RMP
REGIONAL MONITORING
PROGRAM FOR WATER QUALITY
IN SAN FRANCISCO BAY

sfei.org/rmp

MULTI-YEAR PLAN 2023

ANNUAL UPDATE

FINAL: JANUARY 2023

Contribution Number: 1096

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.

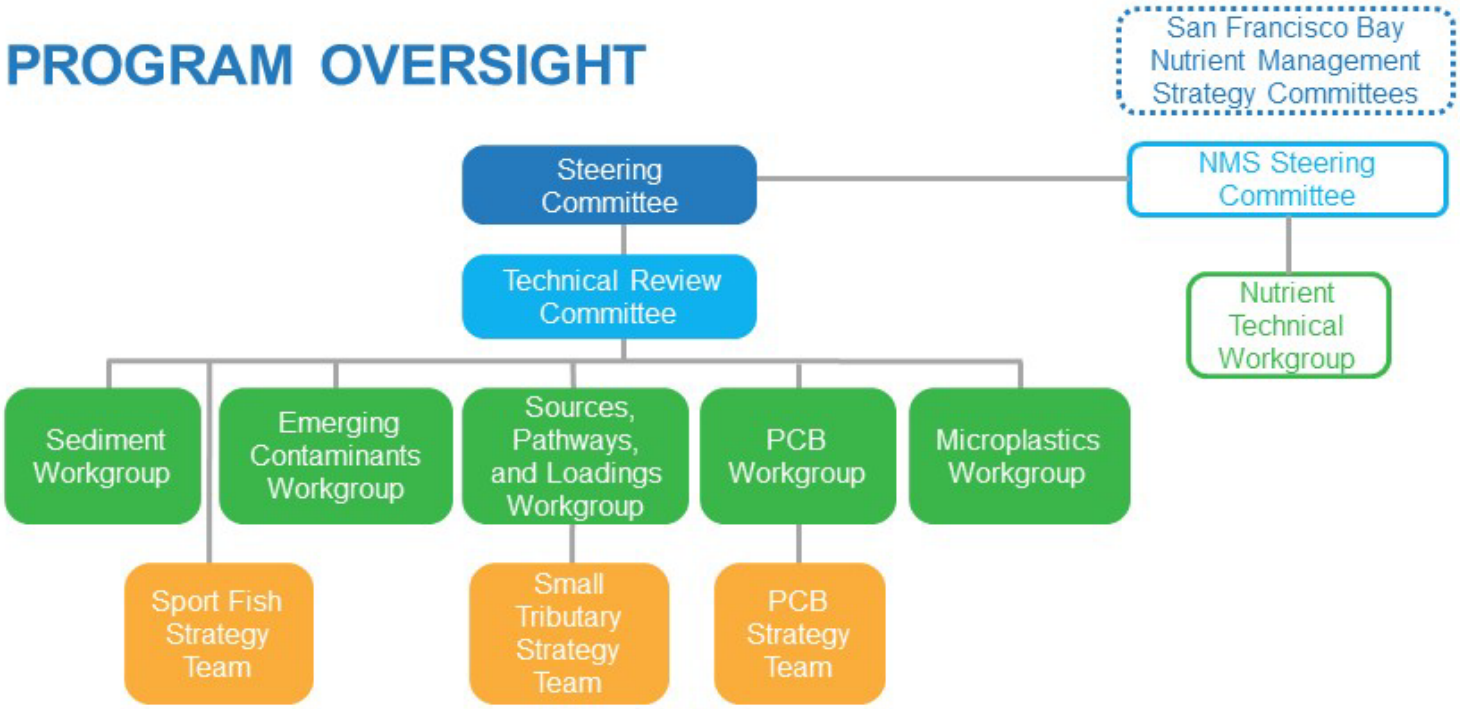
In order to fulfill the overarching goal of the RMP, the Program has to be forward-thinking and anticipate what decisions are on the horizon, so that when their time comes, the scientific knowledge needed to inform the decisions is at hand. Consequently, each of the workgroups and teams develops five-year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



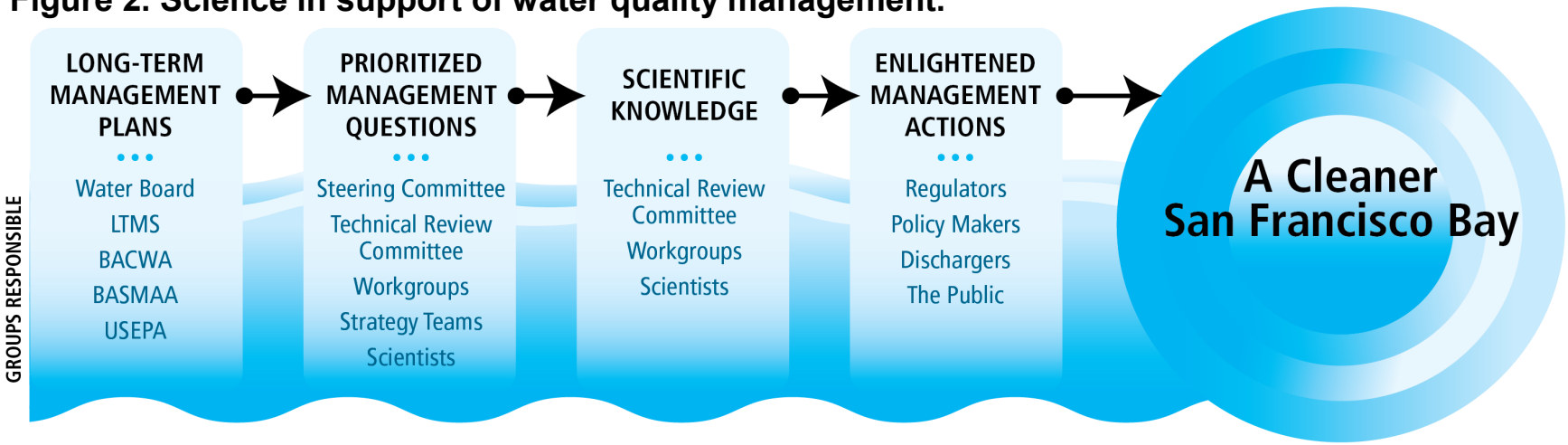
The Steering Committee consists of representatives from discharger groups (wastewater, stormwater, dredging, industrial) and regulatory agencies (Regional Water Board and U.S. Army Corps of Engineers). The Steering Committee determines the overall budget and allocation of program funds, tracks progress, and provides direction to the Program from a manager's perspective.

Workgroups report to the TRC and address the main technical subject areas covered by the RMP. The Nutrient Technical Workgroup was established as part of the committee structure of a separate effort—the Nutrient Management Strategy—and makes recommendations to the RMP committees on the use of the RMP funds that support nutrient studies. The workgroups consist of regional scientists and regulators and invited scientists recognized as authorities in the field. The workgroups directly guide planning and implementation of special studies.

Oversight of the technical content and quality of the RMP is provided by the **Technical Review Committee** (TRC), which provides recommendations to the Steering Committee.

RMP strategy teams constitute one more layer of planning activity. These stakeholder groups meet as needed to develop long-term RMP study plans for addressing high priority topics.

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
  - Multi-Year Planning Workshop
  - Confirm chair(s) and Charter
  - Decision on fees for the year after next
  - Approve workplan and budget for next year
  - Decision on workgroups to be held next year
  - Discuss outcome of the Annual Meeting

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 SEP project list
  - 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
  - Discuss lab intercomparison studies
- 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 2023-2025. The dredger fee schedule is reviewed every 3 years. The most recent approval was for 2022-2024. The MOU between SFEI and the Water Board for administering the RMP is amended every two years. The most recent amendment was for 2023-2024.

Current and anticipated management decisions, policies, and actions by the regulatory agencies that manage water quality in San Francisco Bay

Decisions, Policies, and Actions	Timing
BAY WATERSHED PERMITS (NEXT REISSUANCE)	
Municipal Regional Stormwater Permit	2027
Mercury and PCBs Watershed Permit for Municipal and Industrial Wastewater (Implement mercury and PCB TMDLs)	2027
Nutrient Watershed Permit for Municipal Wastewater (Implement Nutrient Management Strategy)	2024
CURRENT HIGH PRIORITY DRIVERS BY TOPIC	
303(d) List and 305(b) Report Current listings and next cycle	March 2023 2026*/2029
Beneficial Reuse of Dredged Sediment Review sediment guidelines+ and testing criteria Evaluate the effectiveness of strategic placement	Ongoing Ongoing
Contaminants of Emerging Concern Updates to CEC Tiered Risk-Based Framework Opportunities to inform regional actions and state and federal regulations	Annual Ongoing
Determination of Wastewater Permit Limits California Toxics Rule	Ongoing
PCBs Review existing TMDL and inform revisions	Complete by 2028
Mercury Review existing TMDL and inform revisions	Complete by 2026
Nutrients Inform the Nutrient Management Strategy	Ongoing
OTHER DRIVERS BY TOPIC	
Beneficial uses Fish exposure (PCBs, Hg, and PFAS) and tribal uses	Ongoing
Current Use Pesticides EPA Registration Review of fipronil and imidacloprid DPR fipronil mitigation measures	Ongoing

Decisions, Policies, and Actions	Timing
OTHER DRIVERS BY TOPIC	
Copper Site specific objectives triggers+	Ongoing
Cyanide Site specific objectives triggers+	Ongoing
Dioxins Review 303(d) listings and establish TMDL development plan or alternative	Ongoing
Dredging Permits Bioaccumulation testing triggers and in-Bay disposal thresholds+	Ongoing
Legacy Pesticides (DDT, Dieldrin, Chlordane) Monitoring recovery (biota)	Ongoing
Sediment Hot Spots Review 303(d) listings and establish TMDL development plan or alternative	2024
POTENTIAL FUTURE DRIVERS	
Effects of reduced wastewater and stormwater inputs to the Bay	TBD
Effects of reverse osmosis concentrate discharge to the Bay	TBD
South Bay standards-related selenium assessment	TBD
Sea level rise adaptation and changes in salinity, pH, temperature, and dissolved oxygen due to climate change	TBD
Trash and Microplastics	2024
Wetland restoration permits and regional monitoring	TBD
Tribal and subsistence use as beneficial uses	TBD

+ Comparisons to triggers updated every 5 years for sediment and every 2 years for water; *Data for 2029 Integrated Report needed by 2026

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)

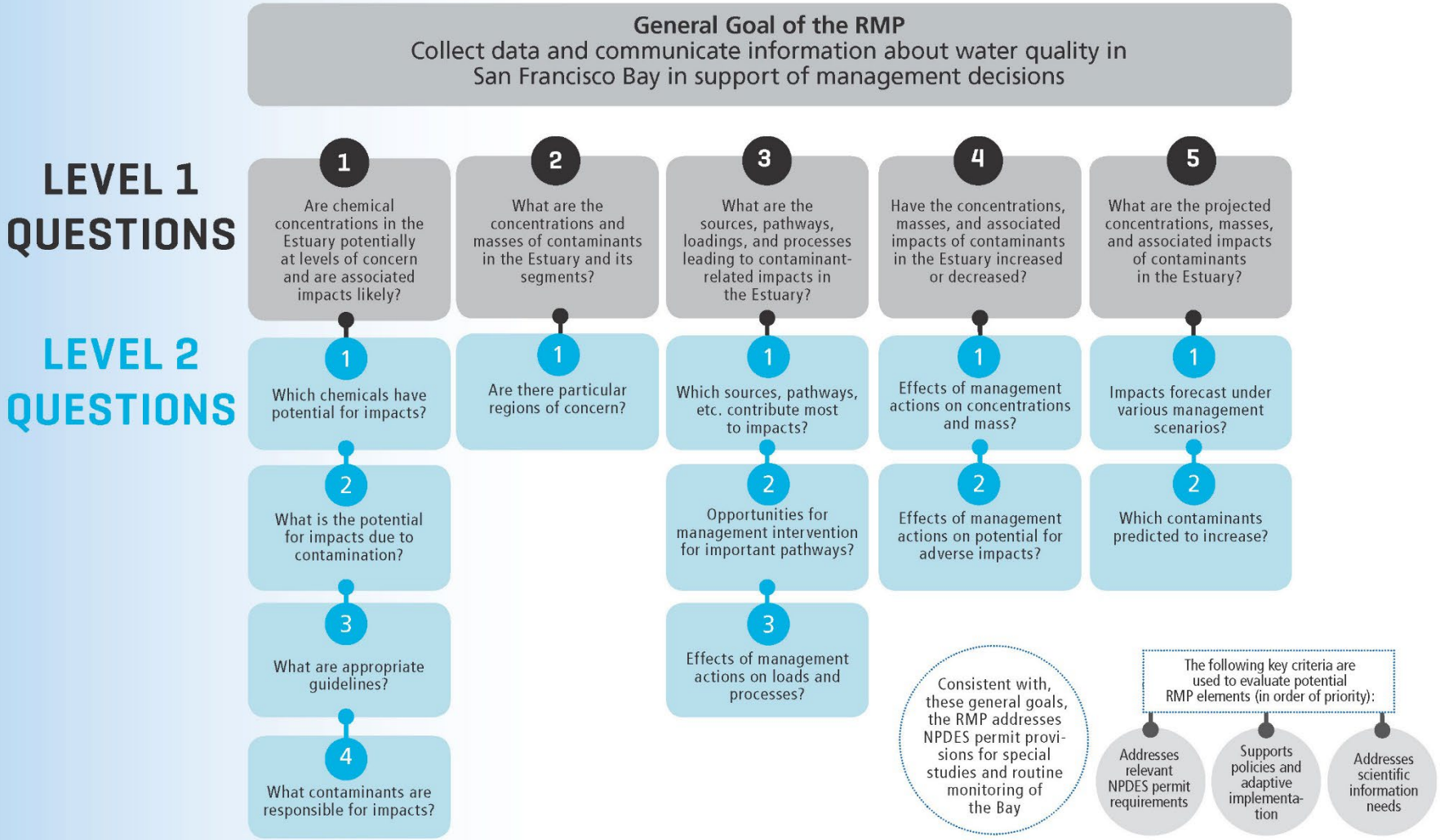
San Francisco Bay 303(d) List Updates
- 2018
- 2010
- 2006
- 2002
- 1998
- 1996

