Overview

The overall goal of the San Francisco Estuary Regional Monitoring Program for Trace Substances (RMP) is to provide and interpret data to help address the informational needs of the San Francisco Bay Regional Water Quality Control Board (Regional Board), regional stakeholders, and environmental managers. Five major objectives of the RMP provide a framework for monitoring activities and guide efforts to respond to more specific management questions:

1. Describe patterns and trends in contaminant concentration and distribution.
2. Describe general sources and loadings of contamination to the Estuary.
3. Measure contaminant effects on selected parts of the Estuary ecosystem.
4. Compare monitoring information to relevant water quality objectives and other guidelines.
5. Synthesize and distribute information from a range of sources to present a more complete picture of the sources, distribution, fates, and effects of contaminants in the Estuary ecosystem.

RMP Monitoring Results

is one of three types of reports produced each year by the RMP, all of which are available on the RMP Homepage or by contacting the San Francisco Estuary Institute (SFEI) at (510) 746-7334. Since different audiences are targeted, each reporting style varies in the depth of scientific discussion.

- *RMP Monitoring Results* present comprehensive data results, including data tables, discussions of results, and charts, from the Status and Trends Monitoring component.
- *The Pulse of the Estuary* summarizes current chemical contaminant problems in the Estuary and discusses efforts by environmental managers to reduce existing problems and prevent the development of new ones.
- *RMP Technical Reports* provide results, detailed analyses, and interpretation from studies designed to address specific contaminant issues or management questions.

In 2000, the Regional Board and seventy-two federal, state, and local agencies and companies funded the RMP (see Table 1.1). These RMP participants also assisted in directing the RMP by having representatives on the Steering and Technical Review committees.

Table 1.1. 2000 RMP Program Participants.

MUNICIPAL DISCHARGERS:

Burlingame Waste Water Treatment Plant
Central Contra Costa Sanitation District
Central Marin Sanitation Agency
City of Benicia
City of Calistoga
City of Hercules
City of Palo Alto
City of Petaluma
City of Pinole
City of Saint Helena
City and County of San Francisco
City of San Jose/Santa Clara
City of San Mateo
City of South San Francisco/San Bruno
City of Sunnyvale
Delta Diablo Sanitation District
East Bay Dischargers Authority
East Bay Municipal Utility District
Fairfield-Suisun Sewer District
Las Gallinas Valley Sanitation District
Marin County Sanitary District #5, Tiburon
Millbrae Waste Water Treatment Plant
Mountain View Sanitary District
Napa Sanitation District
Novato Sanitation District
Rodeo Sanitary District
Sausalito/Marin City Sanitation District
Sewerage Agency of Southern Marin
San Francisco International Airport
Sonoma County Water Agency
South Bayside System Authority
Union Sanitary District
Vallejo Sanitation and Flood Control District
West County Agency
Town of Yountville

INDUSTRIAL DISCHARGERS:

C & H Sugar Company
Chevron Products Company
Dow Chemical Company
General Chemical Corporation
Phillips 66 at Rodeo
Rhodia, Inc.
Shell Martinez Refining Company
Ultramar Inc., Avon Refinery
USS-POSCO Industries
Valero Refining Company

COOLING WATER:

Mirant of California

STORMWATER:

Alameda Countywide Clean Water Program
Caltrans
City and County of San Francisco
Contra Costa Clean Water Program
Fairfield-Suisun Urban Runoff Management Program
Marin County Stormwater Pollution Prevention Program
San Mateo Countywide Stormwater Pollution Prevention Program
Santa Clara Valley Urban Runoff Pollution Prevention Program
Vallejo Sanitation and Flood Control District

DREDGERS:

Black Point Launch Ramp
Captain Edward Payne
Chevron Products Company
Golden Gate Bridge
Marin Yacht Club
Mr. R.S. Gilley
Mr. Gary Scheier
Mr. Ron Valentine
Paradise Cay
Port of Oakland
Port of San Francisco
Sierra Point Marina
TOSCO Corporation
US Army Corps of Engineers
Valero Refining
Vallejo Yacht Club
Yerba Buena Island

