Annual Reporting for FY 2009-2010

Regional Supplement for Pollutants of Concern and Monitoring

San Francisco Bay Area Municipal Regional Stormwater Permit

September 2010
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INTRODUCTION

This Regional Supplement has been prepared to report on regionally-implemented activities that comply with portions of the Municipal Regional Stormwater Permit (MRP), issued to 76 municipalities and special districts (Permittees) by the San Francisco Bay Regional Water Quality Control Board (Water Board). The Regional Supplement describes regionally-implemented activities conducted under the auspices of the Bay Area Stormwater Management Agencies Association (BASMAA)\(^1\), in compliance with the following MRP provisions:

- Provision C.8 (Water Quality Monitoring); and
- Portions of Provisions C.9, C.11, C.12, C.13 and C.14, collectively referred to as “Pollutants of Concern” (POCs).

The 2010 annual reporting requirements for MRP Provisions covered in this Regional Supplement are completely met by BASMAA Regional Project activities, except where otherwise noted. Scopes, budgets and contracting or in-kind project implementation mechanisms for BASMAA Regional Projects follow BASMAA’s Operational Policies and Procedures as approved by the BASMAA Board of Directors (BOD). MRP Permittees, through their program representatives on the BOD and its subcommittees, collaboratively authorize and participate in BASMAA Regional Projects or Regional Tasks. Regional Project costs are shared by either all BASMAA members or among those Phase I programs that are subject to the MRP.\(^2\)

This Regional Supplement does not include separate reporting products that will be required in future years by the following MRP provisions:

- C.8.g.ii Electronic Status Monitoring Data Reports;
- C.8.g.iii or v Urban Creeks Monitoring or Integrated Monitoring Reports; and
- C.8.g.iv Monitoring Project Reports.

The above Provision C.8.g reporting requirements cover most data collection activities required in C.8. While MRP C.8.g reporting is not required for the 2010 Annual Report, in Fiscal Year (FY) 2009-10 the Permittees initiated several Regional Projects for planning and development of tools needed to coordinate and support those data collection and reporting functions, described below in the section on Water Quality Monitoring.

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1 BASMAA is a 501(c)(3) non-profit organization comprised of the municipal stormwater programs in the San Francisco Bay Area.

2 The BASMAA programs supporting MRP Regional Projects include all MRP Permittees as well as the cities of Antioch, Brentwood, and Oakley which are not named as Permittees under the MRP but have voluntarily elected to participate in MRP-related regional activities with the expectation that regionally coordinated activities undertaken by the Contra Costa Clean Water Program and other BASMAA partners will fulfill requirements that will be established by the Central Valley Regional Water Quality Control Board through its separate NPDES permit regulating stormwater discharges from eastern Contra Costa County.

3 Additional activities related to the Pollutants of Concern or Water Quality Monitoring provisions reported here may have been conducted during FY 2009-10 by individual Permittees or groups of Permittees acting through a joint stormwater program. Summaries of these activities contained in annual reports submitted by Permittees or programs may include information that was not required by the MRP, or activities performed for regional compliance with MRP provisions but not approved as part of a Regional Project by the time this Regional Supplement was completed.
POLLUTANTS OF CONCERN

Provisions C.9 through C.14 of the MRP address pollutants that the Water Board has identified as potentially contributing to water quality concerns for the San Francisco Bay and/or local waterbodies. These pollutants are referred to as “pollutants of concern” (POCs). For some POCs, water quality attainment strategies have been adopted such as Total Maximum Daily Loads (TMDLs).

For mercury, polychlorinated biphenyls (PCBs) and other sediment-bound pollutants, the Water Board has proposed to implement control measures through MRP using four modes or levels described in the following framework:

1. Full-scale implementation throughout the region;
2. Focused implementation in areas where benefits are most likely to accrue;
3. Pilot-testing in a few specific locations; and
4. Other: This may refer to experimental control measures, Research and Development, desktop analysis, laboratory studies, and/or literature review.

Many Regional Projects reported in this section focus on MRP provisions relating to modes 3 and 4, which require studies or pilot projects intended to reduce uncertainties about the sources, occurrence or effectiveness of control measures for POCs. Other Tasks will be implemented through participation in regional or state-wide collaborative initiatives, such as:

- The Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP), described in more detail under Provision C.8.b below; and
- Initiatives to control sources of specific pollutants (e.g., Clean Watersheds for a Clean Bay project).

PESTICIDES TOXICITY CONTROL (C.9)

C.9.e Track and Participate in Relevant Regulatory Processes

The essential requirements of this provision are to track USEPA and DPR actions related to urban-use pesticides and actively participate in the shaping of regulatory efforts underway. This provision allows for cooperation among Permittees through the California Stormwater Quality Association (CASQA), BASMAA and/or the Urban Pesticide Pollution Prevention Project (UP3 Project). Recognizing that this approach is the most likely to result in meaningful changes in the regulatory environment, Permittees elected to take this route to achieve compliance with this provision. A project profile was developed by the BASMAA Monitoring and POCs Committee (MPC) to fund the reporting element of this task and the BASMAA Board of Directors (BOD) subsequently approved this Regional Project in May 2010.
The actual work of tracking and participating in the ongoing regulatory efforts related to pesticides was accomplished through BASMAA member participation in the UP3, as well as the chairpersonship of the CASQA Pesticides Subcommittee. Permittees have been working with the UP3 project as well as the CASQA Pesticides Subcommittee for a number of years, so there was no lag time associated with compliance as the committee structures and membership were already fully engaged before the MRP was adopted. As a result, FY 2009-10 was very productive. Details of the specific achievements of this year can be found in the attached report, “Pesticide Regulation for Water Quality Protection, Annual BASMAA Participation Summary and Outcomes Assessment, 2010” prepared by TDC Environmental, LLC. (Appendix A1)

C.9.g Evaluate Implementation of Source Control Actions Relating to Pesticides

There are no Annual Reporting requirements for Provision C.9.g in 2010. In future years, additional information will be provided on the status of implementation activities designed to comply with this provision.

JOINT MERCURY AND POLYCHLORINATED BIPHENYLS (PCBS) CONTROLS (C.11 AND C.12)

Provisions C.11.c through Provision C.11.g for mercury are essentially identical to Provisions C.12.c through C.12.g for PCBs. This reflects similarities between the respective TMDLs for these pollutants, based on the legacy and sediment-associated nature of their occurrence. For Provisions C.11/12.c through C.11/12.f, MRP requirements focus on pilot studies; sites for these pilots will primarily be chosen on the basis of the potential for reducing PCB loads, but consideration will be given to mercury removal in the final design and implementation of the studies. Provisions C.11.i and C.12.i are also written identically, since fish consumption is a primary concern for both mercury and PCBs.

Clean Watersheds for a Clean Bay (CW4CB) is a new project funded by a grant to BASMAA from the US Environmental Protection Agency (USEPA). Implementation of the CW4CB project will result in Permittee compliance with the following MRP provisions:

- C.11/12.c - Pilot Projects To Investigate and Abate Mercury/PCB Sources;
- C.11/12.d - Pilot Projects to Evaluate and Enhance Municipal Sediment Removal and Management Practices;
- C.11/12.e - Conduct Pilot Projects to Evaluate On-Site Stormwater Treatment via Retrofit; and
- C.11/12.i - Development of a Risk Reduction Program Implemented Throughout the Region.

The project is a partnership of Bay Area municipalities and countywide municipal stormwater management agencies. The CW4CB's overarching objective is to
implement priority actions called for by the San Francisco Bay PCBs and mercury Total Maximum Daily Load (TMDL) water quality restoration programs\(^4\) including developing and pilot-testing a variety of methods to potentially reduce urban runoff loading of PCBs and mercury to the Bay. BASMAA will receive $5.0 million in funding from the USEPA’s San Francisco Bay Area Water Quality Improvement Fund towards the $6.84 million total project cost. The remaining $1.84 million (about 27% of the total project cost) will be contributed by BASMAA and six of the Bay Area countywide stormwater management programs as a match to the funding received from the USEPA. In addition, in-kind assistance from participating Permittee staff will provide additional resources to leverage the project effort. Appendix A2 contains the CW4CB project work plan, which was approved by the USEPA on July 1, 2010.

The CW4CB project management team consisting of BASMAA’s Executive Director and representatives from several BASMAA agencies and participating Permittees provides project oversight and coordination. The team meets monthly on second Wednesday of each month to discuss the status of the project, implementation of tasks, and coordination among project participants.

Appendix A3 is a memorandum describing the CW4CB project’s current status. It should be noted that the project started significantly later than originally anticipated. USEPA’s original Request for Proposal included an anticipated award date of February 2010. However, despite USEPA’s and BASMAA’s best efforts to expedite the process, USEPA was not able to provide BASMAA with an assistance agreement until June 2010 which resulted in a project start date of July 1, 2010. Thus project implementation is currently at a very early stage.

C.11/12.c  Pilot Projects To Investigate and Abate Mercury/PCB Sources

Provisions C.11/12.c. require that Permittees work collaboratively to identify five Bay Area watershed areas that contain high levels of mercury and/or PCBs and conduct pilot projects to investigate and abate these high mercury and/or PCB concentrations. The CW4CB has developed proposed criteria to inform selection of the five watershed areas and is currently performing a comprehensive review of existing data relevant to the selection. Most of these data were originally compiled and made available by the Regional Stormwater Monitoring and Urban BMP Evaluation Project conducted by the San Francisco Estuary Institute (SFEI). The SFEI study investigated options for better managing mercury and PCBs in urban stormwater and was conducted in collaboration with BASMAA and the Water Board. It was funded through a grant from the State of California Proposition 13 stormwater non-point-source program. The SFEI recently completed the study and is currently updating a web site that will make the project data and results readily available. The memorandum in Appendix A3 provides additional details about the watershed selection process and status.

\(^4\)The MRP implements those TMDL actions related to stormwater runoff.
C.11/12.d  Pilot Projects to Evaluate and Enhance Municipal Sediment Removal and Management Practices

Provisions C.11/12.d of the MRP require that Permittees work collaboratively to develop and pilot-test methods to enhance removal of sediment with PCBs and mercury, mainly during existing municipal street and storm drain system operation and maintenance activities. Permittees are required to conduct this pilot work in the five pilot watersheds selected for Provisions C.11/12.c. The evaluation will include typical routine municipal operation and maintenance practices such as street sweeping, catch basin cleaning, and stormwater conveyance system cleaning, and will also include consideration of street flushing with routing of wash water to a sanitary sewer. Evaluation of existing information on high-efficiency street sweepers is also a specific C.11/12.d requirement. Permittees are required to submit a progress report on the results of these two evaluations in this 2010 Annual Report and the final evaluation results in the 2011 Annual Report. As described in the memorandum in Appendix A3, BASMAA agencies have initiated a comprehensive review of existing literature and other information relevant to the evaluations.

C.11/12.e - Conduct Pilot Projects to Evaluate On-Site Stormwater Treatment via Retrofit

Provisions C.11/12.e require that Permittees retrofit PCB and mercury treatment systems into existing storm drainage infrastructure at ten locations throughout the Permittees’ jurisdictions and evaluate effectiveness. It is anticipated that some but not all of the retrofits will be sited within the five pilot watersheds identified through Provisions C.11/12.c. Permittees are required to install at least one retrofit in each of five major Bay Area counties covered by the MRP (Santa Clara, San Mateo, Alameda, Contra Costa, and Solano) and report on candidate locations with types of treatment retrofit for each location in the September 2011 Annual Report. This effort is at an early stage and has consisted to-date of initial conceptual discussions at project management team meetings. The project management team is also working with USEPA to better define procurement rules related to retention of consultants to assist with the project. The initial project need is to obtain a consultant to perform an initial conceptual screening of treatment retrofits potentially applicable to this project.

C.11/12.i  Development of a Risk Reduction Program Implemented throughout the Region

Provisions C.11/12.i require that Permittees implement a regional program of risk communication activities to raise public awareness of fish contamination issues in San Francisco Bay and to encourage fish-consuming populations to reduce their exposure to pollutants in contaminated fish. These provisions require that Permittees submit in this 2010 Annual Report the specific manner in which these risk reduction activities will be accomplished and the associated schedule for their implementation. Task 6 of the CW4CB project work plan in Appendix A2 includes a description of the tasks that will be conducted via the project to raise public awareness and encourage reduction of exposure. Table 3 of the CW4CB project work plan includes the Task 6 schedule.
C.11/12.f Diversion of Dry Weather and First Flush Flows to POTWs

Provisions C.11.f and C.12.f are nearly identical provisions for control of mercury (C.11) and PCBs (C.12) requiring the evaluation of diversion of dry weather urban runoff and first flush events into publicly owned treatment works (POTWs). The first product required under these provisions is a feasibility evaluation to be included in the 2010 Annual Report. The feasibility evaluation is to include, but is not limited to, costs, benefits, and impacts on the stormwater and wastewater agencies and the receiving waters relevant to the diversion and treatment of the dry weather and first flush flows. The report entitled "Stormwater Pump Station Diversions Feasibility Evaluation (AppendixA4) summarizes the feasibility evaluation including:

- Proposed selection criteria to inform the identification of five candidate and five alternate pump stations;
- Draft proposed time schedules for conducting pilot studies; and
- A draft proposed method for distributing mercury and PCBs load reductions to participating wastewater and stormwater agencies.

To comply with provisions C.11.f and C.12.f, BASMAA chose to approach this project as a Regional Project and a number of steps were taken to carry it out in FY 2009-10. A detailed scope of work was developed in the January – April 2010 time frame and the firm of Brown and Caldwell was retained to perform the work. Brown and Caldwell’s work was directed and overseen by a Technical Oversight Committee (TOC) made up of BASMAA participants that recently began meeting on the afternoon of the second Wednesday of each month. This first TOC meeting was held July 14, 2010 during which a draft technical memorandum was reviewed that presented selection criteria for pump station projects. Data gathered to date were also reviewed by the TOC and direction was provided for completion of the feasibility evaluation report.

Following completion of the feasibility evaluation report, the oversight committee will identify how best to support programs and / or individual Permittees in using the report to scope out candidate pilot projects that are required to be completed during this permit term, for reporting in the 2014 Integrated Monitoring Report.

C.11/12.g Monitor Stormwater Pollutant Loads and Loads Reduced

Provisions C.11.g and C.12.g require Permittees to develop and implement a monitoring program to quantify mercury and PCB loads and loads reduced through source control, treatment and other management measures implemented by Permittees. Average annual mercury (160 kg/yr) and PCB (20 kg/yr) loads to the San Francisco Bay from urban (and non-urban) runoff discharges have been calculated by the Water Board through the development of Total Maximum Daily Loads (TMDLs) for these pollutants. Over the next five years, refinement of PCB and mercury loading estimates will occur through the implementation of POC Monitoring required by Provision C.8.e, and associated technical studies coordinated through the BASMAA Regional Monitoring Coalition (see Water Quality Monitoring Section) and the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP). These loading
estimates provide a baseline to which compliance with TMDL Waste Load Allocations (WLAs) issued to Bay Area stormwater agencies can be determined.

Through a BASMAA Regional Project in FY 2009-10, preliminary draft methods to assess Permittee progress towards TMDL milestones and attainment of WLAs began to be developed. This project is intended to assist Permittees in calculating PCB and mercury loads reduced through stormwater management measures. The regional project entails the review of existing information on loads reduced methodologies developed through other recent efforts (e.g., SFEI Proposition 13 Urban Runoff BMP Project) and development of draft loads reduced formulas for specific stormwater management measures.

A Working Draft Technical Memorandum is provided in Appendix A5 that describes preliminary loads reduced methodologies for PCBs and mercury. This Technical Memorandum is a work-in-progress that requires additional feedback and revisions based upon Permittee review. During FY 2010-11, the Draft Technical Memorandum will be further developed and presented to Water Board staff for discussion and input. After further revisions, a Final Technical Memorandum will be developed and made available to Permittees to use as a tool to account for pollutant reductions that are attributable to specific stormwater management measures implemented by Permittees, and assess progress towards PCB and Mercury TMDL WLAs.

**MERCURY CONTROLS (C.11)**

This section describes regional activities designed to comply with specific requirements in MRP Provision C.11 that are not connected to parallel PCB provisions in C.12.

**C.11.b Monitor Methylmercury**

MRP Provision C.11.b duplicates the requirement in Provision C.8.g - to report results of methyl mercury monitoring required in Provision C.8.e. Per the schedule for commencement of monitoring described in the Water Quality Monitoring section of this report below, there is no data collection to report for FY 2009-10.

**C.11.h Fate and Transport Study of Mercury in Urban Runoff**

This MRP provision requires Permittees to conduct, or cause to be conducted, studies aimed at better understanding the fate, transport, and biological uptake of mercury discharged in urban runoff to San Francisco Bay and tidal areas. The 2010 annual reporting requirement includes a work plan describing the specific manner in which these information needs will be accomplished and describing the studies to be performed with a schedule.

This requirement is met through the RMP, which has approved a Mercury Synthesis project in 2011 (Appendix A6). The RMP Master Planning process incorporates several
Strategies to address pollutant-specific information needs and support management decisions through investigation of prioritized Management Questions. The RMP Mercury Strategy previously funded a multi-year suite of special studies being completed in 2010. The synthesis will combine results and noteworthy findings from recent Status and Trends monitoring to set the stage for a new multi-year plan for RMP studies in 2012 and beyond. Ongoing or projected future RMP efforts for the Mercury Strategy also include:

- Monitoring of mercury, PCBs and other pollutants in biota, both ongoing (Status & Trends) and in a special 3-year study of Small Fish living along the Bay margins that are an important link in the Bay food web (funded 2008-2010); and
- Development of conceptual models of transport and food web uptake for mercury and PCBs, and Bay Margin areas that will be incorporated with a planned water-sediment-contaminant model linking small tributary inputs to Bay processes.

In FY 2010-11, BASMAA representatives will continue participating in RMP Work Groups and committees to ensure future implementation of studies that meet the MRP’s stated information needs, which include understanding the in-Bay transport of mercury discharged in urban runoff, the influence of urban runoff on the patterns of food web mercury accumulation, and the identification of drainages where urban runoff mercury is particularly important in food web accumulation.

C.11.j Develop Allocation Sharing Scheme with Caltrans

Wasteload allocations (WLAs) assigned to urban stormwater dischargers through the San Francisco Bay Mercury TMDL implicitly include California Department of Transportation (Caltrans) roadway and non-roadway facilities within the geographic boundaries of MRP Permittees. Provision C.11.j, requires Permittees to develop an equitable mercury allocation-sharing scheme in consultation with Caltrans to address the Caltrans facilities in the program area, and report the details to the Water Board.

In an effort to begin the development of an equitable mercury allocation-sharing scheme in FY 2009-10, the BASMAA regional technical lead for the mercury TMDL (on behalf of all Permittees) contacted lead Water Board and CalTrans staff to set a course for working collaboratively on this project. Based on these discussions, technical staff representing Permittees and CalTrans will meet in FY 10-11 to assess agency perspectives, potential methods for sharing allocations, and future collaborative efforts to reduce mercury impairment in San Francisco Bay. Additional information on the progress of collaboratively developing an allocation-sharing scheme between Permittees and CalTrans will be provided in the 2011 and subsequent Annual Reports.
PCB CONTROLS (C.12)

This section describes regional activities designed to comply with specific requirements in MRP Provision C.12 that are not connected to parallel mercury provisions in C.11.

C.12.a Identification of PCBs and PCB-Containing Equipment During Industrial Inspections

Provision C.12.a requires Permittees to develop training materials and train municipal industrial facility inspectors to identify, in the course of their existing inspections, PCBs or PCB-containing equipment. Additionally, Permittees are required to incorporate such PCB identification into existing industrial inspection programs. To assist Permittees in complying with this provision, the BASMAA Board of Directors (BOD) agreed to fund a regional project in FY 2009-10 to develop training material for stormwater inspectors. The scope of the project was to develop regional training and reporting materials to assist commercial/industrial facility stormwater inspectors in identifying PCBs, copper and mercury during their inspections, and provide inspectors with useful Best Management Practices (BMPs) and information materials for distribution to facility owners/operators. The draft training materials were completed in late FY 2009-10 and included a guidance manual for stormwater inspectors (see Appendix A7), inspection form templates, power point training presentation and example BMP materials. Results of training conducted by Permittees in FY 2009-10 are included in Permittee-specific Annual Reports.

C.12.b Conduct Pilot Projects to Evaluate Managing PCB-Containing Materials and Wastes during Building Demolition and Renovation (e.g., Window Replacement) Activities

Provision C.12.b requires that Permittees conduct pilot projects to evaluate managing PCB-containing materials and wastes during building demolition and renovation, including some activities that may not require permitting (e.g., replacement of window panes). Permittees are complying with Provision C.12.b via BASMAA’s proactive participation in a project entitled “PCBs in Caulk.” The project is administered by the San Francisco Estuary Partnership. The project partners include BASMAA, the San Francisco Estuary Institute (SFEI), and a variety of consultants. Project funding was originally provided through a state Proposition 50 Coastal Nonpoint Source Pollution grant but was replaced by federal stimulus funds (American Recovery and Reinvestment Act of 2009 through the Clean Water State Revolving Fund). Consistent with the requirements of Provision C.12.b, the PCBs in Caulk project will:

- Evaluate PCB levels in caulk from at least 10 Bay Area sites to better understand which types/ages of buildings are most likely to have caulks with PCBs, so that management actions can be targeted effectively. Surveys previously conducted in Europe and other parts of North America have found sealants

5The San Francisco Estuary Partnership is a project of the Association of Bay Area Governments.
containing PCBs, sometimes in very high concentrations, in a large proportion of older buildings, particularly those built or renovated in the 1950’s, 1960’s and 1970’s.

- Develop Best Management Practices (BMPs) and associated model policies or ordinances to prevent the release of PCBs from caulks into urban runoff during renovation, maintenance and demolition of Bay Area buildings. The project will build on work that was performed elsewhere and develop methods to identify, handle, contain, transport, and properly dispose of PCB-containing caulks.

- Test and evaluate the effectiveness of the proposed BMPs at three to five sites in the Bay Area and document which methods work best in our region and other lessons learned.

The long-term goal is for Bay Area municipalities to adopt policies or ordinances requiring construction sites to implement the management practices developed by this project, so that legacy caulks containing PCBs are prevented from polluting urban runoff and the Bay.

Appendix A8 contains the project work plan. BASMAA has approved a Regional Project that allows staff from member stormwater programs to dedicate time on behalf of all Permittees to working with the partnership’s project team on implementing the project. The stormwater program staff report to and receive feedback and guidance from the BASMAA Monitoring and POCs Committee. The staff have fully participated in all facets of the project, including frequent project teleconferences, development of project work plans, review and commenting on all project deliverables (e.g., the Sampling and Analysis Plan described below), selection of a contractor to develop BMPs, a stakeholder meeting held July 15, 2010, and a public meeting held by EPA on July 22, 2010 on a proposed rulemaking related to relevant PCBs regulations.

Provision C.12.b’s requirements include development of a Sampling and Analysis Plan (SAP) to evaluate PCBs at construction sites (including research on when, where, and which materials potentially contained PCBs). Submittal of the SAP is required in this 2010 Annual Report and Appendix A9 contains the SAP. It should be noted that the project has also prepared a Quality Assurance Project Plan (Appendix A10).

Provision C.12.b also requires that this 2010 Annual Report include a status report on the sampling and analysis along with whatever sampling results are available. The sampling and analysis has not yet commenced. Early in 2010 BASMAA representatives began attempting to obtain permission to access municipal properties to perform sampling and analysis and BMP implementation trials. This effort included contacting all Permittees through BASMAA e-mail distribution lists and speaking directly to individual representatives from a number of municipalities. In all cases the BASMAA representatives were informed that municipalities could not further consider providing access to their buildings and projects until they are provided with additional information, including the exact field methods that will be applied and the potential
consequences to municipal agencies that agree to participate in the field investigation. One particular concern is that EPA currently requires preparation of a cleanup plan and implementation of that plan if PCBs are found at a level exceeding 50 ppm in building materials such as caulks and sealants. The project is therefore preparing during the fall of 2010 a memorandum that will articulate the study methods and available information about potential consequences, including estimated costing information related to cleanup and proper disposal of PCB-laden materials. The sampling and analysis and BMP implementation trials are currently scheduled to commence in parallel near the end of calendar year 2010.

C.12.h Fate and Transport Study of PCBs in Urban Runoff

This MRP provision requires Permittees to conduct, or cause to be conducted, studies aimed at better understanding the fate, transport, and biological uptake of PCBs discharged in urban runoff. The 2010 reporting requirement includes a work plan describing the specific manner in which these information needs will be accomplished and describing the studies to be performed with a schedule. This requirement is met through participation in the RMP, which has approved a PCBs Synthesis project in 2011 (Appendix A11). The RMP Master Planning process incorporates several Strategies to address pollutant-specific information needs and support management decisions through investigation of prioritized Management Questions. The synthesis will combine noteworthy findings from recent Status and Trends monitoring and special studies to set the stage for a new multi-year plan for RMP studies in 2012 and beyond. Ongoing or projected future RMP efforts for the PCBs Strategy also include:

- Monitoring of mercury, PCBs and other pollutants in biota, both ongoing (Status & Trends) and in a special 3-year study of Small Fish living along the Bay margins that are an important link in the Bay food web (funded 2008-2010); and
- Development of conceptual models of transport and food web uptake for mercury and PCBs, and Bay Margin areas that will be incorporated with a planned water-sediment-contaminant model linking small tributary inputs to Bay processes.

BASMAA representatives will continue participating in RMP work groups and committees to ensure future implementation of studies that meet the MRP’s stated information needs, which include understanding the in-Bay transport of PCBs discharged in urban runoff, the influence of urban runoff on the patterns of food web PCBs accumulation, and the identification of drainages where urban runoff PCBs are particularly important in food web accumulation.

COPPER CONTROLS (C.13)

C.13.c Vehicle Brake Pads

The MRP requires that Permittees report on legislation development and implementation status in Annual Reports during the permit term. Compliance is being
achieved through continued participation in the Brake Pad Partnership (BPP) process to develop California legislation phasing out copper from certain automobile brake pads sold in California.

Appendix A12, an “Investor’s Circle Update” from Sustainable Conservation, provides a primer on the issue of copper from brake pad wear, the Brake Pad Partnership (BPP), and the control measure determined through the BPP to be the most appropriate for reducing copper emissions from brake pads: proposed legislation SB 346 (Kehoe) – Hazardous materials: motor vehicle brake friction materials. As described in the Update, SB 346 was introduced to the California legislature in early 2009 and, after passing out of the Senate and moving to the Assembly, was made a two-year bill in late June 2009.

In FY 2009-10, Permittees’ efforts focused on:

1. Researching and providing information to assist with bill language;
2. Helping the bill’s sponsors to further develop the bill language to address concerns raised by industry representatives from the auto and brake pad manufacturers, brake pad wholesalers and retailers, and car dealers; and
3. Advocating for passage of the bill by the Assembly Environmental Safety and Toxic Materials (Toxics) Committee.

The above activities were coordinated through the California Stormwater Quality Association (CASQA) BPP Team, a group of stormwater quality agencies affected by copper or metals listings, TMDLs, or permit requirements. Permittees participated in the process through BASMAA representation on the BPP team and supported SB346 with letters and lobbying efforts.

The language of SB 346 as of the end of FY 2009-10, two fact sheets on the bill, and BASMAA’s letter of strong support for SB 346 to the Assembly Toxics Committee are provided in Appendices A13, A14, A15 and A16, respectively.

C.13.d. Industrial Sources

Provision C.13.d requires Permittees to identify facilities likely to use copper or have sources of copper (e.g., plating facilities, metal finishers, auto dismantlers) and include them in their inspection program plans. Additionally, Permittees are required to educate industrial inspectors on industrial facilities likely to use copper or have sources of copper and proper Best Management Practices (BMPs).

As part of the regional project described under Provision C.12.a, BASMAA developed training materials in FY 2009-10 to assist Permittees in complying with Provision C.13.d. Specifically, draft training materials were for developed to assist Permittees in training commercial/industrial facility stormwater inspectors to identify PCBs, copper and mercury during their inspections, and provide inspectors with useful BMPs and information materials for distribution to facility owners/operators. Results of training
conducted by Permittees in FY 2009-10 are included in Permittee-specific Annual Reports.

C.13.e  Studies to Reduce Copper Pollutant Impact Uncertainties

This MRP provision requires Permittees to conduct, or cause to be conducted, technical studies to investigate possible copper sediment toxicity and technical studies to investigate sub-lethal effects on salmonids. These uncertainties regarding copper effects in the Bay are described in the amended Basin Plan’s implementation program for copper site-specific objectives.

The MRP reporting requirement for 2010 includes description of the specific manner in which these information needs will be accomplished and of the studies to be performed with a schedule. The information needs will be filled by RMP studies coordinated through the Exposure Effect Work Group (EEWG). The RMP Master Plan (currently under development) lists EEWG priorities for the next 5 years, including effects on benthos and fish. EEWG efforts on benthos in 2011 will focus on completion of studies from prior years that include development of methods and tools for identifying the causes of sediment toxicity, followed by development of long-term plans for 2012 and beyond.

Copper impacts to the olfactory system of salmonids have been found in freshwater experiments, where short-term exposure to increased copper reduced response to alarm odors, and affected predator-avoidance behavior of young coho salmon. A special study approved for 2011 (Appendix A17) will use similar experimental methods on young Chinook salmon in saltwater.

BASMAAA representatives will continue participation in the EEWG and the Benthos work groups as needed to ensure that the developing work plans include appropriate follow-up studies in these two areas.

PBDES, LEGACY PESTICIDES, AND SELENIUM (C.14)

C.14.a  Control Program for PBDEs, Legacy Pesticides, and Selenium.

This MRP provision requires the Permittees to work with the other municipal stormwater management agencies in the Bay Region to identify, assess, and manage controllable sources of polybrominated diphenyl ethers (PBDEs), legacy pesticides, and selenium found in urban runoff. The reporting requirement for 2010 is to describe progress towards the following MRP implementation objectives:

C.14.a.ii. Implementation Level – The PBDEs/Legacy Pesticides/Selenium Plan shall include actions to do the following: Characterize the representative distribution of PBDEs, legacy pesticides, and selenium in the urban areas of the Bay Region covered by this permit to determine:
(1) If PBDEs, legacy pesticides, and selenium are present in urban runoff;
(2) If PBDEs, legacy pesticides, or selenium are distributed relatively uniformly in urban areas; and
(3) Whether storm drains or other surface drainage pathways are sources of PBDEs, legacy pesticides, or selenium in themselves, or whether there are specific locations within urban watersheds where prior or current uses result in land sources contributing to discharges of PBDEs, legacy pesticides, or selenium to San Francisco Bay via urban runoff conveyance systems.

The 2012 Annual Report will provide the results of the above characterization and information necessary to calculate loads of these pollutants in stormwater. The 2013 Annual Report will identify control measures and/or management practices to eliminate or reduce discharges of these pollutants from urban runoff conveyance systems.

Legacy organochlorine (OC) pesticides (e.g. DDT, dieldrin and chlordane), PBDEs, and selenium are either known to impair or potentially impair Bay and tributary beneficial uses. The Water Board is planning or developing TMDLs for each of these groups of pollutants: Selenium in the North Bay and for all parts of the Bay for PBDES and legacy OC pesticides.

The Permittees will address this provision through a BASMAA Regional Project that will compile existing monitoring data from multiple sources including:

- Reconnaissance characterization and Pollutant of Concern Loads Monitoring as described for Provision C.8.e under Water Quality Monitoring below.
- Local tributary monitoring by the RMP, including Coyote Creek and Guadalupe River, and more recent data on PBDEs and OC pesticides at Zone 4 Line A in Hayward; some samples were also analyzed for selenium in winter 2010.
- Previous BASMAA agency sampling for OC pesticides in storm drain sediments conducted through the Joint Stormwater Agency Project.

In FY 2009-10 BASMAA representatives participated in the RMP’s Sources Pathways and Loadings Work Group and Small Tributaries Loading Strategy (STLS) Team to guide RMP sampling and to design future stormwater sampling for both the RMP and MRP Permittees under Provision C.8.e.
WATER QUALITY MONITORING

Provision C.8 of the MRP requires Permittees to conduct water quality monitoring and associated projects during the permit term. All water quality monitoring activities required by Provision C.8 are coordinated regionally through the BASMAA Regional Monitoring Coalition (RMC). Scopes and budgets for specific RMC monitoring projects are proposed for BASMAA Board of Directors (BOD) approval by the BASMAA Monitoring and Pollutants of Concern Committee (MPC). Many were approved as Regional Projects by the BOD during FY 2009-10. Others are planned to begin in FY 2010-11 or subsequent fiscal years based on schedules outlined in the MRP.

This portion of the Regional Supplement provides a status report on water quality monitoring activities/projects coordinated through the RMC in FY 2009-10 and briefly describes RMC projects planned to occur in future fiscal years. Activities described herein were conducted on behalf of all RMC participants, and in full compliance with Provision C.8 of the MRP. Summaries of the following C.8 sub-provisions are included in this section:

- Compliance Options (C.8.a)
- San Francisco Estuary Receiving Water Monitoring (C.8.b)
- Creek Status Monitoring (C.8.c)
- Monitoring Projects (C.8.d)
- Pollutants of Concern and Long-Term Trends Monitoring (C.8.e)
- Citizen Monitoring and Participation (C.8.f)
- Reporting (C.8.g)
- Monitoring Protocols and Data Quality (C.8.h)

C.8.a Compliance Options

Provision C.8.a (Compliance Options) of the MRP allows Permittees to address monitoring requirements through a “regional collaborative effort” (e.g., RMC), its’ Stormwater Program, and/or individually. The regional collaborative effort option is only available if a majority of MRP Permittees agree to participate. If the regional monitoring collaborative option is selected, participants must formally notify to the Water Board in writing by July 1, 2010 and their water quality data collection required by Provision C.8 must commence by October 2011. If the stormwater program or Permittee option is selected, monitoring efforts are required to commence by October 2010. This one-year extension for the regional collaboration option is due to the time and resources needed to develop a regional monitoring collaborative.

In June 2010, Permittees notified the Water Board in writing of their agreement to participate in a regional monitoring collaborative to address requirements in Provision C.8. The regional monitoring collaborative is referred to as the BASMAA Regional Monitoring Coalition.

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6 The Cities of Antioch, Brentwood and Oakley, although not named as Permittees under the MRP, have voluntarily elected to participate in the RMC.
Monitoring Coalition (RMC). With notification of participation in the RMC, participating Permittees are required to commence water quality data collection by October 2011. Therefore, with the exception of monitoring described in this section under Provision C.8.b (SF Bay Receiving Water Monitoring), Permittee efforts in FY 2009-10 described in this section were generally focused on the development of the RMC and associated near-term projects.

BASMAA Regional Monitoring Coalition (RMC)
The RMC is a collaboration of San Francisco Bay Area stormwater programs and associated Permittees focused on effectively and efficiently developing and implementing a regionally coordinated water quality monitoring program that will improve stormwater management in the region. The goals of the RMC are to:

- Assist Permittees in complying with requirements in MRP Provision C.8 (Water Quality Monitoring);
- Develop and implement regionally consistent creek monitoring approaches and designs in the Bay Area, through the improved coordination among RMC participants and other agencies (e.g., Water Board) that share common goals; and
- Stabilize the costs of creek monitoring by reducing duplication of effort and streamlining reporting.

Through its implementation, the RMC allows Permittees and the Water Board to effectively modify their existing creek monitoring programs, which improves their ability to collectively answer core management questions in a cost effective and scientifically rigorous way. Participation in the RMC is coordinated by stormwater program and or Permittee representatives (or equivalent), and facilitated through the BASMAA Monitoring and Pollutants of Concern Committee (MPC), which meets monthly.

To guide implementation of the RMC over the term of the MRP, stormwater program representatives developed a Draft RMC Work Plan (Draft RMC Work Plan) in FY 2009-10 (see Appendix B1). Applicable management questions, descriptions of over 30 RMC monitoring projects, and associated project schedules are included in the Draft RMC Work Plan. Monitoring projects described in the Draft RMC Work Plan that were approved by the BOD and begun in FY 2009-10 include:

- Creek Status and Long-Term Trends Monitoring Standard Operating and Data Quality Assurance Procedures
- Creek Status and Long-Term Trends Standard Contract Language and Reporting Formats
- Multi-Year Pollutants of Concern (POC) Sampling Plan
- POC Standard Operating and Quality Assurance Procedures
- POC Laboratory Standard Contract Language and Reporting Formats
- POC Monitoring Information Management System Development
- POC Information Management and Quality Control
- Sediment Estimate Budget Development
Additional RMC monitoring projects described in the Draft RMC Work Plan are being considered for approval as Regional Projects by the BOD in FY 2010-11 and for future fiscal years through annual planning. Status reports on RMC projects that began in FY 2009-10 are included under the applicable MRP C.8 provision in this report.

C.8.b San Francisco Estuary Receiving Water Monitoring
As described in Provision C.8.b, Permittees are required to contribute their fair-share financially on an annual basis towards implementing an Estuary receiving water monitoring program that at a minimum is equivalent to the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP). During FY 2009-10, Permittees complied with this provision by making financial contributions to the RMP directly or through stormwater programs (Appendix B2). Additionally, Permittees actively participated in RMP committees and work groups through Permittee and/or stormwater program staff as described below. The following sections provide a brief description of the RMP, associated monitoring activities conducted in FY 2009-10, and Permittee participation RMP committees and work groups.

Regional Monitoring Program (RMP)
The Regional Monitoring Program for Water Quality in the San Francisco Estuary is a long-term monitoring program that shares financial support, direction, and participation by regulatory agencies and the regulated community with the goal of assessing water quality in the San Francisco Bay. The regulated community includes Permittees, publicly owned treatment works (POTWs), dredgers and industrial dischargers. The RMP is intended to answer the following core management questions:

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

The RMP budget is generally broken into two major program elements: Status and Trends, and Pilot/Special Studies. The following paragraphs provide a brief overview of these programs.

RMP Status and Trends Monitoring Program
The Status and Trends Monitoring Program (S&T Program) is the long-term contaminant-monitoring component of the RMP. The S&T Program was initiated as a pilot study in 1989 and redesigned in 2007 based on a more rigorous statistical design that enables
the detection of trends. In FY 2009-10, the S&T Program was comprised of the following program elements that collect data to address RMP management questions described above:

- Water/Sediment/Biota Chemistry and Toxicity Monitoring
- Sediment Benthos Monitoring
- Small and Large Tributary Loading Studies
- Small Fish and Sport Fish Contamination Studies
- Studies to Determine the Causes of Sediment Toxicity
- Suspended Sediment, Hydrography and Phytoplankton Monitoring
- Bird Egg Monitoring

Additional information on the S&T Program and associated monitoring data are available for downloading via the RMP website using the Status and Trends Monitoring Data Access Tool at www.sfei.org/rmp/data.htm.

**RMP Pilot and Special Studies**
The RMP also conducts Pilot and Special Studies (P/S Studies) on an annual basis. Studies usually are designed to investigate and develop new monitoring measures related to anthropogenic contamination or contaminant effects on biota in the Estuary. Special Studies address specific scientific issues that RMP committees and standing workgroups identify as priority for further study. These studies are developed through an open selection process at the workgroup level and selected for funding through RMP committees. Results and summaries of the most pertinent P/S Studies can be found on the RMP website (www.sfei.org/rmp/).

**Participation in Committees, Workgroups and Strategy Teams**
In FY 2009-10, Permittees actively participated in the following RMP committees and work groups:

- Steering Committee (SC)
- Technical Review Committee (TRC)
- Sources, Pathways and Loadings Workgroup (SPLWG)
- Contaminant Fate Workgroup (CFWG)
- Exposure and Effects Workgroup (EEWG)
- Emerging Contaminant Workgroup (ECWG)
- Sport Fish Monitoring Workgroup
- Toxicity Workgroup
- Strategy Teams (e.g., PCBs, Mercury, Dioxins, Small Tributaries)

Committee and workgroup representation was provided by Permittee, stormwater program staff and/or designees that were agreeable to RMC participants and the BASMAA Board of Directors (BOD). Representation included participating in meetings, reviewing technical reports and work products, co-authoring articles included in the RMP’s Pulse of the Estuary, and providing general program direction to RMP staff. Representatives of the RMC also provided timely summaries and updates to, and
received input from stormwater programs representative (on behalf of Permittees) during MPC and/or BOD meetings to ensure Permittees interests were adequately represented.

C.8.c  Creek Status Monitoring

Provision C.8.c requires Permittees to conduct creek status monitoring that is intended to answer the following management questions:

1. Are water quality objectives, both numeric and narrative, being met in local receiving waters, including creeks, river and tributaries?
2. Are conditions in local receiving waters supportive of or like supportive of beneficial uses?

Creek status monitoring parameters, methods, occurrences, durations and minimum number of sampling sites for each stormwater program are described in Table 8.1 of the MRP. Based on the implementation schedule described in MRP Provision C.8.a(ii), Permittees were not required to conduct creek status monitoring in FY 2009-10. Alternatively, Permittee and stormwater program staff (on behalf of Permittees) spent considerable time identifying and scoping RMC projects included in the Draft RMC Work Plan. Planning efforts conducted in FY 2009-10 were intended to assist Permittees in designing and implementing a regional creek status monitoring program that will allow each stormwater program to assess the status of local water bodies, while contributing data to answering regional questions about water quality and beneficial use condition in all Bay Area creeks.

As described in the RMC Draft Work Plan, most creek status monitoring tasks will begin in FY 2010-11, with the exception of standard operating and data quality assurance procedure development, which is described under Provision C.8.h in this report. Additional information on the status of RMC tasks associated with Provision C.8.c (Creek Status Monitoring) will be included in future Annual Reports.