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

Fish Advisory
- SF Bay (2011)

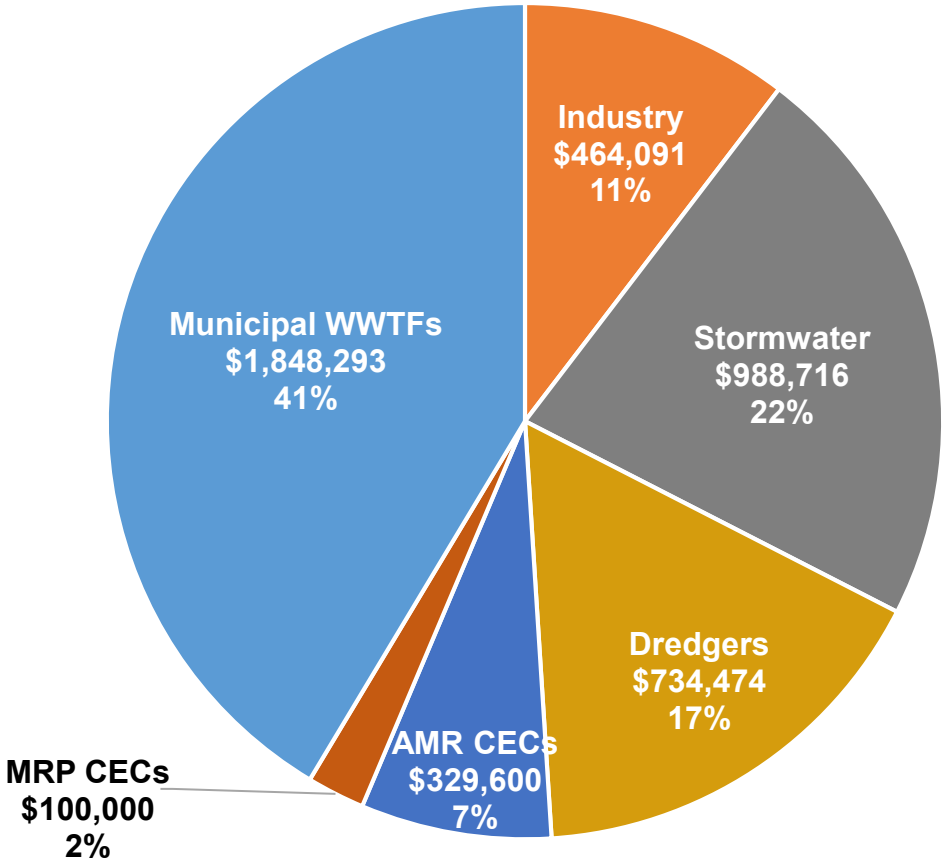
RMP GOAL AND MANAGEMENT QUESTIONS

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.



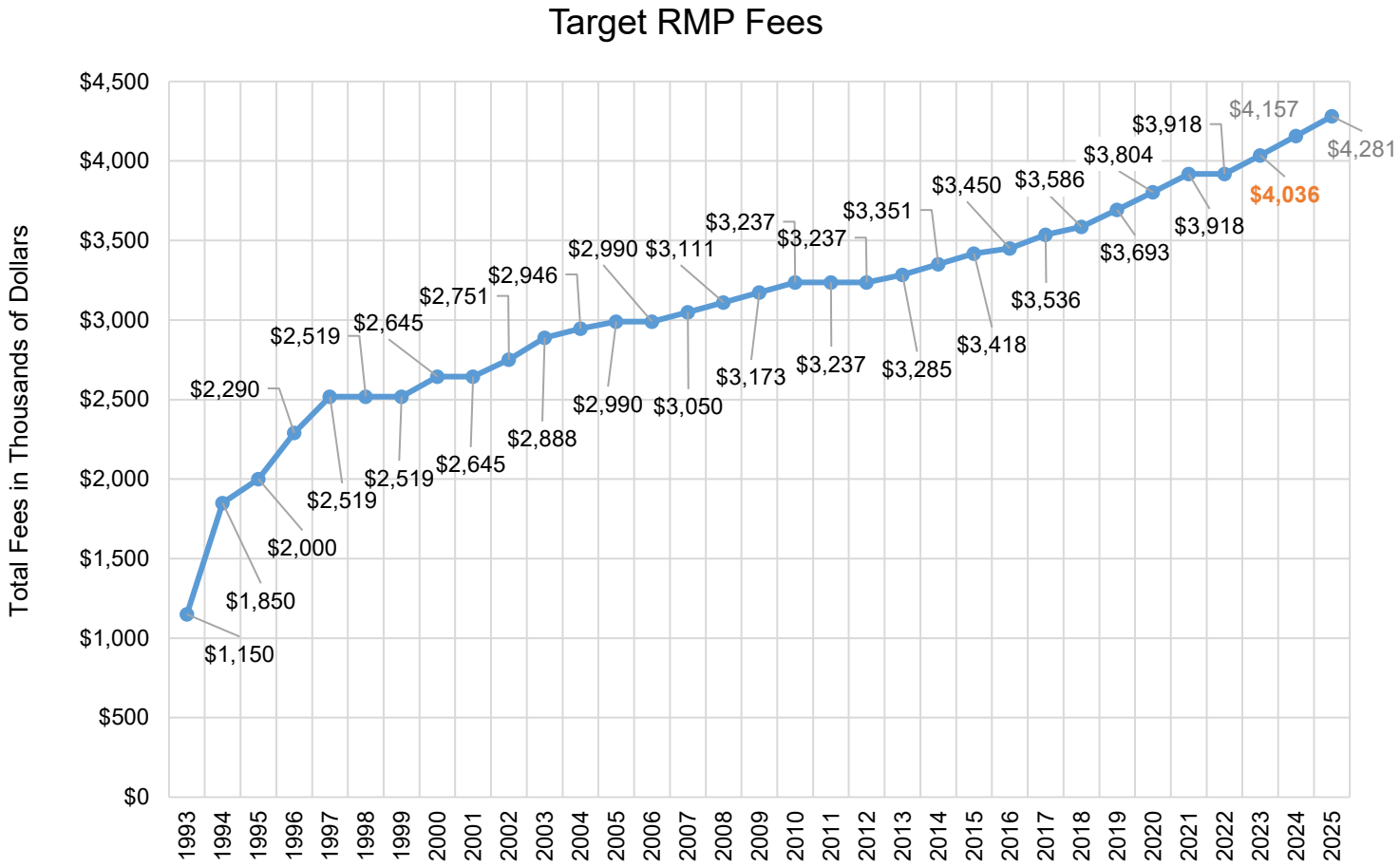
BUDGET: Revenue by Sector 2023

RMP fees are divided among four major discharger groups. Core RMP fees in 2023 are $4.036 million. Municipal wastewater treatment agencies are the largest contributor, followed by stormwater agencies. The contribution from dredgers includes $400,000 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 funding for emerging contaminant-related studies from Alternate Monitoring and Reporting (AMR) Program funds from municipal wastewater agencies ($329.6k) and a supplement from the municipal stormwater dischargers ($100k) as outlined in the Municipal Regional Stormwater Permit.



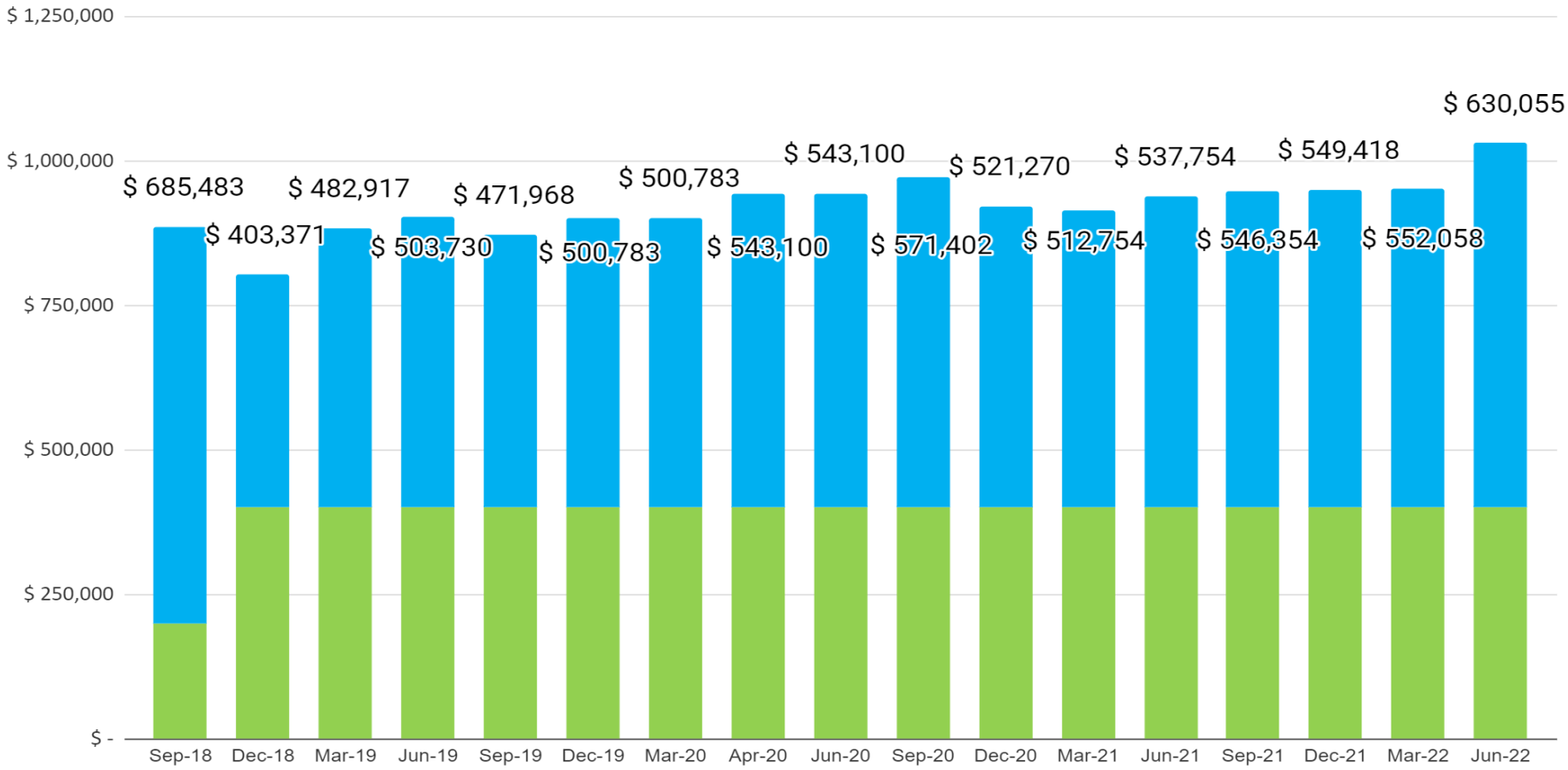
BUDGET: Revenue by Year

Target RMP fees in 2023 are $4.036 million, an increase in 3% from 2022. For 2023-2025, the Steering Committee has approved a 3% increase in fees for each year. Over the past 20 years, RMP fee growth has not kept up with inflation.



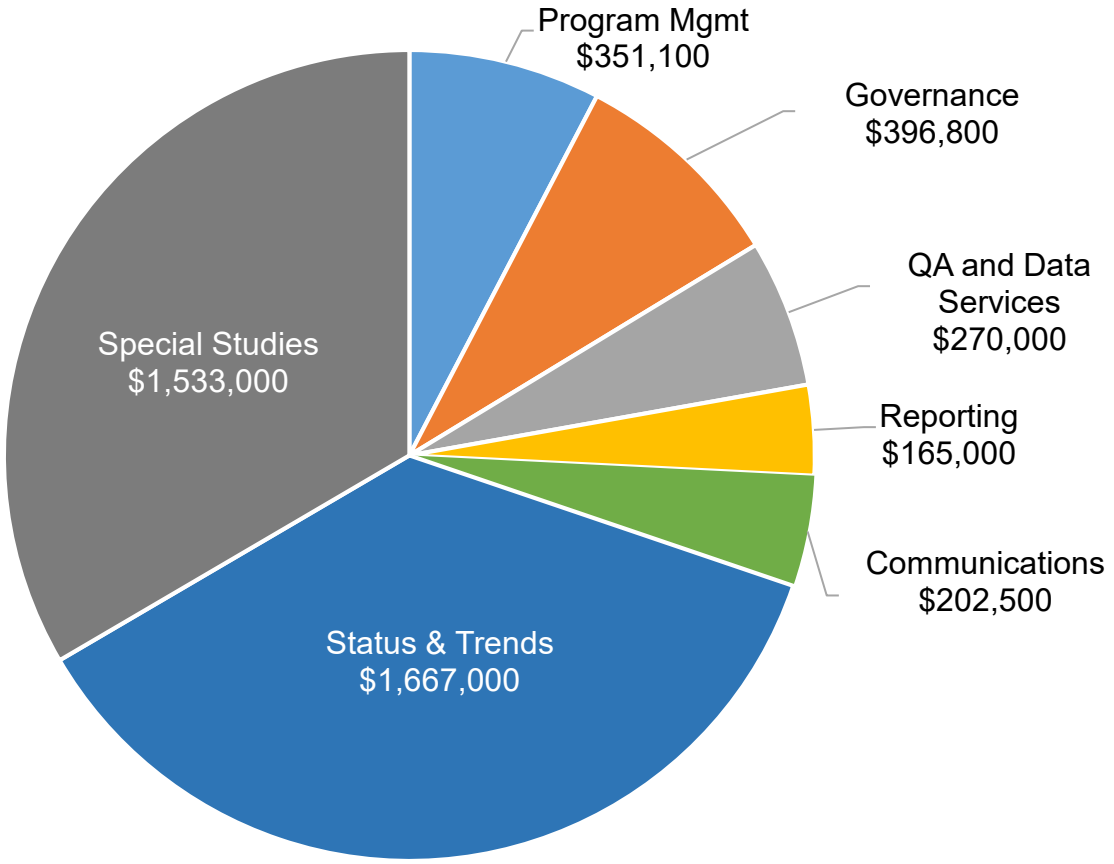
BUDGET: Reserve Funds

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 four 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 the reserve is now approximately 10% of the annual Program budget.