1.0 Introduction

1.1 Background

The San Francisco Bay Regional Water Quality Control Board (Regional Board) established the Regional Monitoring Program for Trace Substances (RMP) in 1993. The sampling design was based on the Regional Board's Bay Protection and Toxic Cleanup Program (BPTCP) Pilot Studies conducted during 1991 and 1992 (Flegal *et al*. 1994). Each year the monitoring plan has been reviewed and adjusted as deemed appropriate by the RMP's advisory committees. For example, several new stations were added in 1994 to fill spatial gaps or to monitor near major tributaries at Coyote Creek (BA10), San Bruno Shoal (BB15), Alameda (BB70), Red Rock (BC60), Petaluma River (BD15), and Honker Bay (BF40) (SFEI 1996). Two additional stations were added in the southern-most end of the Estuary in cooperation with the cities of San Jose (C-3-0) and Sunnyvale (C-1-3) and the Regional Board's National Pollutant Discharge Elimination System (NPDES) monitoring. As part of the Estuary Interface Pilot Study that began in 1996, water and sediment monitoring was conducted at two stations located at the bottom of two South Bay watersheds: Standish Dam (BW10) in Coyote Creek and Guadalupe River (BW15) in the Alviso Slough.

External review of the RMP's technical and administrative structure and performance is conducted every five years to ensure that the RMP can adapt to scientific and technological advances and continue to be useful to the regulatory and scientific communities. Recommendations proposed during the last review process in 1997 included revising the RMP's objectives (see *RMP Overview*) to better address more focused scientific questions arising from implementing the Clean Water Act and San Francisco Bay Basin Plan. In 2000 and 2001, a workgroup of experts on environmental monitoring was assembled to design a new monitoring strategy that would address the new RMP objectives and incorporate the current state of knowledge acquired from contaminant monitoring in the Estuary (see *RMP News: Winter 2001/2002* at *http://www.sfei.org/rmp/rmpnews.htm*). An interim monitoring scheme was designed to incrementally phase in adjustments over two sampling years (2000-2001), with the fully revised RMP being implemented in 2002. Some of these modifications have included shifting sampling frequency from seasonal to annual sampling in the dry season to reduce interannual variability; incorporating separate, focused pilot and special studies to evaluate sources, pathways, and loadings of contaminants to the Estuary; and revising the list of analytes measured in samples.

1.2 2000 Status and Trends Monitoring Design

In 2000, the RMP consisted of the Status and Trends Monitoring component (formerly referred to as the Base Program) and several pilot and special studies, which are briefly described in Section 1.2.5. As in prior years, water, sediment, and bivalve tissue samples were collected in 2000, and analyses were conducted for: (1) conventional water quality and chemistry, (2) aquatic bioassays, (3) sediment quality and chemistry, (4) sediment bioassays, (5) transplanted bivalve bioaccumulation, survival, and condition, and (6) transplanted bivalve and fish tissue chemistry (Table 1.2). A summary of the sample collection methods and analytical procedures is provided in the *Description of Methods*. In addition, data results are available as a PDF file (see *Data Tables*) or can be downloaded at http://www.sfei.org/rmp/data.htm.

The locations of the twenty-six sampling stations, including the Southern Slough (C-3-0 and C-1-3) and Estuary Interface (BW10 and BW15) stations, are shown in Figure 1.1. Stations were primarily located in the deeper shipping channels along the "spine" of the Estuary and were selected to collect baseline data on trace substances in the Estuary and to determine seasonal and long-term trends in contaminant concentrations. Table 1.3 lists the station names and codes, target latitude and longitude coordinates, and sampling dates for the 2000 sampling stations. Information on the sampling activities conducted at each station is also provided, since all parameters were not measured at every station during each sampling period. Water, sediment, and bioaccumulation sampling sites that have the same station name may have different station codes, as they are situated at slightly different coordinate locations due to practical considerations, such as sediment type or ability to deploy bivalves. For example, at the South Bay site, BA20 is the water station code and BA21 is the sediment station code.

The analyses of RMP samples required the collaboration of a group of Principal Investigators, which is listed in Table 1.4. The RMP Principal Contractor, Applied Marine Sciences, coordinated the 2000 field sampling for water, sediment, and bivalve tissue and the distribution of samples for analysis. Water and sediment samples were collected from the *R/V David Johnston* chartered through the University of California, Santa Cruz during separate sampling cruises (three to five days in duration). Bivalve sampling required three phases: deployment of transplanted bivalves from reference sites, maintenance, and retrieval. Most of the bivalve monitoring was conducted aboard the *R/V Questuary*, owned by San Francisco State University, with back-up services provided by the California Department of Water Resources. Moss Landing Marine Laboratories – Marine Pollution Studies Lab conducted the spring and summer sportfish sampling.

1.2.1 Water Sampling

Changes to water sampling frequency and analytes measured were implemented in the 2000 interim monitoring design. Sample collection for conventional water quality parameters and trace elements were reduced to two events (one during the wet season in February and one during the dry season in July). Sampling previously conducted during the period of declining Delta outflows in late April was discontinued, since the dry season was determined to be more indicative of ambient contaminant concentrations in the Estuary. Since most of the trace organic contaminants currently measured are considered legacy pollutants that degrade slowly, one sampling event per year in the dry season was determined to be sufficient to meet the objectives of evaluating trends and comparing data to regulatory guidelines. A limited number of stations near the Estuary margins were sampled twice a year, in conjunction with water chemistry sample collection, to test for aquatic toxicity.

