RMP
REGIONAL MONITORING
PROGRAM FOR WATER QUALITY
IN SAN FRANCISCO BAY

sfei.org/rmp

MULTI-YEAR PLAN

2020 ANNUAL UPDATE

FINAL: JANUARY 2020

Contribution Number: 959

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 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 from 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 put forward recommendations for special studies to the Technical Review Committee (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 who then considers this recommendation and makes the final decision on the annual workplan.

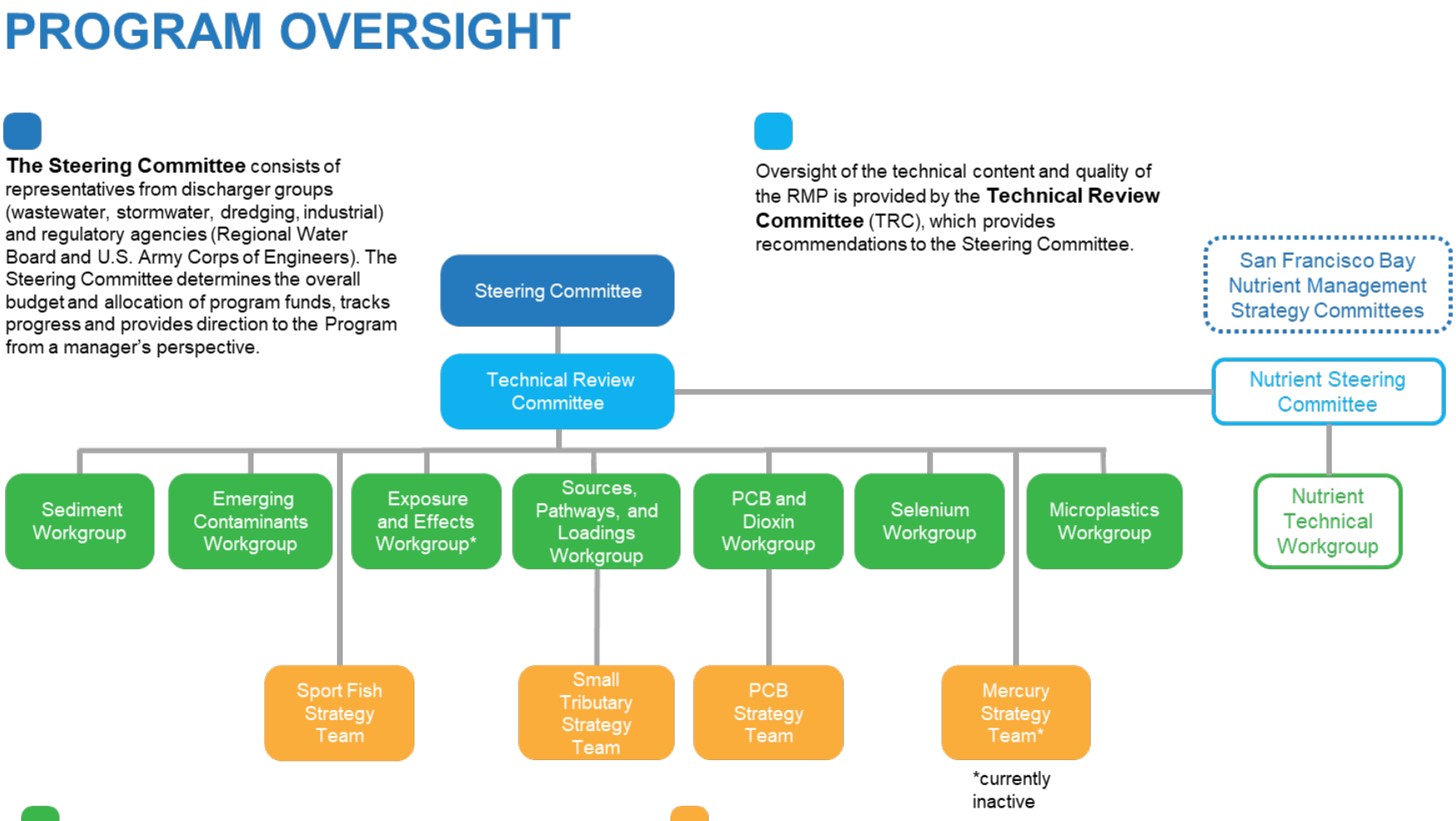
In order to fulfill the overarching goal of the RMP, the Program has to be forward-thinking and anticipate what decisions are on the horizon, so that when their time comes, the scientific knowledge needed to inform the decisions is at hand. Consequently, each of the workgroups and teams develops five-year 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 (Figure 2). In order to turn the plans into effective actions, the RMP distills prioritized lists of management questions that need to be answered (Page 8). The prioritized management questions then serve as a roadmap for scientists on the Technical Review Committee, workgroups, and 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 is achieved through the engagement of stakeholders and scientists in frequent committee and workgroup meetings.



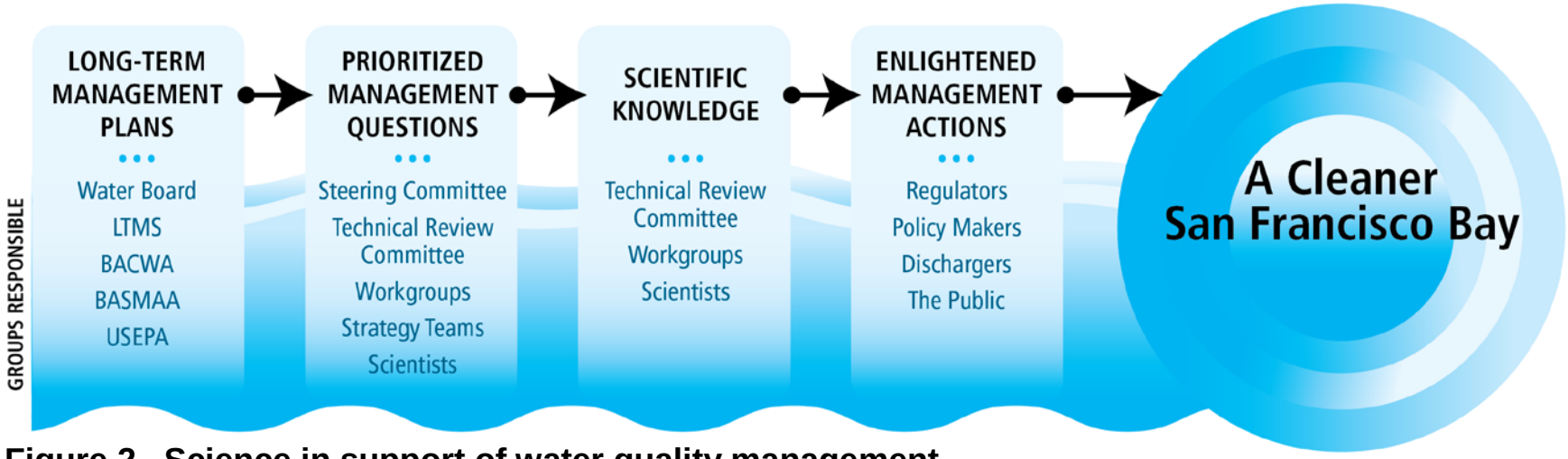


Figure 2. Science in support of water quality management.

Section 2 provides an overview of the RMP budget, 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: emerging contaminants, microplastics, nutrients, PCBs, sediment, selenium, and small tributary loads. Led by the stakeholder representatives that participate in these groups, each workgroup and strategy team develops 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 are 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 the 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 five 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, stormwater discharges, and municipal and industrial wastewater 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).

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

Annual Steering Committee Calendar

- January
  - Approve Multi-Year Plan
  - Review incomplete projects from the previous year
  - Approve annual report outline
  - Pick date for Annual Meeting
- April
  - Plan for Annual Meeting
  - Provide additional planning guidance to workgroups
- July
  - Multi-year Plan: mid-year check-in, workshop planning
  - Approve special studies recommended by the TRC for the next year and update projects list for SEP funding
  - Plan for Annual Meeting
  - Report on SFEI financial audit
  - Briefly discuss fees for year after next
  - Select annual report theme for next year
- October
  - Confirm chair(s) and Charter
  - Multi-Year Planning Workshop
  - Decision on fees for the year after next
  - Approve workplan and budget for next year
  - Approve annual report outline for next year
  - Decision on workshops to be held next year

Each meeting (except October) includes a Science Program Update from a workgroup or strategy team focus area.

Annual Technical Review Committee Calendar

- March
  - Confirm chair(s)
  - Review special studies to ensure coordination
  - Provide planning guidance to workgroups
- June
  - Recommend special studies for funding
  - Review S&T target analyte list, CEC tiers
  - Review plans for Annual Meeting and annual report
- September
  - Prepare for Annual Meeting
  - Review Status and Trends Monitoring Design
- December
  - Review annual report outline for next year
  - Informatics update
  - Present workplan for next year and outcome of Multi-Year Planning Workshop
  - Review intercalibration studies and plans

Each meeting includes feedback on proposed and ongoing studies.

Annual Workgroup Calendar

Workgroups meet annually between April and June to discuss results from prior studies and select proposals to recommend to the TRC and SC for funding the next year.

Multi-Year Calendar: RMP fees are approved in 3-year increments. The most recent approval was for 2019-2021. The dredger fee schedule is reviewed every 3 years. The most recent approval was for 2018-2020. The MOU between SFEI and the Water Board for administering the RMP is amended every two years. The most recent amendment was for 2019-2020.

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

Decisions, Policies, and Actions	Timing
BAY WATERSHED PERMITS (CURRENT & NEXT RENEWAL)	
Municipal Regional Stormwater Permit	2015, 2020*
Mercury and PCBs Watershed Permit for Municipal and Industrial Wastewater	2017, 2022
Nutrient Watershed Permit for Municipal Wastewater	2019, 2024
CURRENT DRIVERS BY TOPIC	
Determination of Wastewater Permit Limits	Ongoing
303(d) List and 305(b) Report Current listings and next cycle	Ongoing
Dredging Permits Bioaccumulation testing triggers and in-Bay disposal thresholds+	2019
Copper Site specific objectives triggers+	2018
Cyanide Site specific objectives triggers+	2018
PCBs Review existing TMDL and establish plan to revise*	TBD
Mercury Review existing TMDL and establish plan to revise*	2020
Selenium North Bay Selenium TMDL EPA Water Quality Criteria South Bay Selenium TMDL	2016 ~2018 ~2020?
Nutrients Nutrient Management Strategy Nutrient Monitoring Program Nutrient Water Quality Objective	Ongoing 2019 2024
Chemicals of Emerging Concern Updates to CEC Tiered Risk Framework Opportunities to inform regional actions and state and federal regulations	Annual Ongoing

Decisions, Policies, and Actions	Timing
Current Use Pesticides EPA Registration Review of fipronil and imidacloprid DPR fipronil mitigation measures	Ongoing
Legacy Pesticides (DDT, Dieldrin, Chlordane) Monitoring recovery	Ongoing
Dioxins Review 303(d) listings and establish TMDL development plan or alternative	2018
Toxicity New state plan on effluent and receiving water toxicity (schedule depends on State Water Board)	2019
Sediment Hot Spots Review 303(d) listings and establish TMDL development plan or alternative Phase 2 Sediment Quality Objectives (Human Health)	2018, 2022 2018
Long-Term Management Strategy for Placement of Dredged Material Regional Sediment Management Strategy	Ongoing
Pathogens Bay Beaches Bacteria TMDL Amend TMDL to add 2017 listings State Board Bacteria Objectives	2016 2019 2018
Suisun Marsh Establish TMDL for DO, mercury, nutrients, salinity	2018
POTENTIAL FUTURE DRIVERS	
Wetland Restoration Permits Regional wetland monitoring (under development)	2020
Trash and Microplastic	2021
Changes in salinity, temperature, pH, and dissolved oxygen due to climate change	TBD
Effects of reduced wastewater and stormwater inputs to the Bay	TBD

+ Comparisons to triggers will be updated on the RMP sampling frequency (every 4 years for sediment, every 2 years for water)

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

RMP Outcomes (as of February 2019)

Legislation

- CA Flame Retardants in Consumer Products (2018)
- CA Pharmaceutical Stewardship (2018)
- SF Flame Retardant Ordinance (2017)
- Palo Alto & San Francisco expanded polystyrene ordinances (2015, 2016)
- CA Microbead Ban (2015)
- US Microbead Ban (2015)
- CA Copper in Brake Pads (2010)
- CA PBDE Ban (2003)

NPDES Regional Permits

- *Municipal and industrial wastewater*
  - Mercury and PCBs (2017)
- *Municipal stormwater*
  - MRP 2.0 (2015)
  - MRP 1.0 (2010)

Regulations

- CA Safer Consumer Products Regulations (ongoing)
- CA Fipronil Application (2017)
- CA Flame Retardants in Furniture (2013)
- CA Pyrethroid Application (2012)

TMDLs

- Selenium (2016)
- PCBs (2009)
- Mercury (2008)
- Urban Creeks Diazinon and Pesticide-Related Toxicity (2007)

Water Quality Objectives

- Copper and Nickel (North of Dumbarton) (2010)
- Copper and Nickel (North of Dumbarton) (2002)

