REGIONAL MONITORING PROGRAM FOR WATER QUALITY IN SAN FRANCISCO BAY

MULTI-YEAR PLAN

2015 ANNUAL UPDATE

FINAL: January 2015

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 21 years has been a successful and effective partnership of regulatory agencies and the regulated community.

The goal of the RMP is to collect data and communicate information about water quality in San Francisco Bay in support of management decisions.

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 (Figure 1).

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.

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 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.

Figure 1. Collaboration and adaptation in the RMP are achieved through the engagement of stakeholders and scientists in frequent committee and workgroup meetings.

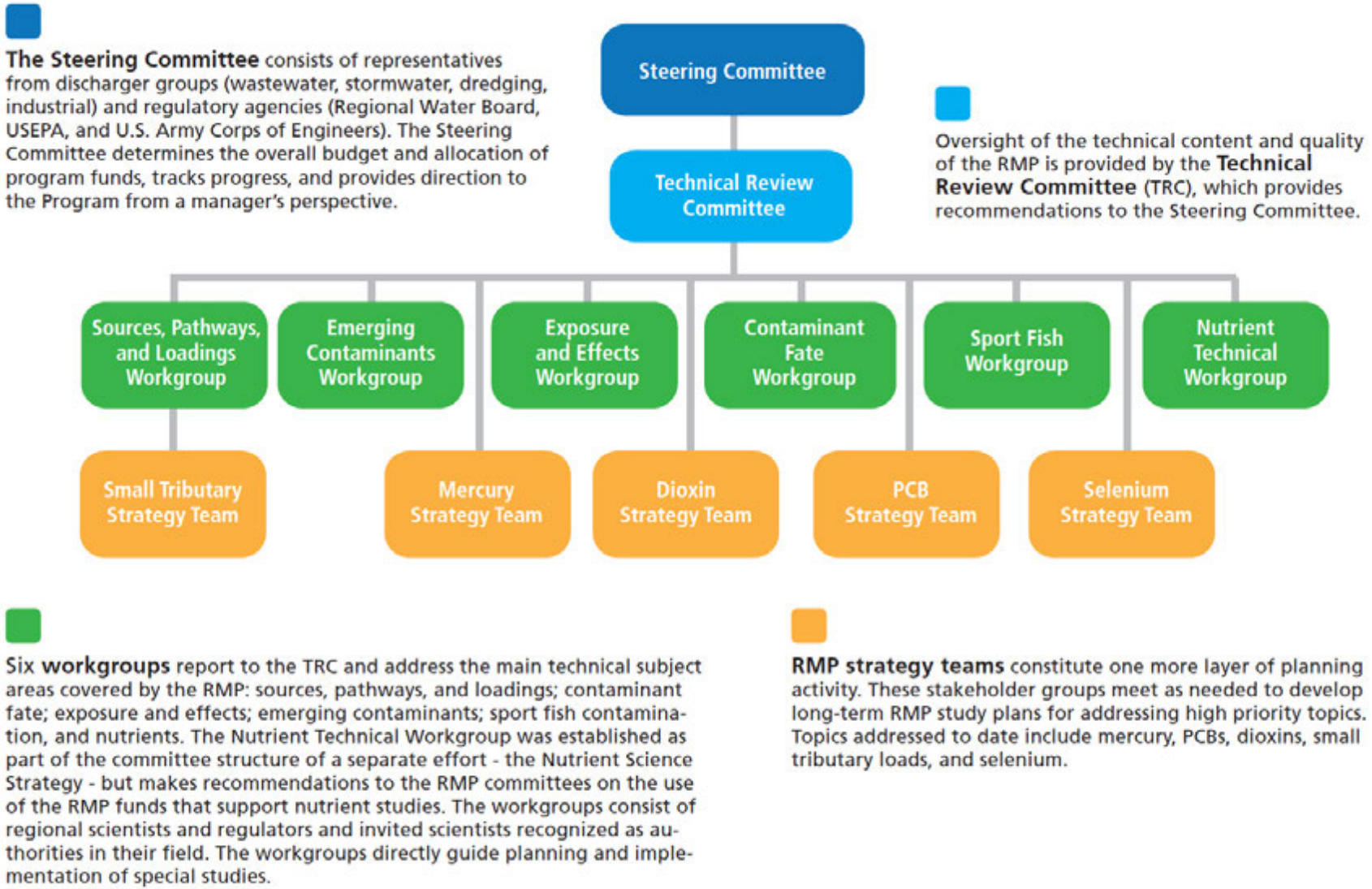


Figure 2. Science in support of water quality management.

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 often conducted to 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 Phil Trowbridge (philt@sfei.org) with questions or suggestions for improving this document.

Figure 3. Annual planning calendar for the Steering Committee.

Annual Steering Committee Calendar

- January
  - Approval of Multi-Year Plan
  - Review of incomplete projects from the previous year
- 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
  - Approval of Pulse outline for next year
  - Decision on workshops to be held 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

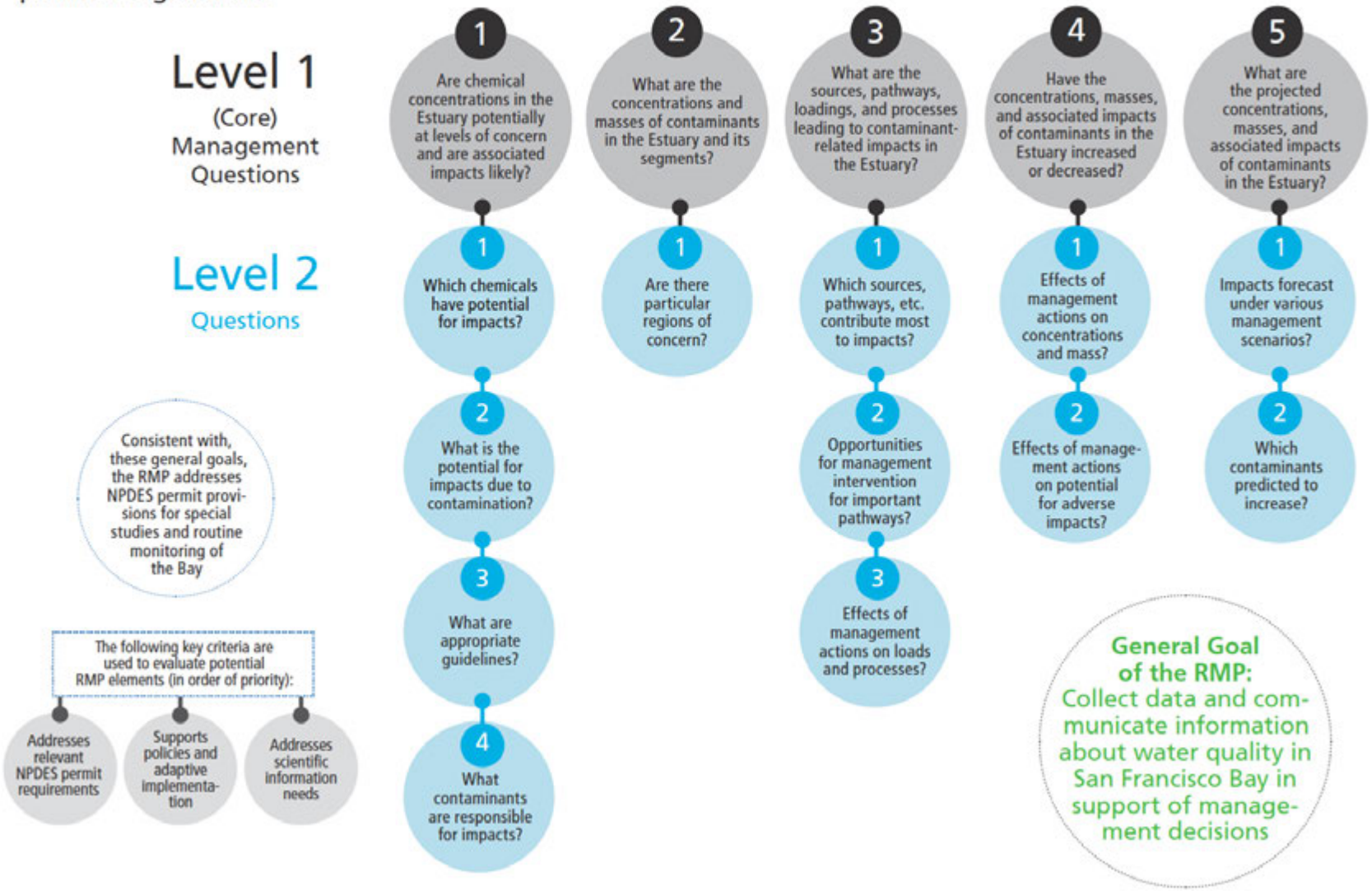
Decisions, Policies, and Actions	Timing
ONGOING AND EXISTING	
Determination of Reasonable Potential and Permit Limits	Ongoing
Long-Term Management Strategy for Placement of Dredged Material/Dredged Material Management Office Regional Sediment Management Strategy	Ongoing
Dredging Permits Bioaccumulation testing triggers and in-Bay disposal levels	Annual
303(d) List and 305(b) Report	2016, 2022
Copper Compare levels to site specific objectives triggers Evaluation of the site-specific objectives	 Annual Triennial (2015)
Cyanide Compare levels to site specific objectives triggers Evaluation of the site-specific objectives	 Annual Triennial (2015)
Selenium North Bay Selenium TMDL EPA Water Quality Criteria South Bay Selenium TMDL	 2015 2016 >2016
Dioxins Review 303(d) listings and establish TMDL development plan or alternative	2018
Mercury Review existing TMDL and establish plan to revise*	2018
PCBs Review existing TMDL and establish plan to revise*	2020