In 2000, chromium was removed from the list of analytes measured in water, sediment, and tissue samples. For sites suspected to have high methylation activity, methylmercury measurements were added, since ratios of methylmercury to total mercury can be used to identify the types of environments that promote methylation.

1.2.2 Sediment Sampling

Sediment sample collection was scaled back in 2000 to once a year during the dry season (in July) at all stations. Several stations were also sampled during the wet season (in February) in the Northern Estuary at San Pablo Bay (BD22), Petaluma River (BD15), Napa River (BD50), and Davis Point (BD41) in collaboration with the Coastal Intensive Sites Network (CISNet) Project and EPA's Environmental Monitoring Assessment Program (EMAP) (see link: *http://my.engr.ucdavis.edu/~edllab/Projects/CISNet/ cisnet.html*). Although RMP sediment toxicity results have exhibited distinct seasonality at the Estuary margin stations, toxicity tests were conducted in 2000 at the same frequency and locations as the sediment chemistry and benthos sampling stations to generate data to support the "sediment triad" concept (Chapman *et al.* 1997).

1.2.3 Bivalve Tissue Sampling

Similar to water and sediment, bivalve tissue concentrations were sampled only once during the dry season (in September), when Estuary conditions are more consistent on an interannual basis. Notable changes in the 2000 bivalve monitoring design included: (1) deploying a third species of bivalve, *Mytilus edulis,* at locations experiencing a variety of salinity regimes in order to study survival levels and growth, (2) testing an alternative cage system that would potentially not require an intermediate maintenance cruise at five stations: Redwood Creek (BA40), Yerba Buena Island (BC10), Horseshoe Bay (BC21), San Pablo Bay (BD20), and Napa River (BD50), (3) discontinuing measurements of mercury, since RMP results suggest little bioaccumulation of the contaminant above background concentrations, and (4) discontinuing analysis of arsenic due to the absence of serious arsenic contamination in the Estuary (Jones and Luoma 1990).

1.2.4 Fish Tissue Sampling

Assessment of contamination in fish tissue, which in prior years (1994 and 1997) was conducted as part of the Fish Contamination Pilot Study (Fairey *et al.* 1997), was incorporated into the Status and Trends Monitoring component in 2000. Sampling will continue to be conducted on a three-year cycle. In 2000, six locations were sampled: South Bay, Oak-

land Inner Harbor, San Francisco Waterfront, Berkeley, San Pablo Bay, and San Leandro Bay. Although preliminary fish data results are included in this report (see *Data Tables*), a thorough discussion of findings is currently being prepared as a RMP technical report and will be available in September 2002 on the RMP Reports and Publications page at http://www.sfei.org/rmp /reports.htm.

1.2.5 2000 Special and Pilot Studies

As in prior monitoring years, the United States Geological Survey (USGS) (see link: *http://ca.water.usgs. gov /projects00/*) continued to supplement RMP monitoring by conducting two special studies. A sediment transport study examined the role of factors controlling suspended sediments in the Estuary, such as tides, winds, storm events (runoff), and wind waves. Another study performed monthly measurements of five water quality parameters to describe the changing spatial patterns of water-quality conditions from the lower Sacramento River to the southern limit of the South Bay. These measurements included salinity, temperature, dissolved oxygen, suspended sediments, and phytoplankton biomass, which can influence the partitioning of reactive contaminants between dissolved and particulate forms.

In addition to the Status and Trends Monitoring component, several pilot studies addressed specific topics of contamination in the Estuary. These studies examined air deposition of trace metals, PAHs, and PCBs; sediment contaminant loadings at the Estuary interface; episodic toxicity testing of ambient water samples following significant rainstorm events; and sampling of sediments and benthic invertebrates in San Pablo Bay. Results and discussions from these studies will be reported in separate technical reports and made available on the RMP Reports and Publications page at http://www.sfei.org/ rmp/reports.htm.

1.3 References

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Fairey, R., K. Taberski, S. Lamerdin, E. Johnson, R. P. Clark, J. W. Downing, J. Newman, and M. Petreas. 1997. Organochlorines and other environmental contaminants in muscle tissues of sportfish collected from San Francisco Bay. Marine Pollution Bulletin 34:1058-1071.

