Monitoring Plan for "Regional Stormwater Monitoring and Urban BMP Evaluation: A Stakeholder Driven Partnership to Reduce Contaminant Loadings"

SWRCB Agreement No. 04-139-552-0

Prepared for:

San Francisco Regional Water Quality Control Board
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Approvals:

QA Officer (SFEI): ____

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QA Officer (Water Board): ____

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Table of Contents

1.0 Project Management

1.1. Project Background

High concentrations of Polychlorinated Biphenyls (PCBs) and mercury (Hg) in fish tissue were factors in the Office of Environmental Health Hazard Assessment (OEHHA) issuing an interim health advisory for people consuming fish from San Francisco Bay (OEHHA, 1997). This in turn led the San Francisco Bay Regional Water Quality Control Board (Water Board) to list the Bay as impaired by PCBs and Hg. The Water Board has developed a Total Maximum Daily Load (TMDL) report for PCBs in San Francisco Bay (SFBRWQCB, 2003a) and Hg in San Francisco Bay (SFBRWQCB, 2003b) and a basin plan amendment has been developed for Hg.

Both TMDLs assert the significance of urban runoff and calls for more, improved, and enhanced best management practices (BMPs) in urban areas to reduce nonpoint source loadings in urban runoff. Specifically, the TMDLs call for a 94% load reduction of PCBs and a 48% load reduction of Hg from urban runoff. There are a number of individual BMP options that could be considered within source control, treatment control, or maintenance control BMPs. Combinations of these may be considered a scenario that might be applied to each use category, location, or land use. However, there is presently no consensus on which BMPs or scenario's to apply to best address the TMDL needs. This project aims to develop plans to implement the Hg and PCB TMDLs through the development of specific information on urban runoff BMPs and pollutant loadings and to address the Region 2 specific priority 204 ["…implementation strategies associated with Total Maximum Daily Loads (TMDLs)"].

The purpose of this project is to generate an improved understanding of the effectiveness of stormwater management in the Bay Area and prioritize the implementation of further efforts to improve Bay water quality. The final outcome will be two implementation plans, one for PCBs and one for Hg that describe (through stakeholder censuses based on sound scientific input) the application of BMPs (source control, treatment control and maintenance activities) and scenario's (combinations of these BMPs) to apply under each current or historic use category or land use situation. These need to be compatible with BMPs developed to control other pollutants of concern. The products and information from this project will be important tools for local runoff managers who need to effectively allocate resources to make load reductions for TMDL pollutants. Many of the outcomes of the project (in particular, the BMP review and evaluation tasks) will be applicable to similar efforts in other regions of California and overall the project will serve as a template for other areas of California.

1.2. Project Description

The overall project is organized in to major phases:

1) An existing information and data review and data gaps analysis;

2) Further data compilation and field data collection and sampling to fill data gaps;
3) The development of two implementation plans that will outline a recipe for addressing the load reduction objectives outlined in the TMDLs.

This Monitoring Plan (MP) addresses the second phase of the project. In order to achieve the project purpose (an improved understanding effectiveness of BMPs and prioritization for the implementation of BMPs for Hg and PCB management in urban areas) phase 2 of the project focuses on existing data analysis using a geographic information system (GIS) and field data collection. SFEI project staff with assistance from GeoSyntec project staff will compile existing spatial data including storm sewershed boundaries, sediment source estimates, BASMAA bed sediment mercury and PCB concentrations, car wrecking facilities, PG&E facilities, railway lines, stormwater pump stations, first flush volume estimates, and wastewater treatment facilities. These data will be used to help prioritize watersheds and storm sewersheds for collections of soil, sediment and water samples. We will then collect between 400-500 samples for analysis of PCB, Hg, and organic carbon concentrations. About 80 of these will be analyzed for grainsize distribution, about 120 will be analyzed for suspended sediment concentration, and about 30 samples will be analyzed for concentrations of PCBs and Hg in three grainsize fractions (<25, 25-75, >75 micron) to provide information for structural treatment options for stormwater. At the end of the sampling and analysis we should have information on concentrations of Hg found in soils, sediments, and water in key areas known to be contaminated, concentrations of Hg and PCBs in three grain sizes in road dust, street sweeping material, and street washing water and an evolving consensus through stakeholder (BASMAA and Water Board Staff) on BMP scenarios to achieve loads reductions.

1.3. Project Organization and Responsibilities

The SFEI Prop 13 Grant Project will make use of the cooperative efforts of several parties involved in the design and implementation of the various components of the project. The main roles and responsibilities are defined below.

1.3.1. Contract Manager (SWRCB / Water Board)

The Contract Manager at the State Water Resources Control Board (SWRCB) / Water Board will be responsible for ensuring that all work performed through the SFEI Prop 13 Grant Project is consistent with grant proposal and project objectives. The Contract Manager will review all workplans produced as a result of the project implementation prior to their implementation. The Contract Manager will be notified of any proposed deviations from project proposal or workplans, and will need to give approval of major deviations.

1.3.2. Project Manager (SFEI)

The Project Manager will be responsible for oversight of day-to-day efforts associated with the SFEI Prop 13 Grant Project. The Project Manager will be responsible for planning and implementation of the data collection and interpretation program. Additionally, the Project Manager will act as the liaison between Subcontractors

(GeoSyntec, AXYS Analytical, and Moss Landing Marine Laboratories) and the Contract Manager. The Project Manager will also be responsible for ensuring that sampling personnel adhere to the provisions of the Monitoring Plan (MP) and the Quality Assurance Project Plan (QAPP) and for custody of samples until receipt by analytical laboratory. Oversight of all efforts performed by the Subcontractors, including field sampling, laboratory analysis, data interpretation, and reporting are also the responsibility of the Project Manager

1.3.3. Data Manager (SFEI)

The Data Manager will be responsible for receipt and review of all project related documentation and reporting associated with both field efforts and analysis.

1.3.4. QA Officer (SFEI)

The project quality assurance (QA) officer and will be responsible for verifying compliance of all analytical data with the requirements established by the SFEI Prop 13 Grant Project QAPP before its use for interpretive purposes. Analytical data will be generated by AXYS Analytical and MPSL-DFG. Subcontract laboratories will perform analyses of the samples collected independent of SFEI. The Project QA Officer will be responsible for maintaining and making changes to the QAPP as needed.

1.3.5. QA Officer (Water Board)

The Water Board quality assurance (QA) officer and will be responsible for verifying that the SFEI project manager and team have followed all the QA procedures as specified by the Grant and interpreted in the Quality Assurance Project Plan.

1.3.6. Technical Support (GeoSyntec)

GeoSyntec will assist during the data collection and with the interpretation of the data collected.