Decisions, Policies, and Actions	Timing
NEW AND FUTURE	
Nutrients Nutrient Management Strategy Nutrient Water Quality Objective	 Ongoing 2024
Legacy Pesticides (DDT, Dieldrin, Chlordane) Review 303(d) listings and delist, establish TMDL development plan or alternative	2016
Pathogens Bay Beaches Bacteria TMDL	2015
Sediment Quality Objectives and Hot Spots Review 303(d) listings and establish TMDL development plan or alternative	2016
Chemicals of Emerging Concern Review of RMP strategy	Annual
Toxicity New state plan on effluent and receiving water toxicity	2015
BAY WATERSHED PERMITS	
Municipal Regional Stormwater Permit	2015, 2020*
Mercury and PCBs Watershed Permit for Municipal and Industrial Wastewater	2017
Nutrient Watershed Permit for Municipal Wastewater	2019

* The schedules for revising the Mercury and PCB TMDLs coincide with the schedule for reissuing the Municipal Regional Stormwater Permit.

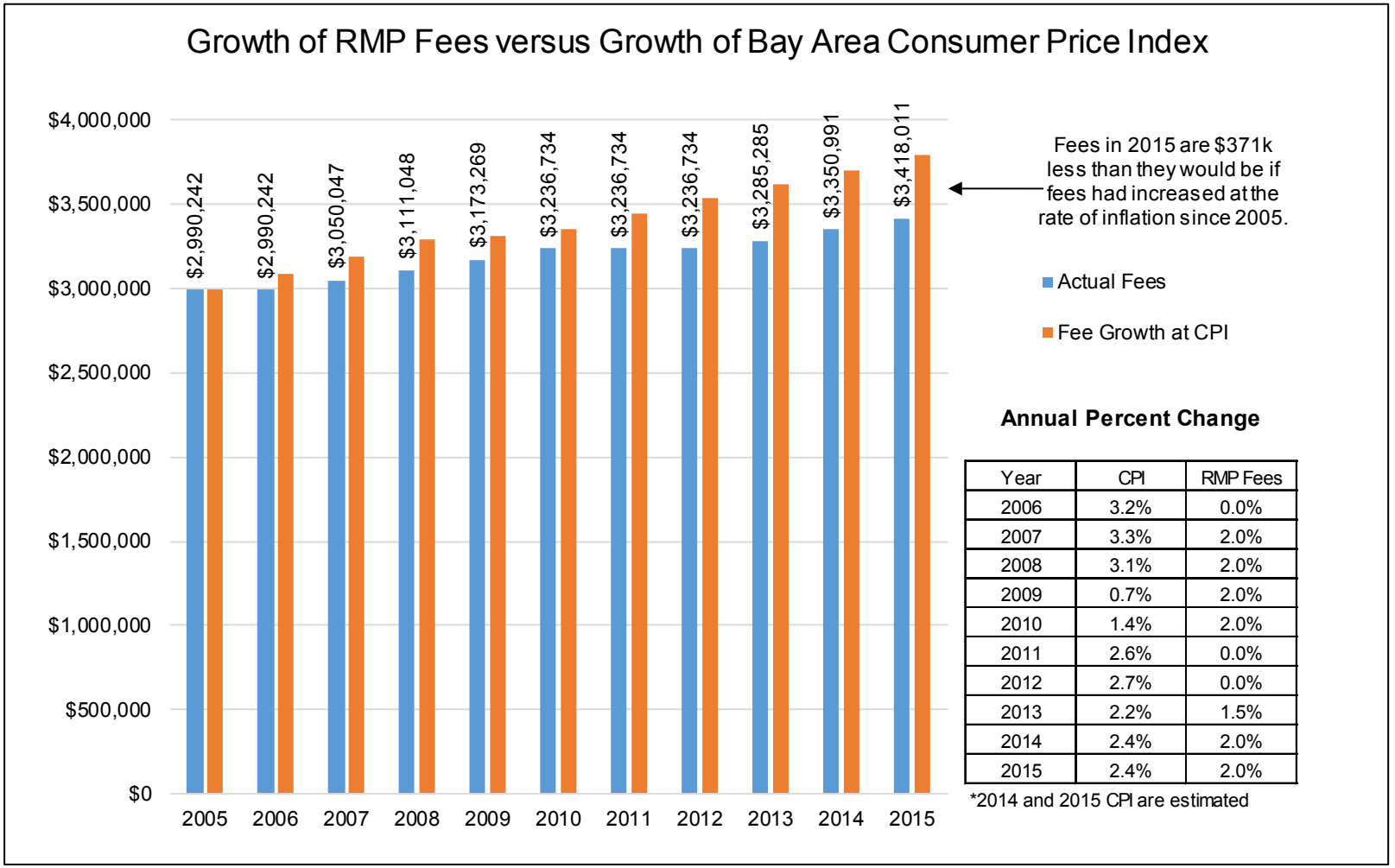
RMP GOAL AND MANAGEMENT QUESTIONS

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.



BUDGET: Revenue by Year

RMP fees in 2015 are $3.418 Million. The schedule for fee increases is set by the Steering Committee every three years. Between 2005 and 2015, the RMP fees have grown at an annual average rate of 1.3%, which is slower than inflation (2.4% for 2005-2013).



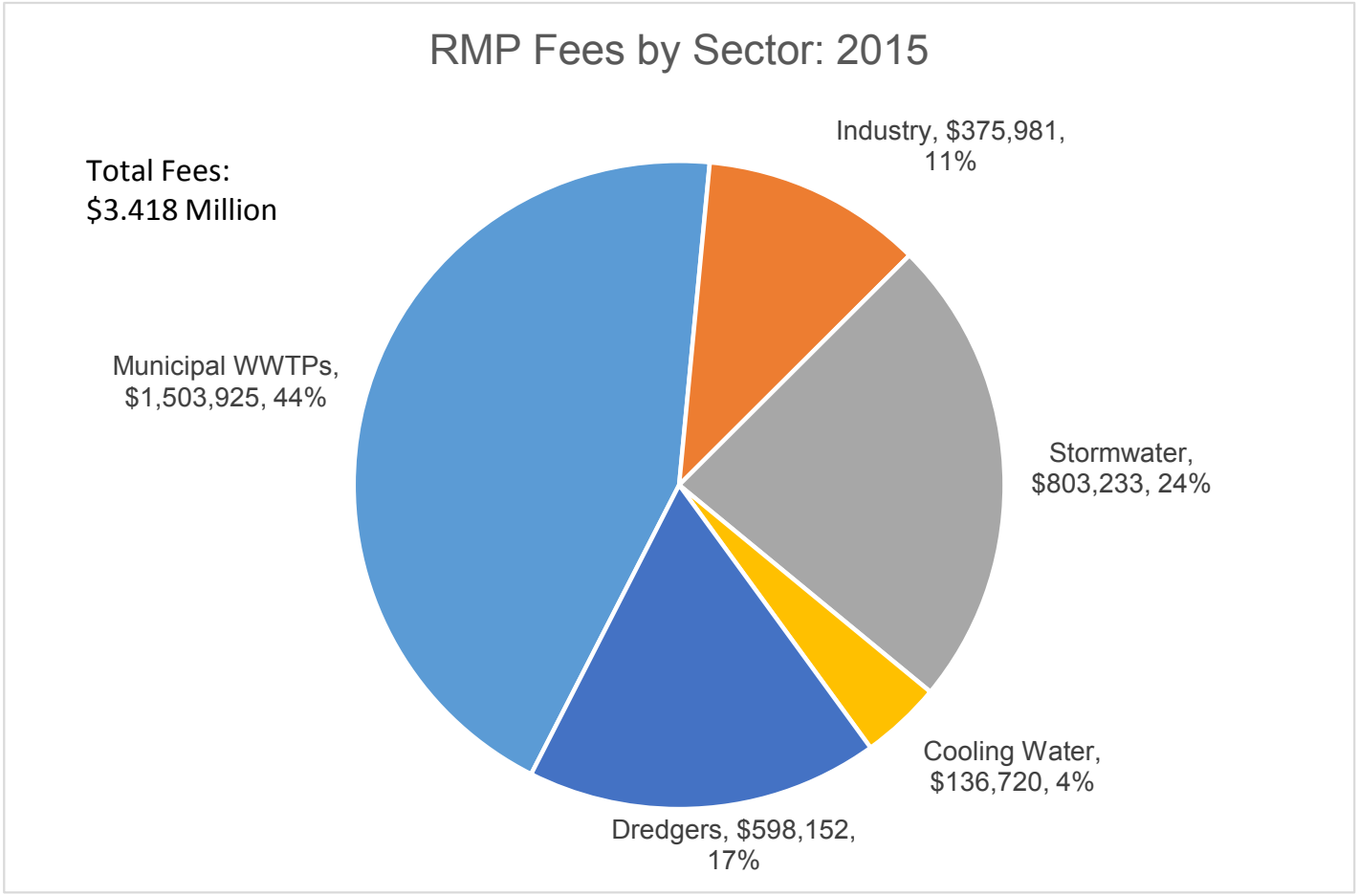
Annual Percent Change

Year	CPI	RMP Fees
2006	3.2%	0.0%
2007	3.3%	2.0%
2008	3.1%	2.0%
2009	0.7%	2.0%
2010	1.4%	2.0%
2011	2.6%	0.0%
2012	2.7%	0.0%
2013	2.2%	1.5%
2014	2.4%	2.0%
2015	2.4%	2.0%

