Regional Monitoring Program

2008 Detailed Workplan

January 1, 2008

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Regional Monitoring Program (RMP) for Water Quality in the San Francisco Estuary

2008 Detailed Workplan

Overview

This document is a detailed workplan that describes the major Program elements and tasks to be completed in 2008 under the RMP. It is the guiding document for planning and allocating funds for 2008. The workplan is divided into Program areas or tasks. For each Program task, the following information is provided: a description of the task and how it relates to the RMP objectives and management questions; identification of subtasks; a schedule of deliverables; and an estimate of SFEI labor costs. All major tasks and associated SFEI labor costs to complete these tasks are presented on Table 1.

The labor costs are not definitive but rather are our best estimate at present as to the level of effort we anticipate that it will take to complete each of the proposed tasks for 2008. It is likely that as the year progresses, adjustments will be made to the individual labor cost estimates for each task; however, the total labor budget for 2008 will remain fixed.

The 2008 monitoring effort is designed to address the following RMP objectives[1]:

1) Describe spatial patterns and long-term trends of pollutant concentrations in the Estuary;
2) Project future impairment;
3) Describe sources, pathways, loadings and processes leading to pollutant-related impairment in the Estuary;
4) Characterize the potential for adverse effects on humans and aquatic life due to pollution of the Estuary ecosystem;
5) Provide monitoring information for comparison to regulatory guidelines and fore establishing regulatory guidelines; and
6) Effectively communicate information from a range of sources to present a more complete picture of the sources, distribution, fate, and effects of contaminants in the Estuary ecosystem.

This document is divided into five chapters that present the five major elements of the RMP. Chapter 1 explains the overall management of the Program and the efforts made to coordinate the Program both internally with SFEI staff and externally with the many

[1] The RMP objectives are currently being revised by the TRC and SC. A draft version of these objectives has been reviewed by the TRC and SC.

agencies and organizations that are responsible for stewardship of the Estuary. Chapter 2 describes how the results of the RMP studies are reviewed, validated, synthesized, and disseminated to researchers, regulators, and the public at large. The long-term monitoring component of the Program, Status and Trends monitoring, is presented in Chapter 3. Chapters 4 and 5 describe the pilot studies and special studies that were selected for 2008, respectively.

Task 1 Program Management

The administration and management of the RMP requires a substantial effort from SFEI staff. Costs for this component of the RMP reflect the staff time required to: manage finances and contracts; track deliverables and project status; coordinate SFEI staff; and plan and coordinate activities among external agencies and organizations that have a vested interest in the RMP. This task is divided into four subtasks that are described below: internal coordination; external coordination; contract and financial management; and Program planning.

1.1 Internal Coordination

The purpose of this task is to coordinate and facilitate among the Program participants, sub-contractors, Program collaborators, Regional Water Quality Control Board staff, and members of the Steering and Technical Review Committees. This coordination is important to facilitate exchange of information, to avoid duplication of efforts, to identify and inform members of critical decisions and important issues, and to ensure that RMP activities complement and enhance other scientific efforts by RMP participants, the Regional Board, and others. This task also includes the internal coordination of RMP staff (e.g., the coordination and technical oversight of different RMP tasks).

1.2 External Coordination

External coordination promotes comprehensive and coordinated understanding and monitoring of the Estuary through participation in workgroups and committees outside of the RMP umbrella. Currently, the RMP has four workgroups: Sources Pathways and Loadings; Contaminant Fate; Exposure and Effects; and Emerging Contaminants. In addition to these four workgroups, a focused RMP workgroup was formed in 2007 to specifically address issues concerning mercury. All of these workgroups have advisory panels comprised of prominent outside experts which provide peer review to assure that the projects developed and implemented are technically sound.

Members of RMP staff participate in the Interagency Ecological Program (IEP), the Surface Water Ambient Monitoring Program (SWAMP), Regional Board 5 activities, , Northern California Society for Environmental Toxicology and Chemistry (SETAC), CALFED, BASMAA, BACWA, LTMS, and various Total Maximum Daily Load (TMDL) work groups and committees. In addition, RMP staff is frequently asked to

present guest lectures at universities and national and international working group meetings and to serve on advisory boards.

Funds from this task are also used to organize the annual Mercury Coordination Meeting. The purpose of this meeting is to facilitate the flow of information among researchers and regulators and to encourage collaborations among the various organizations that are conducting mercury research in the Estuary. This meeting is typically held in mid-February.

1.3 Contract and Financial Management

Tasks in this category include efforts related to tracking progress and expenditures on all budgeted items, including invoicing of Program Participants, tracking incoming and outgoing funds, accounting and working with the SFEI auditor, working with the Fiscal and Administration Subcommittee of the SFEI Board of Directors, providing financial status updates, and communicating with the Steering Committee on financial matters. It also includes development of contracts after scopes of work have been negotiated, scientific oversight of products, coordination of field and laboratory components, trouble-shooting, scheduling, and implementing course adjustments as necessary, cost-effectiveness/performance evaluations of existing contractors and identifying potential new subcontractors as needed.

1.4 Program Planning

Program planning for the RMP involves several tasks including the development of the Program Plan and project plan reports, proposal writing, development of RFPs, and development of scopes of work, both internally and externally for contracts. In 2007, five-year Program plans were revised for each of the workgroups (e.g., Sources Pathways and Loadings, Contaminant Fate, and Exposure and Effects) as part of an effort to prioritize study ideas and to develop long-term strategies for effectively addressing the RMP management questions. In 2008, an overall five-year Program Plan for the RMP will be developed.

1.5 Schedule, Deliverables, and Budget

Program planning activities are implemented year round. Deliverables for these tasks also occur year round and are commensurate with the RMP activities at hand (e.g., contracts are negotiated at the beginning of the fiscal year, invoicing of stakeholders occurs in the summer, and preparation for the quarterly TRC and SC meetings occurs throughout the year). Both technical and administrative staff are involved with project management as this encompasses a wide variety of activities (e.g., negotiation of contracts, preparation of invoices, coordination with external groups, and coordination internally among staff members).

Estimated costs for each subtask are presented below:

Subtask	**Estimated Cost 2008**
Internal Coordination	$150,000
External Coordination	$ 160,000
Contract and Financial Management	$142,000
Program Planning	$15,000
Total	$470,000

Task 2 Information Management and Dissemination

To meet RMP Objective 6: "Effectively communicate information from a range of sources to present a more complete picture of the sources, distribution, fate, and effects of contaminants in the Estuary ecosystem", activities related to data management, RMP web-site maintenance, development of newsletters, the RMP Annual Meeting, presentations, and information transfer to a variety of audiences, including preparation of the RMP Annual Monitoring Results and the "Pulse of the Estuary", are included in this category.

2.1 Data Management

The primary objectives of this task are to manage, maintain, and improve the RMP database and to enable easy public access to RMP Status and Trends data. In addition to the formatting and reporting of the current year's monitoring data, it is also necessary to periodically update and standardize data from prior years. In accordance with these objectives, our information management and dissemination goals for 2008 are as follows (listed in order of priority):

- Upload current and historic RMP Status and Trends Program analytical results into the SFEI database (compatible with the State Surface Water Ambient Monitoring Program (SWAMP) database format) and continue to validate data to assure they are compliant with our QAPP and consistently reported for all years of the RMP Status and Trends monitoring program;
- Continue updates and maintenance of the web-based data access tool that provides public access to the Status and Trends water, sediment, and bivalve data. In 2008, the Status and Trends Sport Fish Bioaccumulation data will also become available through this data access tool;
- Continue to work with subcontracting laboratories on reporting their data in standardized formats to facilitate web submittals at some future date;
- Develop tools to increase the efficiency of data management processes including data format review, uploading the data into the SFEI database tables, and improving the consistency and quality of the QA/QC review and report;

Upload select datasets from RMP Pilot & Special Studies (or other studies) into the new SFEI database format (if funding permits).

A description of each of these subtasks is presented below.

SUBTASK DESCRIPTIONS

Subtask 1 Data Formatting, QA/QC, and Upload

The data formatting process consists of several steps:

1) Verifying accuracy and completeness of each data submission from the sub-contracting laboratories
2) Transferring the electronic data submittals to the SFEI relational database format
3) Conducting a complete QA/QC review of each data submission to ensure data are appropriately qualified according to RMP data quality objectives and consistently reported compared to the RMP historic data.
4) Follow-up with laboratories regarding questionable or missing data and ways to improve data quality

All results are reviewed according to the data quality requirements outlined in the 1999 QAPP and validated before being publicly released on the Institute's website.

Subtask 2 Database Maintenance and Web Access

In addition to managing data for the current monitoring year, data updates and routine maintenance tasks are performed in order to provide reliable and standardized data for all years of the Program. Data are continually updated to comply with reporting requirements. Inconsistencies are identified, qualifiers are updated, and reanalyzed results are added to the database as they are received from the laboratories. This subtask involves contacting laboratory representatives, updating data records and tracking data management processes, and periodically archiving work files to compact disks.

Subtask 2.1.2.1 Update Web Query Tool

Updates and maintenance of the web-based data access tool.

Subtask 2.1.2.2 Update and Maintain SWAMP Database Compatibility

The RMP Status and Trends database has been converted into a comparable version of the Surface Water Ambient Monitoring Program (SWAMP) database format (version 2.5 was released in September of 2007). The goal of converting the RMP database to SWAMP-comparable format is to make the data more accessible to regulators, researchers, and the public by using the same standardized data format required by SWAMP and all State-funded grant projects. The new database design will make it possible to submit RMP data to the California Environmental Data Exchange Network (CEDEN). SFEI is working with IEP-DWR Information Technology staff to become a Data Center (part of CEDEN) so that more San Francisco Bay-related data will become available through the State's data exchange network. RMP Status and Trends data will be among the data types that will be exchanged with CEDEN.

The SWAMP database conversion process is extremely detailed and must be updated as the SWAMP data management team continues to develop their database standards. The RMP will keep up to date and comparable with SWAMP database formats.

Subtask 3 Data Management Efficiencies

This task will continue the process of developing standards and tools for Status and Trends laboratories to submit their data electronically in standard electronic data deliverable formats (EDDs) and tools for staff to evaluate completeness and accuracy of those data submissions. The tools will perform a preliminary review of the EDDs to ensure that data are submitted in current database formats prior to being parsed into the many SFEI relational database tables. Additional review queries will evaluate datasets for completeness and provide preliminary QA/QC review summaries.

Several routine calculations and procedures (e.g., summing of organics totals, QA/QC validation procedures, and assignment of QA qualifiers, etc.) could be made more efficient through additional programming. The goal of this subtask is to build additional efficiencies into the RMP QA/QC process and to eventually link these tools to a web-based data submission process as opportunities arise.

Subtask 4 Mapping Assistance (GIS)

This task will consist of periodic GIS support for RMP reporting and outside inquiries.

Staff Involved

Staff leads for Data Management are Cristina Grosso, John Ross, and Sarah Lowe. Other key staff include: Donald Yee, Susan Klosterhaus, Amy Franz, and Todd Featherston.

Schedule and Deliverables

Data management tasks are ongoing and updates are made available as soon as they are deemed complete. Data are made available for report production and meeting deadlines.

Budget

The estimated budget for data management for 2008 is presented on the table below.

Subtask	**Estimated Labor Cost 2008**
Data Formatting, QA/QC, and Upload	$210,000
Database Maintenance & Web Access	$90,000
Data Management Efficiencies	$30,000
Mapping Assistance	$1,000
Total	$330,000

2.2 RMP Web Site

Web site updates are carried out throughout the year as updated information becomes available.

OVERVIEW

The RMP web site has an important role in making data, technical reports, newsletters, bibliographies, Powerpoint presentations, and other documentation available to the public. This task includes: publication of RMP *Annual Monitoring Results* and uploading new documents to the web site (e.g, reports, SC and TRC meeting packages, etc.); maintenance of web directories; updating the RMP page; and improving the overall design of the RMP web site.

SUBTASK DESCRIPTIONS

Subtask 1 2007 Annual Monitoring Results

The RMP *Annual Monitoring Results* is published only on our website. The graphics group prepares the web layout and designs the cover page, and chapter cover pages with oversight from the report lead and the IT manager.

Subtask 2 General Report Formatting for the Web

Most RMP reports are formatted by the authors and converted to PDF format for access on the RMP web site. Appropriate links are added to the RMP reports page to provide access to the report.

Subtask 3 Maintenance of RMP Data Access Page

Data Access via the Web Query Tool, csv files (e.g. pilot studies), and the QA Summary Tables

The graphics group is responsible for maintaining the data access homepage and making sure it effectively provides access to the data associated with RMP reports including the Status and Trends data, Pilot and Special Study data, and QA/QC summary reports. The Data Access Page also has links to associated reports, provides contacts for assistance, and links to additional information.

In 2008, SFEI will update the website to make it more user-friendly (e.g., revising drill down tabs and text formats).

Subtask 4 Overall RMP Web Site Maintenance

Overall maintenance of the RMP directory includes:

1) updating the RMP Homepage for calendar items and other “new” elements;
2) updating the data query pages and source database;
3) maintaining the links in the site;
4) generating new graphics (buttons, etc.) as needed;

5) updating content and adding pages as necessary;
6) reviewing overall site architecture and maintaining an intuitive hierarchy; and
7) reviewing "like-minded" web sites for improvement ideas.

Staff Involved
Key staff involved with this task include: Mike May, Linda Wanczyk, Joanne Cabling, Meg Sedlak, and Katie Harrold.

Schedule and Deliverables
Maintenance of the web site is an on-going activity. The site is updated as new reports become available and new events are planned.

Budget
The cost for web-site maintenance in 2008 is estimated to be $19,000.

2.3 Information Dissemination

The primary purpose of this task is to satisfy RMP objective number 6 (to synthesize and distribute information from a range of sources to present a more complete picture of sources, distributions, fates and effects of contaminants in the Estuary ecosystem). RMP results are synthesized and disseminated by a variety of means including the RMP Newsletter, conferences, guest presentations, and external publications. We will continue to take advantage of existing venues for information distribution, such as the ESTUARY newsletter. As appropriate, press outreach, formal presentations to community groups and other organizations, and scientific conferences will also provide information about the RMP and its findings. This task also includes work related to planning and executing the RMP Annual Meeting.

Subtask 1 Newsletters/Inserts
Subtask 1.1 RMP Newsletter

The newsletter provides RMP participants, and the wider community interested in Bay water quality with regular news on the Program that is not covered in the *Pulse* or *Annual Monitoring Results*, such as announcing new projects or findings, discussing related background topics for pilot studies, and disseminating special interest news articles contributed by guest authors. In 2007, the newsletter switched from a biannual publication to an annual publication.

Newsletter production tasks include: soliciting/planning articles; writing and editing; developing the illustration design and layout; and coordinating mailing of the newsletter. Staff members include: graphics (production), RMP manager (editorial review and developmental editing), RMP senior science staff (editorial review), Administrative staff, and other members of the RMP staff for article contributions.