1.3.7. Subcontractor Laboratories

The Laboratory Project Manager and Chemists at the selected analytical laboratories will be responsible for ensuring that the laboratory's quality assurance program and standard operating procedures are consistent with the SFEI Prop 13 Grant Project QAPP, and that laboratory analyses meet all applicable requirements or explain any deviations. The Laboratory Project Manager will also be responsible for coordinating with the SFEI Project Manager and other staff (e.g. Data Manager, QA Officer) as required for the project. Analyses for trace organic compounds will be performed by AXYS Analytical Ltd., P.O. Box 2219, Mills Road West, Sidney, British Columbia, Canada (AXYS). Analyses for Hg, total organic carbon, and suspended sediment concentrations and grainsize will be conducted at the Moss Landing Marine Pollution Studies Laboratory – Department of Fish and Game, 7544 Sandholdt Road, Moss Landing CA 95039 (MPSL-DFG).

1.3.8. Other Collaborator (BASMAA)

The Bay Area Stormwater Agencies Association (BASMAA) forms an important and intergral part of the oversight team on this project. Through attendance in meeting, phone conferences and phone calls, they have already provided substantial in-kind services and guidance on the project. BASMAA will continue to fill the oversight role and in addition assist with the selection of monitoring locations, field logistics, and permission to access field locations (encroachment permits etc). BASMAA will coordinate its involvement through the Project Manager, and will be encouraged to review and comment on every aspect of the SFEI Prop 13 Grant Project, including the project MP and QAPP.

Several Bay Area groups are interested in the methods being explored by the SFEI Prop 13 Grant Project as a potential tool for controlling sediment-associated TMDL pollutants in urban runoff, including the Sources Pathways and Loadings Work Group (SPLWG) of the Regional Monitoring Program (RMP), and the PCB and Hg Work Groups of the Clean Estuary Partnership (CEP), a coalition of BASMAA, the Bay Area Clean Water Agencies (BACWA), and the Regional Water Board. To help these groups disseminate relevant information among related projects and stakeholders, BASMAA will serve as liaison between these groups and the Project through the following activities:

- Attending meetings
- Providing updates as appropriate for information requests by these groups that are not addressed by the deliverables and schedule of the SFEI Prop 13 Grant Project.
- Providing selected documents upon request and asking for and receiving review of draft products.

BASMAA will support the above communications where practicable within the timeline established for the SFEI Prop 13 Grant Project.

2. Bay Area Watershed Information Sources

2.1. Prior Investigations

During the late 1980s and early 1990s, BASMAA agencies made assessments of water quality and loadings of sediments and pollutants in urban environments. This effort, discontinued in 1995, provided the best data set at the time on concentrations and loadings of suspended sediments and trace pollutants (BASMAA, 1996). The first technical report of the RMP Sources Pathways and Loadings Workgroup (SPLWG) (Davis et al., 1999) reignited support for improved assessment of the magnitude of nonpoint source loadings in urban areas and the potential impacts to water quality in the Bay. This desktop evaluation suggested that nonpoint source loads from urbanized drainages would probably be significant sources of mercury, and possibly significant for PCBs. A State Bill Sponsored project on Contaminant Loads to Coastal Waters (Davis et al., 2000) concluded that nonpoint source loads were the dominant influence on water quality in the Bay for sediment, cadmium, chromium, copper, nickel, and zinc. Data were insufficient to make estimates for some key pollutants, in particular mercury, PCBs, OC pesticides and PBDEs. In the context of source identification and monitoring and management prioritization, base maps of urban drainages were deemed insufficient by Davis et al. (2000) to model loads on a watershed basis and review of hydrography of urbanized watersheds in the Bay Area found that that the quality and coverage of maps was insufficient to compile a regional base map (Wittner and McKee, 2002). In an effort to regionally prioritize sources of contamination, the BASMAA agencies carried out a series of field studies that analyzed concentrations of trace pollutants in the bed sediments of urban creeks and storm drainage lines in the Bay Area (KLI 2001, 2002; Gunther et al., 2001). These reports concluded that as compared with rural or open space areas, urban areas had higher concentrations of PCBs, mercury, methyl mercury and total organic carbon in bed sediments and further suggested that BMPs in urban areas can influence pollutant loads. SFEI carried out two detailed reviews of existing data for suspended sediments and pollutants in rivers, creeks and urban drainages tributary to San Francisco Bay (McKee et al., 2002, 2003). These reports further supported the conclusions of earlier studies that found that nonpoint source pollution was the major source of trace pollutants relative to other pathways in the Bay Area. SFEI has now completed five years of field study to determine loads in two watersheds (Leatherbarrow, et al., 2004; McKee et al., 2004, 2005, 2006a, 2006b). These studies have strongly supported the development of urban load allocations for mercury and PCBs TMDLs for the Bay.

Given the ever-increasing need to improve nonpoint source pollutant management in urban and urbanizing areas, the International Stormwater Best Management Practices (BMP) Database was developed to create a centralized scientifically sound tool for assessing and optimizing the design, selection and performance of treatment control BMPs under various conditions (UWRRC, 2001). The California Stormwater Quality Association recently revised the California Stormwater BMP Handbook including the section about treatment controls for new development and redevelopment (CASQA, 2003). Both the BMP data base and the CASQA handbooks lack any BMP performance information specific to PCBs and Hg so the practitioner is left with the use of sediment as a surrogate. However, we presently have no data on the relationships between PCBs and Hg and grainsize of sediments in Bay area urban runoff or the storm characteristics that mobilize various particle sizes, and we therefore are unable to predict the performance of a given BMP.

To begin the process of addressing the lack of knowledge that is fundamental for management of urban runoff loads PCBs and Hg in the Bay area (and address the San Francisco Bay PCB and Hg TMDLs), the SFEI Prop 13 Grant Project was created. Two key products of the project have been drafted (SFEI and GeoSyntec, 2006; GeoSyntec and SFEI, 2006). The first of these products was a thorough review of the state of knowledge about PCB and Hg sources in the urban landscape (using a mass balance approach), concentrations found in various urban media (soils, street dust, roof tops, conveyance sediment), processes of transport, and BMPs for loads reduction (SFEI and GeoSyntec, 2006). The data organized by this literature review were then reorganized by land use and used as input to a preliminary desktop evaluation of BMP scenarios. The following pertinent findings are driving the next phases of the project:

1) Historically, the greatest uses of Hg were batteries>paint>laboratory>"other uses". Today, the annual average usage has dropped to about 7,000 t down from a 1950-90 average of 13,000 t. Today's main uses are "other uses" > batteries > instruments > dental > laboratory > lighting.
2) Historically, PCBs were mostly used in transformers and large capacitors (~60%) and plasticizers (25%). Today there are no new uses, but there are still legacy uses that are gradually being phased out.
3) A review of the world literature and limited local data suggest the distribution of Hg and PCBs in the urbanized watershed soils, sediments, and street dusts is not at a consistent "background" level. Median concentrations in industrial areas are 50x and 500x greater than found in background areas for Hg and PCBs respectively. Maximum concentrations associated with individual use or spill locations are another 10x great for Hg and 4 – 5 orders of magnitude greater for PCBs.
4) Rainfall and runoff on surfaces in and near use or spill areas mobilize polluted soils and sediments and transports Hg and PCBs from watershed surfaces into stormwater conveyances systems and into the Bay. Accumulation of sediment on impervious surfaces, roads, roofs, driveways and right-of-ways is enhanced by vehicle tire tracking and wind re-suspension and re-deposition.
5) Suspended sediment in urban runoff can be usefully categorized as colloidal (<1 μm), suspended (<25 μm), and settleable (25 – 75 μm). Higher concentrations of Hg and PCBs are associated with smaller particles that are hard to trap due to slow settling velocities relative to the short residence time of stormwater in conveyances systems.
6) Hg and PCBs differ substantially in their spatial usage patterns. The largest two uses of Hg (batteries and paint) were dispersive applications, whereas the largest use of PCBs were associated with power distribution and factories with high electricity demand. Our review of concentrations found in urban soils indicated that after release, PCBs appear to disperse a lesser distance from source than Hg. The use history and dispersive mechanisms for each substance has led us to estimate contrasting pollution loading patterns (Table 1 and Table 2).

Table 1. Estimated Hg distribution in the San Francisco Bay urban environment (GeoSyntec and SFEI, 2006).

Land Use	Load (kg/yr)	Area (km^2)	Unit Loading ($g/km^2/yr$)	Unit Loading Normalized to Open Space
Industrial	34	374	92	7
Commercial	30	404	74	6
Residential	39	1,726	22	2
Open/ Agriculture	52	4,147	12	1
Total	155			

Table 2. Estimated PCB distribution in the San Francisco Bay urban environment (GeoSyntec and SFEI, 2006).

Land Use	Load (kg/yr)	Area (km^2)	Unit Loading ($g/km^2/yr$)	Unit Loading Normalized to Open Space
Industrial	18	374	48	16
Commercial	8	404	20	7
Residential	10	1,726	6	2
Open/ Agriculture	12	4,147	3	1
Total	49			

7) Preliminary desktop evaluation of BMP scenarios has shown (using a number of reasonable assumptions), that the management methods for each substance will likely be contrasting (Figure 1).

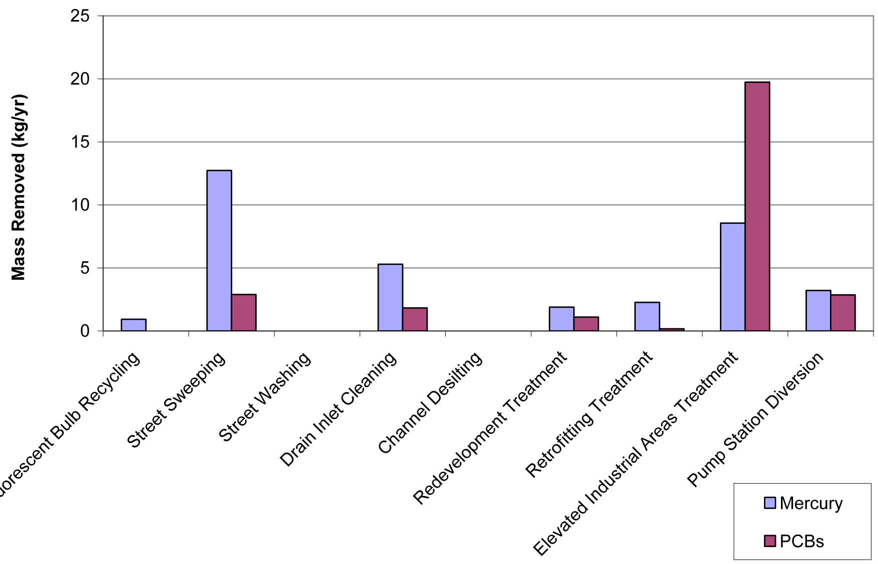

Figure 1. Projected Incremental Mass of Mercury and PCBs Removed per Year in 2025 (GeoSyntec and SFEI, 2006).

8) The first two products have provided an excellent framework for focused problem definition on a regional scale. The next phases of the project will test theories and hypotheses at the scales of single stormwater sewersheds, outfalls and BMPs and generate new and unique field data rarely found in any world literature. This data will be interpreted and used to develop the implementation plans that will include prescriptions on how to reduce urban runoff loads of Hg and PCBs.

A key deliverable of the first two products was the analysis of information and data gaps to be addressed in the next phase of the grant and reflected in this MP and the associated

QAPP. The information and data gaps are grouped into three components: 1. Non-measurement Data Acquisition in the form of further existing data compilation (mapping and interpretation), 2. Reconnaissance field data acquisition, and 3. Focused field data acquisition.

2.2. Non-measurement Data Acquisition

During the development of the initial deliverables of the Grant we were able determine a range of possible locations for field data acquisition, however, in order to make final sampling location selection, we will carry out further non-measurement data acquisition ("Orange Zone" mapping). "Orange zone" in this Project refers to areas within watersheds or in some cases whole sewersheds with past use of either Hg or PCBs. An Orange Zone may include a number of "Hotspots" and associated lesser contaminated zones of influence (or halos). Using a geographic information system (GIS), the objectives of this component are to:

1. Create the base watershed layer and determine the number of discrete watersheds from Richmond south along the East Bay to San Jose and then back up the peninsula to San Francisco.
2. Qualitatively estimate the sediment / water dilution potential, predict the watersheds with elevated soil concentrations and potentially the largest loads of Hg and PCBs,
3. Determine which contaminated watersheds have pumping facilities that might allow a watershed scale BMP such as diversion of the first flush winter storm to wastewater treatment,
4. Determine the distance (km) between pump stations in the most contaminated watersheds and treatment facilities,
5. Make a first cut on which treatment facilities might have available wet weather capacity,
6. Determine what part of the first flush volume might physically be treated, and
7. Determine which orange zones to focus characterization efforts on.

In addition we will estimate runoff volume during first flush storms using the simple model (Davis et al., 2000) and historical rainfall records.

3. Field Sampling

3.1. Sampling Design

The number of sites to be sampled and samples to be collected are largely restricted by the budget set aside for laboratory analyses in the SFEI Prop 13 Grant Project contract language. Overall we have budget for sampling 300-450 locations for either soil or sediment material or water. The sampling design includes two components: 1) Hotspot / Orange Zone Reconnaissance Characterization and 2) Hot spot / Orange Zone detailed evaluation.