C.8.d  Monitoring Projects

Three types of monitoring projects are required by Provision C.8.d of the MRP: 1) Stressor/Source Identification (C.8.d.i); 2) BMP Effectiveness Investigation (C.8.d.ii); and 3) Geomorphic Project (C.8.d.iii). Based on the compliance schedules described in the MRP for these provisions, in FY 2009-10 Permittees focused mostly on scoping future collaborative RMC projects associated with these requirements. These projects are generally described in the Draft RMC Work Plan (see Appendix B1) and will be implemented in future fiscal years.
C.8.e  Pollutants of Concern and Long-Term Trends Monitoring

POC Loads Monitoring
Pollutants of Concern (POC) loads monitoring is required by Provision C.8.e (i) of the MRP. Loads monitoring is intended to assess inputs of POCs to the Bay from local tributaries and urban runoff, assess progress toward achieving wasteload allocations (WLAs) for TMDLs, and help resolve uncertainties associated with loading estimates for these pollutants. In particular, there are four priority management questions that need to be addressed through POC loads monitoring:

1. Which Bay tributaries (including stormwater conveyances) contribute most to Bay impairment from POCs;
2. What are the annual loads or concentrations of POCs from tributaries to the Bay;
3. What are the decadal-scale loading or concentration trends of POCs from small tributaries to the Bay; and
4. What are the projected impacts of management actions (including control measures) on tributaries and where should these management actions be implemented to have the greatest beneficial impact.

Based upon compliance schedules described in MRP Provision C.8.a(ii), participants of the RMC are required to begin POC loads monitoring in October 2011. Therefore, RMC participant activities associated with POC loads monitoring during FY 2009-10 were generally spent preparing for monitoring in future years. More specifically, Permittees continued to monitor POC loads via the RMP (i.e., Zone 4 – Line A) and began exploring alternative approaches to POC loads monitoring prescribed in Provision C.8.e. As described below, Permittee exploration of alternative approaches occurred through the RMP’s Small Tributary Loading Strategy (STLS) Team, which includes RMC representatives, Water Board staff, RMP staff and technical advisors.

Small Tributaries Loading Strategy (STLS)
To assist Permittees in effectively and efficiently conducting POC loads monitoring required by the MRP and answer POC loads management questions, a draft Small Tributaries Loading Strategy (STLS) was developed in 2009 by the STLS Team (Appendix B3). The objective of the STLS is to develop a comprehensive planning framework for POC loads monitoring/modeling within which associated activities conducted via the RMP and monitoring by Permittees in compliance with the MRP will be complementary.

FY 2009-10 STLS Projects
Consistent with the STLS, POC loads monitoring continued at one station and special studies designed inform future loads monitoring were conducted via the RMP in FY 2009-10. More specifically, the following three RMP special studies related to POC loads monitoring began/continued in FY 2009-10:
• **Small Tributaries Loads Monitoring** – Loads monitoring continued in Zone 4-Line A, a small flood control channel located in Hayward that drains to the Bay. The watershed draining to the monitoring site is highly impervious and comprised of mostly industrial land use. Fiscal Year 2009-10 served as the fourth year of monitoring at this site.

• **Watershed Categorization** - The STLS Team conducted a desktop study in FY 2009-10 that categorized watersheds into different “types” based on a variety of watershed characteristics (e.g., land use, imperviousness, area, sediment loading, and contaminant history). The goal of this study was to assist the RMP and Permittees in selecting groups of tributaries where POC loads monitoring will occur.

• **Sampling Methods Comparison** - This study evaluated a variety of POC loads sampling methods, including currently employed RMP sampling methods (e.g., turbidity surrogate) and MRP default sampling methods (i.e., flow-weighted composite), in an effort to develop recommendations on the most cost effective methods that could be employed Permittees and still adequately address POC loads management questions.

Results of these studies are currently in draft form and will be finalized by early 2011. Additional STLS studies that began in FY 2009-10 include the initial development of a spreadsheet model designed to estimate POC loads from specific watersheds to the Bay, and scoping the need for the development of Event Mean Concentrations (EMCs) for specific POCs. These studies/projects are planned to be completed in FY 2010-11 via the RMP and intended to provide additional tools to assist Permittees in answering POC loads management questions.

**FY 2010-11 Projects**

In addition to STLS projects mentioned above that will continue in FY 2010-11, an additional related project will also begin in late 2010. As an alternative to conducting long-term POC loads monitoring at bottom of watershed locations (e.g., Zone 4 – Line A), the STLS Team agreed that the RMP should conduct a geographically broader study in FY 2010-11 to characterize POC concentrations in a number of small tributaries in the Bay Area. The STLS Team is currently developing the full scope of the study, but it will generally be designed to further assist Permittees in selecting POC loads monitoring sites. The project will occur early in the FY 2010-11 wet weather season (October 2010 – April 2011) and entail the collection and analysis of POCs in water from between 15 and 20 small tributaries during one or two storms. The proposed list of POC analytes for this reconnaissance includes PCBs, total mercury, PBDEs, and polycyclic aromatic hydrocarbons (PAHs). A report documenting the results of the characterization study is planned for completion in early 2011.

All FY 2009-10 and FY 2010-11 STLS studies described above are intended to assist Permittees in complying with Provision C.8.e through alternative approaches to those prescribed in the MRP. Based on the results of these studies and Permittee input, RMC participants may choose to propose an alternative approach to POC loads monitoring to the Water Board’s Executive Officer (EO). If an alternative approach is agreed to
among RMC participants, an RMC *Multi-Year POC Loads Monitoring Plan* (POC Loads Monitoring Plan) documenting the alternative approach will be submitted to the Water Board EO for approval prior to commencement of POC loads monitoring required by the MRP (October 2011). The POC Loads Monitoring Plan will include the rationale for the choice of sampling locations and methods (i.e., number and type of samples, number of storms, and recurrence interval for sampling).

**Long-Term Trends Monitoring**

In addition to POC loads monitoring, Provision C.8.e requires Permittees to conduct long-term trends monitoring to evaluate if stormwater discharges are causing or contributing to toxic impacts on aquatic life. Required long-term monitoring parameters, methods, intervals and occurrences are included in Table 8.4 of the MRP and prescribed long-term monitoring locations are included in Table 8.3. Applying MRP Provision C.8.a in a manner similar to that described above for creek status and POC loads monitoring, long-term trends monitoring is scheduled to begin in October 2011 for RMC participants.

The State of California’s Surface Water Ambient Monitoring Program (SWAMP) through its Statewide Stream Contaminant Trend Monitoring Program currently monitors the seven long-term monitoring sites required by Provision C.8.e.ii, at the sampling occurrence and interval described in Provision C.8.e.iii in the MRP. Although a long-term trends design for creeks will likely be included in the design of the RMC creeks monitoring design, at this time, RMC participants continue to assume that SWAMP will continue to conduct long-term monitoring at a level of effort necessary to comply with the long-term trends requirement in the MRP (as allowed by Provision C.8.e.ii). In FY 2010-11, RMC representatives will confirm that SWAMP will continue the current level of effort of this program in future years and plan accordingly.

**Sediment Delivery Estimate/Budget**

Provision C.8.e(vi) of the MRP requires Permittees to develop a design for a robust sediment delivery estimate/sediment budget in local tributaries and urban drainages, and implement the study by July 1, 2012. The purpose of the sediment delivery estimate is to improve the Permittees’ ability to estimate urban runoff contributions to loads of POCs, which are generally closely associated with sediment. To determine a strategy for a robust sediment estimate/budget, the BASMAA Board of Directors (BOD) approved a Regional Project in FY 2009-10 to begin reviewing current sediment delivery estimates, better define the objectives for improvement and determine what additional work is needed in FY 2010-11. Tasks that may be coordinated through the RMC include: 1) updating sediment delivery estimates recently completed via the RMP by incorporating an improved watershed boundaries dataset, that will also be the basis for future spreadsheet modeling of POC loads under the STLS; 2) listing potential data needs and the extent to which they will be filled through the STLS and MRP creek monitoring; and 3) identifying methods and a schedule for incorporating the above to produce a robust estimate/budget. Additional information on the status of this project will be included in the FY 2010-11 Annual Report.
Emerging Pollutants Work Plan
In compliance with Provision C.8.e.v, Permittees are required by March 2014 to develop a work plan and schedule for initial loading estimates and source analyses for the following emerging pollutants: 1) endocrine-disrupting compounds; 2) PFOS/PFAS (Perfluorooctane Sulfonates (PFOS); 3) Perfluoroalkyl Sulfonates (PFAS); and 4) and NP/NPEs (nonylphenols/nonylphenol esters —estrogenlike compounds). The intent of the work plan is to begin planning for implementation during the next permit term (i.e., post December 2014). Because the compliance date for completion of this work plan is over four years into the future, only initial discussions of the scope of this project were discussed in FY 2009-10 by the MPC. BASMAA Representatives t the RMP will coordinate efforts with the Emerging Contaminants Strategy being developed by the RMP through the Master Planning process. Additional information on the status of this project will be provided in subsequent Annual Reports.

C.8.f  Citizen Monitoring and Participation
Participants of the RMC, to varying degrees, currently coordinate with or support citizen monitors within their geographical areas. As a result, relationships have been developed between RMC participants and citizen monitors. In FY 2009-10, Permittees began to plan for future coordination with citizen monitors in their respective geographical areas. Information sharing among RMC participants about activities designed to encourage citizen monitoring is planned to occur in FY 2010-11 and future years at MPC meetings.

C.8.g  Reporting
Provision C.8.g requires Permittees to report annually on water quality data collected in compliance with the MRP. Annual reporting requirements include: 1) water quality standard exceedances; 2) creek status monitoring electronic reporting; and 3) urban creeks monitoring reporting. For RMC participants, annual reporting requirements begin following monitoring which is scheduled to commence in October 2011. Therefore, reporting of water quality monitoring data collected in compliance with the Provision C.8 of the MRP is not required in this FY 2009-10 Annual Report.

In preparation for the development of future annual reports described above, and less frequent reporting requirements included in Provisions C.8.g.iv (Monitoring Project Reports) and C.8.g.v (Integrated Monitoring Report), the Draft RMC Work Plan describes projects planned for implementation in future fiscal years. These projects include: 1) standardized reporting templates for creek status electronic reporting; 2) model annual urban creeks monitoring report templates; and 3) reporting templates and outlines for the integrated monitoring report due near the end of the permit term.

C.8.h  Monitoring Protocols, Data Quality and Data Management
Provision C.8.h requires that water quality data collected by Permittees in compliance with the MRP should be of a quality that is consistent with the State of California’s Surface Water Ambient Monitoring Program (SWAMP) standards, set forth in the SWAMP
Quality Assurance Project Plan (QAPP). To assist Permittees in meeting SWAMP data quality standards and developing data management systems that allow for easy access of water quality monitoring data by Permittees, the RMC began scoping and/or implementing regional projects in FY 2009-10. These include:

- **Standard Operating and Data Quality Assurance Procedures** – Two projects designed to address monitoring protocols and data quality requirements described in Provision C.8.h were approved by the BOD in FY 2009-10. The first entails the development of a new field standard operating procedure (SOP) and quality assurance project plan (QAPP) for POC loads monitoring. The SOP and QAPP will be completed in FY 2010-11 once a final sampling methodology for POC loads monitoring is agreed to by RMC participants (see POC Loads Monitoring discussion). The second project entails the adaptation of existing creek status monitoring SOPs and QAPP developed by SWAMP or creation of new SOPs, as necessary, that document the field procedures necessary to maintain comparable and high quality data region-wide. The project is also scheduled for completion in FY 2010-11.

- **Information Management System Development/Adaptation** – As described in the Draft RMC Work Plan, participants would like to store and manage water quality data collected in compliance with Provision C.8 in a cost effective manner that allows data users to easily access and query data and information. Therefore, in FY 2009-10 the RMC began scoping a series of Regional Projects that are scheduled to begin in FY 2010-11 and designed to develop new or adapt existing Information Management Systems (IMSs) for use by the RMC. The goal of these projects is to provide standardized data storage formats, thus providing a mechanism for sharing data among RMC participants. MRP Provision C.8.e.vi requires Permittees to develop a design for a robust sediment delivery estimate/sediment budget in local tributaries and urban drainages, and implement the study by July 1, 2012. The purpose of the sediment delivery estimate is to improve the Permittees’ ability to estimate urban runoff contributions to loads of Pollutants of Concern, which are generally closely associated with sediment.
ACRONYMS AND ABBREVIATIONS

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<th>Acronym</th>
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<tr>
<td>BASMAA</td>
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<td>BMP</td>
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<td>Wasteload Allocations (in TMDLs)</td>
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MRP Regional Supplement for Pollutants of Concern and Monitoring

Appendix A: Pollutants of Concern


A2 Clean Watersheds for a Clean Bay - Implementing the San Francisco Bay PCBs and Mercury TMDLs with a Focus on Urban Runoff. Bay Area Stormwater Management Agencies Association (BASMAA). April 19, 2010.


A6 RMP Special Study Proposal: Synthesis of Information on Mercury

A7 Coversheet of the Pollutants of Concern Stormwater Inspectors’ Guidance Manual


A11 RMP Special Study Proposal: Synthesis of Information on PCBs

A12 Sustainable Conservation Investor’s Circle Update, Fourth Quarter 2009

A13 SB 346 as amended June 21, 2010

A14 Fact Sheet —Reducing Water Pollution Caused by Vehicle Brake Pads

A15 Fact Sheet on SB 346 as amended June 7, 2010

September 15, 2010
A16 BASMAA Support Letter for SB 346, June 3, 2010
A17 RMP Special Studies Proposal for 2011: Impact of dissolved copper on the olfactory system of seawater-phase juvenile salmon

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MRP Regional Supplement for POCs and Monitoring

Appendix A
Pesticide Regulation for Water Quality Protection

Annual BASMAA Participation Summary and Outcomes Assessment 2010

Documentation of action taken to comply with San Francisco Bay Area Municipal Regional Stormwater NPDES Permit, Order R2-2009-0074, Section C.9.e.

Prepared for the Bay Area Stormwater Management Agencies Association

August 30, 2010
PREFACE

This is a report of research performed by TDC Environmental, LLC for the Bay Area Stormwater Management Agencies Association (BASMAA). This report was prepared to assist San Francisco Bay Area municipalities with documenting compliance with Municipal Regional Stormwater Permit Provision C.9.e. Preparation of this report was funded by the Alameda Countywide Clean Water Program through an agreement with Applied Marine Sciences, Inc.

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ACKNOWLEDGEMENTS

The author greatly appreciates assistance provided by members of the Urban Pesticides Committee in navigating California and Federal pesticide regulatory activities relating to water quality. TDC Environmental thanks the following colleagues and reviewers for their assistance with completing this report:

- BASMAA Monitoring and Pollutants of Concern Committee
- Geoff Brosseau, Bay Area Stormwater Management Agencies Association
- Jamison Crosby, Contra Costa Clean Water Program (CCCWP)
- Arleen Feng and James Scanlin, Alameda Countywide Clean Water Program (ACCWP)
- Athena Honore, San Francisco Estuary Partnership
- Dave Tamayo, Sacramento County Stormwater Quality Program

Thanks are also due to Jamison Crosby of CCCWP and Paul Salop of Applied Marine Sciences for project management.

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EXECUTIVE SUMMARY
Section C.9.e. of the San Francisco Bay Area Municipal Regional Stormwater NPDES Permit (MRP) requires tracking and participating in pesticide-related California and Federal regulatory processes and reporting on these activities. This regional report is intended to document actions taken to comply with Section C.9.e.i. to fulfill the reporting requirement in Section C.9.e.ii. The time period covered by this report is July 1, 2009 through June 30, 2010 (fiscal year [FY] 2010).

During this time period, Bay Area Stormwater Management Agencies Association (BASMAA) members participated in pesticide regulatory activities through the California Stormwater Quality Association (CASQA). CASQA is supported by its statewide membership—including BASMAA agencies—which manage, staff, and fund consultant support for pesticide regulatory engagement. CASQA also relied on the Urban Pesticide Pollution Prevention Project (UP3 Project) for tracking California and Federal pesticide regulatory activities, identifying priorities for municipality engagement, and coordinating CASQA’s regulatory engagement with the pesticide regulatory activities of California municipal wastewater treatment plants and the State Water Resources Control Board and Regional Water Quality Control Boards. All of these agencies relied on the UP3 Project to provide scientific information, regulatory analysis, and assistance in communicating with pesticide regulators.

The ultimate goals of CASQA’s and BASMAA’s pesticide regulatory engagement are to prevent surface water impairment and to prevent violations of stormwater NPDES permits (see Section 4.1). Major FY 2010 objectives were to end pyrethroid-related toxicity in California urban watersheds without transitioning to other harmful products and to encourage changes in California and Federal pesticide regulatory processes such that these processes effectively prevent future water quality and compliance problems.

CASQA’s pesticide regulatory engagement prioritized the pesticides of concern listed in the MRP (see Section 3.2). Pyrethroid insecticides, which have been linked to widespread toxicity in creek waters and sediments, were the highest priority for pesticide regulatory involvement. CASQA wrote 6 letters, participated in 2 public workshops, and 6 regulatory process meetings to provide information and recommendations to pesticides regulators (see Section 3.3 and Table 2). CASQA also shared information with regulators and other stakeholders at four Urban Pesticides Committee meetings and through UP3 Project informal contacts with regulators (Table 2).

Although regulatory processes can take many years to reach outcomes, the results of pesticide regulatory engagement are starting to be evident, and show substantial progress toward the BASMAA, CASQA, and Water Board goals of preventing surface water impairment from pesticides, implementing the Diazinon and Pesticide-Related Toxicity in Bay Area Urban Creeks Water Quality Attainment Strategy and Total Maximum Daily Load, and preventing pesticide-related violations of stormwater NPDES permits (see Section 4 and Table 3). Nevertheless, much additional work will be needed to end pyrethroid-related toxicity in urban watersheds and to achieve the ultimate goal of ensuring that pesticides do not interfere with Clean Water Act compliance.
1.0 INTRODUCTION

1.1 Scope of This Report

The San Francisco Bay Area Municipal Regional Stormwater NPDES Permit includes the following provision for tracking and participating in pesticide-related regulatory processes and for reporting on these activities:

C. 9. e. Track and Participate in Relevant Regulatory Processes (may be done jointly with other Permittees, such as through CASQA or BASMAA and/or the Urban Pesticide Pollution Prevention Project)

i. Task Description

(1) The Permittees shall track USEPA pesticide evaluation and registration activities as they relate to surface water quality, and when necessary, encourage USEPA to coordinate implementation of the Federal Insecticide, Fungicide, and Rodenticide Act and the CWA and to accommodate water quality concerns within its pesticide registration process;

(2) The Permittees shall track California Department of Pesticide Regulation (DPR) pesticide evaluation activities as they relate to surface water quality, and when necessary, encourage DPR to coordinate implementation of the California Food and Agriculture Code with the California Water Code and to accommodate water quality concerns within its pesticide evaluation process;

(3) The Permittees shall assemble and submit information (such as monitoring data) as needed to assist DPR and County Agricultural Commissioners in ensuring that pesticide applications comply with water quality standards; and

(4) As appropriate, the Permittees shall submit comment letters on USEPA and DPR re-registration, re-evaluation, and other actions relating to pesticides of concern for water quality.

ii. Reporting – In their Annual Reports, the Permittees who participate in a regional effort to comply with C.9.e. may reference a regional report that summarizes regional participation efforts, information submitted, and how regulatory actions were affected. All other Permittees shall list their specific participation efforts, information submitted, and how regulatory actions were affected.

This regional report is intended to document actions taken to comply with Section C.9.e.i. to fulfill the reporting requirement in Section C.9.e.ii. The time period covered by this report is July 1, 2009 through June 30, 2010 (fiscal year [FY] 2010).

1.2 Report Organization

This report is organized as follows:

- Section 1 (this section) provides the scope and organization of the report.
Section 2 explains why BASMAA members have joined municipalities across California in participating in pesticide regulatory activities and summarizes the major California and Federal pesticide review processes.

Section 3 summarizes FY 2010 pesticide regulatory engagement.

Section 4 evaluates the outcomes of pesticide regulatory engagement to the extent that outcomes were known as of July 2010 (most pesticide regulatory processes of interest in FY 2010 are still underway).
2.0 BACKGROUND

2.1 Pesticides and Water Quality—A Regulatory Gap

Numerous scientific studies have demonstrated that use of some pesticides registered in accordance with Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requirements can adversely affect aquatic species. Those impacts can, in turn, cause violations of water quality standards. As a result of discharges containing pesticides registered for use by the U.S. Environmental Protection Agency (U.S. EPA), many surface waters in California have been designated as “impaired” in accordance with Federal Clean Water Act §303(d). This finding means that the surface waters do not meet water quality standards. These listings demonstrate that current U.S. EPA and California Environmental Protection Agency (Cal-EPA) procedures for regulating pesticides are insufficient to ensure that pesticide use does not cause violations of the Federal Clean Water Act and California Porter-Cologne Water Quality Control Act.

Federal law provides U.S. EPA with the ability to protect surface water from pesticides. California law technically provides two parts of the California Environmental Protection Agency (Cal-EPA), the California Department of Pesticide Regulation (DPR) and California state water quality regulators, with the ability to protect surface water from pesticides. Except in extraordinary circumstances, California Water Boards defer pesticides regulation to DPR.

While the mandates of these pesticide and water quality laws differ slightly, the approaches to implementing these two groups of laws are very different and have important ramifications for pesticides and water quality. In general, pesticide regulatory programs are structured to respond slowly when water quality problems occur—and without financial penalties to pesticide manufacturers or users. In contrast, water quality programs are generally structured to react quickly when water quality problems occur—with immediate financial consequences, particularly for municipalities. Pesticide regulators and water quality regulators employ very different procedures to manage pesticides. While these differences sometimes seem arcane, they create regulatory gaps that leave states and municipalities responsible for solving water quality problems that could have been prevented at the time a pesticide was registered or re-registered.

Three groups of agencies that manage California’s water quality are working with pesticide regulators to address this regulatory gap: the State Water Resources Control Board and Regional Water Quality Control Boards (“Water Boards”), municipal wastewater treatment plants (also known as sewage treatment plants or publicly-owned treatment works [POTWs]), and urban runoff management agencies (including BASMAA members). This report refers to these three groups of agencies collectively as “California water quality agencies.”

Urban runoff management agencies—including BASMAA’s members—have conducted their portion of this effort through their statewide organization, the California Stormwater Quality Association (CASQA).

Why California Municipalities Are Working with Pesticide Regulators

California municipalities began regular engagement in pesticide regulatory processes because they had concluded that the most cost-effective approach to protecting surface water from pesticide-related toxicity is to prevent pesticide uses that have significant potential to cause water quality impairment or that cause violations of NPDES permits.
Preventing water quality problems at the source is well known to be more effective—and far less costly—than alternatives.

The recent scientific finding that pyrethroid insecticides are linked to widespread toxicity to sediment-dwelling organisms in California urban creeks\(^1\) has increased the importance of active California municipality participation in California and Federal pesticide regulatory processes. Since California law precludes local regulation of pesticides, municipal urban runoff programs must rely on pesticide regulators to solve this problem.

**Role of the Urban Pesticide Pollution Prevention Project (UP3 Project)**

Because understanding and participating in regulatory activities is complex and time-intensive, CASQA, the Water Boards, and POTWs found that they needed scientific and regulatory support to participate in pesticide regulatory processes. The Urban Pesticide Pollution Prevention (UP3) Project was established in mid-2004 specifically to provide this much-needed support.

To maximize the effectiveness of their pesticide regulatory involvement and minimize cost, CASQA, the Water Boards, and POTWs have organized their pesticide regulatory involvement efforts jointly. Since its inception, the UP3 Project has taken on the role of coordinating the joint cooperative regulatory involvement effort.

The UP3 Project supports California water quality agency participation in pesticide regulatory actions by identifying and tracking pesticide regulatory processes of significant interest for water quality, analyzing pesticide regulatory documents to identify water quality protection gaps, and reviewing scientific studies to assemble the information needed to fill the identified gaps. The UP3 Project assists water quality agencies with communicating this information directly to regulators at U.S. EPA, and California Department of Pesticide Regulation (DPR) through letters, meetings, informal communications, and presentations.

To coordinate agency activities and facilitate dialog, the UP3 Project also manages the Urban Pesticides Committee (UPC), which serves as a center for information exchange, coordination, and collaboration among local, regional, and state agencies and other stakeholders seeking to end pesticide-related surface water toxicity problems.

The UP3 Project operates an announcement-only e-mail list for UPC members to keep them up to date on regulatory, scientific, and educational program developments.

The UP3 Project also maintains a web site ([www.up3project.org](http://www.up3project.org)) that provides documents and other resources to assist agencies with implementing programs to prevent pesticide-related water quality problems.

From its inception through 2010, UP3 Project has been funded by a State Water Resources Control Board grant administered by the San Francisco Estuary Partnership (SFEP). TDC Environmental has provided technical support for the project.

The UP3 Project is currently seeking funding to allow it to continue after the end of 2010.

### 2.2 U.S. EPA and DPR Pesticide Review Processes

California water quality agencies primarily engage with pesticide regulators within the existing regulatory processes established by U.S. EPA and DPR. Both U.S. EPA and

DPR have processes to review pesticides prior to their first use and processes to respond to human health and environmental problems that occur after a pesticide is approved for use. Both agencies also have the responsibility to review all pesticides periodically. Table 1 (on the next two pages) provides a brief description of the various pesticide review processes conducted by U.S. EPA and DPR and identifies the public input opportunities associated with each process.

If a pesticide-related water quality problem (like the problems with diazinon, chlorpyrifos, and the pyrethroids) is documented in the environment, the DPR regulatory process offers the most immediate response mechanism. DPR’s pesticide “reevaluation” process is structured to respond to environmental problems more rapidly than the “special review” process at U.S. EPA.

On the basis of the structure of the public involvement processes and the nature pesticide regulatory agency authorities, two pesticide regulatory processes have been the focus of regulatory engagement: U.S. EPA Pesticide Registration Review and California DPR pesticide reevaluation. While the focus is on engagement in formal regulatory processes, the participation has extended to less formal situations, to facilitate a sharing of scientific information and to increase mutual understanding of the regulatory context provided by California and Federal pesticide and water quality legal frameworks.
### Table 1: Summary of U.S. EPA and DPR Pesticide Review Processes

<table>
<thead>
<tr>
<th>Agency</th>
<th>Process</th>
<th>Description</th>
<th>Overview of Public Input Opportunities</th>
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<tr>
<td>U.S. EPA</td>
<td>Registration</td>
<td>New pesticides must be registered or exempted by U.S. EPA before they may be sold. New uses of existing pesticides must also be registered. During registration, U.S. EPA evaluates effects on humans and the environment (including surface water).</td>
<td>Other than making its registration workplan available, U.S. EPA has no public involvement process for pesticide registration.</td>
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<td>Registration review</td>
<td>All currently registered pesticides are planned for review on a 15-year cycle. Each pesticide’s review process starts with a &quot;docket opening,&quot; which is an opportunity to submit scientific information and to comment on the registration review workplan. Subsequent steps are established by the workplan.</td>
<td>Public involvement opportunities after the docket opening depend on the workplan; these may include opportunities to review U.S. EPA-prepared risk assessments, to provide recommendations for risk reduction options, and to comment on U.S. EPA’s proposed registration review decision.</td>
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<td></td>
<td>Special review</td>
<td>U.S. EPA initiates special review when it discovers that the use of a registered pesticide may result in unreasonable adverse effects on humans or the environment. The special review process usually involves intensive review of a specific problem. During special review, U.S. EPA may review scientific information, re-evaluate the identified risk, and select risk reduction measures.</td>
<td>Processes vary. At a minimum, the public is offered the opportunity to comment on the decision proposed by U.S. EPA on the basis of its special review.</td>
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3 Schedules are available on the Internet: http://www.epa.gov/oppsrrd1/registration_review/schedule.htm
Table 1: Summary of U.S. EPA and DPR Pesticide Review Processes (Continued)

<table>
<thead>
<tr>
<th>Agency</th>
<th>Process</th>
<th>Description</th>
<th>Overview of Public Input Opportunities</th>
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<tr>
<td>DPR</td>
<td>Registration</td>
<td>California has a state requirement for pesticide registration. Like U.S. EPA, it evaluates effects on humans and the environment. Unlike U.S. EPA (which reviews products containing the same active ingredient as group) DPR registers each pesticide product individually. DPR determines whether to evaluate a pesticide product’s potential to cause surface water quality or wastewater discharge impacts on a case by case basis.</td>
<td>Other than making lists of products entering review available, DPR has no public involvement process for pesticide registration. By providing these lists to its interagency advisory committee (the Pesticide Registration and Evaluation Committee), DPR provides an opportunity for interagency consultation.</td>
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<td>Annual Registration Renewal</td>
<td>California law requires annual renewal of all pesticide registrations. This review is very brief; ordinarily, registrations are renewed if fees are paid and if registrants certify compliance with the requirement to disclose factual or scientific evidence of any adverse effect or risk of the pesticide to human health or the environment.</td>
<td>DPR issues a formal notice of the proposed annual renewal for all pesticides and provides a comment period. Because the notice does not include pesticide-specific information, the process serves as an annual opportunity for the public to provide DPR with information about adverse effects of pesticides.</td>
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<td></td>
<td>Reevaluation</td>
<td>If DPR finds that a significant adverse impact has occurred or is likely to occur from the use of a pesticide, it initiates a reevaluation. During reevaluation, DPR reviews existing data and may require development of additional data related to the impacts of the pesticide. DPR’s goal is to identify ways to reduce or eliminate confirmed problems.</td>
<td>DPR has no formal public involvement process for reevaluation; however, it has offered selected stakeholders opportunities to review various documents associated with the reevaluation of pyrethroid insecticides. DPR usually consults with its interagency advisory committee (the Pesticide Registration and Evaluation Committee) when approaching major reevaluation decisions.</td>
</tr>
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</table>
3.0 PESTICIDE REGULATORY ENGAGEMENT SUMMARY

3.1 BASMAA Participated through CASQA and UP3 Project

Since 2005, urban runoff management agencies—including BASMAA’s members—have conducted their engagement in pesticide regulatory activities through their statewide organization, the California Stormwater Quality Association (CASQA). In keeping with this strategy, the BASMAA Monitoring/Pollutants of Concern (POC) Committee established that BASMAA’s FY 2010 pesticide regulatory involvement would be conducted via CASQA. In FY 2010, MRP Permittees participated in pesticide regulatory processes through CASQA.

CASQA has a Pesticides Subcommittee that manages its day-to-day involvement in pesticide regulatory activities. In fiscal year 2010, the subcommittee had two co-chairs: Jamison Crosby of the Contra Costa Clean Water Program (CCCWP) and Dave Tamayo of the Sacramento County Stormwater Quality Program. Ten teleconference meetings were held in FY 2010. Representatives of the Alameda Countywide Clean Water Program (ACCWP), the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), and the City of Palo Alto are also on the subcommittee roster. Both CCCWP and ACCWP actively participated in subcommittee meetings in FY 2010.

The CASQA Pesticides Subcommittee coordinates stormwater agency participation in pesticide regulatory activities. The subcommittee determines the actions to be taken by CASQA, provides direction to its representatives for participation in agency meetings, peer reviews draft correspondence, and shares information among members. As co-chair, Ms. Crosby has assumed a role in identifying financial resources necessary to support CASQA’s activities (which are obtained not only from CASQA but also through contributions from member agencies) and in managing committee-related contracts.

Ms. Crosby provides the linkage between CASQA and the BASMAA Monitoring/POC Committee.

3.2 Engagement Prioritized Pesticides of Concern in the MRP

U.S. EPA and DPR regulatory processes involve thousands of pesticides each year. Only a small fraction of these pesticides pose significant threats to the quality of urban runoff. CASQA has focused its participation in pesticide regulatory processes on pesticides identified by the UP3 Project as most likely to threaten urban surface water quality through urban runoff. Of these pesticides, the highest priorities are the same current-use pesticides listed as pesticides of concern in the MRP (pyrethroids, fipronil, carbamates, and organophosphorous pesticides).

On the basis of urban watershed monitoring data from across California and urban pesticide use estimates assembled by the UP3 Project, when further prioritization is necessary, CASQA has followed the UP3 Project recommendation to prioritize the pyrethroids (bifenthrin, cyfluthrin, beta-cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin, permethrin, and tralomethrin) and fipronil. Among the pyrethroids, those most commonly linked to aquatic toxicity (bifenthrin, cyfluthrin [including beta-cyfluthrin], and cypermethrin) have been prioritized.

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According to UP3 Project analysis, organophosphates (chlorpyrifos, diazinon, and malathion) and carbamates (carbaryl) are lower priorities than the pyrethroids and fipronil. Neither diazinon nor chlorpyrifos pose a continuing threat to urban watersheds now that U.S. EPA has prohibited almost all urban use.\(^6\) Similarly, urban watersheds are benefitting from significant reductions in use of both carbaryl and malathion, likely the consequence of U.S. EPA regulatory requirements.\(^7\)

3.3 Engagement Summary for Fiscal Year 2010

CASQA and UP3 Project Conducted All Four Tasks Listed in MRP Section C.9.e.

CASQA encouraged USEPA and DPR to coordinate implementation of pesticide and water laws to accommodate water quality concerns as required under MRP sections C.9.e.i.(1) and (2) and submitted comment letters as required under C.9.e.1.(4). Table 2 (on the following pages) lists specific CASQA and BASMAA member actions, including meetings and correspondence.

In FY 2010, CASQA relied on the UP3 Project to complete the pesticide evaluation and registration activities tracking required under C.9.e.i.(1) and (2) and the assembly and submittal of information to DPR as required under C.9.e.i.(3). UP3 Project regulatory tracking tables for FY 2010 are available on the UP3 Project website together with other Urban Pesticides Committee (UPC) meeting materials. Due to the suspension of grant funding for part of the fiscal year, tracking tables were prepared four times during the fiscal year instead of bimonthly. UP3 Project submittal of information to DPR is included in Table 2.

During the UP3 Project’s 2009 grant hiatus, UP3 Project regulatory tracking, communications with U.S. EPA and DPR, and one FY 2010 UPC meeting were partially funded by two Bay Area municipalities: the Cities of San Francisco and Palo Alto. (Other funding was provided by other CASQA members and by POTWs).

California Pyrethroid Reevaluation Was 2010 Priority

Responding to widespread toxicity in California surface waters linked to pyrethroid insecticides, in August 2006 DPR initiated regulatory action (“reevaluation”) to identify mitigation measures to address the toxicity. DPR has offered California water quality agencies—including CASQA—opportunities to provide information at various junctures in the pyrethroid reevaluation. Participating in DPR’s pyrethroid reevaluation was the top priority for CASQA in FY 2010. DPR has responded to California water quality agency engagement—the level of interagency information-sharing occurring in the pyrethroid reevaluation is unprecedented in the history of DPR reevaluations.

\(^6\) For this reason they were dropped from the UP3 List of pesticides of concern in urban runoff (see TDC Environmental (2010). Pesticides in Urban Runoff, Wastewater, and Surface Water. Annual Review of new Scientific Findings 2010. Prepared for the UP3 Project. March.)

### Table 2: Pesticide Regulatory Process Participation in FY 2010

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<th>Organization</th>
<th>Process</th>
<th>Action</th>
<th>Desired Outcome</th>
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Thanked U.S. EPA for initiating project, requested project scope expansion to include differences in aquatic toxicity test species, asked that the U.S. EPA project team be expanded to include OW Office of Wastewater Management, and that the project be designed to consider both fresh and salt water.  
Oral testimony by representatives of CASQA, CCCWP, ACCWP, and SCVURPPP at U.S. EPA stakeholder meeting – January 22, 2010  
Thanked U.S. EPA for conducting the project, explained the regulatory gap caused by inconsistent effects assessment methods between the two U.S. EPA Offices, provided examples of aquatic toxicity resulting from this gap, described costs to municipalities to respond to this toxicity, and requested that U.S. EPA expand the scope of the project to resolve the toxicity testing differences. | Expand project scope to examine approaches for coordinating OPP’s effects assessments with the OW-approved toxicity testing procedures.  
Educate U.S. EPA OPP environmental risk assessors.  
Draw attention to pesticide-related toxicity in urban watersheds and ask U.S. EPA to change its regulatory processes so that they identify and prevent this toxicity. |
Supported U.S. EPA’s intention to require disclosure of pesticide inert ingredients. Urged U.S. EPA to develop this rule so as to capture the full range of such chemicals that may be harmful to human health or the environment, and to require public disclosure of their presence in any products that are available for use by “consumers” including both government agencies and the general public. Provided responses to specific questions raised by U.S. EPA describing how the regulation could best be designed to assist with water quality protection.  
San Francisco Department of the Environment letter – April 21, 2010  
Echoed CASQA’s comments plus provided information based on City experience operating a municipal integrated pest management program. | Disclosure of pesticide inert ingredient identities to assist with efforts to prevent water pollution. Of interest because some “inert” (other) pesticide ingredients are water pollutants; others facilitate the transport of pesticides into urban runoff. |
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<th>Organization</th>
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<tr>
<td>U.S. EPA</td>
<td>Esfenvalerate Registration</td>
<td>CASQA letter – February 16, 2010&lt;br&gt;Requested specific changes to Registration Review workplan, including an exposure assessment for urban uses of esfenvalerate including both water column and sediments as well as cumulative risks with other pyrethroids in urban watersheds. Supported proposed environmental risk assessment data request list. Recommended utilization of existing information from the scientific literature, from surface water monitoring programs, and from the DPR pyrethroid reevaluation.</td>
<td>Changes to the registration review process to better identify and mitigate urban water quality impacts and adoption of these changes as part of U.S. EPA’s overall approach to the registration review process for all pesticides with urban use patterns.</td>
</tr>
<tr>
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<td>Review</td>
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<tr>
<td>Deltamethrin</td>
<td>Registration Review</td>
<td>CASQA letter - June 1, 2010&lt;br&gt;Requested specific changes to Registration Review workplan, including an exposure assessment for urban uses of deltamethrin including both water column and sediments as well as cumulative risks with other pyrethroids in urban watersheds. Recommended utilization of existing information from surface water monitoring programs and from the DPR pyrethroid reevaluation.</td>
<td>Changes to the registration review process to better identify and mitigate urban water quality impacts and adoption of these changes as part of U.S. EPA’s overall approach to the registration review process for all pesticides with urban use patterns.</td>
</tr>
<tr>
<td>None</td>
<td>The UP3 Project provided the following information to U.S. EPA:</td>
<td>Information on fipronil to support concerns about its presence in urban runoff – December 2009&lt;br&gt;Paper on urban runoff modeling approaches - January 2010&lt;br&gt;Conceptual model for pyrethroids in urban runoff – March 2010</td>
<td>Improve U.S. EPA’s scientific understanding of pesticides in urban runoff such that EPA has sufficient scientific information to structure regulatory processes to ensure that pesticide applications comply with water quality standards.</td>
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### Table 2: Pesticide Regulatory Process Participation in FY 2010 (Continued)

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<th>Organization</th>
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| DPR          | Pyrethroid Reevaluation | CASQA/PWG Meeting – July 22, 2009  
At DPR’s request, CASQA representatives, including Jamison Crosby of CCCWP, met directly with PWG to explain concerns with the slow pace of the pyrethroids reevaluation including the potential for high monitoring costs for municipalities due to pyrethroids and associated toxicity, and the ongoing threat of third-party lawsuits. CASQA asked for faster progress and for the next steps to be rooted in a conceptual model developed on the basis of the extensive existing scientific literature about pollutants in urban runoff. CASQA and PWG agreed that communications processes for to the pyrethroid reevaluation needed to be improved.  
**CASQA/PWG Meeting – December 9, 2009**  
At DPR’s request, CASQA met with PWG to provide verbal comments to PWG on its draft conceptual model for pyrethroids in urban runoff and a draft list of scientific studies proposed to fill what PWG had identified as priority data gaps. Agreed with the general conceptual model with some minor modifications, but found the model was not structured in a manner that meets the needs for the next steps in the pyrethroid reevaluation.  
Recommended significant modifications to the list of scientific studies and an urban runoff literature review to eliminate perceived data gaps and provide a scientifically based focus for study designs and mitigation proposals. | End pyrethroid-related toxicity in California urban watersheds without transitioning to other harmful products.  
Educate DPR about pesticide-related toxicity in urban watersheds. Ask DPR to change its regulatory processes so that it identifies and prevents such toxicity. |
| PWG Controlled Urban Pyrethroid Applications and Monitoring Study – CASQA Letter July 10, 2009  
Recommended against pursuing this study proposal because it would be time-consuming and would have a low probability of providing useful information. Detailed scientific comments supported these points. |
### Table 2: Pesticide Regulatory Process Participation in FY 2010 (Continued)

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<td>DPR</td>
<td>Pyrethroid Reevaluation</td>
<td>PWG Applicator Survey Proposal – Input to Sacramento County Letter to DPR, January 28, 2010 Because DPR afforded an abbreviated review period for this PWG study proposal, CASQA did not have time to complete required internal peer review prior to submitting a letter. To provide a quicker alternative, Sacramento County volunteered to incorporate CASQA’s recommendations into a letter to DPR. Recommendations included focusing the survey on priority data gaps about professional structural pest control identified by the UP3 Project (differentiating outdoor, indoor, underground, and pre-construction termiticide applications and understanding the relative quantities applied on outdoor impervious and pervious surfaces); reducing the survey length and taking other actions to increase participation; and making other changes to increase the validity of survey results.</td>
<td>See above</td>
</tr>
<tr>
<td>CASQA meeting with DPR &amp; Water Boards – March 17, 2010</td>
<td>Requested faster pace toward ending pyrethroid-related toxicity in urban watersheds. Explained concerns with the slow pace of the pyrethroids reevaluation including the potential for high monitoring costs for municipalities due to pyrethroids and associated toxicity, and the ongoing threat of third-party lawsuits. DPR announced its intent to initiate monthly stakeholder meetings, and requested participation of CASQA decision-makers. CASQA agreed. Obtained insight into practical aspects of various DPR regulatory options to address pyrethroid-related toxicity.</td>
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</table>
### Table 2: Pesticide Regulatory Process Participation in FY 2010 (Continued)