*2014 and 2015 CPI are estimated

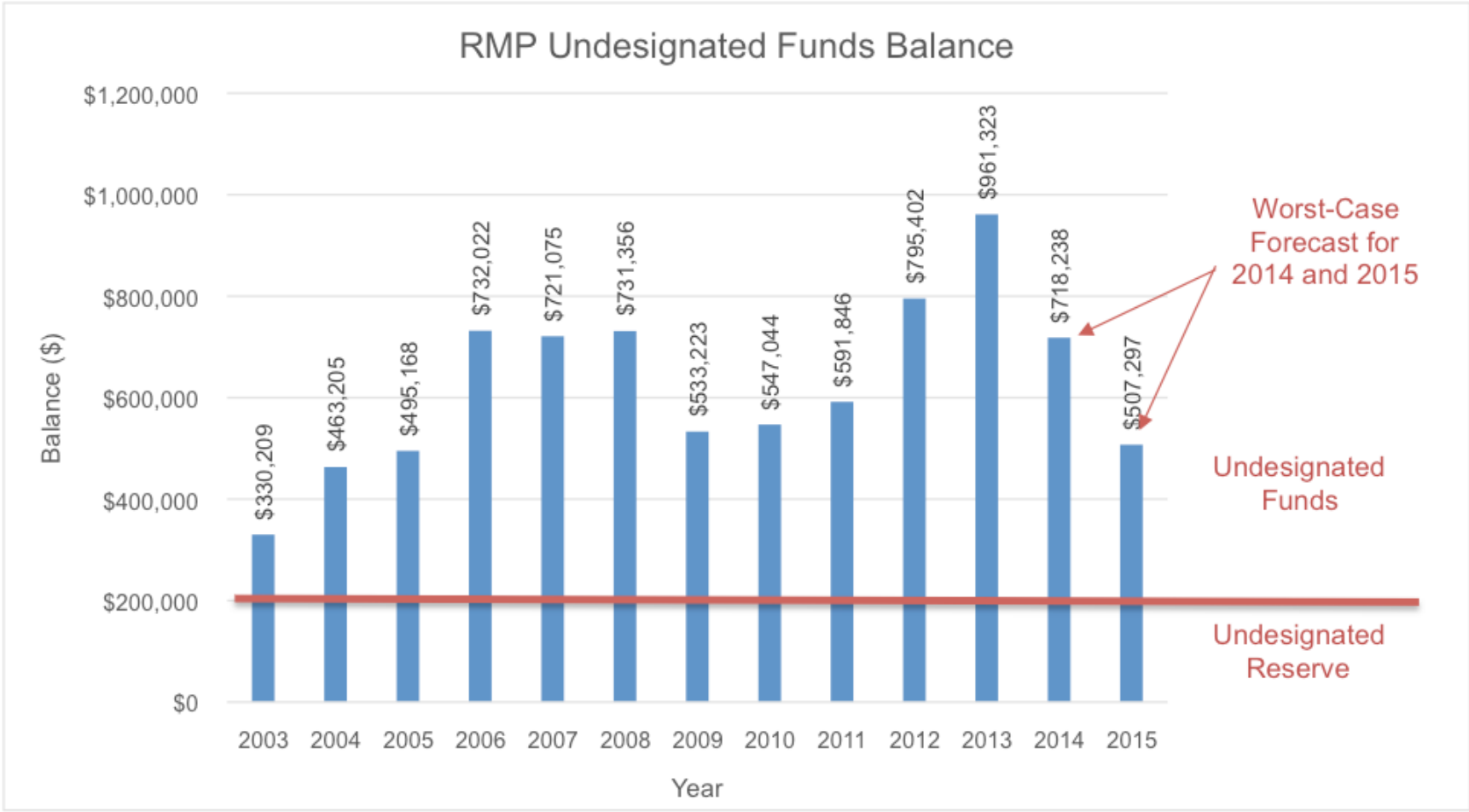
BUDGET: Revenue by Sector

The RMP fees are divided among five major discharger groups. Municipal wastewater treatment plants are the largest contributor (44%), stormwater agencies are the second largest contributor (24%). The contribution from dredgers includes $250,000 from the U.S. Army Corps of Engineers. Refineries constitute the majority of the industrial sector, and also contribute to the program due to dredging activities at their facilities.



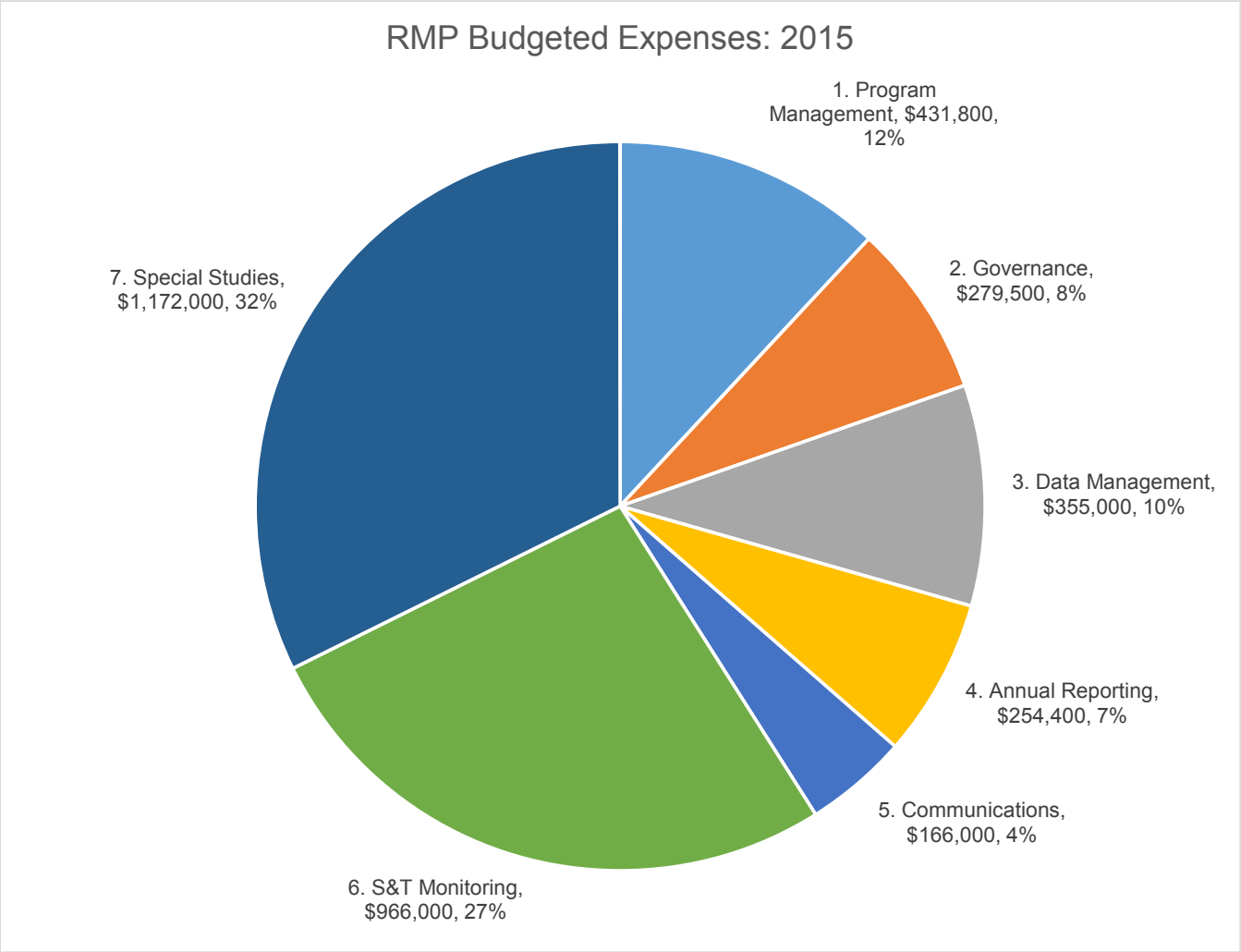
BUDGET: Reserve Funds

The RMP maintains a balance of Undesignated Funds for contingencies. Higher than anticipated revenues and elimination or reduction of lower priority elements sometimes leads to accumulation of funds that can be used for high priority topics at the discretion of the Steering Committee. It is the policy of the RMP to maintain a minimum balance of $200,000 of the Undesignated Funds as a reserve for unanticipated urgent priorities.



