REGIONAL MONITORING PROGRAM FOR WATER QUALITY IN SAN FRANCISCO BAY

MULTI-YEAR PLAN

2016 ANNUAL UPDATE

FINAL: January 2016

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 ensuing 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.

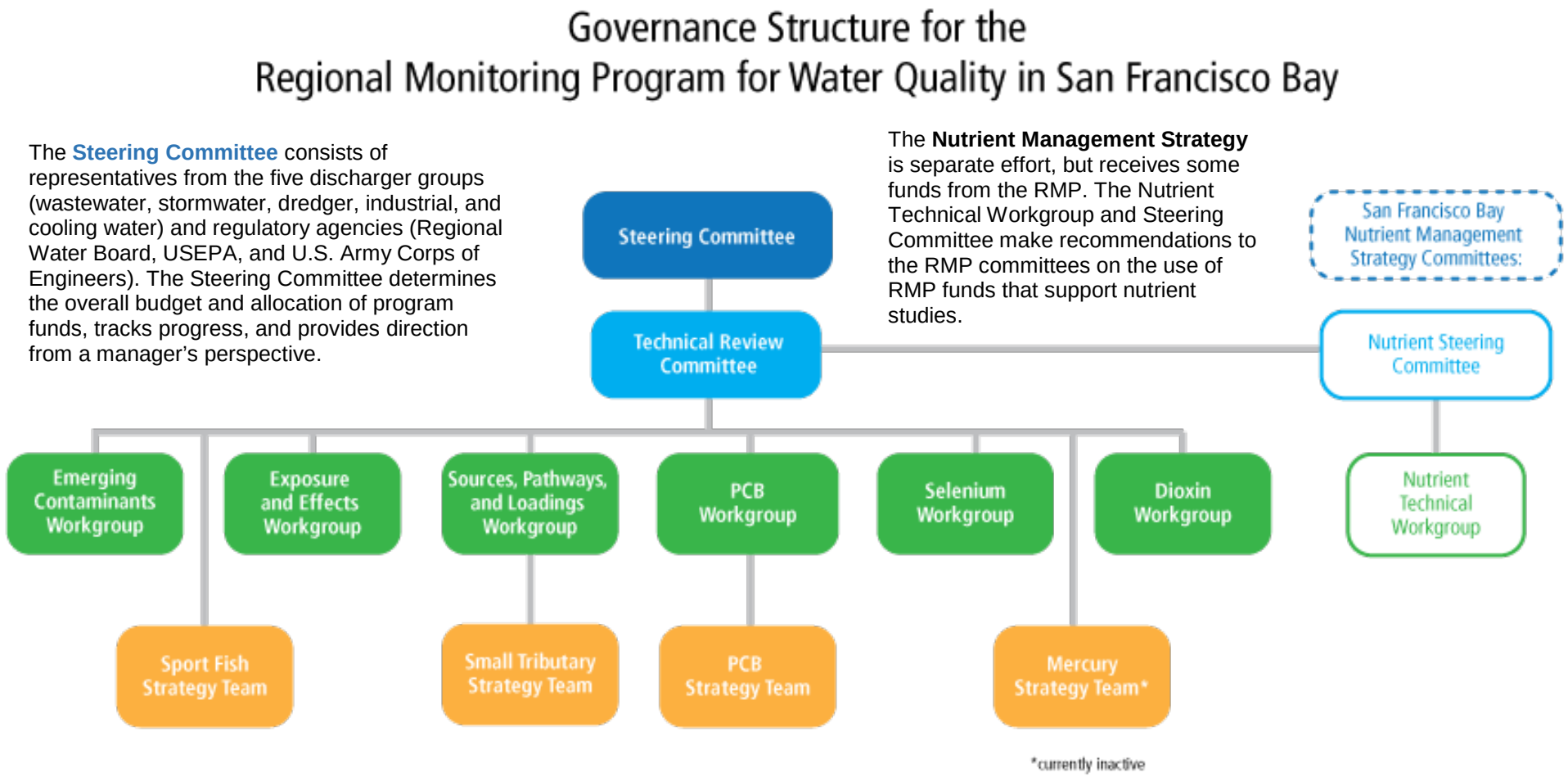
In order to fulfill the overarching goal of the RMP, the Program has to be forward-thinking and anticipate what decisions are on the horizon, so that when their time comes, the scientific knowledge needed to inform the decisions is at hand. Consequently, each of the workgroups and teams develops five-year 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.

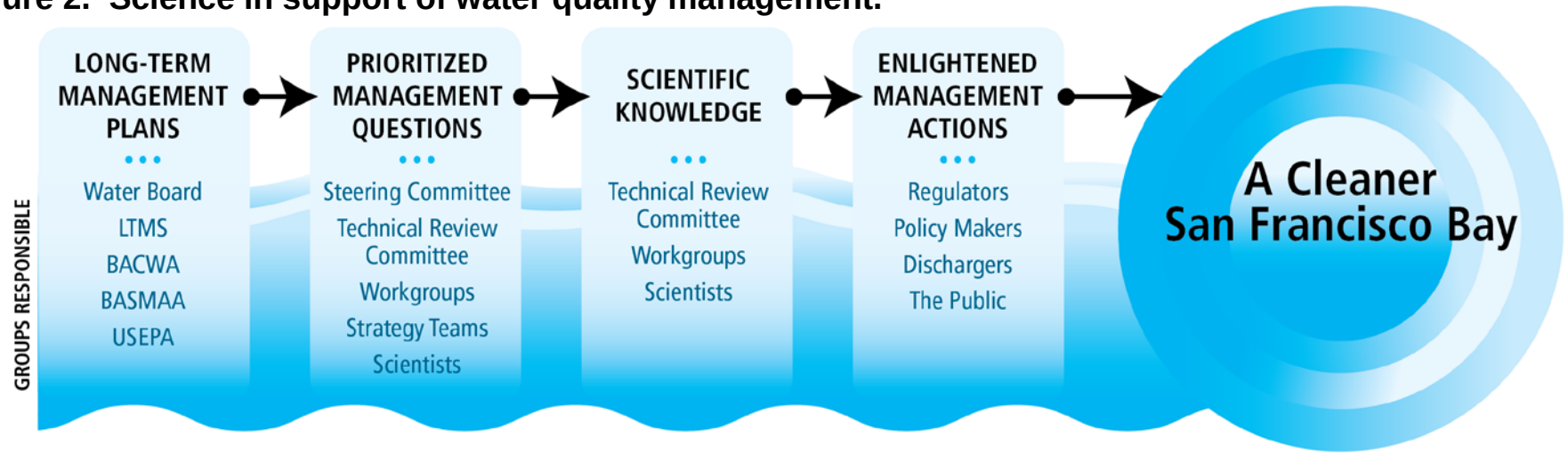


The **Technical Review Committee** consists of technical representatives from the Water Board, discharger groups, USEPA Region IX staff, and non-governmental organization. The Technical Review Committee provides oversight of the technical content and quality of the RMP, and provides recommendations to the Steering Committee.

Six **workgroups** report to the TRC and address the main technical subject areas covered by the RMP: emerging contaminants; exposure and effects; sources, pathways, and loadings; PCBs; selenium; and dioxins. Workgroups consist of regional scientists and regulators, as well as external science advisors recognized as leaders in their field. The workgroups directly guide planning and implementation of special studies and Status and Trends monitoring, and provide objective peer-review of study plans and final work products.

Strategy Teams are stakeholder groups that meet as needed to provide frequent feedback on areas of emerging importance, and develop long-term RMP study plans for addressing these high priority topics. The RMP currently has active strategy teams for sport fish monitoring, small tributary loadings, and PCBs.

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 the current focus areas: PCBs, dioxins, selenium, emerging contaminants, small tributary loads, exposure and effects, and nutrients. 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: Status and Trends Monitoring, Program Management, Communications, Data Management, and Quality Assurance.

Section 5 contains lists of RMP studies that are relevant to specific permit conditions for dredging, wastewater discharges, and stormwater discharges.

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 before 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 Detailed Workplan (available at **www.sfei.org/rmp/**). Please contact Phil Trowbridge (philt@sfei.org) with questions.

Figure 3. Annual planning calendar for the Regional Monitoring Program.

Annual Steering Committee Calendar

- January
  - Approval of Multi-Year Plan
  - Review of incomplete projects from the previous year
  - Review Pulse outline for next 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) and Charter
  - Planning Workshop
  - Decision on fees for the year after next
  - Approve workplan and budget for next year
  - Approval of Pulse outline for next year
  - Decision on workshops to be held next year

Each meeting includes a Science Program Update from a workgroup or strategy team focus area.

Annual Technical Review Committee Calendar

- March
  - Confirm chair(s)
  - Additional guidance to workgroups
- June
  - Recommend special studies for funding
  - Review plans for Annual Meeting and Pulse report
- September
  - Prepare for Annual Meeting
- December
  - Review Pulse outline for next year
  - Present workplan for next year and outcome of Multi-Year Planning Workshop

Each meeting includes a Science Program Update from a workgroup or strategy team focus area, and feedback on current and proposed studies

Annual Workgroup Calendar

Workgroups meet annually in April-June to discuss results from previous years' studies and select proposals to recommend to the TRC and SC for funding for the next year.