Subtask 1.2 Estuary Insert

The *ESTUARY* Insert is generally produced in the late Fall as a four-page supplement to *ESTUARY* newsletter and is essentially a "mini" issue of *RMP News*. These inserts are used to provide updates on the Progam. *ESTUARY's* audience is broader than *RMP News*, thus providing the Program with an opportunity to reach new readers. Insert production consists of planning, writing, editing, layout of articles and pre-press collaboration with *ESTUARY* staff. Staff members consist of the *RMP News* staff.

Subtask 1.3 Other Print Media

RMP staff will assist other organizations and news services with articles about the Estuary in general, and the RMP and RMP data in particular. When feasible, the Production department may provide assistance in writing, editing and layout of article submissions.

Subtask 2 Record of Publications

The RMP will keep track of all publications that use mainly RMP data. Each publication will be assigned an SFEI Contribution number and entered into an EndNote database in full bibliographic format. Though the contribution list also includes other SFEI programs (Wetlands, CMR etc.), and will be used as a means of presenting SFEI reports on the SFEI Web site, RMP publications will be independently tracked by means of a "profit center" field in EndNote. SFEI's Production/Graphics team is responsible for assigning contribution numbers and maintaining the publications list in EndNote.

Subtask 3 Posters

Subtask 3.1 Posters

The RMP will produce posters for display at poster sessions at various conferences (e.g., SETAC, CalFed, State of the Estuary, etc.). Staff members involved include RMP technical staff and Production.

Subtask 4 Presentations

RMP staff present technical and non-technical talks at various venues (e.g., conferences, universities, and meetings). Assistance with graphics-related issues is provided by Production/Graphics.

Subtask 5 Annual Meeting

The RMP Annual Meeting requires preparation by RMP technical and administrative staff. RMP technical staff members are responsible for developing a variety of presentations; Production/Graphics is responsible for flyers, postcards, photos, and web site announcements; and administration is responsible for meeting logistics (e.g., venue, food, setup, etc.) and for mailings of printed matter.

Subtask 6 Press Outreach

The RMP will seek appropriate opportunities for disseminating RMP information through the media. For example, the RMP staff have developed a number of press contacts which resulted in a number of lead articles for several RMP activities (see for example, write-up of the Annual Meeting in San Francisco Chronicle, October 1, 2007). In addition, individual staff members served as technical resources for reporters on select topic such as effluent exceedances (October 12, 2007 San Francisco Chronicle).

Staff Involved

Most of SFEI staff are involved in some aspect of Information Dissemination. Technical staff write articles for the RMP News and Estuary insert. The graphics staff is critical for the production of inserts, posters, and presentations. Senior staff and the Executive Director are involved in conducting media outreach.

Schedule and Deliverables

Key deliverables for this task are presented below.

Deliverable	**Target Date**
RMP News	Spring
ESTUARY insert	October
RMP Record of Publications	On-going
Posters and Presentations	On-going
Annual Meeting	September
Press Outreach	Periodic

Budget

The estimated budget for information dissemination for 2008 is presented below.

Subtask	**Estimated Labor Cost 2008**
General Information Dissemination (e.g., RMP News, ESTUARY insert, posters, etc.)	$70,000
Press Outreach/Program Development	$5,000
RMP Annual Meeting	$40,000
Total	$115,000

2.4 Annual Reporting

Annual reporting consists of the preparation and production of the *Annual Monitoring Results* and the *Pulse of the Estuary* that are posted on the SFEI website. The *Pulse of the Estuary* is also published in hardcopy.

Subtask 1 ***2007 Annual Monitoring Results***

This report will present six years of randomized sampling for water and sediment. It will follow a format similar to the *2006 RMP Annual Monitoring Results*. Data will be presented in the form of maps with bubble plots of contaminant concentrations at each site and an indication of which sites are above water quality criteria (WQC) or sediment guidelines. Box plots and cumulative distribution frequency plots, by segment, will also be reported. The specifics of the report outline and data presentation will be developed through meetings with SFEI staff, the TRC, and consultation with Dr. Don Stevens, a professor of statistics at Oregon State University.

In years past, the *Annual Monitoring Results* report was prepared concurrently with the Pulse; however, preparation of both reports and holding the Annual Meeting has presented a logistical challenge for staff. In 2008, we will stagger the reporting of the *Pulse* and the *Annual Monitoring Results* with the *Pulse* being reported out in time for the *Annual Meeting* and the *Annual Monitoring Results* approximately two months later (December 1). An outline for the report will be developed and presented at the June TRC meeting.

Subtask 1.1 Preparation of the Annual Report

Web-ready graphics and various tables, including analyte lists and regulatory criteria and guidelines, will be reviewed and updated. Introduction, water, sediment, tissue and QA/QC chapters will be updated to reflect the 2007 data.

Subtask 1.2 Internal Reviews

The *2007 Annual Monitoring Results* draft will be reviewed internally by SFEI staff, the TRC, and interested parties.

Subtask 1.3 2006 Annual Monitoring Results Distribution

The *Annual Monitoring Results* document will be made available through the RMP website *Documents and Reports* link. The 2007 data and QA/QC summaries will be made available on the RMP website through the *Data Access* link. Additional tasks include public outreach and mailings.

Subtask 2 ***2008 Pulse of the Estuary***

The 2008 *Pulse* will summarize RMP monitoring, highlighting results from 2007. The 2007 *Pulse of the Estuary* will be finished in time for the Annual Meeting in the fall.

A detailed outline will be developed under guidance of the Technical Review (TRC) and Steering Committees (SC). First drafts of articles will be sent out for review in May. The articles will be revised in response to comments. A laid-out version of the report will

be distributed to the SC and TRC for a second review in July. The report will be printed by early September, and distributed at the Annual Meeting on September 30. An electronic PDF file will be posted on SFEI's web site.

Staff Involved
The production of the *Annual Monitoring Results* will include: John Oram, Amy Franz, Sarah Lowe, Meg Sedlak, John Ross, Cristina Grosso, Jennifer Hunt, and Nicole David. Leads on the *Pulse* will include: Jay Davis, Mike Connor, Meg Sedlak, and Linda Wancyzk.

Schedule and Deliverables
A detailed schedule of tasks is presented below.

Deliverable	**Target Date**
2007 RMP Annual Monitoring Results - Draft for internal review	November 2008
2007 RMP Annual Monitoring Results – Final on web	December 2008
2007 Pulse of the Estuary	September 2008

Budget
The estimated SFEI labor budget for the *Annual Monitoring Results* and the *Pulse of the Estuary* for 2008 is presented on the table below.

Subtask	**Estimated Labor Cost 2008**
Annual Monitoring Results 2007	$46,000
Pulse of the Estuary 2008	$76,000
Total	$122,000

2.5 Quality Assurance and Quality Control (QA/QC)

OVERVIEW
Planned tasks for 2008 include:

- working with the RMP laboratories to develop better analytical methods for metals analysis,
- finalizing the draft archival protocol,
- completing the update of the Quality Assurance Program Plan (QAPP),
- implementing laboratory audits, and
- analyzing data from special QA/QC studies conducted in 2005.

BACKGROUND

The RMP QA/QC program ensures the consistency and usability of data generated by various subcontractor laboratories and among different facets of RMP estuarine monitoring. The requirements presented in the RMP QAPP are intended to ensure data comparability among different laboratories and different years.

The RMP quality assurance component has been recognized as one of the most thorough and systematic efforts of any ambient monitoring program. For example, ultra-clean field sampling techniques, first developed and refined by one of the RMP team members, are now becoming the standard and are EPA approved (Flegal and Stukas, 1987; EPA Method 1669). In addition, the continuous performance evaluation exercises are useful for most RMP contract laboratories in sharing expertise, method refinement, and maintaining the rigor of the data collection and analysis effort.

The QA program includes the following tasks:

1. Routine data verification and validation procedures to determine if laboratories are able to meet data quality guidelines specified in the current RMP QAPP and to determine if the data quality meets the expectations of the data users.

2. Updates of the QAPP to meet evolving management priorities and incorporate new components (e.g., ELISA techniques, new analytes, or new data acceptability criteria).

3. Special QA/QC projects that are limited in scope and that may assist in the evaluation of data accuracy among different laboratories, or in the development of new field collection or analytical methods (e.g., evaluation of samples split among labs or intercalibration exercises).

This section outlines the annual data quality assurance procedures to be conducted in 2008, the periodic review of RMP contract laboratories to ensure high quality performance, and the general evaluation of factors contributing to analytical variation and other causes of measurement uncertainty.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

1.0 Describe spatial patterns and long-term trends of pollutant concentrations in the Estuary.

QA/QC measurements are an essential component in evaluating trends and patterns in contaminant concentrations by providing an indication of the baseline "noise" in sample collection and analyses to which apparent differences in contaminant concentrations can be compared.

2.0 Project future impairment

QA/QC also provides an indication of the likely uncertainty in loading estimates.

4.0 Characterize the potential for adverse effects on humans and aquatic life due to pollution of the Estuary ecosystem

QA/QC is necessary for toxicity testing, to evaluate the significance of apparent impacts on growth, survival, and other measures.

5.0 Provide monitoring information for comparison to regulatory guidelines and for establishing regulatory guidelines.

QA/QC measurements gauge the ability of the analyses to provide information on water quality objective achievement or exceedance.

6.0 Effectively communicate information from a range of sources to present a more complete picture of the sources, distribution, fate, and effects of contaminants in the Estuary ecosystem.

Standardized and well-documented QA/QC allows the integration of information from a number of sources.

SUBTASK DESCRIPTIONS

Subtask 1 QA Management and Revision of the QAPP

This task includes review and updating of the Field Operations Manual (FOM) and QAPP to reflect new measurements added to the RMP. A number of improvements in analytical techniques have occurred since the 1997 QAPP was prepared. In 2008, we propose to revise the QAPP to incorporate these changes and make the RMP QAPP more consistent with the SWAMP QAPP.

A draft version of the SWAMP QAPP has been sent to RMP laboratories for comments. These comments will be considered as part of the revision of the QAPP. Coordination with the laboratories and contractors for the development and refinement of sampling and analytical procedures, and review of QA procedures for special and pilot studies will be included in this task as well.

Subtask 2 Optimizing Metal Analyses

In 2007, the RMP switched from using the UC-Santa Cruz laboratory to a commercial trace metals laboratory. In part this was driven by elevated methyl mercury quantitation limits in the UCSC laboratory as compared to results that were achieved by commercial laboratories and municipal laboratories (such as the City of San Jose). As part of this switch, preliminary data suggest that additional trouble-shooting with regard to metal analyses will be needed.

Subtask 3 Finalizing a Sample Archive Protocol

Sample archives are extremely valuable in identifying long-term trends of emerging contaminants, re-evaluation of trends with improved analytical methods, and providing insurance in case of analytical problems that may arise. As one example, Dr. Ron Hites was able to identify a significant increase in PBDEs in the Great Lakes since the 1980s using archival materials (Hites 2004). In 2007, SFEI staff developed a draft sample archive protocol for documenting what materials will be archived, how they will be stored, and under what circumstances they might be used. In 2008, this document will be peer-reviewed by the ECWG and TRC, and finalized and posted on the RMP website.

Subtask 4 Laboratory/Sample Intercomparisons (RMP Status and Trends)

The RMP conducts periodic limited QA/QC studies such as blind field samples, duplicate field samples, and inter-comparison studies among laboratories to evaluate data quality. These samples are included in the Status and Trends sub-contracts and reported, validated, and reviewed as part of the Status and Trends task. We plan to continue these exercises in 2008.

With AXYS Analytical now using new extraction procedures for XAD columns, some evaluation of extraction yield by comparison to split (whole) water samples at selected sites will be used to assure continued acceptable recoveries for water analytes.

Subtask 5 Laboratory Audits

In 2008, the RMP will begin a process of auditing the laboratories that provide services to the RMP. A review of audit protocols used by SWAMP, CalFED, and NELAP will be conducted to determine which protocol is most appropriate for use in the RMP. A desktop audit will be conducted prior to a site visit to the laboratory. The desktop audit will likely consist of a review of QA/QC information and standard operating procedures already collected for RMP, possibly requesting additional data sets (particularly for laboratories with fewer than three years of data for RMP). The site visit will be conducted to ground truth the information provided by the laboratory and to determine if there are issues associated with implementation of the standard operating procedures. The purpose of the audits will be to assist the laboratory in trouble-shooting issues before they adversely impact the laboratory analysis. The audits will be conducted in a spirit of mutual learning and education.

Staff Involved

The leads on the QA/QC task will include: Don Yee, Susan Klosterhaus, Meg Sedlak, Sarah Lowe, and Cristina Grosso. Other staff members involved in this task will include: John Ross, Jen Hunt, and Amy Franz.

SCHEDULE AND DELIVERABLES
A detailed schedule of tasks is presented below.

Deliverable	Target Date
Validated 2007 S&T data and other studies as needed	On-going
Trouble-shooting Metal Analyses	On-going
Finalize Sample Archive Protocol	June 2008
Conduct laboratory audit of RMP lab	September 2008
Update RMP Status and Trends QAPP	November 2008

BUDGET
The estimated SFEI labor budget for QA/QC is approximately 35,000.

2.6 Data Integration

OVERVIEW
This category provides resources for activities that focus on integration of data from the RMP and non-RMP studies of contaminants in the Bay, and on synthesis of all of this information in evaluations of past trends, present status, loadings, exposure and effects, and projected future trends. Other sources of information on Bay contamination include USGS studies, SWAMP, CALFED, EMAP, NOAA's Status and Trends Program, and the Clean Estuary Partnership (CEP). Tasks planned or proposed for 2008 include completion of development of Version 2.0 of the multibox PCB model; contaminant screening with the multi-box model; a set of tasks to evaluate confidence in sediment quality assessment tools; and the development of a mass budget for methylmercury in the Bay.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

Objective 2. Project future impairment

2.1 What patterns of impairment are forecast for major segments of the Estuary under various management scenarios?
Addressed by: Multibox Pollutant Screening, Understanding and Improving Sediment Assessment Tools, Methylmercury Mass Budget

2.2 Which contaminants are predicted to increase and potentially cause impairment in the Estuary?
Addressed by: Multibox Pollutant Screening

Objective 3. ***Describe sources, pathways, loading, and processes leading to pollutant-related impairment in the Estuary***

3.1 Which sources, pathways, and processes contribute most to impairment?
Addressed by: Methylmercury Mass Budget

Objective 4. ***Characterize the potential for adverse effects on humans and aquatic life due to pollution of the Estuary ecosystem***

4.2 What potential for adverse effects on humans and aquatic life exists due to pollutants in the Estuary ecosystem?
Addressed by: Understanding and Improving Sediment Assessment Tools

Objective 5. ***Provide monitoring information for comparison to regulatory guidelines and for establishing regulatory guidelines***

5.2 What is the percentage and degree of impairment in each Bay segment?
Addressed by: Understanding and Improving Sediment Assessment Tools

5.3 What are appropriate guidelines for protection of beneficial uses?
Addressed by: Understanding and Improving Sediment Assessment Tools

Objective 6. Effectively communicate information from a range of sources to present a comprehensive picture of the sources, distribution, fate, and effects of pollutants and beneficial use attainment or impairment in the Estuary ecosystem.