BUDGET: Budgeted Expenses

The budget for the RMP reflects the priorities of the program. Fifty-nine percent of the expenses are for monitoring and special studies. Reporting results and properly archiving data comprise 11% and 10% of the budget, respectively. Governance meetings (8%) are critical to ensure that RMP is addressing stakeholder needs. Finally, 12% of the budget is needed for program management, including fiduciary oversight of contracts and expenditures.



COORDINATION WITH OTHER ORGANIZATIONS AND PROGRAMS

Small Tributary Loads
- MRP cities, counties, and districts
- San Francisco Bay Water Board
- San Francisco Estuary Institute

Nutrients
- U.S. Geological Survey
- State Water Board
- San Francisco Bay Water Board
- Bay Area Clean Water Agencies
- Central Contra Costa Sanitation District
- Interagency Ecological Program
- State and Federal Contractors Water Agency
- San Francisco Estuary Institute

Forecasting
- U.S. Geological Survey
- Bay Area Clean Water Agencies
- San Francisco Estuary Institute

Emerging Contaminants
- State Water Board
- San Francisco Bay Water Board
- National Oceanic and Atmospheric Administration
- Southern California Coastal Water Research Project
- San Francisco Estuary Institute

Legacy Contaminants
- State Water Board (SWAMP)
- San Francisco Bay Water Board
- San Francisco Estuary Institute

Exposure and Effects
- State Water Board
- San Francisco Bay Water Board
- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- Bay Planning Coalition
- National Oceanic and Atmospheric Administration
- Southern California Coastal Water Research Project
- U.S. Geological Survey
- San Francisco Estuary Institute

Status and Trends
- U.S. Geological Survey
- State Water Board (SWAMP)
- San Francisco Bay Water Board
- Interagency Ecological Program
- San Francisco Estuary Institute

Communication
- San Francisco Estuary Partnership
- California Water Quality Monitoring Council
- San Francisco Estuary Institute

Data Management
- State Water Board (CEDEN)
- San Francisco Estuary Institute

RMP SPECIAL STUDIES: 2013-2018

RMP expenditures on special study topics. Figures for 2013-2015 are actual amounts. Figures for 2016 and beyond are estimates for planning.

	ACTUAL BUDGETS			ESTIMATED BUDGETS		
	2013	**2014**	**2015**	**2016**	**2017**	**2018**
SPECIAL STUDIES TOTAL	**$1,228,000**	**$1,353,000**	**$1,172,000**	**$1,348,000**	**$1,373,000**	**$1,353,000**
Mercury	$0	$0	$0	$0	$0	$0
PCBs	$0	$0	$85,000	$120,000	$180,000	$160,000
Dioxins	$0	$24,000	$0	$40,000	$0	$0
Emerging Contaminants	$141,000	$209,000	$84,000	$100,000	$100,000	$100,000
Small Tributaries*	$468,000	$487,000	$470,000	$500,000	$500,000	$500,000
Other SPL	$0	$0	$0	$0	$0	$0
Exposure and Effects	$114,000	$80,000	$0	$45,000	$0	$0
Forecasting	$100,000	$0	$0	$0	$0	$0
Selenium		$33,000	$63,000	$43,000	$93,000	$93,000
Nutrients*	$405,000	$520,000	$470,000	$500,000	$500,000	$500,000

*The estimated RMP budgets on this table do not cover all of the research needs for the Nutrients Management Strategy and Small Tributary Loading Strategy. Research for these strategies is partially supported by additional funds from other sources.

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

Nutrient synthesis and monitoring, and **forecasting** of future scenarios for nutrients are high priorities. Characterization of **small tributary loads** of pollutant remains a high priority. Screening for and improving tools for monitoring **emerging contaminants** is also a continuing priority.

SMALL TRIBUTARY LOADING

Relevant Management Policies and Decisions

- Refining pollutant loading estimates for future TMDLs and management decisions, including TMDL updates.
- Provisions of the current and future versions of the Municipal Regional Stormwater Permit (MRP).
- Identifying small tributaries to prioritize for management actions.
- Informing decisions on the best management actions for reducing concentrations and loads.

Water quality sampling device in the North Richmond Pump Station. Photograph by Lester McKee.

Recent Noteworthy Findings

- Small tributaries are the dominant loading pathway for suspended sediment, PCBs, and mercury.
- PCB and mercury loads in stormwater are primarily associated with large storms and transport of suspended sediment particles.
- Greater PCB and mercury concentrations are associated with older urban and industrial land uses.
- PCB concentrations vary more widely in stormwater and soils relative to mercury because PCB uses were historically more localized and mercury more readily cycles to and from the atmosphere.
- Based on data collected at 24 locations so far, primarily using RMP funding, PCB concentrations on particles in stormwater are greatest in the watersheds of Pulgas Creek Pump Station (North and South), Santa Fe Channel and Ettie Street Pump Station. In addition, several samples indicate sources in the Sunnyvale East Channel watershed. This dataset is being collected as a primary indicator of pollution sources and will continue to grow each year.
- Stormwater agencies are pursuing PCB mitigation efforts in five pilot drainage areas in the cities of Richmond (Lauritzen and Parr Channels), Oakland (Ettie Street Pump Station), San Jose (Leo Avenue), and San Carlos (Pulgas Creek).
- The next MRP will continue to focus on reducing PCB loads in urban stormwater.

Note:
"Small tributary" refers to the rivers, creeks, and storm drains that enter the Bay

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, and where should management actions be implemented in the region to have the greatest impact?

SMALL TRIBUTARIES LOADING STRATEGY

Screening to identify high-leverage watersheds will be the major emphasis for the next several years. This work will be closely coordinated with and substantially augmented by MRP monitoring.

Small tributaries loading studies in the RMP from 2013 to 2018. Numbers indicate budget allocations in $1000s.

Funder	Task Description		2013	2014	2015	2016	2017	2018
RMP	**Coordination and management**		20	25	26	26	26	26
	Regional Watershed Spreadsheet Model							
RMP	Phase I – Water, Sediment, PCBs and Mercury		25	30	35	35	35	35
BASMAA	Phase I – Sediment			(32)				
RMP	Phase II – Other Pollutants of Concern							
BASMAA	Phase II– PBDE, DDT, chlordane, dieldrin			(20)				
RMP	Phase III – Periodic Updates							
RMP	**Source Area Monitoring / EMC Development**		80	80				
	Small Tributaries Monitoring							
RMP	Monitor Two Representative Small Tributaries		343	352				
BASMAA	Monitor Two to Four Representative Small Tributaries or Sites Downstream of Management Actions		(480)	(480)				
BASMAA	Lab Analyses, Quality Assurance, Data Management		(320)	(320)				
BASMAA	**Data Analysis, Communications, Administration**		(85)					
RMP	Watershed Screening				374	374	374	374
RMP	Trends Strategy				35	35	35	35
RMP Total			**468**	**487**	**470**	**470**	**470**	**470**
BASMAA Total			**885**		TBD	TBD	TBD	TBD
		TOTAL	**1,403**		TBD	TBD	TBD	TBD

NUTRIENTS

Relevant Management Policies and Decisions

- Nutrient numeric endpoints and assessment framework
- Evaluate need for revised objectives for dissolved oxygen (DO) and ammonia/ammonium
- Water quality assessment – impairment status
- NPDES permits (e.g., POTW, MRP) - ongoing

Recent Noteworthy Findings

- Several lines of evidence suggest that San Francisco Bay's resistance to the harmful effects of nutrient enrichment is weakening.
- Since the late 1990s, regions of the Bay have experienced significant increases in phytoplankton biomass (30-105% from Suisun to South Bay). Data from the last 3-4 years suggest biomass levels may be leveling off in South Bay.
- Observed biomass increases could be related to one or more factors, including: higher light levels from declining suspended sediments in the Bay and decreases in benthic grazers.
- Continuous sensor measurements at Dumbarton Bridge showed that DO concentration varies substantially with tides, with minimum DO occurring at lowest tide. During some periods, chlorophyll also showed strong tidal variations, with peaks at low tide.
- While DO in deep subtidal areas is typically above 5 mg/L, analysis of data in sloughs and creeks south of Dumbarton Bridge suggest that DO < 5 mg/L is a common occurrence at some sites.
- Although treated wastewater effluent is the greatest source of nitrogen and phosphorus south of the Bay Bridge, effluent loads to Suisun Bay are smaller than Delta loads to Suisun Bay.
- The phycotoxins (toxins produced by phytoplankton) domoic acid and microcystin are detected throughout the Bay.
  - Recent reports confirm a continued need for long-term status and trends monitoring of nutrients, and the need for greater effort directed toward phytoplankton composition, phycotoxins, high frequency measurements, and monitoring in Bay margins and sloughs.

i Video available in eBook edition: up14.sfei.org/26

Inspecting the continuous monitoring probe in Alviso Slough. Photograph by April Robinson.