Agendas and meeting summaries available at https://sites.google.com/a/sfei.org/rmp-operations/home/workgroup-notes

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[+]	2015, 2019,…
303(d) List and 305(b) Report	2017, 2022
Copper Compare levels to site specific objectives triggers[+]	2016, 2018,…
Cyanide Compare levels to site specific objectives triggers[+]	2016, 2018,…
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) Monitoring recovery	Ongoing
Pathogens Bay Beaches Bacteria TMDL Source identification at non-compliant beaches	 2016 2018?
Chemicals of Emerging Concern Review of RMP strategy, development of action plans	Annual
Toxicity New state plan on effluent and receiving water toxicity	2016
Suisun Marsh Establish TMDL for DO, mercury, nutrients, salinity	2018
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

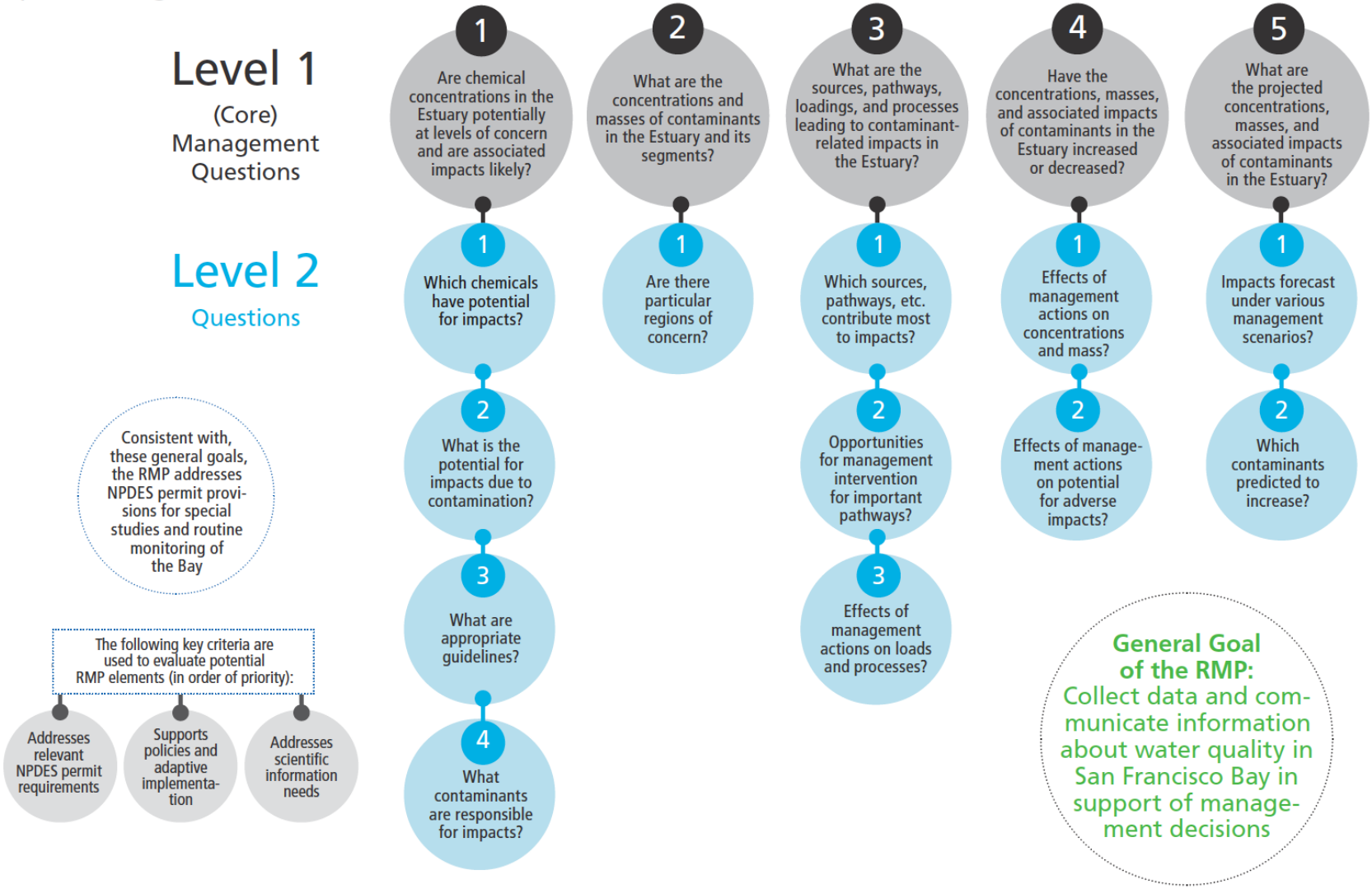
* The schedules for revising the Mercury and PCB TMDLs coincide with the schedule for reissuing the Municipal Regional Stormwater Permit.

See meeting summary from 11/10/15 Planning Workshop for additional details.

[+] Triggers will be updated on the RMP sampling frequency (every 4 years for sediment, every 2 years for water).

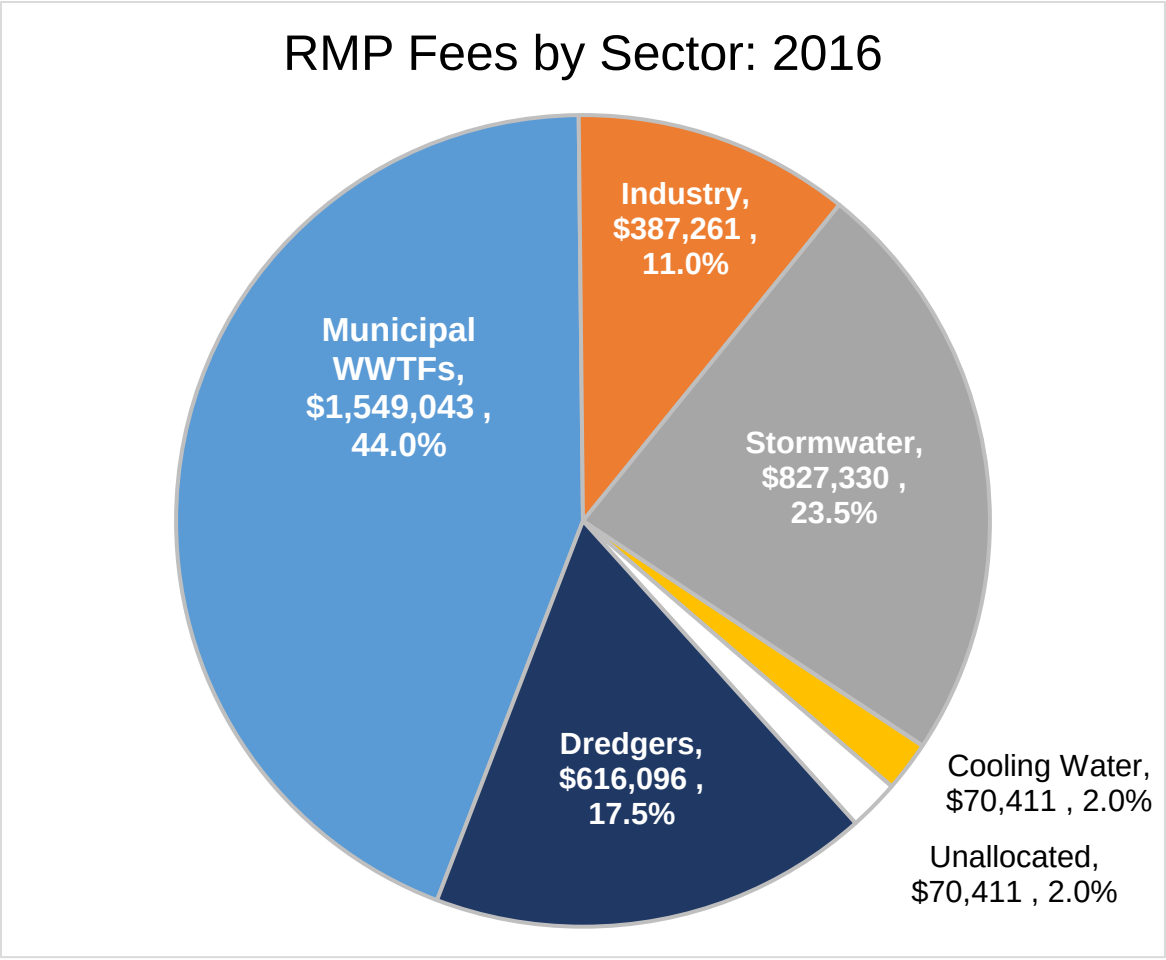
RMP GOAL AND MANAGEMENT QUESTIONS

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.