1) Orange Zone Reconnaissance Characterization

In this component we will sample sediments and soils to test the effectiveness of the Orange Zone methodology in identifying contaminant source areas to which management could be focused to help achieve TMDL goals. The Project team will sample bed sediments in stormwater conveyances that drain known or suspected Hg and/or PCB Orange zones / hotspots. Information from previous work products (SFEI and GeoSyntec, 2006; GeoSyntec and SFEI, 2006), along with information gained from non-measurement data sources (2.2 above) will be put together and the criteria listed in Table 3 used to make final decisions on sampling locations. Within confirmed Orange Zones we will carry out one more step to identify historic businesses or activity areas where PCBs and Hg were used. Sediment in stormwater conveyances will be sampled and analyzed using methods aiming to achieve no worse than 0.1 part per million (ppm) detection limits for both Hg (method 7473) and PCBs (method 8082) in small (typically ~2 g) samples. We anticipate concentrations of Hg in >1 ppm and PCBs concentrations >5 ppm in stormwater conveyance sediments downstream from orange zones and Hotspots based on our screening level study (SFEI and GeoSyntec 2006).

In areas with elevated contaminant concentrations, we will sample soils and sediments in public right-of-ways, side walks / street sidings, and street surfaces adjacent to premises where use of Hg and/or PCBs is/was known to occur. Samples will be analyzed for PCBs using spectrometry (HRGC/HRMS) following EPA Method 1668a and for Hg using cold vapor atomic fluorescence following U.S. EPA method 1631e. Low detection limit methods will be used in this instance because we intend to complete grainsize specific analyses and use congener patterns to better understand differences between locations based on our understanding of use characteristics. Our objectives are to better determine the number of Hotspots / *Orange* Zones in the Bay area, apply the bed sediment methodology as a prospecting method for PCBs in other areas, and for Hg in particular, fully develop a "Hg prospecting methodology". Interim products from this component will also be used to prioritize locations for detailed follow-up field sample capture and analysis to be completed in Component 2.

Table 3. Criteria for selecting sampling sites from among identified Hotspots and Orange Zones for reconnaissance study.

Priority	Indicator
High	• Previously identified Hg or PCB spill site • Historic land use associated with Hg or PCB-containing materials • Historic or current areas where Hg or PCB containing equipment is being recycled (dismantlers, recyclers, auto wreckers) • Sites with outdoor storage yards and storage tanks
Medium	• Storm sewersheds with large areas associated with historic railway spur lines • Storm sewersheds with many PG&E yards • Present / former industrial sites exhibiting poor housekeeping • Storm sewersheds with high (>70%) industrial land use • Present / former industrial sites with poor sediment retention • Sites with known recent large-scale window replacements (potential for PCB-containing caulks to be disturbed)
Low	• Non-industrial land uses • Sites with history of Hg or PCB-related activities with no current potential for sediment loading to stormwater system

2) Orange Zones Detailed Evaluation

In confirmed Orange Zones where we have evidence of contaminants in conveyances as well as on street surfaces or properties, we will examine characteristics of sediments and waters that transport or are likely to transport pollutants during the wet season. The size distribution of particles carrying pollutants and the concentrations of pollutants on each size fraction will help to determine the potential efficacy of various control measures. In this Component (2) we will carry out detailed evaluation of concentrations of Hg and PCBs in runoff from Orange Zones / hotspots, street dust, street sweeping materials, street wash water.

Locations for stormwater sampling will be selected based on the criteria above (Table 3) and any available preliminary information from concentrations in Orange Zone Reconnaissance Characterization samples described above. Use of the latter is contingent on receiving the first component data from the labs before the first rains of the wet season. Collection of water samples will occur during early season storm events to try to capture "first flush", when we expect concentrations of both suspended sediments and contaminants will be greater (McKee et al., 2003). All samples in stormwater will be analyzed for total concentrations of Hg (method EPA 1631e), PCBs (method EPA 1668 revision A) and suspended sediment (method ASTM D 3977) in water (mass / unit volume). All samples analyzed for PCBs will also be analyzed for dissolved and particulate organic carbon (DOC and POC) (method EPA 415.1) to determine if there is a relationship between organic carbon and PCB concentrations and to allow normalization. About one in three (1:3) samples in stormwater will be analyzed for concentrations of Hg and PCBs (mass / unit mass) in three grainsize fractions: <0.025, 0.025 - 0.075 mm, and >0.075 mm. In this case, 30 L of sample volume will be collected in order to obtain enough sampling material for analysis (aiming for 2 g per fraction). The same 1:3 proportion of water samples will be analyzed (standard sieves) for grain size distribution (% finer than) using USGS standard methods (Guy, 1969).

Locations for analysis of street sediments, sweeping materials, and street washing will also be focused on industrial areas. Given the City of San Francisco has a combined sewer system, preference will be given to selecting areas for study there because effluent associated with any street washing exercise can be allowed to drain to the sewer systems, avoiding the need for alternate disposal methods. Samples will be analyzed following the methods for water soil and sediment listed above. All samples will be analyzed for concentrations on each size fraction (<0.025, 0.025 - 0.075 mm, and >0.075 mm).

The objectives of Component 2 are to provide data (in many cases first-of-its-kind) with interpretations to provide stakeholders information on options for offsite treatment of runoff from Hotspots in *Orange Zones*, street sweeping and washing effectiveness as management measures, development and testing of a "prospecting methodology" for finding Hg Hotspots, and prioritizing areas for applying management measures (to be described in the implementation plans – the end product of this Grant Project).

3.2. Sample types

Soil and sediment samples will make up the majority of environmental samples to be collected for the SFEI Prop 13 Grant Project. However, sampling personnel will be prepared to collect samples from a variety of sampling environments. The following types of samples may be encountered.

3.2.1. Soil and Sediment Samples, Dry

Dry soil and sediment samples may be present on-site in surface areas such as unpaved lots and storage yards, or may have accumulated at stormwater conduits, public right-of-ways, etc.

3.2.2. Soil and Sediment Samples, Wet

Wet soil and sediment samples may be collected from within on-site stormwater facilities such as road gutters, drop inlets, open channels, and underground pipes.

3.2.3. Street sweeping materials

Sediments will be sampled from the hoppers contents of street sweeper machines. These might include standard brush sweepers or later technology models (so called high intensity sweepers) that incorporate water spray and vacuum in addition to brushes.

3.2.4. Street washing water

Representative water samples will be taken from street wash water. A power washing exercise will be carried out in selected industrial areas. Water will be captured below the rim of the drop inlet to determine the mass of contaminant removed during the washing exercise.

3.2.5. Flowing Stormwater

Samples will be collected from flowing stormwater during early season rain events from potentially any type of stormwater conveyance system including road gutters, drop inlets, open channels, and underground pipes.