<table>
<thead>
<tr>
<th>Organization</th>
<th>Process</th>
<th>Action</th>
<th>Desired Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPR</td>
<td>Pyrethroid Reevaluation</td>
<td>DPR Pyrethroid Reevaluation Stakeholder Meetings (PRSM meetings) – Monthly starting in May 2010 (two in FY 2010)</td>
<td>See above</td>
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<td>Initiated monthly meetings among DPR, CASQA, the Water Boards, POTWs, PWG, and professional pest control applicators to improve communications, to conduct joint fact finding, to identify priority data gaps requiring additional information to be generated by pyrethroid manufacturers, and to identify mitigation strategies to end pyrethroid-related toxicity in urban watersheds.</td>
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<td></td>
<td></td>
<td>In FY 2010 meetings, the stakeholder group came to agreement on a conceptual model for pyrethroids in urban runoff, shared information about the feasibility and environmental benefits of various pyrethroid mitigation strategies, and shared relevant scientific information with DPR and other stakeholders. CASQA and the UP3 Project provided the following information to DPR at FY 2010 meetings:</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• A CASQA-UP3 Project alternative conceptual model for pyrethroids in urban runoff prepared with joint funding from the UP3 Project.</td>
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<tr>
<td></td>
<td></td>
<td>• A UP3 Project compilation of bifenthrin monitoring data for urban runoff and urban watersheds across California.</td>
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<td></td>
<td></td>
<td>• A UP3 Project compilation of available pyrethroid environmental fate data to highlight data gaps and to show indications that bifenthrin’s slow environmental degradation is one of several reasons that it alone is the largest contributor to pyrethroid-related toxicity in urban watersheds.</td>
<td></td>
</tr>
<tr>
<td>Conceptual model for Pyrethroids in Urban Runoff</td>
<td>CASQA and the UP3 Project jointly funded UP3 Project development of a conceptual model for pyrethroids in urban runoff that can be used to quantify the linkage between urban pyrethroid use patterns and pyrethroids in urban waterways. The UP3 Project provided the model to U.S. EPA and DPR, and shared it with these agencies other stakeholders via presentations at the following events:</td>
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<td>• American Chemical Society Pyrethroids session – March 24, 2010</td>
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<tr>
<td></td>
<td></td>
<td>• DPR PRSM meeting May 2010</td>
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</table>
Table 2: Pesticide Regulatory Process Participation in FY 2010 (Continued)

<table>
<thead>
<tr>
<th>Organization</th>
<th>Process</th>
<th>Action</th>
<th>Desired Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPR</td>
<td>Surface Water Regulatory Concept</td>
<td>Teleconference meeting with DPR – November 18, 2009</td>
<td>Implement effective measures to prevent water pollution associated with professional urban pesticide use.</td>
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<tr>
<td></td>
<td></td>
<td>Thanked DPR for pursuing regulatory concept. Supported adoption of surface water protection regulations. Learned about DPR’s approach to the regulations. Asked questions on areas of concern like the list of covered pesticides and the exemption for applicators participating in a “green or sustainable program.” Obtained feedback from DPR that will be used to inform the preparation of written comments.</td>
<td>Include in regulatory structure the ability to control pesticides most likely to threaten urban surface water quality through urban runoff, including pesticides that might be registered in the future.</td>
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<td></td>
<td></td>
<td>Oral testimony by a representatives of CASQA and CCCWP at DPR Workshop –February 11, 2010</td>
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<tr>
<td></td>
<td></td>
<td>Thanked DPR for pursuing regulatory concept. Supported adoption of surface water protection regulations. Requested DPR establish clear water quality protective standards and process for the exemption for applications under a “green or sustainable program.”</td>
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</tr>
<tr>
<td>Pest Management Advisory Committee (PMAC)</td>
<td>DPR PMAC meetings – Quarterly</td>
<td>DPR has one general external stakeholder advisory group, called the Pest Management Advisory Committee. A CASQA representative (Dave Tamayo of the Sacramento County Stormwater Quality Program) participates in most meetings and is formally an alternate member of the committee (the lead member in the seat is a POTW representative).</td>
<td>Educate DPR and other urban pest management stakeholders.</td>
</tr>
<tr>
<td>None</td>
<td>The UP3 Project provided the following information to DPR:</td>
<td>Scientific information relevant to two new outdoor urban insecticides (indoxacarb and spinosad), their aquatic toxicity and potential water quality impacts – March 2010</td>
<td>Improve DPR’s scientific understanding of pesticides in urban runoff such that EPA has sufficient scientific information to structure regulatory processes to ensure that pesticide applications comply with water quality standards.</td>
</tr>
</tbody>
</table>
Table 2: Pesticide Regulatory Process Participation in FY 2010 (Continued)

<table>
<thead>
<tr>
<th>Organization</th>
<th>Process</th>
<th>Action</th>
<th>Desired Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP3 Project</td>
<td>Urban Pesticides Committee (UPC)</td>
<td>UPC meetings - Four meetings in FY 2010</td>
<td>Educating other stakeholders through informal interactions. Become informed about issues relevant to the development of regulatory and non-regulatory measures to prevent pesticide-related water pollution.</td>
</tr>
</tbody>
</table>
|                  | Meetings                             | The UPC serves as a center for information exchange, coordination, and collaboration among local, regional, and state agencies and other stakeholders seeking to end pesticide-related surface water toxicity problems. Examples of information and insights shared by CASQA in 2010 include:  
- Concerns about the slow pace of the pyrethroid reevaluation and need for an approach based on existing scientific literature relevant to urban runoff.  
- Summaries of meetings with pyrethroid manufacturers.  
- Concerns with the ongoing pyrethroid-related toxicity—the potential for high monitoring costs for municipalities due to pyrethroids and associated toxicity, and the ongoing threat of third-party lawsuits.  
- Perspectives on the National Pest Management Association’s Green Pro certification.  
- Updates on participation in California and Federal pesticide regulatory activities. |
### Table 2: Pesticide Regulatory Process Participation in FY 2010 (Continued)

<table>
<thead>
<tr>
<th>Organization</th>
<th>Process</th>
<th>Action</th>
<th>Desired Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>County Agricultural Commissioners</td>
<td>None</td>
<td>MRP Permittees had the following communications with County Agricultural Commissioners regarding pest management to improve water quality protection:</td>
<td>Encourage Agricultural Commissioners to strengthen incorporation water quality protection into their implementation of local pesticide regulatory programs.</td>
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<td>- Contra Costa County has been meeting regularly (bimonthly) with the Agricultural Commissioner’s office to cover all topics related to integrated pest management (IPM). Meetings were held on July 1, 2009; September 2, 2009; November 4, 2009; January 6, 2010; March 3, 2010 and May 5, 2010. Topics included discussions of the various IPM methods being used by the Flood Control and Water Conservation District (including weed abatement with manual labor, tractor mower, sheep grazing, and spot spraying of broadleaf weeds) and by County Departments (regarding the placement of sticky traps to monitor pest invasions, placement of door sweeps, sealing of cracks, and other physical deterrents [including the use of the “Rodenator”], while encouraging biological controls with the installation of owl boxes and raptor perches).</td>
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<td>- In June 2010, the City of Concord asked the Contra Costa County Agricultural Commissioner's office for advice in dealing with a sudden surge of bugs this summer in some city parks. The Agricultural Commissioner confirmed the bugs were leaf hoppers and since they do not bite or sting and their populations were predicted to drop sharply in a few weeks, no treatment was recommended. Concord city staff monitored the parks to confirm that the problem did indeed go away in a few weeks without the use of pesticides.</td>
<td>-----------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
4.0 EVALUATION OF 2010 OUTCOMES

4.1 Goals and Objectives for Pesticide Regulatory Engagement

The goals of CASQA’s and BASMAA’s engagement in pesticide regulatory processes are:

1. To prevent surface water impairment.
2. To prevent violations of stormwater NPDES permits.

To achieve these goals, CASQA has three long-term objectives for its participation in pesticide regulatory processes:

A. Improve design of pesticide water quality impact evaluations. Pesticide water quality impact evaluations conducted by U.S. EPA and DPR should be based on all available scientific information, assess the impacts of pesticides transported to surface water via all pathways (including urban runoff), fully address all urban use patterns, and incorporate evaluation endpoints consistent with Clean Water Act regulatory endpoints.

B. Encourage pesticide regulators to address urban surface water quality in pesticide risk management decisions and to do so in a timely manner. Pesticide risk management decisions should address all significant surface water quality risks including those posed by urban pesticide use patterns, consider costs to water quality agencies, be implemented quickly when water quality problems occur, and prevent new environmental or health impacts from future pesticide market shifts.

C. Seek meaningful public participation opportunities for water quality agencies. To achieve the above objectives, pesticide regulatory decisions relevant to water quality need to include public participation processes that make all relevant information available for water quality agency review and provide opportunity for water quality agencies to share information to ensure that decisions are based on accurate scientific and management information and include practical and effective risk management strategies.

Major FY 2010 objectives were:

- To end pyrethroid-related toxicity in California urban watersheds without transitioning to other harmful products.
- To encourage changes in pesticide regulatory processes such that these processes effectively prevent future water quality and compliance problems.

4.2 Overview of Past Outcomes

Regular interagency dialogue about pesticide-related water quality problems started with the formation of the Urban Pesticides Committee (UPC) in the mid-1990s. By the late 1990s, California water quality agencies recognized that while the information-exchange forum provided by the UPC is valuable, informal dialogue with pesticide manufacturers and pesticide regulators was not a sufficient means to achieve the changes needed to ensure long-term water quality protections from the impacts of urban pesticide use.

In 1999, California water quality agencies started to engage in pesticide regulatory processes on an ongoing basis. In 2003, the scope of the effort was increased in recognition of the water quality threat posed by the market shift to pyrethroid insecticides.
in response to the phase out of most urban uses of diazinon and chlorpyrifos. Beginning in mid-2004, the effort was further strengthened due to State Water Board grant funding to the UP3 Project, which provided California water quality agencies with an ongoing base of scientific and regulatory support for their individual engagement with pesticide regulators.

Although the process was slow at first, by 2005 staff from both pesticide and water quality regulatory agencies had recognized the importance of pesticide-related water quality issues. By 2007, pesticide regulators had recognized and acknowledged that gaps in their regulatory processes—particularly gaps related to urban pesticide use—were connected to urban water quality problems from pesticides.

In 2006, pesticide regulatory agencies began to take specific steps to address pesticide-related urban surface water quality problems. At the Federal level, U.S. EPA changed allowable uses for several pesticides due to water quality problems. California DPR initiated the pyrethroid reevaluation in response to water quality problems and created the Urban Pest Management Workgroup to give it advice on development of management strategies specific to pesticide use in urban areas.

In 2007-2009, further changes continued, particularly at the Federal level. Federal regulators required a few initial measures to prevent washoff of pyrethroids into urban runoff. Federal regulators also initiated the Office of Pesticide Programs (OPP) and Office of Water (OW) Effects Assessment Methodology Reconciliation Project to address a regulatory gap highlighted in California water quality agency comments.

### 4.3 FY 2010 Outcomes

Table 3 (on the next two pages) summarizes the outcomes of CASQA’s recent pesticide regulatory engagement. Outcomes since the last UP3 Project regulatory outcomes evaluation in December 2008 are included in the table.

In FY 2010, encouraging progress continued. Federal pyrethroid Registration Review workplans acknowledged the need to address urban runoff. California regulators floated the idea of surface water protection regulations, including measures to protect urban runoff. DPR accelerated the pace of the pyrethroid reevaluation and solved a communication problem by initiating monthly stakeholder meetings.

While these specific outcomes reflect meaningful progress toward achieving the goals listed above, the goals of California water quality agency engagement in pesticide regulatory processes have not yet been fully achieved. The record shows that the engagement of California water quality agencies has significantly improved water quality protection since their initial engagement in the 1990s.

This evaluation is necessarily an interim evaluation. The types of processes that CASQA and other California water quality agencies have engaged in take years to complete—and the systemic changes desired will probably take many years to implement fully. Due to the complexity of pesticide regulatory processes, responses to comments may not be issued for more than one year after comments are submitted and outcomes often occur years after comments are made.

In evaluating regulatory outcomes, it is important to recognize that water quality is but one of many economic, social, and environmental factors that U.S. EPA and DPR consider when making regulatory decisions.

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### Table 3. FY 2010 Pesticide Regulatory Engagement Outcomes

<table>
<thead>
<tr>
<th>Regulatory Process</th>
<th>Desired Outcome</th>
<th>Actual Outcome</th>
<th>Assessment of Relationship of Water Quality Agency Involvement to Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U.S. EPA Antimicrobials Data Rule</strong></td>
<td>Require manufacturers to provide all data necessary for a complete evaluation of urban runoff impacts when a pesticide is registered or is subject to registration review.</td>
<td>Unknown. Waiting for U.S. EPA to finalize the regulation.</td>
<td>To be determined</td>
</tr>
<tr>
<td><strong>U.S. EPA Office of Pesticide Programs (OPP) and Office of Water (OW) Effects Assessment Methodology Reconciliation Project</strong></td>
<td>Expand project scope to examine approaches for coordinating OPP’s effects assessments with the OW-approved toxicity testing procedures. Educate U.S. EPA OPP environmental risk assessors. Draw attention to pesticide-related toxicity in urban watersheds and ask U.S. EPA to change its regulatory processes so that they identify and prevent this toxicity.</td>
<td>Project-specific outcome unknown. Waiting for U.S. EPA to take next step in project. Education goals apparently achieved as evidenced by improved, more well-informed environmental risk assessment workplans for pyrethroids.</td>
<td>Project-specific relationship cannot yet be determined High for education goals. Informal communications with U.S. EPA indicate a direct linkage between California communications and environmental risk assessment workplan improvements.</td>
</tr>
<tr>
<td><strong>U.S. EPA Advanced Notice of Proposed Rulemaking – Pesticide Inert Ingredients Disclosure</strong></td>
<td>Disclosure of pesticide inert ingredient identities to assist with efforts to prevent water pollution.</td>
<td>Unknown. Waiting for U.S. EPA to issue the draft regulation.</td>
<td>To be determined</td>
</tr>
<tr>
<td><strong>U.S. EPA Esfenvalerate, Deltamethrin, and Cyphenothrin Registration Review</strong></td>
<td>Changes to these registration review processes to better identify and mitigate urban water quality impacts and adoption of these changes as part of U.S. EPA’s overall approach to the registration review process for all pesticides with urban use patterns.</td>
<td>Unknown. Waiting for U.S. EPA to issue final workplans.</td>
<td>To be determined</td>
</tr>
<tr>
<td>Regulatory Process</td>
<td>Desired Outcome</td>
<td>Actual Outcome</td>
<td>Assessment of Relationship of Water Quality Agency Involvement to Outcome</td>
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<tr>
<td><strong>DPR Pyrethroid Reevaluation</strong></td>
<td>End pyrethroid-related toxicity in California urban watersheds without transitioning to other harmful products. Educate DPR about pesticide-related toxicity in urban watersheds. Ask DPR to change its regulatory processes so that it identifies and prevents such toxicity. 2010 priorities: Implement mitigation measures quickly. Modify process to increase the pace toward a full solution.</td>
<td>As of July 2010, the reevaluation process had not generated significant new scientific information nor had substantial progress been made toward an end to pyrethroid-related toxicity. Initial mitigation is being implemented. At DPR’s request, U.S. EPA asked all pyrethroid manufacturers to submit revised product labels implementing a set of water quality protection mitigation measures by June 2010. DPR restructured the reevaluation process to include monthly stakeholder meetings intended to increase the pace of the reevaluation toward ending pyrethroid-related toxicity.</td>
<td>High. Without active involvement by CASQA and other California Water Quality Agencies, reevaluation would probably still be stalled. Label change process was initiated in response to joint CASQA/Water Board comments and was based on a list of potential early mitigation measures provided with the comments.</td>
</tr>
<tr>
<td><strong>DPR Surface Water Regulatory Concept</strong></td>
<td>Implement effective measures to prevent water pollution associated with professional urban pesticide use. Include in regulatory structure the ability to control pesticides most likely to threaten urban surface water quality through urban runoff, including pesticides that might be registered in the future.</td>
<td>Initial goal achieved—DPR has announced its intent to proceed with development of formal regulations. Detailed outcome is unknown. CASQA is currently preparing detailed comments and is waiting for DPR to issue first draft of formal regulation.</td>
<td>High. It is unlikely that DPR would have included urban areas in these regulations without CASQA/Water Board engagement and UP3 Project scientific information linking professional pesticide applications to water pollution.</td>
</tr>
</tbody>
</table>

Source: TDC Environmental evaluation of U.S. EPA and DPR regulatory documents and meetings.
Acronyms

**ACCWP** – Alameda Countywide Clean Water Program

**BASMAA** – Bay Area Stormwater Management Agencies Association

**Cal-EPA** – California Environmental Protection Agency

**CASQA** – California Stormwater Quality Association

**CCCWP** – Contra Costa Clean Water Program

**DPR** – California Department of Pesticide Regulation

**FIFRA** – Federal Insecticide, Fungicide, and Rodenticide Act

**FY** – Fiscal Year (July 1 through June 30)

**MRP** – Municipal Regional Permit (NPDES permit for urban runoff from Bay Area municipalities)

**NPDES permit** – National Pollutant Discharge Elimination System permit (permit for discharge of wastewater or urban runoff to surface waters)

**OPP** – U.S. EPA Office of Pesticide Programs

**OW** – U.S. EPA Office of Water

**PMAC** – DPR Pest Management Advisory Committee

**POTW** – Publicly-Owned Treatment Works (municipal wastewater treatment plant)

**PRSM** – Pyrethroid Reevaluation Stakeholder Meetings hosted by DPR

**PWG** – Pyrethroid Working Group (organization of pyrethroid insecticide manufacturers)

**SCVURPPP** – Santa Clara Valley Urban Runoff Pollution Prevention Program

**SFEP** – San Francisco Estuary Partnership

**TMDL** – Total Maximum Daily Load (regulatory plan for solving a water pollution problem)

**UP3 Project** – Urban Pesticides Pollution Prevention Project

**UPC** – Urban Pesticides Committee

**U.S. EPA** – United States Environmental Protection Agency
MRP Regional Supplement for POCs and Monitoring
Appendix A
Clean Watersheds for a Clean Bay
BASMAA SFB WQIF Proposal (Revised)(v.4-19-10)

Project Title: CLEAN WATERSHEDS FOR A CLEAN BAY - Implementing the San Francisco Bay PCBs and Mercury TMDLs with a Focus on Urban Runoff.

Abstract: Clean Watersheds for a Clean Bay (CW4CB) will use a partnership-driven strategy to take the next step in a multi-year regional effort to reduce loading of sediment-bound pollutants to the Bay and implement the PCBs and mercury Total Maximum Daily Load (TMDL) water quality restoration programs. CW4CB will make substantial progress towards reducing annual loading of PCBs and mercury to the Bay and will lay the groundwork for fully meeting the TMDL allocations in the future. CW4CB will select five high priority subwatersheds that discharge urban runoff with PCBs and other pollutants to the Bay, identify PCB and mercury source areas within the project subwatersheds and refer these sites to regulatory agencies for cleanup and abatement, develop methods to enhance removal of sediment with PCBs and other pollutants during municipal sediment management activities, retrofit eight to 10 urban runoff treatment facilities into existing infrastructure throughout the Bay Area, and facilitate development and implementation of a regional risk reduction program that focuses on educating the public about the health risks of consuming certain species of Bay fish that contain high levels of PCBs and mercury. The knowledge and experience gained and the lessons learned during CW4CB will be promoted and made readily available to inform future similar efforts by others in the Bay Area and elsewhere in California and the United States.

Applicant: Bay Area Stormwater Management Agencies Association (BASMAA)
Principal Investigator: Geoff Brosseau (BASMAA Executive Director)
P.O. Box 2385, Menlo Park, CA 94026, (510) 622-2326, info@basmaa.org

Funding Requested: $5 Million
Total Project Cost: $6.84 Million ($1.84 Million Non-Federal Match)

Project Period: Four Years (May 2010 – April 2014)

Proposal Narrative Organization
This proposal narrative consists of the following sections: 1) Introduction, 2) Project Overview, 3) Problem Statement, 4) Environmental Results, 5) Partnering and Budget Narrative 6) Scope of Work, and 7) Programmatic Capability. These sections are followed by Attachment A) Resumes, B) Support Letters, and C) Watershed Maps.

1. Introduction
San Francisco Bay is one of the largest and most biologically diverse estuaries on the west coast of the United States. The Bay Area basin (Figure 1) is world renowned for its scenic beauty, commercial and industrial enterprises, recreational opportunities, fisheries, and wildlife habitat. All of these features are vital to the health and economies of the local communities, where more than seven million people live and work in the highly developed watersheds that surround the Bay. The water quality of this precious resource is inextricably linked to historical and current human activities in these urban watersheds. Urban stormwater runoff is of particular concern as it conveys many types of pollutants from the urban landscape to the Bay.
The Bay Area Stormwater Management Agencies Association (BASMAA), a 501(c)(3) non-profit organization representing Bay Area cities and counties, focuses on a number of regional challenges related to stormwater runoff, including identifying opportunities to improve the quality of urban runoff that flows to the Bay. The water quality link between the Bay and its surrounding watersheds inspired BASMAA to propose the project described below - Clean Watersheds for a Clean Bay (CW4CB).

2. Project Overview

CW4CB represents the next step in a multi-year regional effort that began in 2000 to reduce loading of sediment-bound pollutants to the Bay and implement the PCBs and mercury Total Maximum Daily Load (TMDL) water quality restoration programs. CW4CB will select five high priority subwatersheds that discharge urban runoff with PCBs and other pollutants to the Bay, usually in areas with industrial land uses dating back many decades. CW4CB will then identify PCB and mercury source areas within the project subwatersheds and refer these sites to regulatory agencies for cleanup and abatement. CW4CB will also develop methods to enhance removal of sediment with PCBs and other pollutants during municipal sediment management activities (e.g., street sweeping) in the project subwatersheds. Furthermore, CW4CB will retrofit eight to 10 urban runoff treatment facilities into existing infrastructure throughout the Bay Area to address areas with elevated PCBs and other pollutants in urban runoff. Yet another element of this project will facilitate development and implementation of a regional risk reduction program that focuses on educating the public about the health risks of consuming certain species of Bay fish that contain high levels of PCBs and mercury. Finally, the knowledge and experience gained and the lessons learned during CW4CB will be promoted and made readily available to inform future similar efforts by others in the Bay Area and elsewhere in California and the United States. BASMAA is requesting $5M in project funds from USEPA's San Francisco Bay Area Water Quality Improvement Fund towards the $6.84M total project cost. The remaining $1.84M (about 27% of the total project cost) will be a match contributed by BASMAA and six of the Bay Area countywide stormwater management agencies.

3. Problem Statement

PCBs, mercury and other sediment-bound pollutants are found in San Francisco Bay water, sediments, and biota. Concentrations of PCBs and mercury in certain Bay fish exceed target levels and may pose a health risk to people who consume fish caught in the Bay. As a result, the California Office of Environmental Health Hazard Assessment issued an advisory on the consumption of fish from the Bay. Thus it was established that a vital beneficial use of the Bay, commercial and sport fishing, is not attained, with local subsistence fishers and their families being of particular concern. This led to the Bay being designated an impaired water body on the Clean Water Act "303(d) list" due to PCBs and mercury. In response, the San Francisco Bay Regional Water Quality Control
Board (Regional Water Board) has developed comprehensive TMDL programs to identify and control sources of PCBs and mercury to the Bay and restore water quality.

It has long been suspected that municipal stormwater discharges may contribute to the PCB and mercury water quality problem in the Bay, but before the year 2000 there was little direct evidence to support this hypothesis. BASMAA agencies addressed this data gap by surveying concentrations of PCBs and mercury in embedded sediments collected from stormwater conveyances (e.g., catch basins, storm drain system piping, stormwater pump station sumps, flood control channels, and creeks) throughout the Bay Area during the fall of 2000 and 2001. This project is referred to as the Joint Stormwater Agency Project (JSAP). PCB and mercury concentrations were highly variable in urban locations, but ranged up to three orders of magnitude higher than in open space areas. Concentrations were also up to two orders of magnitude higher in urban sediment than in Bay surface sediments collected and analyzed by the San Francisco Estuary Regional Monitoring Program (RMP), suggesting that urban runoff may impact the Bay.

Over the next several years following the JSAP, individual stormwater programs performed case studies in selected urban areas with relatively elevated pollutant concentrations to begin identifying sources and controls, with a focus on PCBs. The techniques employed included further collection and analysis of embedded sediment samples and research on historical and current land use. About 20 areas were investigated.

Most recently, a California Proposition 13-funded project implemented by the San Francisco Estuary Institute (SFEI) performed additional sediment surveys for PCBs and mercury, with the goal of better defining urban watersheds and subwatersheds with elevated levels of these pollutants throughout the Bay Area. The results of this effort are anticipated to be available in the near future.

All of these efforts have identified some watersheds with relatively elevated levels of PCBs and mercury and in a few cases source areas were discovered within these watersheds, but much work remains to be done to identify remaining source areas and in particular, to implement methods to prevent discharges of stormwater runoff containing PCBs, mercury and other pollutants from urban watersheds to the Bay.

4. Environmental Results - Project Outputs and Outcomes

CW4CB is the next step in the above-described multi-year regional effort to reduce loading of PCBs, mercury and other sediment-bound pollutants (e.g., dioxins, PBDEs, chlorinated pesticides and PAHs) to the Bay from urban watersheds, reduce levels entering the estuary food chain, and thereby reduce harm to aquatic ecosystems and human communities.¹²

CW4CB's overarching objective is to implement priority actions called for by the San Francisco Bay PCBs and mercury TMDLs and make substantial progress towards attaining the PCB TMDL urban runoff allocation. Although CW4CB is anticipated to reduce loadings of mercury and other sediment-bound pollutants to the Bay as an ancillary benefit, project activities will be designed and implemented to optimize the reduction of PCB loads. CW4CB's effectiveness evaluation will also focus on PCB load reductions. It is anticipated that the combined effect of all project activities will

¹EPA Strategic Plan Goal 2 (Clean and Safe Water), Objective 2.2 (Protect Water Quality), and Sub-Objective 2.2.1 (Improve Water Quality on a Watershed Basis).
²EPA Strategic Plan Goal 4 (Healthy Communities and Ecosystems) and Objective 4.3 (Restore and Protect Critical Ecosystems).
reduce annual loading of PCBs to the Bay by approximately 0.3 - 1.5 kg per year, reducing the current estimated stormwater runoff load of 20 kg per year \(^1\) by about two to eight percent. Furthermore, CW4CB will lay the groundwork for fully meeting the TMDL allocations in the future and thereby help address important impairments to the Bay’s beneficial uses. Table 1 summarizes key project tasks and associated outputs and outcomes.

CW4CB is comprised of priority activities that will achieve significant and sustainable environmental results, based on the planning and assessment work completed for the PCB and mercury TMDLs. The TMDL urban runoff requirements will be implemented through the San Francisco Bay Area NPDES Municipal Regional Stormwater Permit (MRP). \(^4\) The MRP is anticipated to be adopted in the near future and will require a number of PCBs and mercury control activities that are consistent with the TMDLs and CW4CB’s tasks. CW4CB’s general strategy is also consistent with the San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan), the Bay Area Integrated Regional Water Management Plan, and the San Francisco Estuary Project Comprehensive Conservation and Management Plan, as summarized in below.

<table>
<thead>
<tr>
<th>SF Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) (January 2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ 2. Beneficial Uses</td>
</tr>
<tr>
<td>✓ 3. Water Quality Objectives</td>
</tr>
<tr>
<td>✓ 4. Implementation Plans</td>
</tr>
<tr>
<td>✓ 5. Plans and Policies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PCBs &amp; Mercury Total Maximum Daily Loads (TMDLs) (February 2008)</th>
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</thead>
<tbody>
<tr>
<td>✓ Water Quality Attainment Strategies</td>
</tr>
<tr>
<td>✓ Urban Runoff Allocations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>San Francisco Bay Area NPDES Municipal Regional Stormwater Permit (Tentative Order, 2-11-2009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ C.11/12.c - Investigate and Abate Sources of PCBs and Mercury</td>
</tr>
<tr>
<td>✓ C.11/12.e - Urban Runoff Treatment Retrofits</td>
</tr>
<tr>
<td>✓ C.11/12.i - Regional Risk Reduction Program</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bay Area Integrated Regional Water Management Plan (November 2006)</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Goal A: Contribute to the promotion of economic, social, and environmental sustainability</td>
</tr>
<tr>
<td>✓ Goal D: Contribute to the protection and improvement of the quality of water resources</td>
</tr>
<tr>
<td>✓ Goal E: Contribute to the protection of public, health, safety, and property</td>
</tr>
<tr>
<td>✓ Goal F: Contribute to the protection of environmental resources and habitats.</td>
</tr>
<tr>
<td>✓ Water Management Strategies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>San Francisco Estuary Project Comprehensive Conservation and Management Plan (2007 Update) Key Program Areas:</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Aquatic Resources</td>
</tr>
<tr>
<td>✓ Wildlife</td>
</tr>
<tr>
<td>✓ Pollution Prevention and Reduction</td>
</tr>
<tr>
<td>✓ Land Use Management</td>
</tr>
<tr>
<td>✓ Public Involvement and Education</td>
</tr>
<tr>
<td>✓ Research and Monitoring</td>
</tr>
</tbody>
</table>

\(^1\)PCBs Total Maximum Daily Load, SFBRWQCB, February 2008.

\(^4\)Municipal Regional Permit, Revised Tentative Order, February 11, 2009.
### Table 1. Summary of Key CW4CB Tasks and Associated Budgets, Outputs and Outcomes.

<table>
<thead>
<tr>
<th>TASK</th>
<th>IMPLEMENTING PARTIES</th>
<th>USEPA FUNDING</th>
<th>MATCH</th>
<th>TOTAL</th>
<th>OUTPUTS/OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Management, oversight, and reporting.</td>
<td>BASMAA, TAC, QAPP consultant.</td>
<td>--</td>
<td>$460,000</td>
<td>$460,000</td>
<td>QAPP, quarterly progress reports, draft/final project report.</td>
</tr>
<tr>
<td>2. Select project watersheds.</td>
<td>BASMAA.</td>
<td>--</td>
<td>$30,000</td>
<td>$30,000</td>
<td>Five priority subwatersheds identified.</td>
</tr>
</tbody>
</table>
| 3. Identify locations with elevated PCBs/Hg, refer sites to regulatory agencies, and establish cleanup fund. | BASMAA, records review consultant, city staff, monitoring contractor. | $750,000 | $350,000 | $1,100,000 | Locations referred for cleanup.  
100K fund to facilitate cleanups established.  
PCB and other pollutant loadings to the Bay reduced.¹ |
| 4. Enhance municipal sediment removal and management practices. | BASMAA, city staff, monitoring contractor. | $400,000 | $350,000 | $750,000 | Enhanced municipal removal and management of sediment with pollutants.  
PCB and other pollutant loadings to the Bay reduced.¹ |
| 5A. Urban runoff treatment retrofits - planning and design. | BASMAA, design consultant, city staff. | $550,000 | $200,000 | $800,000 | Conceptual/engineering design, planning and permitting of eight to ten urban runoff treatment retrofits. |
| 5B. Urban runoff treatment retrofits - construction, operation and monitoring. | BASMAA, city staff, construction firms, monitoring contractor. | $3,200,000² | $200,000 | $3,350,000 | Eight to ten urban runoff treatment retrofits installed and evaluated.  
An estimated 2 to 12 square miles treated by retrofits to reduce potential hydrologic impacts on downstream receiving waters.  
PCB and other pollutant loadings to the Bay reduced.¹ |
| 6. Regional risk reduction program. | BASMAA (other partners may include CDPH, BACWA and WSPA). | $100,000 | $100,000 | $200,000 | Public education/outreach materials.  
Impacted populations will have a greater awareness and understanding of fish contamination issues and options for reducing exposures to pollutants in Bay fish. |
| 7. Outreach and technology transfer. | BASMAA, consultant(s) | -- | $150,000 | $150,000 | Project web portal.  
Guidance manual.  
Written outreach materials.  
Technical workshops. |
| **TOTAL:** | **$5,000,000** | **$1,840,000** | **$6,840,000** | |

¹All project activities combined are anticipated to reduce PCBs loadings about 0.3 - 1.5 kg/year.  
²This figure assumes a 15% contingency will be built in to estimated construction costs.
CW4CB will yield a number of other important local and regional benefits, including:

- Providing residents, workers and visitors in the project watersheds with a safer and healthier environment (PCBs concentrations in sediment samples from Bay Area watersheds have sometimes exceeded screening levels for human direct exposure at sites within residential and commercial/industrial land uses).
- Enhancing the desirability of commercial enterprise zones and residential neighborhoods in the project watersheds.
- Increasing Bay Area urban acreage treated with infrastructure retrofits to remove pollutants and reduce hydrologic impacts on downstream receiving waters and thereby protect their beneficial uses.
- Reducing pollution in run-off from urban development and helping mitigate the impact of development on water quality.
- Informing future land use planning, development practices (e.g., low impact development), and efforts to investigate and abate sediment-bound pollutants in other urban watersheds, and thus leading to improvements in water quality and the environment in the Bay Area and other urban areas in California and the United States.

In summary, CW4CB is anticipated to realize significant and sustainable environmental benefits to Bay Area local communities, the region, and other urban communities in California and the United States that apply the lessons learned in this project.

5. Partnering and Budget Narrative

BASMAA is a well established regional partnership that focuses on water quality issues related to stormwater runoff. BASMAA is comprised of the nine municipal stormwater programs in the San Francisco Bay Area which in turn represent 96 agencies, including 79 cities and 6 counties. The jurisdictions of these agencies cover most of the watershed immediately surrounding San Francisco Bay. The BASMAA partnership facilitates the efficient use of public resources through regional information sharing, consistency, and cooperation.

BASMAA member agencies\(^5\) comprise six of CW4CB’s specific project partners. An additional potential partner, the Bay Area Clean Water Agencies (BACWA), is not part of BASMAA. BACWA is a joint public powers authority whose members include public utilities that collect and treat municipal wastewater from the nine Bay Area counties that surround San Francisco Bay. BACWA’s partnership in CW4CB would focus on the regional risk reduction task described later.

BASMAA is requesting $5M in project funds from USEPA’s San Francisco Bay Area Water Quality Improvement Fund towards the $6.84M total project cost. The remaining $1.84M (about 27% of the total project cost)\(^6\) match will be comprised of contributions from project partners over the four year project term (Table 2). These contributions will be largely in the form of in-kind services. A

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\(^5\)These agencies are the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), the Alameda Countywide Clean Water Program (ACCWP), the Contra Costa Clean Water Program (CCWCP), the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP), the Fairfield-Suisun Urban Runoff Management Program (FSURMP), and the Vallejo Sanitation and Flood Control District (VSFCD).

\(^6\)Bay Area municipal agencies were able to commit to this $1.84M match despite the current difficult economic climate and budget shortfalls faced by many local agencies.
letter is attached from each of these agencies verifying the commitment to contribute to the project match.

Many of the project activities will take place within the Cities of San Carlos, San Jose, Oakland and Richmond. These cities have agreed to be additional project partners and, as described later, host project subwatersheds (support letters are attached), but are not making a specific financial commitment to the project. However, many of CW4CB’s activities will be leveraged in that staff from these cities will assist with implementation of various aspects of the project fieldwork, as described in more detail later. The opportunity for future leveraging of some tasks is also anticipated through California’s Proposition 84 Bond.

Table 1 summarizes the project tasks, implementing parties, and associated budgets, including how USEPA funding and the project match are apportioned to each task. It should be noted that Table 1 divides Task 5, Urban Runoff Treatment Retrofits, into subtasks A and B, with the budget itemized for each subtask. Subtask A covers planning and design, including preparing the documentation required to enable environmental review of the proposed retrofit projects under the California Environmental Quality Act (CEQA). Subtask B includes construction, operation/maintenance and monitoring.

<table>
<thead>
<tr>
<th>BASMAA Agency</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCVURPPP</td>
<td>$570,000</td>
</tr>
<tr>
<td>ACCWP</td>
<td>$500,000</td>
</tr>
<tr>
<td>CCCWP</td>
<td>$285,000</td>
</tr>
<tr>
<td>SMCWPPP</td>
<td>$240,000</td>
</tr>
<tr>
<td>FSURMP</td>
<td>$45,000</td>
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<tr>
<td>VSFCDC</td>
<td>$40,000</td>
</tr>
<tr>
<td>BASMAA</td>
<td>$160,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,840,000</strong></td>
</tr>
</tbody>
</table>

Table 2. Non-Federal Match Contributions.

6. Scope of Work / Approach

The following sections describe CW4CB’s seven project tasks. Table 3 summarizes the schedule of project milestones and deliverables. Figure 2 is a flow chart illustrating the interrelationships among the tasks and associated sub-tasks.

Task 1. Management, Oversight, and Reporting

- **WQIF Funding:** $0. **Non-federal Matching Funds:** $460,000.
- **Key Tasks and Activities:** Project management, record-keeping, accounting, reporting, technical oversight of all project activities, and QAPP development.
- **Deliverables:** QAPP, quarterly progress reports and draft and final project report.

BASMAA will serve as CW4CB's prime contractor. On behalf of the BASMAA Board of Directors, the Principal Investigator (PI) will be Geoff Brosseau, BASMAA's Executive Director. He will be responsible for overall project management and all fiscal activities related to agreements with USEPA and sub-contractors. Mr. Brosseau will be assisted by a project management team consisting of representatives from several BASMAA agencies (i.e., stormwater management programs). One member of the team and BASMAA’s technical lead on PCBs, Jon Konnan (SMCWPPP), will be the Project Manager (PM). The other members of the project management team will be: Chris Sommers (SCVURPPP), Arleen Feng (ACCWP), Jamison Crosby (CCCWP),
Figure 2. Flow Chart of Project Tasks
## Table 3. Schedule of CW4CB Milestones and Deliverables

<table>
<thead>
<tr>
<th>Project Milestones and Deliverables</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
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<tr>
<td>Task 1. Management, Oversight, and Reporting:</td>
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<td></td>
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<tr>
<td>Convene Technical Advisory Committee (TAC)</td>
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<tr>
<td>Quarterly Progress Reports to USEPA</td>
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<tr>
<td>Draft Quality Assurance Project Plan (QAPP)</td>
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<tr>
<td>USEPA Approval of QAPP</td>
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<tr>
<td>Draft Project Report to USEPA</td>
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<tr>
<td>Final Project Report to USEPA</td>
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<td>[ ]</td>
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<tr>
<td>Task 2. Select Project Subwatersheds:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review Existing Data &amp; Select Subwatersheds</td>
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<tr>
<td>Task 3. Identify Locations with Elevated PCBs and/or Mercury for Abatement:</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Records Review</td>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
<td></td>
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<tr>
<td>Reconnaissance Surveys &amp; Inspections</td>
<td>[ ]</td>
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<tr>
<td>Sediment Sampling and Analysis</td>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
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<tr>
<td>Identify Sites for Potential Expedited Abatement</td>
<td>[ ]</td>
<td>[ ]</td>
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<td>[ ]</td>
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<tr>
<td>Refer Sites to Regulatory Agencies for Cleanup</td>
<td>[ ]</td>
<td>[ ]</td>
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<td>[ ]</td>
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<tr>
<td>Assist with Identifying Abatement &amp; Funding Options</td>
<td>[ ]</td>
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<tr>
<td>Effectiveness Evaluation</td>
<td>[ ]</td>
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<tr>
<td>Task 4. Enhance Municipal Sediment Removal and Management Practices:</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare Proposed Subwatershed Strategies</td>
<td>[ ]</td>
<td>[ ]</td>
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<td>[ ]</td>
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<tr>
<td>Implement Subwatershed Strategies &amp; Monitoring</td>
<td>[ ]</td>
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<td>[ ]</td>
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<tr>
<td>Effectiveness Evaluation</td>
<td>[ ]</td>
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</tr>
</tbody>
</table>

9 of 22
### Task 5. Urban Runoff Treatment Retrofits: *

<table>
<thead>
<tr>
<th>Activity</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual Design - Retrofit Locations &amp; Types</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning/Engineering Design/Permitting/CEQA</td>
<td></td>
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<tr>
<td>Construction of Retrofits (Dry Season)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Retrofit Operation &amp; Monitoring (Wet Season)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness Evaluation</td>
<td></td>
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</tbody>
</table>

### Task 6. Regional Risk Reduction Program:

<table>
<thead>
<tr>
<th>Activity</th>
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<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convene a risk reduction stakeholder advisory group (SAG)</td>
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<tr>
<td>Develop a broad risk communication strategy</td>
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<tr>
<td>Award and oversee implementation of mini-grants</td>
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<tr>
<td>Conduct evaluation activities</td>
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</table>

### Task 7. Outreach and Information Transfer:

<table>
<thead>
<tr>
<th>Activity</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop and Update Project Web Portal</td>
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<tr>
<td>Develop Written Outreach Materials</td>
<td></td>
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<tr>
<td>Develop Guidance Manual</td>
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<tr>
<td>Technical Workshop</td>
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* Note: Generic schedule; Actual schedules expected to vary by location.
and Kevin Cullen (FSURMP). The project management team will assist the PI and PM to ensure that all project activities are completed on-time and within budget by having specific responsibility for oversight of project activities within the jurisdiction of the BASMAA agency that they represent. BASMAA will consult with USEPA and contract with project consultants, contractors and construction firms. In addition, the project management team will coordinate with the project partners and key regional agencies for project activities within the jurisdiction of the BASMAA agency that they represent, including the Regional Water Board, and prepare quarterly progress reports and a draft and final project report. The project management team will also work closely and coordinate with key personnel from the project partners, including the following Bay Area city personnel: James Downing (City of San Jose), Robert Weil (City of San Carlos), Lesley Estes (City of Oakland), and Lynne Scarpa (City of Richmond).

Resumes are attached for the PI, PM, project management team members, and project partner key personnel.