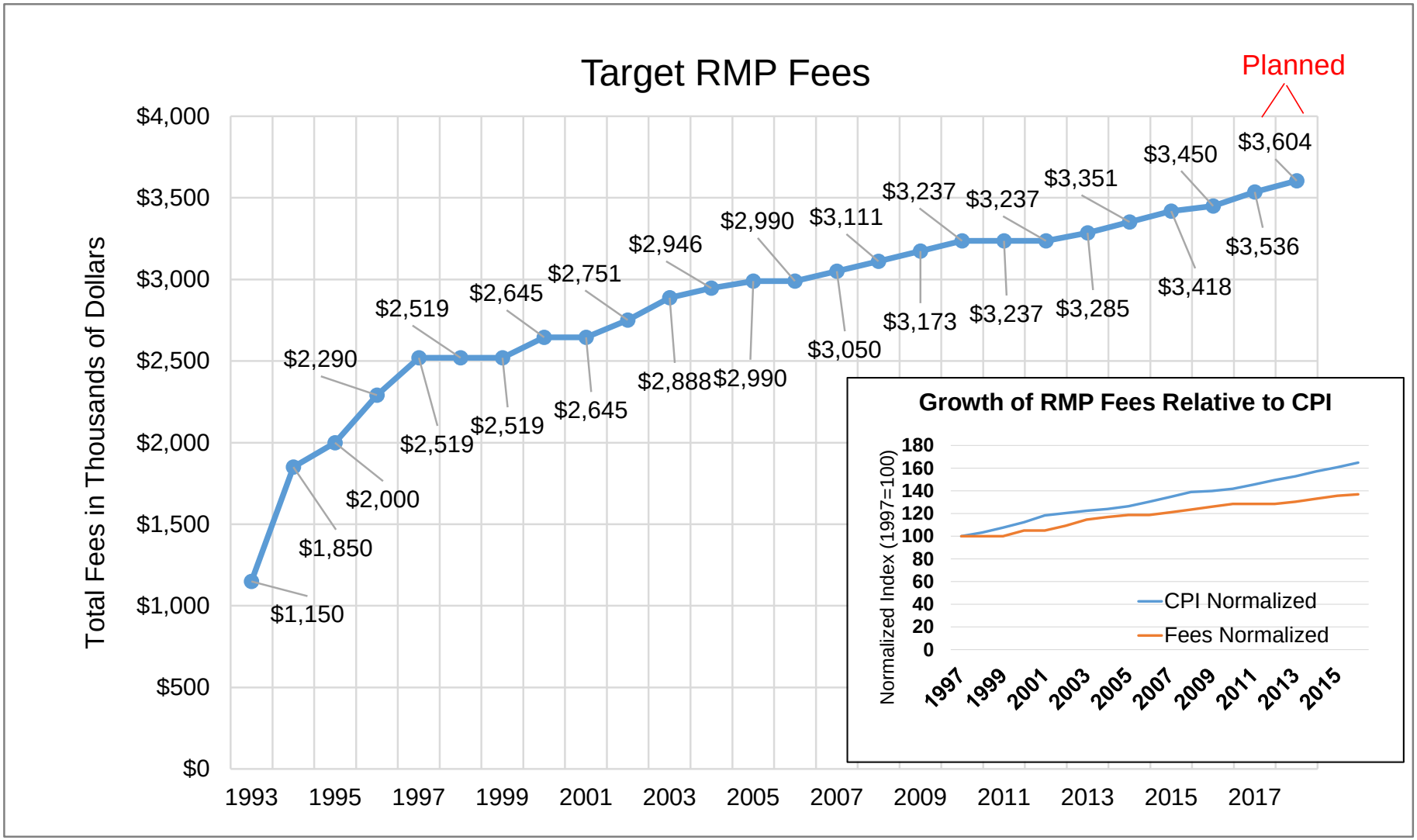
BUDGET: Revenue by Sector

The RMP fees are divided among five major discharger groups. Municipal wastewater treatment agencies are the largest contributor (44%), stormwater agencies are the second largest contributor (23.5%). 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. The last cooling water discharge is phasing out of operation - discharges to the Bay and payments to the RMP will cease in 2018. For 2016, the cooling water allocation dropped from 4% to 2% of the fees. The Steering Committee has not yet decided how to make up the lost revenue.



BUDGET: Revenue by Year

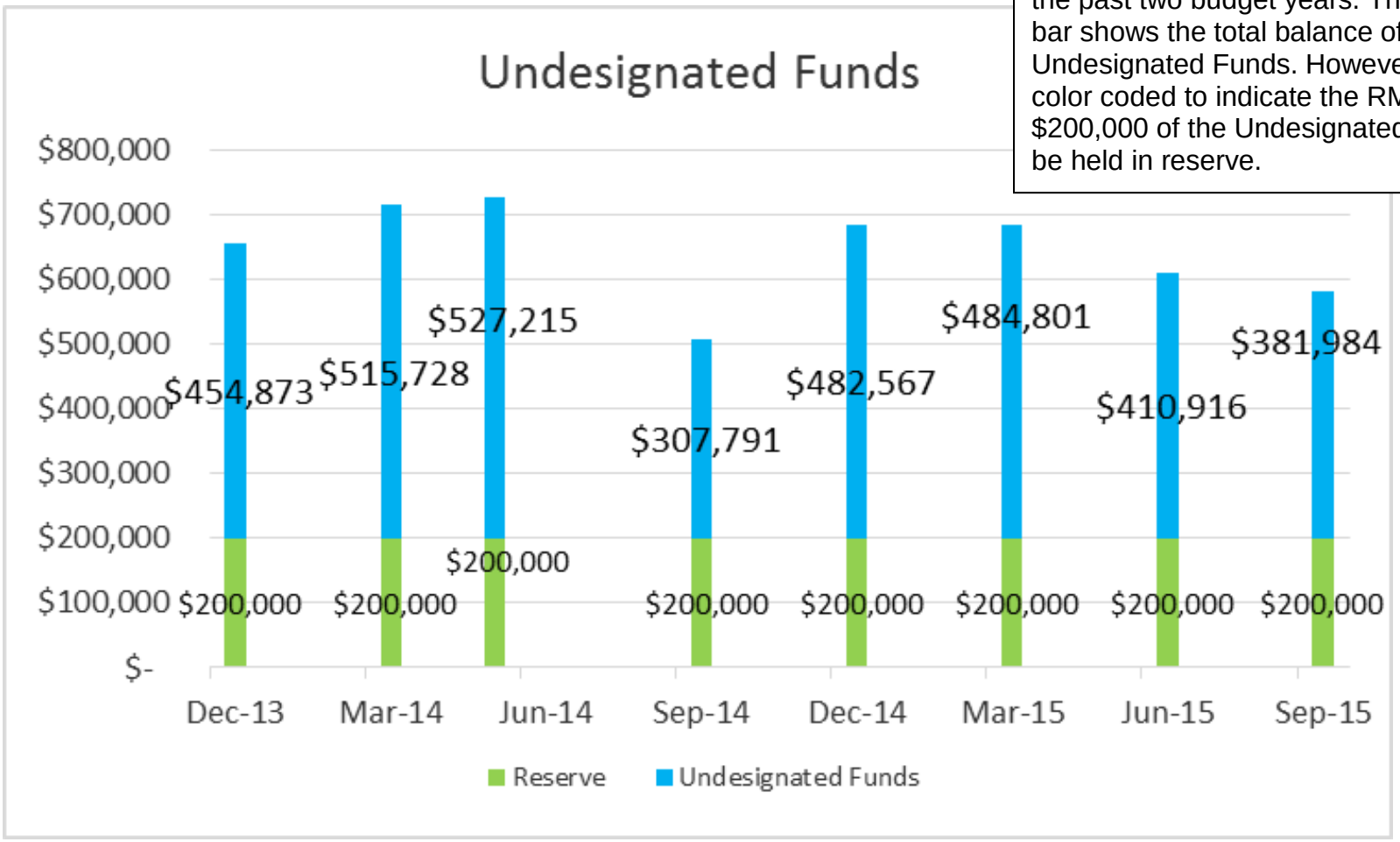
Target RMP fees in 2016 are $3.450 million. The RMP fees are set by the Steering Committee every three years and are approved to be $3.536 million in 2017 and $3.604 million in 2018. RMP fee growth has not kept up with inflation.



BUDGET: Reserve Funds

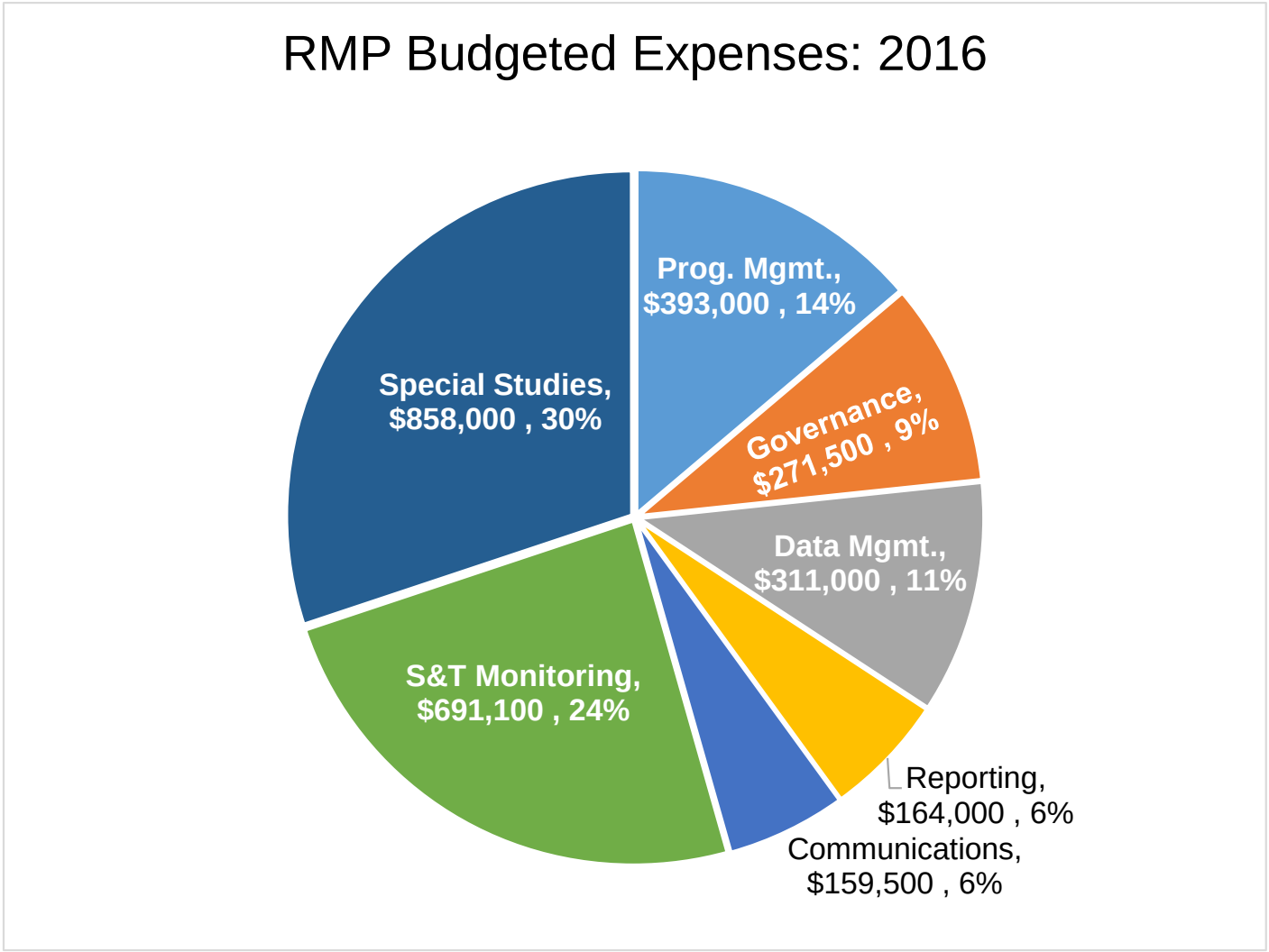
The RMP maintains a balance of Undesignated Funds for contingencies. Higher than anticipated revenues and elimination or reduction of lower priority elements sometimes leads to accumulation of funds that can be used for high priority topics at the discretion of the Steering Committee. It is the policy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

Bay RMP Undesignated Funds balance over the past two budget years. The height of the bar shows the total balance of the Undesignated Funds. However, the bar is color coded to indicate the RMP policy that $200,000 of the Undesignated Funds should be held in reserve.