San Francisco Bay 303(d) List Updates

- 2018
- 2010
- 2006
- 2002
- 1998
- 1996

Phase-outs

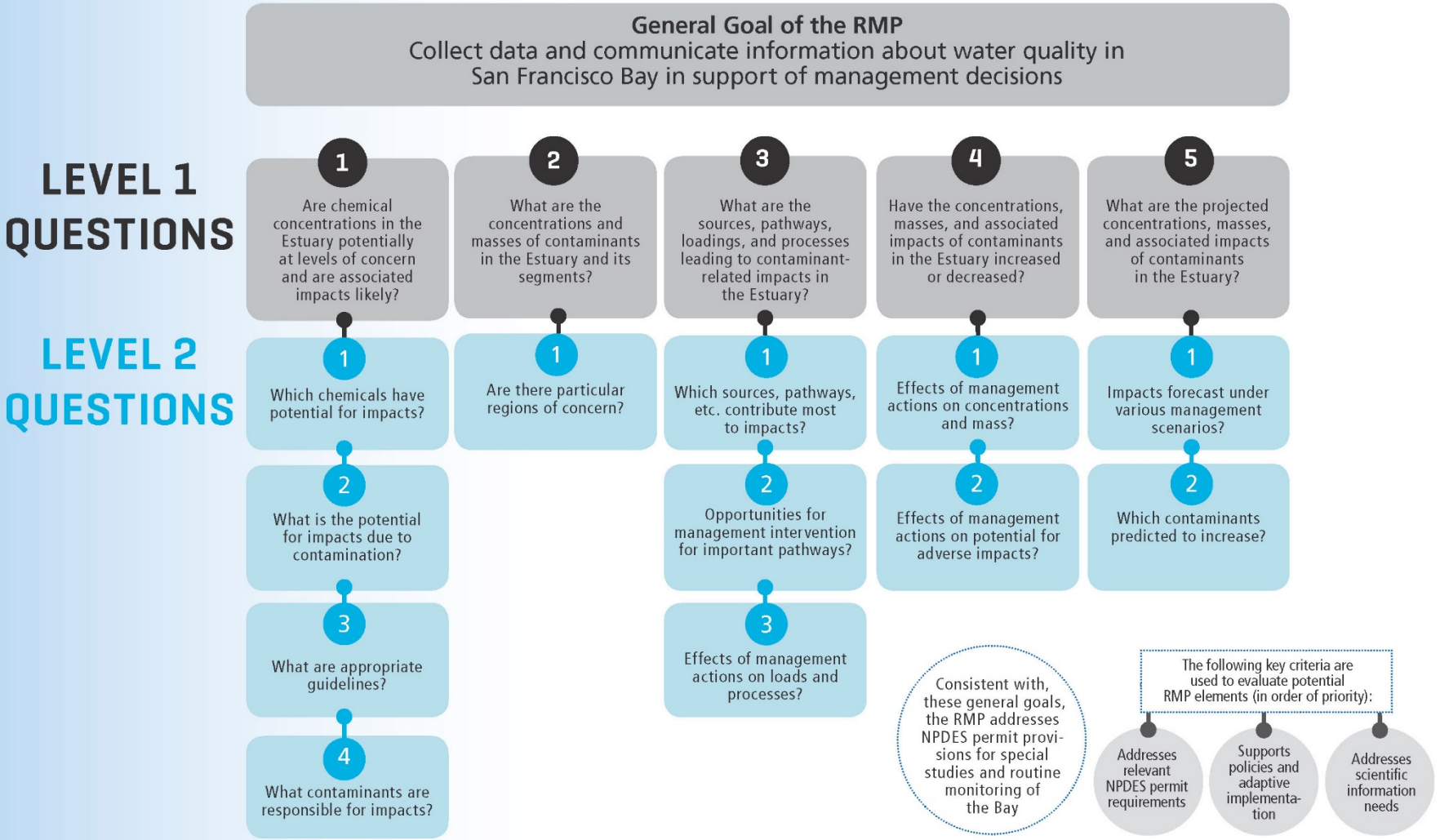
- US PFOA (2015)
- US Deca-BDE (2013)
- US PFOS (2002)

Fish Advisory

- SF Bay (2011)

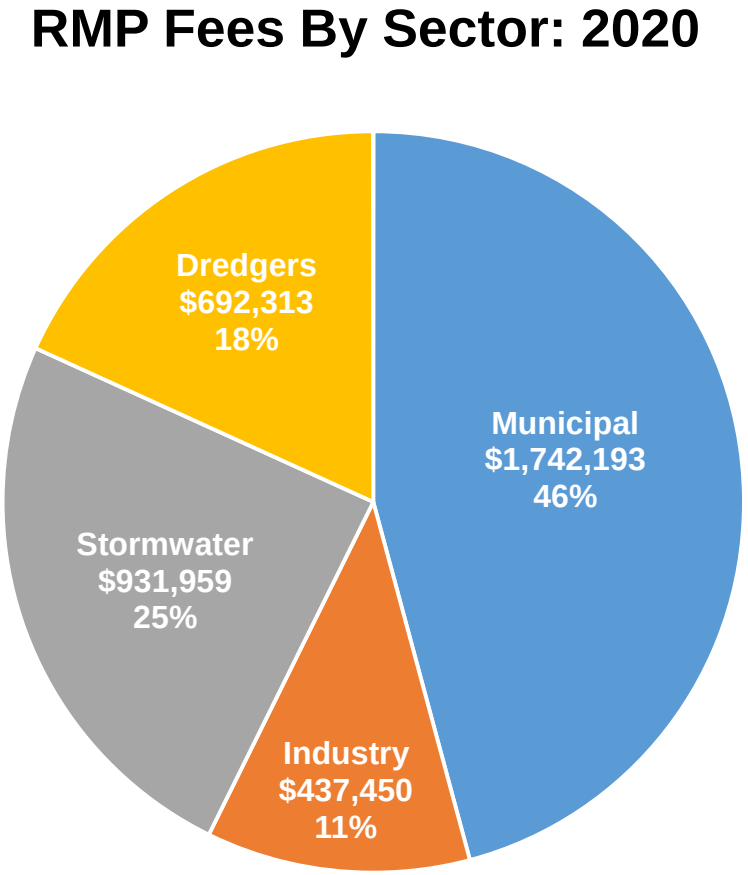
RMP GOAL AND MANAGEMENT QUESTIONS

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.



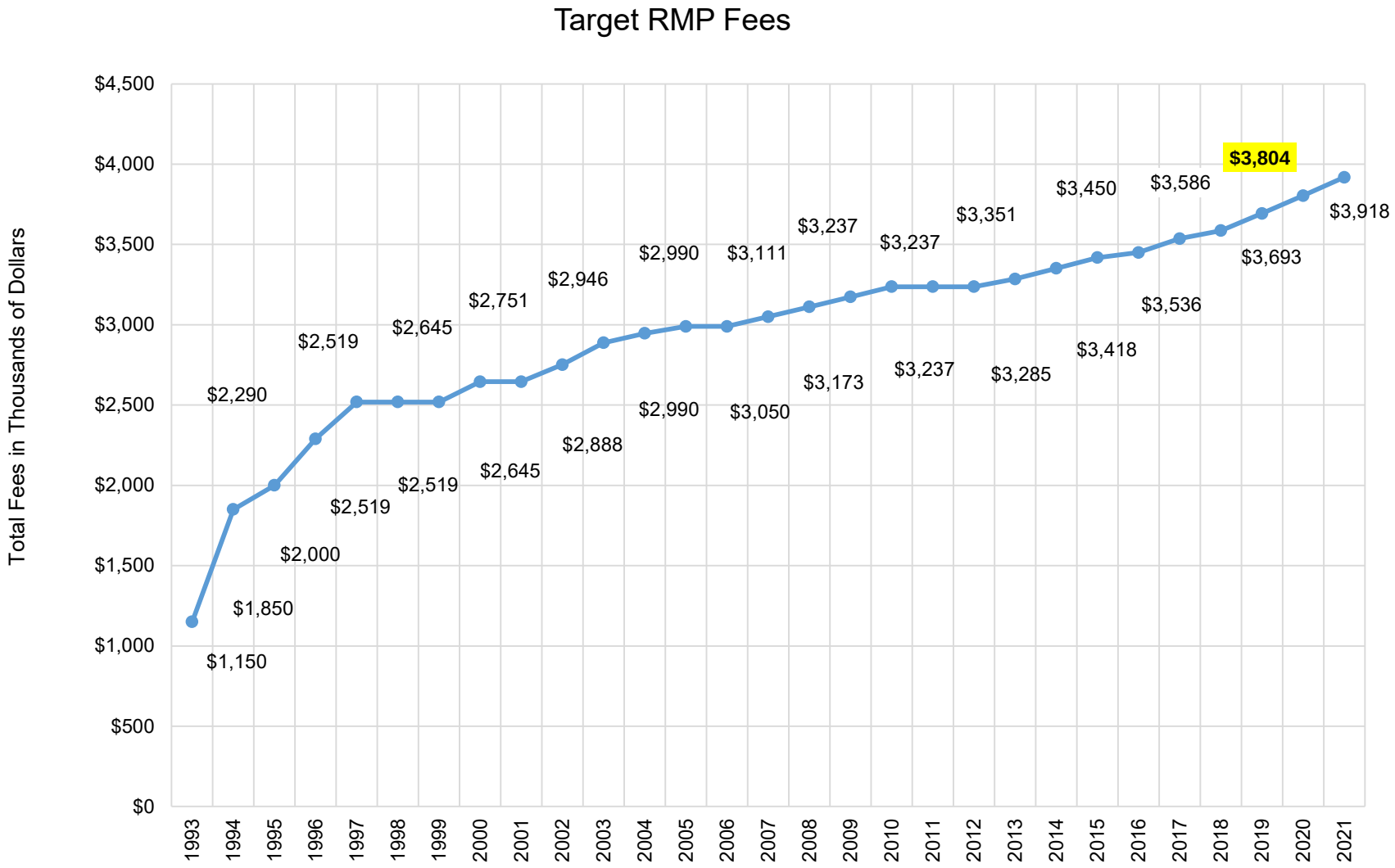
BUDGET: Revenue by Sector

RMP fees are divided among four major discharger groups. Total fees in 2020 will be $3.803 million. Municipal wastewater treatment agencies are the largest contributor, and stormwater agencies are the second largest contributor. 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. In addition to fees, the RMP also receives penalty funds for Supplemental Environmental Projects and Alternative Monitoring Requirement funds from municipal wastewater agencies.



BUDGET: Revenue by Year

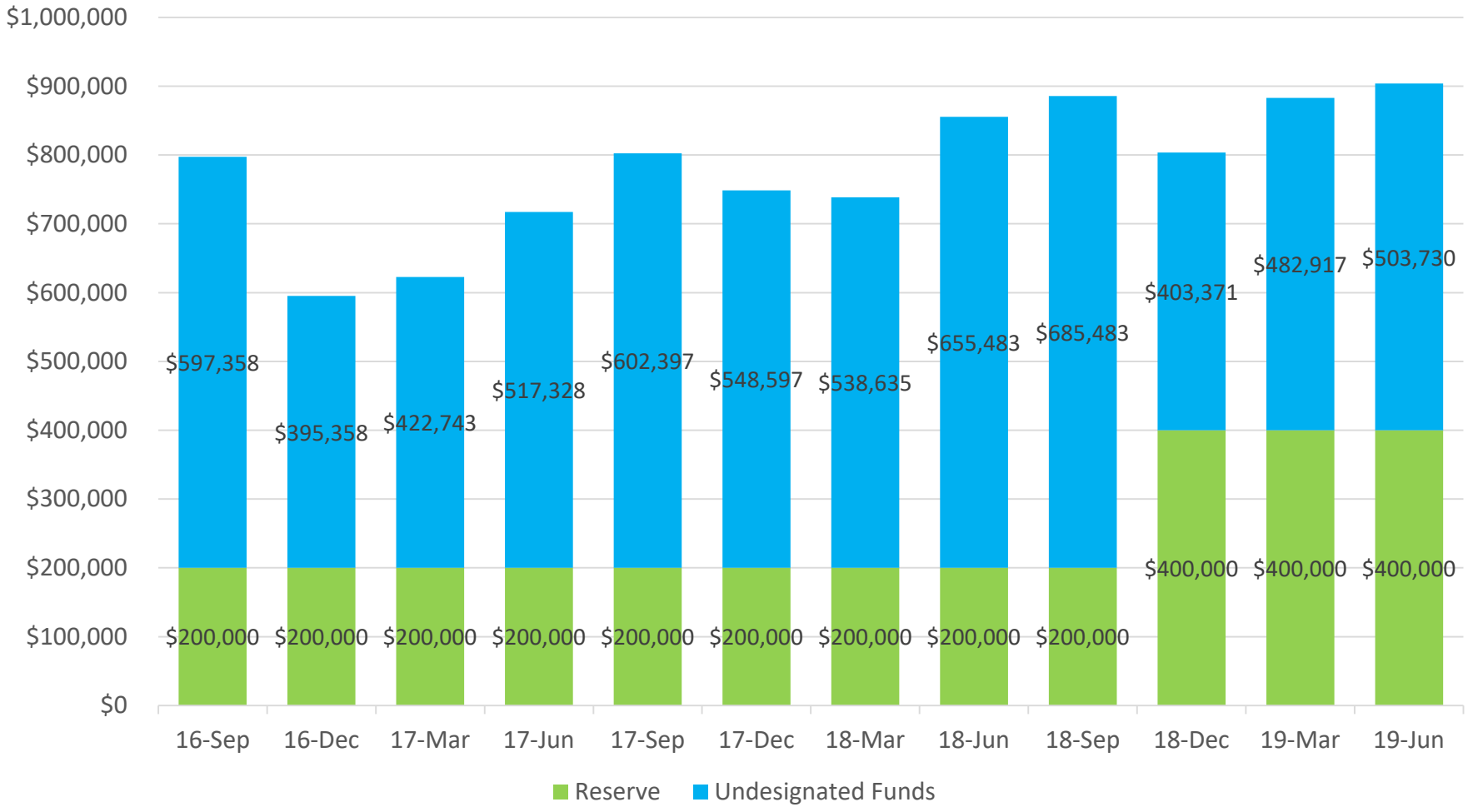
Target RMP fees in 2020 are $3.803 million. For 2019-2021, the Steering Committee has approved 3% per year increases in fees. Over the past 20 years, RMP fee growth has not kept up with inflation.