At the outset of the project, BASMAA will convene a Technical Advisory Committee (TAC). The TAC will be tasked with providing the project with technical guidance and oversight, including key input on all major decision points (e.g., confirming the location of project subwatersheds and selecting and siting treatment retrofits) and reviewing and commenting on drafts of all project deliverables. The TAC will be comprised of Dr. Tom Mumley (Assistant Executive Officer, Regional Water Board) and other appropriate technical experts from the Bay Area and elsewhere in the United States.

During the first quarter of year one of the project (Table 3), a Quality Assurance Project Plan (QAPP) addressing the field monitoring in the below tasks will be developed and submitted to USEPA for approval. All specified field and laboratory sampling and Quality Assurance / Quality Control (QA/QC) protocols, data management methods, and reporting procedures will be compatible with the California Surface Water Ambient Monitoring Program (SWAMP) and the San Francisco Estuary Regional Monitoring Program (RMP).

<table>
<thead>
<tr>
<th>Task 2. Select Project Subwatersheds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WQIF Funding:</strong> $0. <strong>Non-federal Matching Funds:</strong> $30,000.</td>
</tr>
<tr>
<td><strong>Key Tasks and Activities:</strong> Implement pertinent data review and final selection of five project subwatersheds.</td>
</tr>
<tr>
<td><strong>Deliverables:</strong> Subwatershed selection documented in first quarterly progress report.</td>
</tr>
<tr>
<td><strong>Outputs:</strong> Five priority Bay Area subwatersheds identified.</td>
</tr>
</tbody>
</table>

CW4CB will include a program of pollution investigation and abatement in high priority Bay Area watersheds. The project will target urban subwatersheds with high potential for discharges of PCBs in urban runoff that is ultimately conveyed to the Bay. The project subwatersheds will include areas of current or historic industrial land uses where elevated levels of PCBs have been found in sediments collected from creeks, stormwater conveyances and roadway-related infrastructure. The selection of project subwatersheds will primarily focus on the presence of PCBs, which are often found in areas with industrial land uses dating back several decades, but mercury and other sediment-bound pollutants will likely be present in such locations. At the outset of the project, CW4CB will perform a comprehensive review of the existing data described earlier (Section 3), including the JSAP, follow-up stormwater program case study work, and sediment surveys.
conducted by the SFEI Proposition 13-funded project. Based on the above review and input from the TAC, five project subwatersheds will be selected.

At the time of this application the Cities of San Carlos, San Jose, Oakland and Richmond have agreed to host project subwatersheds (support letters are attached). Most or all of the project subwatersheds will be located in these cities. Examples of candidate subwatersheds are described below.

**Pulgas Creek Pump Station Subwatershed, San Carlos**

The Pulgas Creek pump station subwatershed is located in the City of San Carlos in San Mateo County. San Carlos has agreed to host one of the five project subwatersheds and this subwatershed will likely be selected. Much of the land use within this approximate 0.5-square mile subwatershed has been industrial dating back several decades. PCBs have been detected at up to about 11 parts per million (ppm) in embedded storm drain and creek sediment samples collected from the pump station sump and its drainage. Based on the results of field sampling and agency research, two potential sources of PCBs to storm drains in the study area were identified: a PG&E substation and a soil and groundwater investigation and remediation site with PCBs and other pollutants. Investigations to date also suggest multiple unidentified sources of PCBs in the study area, given the widespread spatial distribution of PCBs found in storm drain sediments.

**Ettie Street Pump Station Subwatershed, Oakland**

The Ettie Street pump station subwatershed is located in the City of Oakland in Alameda County. Oakland has agreed to host one of the five project subwatersheds and this subwatershed may be selected. This approximate 2.5-square mile subwatershed includes residential, commercial, and industrial land uses. As part of a state-funded water quality grant project, Oakland has performed visual inspections of public and private properties in this subwatershed and sampling of sediments and soils. PCBs have been found at concentrations up to about 93 ppm in sediments and soils collected from the pump station sump and other locations throughout the subwatershed.

**Leo Avenue Subwatershed, San Jose**

The Leo Avenue subwatershed is located in the City of San Jose in Santa Clara County. San Jose has agreed to host one of the five project subwatersheds and this subwatershed is under consideration. Land uses in the subwatershed are primarily commercial and industrial. Relatively elevated levels of PCBs (up to about 20 ppm) have consistently been found in the Leo Avenue area. The spatial distribution of PCBs concentrations coupled with an analysis of PCBs homolog distributions suggested that the Union Pacific railroad track right-of-way adjacent to Leo Avenue is a source of PCBs in this subwatershed. Other potential PCB sources include historical activities at other properties adjacent to Leo Avenue.

**North Richmond Pump Station Subwatershed, Richmond**

The North Richmond Pump Station subwatershed is located in the City of Richmond in Contra Costa County. The City of Richmond has agreed to host one or two of the five project subwatersheds and this area is under consideration. The drainage area of this subwatershed is about 0.5 square miles and includes a variety of land uses. The City of Richmond recently embarked on a planning effort to identify target pollutants in city stormwater, identify priority watersheds within the city, identify likely sources of pollutants, and identify potential control mechanisms for these
pollutants. The primary pollutants of concern in this subwatershed are PCBs and mercury, which are likely present due to a long history of industrial activity in the area. Concentrations of PCBs found in sediment have ranged up to about 1 ppm.

Santa Fe Channel Subwatershed, Richmond

Another subwatershed under consideration in Richmond is the Santa Fe subwatershed. This approximately 2.3 square mile watershed includes a variety of land uses and has historical PCBs and mercury contamination. The City of Richmond has selected the Sante Fe subwatershed as a priority watershed and concentrations of PCBs in sediment have ranged up to about 2 ppm in industrial areas.

Task 3. Identify Locations with Elevated PCB and/or Mercury Concentrations for Abatement

- **WQIF Funding:** $750,000. **Non-federal Matching Funds:** $350,000.
- **Leveraged Resources:** City staff will assist with site inspections and other aspects of the fieldwork. Site cleanups will be overseen by appropriate regulatory agencies and implemented by responsible parties or with other available funding.
- **Key Tasks and Activities:** Implement review of existing data and field inspections and monitoring to identify locations with elevated PCB concentrations within project subwatersheds, refer sites to regulatory agencies for cleanup, and establish fund to facilitate site cleanups.
- **Deliverables:** Results documented in quarterly progress reports and draft and final project report.
- **Outputs:** Properties/locations with elevated PCBs and potentially mercury and other pollutants identified and referred to regulatory agencies for cleanup and fund to facilitate cleanups established.
- **Outcomes:** PCB and mercury loadings to San Francisco Bay reduced.

This task focuses on identifying specific locations and properties within the project subwatersheds that are potential sources of PCBs and/or mercury to stormwater conveyances. One model for this task is a recent project conducted by the City of Oakland through a Proposition 13 grant in the amount of $460,000 awarded by the California State Water Resources Control Board. The project focused on identifying sources of PCB-containing sediments to the storm drain system in the Ettie Street Pump Station subwatershed in Oakland. Based on the Ettie Street project, CW4CB will conduct the below steps at each project subwatershed, adapting and refining these methods as appropriate to local conditions.
1. **Records Review.** CW4CB will interview local and state agency staff and review local and state databases and information sources (e.g., Geotracker, SLIC, Cerclis, and Vistacheck.com), appropriate agency files (e.g., local environmental/health department data, local fire department hazardous material records, and facility inspection and illicit discharge records), and other readily available information, as appropriate (e.g., land use records, historical aerial photographs, reverse telephone directories, Sanborn Fire Insurance Maps, and transformer locations requested of PG&E) to identify potential PCB/mercury source properties and areas where PCB/mercury contaminated sediment accumulates within each of the project subwatersheds, including within stormwater conveyances. To the extent practicable, appropriate records on all businesses in each subwatershed will be screened. Potential PCB/mercury source areas in each subwatershed will be identified and given a preliminary priority ranking.

2. **Driving/Walking Survey.** CW4CB will work with municipal staff to perform a driving/walking survey of the entire area of each project subwatershed to identify properties that are high priority for site inspections. The survey will build upon the results of the above records review to further identify potential source areas and determine whether runoff from such locations is likely to convey soils/sediments with PCBs or mercury to municipal stormwater conveyances. Based on criteria developed during the Ettie Street project, examples of potential high priority sites include:
   - Previously identified PCB spill site.
   - Historic land use associated with PCB-containing materials.
   - Potential for soils/sediments to erode and migrate off-site, including unpaved areas.
   - Sites with outdoor storage yards and storage tanks.
   - Sites with poor housekeeping.

3. **Site Inspections.** CW4CB will work with municipal staff to perform inspections of selected high priority sites within each project subwatershed. Inspectors will use a checklist developed for Ettie Street project regarding priority uses and activities potentially associated with PCBs, adapted as appropriate for this project. Inspected sites will then be ranked for further investigation, including the below soil/sediment sampling, using criteria developed during the Ettie Street project, adapted for this project as appropriate.

4. **Sediment/Soil Sampling.** CW4CB will test for elevated PCB/mercury concentrations through surface sediment/soil sampling and analysis where visual inspections and/or other information suggest potential source areas within each subwatershed. As with the Ettie Street project, sampling will occur on both the public right of way and private properties. It is anticipated that the process of reconnaissance/inspections and sediment sampling will be iterative in many cases to hone in on source areas in the most cost-effective manner. CW4CB will collect and analyze approximately 70 soil/sediment samples from each of the five project subwatersheds, a number of samples comparable with the Ettie Street project on a per subwatershed basis. Based on 350 samples analyzed for PCBs, total mercury, total organic carbon and particle size distribution (and ten percent of these samples analyzed for the following additional analytes: dioxins, PBDEs, legacy chlorinated pesticides, and PAHs), the total estimated laboratory analysis cost is $366,000.

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7This is an extensive task (e.g., the Ettie Street Pump Station subwatershed had approximately 1,700 businesses).
5. **Site Referrals.** Where laboratory data confirm significantly elevated PCB/mercury concentrations in surface sediments/soils, available information on current site conditions and owner/operators and other potentially responsible parties will be provided to the Regional Water Board. The Regional Water Board is a state regulatory agency with investigation and cleanup authorities to facilitate issuance of orders for further investigation and remediation of the subject sites. The Regional Water Board may refer sites to other regulatory agencies if appropriate (e.g., Department of Toxic Substance Control, USEPA). CW4CB will also provide Regional Water Board staff with general assistance in evaluating abatement options and identify funding sources for abatement. In addition, CW4CB will identify areas within the project subwatersheds for potential expedited abatement on the basis of loading potential including factors such as PCB concentration, mass of sediment, and mobilization potential and/or human health protection thresholds, such as California Human Health Screening Levels. CW4CB will set aside a budget of $100,000 for technical services to facilitate priority site cleanups as needed on a case by case basis (e.g., further identification of cleanup funding sources, additional history/records research, additional sampling and analysis, communications, other activities as needed to move the cleanup process forward).

To evaluate the effectiveness of this task, CW4CB will assess the available data on the effectiveness of the abatement activities at specific properties/locations within the project subwatersheds and quantitatively estimate the resulting reduction in loads of PCBs (and mercury where applicable) to the Bay. The results of the effectiveness evaluation will be reported in the progress reports as data become available and summarized in the draft and final project report. It is anticipated that the efforts described in this task will be highly leveraged since the cleanups of the identified source areas will be funded outside of this project, including oversight by appropriate regulatory agencies (most likely state agencies) and implementation by responsible parties or with other available funding (e.g., California Cleanup and Abatement Account). In addition, city staff will assist with implementation of the fieldwork, further leveraging this task’s efforts.

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**Task 4. Enhance Municipal Sediment Removal and Management Practices**

- **WQIF Funding:** $400,000. **Non-federal Matching Funds:** $350,000.
- **Leveraged Resources:** City staff will assist with implementation of the fieldwork and sediment management enhancements put into place will likely continue in the project subwatersheds (and expand to other locations) into the future.
- **Key Tasks and Activities:** Preparation of subwatershed-specific strategies to enhance the pollutant load reduction benefits of municipal operation and maintenance activities; implementation of the strategies in the field in the project subwatersheds.
- **Deliverables:** Subwatershed-specific strategies report; implementation results documented in quarterly progress reports and draft and final project report.
- **Outputs:** Enhanced removal of sediment with PCBs and other pollutants during municipal sediment removal and management activities.
- **Outcomes:** PCB and mercury loadings to San Francisco Bay reduced.

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*The point of contact with the Regional Water Board will be Janet O’Hara, the Regional Water Board Staff currently tasked with implementation of the San Francisco Bay PCBs TMDL.*
In the project subwatersheds, CW4CB will evaluate ways to enhance the PCB, mercury, and other pollutant load reduction benefits of municipal operation and maintenance activities that remove or manage sediment. The evaluation will include working with city staff to enhance sediment-bound pollutant removal during municipal activities such as street sweeping, storm drain inlet and catch basin cleaning, stormwater conveyance maintenance, and pump station maintenance. The evaluation will include consideration of street flushing (potentially with recycled water) and capture, collection, and/or routing to the local sanitary sewer. Simple removal of sediments from gutters and storm drains will also receive consideration. CW4CB will work with city staff to prepare a written strategy for implementing enhancements in each project subwatershed. The TAC will review the subwatershed-specific strategies and provide key input and recommendations to the project management team before the fieldwork to implement enhancements commences.

To evaluate the effectiveness of this task, CW4CB will collect and analyze appropriate sediment samples to inform a quantitative estimation of how the enhanced sediment removal and management activities reduce loads of PCBs (and mercury as applicable) to the Bay. The results of the effectiveness evaluation will be reported in the progress reports as data become available and summarized in the draft and final project report.

The efforts described in this task will be leveraged in that city staff will assist with implementation of the fieldwork. It is also anticipated that these efforts will be leveraged into the future in that the sediment management enhancements put into place and the associated pollutant load reductions will likely continue in the project subwatersheds (and expand to other locations) after the four year project period.

**Task 5. Urban Runoff Treatment Retrofits**

- **WQIF Funding:** $3,750,000. **Non-federal Matching Funds:** $400,000.
- **Leveraged Resources:** City staff will assist with aspects of siting, designing, installing and operating/maintaining the retrofit facilities and operation/maintenance of the retrofits will likely continue into the future. During retrofit conceptual design CW4CB will leverage BACWA's study on the feasibility of diverting stormwater to wastewater treatment plants.
- **Key Tasks and Activities:** Implementation of retrofits, including conceptual design (retrofit locations and types); planning/design/permitting/CEQA; construction of retrofits (dry season); operation and monitoring (wet season); effectiveness evaluation.
- **Deliverables:** Conceptual design report (retrofit locations and types); implementation results documented in quarterly progress reports and draft and final project report.
- **Outputs:** Installation of eight to 10 urban runoff treatment retrofits.
- **Outcomes:** PCB and mercury loadings to San Francisco Bay reduced and an estimated two to twelve square miles treated by retrofits to reduce potential hydrologic impacts on downstream receiving waters.

CW4CB will retrofit urban runoff treatment systems into existing MS4s at selected sites in the Bay Area urban landscape to intercept pollutants before they can enter San Francisco Bay. Solids removal is generally the most feasible option to treat PCBs and other sediment-bound pollutants in stormwater runoff. Stormwater treatment structures that remove solids commonly rely on sedimentation, filtration, flow through separation, or some combination of these processes. These
technologies are readily available and can effectively remove sediment and associated pollutants when properly designed, installed, operated and maintained (CASQA 2003).

CW4CB will identify eight to 10 locations throughout the Bay Area that present opportunities to retrofit treatment systems and assess the best retrofit options for each location. If CW4CB evaluates 10 retrofits, up to two of these may be existing retrofits, provided they meet all project goals. Retrofit locations will be selected primarily on the basis of elevated PCBs concentrations with additional consideration given to mercury concentrations. Options considered for types of retrofits will include detention basins, media filtration structures (e.g., sand filter), bioretention units, infiltration basins, constructed wetlands, and diversions from stormwater pump stations to existing domestic wastewater treatment plants.9

The planning of stormwater treatment retrofitting is potentially complex and will be carried out in a watershed context primarily during year one of the project (Table 3). To the extent feasible, Low Impact Development principles will be considered to reduce potential hydrologic impacts on downstream receiving waters (e.g., tidal portions of creeks, sloughs, and wetlands) and thereby protect related beneficial uses, habitat and ecosystems. The evaluation will consider technical and economical feasibility, taking into consideration that siting of some technologies may be limited by factors such as soil types, groundwater elevation, slopes, insect breeding and space constraints. In addition, in some cases treatment structure design may need to account for minimizing mercury methylation. The evaluation will include GIS spatial analysis and ground-truthing of potential sites and will consider appropriate locations both within and outside of the project subwatersheds discussed previously. The final selections will span treatment types and Bay Area watershed characteristics. A conceptual design report with proposed retrofit locations and types will be prepared with input and recommendations from the TAC.

Engineering design and permitting, including local agency approval, is anticipated to occur primarily during year two of the project. As required and appropriate, CW4CB will also prepare the documentation required to enable environmental review of the proposed retrofit projects under the California Environmental Quality Act (CEQA). It is anticipated that the environmental review under CEQA will not require developing an Environmental Impact Report (EIR) and at most initial studies with mitigated negative declarations will be sufficient.

We anticipate that the retrofits will be constructed during the dry season of the third year of the project and operation and evaluation of the retrofits will span the wet season between years three and four. Retrofit influent and effluent sampling and analysis data will be collected to evaluate and quantify the removal of PCBs, mercury, and other pollutants. The results of the effectiveness evaluation will be reported in the progress reports as data become available and summarized in the draft and final project report. The efforts described in this task will be leveraged in that city staff will assist with aspects of siting, designing, installing and operating/maintaining the retrofit facilities. It is also anticipated that these efforts will be leveraged into the future in that the operation/maintenance of the retrofits and the associated pollutant load reductions will likely continue after the four year project period.

9The Bay Area Clean Water Agencies are currently preparing a "white paper" that will evaluate existing data to describe the feasibility of diverting stormwater to wastewater treatment plants in the Bay Area. CW4CB will leverage this effort by reviewing the results of the evaluation during retrofit conceptual design.
Fish caught in San Francisco Bay have elevated levels of harmful chemicals, including mercury and PCBs. The current health advisory recommends limiting consumption of most Bay fish to no more than two meals per month. For high risk groups (pregnant and breastfeeding women, and children) only one meal per month is advised. The San Francisco Bay Seafood Consumption study showed that approximately two-thirds of people fishing in the Bay had limited understanding or no awareness of the health advisory. This study also showed that the consumption patterns among certain ethnic groups result in higher exposure to contaminants in Bay fish. CW4CB will implement a regional program of risk communication activities to raise public awareness of fish contamination issues in San Francisco Bay and to encourage fish-consuming populations to reduce their exposure to pollutants in contaminated fish. BASMAA may partner with the Bay Area Clean Water Agencies (BACWA) and other agencies to perform this task. Based on consultations with the California Department of Public Health (CDPH), the risk reduction task will consist of the following four sub-tasks.

**Sub-task 1. Convene a risk reduction stakeholder advisory group (SAG)**
CW4CB will initiate a stakeholder process to bring together local groups and organizations that are interested in seeking ways to reduce exposures to chemicals in contaminated fish. We will reach out to a broad range of stakeholders for participation on the SAG, including, but not limited to, community-based, social services, watershed, fishing, environmental justice, and parks organizations, as well as state and local agencies. The objective of the SAG will be to create, inform, and guide the development of a risk communication strategy (Task 2). In addition, CW4CB will use the SAG meetings to solicit general input on the objectives of the mini-grants program (Task 3), to keep members updated on the progress of the mini-grants and related activities (e.g., fish monitoring activities, Bay PCBs TMDL, new San Francisco Bay fish consumption advisory), and encourage new activities and collaborations among the participating groups (e.g., sign posting by fishing location managers).

**Sub-task 2. Develop a broad risk communication strategy**
CW4CB will work closely with the SAG to develop a broad risk communication strategy that will serve as the basis for planning future outreach, education, and risk reduction activities. The strategy will address how to communicate information about fish contamination issues, including the current advisory, to fish consuming populations, with an emphasis on those populations at greatest risk. The risk communication strategy that was used in the CALFED-funded Fish Mercury Project risk...
reduction project in the Central Valley and Sacramento/San Joaquin Rivers watershed will be used as a model, but tailored by the SAG for the purpose of this project. The strategy will describe the target populations, the key messages that will be communicated, the types of future activities that would be most effective to reach these target populations (e.g., focused community/population-specific mini-grants, broader-based education efforts through established non-profit education centers), and methods for evaluating the effectiveness of these activities. The strategy will be updated as relevant and critical information becomes available, including a new fish consumption advisory for San Francisco Bay that the Office of Environmental Health Hazard Assessment plans to issue in 2010. One important component of the strategy will be a mini-grant program (Task 3) to engage some of the SAG members in implementing outreach, education, or risk reduction projects in the short term.

**Sub-task 3. Award and oversee implementation of mini-grants**
It is important to begin engaging local organizations regarding implementing outreach, education, and risk reduction activities concurrent with developing the broad risk communication strategy (Task 2). Local organizations may already have close relationships with communities who consume Bay fish and be able to address language and cultural barriers. CW4CB will develop a process to select and award small grants for local organizations to conduct these projects. We will seek input from the SAG to guide the general goals of the mini-grant program and seek SAG participation on the selection panel. Based on the needs of the funded groups, CW4CB may, as needed, conduct limited capacity building trainings on topics related to fish contamination (e.g., mercury health impacts, advisories) and help the groups to develop the skills needed to implement their projects. CW4CB will also monitor their progress and assist with evaluation and reporting requirements.

**Sub-task 4. Conduct evaluation activities**
Evaluation activities will include the following parts: evaluation of the SAG; mini-grant evaluation activities by the funded groups; CW4CB evaluation of mini-grants; and potentially evaluation of other broader-based education efforts through established non-profit education centers conducted in association with CW4CB. CW4CB will conduct evaluation of the SAG process, focusing on process indicators (e.g., who attends SAG meetings, what input they provide, how they guide strategy development). Broader feedback will also be solicited on whether the SAG is meeting its goals, the SAG activities that were most helpful to members, and ways the SAG could be improved. Mini-grant funded groups will implement an evaluation of their mini-grant project activities. CW4CB will provide guidance on how to conduct these evaluations. Evaluation will most likely focus on process indicators, such as the number of people who were reached by their mini-grant project activities or the number of materials distributed. CW4CB will also provide an evaluation summary that describes evaluation activities across funded groups. The evaluation summary will also include input from funded groups on their overall experience in the mini-grant program and how it could be improved, and grantee feedback on how their mini-grant activities will be sustained after the mini-grant funding ends.
Task 7. Outreach and Technology Transfer

- **WQIF Funding:** $0. **Non-federal Matching Funds:** $150,000.
- **Key Tasks and Activities:** Development of project web portal, written outreach materials, and project guidance manual; technical workshops.
- **Deliverables:** Results documented in quarterly progress reports and draft and final project report.
- **Outputs:** Project web portal, guidance manual, written outreach materials, technical workshops.

CW4CB will document the knowledge and experience gained and the lessons learned during this project. The goal will be to make information and guidance readily available to inform future efforts to mitigate urban runoff discharges of PCBs and other pollutants from other urban watersheds in the Bay Area and elsewhere in California and the United States. This task will promote the use of project results by others and will result in the public and professionals in the field being informed and engaged. CW4CB's methods and tools to facilitate outreach and information transfer will include the following:

- A project web portal will be developed at the outset of project and updated quarterly throughout the project term.
- A guidance manual will be prepared that provides essential information to others that wish to implement similar efforts.
- Written outreach materials will be developed, including a user-friendly summary of the project with references to where additional information is available (e.g., the web portal and guidance manual). The urban runoff treatment retrofits will be publicized and presented as demonstration projects.
- A technical workshop will be held covering all aspects of the project.

As feasible and appropriate, the monitoring data from this project (especially the urban runoff treatment retrofit monitoring) will be submitted for inclusion in the International Stormwater BMP Database.

7. Programmatic Capability and Past Performance

The Bay Area Stormwater Management Agencies Association was established in 1989 as a regional association through a memorandum of understanding (MOU) covering the nine Bay Area counties. BASMAA was started by local municipalities to facilitate information sharing and cooperation and to develop products and programs that would assist them in meeting their NPDES permit and Clean Water Act requirements. BASMAA is designed to encourage information sharing and collaboration and it provides an institutionalized mechanism for its member agencies to develop innovative products and programs that are more cost-effective done regionally than can be accomplished locally.

BASMAA is focused on regional challenges and opportunities to improving the quality of stormwater that flows to our local creeks, San Francisco Bay and Delta, and the Ocean. BASMAA's work covers the full breadth of stormwater-related topics including monitoring, new
development, public information / participation, commercial / industrial, illicit discharges, flood control, TMDLs, and permitting.

Currently, BASMAA is a consortium of nine San Francisco Bay Area municipal stormwater quality programs, comprised of 96 Bay Area agencies (municipalities, counties, and special districts). Each BASMAA member agency plays a significant role in managing stormwater and urban runoff within its jurisdiction and in coordination with others in our region in order to protect the health of waters and aquatic life of Bay Area watersheds that drain into the region’s six USEPA-identified sub-basins: Suisun Bay, San Pablo Bay, Coyote Creek, San Francisco Bay, Tomales-Drake Bays, and San Francisco Coastal South.

For the past 20 years, BASMAA has provided a forum for agencies with common interests, challenges, and responsibilities to collaborate on stormwater management issues of mutual interest and needs. Though its organizational framework has evolved from an assortment of agencies bound together by an MOU to the 501(c)(3) nonprofit entity it is today, BASMAA has continued to help its members by promoting understanding of existing and emerging stormwater quality management issues and technologies, facilitating agency cooperation, increasing program efficiency and effectiveness, and advancing sustainable stormwater quality management approaches in executive and legislative decision-making and public debate. Through BASMAA, stormwater quality management programs have been able to address regional, partnership, and locally specific needs as set forth in NPDES stormwater management permits issued by the Regional Water Board.

BASMAA committees and work groups have overseen the completion of numerous collaborative regional projects contracted to its agencies or consultants under its baseline and tasks of regional benefit budgets. BASMAA’s new challenge and opportunity is to assist its member stormwater quality management programs and their constituent agencies to work with the Regional Water Board on the finalized version of a municipal regional stormwater permit (MRP) that addresses watersheds in the Bay Area, and to foster collaboration and mutual assistance on implementation of MRP provisions. For the past twenty years, BASMAA and its participating entities have proven their capacity to collaborate on significant projects of regional importance, and have produced deliverables and outcomes that provide much of the foundation for current regional stormwater quality management efforts, including this proposal. BASMAA fully expects to continue to deliver the same quality of project capacity and success its members have achieved through collaborative association.

### Some Major BASMAA Regional Projects
- Recognized Surface Cleaner program (1996 - )
- Construction site inspection / education program (1990s)
- Regional Advertising Campaigns (1996 - )
- Brake Pad Partnership (1996 - )
- *Start at the Source* design manuals (1997, 1999)
- IPM Partnership / *Our Water, Our World* program (1998 - )
- Joint Stormwater Agency Project to Study Urban Sources of Mercury, PCBs, and Organochlorine Pesticides (2001-'03)
- Bay Are Hydrology Model (BAHM) (2003)

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10 For additional capacity documentation, see Attachments Section for key staff resumes and the BASMAA Baseline Budget Projects and Programs Report.
In addition to the tens of projects and programs started and sustained by BASMAA using millions of dollars in funds from its members and other agencies over the years, BASMAA has received and conducted one USEPA grant project: the *Our Water, Our World Promotion — Statewide Expansion and Evaluation*; funded through a Pesticide Environmental Stewardship Program (PESP) grant through the National Foundation for IPM Education. Although the grant amount was relatively small ($40,000), the actual tasks were significant, including using some of the grant monies to leverage the existing *Our Water, Our World* Program in the Bay Area to expand the program statewide by recruiting tens of agencies outside of the Bay Area to start and support the program in their jurisdictions. The other key aspect of the grant was the development and implementation of a program evaluation to evaluate the effectiveness of the *Our Water, Our World* Promotion through direct performance measurement of store customers and to make recommendations for future efforts.¹¹

¹¹ See Attachments section for Final PESP Grant Compliance Report.
MEMORANDUM

TO: CW4CB Project Management Team
FROM: Kristin Kerr and Jon Konnan, EOA, Inc.
DATE: September 13, 2010
SUBJECT: Clean Watersheds for a Clean Bay (CW4CB) Project Status

1.0 INTRODUCTION

This memorandum presents the status of Clean Watersheds for a Clean Bay (CW4CB), a new project funded by a grant to the Bay Area Stormwater Management Agency Association (BASMAA) from the United States Environmental Protection Agency (EPA).\(^1\) It was prepared to address the 2010 reporting requirements for portions of Provisions C.11 and C.12 (described below) of the regional stormwater NPDES permit adopted October 14, 2009 by the San Francisco Bay Area Regional Water Quality Control Board (Regional Water Board), which is commonly referred to as the “Municipal Regional Permit” (MRP).\(^2\)

The CW4CB project is a partnership of Bay Area municipalities and countywide municipal stormwater management programs. The overarching project objective is to implement priority actions called for by the San Francisco Bay PCBs and mercury Total Maximum Daily Load (TMDL) water quality restoration programs\(^3\) including developing and pilot-testing a variety of methods to potentially reduce urban runoff loading of PCBs and mercury to the Bay. The project work plan (BASMAA 2010) submitted to EPA on September 23, 2009 (the final revised version is dated April 19, 2010) describes the project’s principal tasks:

- Selecting for pilot investigations five Bay Area region watersheds with relatively high levels of PCBs\(^4\) in sediments collected from roadway and stormwater drainage infrastructure and other desirable attributes;
- Identifying PCB and mercury source areas within the pilot watersheds and referring these sites to regulatory agencies for cleanup and abatement;
- Developing and pilot-testing methods to enhance removal of sediment with PCBs and mercury, mainly during existing municipal street and storm drain system operation and maintenance activities in the five pilot watersheds;
- Retrofitting eight to ten urban runoff treatment facilities into existing infrastructure in the Bay Area region to remove PCBs and mercury; and

\(^1\)Funding is provided through EPA’s San Francisco Bay Water Quality Improvement Fund.
\(^2\)National Pollutant Discharge Elimination System (NPDES) Permit No. CAS612008, Order R2-2009-0074.
\(^3\)The MRP implements the TMDL actions related to stormwater runoff.
\(^4\)Per the MRP, “Reducing loads of PCBs is the main pilot location selection factor...and reducing loads of mercury is a secondary criterion.”
Facilitating development and implementation of a Bay Area regional exposure reduction program that focuses on educating the public about the health risks of consuming certain species of Bay fish that contain relatively high levels of PCBs and mercury.

The successful project outcome will contribute to developing a comprehensive regional strategy for reducing PCB and mercury loads in urban runoff, based on the cost-effectiveness of a range of pollutant control strategies, including pollution prevention, site remediations, enhanced sediment management, stormwater treatment retrofits, and diversion of stormwater to existing publicly owned treatment works (POTWs). The knowledge and experience gained and the lessons learned during the CW4CB project will inform similar efforts by others in the Bay Area and elsewhere in California and the United States.

The anticipated project period is four years, beginning July 1, 2010. BASMAA is receiving $5.0 million in funding from the EPA toward the $6.84 million total project cost. The remaining $1.84M (about 27% of the total project cost) is matching funding contribution from BASMAA and six of the Bay Area countywide stormwater management programs. In addition, in-kind assistance from participating city staff will leverage the project effort.

A project management team consisting of BASMAA’s executive director and representatives from several BASMAA countywide programs and Bay Area cities is providing project oversight and coordination. The team recently began meeting regularly on the second Wednesday of each month.

CW4CB is also convening a Technical Advisory Committee (TAC) comprised of local and national experts. The TAC will help optimize the scientific and technical soundness, integrity, and objectivity of the project. It will be comprised of Dr. Tom Mumley (Assistant Executive Officer, Regional Water Board), Dr. Lester McKee (Director of the Watershed Program, San Francisco Estuary Institute), and other appropriate technical experts from the Bay Area and elsewhere in the United States. CW4CB project management team members have conducted initial discussions with the existing two TAC members regarding finding additional members and have prepared a draft scoping document and a list of questions to ask when interviewing candidate additional members. Per the initial discussions, the project will seek to find TAC members with experience related to implementation of stormwater controls targeting particulate-bound pollutants in highly urbanized built-out industrial areas where available land is often sparse. Per Table 3 of the CW4CB project work plan, the schedule for initially convening the TAC is during the first quarter of the project (see Task 1).

The project work plan includes seven major tasks, several of which are intended to directly assist Permittee compliance with specific MRP provisions. These tasks and the corresponding provisions are as follows:

- **CW4CB Tasks 2 and 3** (MRP Provisions C.11/12.c - Pilot Projects to Investigate and Abate Mercury/PCB Sources).

Pollution prevention and stormwater diversion to POTW strategies are being developed and pilot-tested separately from CW4CB.
• CW4CB Task 6 (MRP Provisions C.11/12.i - Development of a Risk Reduction Program Implemented throughout the Region).

The following sections in this memorandum describe progress to-date on each of the above CW4CB tasks and corresponding MRP provisions and the schedule for moving forward. It should be noted that although CW4CB’s conceptual planning and discussion began in early 2010, the actual project start date was July 1, 2010.6

2.0 PILOT PROJECTS TO INVESTIGATE AND ABATE MERCURY/PCB SOURCES

Provisions C.11/12.c. of the MRP require that Permittees work collaboratively to review pertinent existing data and identify five Bay Area watersheds that contain relatively high levels of PCBs and mercury (CW4CB Task 2) and conduct pilot projects to investigate and abate these pollutants (CW4CB Task 3). The CW4CB project management team is developing selection criteria and is currently working with Permittees towards selecting the five pilot watersheds by reviewing and evaluating relevant existing data.

Table 1 summarizes the proposed criteria that will inform selection of the five watersheds and the associated existing data sources. Most of these data were originally compiled and made available by the Regional Stormwater Monitoring and Urban BMP Evaluation Project conducted by the San Francisco Estuary Institute (SFEI) and referred to as the “SFEI Proposition 13 Study.” The study investigated options for better managing mercury and PCBs in urban stormwater and was conducted in collaboration with BASMAA and the Regional Water Board. It was funded through a grant from the State of California Proposition 13 stormwater non-point-source program. SFEI recently completed the study and is currently updating a web site that will make the project data and results readily available.

The CW4CB project management team is currently working with SFEI to perform a GIS analysis of the SFEI Proposition 13 Study data to inform pilot watershed selection. The available data types include: watershed boundaries; spatial (including clustering) and temporal aspects of concentrations of PCBs and mercury in sediments; potential pollutant source sites (e.g., pollutant spill sites, PG&E facilities,7 transformers with PCBs registered with the EPA, auto dismantlers, and historic railroads); historic land use; and pump station locations.

MRP Provisions C.11/12.d. require that Permittees work collaboratively to develop and pilot-test methods to enhance removal of sediment with PCBs and mercury during existing municipal street and storm drain system operation and maintenance activities. Permittees are required to conduct this pilot work in the five pilot watersheds selected for Provisions C.11/12.c. Thus the pilot watersheds will be located in areas where such municipal operation and maintenance activities are conducted routinely.

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6The project started significantly later than originally anticipated. EPA’s original Request for Proposal included an anticipated award date of February 2010. However, despite EPA’s and BASMAA’s best efforts to expedite the process, EPA was not able to provide BASMAA with a proposed assistance agreement until June 2010, resulting in the project start date of July 1, 2010. Thus the project is currently at an early stage.

7CW4CB currently does not have permission to use PG&E facility data but is working with Regional Water Board staff and SFEI to obtain that permission.
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<tr>
<th>Category</th>
<th>Criterion</th>
<th>Data Sources</th>
</tr>
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<tbody>
<tr>
<td>Benefits - Potential Pollutant Load Reductions</td>
<td>Are there relatively high levels of PCBs (and secondarily mercury) in sediments collected from roadway and stormwater drainage infrastructure in the watershed?</td>
<td>SFEI Proposition 13 Study compilation of sediment chemistry data.</td>
</tr>
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<td>Are there other indicators of potential sources of PCBs in the watershed?</td>
<td>• SFEI Proposition 13 Study “hot spot” GIS layer.</td>
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<td>• SFEI Proposition 13 Study GIS land use analysis using ABAG data.</td>
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<td>• SFEI Proposition 13 Study PG&amp;E facility GIS layer.</td>
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<td>• SFEI Proposition 13 Study auto dismantler GIS layer.</td>
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<td>• SFEI Proposition 13 Study railroad GIS layer.</td>
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<td>• EPA Transformer Database (GIS layer created by SFEI).</td>
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<td>Is the watershed’s size (i.e., area in square kilometers) within an acceptable range for the pilot study work?</td>
<td>SFEI Proposition 13 Study Bay Area watershed GIS layer.</td>
</tr>
<tr>
<td></td>
<td>Is there a pump station at the bottom of the watershed?</td>
<td>SFEI Proposition 13 Study Bay Area pump station GIS layer.</td>
</tr>
<tr>
<td></td>
<td>Are municipal street and storm drain system operation and maintenance activities conducted routinely in the watershed?</td>
<td>CW4CB project management team knowledge, municipal staff interviews.</td>
</tr>
<tr>
<td>Other Desirable Watershed Attributes</td>
<td>Will pilot work in this watershed fit into the broader regional context of pilot-testing a range of pollutant control strategies, including pollution prevention, site remediations, enhanced sediment management, stormwater treatment retrofits, and diversion of stormwater to existing POTWs?</td>
<td>CW4CB project management team knowledge.</td>
</tr>
<tr>
<td>Regional Context</td>
<td>Are there institutional, regulatory, political, technical, and/or organizational barriers to conducting pilot work in the watershed that cannot be easily addressed?</td>
<td>CW4CB project management team knowledge, municipal staff interviews.</td>
</tr>
<tr>
<td></td>
<td>Have previous pertinent studies been conducted in the watershed?</td>
<td>CW4CB project management team knowledge, municipal staff interviews, project reports or other data.</td>
</tr>
</tbody>
</table>

1 CW4CB currently does not have permission to use PG&E facility data but is working with Regional Water Board staff and SFEI to obtain that permission.
The CW4CB project management team and municipal staff will also determine whether there are institutional, regulatory, political, technical, and/or organizational barriers associated with a potential pilot watershed. In addition, an important consideration during the selection process will be whether pilot work in a proposed watershed would fit into the broader regional context of pilot-testing a range of pollutant control strategies, including pollution prevention, site remediations, enhanced sediment management, stormwater treatment retrofits, and diversion of stormwater to existing POTWs.

The CW4CB project work plan schedule calls for completing the pilot watershed selection process by the end of the first quarter of the project (September 30, 2010). It is anticipated that most or all of the watersheds will be selected by this date. After the five pilot watersheds are selected, CW4CB Task 3 will identify PCB and mercury source areas within the project watersheds and refer these sites to regulatory agencies for cleanup and abatement. Table 3 of the CW4CB work plan includes the schedule for implementation of this effort.

3.0 PILOT PROJECTS TO EVALUATE AND ENHANCE MUNICIPAL SEDIMENT REMOVAL AND MANAGEMENT PRACTICES

As noted previously, MRP Provisions C.11/12.d. require that Permittees work collaboratively to develop and pilot-test methods to enhance removal of sediment with PCBs and mercury, mainly during existing municipal street and storm drain system operation and maintenance activities. CW4CB Task 4 will implement this requirement. Permittees are required to conduct this pilot work in the five pilot watersheds selected for Provisions C.11/12.c. (CW4CB Tasks 2 and 3). The evaluation will include typical routine municipal operation and maintenance practices such as street sweeping, catch basin cleaning, and stormwater conveyance system cleaning, and will also include consideration of street flushing and routing the wash water to a sanitary sewer. Evaluation of existing information on high-efficiency street sweepers is also a specific C.11/12.d. requirement. As a first step, CW4CB has recently initiated a review of existing literature and other information relevant to these evaluations. Table 3 of the CW4CB work plan includes the schedule for implementation of this effort (see Task 4).

4.0 PILOT PROJECTS TO EVALUATE ON-SITE STORMWATER TREATMENT VIA RETROFIT

Provisions C.11/12.e. require that Permittees retrofit PCB and mercury treatment systems into existing storm drainage infrastructure at 10 locations throughout the Permittees’ jurisdictions and evaluate effectiveness. CW4CB Task 5 will implement this requirement. It is anticipated that some but not all of the retrofits will be sited within the five pilot watersheds identified by CW4CB Task 2. Permittees are required to install at least one retrofit in each of five major Bay Area counties covered by the MRP (Santa Clara, San Mateo, Alameda, Contra Costa, and Solano) and report on candidate locations with types of treatment retrofit for each location in the September 2011 Annual Report. This effort is at an early stage and has consisted to-date of initial conceptual discussions at the project management team meetings. The project management team is also working with EPA to better define procurement rules in relation to retaining a consultant in the near future to perform an initial conceptual screening of retrofits potentially applicable to this project. Table 3 of the CW4CB work plan includes the schedule for implementation (see Task 5).
5.0 DEVELOPMENT OF A RISK REDUCTION PROGRAM IMPLEMENTED THROUGHOUT THE REGION

Provision C.11/12.i. requires that Permittees implement a regional program of risk communication activities to raise public awareness of fish contamination issues in San Francisco Bay and to encourage fish-consuming populations to reduce their exposure to pollutants in contaminated fish. CW4CB Task 6 will implement this requirement. The project work plan (BASMAA 2010) describes how this effort will be accomplished and includes four general subtasks:

- Sub-task 1. Convene a risk reduction stakeholder advisory group.
- Sub-task 2. Develop a broad risk communication strategy.
- Sub-task 3. Award and oversee implementation of mini-grants.
- Sub-task 4. Conduct evaluation activities.