BUDGET: Expenses 2023

In 2023, 75% of the budget is allocated on Status & Trends and Special Studies. Quality assurance and data systems, reporting, and communications are each approximately 5% of the budget. Governance meetings (9%) 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, 8% of the budget is needed for program management, including fiduciary oversight of contracts and expenditures.



ACTUAL AND FORECAST BUDGETS: Special Studies 2017-2025

RMP actual and planned expenditures on special study topics. Costs for 2016-2023 are based on approved budgets. Costs for 2024 and beyond are estimates for planning based on the most recent input from the Workgroups and Strategy Teams. The funds available for 2024-2025 were estimated based on a 3% RMP revenue increase each year, and subtracting estimated Status and Trends monitoring costs (page 39) and programmatic expenses.

FOCUS AREA	2020	2021	2022	2023	2024	2025
	Budget	*Budget*	*Budget*	*Budget*	*Forecast*	*Forecast*
Emerging Contaminants	$327,900	$338,000	$320,000	$638,000	$657,000	$829,000
Microplastic	$50,000	$61,500	$35,500	$13,000	$116,000	$142,000
Nutrients*	$250,000	$250,000	$250,000	$250,000	$400,000	$400,000
PCBs	$101,000	$131,880	$108,000	$75,000	$90,000	$64,000
Sediment	$180,500	$214,050	$185,000	$267,000	$300,000	$555,000
Selenium‡	$84,000	$0	$0	$0	$0	$0
Sources, Pathways, Loading	$287,000	$265,000	$193,000	$290,000	$492,000	$289,000
SPECIAL STUDIES TOTAL	**$1,280,000**	**$1,260,430**	**$1,091,500**	**$1,533,000**	**$2,055,000**	**$2,279,000**
Predicted RMP Core Budget for Special Studies			$820,699	$1,083,586	$1,188,586	$1,120,907
Predicted AMR Funds			$320,000	$329,600	$339,488	$349,673
Predicted Stormwater CEC Funds				$100,000	$100,000	$100,000
PREDICTED SPECIAL STUDIES BUDGET TOTAL			**$1,140,699**	**$1,513,186**	**$1,628,074**	**$1,570,580**

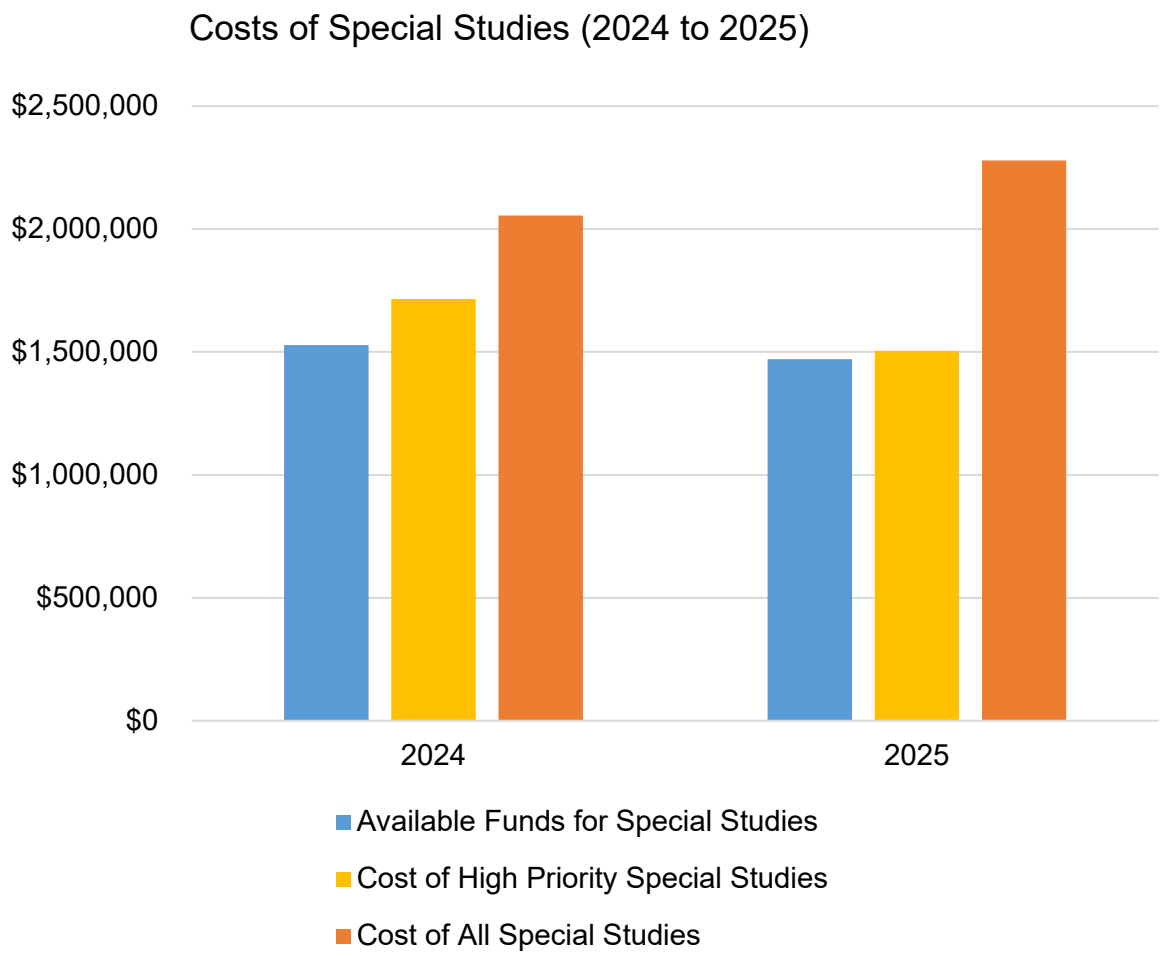
*The estimated RMP budgets on this table do not cover all of the funding needs for the Nutrients Management Strategy. Funding for these strategies is partially provided from other sources.

‡Funding for Selenium studies moved to the Status and Trends Program beginning in 2021.

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 expired in 2021 but was replaced with a similar permit amendment for CEC monitoring starting in 2022. The MRP issued in 2022 included an opportunity for Municipal Stormwater entities to contribute $100k to the RMP in lieu of individual monitoring for CECs. The SEP funds are not predictable. The AMR and MRP funds have been included in the predicted special studies budget total in the table above because these funds are predictable. AMR funds will increase at the same rate as the core RMP fees.

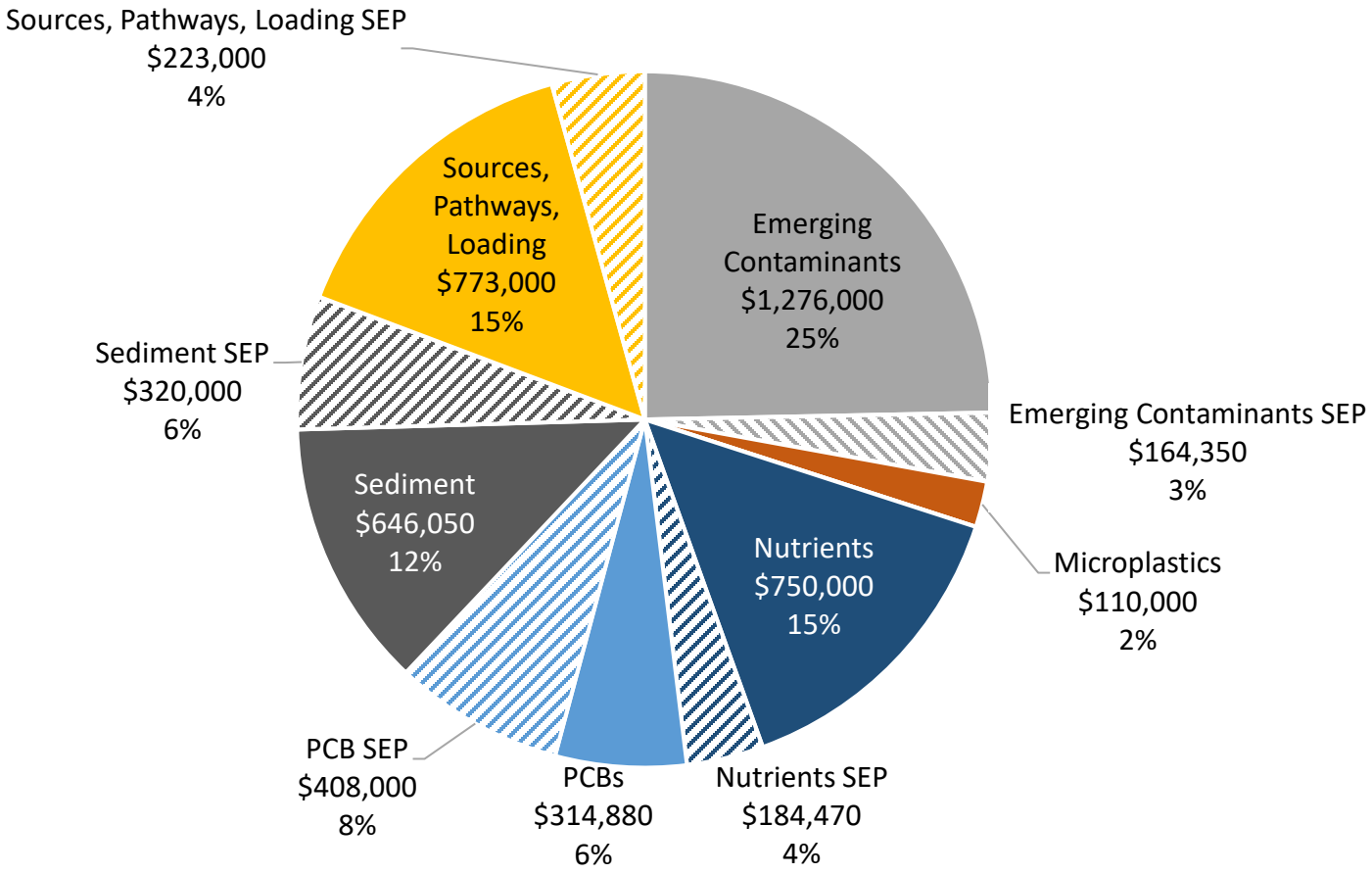
PROJECTED BUDGET: SPECIAL STUDIES 2023 to 2025

Projected funds available for special studies in 2024-2025 (blue), the cost of high priority studies (yellow), and the cost of all special studies based on the multi-year plans for all workgroups (orange). High priority studies for 2025 are estimates because not all workgroups have selected and prioritized studies for those years.



