THE RMP MASTER PLAN

DRAFT

01-14-09

RMP Planning

The goal of the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP) is to provide the high quality body of knowledge on estuarine contamination needed for managing water quality in this treasured aquatic ecosystem. This goal is achieved through a cooperative effort of a wide range of regulators, dischargers, scientists, and environmental advocates. In the 17 years since its inception in 1993, 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.

This collaboration and adaptation is achieved through the participation of stakeholders and scientists in frequent committee and workgroup meetings. The Steering Committee (Figure 1) determines the overall budget, allocation of program funds, tracks progress, and provides direction to the Program from a manager's perspective. Oversight of the technical content and quality of the RMP is provided by the Technical Review Committee (TRC), which provides recommendations to the Steering Committee. Four workgroups report to the TRC and address the main technical subject areas covered by the RMP: sources, pathways, and loadings; contaminant fate; exposure and effects; and emerging contaminants. Workgroups consist of regional scientists and regulators and invited scientists recognized as authorities in their field. The workgroups directly guide planning and implementation of pilot and special studies. RMP "strategy teams" comprise one more layer of planning activity. These stakeholder groups meet as needed to develop long-term RMP study plans for addressing high priority topics. Topics addressed to date include mercury, PCBs, dioxins, small tributary loads, and modeling. Another strategy team will be formed this year to develop a plan for evaluating atmospheric deposition.

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 on hand. Consequently, each of these workgroups and teams has developed five-year plans for studies to address the highest priority management questions for their subject area. Collectively, the efforts of all these groups represent quite a substantial body of deliberation and planning.

Purpose and Organization of this Document

The purpose of this document is to provide a concise summary of all of the plans developed within the RMP. The intended audience includes representatives of the many organizations that directly participate in the Program, in addition to technical and nontechnical individuals that are not directly involved but are interested in an overview of the Program and where it is heading.

The next section of this Master Plan (section 2) shows the overarching framework of

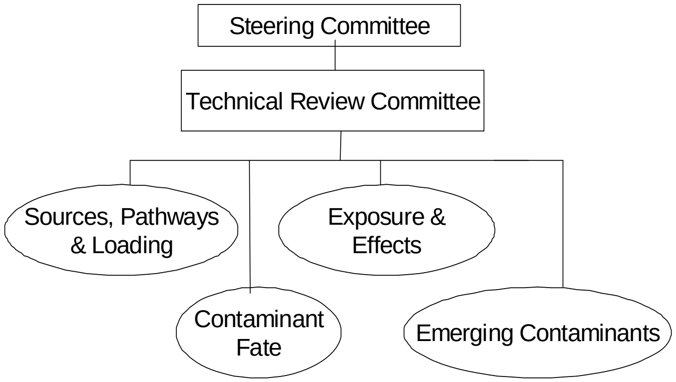


Figure 1. RMP organizational structure.

management questions that describes the major topics that the RMP aims to address. The RMP has been designed to answer questions in five basic general areas referred to as the level I or core management questions (page xx). A more specific set of questions (level II questions) has been articulated under each of the level I questions. The RMP goal and level I and II management questions define the focus of the program.

Section 3 presents even more specific guidance for the Program in the form of statements of information needs provided by each of the major groups of RMP participants. These statements represent an effort by each of these groups to explicitly identify information that they will need to support management policies, decisions, and actions over the next five years.

Section 4 contains the five-year plans developed by the workgroups and strategy teams. Led by the stakeholder representatives that participate in these groups, each workgroup and team has developed a specific list of high priority questions that the RMP will strive to answer over the next five years. With guidance from the science advisors on each group, plans have been developed to address these questions. These plans are presented in the form of annual budgets. Several other types of information are also included to provide context for the multi-year plans. First, for each high priority topic, management policies or decisions that are anticipated to occur in the next few years are listed. Second, the latest advances in understanding achieved through the RMP and other programs on Bay water quality topics of greatest concern are summarized. Lastly, additional context is provided by listing studies performed within the last two years and studies that are currently underway.

A Living Document

This is the first edition of the RMP Master Plan. This document will be updated annually to provide an up-to-date description of the priorities and directions of the Program.

For additional information on the RMP please visit our website at www.sfei.org/rmp, or contact Jay Davis, RMP Lead Scientist, at jay@sfei.org with questions or suggestions for improving this document.