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 the Bay impaired by any form of nutrients?
   c. Are trends spatially the same or different in the segments of the Bay?
2. What are appropriate guidelines for assessing the 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, urban stormwater runoff, non-point sources, etc.) to the Bay overall and the Bay's key sub-systems, and how do these loads vary seasonally?
   b. What is the contribution of nutrient regeneration (benthic fluxes) from sediments and denitrification/nitrogen fixation to 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 BACWA, RMP, USGS, the State and Regional Boards, and hopefully others. Funding and oversight are provided by these multiple organizations through the Nutrient Strategy Steering Committee. Multiagency collaboration is essential to address the information needs for nutrients in the Bay.

Nutrient studies in the Bay from 2011 to 2018. Numbers indicate budget allocations in $1000s.

Tasks	Funding Agency	Questions Addressed	2011	2012	2013	2014	2015	2016	2017	2018
RMP-funded tasks										
Program coordination	RMP	*1-5*	20	10	20	20				
Monitoring/special studies: moored sensors	RMP	*1*			200	215	190			
Monitoring/special studies: algal biotoxins	RMP	*1*			65					
Monitoring/special studies: stormwater loads	RMP	*3*		30	40	35				
Monitoring/special studies: monitoring program development	RMP	*1,3*				50				
Modeling[1]	RMP	*4,5*		100	100	200	165			
Synthesis: conceptual model report	RMP	*1-5*		80	50					
Synthesis: nutrient loads and data gaps	RMP	*3*		20	30					
General allocation (exact projects TBD)	RMP						115	500	500	500
RMP S&T ship-based monitoring (USGS, Cloern)	RMP	*1,3*	110	110	110	172	172	172+?	172+?	172+?
SUBTOTALS	**RMP S&T Monitoring**		**110**	**110**	**110**	**172**	**172**	**172+?**	**172+?**	**172+?**
	RMP Nutrients Studies		**20**	**240**	**505**	**520**	**470**	**500**	**500**	**500**
BACWA-funded tasks										
Program coordination	BACWA	*1-5*	10	135	135	75	100[2]			
Science plan development	BACWA	*1-5*			15	15				
Monitoring/special studies: ship-based sampling	BACWA	*1*					75[2]			
Monitoring/special studies: moored sensor	BACWA	*1*			75	75	150[2]			
Monitoring/special studies: POTW and refinery effluent characterization[3]	Dischargers, BACWA	*3*		200	315	200				
Monitoring/special studies: algal toxins	BACWA	*1*					175[2]			
Monitoring/special studies: phytoplankton composition	BACWA	*1*			60	60				
Monitoring/special studies: monitoring program development	BACWA	*1,3*			35	40	80[2]			
Synthesis: Suisun Bay, Lower South Bay, other	BACWA	*1,3*		100	100	150				
General allocation (exact projects TBD)	BACWA						285[2]	880[2]	880[2]	880[2]
SUBTOTALS		***BACWA Total***	**10**	**435**	**735**	**615**	**865[2,4]**	**880[2,4]**	**880[2,4]**	**880[2,4]**

Tasks	Funding Agency	Questions Addressed	2011	2012	2013	2014	2015	2016	2017	2018
Other funding sources[5]										
Program coordination	SWRCB	*1-5*	15	5						
Science plan development	SFBRWQCB	*1-5*				100				
Monitoring: program development	SWRCB	*1,3*		10	20	20				
Delta loads to Suisun	DWR-EMP	*3*			90	90				
Grand total										
RMP, BACWA and other funding sources			**145**	**800**	**1,460**	**1,517**	**1,507**	**1,552 + ?**	**1,552 + ?**	**1,552 + ?**

[1] Originally allocated as a combined proposal with RMP Forecasting Strategy

[2] Bay-wide nutrient permit funding. The Bay-wide Nutrient Permit funds ($880k/yr) are being directed toward nutrient science studies in the Bay. The intent is for these funds to be combined with funds from the RMP and other entities, and that the Nutrient Management Strategy Steering Committee will make decisions about how to allocate funds, based on recommendations in a Science Plan, which is under development. Therefore, other than total anticipated funds requested from the RMP, the specific categories are not identified here.

[3] Non-BACWA dischargers (i.e. refineries) also contributed to effluent characterization, but all data interpretation was BACWA-funded (15k in 2013, unspecified amount in 2014)

[4]Indicates fiscal year

[5]This table only lists contributions from other funding sources for projects that SFEI is directly involved in. There are additional efforts by numerous agencies (USGS, DWR-EMP, SFCWA, SFBRWQCB, SWRCB) that directly or indirectly support the Nutrient Management Strategy, but are not included here for simplicity

TBD = To be determined.

EMERGING CONTAMINANTS

Video available in eBook edition: up14.sfei.org/28

Harbor seal sampling. Conducted under NOAA-NMFS permit number 16991. Photograph by Linda Wanczyk.

Relevant Management Policies and Decisions

- Support for early management intervention, including recommendations for green chemistry and pollution prevention
- Narrative water quality objectives for toxicity, bioaccumulation, and aquatic organisms population and community ecology

Recent Noteworthy Findings

- In 2013, the RMP published both a summary of the current state of knowledge on emerging contaminants in the Bay and a strategy for future investigations.
- Synthesis of a decade of Bay PBDE monitoring data indicates levels have declined in biota and sediment following nationwide phase-outs and state bans of these toxic and persistent flame retardant chemicals.
- A study to screen Bay wildlife for emerging contaminants with an analytical technique that allows detection of a broad spectrum of contaminants, rather than just those that are on a pre-defined list of target chemicals, detected seven chemicals of potential interest. Levels of these newly identified contaminants were significantly lower than those for legacy contaminants of concern, such as PCBs.
- Special studies of perfluorochemicals (PFCs), including toxic compounds once used in the manufacture of Scotchgard, Teflon, and other surface coatings, revealed new details about these contaminants. Bay harbor seals have unusually high levels of perfluorooctane sulfonate (PFOS), despite a nationwide phase-out in 2002. Cormorant egg PFOS levels measured in 2012 were one-third lower than levels measured in 2006 and 2009. New toxicity data suggest that these levels may still be harmful to birds. Analyses of treated wastewater and Bay sediment have uncovered the presence of many different PFCs, including so-called "precursor" chemicals that may degrade to form PFOS or other potentially toxic and persistent PFCs.
- Fipronil, a broad-spectrum insecticide of particular concern due in part to growing urban uses, has been detected in Bay stormwater and sediment. Observed concentrations of fipronil and its degradation products in sediment have exceeded effect thresholds on occasion, suggesting these compounds may pose risks to Bay aquatic life. In 2013, fipronil and its degradation products were not detected in Bay ambient water samples.
- Siloxanes, found in cleaning solvents and personal care products, were detected at low levels in bivalves from all 11 Bay sites sampled. Concentrations were highest in Central Bay samples. Siloxane levels are unlikely to be a concern for humans consuming Bay shellfish

Priority Questions for the Next Five Years

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

EMERGING CONTAMINANTS

Emerging contaminant studies in the RMP have been augmented substantially by coordination and pro bono work. Monitoring of two high priority CECs (PFOS and fipronil) in wastewater is a highlight for 2015.

Emerging contaminant studies and monitoring in the RMP from 2008 to 2018. 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 Address-ed	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Perfluorinated Compounds	1	35	52			87		26				
Alternative Flame Retardants	1	48						107				
Chlorinated Paraffins in Biota (CDFO)	1	0 (5)										
Triclosan in Sediment (USEPA)	1	0 (5)										
CECs in Wastewater	1		30						55			
Nonylphenol in Small Fish (Cal Poly)	1		0 (2)									
AXYS Brominated Dioxins in Sediments and Biota (AXYS)	1			0(18)								
Broadscan Screening of Biota for EC (NIST, SCCWRP, MMC, SDSU)	1			55 (75)	70 (75)							
AXYS Mussel Study (AXYS)	1			27 (33)								
NOAA Mussel Pilot Study (NOAA, SCCWRP, SWRCB)	1			33 (50)								
EC Synthesis, Strategy Development	1				30	30	20	20	20	20	20	20
Bioanalytical Tools	1						70	56				
PBDE Synthesis	1						36					
Current Use Pesticides	1						15			55		
EC Strategy Implementation	1											
Nanoparticles (Duke Univ.)	1			0 (5)								
Microplastics	1								9			
General Allocation	1									25	80	80
RMP Total		**83**	**82**	**115**	**100**	**117**	**141**	**209**	**84**	**100**	**100**	**100**
Non-RMP Total		**10**	**2**	**176**	**75**	**0**	**0**	**0**	**TBD**	**TBD**	**TBD**	**TBD**
Overall Total		**93**	**84**	**291**	**175**	**117**	**141**	**209**	**TBD**	**TBD**	**TBD**	**TBD**

Gray cells – further work on this topic not anticipated
Possibilities: additional work on flame retardants, broadscan followup