BUDGET: Budgeted Expenses

The budget for the RMP reflects the priorities of the program. Sixty percent of the expenses are for monitoring and special studies. Reporting results and properly archiving data each comprise 10% of the budget. 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.



BUDGET: Special Studies 2013-2019

RMP actual and planned expenditures on special study topics. Costs for 2013-2015 are actual amounts. 2016 are budget values. Costs for 2017 and beyond are estimates for planning based on the most recent feedback from the Workgroups and Strategy Teams. The special studies budgets for 2017-2019 were estimated by assuming RMP revenue will increase by 3% year-over-year, subtracting ~40% for programmatic expenses (see page 11), and subtracting estimated Status and Trends monitoring costs for each year (see page 32).

FOCUS AREA	2013	2014	2015	2016	2017	2018	2019
	Actuals	*Actuals*	*Actuals*	*Budget*	*Forecast*	*Forecast*	*Forecast*
Mercury	$0	$0	$0	$0	$0	$0	$0
PCBs	$0	$0	$85,000	$40,000	$110,000	$140,000	$130,000
Dioxins	$0	$24,000	$0	$0	$40,000	$0	$0
Emerging Contaminants	$141,000	$209,000	$84,000	$130,000	$234,000	$270,000	$280,000
Small Tributaries*	$468,000	$487,000	$470,000	$311,000	$470,000	$470,000	$470,000
Exposure and Effects	$114,000	$80,000	$0	$30,000	$0	$0	$0
Forecasting	$100,000	$0	$0	$0	$0	$0	$0
Selenium	$0	$33,000	$84,000	$47,000	$102,000	$70,000	$70,000
Nutrients*	$405,000	$520,000	$470,000	$300,000	$500,000	$500,000	$500,000
Other	$0	$0	$0	$0	$100,000	$0	$0
SPECIAL STUDIES TOTAL	**$1,228,000**	**$1,353,000**	**$1,193,000**	**$858,000**	**$1,556,000**	**$1,450,000**	**$1,450,000**
PREDICTED SPECIAL STUDIES BUDGET					**$1,073,000**	**$1,083,000**	**$1,206,000**

*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.

Nutrient synthesis, monitoring, and modeling 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.

At the 2015 Multi-Year Planning Workshop, stakeholders identified **potential new focus areas** for the RMP: beneficial reuse of effluent and RO concentrate, beneficial reuse of sediment, and trash. RMP stakeholders will define the RMP's niche on these topics. If appropriate, RMP staff will develop proposals to develop strategies for some of these topics in 2017.

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SMALL TRIBUTARY LOADING

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

Relevant Management Policies and Decisions

- Refining pollutant loading estimates for future TMDLs and management decisions, including TMDL updates.
- Informing 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 practices 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 suspended sediment particles during the largest storms.
- Greater PCB and mercury concentrations are associated with older urban and older 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 amassed at 22 locations so far, PCB concentrations on particles in flowing stormwater are greatest in Sunnyvale East, Santa Fe channel and Pulgas Creek Pump Station watersheds. This dataset is being collected as a primary indicator of pollution sources and will continue to evolve each year. Nineteen additional sites were monitored during WY 2015 and data will soon be analyzed and reported.
- Finding small areas with highly polluted soils within watersheds is a challenge, but the 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 and Hg loads in urban stormwater through source and treatment control measures (including Green Infrastructure) and pollution prevention strategies, and document progress and expectations using a reasonable and technically sound load reduction accounting system and a reasonable assurance analysis that demonstrates how green infrastructure will be implemented in order to achieve load reductions across the permit area by 2040.

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?
5. Which sources or watershed source areas provide the greatest opportunities for reductions of POCs in urban stormwater runoff?

SMALL TRIBUTARIES LOADING STRATEGY

Screening and characterization 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 2019. Numbers indicate budget allocations in $1000s.

Funder	Task Description		2013	2014	2015	2016	2017	2018	2019
RMP	**Coordination and management**		20	25	26	26	26	26	26
	Regional Watershed Spreadsheet Model								
RMP	Phase I – Water, Sediment, PCBs and Mercury		25	30	35	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 and Characterization				374	150	150		
RMP	Trends Strategy				35	100	259	409	409
RMP Total			**468**	**487**	**470**	**311**	**470**	**470**	**470**
BASMAA Total			**885**		TBD	TBD	TBD	TBD	TBD
		TOTAL	**1,403**		TBD	TBD	TBD	TBD	TBD

NUTRIENTS

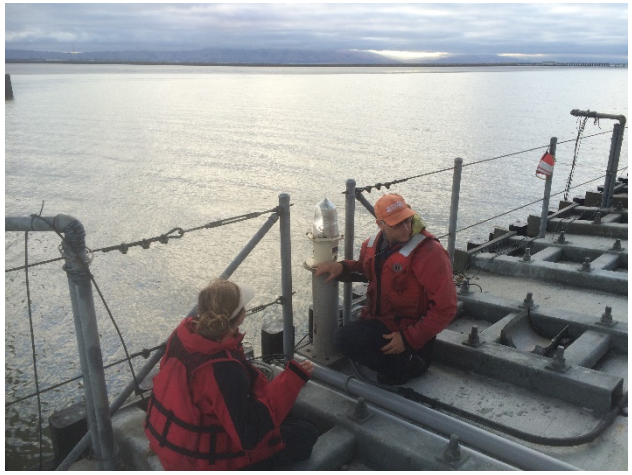
Relevant Management Policies and Decisions

To address concerns about potential adverse impacts of nutrients, the Water Board and stakeholders developed the San Francisco Bay Nutrient Management Strategy in 2012

A multi-stakeholder Steering Committee was formed in April 2014 to guide implementation of a Bay Nutrient Management Strategy

A Bay-wide nutrient discharge permit for POTWs went into effect in July 2014, which sets aside funding to support science and monitoring to inform nutrient management decisions.

Work is underway to development a framework for assessing the health of San Francisco Bay related to nutrient over-enrichment



SFEI and collaborators at USGS service moored sensor monitoring equipment installed at the Dumbarton Bridge. Photo: P. Bresnahan

Recent Noteworthy Findings

- Nitrogen (N) and phosphorus (P) concentrations in the Bay substantially exceed those in other estuaries where water quality has been impaired by nutrient pollution
- Nitrogen (N) concentrations have shown long-term decline in Lower South Bay and long-term increases in Suisun Bay
- The dominant source of nutrients to most of the Bay is wastewater effluent, but tributary loading can be significant for some portions of the Bay during high-flow months
- A network of eight moored sensors for measuring water quality parameters such as chlorophyll and dissolved oxygen has been initiated.
- DO levels are generally above the water quality objective of 50% saturation in the open Bay, but sometimes is below this value in many sloughs
- Slough and margin habitats could be an important source of organic matter to the open Bay
- Harmful algal species have been detected in San Francisco Bay and low concentrations of algal toxins are ubiquitous in the Bay
- Method development and monitoring program design are underway for harmful algae, algal toxins, and more efficiently characterizing phytoplankton community composition
- Development of a biogeochemical model for San Francisco Bay is underway, beginning with regional models for Lower South Bay and Suisun Bay

Priority Questions for the next 5 years

- Is there a problem or signs of a problem?
  - Are anthropogenic nutrients currently, or trending towards, adversely affecting beneficial uses of the Bay?
- What are the appropriate guidelines for assessing the Bay's health with respect to nutrients and eutrophication?
- Which nutrient sources, pathways and transformation processes contribute most to concern?
  - What is the relative contribution of each loading pathway to the Bay overall and key subembayments, and how does this vary seasonally?
  - What is the contribution of nutrient regeneration and transformation processes to Bay nutrient budgets?
- What nutrient loads can the Bay assimilate without impairment of beneficial uses?
- What future nutrient-related impairment is predicted for 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 2013 to 2019. Numbers indicate budget allocations in $1000s. The exact distribution of projects between RMP and Nutrient Permit funds past 2016 is not yet defined, so just general allocations are indicated

Tasks	Funding Agency	Questions Addressed	2013	2014	2015	2016	2017	2018	2019
Program coordination	RMP	*1-5*	20	20					
Monitoring/special studies: moored sensors	RMP	*1*	200	215	190	30			
Monitoring/special studies: algal biotoxins	RMP	*1*	65						
Monitoring/special studies: stormwater loads	RMP	*3*	40	35					
Monitoring/special studies: monitoring program development	RMP	*1,3*		50		20			
Monitoring/special studies: dissolved oxygen						200			
Monitoring/special studies: HF mapping					115				
Modeling[1]	RMP	*4,5*	100	200	165				
Synthesis: conceptual model report	RMP	*1-5*	50						
Synthesis: nutrient loads and data gaps	RMP	*3*	30						
General allocation (exact projects TBD)	RMP					50	500	500	500
RMP S&T ship-based monitoring (USGS, Cloern)	RMP	*1,3*	110	172	172	192	172+?	172+?	
SUBTOTALS	**RMP S&T Monitoring**		**110**	**172**	**172**	**192**	**172+?**	**172+?**	**172+?**
	RMP Nutrients Studies		**505**	**520**	**470**	**300**	**500**	**500**	**500**
Program coordination and management	Permit	*1-5*	135	75	150	270			
Science plan development	Permit	*1-5*	15	15					
Monitoring/special studies: ship-based sampling	Permit	*1*			75	95			
Monitoring/special studies: moored sensor	Permit	*1*	75	75	150[2]				
Monitoring/special studies: POTW and refinery effluent characterization[3]	Dischargers, Permit	*3*	315	200					
Monitoring/special studies: algal toxins	Permit	*1*			175[2]	125			
Monitoring/special studies: phytoplankton composition	Permit	*1*	60	60					
Monitoring/special studies: monitoring program development	Permit	*1,3*	35	40	80[2]				
Monitoring/special studies: research vessel	Permit	*1,3*				200			
Synthesis: Suisun Bay, Lower South Bay, other	Permit	*1,3*	100	150					
General allocation (exact projects TBD)	Permit				280[2]	190[2]	880[2]	880[2]	880[2]
SUBTOTALS	***BACWA Total***		**735**	**615**	**865[2,4]**	**880[2,4]**	**880[2,4]**	**880[2,4]**	**880[2,4]**