BUDGET: Reserve Funds

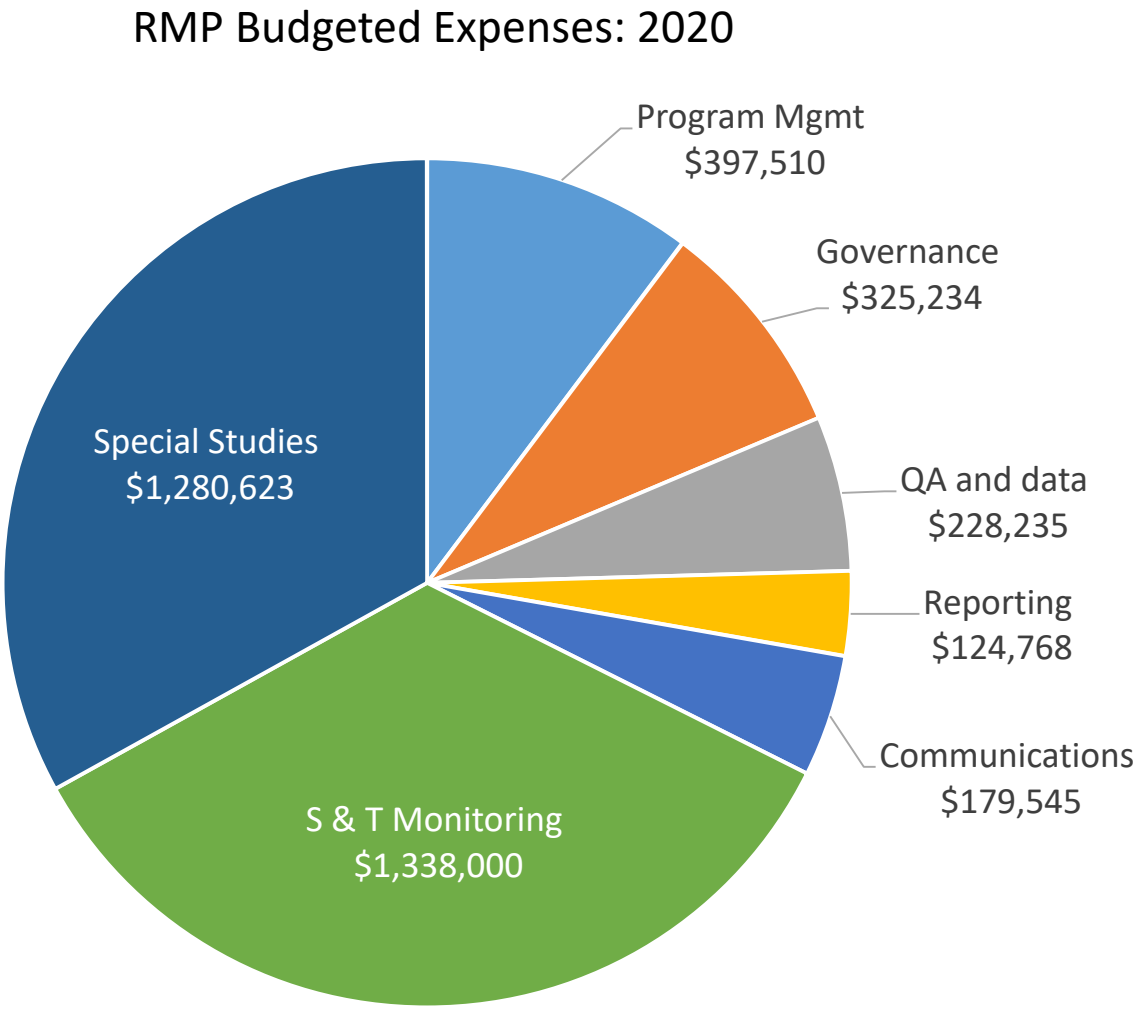
The RMP maintains a balance of Undesignated Funds for contingencies. Higher than anticipated revenues and elimination or reduction of lower priority elements sometimes leads to accumulation of funds that can be used for high priority topics at the discretion of the Steering Committee.

The Bay RMP Undesignated Funds balance over the past two budget years is shown below. The height of the bar shows the total balance of the Undesignated Funds. The bars are color coded to indicate the RMP policy that $400,000 of the Undesignated Funds should be held as a Reserve. The Steering Committee increased the Reserve amount from $200,000 to $400,000 in 2018 so that it is now approximately 10% of the annual Program budget.



BUDGET: Expenses

Each year, approximately 70% of the budget is spent on monitoring and special studies. Quality assurance and data systems, reporting, and communications are each approximately 5% of the budget. Governance meetings (8%) are critical to ensure that the RMP is addressing stakeholder needs and conducting studies that include peer-review from project planning through report preparation. Finally, 12% of the budget is needed for program management, including fiduciary oversight of contracts and expenditures.



ACTUAL AND FORECAST BUDGETS: Special Studies 2016-2023

RMP actual and planned expenditures on special study topics. Costs for 2016-2020 are the approved budgets. Costs for 2020 and beyond are estimates for planning based on the most recent input from the Workgroups and Strategy Teams. The funds available for 2020-2023 were estimated by assuming RMP revenue will increase by 3% per year, subtracting estimated programmatic expenses (pages 13-30), and subtracting estimated Status and Trends monitoring costs (page 32).

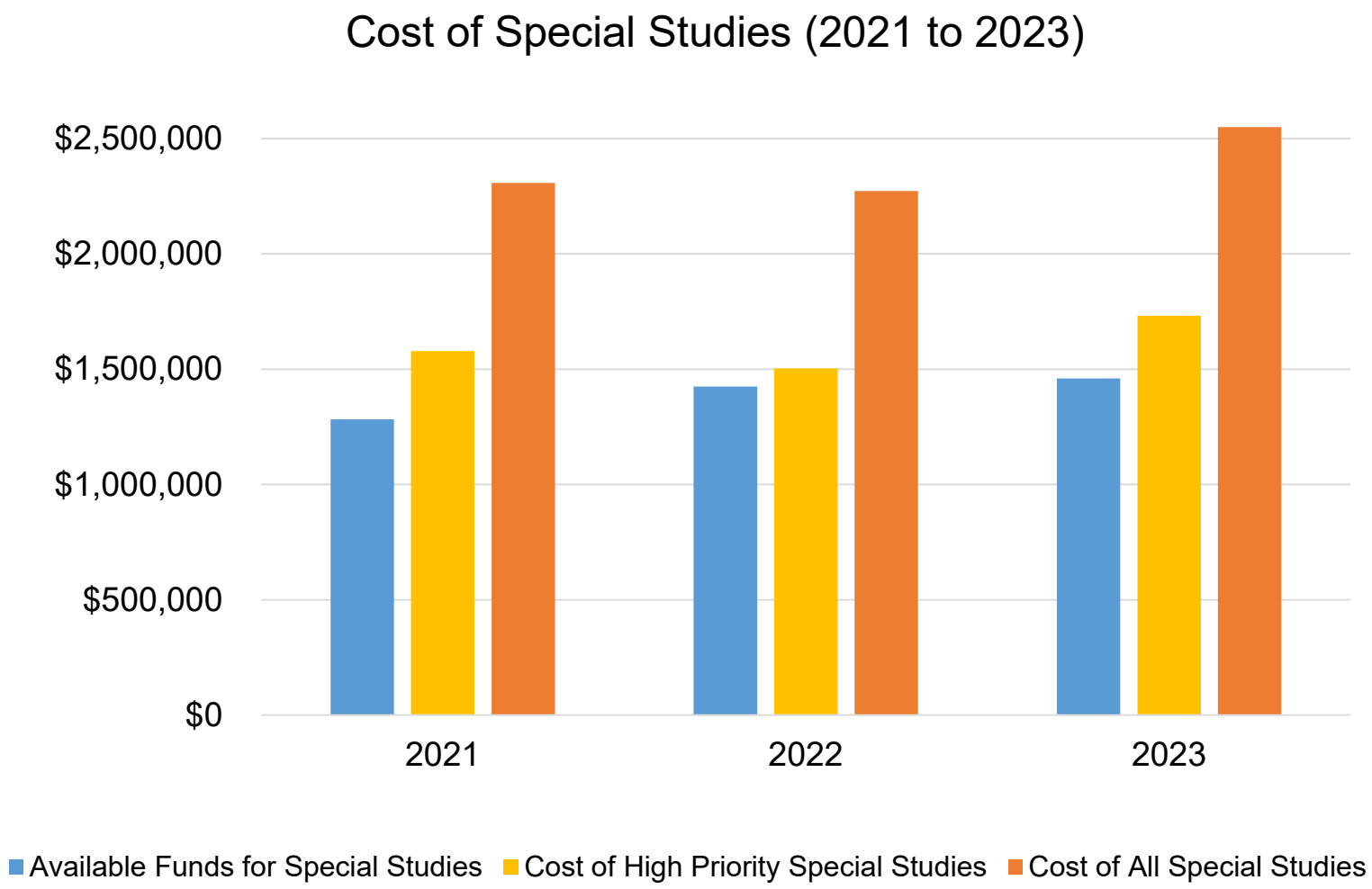
FOCUS AREA	2016	2017	2018	2019	2020	2021	2022	2023
	Budget	*Budget*	*Budget*	*Budget*	*Budget*	*Planning*	*Forecast*	*Forecast*
Emerging Contaminants	$130,000	$284,835	$366,000	$325,000	$327,900	$486,000	$849,000	$945,000
Exposure and Effects	$35,000	$55,000	$61,000	$0	$0	$0	$0	$0
Microplastic	$25,000	$75,000	$46,000	$30,000	$50,000	$190,000	$310,000	$235,000
Nutrients	$300,000	$373,000	$350,000	$250,000	$250,000	$400,000	$400,000	$400,000
PCBs	$40,000	$70,000	$31,000	$40,000	$101,000	$110,000	$164,000	$108,000
Sediment	$33,000	$90,000	$215,000	$215,000	$180,500	$330,000	$450,000	$355,000
Selenium	$47,000	$106,000	$10,000	$107,000	$84,000	$107,000	$249,000	$207,000
Small Tributaries	$311,000	$410,000	$302,000	$275,000	$287,000	$470,000	$500,000	$500,000
SPECIAL STUDIES TOTAL	**$921,000**	**$1,515,835**	**$1,381,000**	**$1,242,000**	**$1,280,623**	**$2,093 ,000**	**$2,922,000**	**$2,750,000**
PREDICTED SPECIAL STUDIES BUDGET TOTAL						**$1,282,082**	**$1,424,835**	**$1,459,480**
Predicted RMP Core Budget for Special Studies						$1,012,082	$1,154,835	$1,189,480
Predicted AMR Funds						$270,000	$270,000	$270,000

*The estimated RMP budgets on this table do not cover all of the funding needs for the Nutrients Management Strategy and Small Tributary Loading Strategy. Funding for these strategies is partially provided from other sources.

In 2016, the RMP became eligible to receive penalty funds for Supplemental Environmental Projects. Wastewater agencies also began to provide the RMP with Alternative Monitoring Requirement (AMR) funds for additional emerging contaminants studies. These new funding streams will augment the core RMP budget for special studies. The AMR funds are tied to a permit condition so the amount is predictable. The SEP funds are not predictable. Therefore, only AMR funds have been included in the predicted special studies budget total in the table above.

PROJECTED BUDGET: SPECIAL STUDIES 2021 to 2023

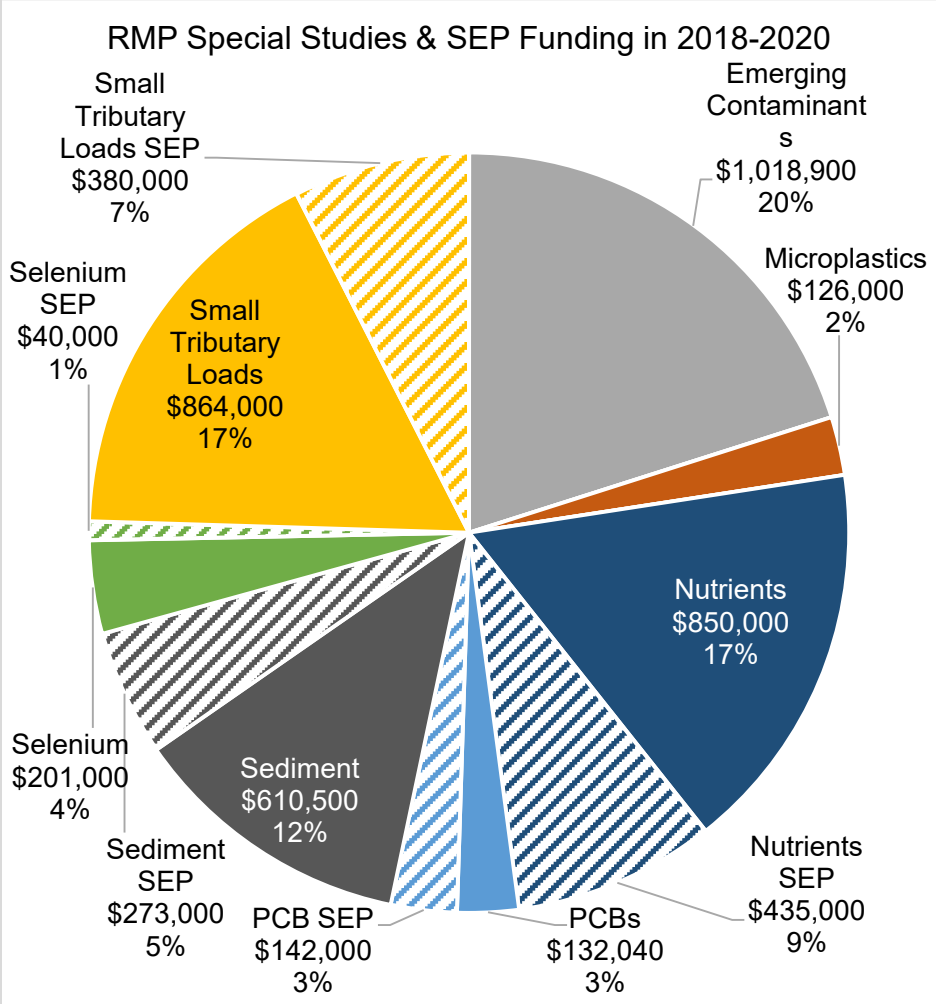
Projected funds available for special studies for 2021-2023 (blue), the cost of high priority studies identified for 2021 (yellow), and the cost of all special studies in the preliminary plans for each workgroup (orange). High priority studies for 2021 and 2022 are estimates and have not yet been selected by the workgroups.