Table 3 of the CW4CB work plan includes the schedule (see Task 6). It should be noted that BASMAA developed the work plan tasks and schedule in coordination with a Bay Area risk reduction work group that includes representatives from BASMAA, the California Department of Public Health, Bay Area Clean Water Agencies (BACWA), and Regional Water Board staff. Task 6 is being funded through CW4CB, potentially with additional funding from other dischargers to the Bay that have similar NPDES permit requirements, including BACWA and industrial dischargers. The work group held scoping meetings on December 1, 2009 and January 26, 2010 and also had many telephone and e-mail communications during early 2010 related to task and schedule development.

6.0 REFERENCES

BASMAA 2010. Clean Watersheds for a Clean Bay - Implementing the San Francisco Bay PCBs and Mercury TMDLs with a Focus on Urban Runoff. Prepared by the Bay Area Stormwater Management Agencies Association (BASMAA) for USEPA. September 23, 2009 (Revised April 19, 2010).
DRAFT

Stormwater Pump Station Diversions Feasibility Evaluation

Prepared for
Bay Area Stormwater Management Agencies Association (BASMAA)
Oakland, California
DRAFT

Stormwater Pump Station Diversions
Feasibility Evaluation

Prepared for
Bay Area Stormwater Management Agencies Association (BASMAA)
Oakland, California
September 13, 2010

This is a draft and is not intended to be a final representation of the work done or recommendations made by Brown and Caldwell. It should not be relied upon; consult the final report.
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASMAA</td>
<td>Bay Area Stormwater Management Agencies Association</td>
</tr>
<tr>
<td>CW4CB</td>
<td>Clean Watersheds for a Clean Bay</td>
</tr>
<tr>
<td>FER</td>
<td>Feasibility Evaluation Report</td>
</tr>
<tr>
<td>GIS</td>
<td>geographic information systems</td>
</tr>
<tr>
<td>gpm</td>
<td>gallons per minute</td>
</tr>
<tr>
<td>HMP</td>
<td>hydromodification management plans</td>
</tr>
<tr>
<td>LID</td>
<td>Low Impact Development</td>
</tr>
<tr>
<td>mgd</td>
<td>million gallons per day</td>
</tr>
<tr>
<td>MPC</td>
<td>Monitoring and Pollutants of Concern</td>
</tr>
<tr>
<td>MS4s</td>
<td>municipal separate storm sewer systems</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>operations and maintenance</td>
</tr>
<tr>
<td>PCBs</td>
<td>polychlorinated biphenyls</td>
</tr>
<tr>
<td>POTWs</td>
<td>publicly owned treatment works</td>
</tr>
<tr>
<td>PPDG</td>
<td>Project Planning and Design Guide</td>
</tr>
<tr>
<td>ROW</td>
<td>Right-of-way</td>
</tr>
<tr>
<td>SCADA</td>
<td>Supervisory control and data acquisition</td>
</tr>
<tr>
<td>SFEI</td>
<td>San Francisco Estuary Institute</td>
</tr>
<tr>
<td>SFB-RWQCB</td>
<td>San Francisco Bay Regional Water Quality Control Board</td>
</tr>
<tr>
<td>the Bay</td>
<td>San Francisco Bay</td>
</tr>
<tr>
<td>TMDL</td>
<td>Total Maximum Daily Load</td>
</tr>
<tr>
<td>TOC</td>
<td>Technical Oversight Committee</td>
</tr>
<tr>
<td>WLAs</td>
<td>Wasteload allocations</td>
</tr>
</tbody>
</table>
Executive Summary

This Feasibility Evaluation Report (FER) fulfills reporting requirements for Fiscal Year 2009/10 under provisions C.11.f and C.12.f of the Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (Order No R2-2009-0074), more commonly referred to as the Municipal Regional Permit (MRP). Provisions C.11.f and C.12.f of the MRP are nearly identical provisions for control of mercury (C.11) and polychlorinated biphenyls (PCBs) (C.12) that require the evaluation of pilot diversions to publicly owned treatment works (POTWs) of dry weather urban runoff and/or first flush events from stormwater pump stations. The pilot projects are being evaluated in parallel with other BMP pilot implementation projects, including stormwater treatment retrofits, sediment management pilot projects, and source investigations to identify contaminated sites. The first product required under these provisions is a feasibility evaluation to be included in the 2010 Annual Reports for each Permittee. The feasibility evaluation is to include, but is not limited to, costs, and impacts on the stormwater and wastewater agencies and benefits to the receiving waters that would result from pilot projects that divert and treat dry weather runoff and first flush flows. The 2010 Annual Report is to summarize the feasibility evaluation, including:

- Selection criteria leading to the identification of five candidate and five alternate pump stations;
- Time schedules for conducting pilot studies; and
- A proposed method for distributing mercury and PCBs load reductions to participating wastewater and stormwater agencies.

Selection criteria have been developed based on a review of other programs that have scoped and/or implemented urban runoff diversion projects and discussions with stormwater program representatives. The Selection criteria are intended to inform the selection of sites (i.e., pump stations) for potential diversion and framed around water quality needs, the broader regional context of pilot-testing a variety of pollutant control strategies in the Bay Area, and acceptability, as summarized in Table ES-1 below.

Maps of PCB concentrations in sediments, pump station locations, and POTW service areas are included in this report to assist with the needs criterion. Guidance is also provided for addressing the acceptability criteria. Tools for developing cost estimates and estimating potential load reductions of PCBs and Hg from stormwater discharges as a result of pilot diversion projects are also included.
### Table ES-1. Proposed Selection Criteria and Information Needed

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Information Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Needs</strong></td>
<td></td>
</tr>
<tr>
<td>Will the project yield a significant PCB load reduction?</td>
<td>PCB concentrations in sediments from the local drainage;</td>
</tr>
<tr>
<td></td>
<td>Pump station inventories in GIS and tabular formats</td>
</tr>
<tr>
<td></td>
<td>Event-mean PCB concentrations in stormwater;</td>
</tr>
<tr>
<td></td>
<td>TSS and flow measurements;</td>
</tr>
<tr>
<td></td>
<td>Drainage area assessments</td>
</tr>
<tr>
<td>Will the project provide unique or new information?</td>
<td>Peer review from Technical Oversight Committee</td>
</tr>
<tr>
<td>Does a pilot project fit into the broader regional context of pilot-</td>
<td>Peer review from Technical Oversight Committee</td>
</tr>
<tr>
<td>testing a range of pollutant control strategies, including pollution</td>
<td></td>
</tr>
<tr>
<td>prevention, site remediations, enhanced sediment management, and</td>
<td></td>
</tr>
<tr>
<td>stormwater treatment retrofitting strategies?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Costs and Alternatives</strong></td>
<td></td>
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<tr>
<td>Are the capital and operation and maintenance costs associated with</td>
<td>Site investigations</td>
</tr>
<tr>
<td>diversion prohibitive?</td>
<td>Conceptual designs and drawings</td>
</tr>
<tr>
<td></td>
<td>Preliminary site-specific cost estimates</td>
</tr>
<tr>
<td></td>
<td>Treatment and connection costs/charges.</td>
</tr>
<tr>
<td>Are there ways to control upstream sources of PCBs through remediation,</td>
<td>Source identification studies</td>
</tr>
<tr>
<td>removal, isolation, or run-on diversion?</td>
<td>Peer review from Technical Oversight Group</td>
</tr>
<tr>
<td>Can onsite treatment or infiltration retrofits be implemented?</td>
<td>Site investigations, including right-of-way mapping</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acceptability</strong></td>
<td></td>
</tr>
<tr>
<td>Is there an accessible POTW willing and able to provide treatment</td>
<td>POTW service area map</td>
</tr>
<tr>
<td>service?</td>
<td>Communication with POTW managers</td>
</tr>
<tr>
<td>Can the pilot diversion be sited within acceptable design criteria?</td>
<td>Pre-design checklist assessment (Table 1)</td>
</tr>
</tbody>
</table>

The cost and load estimating tools were applied to three hypothetical scenarios: a constructed pilot diversion, a temporary pilot diversion, and a strategic conveyance system cleanout pilot project. The constructed pilot diversion scenario resulted in an estimated PCB load reduction of 1.6 grams per year discharged to the Bay at a one-time cost of $750,000; over twenty years this would reduce 32 grams of PCBs at a cost of $23,500 per gram of PCBs removed; the cost per gram would increase if the hypothetical pilot diversion were to be terminated in less than twenty years. The temporary pilot diversion scenario resulted in an estimated one-time load reduction of 0.11 grams discharged to the Bay, at a cost of $180,000, or $1,600,000 per gram of PCBs removed in total. The strategic conveyance system cleanout scenario resulted in an estimated one-time load reduction of 0.095 grams of PCBs per year, at a cost of $28,000, or $300,000 per gram of PCBs removed in total. All three of these scenarios represent fractionally small (0.0006 to 0.008 percent) amounts of the total estimated stormwater PCB load currently discharged to the Bay (20 kg). Those hypothetical costs all reflect the simplifying assumption that the receiving POTW waives treatment fees.

The simplifying assumption that a POTW waives treatment fees is, in fact, unlikely. In most cases, wastewater and stormwater programs are funded through separate sources, and so institutional factors may make such a waiver problematic. Connection fees typically range from $9,000 to $18,000 per thousand gallons per day, and treatment fees typically range from $300 to $2,400 per MG treated. As a result, these cost estimates for the hypothetical scenarios are likely underestimated. Other charges may also be assessed, such as East Bay MUD’s “wastewater capacity fee” of at least $97.40 per 100 cubic feet per month, or $130,000/MG/month.

The report concludes with a proposed approach to distribute credit for load reductions to participating stormwater programs and POTWs, and a proposed preliminary schedule for pilot project implementation.
Section 1

Background

This Feasibility Evaluation Report (FER) fulfills reporting requirements for Fiscal Year 2009/10 under provisions C.11.f and C.12.f of the Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (Order No R2-2009-0074), more commonly referred to as the Municipal Regional Permit (MRP). Provisions C.11.f and C.12.f of the MRP are nearly identical provisions for control of mercury (C.11) and polychlorinated biphenyls (PCBs) (C.12) that require the evaluation of pilot diversions to publicly owned treatment works (POTWs) of dry weather urban runoff and/or first flush events from stormwater pump stations. The pilot projects are being evaluated in parallel with other BMP pilot implementation projects, including stormwater treatment retrofits, sediment management pilot projects, and source investigations to identify contaminated sites. The first product required under these provisions is a feasibility evaluation to be included in the 2010 Annual Reports for each Permittee. The feasibility evaluation is to include, but is not limited to, costs, and impacts on the stormwater and wastewater agencies and benefits to the receiving waters that would result from pilot projects that divert and treat dry weather runoff and first flush flows. The 2010 Annual Report is to summarize the feasibility evaluation, including:

- Selection criteria leading to the identification of five candidate and five alternate pump stations;
- Time schedules for conducting pilot studies; and
- A proposed method for distributing mercury and PCBs load reductions to participating wastewater and stormwater agencies.

The data sources, computational tools, and recommendations of this report are intended to guide municipal Permittees in the selection and scoping of stormwater pilot diversion pilot projects. This section presents a brief overview of the problem statement and planning context of the pilot diversion concept. The second section summarizes the approach to develop this Feasibility Evaluation Report (FER). The third section summarizes the findings in regard to:

- Selection criteria to inform site selection
- Cost/benefit analysis of three example scenarios
- A framework for crediting load reductions attained
- Information tools available
- Opportunities and constraints

The fourth section of the report briefly summarizes for Permittees how the tools in this report can be used to scope out candidate pump station pilot diversion projects. The report concludes with a proposed preliminary schedule for selection of candidate pump stations and development and implementation of pilot project studies.

1.1 Problem Statement

Bay Area storm water dischargers have been required to implement significant reductions in the annual loads of mercury and polychlorinated biphenyls (PCBs) discharged to San Francisco Bay (the Bay) from areas served by municipal separate storm sewer systems (MS4s). The requirements have been established as wasteload allocations (WLAs) in the Total Maximum Daily Load (TMDL) plans for mercury and PCBs in the Bay adopted by the San Francisco Bay Regional Water Quality Control Board.
The mercury TMDL requires a two-fold reduction in the annual average mass of mercury discharged from urban stormwater, from the current estimated load of 160 kg/yr down to 82 kg/yr by the year 2026. The PCBs TMDL requires approximately a tenfold reduction in the annual average mass of PCBs discharged from all stormwater\(^1\) (i.e., urban and non-urban), from 20 kg/yr down to 2 kg/yr by the year 2028.

Those numeric load reduction targets are important to keep in mind when evaluating the load reduction benefit of any specific pilot project and comparing to other alternatives for PCB load reduction. They also show that PCB load reduction is the driver for planning control measure implementation, because the reductions required are larger than those of mercury. For this reason, SFB-RWQCB staff has guided Bay Area Stormwater Management Agencies Association (BASMAA) members to plan pilot projects with a focus on PCB load reductions, and report the mercury load reductions attained by those same pilots. Following that guidance, this FER focuses on PCBs for planning and scoping pump station pilot diversion projects; parallel load reduction calculations for mercury are included for completeness with the MRP requirements.

The MRP states that the objectives of the pilot diversion pilot studies are to:

- Evaluate the reduced loads of PCBs and mercury from diversion of dry weather and first flush urban runoff to sanitary sewers;
- Gain knowledge and experience to determine the implementation level of urban runoff diversion in subsequent permit terms; and
- Document the knowledge and experience gained through pilot implementation.

The pilot diversion projects that would result from this study are not expected to be the sole, or even most significant, actions to implement reductions in discharges for the PCBs TMDL. Although pilot diversions are expected to yield some quantifiable pollutant load reduction benefit, the most significant benefit of the pilot projects is the lessons learned about key management questions:

- Can pilot diversion of first flush and/or dry weather urban runoff significantly reduce stormwater loads of PCBs?
- What is the cost per gram of PCBs removed by the pilot diversion approach?
- How does that cost per gram for pilot diversion compare to alternatives such as pollution prevention, remediation of contaminated sites, strategies to enhance pollutant removal during sediment management, and stormwater treatment retrofits?
- What are the technical, regulatory, and institutional challenges to stormwater diversion into POTWs for the purposes of reducing PCB loads?
- What would motivate a POTW to accept stormwater for treatment?

Answering these management questions is beyond the scope of this FER. The questions above establish a framework for the final report on the pilot projects.

---

\(^1\) The PCBs TMDL assumes that the non-urban contribution of PCBs is relatively small, i.e., < 0.1 kg/yr, compared to the urban contribution. If this assumption is correct, then the requirement for a 90 percent load reduction from “all stormwater sources” would have essentially the same outcome as requiring a 90 percent load reduction from urban stormwater.
1.2 Planning Context

It is important to understand the overall planning context of this FER. Pilot diversion projects are but one facet of a broader control strategy for PCBs and mercury that involves many different activities (Figure 1-1). The implementation plans for the PCBs and mercury TMDLs are adaptive – lessons learned during the first decade of implementation will guide future emphasis on projects and activities that have relatively greater efficacy per unit cost. Projects required of stormwater dischargers to adaptively implement the mercury and PCBs TMDLs are specified in provisions of the MRP, and are briefly summarized below.

Load reductions expressed as WLAs in a TMDL are implemented by the SFB-RWQCB through provisions in adopted NPDES permits. For Bay Area stormwater dischargers, the MRP requires four general types of pilot projects and activities to show progress towards attaining WLAs for PCBs and mercury: pollution prevention, remediation of contaminated sites, strategies to enhance pollutant removal during sediment management, and stormwater treatment.

Pollution prevention activities focus on stopping PCBs and mercury from getting into stormwater in the first place. Pollution prevention for mercury focuses on collection and recycling of mercury-containing products (Provision C.11.a of the MRP). Pollution prevention for PCBs focuses on industrial inspections (Provision C.12.a), such as the evaluation and prevention of PCB release from building materials such as caulk (Provision C.12.b).

Remediation of contaminated sites and strategies to enhance pollutant removal during sediment management rely on the fact that both mercury and PCBs tend to be associated with sediments. Monitoring studies have shown that PCB concentrations are heterogenous throughout the San Francisco Bay area. Substantial concentrations of PCBs in sediments (e.g., 1 mg/kg up to 90 mg/kg) may be found today in flood control conveyances downstream of areas where PCBs were historically used and/or released (Yee and Mckee, 2010). The report by Yee and Mckee (2010) also pointed out that in many cases, identification of high PCB concentrations in sediments at one location would indicate that a “halo” of elevated PCB concentrations in sediments may be found within approximately 2500 meters of the contaminated site. Provisions C.11.c and C.12.c require pilot projects to investigate and remediate on-land locations with elevated PCB and mercury concentrations in sediment.

Provisions C.11.d and C.12.d require pilot projects to develop and pilot-test methods to enhance removal of sediment with PCBs and mercury, mainly during existing municipal street and storm drain system operation and maintenance activities. These provisions also require consideration of street flushing and routing to the sanitary sewer, an approach that overlaps with one of the scenarios evaluated in this FER (stormwater conveyance cleanouts). In addition to managing contaminated sediments through street sweeping and cleanouts of stormwater conveyances, it will be important to focus efforts on removing or capping in-place sources of contaminated sediments to streets and stormwater conveyances.

Stream maintenance and ecosystem restoration projects in streams and baylands at times involve sediment removal and/or stream bank stabilization. To the extent that those activities also remove or isolate in place contaminated sediment, they provide a load reduction benefit to the Bay. Conversely, if stream maintenance or ecosystem restoration projects mobilize previously isolated contaminated sediments, those activities would increase contaminant loads to the Bay.

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2 The summary report by Yee and Mckee compiles data from studies including: Applied Marine Sciences (AMS) Inc. (2002a); AMS 2002b; AMS, 2007; EOA (2000a2); EOA (2002b); EOA (2002c); EOA (2003a); EOA (2003b); EOA (2004); EOA (2007a); EOA (2007b); and Klienfelder (2006). Those original reports are available in the supplemental CD provided with this FER.
Stormwater treatment may be beneficial in situations where it is too late to prevent on-land pollution, and defined, controllable source areas cannot be identified. Stormwater treatment can include designing and constructing dedicated treatment retrofits to serve contaminated catchments. Pilot treatment retrofits are required under Provision C.11.e for mercury and C.12.e for PCBs.

MRP Provisions C.11/12.c., d., and e. are being implemented through a regional collaboration that is funded through a grant from the United States Environmental Protection Agency, with local cost matches (BASMAA, 2010). Alternatively, stormwater treatment can be accomplished by existing POTWs, if diversion and conveyance systems can be feasibly constructed and a local POTW can be identified that is willing and able to provide treatment services. That approach is required by Provision C.11.f for mercury and C.12.f for PCBs, and this approach is the focus of this FER.

Figure 1-1. Conceptual Illustration of Pilot Stormwater Diversion to POTW Projects in Context with Other Potential Control Strategies
Section 2

Approach

2.1 BASMAA Technical Oversight

This report has been prepared under the direction of BASMAA representatives. The scope of work was developed through a series of discussions at BASMAA Monitoring and Pollutants of Concern (MPC) committee meetings in January through March, 2010. Staff and Permittees from each countywide stormwater program began meeting once a month in June 2010 to provide technical oversight to development of this FER. This Technical Oversight Committee (TOC) will continue to advise Permittees who are scoping and implementing pilot diversion projects. The primary role of TOC during the implementation stage will be to provide consistency in effectiveness evaluation methods and peer review on the value of new information expected from pilot projects and the merits of diversion pilots as compared to other pollutant control alternatives possible at the proposed locations. The TOC for this FER also has considerable overlap with the Clean Watershed for a Clean Bay (CW4CB) grant project, providing coordination between the two experts.

2.2 Information gathered

In general, two types of information were gathered and compiled for this report: information on contaminated sediments in the Bay Area, and information about urban runoff diversion into POTWs. In addition, geographic information systems (GIS) data were made available by the San Francisco Estuary Institute (SFEI) upon completion of their Proposition-13 funded study focused on urban runoff best management practices (Yee and Mckee, 2010). Concentrations of PCBs in sediments have been superimposed on locations of pump stations and POTWs to assist in the selection of candidate locations. Maps of POTW service areas are provided alongside the GIS representations to further assist the selection3.

2.3 Approach to Development of Selection Criteria

The approach to developing the draft selection criteria starts by looking at other programs that have scoped and/or implemented urban runoff diversion projects. The approach builds on the thought process worked out by other programs by addressing the following questions:

- What selection criteria have been used by other programs to evaluate the feasibility of urban runoff diversions into treatment plants?
- What are the most appropriate selection criteria for projects in the San Francisco Bay region that would meet the requirements of Provision C.11.f/C.12.f? Selection criteria should address relevant pump station and POTW characteristics and institutional barriers/incentives.
- What regional and site information is needed to evaluate a project using the selection criteria?
- What specific regional information is currently available that would enable use of the selection criteria?

3 Note to BASMAA reviewers: GIS layers of POTW service areas have been recently acquired and, at the direction of the oversight committee for this report, can be incorporated directly onto the maps of contaminated sediments and pump station locations.
What are the known data gaps?
How would a program that is scoping a diversion project address the data gaps?

### 2.3.1.1 Selection criteria used by other programs

This section summarizes selection criteria used to scope and/or implement pilot diversion projects from three case studies: California Beach communities, the Las Vegas Valley, and the California Department of Transportation.

#### 2.3.1.1.1 California Beach Communities

During the information gathering stage of this project, the following California communities were identified that have developed diversion programs:

- Orange County
- San Diego County
- Los Angeles County
- Ventura County
- Monterey County
- Santa Cruz County

All of the counties above have beach communities. Essentially all of the dry weather diversion projects carried out in those communities have been motivated by the need to reduce or eliminate sources of bacteria to beaches and other areas used for water contact recreation. Of the programs reviewed, the Orange County Watersheds (2003) report was the only one which provided detailed documentation of their selection (or decision) criteria. The flowchart illustrating the decision criteria for dry weather diversions in Orange County is shown in Figure 1.

The Orange County selection criteria thought process illustrated in Figure 1 starts by screening against the two following general questions about dry weather discharges in coastal watersheds:

- Is there a water quality impairment to be addressed?
- Are there source control or treatment alternatives to dry weather diversions?

If the answers are yes, there is a water quality impairment and no, there are no better alternatives such as source control or onsite treatment, then the site is assessed against acceptability criteria for diversion into the Orange County Sanitation District conveyance and treatment system. Acceptability criteria used in Orange County Watersheds (2003) are:

- Local conveyance and treatment capacity;
- Potential to impact recreation or habitat by diversion;
- Other community and/or regulatory concerns.

As noted above, the Orange County Watersheds (2003) report is the most formal documentation of diversion selection criteria available. Interviews with project stakeholders from some of the above beach communities (e.g., City of Santa Cruz, Orange County Sanitation District), were conducted during the development of a draft Selenium Management Plan for Las Vegas Wash (Brown and Caldwell, 2009a). In addition, stakeholders involved in dry weather diversions in the cities of Los Angeles and Ventura were interviewed during the development of a white paper on urban runoff diversions on behalf of the Bay Area Clean Water Agencies (Carollo, 2009). Those stakeholder interviews tend to support the more formal acceptability criteria, as outlined above.
Figure 2-1. Decision Tree for Dry Weather Diversion Consideration in Orange County, California.

From Orange County Stormwater Program (2003)
2.3.1.1.2 Las Vegas Valley

The draft Las Vegas Wash Selenium Management Plan (Brown and Caldwell, 2009a) followed an overall thought process similar to Southern California beach diversion projects, starting with water-quality needs and source area opportunities, and subsequently screening opportunity areas against capacity, constructability, cost, and community acceptance criteria. In the case of the Las Vegas Wash, the pollutant of concern was selenium in a desert wetland ecosystem, rather than bacteria in waters of swimmable beaches. The interest in reducing selenium loads was as a mitigation measure for the construction of an effluent bypass pipeline project to a deepwater outfall at Lake Mead. If constructed, the pipeline would generate electric power from the elevation drop to Lake Mead, and it would remove treated wastewater discharges from the Las Vegas Wash. These discharges provide dilution of selenium concentrations within existing groundwater seepage that enters the wash. Consequently, a means of reducing selenium loads via diversion of dewatering and seepage flows from tributaries of the wash into wastewater treatment plants would add value to the project by enabling diversion of relatively larger effluent flows from Las Vegas Wash into the pipeline, thereby creating relatively more electric power while concurrently reducing surface water impacts of treated effluent to Lake Mead, as the pipeline would allow discharge at the bottom of the lake.

The selection criteria led to diversion of selenium seepage sources into treatment plants from the base of watersheds as the most cost-effective alternative, because of the economic value of water flowing through the proposed bypass pipeline. The plan accounted for uncertainty in the alternatives analysis by proposing an adaptive approach that would initiate the more straightforward diversion projects in initial stages, while concurrently evaluating the feasibility of reducing seepage flows by changes in upland irrigation management practices or installation of onsite treatment or upstream diversion projects. The adaptive management decision tree proposed in the draft Las Vegas Wash Selenium Management Plan is illustrated in Figure 2-2 below.

Owing to declining economic conditions in the Las Vegas Valley, the bypass pipeline project has been put on hold (i.e., shelved); therefore, the draft Selenium Management Plan has not advanced beyond the planning and conceptual design/cost estimating stage. The draft plan does offer useful preliminary design and cost estimating concepts for large scale (i.e., 1 to 6 mgd) diversion projects involving varying levels of complexity in conveyance system design.
2.3.1.1.3 The California Department of Transportation (Caltrans)

The Caltrans Stormwater Quality Handbooks’ Project Planning and Design Guide (PPDG) defines a regimented process for selection of structural BMPs during the design process for major projects. Selection criteria are defined by the “T-1 Checklist,” which appears in Appendix E of the PPDG. If dry weather flows are present, designers are to consider dry weather diversions. Figure 2-3 below shows the feasibility and design criteria used in the Caltrans design process to consider dry weather diversions. The Caltrans example is a useful starting point for informing more detailed selection analysis of siting and design feasibility.

One example of a dry weather diversion constructed by Caltrans is the Jamboree Road overcrossing near Interstate 5 in Orange County. In that location, dewatering discharges are sent to the Orange County Sanitation District because of concerns over nitrogen and selenium in San Diego Creek. An example of temporary diversions by Caltrans is the Caldecott Tunnel, connecting Alameda County and Contra Costa County. Power washing discharges from the tunnel are diverted to the East Bay Municipal Utility District.


Dry Weather Flow Diversion

Feasibility

1. Is a Dry-Weather Flow Diversion acceptable to a Publicly Owned Treatment Works (POTW)?
   - Yes
   - No

2. Would a connection require ordinary (i.e., not extraordinary) plumbing, features or construction methods to implement?
   - Yes
   - No

   If “No” to either question above, Dry Weather Flow Diversion is not feasible.

3. Does adequate area exist within the right-of-way to place Dry Weather Flow Diversion devices?
   - Yes
   - No

   If “Yes”, continue to Design Elements sections. If “No”, continue to Question 4.

4. If adequate area does not exist within right-of-way, can additional right-of-way be acquired to site Dry Weather Flow Diversion devices and how much right-of-way would be needed? _________ (acres)
   - Yes
   - No

   If “Yes”, continue to the Design Elements section.

   If “No”, continue to Question 5.

5. If adequate area cannot be obtained, document in Section 5 of the SWDR that the inability to obtain adequate area prevents the incorporation of this Treatment BMP into the project.
   - Complete

Design Elements

* **Required** Design Element – A “Yes” response to these questions is required to further the consideration of this BMP into the project design. Document a “No” response in Section 5 of the SWDR to describe why this Treatment BMP cannot be included into the project design.

** **Recommended** Design Element – A “Yes” response is preferred for these questions, but not required for incorporation into a project design.

1. Does the existing sanitary sewer pipeline have adequate capacity to accept project dry weather flows, or can an upgrade be implemented to handle the anticipated dry weather flows within the project’s budget and objectives? *
   - Yes
   - No

2. Can the connection be designed to allow for Maintenance vehicle access? *
   - Yes
   - No

3. Can gate, weir, or valve be designed to stop diversion during storm events? *
   - Yes
   - No

4. Can the inlet be designed to reduce chances of clogging the diversion pipe or channel? *
   - Yes
   - No

5. Can a back flow prevention device be designed to prevent sanitary sewage from entering storm drain? *
   - Yes
   - No

Figure 2-3. Feasibility and Design Criteria Used by Caltrans for Dry Weather Diversions.
From the December 2008 Update of the Caltrans PPDG, Appendix E, T-1 Checklist Part 3

Feasibility Question #2 in Figure 2-3 above references “extraordinary plumbing.” By way of example, the Caltrans PPDG defines extraordinary plumbing:
“Sites requiring extraordinary plumbing to collect and treat runoff (e.g., jacking operations under a highway, bridge deck collection systems, etc.) may be considered infeasible due to their associated costs. Sites requiring extraordinary features or construction practices, such as retaining walls and shoring, may also be infeasible due to their associated costs relative to the cost of the BMP itself.”

Other than those examples of extraordinary plumbing, the wording of the PPDG is deliberately broad to allow the designer and the District Stormwater Coordinator latitude to make design decisions.

In summary, the most well-documented programs of urban runoff diversion into sanitary conveyance and treatment systems involve dry weather diversions of urban runoff. In both the California beaches and Las Vegas Wash examples discussed above, the evaluation criteria started with water quality needs, then looked for alternatives to diversion to POTWs, and then screened diversions against acceptability criteria including conveyance and treatment capacity, constructability, cost, and community/regulatory acceptance. In the Caltrans example, the selection criteria reviewed focused on feasibility and constructability. Some important distinctions that set the above examples apart from this FER are:

- The tangible benefits of reducing beach closures or harvesting water in a desert may be more immediate and apparent to municipal decision makers than the concept of reducing PCB loads to the Bay; and
- The technical challenges of capturing and treating first flush and other stormwater flows would require some refinements to selection criteria to be used in this FER.

With those distinctions in mind, Section 3.1 in the Findings section below builds on the framework of “needs, alternatives, acceptability” to propose screening criteria to be used in this FER.

2.4 Approach to Develop Cost/Benefit Analysis

2.4.1 Cost Estimating Tools

Cost estimates for pilot diversions can be divided into two categories: capital costs, and operations and maintenance (O&M) costs.

Capital cost estimates for each component of a pilot diversion project are shown in Table 2-1. The estimates were developed from existing case studies for different agencies. These estimates are provided to illustrate ranges and will vary substantially depending on the agency and pump station location. Construction materials and labor will vary depending on the type of pilot diversion to be constructed. A pilot diversion which requires no additional pumps and is adjacent to a sanitary sewer line with excess capacity will have relatively small construction costs, while a pilot diversion which requires large quantities of large diameter pipe will cost much more. Connection fees will also vary depending on the sanitation agency and location of the pilot diversion. Diversions to POTWs with excess plant and sanitary sewer capacity will cost less than locations which require upgrades to sanitary sewers and treatment plants. Right-of-way (ROW) acquisition would depend on the type and quantity of land which is acquired. For the purposes of this analysis, it is assumed that ROW acquisition (or overly complex easement agreements) or treatment plant upgrades would lead to the conclusion that a pilot diversion project is not feasible. Supervisory control and data acquisition (SCADA) control costs will vary depending on the type of monitoring and control equipment specified. Some form of monitoring and controls would likely be required in all cases.
### Table 2-1. Planning Cost Estimates for Pilot Diversion Project Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost Range ($1000's)</th>
<th>Factors Affecting Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Materials and Labor</td>
<td>25 – 750</td>
<td>Type of pilot diversion, length</td>
</tr>
<tr>
<td>Connection Fees</td>
<td>9 – 18/1,000 gpd</td>
<td>Sanitary sewer capacity, plant capacity, sanitary sewer</td>
</tr>
<tr>
<td>Right of Way</td>
<td>Variable</td>
<td>Size, land use, location</td>
</tr>
<tr>
<td>SCADA/Safety Controls</td>
<td>10 – 50</td>
<td>Type of monitoring/control</td>
</tr>
<tr>
<td>Capital Support (Permits, Planning and Design)</td>
<td>40 percent of construction costs</td>
<td>Complexity of diversion</td>
</tr>
</tbody>
</table>

Cost estimates based on information from Brown and Caldwell (2009a); Brown and Caldwell (2009b); Sacramento Stormwater Quality Partnership (2006); Orange County Stormwater Program (2003); San Francisco Estuary Partnership (2010).

Another significant consideration affecting capital costs would be the need to re-route existing utilities to accommodate the diversion. This has been a major cost factor in determining acceptable locations for treatment measures targeted at other pollutants, e.g. large in-line trash capture devices. For the purposes of this FER, those additional costs are not considered for pilot projects, as significant re-routing is assumed to be outside the scope of a pilot project.

**O&M Costs** are primarily related to the annual cost of electricity to operate pumps (if needed), monitoring the diversion to ensure proper function, scheduled and emergency maintenance of pumps and diversion structure, and the treatment fees established by the receiving POTW. Cost estimates for these activities and items are summarized in Table 2-2 below. The annual costs of electricity, inspections and maintenance are derived from monthly O&M costs reported by the Orange County Stormwater Program (2003) for small diversions ranging from 0.01 MGD to 0.3 MGD. By comparison, the Sacramento Stormwater Quality Partnership (2006) estimated annual O&M costs of $40,000 for similarly sized diversions. The lower range of treatment fees is based on the estimated “chemicals and electricity only” costs for a large Las Vegas Valley treatment plant estimated by Brown and Caldwell (2009a). The upper range is based on the “whole plant operational costs” estimated by Brown and Caldwell (2009a). The actual fee charged will depend on the individual POTW, and the jurisdictional relationship between the POTW and the stormwater discharger and local sanitary sewer use ordinance requirements. For comparison, treatment fees estimated by the Sacramento Stormwater Quality Partnership (2006) are approximately $340 per MG treated; The San Jose /Santa Clara Water Pollution Control Plant reports O&M costs of approximately $400 per MG treated.

### Table 2-2. Planning O&M and Treatment Cost Estimates for Pilot Diversion Projects

<table>
<thead>
<tr>
<th>Cost Description</th>
<th>Cost Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump electricity, inspections and maintenance ($/year)</td>
<td>10,000 – 60,000</td>
</tr>
<tr>
<td>Treatment fees ($/MG gallons treated)</td>
<td>300 – 2400</td>
</tr>
</tbody>
</table>

Cost estimates based on information from Brown and Caldwell (2009a); Brown and Caldwell (2009b); Sacramento Stormwater Quality Partnership (2006); Orange County Stormwater Program (2003). Electricity costs would be reduced for intermittent pumping, in proportion to the planned run time. For planning purposes, it can be assumed that a minimum of $5,000 per year is required for inspections and maintenance.

Table 2-3 shows the estimated costs for different potential pilot diversion scenarios. It is important to note that these cost estimates are based on simplifying assumptions and existing information. Actual costs can vary heavily depending on site/diversion specific characteristics.

For non-constructed pilot diversions there are no capital costs as the pilot diversion occurs by rented equipment and hired labor. The operation costs will vary depending on how the pilot diversions are
staged. For pilot diversion and cleanouts staged during dry weather, scheduling and availability of equipment and staff is easier, thus lower costs are achieved, as opposed to increased costs attributed to mobilizations in response to wet weather events. The expected capital costs of constructed pilot diversions will vary depending on conveyance distance, pipe size, and if additional hydraulic head is required to divert stormwater.

Two types of constructed pilot diversions are potentially available. The type employed would depend on the location of the pump station (Figure 2-4). The one type (Option 1) would involve the installation of an additional pump (or pumps) within the wet well to divert flow directly to the sanitary sewer. This type of diversion provides inherent control of the quantity of water that can be diverted to the sanitary sewer, but involves higher initial costs due to pump station reconfiguration. However, the use of dedicated pumps selected to match the specific head requirements of the conveyance system would allow that system to be optimized, i.e., smaller pipe sizes can be used. This could result in cost saving for the conveyance system, which could be of particular importance for systems that require long conveyance pipes. Operation and maintenance would vary depending on the type and size of the pilot diversion. Another option (Option 2) would be a gravity-fed flow system using the existing pumps and capacity of the station. All stormwater discharged after the pumps would be diverted using only gravity flow to the sanitary sewer. A weir or other control device would be needed to prevent overloading of the sanitary sewer during large storm events. This type of pilot diversion requires larger-sized pipes, but no additional pumps. Gravity flows and passive pilot diversions would require less O&M while larger flows and pumps would regularly fall on the higher end of the expected range.

Figure 2-4. Conceptual diagram of two different options for pump station diversions.
Table 2-3. Estimated Costs for Different Pilot Diversion Approaches

<table>
<thead>
<tr>
<th>Pilot Diversion Approach</th>
<th>Capital Cost ($1,000)</th>
<th>O&amp;M Cost ($1,000/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-constructed pilot diversion using all rented equipment for strategic cleanout (7 days duration)</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>Non-constructed pilot diversion using all rented equipment in dry weather (90 days duration)</td>
<td>0</td>
<td>360</td>
</tr>
<tr>
<td>Non-constructed pilot diversion using all rented equipment in wet weather (30 days duration)</td>
<td>0</td>
<td>180</td>
</tr>
<tr>
<td>Constructed pilot diversion adjacent to sanitary sewer large enough to support gravity feed</td>
<td>100</td>
<td>10 - 60</td>
</tr>
<tr>
<td>Constructed pilot diversion adjacent to sanitary sewer requiring pumped feed</td>
<td>500</td>
<td>10 - 60</td>
</tr>
<tr>
<td>Constructed pilot diversion with moderate connection distance (&lt;500 ft) to sanitary sewer large enough to support gravity feed</td>
<td>500 - 1,500</td>
<td>10 - 60</td>
</tr>
<tr>
<td>Constructed pilot diversion with moderate connection distance (&lt;500 ft) to sanitary sewer via small diameter conveyance requiring pump</td>
<td>500 - 1,000</td>
<td>10 - 60</td>
</tr>
<tr>
<td>Constructed pilot diversion with long connection distance (&gt;500 ft) to sanitary sewer large enough to support gravity feed</td>
<td>1,500 - 3,000+</td>
<td>10 - 60</td>
</tr>
<tr>
<td>Constructed pilot diversion with long connection distance (&gt;500 ft) to sanitary sewer via small diameter conveyance requiring pump</td>
<td>500 - 1,500</td>
<td>10 - 60</td>
</tr>
</tbody>
</table>

Temporary pilot diversion costs assume $4,000 per day for labor during dry weather pilot diversions (four person crew) and equipment (one 20,000 gallon storage tank, three pumps, two support trucks, temporary check dams, and incidental equipment). Temporary pilot diversion costs are assumed to be 50 percent higher ($6,000 per day) during wet weather because of difficulties introduced by scheduling, safety and logistics.

2.4.2 Load Estimating Tools

The potential PCB load reduction benefits attainable from pilot diversion projects can be estimated based on either expected average PCB concentrations in stormwater, or expected average PCB concentrations in sediments captured by the pilot diversion. This section provides planning tools to assist with this estimation.

The first approach starts by asking “how much water is expected to be diverted into the POTW,” and “what is the average PCB concentration in that diverted water?” Water volumes can be estimated from the design storm perspective and the conveyance and treatment capacity perspective. The design storm perspective would multiply the catchment area (acres) by the design storm event (inches of rain) to derive the treatment volume, after unit conversion. However, in most cases, the limiting factor on treatment volume would be storage, conveyance and treatment capacity. Therefore, it makes most sense, for scoping purposes, to base treatment volume estimates on constraints established by the conveyance system, available storage capacity (if any), and limits on the treated volume that are either set by the POTW or that necessarily result from treatment costs. A similar approach would apply to dry weather diversions; rather than design storm considerations the flow question for a dry weather diversion would be “what is the average expected dry weather flow.”

For reference, a typical portable water tank can hold approximately 20,000 gallons. A diversion pump running at 75 gpm would move approximately 100,000 gallons in a day. If a 50 MGD treatment plant accepted up to 500,000 gallons of stormwater per day, the pilot diversion would use about 1 percent of the treatment capacity of the plant. Flows spanning this range are used to estimate loads.

PCB concentrations in stormwater can be estimated based on limited case study information available. The Ettie Street Pump Station Supplemental Environmental Project report (EBMUD 2010) serves as a useful benchmark for PCB concentrations in stormwater from a highly contaminated catchment of about 8 square kilometers comprised of mixed urban land uses with a predominantly industrial history. The report also provides data from Cerrito Creek, which is a similar sized catchment having an open creek in a suburban location that recieves stormwater flows from upstream residential and commercial areas.
- Average PCB concentrations in dry weather from the Ettie Street Pump Station ranged from 3 ng/L to 5 ng/L at the pump station, and approximately 1 ng/L at the reference creek (Cerrito Creek).
- Average first flush stormwater concentrations ranged from 16 ng/L in Cerrito Creek to as much as 50 ng/L in the first flush and wet weather influent to the Ettie Street Pump Station.
- Episodic measurements as high as 200 ng/L were observed.
- That concentration range is used as a basis for estimating PCB loads removed by pilot diversions ranging from 20,000 gallons to 500,000 gallons in Table 2- below.

Table 2-4 highlights the fact that dry weather diversions would not yield substantial load reduction benefits if the PCB concentrations are relatively low (e.g., 1 ng/L). A dry weather diversion of 0.1 mgd would yield between 0.0004 to 0.004 grams of PCBs per day, or 0.1 to 1 grams per year if dry weather flows were pumped 250 days out of the year. That is equivalent to 0.0006 to 0.006 percent of the total PCB load reduction (18 kg) required from urban stormwater by the TMDL. To attain 10 percent of the total PCB load reduction (i.e., 1.8 kg), a total of 3.5 billion gallons per year of dry or wet weather runoff having an average concentration of 50 ng/L would be required.

For storm events that yield higher PCB concentrations in runoff, more substantial load reductions may be attained. If 100,000 gallons of water having 200 ng/L PCBs were diverted from a single storm event, a total mass of 0.08 grams of PCBs could be diverted from discharge to the Bay. If 500,000 gallons could be diverted during a single event, it would be equivalent to 0.4 grams of PCBs, or 0.002 percent of the 18 kg load reduction required of urban stormwater by the TMDL.