RMP GOAL AND MANAGEMENT QUESTIONS

LEVEL I (CORE) Management Questions

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

General Goal of the RMP

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

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

STAKEHOLDER INFORMATION NEEDS

Water Board

Sediment Dynamics: Flux from erosive areas, recovery or degradation of depositional areas and depth of the active layer.	▪ **Modeling Strategy** ▪ Status and Trends suspended sediment monitoring
Sediment toxicity: Causes of sediment toxicity. Follow-up on observed copper toxicity. Methods to identify pesticide toxicity. **Benthos:** Process to evaluate benthic indicators in the Bay that includes local benthic ecologists, regulators and stakeholders.	▪ Molecular TIEs (2010) ▪ Sediment Toxicity (Annual S&T) ▪ *Copper not specifically covered* ▪ *Pesticides not specifically covered* ▪ SQO assessment study (2008-9, 2010)
Small Fish: Analysis of PCBs and Se as well as Hg.	▪ **PCB Strategy** ▪ *Se not covered*
Sport fish bioaccumulation: Selenium baseline and trends. **Dioxin:** Refer to Dioxin Strategy.	▪ Selenium included in 2009, all fish species ▪ **Dioxin strategy**
Copper: Potential for impairment of the olfactory system of salmonids. **303(d) Listed Sediment Hotspots:** Conceptual Model/Impairment assessment needed for San Leandro Bay and Oakland Inner Harbor hot spots.	▪ Copper in salmon study (2011 [proposed]) ▪ San Leandro Bay being addressed through Aquatic Science Center proposal ▪ *Oakland Inner Harbor not covered*
Bay Margins (includes "hotspots"): Fate of contaminants at contaminated sites, the effect of management interventions, predicted recovery. **Local Tributaries :** Monitoring for mercury, PCBs, copper and PBDEs to support margin modeling, watershed modeling, and assess progress on TMDLs. Nutrient loads. Selenium in South Bay tributaries.	▪ **Modeling Strategy** ▪ **Small Tributaries Loading Strategy**
Mercury Modeling: Mercury Strategy. **Pyrethroids:** Coarse level of monitoring, trend assessment, evaluation of Bay Margin loading and toxicity.	▪ **Mercury Strategy** (methylmercury) ▪ **Modeling Strategy** (total mercury) ▪ Pyrethroids in sediments (Status and Trends) ▪ *Not monitoring tributaries or water column for pyrethroids*
Dioxins/PAHs: Patterns of impairment, simple box models, food web models for TMDL linkage, linkage to air quality and watershed monitoring and models. Monitoring and trend assessment - coarse assessment of Bay Margin loading and toxicity. **Legacy Pesticides:** Candidate for modeling as part of the margin modeling strategy, local sources or major small tributary pathways, trend monitoring.	▪ **Dioxins: Dioxin Strategy** ▪ **PAHs:** Status and Trends, Effects on flatfish study, *no specific plans for modeling, no overarching strategy or other plans* ▪ **Modeling strategy** ▪ Status and Trends ▪ *LPs not on analyte lists for loading studies*
Selenium: Further develop bioaccumulation model for the future TMDL. Speciation in water and sediment.	▪ SFEI is participating in TMDL model development ▪ *Selenium speciation in RMP water sampling not covered* ▪ *Selenium speciation in RMP sediment sampling not covered*

STAKEHOLDER INFORMATION NEEDS

BASMAA

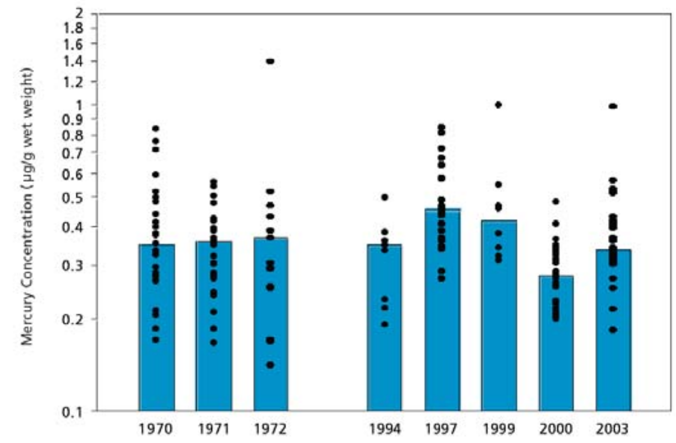
High Priority	**Mercury**	Loading from small tributaries (Including methylmercury)	▪ **Small Tributaries Loading Strategy**
		Fate, transport and biological uptake in the Bay and tidal areas	▪ **Mercury Strategy** (methylmercury) ▪ **Modeling Strategy** (total mercury)
		Contributions from local air sources to Bay Area watersheds	▪ **Atmospheric Deposition Strategy** (being developed in 2010)
		Bay status and trends (progress towards TMDL targets)	▪ **Status and Trends** (methylmercury and total mercury)
	PCBs	Loading from small tributaries Natural attenuation of PCBs in Bay Area watersheds	▪ **Small Tributaries Loading Strategy** ▪ **PCB Strategy** (conceptual model, wetland cores, degradation studies)
		Bay status and trends (progress towards TMDL targets)	▪ **Status and Trends** ▪ **PCB Strategy** (small fish)
Low Priority	**Legacy Pesticides**	Loading from small tributaries	▪ **Small Tributaries Loading Strategy**
		Bay status and trends	▪ **Status and Trends**
	Selenium	Loading from small tributaries	▪ **Small Tributaries Loading Strategy**
		Bay status and trends (progress towards TMDL targets)	▪ **Status and Trends**
	Copper	Loading from small tributaries	▪ **Small Tributaries Loading Strategy**
		Bay status and trends (progress towards TMDL targets)	▪ **Status and Trends**
	Dioxins	Bay status and trends	▪ **Status and Trends**
	PBDEs	Loading from small tributaries	▪ **Small Tributaries Loading Strategy**
		Bay status and trends	▪ **Status and Trends**
	Nutrients	Loading from small tributaries	▪ **Small Tributaries Loading Strategy**
	PAHs	Loading from small tributaries Bay status and trends	▪ **Small Tributaries Loading Strategy** ▪ **Status and Trends**
	Emerging Contaminants (e.g., PFCs, nonylphenols, endocrine disruptors)	Bay status and trends	▪ **Emerging Contaminants Strategy** (PFCs in Biota, Sources of PFCs, pro bono Nonylphenols in Fish, NMW study, *no plans to evaluate endocrine disruptors*