Addressed by: Multibox Pollutant Screening, Understanding and Improving Sediment Assessment Tools, Methylmercury Mass Budget

SUBTASK DESCRIPTIONS

Subtask 1 Completion of PCB Multibox Model Version 2.0

This subtask is a continuation of a subtask from the 2007 Data Integration workplan. The draft technical report on Multibox Model Version 2.0 will be distributed in December 2007. Revision in response to comments and preparation of the final report will occur in 2008.

Subtask 1.1 Prepare Final Technical Report on PCB Multibox Version 2.0

The final technical report on version 2.0 will be prepared by April 30, 2007.

Subtask 2 Multibox Pollutant Screening (Pending Discussion by the CFWG)
The draft Five Year Plan of the CFWG includes this element. The Plan will be further discussed and finalized in early 2008, and, if approved by the CFWG, a decision from the TRC on inclusion of this element would be sought at the March TRC meeting.

The RMP is charged with monitoring known contaminants and identifying emerging contaminants in water, sediment, and wildlife in the Bay and surrounding watersheds. The list of contaminants monitored by the RMP is dictated by stakeholder needs and existing environmental policy. As a result, the current list of contaminants monitored is long. Due to limited resources, environmental fate and risk are studied in depth for only a subset of the monitored contaminants. Contaminants identified for such detailed study are prioritized by management needs (e.g., Total Maximum Daily Loads development) and stakeholder interests (e.g., methylmercury production in restored wetlands). Contaminants that are not of regulatory or stakeholder priority are generally not investigated in detail; their monitoring results are simply reported in the Annual Monitoring Results. As a result, only a fraction of the power of monitoring activities is being used to improve our understanding of the physical, chemical, and biological processes controlling contaminant fate in San Francisco Bay. Analysis within a multi-contaminant framework is lacking.

This subtask would develop a multi-contaminant framework for assessing the environmental fate of contaminants in San Francisco Bay. Results from ongoing monitoring efforts will be incorporated into a numerical model (Multibox Version 2.0) of contaminant fate to estimate the relative importance of physical, chemical, and biological processes in controlling the fate of a range of contaminants (selenium, copper, PCB 118, BDE 47, BDE 209, DDT, dieldrin, and chlordane). These contaminants have a broad range of partitioning characteristics, degradation rates, and external loads (the parameters thought to exert the most control on contaminant fate). The proposed project would integrate, and advance, existing RMP assets, with the objectives of identifying the major uncertainties in estimating the environmental fate of various contaminants (e.g., whether uncertainties in load calculations, understanding of partitioning, or understanding of exchange between Bay regions are more critical) and better constraining model parameters shared in common among contaminants (e.g., watershed sediment loading rates, sediment mixed layer depth, net sedimentation rate). The final product will be a screening tool that can be used by managers to estimate the environmental fate of current and emerging contaminants in San Francisco Bay in a way that will help prioritize management efforts. Results will be especially useful for screening emerging contaminants and will enable managers to assess whether an emerging contaminant poses a long-term threat to ecosystem health.

Subtask 2.1: Literature review

A thorough literature review will be conducted to identify previous work and to collect/compile information on key model parameters for each contaminant.

Subtask 2.2: Model coding

The multibox model is currently coded specifically for PCBs. This task will code the model so that it can be used to model a wide range of contaminants. Efforts will focus on making the model much more flexible in regards to how it handles partitioning, spatial and temporal distributions of external loads, degradation, sediment-water exchange, and water-air exchange.

Subtask 2.3: Loads development

Existing data will be analyzed to develop loads estimates.

Subtask 2.4: Inventory and trends development

Existing data will be analyzed to determine best estimates of current inventories in Bay water and sediment. Where possible, data will be analyzed for the presence of spatial and temporal trends.

Subtask 2.5: Data integration / Modeling and Reporting

Information gathered/developed in previous tasks will be integrated with the newly coded multibox model. The model will be run to steady-state under various loading conditions and results for multiple contaminants will be compared and contrasted. Estimates of such relationships would provide a simple method to assess how the Bay might respond to a given contaminant under various loading scenarios. Sensitivities of model response to other contaminant characteristics such as degradation rates and the spatial distribution of external loads will also be tested through such exploration.

Subtask 3 Understanding and Improving Sediment Assessment Tools

This subtask is a component of the Five Year Plan of the EEWG that was approved by that group at their November 26 meeting and recommended for inclusion in the RMP.

The SQO framework is a new approach for assessing sediment condition, using sediment chemistry, toxicity, and benthic community assessments. Initial application of the approach to the Estuary produced results that need further examination and interpretation. For example, toxicity in the San Francisco Estuary occurs at lower contaminant concentrations than in southern California, leading to the conclusion that most of the sediment in the polyhaline and mesohaline regions of the Estuary are "possibly" to "likely" impacted. In addition, different benthic indices that have been developed for the Estuary appear to yield somewhat different results. Investigating and resolving these questions and others is important in allowing environmental managers to make management decisions based on a full understanding and confidence in the SQO assessment results.

This component of the RMP Sediment Plan includes tasks that will explore the relationships within and among its three main lines of evidence used in the SQO

assessments(chemistry, toxicity, and benthos). It may include recommending refinements to some of the SQO assessment methods, in order to tailor the methods to be optimally adapted to the environmental conditions in the San Francisco Estuary. Understanding the relationships between benthic community attributes, pollution, salinity gradients, TOC, and other environmental conditions in the Bay-Delta system will be important in interpreting the and refining the SQO assessments in the future. Because of the multidisciplinary nature of the SQO assessments, workshops will be needed to both present and discuss the details of SQO calculations and interpretations with RMP participants and scientists from the region, and develop ideas about how to refine and tailor the methods to more accurately reflect sediment condition in the different regions of the Estuary.

In 2008 two workshops will be held to refine and develop consensus on benthic indices. At the workshops the details of SQO calculations and interpretations will be presented and discussed with RMP participants and scientists from the region, and ideas will be developed about how to refine the methods to more accurately reflect sediment condition in the different regions of the Estuary. At a second workshop, findings of the recommended refinement studies will be presented to the group.

Another topic to be evaluated in detail is the variation in the relationship between sediment contamination and amphipod mortality between San Francisco Bay and southern California locations (SCCWRP 2007). Investigation of the explanation for this relationship will begin with a careful review of the data that were used in the analyses. Possible explanations to be evaluated include 1) chemical analytical methods differences and/or differences in the number of parameters that went in to each chemistry score, and 2) environmental differences in regions (grain size differences, TOC, depth of sampling, etc).

The EEWG also recommended that in later years (2009 – 2012), funds ($20,000) be allocated annually to allow for continual evaluation and refinement of the SQO assessment tools and results in order to build confidence in its application as a water quality management tool.

Subtask 4 Methylmercury Mass Budget

This subtask has been recommended for inclusion in the RMP by the CFWG at their September 14 meeting. It was originally anticipated that this could be included in the 2007 RMP Workplan, but budgetary and timing considerations have pushed it into 2008.

This subtask would consider MeHg in a mass balance model. Data gaps and the importance of interconversion rates may become explicitly important in such an exercise. Although uncertainties around various possible inputs are quite large - e.g., wetlands can be net sources or sinks at different times (Stephenson et al. 2007) - a mass balance model can provide an indication of the scale of uncertainties, which may allow prioritization on which particular inputs most need better quantification. The mass balance model will

include estimates of *in situ* methylation/demethylation rates to account for imbalances in loading and discharge rates from receiving waters.

SCHEDULE AND DELIVERABLES 2008
A detailed schedule of deliverables is presented below.

Deliverable	**Target Date**
Final Technical Report on PCB Multibox Version 2.0	April
Draft Technical Report on Multibox 2.0 Pollutant Screening	December
Sediment Assessment Workshops 1 and 2	To Be Determined
Draft Technical Report on the Correlation of Toxicity and Pollutant Concentrations in San Francisco Bay	December
Draft Technical Report on a Methylmercury Mass Budget	March

STAFF INVOLVED
Staff working on Data Integration will include: John Oram, Don Yee, Jay Davis, Lester McKee, Sarah Lowe, Bruce Thompson, Aroon Melwani, and Meg Sedlak.

BUDGET FOR DATA INTEGRATION 2008

The estimated SFEI labor budget for Data Integration is presented below. Approximately $5,000 will allocated to Dr. Bruce Thompson as a subcontract.

Subtask	**Estimated Labor Cost 2008**
Completion of PCB Multibox Model Version 2.0	$10,000
Multibox Pollutant Screening	$40,000 (Pending Discussion by the CFWG)
Understanding and Improving Sediment Assessment Tools	$15,000
Methylmercury Mass Budget	$20,000
Total	$85,000

Task 3 Status and Trends Monitoring

In 2005, RMP staff, and members of the TRC and SC began a process to review the Status and Trends (S&T) program based on several reasons. First, new findings are changing our understanding of the Bay and as a result, it is important that the Program adapt and respond to these changes. Second, the regulatory focus is changing from establishing specific thresholds for contaminants in water to establishing thresholds for the sensitive biota. An example of this is the mercury marine water quality objective which was vacated in place of two criteria for biota (i.e., sport fish and small fish). Again it is important the Program respond and provide data that is of use to the regulated community and regulators. The redesign of S&T was completed into 2007 with major changes that will occur in 2008. A report summarizing the results of the redesign is currently undergoing external review.

Prior to 2007, the S&T Program was comprised of four program elements: long-term water, sediment, and bivalve monitoring; causes of sediment toxicity (previously known as episodic toxicity); sport fish bioaccumulation; and the USGS hydrographic and sediment transport studies. In 2007, as part of the redesign, the TRC and SC elected to include the following pilot and special studies into S&T: small tributary loading (annual); large tributary loading (triennial); Guadalupe tributary loading (triennial); small fish (annual); and bird egg monitoring (triennial). The small tributary loading element and the bird egg monitoring element will commence in 2008 and are described below. Monitoring of small fish will continue for one more year under the Exposure and Effects Pilot Study (EEPS) before being incorporated into S&T (a description of this element can be found in Section 4).

The 2008 RMP sampling will mark the seventh year of the randomized sampling design. The S&T monitoring program for water and sediment was significantly revised in 2002, moving from a fixed sampling design to a randomized design. A long-term plan for this design, including a 20-year cycle of rotating panels, is being implemented. The design follows the EMAP example of a randomized design capable of addressing questions related to a representative characterization of contaminant concentrations in water and sediment. The bivalve program uses a fixed station, rather than random, sampling design.

The S&T monitoring component of the RMP addresses primarily RMP Objectives 1, 2, 4 and 5. With regard to Objective 1, describe the distribution and trends of pollutant concentrations in the Estuary, the S&T randomized sampling design allows for representative characterization of contamination within each Bay segment. Data from the S&T monitoring are used to develop models for addressing Objective 2 and for understanding the impacts of chemical contamination on biota, Objective 4. The data from S&T are also used to fulfill Objective 5, compare monitoring information to relevant guidelines, such as TMDL targets, tissue screening levels, water quality objectives, and sediment quality objectives. These comparisons are conducted in the *Annual Monitoring Results* and the *Pulse of the Estuary.*

The S&T monitoring program is augmented by short-term Special and Pilot Studies that are designed to answer specific management questions (e.g., what is the potential of currently buried contaminants to emerge from eroding sediment layers and become a contaminant input to the ecosystem?), or to test on a small scale the efficacy of new monitoring approaches or methodologies, for possible inclusion in the S&T program. The 2007 Pilot Studies and Special Studies are discussed in more detail in Chapters 4 and 5, respectively.

Since 2002, water, sediment, and bivalve bioaccumulation sampling for the S&T monitoring program were conducted in the summer. Summer was selected for sampling because inter-annual variation due to natural variables, primarily freshwater inflow, is minimized during this period. However, significant toxicity is observed in the winter in sediments. To better understand the causes of toxicity and the variability that may be observed in the rainy season, the TRC and SC recommended as part of the redesign of S&T that sediment be sampled in alternating years in the summer and winter months. Sampling of sediment will occur in the winter of 2009.

Five historical water stations and seven historical sediment stations are sampled to maintain time series for long term trend analyses. The Annual Monitoring Results reports further describe the scope of work, analytes measured, and the analytical and reporting expectations for the S&T monitoring program.

Much of the S&T monitoring effort consists of sample collection and laboratory analysis that is undertaken largely by subcontractors (e.g., AXYS Analytical, and Applied Marine Sciences). SFEI provides oversight, coordination with the laboratories, water sampling for organics, and field assistance.

3.1 Status and Trends: Long Term Monitoring of Water, Sediment, Bivalves, Benthos, and Toxicity

In 2005, the RMP began a process to redesign the Status and Trends program element. This was completed in 2007 and a summary report written that is currently undergoing external review. A number of changes will be implemented in 2008 including the reduction of organic analyses in water and inclusion in benthic assessments. These changes are discussed in more detail below.

Subtask 1 Water Chemistry

Conventional water quality, trace metals, and trace organics sampling in water will occur during the dry season. As part of the redesign, the number of stations was reduced from 31 to 22, including four random stations per segment with the exception of the Lower South Bay segment which has five. In addition to the randomized sites, five fixed historical stations will be maintained.

In 2006, the TRC recommended that with one exception, organics (i.e., PCBs, PAHs and legacy pesticides) should be analyzed on a biennial basis. Because of the greater interest in PBDEs, PBDEs will continue to be analyzed annually. In 2006, analysis of dissolved and total organic contaminant concentrations were eliminated in favor of total organics. Current water quality objectives are based on total concentrations.

Subtask 2 Sediment Chemistry

Sediment samples will be collected in the dry season in 2008 and will alternate wet and dry seasons after 2008. During the dry season, sediment chemistry will be analyzed at 40 random sites and 7 fixed sites. In the wet season, sediment chemistry with be analyzed at 27 sites (20 random sites and 7 fixed sites).

In 2008, the sediment analysis will be similar to 2007.

Subtask 3 Sediment Benthos

In 2008, the sediment quality objectives (SQOs) are scheduled to be promulgated by the State. The SQOs consist of sediment chemistry, toxicity, and benthic assessments. To provide the data needed for sediment triad evaluation, the RMP will begin to collect samples for benthic community analysis. To be consistent with the state assessment, sediment samples will be characterized for chemistry, toxicity and benthic assemblages.