3.2.6. Field Blanks

True sediment field blanks (e.g., ultra-pure sand processed through sampling) are not collected, although bottle/equipment blanks (e.g. extractions with sampling containers) will be used to assess contamination not originating from sampled sediments. Aqueous field blanks using pre-cleaned sampling equipment to collect reagent grade water will be collected and forwarded for analysis. Aqueous field blanks will be collected with the first collection of an aqueous samples and then at the frequency of a minimum of one blank per twenty (20) sites sampled.

3.2.7. Field Duplicates

Adjacent samples will be collected as field duplicates for bedded conveyance and surface street sediments as mass allows, to compare impacts from small-scale variation and collection procedures against larger watershed scale variation. For aqueous samples, field duplicates will be collected successively from the same media using identical techniques. For both sediment and aqueous samples, field duplicates will be collected at a minimum rate of one duplicate for every twenty (20) sites sampled.

3.2.8. Unprocessed Splits

Some samples undergoing post-collection processing (e.g. drying and sieving) will be unprocessed split samples taken where sufficient material remains, to evaluate potential losses or contamination introduced by the sample processing. Unprocessed splits will be collected at the frequency of one for every 20 samples processed, as total sample size allows.

4. Field Documentation

Proper documentation of sampling locations and methods is important to interpretation of grant results. Overall documentation will include information recorded on sample labels, field logbooks, data collection forms, and photographic documentation.

4.1. Field Logbooks

Sampling personnel will to record relevant information in bound logbooks. All information should be recorded in permanent ink. Any changes made to recorded information will be made using single strike-through and will be initialed and dated by the person making the change. An example logbook page is shown in Appendix A.

4.2. Forms

Field data sheets will be compiled for each site, and shall include at a minimum: date, names of crew members, narrative description of the sampling site (general location), weather conditions, sample matrix, whether sediment is submerged or exposed (if sediment), method used to collect sample, and sample IDs collected for analysis or archive. Volume of water will be recorded during the street washing exercise. We will also record other miscellaneous comments paying particular attention to evidence of offsite soil or sediment movement and sources of sampled sediment. A minimum of one set of coordinates per sample site shall be obtained from a Garmin III+ or Megellan GPS unit (or equivalent) recorded at time of sampling in addition to cross streets, and either a lot number, house number, or business name.

4.3. Photographic Documentation

Photographic documentation is an important part of sampling procedures. An associated photo log will be maintained documenting sites and subjects associated with photos and effort will be made to indicate scale in the photograph. The date time feature will be turned on. The photo log will include an approximate view direction (looking N, NE, E, SE, S, SW, W, NW). A copy of all photographs should be provided to the Data Manager, preferably on CD-ROM, at the conclusion of sampling efforts and maintained for grant duration.

4.4. Sample Identification

Samples will be assigned unique sample identification codes to provide a method for tracking each sample, and codes will be recorded on sample labels. Each sample will be identified by a unique code that indicates the sampling date, type, and sample number. Each sample will be doubled labeled using a paper adhesive label and a permanent marking pen directly onto the sample bag or container. The following is an example of the sample identification code for the samples:

20060901-S-XX-001

where: 20060901 indicates the sampling date, September 1, 2006;
S indicates soil (D will be used for sediment and L will be used for Liquid);
XX indicates sampler's initials;
001 indicates the sample number, which will start at '1'and increase by one consecutively with each sample collected from Day 1.

Sufficient sampling information must be recorded in the field that allows tracking sample shipments from field to laboratory and from laboratory through data processing and quality assurance. Custody for samples remains with the sampling personnel until time of receipt by analytical laboratory.

5. Sampling Equipment and Procedures

The following section describes multiple field sampling techniques that will potentially be used, depending on site-specific conditions encountered during inspections and sampling operations. Where appropriate, procedures for sediment sampling mobilization and implementation will follow those implemented during the previous ACCWP investigations (Salop et al., 2002). These sampling procedures were developed based in large part on those in use by the RMP (Bell et al., 1999) and the USGS National Water Quality Assessment Program (NAWQA) [Shelton and Capel, 1994]. Selection of appropriate sampling procedures will be made at time of sampling by the Project Manager and recorded in the field logbook.

5.1 Sampling Procedures

It is expected that samples may be collected from a number of different types of facilities within an individual site. Examples may include surface soils or sediments, through manholes (sampling from above not entering), drop inlets, sump basins, etc, for sample types described in Section 3. In certain instances, sampling techniques may need to be adjusted in response to sampling conditions present (see Nonconformance / Corrective Action section).

5.1.1 Soil and Sediment Samples, Dry

Field personnel will collect the surface soil or sediment samples using a Kynar-coated (or similar) trowel or scoop. Any sampling location covered with vegetation will be cleared of vegetation or large gravel (>4 mm) prior to collecting the sample. The soil or sediment will be scooped from the sample location with the trowel and placed into the compositing bucket or in the sample container if no compositing will take place. In cases where samples are taken from street surfaces or other impervious (or hard packed) areas, a small nylon pre-cleaned brush will be used in conjunction with the trowel (e.g. Chutke et al., 1995). In the event that soil samples will be collected from below the ground surface, a Kynar-coated (or similar) hand auger will be used to reach the desired depth. The hand auger will then be decontaminated and used to collect the soil from the specified depth. The soil will then be placed from the hand auger directly into the compositing bucket or in the sample container if no compositing will take place.

When all of the soil samples from a given site have been collected in the compositing bucket, the soil will be composited in the field by thoroughly mixing with a gloved hand for 2 minutes (timed). From there, the sample will be passed through a 0.25 mm mesh to remove larger sediments and retain the part of the sample that carried the majority of the contaminant concentration. In the reconnaissance component of the study, one in five 1:5 samples will be passed as sampled (without drying) through a 2 mm sieve and analyzed for bulk sediment contaminant concentrations and grainsize (%finer than 0.0625 mm). The composite sample will then be scooped with the trowel into a laboratory-provided glass container, sealed, labeled, and placed in a chilled cooler pending delivery under chain-of-custody (COC) to the laboratory.

5.1.2 Soil and Sediment Samples, Wet

Procedures for collection of wet soil and sediment samples are similar to those for dry samples. Additional steps may include removal of overlying water using a peristaltic pump. Where access to the sediment surface is limited, a stainless steel Ekman Dredge will be used. In this case, the dredge will be dropped onto the sediment surface aiming at a penetration of 5 cm and then triggered by hand or with a messenger. The top 2-3 cm of the sample will then be scooped out of the dredge or if appropriate, the whole sample tipped into the compositing bucket. The composite sample will then be scooped with the trowel into a laboratory-provided glass container, sealed, labeled, and placed in a chilled cooler pending delivery under chain-of-custody (COC) to the laboratory. There it will be dried (60 degrees Celsius). The sample will then be passed through a 0.25 mm mesh to remove larger sediments and improve the uniformity between samples. One in five (1:5) samples will be passed through a 2 mm sieve and analyzed for bulk sediment concentrations and grainsize (%finer than 0.0625 mm). The need for additional required field equipment is likely to be identified through process of site inspections to be conducted prior to field sampling operations.

