |
| RMP Exposure and Effects | Causes of Sediment Toxicity: TIES | 76 | | | | | | | | |
| RMP Exposure and Effects | Causes of Sediment Toxicity: Molecular TIES | | 60 | | | | | | | |
| RMP Exposure and Effects | Causes of Sediment Toxicity: Moderate Toxicity Strategy | | | | 50 | 50 | | | | |
| RMP Exposure and Effects | New Reference Site(1), Recovery of Benthos After Dredging | | | | | 50 | | | | |
| RMP Exposure and Effects | Effects of PAHs on Flatfish | 50 | | | | | | | | |
| LTMS | Eeelgrass Buffer Zone Study(2) - proposed | | | | | | | | | |
| | | | | | | | | | | |

1 identifying a reference site for toxicity testing rather than referring to disposal sites
2 evaluating the appropriateness of the 250 foot buffer zone in effect to protect eelgrass from dredging

# RMP STUDIES SATISFYING SPECIFIC PERMIT CONDITIONS

**Industrial Wastewater Treatment Plants**

| Policy | Provision | Study |
|---|---|---|
| Mercury Watershed Permit | Better understand mercury fate, transport, the conditions under which methylation occurs, and biological uptake | Mercury Strategy Studies: Food Web Uptake (small fish), DGTs, Isotopes |
| Copper Action Plan | Investigate possible copper sediment toxicity | S&T Sediment Toxicity |
| Copper Action Plan | Investigate sublethal effects on salmonids | Effects of Copper on Salmon (NOAA) |
| | | |

# RMP STUDIES SATISFYING SPECIFIC PERMIT CONDITIONS

**Municipal Wastewater Treatment Plants**

| Policy | Provision | Study |
|---|---|---|
| Mercury Watershed Permit | Better understand mercury fate, transport, the conditions under which methylation occurs, and biological uptake | Mercury Strategy Studies: Food Web Uptake (small fish), DGTs, Isotopes |
| Copper Action Plan | Investigate possible copper sediment toxicity | S&T Sediment Toxicity |
| Copper Action Plan | Investigate sublethal effects on salmonids | Effects of Copper on Salmon (NOAA) |
| | | |

# RMP STUDIES SATISFYING SPECIFIC PERMIT CONDITIONS

**Urban Stormwater**

| Policy | Provision | Study |
|---|---|---|
| Municipal Regional Stormwater Permit (MRP) | C.8.e Pollutants of Concern and Long-Term Trends Monitoring | Small Tributary Loading Strategy (STLS) Studies |
| MRP | C.11.b. Monitor Methylmercury | STLS |
| MRP | C.11.g. Monitor Stormwater Mercury Pollutant Loads and Loads Reduced | STLS |
| MRP | C.11.h. Fate and Transport Study of Mercury in Urban Runoff | Mercury Strategy Studies (Small Fish, DGTs, Isotopes); Modeling Strategy Studies |
| MRP | C.12.g. Monitor Stormwater PCB Pollutant Loads and Loads Reduced | STLS |
| MRP | C.12.h. Fate and Transport Study of PCBs in Urban Runoff | PCBs in small fish, Modeling Strategy Studies |
| MRP | C.13.e. Studies to Reduce Copper Pollutant Impact Uncertainties | S&T Sediment Toxicity, Effects of Copper on Salmon (NOAA) |
| MRP | C.14.a. Control Program for PBDEs, Legacy Pesticides, and Selenium. | STLS |