Subtask 4 Bivalve Bioaccumulation

The bivalve monitoring component maintains the long-term database started by the State Mussel Watch Program in the early 1980s. Because of logistical complexities, a randomized design is not economically feasible, nor is it technically desirable for this long-term trend monitoring tool. Bivalves are excellent trend indicators particularly for organic contaminants. The redesign workgroup recommended that a biennial plan that was implement in 2007. In 2008, bivalves will be sampled for organics and inorganics.

Subtask 5 Toxicity (Aquatic and Sediment)

Because the RMP S&T aquatic toxicity monitoring in the Estuary has shown little toxicity over the past several years, aquatic toxicity sampling has been scaled back to a screening effort every five years. The next aquatic toxicity testing is scheduled for 2012.

RMP S&T sediment toxicity monitoring will continue as in previous years. Sediment toxicity measurements will be made at 27 sites in the Estuary (20 randomly allocated sediment chemistry stations and seven historical RMP sampling sites) in the summer in 2008. In 2009, sediment toxicity monitoring will occur in the winter.

Toxicity tests will be conducted with *Eohaustorius* (a solid phase test with survival as the endpoint) and *Mytilus* (an elutriate test with normal larval development as the endpoint). It is possible that the sediment-water interface test will be used instead of the elutriate test to be consistent with the SQOs; however, this is pending EEWG discussion and TRC/SC approval. TIEs will be conducted in samples that show significant toxicity. TIE testing was not conducted in 2005 while UC Davis developed a better method for identifying

toxicity. It is hoped that the improved methods will help us better understand the causes of toxicity in the north and south Bays.

STAFF INVOLVED
The leads on the S&T long-term monitoring task will include: Sarah Lowe, Meg Sedlak, John Oram, and Don Yee. Other staff members involved in this task will include: John Ross, Nicole David, Jen Hunt, and Amy Franz.

SCHEDULE AND DELIVERABLES
The S&T field sampling cruise will occur in July and August 2008. Monitoring of loads from small tributaries will commence as part of the 2007/2008 rainy season.

BUDGET
The estimated SFEI labor budget for S&T long-term monitoring task is presented below.

Subtask	**Estimated Labor Cost 2008**
S&T Field Sampling and Oversight	$46,000
Total	$46,000

3.2 Causes of Sediment Toxicity

OVERVIEW

The Five Year Plan developed by the EEWG for evaluating risks to benthic biota includes a primary focus on determining the causes of toxicity in sediment toxicity tests. Determining the causes of impacts in sediment has been identified as a high priority for the RMP. Sediment toxicity has been observed at a high proportion of RMP sampling locations since the Program began in 1993. Reducing this toxicity depends on determining which pollutants or other factors are responsible. The annual SQO assessments will provide information about sediment condition in the Estuary, but will not identify causes of the observed toxicity or benthic community impacts. This component of the Sediment Plan will investigate causes of observed sediment toxicity and benthic impacts. "Stressor identification" is a key element of the Water Quality Plan for implementation of the SQOs.

One means of stressor identification will be to conduct Toxicity Identification Evaluations (TIEs) on any Status and Trends sediment samples that are sufficiently toxic. Funding for TIEs will come from the RMP contingency fund.

Another means of stressor identification will be to evaluate triad indicators at sites that have demonstrated gradients of toxicity and benthic impacts to evaluate statistical associations between sediment quality, other factors (e.g., grain-size, TOC, salinity), and observed toxicity and benthic community metrics. TIEs will be conducted when warranted to identify possible contaminant causes along the gradients.

Work on this study in 2008 will complete the tasks begun in 2007.

The EEWG recommended that this work be continued over the next five years, with $150,000 allocated for this work in 2009. The results of this study will be evaluated and, if warranted, another round of the work will be performed in 2011.

The 2007 "Causes of Sediment Toxicity" project was a two-year effort to use Toxicity Identification Evaluation (TIE) methods on estuarine sediments to investigate causes of sediment toxicity to amphipods in the Estuary. The 2007-2008 study focuses on determining what is causing the persistent sediment toxicity observed in the Estuary through the RMP S&T monitoring effort.

The long-term goals of the study are to locate toxic stations within the Estuary, use TIEs to investigate the likely causes of sediment toxicity to the estuarine amphipod *Eohaustorius estuarius*, and to eventually combine TIEs with sediment quality triad studies to evaluate SWRCB sediment quality objectives in SF Estuary. The 2007-2008 plan only includes the following elements:

1. Conduct screening to locate estuarine stations at the mouths of tributaries, which have persistently toxic sediments: evaluate temporal variability of sediment toxicity during the rainy season at the most toxic stations.
2. Conduct TIEs at the stations demonstrating the greatest magnitude of toxicity to identify the causes of sediment toxicity
3. Conduct spatial analyses of chemical contamination and sediment toxicity to identify sites with distinct horizontal contamination and toxicity gradients.
4. Conduct sediment quality triad studies at gradient sites to evaluate application of SWRCB sediment quality objectives assessment protocols for use in the Estuary

A description of the 2007-2008 project plan can be found in last years Detailed Work Plan. The 2008 workplan is to complete the work from 2007, write a report or publication (if warranted) and plan for the next phase of this project, which includes items 3 and 4 above, and is planned for 2009.

To date, one highly toxic station was located (Mission Creek in San Francisco) and an extensive TIE was conducted. Sediments and TIE extract samples were sent to the lab for a complete analysis, and the results are pending. The project leads are preparing to sample four more stations in January to locate the second highly toxic site for conducting the second TIE study. The project report is expected to be available in draft by October of 2008 (allowing time for all chemistry results to be included in the interpretive report) and the final draft is scheduled for December 2008.

STAFF INVOLVED
The lead on the S&T Causes of Sediment Toxicity project is Sarah Lowe who will work closely with UC-Davis collaborators Brian Anderson, Bryn Phillips, and John Hunt.

SCHEDULE AND DELIVERABLES
Second site located and TIE study performed January-March 2008
Draft Report October 2008
Final Report December 2008

BUDGET
The estimated SFEI labor budget for the 2008 work related to this ongoing project is $10,000

3.3 Sport Fish Bioaccumulation Monitoring

Sport fish sampling in the RMP began in 1997 and occurs on a three-year cycle. Based on a recommendation from the RMP Fish Committee, sampling in 2006 included continued evaluation of key fish species for long-term trend detection, combined with follow-up sampling of additional species. The trend detection species include shiner surfperch, white croaker, striped bass, and white sturgeon. The follow-up sampling is intended to establish a more extensive data set for species consumed by San Francisco Bay sport fishers but not previously targeted. The additional species targeted include brown Chinook salmon, brown rockfish, anchovy, black surfperch, walleye surfperch, pacific herring, and sardines. Samples have been analyzed for mercury, PCBs, organochlorine pesticides, and polybrominated diphenyl ethers (PBDEs). Selenium was also analyzed in white sturgeon. It is anticipated that carryover funds from 2007 will be used to complete the report early in 2008.

This task fulfills RMP Objective 1 (i.e., describe patterns and trends in contaminant concentration and distribution) by evaluating the temporal trends in impairment of the fishing beneficial use of Bay waters. In addition, some fish species (especially shiner surfperch) are valuable for analysis of spatial patterns. The collection of fish will be compared to screening values for protection of human health, representing a key impairment indicator for the Estuary and therefore, fulfills Objective 4 (i.e., compare monitoring information to relevant water quality objectives and other guidelines). Lastly, the collection of fish data can be integrated with data from other studies (e.g., TSMP, Selenium Verification and Calfed Studies) to fulfill Objective 6 (i.e., effectively communicate information from a range of sources to present a more complete picture of the sources, distribution, fate, and effects of contaminants in the Estuary ecosystem).

STAFF INVOLVED
This task will be performed by Jennifer Hunt, Ben Greenfield, and Jay Davis.

BUDGET
The estimated labor budget for this task will be from carryover funds from 2007. At the writing of this report, it is anticipated that approximately $25,000 will be available for carryover.

3.4 Small Tributary Loading – Hayward Zone 4 Line A

OVERVIEW

Davis et al. (2000) recommended that six observation watersheds picked on the basis of land use. This long standing recommendation by the SPLWG was endorsed by the Sources Pathways and Loading workgroup (SPLWG) in 2005 and written into the SPLWG 5-year Work Plan (McKee, 2005). To-date, most information on the functioning of small tributaries in the Bay Area is based on water and sediment data collected by the USGS. During WY 2003-2006, the SPLWG oversaw the first small tributaries loading study on the Guadalupe River (McKee et al., 2004, 2005, and 2006); this site was chosen based on recommendations by Leatherbarrow et al. (2002). During 2005, the SPLWG oversaw a small pilot reconnaissance study of small tributaries in an effort to make a decision on where to begin a second small tributary loading study. The reconnaissance study provided the workgroup information on 18 possible locations. Zone 4 Line A, an industrial watershed in Hayward, was recommended by the work group because of its high industrial usage and small size (~4 km^2) in contrast with Guadalupe River. Of interest, Zone 4, covering the Mohrland and Russell City areas of Hayward, is one of the smallest zones in the Alameda County Flood Control and Water Conservation District (ACFCWCD). It is wholly situated on a coastal plain made up of sand, silt and mud that was deposited over several thousand years by water flowing to the San Francisco Bay during historic seasonal floods. Study began in WY 2007 with the installation of measuring equipment for rainfall, stage, and turbidity. During the first year, there were periods of missed turbidity data associated with the way the probe was mounted and periods of very low flow. In WY 2008 we intend to bed mount the probe to try to improve data capture and quality and plan to continue monitoring in this location for at least one more water year (WY 2009) as well as some dry weather flows during the Spring and Summer of WY 2008 and perhaps WY 2009 depending on the outcomes.

Objectives

a) To improve our knowledge of the magnitude of contaminant loads entering the Bay from local small tributaries (in this case a small industrial watershed with an added mix of commercial and residential use)
b) To provide loadings data to improve our knowledge on processes in the Bay (such as described by the Hg, PCB, PAH, and OC pesticide models for the Bay) thereby assisting the in the development of Bay TMDLs
c) To demonstrate a methodology for use in other watersheds and make recommendations on how best to sample other watersheds

d) To provide input data for the eventual development of a watershed based model to predict loads on a regional scale

Study of this small watershed in industrial/commercial Hayward will provide valuable information on loads derived from small, low rainfall, but highly impervious, commercial and industrialized "storm drain watersheds" on the Bay margin. This is particularly important for updating regional TMDL estimates of Hg and PCBs loads derived from urban runoff. In addition, loadings studies will provide baseline data so that trends through time can be assessed, and provide data for models that describe biological effects in the Bay.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

RMP Objective 1: Describe spatial patterns and long-term trends of pollutant concentrations in the Estuary

- Sediment and contaminant loads from the Delta to the Bay
- Variability over scales of days, months, individual floods and between years

RMP Objective 3: Describe sources, pathways, loading, and processes leading to pollutant-related impairment in the Estuary

- The information from this study with help to quantify one of the major loadings of contaminants to the Estuary and aid in the general description of which of the sources or pathways for each specific contaminant are most important in terms of managing or designing studies for maintaining or improving environmental quality of the Bay.

RMP Objective 6: Effectively communicate information from a range of sources to present a more complete picture of sources, distribution, fate, and effects of pollutants and beneficial use attainment or impairment in the Estuary ecosystem.

- Information from these studies will be combined with information from other studies mainly through mass budgets to provide a more complete picture of temporal trends and spatial patterns in contaminant loads in the Bay

SUBTASK DESCRIPTIONS

Subtask 1 Field Sampling

All sampling will be carried out on Zone 4 Line A at Cabot Blvd. in Hayward. At that location, the County of Alameda granted us an encroachment permit to build a sampling platform across the channel on the upstream side of the road convert. We have installed a range of automatic recording equipment including a pressure transducer for measuring stage, a Forest Technology Systems Ltd. DTS 12 turbidity sensor attached to an articulated boom, an ISCO auto sampler with Teflon tubing for sampling SSC and Hg, a Campbell Scientific rain gauge, and Campbell data logger and a cellular modem for transmitting data real-time. This location flow rises to peak within 2 hours of peak rainfall and responds to rainfall within 15 minutes. Sampling crews will be deployed when rain is forecast and work while it is raining and for 3 hours post rain. Water samples during non-wading stages (>1.6 ft at the gauge) will be taken using our D-95 trace-metal

clean depth-integrating water quality sampler and during wadable stages by hand dipping to mid-depth in the center of the channel. Velocity measurements will be taken at 1 foot intervals at up to three depths using a Marsh McBirney Flo-Mate 2000 velocity meter and used to develop a stage-flow relationship.

Subtask 2 Chemical Analysis
Chemical analysis will be carried out for PCBs, PBDEs, PAHs, OC pesticides, pyrethroid pesticides, organic carbon, suspended sediment concentration (SSC), total mercury, dissolved mercury, methyl mercury, dissolved methyl mercury, and a range of trace metals including copper and selenium. Analyses of organic compounds will be conducted by AXYS Analytical laboratory. Analysis dissolved and particulate organic carbon will be conducted by AMS Texas. Analyses for SSC, mercury and trace metals will be conducted by MLML.

Subtask 3 Data Management
SFEI staff will carry out data management and QA/QC management. The subtasks will involve review of the lab protocols, review of the QA/QC reports issued with the data and primary data quality checking. Data will go through a secondary QA/QC process as it is synthesized and interpreted. Once these processes are complete, the data will be prepared for upload onto SFEI's website.

Subtask 4 Project Management and Reporting
The project will be managed by SFEI staff. Management tasks will include addressing contract and budget issues, preparing and coordinating field sampling and laboratory deliverables, and organizing workgroup participation with the SPLWG. A second year report will be presented for review in October 2008.

STAFF INVOLVED
SFEI staff involved include: Cristina Grosso, Donald Yee, Lester McKee, John Ross, Nicole David, Sarah Pearce, Jennifer Hunt, Meg Sedlak, John Oram, Kat Ridolfi, Katherine Harrold, Mikolaj Lewicki, Amy Franz, Lawrence, Leung, April Robinson, Meredith Williams, Alicia Gilbreath, Michelle Lent, Sarah Rothenberg

SCHEDULE AND DELIVERABLES

Deliverable	Target Date
Year 2007 – RMP Technical Report	October 2008

BUDGET

Subtask	Estimated Labor Cost 2008
Field sampling	$25,000
Data management	$10,500
Project reporting and management	$26,500
Total	$62,000

REFERENCES

Leatherbarrow, J.E. Hoenicke, R. and McKee, L.J., 2002. Results of the Estuary Interface Pilot Study, 1996-1999, Final Report. A Technical Report of the Sources Pathways and Loading Work Group (SPLWG) of the San Francisco Estuary Regional Monitoring Program for Trace Substances (RMP). San Francisco Estuary Institute, Oakland, CA. March 2002. 90pp.