Flegal, A.R., R.W. Risebrough, B. Anderson, J. Hunt, S. Anderson, J. Oliver, M. Stephenson, and R. Packard. 1994. San Francisco Estuary Pilot Regional Monitoring Program: Sediment Studies. San Francisco Bay Regional Water Quality Control Board, State Water Resources Control Board.

Johns, C and S. N. Luoma. 1990. Arsenic in benthic bivalves of San Francisco Bay and the Sacramento/San Joaquin River Delta. Science of the Total Environment 97-98:673-684.

SFEI. 1996. 1994 Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. Prepared by the San Francisco Estuary Institute, Richmond, CA. 339pp.

Figure 1.1. 2000 RMP sampling locations.

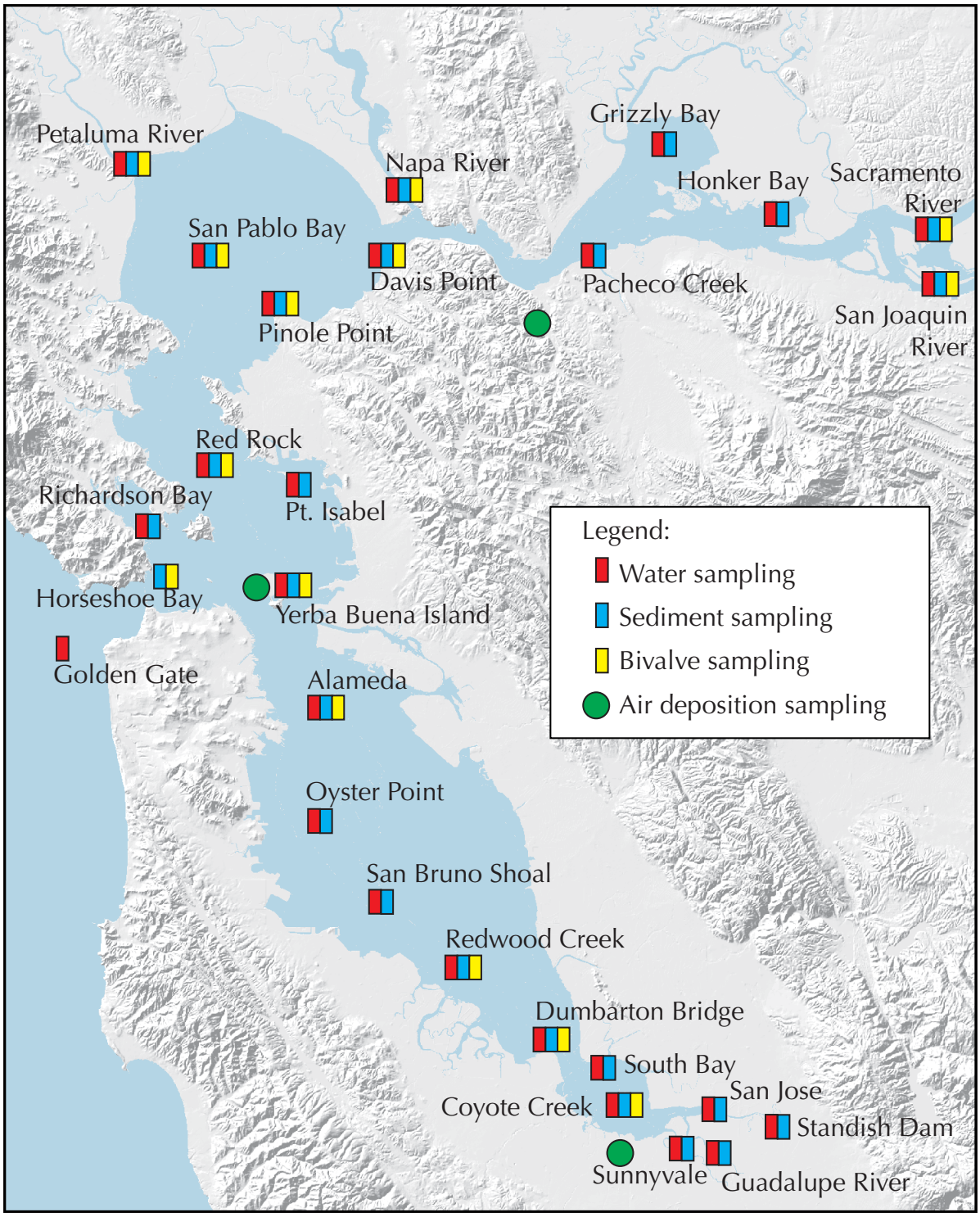

Table 1.2. 2000 RMP parameters analyzed in water, sediment, and bivalve and fish tissue.