Tasks	Funding Agency	Questions Addressed	2013	2014	2015	2016	2017	2018	2019
Other funding sources[5]									
Program coordination	SWRCB	*1-5*							
Science plan development	SFBRWQCB	*1-5*		100					
Monitoring: program development	SWRCB	*1,3*	20	20					
Delta loads to Suisun	DWR-EMP	*3*	90	90					
Grand total									
RMP, BACWA and other funding sources			**1,460**	**1,517**	**1,507**	**1,572**	**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

Relevant Management Policies and Decisions

- Support for the San Francisco Bay Water Board CECs Management Strategy, including Action Plans to address the Bay's Moderate Concern (Tier III) CECs
- 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

- A major success story for the Bay, declines in a toxic flame retardant family, polybrominated diphenyl ethers (PBDEs), in wildlife and sediment were documented following an industry phase-out and state ban. More recent Status and Trends monitoring results are consistent with continuing declines of PBDEs.

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

- Manufacturers now use alternative, non-PBDE flame retardants in their products to meet flammability standards. Preliminary results from an RMP study of Bay water, sediment, stormwater, treated wastewater, harbor seals, and bivalves indicate many alternatives are present in the Bay. One flame retardant, triphenyl phosphate, was detected in Bay water at concentrations comparable to a conservative toxicity threshold for marine ecosystems. For many others, the risks are unknown due to a lack of information on toxicity. Meanwhile, recent changes to California's flammability standards have reduced use of flame retardants in some consumer goods, which may result in lower levels of contamination in the Bay

- San Francisco Bay wildlife were tested for previously unmonitored contaminants using a non-targeted analysis that screens mainly for long-lived, fat-soluble, chlorine and bromine-rich chemicals. Bay mussels and harbor seals contained five contaminants not previously identified in Bay wildlife, and for which toxicity is largely unknown. Most of the Bay chemical contamination was from high priority contaminants that the RMP already monitors, such as PCBs, or closely related compounds. An RMP Special Study for 2016 will employ a similar method to identify previously unmonitored water-soluble contaminants in the Bay

- Special studies of per- and polyfluorinated alkyl substances (PFAS), including toxic compounds once used in the manufacture of Scotchgard, Teflon, and other surface coatings, revealed new details about these contaminants. Levels of PFOS (perfluorooctane sulfonate) in Bay bird eggs and harbor seal blood are high relative to other sites around the world. PFOS in South Bay bird eggs has declined from 1,200 ppb (2006/2009) to 390 ppb (2012). Although bird egg levels are now lower than an established toxicity threshold of 1,000 ppb, they remain at levels associated with impaired hatchling success in tree swallows. Concentrations of PFOS in seal blood have declined from approximately 1,000 ppb (2004) to 350 ppb (2014). Toxicity thresholds for marine mammals exposed to perfluorinated compounds are not available; however, studies in other mammals suggest that these concentrations may be of concern.

- A pro bono collaboration with the Department of Toxic Substances Control provided further insights regarding PFAS in treated wastewater discharged to the Bay. A comparison of effluent provided by eight WWTPs showed discharges from the San Francisco Airport industrial treatment and Fairfield Suisun facilities contained the highest concentrations of PFASs. Both treatment plants receive runoff from areas likely impacted by aqueous-film-forming foam (referred to as AFFF), industrial firefighting products and major sources of PFASs. The other six effluent samples had lower levels, with short chain perfluorinated acids (C6 and shorter carboxylates) predominant, followed by the C8 forms, PFOS (perfluorooctane sulfonate) and PFOA (perfluorooctanoic acid). This study was unique in that it quantified the contribution of unidentified PFAS precursors that can degrade to PFOA and PFOS. Unidentified precursors accounted for 30% to 60% of total PFAS, with short chain species predominant.

- Fipronil, a broad-spectrum insecticide with growing urban uses, has been detected in Bay sediment and in urban creeks. Observed concentrations of fipronil and its degradates in sediment have exceeded effect thresholds on occasion, suggesting that these compounds may pose risks to Bay aquatic life. The 2014 sediment monitoring data featured detections of one degradate at levels comparable to a toxicity threshold, suggesting concern is still warranted. The RMP has funded a study in 2016 that will provide key information on this pesticide in wastewater.

- Motivated by recent state efforts to ban microbeads in personal care products, an RMP Special Study for 2014 monitored Bay surface water and treated wastewater for microplastic contaminants. Microplastic is a term used to describe plastic particles smaller than 5 mm. Nine Central and South Bay surface water samples were collected, as well as single samples of effluent eight facilities discharging to the Bay. Microplastics were characterized by size, type, and abundance. Results suggest microplastic contamination is higher in the Bay than in the Great Lakes or Chesapeake Bay.

Priority Question 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 and monitoring in the RMP from 2013 to 2020. Numbers indicate budget allocations in $1000s. Pro-bono contributions are listed separately in grey. More detail can be found in the draft 2015 CEC Strategy Update

Task	Funder	Questions addressed	2013	2014	2015	2016	2017*	2018	2019	2020
CEC Strategy**	RMP - SS	1	20	20	20	48	40	40	40	50
Moderate Concern CECs	RMP - SS	1	36	26	55	30	72	80	60	50
	pro bono	1	0	30	50	50				
Possible/Low/New CECs	RMP - SS	1	15	107	9	0	72	50	160	65
	pro bono	1	0	135	42	10				
Non-targeted/Other Studies	RMP - SS	1	70	56	0	52	30	80	0	60
	pro bono	1	0	125	0	16				
RMP Special Studies TOTALS			**141**	**209**	**84**	**130**	**214**	**250**	**260**	**225**
pro bono studies TOTALS			0	290	92	76				
Overall TOTALS			**141**	**499**	**176**	**206**	**214**	**250**	**260**	**225**

*Potential Special Studies for 2017 include:

i) PFOS/PFAS synthesis to inform management actions;
ii) Phosphate flame retardant monitoring in water, including new analytes;
iii) Characterization of CECs in reverse osmosis concentrate from recycled water facilities.

**Includes full revision of CEC strategy document in 2016 and 2020

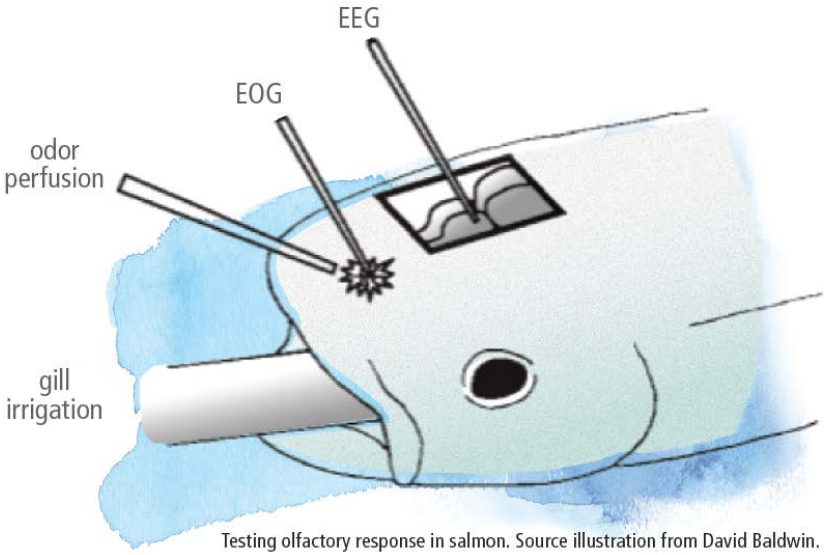
EXPOSURE AND EFFECTS

Relevant Management Policies and Decisions

- Implementation of sediment quality objectives
- Permitting decisions regarding dredging projects
- Review contaminanted sediment 303(d) listings and potential to delist contaminants
- Copper control plan, especially with regard to risks to salmon xx underlying text still visible
- Implementation of narrative water quality objectives for toxicity, bioaccumulation, and aquatic organisms population and community ecology

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
- RMP studies conducted by NOAA indicate that even at very high concentrations of copper in seawater (> 100 ug/L), Chinook salmon's sense of smell is not impaired. For juvenile salmon, copper concentrations up to 50 ug/L did not have impacts on the olfactory system at salinities >10 ppt.
- 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 concentratiosn found in the Bay do not appear likely.
- Laboratory studies showed that kaolin clay, the dominant clay type in the Estuary, has size-specific mortality effects on the amphipod *Eohaustorius estuarius*, which is the primary organism used in the sediment toxicity testing protocol for the Water Board's Sediment Quality Objectives program. Larger amphipods appear to be more sensitive to clay particles. Future field studies aim to verify these findings and inform a potential revision of the toxicity testing protocol.



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

Priority Questions Over the Next Five Years

Effects on Benthos

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

Effects on Birds

4. Do spatial patterns in accumulation indicate particular regions of concern?

Effects on Fish

5. What are appropriate thresholds of concern for contaminant concentrations in Bay species?
    - Is the total PAH threshold for dredged sediments (4500 ppb) protective for resident flat fish, such as English sole?