STAKEHOLDER INFORMATION NEEDS

Municipal and Industrial Dischargers

Dioxins	Monitoring (water, sediments, tissue, atmospheric deposition) to derive BEFs and develop a multi-media dioxin strategy	▪ **Dioxin strategy**
Mercury	Fate, transport, the conditions under which mercury methylation occurs, and biological uptake	▪ **Mercury strategy**
	Potential for local effects on fish and wildlife near wastewater discharges	▪ **Mercury strategy**
PCBs	Mass budget modeling and food web model improvements	▪ **Modeling strategy**
	Rate of natural attenuation of PCBs in the Bay environments	▪ **PCB Strategy**
	Monitoring to demonstrate progress toward attainment of allocations and the numeric TMDL targets	▪ **Status and Trends**
Emerging Contaminants	Which chemicals have potential for impacts?	▪ **Emerging Contaminant Strategy**

MERCURY



Mercury concentrations (ppm) in striped bass from 1970-2003. Concentrations expressed as an average for a 55 cm fish. Bars indication medians, points are individual fish.

Forthcoming Management Decisions

- The next iteration of the mercury TMDL (wasteload allocations, cleanup targets)
- Which small tributaries and contaminated margin sites are the highest priorities for cleanup?
- What management actions are the best options?

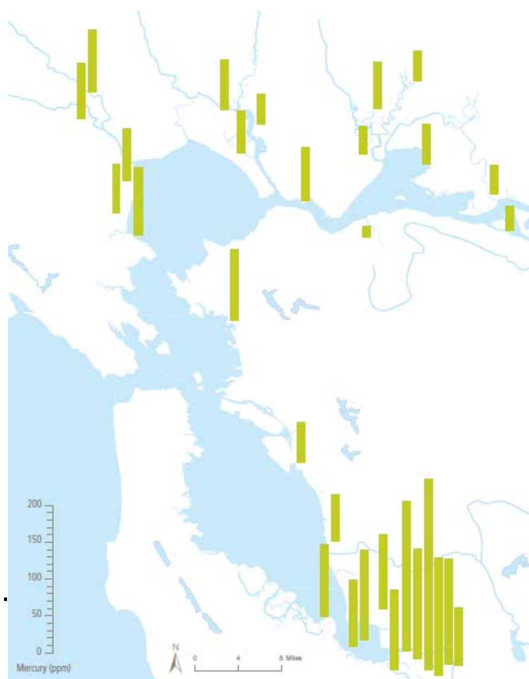
Recent Advances in Understanding

- The median mercury concentration in striped bass (the key indicator species in the TMDL) in 2003 was 0.33 ppm, higher than the TMDL target of 0.20 ppm. Concentrations have shown no decline since 1970.
- Based on mercury concentrations in blood, nearly 60% of all breeding Forster's terns sampled in the Bay are at high risk of toxic effects.
- Monitoring of mercury in small fish indicates that a high proportion (64% in 2005-2007) of samples is above the 0.03 ppm TMDL target for wildlife prey.
- The small fish monitoring also indicates that concentrations are relatively high in the Lower South Bay region, and relatively low near wastewater treatment plant outfalls.
- Sediment cores from open-water exhibited total mercury concentrations in deeper sediments were generally similar to surface sediments, suggesting extensive transport and mixing of past loads and diminished concern for erosion of contaminated subsurface material.
- A preliminary mass budget for methylmercury indicates that in-Bay production of methylmercury is about 100 times greater than external loading, suggesting that reduction efforts should focus on internal production.

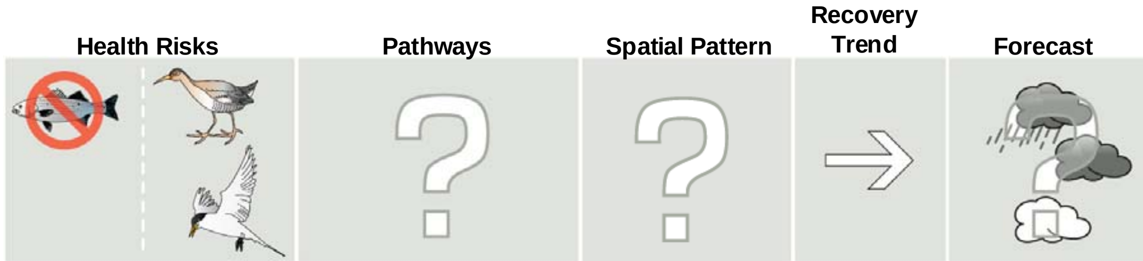
Priority Questions for the Next Five Years

1. Where is mercury entering the food web?
2. Which processes, sources, and pathways contribute disproportionately to food web accumulation?
3. What are the best opportunities for management intervention for the most important pollutant sources, pathways, and processes?
4. What are the effects of management actions?
5. Will total mercury reductions result in reduced food web accumulation?