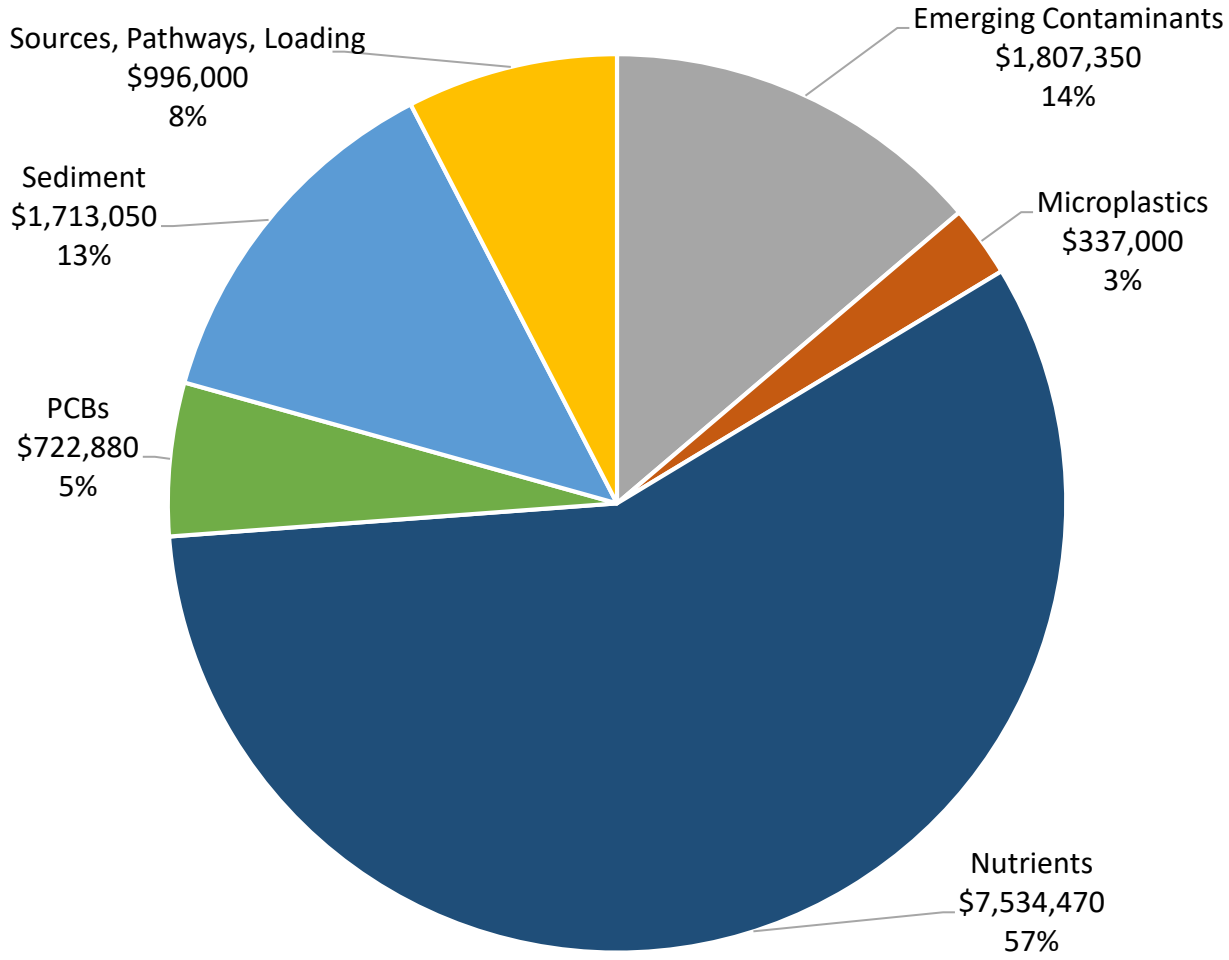
BUDGET: Special Studies and SEP funding 2021-2023

Special Studies (solid pies) and Supplemental Environmental Projects (hashed pies) funded over the past three years. Total funds: $5,169,750



BUDGET: Total Workgroup Funding 2021-2023

Total funding for Special Studies over the past three years, including Supplemental Environmental Projects, Alternative Monitoring Requirements, RMP partner funding, and external funding. Total funding is $13,110,750.



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

State Water Board CEC Program

DTSC Safer Consumer Products Program

Recent Noteworthy Findings

In 2022, the RMP launched an effort to review and revise the overall CEC Strategy guiding the program. An early outcome of this revision is a proposal to change the tiered risk-based framework for emerging contaminants, increasing the number of tiers to provide greater ability to distinguish relative risks and communicate RMP monitoring priorities. At present, no CECs would fall into the Very High Concern tier outlined in this revised framework. PFAS and organophosphate esters would be listed as High Concern CECs for the Bay. Moderate Concern CECs include alkylphenols and alkylphenol ethoxylates (surfactants), bisphenols (plastic ingredients), the urban-use pesticides fipronil and imidacloprid, and microplastics (a separate focus area, see page 25). The multi-year plan for emerging contaminants on the following pages has been reorganized to reflect the proposed revision to the framework.

The RMP continues a major focus on PFAS, widely used fluorine-rich specialty chemicals that are persistent and of high toxicological concern for humans and wildlife. In 2021, the RMP sport fish report indicated concentrations of PFAS, particularly in South Bay fish, exceed thresholds that have been established by other states for the development of consumption advisories. In 2022, RMP stakeholders and scientists participated in a forum with local community groups and tribes to build consensus on next steps to protect fishing communities. Meanwhile, Bay water samples collected in summer 2021 revealed PFAS contamination remains present, with higher levels found in South Bay and Lower South Bay.

A major RMP effort to screen Bay Area stormwater for CECs is drawing to a close. The fourth and final year of monitoring is now complete, and data analysis and interpretation is underway. In parallel, scientists and stakeholders are developing the RMP strategy for continued work on CECs in stormwater, and designing and testing new remote sampling equipment.

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 2019 to 2026. 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 within other workgroups. Bold boxes indicate multi-year studies. Items shaded in yellow are considered high priority for 2024 funding and beyond.

Element	Study	Funder	Questions addressed	2019	2020	2021	2022	2023	2024	2025	2026
Strategy	CEC Strategy[1] (no proposal needed after 2020)	RMP	1-6	70	75	60	90	95	62	64	66
	Tires Strategy	RMP	1-6					10	10	10	10
	Stormwater Monitoring Strategy	RMP	1,2				50	55			
STORMWATER MONITORING AND MODELING											
Stormwater	Strategy-driven Stormwater CECs Monitoring and Modeling (multiple contaminant classes)	RMP WQIF‡	1,2					250 (100)	200 (100)	200 (100)	200
HIGH CONCERN CECs											
PFAS	PFAS: Synthesis and Strategy	RMP	1-6						85		
	Stormwater PFAS[2]	RMP	1,2	33	40	29.6	20				
	PFAS in Ambient Bay Water	RMP	1,4,6			50					
	PFAS in Influent, Effluent, Biosolids; Study TBD, est. value	BACWA	1,2,4,6			(135)	(290)				
	PFAS in Archived Sport Fish	RMP Water Brd	1,4				12.5 (20)	42			
	North Bay Margin Sediment PFAS[3]	SEP	1,2,4,6					(53)			
	Marine Mammals (PFAS and Nonpolar NTA)[4]	RMP S&T	1,4,6					57.75	63.25		
	Bay Water TOP Assay	RMP	1						20	40	40
	PFAS Air Monitoring (~$50-150k)	SEP proposal	1,2								
	Agricultural (Biosolids) PFAS in Water & Sediment of North Bay Margins (~$100-200k)	SEP proposal	1,2,3								

Element	Study	Funder	Questions addressed	2019	2020	2021	2022	2023	2024	2025	2026
	RMP Status and Trends[5]	RMP S&T	1,4	F 9*			E, wet 15.5*	W, S, wet 55.5*	E, F, wet ~35*	W 13*	wet, seals ~25*
Organo-phosphate Esters	Organophosphate Ester Flame Retardants in Ambient Bay Water	RMP ECCC	1,4								
	Stormwater Organophosphate Ester Flame Retardants[2]	RMP	1,2	33	40	29.6	20				
	OPE Wastewater Monitoring	RMP	1,2,4,6						40		
	OPE Air Monitoring (~$50-150k)	SEP proposal	1,2,3,6								
	OPEs: Synthesis and Strategy	RMP	1-6								75
	RMP Status and Trends[5]	RMP S&T	1,4			W 17*	wet 11*	W, wet 28*	wet 11*	W 17*	wet 11*
MODERATE CONCERN CECs											
Alkylphenols & Alkylphenol Ethoxylates	Stormwater Ethoxylated Surfactants[2]	RMP	1,2	33	40	29.6	20				
	Ethoxylated Surfactants in Water, Margin Sediment, Wastewater	RMP	1,2,4	123							
	Followup Study	RMP	1,2,4				30	30			
Bisphenols	Bisphenols in Stormwater[2]	RMP	1,2		21	29.6	20				
	Bisphenols in Wastewater, Sediment	RMP	1,2		72						
	Bisphenols in Biota	RMP	1						80		
	RMP Status and Trends[5]	RMP S&T	1,4			W 13*	wet 8.5*	W, S, wet 47.5*	wet 8.5*	W 13*	wet 8.5*
LOW or POSSIBLE CONCERN CECs											
PBDEs	RMP Status and Trends[5]	RMP S&T	1,3,4	F 24*			E 11.5*	S 20.5*	F 24*		
Plastic Additives	Phthalates and Replacements in Water, Archived Sediment	RMP	1,4							100	
Personal Care & Cleaning	Sunscreens in Wastewater	MMP	1,2		(36.5)						
	QACs in Wastewater	MMP NSF	1,2,4			(58.2) (20)					

Element	Study	Funder	Questions addressed	2019	2020	2021	2022	2023	2024	2025	2026
	QACs & New Concerns in Bay Water, Wastewater[6]	RMP								40	
Pesticides	DPR Priorities in Water & Sediment[5]	RMP USGS	1,2,3								
	Ag Pesticides in Water & Sediment of North Bay Margins (~$100k)	SEP proposal	1,2								
	Antimicrobials in Bay Water, Wastewater[6]	RMP	1,2							30	
Brominated Azo Dyes	Archived Sediment (~$60k)	SEP proposal	1								
Building Materials	Isothiazolinone Biocides and Other Contaminants in Stormwater (~$50k)	U Iowa SEP Proposal	1,2	(2)							
	New concerns	RMP	1								50
Chlorinated Paraffins	Chlorinated Paraffins (medium-long) in Sediment[3]	SEP	1					(53)			
	Chlorinated Paraffins in Ambient Bay and Pathways	RMP	1								120
Vehicles, Roadways (studies also listed in Tires MYP)	Tire, Roadway Contaminants Follow-up from NTA, Stormwater[2]	RMP	1,2	33	40	29.6	20				
	Tire Contaminants Wet Season Water Screen	RMP	1,2				50	40	50		50
	Newly Identified Tire Contaminants (Bay or Stormwater)	RMP	1,2							50	50
	Total Tire Rubber/Tire Chemical Indicators (Stormwater, Bay Wet Season Water, Sediment)	RMP	1,2							25	75
NONTARGETED & OTHER STUDIES											
NTA (including followup targeted studies	Marine Mammals (PFAS and Nonpolar NTA)[4]	RMP S&T	1,4,6					57.75	63.25		
	NTA Data Mining of Water & Sediment Findings	RMP	1,2					45			
	Non-targeted Analysis of Bay Fish	RMP	1						50	50	

Element	Study	Funder	Questions addressed	2019	2020	2021	2022	2023	2024	2025	2026
based on NTA findings)	Follow-up Targeted Study (data mining results)	RMP	1							50	
	Microplastic Additives NTA Study[7]	RMP	1							100	
Other	Toxicology	RMP	1	15		60			60	60	60
RELEVANT STUDIES IN OTHER WORKGROUPS											
Modeling (SPLWG)	Integrated Monitoring and Modeling Strategy - CEC Conceptual Model	RMP	1,2,4			50*					
Modeling (SPLWG)	CEC Stormwater Load Modeling Exploration	RMP	2				25*				
Strategy (MPWG)	Tires Strategy, Multi-Year Plan	RMP	1,2,3,6				25.5*				
RMP-funded Special Studies Subtotal - ECWG				**325**	**328**	**318**	**332.5**	**567**	**657**	**819**	**796**
High Priority Special Studies for Future RMP Funding									**517**	**479**	**516**
RMP Status and Trends Analytical Costs for CECs				**33**	**0**	**30**	**46.5**	**267**	**205**	**43**	**44.5**
RMP-funded Special Studies Subtotal – Other Workgroups				**0**	**0**	**50**	**50.5**	**0**			
MMP & Supplemental Environmental Projects Subtotal				**0**	**36.5**	**58.2**	**0**	**106**			
Pro-Bono & Externally Funded Studies Subtotal				**2**	**0**	**155**	**310**	**100‡**	**100‡**	**100‡**	
OVERALL TOTAL				**327**	**364.5**	**531.2**	**642.5**	**773**	**757**	**919**	**796**

1 – The CEC Strategy funds preparation of RMP CEC Strategy Revisions, Updates, and Memos; it also funds literature review, scientific conference attendance, and responses to information requests from RMP stakeholders. A Revision to the CEC Strategy is planned for 2022, resulting in a higher funding request than in the prior years. After 2020, a Special Study proposal is not required for CEC Strategy funding.
2 – The multi-year (2019-2022) stormwater study includes five groups of analytes: PFAS, ethoxylated surfactants, organophosphate esters, bisphenols (added year 2), and targeted stormwater analytes identified via non-targeted analysis. The total projected cost ($586k) is spread across five groups and four years.
3 – A SEP received in 2022 will fund sediment analysis of PFAS and chlorinated paraffins; the $106k budget is split between these classes.
4 – The non-targeted analysis of marine mammal tissues includes investigations of PFAS (targeted and suspect screening) and nonpolar compounds; budgets are split between PFAS and NTA categories.
5 – When a CEC may be included in the the RMP Status and Trends monitoring, there is a code in the cell denoting the matrix for which monitoring is proposed: W = water; S = sediment; B = bivalve; E = eggs; F = fish. Approximate analytical costs are provided to indicate CECs resources provided by Status and Trends monitoring. A review of the Status and Trends design has resulted in expected modifications over future years, with scheduling for some activities uncertain at this time. New codes include “wet,” or pilot wet season water monitoring, and “seals,” indicating potential inclusion of this matrix in future years.
6 – A special study suggested for 2025 could analyze cleaning product ingredients including QACs and other antimicrobials; costs are split among these groups.
7 – A suggested special study that uses non-targeted analysis to identify additives in microplastics is listed as potentially co-funded via both ECWG and MPWG.

‡ The RMP has submitted a proposal to the San Francisco Bay Water Quality Improvement Fund (WQIF) that would support stormwater CECs monitoring at a level of ~$100k per year for three years (2023-2025). This MYP lists these potential funds, and will be updated to reflect the final funding decision relating to this proposal.