EXPOSURE AND EFFECTS

Exposure and effects studies and monitoring in the RMP from 2011 to 2019. Numbers indicate budget allocations in $1000s.

	Element	Questions Addressed				2011	2012	2013	2014	2015	2016	2017	2018	2019
Benthos	Benthic Assessment Tools	3					50	76						
	Causes of Sediment Toxicity: TIEs and LC50 Work	2												
	Causes of Sediment Toxicity: Molecular TIEs	2												
	Causes of Sediment Toxicity: Moderate Toxicity Strategy	2,3					50		30		30			
	USEPA Water Quality Synthesis (National Coastal Condition Assessment) (USEPA)	1,3				(100)	(50)							
	Hotspot Followup Study	1,2,3				60	30							
	Reference Site, Benthos Recovery After Dredging	1							50					
Fish	Effects of PAHs on Flat Fish	5										TBD		
	Effects of Copper on Salmon (NOAA)	5				37		(38)						
RMP Total						**97**	**130**	**76**	**80**	**0**	**30**	**TBD**	**TBD**	**TBD**
Non-RMP Total						**100**	**50**	**38**	**0**	**0**	**0**	**TBD**	**TBD**	**TBD**
Overall Total						**197**	**180**	**114**	**80**	**0**	**30**	**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 receiving water 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, 4	50									
PCB Conceptual Model Update	1,2,3,4,5,6		53								
Development and updating of multi-year workplan and continued support of PCB Strategy Team meetings							10	10	10	10	10
Prioritize Margin Units	1, 4, 5, 6						30				
Develop Conceptual Site Models and Mass Balances for PMUs (4 PMUs)	1, 4, 5, 6						45	30	70	50	
PMU Field Studies to Support Development of Conceptual Site Models and Monitoring Plans	1, 4, 5, 6								30	20	
PMU Trend Monitoring (5 PMUs)	1, 4, 5, 6									60	120
TOTAL		50	53				85	40	110	140	130

SELENIUM

Relevant Management Policies and Decisions

- North Bay TMDL – Draft Staff report released 2015. Board consideration November 2015. Xx problem with underlying text
- USEPA Region 9 Selenium Criteria for San Francisco Bay – 2016
- South Bay TMDL – 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
- Selenium concentrations measured in sturgeon muscle plugs are within the range of concentrations measured in muscle fillets

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?

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

Selenium

Selenium studies and monitoring in the RMP from 2014 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
Selenium Sturgeon Plugs	1,2,3,4	23	35		42		
Selenium Sturgeon Derby	1,2,3,4		29	37			
Selenium in Sturgeon Eggs	1,2,3				40		
Selenium South Bay Synthesis	1,2,3,4,5					50	
Selenium South Bay Food Web Sampling	1,2,3,4						50
Selenium South Bay Model	5						
	TOTAL	33	84	47	102	70	70

Studies to support the development of methods for non-lethal monitoring of selenium in plugs of sturgeon muscle tissue is a focus for the near-term.

DIOXINS

Relevant Management Policies and Decisions

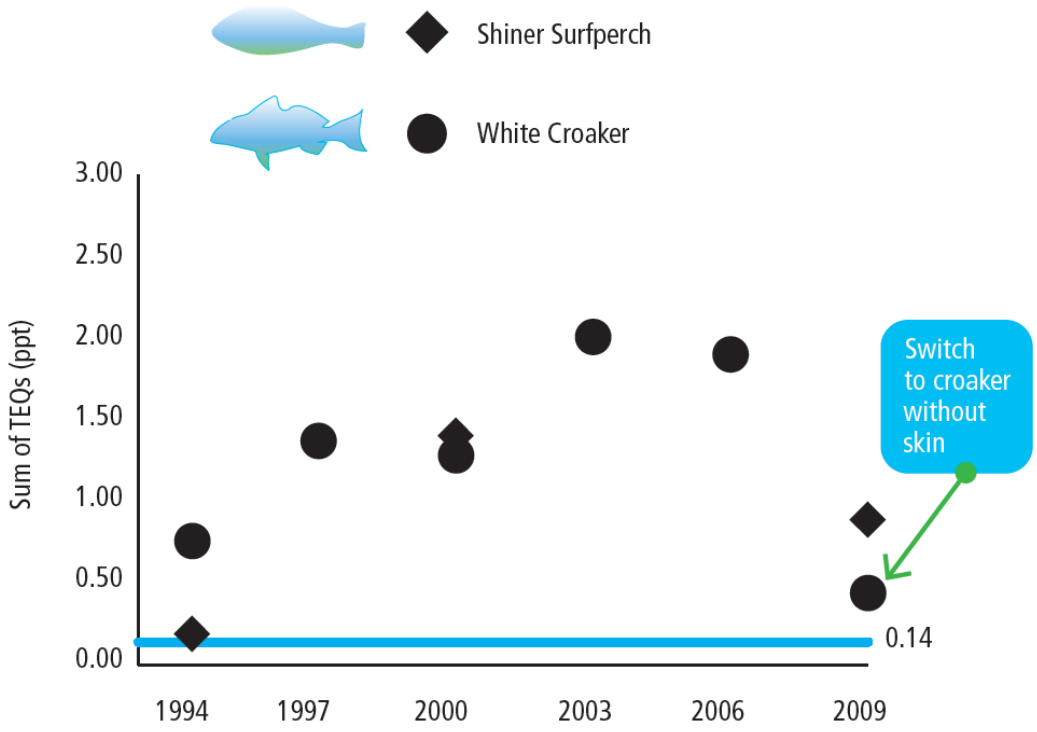
- Review 303(d) listings and establish TMDL development plan or alternative

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 2019. 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 2017 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	2018	2019
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	1,2,3,4,5,6										40		
Loads	Atmospheric Deposition	5,6			20									
RMP Total			0	120	234	26	65	0	24	0	0	40	TBD	TBD
Non-RMP Total			0	0	0	0	0	0	0	0	0	0	TBD	TBD
Overall Total			0	120	234	26	65	0	24	0	0	40	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 South Bay and are attributed to a variety of possible drivers (e.g., decrease in suspended-sediment concentrations, an increase in bivalve predators, and/or dramatic decrease in discharge of toxic pollutants, such as copper and other dissolved metals).
- Decreasing chlorophyll concentrations have been observed in Suisun Bay and the Delta and are attributed to other possible drivers: consumption of phytoplankton by *Corbula* clams after its introduction and wide-spread colonization in 1987, increasing loads and concentrations of ammonium in the upper estuary, and/or impacts of fresh water withdrawals or possibly other toxic pollutant effects.
- 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.

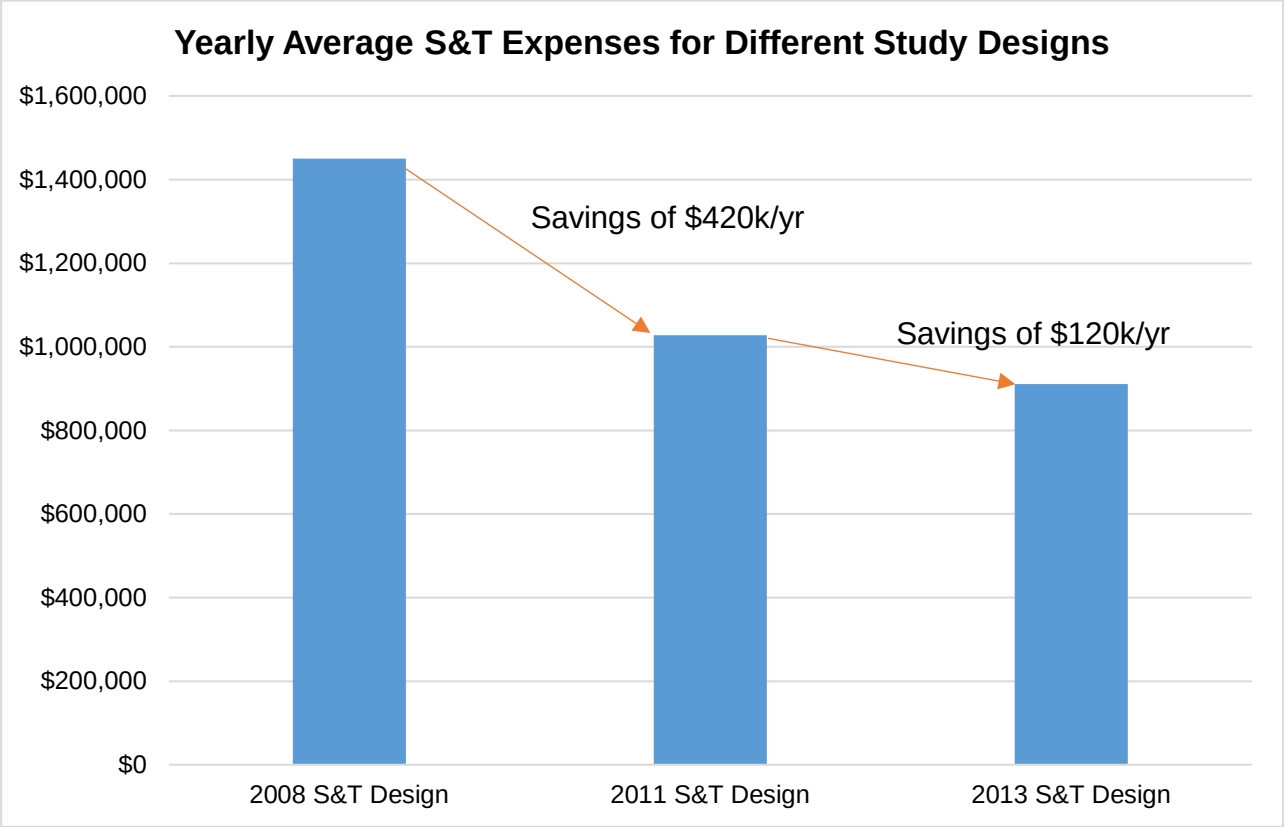
Priority Questions for the Next Five Years

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?