6.



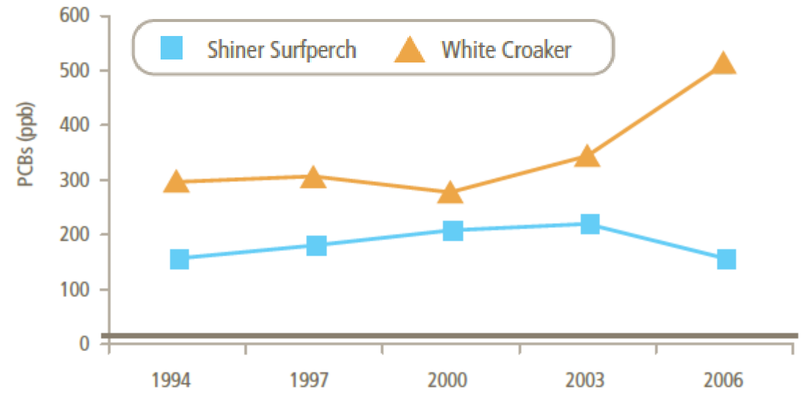
Mercury concentrtions in small fish, 2008.



Mercury and methylmercury studies and monitoring in the RMP from 2008 to 2014. Numbers indicate budget allocations in $1000s.

General Area	Element	Mercury Questions Addressed	2008	2009	2010	2011	2012	2013	2014
Mercury Strategy	Food Web Uptake (Small Fish)	1	150	150	150	100?	100?		
	High Leverage Pathways (DGTs)	2	100	100		150?	150?		
	High Leverage Pathways (Isotopes)	2	100	100		150?	150?		
	Methylmercury Fate Model	3, 4		25		?			
	Methylmercury Bioaccumulation Model?	3, 4				?	?		
Effects	Effects on Birds		*70*	54					
Status and Trends	Sport Fish	1		*240*			*218*		
	Avian Eggs	1		*120*		*120*			*120*
	Surface Sediments (THg, MeHg)	1	*160*	*160*	*160*	*160*	*160*	*160*	*160*
	Water (THg, MeHg)	1	*140*	*140*	*140*	*140*	*140*	*140*	*140*
Loads	Small Tributary Loading Strategy Studies: Synthesis		*40*	*80*	*35*	*10*	*10*	*10*	*10*
	Small Tributary Loading Strategy Studies: Monitoring		*62*	*100*	*235*	*350*	*350*	*350*	*350*
	Small Tributary Loading Strategy Studies: Dynamic Modeling		*75*	*75*			*150*	*75*	*??*
	River Loading (THg)				*100*				
	Atmospheric Deposition				*10*	*?*			
Forecast	Modeling Strategy Studies			40	141	50	100	100	140
	Sediment Cores?					?			

PCBS



Median PCB concentrations (ppb) in Bay fish from 1994-2006. TMDL target is 10 ppb.

Forthcoming Management Policies and Decisions

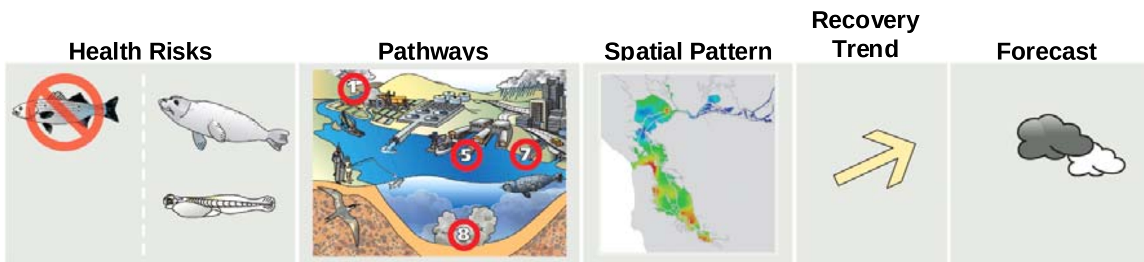
- The next iteration of the PCBs TMDL (wasteload allocations, cleanup targets)
- Which small tributaries and contaminated margin sites are the highest priorities for cleanup?
- What management actions are the best options?