TIRES

This short-term multi-year plan (MYP) responds to recent data revealing the magnitude of tire chemical/particle emissions and their toxicity to aquatic organisms. The plan synthesizes the tire-related studies in the ECWG and MPWG multi-year plans; we do not anticipate the need to highlight these studies in a tire-specific plan after 2027. Studies are synthesized here and also included in the MYPs of relevant workgroups.

Relevant Management Policies and Decisions

Department of Toxic Substances Control's Safer Consumer Products Program (tire chemicals, microplastics)

California's Statewide Microplastics Strategy adopted by the Ocean Protection Council (OPC) calls for development of a tires-specific pollution prevention strategy by 2023

Department of Resources Recycling and Recovery Waste Tire Recycling Management Program implementation

State and Regional Water Board decisions on addressing tire-related chemicals or microplastics under the Clean Water Act

Recent Noteworthy Findings

Tires may be the biggest source of microplastic pollution globally. In the US, vehicles release 3-5.5 kg/capita of tire wear particles annually. When it rains, stormwater runoff carries micro and nano-sized tire particles—and the toxic chemicals associated with them—from outdoor surfaces to creeks and the Bay.

Tire particles contain hundreds of chemicals, some of which are known or suspected to be toxic to aquatic organisms or to have toxic transformation products. Examples include N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine (6PPD), zinc, benzothiazoles, bisphenols, 1,3-diphenylguanidine, polyaromatic hydrocarbons (PAHs), phthalates, hexa(methoxymethyl)melamine, glycols and glycol ethers, and alkylphenol ethoxylates.

RMP monitoring has detected tire particles and tire-related chemicals in Bay Area stormwater and in San Francisco Bay during the wet season. Analysis of these monitoring data and additional Bay wet season monitoring of tire-related chemicals is in progress.

The RMP collaborated in a recent study that found a highly toxic chemical (6PPD-quinone) derived from vehicle tires in Bay Area stormwater at levels that are lethal to coho salmon. New data indicate that steelhead and Chinook, salmon species still migrating through the Bay to surrounding watersheds, experience the same symptoms as coho and some die after laboratory exposure to highway runoff.

Studies exposing standard estuarine and freshwater test organisms (*Menidia beryllina, Americamysis bahia, Daphnia magna*, and others) to tire microparticles, tire nanoparticles, and tire leachate revealed lethal and sublethal effects (e.g., on reproduction, growth, and behavior) at concentrations believed to be environmentally relevant; however, Bay concentrations of tire particles are currently unknown.

At present, risks from tire-related chemicals are largely unknown because tire formulations are proprietary. Furthermore, transformation products and their toxicity are not fully understood.

The OPC and the RMP funded the development of a stormwater conceptual model report that identified scientific information needs and enumerated a broad spectrum of potential measures to address tire pollution. A second RMP report in progress will include Bay Area-specific estimates of tire emissions and tire market information gleaned from a pro-bono UC Berkeley project. This information can be used to focus study designs by non-RMP scientists whose work can inform the RMP.

Priority question for the next five years

Proposed: Do tire particles or chemicals have the potential to adversely impact beneficial uses in San Francisco Bay?

Recommended RMP Special Studies

Conduct additional measurements of known tire contaminants in the Bay. Follow up on Bay wet season detections to obtain additional data to better characterize Bay wet weather concentrations, leveraging the Bay wet season Status and Trends pilot sampling planned in water years 2023 and 2024 and possibly 2026.

Tires Strategy. Participate in scientific meetings to encourage scientific research to address RMP information needs, such as identifying tire chemicals and toxicity. Obtain and analyze new, relevant information about tire particles, chemicals, and their toxicity to support RMP study designs and risk evaluation. Provide scientific information to RMP stakeholders. At present, addressing the high volume of scientific activity in this field and extensive requests for SFEI to interpret and share information with RMP stakeholders cannot be accomplished within routine RMP budgets. Starting in 2028, we anticipate this work can be accommodated within routine RMP budgets.

Measure total tire rubber and tire chemical indicators in stormwater, Bay water, and sediment. Measurements of tire rubber and chemical indicators (various tire additives) provide a means of calculating total tire material in water and sediment. These data would make it possible to determine the relevance of the growing body of tire particle toxicity data indicating potential for adverse effects to diverse aquatic organisms at concentrations that could potentially occur in the Bay ecosystem. Sample collection would leverage RMP Bay water, stormwater, and sediment monitoring activities, minimizing costs. Data on tire chemical indicators could be used for benchmarking purposes (comparison to other studies) and to explore more cost-effective options for future monitoring related to tires. The recommended structure of this multi-year study includes an initial pilot testing year to evaluate sample collection methods, followed by a more significant sample collection phase.

Conduct measurements of additional, newly identified tire contaminants that might adversely impact beneficial uses in San Francisco Bay. In the future, additional tire-related chemicals that have the potential to harm aquatic ecosystems are likely to be identified through ongoing tire chemical characterization and toxicity evaluation by non-RMP scientists. Tires science tracking (under the tires strategy) would identify potential chemicals for monitoring; specific information on proposed study design, including the rationale for selecting analytes of interest, would be reviewed by the RMP via the annual ECWG special study proposal prioritization process. At present, no other surface water monitoring of tire contaminants is known in California. Sample collection would leverage RMP Bay water and stormwater monitoring activities, minimizing costs. If no such contaminants are identified, the study would not be proposed for implementation.

The focus for the next few years will be on the presence of and potential for tire-related particles and chemicals to affect the San Francisco Bay ecosystem, recognizing the unique pathways for transport and release of these chemicals into the ecosystem due to their microplastic particle source.

MULTI-YEAR PLAN FOR SHORT-TERM EFFORT ON TIRE-RELATED CHEMICALS AND PARTICLES

Tire-related studies in the RMP from 2017 to 2027. Numbers indicate budget allocations in $1000s. Budgets in parentheses represent funding or in-kind services from external partners. Budgets that are starred include items beyond tires. Items shaded in yellow are considered high priority for 2024 funding and beyond. Bold boxes indicate multi-year studies. *Studies are synthesized in this short-term MYP and are also included in the MYPs of relevant workgroups (ECWG, MPWG).*

Element	Study	Funder	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Strategy	Tires strategy	RMP ECWG							10	10	10	10	10
Monitoring	Tire contaminants in Bay wet season	RMP ECWG						50	40	50		50	
	Total tire rubber/tire chemical indicators (stormwater, Bay wet season, sediment)	RMP ECWG									25	75	50
	Tire and road contaminants (stormwater)	RMP ECWG			33	40	29.6	20					
	Newly identified tire contaminants (Bay or stormwater)	RMP ECWG									50	50	
	RMP tires strategy	RMP MPWG						25.5					
	Stormwater conceptual model - all elements	RMP MPWG OPC				30* (30*)	40* (90*)						
	Microplastics regional study - all elements	RMP MPWG Moore/External	75* (518*)	(210*)	(340*)								
	Tire market synthesis to inform science (pro bono)	BEACN (UCB)					(20)						
	Green stormwater infrastructure: Evaluating the efficacy of rain gardens	EPA/External	(10*)					(62*)	(62*)	(62*)			
RMP-funded Special Studies Subtotal – Tires					**33**	**70**	**69.6**	**95.5**	**50**	**60**	**85**	**185**	**60**
High Priority Special Studies for RMP Funding									**50**	**60**	**85**	**135**	**60**
Pro-Bono & Externally Funded Studies Subtotal			**528**	**210**	**340**	**30**	**110**	**62**	**62**	**62**			
OVERALL TOTAL			**603**	**210**	**373**	**100**	**179.6**	**157.5**	**112**	**122**	**85**	**185**	**60**

*Includes items beyond tires

MICROPLASTIC

Relevant Management Policies and Decisions

State-wide microplastics strategy and state-wide drinking water monitoring

Plastic Pollution Prevention and Packaging Producer Responsibility Act (SB 54, Allen, 2022)

State and regional bans and other management actions on single-use plastics, including plastic bags, foam packaging materials, plastic straws

DTSC Safer Consumers Products Program decisions on regulation of chemicals in tires, food packaging, building materials

Federal policy on microplastics and microfiber pollution

State and Federal bans on microbeads

State-wide trash requirements

Municipal pollution prevention strategies including green stormwater infrastructure

Recent Noteworthy Findings

Plastics are among the most ubiquitous materials used in modern society. Microplastics, pieces of plastic under 5 mm in size, have been identified in virtually every environment on Earth. Microplastics are often derived from larger plastic items, such as tiny tire wear particles shed while driving, fibers shed from textiles during washing and drying, and fragments from litter. Tire particles may be the biggest global source of microplastics. Due to our car culture, scientists estimate that the US has the highest tire particle emissions in the world—7 to 12 pounds per person every year.

The San Francisco Bay Microplastics Project was completed in 2019, and found microplastics to be ubiquitous in Bay water, sediment, bivalves, and prey fish. This study quantified for the first time microplastics in urban stormwater runoff, and made the breakthrough discovery that concentrations in urban runoff were significantly higher than wastewater effluent. The vast majority of particles observed in urban stormwater runoff were suspected to be tire wear particles and fibers.

Additionally in 2020, a collaboration with University of Washington identified various tire ingredients present in Bay stormwater runoff, including 6PPD-quinone at concentrations that are lethal to a salmon species that was historically present in the Bay (coho). More recent data indicate that steelhead, a salmon species still migrating through the Bay to surrounding watersheds, are also sensitive to this chemical.

While fibers were the second most common class of microplastics observed in stormwater, there is minimal understanding of the major sources of fibers observed in urban stormwater.

Air transport of microplastics is a key data gap in our understanding of microplastic sources and pathways. Air transport is particularly important for tire wear particles and fibers because both types of particles have characteristics that make them easily suspended in the air and have the potential to be transported long distances. Other important remaining data gaps include exposure of Bay aquatic organisms and risk for adverse impacts, and the effects of current and future solutions implemented to reduce microplastic pollution.

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 2020 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 within other workgroups. Bold boxes indicate multi-year studies. Items shaded in yellow are considered high priority for 2024 funding and beyond.

Element	Study	Funder	Questions Addressed	2020	2021	2022	2023	2024	2025
Strategy	Microplastic Strategy	RMP Patagonia/OPC	1,2,3,4,5	20 (30)	10	10	40 (250)‡	16	17
	Tires Strategy (ECWG)	RMP	1,2,3			25.5	10*	10*	10*
Monitoring biota	Bivalves	RMP	1,2						
	Fish	RMP							
	Assessing Information on Ecological Impacts	RMP NSF/CCCSD/External		(50)	18 (7.5+50)				
Monitoring water and sediment	Open Bay and Margins Sediment	RMP NOAA	1,2,3						25 (50)‡
	Surface Water: Bay and Sanctuaries								
	Limited particle size distribution analysis to refine water measurements	SEP						(25)	
	Sediment core (archive, pro bono analysis)	RMP (U. Rovira I Virgili)			3.5		(10)		
Characterizing sources, pathways, loadings, processes	Wastewater	SCCWRP	1,3,5		(26)				
	Stormwater (method evaluation and monitoring) (SPLWG)	RMP NOAA						25 (200)‡	25 (200)‡
	Stormwater Conceptual Model	RMP OPC		30 (30)	40 (90)				
	Investigate sources and pathways to inform management (e.g., air monitoring)	RMP Patagonia/OPC					(25)	75 (100)	75 (75)
	Tire market synthesis to inform science (pro bono)	UC Berkeley				(20)			
	Green stormwater infrastructure: Evaluating the efficacy of rain gardens	EPA/External				(62)	(62)	(62)	
RMP-funded Special Studies Subtotal – MPWG				**50**	**71.5**	**35.5**	**40**	**116**	**142**
High Priority Special Studies for Future RMP Funding								**41**	**42**
RMP-funded Special Studies Subtotal – Other Workgroups							**10**	**10**	**10**
Externally-funded Special Studies Subtotal				**110**	**173.5**	**82**	**347**	**387**	**325**
OVERALL TOTAL				**160**	**245**	**117.5**	**387**	**503**	**467**

‡ The RMP has submitted proposals for these projects. This MYP lists these potential funds, and will be updated to reflect the final funding decision relating to this proposal.

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

High frequency sensors are providing continuous data at nine sites in South Bay and Lower South Bay. These data show that elevated phytoplankton biomass and low dissolved oxygen are frequently observed in Lower South Bay margin habitats and suggest that water from the salt ponds introduces high phytoplankton biomass into Lower South Bay sloughs and increases the potential for low dissolved oxygen events.

Unprecedented fog and smoke coverage from wildfires in 2020 led to the lowest dissolved oxygen concentrations ever observed in Lower South Bay. The absence of light resulted in a shift in the metabolic balance of the system, causing oxygen concentrations to plummet, putting fish and other biota at risk.

Progress continues on model simulations of nutrient transport, phytoplankton blooms, oxygen cycling, biogeochemical processes, and quantifying uncertainty in models.

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?

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

4. What management actions would be required to mitigate such impairments and protect beneficial uses?

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

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

7. 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?

8. When nutrients exit the Bay through the Golden Gate, where are they transported and how do they influence water quality in coastal areas?

9. 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 2020 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 within other workgroups. Bold boxes indicate multi-year studies. Items shaded in yellow are considered high priority for 2024 funding and beyond.