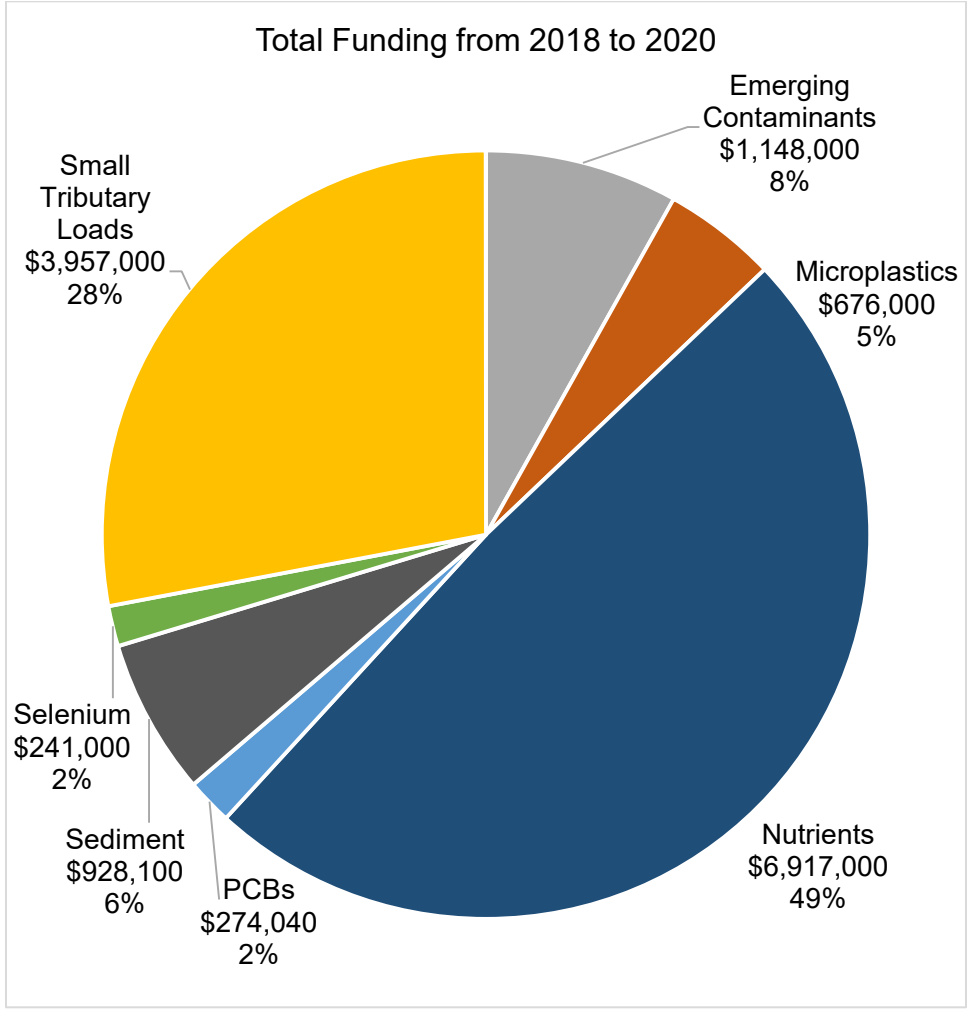


BUDGET: Special Studies 2018-2020

Special Studies and Supplemental Environmental Projects funds over the past three years. Total funds: $6,819,835

Total funding for Special Studies over the past three years, including Supplemental Environmental Projects, Alternative Monitoring Requirements, RMP partner funding, and external funding. Total funds: $14,992,023





Fishing on the Bay. Photograph by Shira Bezalel.

EMERGING CONTAMINANTS

Relevant Management Policies and Decisions

Regional Action Plans for emerging contaminants

Early management intervention, including green chemistry and pollution prevention

State and federal pesticide regulatory programs

Recent Noteworthy Findings

Due to recent detections of bisphenols and organophosphate esters in Bay waters in the range of thresholds for protection of aquatic life, bisphenols and organophosphate esters were moved from the Possible Concern risk category to Moderate Concern in the Bay. Both compound classes are endocrine-disrupting classes of synthetic compounds that are manufactured in high volumes, water soluble, and not effectively removed via traditional wastewater treatment processes. Imidacloprid, a popular insecticide, was also detected at concentrations comparable to toxicity thresholds, and was also classified as Moderate Concern.

In the summer of 2017, the RMP measured pesticides and other emerging contaminants in water samples from 12 stations in the margins of South Bay. Findings from this study provided additional support for the RMP's designation of fipronil as a Moderate Concern contaminant.

PFOS concentrations in cormorant eggs from the South Bay have varied considerably. PFOS concentrations in cormorant eggs in the South Bay may be of concern because concentration levels were similar to field studies indicating approximately 50% reduction in hatching success of tree swallows.

In 2017, due to the declines in multiple indicators (bird eggs, bivalves, sport fish, and sediment) and resolved uncertainties about risks to humans and wildlife, PBDEs were reclassified by the RMP from a moderate concern to a low concern for the Bay. This represents a success of management actions that phased-out and banned PBDES in the mid-2000s. Bay data collected since 2017 continue to support the Low Concern classification for these contaminants.

Priority Questions for the Next Five Years

1. Which CECs have the potential to adversely impact beneficial uses in San Francisco
2. What are the sources, pathways and loadings leading to the presence of individual CECs or groups of CECs in the Bay?
3. What are the physical, chemical, and biological processes that may affect the transport and fate of individual CECs or groups of CECs in the Bay?
4. Have the concentrations of individual CECs or groups of CECs increased or decreased in the Bay?
5. Are the concentrations of individual CECs or groups of CECs predicted to increase or decrease in the future?
6. What are the effects of management actions?

MULTI-YEAR PLAN FOR EMERGING CONTAMINANTS

Special studies and monitoring in the RMP from 2014 to 2023. Numbers indicate budget allocations in $1000s. Budgets in parentheses represent funding or in-kind services from external sources. Items highlighted in blue are additions and changes from the multi-year plan approved in 2019.

Element	Study	Funder	Questions addressed	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
CEC Strategy				20	20	48	50	65	70	75	65	80	65
MODERATE CONCERN CECs													
PFOS/ PFASs	Perfluorinated Compounds in Harbor Seals	RMP	1,4,6	26									
	Sediment, Effluent Precursor Monitoring	AXYS	1,2	(30)									
	CECs in Municipal Wastewater[1]	RMP	1,2,4		27.5								
	Effluent TOP Analysis	DTSC	1,2,4,6		(50)								
	Perfluorinated and Polyfluorinated Compounds in San Francisco Bay: Synthesis and Strategy	RMP	1-6				56						
	Margin Sediment Archiving	RMP	1					2.5					
	PFOS/PFOA Bay Model Development	Interwaste	1,2,3,5					(7)					
	Stormwater PFASs[2]	RMP	1,2						33	40	39		
	North Bay Margin Sediment PFAS										40		
	Harbor Seal PFAS	RMP	1,2,4,6									40	
	PFASs in Ambient Bay Water	RMP	1,4,6								65		
	Air Deposition PFASs	RMP	1,2									100	
	PFASs in Sewershed and Effluent	RMP	1,2,4										100
	RMP Status and Trends[3]	RMP S&T	1,4	F		E		E	F		E		
NP/NPEs	Margin Sediment Archiving, Analysis	RMP	1,4					2.5					
	Stormwater Ethoxylated Surfactants[2]	RMP	1,2						33	40	39		
	Ethoxylated Surfactants in Water, Margin Sediment, and Wastewater	RMP	1,2,4						123				

Element	Study	Funder	Questions addressed	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Archived Tissue	RMP	1,4									100	
Fipronil	CECs in Municipal Wastewater[1]	RMP	1,2,3		27.5								
	Fipronil, Fipronil Degradates, and Imidacloprid in Municipal Wastewater	RMP	1,2,3			30							
	Fipronil, Fipronil Degradates, and Imidacloprid in Biosolids	ASU	1,2,3			(8)							
	Conceptual and Quantitative Model	RMP	1,2,3,6										70
	RMP Status and Trends[3,4]	RMP	1,3,4	S				S	F			S	
LOW or POSSIBLE CONCERN CECs													
PBDEs	RMP Status and Trends[3]	RMP S&T	1,3,4	S, B, F		B, E		S, E	F		E	S	
Alt. Flame Retardants	Monitoring Alternative Flame Retardants in SF Bay Water, Effluent, Stormwater, Sediment and Biota	RMP	1,2,4	104									
	Phosphate Flame Retardants in Ambient Bay Water	RMP ECCC	1,4	(2)			47				60		60
	Stormwater Phosphate Flame Retardants[2]	RMP	1,2						33	40	39		
	Conceptual and Steady-State Model[6]	RMP	1,2,3,6									94	
	Brominated Flame Retardants in Bay Matrices	RMP	1,4										80
Pharmaceut-icals	Pharmaceuticals in Wastewater	RMP POTWs	1,2,4			(68)		30					
	Antibiotics and QACs in Surface Sediment and Cores	U Minn	1,3,4					(8)					
	Pharmaceuticals in Water & (Archived) Sediment	RMP	1,2,4										180
Plastic Additives	Bisphenols in Bay Water	RMP SIU	1		(25)		50				50		50
	Bisphenols in Sport Fish, Bivalves	RMP	1									80	
	Phthalates in Bay Matrices	RMP	1,4								70		
	Bisphenols in Wastewater and	RMP	1							72			

Element	Study	Funder	Questions addressed	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Sediment												
	Bisphenols in Stormwater	RMP								21	30		
Personal Care/ Cleaning	Siloxanes in Bivalves	ECCC	1	(5)									
	Triclosan in Small Fish	RMP	1				41						
	Musks in Water & Sediment[5]	RMP	1					64.5					
	Siloxanes in Sediment and Effluent	SWEAM DTSC	1,2					(15)					
	Sunscreen Chemicals in Wastewater (~$50K)	MMP	1,2							36.5			
	New Concerns in Bay Water, Wastewater	RMP	1,2										80
Pesticides	Imidacloprid, Imidacloprid Degradates and other Neonicotinoids in Ambient Bay Water	RMP	1				40						
	DPR Priorities in Water & Sediment[5]	RMP USGS	1,2,3					64.5 (6.8)					
	Agricultural Pesticides in Water & Sediment – coordinated with North Bay Margins (~$100K)	SEP proposal	1,2										
	Wet Season Monitoring of Current-Use Pesticides and Imidacloprid	RMP	1,2										100
SDPAs/ BZTs	Water, Sediment	ECCC	1	(3)									
OH-BDEs / Triclosan	Water, Sediment Cores	U Minn	1,3,4	(125)									
PHCZs	Sediment, Tissue	SIU	1		(15)	(20)	(40)						
Brominated Azo Dyes	Archived Sediment, Tissue	RMP	1								60		
Construction / Building	Isothiazolinone Biocides and Other Contaminants in Stormwater (~$50K)	U Iowa SEP Proposal	1,2						(2)				
NON-TARGETED & OTHER STUDIES													
Non-targeted	Non-targeted Analysis of Water-soluble CECs	RMP / Duke / AXYS	1,2			52 (10)							

Element	Study	Funder	Questions addressed	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
						(6)							
	Non-targeted Analysis of Sediment	RMP	1,2					101					
	Follow-up Targeted Study, Stormwater[2]	RMP	1,2						33	40	39		
	Tissue (Polar and Nonpolar Compounds)	RMP	1								75	75	
	Follow-up Targeted Study (2018 sediment results)	RMP	1									100	
	Non-targeted Analysis of Runoff from North Bay Wildfires	RMP DTSC Water Board Duke	1,2					36 (20) (27) (3)					
	Trash Hot Spots Study	RMP	1									120	
	Follow-up Targeted Study (2022 biota)	RMP	1										100
Other	Toxicology	RMP	1						15		60	60	60
RELEVANT STUDIES IN OTHER WORKGROUPS													
Bioassay (EEWG)	Linkage of In Vitro Estrogenic Assays with In Vivo End Points	RMP SCCWRP UF	1,2	56 (125)			45						
RMP-funded Special Studies Subtotal - ECWG				**150**	**75**	**130**	**284**	**366**	**325**	**328**	**731**	**849**	**945**
High Priority Special Studies for RMP funding											**486**	**489**	**515**
RMP-funded Special Studies Subtotal – Other Workgroups				**56**	**0**	**0**	**45**	**0**	**0**	**0**			
RMP Supplemental Environmental Project Subtotal				**0**	**0**	**0**	**0**	**0**	**0**				
Pro-Bono & Externally Funded Studies Subtotal				**165**	**90**	**112**	**90**	**37**	**2**				
OVERALL TOTAL				**371**	**165**	**242**	**419**	**403**	**327**	**328**	**731**	**849**	**945**

1 – The 2015 CECs in Municipal Wastewater study was a $55k study that included analyses of PFOS/PFAS and fipronil; in this table the budget for this study has been split between these two contaminant groups.
2 – The proposed multi-year (2019-2021) stormwater study includes four sets of analytes: PFASs, ethoxylated surfactants, phosphate flame retardants, and followup target stormwater analytes identified via non-targeted analysis. The total cost ($448k) is spread across the four analyte groups and three years of study.
3 – When a CEC is proposed for inclusion in the the RMP Status and Trends monitoring, there is a letter in the cell denoting the matrix for which monitoring is proposed: W = water; S = sediment; B = bivalve; E = eggs; F = fish.