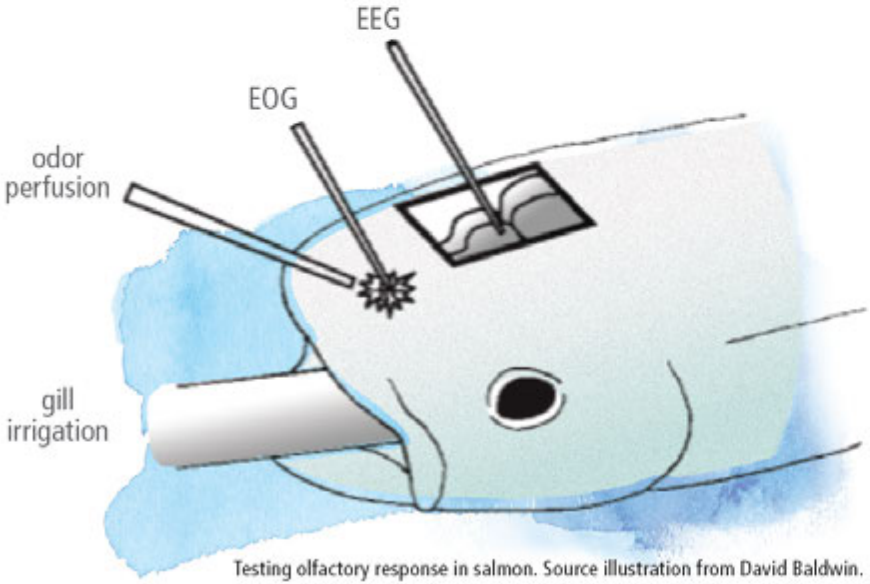
EXPOSURE AND EFFECTS

Relevant Management Policies and Decisions

- Implementation of sediment quality objectives
- Permitting decisions regarding dredging projects
- Implementation of narrative water quality objectives for toxicity, bioaccumulation, and aquatic organisms population and community ecology
- Review contaminated sediment 303(d) listing and potential to delist
- Copper control plan, especially with regard to risks to salmon

Recent Noteworthy Findings

- Sediment quality objective (SQO) analyses of 125 RMP sites from 2008 to 2012 indicate that severe impacts to the benthic community are not observed in the Bay. Forty percent of the Bay was classified as Possibly Impacted, indicating that the impacts are small or uncertain due to conflicting lines of evidence.
- Recent studies by NOAA indicate that even at very high concentrations of copper in seawater (> 100 µg /L), Chinook salmon's sense of smell is not impaired.
- Tern embryos are less sensitive to PBDE exposure than the most sensitive species studied (American Kestrel). Reproductive and developmental effects on tern embryos at the concentrations found in the Bay do not appear likely.



Testing olfactory response in salmon. Source illustration from David Baldwin.

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?

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

Studies to address information needs relating to dredged material testing are a priority for 2014. No studies are planned for 2015.

Exposure and effects studies and monitoring in the RMP from 2008 to 2017. 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	76				
	Causes of Sediment Toxicity: TIEs and LC50 Work	2	10	80								
	Causes of Sediment Toxicity: Molecular TIEs	2			60							
	Causes of Sediment Toxicity: Moderate Toxicity Strategy	2,3					50		30			
	USEPA Water Quality Synthesis (National Coastal Condition Assessment) (USEPA)	1,3				(100)	(50)					
	Hotspot Followup Study	1,2,3				60	30				50	
	Reference Site, Benthos Recovery After Dredging	1							50			
Fish	Endocrine Disruption in Fish	4,6	35									
	Effects of PAHs on Flatfish (NOAA)	4,5,6	40	50								
	Effects of Copper on Salmon (NOAA)	4,5				37		(38)				
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**	**76**	**80**	**TBD**	**TBD**	**TBD**
Non-RMP Total			**0**	**0**	**0**	**100**	**50**	**38**	**TBD**	**TBD**	**TBD**	**TBD**
Overall Total			**179**	**209**	**138**	**197**	**180**	**114**	**TBD**	**TBD**	**TBD**	**TBD**

Gray cells – further work on this topic not anticipated

PCBS

Relevant Management Policies and Decisions

- PCBs TMDL and potential update
- Selecting management actions for reducing PCB impairment

Recent Noteworthy Findings

- Shiner surfperch have concentrations 12 times higher than the TMDL target, and these have resulted in an advisory from OEHHA recommending no consumption for all surfperch in the Bay. Concentrations in shiner surfperch and white croaker show no clear sign of decline.
- Small fish on the Bay margins accumulate high concentrations of PCBs that correlate with concentrations in sediment and represent a pathway for impact on piscivorous wildlife.
- For birds, seals, and fish there is evidence of PCB exposure to a degree in certain locations that may be reducing health and survival.
- Average concentrations in Suisun Bay sediments are lower than in the other Bay segments.
- Wetland sediment cores provide evidence of dramatic declines from the 1960s to the present.
- Patterns of PCB bioaccumulation suggest that there are two broad habitat categories that appear to have food webs that are largely distinct: the margins and the open Bay. Impairment is far more severe in contaminated margin locations.
- Monitoring, forecasting, and management should treat these margin locations as discrete local-scale units. Local-scale actions within a margin area, or in upstream watersheds, will be needed to reduce exposure within that area.
- Santa Fe Channel, Pulgas Creek Pump Station North and South, Ettie Street Pump Station, and North Richmond Pump Station appear to have relatively polluted sediment particles and have the potential to be high leverage watersheds where control actions are a cost-effective way of reducing downstream impacts.
- Recent fish monitoring data point to several contaminated margin sites that are high priorities for management, including: Hunters Point, Stege Marsh, Oakland Inner Harbor, Richmond Inner Harbor, San Leandro Harbor, San Leandro Bay, and Coyote Point.
- Stormwater management actions are being developed and tested.
- Recent estimates of total loads for POTWs and industrial facilities were well below the waste-load allocations in the TMDL.
- The RMP list of 40 congeners is the most appropriate PCB index for monitoring in support of the PCB TMDL.

Priority Questions for the Next Five Years

1. What are the rates of recovery of the Bay, its segments, and in-Bay contaminated sites from PCB contamination?
2. What are the present loads and long-term trends in loading from each of the major pathways?
3. What role do in-Bay contaminated sites play in segment-scale recovery rates?
4. Which small tributaries and contaminated margin sites are the highest priorities for cleanup?
5. What management actions have the greatest potential for accelerating recovery or reducing exposure?
6. What are the near-term effects of management actions on the potential for adverse impacts on humans and aquatic life due to Bay contamination? (newly added question)

Collecting small fish with a beach seine.
Photograph by Ben Greenfield.

PCBs

Studies under the PCB Strategy began in 2010. A synthesis completed in 2014 set the stage for a multi-year study plan for 2015 and beyond, focusing on monitoring the response to management actions in high-leverage watersheds.

PCB studies and monitoring in the RMP from 2010 to 2019. Numbers indicate budget allocations in $1000s.

Element	PCB Questions Addressed	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Food Web Uptake (Small Fish)	1,7	50									
PCB Conceptual Model Update	1,2,3,4,5,6,7,8,9		53								
Development of multi-year workplan							10	10	10	10	10
Prioritize Margin Units							30				
Develop Conceptual Site Models and Mass Balances for PMUs (5 PMUs)							45	80	80		
PMU Trend Monitoring (5 PMUs)								30	90	150	150
TOTAL		50	53				85	120	180	160	160

SELENIUM

Relevant Management Policies and Decisions

- North Bay TMDL – Board consideration 2015
- South Bay TMDL or other control plan – After 2016

Recent Noteworthy Findings

- Sturgeon, a benthic species, is recognized as a key indicator of selenium impairment in the North Bay due to its susceptibility to selenium bioaccumulation.
- No trend is apparent in sturgeon concentrations in monitoring going back to 1987.
- The Lower South Bay has much higher average selenium concentrations in water than the other Bay segments, but white sturgeon collected in South Bay have had lower concentrations than North Bay sturgeon.
- Selenium concentrations in bird eggs are usually well below a target developed to protect birds in Newport Bay.
- Concentrations in cormorant eggs were unusually high in 2009, but were back down to more typical concentrations in 2012.

Priority Questions for the Next Five Years

1. What are appropriate thresholds?
2. Are the beneficial uses of San Francisco Bay impaired by selenium?
3. What is the spatial pattern of selenium impairment?
4. How do selenium concentrations and loadings change over time?
5. What is the relative importance of each pathway of selenium loading in the Bay?

Workplan Highlights

- Monitoring of selenium in plugs of muscle tissue obtained non-lethally

Partners and Coordination

- California Department of Fish and Wildlife
- US Fish and Wildlife Service
- US Geological Survey

*Another potentially relevant management policy and decision are the water quality criteria that are being developed by EPA Region IX.

White sturgeon collected in RMP fish sampling. Photograph by Zachary Epperson.

Selenium

Monitoring of selenium in plugs of sturgeon muscle tissue obtained non-lethally is a focus for 2014 and 2015.

Selenium studies and monitoring in the RMP from 2010 to 2019. Numbers indicate budget allocations in $1000s.