Element	Study	Funder	Collaborations with other WGs	Questions Addressed	2020	2021	2022	2023	2024	2025
Strategy	Program coordination	RMP		1-5						
Monitoring	Moored sensors	RMP		1	250	250	250	250	400	400
	HF mapping on the shoal	SEP		1,3			(185)			
	Water quality in the Bay	RMP		1	250	250	258	265	274	283
Modeling	Nutrient Modeling	SEP	PCBWG	4,5				(408)*		
RMP-funded Special Studies Subtotal					**250**	**250**	**250**	**250**	**400**	**400**
High Priority Special Studies for RMP Funding									**400**	**400**
RMP Status and Trends for Nutrients					**250**	**250**	**258**	**265**	**274**	**283**
RMP-funded Special Studies Subtotal – Other Workgroups								**408**		
RMP Supplemental Environmental Projects Subtotal							**185**			
Pro-Bono & Externally-funded Special Studies Subtotal[1]					**2200**	**2200**	**2200**	**2200**	**2200**	**2200**
OVERALL TOTAL					**2450**	**2450**	**2635**	**2450**	**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 – support for appropriate changes to the TMDL

NPDES Municipal Regional Stormwater Permit and wastewater permit requirements

Focusing management actions and/or locations for reducing PCB impairment (upland)

Determining cleanup priorities (in-Bay)

Recent Noteworthy Findings

In 2019, shiner surfperch had a Bay-wide average PCB concentration 18 times higher than the TMDL target. 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. PCB concentrations in shiner surfperch and white croaker show limited signs of decline.

Urban stormwater is the pathway carrying the largest PCB loads to the Bay and has the highest load reduction goals. Concentrations of PCBs and mercury on suspended sediment particles from a wide range of watersheds have been measured as an index of the degree of watershed contamination and potential for effective management action. The three sites with the highest estimated particle PCB concentrations as of 2019 were Pulgas Pump Station South (8,220 ng/g), Industrial Rd Ditch in San Carlos (6,139 ng/g), and Line 12H at Coliseum Way in Oakland (2,601 ng/g).

Assessments of three “priority margin units” (Emeryville Crescent, San Leandro Bay [SLB], and the Steinberger Slough/Redwood Creek area [SS/RC]) established conceptual models as a foundation for monitoring response to load reductions and for planning management actions. A key finding was that PCB concentrations in sediment and the food webs in the Crescent and SLB could potentially decline fairly quickly (within 10 years) in response to load reductions from the watershed. In contrast, recovery in SS/RC appears likely to be ultimately limited by the relatively high PCB concentrations that prevail in the South Bay compared to other subembayments.

In spite of the expected responsiveness of SLB, extensive field studies 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?
    a. What would be the impact of focused management of PMU watersheds?
    b. What would be the impact of management of in-Bay contaminated sites (e.g., removing and/or capping hot spots), both within the sites and at a regional scale?

MULTI-YEAR PLAN FOR PCBs

Special studies and monitoring in the RMP from 2019 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 within other workgroups. Bold boxes indicate multi-year studies. Items shaded in yellow are considered high priority for 2024 funding and beyond. ss – Steinberger Slough; sl – San Leandro Bay

Category	Study	Funder	Questions addressed	2019	2020	2021	2022	2023	2024	2025
General	Develop and update multi-year workplan and continued support of PCB Workgroup meetings	RMP	1a,b	10	10					
	In-Bay Fate Model	RMP SEP WQIF	1a,b			45	75	(408) (350)‡	(340)‡	(235)‡
	Integrated Watershed-Bay Model (SPLWG)	SEP	1a,b			(200)*				
	Margins Ambient	RMP								
PMU	PMU Stormwater	SEP	1a	(40)*						
	PMU Sport Fish Monitoring (3 PMUs)	SEP	1a	(60)[a]					50[a]	
	Passive Samplers	RMP	1a		91ss	87sl				
	PMU Prey Fish Monitoring (4 PMUs)	RMP	1a				26ss[b]	37ss[c]		64sl
	PMU Sediment	RMP	1a,b				26ss[b]	38ss[c]	40	
PMU/General	Food Web Model	WQIF	1a,b					(71)‡	(71)‡	
RMP-funded Special Studies Subtotal – PCBWG				**10**	**101**	**132**	**127**	**75**	**90**	**64**
High Priority Special Studies for Future RMP Funding									**90**	**64**
RMP-funded Special Studies Subtotal – Other Workgroups				**40**	**0**	**200**	**0**			
RMP Supplemental Environmental Projects Subtotal				**60**	**0**	**0**	**0**	**408**		
Pro-Bono & Externally-funded Special Studies Subtotal				**0**	**0**	**0**	**0**	**421‡**	**411‡**	**235‡**
OVERALL TOTAL				**70**	**101**	**132**	**127**	**904**	**501**	**299**

[a] Shiner surfperch; [b] Sample collection; [c] Sample analysis and reporting; [d] WQIF

‡ The RMP has submitted a proposal to the San Francisco Bay Water Quality Improvement Fund (WQIF) that would support stormwater CECs monitoring at a level of ~$100k per year for three years (2023-2025). This MYP lists these potential funds, and will be updated to reflect the final funding decision relating to this proposal.

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

A 2020 RMP special study analyzed PCB data from the DMMO database to determine if the bioaccumulation trigger is a useful criterion for assessing whether sediment chemistry is correlated with the bioaccumulation test results. A similar analysis for mercury resulted in the elimination of the bioaccumulation trigger. The PCB analysis suggested that there was no significant difference in bioaccumulation testing results for sediment chemistry values below the bioaccumulation trigger compared to those above the bioaccumulation trigger but below the TMDL. This results suggests tha the bioaccumulation trigger may not be a useful criterion for determining when the risk of adverse bioaccumulation may increase.

Suspended sediment monitoring by the USGS at Dumbarton Bridge in WY 2016 showed particle flocculation is an important factor when calculating sediment flux. Based on these findings, the RMP funded studies in South Bay and at the Benicia Bridge to investigate the importance of flocculation in sediment flux estimates. In South Bay, the estimate of sediment settling velocity is most strongly tied to the method used. At the Benicia Bridge, cross-sectional variability in suspended sediment and flocculation are both important components needed to accurately estimate suspended sediment concentrations.

In 2023, the Workgroup will complete the development of a Bay sediment conceptual model that will highlight what is known and not known about sediment delivery and deposition dynamics at multiple spatial and temporal scales. These findings will be used in the development of a multi-year Sediment Monitoring and Modeling Workplan that will describe studies aimed at addressing key sediment knowledge gaps.

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 the 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 Estuary Blueprint.

MULTI-YEAR PLAN FOR SEDIMENT

Sediment Workgroup special studies for 2020 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 within other workgroups. Bold boxes indicate multi-year studies. Items shaded in yellow are considered high priority for 2024 funding and beyond.

Element	Study	Funder	Questions addressed	2019	2020	2021	2022	2023	2024	2025
Strategy	Sediment Monitoring Strategy	RMP WQIF/SEP	1,3,4	78			(200)			15
	Workgroup Stategy	RMP	1,2,3,4		10		10	10		
	Sediment Modeling Strategy	RMP	1,2,3,4		26					15
	Sediment Conceptual Model	SEP BCDC/USACE	1,2,3,4		(142)	(747)				
Screening Values	Sediment Bioaccumulation Guidance	RMP	1		23					
	Benthic Index Development	RMP	1							
	Toxicity Reference Value Refinement	RMP	1							
Dredging Impacts on Essential Fish Habitat	Benthic Invertebrate Assessment	RMP LTMS	2							
	Light Attenuation Near Dredging	RMP LTMS	1,2							
Data Mining	DMMO Database and Online Tools	RMP	1	Database maintenance costs covered by core program						
	DMMO Data Synthesis	RMP SEP	1,2							
	DMMO Database Enhancement	RMP	1,2			40	20			
Beneficial Reuse	Beneficial Reuse	RMP	1,2	30		34				
Loading to the Bay	Sediment Supply Synthesis	RMP	3,4							50
	Maintain Stream Gages and Add New Ones	RMP SEP	3,4							
	Monitor Mallard Island Suspended Load and Bedload Flux	RMP	3,4							
	Monitor Tributary Suspended Load and Bedload Flux	RMP			(385)*					
	Model Tributary Suspended Load and Bedload Flux	RMP								75

Element	Study	Funder	Questions addressed	2019	2020	2021	2022	2023	2024	2025
	Monitor Sediment Flux at Key Locations in the Bay (e.g., major creek mouths downstream of head of tide, mudflats/shallows, major bridges, Golden Gate)	RMP SEP	3,4	(158)				52, 70	100	
	Model Current and Future Sediment Flux at Key Locations throughout the Bay	RMP SEP	3,4		45		(408)*		50	75
Sinks & reservoirs	Monitor Sediment Deposition at Key Locations in the Bay (e.g., creek reaches downstream of head of time, mudflats/shallows)	RMP SEP	3,4			140	215	15 (120)	100	100
	Model Current and Future Sediment Deposition Dynamics throughout the Bay	RMP WQIF	3,4					(350)*‡	50 (340)*‡	75 (235)*‡
	Bathymetric Change Studies	RMP USGS	3,4	77 (5)	77 (5)					
	Bathymetric Data Collection	RMP	3,4							75
Sediment characteristics	Bulk Density of Sediment Types	RMP	4	30						
	Mapping Bed Sediment Characteristics for Model Calibration	RMP	3,4							
	Characterizing Impacts of Flocculation on Settling Velocity	RMP SEP	3,4		(264)					
Bay water column characteristics	Using Satellite Imagery to Analyze Turbidity and Suspended Sediment Concentration	RMP	5							75
RMP-funded Special Studies Subtotal – Sediment				**215**	**181**	**214**	**245**	**147**	**300**	**555**
High Priority Special Studies for RMP Funding									**300**	**330**
RMP-funded Special Studies Subtotal – Other Workgroups				**0**	**385**	**0**	**408**	**350**	**340**	**235**
RMP Supplemental Environmental Projects Subtotal				**158**	**406**	**0**	**200**	**120**		
Pro-Bono & Externally Funded Studies Subtotal				**5**	**5**	**747**	**0**			
OVERALL TOTAL				**378**	**592**	**961**	**445**	**267**	**300**	**555**

‡ The RMP has submitted a proposal to the San Francisco Bay Water Quality Improvement Fund (WQIF) that would support contaminant, sediment, and nutrient modeling at a level of ~$235-350k per year for three years (2023-2025). This MYP lists these potential funds, and will be updated to reflect the final funding decision relating to this proposal.

SOURCES, PATHWAYS AND LOADING

Relevant Management Policies and Decisions

Using integrated monitoring and modeling to estimate contaminant loads and trends from local tributaries to the Bay for future TMDL updates

Identifying local tributaries to prioritize for upstream source tracking

Informing decisions on the control measures for reducing contaminant concentrations and loads

Informing provisions of the current and future versions of the Municipal Regional Stormwater Permit (MRP)

Recent Noteworthy Findings and Future Directions

Shifting Focus: The Sources, Pathways and Loadings Workgroup (SPLWG) is continuing to shift its focus to an integrated approach that combines modeling and monitoring to answer management questions. The SPLWG is also shifting away from focusing on legacy pollutants only, including PCBs and Hg, to include contaminants of emerging concern (CECs) as a focus.

Modeling: A suite of models (e.g., RWSM, BAHM) is being developed to simulate hydrology, sediment, and water quality in Bay watersheds. The watershed dynamic model (WDM) for the Bay Area is capable of simulating large, complex regions with mixed land-use types, a wide range of contaminants, upland erosion and sediment transport, and in-stream processes at an hourly scale over multiple years. The sediment module of the WDM was completed in 2022 and is now being expanded to include contaminants load simulation (PCBs and Hg as pilot cases). The ongoing CECs load modeling review project is focusing on investigating and recommending appropriate ways of combining limited monitoring data and modeling to estimate regional scale CEC loads. We have also begun developing a watershed-bay modeling strategy and designing a pilot application of a coupled watershed-bay model to simulate the fate of sediment and contaminants.

Monitoring: Winter storm sampling by the RMP for legacy pollutants has been conducted in 93 watersheds and for CECs in 25 watersheds. PCB concentration results from sampling downstream of Oakland GE led to collaboration this year with the EPA to implement clean-up actions at that site. Additional sampling will be done in 2023 to characterize the current conditions prior to these management actions. Notable drought conditions during the last three years have required us to focus on increasing our remote sampling techniques toolbox and two projects funded for 2023 include remote sampler development for CECs and for deployment in tidal areas. Stormwater sampling goals continue to shift towards supporting the ECWG as well as legacy pollutant modeling. Planned sampling during WY2023 includes suspended sediment, PCBs, and Hg loads co-located with existing flow gauging to support model development, and PCBs concentrations in the watersheds of priority margin units (PMUs).

Integration of Monitoring and Modeling: The advanced data analysis (ADA) method developed in 2019 was the first step in our new integrated watershed monitoring and modeling (IWMM) approach for data interpretation. This approach addresses the weakness that concentration in stormwater or on particles in stormwater is non-conservative and an imperfect indicator of a pollutant source because of variation in dilution by both flow volume and sediment mass between storms and between sites. By accounting for these issues and using a spatial data layer of sources, an IWMM approach to data interpretation provides a direct comparison between sources of interest rather than an indirect comparison at the watersheds scale. With the completion of the WDM and with additional identification of sources for other contaminants of interest, the vision is to continue developing the IWMM approach for supporting PCB management decisions and potentially decisions for other contaminants in the future. An IWMM approach to data interpretation is a much more powerful science tool to support management than comparing concentrations between sites in raw form.