Recent Noteworthy Findings

- Sport fish were as high as ever in the most recent sampling (2006). White croaker, a key indicator species for the TMDL, had a Bay-wide average concentration of 329 ppb, more than 30 times higher than the TMDL target of 10 ppb.
- Risks to fish-eating birds persist. In 2000-2003, 17% of 149 tern eggs were above an effects threshold.
- Small fish are surprisingly high in PCBs. Unexpectedly, topsmelt analyzed in 2007 were almost as high as the highest sport fish species, up to 422 ppb.
- Bivalve monitoring continues to indicate declines, with half-lives ranging among stations from 7 to 14 years, and longer half-lives in the South Bay.
- Bay sediment appears to be cleaner than in the 1990s. The Bay-wide average was 6.6 ppb in 2004-2008 compared to 31 ppb in the 1990s. A different sampling design and different methods probably contribute to this apparent decrease.
- Average concentrations in Suisun Bay are lower than in the other Bay segments, and getting close to the sediment goal discussed in the PCBs TMDL.
- Bay cores show some areas with higher concentrations at depth, but this may be less of a concern than previously thought.
- A new PCB has been identified in effluents and the environment across the U.S. PCB 11 and several other PCBs are inadvertent byproducts in the manufacturing of commonly used pigments. These pigment PCBs are distinct from the Aroclor-derived PCBs that are the subject of the PCBs TMDL.

Priority Questions for the Next Five Years

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



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

General Area	Element	PCB Questions Addressed	2008	2009	2010	2011	2012	2013	2014
PCB Strategy	Food Web Uptake (Small Fish)	1,7			50				
	PCB Conceptual Model Update	1,2,3,4,5,6,7, 8,9				50?			
	Small Tributary Wetland Cores?	3,4,5,7				?			
	RFP on PCB Degradation Rates?	3,4,5,6					?		
Effects	No specific studies planned								
Status and Trends	Sport Fish	1		*240*			*218*		
	Avian Eggs	1,4		*120*			*120*		
	Surface Sediments	2,3,4,6,7	*160*	*160*	*160*	*160*	*160*	*160*	*160*
	Water		*140*	*140*	*140*	*140*	*140*	*140*	*140*
Loads	Small Tributary Loading Strategy Studies: Synthesis	5,7,8	*40*	*80*	*35*	*10*	*10*	*10*	*10*
	Small Tributary Loading Strategy Studies: Monitoring	5,7,8	*62*	*100*	*235*	*350*	*350*	*350*	*350*
	Small Tributary Loading Strategy Studies: Dynamic Modeling	5,7,8	*75*	*75*			*150*	*75*	*??*
	River Loading (THg)	5			*100*				
	Atmospheric Deposition	5			*10*				
Forecast	Modeling Strategy Studies	3,4,5,6,7,8		40	141	50	100	100	140
	Sediment Cores?	3,4,5				?			

DIOXINS

Forthcoming Management Policies and Decisions

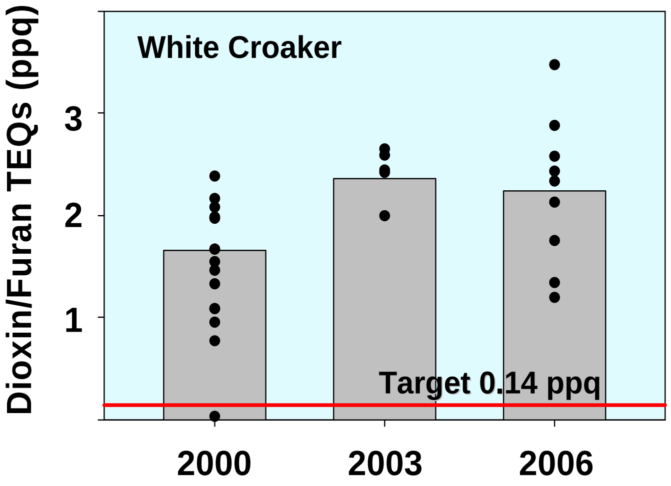
- A TMDL is in development.

Recent Noteworthy Findings

- The key sport fish indicator species (white croaker) have been more than ten times higher than the Water Board target of 0.14 ppq. Concentrations have shown no decline since 1970.
- Dioxin-toxic equivalents in Least Tern, Caspian Tern, and Forster's Tern eggs are at or above estimated thresholds for adverse effects; risks especially significant in combination with dioxin-like PCBs.
- Few data on dioxins are available on other priority questions – the Dioxin Strategy was developed to address this need.

Priority Questions for the Next Five Years

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



Dioxin and furan TEQ concentrations (ppq) in white croaker from 2000 to 2006. Bars indicate medians, points indicate individual composite samples.