Conventional Water Quality Parameters
Conductivity
Dissolved Organic Carbon
Dissolved Oxygen
Hardness (when salinity is <5 ‰)
pH (acidity)
Phaeophytin (a chlorophyll degradation product)
Salinity
Temperature
Total Chlorophyll-*a*
Total Suspended Solids
Dissolved Phosphates
Dissolved Silicates
Dissolved Nitrate
Dissolved Nitrite
Dissolved Ammonia

Sediment Quality Parameters
% Clay (<4 µm)
% Silt (4 µm–62 µm)
% Sand (63 µm–2 mm)
% Gravel (>2 mm)
% Solids
Hydrogen Sulfide
pH
Total Ammonia
Total Organic Carbon
Total Sulfide
Total Nitrogen

Bivalve Tissue Parameters
% Lipid
% Moisture
Bivalve % Survival
Condition Index Mean/Standard Error
Gonad Condition Index Mean/Standard Error
Change in Internal Shell Volume
Shell Volume
Dry Flesh Weight

Fish Tissue Parameters
% Lipid
% Moisture
Length
Stable Carbon Isotope ($^{13}C/^{12}C$) Signature
Stable Nitrogen Isotope ($^{15}N/^{14}N$) Signature

Toxicity
Aquatic Toxicity – (Mysid) % Survival
Sediment Toxicity – (Amphipod) % Survival
Sediment Toxicity – (Bivalve) % Normal Development

Trace Elements	Water	Sediment	Bivalve Tissue	Fish Tissue
Aluminum*		.	.	
Arsenic	.	.		
Cadmium*	.	.	.	
Copper*	.	.	.	
Iron*		.		
Lead*	.	.	.	
Manganese*		.		
Mercury**	.	.		.
Methylmercury	.	.		
Nickel*	.	.	.	
Selenium	.	.	.	.
Silver*	.	.	.	
Zinc*	.	.	.	
Dibutyltin (DBT)			.	
Monobutyltin (MBT)			.	
Tributyltin (TBT)			.	
Tetrabutyltin (TTBT)			.	

* Near-total rather than total concentrations for water. Near-total metals are extracted with a weak acid (pH < 2) for a minimum of one month, resulting in measurements that approximate bioavailability of these metals to Estuary organisms.

** Both dry and wet weight concentrations reported for fish tissue.

Table 1.2. (continued). 2000 RMP parameters analyzed in water, sediment, and bivalve and fish tissue.

Polycyclic Aromatic Hydrocarbons (PAHs)	Water	Sediment	Bivalve Tissue
2 rings			
1-Methylnaphthalene	.	.	.
2,3,5-Trimethylnaphthalene	.	.	.
2,6-Dimethylnaphthalene	.	.	.
2-Methylnaphthalene	.	.	.
Biphenyl	.	.	.
Naphthalene	.	.	.
3 rings			
1-Methylphenanthrene	.	.	.
Acenaphthene	.	.	.
Acenaphthylene	.	.	.
Anthracene	.	.	.
Dibenzothiophene	.	.	.
Fluorene	.	.	.
Phenanthrene	.	.	.
4 rings			
Benz(a)anthracene	.	.	.
Chrysene	.	.	.
Fluoranthene	.	.	.
Pyrene	.	.	.
5 rings			
Benzo(a)pyrene	.	.	.
Benzo(b)fluoranthene	.	.	.
Benzo(e)pyrene	.	.	.
Benzo(k)fluoranthene	.	.	.
Dibenz(a,h)anthracene	.	.	.
Perylene	.	.	.
6 rings			
Benzo(ghi)perylene	.	.	.
Indeno(1,2,3-cd)pyrene	.	.	.
Alkylated PAHs			
C1-Chrysenes	.	.	.
C2-Chrysenes	.	.	.
C3-Chrysenes	.	.	.
C4-Chrysenes	.	.	.
C1-Dibenzothiophenes	.	.	.
C2-Dibenzothiophenes	.	.	.
C3-Dibenzothiophenes	.	.	.
C1-Fluoranthenes/Pyrenes	.	.	.
C1-Fluorenes	.	.	.
C2-Fluorenes	.	.	.
C3-Fluorenes	.	.	.
C1-Naphthalenes	.	.	.
C2-Naphthalenes	.	.	.
C3-Naphthalenes	.	.	.
C4-Naphthalenes	.	.	.
C1-Phenanthrenes/Anthracenes	.	.	.
C2-Phenanthrenes/Anthracenes	.	.	.
C3-Phenanthrenes/Anthracenes	.	.	.
C4-Phenanthrenes/Anthracenes	.	.	.