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3.5 Bird Egg Monitoring

The Exposure and Effects Pilot Study (EEPS) has conducted bird egg monitoring of cormorants which are valuable regional indicators of contamination on the open waters of the Bay and Forster's terns which are more sensitive to contaminant effects and are indicators of contamination in shallower water habitats around the margins of the Bay .

EEPS monitored cormorant eggs in 2002, 2004, and 2006. At three locations in the Bay, two composites from ten eggs were analyzed for PCBs, PBDEs, musks, phthalates, Hg, Se, pesticides, nonylphenol, and dioxins. In 2006, eggs were also analyzed for perfluorinated compounds. In 2008, based on the recommendation of the redesign committee, cormorant eggs will be collected at three sites (consisting of three composites

from each site). The eggs will be analyzed for PCBs, PBDEs, Hg, Se, pesticides, dioxins, perfluorinated compounds, and possibly other emerging contaminants.

EEPS monitored tern eggs for mercury in 2002 and 2003. Recent work, in part funded by the RMP, has shown that level of mercury in Forster's terns are sufficiently high that they appear to be significantly affecting the reproductive success of the birds. As part of the redesign of S&T, it was recommended that tern eggs be monitored on a triennial basis. The design of this element will be decided in early 2008 with review from the Exposure and Effects Workgroup and the TRC.

Approximately $100,000 has been set aside for bird egg sampling and chemical analysis by subcontractors ($50,000 for each for cormorants and terns).

STAFF INVOLVED
SFEI staff involved include: Jennifer Hunt and Jay Davis.

SCHEDULE AND DELIVERABLES

Deliverable	**Target Date**
RMP Technical Report	October 2009

SFEI LABOR BUDGET

Subtask	**Estimated Labor Cost 2008**
Project Management, Coordination, Data Analysis, and Reporting	$20,000
Total	$20,000

3.6 RMP-Sponsored United States Geological Survey Studies

The United States Geological Survey (USGS) has been a collaborating agency in the RMP since the beginning of the Program and has contributed in-kind services through Department of Interior funding, IEP funding, and other sources to enhance the RMP financial contributions designed to address basic hydrographic and sediment transport processes. An understanding of these basic processes is necessary to interpret the patterns and dynamics that are emerging from the RMP database on chemical indicators of water quality condition. The funds contributed by the RMP are generally less than half of the overall USGS costs to conduct both monitoring components outlined below. Because these tasks are undertaken entirely by the USGS, no SFEI labor costs are associated.

Subtask 1 Factors Controlling Suspended Sediment in San Francisco Bay
Since 1993, this element of the RMP focused on monitoring and understanding suspended sediment dynamics in the Estuary through the monitoring of suspended sediments at key locations in the Estuary. This work has yielded many insights into sediment and contaminant dynamics in the Estuary, as summarized in articles by Dr. Schoellhamer in the 2003 *Pulse of the Estuary* and the 2005 *Pulse of the Estuary*.

In 2005, faced with a significant funding shortfall, USGS reduced the number of sites at which it measured suspended sediment concentrations from ten to six (five fixed sites and one temporary site in the vicinity of the aquatic transfer station for Hamilton Air Force base). The proposed sites for 2007/2008 are Alcatraz, Mallard, Benicia, Richmond Bridge, and Dumbarton. The Richmond Bridge site replaced the Point San Pablo in 2006 because the pier was structurally unsound. The temporary station is not currently deployed due to vandalism. The US Army Corps of Engineers is currently reviewing its monitoring needs. It is possible that the temporary station may be moved or funds reallocated in 2008.

In addition to the suspended sediment monitoring, USGS will continue to provide assistance on the multi-box model of contaminant fate.

STAFF INVOLVED
Dr. David Schoellhamer of the USGS in Sacramento, California is the lead investigator for this project. SFEI staff members are not directly involved in this task.

Schedule and Deliverables

Deliverable	Target Date
Progress reports	Quarterly
Annual summary report	December 2008

BUDGET
Because this work is entirely conducted by USGS, no SFEI labor hours are allocated to this task. The total budget for this task is $250,000 (as a subcontract).

Subtask 2 Hydrography and Phytoplankton
This study will continue its measurement program in support of the RMP, with monthly water sampling in 2008 to map the spatial distributions of basic water quality parameters along the entire Bay-Delta system. Measurements will include salinity, temperature and dissolved oxygen, which influence the chemical form and solubility of some trace contaminants; suspended sediments and phytoplankton biomass, which influence the partitioning of reactive contaminants between dissolved and particulate forms. This basic information is required to follow the seasonal changes in water quality and estuarine habitat as they influence biological communities and the distribution and reactivity of

trace contaminants. Highlights from this work were described by Dr. Cloern in the 2003 *Pulse of the Estuary* and the 2006 *Pulse of the Estuary.* In the 2006 publication, Dr. Cloern and his colleague, Dr. Alan Jassby documented the dramatic change that has occurred in the estuary with the advent of a fall phytoplankton bloom and larger spring blooms. We will continue to monitor these changes.

STAFF INVOLVED

Dr. Jim Cloern of the USGS in Menlo Park, California is the lead investigator for this project. SFEI staff is not involved in this task.

Schedule and Deliverables

Deliverable	**Target Date**
Annual summary report	December 2008

BUDGET

Because this work is entirely conducted by USGS, no SFEI labor hours are allocated to this task. The total subcontract budget for this task is $110,000.

Task 4 Pilot Studies

4.1 Exposure and Effects Pilot Study 2008

INTRODUCTION

Year 2008 is the last year of ear-marked funding for the Exposure and Effects Pilot Study (EEPS), which evaluates the effect of contaminants on biota in the Bay. The EEPS study began in 2002 and in 2003 RMP Program Review Panel recommended an increase in the budget and stated that biological effects research should be a priority. In response to this concern, the SC increased the funding for the EEPS budge to $200,000 per year and extend the pilot study through 2008. This budget includes funds for SFEI labor, subcontractors (e.g., analytical laboratories), and direct costs.

The study is multifaceted, and has included a variety of different exposure and effects indicators of beneficial use impairment. The purpose of EEPS is to develop suite of environmental indicators that can be incorporated into the core Status and Trends monitoring program.

A. Small Fish

OVERVIEW

Small fish are a good indicator of spatial and temporal variability in contaminants in the Bay food web. This study will examine methylmercury concentrations in pelagic and benthic fish less than one-year in age. Small fish tend to have small ranges in habitat and are dominant food-source for piscivorous fish. The purpose of this study is three-fold: to provide information of the accumulation of methyl mercury into the food web; to determine the impacts of management actions on biota (e.g., restoration of wetlands in the South bay), and to provide data for food web modeling of exposure to wildlife. This study is a four-year study that began in 2005. The primary focus of this study has been mercury; however, in 2007, small fish were collected for analysis of trace organic concentrations (i.e., PCB, pesticide, and PBDEs).

Funds for small fish was set aside under the EEPS program in 2004, 2005, 2006, and 2008. In 2007, this element was funded through general pilot and special study pool. In 2008, approximately $50,000 was set aside for small fish sampling under the EEPS program. Understanding how and where mercury is incorporated into the food web is a high priority for RMP participants; as a result, the small fish project will be augmented with $100,000 from general pilot and special study funds.

TASKS

The scope of work for the small fish project has not yet been determined. It will be developed in consultation with the Regional Water Quality Control Board, RMP participants, the Contaminant Fate workgroup, the Exposure Effects workgroup, and the TRC. It will also be coordinated with other collection efforts (e.g., the South Bay Salt Pond project which is collected flies, small fish, and songbirds to evaluate mercury uptake in the South Bay).

STAFF INVOLVED

Ben Greenfield is the project manager for this task. Field support will be provided by Katie Harrold, Michelle Lent, and other staff as appropriate. Technical feedback will be provided by Letitia Grenier and other staff as appropriate.

SCHEDULE AND DELIVERABLES

Sample Site Selection and Permitting	June -August 2008
Small fish collection	Sept-Nov 2008
Analysis	Dec 2008 – Mar 2009
Reporting	Apr-June 2009

BUDGET
The overall budget for the project is $150,000 ($50,000 from EEPS and $100,000 from the general PS/SS). Approximately $100,000 will be allocated to SFEI labor.

B. Mercury and Selenium Effects on the Reproductive Success of Tern and Stilts in San Francisco Bay

OVERVIEW

Mercury (Hg) and selenium (Se) are known to impair reproduction in wildlife and these contaminants can accumulate to high concentrations in waterbirds breeding in San Francisco Bay. Although Hg and Se have different mechanistic modes of action, the primary risk of each contaminant to wildlife populations is impaired reproduction. Moreover, both contaminants are toxicologically linked such that they may interact with one another in an antagonistic or synergistic fashion. Because of their toxicological relationships, individual assessments of reproductive impairment related to either contaminant may be confounded by the relationship with the other. This study will examine the interaction of Hg and Se on the reproductive success (i.e., hatchability, abandonment, and chick survival).

TASKS AND SCHEDULE

Task 1: Sample collection, nest monitoring, and analysis
When terns begin initiating nests (late April), USGS will sample colony sites weekly to assess chronology and colony establishment. Individual eggs will be sampled using a drilling technique developed by USGS and the albumin will be sent off for mercury and selenium analyses.

Task 2: Review of Results and Report Preparation
Submittal of samples for Hg and Se determination will occur by approximately November 2008 (2-months after the end of the field season), and the results should be through complete QA/QC within 2-3 months of submittal. A logistic regression model will be used to assess the effects of Hg and Se on hatching success, and compared to the hatching success of drilled vs. control eggs to further assess the error associated with the albumin-removal technique. The results will be compared to previous data generated on Forster's terns in the Bay to refine wildlife risk estimates. A draft report will be provided to SFEI and the RMP/EEPS by approximately April 2009, with a final version submitted by June 2009.

BUDGET

The budget for this task is $75,000 as a subcontract to the USGS.

C. Impacts of PAH-contaminated sediment of early life history stages of benthic fish

OVERVIEW

EEPS will fund a study evaluating the effects of PAH-contaminated sediments on the development of juvenile flatfish. The impacts of pyrogenic PAHs (like those detected in San Francisco Bay) on juvenile flatfish development are largely unknown. This is a two-year study which in the first year will examine the effects of pyrogenic (higher molecular weight) PAHs on a model fish such as zebra fish. After the identification of biological endpoints with a model fish, in the second year, the study will examine a native species such as the California flat fish. In addition, environmental sediment samples with a PAH signature similar to San Francisco Bay will be used.

SCHEDULE AND DELIVERABLES

In Task 1, NOAA researchers will determine the primary pathways of early life history stage toxicity for the high molecular weight PAHs representative of San Francisco Bay sediments as determined by the SFEI RMP. Task 2 will determine the threshold for these effects in sediment-exposed larvae of native flatfish such as California halibut and English sole. The general approach will be to first determine the effects of individual

PAHs in aqueous exposures of zebrafish larvae, then characterize the effects of aqueous mixtures in zebrafish. These studies will identify biological processes affected by PAH exposure. In parallel, a comparative analysis of individual compounds and mixtures will be performed with California halibut larvae. Finally, sediment exposures will be carried out with California halibut larvae to validate these findings and establish environmentally relevant thresholds for effects.

A report summarizing the findings will be available in February 2009.

D. Summary of EEPS Activities

The EEPS program elements address the following RMP objectives and management questions.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

RMP Objective 1: Describe spatial patterns and long-term trends of pollutant concentrations in the Estuary.

- Understanding the distribution of methylmercury in the Estuary in biota is a high priority for managing mercury in the Bay. The small fish monitoring will provide key information regarding the uptake of mercury into the foodweb.

RMP Objective 2: Project future impairment.

- Understanding the uptake of mercury into biota will assist us in forecasting future impairment based on current mercury concentrations.

RMP Objective 4: Characterize the potential for adverse effects on humans and aquatic life due to pollution of the Estuary ecosystem.

- Study of the interactions between selenium and mercury fills an important data gap. The bird egg monitoring study will build upon the 2007 study that developed the use of egg albumin and feather down to indicate hatching and reproductive success.
- The study of flatfish and PAHs will determine whether early life history stages of benthic fish are at risk for sublethal effects of PAHs in contaminated sediment.
- Small fish are at the based on the foodweb and are prey species for piscivorous sportfish such as striped bass and sturgeon as well as piscivorous birds.

RMP Objective 5: Provide monitoring information for comparison to regulatory guidelines and for establishing regulatory guidelines.

- All of the effects studies would indicate compliance with the Basin Plan narrative objective prohibiting toxic concentrations of contaminants.

- The mercury TMDL specific culls out that bird egg monitoring should be conducted.
- The mercury TMDL set an objective for small fish of 0.03 ug/g.

RMP Objective 6: Effectively communicate information from a range of sources to present a more complete picture of the sources, distribution, fate and effects of pollutants and beneficial use attainment or impairment in the Estuary ecosystem.

- Information from these studies will be combined with information from other studies to provide a more complete picture of temporal trends and spatial patterns in contaminant exposure and effects in the Bay

Staff Involved

Staff involved with these tasks include: Letitia Grenier, Ben Greenfield, Jen Hunt, Meg Sedlak, and Jay Davis.

EEPS Science Advisory Panel

The EEPS Science Advisory Panel consists of the following individuals: Harry Ohlendorf (CH2MHill); Michael Fry (American Bird Conservatory), Daniel Schlenk (University of California – Riverside), Steve Weisberg (Southern California Coastal Water Research Project), and Don Weston (University of California – Berkeley).

Schedule and Deliverables

Deliverable	**Target Date**
Small fish report	June 2009
Report on mercury and selenium effects on terns	June 2009
Effects of PAH on juvenile flatfish report	February 2009

Budget

Several of these tasks will be overseen by SFEI staff. The total budget approved for EEPS (i.e., SFEI labor and subcontractors) is $200,000.

Subtask	**RMP Labor Budget**	**Subcontractor Budget**
Mercury and Selenium Interactions in Terns		$75,000
PAH effects in juvenile fish		$40,000
Small fish		$50,000
Management/Reporting	$35,000	
Total		$200,000

Task 5 Special Studies

5.1 Guadalupe Model

OVERVIEW

High levels of PCBs and mercury have been detected in the Guadalupe River. The RWQCB, SFEI and other agencies have developed an extensive database of concentration of contaminants in water, sediment, and fish tissues in the Guadalupe River watershed. In part based on these data, the Guadalupe River Watershed TMDL identifies mercury fish targets, bed and suspended sediment targets for runoff from mining areas, and load allocations from urban areas. The Bay Hg TMDL calls for Guadalupe River watershed load reductions of 98% and the Bay PCB TMDL calls for load reductions of greater than 95% for urban areas. In response, managers in the Guadalupe River have already started implementing management actions to mitigate contaminant effects including experimenting with aeration in the reservoirs to reduce mercury methylation and removal of contaminated sediment from drainage lines.