The equation used to calculate values in Table 2-4 is:

$$PCB(g) = PCB\left(\frac{ng}{L}\right) \times Volume\ (gal) \times \frac{3.785\ L}{gal} \times \frac{1g}{10^9ng}$$

<table>
<thead>
<tr>
<th>Diverted Volume (gal)</th>
<th>PCB Concentration in Stormwater (ng/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>20,000</td>
<td>0.0001</td>
</tr>
<tr>
<td>50,000</td>
<td>0.0002</td>
</tr>
<tr>
<td>100,000</td>
<td>0.0004</td>
</tr>
<tr>
<td>200,000</td>
<td>0.0008</td>
</tr>
<tr>
<td>400,000</td>
<td>0.0015</td>
</tr>
<tr>
<td>500,000</td>
<td>0.0019</td>
</tr>
<tr>
<td>1,000,000</td>
<td>0.0038</td>
</tr>
</tbody>
</table>
For context, the expected range of PCB concentrations in stormwater can be estimated based on assumed concentrations of PCBs in sediments and total suspended sediments (TSS) concentrations (Figure 2-5). Typical PCB concentrations in sediments within the urban landscape range from 0.1 mg/kg to 1 mg/kg; contaminated sediments found in localized areas can be as high as 10 mg/kg or more. It is assumed that highly contaminated sediments would be addressed through sediment management or site remediation, and that diversion projects would address more diffuse contamination areas where the average first flush concentration of PCBs on suspended sediments is 1 mg/kg or less. Under typical TSS concentrations in stormwater (< 500 mg/L), PCB concentrations would tend to be 200 ng/L or less.

![Graph](image)

**Figure 2-5. Concentrations of PCB vs. TSS under different assumed concentrations of PCBs in sediment.**

*Solid line indicates the California Toxics Rule (CTR) water quality objective (0.17 ng/L)*

Tools similar to those used for PCBs can also be applied to estimating mercury loads avoided (Table 2-5, Figure 2-6). The higher range of mercury concentrations in stormwater (< 2,000 ng/L) reflects the assumption that mercury concentrations in suspended sediments from contaminated areas could be as high as 10 mg/kg.

This approach to load estimating is used to develop the cost-benefit analysis of example pilot diversion scenarios in Section 3.2.
Table 2-5. Hg Load Estimating Tool (grams)

<table>
<thead>
<tr>
<th>Diverted Volume (gal)</th>
<th>Hg Concentration in Stormwater (ng/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>20,000</td>
<td>0.0001</td>
</tr>
<tr>
<td>50,000</td>
<td>0.0002</td>
</tr>
<tr>
<td>100,000</td>
<td>0.0004</td>
</tr>
<tr>
<td>200,000</td>
<td>0.0008</td>
</tr>
<tr>
<td>400,000</td>
<td>0.0015</td>
</tr>
<tr>
<td>500,000</td>
<td>0.0019</td>
</tr>
<tr>
<td>1,000,000</td>
<td>0.0038</td>
</tr>
</tbody>
</table>

Figure 2-6. Concentrations of Hg vs. TSS under different assumed concentrations of Hg in sediment.

Solid line indicates the California Toxics Rule (CTR) water quality objective (0.50 ng/L)
Section 3

Findings

3.1 Recommended Selection Criteria

This section proposes screening criteria that are developed around the framework of needs, alternatives, and acceptability outlined in the previous sections. These criteria are intended to inform the selection of pilot diversion sites, but may not include all considerations that would need to be taken into account as potential pilot diversion sites are evaluated.

3.1.1 Needs

The overall water quality need is a reduction in the load of PCBs and mercury discharged from urban areas into the Bay. Guidance from the SFB-RWQCB further specifies that pilot diversion projects should focus on abating discharges of PCBs from contaminated drainages, and concurrently evaluate the added value of mercury load reductions achieved by PCB-focused projects. That is, project siting decisions should be led primarily by PCB loads.

Watershed load reduction goals help put PCB loads into context as a selection criterion. The CW4CB grant recently awarded to BASMAA sets forth the ambitious goal of reducing PCB loads by 0.3 to 1.5 kg per year through a series of coordinated investigation, reporting, potential remediation, and treatment retrofit projects. If the goal is achieved, the load reduction would be about one to seven percent of the currently estimated 20 kg per year of PCBs discharging from Bay Area urban storm systems.

It is proposed that individual pilot diversion projects that reduce the current PCB load to the Bay by one percent or more per year (i.e., reduce PCBs by 0.2 kg/yr or more) could be considered meaningful steps towards attainment of the PCB wasteload allocation for urban stormwater. In contrast, pilot projects that attained load reductions on the order of 0.01 kg/year (ten grams) or less would not yield significant progress, by themselves. Small pilots could be useful if they can be cost-effectively replicated numerous times throughout the watershed, or if they provide information that can be scaled up to evaluate the costs and benefits of larger projects.4

The selection criteria based on water quality needs are summarized by the following two questions:

Will the project yield a substantial PCB load reduction? An important tool for answering this question is an understanding of the spatial distribution of PCBs in sediments of the San Francisco Bay watersheds. The most recently available synthesis of PCB monitoring data is available in the grant-funded study by Yee et al (2010), titled “Concentrations of PCBs and Hg in soils, sediments and water in the urbanized Bay Area: Implications for best management.” Figures and tables in that report highlight urbanized areas of the Bay with the highest PCB concentrations in sediments collected from catch basins and street curbs.

Provisions C.11.f and C.12.f strongly emphasize existing stormwater pump stations as the most likely areas for pilot diversion projects. Pump station inventory reports have been submitted to the SFB-RWQCB and compiled in tabular and GIS formats. Matching areas of high PCB concentrations in sediments with the known spatial distribution of pump stations is a useful step to efficiently make an

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4 The SFB-RWQCB has stated that diversion projects may have other benefits unrelated to PCBs and Hg (e.g., reductions in discharges of low DO water, bacteria, etc.)
initial screening of likely candidate pump stations based on potential for load reductions. Figures 3-1 through 3-6 below show the locations of pump stations, measured PCB concentrations in storm drain sediments, and POTW service areas. For illustration purposes, only sediment samples with detectable PCB concentrations are included in the figures. These planning tools can be used to assist in the evaluation of the water quality needs criteria.
Figure 3-1. Map of Pump Station Locations, PCB concentrations in Sediments, Locations of POTWs, and POTW Service Areas in San Mateo County.

GIS layers for PCBs in sediments and pump stations courtesy SFEI. GIS layers for POTW service areas courtesy Caltrans District 4. All GIS information is preliminary; Brown and Caldwell and the GIS information providers make no guarantees as to the accuracy of GIS information provided in this report.
Figure 3-2. Map of Pump Station Locations, PCB concentrations in Sediments, Locations of POTWs, and POTW Service Areas in Napa County.

GIS layers for PCBs in sediments and pump stations courtesy SFEI. GIS layers for POTW service areas courtesy Caltrans District 4. All GIS information is preliminary; Brown and Caldwell and the GIS information providers make no guarantees as to the accuracy of GIS information provided in this report.
Figure 3-3. Map of Pump Station Locations, PCB concentrations in Sediments, Locations of POTWs, and POTW Service Areas in Marin County.

GIS layers for PCBs in sediments and pump stations courtesy SFEI. All GIS information is preliminary; Brown and Caldwell and the GIS information providers make no guarantees as to the accuracy of GIS information provided in this report.
Figure 3-4. Map of Pump Station Locations, PCB concentrations in Sediments, Locations of POTWs, and POTW Service Areas in Contra Costa County.

GIS layers for PCBs in sediments and pump stations courtesy SFEI. GIS layers for POTW service areas courtesy Caltrans District 4. All GIS information is preliminary; Brown and Caldwell and the GIS information providers make no guarantees as to the accuracy of GIS information provided in this report.
Figure 3-4. Map of Pump Station Locations, PCB concentrations in Sediments, Locations of POTWs, and POTW Service Areas in Alameda County.

GIS layers for PCBs in sediments and pump stations courtesy SFEI. GIS layers for POTW service areas courtesy Caltrans District 4. All GIS information is preliminary; Brown and Caldwell and the GIS information providers make no guarantees as to the accuracy of GIS information provided in this report.
Figure 3-5. Map of Pump Station Locations, PCB concentrations in Sediments, Locations of POTWs, and POTW Service Areas in Santa Clara County.
GIS layers for PCBs in sediments and pump stations courtesy SFEI. GIS layers for POTW service areas courtesy Caltrans District 4. All GIS information is preliminary; Brown and Caldwell and the GIS information providers make no guarantees as to the accuracy of GIS information provided in this report.
Figure 3-6. Map of Pump Station Locations, PCB concentrations in Sediments, Locations of POTWs, and POTW Service Areas in Solano County.

GIS layers for PCBs in sediments and pump stations courtesy SFEI. GIS layers for POTW service areas courtesy Caltrans District 4. All GIS information is preliminary; Brown and Caldwell and the GIS information providers make no guarantees as to the accuracy of GIS information provided in this report.
**Will the project provide unique or new information?** This is a more subjective question that would require input from the Technical Oversight Committee, including the SFB-RWQCB, to properly screen. It is an important question because, given the compliance time frame and inherent scale of pilot projects, they will most likely be small and temporary in nature. Therefore, in addition to targeting opportunity areas where pump stations serve drainage areas that have high PCB concentrations, pilot projects should be designed with the intent of producing information that will be useful to assess the costs and benefits of full scale implementation.

### 3.1.2 Costs and Alternatives

Overall cost is an important screening criteria for pilot projects. Some simple planning tools for determining whether or not a pilot project is cost prohibitive are presented in Section 2.4.1 above. In general, pilot projects that would require significant new conveyance infrastructure or incur significant treatment costs may be less attractive than pilot projects with relatively simple diversion connections located in jurisdictions where reduced or waived treatment costs could be negotiated.

Alternatives to diversion, such as pollution prevention, street sweeping, sediment management, and stormwater treatment retrofits, should always be considered in conjunction with diversion to POTWs. This FER is developed to comply with an MRP requirement that also prescribes five pilot projects; therefore, consideration of alternatives is not a specific screening criterion for pilot projects, although it would be an important screening criteria for additional implementation beyond the pilot stage. The oversight committee will provide input and feedback on diversion sites considering the broader regional context of pilot-testing a variety of pollutant control strategies in the Bay Area.

### 3.1.3 Acceptability

There are two screening criteria that should be evaluated to determine whether diversion into POTWs is acceptable:

**Is there an accessible POTW willing and able to provide treatment service?** A key piece of information to help identify the POTW which serves an area of interest is a map of POTW service areas, such as the examples shown in Figures 3-1 through 3-9. Additionally, Pump station inventory data compiled by the SFB-RWQCB includes partial listings of the nearest POTW. The best way to assess the willingness, existing ability and challenges of a POTW to accept a diversion is to begin discussions with the appropriate staff and collectively explore opportunities and constraints of the potential diversion in question. Because of the likely change needed to existing POTW procedures, policies, and principles, it is expected that inevitably, decision makers representing the POTW will also need to be involved and approve the pilot diversion. In order for a POTW decision maker to evaluate the request, they would need certain information, including the amount to be diverted, the expected timing and duration of the pilot diversion, and the loads of PCBs, mercury, suspended sediment, dissolved solids, and biochemical oxygen demand expected. Some of the concerns of POTWs are briefly summarized in Section 3.3 below and by the Bay Area Clean Water Agencies (Carollo, 2009)

**Can the pilot diversion be sited within acceptable design criteria?** This criterion would be evaluated using maps, diagrams, a site walk, and other resources necessary to complete a pre-design checklist comparable to the one illustrated in Figure 2-3. A more pertinent checklist has been developed for this FER and is shown in Table 3-1.
Table 3-1. Proposed Checklist for Evaluating Engineering Feasibility of Pilot Diversions

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Does the POTW in question have existing capacity during wet weather?</td>
</tr>
<tr>
<td>2</td>
<td>Does the POTW in question have existing capacity during dry weather?</td>
</tr>
<tr>
<td>3</td>
<td>What is the distance to any potential sanitary sewer pilot diversion connections (linear feet)?</td>
</tr>
<tr>
<td>4</td>
<td>Does the potential connection require any land acquisition or easements?</td>
</tr>
<tr>
<td>5</td>
<td>Does the POTW fully own or control the sanitary sewer system?</td>
</tr>
<tr>
<td>6</td>
<td>Is the POTW willing to accept discharge from a stormwater pilot diversion project?</td>
</tr>
<tr>
<td>7</td>
<td>What is the capacity of the pump station (gpm)?</td>
</tr>
<tr>
<td>8</td>
<td>What is the wet weather capacity of the sanitary sewer system downstream of the potential pilot diversion connection?</td>
</tr>
<tr>
<td>9</td>
<td>What percentage of the pump station flow can be diverted to the sanitary sewer system if at all?</td>
</tr>
<tr>
<td>10</td>
<td>Does the pump station have sufficient area in either the wet well or after the pump to build a pilot diversion?</td>
</tr>
<tr>
<td>11</td>
<td>Would the pump station convey flow to the sanitary sewer system via gravity flow or an additional pump.</td>
</tr>
</tbody>
</table>

Questions 1 and 2 initially determine the feasibility of a POTW to accept stormwater flow. POTWs with little excess capacity will not likely take on stormwater discharges. If it is possible to divert water, questions 3, 4, and 5 consider the route necessary to convey water to the sanitary sewer system. Longer distance pilot diversions will likely be cost prohibitive, as well as routes which require acquisition of land or easements for construction. If the POTW does not own the sanitary sewer system, or shares ownership, negotiations for sanitary sewer capacity and the timing of discharges would involve more parties, and likely be more complex. Questions 6, 7, and 8 determine the capacity of the sanitary sewer system at a chosen pilot diversion point, to accept, some, all, or none of the wet or dry weather flow from the diversion. Of particular concern is whether accepting a diversion would increase the risk of a Sanitary Sewer Overflow (SSO). Finally, questions 9 and 10 determine whether the pump station itself is amenable to retrofit for pilot diversion. Pump stations in small areas with limited space for expansion would likely be ill-suited to build a flow control device for gravity flow to a sanitary sewer connection. In stations with small wet well capacity it would be difficult to install new pumps for conveyance.

Table 3-2 below summarizes the selection criteria, and the information needed to apply the criteria.
Table 3-2. Proposed Selection Criteria and Information Needed

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Information Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Needs</strong></td>
<td>Will the project yield a significant PCB load reduction?</td>
</tr>
<tr>
<td></td>
<td>Will the project provide unique or new information?</td>
</tr>
<tr>
<td></td>
<td>Does a pilot project fit into the broader regional context of pilot-testing a range of pollutant control strategies, including pollution prevention, site remediations, enhanced sediment management, and stormwater treatment retrofitting strategies?</td>
</tr>
<tr>
<td><strong>Costs and Alternatives</strong></td>
<td>Are the capital and operation and maintenance costs associated with diversion prohibitive?</td>
</tr>
<tr>
<td></td>
<td>Are there ways to control upstream sources of PCBs through remediation, removal, isolation, or run-on diversion?</td>
</tr>
<tr>
<td></td>
<td>Can onsite treatment or infiltration retrofits be implemented?</td>
</tr>
<tr>
<td><strong>Acceptability</strong></td>
<td>Is there an accessible POTW willing and able to provide treatment service?</td>
</tr>
<tr>
<td></td>
<td>Can the pilot diversion be sited within acceptable design criteria?</td>
</tr>
</tbody>
</table>

### 3.2 Cost and Benefit Analysis of Three Scenarios

This section evaluates three hypothetical scenarios to estimate the costs, grams of PCBs removed, and resulting cost per gram. These scenarios are hypothetical, based on untested assumptions and may not represent actual conditions or costs associated with stormwater pump station diversions in the Bay Area. Additionally, these scenarios are intended to only represent a range of possible costs and benefits that may be expected. Costs and benefits are evaluated in the context of three types of scenarios that are inherently different in scale and implementation timeframes. For those scenarios with longer implementation timeframes, costs can be spread out accordingly and therefore provide an unequal comparison against scenarios with shorter implementation durations. For these reasons, costs should not be used to directly compare the cost efficiencies between scenarios presented, but rather used to assess the range of costs that may be expected for an individual scenario. Constructed Pilot Diversions

Under this scenario, it is assumed that a pilot diversion is constructed which includes operational controls that allow selective pilot diversion of first flush and wet weather events. The pilot diversion is assumed to require minimal distance to tie into the sanitary sewer system. The pilot diversion is assumed to be a gravity feed into a large capacity sewage line, requiring minimal annual O&M costs due to electricity. The receiving POTW has agreed to accept one million gallons per 24-hour storm event no more than eight times during the storm season. It is assumed, for this hypothetical scenario, that the
POTW has agreed to waive treatment fees\(^5\). A pilot diversion and pump system has been constructed which can convey large volumes of flow (750 gpm to deliver one million gallons in 24 hours). Based on Table 2-1, the capital outlay for this project is assumed to be $750,000. The removal effectiveness for PCBs and Hg is assumed to be >95 percent.

If the average PCB concentration in diverted stormwater were 50 ng/L, each million gallons diverted would reduce PCB loads discharged directly to the Bay by 0.2 grams (see Table 2-4). Eight such events each year would annually reduce PCB loads by 1.6 grams. Over twenty years, this would correspond to 32 grams of PCBs (assuming concentrations would remain unchanged over this timeframe).

Assuming that a ten-fold higher stormwater mercury concentration (500 ng/L), this would correspond to a load reduction of 16 grams of mercury per year, or 320 grams over twenty years.

If the treatment plant provides treatment service for free, then achieving a total load reduction of 32 grams PCBs and 320 grams mercury over twenty years by this approach would result in a capital outlay and operation and maintenance cost of approximately $23,500 per gram of PCBs reduced, and $2,350 per gram of mercury reduced. This estimate is a very crude, demonstrative example that does not consider life-cycle costs, net present worth cost adjustments, or other complexities. The cost per gram would increase substantially if the hypothetical pilot diversion were to be terminated in less than twenty years.

3.2.1 Non-constructed Pilot Diversions

Under this scenario, it is assumed that a wet weather pilot diversion project that does not require the construction of diversion structures, but rather is implemented using check dams and pumps to divert storm flows into storage tanks, and subsequently routing into a sanitary sewer when there is sufficient capacity. Because no capital costs incurred under this scenario, municipalities diverting stormwater have less financial risk compared to the first scenario described. It is assumed that sufficient site area is available to locate ten storage tanks, and that the site area has pavement competent to withstand the weight of ten full tanks. The project is assumed to last for thirty days, and the daily cost of equipment rental and staffing is $6,000, for a total project cost of $180,000 (per Table 2-3). As with the constructed pilot diversion scenario above, treatment fees are assumed to be waived for this scenario\(^5\).

The project is assumed to occur in the wettest months (i.e., January – February), and for the purposes of this scenario is assumed to capture a total of three major storm events, diverting a total of 600,000 gallons of wet weather flows (200,000 gallons each event) having an average PCB concentration of 50 ng/L.

Referring to Table 2-4, each 200,000 gallon pilot diversion event would capture 0.04 grams of PCBs, for a total of 0.12 grams diverted into the POTW. Again assuming 95 percent removal, this would yield a net load reduction of 0.11 grams, or 0.0006 percent of the total currently estimated PCB stormwater load. Although the total project cost is lower compared to construction of a constructed pilot diversion, the cost per gram removed is significantly higher: approximately $1,600,000 per gram of PCBs removed.

Assuming a ten-fold higher Hg concentration (500 ng/L), the net load reduction would be 1.1 grams for this scenario, at a cost of $160,000 per gram.

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\(^5\) The simplifying assumption that a POTW waives treatment fees is, in fact, unlikely. In most cases, wastewater and stormwater programs are funded through separate sources, and so institutional factors may make such a waiver problematic. As noted in Tables 2-1 and 2-2 above, connection fees typically range from $9,000 to $18,000 per thousand gallons per day, and treatment fees typically range from $300 to $2,400 per MG treated. As a result, these cost estimates for the hypothetical scenarios are likely underestimated. Other charges may also be assessed, such as East Bay MUD’s “wastewater capacity fee” of at least $97.40 per 100 cubic feet per month, or $130,000/MG/month. See, for example:

3.2.2 Conveyance System Cleanout

Under this scenario, it is assumed that a sediment sampling and visual inspection has identified a conveyance with contaminated sediments. A cleanout of the impacted portion of the system takes place over a period of seven days, at a lower cost ($4,000 per day) than the wet weather pilot diversion because the dry weather work can be more easily scheduled. A total of ten kilograms of contaminated sediments having an average PCB concentration of ten parts per million (10 mg/kg) is flushed from the system and captured in a single, 20,000 gallon storage tank, and then discharged into the sanitary sewer. Again, treatment fees are assumed to be waived for this analysis. Under this scenario, the total mass of PCBs removed would be 100 mg, or 0.1 grams. If 95 percent of the PCB load discharge to the POTW is removed by treatment, the net load reduction benefit to the Bay would be 0.095 grams. The total project cost is $28,000. The cost per gram of PCBs removed under this scenario would be approximately $300,000 per gram.

Under this scenario, it is assumed that sediment with 10 mg/kg PCBs have mercury concentrations of 1 mg/kg. This assumption reflects the observations that sediments from old industrial areas that are substantially contaminated with PCB are not typically found in the same locations as sediments impacted by mining waste that have mercury concentrations of 10 mg/kg or more. The corresponding load reduction of mercury would be 0.01 grams, at a cost of $3,000,000 per gram.

Although this third scenario is the most cost-effective, in terms of cost per gram, and also one of the most likely scenarios to be acceptable to a POTW, the overall load reduction is still relatively small – again about 0.0005 percent of the total stormwater PCB load to the Bay. Additionally, this scenario (and non-constructed diversions) allow municipalities to be more adaptive in directing resources where they are most needed. This scenario could, however, be a useful diagnostic tool. If, after conducting the cleanout, follow-up inspections show that contaminated sediments are again found in the conveyance system after the rainy season ends, that would suggest a need to look upstream to possibly identify areas where sediment removal, capping, and/or run-on pilot diversion could be implemented to protect the stormwater conveyance system.

3.3 POTW and Collection System Agency Constraints/Concerns

A draft white paper developed by the Bay Area Clean Water Agencies presents a summary of constraints faced by POTWs when deciding whether or not to accept stormwater discharges for treatment (BACWA, 2009). Those issues have been raised in previous technical reports submitted to the SFB-RWQCB (e.g., Applied Marine Sciences, 2003).

Some of the main constraints faced by POTWs include:

**Treatment capacity and conveyance system capacity** - The BACWA (2009) white paper noted that most treatment and conveyance system capacity issues could be addressed by restricting diversion flows. Restrictions could be achieved through the design of orifices, weirs, and pumps. As noted in the cost / benefit analysis, treatment and conveyance and capacity issues may limit the load reduction benefits attainable.

**Conveyance system ownership and permission of all owners** - Not all POTWs own the collection and conveyance systems that serve them. If a different entity than the POTW owns the collection system, it would require another negotiation to enable the diversion. If there are multiple collection system owners, the negotiation could be more complex.

**Ordinance prohibitions** - The BACWA (2009) white paper notes that:
“There are few existing agreements and local laws (e.g. ordinances) that relate to stormwater diversions, including a POTW’s ability to accept, deny or condition the acceptance of stormwater diversions (e.g. flow restrictions, pretreatment requirements). Most wastewater agencies operating separate sanitary sewers currently forbid the discharge of stormwater into the sanitary system. However, many wastewater agencies have a stipulation in their rules that allow diversions to the sanitary system with the permission of the POTW.”

**Potential to upset biological processes, especially in advanced treatment plants.** Introduction of heterogeneous surface waters puts a POTW at risk of treatment system upsets, particularly in advanced plants where inoculations of foreign bacteria can interfere with microbial communities essential to the treatment process.

**Effect of PCB loads on effluent** - In its report on the Ettie Street Pump Station diversion project (EBMUD, 2010), EBMUD noted that PCB loads to influent are not 100% removed by the treatment process. As a result, EBMUD stated that the compliance with respect to “PCBs and other pollutants for which the Bay is impaired would require particularly close evaluation for diversion potential.” There is only a small, preliminary amount of data available on current concentrations of PCBs in treated effluent (SFRWQCB, 2008). However, the limited amount of information available indicates that PCB concentrations in treated effluent are likely to be above water quality objectives for PCBs established in the California Toxics Rule.

**Effect of PCB loads on biosolids** - Initial discussions with the Technical Oversight Committee (July 14, 2010) led to the conclusion that PCB loads from pilot diversion projects may be sufficiently small that they would not significantly change the PCB concentration of biosolids. The preliminary load calculations in Section 3.2 tend to support this – conveyance system and treatment plant capacity would likely become limiting factors before PCB concentrations in biosolids would be a constraint. However, it is worth noting that deliberate introduction of PCBs into sewage treatment systems has strong potential to cause perception problems related to biosolids. For example, a recent incident in Milwaukee, Wisconsin led to the inadvertent introduction of PCB contaminated sediments in to the municipal sewage treatment system during a sanitary sewer system rehabilitation project (Behm, 2009). As a result, commercial production and sale of biosolids from the treatment plant was halted for several months. Recovery from the incident caused the Milwaukee Metropolitan Sewerage District approximately $4 million.

### 3.4 Conceptual Framework for Crediting PCB Load Reductions

The MRP requires that this FER include “a proposed method for distributing PCBs load reductions to participating wastewater and stormwater agencies.” proposed approach for crediting mercury and PCB load reductions to POTWs. This section proposes a method for illustrative purposes, in order to comply with the NPDES permit. Any program of incentives or credits to POTWs would need to be developed with POTW involvement.

The effect of a diversion on compliance would be of particular concern. For example, in its report on the Ettie Street Pump Station pilot diversion project (EBMUD, 2010), EBMUD noted that PCB loads to influent are not 100 percent removed by the treatment process. As a result, EBMUD stated that the compliance with respect to “PCBs and other pollutants for which the Bay is impaired would require particularly close evaluation for pilot diversion potential.”

There is only a small, preliminary amount of data available on current concentrations of PCBs in treated effluent (SFB-RWQCB, 2008). However, the limited amount of information available indicates that PCB concentrations in treated effluent are likely to be above water quality objectives for PCBs established in the California Toxics Rule. The San Francisco Bay PCBs TMDL has established WLAs for PCBs in treated effluent that add up to 2 kg per year for all Bay Area wastewater dischargers combined. The estimated current loads are slightly higher, 2.3 kg per year. The SFB-RWQCB has stated that it expects PCB
concentrations in effluent to decrease over time as a result of the fact that PCBs are no longer manufactured or used. Recognizing that pilot diversion projects would increase PCB loads to POTWs, the SFB-RWQCB also included a 1 kg per year WLA to be made available to individual POTWs who agree to accept stormwater for discharge.

IN the staff report accompanying the San Francisco Bay PCBs TMDL, the explanation for the 1 kg per year WLA available for stormwater treatment is as follows:

“A potential means to reduce urban stormwater runoff PCBs loads will be to strategically intercept and route runoff to municipal wastewater treatment systems. We propose a separate wasteload allocation for discharges associated with urban stormwater runoff treatment via municipal wastewater treatment systems, since such actions will result in increased PCBs loads from municipal wastewater dischargers, and the proposed individual wasteload allocations for municipal wastewater dischargers reflect current performance levels. We propose a wasteload allocation of 0.9 kg/yr, which is the difference between the TMDL of 10 kg/yr and the sum of the other proposed wasteload and load allocations.”

The proposed method is to credit the participating stormwater permittee for the estimated load diverted as progress towards attainment of the TMDL wasteload allocation. Participating POTWs would likely seek some form of regulatory protection from effluent limit exceedances or system upsets caused by the pilot diversions. The SFB-RWQCB could consider offering some of the 1 kg per year WLA as an incentive for POTW participation. A crediting ratio could be proposed to allow a small increase in POTW loads in comparison to the stormwater loads removed. For example, if the crediting ratio were 10:1, then the 1.6 grams of PCBs removed annually under Scenario 1 above would allow the participating POTW to increase loads by 0.16 grams per year. A crediting ratio of 10:1 would allow for a 90 percent removal efficiency by the POTW: for every ten additional grams of PCBs in stormwater treated by the POTW, an additional one tenth of a gram would be discharged, resulting in a net PCB load reduction. The SFB-RWQCB would likely need to seek input and buy-in on this concept from the United States Environmental Protection Agency, as well as local environmental stakeholders, to incorporate this or any other crediting framework into NPDES permits.
Section 4

Process and Schedule for Pilot Project Implementation

A proposed timeline for pilot project implementation is shown in Table 4-1 below. This FER completes Task 1, which is led by a BASMAA as a regional project. Task 2.0 will begin upon submittal of this FER. Copermittees, with some assistance from BASMAA as needed, would use this report to propose five candidate and five alternate pump stations for pilot projects. A technical memorandum summarizing the candidate and alternate pump stations would be submitted to the SFB-RWQCB by September 15, 2011. After that time, preliminary designs and cost estimates for the pilot diversions would be advanced.

Sampling and analysis plans would be developed though a regional project. Progress would be summarized in Annual Reports submitted by BASMAA to the SFB-RWQCB. The MRP requires a final report to be completed by March 15, 2014.
Table 4-1. Proposed Schedule for Pilot Project Implementation

<table>
<thead>
<tr>
<th>Task</th>
<th>Programs/Permittees</th>
<th>Regional</th>
<th>Suggested Start Date</th>
<th>Suggested End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 - Feasibility Evaluation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Develop draft list of criteria that should be considered when selecting areas or stormwater pump stations for potential pilot diversions to POTWs, and associated data/information needed to apply the criteria.</td>
<td>A</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2 Develop a preliminary cost and benefit assessment for three (?) types/configurations of areas or pump stations using existing data and information</td>
<td>A</td>
<td>X</td>
<td>May 15, 2010</td>
<td>July 21, 2010</td>
</tr>
<tr>
<td>1.3 Develop draft methodologies for distributing loads between POTWs and stormwater programs when diverting areas or pump station discharges to POTWs.</td>
<td>A</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4 Summarize criteria, cost benefit analysis, and loads methodology in a report and include a time schedule for selection and implementation of pilot diversions.</td>
<td>A</td>
<td>X</td>
<td>Draft – August 11, 2010</td>
<td>Final – September 15, 2010</td>
</tr>
<tr>
<td>2.0 Pump Station Retrofits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Apply criteria developed in Task 1.1 and select a minimum of 5 primary and 5 alternate pump stations or areas (2 per county) that will be considered for pilot diversion.</td>
<td>X</td>
<td>A</td>
<td>September 8, 2010</td>
<td>February 28, 2011</td>
</tr>
<tr>
<td>2.2 Develop memorandum summarizing pump stations or areas selected in task 2.1 above and a refined cost benefit assessment for these pump stations or areas.</td>
<td>A</td>
<td>X</td>
<td>March 1, 2011</td>
<td>Draft – May 15, 2011; Final – August 15, 2011</td>
</tr>
<tr>
<td>2.3 Further scope pilot diversion infrastructure needs, and develop preliminary/conceptual design (5 percent) and engineering for pump stations or areas selected in Task 2.1.</td>
<td>X</td>
<td>A</td>
<td>June 1, 2011</td>
<td>December 1, 2011</td>
</tr>
<tr>
<td>2.4 Refine conceptual design into 30 percent level of design and acquire permits/agreements as needed.</td>
<td>X</td>
<td>A</td>
<td>December 1, 2011</td>
<td>December 11, 2012</td>
</tr>
<tr>
<td>2.5 Retrofit existing pump stations or areas to allow for pilot diversion to POTW (i.e., construction) under predefined conditions</td>
<td>X</td>
<td>A</td>
<td>January 21, 2013</td>
<td>June 1, 2013</td>
</tr>
<tr>
<td>3.0 Monitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Develop regional sampling and analysis plan (Including a QAPP and SOP) and data reporting templates</td>
<td>A</td>
<td>X</td>
<td>July 1, 2011</td>
<td>June 30, 2013</td>
</tr>
<tr>
<td>3.2 Monitor diversions (early implementation may be possible at some stations)</td>
<td>X</td>
<td>A</td>
<td>July 1, 2013</td>
<td>January 31, 2014</td>
</tr>
<tr>
<td>3.3 Conduct QA/QC, data analyses</td>
<td>A</td>
<td>X</td>
<td>July 1, 2013</td>
<td>February 28, 2014</td>
</tr>
<tr>
<td>4.0 Reporting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1 Summarize pilot diversion project status/progress in Annual Report</td>
<td>X</td>
<td>A</td>
<td>July 1, 2010</td>
<td>September 15, 2014</td>
</tr>
</tbody>
</table>

Section 5

Limitations

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### Attachment 1. List of Major POTWs in the Bay Area

<table>
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<tr>
<th>NPDES Permit</th>
<th>POTW</th>
<th>Area</th>
<th>Outfall</th>
<th>Agencies</th>
<th>Service Population</th>
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## Attachment 1. List of Major POTWs in the Bay Area

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MRP Regional Supplement for POCs and Monitoring
Appendix A
Methods for Quantifying Mercury and PCB Loads Reduced From Urban Stormwater Runoff

Assessing municipal stormwater program progress towards TMDL wasteload allocations through control measure implementation

*Working Draft Technical Memorandum*

Prepared for

Bay Area Stormwater Management Agencies Association (BASMAA)

Prepared by:

EOA, Inc.
1410 Jackson St.
Oakland, CA 94612

September 10, 2010
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<td>LA</td>
<td>TMDL Load Allocations</td>
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<td>MPC</td>
<td>Monitoring and Pollutants of Concern</td>
</tr>
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<td>MRP</td>
<td>Municipal Regional Stormwater NPDES Permit</td>
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<td>MS4s</td>
<td>Municipal Separate Storm Sewer Systems</td>
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<td>National Pollutant Discharge Elimination System</td>
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PREFACE

This working draft technical memorandum (TM) was developed under the direction of the Bay Area Stormwater Management Agencies Association (BASMAA) and its associated member agencies. This TM is a working draft that is only intended to demonstrate initial concepts regarding methods for quantifying mercury and PCB loads reduced from urban stormwater runoff in the San Francisco Bay Area. This TM should not be construed as a complete or finalized product, but rather a work-in-progress. Methods discussed in the TM are a result of a preliminary review of applicable literature and initial loads reduced formula development. The literature review will continue and loads reduced formulas will be updated in the future based on comments received from stakeholders.
EXECUTIVE SUMMARY - TO BE COMPLETED
1.0 INTRODUCTION

Municipalities in the San Francisco Bay Area (Bay Area) implement numerous measures at the local level in an attempt to control pollutants (e.g., mercury, PCBs, trash and pesticides) from entering urban stormwater runoff and receiving water bodies (e.g., local creeks, the Bay, and Pacific Ocean). Additionally, through tracking, lobbying and direct participation in task forces and committees, municipalities support and influence the development of pollutant control measures\(^1\) that are implemented at the State or national level through regulatory solid and hazardous waste programs (e.g., mercury product recycling programs). These control measures serve as the best management practices (BMPs) municipalities and flood control agencies can implement to reduce potential adverse impacts to beneficial uses (e.g., fish consumption, recreation, and fisheries habitat) of water bodies in the region.

The effectiveness of these control measures can be evaluated in many ways (CASQA 2007, Strecker et al. 2001), but generally requires the collection and/or tracking of data and information that is directly related to the desired result or outcome of implementing the control. With regard to urban stormwater runoff, the effectiveness of a control measure is generally measured using one or more of following three methods:

1. **Increases in Awareness/Behavior** - Estimating or quantifying changes in awareness, knowledge or behavior of individuals or populations of individuals;
2. **Loads Reduced from Sources** - Quantifying reductions in the mass (loads) of pollutants from sources entering stormwater; and
3. **Runoff and Receiving Water Improvements** - Empirical measurements of water quality (stormwater or receiving water) improvements.

Since stormwater pollution is an issue generally created by the actions of residents or businesses, Bay Area urban stormwater management programs (stormwater programs) have historically used surveys and inspections to assess changes in awareness or behaviors, or water quality monitoring data to evaluate improvements in runoff or receiving water quality. As an alternative approach, this technical memorandum presents preliminary methodologies to quantify the load reductions for priority Pollutants of Concern (POCs) from specific urban stormwater runoff control measures. These methodologies are presented here in preliminary form, as a way to assess progress towards regulatory goals promulgated as Total Maximum Daily Load wasteload allocations for mercury and polychlorinated biphenyls (PCBs) and incorporated into Provisions C.11 and C.12 of the Municipal Regional Stormwater Permit (MRP).

1.1 Regulatory Background

1.1.1 PCBs and Mercury Total Maximum Daily Loads (TMDLs)

Based on a determination of water quality impairment of the San Francisco Bay by Polychlorinated Biphenyls (PCBs) and mercury, the San Francisco Bay Regional Water Quality Control Board (Regional Board) recently developed Total Maximum Daily Loads (TMDLs) for these pollutants. The purpose of the TMDLs is to attain water quality standards that will protect sport fishing, human health, aquatic organisms, wildlife and rare and endangered species in the San Francisco Bay. To attain water quality

\(^1\) For the purpose of this document, control measures defined as pollution prevention practices, source controls and treatment controls that Permittees conduct or cause to be conducted.
standards, the TMDLs set regulatory targets and a maximum total allowable pollutant load from all sources combined (i.e., TMDL). Loads reductions needed to obtain the TMDLs are assigned to sources through wasteload (point sources) and load (nonpoint sources) allocations. Urban stormwater runoff was identified as a pollutant source in both the PCBs and mercury TMDLs and was therefore assigned wasteload allocations accordingly.

On February 12, 2008, the federal Environmental Protection Agency approved a Basin Plan amendment incorporating a Total Maximum Daily Load (TMDL) for mercury in San Francisco Bay (Mercury TMDL) and an implementation plan to achieve the TMDL. The amendment was formerly adopted by the Regional Board, the State Water Resources Control Board, and the state Office of Administrative Law. Mercury TMDL targets include: 1) a Baywide suspended sediment mercury concentration of 0.2 mg mercury per kg dry sediment; 2) a large fish target of 0.2 mg mercury per kg fish tissue that applies striped bass; and, 3) a small fish target of 0.03 mg mercury per kg fish for protection of wildlife (i.e., piscivorous birds).

The U.S. Environmental Protection Agency approved a TMDL for PCBs in the San Francisco Bay on March 29, 2010. The Basin Plan amendment incorporating this TMDL and an implementation plan to achieve the TMDL was formerly adopted or approved by the Regional Board, the State Water Resources Control Board, and the state Office of Administrative Law. The PCBs TMDL includes one target, a fish tissue target of 10 ng of Total PCBs per g of fish tissue (white croaker or shiner surfperch).

**TMDL Wasteload Allocations**

To reach the TMDL targets described above and obtain water quality standards in the Bay for mercury and PCBs, the pollutant reductions are required from each source causing or contributing to Bay impairment. For mercury, a 43% reduction of total mercury discharged to the Bay from all sources combined is required. The largest mercury reductions are required from the Guadalupe River (legacy mining), Central Valley watershed, and urban stormwater runoff. For PCBs, a 24 kg/yr (~70%) load reduction of total PCBs in discharges to the Bay is required from all sources combined to obtain water quality standards. The largest PCB load reductions are required from the Central Valley watershed and stormwater runoff.

The PCBs and mercury TMDL Staff Reports (Regional Board 2006, 2008) provide estimates of pollutants loads from urban stormwater runoff. Additionally, wasteload allocations (i.e., allowable annual discharges) for urban stormwater runoff are assigned by county to Bay Area stormwater programs. Stormwater programs identified in the TMDLs that represent Permittees to the Municipal Regional Stormwater NPDES Permit (see next section) include:

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

---

2 Based on the use the term “Total PCBs” in the PCBs TMDL, Total PCBs is defined as either: 1) sum of Aroclors; 2) sum of the individual congeners routinely quantified by the Regional Monitoring Program (RMP) for Water Quality in the San Francisco Estuary; or 3) sum of the National Oceanic and Atmospheric Administration (NOAA) 18 congeners converted to total Aroclors.
Mercury and PCB TMDL loads, wasteload allocations (WLA), and load reductions assigned to these stormwater programs are included in Table 1-1. Pollutant load reductions represent the goal that stormwater programs should strive to attain through stormwater control measure implementation.

### Table 1-1. Mercury and PCB loads, wasteload allocations and load reduction goals for Bay Area Phase I stormwater programs.

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<td>City of Vallejo and VSFCD¹</td>
<td>3.2 1.6 1.6</td>
<td>1.0¹ 0.1¹ 0.9³</td>
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</tbody>
</table>

¹Vallejo Sanitation and Flood Control District
²Includes the City of Fairfield and Suisun City
³The PCB TMDL assigns a combined allocation to “Solano County”, which only includes discharges from the cities of Vallejo, Fairfield, Suisun City

Load reductions presented in the table were calculated for each stormwater program by subtracting the applicable WLA (originally based on relative populations) from the pollutant load (originally based on relative population).

Wasteload allocations (WLAs) for urban stormwater runoff programs presented in Table 1-1, implicitly include all current and future permitted discharges within the geographic boundaries of municipalities and unincorporated areas. Permitted discharges include those covered under municipal stormwater NPDES permits, and discharges attributable to the California Department of Transportation (Caltrans) roadways and non-roadway facilities and rights-of-way, atmospheric deposition onto the surface of the watershed, public facilities (e.g., schools), properties adjacent to stream banks, industrial facilities, and construction sites.