Contaminants of Emerging Concern: Prior RMP studies have identified the presence of emerging contaminants of moderate concern in urban runoff and provided evidence that stormwater is an important pathway for CECs to reach the Bay. A four-year preliminary investigation of CECs in stormwater culminates

in 2023, while two new projects have begun—one to explore potential models to estimate CEC stormwater loads (mentioned above) and another to develop a stormwater CECs monitoring approach that integrates modeling. Another project to develop the groundwork for the RMP's future CECs in stormwater monitoring and modeling program is beginning in fall 2022. These projects will feed into a 2023 SPLWG strategy update to reflect the pivot toward CECs and to re-examine activities addressing legacy pollutants.

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?

*Recent workgroup discussions pointed to the need for a Strategy update that could include revising the management question in relation to the changing emphases (particularly on CECs) and greater cross-workgroup collaboration.

MULTI-YEAR PLAN FOR SOURCES, PATHWAYS, AND LOADING

Sources, Pathways and Loadings Workgroup studies in the RMP from 2020 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. Bold boxes indicate multi-year studies. Items shaded in yellow are considered high priority for 2024 funding and beyond.

Element	Study	Funder	Collaboration with other Workgroups	Questions addressed	2020	2021	2022	2023	2024	2025
Strategy	SPLWG strategy (formerly STLS coordination)	RMP			40	25	35	35	37	39
	SPLWG strategy report & management questions update	RMP	ECWG	1,2,3,4,5				45		
Monitoring	Monitoring to support regional loads and trends	RMP		1,3				10		
	POC reconnaissance monitoring	RMP		1,2,3,4	110	65	43			
	Tidal area remote sampler development	RMP		1,2,4				85	25	
	Remote sampler purchase	RMP							180	
	Priority margin units (PMU) PCB monitoring	RMP		1,2,4	10					
	Priority margin units (PMU) PCB monitoring	SEP	PCBWG	1,2,4	37*					
Modeling	Modeling to support regional loads and trends (PCB/Hg)	RMP		3,5	100	150	90	130		
	WDM model maintenance	RMP		1					50	50
	CECs stormwater modeling	RMP		1			25			
	Advanced Data Analysis	RMP		1,2,3,4	50					
	Update San Francisco Bay region land-use map	SEP		2,4,5	(50)					
	Regional Watershed Spreadsheet Model update	SEP				(23)				
	Integrated watershed-bay modeling strategy and pilot implementation	SEP				(200)				
Integrated Studies	Integrated watershed monitoring and modeling strategy	RMP				50				
	PCB/Hg monitoring and modeling to support load and trend assessment	RMP		1,3,5					400	

RELEVANT STUDIES IN OTHER WORKGROUPS										
Monitoring	CECs stormwater monitoring and modeling	RMP WQIF‡	ECWG	1,2,4	181*	148*	100*	250* (100) ‡	200* (100) ‡	200* (100) ‡
Monitoring	Stormwater CECs monitoring strategy (approach)	RMP	ECWG				50*	55*		
Monitoring	Stormwater (method evaluation and monitoring)	RMP NOAA‡	MPWG						25* (200)‡‡	25* (200)‡‡
RMP-funded Special Studies Subtotal – STLS					**310**	**290**	**193**	**305**	**492**	**289**
High Priority Special Studies for RMP Funding									**467**	**289**
RMP-funded Special Studies Subtotal – Other Workgroups					**218**	**148**	**150**	**305**	**200**	**200**
RMP Supplemental Environmental Projects					**50**	**223**				
OVERALL TOTAL					**360**	**513**	**193**	**305**	**492**	**289**

‡ The RMP has submitted a proposal to the San Francisco Bay Water Quality Improvement Fund (WQIF) that is expected to support stormwater CECs monitoring at a level of ~$100k per year for three years (2023-2025). This MYP lists these potential funds, and will be updated to reflect the final funding decision relating to this proposal.

‡‡ The RMP has submitted a proposal to NOAA that would support monitoring of microplastics in stormwater at a level of ~$200k per year for two years (2024-2025). This MYP lists these potential funds, and will be updated to reflect the final funding decision relating to this proposal.

Photo by Shira Bezalel

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

Inform CEC tiered risk-based framework and CEC management actions

Recent Noteworthy Findings

In 2021, the RMP started to implement the revised S&T design by adding contaminants of emerging concern (bisphenols and organophosphate esters) to the Bay water sampling. Samples for PFAS were also collected as part of a special study and will be added to the S&T design in 2023.

Pilot monitoring for CECs in Bay water commenced during the wet season in WY2022. Samples were collected following one storm event from three nearfield stations near where stormwater enters the Bay (Redwood Creek, Stevens Creek, San Leandro Bay). Samples were also collected at four stations along the spine of the Bay during the monthly USGS nutrients cruise. Samples were also collected at the ambient stations in the dry season to enable comparison between CEC concentrations in wet and dry seasons to understand how long CECs are present in the Bay and if they are found at levels of concern. Pilot sampling will continue in WYs 2022 and 2023.

Bird eggs were collected in 2022 after a one year delay due to Covid. Sampling was limited to double-crested cormorants at three locations. Forster terns were dropped from the bird egg monitoring design as recommended in the S&T Review.

Priority Questions for the Next Five Years

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

2. Are contaminants at levels of concern?

3. Are there particular regions of concern?

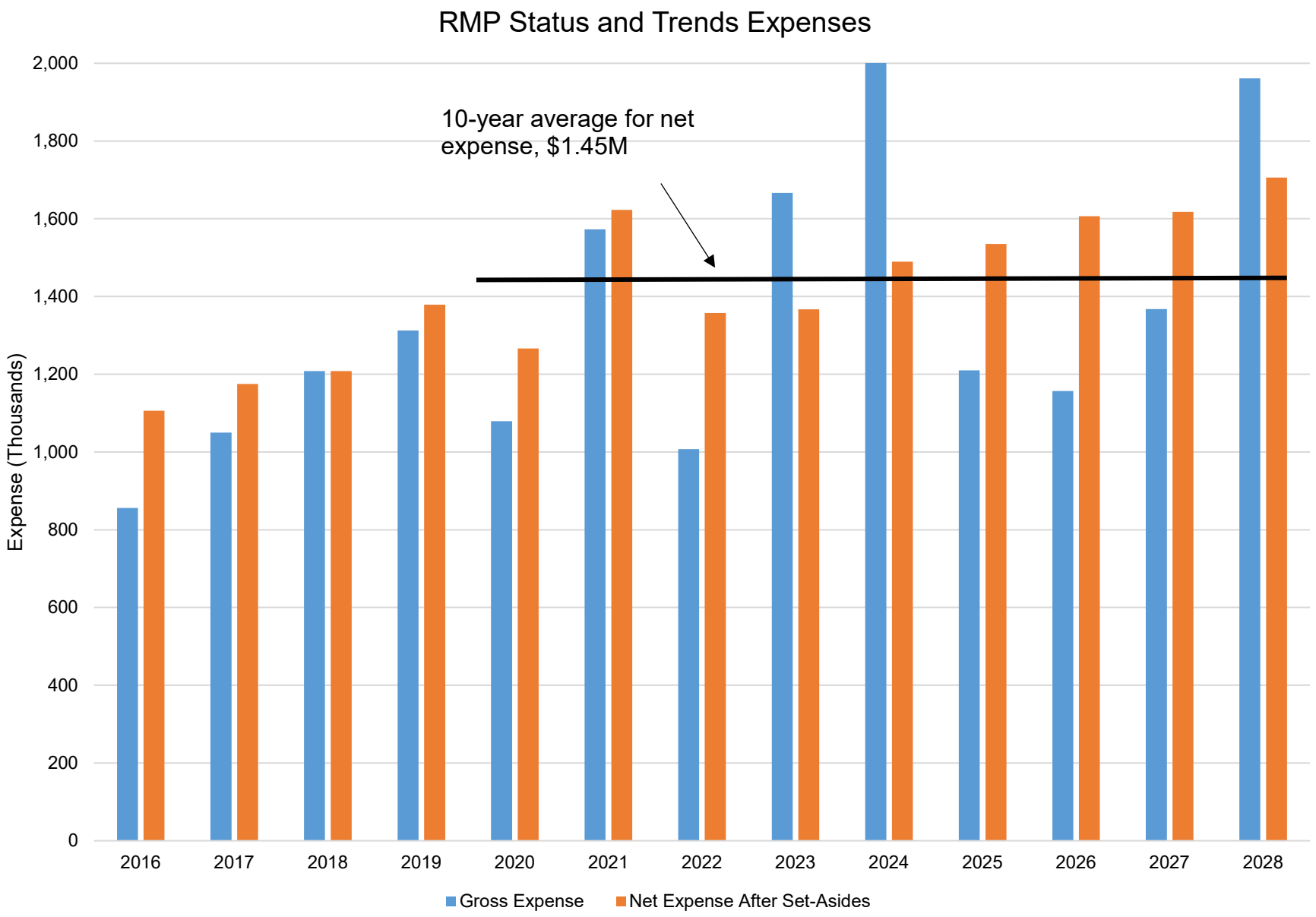
4. Have concentrations and masses increased or decreased?

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

MULTI-YEAR PLAN FOR STATUS AND TRENDS MONITORING

Status and Trends Monitoring costs in the RMP from 2018 to 2028. Values for 2024-2028 are forecasts. Numbers indicate budget allocations in $1000s.

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Monitoring Type	*Actl*	*Actl*	*Actl*	*Actl*	*Actl*	*Fcst*	*Fcst*	*Fcst*	*Fcst*	*Fcst*	*Fcst*
USGS Moored Sensor Network for Suspended Sediment	250	250	300	400	400	400	400	400	460	460	460
USGS Monthly Cruises for Nutrients and Phytoplankton	235	242	250	250	258	265	273	283	292	299	307
S&T North Bay Selenium				72	127		131		136		140
S&T Water		216		243	25	257	27	265		309	0
Water-Wet season					127	60	135		143		
Water-CTR and Organics								88			
Water-Non-target analysis							12	30			
Water-Passives							51				
S&T Bivalves	118										
Bivalves-archive					20		21		21		22
S&T Bird Eggs	222			256			160			165	
S&T Margins Sediment			319			110					235
S&T Sediment	291					200					320
S&T Target Sediment						95					190
S&T Prey Fish						120					126
S&T Sport Fish		405					531				
S&T Harbor Seals							300				
Archives	47	84	62	84	43	80	56	85	60	90	63
Reporting	10	22	23	12	10	20	25	14	14	14	25
Lab Intercomp Studies	30	55	37	28	22	60	82	30	25	52	82
Grand Total	**1,203**	**1,274**	**991**	**1,345**	**1,007**	**1,667**	**2,204**	**1,195**	**1,151**	**1,389**	**1,970**
Set-Aside Funds Used	**0**	**0**	**88**	**0**	**0**	**300**	**650**	**0**	**0**	**0**	**300**
Set-Aside Funds Saved	**0**	**60**	**275**	**50**	**350**	**0**	**0**	**350**	**500**	**250**	**0**
Set-Aside Funds Balance	**593**	**653**	**928**	**978**	**1,328**	**1,028**	**378**	**728**	**1,228**	**1,478**	**1,178**
Net S&T Funding Needed	**1,203**	**1,340**	**1,178**	**1,395**	**1,357**	**1,967**	**1,554**	**1,555**	**1,651**	**1,639**	**1,670**


RMP Status and Trends Expenses
10-year average for net expense, $1.45M
Expense (Thousands)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
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 (2018-2029); sampling frequency from 2022-2029 is reflective of changes made to the Program through the Status and Trends Review process.

Program	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
USGS Moored Sensor Network for Suspended Sediment (5 targeted sites)[1]												
Parameters: SSC, Water temperature, Salinity	X	X	X	X	X	X	X	X	X	X	X	X
USGS Monthly Cruises for Nutrients and Phytoplankton in Deep Channel (38 targeted stations)												
Parameters: CTD profiles, light attenuation, SSC, DO, Chl-a, Phytoplankton speciation, Nutrients (NO_2, NO_3, NH_4, PO_4, Si)[2]	X	X	X	X	X	X	X	X	X	X	X	X
Every 2 Years: Toxic Contaminants in Water – dry season (5 targeted stations and 17 random stations)												
MeHg, Se, Cu (dissolved & particulate fractions in 2017 and onwards); Cu only after 2019		X		X		X		X		X		X
CN, Hardness, SSC, DOC, POC		X		X	X	X	X	X		X		X
Chl-a		X		X		X		X		X		X
CECs – PFAS, bisphenols, organophosphate esters				X	X	X	X	X		X		X
Non-target analysis (5 stations)								?				
Aquatic Toxicity (9 stations)[3]		X						X				
CTR parameters (10 samples at 3 targeted stations)[4], including PCBs and PAHs								X				

Program	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Every 2 years: Toxic Contaminants in Water – wet season (5 targeted stations, 4 ambient stations)												
CECs – PFAS, bisphenols, organophosphate esters					X	X	X		?		?	
Non-target analysis									?			
Every 2 years: Selenium in Water, Clams, and Sturgeon (2 targeted North Bay stations)												
Water – dissolved and particulate Se, chl-a, SSC, DOC		X	X	X	X		X		X		X	
Clam tissue – selenium, stable isotopes (δ13C, δ15N, δ34S)		X	X	X	X		X		X		X	
Sturgeon tissue - selenium					X		X		X		X	
Every 2 years: Toxic Contaminants in Bivalve Tissue (7 targeted Bay stations until 2018[6]; Bay edge stations 2022 onward)												
Se, PAHs (archive only after 2018)	X				X		X		X		X	
PBDEs												
CECs (archive only)					X		X		X		X	
Every 3 Years: Toxic Contaminants in Bird Egg Tissue												
Cormorant Eggs: Hg, Se, PCBs, PBDEs, PFAS, legacy pesticides[5] (3 targeted stations)[7]	X			X			X			X		
Tern Eggs: Hg, Se, PBDEs (variable fixed stations)[8]	X											
Every 5 Years: Toxic Contaminants in Near-field Bay Sediment (12 targeted near-field stations every 5 years)												
PFAS, bisphenols, TOC, N, % solids, grain size						X					X	