5.1.3 Street sweeping materials

Sediments will be sampled from the hoppers contents of street sweeper machines. This will be achieved by dumping the contents of the sweeper hopper, typically <2 m^3, onto clean polythene plastic and mounding the contents into a cone shape. This will then be spread out into 8 approximately equal segments. A Kynar-coated (or similar) trowel or scoop will be used to take an inorganic sample from each of the 8 segments. Large vegetative matter and other debris will be removed before each sub-sample is placed in a compositing bucket. The composite sample will then be field sieved (2 mm) and put into a laboratory-provided glass container, sealed, labeled, and placed in a chilled cooler pending delivery under chain-of-custody (COC) to the laboratory. There it will be dried (60 degrees Celsius to avoid loss of volatile components). The sample will then be passed through a 0.25 mm mesh to remove larger sediments and retain the part of the sample that carried the majority of the contaminant concentration. 1:5 samples will be passed through a 2 mm sieve and analyzed for bulk sediment concentrations and grainsize (%finer than 0.0625 mm).

5.1.4 Street washing water

Water will be captured below the rim of the drop inlet to determine the mass of contaminant removed during the washing exercise. A composite sample will be attained by clean hand techniques (e.g. Bloom, 1995) by placing (for 3 seconds) a laboratory prepared 1 liter Teflon sampling bottle with a 2 inch opening directly under the center of the flow as it passes into the drop inlet. In addition, a sampling for PCB analysis will be taken in the same manner except a laboratory pre-cleaned amber bottle will be used. This exercise will be repeated until each bottle is completely fill. This will be repeated 3 times during the washing exercise and three discrete samples retained for analysis. The samples will be sealed, redouble-bagged, labeled, and placed in a chilled cooler pending delivery under chain-of-custody (COC) to the laboratory.

5.1.5 Rain-induced flowing Stormwater

Samples from drop inlets will be taken in the same manner as street washing water. Samples will be collected from flowing stormwater in open channels or underground pipes using a DH81 sampler and extension handles to attain a length of up to 5 meters (length depends on diameter and storm sewer depth below ground). The sampler will be fitted with Teflon components, an exchangeable laboratory cleaned series of Teflon 1 L sampling bottles and caps/nozzles. If water depth is not sufficient (<100 mm), no sample shall be taken. After sample rinsing three (3) times, a depth integrated iso-kinetic center channel single vertical sample from a flowing stormwater conveyance will be taken by passing the sample bottle into and out of the water column at an even rate until the sample bottle hold approximately 800 mL. In no more than one in 10 samples (1:10), a 30L sample will be taken for analysis of Hg on grainsize (<25, 25-75, >75 micron). The sample will then be decanted immediately into a 1L amber bottle for PCB analysis. Lastly, the exercise will be repeated until the Teflon bottle is completely fill (necessary for Hg). The sample bottle will be loaded into and removed from the DH81 sampler following clean hand protocols (e.g. Bloom, 1995). The samples for Hg will be sealed, redouble-bagged, labeled, and placed in a chilled cooler pending delivery under chain-of-custody (COC) to the laboratory.

5.1.6 Nonconformance / Corrective Actions

Site inspections or conditions present at time of sampling may identify other sampling media of interest beyond what has been proposed through the SFEI Prop 13 Grant Project MP. In this eventuality, the Project Manager will discuss any requested changes to the sampling procedures with the Project Manager and Contract Manager and, if time allows, submit a written proposal to the Water Board for authorization to proceed with proposed sampling or analysis of collected samples. Field personnel may collect samples without prior approval of the Project Manager and Contract Manager, but in no event will analysis be conducted on these samples without approval of both parties.

5.2 Collection of Archives

As sampling media allows, an archive will be collected for each sampling site for potential future additional analyses. The archive will be processed and handled identically to the sample designated for analysis while in the field, and will be transferred to cold storage facilities at our laboratories after completion of field activities or at appropriate intervals. Archives will be kept for a minimum of 1 year. At the end of 1 year or before at the laboratories request, the local stakeholder group will be informed so that if desired the samples can be transferred to another cold storage facility at a cost incurred outside of this present grant.

5.3 Decontamination Procedures

Cleaning methods will follow protocols adapted from the NOAA National Status and Trends Program for use by the Regional Monitoring Program (Bell et al., 1999) and clean hand protocols will be those of Bloom (1995).

5.3.1 Initial Equipment Cleaning

Appropriate sampling equipment is prepared in the laboratory a minimum of four days prior to sampling. Equipment that is pre-cleaned includes:

- Kynar (or similar) coated sample scoops, trowels, etc.
- Kynar (or similar) coated compositing bucket
- Wash bottles for deionized water, hydrochloric acid, and methanol
- Hand auger (if identified by inspections)

Prior to sampling, all equipment will be thoroughly cleaned. Equipment is soaked (fully immersed) for three days in a solution of Alconox, Liquinox, or similar detergent and deionized water. Equipment is then rinsed three times with deionized water. Equipment is next rinsed with a dilute solution (1-2%) of hydrochloric acid, followed by a rinse with petroleum ether, followed by another set of three rinses with deionized water. All equipment is then allowed to dry in a clean place. The cleaned equipment is then wrapped in aluminum foil or stored in clean Ziploc bags until used in the field.

5.3.2 Field Cleaning Protocol

All sampling equipment used will be rinsed with deionized water between uses at different locations within a site. All sampling equipment used at a particular sampling site will be field-cleaned prior to use at a different sampling site. This included the Teflon cap and nozzle used for iso-kinetic sampling flowing water. The field-cleaning protocol calls for 1) removal of sediments using deionized water and a scrub brush; 2) scrubbing of the sampling gear and compositing equipment with an Alconox, Liquinox, or similar solution; 3) rinse with deionized water; 4) rinse with dilute HCL (1-2%); 5) rinse with methanol; and 6) rinse with deionized water.

6 Sample Handling Procedures

The following protocols were developed to maximize likelihood of collected samples to be representative of environmental conditions present.

6.1 Sample Homogenization

Depending on sample collection methodology and amount of sample matrix present, samples may be collected as individual grabs from sites, or may be collected as a sub-sample of material composited from multiple locations within an individual site. Where samples comprise a mixture from several locations within a single site, sampling personnel will record the location of each sub sample and transfer collected material to a pre-cleaned Kynar (or similar) coated container for homogenization. Sampling personnel shall cover the container with clean aluminum foil when not actively adding or mixing material. At the conclusion of sampling within a site, sampling personnel will use pre-cleaned Kynar (or similar) coated stirring implements to homogenize the sample material to a uniform appearance. Depending on viscosity of matrix, the sample material will either be poured directly from the homogenizing container to the sample container or will be transferred using stirring implements. Sample material touching the threads or outside of the sample container will be discarded.