### 1.1.2 Municipal Regional Stormwater Permit Requirements

On December 1, 2009, the Municipal Regional Stormwater NPDES Permit (Order R2-2009-0074), also known as the Municipal Regional Permit (MRP), became effective. The MRP applies to all 76 large and medium municipalities (cities and counties) and flood control agencies in the San Francisco Bay Region. In provisions C.11 and C.12, the MRP requires Permittees to implement a series of control measures at full or pilot-scale that are intended to reduce mercury and PCBs in urban stormwater runoff. These control measures include:

- Collection and Recycling of Mercury-containing Devices (Mercury)
- Investigations and Abatement of Sources in Drainages (Mercury & PCBs)
- Evaluations of Enhanced Municipal Sediment Management Practices (Mercury & PCBs)
- Evaluations of On-Site Stormwater Treatment via Retrofits (Mercury & PCBs)
In addition to these, Permittees have historically and continue to implement control measures that provide additional reduction in pollutant loads. These control measures include:

- Street Sweeping;
- Stormwater Drainage System Maintenance (e.g., removal of material and sediments from catch basin, drop inlet and pump stations);
- Sediment Management in Channels and Water Bodies;
- New and Redevelopment Controls (e.g. low impact development);
- Public Outreach and Participation; and,
- Tracking and Participating in Regulatory Processes (e.g., bans and recycling requirements of pollutant-containing devices)

Provisions C.11.g and C.12.g require Permittees to develop and implement a monitoring program to quantify mercury and PCB loads reduced through the implementation of these (and other) control measures. Consistent with the TMDLs, load reductions and progress toward urban stormwater runoff WLAs may be demonstrated through one of three methods:

1. Quantify through estimates the average annual mercury load reduced by implementing pollution prevention, source control and treatment control efforts required by the provisions of this permit or other relevant efforts; or
2. Quantify the mercury load as a rolling five-year average using data on flow and water column mercury concentrations; or
3. Quantitatively demonstrate that the mercury concentration of suspended sediment that best represents sediment discharged with urban runoff is below the target of 0.2 mg mercury/kg dry sediment.

Permittees are moving forward on studies to demonstrate loads reduced and WLA progress using each of the methods described above. Water quality monitoring activities conducted through the Regional Monitoring Program for Water Quality in the San Francisco Bay (RMP) and the Bay Area Stormwater Management Agencies (BASMAA) Regional Monitoring Coalition (RMC) are currently attempting to estimate changes in pollutant loads (Method #2) and concentrations (Method #3). However, due to the diffuse nature of mercury and PCBs in the San Francisco Bay watershed, observable trends in loads and concentrations in creeks and rivers draining to the Bay could take decades. Quantification of loads reduced through pollution prevention, source controls and treatment controls (Method #1) is the focus of this memorandum.

1.2 Purpose and Scope

Methodologies presented in this document are intended to comply with Provisions C.11.g and C.12.g of the MRP. Additional purposes of the loads reduced quantification methods described in this memorandum include:
Providing MRP Permittees with methodologies to assess progress towards WLAs assigned to urban stormwater runoff in the PCBs and mercury TMDLs;

Assessing the effectiveness of pollution prevention programs, source control activities and treatment controls currently implemented in the Bay Area; and,

Developing concepts for developing baseline levels of control measure implementation and commensurate load reductions, which will allow “new or enhanced” load reduction to be quantified.

1.3 Memorandum Organization
This technical memorandum is organized into four sections: 1) Introduction, background and purpose; 2) Mercury and PCB uses, sources and loadings; 3) Loads quantification methods overview, key assumptions and guiding principles; 4) Factsheets for each control measure that include quantification methods, formulas, assumptions, and data inputs and tracking needs; and, 5) References for all citations.
2.0 MERCURY AND PCB USES, SOURCES AND LOADINGS

2.1 Historical and Current Uses and Sources

2.1.1 Polychlorinated Biphenyls (PCBs)
Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). PCBs were manufactured in the United States and used widely from the late 1920s through the 1970s. Due to their non-flammability, chemical stability, high boiling point and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics and rubber products; in pigments, dyes and carbonless copy paper and many other applications. Because of their persistent qualities, and physical and chemical characteristics, PCBs are found in environmental media worldwide, including air, sediment from street sweeping and stormwater conveyance systems, sediment and water from flood control channels and receiving waters, and urban stormwater runoff.

The U.S. total production of PCBs by Monsanto has been reported to be approximately 640,000 metric tones (de Voogt and Brinkman 1989). Production peaked in 1970 at approximately 30,000 tones or about 6% of the total U.S. production (Figure 2-1). Approximately 57% of total production occurred between 1960 and 1974 and 73% of the U.S. production occurred between 1955 and 1977. Overall, it appears that total production is proportional to total consumption in the U.S. (Breivik et al, 2002). However, although total consumption of PCBs in the U.S. (and Bay Area) continues to be at zero due to the ban in 1977, PCBs still remain in use in certain equipment and devices (e.g., transformers) and may possibly continue to contribute to urban stormwater runoff in the near future.

![Figure 2-1. Annual production of PCBs in the U.S. from 1930 to 1970 (USEPA 1987).](image)

2.1.2 Mercury
Mercury is a naturally occurring persistent, bioaccumulative metal that can be present in the elemental, inorganic or organic forms in the environment. Historically, mercury has been used in a variety of products. Primary among the over 3,000 historical industrial uses in the U.S. were battery manufacturing and chlorine-alkali production. Paints and industrial instruments have also been among the major uses. Mercury is also used in laboratories for making thermometers, barometers, diffusion pumps, and many other instruments, including mercury switches and other electrical apparatuses. Mercury is used as an...
electrode in some types of electrolysis and in some types of batteries (mercury cells). Gaseous mercury is used in mercury-vapor lamps (e.g., fluorescent tubes) and advertising signs. Mercury is also the basis of dental amalgams and preparations, and can be a byproduct of burning fossil fuels and refining petroleum.

Mercury production and consumption in the U.S. have decreased dramatically since its use in gold production peaked in the mid/late 1800’s (Figure 2-2). In the Bay Area, production was almost entirely from the mercury-rich New Almaden Mining District in Santa Clara County. Consumption of mercury in the U.S. has a similar trend as production. As illustrated in Figure 2-3, mercury consumption has also reduced substantially from 1970 to 2000 (Sznopek 2000), and the mass of mercury in the most current products and devices such as light bulbs and auto switches appear to also be decreasing (NEWMOA 2008). These decreases in mercury uses may assist MRP Permittees in reducing loads of mercury to the Bay.

Figure 2-2. Mercury production in the U.S. (dark line) and New Almaden Mining District (dotted line) between 1850 and 2000.

Figure 2-3. Mercury use in the U.S. between 1970 and 2000 (Sznopek 2000).
2.2 Contributions of Pollutant Mass to Stormwater from Sources

In collaboration with BASMAA member agencies, McKee et al. (2006) conducted a thorough literature review on sources and loads of mercury and PCBs entering urban stormwater and developed a mass balance (or conservation of mass) conceptual model based on this information. The intent of the model was to assist managers by providing a framework for identifying the most important mercury and PCBs uses and sources that likely impact Bay Area stormwater runoff. Although disparate information was used to develop the model, it provides the current best estimate of the mass of PCBs and mercury that is contributed to urban stormwater under a steady state scenario. The model also serves as context for management decisions, especially for mercury given its ongoing use (although reduced) in the urban environment and transport via atmospheric deposition. The following sections present the inventory of mercury and PCB sources to urban stormwater runoff based on the current understanding of PCB and mercury uses and linkages to stormwater.

2.2.1 PCBs

As illustrated in Figure 2-4, McKee et al. (2006) estimate that erosion from the surface of the urban watershed is the largest source of PCBs to Bay Area urban stormwater. Watershed surface erosion includes diffuse sources of sediment in urban areas associated with construction sites, vacant lots, unpaved foot paths, and wear debris from road and building surfaces, and represents the mass of PCBs associated with 50+ years of legacy accumulation on the surface of the watershed. Building demolition and remodeling, PCBs that continue to be in use in equipment and devices, and transformers and large capacitors represent the next largest sources. Smaller sources include atmospheric deposition and identified industrial contaminated areas.

![Figure 2-4. Comparison of relative mass inputs of PCBs to Bay Area urban stormwater runoff based on estimates from McKee et al. (2006).](image)
2.2.2 Mercury

Similar to PCBs, McKee et al. (2006) estimate that erosion from the surface of the urban watershed is also the largest source of mercury to Bay Area urban stormwater (Figure 2-5). However, unlike PCBs, atmospheric deposition of mercury to the Bay watershed is estimated to provide a much larger proportion (27%) of the total load to urban stormwater. This suggests that mercury from atmospheric deposition may continue to play an important role in loadings of mercury to the Bay from stormwater. Accidental breakage during transport or disposal of instruments such as barometers, hydrometers, manometers, pyrometers, sphygmomanometers and thermometers, or switches and thermostats that contain relatively large masses of mercury is also suggested to be a large source of mercury to stormwater. Based on these estimates, fluorescent lamps and identified industrial sites with relatively elevated mercury concentrations are far less of a source to stormwater.

One property that distinguishes mercury from PCBs is the fact that mercury bioaccumulation occurs primarily after transformation to methylmercury (methylation). Recent scientific studies have identified monitoring tools to quantify the fraction of mercury most susceptible to methylation – the “reactive mercury” fraction of the total mercury measurement (Marvin-DiPasquale et al. 2009). Studies have also shown that mercury from atmospheric deposition is primarily reactive mercury (Butler 2007). This could mean that stormwater may contain a relatively larger fraction of reactive mercury compared to purely terrestrial sources. If so, water quality benefits could be attained in receiving waters by measures that
reduce the fraction of reactive mercury present in the total load. Although there is not sufficient monitoring data at present to make the case for loads reduced or avoided based on reducing the fraction of reactive mercury, that information may be developed over time and submitted to the Water Board for consideration.
3.0 METHODS OVERVIEW, GUIDING PRINCIPLES AND KEY ASSUMPTIONS

This section provides an overview of key concepts, guiding principles and assumptions incorporated into quantitative methods presented in section 4.0 for determining mercury and PCB loads reduced due to control measure implementation. Quantitative methods for evaluating the effectiveness of urban runoff stormwater programs and control measures have been documented by CASQA (2007) and Strecker et al. (2001). These methods were reviewed and incorporated to the extent possible into loads reduced quantification methods presented in the next section. Additionally, information gained through previous evaluations of urban stormwater control measures for PCBs and mercury, sediment and water quality data collected in the Bay Area, and mercury and PCB use and source information described below were heavily utilized.

3.1 Literature Review

3.1.1 Evaluations of Urban Stormwater BMPs for PCBs and Mercury

The San Francisco Estuary Institute (SFEI) received a grant under the Proposition 13 Coastal Nonpoint Source Program to review and evaluate available existing literature on: 1) historical and current PCB and mercury uses, sources, and transport pathways to urban stormwater runoff; 2) PCB and mercury concentrations in stormwater, including considerations of sediment particle sizes; and, 3) current and potential implementation of best management practices (BMPs) used to reduce loadings of sediment-associated contaminants in urban stormwater. In a series of reports completed as part of the project, uses, sources and conceptual models of mercury and PCB in the urban environment and stormwater (McKee et al. 2006; Rothensberg et al. 2010); geographical distributions of mercury and PCBs in Bay Area sediments (Yee and McKee 2010); and realized and potential control measure effectiveness (Mangarella et al. 2008; SFEI 2010) were documented. Additionally, factors that affect the treatability of these pollutants and the efficacy of treatment devices in removing mercury and PCB from stormwater in the drainage network were summarized (Yee and McKee 2010; SFEI 2010). These studies provide the most complete picture on the effectiveness of pollution prevention, source and treatment control measures of control measures to reduce mercury and PCBs in urban stormwater runoff, and therefore associated results and conclusions were heavily relied upon in the development of quantification methods presented in this technical memorandum.

3.1.2 Pollutant Characterization Studies

As described above, geographical distributions in concentrations of mercury and PCBs in watershed sediments throughout the Bay area are summarized in Yee and McKee (2010). A portion of these data were collected by municipal stormwater programs through initial studies (EOA 2002, ACCWP 2002) and follow up case studies focused on PCBs (Citations), and evaluated during the development of quantification methods. These data were most useful in developing average concentrations of PCBs and mercury in sediment within stormwater drainage systems (e.g., catch basins, drop inlets and pump stations), which were need to quantify average loads of these pollutants removed via drainage system maintenance (i.e., sediment removal).

3.1.3 Street Sweeping Studies

Throughout the past three decades, scientists and engineers have conducted numerous studies designed to assess the effectiveness and efficiencies of municipal street sweeping programs (EOA 2007). These studies have been previously summarized by EOA (2007) as part of a study designed to calculate
pollutant loads removed via street sweeping in Contra Costa County, and Mangarella et al. (2008) as part of a desktop evaluation of control measure scenarios to reduced PCBs and mercury in bay Area stormwater. Lessons learned from these studies were incorporated into loads reduced calculations for street sweeping that are presented in section 4.0. Additional information on PCB and mercury concentrations in materials collected by street sweepers in the Bay Area, composition of the material, sediment particle sizes, and geographical distributions based on land uses and age-of-urbanization were also heavily utilized.

3.1.3 Additional Mercury and PCB Use and Source Information
Information on current and historical uses of mercury and PCBs was also obtained during the literature review. Specifically, to develop load reduction estimates for pollution prevention activities (e.g., recycling programs) the number and volume of devices, equipment and materials that contain mercury and PCBs, and the current and historical mass of these pollutants in each device was obtained.
Information from reports on mercury flow analyses (Barr Engineering 2001), device recycling rates (ALMR 2003, DTSC 2008, USEPA 2009, CIWMB 2009), content (NEMA 2008, DTSC 2008) and emissions (Barr Engineering 2001, USEPA 2008) were utilized. Bay Area specific air emission and deposition rates of mercury were also obtained (Rothensberg 2010; Tsai and Hieneke 2001) to assess load reductions due to improved deposition of mercury onto the Bay watershed.

3.2 Control Measures Evaluated
The following sections briefly describe the control measures initially identified by Permittees as those that should be considered for development of loads reduced methodologies. Based on the availability of information on baseline, current and anticipated implementation levels, pollutant concentrations associated with loads removed, and control measure effectiveness, Permittees may choose to develop quantification methods for additional control measures.

3.2.1 Pollution Prevention
Pollution prevention programs and activities are intended prevent pollutants that are present within materials, devices and equipment from entering the environment and contributing to stormwater pollution. Pollution prevention control measures specific to mercury and PCBs are those that reduce the quantities of these pollutants in products and equipment through voluntary or regulatory approaches (e.g., mercury thermometer recycling programs), prevent accidental release or spills into the environment (e.g., industrial facility inspections), or assist in the recycling of materials that contains these pollutants (e.g., fluorescent lamps, switches, thermostats and transformers). These controls are implemented either directly by Permittees and associated solid waste programs in the Bay Area, or by other regulatory programs in which Permittees actively support, advocate or assist in implementing. More specific descriptions of pollution prevention measures anticipated for implementation are included in section 4.0.

Loads reduced quantification methods for the following pollution prevention control measures are included in this document:

- **Fluorescent Lamp Recycling (Mercury)**
- **Thermostat Recycling (Mercury)**
- **Reduction of Pollutants from Local Atmospheric Sources (Mercury)**
The effectiveness of these measures with respect to stormwater runoff is not easily evaluated given that it is difficult to determine to what extent such mercury and PCBs in these materials would enter urban stormwater compared to other disposal options (e.g., landfills, sanitary sewer system). Therefore, uncertainties remain in loads reduced estimates for pollution prevention measures. Additional control measures for which loads reduced quantification methods may be developed in the future include: stormwater inspections at industrial and commercial facilities (PCBs and mercury), thermometer and auto switch recycling (mercury) and building demolition and renovation waste management (PCBs).

3.2.2 Source (Institutional) Controls

There is no universally accepted definition of “source control” as it pertains to stormwater management. Some practitioners refer to source controls as “non-structural controls”, and many times they are confused with pollution prevention measures described in the previous section. For the purpose of this document, source controls are defined as institutional non-treatment measures that remove pollutants directly from streets, contaminated properties, stormwater conveyance systems, channels or receiving waters once they have already entered the environment.

For decades, MS4s have implemented source controls that have directly or indirectly helped to improve water quality in the Bay Area. For example, street sweeping on roads and parking lots, although mainly targeted at removing trash and other road related debris, also removes pollutants like PCBs and mercury that strongly attach to particles. Source controls have also helped to establish (and limit) the baseline load condition depicted in the PCB and Mercury TMDLs through load and wasteload allocations. Loads reduced quantification methods for the following source (institutional) control measures are included in section 4.0:

- Street Sweeping (Mercury and PCBs)

Quantification methods will also likely be developed for stormwater conveyance system maintenance, sediment management in channels and water bodies, hydromodification controls and low impact development (LID). Methods for quantifying contaminated property remediation (mercury and PCBs) may also be developed as additional data on the effectiveness of this control measure is evaluated through pilot projects implemented as part of BASMAA’s Clean Watersheds for a Clean Bay (CW4CB) project that is intended to comply with MRP requirements.

Because these actions physically remove pollutants from the environment, the process of quantifying the effectiveness of source controls is much more straight-forward and intuitive than pollution prevention activities. Additionally, as described in the previous section, scientist and engineers have conducted many studies aimed at quantifying the effectiveness of source controls. These studies provide numerous datasets and information to base loads reduced quantification tools described in this document.

3.3.3 Treatment Controls

Stormwater treatment controls are engineered devices or systems that can be installed or built in place to enhance the capture of pollutants. Treatment controls have a variety of modes of operation including those that slow down the movement of water, remove sediment and associated contaminants through filtering, settling, or otherwise separating sediment from flowing water, or adsorb and incorporate the substance into some kind of media (e.g. carbon, resin, or living plant material). For the purposes of this document, treatment controls include both those installed or built on-site or within a public right-of-
way, and diversions of stormwater (wet and dry weather) runoff to publically owned treatment works (POTWs).

A variety of treatment controls have been implemented throughout the Bay Area to control stormwater impacts on receiving waters (LFR 2004). The impetus for implementation of these controls, however, was not associated with concerns of PCBs or mercury and effectiveness monitoring was generally not conducted in a manner to yield load reduction estimates. Additionally, little to no data are available outside of the Bay Area on the effectiveness of treatment controls to reduce PCBs or mercury in urban runoff (McKee et al. 2006), other than scenarios described in Mangarella et al. (2008) that were based on their current understanding of demonstrated performance of various treatment controls for reductions of total suspended solids (Winer 2000, CASQA 2003, CalTrans 2004, ASCE and USEPA 2008, CalTrans 2010) and PCB and mercury settling studies (Yee and McKee 2010). Based on these sources, Figure 3-1 provides the estimated median BMP effluent concentrations of a number of stormwater treatment controls and is provided here primarily to represent the relative effectiveness of these controls types.

![Figure 3-1. Estimated concentrations of total suspended solids (TSS) for various stormwater treatment controls (Mangarella et. al 2008).](image)

Based on the limited data available on treatment controls with regard to their effectiveness in reducing PCB and mercury loads in urban stormwater runoff, quantitative methods for these control measures are not included in this technical memorandum at this time. That said, as described in section 1.1.2, Permittees will be implementing a variety of BMP effectiveness projects, treatment controls and diversions to POTWs at pilot-scales during the term of the MRP through the CW4CB project. Information collected on the effectiveness of these control will assist Permittees in developing load reduction quantification methods. As information becomes available, Permittees, stormwater programs or BASMAAA may choose to update section 4.0 with fact sheets describing methods for quantifying the loads reduced via treatment controls.
3.4 Load Reduced Quantification Methods Overview

Quantification methods for assessing mercury and PCBs loads reduced that are presented in section 4.0 were based on a robust review of published and grey literature conducted through this and previous projects (see section 3.1). Quantification methods are intended to assist MRP Permittees in assessing loads of mercury and PCBs reduced through control measures that they have directly implemented (e.g., street sweeping, or assisted in causing the control measure to be implemented (e.g., changes in regulations). This section provides an overview of the guiding principles, key assumptions and concepts behind the methods presented in section 4.0. As quantification methods evolve through trial implementation, assumptions and concepts presented in this section should be adjusted accordingly.

3.4.1 Guiding Principles

Reductions in pollutant loads can be quantified in many ways. To provide transparency in the thought process behind the quantification methods presented in section 4.0, principles that guided the development of these methods are presented below.

- **Quantification methods are constrained by the extent of information available** – Only the information readily available on control measure effectiveness, degree of control measure implementation, concentrations and masses of pollutants in materials/devices/equipment, and baseline loads and loads reduced can be used to develop quantification methods and track annual load reductions. In some cases, information is very limited and assumptions therefore have to be made. Although these assumptions create uncertainties in load reduction calculations, if stated clearly and transparently, assumptions can be tested and revised accordingly as methods evolve.

- **Methods should be as simple and data inputs as tractable as possible** – As a general principle in creating the loads reduced formulas presented in section 4.0, the amount of information that Permittees are required to track as inputs to the formula was considered. In most cases, data that Permittees or stormwater programs will need to track and input into the loads reduced formulas consists of information they collect and submit to the Water Board as part of their Annual Reports. In limited cases, additional information included in reports submitted to State of California by other public agencies or private entities may need to be obtained to provide a complete picture of loads reduced from urban stormwater runoff during a specific year. Such cases are identified in the fact sheets.

- **Pollutant loads reduced targets serve as the goal to achieving WLAs** – The mercury and PCB TMDLs include both baseline loads (circa 2003) and wasteload allocations (WLAs) for urban stormwater runoff. The difference between the two is assumed to be the pollutant load that stormwater programs (and associated Permittees) need to reduce on an annual basis (see section 1.1.1) through control measure implementation. Realistically, however, the pollutant load discharged from urban stormwater runoff to the Bay fluctuates (possibly higher or lower) between years depending rainfall/runoff patterns, pollutant mobility, changes in sales and content of pollutant containing devices, and the degree of control measure implementation. Methods that can be used to estimate annual loads include mass-balances, empirical monitoring and simple or dynamic modeling. That said, given the inherent variability and uncertainties in quantifying urban runoff loads to the Bay on an annual basis, regardless of the method used, it is assumed for the purposes of assessing progress toward WLAs that the annual average loads of PCBs and mercury included in the TMDLs provides the baseline for which loads reduced will be measured, at least until new monitoring and modeling approaches developed through the
Regional Monitoring Program (RMP) Small Tributary Loading Strategy (STLS) yield updated loads information for PCBs and mercury.

- **Baseline levels of control measures implemented at the time loading estimates were developed (i.e., 2003)** are implicitly incorporated into pollutant load estimates from urban runoff to the Bay – Sediment and water quality data used to establish baseline loads in the TMDLs were collected circa 2003. As a simplifying assumption, control measures implemented (at associated pollutant loads reduced) at the time these data were collected are assumed to establish the baseline level of implementation for loads reduced by new or enhanced controls are compared. As described below, future enhancements of control measures implemented in 2003, or new control measures that target products/equipment/material that contain mercury or PCBs that are reasonably liable to enter urban stormwater will help further reduce PCB/mercury loads to the Bay and assist Permittees in addressing WLAs.

- **New and enhanced control measures implemented within the geographical boundaries of the Permittees may be quantified as loads reduced, regardless of the implementing entity** – As described in the PCB and Mercury TMDLs (Water Board 2006, 2008), WLAs for urban runoff implicitly include all current and future permitted discharges within the geographic boundaries of municipalities and unincorporated areas including, but not limited to, California Department of Transportation (Caltrans) roadways and non-roadway facilities and rights-of-way, atmospheric deposition, public facilities, properties proximate to stream banks, industrial facilities, and construction sites. Although implementation of control measures to reduce PCBs and mercury in many of the discharges listed above are outside of the direct jurisdiction of MRP Permittees, load reductions attributable to these control measures need to be accounted for in the context of WLAs assigned to stormwater programs. As such, quantification methods presented in section 4.0 (as well as future methods developed) include actions taken by public agencies and private entities that are assumed to directly affect loads of PCBs and mercury in urban stormwater runoff.

### 3.4.2 Key Assumptions

In addition to the guiding principles above, the key assumptions described below were included in load reduction quantification methods and results. Control measure specific assumptions are included in each fact sheet presented in section 4.0.

- **Control measures are assumed to be independent of each other** – In some cases, the implementation of one control measure could affect the effectiveness of another. For example, reducing mercury air emissions from local sources could affect pollutant accumulation on streets, which in turn could reduce the mass of pollutants available to source controls such as street sweeping. Evaluating the potential interaction of these controls quantitatively was beyond the level of analysis conducted herein, although potential interactions between control measures are identified and discussed in the fact sheets where appropriate.

- **Baseline conditions and control measure effectiveness are assumed to be geographically uniform**– Conditions vary among the various geographical areas that contribute runoff and pollutants to San Francisco Bay. Thus, projecting results obtained by studies conducted at specific locations may not be representative all areas. As a practical matter, however, we assumed that projections to the whole watershed, based on area, land use, or population, were adequate for the development of the proposed methods. As input data are collected to
populate formulas presented, considerations should be given to the spatial representativeness of these data and disaggregated or aggregated as needed.
4.0 LOADS REDUCED QUANTIFICATION FACT SHEETS

This section includes a series of fact sheets that document preliminary loads reduced quantification methods. Fact sheets were developed for a limited number of pollution prevention and source controls, where a reasonable amount of information was obtained through the literature review to develop methods. As such, methods presented in these fact sheets are based on the most currently available information, and are intended to evolve as additional information becomes available. Much of the information reviewed was collected in the San Francisco Bay Area and therefore is applicable to Permittees. Other information used in quantification method development was collected as part of studies conducted in other areas of the U.S., but appear to be applicable to the Bay Area through scaling based on population.

Each fact sheet in this section includes: 1) a brief description pollutant source, 2) summaries of applicable control measures, 2) loads reduced formulas, 3) assumptions and data inputs, 4) future data tracking needs, and 5) references used to establish the methods. Fact sheets in this section include:

Pollution Prevention
- PP-1: Fluorescent Lamp Recycling (Mercury)
- PP-2: Thermostat Recycling (Mercury)
- PP-3: Reduction of Pollutants from Local Atmospheric Sources (Mercury)

Source (Institutional) Controls
- SC-1: Street Sweeping (Mercury and PCBs)

As this technical memorandum evolves through additional review and revisions, fact sheet for other control measures will be included. In particular, fact sheets for stormwater conveyance system maintenance, sediment management in channels and water bodies, hydromodification and low impact development (LID), stormwater treatment controls, and other controls may be developed to document methods.
There are two main categories of lamps (i.e., light bulbs) currently used in large quantities in the United States (U.S.) - incandescent and luminescent gaseous discharge lamps (e.g., fluorescent and low-pressure sodium). Incandescent lamps do not contain mercury. Fluorescent lamps, however, contain mercury and are generally available in two types – tubular or compact. Tubular fluorescent lamps are mostly used in commercial or institutional buildings and usage is believed to have generally remained consistent over time. Compact fluorescent lamps (CFLs), however, are mostly used as energy-saving alternatives to incandescent lamps in homes and have their use has increased substantially in recent years (DTSC 2008).

Recycling of mercury in lamps is the primary control measure used to reduce mercury in the environment from this source. Technologies to reclaim mercury from spent lamps through recycling were developed in the U.S. starting in 1989. However, recycling did not drastically increase until the U.S. EPA announced the addition of lamps to the Universal Waste Rule (UWR) in 1999 (ALMR 2003). The State California’s UWR became effective on February 8, 2002 and today prohibits the disposal of fluorescent lamps into landfills, regardless of the waste generator (household or business). The California Department of Toxic Substances Control (DTSC) has adopted regulations that require safe management and recycling of fluorescent lamps.

**Applicable Control Measures**

Methods describe in this fact sheets are applicable to the following urban stormwater runoff control measures, and as such may be used by Bay Area Permittees to assess progress towards WLA established in TMDLs:

- **HHW Collection** - Household fluorescent lamp recycling in the Bay Area is available at household hazardous waste (HHW) facilities, which are managed by cities, counties and special districts. A list of Bay Area household hazardous waste facilities that currently (2010) provide fluorescent lamp collection/recycling is attached. Information on the number and types of lamps recycled is available through the HHW facility or the California Integrated Waste Management board (CIWMB).

- **Collection at Participating Businesses** – Businesses throughout the Bay Area (e.g., IKEA, Home Depot and Orchard Supply) are beginning to accept spent fluorescent lamps from customers. Although tracking may be difficult, recycling provided by these businesses could be quantified by Permittees.

- **Private Recycling Contractors** - Recycling by small and large businesses occurs through private recycling contractors that coordinate directly with businesses that generate large and small quantities of lamps. The availability of information necessary to quantify loads reduced attributable to this control measure is currently unknown.

**Loads Reduced Formula**

Based on a review of available data and information gained through literature reviews, the following set equations will allow MRP Permittees to determine the mass of total mercury reduced from stormwater as a result of fluorescent lamps recycling conducted in a given year. Please note that the equations are unit-less and will need to be converted appropriately based on standard conversion rates (e.g., milligrams to kilograms).
Reduction_{Lamps} = Current_{Lamps} - Base_{Lamps}

where:
- Reduction_{Lamps} = Mass of total mercury reduced from urban stormwater (above baseline), as a result of fluorescent lamp recycling in year of interest
- Baseline_{Lamps} = Average annual mass of total mercury diverted from Bay Area stormwater during a baseline year(s) due to fluorescent lamp recycling
- Current_{Lamps} = Mass of total mercury diverted from Bay Area stormwater due to fluorescent lamp recycling in a year of interest

and:

Base_{Lamps} = Lamps_{Base#} \cdot Lamps_{BaseMass} \cdot Lamps_{Runoff}

Current_{Lamps} = Lamps_{Current#} \cdot Lamps_{CurrentMass} \cdot Lamps_{Runoff}

where:
- Lamps_{Base#} = Average annual number of fluorescent lamps recycled in baseline year(s)
- Lamps_{BaseMass} = Average mass of total mercury in fluorescent and compact fluorescent lamps recycled in baseline year(s)
- Lamps_{Current#} = Number of fluorescent lamps recycled in a year of interest
- Lamps_{CurrentMass} = Average mass of total mercury in fluorescent and compact fluorescent lamps recycled in a year of interest
- Lamps_{Runoff} = % of total mercury mass in fluorescent lamps that contributes to the urban stormwater load of mercury to the Bay when the lamp is broken (see below)

and:

Lamps_{Runoff} = Dep_{Lamps} \cdot Trans

where:
- Dep_{Lamps} = Average % of total mercury in fluorescent and compact fluorescent lamps that is deposited onto the surface of the watershed when the lamp is broken
- Trans = Average % total mercury deposited onto the surface of the watershed when the lamp is broken that is transported by stormwater to the Bay

Assumptions and Data Inputs

Baseline Loads Reduced (2003)

- Baseline Level of Recycling (Lamps_{Base#}) - The average annual number fluorescent lamps recycled from 2000 through 2003 provides the baseline number of lamp that were recycled prior to the TMDL baseline year of 2003. Estimated total number of fluorescent lamps recycled by in the U.S. businesses and households in 2003 are based on estimates by ALMR (2003). Estimates for the U.S. were normalized by population to the geographical area covered by the Municipal Regional Permit (MRP). Table 4-1 provides baseline (2003) recycling rates.

- Baseline Mercury in Lamps (Lamps_{BaseMass}) – The mass of mercury (kg) in lamps can vary based on the lamp type, size, manufacturer and date manufactured. Considerations are given to changes in the mass of mercury per bulb that has likely occurred between 2003 and the year of interest by including a baseline concentration (Lamps_{BaseMass}) and a concentration for the current year of evaluation (Lamps_{CurrentMass}). The mass of total mercury in lamps in 2003 are assumed to average 21 mg per lamp (US EPA 1998).
Table 4-1. Estimated baseline (2000-2003) number of fluorescent lamps recycled in the jurisdictional boundaries of Bay Area MS4s.

<table>
<thead>
<tr>
<th>Geographical Area/Entity</th>
<th>Households (20%)</th>
<th>Businesses (80%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>2,680,000</td>
<td>150,080,000</td>
<td>152,760,000</td>
</tr>
<tr>
<td>Alameda Countywide Clean Water Program</td>
<td>153,393</td>
<td>613,572</td>
<td>766,965</td>
</tr>
<tr>
<td>Contra Costa Clean Water Program</td>
<td>105,109</td>
<td>420,436</td>
<td>525,545</td>
</tr>
<tr>
<td>San Mateo County Water Pollution Prevention Program</td>
<td>73,226</td>
<td>292,902</td>
<td>366,128</td>
</tr>
<tr>
<td>Santa Clara Valley Urban Runoff Pollution Prevention Program</td>
<td>176,217</td>
<td>704,868</td>
<td>881,085</td>
</tr>
<tr>
<td>City of Vallejo and VSFCD¹</td>
<td>12,460</td>
<td>49,841</td>
<td>62,301</td>
</tr>
<tr>
<td>Fairfield-Suisun Urban Runoff Management Program²</td>
<td>13,494</td>
<td>53,977</td>
<td>67,471</td>
</tr>
</tbody>
</table>

¹Vallejo Sanitation and Flood Control District
²Includes the City of Fairfield and Suisun City

Current Loads Reduced (Year of Interest)

- **Current Mercury in Lamps** \( (\text{Lamps}_{\text{CurrentMass}}) \). The average mass of mercury in a lamp appears to have decreased post-2003 (baseline) due to the increase in CFL usage by households. Specifically, the National Electrical Manufacturers Association (NEMA) announced that under the voluntary commitment, effective April 15, 2007, participating manufacturers will cap the total mercury content in CFLs that are under 25 watts at 5 milligrams (mg) per unit, and CFLs that use 25 to 40 watts of electricity will have total mercury content capped at 6 mg per unit (NEMA 2009). Based on this substantial decrease in mercury mass in CFLs, each bulb recycled is assumed to have an average mass of 5.5 mg. New fluorescent tubes are also assumed to have 5.5 mg on average.

- **Current Level of Recycling** \( (\text{Lamps}_{\text{Current}}) \) – The number of fluorescent lamps recycled in the year of interest represents the current level of effort towards meeting WLAs assigned in the TMDL. Recycling efforts are managed by HHWs, participating stores, and private companies for small and large waste generators (US EPA 2009). Recycling efforts are expected to increase substantially over the next decade (US EPA 2009, DTSC 2008).

Baseline and Current Loads Reduced

- **% Mercury from Broken Lamps that is Deposited on Watershed** \( (\text{Dep}_{\text{Lamps}}) \) – The percentage of mercury in a broken lamp that is assumed to be deposited onto the surface of the watershed is based on a Barr Engineering (2001) study conducted in Minnesota and Wisconsin that focused on the fate of mercury from household products, combined with a partitioning analysis. The authors estimated 37% of the amount of mercury in lamps volatilizes into the atmosphere, resulting from breakage, transfer and transit, as well as air emissions following disposal in landfills, combustion, and incineration. For the purposes of loads reduced calculations, we assume that 100% of the mercury that volatilizes into the atmosphere is deposited onto the surface of the watershed.

- **% of Mercury Transport by Stormwater** \( (\text{Trans}) \) – the average % imperviousness of Bay Area is an important factor because imperviousness is one of the key mechanisms for stormwater transport. Runoff coefficients are based on the % of imperviousness of a given land use. Based on the literature review conducted in support of this technical memorandum development, there remains a need for an average runoff coefficient for the “urban portion of the Bay” to
complete this variable. As an initial percentage, we suggest using a 32% estimate based on modeling conducted as part of a Mercury Air Deposition Study by Tsai and Hoenicke (2001).

References


PP-2: Thermostat Recycling (Mercury)

Thermostats are commonly used in most homes and commercial facilities to regulate room temperature. Older mechanical thermostats often contained elemental mercury in glass bulbs called ampoules. Through the mishandling of thermostats during demolition and waste transport, ampoules can break and mercury can be emitted to the surface of the watershed. Once in the watershed, mercury is available for transport to the Bay via urban stormwater runoff.

The sale of mercury thermostats was prohibited in California beginning on January 1, 2006 (SB 633). Based on this prohibition, the mass of mercury available to urban stormwater from thermostats is expected to decrease overtime. That said, there are roughly 19.8 million mercury thermostats currently in service in California (TRC 2009), suggesting that near-term contributions of mercury to urban stormwater runoff from thermostats may be important.

Applicable Control Measures

Loads reduced through the implementation of the following urban stormwater runoff control measures may be quantified and used by Bay Area MS4s to assess progress towards WLA established in TMDLs:

- **HHW Thermostat Collection** - Mercury thermostat recycling has been available through HHW facilities for a number of years and continues to be utilized by residents in the Bay Area.

- **Recycling by Wholesalers/Retailers** - California’s **Mercury Thermostat Collection Act of 2008 (AB 2347)** requires that by 2009 manufacturers establish a collection and recycling program for out-of-service mercury-added thermostats. The Thermostat Recycling Corporation (TRC) serves as the collection and recycling program for manufacturers in California (TRC 2010). The TRC provides collection containers to HVAC wholesalers, thermostat retailers, and HVAC contractors for a one-time charge. Collection containers are provided by the TRC to HHW facilities at no cost.

- **Other Recycling Efforts** – Although likely limited, other recycling activities conducted within the geographical boundaries of the MS4 may be quantified.

For the purposes of assessing progress towards urban stormwater runoff TMDL wasteload allocations, mercury thermostat recycling that occurs through any of these mechanisms described above may be included in loads reduced calculations.

Loads Reduced Formula

Based on a review of available data and information gained through literature reviews, the following set equations will allow MRP Permittees to determine the mass of total mercury reduced from stormwater as a result of thermostat recycling conducted in a given year. Please note that the equations are unit-less and will need to be converted appropriately based on standard conversion rates (e.g., milligrams to kilograms).

\[
\text{Reduction}_{\text{Therm}} = \text{Current}_{\text{Therm}} - \text{Base}_{\text{Therm}}
\]

where:

- \(\text{Reduction}_{\text{Therm}}\) = Mass of total mercury reduced from urban stormwater (above baseline), as a result of mercury thermostat recycling in year of interest

- \(\text{Base}_{\text{Therm}}\) = Average annual baseline mass (kg) of total mercury diverted from Bay Area stormwater due to mercury thermostat recycling
CurrentTherm = Mass of total mercury diverted from Bay Area stormwater due to mercury thermostat recycling in year of interest

and;

\[ \text{BaseTherm} = \text{Therm}_{\text{Base#}} \times \text{Therm}_{\text{BaseMass}} \times \text{Therm}_{\text{Runoff}} \]

\[ \text{CurrentTherm} = \text{Therm}_{\text{Current#}} \times \text{Therm}_{\text{CurrentMass}} \times \text{Therm}_{\text{Runoff}} \]

where:

- Therm_{\text{Base#}} = Average annual number of mercury thermostats recycled in baseline year(s)
- Therm_{\text{BaseMass}} = Average mass of total mercury in mercury thermostats recycled in baseline year(s)
- Therm_{\text{Current#}} = Number of mercury thermostats recycled in year of interest
- Therm_{\text{CurrentMass}} = Average mass of total mercury in mercury thermostats recycled in year of interest
- Therm_{\text{Runoff}} = % of total mercury mass in mercury thermostat that contributes to the urban stormwater when a mercury thermostat is broken (see below)

and;

\[ \text{Therm}_\text{Em} = \text{Dep}_\text{Therm} \times \text{Trans} \]

where:

- Dep_{\text{Therm}} = Average % of total mercury in thermostats that is deposited onto the surface of the watershed when the thermostat is broken
- Trans = Average % total mercury deposited onto the surface of the watershed that is transported by stormwater

Assumptions and Data Inputs

Baseline Loads Reduced

- Baseline Level of Recycling (Therm_{\text{Base#}}) – The average annual number of mercury thermostats recycled from 2000 through 2003 provides the baseline number of thermostats that were recycled prior to the TMDL baseline year (i.e., 2003). The annual average number of mercury thermostats that were recycled by U.S. businesses and households during this time is based on data from TRC (2008). Estimates for the U.S. were normalized by population to the geographical area covered by the Municipal Regional Permit (MRP). Table 1 provides baseline (2000-2003) recycling rates.

Table 4-2. Estimated baseline (2000-2003) number of thermostats recycled in the jurisdictional boundaries of Bay Area MS4s.

<table>
<thead>
<tr>
<th>Geographical Area</th>
<th># Recycled</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>67,891</td>
</tr>
<tr>
<td>California</td>
<td>3,420</td>
</tr>
<tr>
<td>Alameda County Clean Water Program</td>
<td>341</td>
</tr>
<tr>
<td>Contra Costa Clean Water Program</td>
<td>234</td>
</tr>
<tr>
<td>San Mateo County Water Pollution Prevention Program</td>
<td>163</td>
</tr>
<tr>
<td>Santa Clara Valley Urban Runoff Pollution Prevention Program</td>
<td>392</td>
</tr>
<tr>
<td>City of Vallejo and VSFCD</td>
<td>28</td>
</tr>
<tr>
<td>Fairfield-Suisun Urban Runoff Management Program</td>
<td>30</td>
</tr>
</tbody>
</table>

\(^1\)Vallejo Sanitation and Flood Control District
\(^2\)Includes the City of Fairfield and Suisun City
Current Loads Reduced (in Year of Interest)

- **Current Level of Recycling** ($\text{Therm}_{\text{Current}}$) – The number of thermostats recycled in the year of interest represents the current level of effort towards meeting WLAs assigned in the TMDL. Recycling efforts managed by a combination of the TRC, wholesalers and HHWs within areas covered under the MRP may be counted towards this effort.

**Baseline and Current Loads Reduced**

- **Mercury in Thermostats** ($\text{Therm}_{\text{Base}}/\text{CurrentMass}$) – the amount of mercury in a thermostat is determined by the number of ampoules. There are generally one or two ampoules per thermostat (average is 1.4) and each ampoule contains an average of 2.8 grams of mercury (TRC 2008). Therefore, each thermostat recycled is assumed to contain approximately 4.0 grams of mercury.

- **% Mercury in Thermostats that is Deposited on Watershed** ($\text{Dep}_{\text{Lamps}}$) – The percentage of mercury in a thermostat that when broken is assumed to be deposited onto the surface of the watershed is based on a Barr Engineering (2001) study conducted in Minnesota and Wisconsin that focused on the fate of mercury from household products, combined with a partitioning analysis. The authors estimated 37% of the amount of mercury in lamps volatilizes into the atmosphere, resulting from breakage, transfer and transit, as well as air emissions following disposal in landfills, combustion, and incineration. For the purposes of loads reduced calculations, we assume that 100% of the mercury that volatilizes into the atmosphere is deposited onto the surface of the watershed.