Element	Selenium Questions Addressed	2014	2015	2016	2017	2018	2019
Selenium Strategy Coordination	1,2,3,4,5	10	10	10	10	10	10
Selenium Information Synthesis	1,2,3,4,5		10	10	10	10	10
Selenium Sturgeon Plugs	2,3,4	23	23	23	23	23	23
Selenium Sturgeon Derby	1,2,3,4		20				
Selenium South Bay Synthesis	1,2,3,4,5				50		
Selenium South Bay Food Web Sampling	2,3,4					50	
Selenium South Bay Model	5						
	TOTAL	33	63	43	93	93	43

DIOXINS

Relevant Management Policies and Decisions

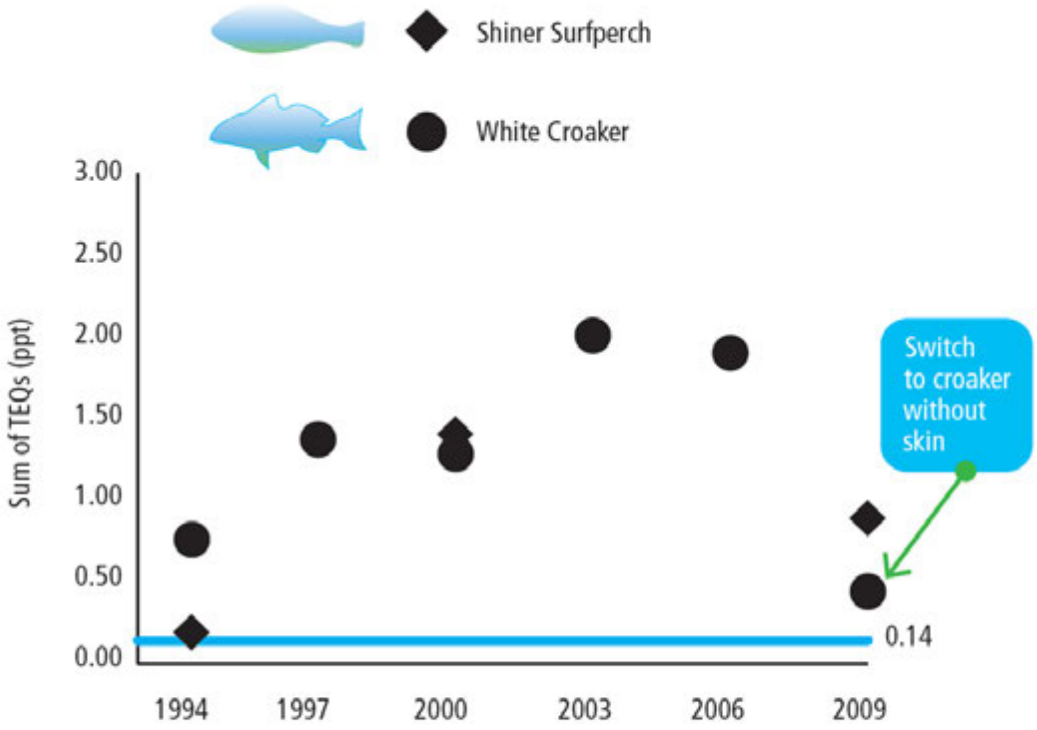
- Review 303(d) listings and establish TMDL development plan or alternative

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 are especially significant in combination with dioxin-like PCBs.
- Wetland sediment cores suggest rapidly declining inputs from local watersheds during recent decades, though additional coring data are needed to support this hypothesis.
- Few data on dioxins are available on other priority questions – the Dioxin Strategy was developed to address this need.

Priority Questions for the Next Five Years

1. What is the dioxin reservoir in Bay sediments and water?
2. Have dioxin loadings/concentrations changed over time?
3. What is the relative contribution of each loading pathway as a source of dioxin impairment in the Bay?



Baywide average dioxin and furan TEQ concentrations (ppt) in white croaker (circles) and shiner surfperch (diamonds). Blue line indicates screening value.

DIOXINS

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.

Dioxin Strategy studies began in 2008, with a multi-year plan extending through 2013. Synthesis activities are planned for 2016 after the data from the earlier studies are available.

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								
Status and Trends	Sport Fish	1,2,4		22					24			
	Avian Eggs	1,2,4					13					
	Surface Sediments	2,3		58	58							
	Water	2,3		26		26						
Loads	Small Tributary Loading	4,5,6			65		52					
	River Loading (THg)	4,5,6			34							
Forecast	Sediment Cores	3,4,6			57							
	Synthesis: One-Box Model	3,4,5,6									20	
	Synthesis: Food Web Model	5,6									20	
Loads	Atmospheric Deposition	5,6			20							
RMP Total			0	120	234	26	65	0	TBD	TBD	TBD	TBD
Non-RMP Total			0	0	0	0	0	0	TBD	TBD	TBD	TBD
Overall Total			0	120	234	26	65	0	TBD	TBD	TBD	TBD

STATUS AND TRENDS

Relevant Management Decisions

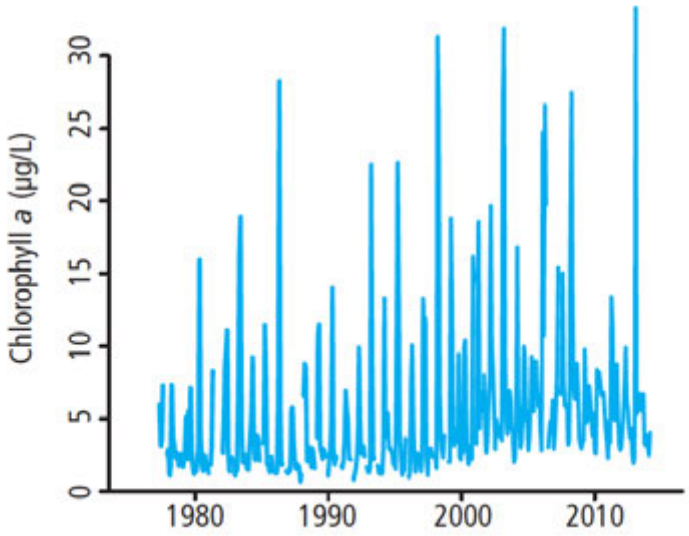
- Development of Se TMDL for North Bay and possibly for South Bay
- Copper site-specific objective and cyanide anti-degradation policies
- Evaluation of sediment and water quality objectives
- Water Quality Assessment - 303(d) impairment listings or de-listings
- Determination of whether there is reasonable potential that a NPDES permitted discharge may cause violation of a water quality standard
- Dredged material management
- Defining ambient conditions in Bay
- Development and evaluation of a Nutrient Assessment Framework (i.e., development of water quality objectives)

Recent Noteworthy Findings

- 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 and has persisted since that time.
- Increasing chlorophyll concentrations have been observed in the Bay and are attributed to a variety of possible drivers (e.g., decrease in suspended-sediment concentrations and an increase in bivalve predators.
- PBDE levels have declined in bivalves, bird eggs, sport fish, and sediment following nationwide phase-outs and state bans of these toxic and persistent flame retardant chemicals.
- Average PAH concentrations in sediment have been highest along the southwestern shoreline of Central Bay.

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?

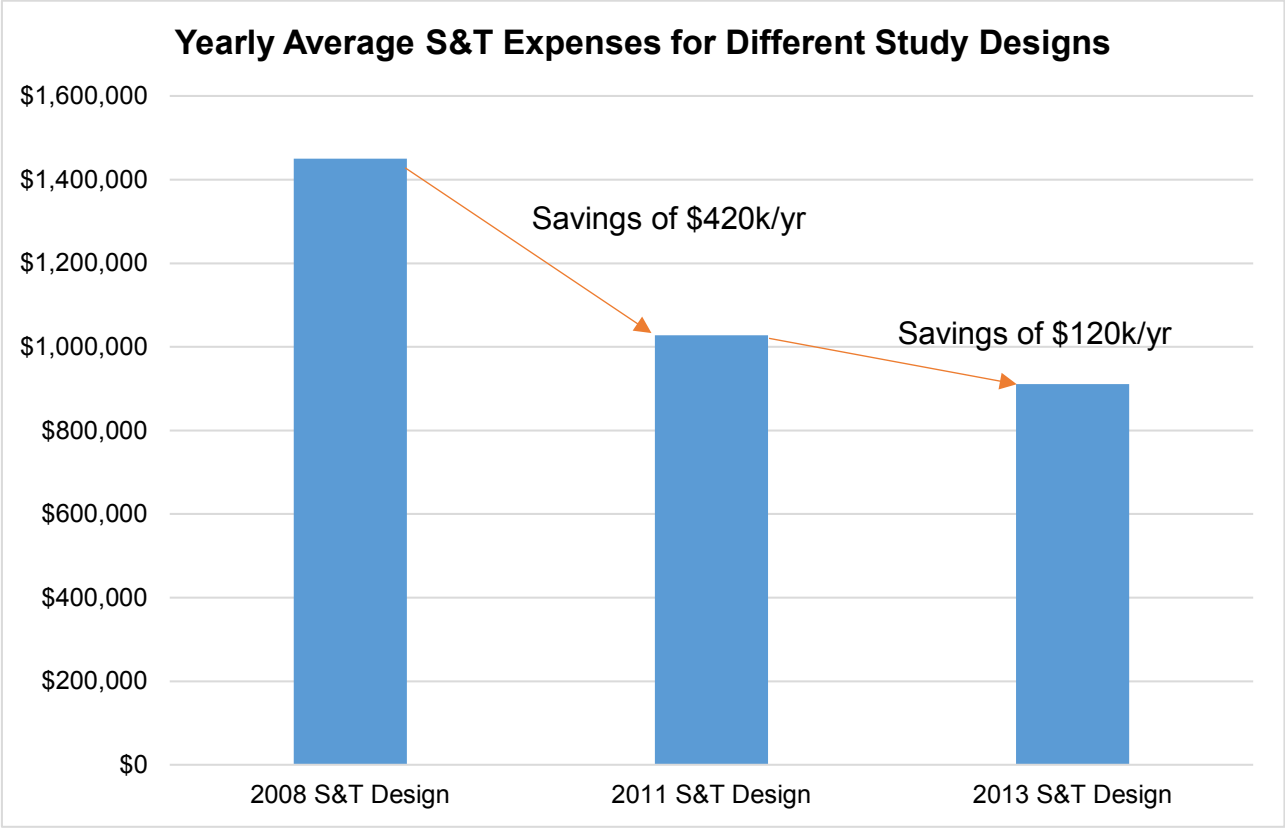


Monthly average chlorophyll concentrations in South Bay have increased in recent years relative to the 1980s and 1990s.