6.2 Sample Sieving

Grab or composite samples will be sieved as dry samples, depending upon the state of the sample at collection and the analysis to be performed. Unprocessed split samples will also be analyzed to ensure that sample handling does not result in contaminant loss or gain in processing. Samples dry-sieved will be oven dried at 60ºC to constant weight (<1% change in weight) before sieving.

6.3 Sample Containers

At each sediment or water sampling site the goal will be to collect a minimum of 10 grams of sediment, although in some instances this may not be feasible. At the conclusion of sampling for a specific site, collected material will be transferred into appropriate pre-cleaned containers provided by the analytical laboratory, and where sufficient material allows, one or more archives.

6.4 Sample Preservation and Storage

At the conclusion of sample processing at each site, all samples will be wrapped in protective material and stored on wet or blue ice in the field. At the conclusion of sampling days, all samples will be stored overnight on wet ice, removed to appropriate cold storage, and shipped to the analytical laboratory on blue ice. Water samples taken for the analysis of Hg will be shipped via FedEx reaching the lab for sample preservation within 48 hours (EPA recommended hold time before sample preservation). Samples collected on Friday, Saturday and public holidays would be the exceptions to this rule; collection on these days will be avoided.

6.5 Sample Custody and Shipment

At appropriate intervals at the conclusion of sampling days, samples will be distributed via priority overnight delivery, with itemized chain-of-custody forms. Sufficient sampling information must be recorded in the field and that allows tracking sample shipments from field to laboratory and from laboratory through data processing (sample number, grab or composite, matrix, date, time, analysis requested, remarks). All samples should be shipped in accordance with laboratory procedures. If requested, laboratories will often send detailed shipping and handling instructions. The following instructions are the most stringent requirements associated with analytical laboratories used for the RMP. Personnel shipping samples should ensure COCs (Appendix B) are filled out completely and legibly and that:

- All samples in shipment are represented on COC
- All samples on COC are included in shipment
- Information on COC and sample container label (e.g., sample ID, collection date, collection time, analysis) are in agreement
- COC lists appropriate grant ID and Data Manager
- COCs are signed by responsible party

Sediment samples can be shipped on blue ice. Glass containers will need to be cushioned more than plastic containers. General packaging guidelines are to:

- Select an appropriate size cooler for shipment
- Place a layer of packing material on the bottom of cooler
- Insert samples separated by sufficient packing material
- Place temperature blank in with samples
- Cover with appropriate ice

- Place additional packing material on top to fill up airspace
- Insert completed COC in sealed Ziploc bag at top of cooler
- Wrap duct tape or shipping tape (1) around circumference of cooler at joint between cooler and lid and (2) over top of cooler to encircle completely to keep from opening if dropped
- Fill out and adhere custody tape to the outside of the cooler at the joint between cooler and lid.

Samples should typically not be shipped on a Thursday or Friday to prevent temporarily lost samples from sitting unrefrigerated over weekends. Thursday shipping is sometimes acceptable if the contract laboratory accepts Friday deliveries. Due to seven day sample hold time associated with chilled samples for analysis of PCBs (by EPA 8082), water sampling should be limited to Monday, Tuesday, or Wednesdays to meet with requirements for shipping and laboratory extraction unless prior arrangement is made with the analytical laboratory. Water samples analyzed by EPA 1668 or sediment samples by 8082 have more lenient holding time requirements (1 year once preserved to pH 2-3, or 14 days to extract, respectively) and may be collected on other days as needed.

The shipping personnel should notify the laboratory in advance when a shipment is made. Contact can be made via email, phone, or fax and the method of delivery and airbill number should be communicated. Shipping personnel should then follow up with the laboratory or shipping company the day shipment is to be completed to verify the shipment was received.

6.6 Laboratory Chain of Custody Procedures

Sample custody transfers to the analytical laboratory at the time of receipt. Upon receipt of samples, laboratory sample custodian should first verify sample integrity. Verification should include:

- Presence of custody seal
- Samples at appropriate temperature
- Chain of custody forms in agreement with samples
- Sample containers intact
- Samples labeled appropriately

Any questions on shipments should be brought to the attention of the Project Manager for resolution. Custody procedures followed by the laboratory should then follow laboratory standard operating procedures.

7 Investigation Derived Waste

7.1 Sampling Residuals

Sampling residuals will be disposed of appropriately.

7.2 Personal Protective Equipment

At the conclusion of sampling efforts, field sampling personnel will collect any protective equipment used in the sampling process for appropriate disposal.

7.3 Decontamination Waste Water

Waste water produced in the decontamination of field equipment process will be collected and removed by sampling personnel for proper disposal. No waste water will be left on-site at the conclusion of sampling.

8 Quality Control for Field Operations

Field personnel will strictly adhere to the SFEI Prop 13 Grant Project protocols to ensure the collection of representative, uncontaminated samples. Sampling methods are designed to be consistent with those employed for the Regional Monitoring Program for Trace Substances in San Francisco Bay (Lowe et al., 1999, Bell et al., 1999) and the previous investigations undertaken by the ACCWP (Gunther et al. 2001, Salop et al., 2002) in order to facilitate comparability among results of the various investigations. The most important aspects of quality control associated with sample collection are as follows:

- Field personnel will be thoroughly trained in the proper use of sample collection equipment and will be able to distinguish acceptable versus unacceptable samples in accordance with pre-established criteria.
- Field personnel will be thoroughly trained to recognize and avoid potential sources of sample contamination (e.g., dirty hands, ice used for cooling).
- Samplers and utensils that come in direct contact with the sample will be made of non-contaminating materials (e.g., glass, butyrate tubing, and/or inert chemical coatings) and will be thoroughly cleaned between sampling stations.
- Sample containers will be pre-cleaned and of the recommended type.
- Proper COC procedures will be followed.

9 Laboratory Analysis

9.1 Laboratory Analytical Methods

Samples collected during the first phase of reconnaissance study (Component 1) will be analyzed using method 8082 (PCBs arochlors) and method 7473 (Hg). All other samples will be analyzed using method 1668 revision A (PCB congeners) and method 1631e (Hg). All samples collected for PCBs Analysis of PCB congeners will be reported as IUPAC congeners. The congener list will be consistent with that of the RMP.[1] Total organic carbon (TOC) will be reported on all soil or sediment samples analyzed for PCBs by either method. Dissolved organic carbon and particulate organic carbon (DOC and POC) will be reported for all water samples analyzed for PCBs and SSC for all water samples. Details on sampling and analysis are shown in Table 4.

9.2 Sample Tracking

Sufficient sampling information must be recorded in the field and that allows tracking sample shipments from field to laboratory and from laboratory through data processing.