A wealth of information has been collecting in the Guadalupe watershed. What is currently lacking is a validated linkage between management measures and changes in watershed loading through time. Such a tool would help managers decide for example, if mass is removed from drainage lines results in an equivalent reduction in an annual load to the Bay.

The aim of this project is to begin the development of a numeric model to assist in estimating mass loads of mercury and PCBs; to extrapolate the data to determine long term average loads for the period of extensive rainfall data collection (1973-present); and to determine the proportional sources in the watershed and refine the assumptions of the Guadalupe River Hg TMDL. Ultimately the model will be used to assess the effects of best management practices and impacts of wetland restoration (e.g., effects of South Bay Salt Pond restoration). It is envisioned that this would be a multi-year study.

Year 1

1. Improve measurements of mass loads of Hg and PCBs for the last 5 years when suspended sediment loads have been measured;
2. Extrapolate the data to determine long term average loads for the period of extensive rainfall data collection (1973-present);
3. Determine the proportional sources in the watershed and refine the assumptions of the Guadalupe River Hg TMDL;

Years 2 and 3 (budget to be developed and approved in future years)

4. Develop model components to test the types of BMPs and implementation efforts in the watershed to reduce Hg, MeHg, and PCB loads entering the Alviso slough; help prioritize management efforts;

5. Link to salt pond restoration models to provide accurate seasonal inputs of water, sediment and contaminants to level breech areas;
6. Provide numerical parameters and equations than can be used to extrapolate the data to the wider urban area of the whole Bay Area;
7. Provide a direct link to Bay fate and biological effects models.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

RMP Objective 1: Describe spatial patterns and long term trends of pollutant concentrations in the Estuary.

RMP Objective 2: Project future impairment.

RMP Objective 6: Effectively communicate information from a range of sources to present a more complete picture of sources, distribution, fate, and effects of pollutants and beneficial use attainment or impairment in the Estuary ecosystem.

SUBTASK DESCRIPTIONS

Subtask 1 Choose model

The two models available that suit our purposes are HSPF and SWMM. There are arguments for and against each model. SWMM is better suited to 100% urban situations and does best at simulating the timing and peak of single event hydrographs, but it does badly in mixed land use watersheds (like Guadalupe), on the shape and magnitude of the falling limb of the hydrograph, on estimating annual volume, is not available as freeware, and contaminant modules need to be built from scratch. HSPF does worse on matching the timing of the peak, and coping with point sources such as wastewater facilities and reservoir releases, but generally does well in mixed land use, estimates annual volume well, and has integrated contaminant modules. We propose to develop a HSPF model (EPA suite) building upon the Bay Area Hydrologic Model, the recent Breakpad partnership Cu modeling completed by Jim Carlton of the EPA and AquaTerra, and lessons learned from SFEIs work in Sonoma Creek and Zone 4 Line A in Hayward.

Subtask 2 Data compilation

We will compile existing data for model input: land use maps, precipitation, evapotranspiration, topography, rainfall, and runoff. Data available to date in the Guadalupe River is extensive and includes 17 years of bed sediment Hg concentration data from locations in many of the contaminated creeks and 1st and 2nd order tributaries collected by a range of agencies, BASMAA monitoring data collected at the San Jose USGS gauge and other locations from 1988-95, storm drain outfall sampling (Hg and PCBs) at multiple locations along the main stem of the Guadalupe collected by CSJ, concentrations of Hg and methyl mercury in a number of locations during isolated

moments in time collected by TetraTech, grab samples in 5 locations in the Historic Monitoring District collected by the Park District over many events from 2003-07, grab samples during isolated moments in time collected by SFEI in San Pedro storm drain in downtown SCJ and in four locations in creeks and tributaries near the Historic Mining District (2004-05), and four years of flood event sampling (Hg and PCBs) at Hwy 101 collected through the RMP small tributary loading study. In addition, there is an abundance of rainfall and runoff data for many locations collected since the early 70s (rainfall) and 1930s (runoff) by the SCVWD, NOAA, and USGS. The hydrology and sediment loads components of the model will be verified using the 5 years of gauging data available for Guadalupe River at Hwy 101.

Subtask 3 Run Model

In the first year we will develop and verify the hydrological model for water and sediment discharge at the scale of sub-catchments in order to determine the proportional flow regime at Hwy 101 (main upper watershed sub-catchments (Canoas Creek, Alamitos Creek, Guadalupe Creek, Ross Creek, and Los Gatos Creek) versus urban sub-catchments). The model will be run for the past 35 years (1973-present). In 2008, the calibrated and verified hydrological model will be used to improve measurements of mass loads of Hg and PCBs for the last 5 years when suspended sediment loads have been measured, to extrapolate the data to determine long term average loads for the period of extensive rainfall data collection (1973-present), and to determine the proportional sources in the watershed thus refining the assumptions of the Guadalupe River Hg TMDL.

Subtask 4 Report Results

Write a draft describing the rational for model choice, data sources, model structure, model runs and new loading estimates. Present preliminary and final results at SPLWG workgroup meetings and address review comments. Finalize and publish report on SFEIs website.

Staff Involved
SFEI staff involved include: John Oram, Michelle Lent, Mikolaj Lewicki, Lester McKee

Schedule and Deliverables

Deliverable	Target Date
Draft and final reports	September 30th 2008

Budget

Subtask	Estimated Labor Cost 2008
Choose model	$ 5,000
Data compilation	$ 25,000
Run model	$ 25,000
Report results	$ 20,000
Total	$ 75,000

REFERENCES

Austin, C.M., 2006. Guadalupe River Watershed: Mercury Total Maximum Daily Load (TMDL) Project Report. Region 2 Water Board. January 2006. 150 pp.

Leatherbarrow, J.E. Hoenicke, R. and McKee, L.J., 2002. Results of the Estuary Interface Pilot Study, 1996-1999, Final Report. A Technical Report of the Sources Pathways and Loading Work Group (SPLWG) of the San Francisco Estuary Regional Monitoring Program for Trace Substances (RMP). San Francisco Estuary Institute, Oakland, CA. March 2002. 90pp.

McKee, L., Leatherbarrow, J., Eads, R., and Freeman, L., 2004. Concentrations and loads of PCBs, OC pesticides, and mercury associated with suspended sediments in the lower Guadalupe River, San Jose, California. A Technical Report of the Regional Watershed Program: SFEI Contribution #86. San Francisco Estuary Institute, Oakland, CA. 79pp.

McKee, L., Leatherbarrow, J., and Oram, J., 2005. Concentrations and loads of mercury, PCBs, and OC pesticides in the lower Guadalupe River, San Jose, California: Water Years 2003 and 2004. A Technical Report of the Regional Watershed Program: SFEI Contribution 409. San Francisco Estuary Institute, Oakland, CA. 72pp.

McKee, L., Oram, J., Leatherbarrow, J., Bonnema, A., Heim, W., and Stephenson, M., 2006. Concentrations and loads of mercury, PCBs, and PBDEs in the lower Guadalupe River, San Jose, California: Water Years 2003, 2004, and 2005. A Technical Report of the Regional Watershed Program: SFEI Contribution 424. San Francisco Estuary Institute, Oakland, CA.

5.2 Watershed Specific Sediment Loads

OVERVIEW

Suspended sediments supplies to San Francisco Bay are vital for maintaining tidal marsh and mudflat habitats and delivering nutrients and organic carbon to the base of the food web. Prior to human intervention, water, sediment, nutrients, and carbon supplies to the Bay would have been maintained in a quasi-equilibrium state based on climate and tectonic activity. Over the past 150 years population in the Bay Area has multiplied dramatically from 2,000 in 1850 to its first million in 1915 to 3,000,000 by 1955 to over 7,000,000 today. Along with increases in population and ongoing changes to the way land and water is managed, water, suspended sediment, and nutrient supply have also changed. Today it is reasonable to hypothesize the sediment loads to the Bay are 3-5 fold greater than pre-western-American conditions bringing with them nutrients and the particle-bound contaminants associated with modern society. TMDLs have proposed sediment

targets for watersheds of 0.2 mg Hg/kg of sediment and perhaps 0.002 mg PCB / kg of sediment. The other target options include demonstrating loading trends, or demonstrating mass removed (loads avoided). In some watersheds (such as Coyote Creek), the 0.2 Hg target is already being achieved. In other watersheds such as Guadalupe River and perhaps some of the more heavily industrialized areas, the PCB and Hg targets are not met. At this time BASMAA has no data to determine where it might be most appropriate to apply limited resources to achieving a mass loading target, a loads avoided target, or a sediment concentration target. The need for this project is described in the draft language for the municipal regional permit (MRP) (RWQCB 2007). Permit language asked for BASMAA agencies to quantify sediment loads on a watershed by watershed basis (a difficult undertaking). This project would provide an estimate of loads from each watershed and provide input into prioritization of which ones to focus empirical observations on in the first and second terms of the permit. So despite the importance of suspended sediment as a key component of Bay ecosystem function, we still have a lot to learn about spatial supply and temporal trends.

The USGS has monitored suspended sediment loads at 24 upland locations around the Bay Area beginning 1960, for total of 160 years of data or an average of 5 years per station. In addition BASBAA monitored and modeled SSC in approximately 5 highly urbanized locations from 1988-1995 and more recently the RMP has measured SSC in a 100% urban watershed in Hayward. Over more than a decade, SFEI has been working with OMC and WLA to put together a map of storm drains and watershed boundaries for the urban Bay margin cities. The effort is still ongoing but presently covers from Richmond to San Jose to San Francisco.

The objective of this project is to bring all the existing data together and use it to estimate suspended sediment loads on a watershed basis and per RMP Bay segment. Uses for this product include:

1. Improving our understanding of contaminant distribution and loads and provide a hypothesis on where it might be most appropriate to apply limited BASMAA resources to achieving a mass loading target, a loads avoided target, or a sediment concentration target;
2. Input into hypotheses about where we are likely to find the most and least contaminated sediment in storm water conveyances and on the Bay margin;
3. Inputs into watershed and Bay modeling;
4. To provide sediment load estimates for salt pond restoration design;
5. To provide BASMAA with a data set to use to make decisions about where to apply limited resources to make detailed measurements in relation permit requirements.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

RMP Objective 1: Describe spatial patterns and long term trends of pollutant concentrations in the Estuary.

RMP Objective 2: Project future impairment.

RMP Objective 3: Describe sources, pathways, and loadings of pollutants entering the Estuary.

RMP Objective 6: Effectively communicate information from a range of sources to present a more complete picture of sources, distribution, fate, and effects of pollutants and beneficial use attainment or impairment in the Estuary ecosystem.

SUBTASK DESCRIPTIONS

Subtask 1 Develop Model

It has long been recognized that suspended sediment loads are influenced by factors including climate, geology, soils and tectonics, slope, basin size, and land use and management. One of the earliest works that demonstrated the correlation between basin size and sediment delivery ratio was Roehl (1962). Since that time, seminal papers have included the work of Walling (e.g. Walling and Webb, 1983; Walling 1987; Walling 2003) and Milliman (e.g. Milliman and Meade, 1983; Milliman and Syvitski, 1992; Syvitski and Milliman, 2007). The authors generally agree that there are strong and definable relationships between physical and human aspects of a watershed and sediment yield, some which are true globally and others which are locally relevant. A notable recent example in California was that of Inman and Jenkins (1999) who noted the influences of decadal scale climate changes on basin yields. Both Anderson (1981) and Inman and Jenkins (1999) attributed most of the variation between watersheds of California to the influence of rainfall and geology on soil erosivity and slope stability. In addition, Inman and Jenkins (1999) found that the urban rivers of Los Angeles (Ballona Creek, Los Angeles River, and San Gabriel River) with its hard-covered streets and river channels had relatively low yields. To generate estimates of suspended sediment loads for unmonitored watersheds in the Bay Area we will review and adapt the published methods in the above cited literature (and additional literature). The developed locally applicable method will then be applied to our local watersheds using our local data.

Subtask 2 Data compilation

Collate drainage and maps for BA watersheds and other applicable watershed attribute data such as rainfall, runoff and sediment loads, geology, soils and tectonics, slope, basin size, landslide locations, reservoir locations, and land use and management.

Subtask 3 Run Model

Apply the model to ungauged and gauged watersheds and add an estimate of urban sediment supply based on our local data (e.g. Z4LA, and other data from California watersheds (SCCWRP literature and Inman and Jenkins (1999)). Compare model outcomes to watershed where there is sediment gauging data available (e.g. Alameda Creek and Niles, Guadalupe River at Hwy 101, Coyote Creek at Hwy 237.

Subtask 4 Report Results

Write a draft describing the rational for model choice, data sources, model structure, model runs and new loading estimates. Present preliminary and final results at SPLWG workgroup meetings and address review comments. Finalize and publish report on SFEIs website.

Staff Involved
SFEI staff involved include: Mikolaj Lewicki, John Oram, Michelle Lent, Lester McKee

Schedule and Deliverables

Deliverable	**Target Date**
Draft and final reports	September 30th 2008

Budget

Subtask	**Estimated Labor Cost 2008**
Develop model	$ 5,000
Data compilation	$ 10,000
Run model	$ 10,000
Report results	$ 15,000
Total	$ 40,000

REFERENCES
RWQCB, 2007. NPDES Municipal Regional Stormwater Permit (Draft). California Regional Water Quality Control Board San Francisco Bay Region, Oakland, CA. 185 pp.

5.3 Characterization of Thyroid Endocrine Disruption in San Francisco Bay Fish

OVERVIEW

Animal endocrine systems are highly responsive to changes in environment, both natural and anthropogenic in origin (e.g., chemical contaminants). Thyroid hormones, part of the endocrine system, are unique in that they exert physiological effects on most tissues, and

their target receptors are found in all cell types. Thyroid hormones are particularly critical for the regulation of growth and development, metabolism, and brain/neural development and function. Because alterations in the thyroid endocrine system may exert broad physiological and developmental impacts, disruption of this system by anthropogenic chemicals presents a significant concern for wildlife.

Polychlorinated biphenyls (PCBs), polyhalogenated aromatic hydrocarbons (PHAHs), and polybrominated diphenyl ethers (PBDEs) have received extensive public and scientific attention in the last several years, as these types of chemicals are persistent in the environment and have ascribed endocrine-disrupting actions. Recently published experimental studies indicate that specific congeners of each class of these chemicals can cause thyroid disruption in fish. It has been most consistently observed that the thyroid plasma T4 concentrations significantly decline as part of the endocrine disrupted condition.

The objective of this work is to characterize the environment-related disruption of the thyroid endocrine system observed in Pacific staghorn sculpin and if possible shiner surfperch. In addition, chemical contaminants in individual fish will be measured to determine whether there is a correlation between contaminants and thyroid effects. The thyroid gland function will be assessed and attempts will be made to develop markers of endocrine disruption.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

RMP Objective 4: Characterize the potential for adverse effects on humans and aquatic life due to pollution of the Estuary ecosystem.