4 – Analysis of fipronil and fipronil degradates in sediment has been added to the RMP Status and Trends monitoring effort for 2018.
5 – The 2018 CECs in Municipal Wastewater study was a $129k study that included analyses of pesticides and fragrance ingredients; in this table the budget for this study has been split between these two contaminant groups.

MICROPLASTIC

Relevant Management Policies and Decisions

Regional bans on plastic bags, foam packaging materials, and plastic straws

Proposed bans on single-use plastic

State and Federal bans on microbeads

Trash TMDL

Potential for public outreach and education regarding pollution prevention for microplastics and macroplastics that can disintegrate to microplastics

Microplastics

Commonly defined as plastic particles smaller than 5 mm, and ranging shape and size. Microplastics include fragments, fibers or fiber bundles, pellets or spheres, films, and foam.

Recent Noteworthy Findings

In late 2016, with a generous grant from the Gordon and Betty Moore Foundation ($968,000) and additional financial support from the RMP, EBMUD, City of Palo Alto, Patagonia, the Virginia Cabot Wellington Foundation, and the Ocean Protection Council, SFEI and the 5 Gyres Institute embarked on a three-year comprehensive study of the San Francisco Bay and the adjacent National Marine Sanctuaries to provide scientific information to answer many of the questions outlined in the RMP Microplastic Strategy (2017). The project team evaluated Bay surface water, sediment, prey fish, and coastal ocean waters for microplastics. Two pollution pathways were also evaluated, urban stormwater runoff and treated wastewater effluent.

Microplastics were detected in all matrices. In comparison to the literature, elevated concentrations were observed in surface water and sediment.

Microplastics were detected in prey fish, suggesting they are entering Bay food webs. Microplastics have been shown to transfer up food chains and cause adverse effects in fish, but the magnitude and types of effects are difficult to predict.

Nearly half of the particles identified in stormwater were black fragments that had a distinctive rubbery texture when handled with tweezers. Spectroscopic analysis and secondary characteristics suggested these particles may be synthetic or natural rubber. This identification is not definitive, as other techniques beyond the scope of this project are needed to confirm the particle composition. The literature suggests that one potential source of these particles is vehicle tire wear. Analysis of a small subset of these particles using pyrolysis has indicated that they were tire tread particles, supporting this hypothesis.

Using the Regional Watershed Spreadsheet Model, the annual discharge via stormwater from small tributaries was estimated to be 7 trillion microplastics. This estimated load is approximately 300 times greater than the estimated annual effluent load from all wastewater treatment plants discharging into the Bay.

Key data gaps remain, including additional information on sources and pathways of microplastics, the exposure of Bay aquatic organisms and risk for adverse impacts, and the effects of current and future solutions implemented to reduce microplastic pollution. These information gaps are articulated in the Microplastic Strategy Update (2019).

Priority Questions for the Next Five Years

1. How much microplastic pollution is in the Bay?
2. What are the health risks?
3. What are the sources, pathways, loadings, and processes leading to microplastic pollution in the Bay?
4. Have the concentrations of microplastic in the Bay increased or decreased?
5. What management actions could be effective in reducing microplastic pollution?

MULTI-YEAR PLAN FOR MICROPLASTICS

Microplastic studies and monitoring in the RMP from 2016 to 2023. Numbers indicate budget allocations in $1000s. Budgets in parentheses represent funding or in-kind services from external partners. Budgets with "x" values indicate unknown total funding. Italicized dollar amounts indicate external funds that are needed but not yet secured. Items included in planning budget are shaded in yellow. Bold boxes indicate multi-year studies.
* Additional contributions were made by the City of Palo Alto, East Bay Municipal Utility District, Patagonia, Virginia Wellington Cabot Foundation, and the Ocean Protection Council.

Element	Study	Funder	Questions Addressed	2016	2017	2018	2019	2020	2021	2022	2023
Strategy	Microplastic Strategy	RMP	1,2,3,4,5	25			15	20	10	10	10
	Additional funding for the Moore Foundation SF Bay Microplastics Project	RMP Others*	1,2,3,4,5		75 (40)		(50)				
Monitoring biota	Bivalves	RMP	1,2,4			46					
	Sport Fish	RMP					15				100
	Prey Fish	RMP Moore Foundation			(130)				50		
	Assessing Ecological Impacts	RMP	1,2						150		
Monitoring water and sediment	Open Bay and Margins Sediment	Moore Foundation	1,3,4		(100)						
	Surface Water: Bay and Sanctuaries	Moore Foundation Bay Keeper			(238)	(x)					
	Follow up Status and Trends Monitoring	RMP								50	50
Characterizing sources, pathways, loadings, processes	Stormwater and Wastewater Effluent	Moore Foundation	1,3,5			(90)					
	Continuation of Stormwater Monitoring	RMP External						*(50)*	*(50)*	50	
	Stormwater Conceptual Model	RMP External						30 *(100)*	30		
	Green stormwater infrastructure: Evaluating the efficacy of rain gardens	RMP SFEP			(10)				(100)	(50)	
	Model transport in Bay & ocean	Moore Foundation				(80)					
	Evaluate microplastics in biosolids	RMP									75
	Monitoring air deposition	RMP								100	
Evaluating control options	Options for source control/efficacy of microbead ban, foam bans	Moore Foundation	1,5			(40)					
	Characterize microplastic additives to assess exposure and identify sources	RMP								100	
Synthesis	Synthesize findings (e.g., report, factsheet, video), hold symposium	Moore Foundation	1,3,5				(290)				
RMP-funded Special Studies Subtotal – MPWG				**25**	**75**	**46**	**30**	**50**	**240**	**310**	**235**
High Priority Special Studies for RMP Funding									**190**		

RMP-funded Special Studies Subtotal – Other Workgroups	**0**	**0**	**0**	**0**				
RMP Supplemental Environmental Projects Subtotal	**0**	**0**	**0**	**0**				
Pro-Bono & Externally-funded Special Studies Subtotal	**0**	**518**	**210**	**340**	**150**	**150**	**50**	
OVERALL TOTAL	**25**	**593**	**256**	**370**	**200**	**390**	**360**	**235**

NUTRIENTS

Relevant Management Policies and Decisions

Developing nutrient numeric endpoints and assessment framework

Evaluating need for revised objectives for dissolved oxygen and other parameters

Assessing water quality impairment status

Implementing NPDES permits for wastewater and stormwater

Recent Noteworthy Findings

In 2016, the NMS finished a 10-year Science Plan for addressing monitoring and research needs.

Major progress on numerical models has been made in the first two years of the program. A major validation report was produced in 2017 that showed the hydrodynamic model in its current state sufficiently represents transport in South Bay to support water quality studies with a South Bay focus.

Data from high-frequency sensors and fish trawls in Lower South Bay are being synthesized to explore the issue of where and when there is adequate dissolved oxygen to support resident fish species. The report, which was completed in 2018, was a collaboration between SFEI and the University of California Davis.

Funding for a Supplemental Environmental Project is being used for a major study on harmful algae and toxins. The study will investigate whether toxins are accumulating in small fish and mussels. The use of new molecular techniques to identify harmful algae will also be tested. A report on this study will be prepared in 2019.

Priority Questions for the Next Five Years

1. What conditions in different Bay habitats would indicate that beneficial uses are being protected versus experiencing nutrient-related impairment?

2. In which subembayments or habitats are beneficial uses being supported? Which subembayments or habitats are experiencing nutrient-related impairment?

3A. To what extent is nutrient over-enrichment, versus other factors, responsible for current impairments?

3B. What management actions would be required to mitigate such impairments & protect beneficial uses?

4A. Under what future scenarios could nutrient-related impairments occur and which of these scenarios warrant pre-emptive management actions?

4B. What management actions would be required to protect beneficial uses under those scenarios?

5. What nutrient sources contribute to elevated nutrient concentrations in subembayments or habitats that are currently impaired, or would be impaired in the future by nutrients?

6. When nutrients exit the Bay through the Golden Gate, where are they transported and how do they influence water quality in the Gulf of Farallones or other coastal areas?

7. What specific management actions, including load reductions, are needed to mitigate or prevent current or future impairment?

The Nutrient Management Strategy (NMS) is a major collaborative regional science program. The RMP funds monitoring and special studies that are complementary to the studies funded by the NMS.

MULTI-YEAR PLAN FOR NUTRIENTS

Special studies and monitoring in the RMP from 2013 to 2022. Numbers indicate budget allocations in $1000s. Budgets in parentheses represent funding or in-kind services from external sources. The projects funded by non-RMP sources are not specified; only general allocations are indicated. This table does not show nutrient monitoring done for Status & Trends. Items included in the planning budget are shaded in yellow. Bold boxes indicate multi-year studies.

Element	Study	Funder	Questions Addressed	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Strategy	Program coordination	RMP	1-5	20	20									
Monitoring	Moored sensors	RMP	1	200	215	190	39.3	220	230	250	250	400	400	400
	Ship-based channel monitoring	RMP	1					153	120					
	Algal biotoxins	RMP SEP	1	65					(195)					
	Stormwater loads	RMP	3	40	35									
	Monitoring program development	RMP	1,3		50		20							
	Dissolved oxygen	RMP					200							
	HF mapping	RMP				115								
	Chl-a analysis	RMP					15.7							
	Data management	RMP					25							
Modeling	Modeling	RMP SEP	4,5	100	200	165		(240)						
Synthesis	Conceptual model report	RMP	1-5	50										
	Synthesis: nutrient loads and data gaps	RMP	3	30										
RMP-funded Special Studies Subtotal				**505**	**520**	**470**	**300**	**373**	**350**	**250**	**250**	**400**	**400**	**400**
High Priority Special Studies for RMP Funding												**400**		
RMP Supplemental Environmental Projects Subtotal				**0**	**0**	**0**	**0**	**240**	**195**	**0**				
Pro-Bono & Externally-funded Special Studies Subtotal[1]				**845**	**725**	**1010**	**880**	**1437**	**1952**	**1480**	**2200**	**2200**	**2200**	**2200**
OVERALL TOTAL				**1460**	**1417**	**1652**	**1372**	**2022**	**2537**	**1730**	**2450**	**2600**	**2600**	**2600**

[1] Funding provided by BACWA, CCCSD, DSP, Regional San, City of Palo Alto, City of Sunnyvale, State Water Resources Control Board, and DWR-EMP for a range of studies that support the Nutrient Management Strategy. The descriptions of these projects are not included here for simplicity. More details about the projects being funded by the Nutrient Management Strategy can be found here: http://sfbaynutrients.sfei.org/books/nutrient-strategy-goals-and-work-elements

PCBs

Relevant Management Policies and Decisions

- PCBs TMDL and potential update
- Implementation of NPDES permits
- Selecting management actions for reducing PCB impairment
- Municipal Regional Permit

Recent Noteworthy Findings

Shiner surfperch have a Bay-wide average concentration nine times higher than the TMDL target, and these concentrations have resulted in an advisory from the Office of Environmental Health Hazard Assessment (OEHHA) recommending no consumption for all surfperch in the Bay. Concentrations in shiner surfperch and white croaker show no clear sign of decline. Average concentrations in Suisun Bay sediments are lower than in the other Bay segments, indicating a lower degree of impairment in this region.

Urban stormwater is the pathway carrying the greatest PCB loads to the Bay and with the greatest load reduction goals. Concentrations of PCBs and mercury on suspended sediment particles from a wide range of watersheds are being measured as an index of the degree of watershed contamination and potential for effective management action. Stormwater samples from Pulgas Creek Pump Station North and South, Industrial Road Ditch, an outfall to Colma Creek, and Gull Drive Storm Drain in San Mateo County; Santa Fe Channel in Contra Costa County; Line 12H at Coliseum Way, and Outfall at Gilman Street in Alameda County; and Outfall to Lower Silver Creek in Santa Clara County had the highest concentrations of PCBs on suspended sediment particles measured to date.

An assessment of the Emeryville Crescent established a conceptual model as a foundation for monitoring response to load reductions and for planning management actions. The key finding was that PCB concentrations in sediment and the food web could potentially decline fairly quickly (within 10 years) in response to load reductions from the watershed.

A conceptual model and extensive field studies in San Leandro Bay have documented persistent sediment contamination that is likely due to continuing inputs from the watershed.

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?

MULTI-YEAR PLAN FOR PCBs

Special studies and monitoring in the RMP from 2015 to 2024. Numbers indicate budget allocations in $1000s. Budgets in parentheses represent funding or in-kind services from external sources. Items included in planning budget are shaded in yellow. Bold boxes indicate multi-year studies.

Element	Study	Funder	Questions addressed	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
General	Develop and update multi-year workplan and continued support of PCB Workgroup meetings	RMP		10	10	10	10	10	10	Covered by core workgroup funding			
PMU	Prioritize Margin Units	RMP	1, 4, 5, 6	30									
	Develop Conceptual Site Models and Mass Balances for PMUs (4 PMUs)	RMP SEP	1, 4, 5, 6	45	30 (30)	60							
	PMU Field Studies to Support the Development of Conceptual Site Models and Monitoring Plans	RMP SEP	1, 4, 5, 6		(202)		51[a]	(40)[b]	91[d]		90[e]	98[f]	
	PMU Trend Monitoring (4 PMUs)	SEP	1, 4, 5, 6					(60)[c]			64[g]		50[c]
DMMO	Synthesis of DMMO data for PCB hot spots and mass removed	SEP	1				(45)						
General	Updated Fate and Food Web Model	RMP	1,3,5,6							100			100
	PCB Synthesis	RMP	1,2,3,4,5,6										
RMP-funded Special Studies Subtotal – PCBs				**85**	**40**	**70**	**31**	**40**	**101**	**100**	**154**	**98**	**150**
High Priority Special Studies for RMP Funding									**101**	**100**	**154**	**98**	**150**
RMP-funded Special Studies Subtotal – Other Workgroups				**0**	**0**	**0**	**0**	**0**					
RMP Supplemental Environmental Projects Subtotal				**0**	**232**	**0**	**45**	**97**					
Pro-Bono & Externally Funded Studies Subtotal				**0**	**0**	**0**	**0**	**0**					
OVERALL TOTAL				**85**	**272**	**70**	**76**	**137**	**101**	**100**	**154**	**98**	**150**

[a] San Leandro Bay gut contents ($21K) and PMU Stormwater sampling ($30K); [b] PMU stormwater sampling; [c] Shiner surfperch; [d] Steinberger Slough passive sampling and cores; [e] SLB PSDs; [f] Steinberger prey fish ($48K) and Steinberger sediment ($50K); [g] SLB prey fish

SEDIMENT

The mission of the Sediment Workgroup is to provide technical oversight and stakeholder guidance on RMP studies addressing questions about sediment delivery, sediment transport, dredging, and beneficial reuse of sediment.