9.3 Data Reporting Requirements

As previously indicated, laboratory personnel will verify that the measurement process was "in control" (i.e., all specified data quality objectives were met or acceptable deviations explained) for each batch of samples before proceeding with the analysis of a subsequent batch. In addition, each laboratory will establish a system for detecting and reducing transcription and/or calculation errors prior to reporting data. Reporting through a laboratory information management system (LIMS), though not required, is encouraged to minimize human error in data handling.

Only data that have met data quality criteria, or data that have acceptable deviations explained, will be submitted by the laboratory. When QA requirements have not been met, the samples will be reanalyzed when possible. Only the results of the reanalysis will be submitted, provided they are acceptable.

10 Disclaimer

Funding for this grant has been provided in full or in part through an Agreement with the State Water Resources Control Board (SWRCB) pursuant to the Costa-Machado Water Act of 2000 (Proposition 13) and any amendments thereto for the implementation of California's Nonpoint Source Pollution Control Program. The contents of this document do not necessarily reflect the views and policies of the SWRCB, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

[1] IUPAC congeners 8, 18, 28, 31, 33, 44, 49, 52, 56, 60, 66, 70, 74, 87, 95, 97, 99, 101, 105, 110, 118, 128, 132, 138, 141, 149, 151, 153, 156, 158, 170, 174, 177, 180, 183, 187, 194, 195, 201, 203.

Table 4. Analytical Methods, Hold Times, and Miscellaneous Sampling Information Associated with Standard Analyses for SFEI Prop 13 Grant Project

Matrix	Analyte	Extraction Method	Extraction Hold Time	Analytical Method	Hold Time (after extraction)	Container Type	Min. Sample Volume
Solid	Hg	None EPA 1631e	N/A	EPA 7473 EPA 1631e	28 days 90 days	500 ml widemouth	10 g
Solid	PCBs	EPA 3540C	14 days	EPA 8082[1] EPA 1668	40 days 1 year	500 ml widemouth	10 g
Solid	TOC	None	N/A	EPA 440.0	100 days	500 ml widemouth	10 g
Solid/ aqueous	Grain Size	None	N/A	ASTM D422M/PSEP[3]	6 months (unfrozen)	500 ml widemouth[3]	
Aqueous	Hg	None EPA 1631e	48 hours to acidify	EPA 7473 EPA 1631e	28 days 90 days	500 ml widemouth	
Aqueous	PCBs	EPA 3540C	7 days	EPA 8082 EPA 1668	40 days 1 year	1 L amber	1 L
Aqueous	DOC POC	None	N/A	EPA 415.1 EPA 440.0	7 days, 28 days pH<2	500 ml widemouth[1]	1 L
Aqueous	SSC	None	N/A	ASTM D3977-97	7 days	500 ml widemouth	

Notes:

[1] Analyses may be conducted on subsamples from a single sample jar.
[2] With dual column confirmation
[3] With peroxide digestion/phi size distinction

Table 5a. Potential Analytes and Units for Sediment Samples Associated with SFEI Prop 13 Grant Project.

Matrix	Parameter & Analyte	Units
Sediment	**PCB congeners**	
	8, 18, 28, 31, 33, 44, 49, 52,56, 60, 66, 70, 74, 87,95, 97, 99, 101, 105, 110,118, 128, 132, 138,141, 149, 151, 153, 156,158, 170, 174, 177, 180, 183, 187, 194, 195, 201, 203	μg/kg
	Total Organic Carbon	%
	Hg	μg/kg
	POC/TOC	%
	Grain Size	
	Gravel >2,000 μm	%
	Sand, very coarse 1,000 – 2,000 μm	%
	Sand, coarse 500 – 1,000 μm	%
	Sand, medium 250 - 500 μm	%
	Sand, fine 125 – 250 μm	%
	Sand, very fine 62.5 - 125 μm	%
	31.3 – 62.5 μm	%
	15.6 – 31.3 μm	%
	3.9 – 7.8 μm	%
	1.95 – 3.9 μm	%
	0.98 - 1.95 μm	%

Sediment persistent organic pollutants are reported on a dry-weight basis.
Note: Organochlorines analyzed by GC-ECD will be determined using two columns of differing polarity (e.g., DB-5 and DB-17) in order to separate co-eluting congeners and reduce the influence of interferences.

Table 5b. Analytes and Units for Aqueous Samples Associated with SFEI Prop 13 Grant Project.

Matrix	Parameter & Analyte	Units
Aqueous	**PCB congeners**	
	8, 18, 28, 31, 33, 44, 49, 52,56, 60, 66, 70, 74, 87,95, 97, 99, 101, 105, 110,118, 128, 132, 138,141, 149, 151, 153, 156,158, 170, 174, 177, 180, 183, 187, 194, 195, 201, 203	pg/l
	Hg	μg/kg
	DOC/TOC	μg/L
	SSC	mg/L
	Grainsize	Weight%

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12 Appendices

A – Field notes form.

B – Chain of Custody form (COC)

SAMPLE DATA SHEET

1. Station Name ________________

2. Deployment Operator____

3. Sampler Start ______________________
   YYYY-MM-DD Time

3. Collection Operator ____

4. Sampler End ______________________
   YYYY-MM-DD Time

5. Sample Type

   Wet (Aerochem) Dry (plate) Bulk

6. Sample IDs (Collection date, location) and weight(s)

7. Comments on sample condition or site operation:

8. Date Shipped: ____________________Received: ____________________
   YYYY-MM-DD Initials YYYY-MM-DD Initials

5.1. APPENDIX A. CHAIN OF CUSTODY AND FIELD OBSERVATION FORMS

CHAIN OF CUSTODY RECORD

Page ___ of ___

Results to:	Bill to:	Shipped to:
San Francisco Estuary Institute 7770 Pardee Lane Oakland, CA, 94621-1424 Phone: 510-746-7334 Fax: 510-746-7300		

Sampled by [Print Name(s)] / Affiliation	Preservatives (see codes)	Project Name:
Sampler(s) Signature(s)	Analyses Requested	

Sample ID No.	Sampled Date	Sampled Time	Grab or Composite	Matrix (see codes)	Number/Size/Type of Containers	Analyses Requested								Remarks

Shipment Method

Out: / / Via:

← Total Number of Containers

Relinquished by / Affiliation	Date	Time	Accepted by / Affiliation	Date	Time

Additional Comments:

Cooler No.(s) / Temperature(s) (C)°

MATRIX CODES: F = Freshwater S = Saline SE = Sediment SW = Surface Water PW = Porewater B = Blanks T = Toxicity O = Other (specify)

PRESERVATIVE CODES: H = Hydrochloric acid + ice I = Ice only N = Nitric acid + ice S = Sulfuric acid + ice O = Other (specify)

GIVE SOMETHING BACK (510) 635-5500