Region	TEQs		
	FOTE	CATE	CLTE
Alviso	173.12± 11.967 B,1	273.62± 22.48 A,B,2	
West Alviso	151.26± 9.70 B		
Eden Landing	231.53± 17.75 A,1	284.18± 27.80 A,1	
Central Bay		244.76± 27.68 B,1	325.29± 1.11 2
Napa Marsh	204.20± 16.96 B,1	289.44± 27.49 B,1	

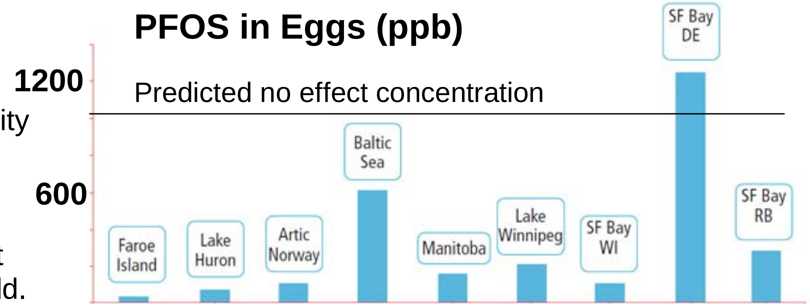
This will be made into a graph

Mean concentrations (± SE, ww) of dioxin and furan TEQs in three tern species, 2000-2003. Estimated ranges for effects thresholds are 206-2,454 ppb ww in Forster's Terns and 432-932 ppb in Caspian Terns. Mean TEQ concentrations for the California Least Tern fall within these ranges, suggesting potential adverse impacts to reproduction in this species. Mean TEQ concentrations for Forster's and Caspian terns are below these concentrations, but concentrations above these ranges were observed in some eggs of both species.

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

General Area	Element	Dioxin Questions Addressed	2008	2009	2010	2011	2012	2013	2014
Dioxin Strategy	QA			20					
	Synthesis Report								
Effects	No specific studies planned								
Status and Trends	Sport Fish			22			22		
	Avian Eggs						10		
	Surface Sediments		57	57			57		
	Water			20		20			
Loads	Small Tributary Loading			34	34	34			
	River Loading (THg)				34				
	Atmospheric Deposition			25	*10*				
Forecast	One-Box Model					20			
	Food Web Model						20		
	Sediment Cores		57			?			

EMERGING CONTAMINANTS



PFOS in bird eggs collected in 2006.

Forthcoming Management Policies and Decisions

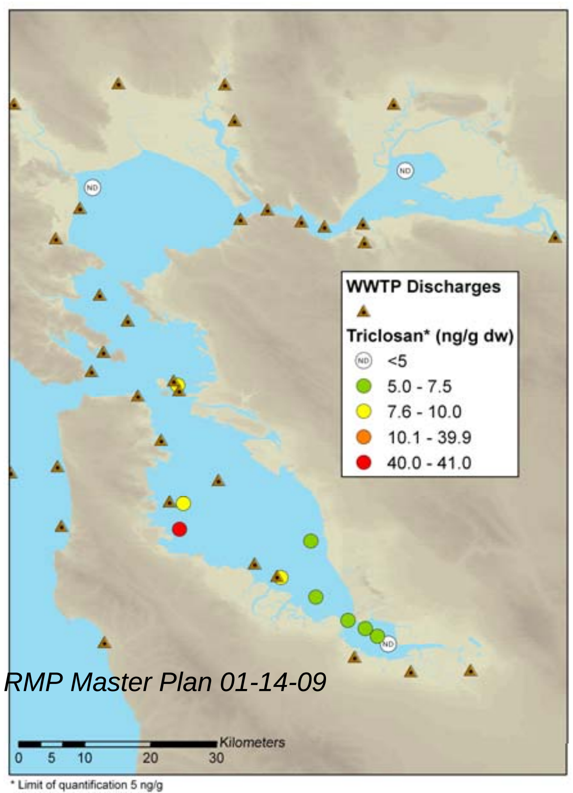
- Possible Water Board policy? Xx I think Tom mentioned something along these lines.
- Continued enforcement of narrative water quality objectives prohibiting toxicity and water quality degradation.

Recent Noteworthy Findings

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

Priority Questions for the Next Five Years

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



Triclosan in sediment, 2008.

Emerging contaminant studies and monitoring in the RMP from 2008 to 2014. Numbers indicate budget allocations in $1000s.

Element	**Emerging Contaminant Questions Addressed**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
PFCs in Biota	1	35						
Alternative Flame Retardants (brominated, Dechlorane Plus, phosphate-based)	1	48						
Chlorinated Paraffins in Biota	1	0						
Triclosan in Sediment	1	0						
White Paper on ECs in Wastewater	1		30					
PFC Sources	1		52					
Nonylphenol in Small Fish	1		0					
Screening of Biota for EC	1			55	75			
Endocrine Disruption Screening?	1				??			
AXYS Mussel Study	1			3				
AXYS Brominated Dioxins in Sediments and Biota	1			0				
NOAA Mussel Pilot Study	1			xx				

SMALL TRIBUTARY LOADS

Forthcoming Management Policies and Decisions

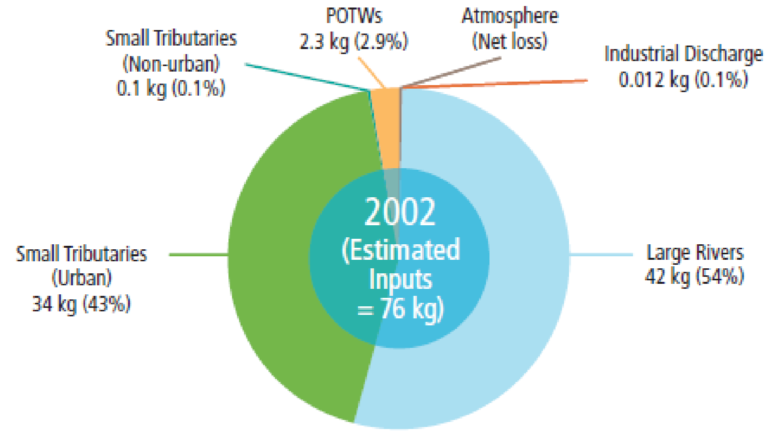
- The next iteration of the mercury TMDL
- The next iteration of the PCBs TMDL
- Provisions of the Municipal Regional Permit
- Which small tributaries are the highest priorities for cleanup?
- What management actions are the best options for small tributaries?