Synthetic Biocides	Water	Sediment	Bivalve Tissue	Fish Tissue
Cyclopentadienes				
Aldrin	.	.	.	.
Dieldrin	.	.	.	.
Endrin	.	.	.	.
Chlordanes				
alpha-Chlordane	.	.	.	.
cis-Nonachlor	.	.	.	.
gamma-Chlordane	.	.	.	.
Heptachlor	.	.	.	.
Heptachlor Epoxide	.	.	.	.
Oxychlordane	.	.	.	.
trans-Nonachlor	.	.	.	.
DDTs				
o,p'-DDD	.	.	.	.
o,p'-DDE	.	.	.	.
o,p'-DDT	.	.	.	.
p,p'-DDD	.	.	.	.
p,p'-DDE	.	.	.	.
p,p'-DDT	.	.	.	.
HCHs				
alpha-HCH	.	.	.	.
beta-HCH	.	.	.	.
delta-HCH	.	.	.	.
gamma-HCH	.	.	.	.
Other				
Chlorpyrifos	.			.
Dacthal	.			.
Diazinon	.			
Mirex	.	.	.	.
Oxidiazon	.			.
Hexachlorobenzene	.	.	.	.

Table 1.2. (continued). 2000 RMP parameters analyzed in water, sediment, and bivalve and fish tissue.

Polychlorinated Biphenyls (PCBs)	Water	Sediment	Bivalve Tissue	Fish Tissue
PCB 008	.	.	.	.
PCB 018	.	.	.	.
PCB 028	.	.	.	.
PCB 031	.	.	.	.
PCB 033	.	.	.	.
PCB 044	.	.	.	.
PCB 049	.	.	.	.
PCB 052	.	.	.	.
PCB 056	.	.	.	.
PCB 060	.	.	.	.
PCB 066	.	.	.	.
PCB 070	.	.	.	.
PCB 074	.	.	.	.
PCB 087	.	.	.	.
PCB 095	.	.	.	.
PCB 097	.	.	.	.
PCB 099	.	.	.	.
PCB 101	.	.	.	.
PCB 105	.	.	.	.
PCB 110	.	.	.	.
PCB 118	.	.	.	.
PCB 128	.	.	.	.
PCB 132	.	.	.	
PCB 138	.	.	.	.
PCB 141	.	.	.	.
PCB 149	.	.	.	.
PCB 151	.	.	.	.
PCB 153	.	.	.	.
PCB 156	.	.	.	.
PCB 158	.	.	.	.
PCB 170	.	.	.	.
PCB 174	.	.	.	.
PCB 177	.	.	.	.
PCB 180	.	.	.	.
PCB 183	.	.	.	.
PCB 187	.	.	.	.
PCB 194	.	.	.	.
PCB 195	.	.	.	.
PCB 201	.	.	.	.
PCB 203	.	.	.	.

Dioxins and Dioxin Like-Compounds	Fish Tissue
2,3,7,8-TCDD	.
1,2,3,7,8-PCDD	.
1,2,3,4,7,8-HCDD	.
1,2,3,6,7,8-HCDD	.
1,2,3,7,8,9-HCDD	.
1,2,3,4,6,7,8-HCDD	.
1,2,3,4,6,7,8,9-OCDD	.
2,3,7,8-TCDF	.
1,2,3,7,8-PCDF	.
2,3,4,7,8-PCDF	.
1,2,3,4,7,8-HCDF	.
1,2,3,6,7,8-HCDF	.
1,2,3,7,8,9-HCDF	.
2,3,4,6,7,8-HCDF	.
1,2,3,4,6,7,8-HCDF	.
1,2,3,4,7,8,9-HCDF	.
1,2,3,4,6,7,8,9-OCDF	.
Co-planar PCB congeners	
077	.
126	.
169	.
Aroclors	
1248	.
1254	.
1260	.

Table 1.3. Summary of RMP 2000 sampling stations and activities.
Latitude and longitude coordinates are reported in degrees (deg) and decimal minutes (dm).