Relevant Management Policies and Decisions

Long-Term Management Strategy for Dredged Material in SF Bay (LTMS) to comply with the Basin Plan

NOAA 2011 Programmatic Essential Fish Habitat Agreement & 2015 LTMS Amended Programmatic Biological Opinion

PCB TMDL

Mercury TMDL

Regional Restoration Plans[1]

Recent Noteworthy Findings

In water years (WY) 2016 and 2017, the USGS monitored the sediment flux through the Golden Gate. This flux is the largest unknown in the sediment budget for the Bay. Results indicate that sediment loads from the Delta during winter storms were mostly retained in San Pablo Bay, even during the historically high floods of WY2017. One recommendation from the report[2] was to use modeling to evaluate cumulative fluxes over longer periods than can be monitored.

USGS monitoring of suspended sediments at the Dumbarton Bridge in WY2016 indicated that particle flocculation is an important factor for accurately calculating the sediment flux into Lower South Bay. The RMP has allocated funds for a special study in 2018-2019 to follow-up on this finding.

A synthesis report estimated that net average annual sediment supply to San Francisco Bay from terrestrial sources during the most recent 22-year period (WY1995-2016) was 1.95 million metric tons. Approximately 63% of the sediment supply was estimated to be from small tributaries that drain directly to the Bay. Net supply from the Central Valley (measured at Mallard Island) was approximately 37% of the total supply. Bedload supply, after accounting for dredging, removals, and storage in flood control channels, was essentially zero. Recent data do not indicate any trends other than the step decrease in supply from the Delta in 1999. The report contains initial recommendations for improvements in sediment supply monitoring.

Priority Questions for the Next Five Years

1. What are acceptable levels of chemicals in sediment for placement in the Bay, baylands, or restoration projects?

2. Are there effects on fish, benthic species, and submerged habitats from dredging or placement of sediment?

3. What are the sources, sinks, pathways and loadings of sediment and sediment-bound contaminants to and within the Bay and subembayments?

4. How much sediment is passively reaching tidal marshes and restoration projects and how could those amounts be increased by management actions?

5. What are the concentrations of suspended sediment in the Estuary and its segments?

[1] San Francisco Bay Restoration Authority Goals, Baylands Goals Update for Climate Change, Subtidal Habitat Goals Project, and Action 13 “Manage sediment on a regional scale and advance beneficial reuse” from the Comprehensive Conservation and Management Plan.

[2] https://www.sfei.org/documents/water-and-suspended-sediment-flux-measurements-golden-gate-2016-2017.

MULTI-YEAR PLAN FOR SEDIMENT

Workgroup special studies for 2016 to 2025. Numbers indicate budget allocations in $1000s. Budgets in parentheses represent funding or in-kind services from external sources (e.g., SEP funds). Budgets that are starred represent funding that has been allocated for the given study within other workgroups. This table does not show suspended sediment monitoring done for Status & Trends. Bold boxes indicate multi-year studies. Items shaded in yellow are considered high priority for the 2021 funding cycle. Dollar signs indicate projected future allocation of RMP funds for special studies.

Element	Study	Funder	Questions addressed	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Strategy	Sediment Monitoring Strategy	RMP WQIF	1,3,4		50 (238)		78					$	
	Strategy/Workgroup Support	RMP	1,2,3,4			10		10	Workgroup support covered by core program				
	Sediment Modeling Strategy	RMP	1,2,3,4					26				$	
Screening Values	Sediment Bioaccumulation Guidance	RMP	1			30*		22.5					
	Benthic Index Development	RMP	1			21*			29				
	Toxicity Reference Value Refinement	RMP	1						30				
Dredging Impacts on Essential Fish Habitat	Benthic Invertebrate Assessment	RMP LTMS	2						50				
	Light Attenuation Near Dredging	RMP LTMS	1,2						40				
Data Mining	DMMO Database and Online Tools	RMP	1			55	Database maintenance costs covered by core program						
	DMMO Data Synthesis	RMP SEP	1,2		12*	(45)				$		$	
	DMMO Database Enhancement	RMP	1,2						40		$		$
Beneficial Reuse	Beneficial Reuse	RMP	1,2				30		40		$		$
	Sediment Placement Projects or Planning	RMP	2							$		$	
Loading to the Bay	Sediment Supply Synthesis	RMP USGS	3,4		40 (40)						$		
	Mallard Island Sediment Flux Monitoring	RMP	3,4			30					$		
	Maintain Stream Gages and Add New Ones	RMP SEP	3,4			(115)				$		$	
Transport	Lower South Bay	RMP	3,4			120							

Element	Study	Funder	Questions addressed	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
pathways	Sediment Flux Study	SEP		(98)			(158)						
	Golden Gate Sediment Flux Study	RMP SEP	3,4	33 (98)	(69)			45			$		
	Monitor Sediment Flux at Key Locations in the Bay (e.g., major creek mouths downstream of head of tide, mudflats/shallows, major bridges)	RMP	3,4						75	$	$	$	$
	Model Sediment Flux at Key Locations throughout the Bay	RMP	3,4						75	$	$	$	$
Sinks & reservoirs	Bathymetric Change Studies	RMP	3,4				77	77	40		$		$
	Monitor Sediment Deposition at Key Locations in the Bay (e.g., creek reaches downstream of head of time, mudflats/shallows)	RMP	3,4						75	$	$	$	$
	Model Sediment Deposition Dynamics throughout the Bay (e.g., baylands, mudflats/shallows, deep water)	RMP	3,4						75	$	$	$	$
Sediment characteristics	Bulk Density of Sediment Types	RMP	4				30					$	
	Mapping bed sediment characteristics for model calibration	RMP	3,4						40		$		$
	Characterizing impacts of flocculation on settling velocity	SEP	3,4										
	Sediment Provenance Study	SEP	3,4										
Bay water column characteristics	Model Bay Turbidity Patterns	RMP	5						95			$	

Element	Study	Funder	Questions addressed	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
RMP-funded Special Studies Subtotal – Sediment				**33**	**90**	**215**	**215**	**180.5**	**704**				
High Priority Special Studies for RMP Funding									***380***				
RMP-funded Special Studies Subtotal – Other Workgroups				**0**	**12**	**51**	**0**						
RMP Supplemental Environmental Projects Subtotal				**196**	**69**	**115**	**158**						
Pro-Bono & Externally Funded Studies Subtotal				**0**	**278**	**0**	**45**						
OVERALL TOTAL				**229**	**449**	**381**	**418**		**704**				

SELENIUM

Relevant Management Policies and Decisions

- North Bay Selenium TMDL
- USEPA Selenium Criteria for the Bay-Delta
- South Bay Selenium TMDL (under consideration)

Recent Noteworthy Findings

White sturgeon, a benthic species, is recognized as a key indicator of selenium impairment in the North Bay due to its susceptibility to selenium bioaccumulation. In general, white sturgeon muscle selenium concentrations measured over the past 30 years have exceeded the North Bay TMDL target in some individual sturgeon, but annual average concentrations have remained below the target and no long-term trend has been apparent since 1987. The highest tissue selenium concentrations were measured in Suisun Bay; the lowest were in Central Bay. Sturgeon muscle plug sampling provides a non-lethal means of obtaining a larger sample size of concentrations in the North Bay. Selenium concentrations measured in sturgeon muscle plugs and muscle fillets are well-correlated. Concentrations in muscle plugs were relatively high in 2015 and 2016, with medians near the TMDL target. Concentrations were much lower, however, in 2017, apparently in response to high flows in the winter of water year 2017.

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. This difference from the North Bay may be due to the low abundance of *Potamocorbula* (overbite clam) in South Bay.

The RMP Selenium Workgroup has developed a monitoring plan for sturgeon, water, and clams to track trends, with a special emphasis on early detection of change. It is an integrated, long-term design for all three indicators based on a solid statistical framework that is explicitly linked to management decision-making.

Priority Questions for the Next Five Years: General

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?

Priority Questions for the Next Five Years: North Bay

6. Are the beneficial uses of north San Francisco Bay impaired by selenium?
7. Are changes occurring in selenium concentrations that warrant changes in management actions?
8. Will proposed changes in water flows and/or selenium loads in the Bay or upstream cause impairment in North Bay?

Selenium Multi-Year Plan

Selenium studies and monitoring in the RMP from 2014 to 2024. Numbers indicate budget allocations in $1000s. Budgets in parentheses represent funding or in-kind services from external sources. Items included in planning budget are shaded in yellow. Bold boxes indicate multi-year studies.

Element	Funder	Questions addressed	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Selenium Strategy Coordination	RMP SEP	1,2,3,4,5, 6,7,8	10	10	10	25 (10)	10	10	10	Covered by core workgroup funding			
Selenium Information Synthesis	RMP SEP	1,2,3,4,5, 6,7,8		10		(50)							
Selenium Sturgeon Plugs	RMP SEP	1,2,3,4, 6,7,8	23	35		(57)		22		22	24	22	
Selenium Sturgeon Derby	RMP	1,2,3,4,6		29	37	42							
Selenium Monitoring in North Bay Clams and Water	RMP	1,2,3,4,5, 6,7,8				39		75	88	95	115	95	115
Data Management for North Bay Selenium Monitoring	SEP	1,2,3,4,5, 6,7,8						(40)					
Selenium in North Bay Water: Synthesis	SEP	1,2,3,4,5, 6,7,8				(50)							
Selenium South Bay Water (Speciated) and Clam Sampling (Wet Year)	RMP	1,2,3								100			
Selenium South Bay Model	RMP	5										100	
Spatial Survey of North Bay Clams	RMP	3									100		
RMP-funded Special Studies Subtotal - Se			**33**	**84**	**47**	**106**	**10**	**107**	**98**	**217**	**249**	**217**	**115**
High Priority Special Studies for RMP Funding										**117**	**149**	**117**	**115**
RMP-funded Special Studies Subtotal – Other Workgroups			**0**	**0**	**0**	**0**	**0**	**0**	**0**				
RMP Supplemental Environmental Projects Subtotal			**0**	**0**	**0**	**167**	**0**	**40**					
Pro-Bono & Externally Funded Studies Subtotal			**0**	**0**	**0**	**0**	**0**	**0**					
OVERALL TOTAL			**33**	**84**	**47**	**273**	**10**	**147**	**98**	**217**	**145**	**217**	**115**

SMALL TRIBUTARY LOADING

Relevant Management Policies and Decisions

Refining pollutant loading estimates for future 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.

Recent Noteworthy Findings

Based on particle ratio information collected by the RMP in stormwater to-date, the samples with the highest concentrations for PCBs have been collected from watersheds draining to Pulgas Creek Pump Station in Redwood City, a ditch on Industrial Rd. in San Carlos, Line 12H at Coliseum Way in Oakland, Santa Fe Channel in Richmond, a storm drain on Gull Dr. in South San Francisco, and an outfall at Gilman Street in Berkeley. Line 12H currently ranks in the top 20 for mercury.

Remote sediment samplers were pilot tested at 14 sites, and show promise as a lower-cost stormwater characterization tool, especially for PCBs. These samplers will be used for characterizing new sites in 2019.

Two new methods for interpreting stormwater data were developed. The first method used indicator congeners to identify the dominant Aroclor mixtures in stormwater and sediment. Results of the pilot study indicated a unique profile in stormwater samples from Pulgas Creek Pump Station South that was traced to one source area using sediment samples. A second method was developed to estimate storm load from a standard storm size. Combined estimates of storm flow with event mean concentrations were normalized to area to determine standard storm yields. These two methods are being used to compare sites and provide additional evidence to support management decisions.

A new modeling and trends strategy has also been developed. The initial focus was on modeling and data collection for PCBs and mercury trends. In 2019, the strategy broadened to include the loading needs of the emerging contaminants, sediment, and nutrient workgroups; trends has been deferred to later model development. As work gains momentum in 2020, broader oversight will be solicited.

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

Special studies for this focus area assess contaminant loading to the Bay from these small tributaries.

Priority Questions for the Next Five Years

1. What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?
2. Which are the “high-leverage” small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?
3. How are loads or concentrations of pollutants of concern from small tributaries changing on a decadal scale?
4. Which sources or watershed source areas provide the greatest opportunities for reductions of pollutants of concern in urban stormwater runoff?
5. What are the measured and projected impacts of management action(s) on loads or concentrations of pollutants of concern from the small tributaries, and what management action(s) should be implemented in the region to have the greatest impact?

Screening and characterization to identify high-leverage watersheds will be the major emphasis for the next several years, along with an increasing focus on data analysis and detecting trends in loads or concentrations of pollutants of concern from small tributaries.

MULTI-YEAR PLAN FOR SMALL TRIBUTARY LOADING STRATEGY

Small tributaries loading studies in the RMP from 2015 to 2023. Numbers indicate budget allocations in $1000s. Budgets in parentheses represent funding or in-kind services from external partners. Items included in the planning budget are shaded in yellow. Bold boxes indicate multi-year studies.