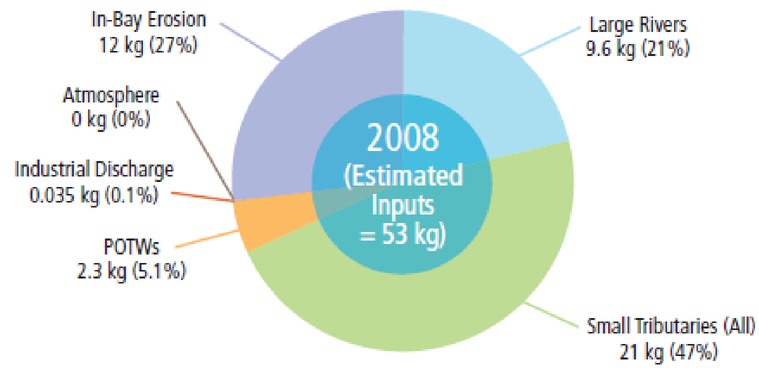
Recent Noteworthy Findings

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

Priority Questions for the Next Five Years

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





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

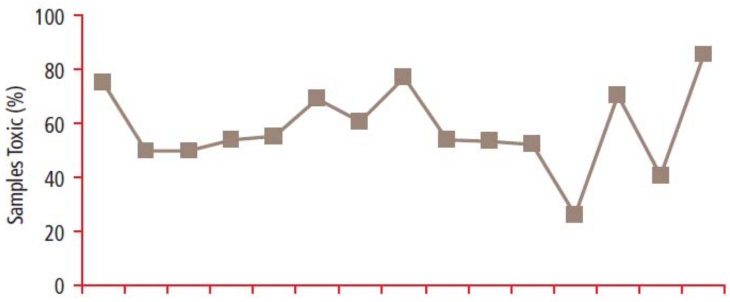
Small tributary loading studies in the RMP from 2008 to 2014. Numbers indicate budget allocations in $1000s.

General Area	Element	STLS Questions Addressed	2008	2009	2010	2011	2014	2013	2014
Synthesis	Develop Multi-year Watershed Loading Sampling Plan			80					
	Regional Loadings Estimates		40		35	10	10	10	10
Monitoring	Zone 4 Small Tributaries Loading Study		62	100	150				
	POC Load Monitoring in Representative Watersheds				85	250	250	250	250
	Monitoring at Representative Land Use Sites					100?	100?	100?	100?
Modeling	Guadalupe River Model		75	75					
	Dynamic Modeling in a 2nd Selected Representative Watershed						150		
	Additional Watershed Model							75	
	Large Scale Watershed Model								??

EXPOSURE AND EFFECTS

Forthcoming Management Policies and Decisions

- The next iteration of the mercury TMDL (cleanup targets)
- 303(d) listing decision for PBDEs
- Implementation of sediment quality objectives
- Permitting decisions regarding dredging projects
- Continued enforcement of narrative water quality objective prohibiting toxicity



Percentage of RMP Sediment Samples Causing Toxicity in Lab Tests.

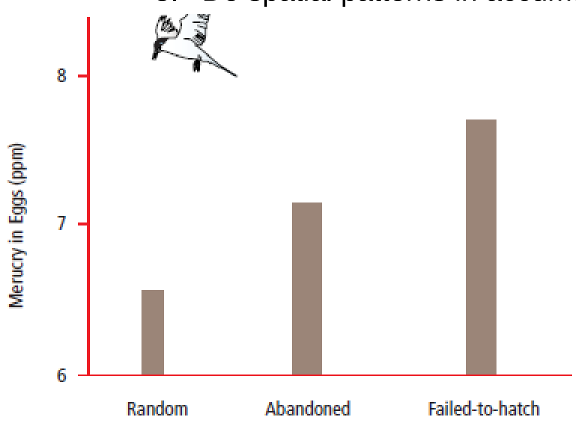
Recent Noteworthy Findings

- In every year since RMP sampling began in 1993, 26% or more of sediment samples have been determined to be toxic to one or more test species. The causes of this toxicity remain unidentified.
- Mercury concentrations in failed-to-hatch eggs of Forster's terns were higher than in abandoned eggs and random eggs sampled from successful nests, indicating that mercury is impairing hatchability of Forster's tern eggs in San Francisco Bay.
- A study examining possible endocrine responses in shiner surfperch and staghorn sculpin found hormonal imbalances that appeared to be related to PCB exposure.