Segment Name	Station Name	Station Code		Type of Sample	Measurements Made	Sampling Dates: Wet Season	Sampling Dates: Dry Season	Target Coordinates: Latitude deg	Latitude dm	Longitude deg	Longitude dm
South Bay	Coyote Creek	BA10		water	Q,M,O	2/2	7/12	37	28.20	122	3.80
		BA10		sediment	Q,M,O,T	-	7/25	37	28.20	122	3.80
		BA10		bioaccumulation	M,O,C	-	9/20	37	28.20	122	3.80
	South Bay	BA20		water	Q,M	2/2	7/11	37	29.69	122	5.34
		BA21		sediment	Q,M,O,T	-	7/25	37	29.69	122	5.34
	Dumbarton Bridge	BA30		water	Q,M,O,T	2/1	7/11	37	30.90	122	8.11
		BA30		sediment	Q,M,O	-	7/25	37	30.90	122	8.11
		BA30		bioaccumulation	M,O,C	-	9/20	37	30.90	122	8.11
	Redwood Creek	BA40		water	Q,M,O	2/1	7/11	37	33.67	122	12.57
		BA40		bioaccumulation	M,O,C	-	9/20	37	33.67	122	12.57
		BA41		sediment	Q,M,O,T	-	7/25	37	33.67	122	12.57
	San Bruno Shoal	BB15		water	Q,M	2/1	7/11	37	37.0	122	17.0
		BB15		sediment	Q,M,O,T	-	7/25	37	37.0	122	17.0
	Oyster Point	BB30		water	Q,M	2/1	7/11	37	40.20	122	19.75
		BB30		sediment	Q,M,O	-	7/25	37	40.20	122	19.75
	Alameda	BB70		water	Q,M,O	2/4	7/14	37	44.66	122	19.30
		BB70		sediment	Q,M,O,T	-	7/24	37	44.66	122	19.30
		BB71		bioaccumulation	M,O,C	-	9/20	37	44.66	122	19.30
Central Bay	Yerba Buena Island	BC10		water	Q,M,O	2/4	7/14	37	49.36	122	20.96
		BC10		bioaccumulation	M,O,C	-	9/19	37	49.36	122	20.96
		BC11		sediment	Q,M,O,T	-	7/24	37	49.36	122	20.96
	Golden Gate	BC20	*	water	Q,M,O	NS	7/13	37	51.81	122	32.20
	Horseshoe Bay	BC21		sediment	Q,M,O,T	-	7/24	37	49.98	122	28.43
		BC21		bioaccumulation	M,O,C	-	9/19	37	49.98	122	28.43
	Richardson Bay	BC30		water	Q,M	2/3	7/13	37	51.81	122	28.66
		BC32		sediment	Q,M,O	-	7/24	37	51.81	122	28.66
	Point Isabel	BC41		water	Q,M	2/3	7/13	37	53.30	122	20.55
		BC41		sediment	Q,M,O	-	7/24	37	53.30	122	20.55
	Red Rock	BC60		water	Q,M,O	2/3	7/13	37	55.0	122	26.0
		BC60		sediment	Q,M,O,T	-	7/24	37	55.0	122	26.0
		BC61		bioaccumulation	M,O,C	-	9/19	37	55.0	122	26.0
Northern Estuary	Petaluma River	BD15		water	Q,M,O	2/7	7/17	38	6.66	122	29.0
		BD15		sediment	Q,M,O	2/10	7/20	38	6.66	122	29.0
		BD15		bioaccumulation	M,O,C	-	9/18	38	6.66	122	29.0
	San Pablo Bay	BD20		water	Q,M,O	2/7	7/17	38	2.92	122	25.19
		BD20		bioaccumulation	M,O,C	-	9/18	38	2.92	122	25.19
		BD22		sediment	Q,M,O	2/10	7/20	38	2.92	122	25.19
	Pinole Point	BD30		water	Q,M,O,T	2/7	7/17	38	1.48	122	21.65
		BD30		bioaccumulation	M,O,C	-	9/18	38	1.48	122	21.65
		BD31		sediment	Q,M,O	-	7/20	38	1.48	122	21.65
	Davis Point	BD40		water	Q,M,O	2/7	7/17	38	3.12	122	16.62
		BD40		bioaccumulation	M,O,C	-	9/21	38	3.12	122	16.62
		BD41		sediment	Q,M,O,T	2/10	7/20	38	3.12	122	16.62
	Napa River	BD50		water	Q,M,O	2/8	7/17	38	5.79	122	15.61
		BD50		sediment	Q,M,O,T	2/10	7/20	38	5.79	122	15.61
		BD50		bioaccumulation	M,O,C	-	9/21	38	5.79	122	15.61
	Pacheco Creek	BF10		water	Q,M	2/8	7/18	38	3.9	122	5.80
		BF10		sediment	Q,M,O	-	7/20	38	3.9	122	5.80
	Grizzly Bay	BF20		water	Q,M,O,T	2/8	7/18	38	6.96	122	2.31
		BF21		sediment	Q,M,O,T	-	7/20	38	6.96	122	2.31
	Honker Bay	BF40		water	Q,M	2/8	7/18	38	4.0	121	56.0
		BF40		sediment	Q,M,O	-	7/20	38	4.0	121	56.0
Rivers	Sacramento River	BG20		water	Q,M,O	2/9	7/19	38	3.56	121	48.59
		BG20		sediment	Q,M,O,T	-	7/20	38	3.56	121	48.59
		BG20	**	bioaccumulation	M,O,C	-	9/22	38	3.56	121	48.59
	San Joaquin River	BG30		water	Q,M,O,T	2/9	7/19	38	1.40	121	48.45
		BG30		sediment	Q,M,O,T	-	7/20	38	1.40	121	48.45
		BG30	**	bioaccumulation	M,O,C	-	9/22	38	1.40	121	48.45
Southern Sloughs	San Jose	C-3-0		water	Q,M,O,T	2/2	7/12	37	27.85	122	1.60
		C-3-0		sediment	Q,M,O,T	-	7/28	37	27.85	122	1.60
	Sunnyvale	C-1-3		water	Q,M,T	2/2	7/12	37	26.8	122	0.64
		C-1-3		sediment	Q,M,O	-	7/28	37	26.8	122	0.64
Estuary Interface	Standish Dam	BW10		water	Q,M,O	1/31	7/10	37	27.10	121	55.29
		BW10		sediment	Q,M,O	-	7/11	37	27.10	121	55.29
	Guadalupe River	BW15		water	Q,M,O	1/31	7/10	37	25.34	121	58.45
		BW15		sediment	Q,M,O	-	7/11	37	25.34	121	58.45