- This project will assist in the identification of endocrine disruptors and the development of indicators of chemical disruption of fish hormonal systems.

Appoach

The objective of this work is to characterize the environment-related disruption of the thyroid endocrine system observed in Pacific staghorn sculpin. While this species will be emphasized in the study due to its stronger environmental responses in preliminary studies, subgroups of shiner perch (*Cymatogaster aggregata*) will be analyzed for comparability.

Phase I –*Screening of SF Bay Sites for Thyroid Disruption and Hepatic Contaminant Accumulaton*

The initial approach will be to define the degree to which fish are experiencing environmental thyroid disruption at a set of study sites reflecting different types of chemical contaminant signatures. These include San Leandro Bay (a PCB contaminated site), Richmond's Lauritzen Channel (a DDT-contaminated site), San Francisco's

Hunter's Point (a POTW-affected location), in addition to San Pablo Bay and the Oakland Inner Harbor which we have previously demonstrated to be associated with significantly reduced T4 levels in both fish species. These sites will be compared with other sites in the San Francisco Estuary (Redwood City, San Francisco waterfront, Richmond waterfront) and in southern California (Los Angeles Harbor—Inner Cabrillo Beach), with far-field reference sites in Tomales Bay, Bodega Bay and the Pacific side of Santa Catalina Island (Two Harbors).

The chosen study sites provide for a diversity of environmental conditions and factors under which indices of thyroid function can be assessed for their relation to specific hepatic contaminant concentrations and biological effects (associated physiological performance impacts) in the fish.

The incidence and magnitude of alterations in plasma T4 and T3 concentrations in fish collected from the different contaminated locations will be determined, and compared with fish from the far-field reference locations. Specific enzyme immunoassays for both hormones have been validated for use in the study fish. Liver samples will be prepared for measurement of contaminant concentrations by GC/MS methods, which will be carried out at the California State University core facility for trace contaminant analyses (www.csulb.edu/programs/iirmes). As part of an ongoing study (SFEI contract 710), plasma T4 levels and hepatic contaminant measurements will be measured in fish from 10 of the 13 sites, and therefore are not a cost in this study. The present study will expand on this by analyzing samples from the remainder of sites, and by measurement of plasma T3 concentrations. Alterations in the ratio of T4 to T3 can serve as an indicator of thyroid disruption and also points to potential mechanism(s) of action by an EDC.

The above measures will be used to choose groups of fish for a second phase of analysis. That is, fish with significantly altered thyroid hormone status will be compared with normal reference fish. We are anticipating three or four chosen study groups, which will accommodate comparisons across environmental locations with different chemical signatures but which both may be associated with thyroid disruption.

Phase II –*Identifying Potential EDCs and mechanism(s) of action of Thyroid Disruption*
In the second phase study fish, thyroid gland function will be assessed by histological analysis of thyroid follicles, and by tests of responsiveness of the fish to pituitary TSH or hypothalamic TRH treatment. Thyroid follicle histological analysis may allow for development of direct morphological markers for endocrine disruption.

Fish sampled from impacted sites (exhibiting disrupted thyroid hormone status) will be injected with pituitary TSH in experiments to determine whether there is a normal or disrupted thyroid gland response (T4 production) to pituitary hormone regulation. Additionally, TRH stimulation of the HPT axis will be similarly determined, to test for pituitary response to hypothalamic stimulation.

Measured hepatic contaminant concentrations will be correlated with indices of thyroid function (T4 and T3 concentrations, T4:T3 ratio, histological measures, and HPT responses as just described). This series of correlative analyses are aimed at identifying specific relationships among different changes in thyroid status (indices of disruption) and concentrations of specific environmental contaminants accumulated in the liver of study animals, such as different PCB congeners.

Phase III –*Characterization of growth impacts in thyroid-disrupted fish*
This phase of the work will assess the relationship between thyroid disruption (an endocrine disorder) and physiological performance relevant to population-level impacts. Thyroid hormones are important regulators of somatic growth and are necessary for maintaining normal growth in all vertebrates including fish. Therefore, three indices of growth status will be measured in thyroid-disrupted and reference fish. These include measurement of plasma concentrations of the primary growth-regulatory hormone, insulin-like growth factor-I (IGF-I), and plasma concentrations of proteins that regulate IGF-I bioactivity, the IGF-binding proteins. These tests will ascertain the degree to which thyroid disruption is related to deficits in growth status in the fish.

Deliverables
This study will take a highly integrative approach in the data analysis and interpretation phase. Correlative analyses are enabled by the measure of multiple factors and indices within the same animals, and comparison of such data will be made across distinct environmental circumstances. The results will shed light on potential affected targets of EDCs along the HPT axis, which is important for determining the mechanism(s) of action as well as to identify possible specific bioassays (and biomarkers) that may be used in later efforts to screen for specific causative environmental factors. Additionally, the findings will establish the extent to which the observed environmental disruption of thyroid function may be translated into impaired growth status in the fish.

The results of this work will be summarized in presentations and a technical report for SFEI and the RMP.

Staff Involved
This work will be conducted by researchers at Cal. State University at Long Beach.

Schedule and Deliverables

Deliverable	Target Date
Final reports	March 2009

Budget

The estimated funding for this project is $35,000 as a subcontract to Dr. Kevin Kelley of Cal. State University – Long Beach.

5.4 Remote Sensing

OVERVIEW

Monitoring suspended sediment concentrations, SSC, in coastal waters and estuaries is crucial for proper ecosystem management. Such monitoring is traditionally done in-situ, with measurements representing SSC at a few discrete points in space and time. However, recent advancement of satellite remote sensing allows for synoptic views of coastal and estuarine dynamics that would otherwise be unavailable. Results are drastically altering our perceptions of coastal ocean transport processes.

This project proposes to use moderate-resolution (250m, 500m, and 1000m) MODIS satellite imagery to investigate episodic sediment transport patterns in San Francisco Bay. Development of an event-scale sediment budget has the potential to significantly improve current estimates of contaminant loading from the Delta to the Bay. It is conceptualized that such episodic contaminant loads account for a significant portion of annual contaminant loads. However, at present we know very little regarding the percent of episodic sediment and contaminant loads that remain within the Bay.

In 2007, this project identified suitable images. Funding for 2008 will be dedicated to processing the images and delineating the boundaries of the plumes.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

Many of the contaminants of concern to the RMP are particle associated and follow particle (i.e. sediment) transport pathways. Improved understanding of these particle transport pathways will help estimates of contaminant fate. In that light, this project most closely addresses the following RMP management questions:

RMP Objective 2: Project future impairment.

RMP Objective 3: Describe sources, pathways, and loadings of pollutants entering the Estuary.

SUBTASK DESCRIPTIONS

The project includes three main components: 1) identify MODIS images with a high percentage of coverage in the Bay corresponding to periods of high Delta flow and process these images to produce true- and false-color images showing two-dimensional sediment transport patterns and quantifying relative concentrations of suspended matter, 2) where appropriate, utilize existing edge-detection algorithms (Oram et al. 2005) to delineate the boundaries of plumes exiting the Golden Gate and estimate mass of

suspended sediment within the plume, and 3) compare remote observations with in-situ USGS SSC measurements collected at Mallard Island to determine the fraction of material entering the Bay via the Delta that is lost to the Pacific Ocean during a given event.

The MODIS images have been identified as part of a pilot and special study for 2007. The images need to be processed and edge-detection algorithms applied (Tasks 2 and 3); this work is proposed for 2008.

Task Descriptions

Task 1. Identify and obtain 'clear' MODIS images of SF Bay.

RMP staff have queried all MODIS images on record from July 2002 to January 2004 and have found that there is nearly a 25% chance of obtaining a 'clear' image (minimal cloud cover) of the Bay on any given day. The chance of obtaining a 'really great' image (no cloud cover whatsoever) is much lower (approximately 1%). From these preliminary results, it is anticipated that the probability of obtaining images during climate events is rather good.

Task 2. Process images to produce true- and false-color images showing two-dimensional sediment transport patterns and quantifying relative concentrations of suspended matter.

Task 2 will process images selected in Task 1 to produce true- and false-color images showing two-dimensional sediment transport patterns. The MODIS sensors aboard the EOS Terra and Aqua satellites acquire data in 36 spectral bands at resolutions of 250m, 500m, and 1000m. Estimates of various physical parameters are made by combining data from these various bands. Algorithms exist to estimate total suspended solids concentration, chlorophyll-a concentration, and sea-surface temperature from MODIS observations (e.g., SeaDAS, 2006).

Task 3. Utilize existing edge-detection algorithms to delineate the boundaries of plumes exiting the Golden Gate and estimate suspended solids mass within the plume.

A subset of the images identified as 'clear' in Task 1 and processed in Task 2 will be further analyzed by an automated edge detection and feature classification algorithm (Oram et al., 2005). An image must meet certain criteria in order for the edge detection algorithm to work; for example, a candidate image must have a high percentage of clear pixels. The edge detection algorithm is capable of objectively locating the boundary of two distinct water masses. In the context of this project, the algorithm will be applied to detect the boundary between Bay waters exiting the Golden Gate and oceanic waters. With this boundary delineated, it is possible to estimate the surface area of the plume. With estimates of total suspended solids (TSS), estimates of the mass of suspended matter within the plum can be made. Significant uncertainty surrounds this estimate, as

the MODIS image only yields information on the upper layer (usually the optical depth) of the water column. A crude estimate of the mass of total solids within the plume can be made by approximating the vertical distribution of suspended solids.

Staff Involved
SFEI staff responsible for this project is John Oram. Dr. Oram will collaborate with Dr. Nezlin from SCCWRP.

Budget
The RMP has allocated $10,000 for labor for this task and $4,000 for subcontractors.

Deliverables
John Oram will present the results of his findings to the TRC at a quarterly meeting.

5.5 Comparison of Contaminant Patterns between San Francisco Estuary and the Coast

OVERVIEW

The RMP has put significant effort towards understanding spatial and temporal patterns in contaminant concentrations within San Francisco Bay (e.g., Greenfield et al. 2005, Connor et al. 2006, SFEI 2006b, 2006a), and the City and County of San Francisco (CCSF) has been surveying multiple locations along the San Francisco coastline since 1987 (CCSF 2006). This study will directly address a recommendation of the RMP Technical Review Committee that the Program integrate data from other programs. The goal is to compare patterns in priority contaminants (in fish, sediment, and other matrices) present within San Francisco Bay and coastline stations at the mouth of the Estuary. This study will evaluate the combined CCSF and RMP data sets to test two hypotheses of interest to the RMP: 1. Are contaminant concentrations (Hg, PCBs, PAHs and DDTs) higher in the Estuary than along the coastline? 2. Are long-term trends in contaminant concentrations similar between the Estuary and the offshore coastline?

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

RMP Objective 1 Describe spatial patterns and long-term trends of pollutant concentrations in the Estuary

1.1 Do pollutant spatial patterns and long-term trends indicate particular regions of concern?

RMP Objective 4 Characterize the potential for adverse effects on humans and aquatic life due to pollution of the Estuary ecosystem

4.2 What potential for adverse effects on humans and aquatic life exists due to pollutants in the Estuary ecosystem?

RMP Objective 5 Compare monitoring information to relevant benchmarks, such as TMDL targets, tissue screening levels, water quality objectives, and sediment quality objectives.

5.2 Which segments should be considered impaired and why, and how do segments compare in terms of recovery targets?

RMP Objective 6 Effectively communicate information from a range of sources to present a more complete picture of the sources, distribution, fate, and effects of pollutants and beneficial use attainment or impairment in the Estuary ecosystem.

SUBTASK DESCRIPTIONS

Subtask 1 Prepare Datasets for Analysis

Aroon Melwani will obtain the necessary data sets through the RMP and CCSF and incorporate these into a Microsoft Access Database that will be used for the analysis tasks of the project.

Subtask 2 Analysis - Compare Status of Contamination

This subtask will compare contaminant concentrations of San Francisco Bay relative to the coast. To the fullest extent possible, the task will integrate CCSF and RMP data across multiple matrices. This integration will begin with the fish and sediment datasets. Contamination status will be examined by comparing concentrations to current management thresholds (addressing RMP Objectives 4 and 5). If regional differences in contamination patterns are found, this may indicate different sources of exposure between the Bay and coast. Subsequently, principal component analyses may be used to further investigate such patterns in the two regions (addressing RMP MQ 1.1).

Subtask 3 Analysis - Compare Long-term Trends

This subtask will compare long-term trends in contamination of the Bay and the coast. This may provide for a clearer understanding of previous trends in priority contaminants (addressing RMP Objective 1). Data analyses will employ techniques to evaluate regional differences in pollutant concentrations, such as comparing relationships using general linear models (e.g., Melwani et al. 2007).

Given sufficient time and budget remaining, subtasks 2 and 3 will integrate other comparable data collected through CCSF and RMP monitoring (e.g., sediment toxicity and benthic macrofauna). Additionally, both subtasks will require an evaluation and interpretation of potential factors of importance in comparing contaminant patterns. Specifically, analyses of fish concentrations will account for differences in lipid and

length distributions, while analyses of sediment will account for differences in TOC and grain size, between the Estuary and the coast.

Subtask 4 Reporting

The findings of this study will be reported by SFEI scientific staff. Since the samples will be spatially distributed throughout the Estuary and San Francisco coastline, the primary reporting objective will be to document the differences in trends and observed fish tissue (and possibly other matrix) concentrations. It is expected that this information would be useful to the RMP and Regional Water Quality Control Board.

A final task will be to provide Internet access to previous CCSF data and annual monitoring reports (e.g., CCSF 2004) so that other regional scientists have access to the underlying data sets and analyses (addressing RMP Objective 6). It is expected that this study will improve collaboration and comparability among the two programs, including potential modifications to the CCSF monitoring design that will benefit the RMP.

Staff Involved

Aroon Melwani is the project manager for this study. Technical feedback will be provided by Ben Greenfield, Mike Kellogg (CCSF), and Robert Brodberg (OEHHA), as appropriate.

Schedule and Deliverables

Obtain and review datasets to be analyzed	February 2008
Analysis of contamination status	May 2008
Analysis of long-term trends	July 2008
Reporting	September 2008

Budget

The estimated budget for the project is $20,150; all of which will fund SFEI staff.

Mike Kellogg will provide project oversight as an in-kind contribution to the project at no cost.

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5.6 Perfluorinated Compounds in Biota

OVERVIEW

In the last 50 years, fluorinated alkyl substances have been used extensively in a variety of commercially available products including fire-fighting foams, refrigerants, stain repellants in textiles, and coatings for paper used in contact with food products. As a result of their chemical stability and widespread use, fluorinated alkyl substances such as perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) have been detected in marine mammals and aquatic organisms throughout the world including relatively pristine environments such as the Arctic, Southern Hemisphere and Pacific Ocean (Kannan *et al.* 2002). PFOS and related perfluorinated compounds have been associated with a variety of toxic effects including mortality, carcinogenity, and adverse development. The major manufacturer of PFOS, 3M Corporation, voluntarily phased out the production of PFOS in 2000 and recently the USEPA and eight manufacturers of PFOA agreed to reduce their presence in products by 95% by 2010. Nonetheless, both of these compounds continue to remain present in the environment because they are by-products and degradation products of other perfluorinated compounds.