STATUS AND TRENDS

The Status and Trends monitoring design was changed in 2011 and 2013 to optimize performance and save money.

The 2011 redesign reduced the frequency of sampling from annual to biennial for 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 change in sampling frequency freed up approximately $400,000 per year for studies on other topics. The S&T design was further optimized in 2013. The frequency of sediment sampling was decreased to every four years and parameters that were changing slowly were scheduled to be monitored less often. The 2013 redesign saved approximately $120,000 per year.



Status and trends monitoring budget allocations in the RMP from 2014 to 2023.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Notes
Water (22 sites per sampling event)											
Chemistry	$0	$37	$0	$37	$0	$37	$0	$37	$0	$141	MeHg, Cu, Se, CN (plus PCB, PAH, pesticides in 2023)
Aquatic Toxicity	$0	$8	$0	$8	$0	$8	$0	$8	$0	$8	
CTR Parameters	$0		$0	$0	$0	$0	$0	$0	$0	$50	Planned for 2015 but canceled due to insufficient funds
Sediment (27 sites per sampling event)											
Chemistry	$94	$0	$0	$0	$94	$0	$0	$0	$75	$0	PBDEs not monitored in 2022
Toxicity	$0	$0	$0	$0	$52	$0	$0	$0	$52	$0	
Benthos	$0	$0	$0	$0	$0	$0	$0	$0	$53	$0	
Bivalves (7 sites (6+T1) per sampling event)											
Chemistry	$18	$0	$11	$0	$11	$0	$11	$0	$18	$0	PAHs, PBDEs, Se, and(PCBs (monitored every 8 years)
Sport Fish											
Chemistry	$231	$0	$0	$0	$0	$231	$0	$0	$0	$0	PCBs, PBDEs, PFCs, Hg, Se
Bird Eggs											
Chemistry	$0	$150	$0	$0	$150	$0	$0	$150	$0	$0	PCBs, PBDEs, PFCs, Hg, Se
USGS Monitoring											
Nutrients	$173	$173	$223	$223	$223	$223	$223	$223	$223	$223	
SSC/Moored Sensors	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	
Field Work and Logistics											
Field, logistics, archive	$228	$193	$128	$193	$253	$193	$128	$193	$253	$193	
Analysis of S&T Impacts		$15									
Bay Margins Sediment Study		$140	$120	$120	$120	$120	$120	$120	$120	$120	Savings from 2013 redesign allocated to bay margins
Total	**$993**	**$966**	**$732**	**$831**	**$1,153**	**$1,062**	**$732**	**$981**	**$1,045**	**$985**	

* 2014 value are actual costs. 2015 values are budgets. 2016-2023 are forecast values in 2014 or 2015 $$.

PROGRAM MANAGEMENT

- Includes the following categories of activities:
  - Program planning ($50k)
  - Contract and financial management ($187k)
  - Technical oversight ($50k)
  - Internal coordination ($90k)
  - External coordination ($30k)
  - Training ($5k)
  - Administration ($20k)

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 necessary at this time 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.
- A review of RMP governance was conducted in 2014 and a charter for the Program was developed.

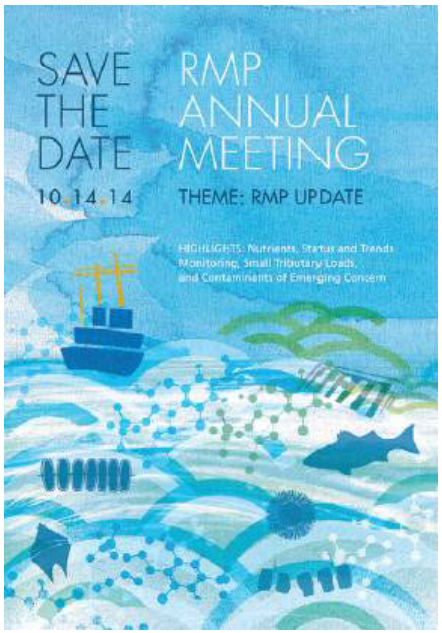
Peer Review

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

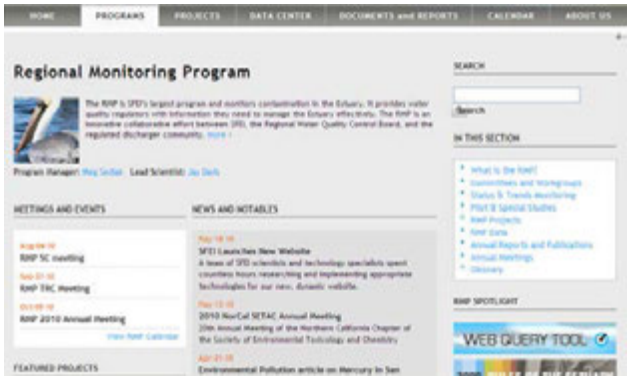
- Averages $166k per year (5% of the total budget).
- Includes the Pulse of the Estuary, Annual Meeting, Multi-Year Plan, State of the Estuary report card, RMP web site, Annual Monitoring Results, technical reports, journal publications, newsletter, oral presentations and posters, media outreach.
- These 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.

Highlights for the Next Five Years

- Next Pulse: 2015
- Closer partnership with SFEP to reach broader audience
- Annual Meeting joint with State of the Estuary in 2015
- Continued web site improvement

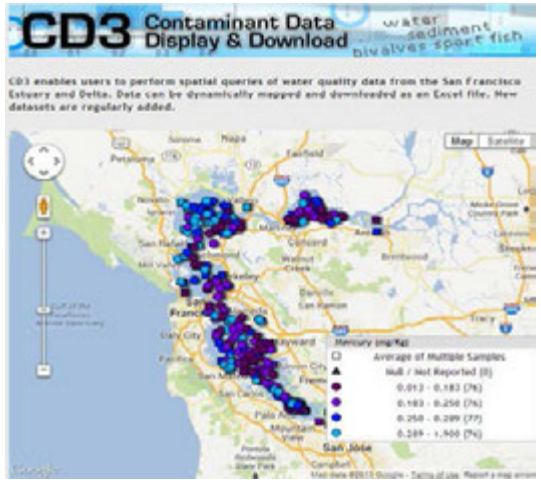


Home page for the RMP web site.

DATA MANAGEMENT AND QUALITY ASSURANCE

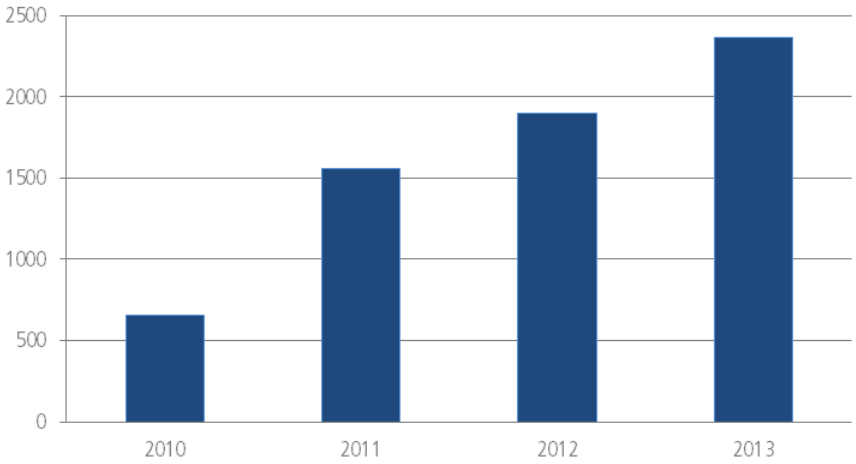
($355k/year)

- **Data Management**
  - The RMP database contains approximately 1.1 million 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.



A data display by the RMP CD3 Tool.

  - These platforms are used to make information from the RMP available to water quality managers, stakeholders, scientists, and the public.



2400 users used the Contaminant Data Display and Download Tool in 2013.

- **Quality Assurance**
  - 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 EDIT Program

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	76				
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		30			
RMP Exposure and Effects	Impact of Dredging on Benthos						50			
RMP Exposure and Effects	Effects of PAHs on Flatfish	50								
RMP Exposure and Effects	Hotspot Followup			60	30				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, Priority Margin Site 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