Element	Funder	Questions addressed	2015	2016	2017	2018	2019	2020	2021	2022	2023
Coordination and management	RMP		26	26	30	32	40	40	50	50	50
Source Area Monitoring/EMC development and RAA	BASMAA	1,2,3,4	(450)	(350)	(450)	(950)	(1000)	(750)	(500)	(500)	(500)
Regional Watershed Spreadsheet Model: Water, Sediment, PCBs and Mercury	RMP	1,2,4	35	35	40	7					
POC Reconnaissance Monitoring	RMP	1,2,3,4	374	150	200	125	125	110	120	120	
POC Reconnaissance Monitoring	BASMAA	1,2,3,4	(200)	(200)	(200)						
Advanced Data Analysis	RMP	1,2,3,4				100	50	50			
Modeling to support regional loads and trends	RMP	3,5	35	100	100		60	100	150	150	150
Monitoring to support regional loads and trends	RMP	1,3							130	180	150
AFR conceptual model development	RMP	1,4				13					
Emerging contaminants coordination	RMP	1,4									
Emerging contaminants monitoring	RMP	1,2,4									
BMP effectiveness monitoring in support of modeling	RMP	3,5									150
Guadalupe River Hg loads	RMP	1,3,4,5			40						
Stream gaging and suspended sediment monitoring in support of modeling	SEP	2,3,4					(380)				
Develop a statistical model for trends evaluation ($35-$50k)	SEP proposal	3									
Expanded pilot testing of remote stormwater sampling devices ($100-200K)	SEP proposal	1,2									
Update land-use maps for the San Francisco Bay region ($95-170K)	SEP proposal	2,4,5									
Mallard Island large rivers loading study ($140-190K)	SEP proposal	1,3,5									
RMP-funded Special Studies Subtotal – STLS			**470**	**311**	**410**	**302**	**275**	**300**	**450**	**500**	**500**
High Priority Special Studies for RMP Funding									**330**		
RMP-funded Special Studies Subtotal – Other Workgroups			**0**	**0**	**0**	**0**	**0**	**0**			
RMP Supplemental Environmental Projects			**0**	**0**	**0**	**0**	**380**				
Pro-Bono & Externally Funded Studies Subtotal			**650**	**550**	**650**	**950**	**1000**	**750**	**500**	**500**	**500**
Overall Total			**1120**	**861**	**1060**	**1252**	**1655**	**1050**	**950**	**970**	**1000**

STATUS AND TRENDS MONITORING

Relevant Management Policies and Decisions

Define ambient conditions in the Bay

Water Quality Assessment – 303(d) impairment listings or de-listings

Determination if there is a reasonable potential that a NPDES-permitted discharge may cause violation of a water quality standard

Evaluation of water and sediment quality objectives

Dredged material management

Development and implementation of TMDLs for mercury, PCBs, and selenium

Site-specific objectives and anti-degradation policies for copper and cyanide

Development and evaluation of a Nutrient Assessment Framework

Recent Noteworthy Findings

In 2015, the RMP monitored sediments in the margin areas of Central Bay. The study determined the ambient concentrations of PCBs, mercury, and other contaminants in these areas. On average, PCB concentrations were 4-5 times higher in the margins than in the open Bay. The study also detected a number of "warm spots" where the concentrations of contaminants were significantly elevated and one previously unknown "hot spot". This assessment was repeated in 2017 in South Bay and Lower South Bay.

In 2017, the RMP published the latest information on contaminant concentrations in sport fish tissue. The most recent data show that there was no long-term trend for mercury and little evidence of PCB declines in important sport fish species.

Copper concentrations in water, last monitored in 2017, remain below trigger levels.

Over a decade of monitoring shows that 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. The RMP now considers PBDEs to be in the "low concern" category and will reduce, but not eliminate, monitoring for them. Conversely, fipronil, a current use pesticide was added to the list of target analytes for sport fish and sediment because of increased concern about this chemical.

Priority Questions for the Next Five Years

1. Are contaminants at levels of concern?

2. What are concentrations and masses of priority contaminants in the Bay, its compartments, and its segments?

3. Are there particular regions of concern?

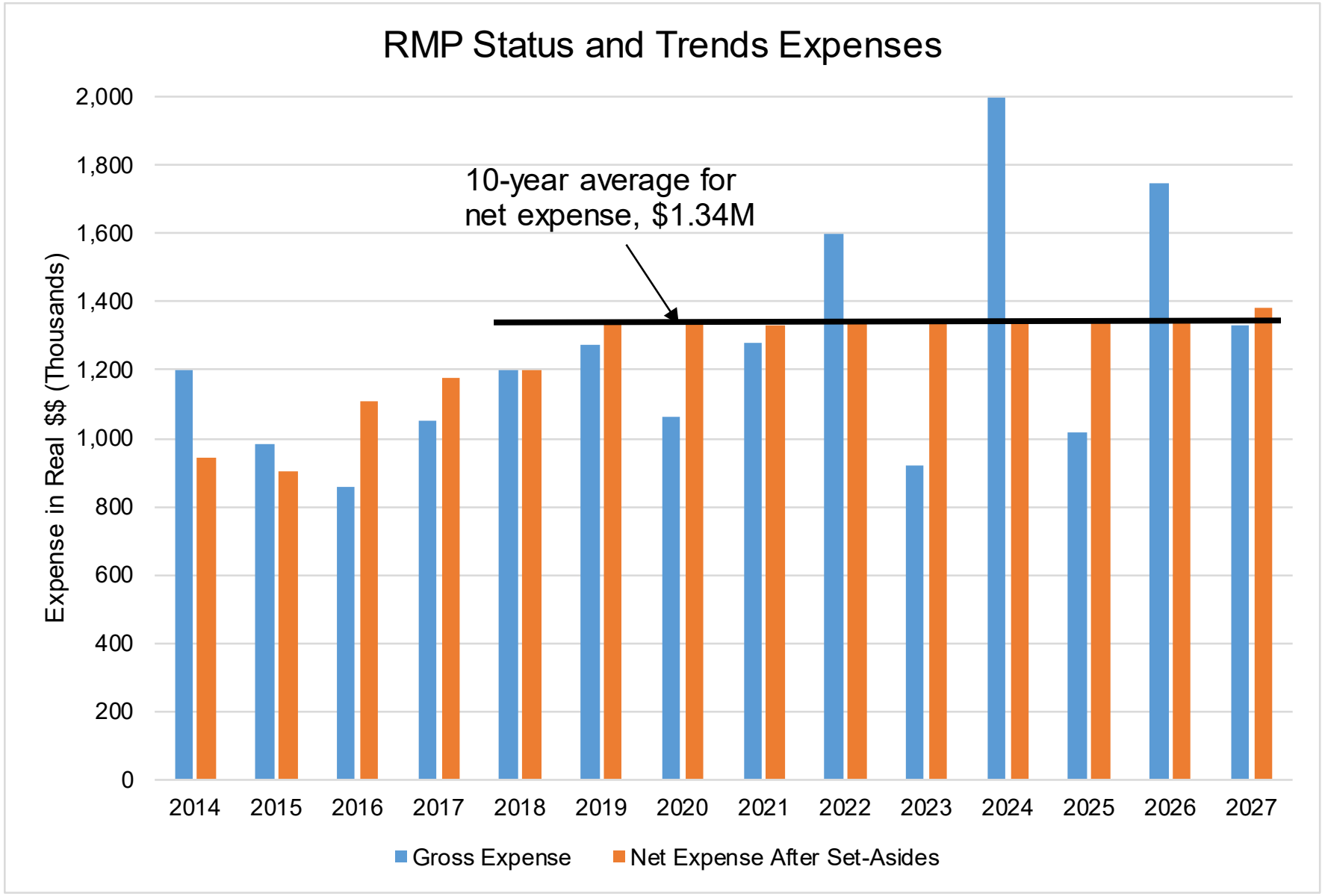
4. Have concentrations and masses increased or decreased?

When recommending addition of any analyte to S&T, the following details need to be specified: relevance of the analyte to a management question, the matrix to be monitored, the frequency of monitoring, the minimum duration of the monitoring, and the spatial extent (e.g., all sites or a subset).

MULTI-YEAR PLAN FOR STATUS AND TRENDS MONITORING

Status and Trends Monitoring in the RMP from 2014 to 2027. Numbers indicate budget allocations in $1000s.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Monitoring Type	*Actl*	*Actl*	*Actl*	*Actl*	*Actl*	*Actl*	*Bdgt*	*Fcst*	*Fcst*	*Fcst*	*Fcst*	*Fcst*	*Fcst*	*Fcst*
USGS Moored Sensor Network for Suspended Sediment	250	250	250	250	250	250	250	250	250	250	250	250	250	250
USGS Monthly Cruises for Nutrients and Phytoplankton	173	173	223	229	235	242	249	257	264	272	281	289	298	307
S&T Water		179		221		216		243		257		273		290
Water-Organics								124						
Water-CTR		40										53		
S&T Bivalves	136		144		118		138		147		156		165	
Bivalves-PCBs									20					
S&T Bird Eggs			198		222			254			277			303
Bird Egg Report											54			
S&T Margins Sediment		233		231			252		267		284		301	
Margins Report		42		50			55							
S&T Sediment	251				291				356				400	
Tox/Benthos									135				152	
S&T Sport Fish	311					355					448			
Sport Fish Report	41					50					60			
Archives	20	48	22	51	47	62	58	60	62	64	66	68	70	72
NIST Contract						22		24		26		27		29
Reporting	19	18	19	8	10	22	23	24	25	26	26	27	28	29
Lab Intercomp Studies				10	30	55	37	43	73	29	100	30	82	52
Grand Total	**1,202**	**983**	**856**	**1,050**	**1,203**	**1,273**	**1,063**	**1,278**	**1,599**	**923**	**2,001**	**1,017**	**1,746**	**1,330**
Set-Aside Funds Used	**417**	**79**	**0**	**0**	**0**	**0**	**0**	**0**	**250**	**0**	**650**	**0**	**400**	**0**
Set-Aside Funds Saved	**161**	**0**	**250**	**125**	**0**	**66.5**	**275**	**50**	**0**	**425**	**0**	**325**	**0**	**50**
Set-Aside Funds Balance	**297**	**218**	**468**	**593**	**593**	**659.5**	**934.5**	**984.5**	**734.5**	**1159.5**	**509.5**	**834.5**	**434.5**	**484.5**
Net S&T Funding Needed	**946**	**904**	**1,106**	**1,175**	**1,203**	**1,340**	**1,338**	**1,328**	**1,349**	**1,348**	**1,351**	**1,342**	**1,346**	**1,380**


RMP Status and Trends Expenses
Expense in Real $$ (Thousands)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
10-year average for
net expense, $1.34M
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
Gross Expense
Net Expense After Set-Asides

Regional Monitoring Program for Water Quality in San Francisco Bay

Monitoring Design for the Status and Trends Monitoring Program (2014-2027)

Program	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
USGS Moored Sensor Network for Suspended Sediment (5 targeted sites) [a]														
Parameters: SSC, Water temperature, Salinity	X	X	X	X	X	X	X	X	X	X	X	X	X	X
USGS Monthly Cruises for Nutrients and Phytoplankton in Deep Channel (38 targeted sites)														
Parameters: CTD profiles, light attenuation, SSC, DO, Chl-a, Phytoplankton speciation, Nutrients (NO_2, NO_3, NH_4, PO_4, Si) [b]	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Every 2 Years: Toxic Contaminants in Water (5 targeted sites and 17 random sites)														
MeHg, Cu, Se (dissolved & particulate fractions in 2017 and onwards, dissolved & total fractions measured in 2015)		X		X		X		X		X		X		X
CN, Hardness, SSC, DOC, POC		X		X		X		X		X		X		X
Aquatic Toxicity (9 stations) [c]		X		X		X		X		X		X		X
Chl-a and Nutrients (NH4, NO3, NO2, TN, PO4, TP, Si) (at GG site only).				X										
PCBs, PAHs, Pesticides								X						
CTR parameters (10 samples at 3 targeted stations) [d]		X										X		
Every 2 years: Toxic Contaminants in Bivalve Tissue (7 targeted sites) [e]														
Se, PAHs	X		X		X		X		X		X		X	
PBDEs	X		X											
PCBs	X								X					
Every 3 Years: Toxic Contaminants in														

Program	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Bird Egg Tissue														
Cormorant Eggs: Hg, Se, PCBs, PBDEs, PFCs (3 targeted sites) [f]			X		X			X			X			X
Tern Eggs: Hg, Se, PBDEs (variable fixed sites) [g]			X		X			X			X			X
Every 2 Years: Toxic Contaminants in Bay Margin Sediments (~40 random sites)														
Ag, Al, As, Cd, Cu, Fe, Hg, MeHg, Mn, Ni, Pb, Se, Zn, PCBs, TOC, N, % Solids, Grain Size		X		X			X		?		?		?	
Every 4 Years: Toxic Contaminants in Sediment (7 targeted sites and 20 random sites) [h]														
Ag, Al, As, Cd, Cu, Fe, Hg, MeHg, Mn, Ni, Pb, Se, Zn, PAHs, PCBs, TOC, N, % Solids, Grain Size	X				X				X				X	
PBDEs	X				X				X					
Fipronil	X				X				X				X	
Legacy Pesticides	X								?				?	
Sediment Toxicity [i]									?				?	
Benthic Macroinvertebrates [j]									?				?	
Every 5 Years: Toxic Contaminants in Sport Fish Tissue (7 targeted sites)														
Hg, Se, PCBs, PBDEs, PFCs, Dioxins	X					X					X			
Fipronil						X					?			