Preliminary data from the 2007 pilot study of seals suggests that the concentration of PFOS is elevated in seals. Due to limited capture success, only three seals were collected in the fall of 2006 and analyzed for perfluorinated compounds. The three animals captured include a male yearling, an adult male, and an adult female. In May 2007, additional seals were captured in the Bay and in Tomales Bay. Approximately 18 samples are currently being analyzed for perfluorinated compounds. Based on the limited 2006/2007 sampling and the initial results, the EC workgroup recommended continued monitoring of these apex predators. The 2008 data will help us to determine background concentrations, the influence of age and gender on concentrations observed in seals.

Several perfluorinated compounds were detected in blood plasma including: perfluorooctanesulfonate (PFOS), perfluorohexanesulfonate (PFHxS); perfluorononanoate (PFNA); and perfluoroundecanoate (PFUnA). Consistent with observations reported in the literature (Houde *et al*. 2006; Bossi *et al* 2005), PFOS was the dominant compound by an order of magnitude. Concentrations ranged from 219 to 649 ng/mL in plasma. Concentrations of PFOS in seal plasma from the Artic from 1990s were 28 ng/mL on average (n=12; Giesy and Kannan 2001); concentrations of PFOS in seal plasma from more urbanized estuaries such as the Baltic Sea were higher 110 ng/mL (n= 18; Giesy and Kannan 2001). The limited results to date suggest that seals in San Francisco Bay have some of the highest concentrations of perfluorinated compounds observed in plasma.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

1. Describe the distribution and trends of pollutants concentrations in the Estuary.

- This study will provide data to determine the distribution of concentrations of perfluorinated compounds in the Estuary and to place these concentrations in context with concentrations observed in other estuaries.

2. Project future contaminant status and trends using current understanding of ecosystem processes and human activities.

4. Measure pollution exposure and effects on selected parts of the Estuary ecosystem (including humans).

- 4.1. Perfluorinated compounds are considered an emerging contaminant. As such, it is important that we determine their concentrations in biota to evaluate whether management actions are needed.
- 4.4 Determining the concentrations of perfluorinated compounds in the upper trophic level is important for assessing both ecological and human health risks.

5. Compare monitoring information to relevant benchmarks, such as TMDL targets, tissue screening levels, water quality objectives, and sediment quality objects

- The concentrations detected in this study would be compared to known threshold effect levels, where possible.

APPROACH
This project will consist of two tasks:

Task 1: Collection of Samples
The Marine Mammal Center based in Sausalito, California is conducting a three-year study of harbor seal health that commenced in August 2006 and presents a unique opportunity for SFEI to sample large mammals. In addition to collecting information of the physical aspects of the seals (e.g., weight, condition, etc.), staff will collect blood. The researchers at The Marine Mammal Center have indicated that they could collect approximately 30 grams of blood for analysis of perfluorinated compounds and brominated flame retardants. Unlike neutral compounds such as polychlorinated biphenyls which accumulate in fatty tissues, perfluorinated compounds tend to bind to protein in blood (Kannan *et al.* 2002). Samples will be sent to AXYS analytical in Sidney, British Columbia for analysis. A list of compounds is included in the Appendix of this proposal. Care will be taken by the staff to avoid the use of Teflon and related PTFE plastics (e.g., vial and tubing). A detailed cost estimate is presented below.

Task 2: Review of Results and Preparation of a Report

Results should be available approximately four months after submission of samples to the laboratory. The results will go through the RMP data validation process (see the 1999 QAPP). These results will be compared to similar studies conducted in the Arctic and elsewhere (e.g., Kannan *et al.* 2002, Giesy and Kannan 2001) and elsewhere to assist in determining whether these compounds present an emerging concern. A draft report and manuscript will be prepared and circulated to the TRC for review. Upon incorporation of comments, the report will be assigned a SFEI contribution number and posted on the SFEI website. The manuscript will be submitted to an environmental journal such as Environmental Science and Technology.

SCHEDULE AND DELIVERABLES

Deliverable	**Due Date**
Task 1. Sample collection	June 2008
Task 2. Chemical analysis by laboratories	September 2008
Task 3. Finalized contaminant data provided by the labs to the RMP data management group	October 2008
Task 4. RMP internal QA completed, data formatted	December 2008
Task 5. Draft report, ECWG review, final report	February 2009

BUDGET

The SFEI labor budget for this task is $13,500.

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5.7 Non-PBDE Current Use Flame Retardants in Biota

BACKGROUND

Polybrominated diphenyl ethers (PBDEs) are chemicals used as flame retardants that have been incorporated into a variety of consumer products to comply with fire safety regulations. Studies conducted by a variety of research groups have revealed that the San Francisco Bay Area is experiencing exceptionally high PBDE bioaccumulation, with concentrations in harbor seals, birds, fish, and people that are among the highest ever reported (She et al. 2002; She et al. 2004; Brown et al. 2006). Environmental and human health concerns have resulted in a ban of the most toxic PBDE mixtures (Penta- and Octa-BDE) in California, which became effective in 2006. Ecological and human health concerns also exist for Deca-BDE, which is historically the PBDE mixture used in the highest volume, but the use of Deca-BDE continues unrestricted in California. Efforts to ban Deca-BDE are ongoing in several states, including California, but to date have only been successful in Washington and Maine. Despite the unrestricted use of Deca-BDE in most states and countries (with the exception of Sweden), many large international electronics companies have reportedly phased-out the use of Deca-BDE in their products (Pakalin et al. 2007). The decline in use of PBDEs will result in an increase in the use of non-PBDE flame retardant chemicals since consumer product flammability standards have not changed and a national furniture flammability standard is in development in the United States. Risk assessment reports on the potential replacement chemicals for Penta-BDE in polyurethane foam and Deca-BDE in polymeric applications in electrical and electronic equipment have been released (US EPA 2005; European Chemicals Bureau 2007). However, compared to the PBDEs, much less is known regarding the toxicity and

fate of these alternative flame retardant chemicals and information on their use (e.g. volume, locations) is generally not available. Substantial data gaps exist for non-PBDE flame retardant chemicals in the San Francisco Estuary. Assessment of the current concentrations of these compounds in the Estuary will allow us to determine the risk of exposure of these chemicals to the estuarine foodweb and to humans consuming sport fish.

APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS

1. Describe the distribution and trends of pollutants concentrations in the Estuary.

- This study will be the first to determine concentrations of non-PBDE flame retardant chemicals in the San Francisco Estuary and will provide some of the first data on concentrations in an urbanized estuary in North America.
- These data will allow us to compare concentrations in the Estuary to those observed in other locations around the world.
- With simultaneous analysis of PBDEs, these data will allow us to determine if restrictions on PBDE use have resulted in declines in bioaccumulation.
- These data may serve as baseline concentrations in the Estuary, since use of the non-PBDE flame retardant chemicals is expected to increase over time.

2. Project future contaminant status and trends using current understanding of ecosystem processes and human activities.

4. Measure pollution exposure and effects on selected parts of the Estuary ecosystem (including humans).

- 4.1. Flame retardant chemicals are considered emerging contaminants. As such, it is important that we determine their concentrations in the Estuary to evaluate whether management actions are needed.
- 4.4 Determining the concentrations of flame retardant chemicals in upper trophic level species is important for assessing both ecological and human health risks.

5. Compare monitoring information to relevant benchmarks, such as TMDL targets, tissue screening levels, water quality objectives, and sediment quality objects

- The concentrations detected in this study will be compared to known threshold effect levels, where possible.

APPROACH

Flame retardant chemicals selected for analysis in this study are primarily based on reports by the U.S. EPA (2005) and the European Chemicals Bureau (Pakalin et al. 2007) on potential PBDE replacements. From these reports, chemicals were selected based on their potential to bioaccumulate (i.e. physical properties), feasibility of analysis, and known use in California and internationally. Additional analytes were targeted based on

published reports of flame retardant concentrations in the environment and discussions with others researching flame retardant chemicals in the environment. The flame retardant chemicals were then separated into two groups based on their likelihood for bioaccumulation in upper trophic levels and analytical feasibility.

Bioaccumulative Contaminants in San Francisco Bay Biota

Based on their physical properties, the brominated flame retardant chemicals have the potential to be bioaccumulative, persistent, and toxic and will therefore be quantified in estuarine biota. In order to obtain a widespread assessment of flame retardant concentrations in the estuarine foodweb, concentrations of hexabromocyclododecane (HBCD), tetrabromobisphenol-A (TBBPA), decabromodiphenylethane (DBDPE), 1,2-Bis(2,4,6 tribromophenoxy) ethane (BTBPE), pentabromoethylbenzene (PBEB), and hexabromobenzene (HBB) will be quantified in the blubber of Pacific harbor seals (*Phoca vitulina richardsi*) collected in 2007-2008 and a subset of archived sport fish and cormorant egg samples collected in 2006. Though it is a chlorinated flame retardant chemical, Dechlorane Plus® will also be included in the analysis because it has been detected elsewhere in the U.S. (Hoh et al. 2006) and may be quantified using the same procedure as the brominated compounds. PBDEs will be quantified in the biota samples to facilitate comparison to the concentrations of their potential replacements and because this data can be acquired at no additional cost (i.e. PBDEs are obtained in the same instrumental analysis as the potential replacements).

Harbor seal blubber samples for chemical analysis will be donated by The Marine Mammal Center, which plans to capture harbor seals in the fall of 2007 and spring of 2008 as part of a separate study. Seals will be weighed, measured, and tagged, and blood samples will be collected for a battery of tests to assess seal health and fitness (e.g., blood cell count, exposure to infectious diseases, presence of pathogenic bacteria, etc.). Sport fish and cormorant egg samples collected in 2006 will be obtained from Regional Monitoring Program (RMP) archives. White croaker and shiner surfperch have historically contained the highest concentrations of PBDEs and other organic contaminants (Davis et al. 2006) and will therefore be the only fish samples analyzed in this study. If possible, the flame retardant chemicals will also be quantified in archived seal blubber samples to obtain trends in flame retardant chemical concentrations.

Phosphate-based Flame Retardants in San Francisco Estuary Water

The phosphate-based flame retardant chemicals will be quantified in surface waters of the Estuary because, based on their higher water solubility and higher susceptibility to metabolism, they are not expected to bioaccumulate in upper trophic levels. Triphenylphosphate and tris(1,3-dichloro-2-propyl)phosphate are primary components of the commercial flame retardant mixtures listed as potential replacements for Penta-BDE in polyurethane foam in furniture (U.S. EPA 2005) and are thus expected to be used in high volume in California to meet the state's furniture flammability standard. These two compounds were previously detected in San Francisco Bay surface waters collected in

1999-2000 (Oros et al. 2003) and may have increased over the last several years as a result of the phase-out of Penta-BDE. Other phosphate-based compounds have reportedly been used as flame retardants (tributylphosphate, tris(2-chloroethyl) phosphate, tris(2-chloro, 1-methyl ethyl) phosphate) and were detected in a survey of U.S. streams by the U.S. Geological Survey in 1999-2000 (Kolpin et al. 2002) and in surface waters in Germany (Andresen et al. 2004). These compounds will also be analyzed since they are quantifiable using the same instrumental analysis.

One liter grab samples of San Francisco Estuary surface water will be collected during the dry season (April-October) for analysis of the phosphate-based flame retardant chemicals. Water sample collection will focus on the Lower South Bay, where PBDEs and other wastewater-derived contaminants have historically occurred in concentrations that are among the highest in the Estuary. If feasible, influent and effluent samples from wastewater treatment facilities will also be collected to assess the influence of the wastewater treatment process on the concentrations of these chemicals in the estuary's surface waters.

TASK DESCRIPTIONS

Task 1 Project management

Coordinate the transfer of tissue and water samples to the analytical laboratories. Communicate with the laboratories during chemical analysis. Conduct all fiscal management and project organization activities.

Task 2 Water sample collection

Collect 1 L grab samples of San Francisco Estuary surface water during the dry season (April-October) for analysis of the phosphate-based flame retardant chemicals. If feasible, influent and effluent samples from wastewater treatment facilities will also be collected.

Task 3 Chemical Analyses

3a. PBDE, DBDPE, BTBPE, PBEB, HBB, Dechlorane Plus in biota - To be conducted by Dr. Heather Stapleton at Duke University (Durham, NC).

3b. Isomer-specific HBCDs and TBBPA in biota - To be conducted by Dr. Aaron Peck at the Skidaway Institute of Oceanography (Savannah, GA).

3c . Phosphate-based compounds in water - To be conducted by Saskia van Bergen and Francois Rodigari at East Bay Municipal Utility District (Oakland, CA).

Task 4 Data Management

Data will be received from the contracted laboratories by our RMP data management team within 60 days of the receipt of samples. The data will be formatted and routed through the RMP QAQC program.

Task 5 Data Analysis and Reporting

The data will be analyzed and interpreted. A technical report will be written at the end of the study and reviewed by the Emerging Contaminant Workgroup. Results of the project will also be submitted for publication in a peer-reviewed journal.

Task 6 Shipping, miscellaneous expenses
Costs include mileage, sample shipping, and any minor miscellaneous expenses.

PROPOSED DELIVERABLES AND TIME LINE

Deliverable	**Due Date**
Task 1. Sample collection	May 2008
Task 2. Chemical analysis by laboratories	August 2008
Task 3. Finalized contaminant data provided by the labs to the RMP data management group	August 2008
Task 4. RMP internal QA completed, data formatted	September 2008
Task 5. Draft report, ECWG review, final report	December 2008

BUDGET

The SFEI labor budget for this task is $25,800.

Table 1
Projected SFEI Labor Costs for 2008

Task	SFEI Labor Cost
Program Management	$470,000
Data Management	$330,000
RMP Website	$19,000
Information Dissemination	$115,000
Annual Reporting	$122,000
QA/QC	$35,000
Data Integration	$85,000
Status & Trends Fieldwork	$46,000
S&T Causes of Sediment Toxicity	$10,000
S&T Small Tributary Monitoring	$62,000
S&T Bird Egg Monitoring	$20,000
Exposure and Effects Pilot Studies	$35,000
Small Fish	$103,000
Guadalupe River Watershed Modeling	$75,000
Watershed Specific Loads	$40,000
Remote Sensing	$10,000
Comparison Coast to Bay	$20,500
Perfluorinated Compounds in Seals	$13,500
Non-PBDE Current Use Flame Retardants in Biota	$25,800
Carryover Tasks 2008 (to be determined at end of 2008)	~$120,000
Total Cost	**$1,750,000**