STATUS AND TRENDS: OPTIMIZATION

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, which is being used to study sediment contamination in the Bay margins.



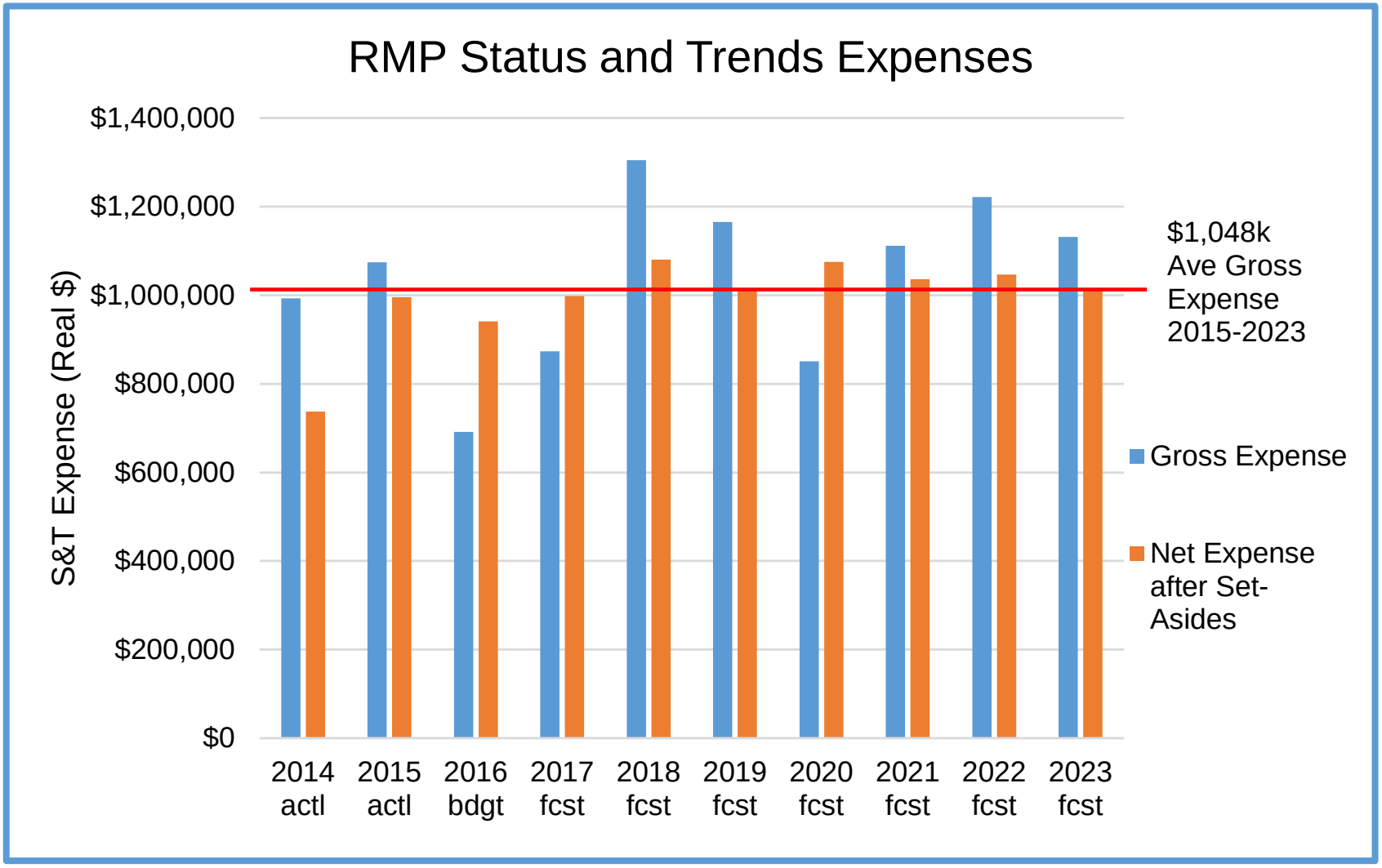
STATUS AND TRENDS: 10-YEAR STUDY DESIGN (2014-2023)

Study design and estimated cost of Status and Trends monitoring. Expenses are expressed as thousands of dollars accounting for inflation. The expense for continuous, sensor-based water quality monitoring by the USGS (top row) does not increase with inflation because these funds are transferred directly to USGS from the U.S. Army Corps. The amount has not changed since 1993. The bottom of the table shows the long-term plan for using set-aside funds to smooth out the cost of S&T between years.

Program	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Actual	Actual	Budget	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast
Continuous: Basic Water Quality (5 targeted sites)	250	250	250	250	250	250	250	250	250	250
Monthly: Basic Water Quality in Open Bay (38 targeted sites)	173	173	223	229	234	240	246	252	259	265
Every 2 Years: Priority Contaminants in Water (5 targeted sites and 17 random sites)	0	60	0	35	0	37	0	39	0	199
Every 2 years: Priority Contaminants in Bivalves (7 targeted sites)	18	0	14	0	15	0	16	0	26	0
Every 3 Years: Priority Contaminants in Bird Eggs	0	150	0	0	162	0	0	174	0	0
Every 4 Years: Priority Contaminants in Open Bay Sediment (7 targeted sites and 20 random sites)	94	0	0	0	220	0	0	0	220	0
Every 5 Years: Priority Contaminants in Sport Fish (7 targeted sites)	231	0	0	0	0	261	0	0	0	0
Bay Margins Studies	0	227	31	129	132	136	139	143	146	150
Field work, Vessel Costs, Archive	228	215	173	230	292	242	199	254	322	267
Gross S&T Total	993	1075	691	873	1305	1166	851	1112	1222	1131
Set Aside Funds Used	417	79	0	0	225	150	0	75	175	120
Set Aside Funds Saved	161	0	250	125	0	0	225	0	0	0
Set Aside Funds Balance	297	218	468	593	368	218	443	368	193	73
Net S&T Funding Needed	738	995	941	998	1080	1016	1076	1037	1047	1011

* 2014-2015 values are actual costs. 2016 values are budgets. 2017-2023 are forecast values using the most recent actual cost and a 2.5% discount rate.

STATUS AND TRENDS: EXPENSES OVER 10-YEAR STUDY DESIGN (2014-2023)



PROGRAM MANAGEMENT

Average budget: $400,000 (12% of the total budget)

Program management includes the following activities:

Program planning
- Preparing the Detailed Workplan and Multi-Year Plan

Contract and financial management
- Tracking expenditures versus budgets
- Developing and overseeing contracts, invoicing
- Providing financial updates to the RMP Steering Committee

Technical oversight
- Internal review by senior staff of reports, presentations, posters, workplans, memos, and other communications

Internal coordination
- Workflow planning
- Tracking deliverables and preparing RMP Deliverables Stoplight and Action items reports
- Staff meetings

External coordination
- 20 meetings with external partners (SCCWRP, Delta RMP, SWAMP, and others) to coordinate programs and leverage RMP funds

Administration
- Office management assistance

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.

A review of RMP governance was conducted in 2014 and a charter for the Program was adopted in 2015. 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.

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 and Strategy teams have been established to address major technical areas and upcoming high priority issues.
- The Steering Committee has taken a more forward-thinking approach in developing an RMP Master Plan and holding an annual planning workshop (beginning in 2010) to provide direction to all of the subcommittees.

Peer Review

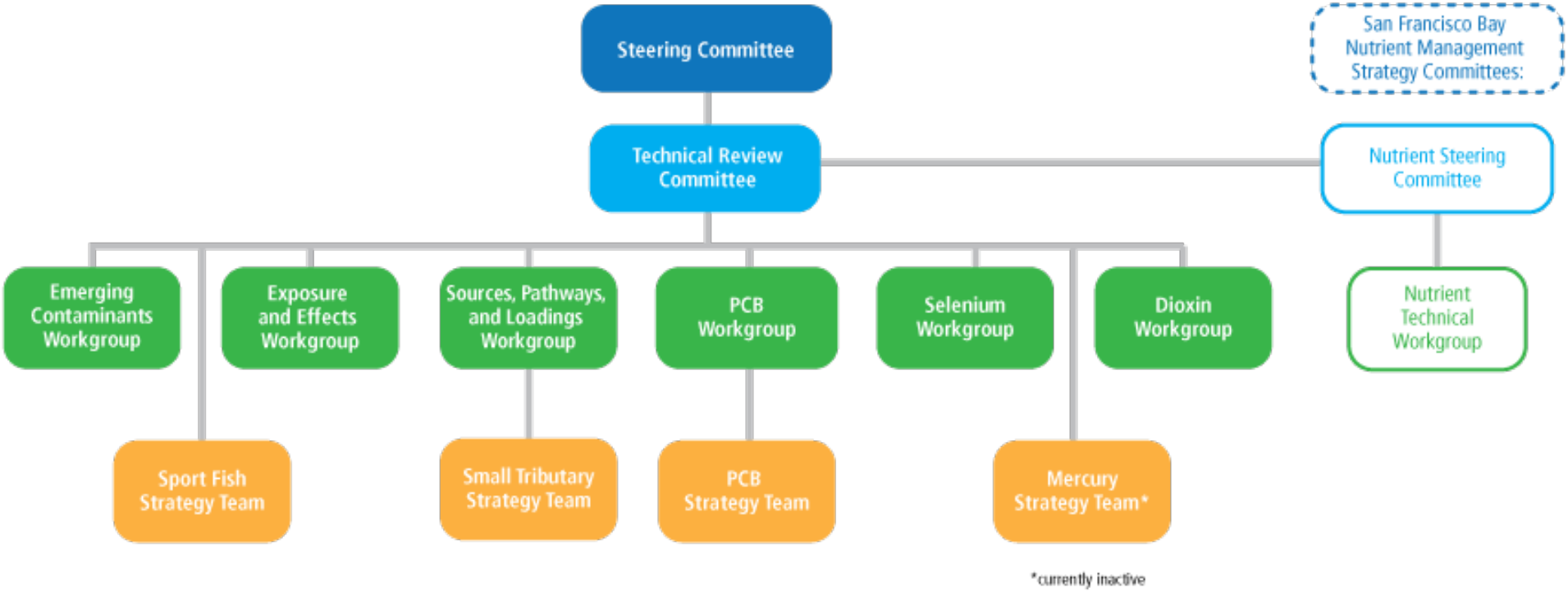
Extensive peer review is a key to the cost-effective production of reliable information in the RMP. This peer review is accomplished through the following mechanisms.
- **Workgroups** include leading external scientists that work with stakeholders to develop workplans and provide feedback on project planning, implementation, and reporting
- The **Technical Review Committee** provides general technical oversight of the Program.
- **Peer-reviewed publications** provide another layer of peer review for most significant RMP studies.