Program	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Every 5 Years: Toxic Contaminants in Bay Margin Sediments (12 random stations every 5 years/24 random station every 10 years)												
PFAS, bisphenols, TOC, N, % solids, grain size						X					X	
Ag, Al, As, Cd, Cu, Fe, Hg, MeHg, Mn, Ni, Pb, Se, Zn, PCBs			X								X	
Every 5 Years: Toxic Contaminants in Sediment (7 targeted stations and 10 random stations)[9]												
PFAS, bisphenols, TOC, N, % solids, grain size						X					X	
Ag, Al, As, Cd, Cu, Fe, Hg, MeHg, Mn, Ni, Pb, Se, Zn, PAHs, PCBs	X										X	
PBDEs (discontinued after 2023)	X					X						
Fipronil (discontinued after 2018)	X											
Every 5 Years: Toxic Contaminants in Sport Fish Tissue (7 targeted stations)												
Hg, Se, PCBs, PBDEs, dioxins		X					X					X
PFAS		X					X					X
Legacy pesticides[5]							X					X
Fipronil		X					?					
Every 5 Years: Toxic Contaminants in Prey Fish Tissue (4 targeted stations, 3 species)												
PFAS, bisphenols						X					X	
PCBs (PMUs only)						X					X	
Every 10 Years: Toxic Contaminants in Harbor Seals												
PFAS						SS	SS		X			

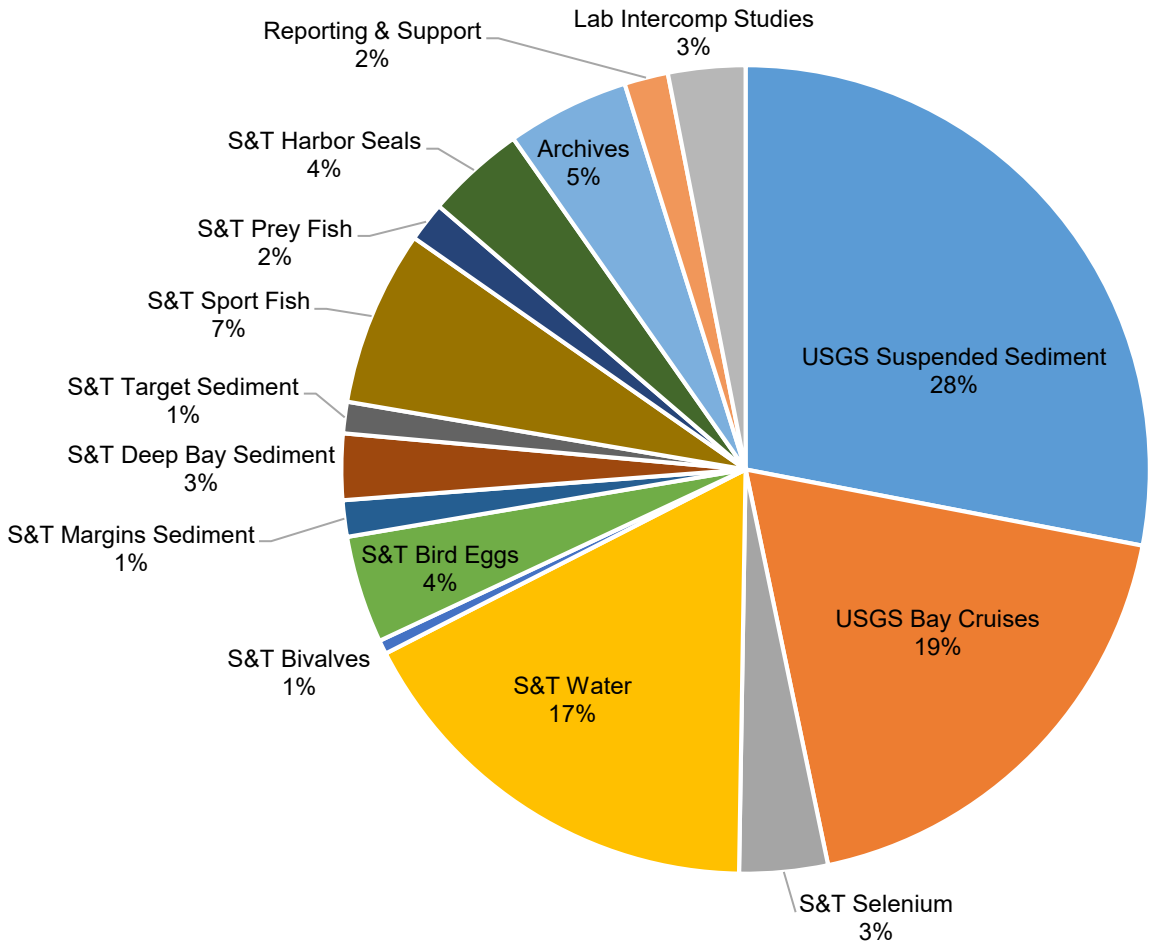
Notes:
"X" = Planned sampling event. "?" = Event that is planned but must be approved by the RMP Steering Committee before implementation. SS = Special Study being conducted to trial sampling methods. Additional parameters can be added to sampling events to support RMP Special Studies.

1. The RMP Status and Trend Program provides direct support to the U.S. Geological Survey (PI: Paul Work) for four SSC stations (Richmond Bridge, Pier 17, Alcatraz Island, Dumbarton Bridge). 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 eight stations and nutrient-related sensors to three stations.
2. Monthly cruises are completed by the U.S. Geological Survey (PI: Brian Bergamaschi). Phytoplankton speciation and nutrient samples are collected at 14 stations.
3. Aquatic Toxicity is measured following EPA Method 1007.0 (*Americamysis bahia*).
4. CTR sampling occurs at the Sacramento River, Yerba Buena Island, and Dumbarton Bridge sites. Three samples collected at each site and one field blank.
5. "Pesticides" includes 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).
6. 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.
7. Double-crested Cormorant (*Phalacrocorax auritus*) eggs are collected at three sites: Don Edwards National Wildlife Refuge, the Richmond-San Rafael Bridge, and Wheeler Island.
8. 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.
9. Sediment samples are collected in the dry season (summer).

Abbreviations:
Ag: Silver
Al: Aluminun
As: Arsenic
Cd: Cadmium
CECs – Contaminants of emerging concern
Chl-a: Chlorophyll-a
CTD: Conductivity, Temperature, and Depth
CTR: California Toxics Rule, see pollutant list here
https://www.waterboards.ca.gov/northcoast/board_decisions/adopted_orders/pdf/2012/120813_Hatcheries_Att_A.pdf
Cu: Copper
DO: Dissolved Oxygen
DOC: Dissolved Organic Carbon
Fe: Iron
Hg: Mercury
MeHg: Methylmercury
Mn: Manganese
NH_4: Ammonia (dissolved)
Ni: Nickel
NO_2: Nitrite (dissolved)
NO_3: Nitrate (dissolved)
PAHs: Polynuclear Aromatic Hydrocarbons
Pb: Lead
PBDEs: Polybrominated Diphenyl Ethers

PCBs: Polychlorinated Biphenyls
PFAS – Perfluorinated alkyl substances
PFCs: Perfluorinated Compounds
PMU – Priority Margin Unit (Emeryville Crescent, San Leandro Bay, Redwood Creek/Steinberger Slough)
PO_4: Phosphate (dissolved)
POC: Particulate Organic Carbon
Se: Selenium
Si: Silica (dissolved)
SSC: Suspended Sediment Concentration
TN: Total Nitrogen
TOC: Total Organic Carbon
TP: Total Phosphorus
Zn: Zinc

S&T Monitoring - Cost by Monitoring Type



5-Year Window
(2023-2027)

Total cost: $7.6M

PROGRAM MANAGEMENT

Approximately 10% 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, Wetlands 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 10% 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.

Photo by Jay Davis

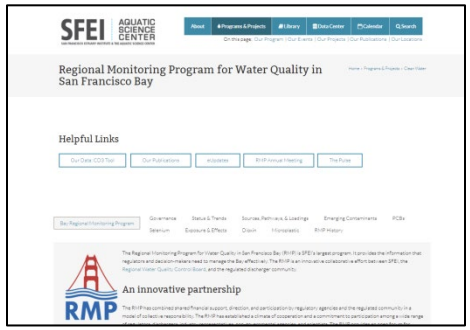
ANNUAL REPORTING & COMMUNICATIONS

Approximately 10% 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

- RMP Update (2022)
- Pulse of the Bay (2023)
- 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 (cd3.sfei.org); coordinating with statewide data management initiatives (e.g., SWAMP and CEDEN); and supporting quality assurance evaluation, data analysis, and RMP report production.

Quality Assurance

Quality assurance includes the review of data submitted by analytical laboratories; development and application of the QAPP; review 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 visualization tool that makes the RMP data available to water quality managers, stakeholders, scientists, and the public. A data download tool allows users to customize their queries and easily download large quantities of data.

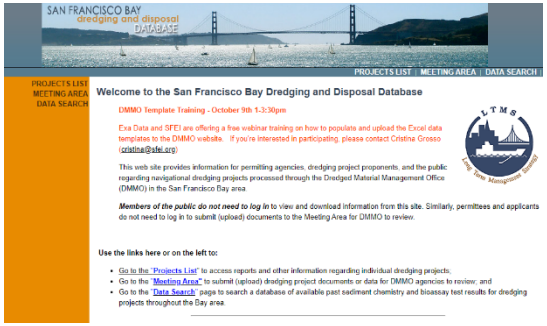
Recent Noteworthy Findings

The RMP's over 25-year dataset contains more than 3.5 million records standardized across all years. All data are stored in SFEI's Regional Data Center database, are comparable to statewide standards, and are regularly exchanged with CEDEN.

CD3 provides public access and visualizes RMP data along with relevant datasets from other programs.

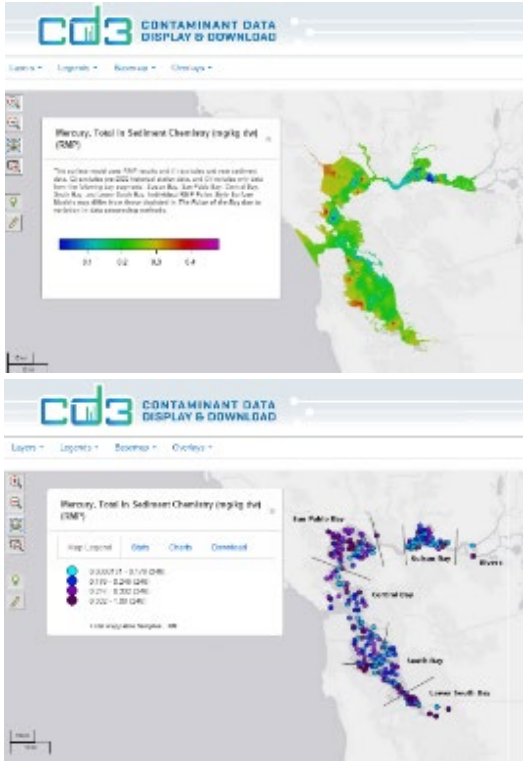
DMMO Database and Website

In 2018, the Dredged Material Management Office (DMMO) dredged sediment testing database and website were transferred to SFEI's Regional Data Center. Near-term priorities include developing standardized data templates, uploading a backlog of data to the database, and integrating DMMO data into CD3. Ongoing costs include uploading data and hosting and maintaining the system.



Priority Initiatives for the Next Five Years

- Efficiencies in Data Uploading and Formatting
- Enhancement of Data Access and Visualization Tools
- Coordination with SFEI's Environmental Informatics Program
- Hosting, managing, enhancing, 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 deep bay and margins 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 deep bay and margins 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; review requirements for PCB bioaccumulation testing	Sediment Conceptual Model, USGS Suspended Sediment Monitoring, Bay sediment budgets, Beneficial Reuse workshop, Floating Percentile Method assessment of chemistry results from dredged sediment, PCB bioaccumulation threshold analysis

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 the food web to inform the 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: https://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2022/R2-2022-0018.pdf

Policy	Provision	Study or linkage
Municipal Regional Stormwater Permit (MRP)	C.8. 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 conducted a special study for emerging contaminants in stormwater, including PFAS, organophosphate esters, bisphenols, stormwater CECs (including tire ingredients), and ethoxylated surfactants. A strategy for ongoing stormwater monitoring and modeling of CECs is currently being developed.
MRP	C.11a/12.a. Assess Mercury / PCB Load Reductions from Stormwater	STLS/ SPLWG information could be used by stormwater programs to help refine and document a methodology assessing load reductions
MRP	C.11e/12.f. 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.11f/12.h. Prepare Implementation Plan and Schedule to Achieve TMDL Wasteload Allocations	STLS/ SPLWG information and the RWSM outputs can help stormwater permittees with the development of a reasonable assurance analysis.
MRP	C.12.i. Fate and Transport Study of PCBs: Urban Runoff Impact on San Francisco Bay Margins	PCB Workgroup developed Conceptual Models for three Priority Margin Units—Emeryville Crescent, San Leandro Bay, and Steinberger Slough/Redwood Creek
		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.