Notes:

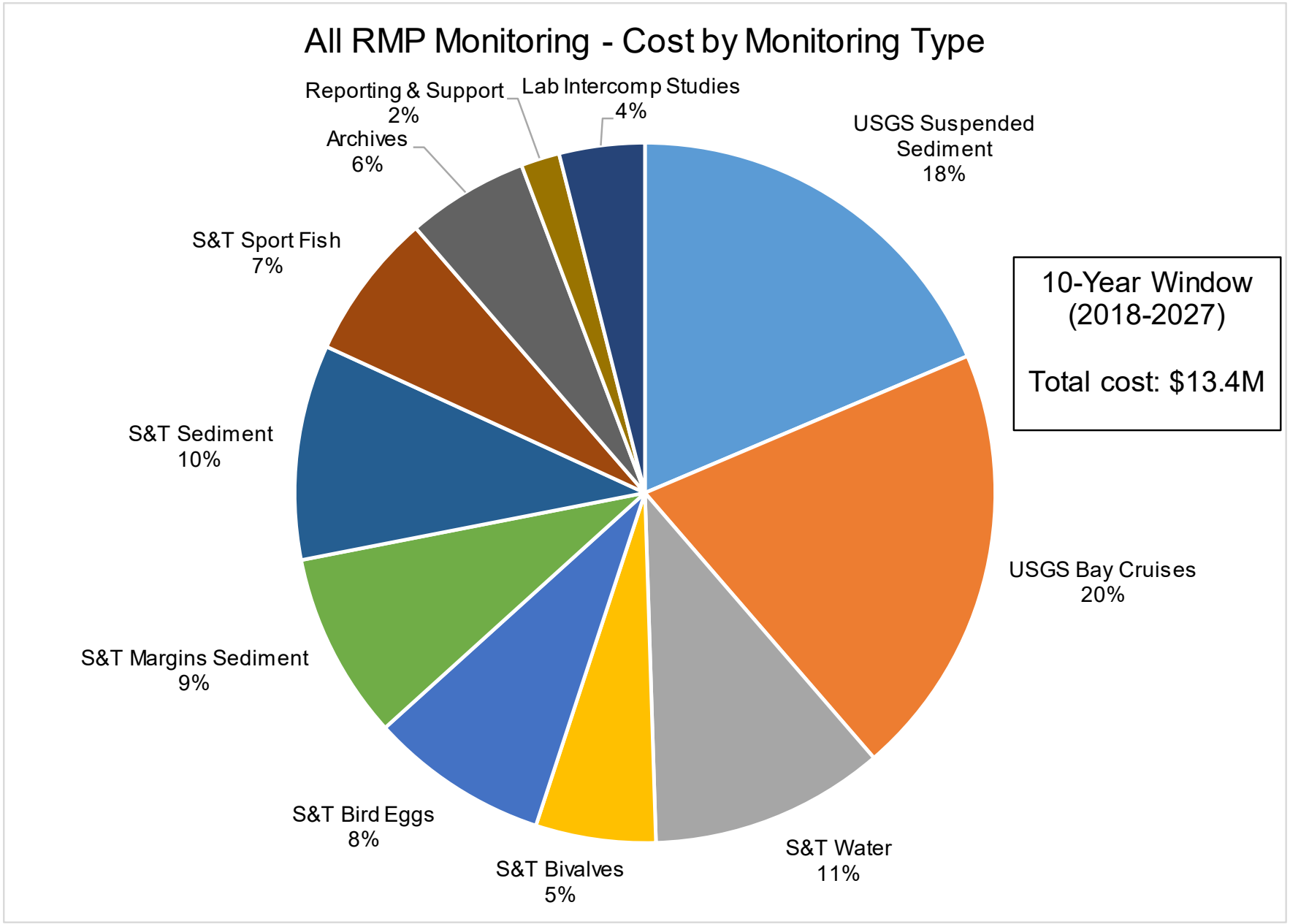
"X" = Planned sampling event. "?" = Event that is planned but must be approved by the RMP Steering Committee before implementation. Additional parameters can be added to sampling events to support RMP Special Studies.

a. The RMP Status and Trend Program provides direct support to the U.S. Geological Survey (PI: Maureen Downing-Kunz) for five SSC stations. However, this contribution leverages SSC data at two more stations and salinity at eight stations funded by other partners. In addition, since 2012, the RMP has used Special Studies funds to add DO sensors at six stations and nutrient-related sensors to three stations.

b. Monthly cruises are completed by the U.S. Geological Survey (PI: Tara Schraga). Phytoplankton speciation and nutrient sampling only occurs at 14 stations.
c. Aquatic Toxicity is measured following EPA Method 1007.0 (*Americamysis bahia*).
d. CTR sampling occurs at the Sacramento River, Yerba Buena Island, and Dumbarton Bridge sites.
e. Mussels (*Mytilus californianus*) are collected from Bodega Head State Marine Reserve, an uncontaminated "background" site of known chemistry, and are transplanted to seven targeted locations in the Bay. After ~100 days, mussels from the transplanted sites and a sample from Bodega Head are collected for analysis. Three of the seven transplant sites serve as back-ups in case something goes wrong with the transplants at the four primary sites. At the same time, resident clams (*Corbicula fluminea*) are collected from two sites in the Sacramento River and San Joaquin River.
f. Double-crested Cormorant (*Phalacrocorax auritus*) eggs are collected at three sites: Don Edwards National Wildlife Refuge, the Richmond-San Rafael Bridge, and Wheeler Island.
g. Forster's Tern (*Sterna forsteri*) eggs are typically collected from multiple sites in the Don Edwards National Wildlife Refuge and the Hayward Shoreline Regional Park.
h. Sediment samples are collected in the dry season (summer).
i. Sediment toxicity is measured using the following methods: EPA 600/R-94-025 (*Eohaustorius estuaries*), EPA 821/R-02-012M (*Ceriodaphnia dubia*), EPA 600/R-99-064 (*Hyalella azteca*), and EPA 600/R-95-136M (*Mytilus galloprovincialis*)
j. Benthic macroinvertebrates are measured during dry-season sediment sampling events (2014, 2022). Sediment samples are sieved through nested 1.0 and 0.5 mm sieves. Organisms are sorted into major taxonomic categories and taxonomy and abundance are determined to the lowest practical taxonomic level.

Acronyms:

SSC: Suspended Sediment Concentration
Chl-a: Chlorophyll-a
CTD: Conductivity, Temperature, and Depth
CTR: California Toxics Rule, see http://water.epa.gov/lawsregs/rulesregs/ctr/
DO: Dissolved Oxygen
DOC: Dissolved Organic Carbon
MeHg: Methylmercury
NH_4: Ammonia (dissolved)
NO_2: Nitrite (dissolved)
NO_3: Nitrate (dissolved)
PAHs: Polynuclear Aromatic Hydrocarbons
PCBs: Polychlorinated Biphenyls
PBDEs: Polybrominated Diphenyl Ethers
"Pesticides": The suite of legacy pesticides that has been routinely measured by the RMP: Chlordanes (Chlordane, cis-; Chlordane, trans-; Heptachlor; Heptachlor Epoxide; Nonachlor, cis-; Nonachlor, trans-; Oxychlordane); Cyclopentadienes (Aldrin; Dieldrin; Endrin); DDTs (DDD(o,p'); DDD(p,p'); DDE(o,p'); DDE(p,p'); DDT(o,p'); DDT(p,p'));
HCHs (HCH, alpha-; HCH, beta-; HCH, delta-; HCH, gamma-);
Organochlorines (Hexachlorobenzene; Mirex).
PFCs: Perfluorinated Compounds
PO_4: Phosphate (dissolved)
POC: Particulate Organic Carbon
Si: Silica (dissolved)
TN: Total Nitrogen
TOC: Total Organic Carbon
TP: Total Phosphorus


All RMP Monitoring - Cost by Monitoring Type
Reporting & Support 2%
Lab Intercomp Studies 4%
Archives 6%
USGS Suspended Sediment 18%
S&T Sport Fish 7%
10-Year Window (2018-2027)
Total cost: $13.4M
S&T Sediment 10%
USGS Bay Cruises 20%
S&T Margins Sediment 9%
S&T Bird Eggs 8%
S&T Bivalves 5%
S&T Water 11%

PROGRAM MANAGEMENT

Approximately 11% 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 and 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
- Twenty 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 external Program Reviews have been conducted to date, in 1997 and in 2003. 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.

A review of RMP governance was conducted in 2014 and a charter for the Program was adopted in 2015. An internal program review was conducted in 2016, focused on identifying new high priority technical areas and issues for the program to address. New science advisors, program partners, and technical focus areas were identified and will be further developed with the Technical Review Committee and Steering Committee.

The timing and scope of Program Reviews are determined by the Steering Committee. The Steering Committee does not consider a further External Program Review necessary at this time, as ongoing review of critical elements is well established.

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

Approximately 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 Figures 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.

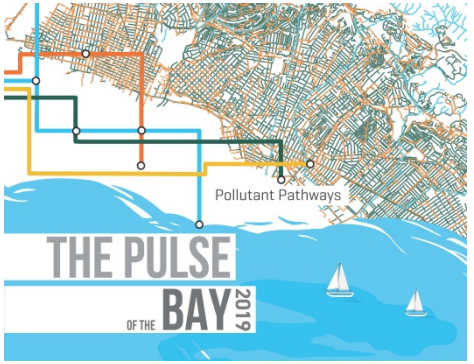
ANNUAL REPORTING & COMMUNICATIONS

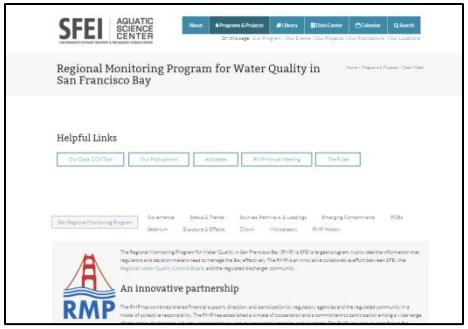
Approximately 8% of the total budget (+$85,000 in years when a full Pulse report is produced)

Includes the Pulse of the Bay, Annual Meeting, RMP Update, Multi-Year Plan, State of the Estuary report card, RMP website, Annual Monitoring Report, technical reports, journal publications, Estuary News, oral presentations, 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 website, 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, Multi-Year Plan, State of the Estuary report card, RMP web site, newsletter, fact sheets, media outreach.
  - **Managers and scientists from other regions**.





www.sfei.org/rmp

Highlights for the Next Five Years

- Pulse of the Bay (2019)
- RMP Update (2020)
- Continued partnership with SFEP's "Estuary News" to reach broader audience
- Continued website improvement

QUALITY ASSURANCE AND DATA SERVICES

Approximately 6% of the total budget for general support, plus funding in Status and Trends for handling S&T datasets

Data Services
Data management includes formatting, uploading, and reporting each year's Status and Trends data; managing, maintaining, and improving the RMP dataset to enable easy access to RMP data through CD3; coordinating with statewide data management initiatives (e.g., SWAMP and CEDEN); supporting quality assurance evaluation, data analysis, and RMP report production.

Quality Assurance
Quality assurance includes the review of data submitted by the analytical 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 problems with the chemical analyses. Occasional special studies to assess sampling methods, analytical methods, or lab performance are conducted.

Online Data Access
CD3 (cd3.sfei.org) is an online tool that makes the RMP data available to water quality managers, stakeholders, scientists, and the public.

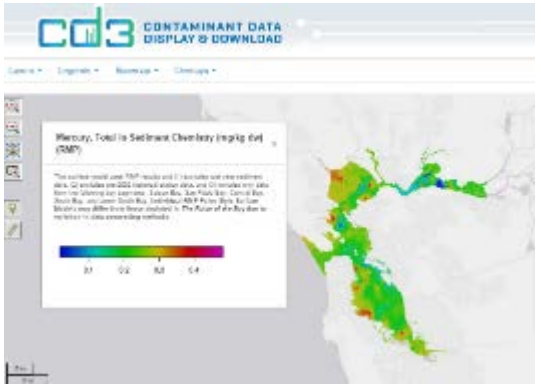
Recent Noteworthy Findings

The RMP's 25-year dataset contains approximately 1.4 million records. All data are stored in SFEI's Regional Data Center database and are comparable to CEDEN's statewide standards.

CD3 provides public access and visualizes RMP data along with other relevant datasets. A new data download tool allows users to customize their queries and easily download large quantities of data.

In 2018, the DMMO database and website were transferred to SFEI's Regional Data Center. The costs for the first few years will include upgrading outdated technology, integrating DMMO data into CD3, and uploading a backlog of data to the database. After completing these security and backlog tasks, annual costs can be reduced to hosting and maintaining the system.

- Efficiencies in Data Uploading and Formatting
- Enhancement of Data Access and Visualization Tools
- Coordination with the Estuary Portal
- Coordination with SFEI's Environmental Informatics Program
- Hosting, managing and providing access to DMMO data



RMP STUDIES ASSISTING PERMITTEES WITH ADDRESSING SPECIFIC PERMIT CONDITIONS

Dredgers

Policy	Provision	Study
2011 Programmatic Essential Fish Habitat Agreement, Measure 1	Conduct benthic recovery study in dredged areas	Benthos Recovery After Dredging, Benthic Assessment Tools
2011 Programmatic Essential Fish Habitat Agreement, Measure 7	Conduct bioaccumulation testing evaluations for in-Bay sediment disposal. Clearly define bioaccumulation triggers for testing and subsequent permitting decisions.	S&T Sediment Monitoring– determine ambient bay sediment concentrations for bioaccumulation testing thresholds
PCBs TMDL	Monitor PCB loads in dredged materials disposed in-Bay relative to TMDL allocation	S&T Sediment Monitoring – determine ambient bay sediment concentrations for in-Bay disposal limits
Mercury TMDL	Monitor mercury loads in dredged materials disposed in-Bay relative to TMDL allocation	S&T Sediment Monitoring– determine ambient bay sediment concentrations for in-Bay disposal limits
Long-Term Management Strategy	Establish how much dredged material can be disposed of in-Bay and where; review sediment guidelines for the beneficial reuse of dredged sediment	USGS Suspended Sediment Monitoring, Bay sediment budgets, Beneficial Reuse workshop

RMP STUDIES ASSISTING PERMITTEES WITH ADDRESSING 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)
North Bay Selenium TMDL	Monitor selenium in food web to inform TMDL	North Bay selenium in water, clams, and sturgeon

RMP STUDIES ASSISTING PERMITTEES WITH ADDRESSING 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 RELATED TO 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.