Priority Questions for the Next Five Years

Effects on Birds

1. Is there clear evidence of pollutant effects on survival, reproduction, or growth of individual birds?
2. Are pollutants in the Bay adversely affecting bird populations?
3. Do spatial patterns in accumulation indicate particular regions of concern?



Effects on Benthos

4. What are the spatial and temporal patterns of impacts of sediment contamination on benthic biota?
5. Which pollutants are responsible for observed impacts on benthic biota?
6. Are the toxicity tests, benthic community assessment approaches, and the overall SQO assessment framework we are using reliable indicators of impacts on benthic biota?

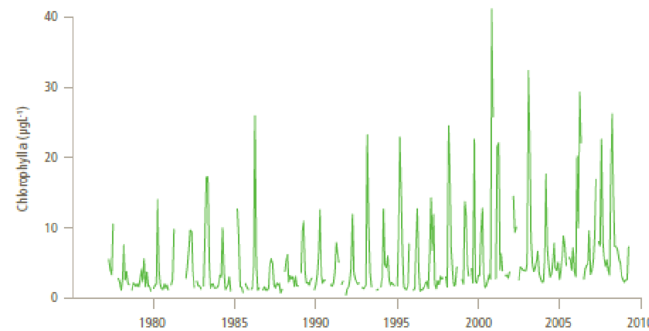
Effects on Fish

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

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

	Element	**Effects Questions Addressed**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Birds	Mercury and Selenium Effects on Terns and Stilts		74	54					
	Tern and Cormorant Egg Monitoring (Status and Trends)			90			90		
	PBDEs: Relative Sensitivity in Terns				48				
Benthos	Spatial and Temporal Patterns of Benthic Impacts (Status and Trends)		*260*	*260*	*260*	*260*	*260*	*260*	*260*
	Causes of Sediment Toxicity (Status and Trends)		10	80	60				
	Understanding and Improving Assessment Tools		20	??	30				
	NOAA EMAP				XX				
Fish	Endocrine Disruption in San Francisco Bay Fish		35						
	Effects of PAHs on Flatfish		40	50					

STATUS AND TRENDS
XX STILL UNDER CONSTRUCTION XX



Forthcoming Management Decisions

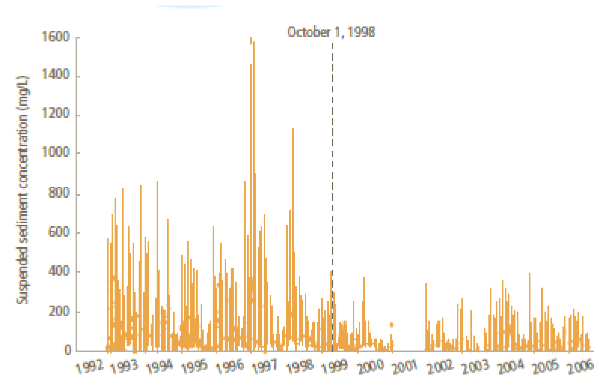
- xx

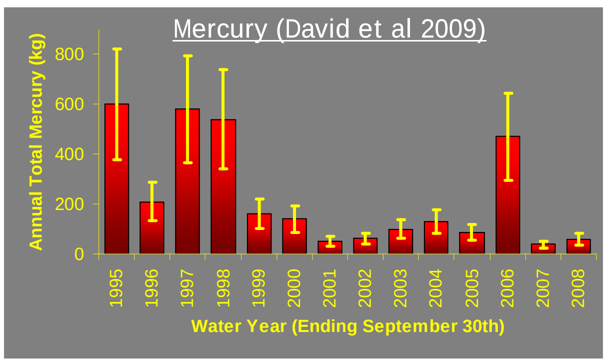
Recent Advances in Understanding

- SSC decline
- Increasing chlorophyll
- Refined estimate of river loading during high flow events
- PBDEs leveling off or declining

Priority Questions for the Next Five Years

1. xx





Status and trends monitoring in the RMP from 2008 to 2014. Numbers indicate budget allocations in $1000s.

General Area	Element	Status and Trends Questions Addressed	2008	2009	2010	2011	2012	2013	2014
Effects	Spatial and Temporal Patterns of Benthic Impacts		260	260	260	260	260	260	260
	Causes of Sediment Toxicity		10	80	60				
Status and Trends	Sport Fish			240			240		
	Small Fish				150	??	??	??	??
	Avian Eggs			120			120		
	Bivalves			45		45		45	
	Surface Sediments		160	160	160	160	160	160	160
	Water		140	140	140	140	140	140	140
	Suspended Sediment		250	250	250	250	250	250	250
	Basic Water Quality		110	110	110	110	110	110	110
Loads	Small Tributary Loading		40	80	35	10	10	10	10
	Small Tributary Loading Strategy Studies: Monitoring		62	100	235	350	350	350	350
	Small Tributary Loading Strategy Studies: Dynamic Modeling		75	75			150	75	??
	River Loading				100				