Legend:
C = bivalve condition index
M = trace elements
NS = not sampled
O = trace organics
Q = water and/or sediment quality
T = toxicity (aquatic and/or sediment)
- sampling not conducted during wet season
* location dependent on salinity
** bivalves not deployed; resident *C. fluminea* collected

Table 1.4. 2000 RMP contractors and principal investigators.

Principal Contractor	Dr. Robert Spies and Dr. Andrew Gunther Applied Marine Sciences, Livermore, CA
BACWA Coordination	Mr. William Ellgas and Ms. Diane Griffin East Bay Municipal Utility District, Oakland, CA
Water Trace Element Chemistry	Dr. Colin Davies, Brooks-Rand, Seattle, WA Dr. Russ Flegal, UC Santa Cruz, CA Dr. Robert Mason, University of Maryland, MD
Water Trace Organic Chemistry	Dr. Walter Jarman University of Utah, Energy/Geoscience Institute, UT
Water Hardness	Ms. Kathleen Irby, Union Sanitary District, Fremont, CA
Water Toxicity Testing	Dr. Scott Ogle Pacific Eco-Risk Laboratories, Martinez, CA
Sediment Trace Element Chemistry	Dr. Colin Davies, Brooks-Rand, Seattle, WA Dr. Robert Mason, University of Maryland, MD Mr. Anthony Rattonetti, City and County of San Francisco, CA
Sediment Trace Organics Chemistry	Mr. François Rodigari East Bay Municipal Utility District, Oakland, CA
Sediment Toxicity Testing	Mr. John Hunt and Mr. Brian Anderson Marine Pollution Studies Lab, Granite Canyon, CA
Bivalve Trace Element Chemistry	Mr. Lonnie Butler, City and County of San Francisco, CA Dr. Colin Davies, Brooks-Rand, Seattle, WA
Bivalve Trace Organics and Butyltins Chemistry	Dr. José Sericano Texas A&M University, TX
Bivalve Condition and Survival	Mr. Paul Salop Applied Marine Sciences, Livermore, CA
Fish Contamination	Dr. Jay Davis San Francisco Estuary Institute, Oakland, CA
Fish Sampling	Mr. Russell Fairey and Ms. Cassandra Roberts Moss Landing Marine Laboratories, Moss Landing, CA
Fish Trace Metals Chemistry	Mr. Gary Ichikawa and Mr. Mark Stephenson Moss Landing Marine Laboratories, Moss Landing, CA
Fish Organochlorine Chemistry	Dr. David Crane California Dept. of Fish and Game, Rancho Cordova, CA
Fish Dioxin Chemistry	Dr. Myrto Petreas Cal/EPA, Hazardous Materials Laboratory, Berkeley, CA
Fish Stable Isotope Chemistry	Mr. David Harris UC Davis, Stable Isotope Lab, Davis, CA
USGS Water Quality	Dr. James Cloern, USGS, Menlo Park, CA
USGS Sediment Transport	Dr. David Schoellhamer, USGS, Sacramento, CA
Estuary Interface Pilot Study	Mr. Jon Leatherbarrow San Francisco Estuary Institute, Oakland, CA Mr. Dane Hardin Applied Marine Sciences, Livermore, CA