GOVERNANCE

Average budget: $275,000 per year (8% of the total budget)

RMP meetings provide a collaborative forum for communication among regulators, regulated entities, and scientists. This forum is provided by regular meetings of organizational and technical committees to track progress and guide future work. Additional information about the function and activities of each governance group can be found in Figure 1 and 3 in this booklet.

- **Steering Committee** – quarterly meetings to track progress, provide management direction, and track financials
- **Technical Review Committee** – quarterly meetings to provide technical oversight
- **Workgroups** – annual meetings to develop multi-year work plans, guide planning and implementation of special studies and Status and Trends monitoring, and provide peer-review of study plans and reports.
- **Strategy Teams** - stakeholder groups that meet as needed to provide frequent feedback on areas of emerging importance, and develop long-term RMP study plans for addressing these high priority topics. The RMP currently has active strategy teams for sport fish monitoring, small tributary loadings, and PCBs.



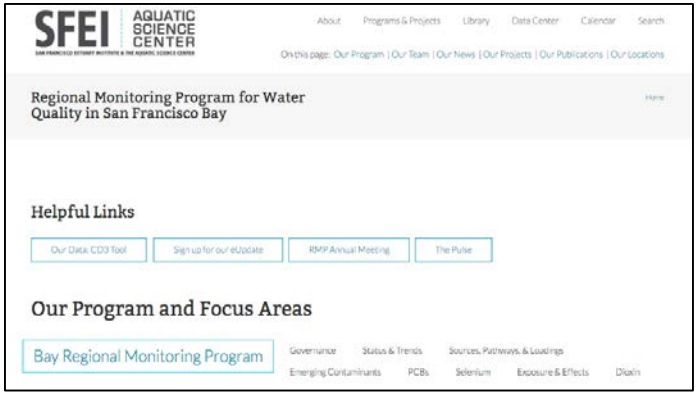
ANNUAL REPORTING & COMMUNICATIONS

Average budget: $350,000-$400,000 per year (10% of the total budget + $50,000 in years when a full Pulse report is produced.)

Includes the Pulse of the Estuary, Annual Meeting, RMP Update, Multi-Year Plan, State of the Estuary report, RMP web site, Annual Monitoring Results, technical reports, journal publications, Estuary News, 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. A target audience for 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

- RMP Update (2016)
- RMP Annual Meeting (2016)
- Pulse of the Estuary (2017)
- RMP Annual Meeting joint with State of the Estuary (2017)
- Continued partnership with SFEP to reach broader audience
- Continued website improvement

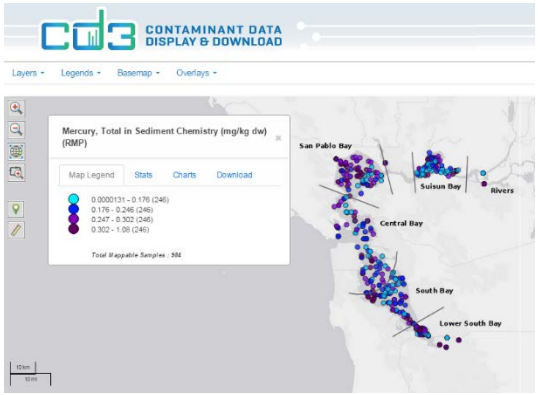
Home page for the new RMP website, released in 2015: www.sfei.org/rmp

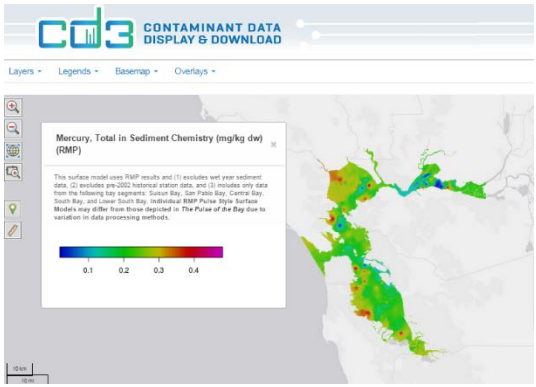
DATA MANAGEMENT AND QUALITY ASSURANCE

Average budget: $330,000 per year (10% of the total budget)

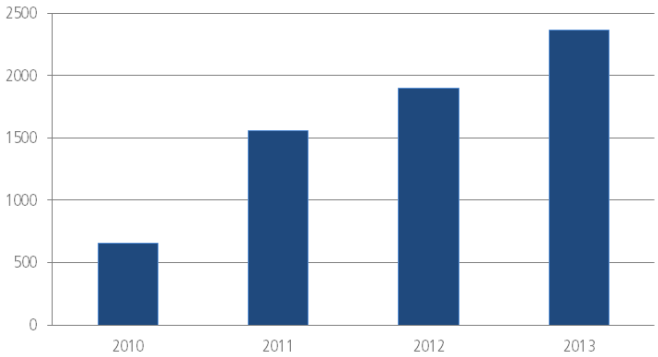
- **Data Management**
  - The RMP dataset contains approximately 1.1 million records since the Program began in 1993. The data are stored in SFEI's Regional Data Center database and are comparable to statewide standards.
    - Data management includes formatting, uploading, and reporting each year's data; managing, maintaining, and improving the RMP dataset 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 in multiple formats as a tabular (Excel, CSV) or spatial (KML or shapefile). 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 that can be customized and downloaded for use in reports and presentations.
    - These platforms are used to make information from the RMP available to water quality managers, stakeholders, scientists, and the public.

- **Quality Assurance**
  - Quality assurance includes QA review of the data that are submitted by the laboratories; development and application of the QAPP; review of data in comparison to data quality objectives and prior results; review of congener ratios; and troubleshooting any problems with the chemical analyses. Occasional special studies to assess sampling methods, analytical methods, or lab performance are conducted.





Data visualizations in CD3 Tool.



The number of external queries performed using CD3 continues to grow each year.

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 Environmental Informatics Program

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

Figures in $000s.

Program	Study	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
RMP Status & Trends	S&T Sediment Triad Monitoring[1]	260	250	250	250		94				220	
RMP Status & Trends	Bay Margins Sediment Monitoring[1]							227	31	129	132	136
RMP Status & Trends	USGS Suspended Sediment Studies	250	250	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		30			
RMP Exposure and Effects	Effects of PAHs on Flatfish	50								TBD		
RMP Exposure and Effects	Hotspot Followup			60	30							
LTMS	Impact of Dredging on Benthos						50			TBD		
LTMS	Sediment Budgets for Subembayments									TBD		
LTMS	Beneficial Reuse of Sediments in Margins and in-Bay									TBD		
LTMS	Ambient SSC in Shallow Margin Areas (using remote sensing)									TBD		

1. 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.

TBD = current priorities based on stakeholder input.

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)
Nutrient Watershed Permit	Characterize nutrients and nutrient-related parameters in the Bay	Contributions to Nutrient Management Strategy studies

RMP STUDIES SATISFYING SPECIFIC PERMIT CONDITIONS

Urban Stormwater

MRP link: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/Municipal/R2-2015-0049.pdf

Policy	Provision	Study or linkage
Municipal Regional Stormwater Permit (MRP)	C.8.f Pollutants of Concern Monitoring	Sources, Pathways, and Loadings Workgroup (SPLWG) / Small Tributary Loading Strategy (STLS) studies on PCBs and Hg and other POCs can fulfill a portion of requirement in conjunction with BASMAA efforts.
		ECWG in collaboration with SPLWG to conduct the required special study for emerging contaminants in stormwater to include at least PFOS, PFOA and alternative flame retardants.
MRP	C.8.g. iii Wet Weather Pesticides and Toxicity Monitoring	Possible linkage to STLS/ SPLWG studies but the details are still to be determined.
MRP	C.11/12.a Implement Control Measures to Achieve Mercury/ PCB Load Reductions	STLS/ SPLWG monitoring efforts will help identify priority watersheds / management areas where coordinated with stormwater program planning.
MRP	C.11/12.b. Assess Mercury/ PCB Load Reductions from Stormwater	STLS/ SPLWG information could be used by stormwater programs to help with refinements and documentation for methodology assessing load reductions
MRP	C.11/12.c. Plan and Implement Green Infrastructure to reduce mercury / PCB loads	STLS/ SPLWG information and the RWSM outputs can help stormwater permittees with quantifying relationships between areal extent of green infrastructure and load reductions.
MRP	C.11/12.d. Prepare Implementation Plan and Schedule to Achieve TMDL Allocations	STLS/ SPLWG information and the RWSM outputs can help stormwater permittees with the development of a reasonable assurance analysis.
MRP	C.12.g. Fate and Transport Study of PCBs: Urban Runoff Impact on San Francisco Bay Margins	PCB Strategy Team will implement required study via the multi-year Bay Margins project to develop Conceptual Models of Priority Margin Units
		STLS/ SPLWG concentrations and loads information is helping to complete the Bay margins mass balance pilot projects that aims to provide information on the fate of PCBs in Urban Runoff and impact on San Francisco Bay margins.