# APPENDIX 1

| | A | B | T | U | V | W | X | Y |
|---|---|---|---|---|---|---|---|---|
| 1 | **REVENUE** | | | | | | | |
| 2 | | | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** |
| 3 | REVENUE | % budget increase: | 0.0% | 1.5% | 2.0% | 2.0% | 2.0% | 2.0% |
| 4 | | Total Participant Fees (budgeted) | $3,236,734 | $3,285,285 | $3,350,991 | $3,418,011 | $3,486,371 | $3,556,098 |
| 5 | | Additional Revenue | $0 | $0 | $0 | $0 | $0 | $0 |
| 6 | | Interest Income (estimated) | $12,000 | $12,000 | $25,000 | $25,000 | $25,000 | $25,000 |
| 7 | | | | | | | | |
| 8 | | Contingency Fund carryover | $50,000 | $25,000 | $25,000 | $25,000 | $25,000 | $25,000 |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | **TOTAL AVAILABLE** | **$3,298,734** | **$3,322,285** | **$3,400,991** | **$3,468,011** | **$3,536,371** | **$3,606,098** |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | **EXPENSES** | | | | | | | |
| 15 | | | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** |
| 16 | | % increase labor | 4.0% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% |
| 17 | PROG MGT | **Program Management** | **$1,136,800** | **$1,160,845** | **$1,189,612** | **$1,219,094** | **$1,249,307** | **$1,280,271** |
| 18 | | Labor Total | $1,005,000 | $1,025,750 | $1,051,140 | $1,077,160 | $1,103,825 | $1,131,151 |
| 19 | | Program Management, Contracts, Meetings | $525,000 | $538,125 | $551,578 | $565,368 | $579,502 | $593,989 |
| 20 | | Data Management and QA | $155,000 | $155,000 | $158,875 | $162,847 | $166,918 | $171,091 |
| 21 | | Communications | $275,000 | $281,875 | $288,922 | $296,145 | $303,549 | $311,137 |
| 22 | | Contingency | $50,000 | $50,750 | $51,765 | $52,800 | $53,856 | $54,933 |
| 23 | | Program Review | | | | | | |
| 24 | | Direct Costs (Program only) | $131,800 | $135,095 | $138,472 | $141,934 | $145,483 | $149,120 |
| 25 | | | | | | | | |
| 26 | | | | | | | | |
| 27 | | | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** |
| 28 | | **Total Available for S&T and Special** | **$2,161,934** | **$2,161,440** | **$2,211,378** | **$2,248,917** | **$2,287,064** | **$2,325,828** |
| 29 | | **Total Planned for S&T and Special** | $2,302,000 | $2,047,900 | $1,809,273 | $1,415,598 | $1,115,598 | $1,100,342 |
| 30 | | | | | | | | |
| 31 | | | $1,421,500 | $1,222,900 | $1,228,148 | $1,278,445 | $1,267,260 | $1,285,597 |
| 32 | | | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** |
| 33 | | % increase subcontractors | 0.0% | 2.5% | 2.5% | 2.5% | 2.5% | 2.5% |
| 34 | STATUS AND TRENDS | **STATUS AND TRENDS TOTAL** | **$1,266,500** | **$1,067,900** | **$1,069,273** | **$1,115,598** | **$1,100,342** | **$1,114,506** |
| 35 | | Water Chemistry (biennial 22 sites) | | $81,667 | $83,708 | $85,801 | $61,250 | $62,781 |
| 36 | | Aquatic Toxicity (every five years) | | $2,333 | $2,392 | $2,451 | $1,000 | $1,025 |
| 37 | | Bivalves (biennial 11 sites) | $45,000 | $30,000 | $30,750 | $31,519 | $32,307 | $33,114 |
| 38 | | Sediment Chemistry (biennial 47 sites dry/27 wet) | $110,000 | $92,500 | $92,500 | $73,750 | $74,000 | $75,850 |
| 39 | | Sediment Toxicity (biennial 27 sites dry/27 wet) | $51,000 | $25,750 | $25,750 | $26,394 | $27,054 | $27,730 |
| 40 | | Sediment Benthos (biennial 27 sites dry/27 wet) | $62,000 | $30,900 | $31,673 | $32,464 | $33,276 | $34,108 |
| 41 | | Fieldwork and Logistics | $214,000 | $221,000 | $217,500 | $222,938 | $228,511 | $234,224 |
| 42 | | Suspended Sediment in SF Bay | $250,000 | $250,000 | $250,000 | $250,000 | $250,000 | $250,000 |
| 43 | | Hydrography and Phytoplankton | $110,000 | $110,000 | $110,000 | $110,000 | $110,000 | $110,000 |
| 44 | | Fish Contamination Study (triennial) | $87,000 | $0 | $0 | $54,000 | $55,350 | $56,734 |
| 45 | | Cormorant Eggs (triennial) | $35,000 | $25,000 | $25,625 | $26,266 | $26,922 | $27,595 |
| 46 | | Forster's Tern Eggs (triennial) | $35,000 | $25,000 | $25,625 | $26,266 | $26,922 | $27,595 |
| 47 | | Archiving | $17,500 | $8,750 | $8,750 | $8,750 | $8,750 | $8,750 |
| 48 | | Data Management | $250,000 | $165,000 | $165,000 | $165,000 | $165,000 | $165,000 |
| 49 | | | | | | | | |
| 50 | | | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** |
| 51 | | **Total Available for Special Studies** | **$895,434** | **$1,093,540** | **$1,142,106** | **$1,133,319** | **$1,171,465** | **$1,225,486** |
| 52 | | **Unencumbered** | **-$140,066** | **$113,540** | **$402,106** | **$833,319** | **$1,171,465** | **$1,225,486** |
| 53 | | | | | | | | |
| 54 | | | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** |
| 55 | SPECIAL STUDY AREAS | **SPECIAL STUDIES TOTAL** | **$1,035,500** | **$980,000** | **$740,000** | **$300,000** | **$0** | **$0** |
| 56 | | **Mercury** | $25,000 | $0 | $0 | $0 | $0 | $0 |
| 57 | | **PCBs** | $0 | $0 | $0 | $0 | $0 | $0 |
| 58 | | **Dioxins** | $95,500 | $0 | $40,000 | $0 | $0 | $0 |
| 59 | | **Emerging Contaminants** | $117,000 | $100,000 | $0 | $0 | $0 | $0 |
| 60 | | **Small Tributaries** | $428,000 | $450,000 | $300,000 | $300,000 | $0 | $0 |
| 61 | | **Other SPL** | $0 | $0 | $0 | $0 | $0 | $0 |
| 62 | | **Exposure and Effects** | $130,000 | $100,000 | $0 | $0 | $0 | $0 |
| 63 | | **Forecasting** | $100,000 | $100,000 | $100,000 | $0 | $0 | $0 |
| 64 | | **Nutrients** | $140,000 | $230,000 | $300,000 | $0 | $0 | $0 |