- **% of Mercury Transport by Stormwater** ($\text{Trans}$) – the average % imperviousness of Bay Area is an important factor because imperviousness is one of the key mechanisms for stormwater transport. Runoff coefficients are based on the % of imperviousness of a given land use. Based on the literature review conducted in support of this technical memorandum development, there remains a need for an average runoff coefficient for the “urban portion of the Bay” to complete this variable. As an initial percentage, we suggest using a 32% estimate based on modeling conducted as part of a Mercury Air Deposition Study by Tsai and Hoenicke (2001).

**References**


Local (e.g., crematoria) and global (e.g., coal power plants in Asia) emissions of mercury can enter the Bay Area air basin and deposit directly onto the San Francisco Bay or on land surfaces within the local San Francisco Bay watershed. Mercury from air emissions may also be exported beyond the San Francisco Bay Area. The mass of mercury deposited onto the Bay is explicitly accounted for in the Mercury TMDL. Mercury deposited onto the surface of the watershed, however, is included in the urban stormwater load and associated wasteload allocation in the TMDL.

Based on an assessment of local air sources in the Bay Area conducted by the San Francisco Estuary Institute (SFEI) through a Proposition 13 grant, local air sources of mercury (e.g., crematoria and Portland cement plants) may be significant contributors of mercury found in urban stormwater runoff. The total estimated emissions of mercury from all air local sources within the San Francisco air basin are estimated at 214 kg/yr (CARB 2010). The emissions from the one Bay Area portland cement manufacturer (i.e., Lehigh Hanson Permanente Cement Plant) located in western Santa Clara County are estimated at 61 kg/yr (Rothenberg et al. 2010). Annual emissions from the approximately 40 crematoria in the nine county San Francisco Bay Area3 have been estimated to range from a most probable value of 12 kg/yr to a worst case of 47 kg/yr (Lindquist and Bateman 2000). The primary source of the mercury in the crematoria emissions is assumed to be dental fillings.

**Applicable Control Measures**

Loads reduced through the implementation of the following control measures that directly affect mercury loads from urban stormwater runoff may be quantified and used by Bay Area MS4s to assess progress towards WLA established in the Mercury TMDL:

- **New Emission Standards for Portland Cement Plants** – The U.S. EPA has proposed *National Emission Standards for Hazardous Air Pollutants from the Portland Cement Manufacturing Industry* that is currently under review. BASMAA and SCVURPPP have provided comment letters to U.S. EPA regarding the proposed adoption regarding the potential nexus between emissions at the plant and mercury in urban stormwater runoff.

- **Reduction in Mercury Emissions from Crematoria** - Mercury has been widely used in the dental industry in amalgam fillings for teeth for decades. Substantial decreases in the use of mercury in dental amalgam due to increased consumer awareness of mercury use in fillings and the availability of more viable alternatives has been documented since 2003 (IMERC 2010). Continued reductions in the use of dental amalgam over time, may in turn reduce mercury emissions from crematoria.

**Load Reduced Formula**

Based on a review of available data and information gained through literature reviews, the following set equations will allow MRP Permittees to determine the mass of total mercury reduced from stormwater as a result of reductions in air emissions conducted in a given year. Please note that the equations are unit-less and will need to be converted appropriately based on standard conversion rates (e.g., milligrams to kilograms).

---

3 Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma
Reduction_{AirEm} = Base_{AirEm} - Current_{AirEm}

where:

- Reduction_{AirEm} = Mass of total mercury reduced from urban stormwater baseline attributable to mercury air emission reductions in a year of interest
- Base_{AirEm} = Average annual baseline mass of total mercury in Bay Area stormwater attributable to local mercury air emissions
- Current_{AirEm} = Mass of total mercury in Bay Area stormwater attributable to local mercury air emissions during the year of interest

and;

- \( Base_{AirEm} = AirEm_{Base\#} \cdot AirEm_{BaseMass} \cdot Dep_{AirEm} \cdot Trans \)
- \( Current_{AirEm} = AirEm_{Current\#} \cdot AirEm_{CurrentMass} \cdot Dep_{AirEm} \cdot Trans \)

where:

- \( AirEm_{Base\#} \) = Number of crematory or portand cement manufacturers in baseline year(s)
- \( AirEm_{BaseMass} \) = Average annual mass of total mercury emitted from crematory or portand cement manufacturers in baseline year(s)
- \( AirEm_{Current\#} \) = Number of crematory or portand cement manufacturers in year of interest
- \( AirEm_{CurrentMass} \) = Mass of total mercury (kg) emitted from crematory or portand cement manufacturers in year of interest
- \( Dep_{AirEm} \) = Average % of total mercury mass in emissions from crematory or portand cement manufacturers that is deposited onto the surface of the watershed
- \( Trans \) = Average % of total mercury mass deposited onto the surface of the watershed that runs off into urban stormwater (based on runoff coefficients)

Assumptions and Data Inputs

Baseline Loads

- Baseline Number of Air Emission Facilities (AirEm_{Base\#}) – In 2003, there were 31 crematoria (see Table 4-3) and one portand cement manufacturer in the geographical area subject to the MRP.

- Mass of Mercury Emitted from Facilities during Baseline Years (AirEm_{BaseMass}) - Emission estimates for crematoria are based on dental statistics and the average amount of mercury used in amalgams. Annual emissions from the approximately 40 crematoria in the nine county San Francisco Bay Area are assumed to be 12 kg/yr (most probable number), or an average of 0.3 kg/yr of mercury per crematoria (Lindquist and Bateman 2000). Mercury emissions from the Lehigh Hanson Permanente Portland Cement Plant located are estimated at 61 kg/yr in 2009 (Rothenberg et al. 2010). For the purposes of establishing baseline, this mass of mercury in 2009 was assumed to also be emitted in 2003.

Current Loads (in Year of Interest)

- Number of Air Emission Facilities in Year of Interest (AirEm_{Current\#}) – Due to the closing of crematoria or portland cement manufacturing plants, the number of facilities emitting mercury in the Bay Area may change overtime. Tracking of these businesses should be conducted accordingly to insure the most up-to-date information is used in loads reduced calculations.

- Mass of Mercury Emitted from Facilities during Year of Interest (AirEm_{CurrentMass}) – Mercury in crematoria emission may change in the future due to the reduction in the number and size of mercury amalgam fillings used. If literature suggests that the number or size of mercury-based
filling decreases, the estimated 0.3 kg/yr should be refined to account for this decrease. Likewise, if regulations go into place for portland cement manufacturers, the estimated mass of mercury emitted from this source should be revised. In the absence of new information or regulation, the baseline mass of mercury emitted from these facilities should be used to calculate the mass emitted during the year of interest.

Baseline and Current Loads Reduced

- **% of Total Mercury in Emitted that is Deposited onto the Watershed (DepAirEm)** – Based on our understanding of air deposition of contaminants, only a percentage of local mercury emissions are deposited onto the surface of Bay watershed. Predicting this percentage through field sampling or modeling, however, is extremely complex and results are typically highly variable and uncertain (USEPA 2001). Therefore, we provide a conservative assumption of 20% of the mercury emitted from these sources is deposited on the surface of the watershed in the Bay Area.

- **% of Total Mercury Mass Deposited that Runs Off (Trans)** – the average % imperviousness of Bay Area is an important factor because imperviousness is one of the key mechanisms for stormwater transport. Runoff coefficients are based on the % of imperviousness of a given land use. Based on the literature review conducted in support of this technical memorandum development, there remains a need for an average runoff coefficient for the “urban portion of the Bay” to complete this variable. As an initial percentage, we suggest using a 32% estimate based on modeling conducted as part of a Mercury Air Deposition Study by Tsai and Hoenicke (2001).

References


Table 4-3. Crematories within the geographic boundaries of MRP Permittees in 2009 (CARB 2010).

<table>
<thead>
<tr>
<th>CARB ID</th>
<th>County</th>
<th>Name</th>
<th>Address</th>
<th>City</th>
<th>Zip Code</th>
<th>2003</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>2501</td>
<td>ALA</td>
<td>LIVERMORE CREMATORY</td>
<td>3833 EAST AVENUE</td>
<td>LIVERMORE</td>
<td>94550</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3314</td>
<td>ALA</td>
<td>ROSELAWN CEMETERY</td>
<td>1240 N Livermore Ave</td>
<td>LIVERMORE</td>
<td>94550</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3576</td>
<td>ALA</td>
<td>BAY AREA CREMATORY</td>
<td>1051 HARDER ROAD</td>
<td>HAYWARD</td>
<td>94542</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3786</td>
<td>ALA</td>
<td>CHAPEL OF THE CHIMES</td>
<td>4499 Piedmont Ave</td>
<td>OAKLAND</td>
<td>94611</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3809</td>
<td>ALA</td>
<td>MOUNTAIN VIEW CEMETERY ASSOCIATION</td>
<td>5000 PIEDMONT AVE</td>
<td>OAKLAND</td>
<td>94611</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4122</td>
<td>ALA</td>
<td>CEDAR LAWN MEMORIAL PARK &amp; MOR</td>
<td>48800 WARM SPRING BLVD</td>
<td>FREMONT</td>
<td>94539</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4134</td>
<td>ALA</td>
<td>IRVINGTON MEMORIAL CEMETERY</td>
<td>41001 Chapel Way</td>
<td>FREMONT</td>
<td>94538</td>
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<td>X</td>
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<tr>
<td>4735</td>
<td>ALA</td>
<td>SENTINEL CREMATION SOCIETIES</td>
<td>4080 Horton Street</td>
<td>EMERYVILLE</td>
<td>94608</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5148</td>
<td>ALA</td>
<td>JESS C SPENCER MORTUARIES INC</td>
<td>21228 Redwood Road</td>
<td>CASTRO VALLEY</td>
<td>94546</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6390</td>
<td>ALA</td>
<td>EVERGREEN CEMETARY</td>
<td>6450 Camden Street</td>
<td>OAKLAND</td>
<td>94605</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>8227</td>
<td>ALA</td>
<td>PACIFIC INTERMENT SERVICE</td>
<td>1094 Yerba Buena Ave</td>
<td>EMERYVILLE</td>
<td>94608</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>8399</td>
<td>ALA</td>
<td>CHAPEL OF THE CHIMES MEMORIAL</td>
<td>32992 Mission Blvd</td>
<td>HAYWARD</td>
<td>94544</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>19321</td>
<td>ALA</td>
<td>ALAMEDA CREMATIONS</td>
<td>2900 MAIN ST, SUITE 1161</td>
<td>ALAMEDA</td>
<td>94501</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>9712</td>
<td>ALA</td>
<td>DIRECT FUNERAL SERVICES</td>
<td>2900 Main St, Suite 1161</td>
<td>ALAMEDA</td>
<td>94501</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2320</td>
<td>CC</td>
<td>OAK VIEW MEMORIAL PARK</td>
<td>2500 E 18th Street</td>
<td>ANTIUCH</td>
<td>94509</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2634</td>
<td>CC</td>
<td>OAKMONT MEMORIAL PARK</td>
<td>2099 RELIEZ VALLEY RD</td>
<td>LAFAYETTE</td>
<td>94549</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7394</td>
<td>CC</td>
<td>SUNSET VIEW CEMETERY ASSOCIATION</td>
<td>101 Colusa Avenue</td>
<td>EL CERRITO</td>
<td>94530</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7564</td>
<td>CC</td>
<td>ROLLING HILLS MEMORIAL PARK</td>
<td>4100 Hilltop Drive</td>
<td>RICHMOND</td>
<td>94803</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11155</td>
<td>CC</td>
<td>HULL'S WALNUT CREEK CHAPEL</td>
<td>1139 Saranap Avenue</td>
<td>WALNUT CREEK</td>
<td>94595</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1426</td>
<td>SCL</td>
<td>GAVILAN HILLS CREMATORY</td>
<td>910 1ST STREET</td>
<td>GILROY</td>
<td>95020</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4205</td>
<td>SCL</td>
<td>OAK HILL MEMORIAL PARK &amp; MORTU</td>
<td>300 Curtner Avenue</td>
<td>SAN JOSE</td>
<td>95125</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11268</td>
<td>SCL</td>
<td>ALTA MESA IMPROVEMENT COMPANY</td>
<td>695 ARASTRADERO ROAD</td>
<td>PALO ALTO</td>
<td>94306</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>11459</td>
<td>SCL</td>
<td>VCA JOHNSON ANIMAL HOSPITAL</td>
<td>524 N Santa Cruz Ave</td>
<td>LOS GATOS</td>
<td>95030</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>12958</td>
<td>SCL</td>
<td>LOS GATOS MEMORIAL PARK</td>
<td>2255 Los Gatos Almadn Rd</td>
<td>SAN JOSE</td>
<td>95124</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>19204</td>
<td>SCL</td>
<td>WYANT &amp; SMITH CREMATORY</td>
<td>174 N SUNNYVALE AVE</td>
<td>SUNNYVALE</td>
<td>94086</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>12867</td>
<td>SCL</td>
<td>WYANT &amp; SMITH FUNERAL HOME</td>
<td>174 N SUNNYVALE AVE</td>
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</table>
SC-1: STREET SWEEPING (MERCURY AND PCBs)

Street sweeping is conducted by most, if not all, Bay Area municipalities. The traditional purpose of street sweeping is to remove trash and debris that collect in the gutters at the edge of streets. However, street sweeping also removes sediment and associated pollutants such as mercury and PCBs that would otherwise be transported to the Bay via urban stormwater runoff. Although many studies⁴ have attempted to assess the effectiveness of street sweeping activities, there continues to be disagreement among stormwater practitioners as to whether sweeping efficiency equates to improvements in the quality of stormwater runoff. Pollutant removal effectiveness of street sweeping may be directly affected by sweeper type, operation (i.e., speed), frequency and inabilities to sweep near curbs due to parked vehicles. Additionally, land uses and proximities to pollutant sources and hot spots may influence the concentration and mass of pollutants removed. These factors make developing pollutant reduction estimates for street sweeping challenging at best. As a practical matter, however, it is difficult to argue from a qualitative perspective that much if not all the material picked up by a sweeper would have otherwise been mobilized and transported by stormwater runoff.

Applicable Control Measures

Pollutant loads reduced through the implementation of the following urban stormwater runoff control measures may be quantified and used by Bay Area MS4s to assess progress towards WLA established in the PCB and Mercury TMDLs:

- **Increases in the Pollutants Collected via Standard of Street Sweeping** – Permittees may increase the volume of pollutants collected via modification to their existing street sweeping program. Modifications may include: 1) increasing the frequency of street sweeping; 2) enforcing parking violations on street sweeping days; or 3) purchasing new more efficient sweepers.

- **Targeted Street Sweeping in Areas with Elevated Pollutants** – Based on previous source studies conducted by Permittees, stormwater programs and SFEI, PCB (and to some extent mercury) concentrations are heterogeneous in the Bay watershed. In compliance with the MRP, pilot studies are currently being developed to test control measures (i.e., source investigations, stormwater treatment retrofits, and diversions to POTWs) in selected areas. These areas may also serve as locations where Permittees may chose to target enhanced street sweeping in the future.

Loads Reduced Formula

Based on a review of available data and information gained through literature reviews, the following set equations will allow MRP Permittees to determine the mass of total mercury and PCBs reduced from stormwater as a result of street sweeping conducted in a given year. Please note that the equations are unit-less and will need to be converted appropriately based on standard conversion rates (e.g., milligrams to kilograms).

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⁴ See citations in the references section and EOA 2007 for a summary of street sweeping studies.
**Reduction**\textsubscript{Streets} = **Current**\textsubscript{Streets} – **Baseline**\textsubscript{Streets}

*where:*

\begin{align*}
\text{Reduction}_{\text{Streets}} &= \text{Mass of total mercury or PCBs reduced from urban stormwater (above baseline), as a result of street sweeping in year of interest} \\
\text{Baseline}_{\text{Streets}} &= \text{Average annual mass of total mercury or PCBs diverted from Bay Area stormwater due to street sweeping in baseline year(s)} \\
\text{Current}_{\text{Streets}} &= \text{Mass of total mercury or PCBs diverted from Bay Area stormwater due to street sweeping in year of interest}
\end{align*}

*and;*

\begin{align*}
\text{Baseline}_{\text{Streets}} &= \text{Streets}_{\text{BaseMass}} \cdot \text{Streets}_{\%\text{Sed}} \cdot \text{Streets}_{\text{BaseVol}} \cdot F \\
\text{Current}_{\text{Lamps}} &= \text{Streets}_{\text{CurrentMass}} \cdot \text{Streets}_{\%\text{Sed}} \cdot \text{Streets}_{\text{CurVol}} \cdot F
\end{align*}

*where:*

\begin{align*}
\text{Streets}_{\text{BaseMass}} &= \text{Average (or measured) concentration of mercury or PCBs in street sweeping sediments collected in baseline year(s)} \\
\text{Streets}_{\text{BaseVol}} &= \text{Average volume of street sweeping material collected in baseline year(s)} \\
\text{Streets}_{\text{CurrentMass}} &= \text{Average (or measured) concentration of mercury or PCBs in street sweeping materials collected in year of interest} \\
\text{Streets}_{\text{CurrentVol}} &= \text{Volume of street sweeping material collected in year of interest} \\
\text{Streets}_{\%\text{Sed}} &= \% \text{ of “sediment” (by volume) in street sweeping material that has constituent PCBs or mercury attached} \\
F &= \text{Factor for converting street sweeping sediment volume to dry mass}
\end{align*}

**Assumptions and Data Inputs**

**Baseline Loads Reduced (2003)**

- **Concentration of Mercury/PCBs in Street Sweeping Sediment in Baseline Years**  
  \(\text{Streets}_{\text{BaseMass}}\) – “Average” concentrations (also called typical concentration values) of PCBs and mercury in street sweeping sediments have been developed through a combination of studies in Contra Costa (EOA 2007), Alameda (Salop and Akashah 2004) and Solano (EOA 2006) counties. Through these studies, pollutant concentrations were compared to sweeper type, land use and age-of-urbanization to determine if significant relationships exist. Based on the results, concentrations of PCBs in street sweeping sediments appear to be dependent upon the very coarse age-of-urbanization categories assigned to cities in Contra Costa and Alameda Counties where street sweeping characterization occurred (Figure 4-1- To be completed). Bay Area age-of-development categories include:

  - **Early 20\textsuperscript{th} Century** – Represents the earliest and most extensive degree of urbanization/industrialization. May include municipalities where shipping and railways were used extensively for transporting industrial materials. Example cities include Richmond, Hayward, Oakland and Martinez.
  - **Mid-Century** – Represents the intermediate range in both time and degree of urbanization/industrialization. Example cities include Pinole, Concord, Orinda and Walnut Creek.
  - **Late 20\textsuperscript{th} Century** – Represents the geographical area with the most recent urbanization. Includes areas where heavy industry never or minimally existed. Example cities include San Ramon, Livermore, Dublin, Brentwood and Clayton.
Other factors appeared to have little to no effect on pollutant concentrations or the particle sizes of sediment collected (EOA 2007). Based on these results, high (75th percentile), average (mean), and low (25th percentile) PCB and mercury concentrations for the three age-of-urbanization categories were developed for use in loads reduced estimates (Table 4-4). To apply these concentrations, Permittees should determine which age-of-urbanization category best fits their municipality based on development patterns and degree of industrialization. Permittees may also choose to use default concentrations of total PCBs (0.094 mg/kg) or mercury (0.14 mg/kg), dry weight, or develop their own average concentrations based on methods similar to those used in Bay Area studies.

Table 4-4. Average (mean), low (25th percentile) and high (75th percentile) estimates for PCBs and mercury in street sweeping material collected by MRP Permittees.

<table>
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<th>Constituent (mg/kg)</th>
<th>Municipality’s Age-of-Urbanization</th>
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<tr>
<td></td>
<td>Early 20th Century</td>
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<tr>
<td></td>
<td>Low</td>
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<tr>
<td>Total PCBs</td>
<td>0.10</td>
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<tr>
<td>Total Mercury</td>
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- **Average Volume of Street Sweeping Material Collected in Baseline Years (StreetsBaseVol)** - The average volume of street sweeping material collected by Permittees has been reported annually to the Water Board via annual compliance reports for over a decade. Volumes are typically visually estimated by municipal maintenance staff and can be variable from year to year. For each Permittee, the volume of street sweeping material collected from 2000 to 2003 will be used as baseline for the purposes of calculating loads reduced.

**Current Loads Reduced (Year of Interest)**

- **Average (or measured) Concentration of Mercury or PCBs in Street Sweeping Materials Collected in Year of Interest (StreetsCurrentMass)** – Average concentrations of PCBs and mercury in street sweeping sediments based on recent studies are presented in Table 1. These concentrations (or default) concentrations should be used by Permittee as “current” concentrations unless new information is collected. Additionally, average concentrations may be replaced with site specific data collected through field studies.

- **Volume of Street Sweeping Material Collected in Year of Interest (StreetsCurrentVol)** - The volume of street sweeping material collected by Permittees should continue to be tracked and reported on an annual basis. To maintain comparability with baseline volumes, volumes should continue to be estimated in a similar manner as in previous years (visually).

**Baseline and Current Loads Reduced**

- **% of Street Sweeping Material that has PCBs or Mercury Attached (Streets%Sed)** – It is generally believed that sediment-associated pollutants adsorb to smaller sediment grain sizes due to the increased surface area available. However, it is currently unknown what
grain size fractions in street sweeping material constitute the largest percentage of pollutants. This issue continues to be studied and information gained through future investigation will assist in defining the proportion of street sweeping material which is heavily associated with sediment-associated pollutants. For the purposes of developing loads reduced calculations, information gained through EOA (2007) and Salop and Akashah (2004) were utilized to establish that on average 60% of street sweeping material collected is < 2mm and therefore represents a large portion of the pollutant mass in street sweeping material (CH2MHill 1982, Bannerman 1983, Brinkman 1999, Walker and Wong 1999). (Please note that sweeper technology has also advanced considerably over the past 20 years with the emphasis on designing sweepers to remove fine sediments and associated pollutants, if Permittees acquire sweepers that are believed to be significantly more effective at removing fine sediments, this 60% factor presented here should be reconsidered).

- **Factor for Converting Street Sweeping Sediment Volume to Dry Mass (F)** – The material collected during street sweeping is typically reported in volumes (cubic yards). However, to calculate pollutant loads reduced, a volume to mass conversion factor must be applied. FEECO International developed volume to mass conversion factors for a variety of waste materials in support of the California Integrated Waste Management Act of 1989. These factors continue to be utilized by the California Integrated Waste Management Board (CIWMB 2003). Although the conversion factors may not be representative of every material collected by every Permittee, they are the best currently available. The volume to mass conversion factor is 918.4 kg per cubic yard (CY) of material collected.

**References**


5.0 REFERENCES – TO BE COMPLETED
RMP Special Study Proposal: Synthesis of Information on Mercury

Estimated Cost: $75,000
Oversight Group: TRC, CFWG
Proposed by: Jay Davis, SFEI

PROPOSED DELIVERABLES AND TIME LINE

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</tr>
<tr>
<td>Draft report</td>
<td>May 2011</td>
</tr>
<tr>
<td>Final report</td>
<td>August 2011</td>
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BACKGROUND AND JUSTIFICATION

The RMP Mercury Strategy has funded a significant body of work to address the first two questions in the Strategy (listed below). This included three years of intensive monitoring of spatial and temporal patterns in mercury in small fish (a total budget of $450,000), a two-year study of mercury isotopes ($115,000), and a two-year study of passive samplers for aqueous methylmercury – “DGTs” – ($80,000). The results of these studies are either just being evaluated now (isotopes and DGTs) or will be available in December 2010 (the three-year dataset on small fish). In addition, extensive monitoring of other indicators of spatial patterns, temporal trends, fate, and effects have been conducted by RMP and other programs and projects in the last few years. Our state of knowledge has been advancing rapidly.

The RMP Mercury Strategy has articulated management questions to guide a long-term program of studies to support the goal of identifying and reducing high leverage pathways and thereby reducing mercury impairment in the Bay. The studies conducted to date are providing partial answers to some of the questions in the Strategy, but it is clear that we have not yet answered all of them. The optimal next steps to take in answering the questions, however, are unclear. A prudent next step to ensure effective use of RMP funds would be to thoroughly evaluate and synthesize all of the information acquired in the last several years and to use this synthesis as the basis for a plan for the next few years of mercury studies.

The complex biogeochemistry and spatial and temporal dynamics of mercury and especially methylmercury pose a challenge for such a synthesis effort. A large body of information on the various aspects of mercury science has been generated in the Estuary in the past few years. An interdisciplinary approach to the synthesis is called for, with the collaboration of a team spanning the different branches of mercury science. It will be important to include tidal wetlands within the scope of the review, given their potential influence on regional patterns of contamination in the Bay and the potential importance as a zone of methylmercury impact.
APPLICABLE RMP MANAGEMENT QUESTIONS

The most relevant questions for this synthesis are the questions articulated specifically for the Mercury Strategy.

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

OBJECTIVES AND APPROACH

The goal of the synthesis effort will be to produce a technical report that answers, to the extent possible, the Mercury Strategy questions based on the information that has accumulated to date. Other questions may also be addressed. Stakeholder input on an outline of the report will be obtained as a first step in the project.

A considerable body of information generated by the RMP and other programs has accumulated in recent years. Some of the datasets to be covered in the review are listed below.

- Status and Trends: RMP (Sport fish, Avian eggs, Sediment, Water), USGS Clapper rail feathers
- RMP Mercury Strategy: Small fish, Isotopes, DGTs
- Effects: RMP/CALFED Avian egg work, USFWS Rail work, Effects on fish
- Fate: RMP (cores, methylmercury budget)
- Loading Studies: Central Valley loads (RMP, Region 5), Small tributaries (loading studies, BMP study), atmospheric deposition (global, local), POTWs (Region 2, WERF, Sacramento regional)
- Wetlands: SBSP, Petaluma, Hamilton, Suisun Marsh, Crissy Field, Twitchell Island

Stakeholder suggestions on additional datasets to include will also be encouraged.

The synthesis will also evaluate progress relative to the Conceptual Model of Mercury in San Francisco Bay developed by Tetra Tech (2006) for the Clean Estuary Partnership.

The findings of this synthesis will be incorporated into an article to be published as in a special issue of a journal featuring synthesis papers for seven major ocean regions as part of the Coastal and Marine Mercury Ecosystem Research Collaborative (C-Merc), sponsored by the Dartmouth College Toxic Metals Superfund Research Program. C-Merc has convened a team of scientists and stakeholders to work together over a two-year period to gather and analyze data and publish a series of papers related to the inputs, cycling, and uptake of mercury in marine ecosystems. The other ocean regions to be covered include the Mediterranean, the tropics, the open ocean, the Gulf of Mexico, the
Gulf of Maine, and the arctic. Other papers on global mercury topics (e.g., mercury isotopes, climate change, health effects) will also be included in the special issue. The RMP effort will benefit from the synergy that comes from sharing and comparing data from San Francisco Bay with data from other parts of the world. The use of RMP funds will be strictly limited to answering the management questions identified by RMP stakeholders. Any work for C-Merc beyond that scope will be funded by SFEI. C-Merc will pay for travel to participate in workshops with other C-Merc authors.

**LITERATURE CITED**


**BUDGET**

The estimated budget for this task is $75,000, all for SFEI labor. The hours allocated for each staff person are indicated below.

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**Pollutants of Concern**  
STORMWATER INSPECTORS’ GUIDANCE MANUAL

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**Purpose**

The purpose of this manual is to provide guidance to municipal stormwater inspectors on inspecting industrial/commercial facilities for three pollutants of concern, i.e., copper, mercury and Polychlorinated Biphenyls (PCBs).

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**Organization of Guidance Manual**

This manual is organized into five sections:

1. Regulatory Background – This section provides information on the regulations and permits that require agencies to inspect industrial/commercial facilities for the three pollutants of concern (POCs).
2. POC Matrix – This section identifies facilities and potential sources of copper, mercury and PCBs.
3. POC: Copper – This section identifies facilities and potential copper sources, and identifies BMPs that should be implemented at the facilities. The focus of this section is to meet MRP requirements for copper control BMPs at industrial facilities.
4. POC: Mercury – The focus of this section is to identify products that contain mercury that may be found at industrial and commercial facilities and identify proper disposal/recycling and spill cleanup BMPs.
5. POC: PCBs – This section provides information on PCB regulations, PCB containing equipment, BMPs that should be implemented and guidance on referring facilities to regulatory agencies as appropriate.
PCBs IN CAULK PROJECT
REVISED WORKPLAN

TAKING ACTION FOR CLEAN WATER:
BAY AREA TMDL IMPLEMENTATION

Agreement #09-305-550
between the State Water Resources Control Board
and the Association of Bay Area Governments
ARRA restart of original Prop 50 grant agreement #09-305-550

Revision prepared by San Francisco Estuary Partnership, December 2009

Original workplan submitted and approved July 2007
PCBs IN CAULK PROJECT
REVISED WORKPLAN

INTRODUCTION

This workplan describes revisions to activities for the PCBs in Caulk project, which is one part of the San Francisco Estuary Partnership (SFEP)’s grant-funded Taking Action for Clean Water project (Bay Area TMDL Implementation). The original workplan was submitted in July 2007. The revisions to this workplan are based on delays incurred by the state bond freeze and significant progress on the issue of PCBs in caulk since the original workplan submission. The original workplan is included at the end of this document for reference.

The Taking Action for Clean Water project undertakes water quality improvement actions to protect California coastal waters and to implement San Francisco Bay Area TMDLs for sediment, urban pesticides, and polychlorinated biphenyls (PCBs). Taking Action for Clean Water was originally funded by the Proposition 50 Coastal Nonpoint Source Pollution Control Program, and the project commenced in April 2007. California’s bond freeze put the project on hold in December 2008. Funding to restart this project has been provided by the American Recovery and Reinvestment Act of 2009 and the Clean Water State Revolving Fund, through an agreement with the State Water Resources Control Board. The PCBs in Caulk Project works to improve management of PCBs that remain in Bay Area structures to prevent release into urban runoff.

The project was originally called the Structural PCBs project. We have changed the name to PCBs in Caulk project for clarity.

BACKGROUND

Elevated PCB levels threaten the health of people and wildlife consuming fish from San Francisco Bay. A TMDL to address PCB impairment of all segments of San Francisco Bay has been adopted by the San Francisco Bay Regional Water Quality Control Board. The San Francisco Bay PCBs TMDL Project Report found that urban runoff was one of the major sources of PCB loads to the Bay and concluded that controlling PCBs sources in urban runoff was one of two top priorities for TMDL implementation.¹

Based on this conclusion, the Clean Estuary Partnership (CEP) evaluated available data on sources of PCBs in urban runoff and recommended approaches for addressing two major sources: past PCBs releases that have contaminated soil and sediments and PCB-containing historic building materials, specifically uncontained materials like sealants, caulking and paint.² This project builds on the building materials portion of the CEP report.

The CEP report found that when PCB-containing building materials fail or structures in which they occur are remodeled or demolished, PCBs are released onto the ground and can be washed

off by urban runoff. A survey by the Swiss government of 1,348 buildings constructed between 1950 and 1980 found that almost half of the buildings contained PCBs; almost 10% contained sealants with PCB concentrations exceeding 10% by weight; and that the total PCBs reservoir was an estimated 50-150 metric tons.\textsuperscript{3} A less rigorous study was conducted in Boston with similar findings.\textsuperscript{4} A Swedish study found that significant quantities of PCBs were released into soil and water runoff during building remodeling.\textsuperscript{5}

Management practices have been developed that can prevent PCBs releases from building materials into urban runoff.\textsuperscript{6} Both the Swiss and Swedish governments have developed active programs to manage PCB-containing building materials in response to public health concerns (related both to direct exposures and to the adverse effect of PCBs on Europe’s fisheries).

**PROJECT TEAM AND ROLES**

To complete the PCBs in Caulk project, SFEP is partnering with a core project team that includes BASMAA (Bay Area Stormwater Management Agencies Association), the San Francisco Regional Water Quality Control Board, and subcontractors including San Francisco Estuary Institute (SFEI) and TDC Environmental, LLC:

- **SFEP** will provide project management and coordination, as it does for more than forty projects under a range of local, state, and Federal grants and contracts. SFEP is a project of the Association of Bay Area Governments (ABAG), dedicated to developing and facilitating collaborative regional programs and projects that promote the health of the San Francisco Estuary.
- **BASMAA** represents and promotes coordinated, consistent stormwater management among urban runoff/stormwater programs for municipalities throughout the Bay Area. BASMAA staff will help coordinate this project with municipal efforts to reduce PCBs in runoff. They will help connect the project to relevant municipal departments such as building permits and inspection. BASMAA staff experience conducting other PCBs studies and projects will inform this project.
- **The San Francisco Regional Water Quality Control Board** is providing staff input on the project to coordinate with the San Francisco Bay PCBs TMDL and the newly adopted Municipal Regional Permit for Stormwater (MRP, adopted October 14, 2009). The MRP contains stormwater permit regulations for 76 Bay Area municipalities. One requirement of the MRP is for permittees to conduct the same work as outlined in the PCBs in Caulk project, i.e., sample at least ten locations, pilot-test the BMPs, and develop model implementation ordinances or policies.
- **SFEI** will conduct the scientific assessment of PCB levels in caulk in Bay Area buildings. SFEI is a non-profit organization whose mission is to foster the scientific understanding needed to protect and enhance the San Francisco Estuary and its watershed. Its staff conducts science studies, synthesizes data and information, and collaborates with other scientists to provide a holistic integration of information from many disciplines to support management activities.

\textsuperscript{6} Procedures in other languages have been reviewed and will be translated as appropriate.
TDC Environmental, LLC is an environmental consulting firm that identified the potential for building materials to be a significant source of PCBs in urban runoff. TDC is providing technical support to SFEP and stakeholders to facilitate effective project implementation based on the latest scientific information.

One additional subcontractor (or team of subcontractors) will be brought on to develop best management practices (BMPs) and an implementation process to prevent release of PCBs from building materials into urban runoff.

SFEP will convene a stakeholder group that will guide the project and review its products.

**STAKEHOLDER WORKGROUP**

The stakeholder process for the PCBs in Caulk project includes a workgroup convened by SFEP to assist with project implementation: advising on project direction and review of products. The stakeholder group first met in July 2007 with twenty-plus attendees representing:

- BASMAA
- San Francisco Bay Area municipalities
- Port of San Francisco
- San Francisco Bay Regional Water Board
- California Department of Transportation (Caltrans)
- California Department of Toxic Substances Control
- California Integrated Waste Management Board
- California Office of Environmental Health Hazard Assessment
- U.S. EPA Region 9
- Environmental consultants
- Construction industry
- Environmental nonprofits

A core group will continue to meet periodically to provide guidance during key steps of the project. Ongoing participation is anticipated from (but is not limited to) representatives from U.S. EPA, California Department of Toxic Substances Control, local governments, other agencies, building/construction and demolition industry representatives, and building managers. School districts may join the stakeholder group as well.

Stakeholder meeting points in relation to the development of other products can be found on the new project timeline (following).
PROJECT STRUCTURE AND REVISIONS

Project Structure - Original. The original workplan was approved by the State Water Board in July 2007. It described distinct project phases which were intended to run sequentially, with each successive phase beginning after the preceding phase had been completed. Phases included:

1. The “Local Information Phase,” in which SFEI would obtain Bay Area specific information on the presence of PCBs in historic building materials, to help target management actions specifically to the structures most likely to contain PCBs that threaten water quality.

2. The “BMP Development Phase,” in which the project would develop (BMPs) and a model implementation process (MIP) to prevent release of PCBs from uncontained building materials into urban runoff. Swiss and Swedish management practices would guide development of Bay Area-specific BMPs.

3. The “Pilot Project Phase,” in which BMPs would be piloted in 3-5 municipalities.

4. The “Regional Implementation Phase,” in which phased implementation throughout the region would be pursued, with a long-term target of achieving a 10% reduction in PCBs stormwater loads to the Bay.7

The initial workplan noted that in practice, some overlap might exist between these conceptual phases; for example, some might begin before others are complete.

Rationale for Changes. The PCBs project has been revised several times, due to difficulties encountered early in the original grant period, the bond freeze period of no work on the project, and external events related to PCBs in caulk that affect this project. Issues and resolutions are summarized below.

Issue: An unforeseen obstacle arose early in the grant period: immediate removal and disposal requirements for PCBs in caulk at levels over 50ppm.

- The project team found that since caulk was not explicitly listed as an exempted use under Toxic Substances Control Act, any sampling that found PCBs over 50ppm would trigger a requirement that the PCB-containing material be removed immediately and treated as hazardous waste. Since the project design included testing materials anticipated to contain PCBs at levels that would often far exceed 50ppm, the immediate cleanup and abatement requirements would incur substantial cost and risk for project sampling partners. The project team discussed the original project plans with potential partners, and became concerned that it would be impossible to find partners willing to sample their buildings for PCBs under those conditions.

Resolution: Liability concerns were addressed through approval to use a blind sampling method, and by increasing the focus on an indicator screening technique and reducing direct sampling.

- In July 2008, the Grant Manager (Susan Gladstone of the San Francisco Regional Board) issued direction that blind sampling would be acceptable: buildings could be sampled without reporting GPS coordinates or other exact identifiers of location.

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7 This target is based on information in Larry Walker Associates, TDC Environmental, and Ann Blake (2006).
A CEP memo\textsuperscript{8} developed with the participation of project suggested using a combination of field screening with portable XRF analysis and confirmation sampling with PCBs measurements by an analytical laboratory. Since XRF screening provides an indicator rather than a direct measurement, using XRF would provide some information about potential PCBs levels in Bay Area buildings but would not necessarily trigger cleanup and liability requirements for sampling partners. In addition, the XRF analyzer device could provide a rapid result and was much less expensive than traditional sampling. The project team was working to shift the balance of sampling towards XRF in late 2008, and stakeholders continued investigations during 2009 under non-grant funds.

\textit{Issue:} California’s bond freeze in December 2008 delayed project implementation

\textit{Resolution:} The project restarted under ARRA funds in August 2009.

- During the bond freeze, no work took place. Between the grant initiation and the restart, there were numerous turnovers among project staff and stakeholders. Bringing new staff up to speed took time. The project subcontracts also had to be renegotiated.
- The delay also benefited the project in some ways:
  - The project got some external support when the San Francisco Regional Water Board adopted the Municipal Regional Permit (MRP) for Stormwater (October 14, 2009). The MRP (Provision C.12.b) requires its 76 permittees to conduct the same tasks as outlined in this project. This requirement should help reduce the difficulty in finding sampling partners. The MRP requires permittees to implement sampling and analysis at 10 sites around the Bay Area, and to pilot test BMPs at 5 sites around the Bay Area.
  - U.S. EPA began outreach to distribute information about PCBs in caulk in schools. The presence of PCBs in building materials is becoming a widely recognized issue with a higher profile than it had at the start of the project. In September 2009, EPA launched a major campaign for building owners and facilities managers—particularly those at school districts—to test for and manage PCBs in caulk. The increased visibility may help the project team partner with interested school districts or other entities to pilot sampling and BMPs, and renews EPA’s commitment to the project.

\textbf{Project Structure Revisions.} The project structure is now reframed from sequential phases to concurrent execution of the Local Information and BMPs Development phases, followed by the Pilot Project phase. The attached project timeline illustrates the sequence and timing of the various steps included in the project.

The original sequential structure included a “go/no-go decision” after Phase 1 (Local Information Phase), intended to ensure that enough PCBs in caulk were found locally to justify the pursuing the remaining project phases. The project team met before the bond freeze to discuss concerns about project timing, and with approval from Grant Manager Susan Gladstone decided that a go/no-go decision was not needed in light of the dramatic increase in work and literature on PCBs in caulk in the three years since the original project proposal, including numerous high-profile remediation projects on the East Coast and guidance from U.S. EPA. Based on this

\textsuperscript{8} TDC Environmental, SFEI, et al. (2007). \textit{First Phase Support Information for PCB Portion of Taking Action for Clean Water Grant.} Prepared for CEP.
information it appears safe to assume that PCBs are present in caulking in Bay Area buildings. The Local Information Phase remains in the project, but its purpose is to inform development of management practices by obtaining as much detailed local information as possible about what types of buildings, materials, etc. contain caulking with PCB levels of concern. The revised project structure now has the BMPs and model implementation process being developed concurrently with the local information phase.

In the current organization, implementation trials are scheduled to begin after the BMPs and model implementation process have been developed and been reviewed by the stakeholder group. Restructuring the project allows for maximum time/ flexibility to conduct implementation trials. The economic slowdown has reduced the pace of demolition/renovation activities, so getting started on BMP development earlier allows us to be more opportunistic in seeking sites.

The Regional Implementation Phase has been eliminated from the project because it would not be possible to complete under the remaining time in the grant. The project will prepare for phased regionwide implementation by providing technology transfer to municipalities and appropriate parties and stakeholders. The project team, including BASMAA and the San Francisco Regional Water Quality Control Board, will be involved in discussions regarding next steps for the project after the grant period is completed, including feasibility of regionwide implementation.

In December 2009, SFEP requested extension of the final deadlines from June 2011 to December 2011. These revised end dates will allow meaningful trials of the BMPs developed in earlier phases of the project. The dates listed in the Project Schedule and Deliverables section below are these proposed dates. Some project deadlines have been moved earlier, such as the draft and revised BMPs and draft and revised implementation process.

The project concludes with a final report from SFEI, training materials and technology transfer, and an effectiveness evaluation as part of the final project report by SFEP.
<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Start</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Revise workplan</td>
<td>Thu 11/12/09</td>
<td>Thu 12/31/09</td>
</tr>
<tr>
<td>2</td>
<td>Obtain Bay Area specific estimates on loadings to runoff from hist</td>
<td>Wed 12/16/09</td>
<td>Wed 11/16/11</td>
</tr>
<tr>
<td>3</td>
<td>Monitoring Plan and QAPP draft</td>
<td>Wed 12/16/09</td>
<td>Mon 2/1/10</td>
</tr>
<tr>
<td>4</td>
<td>BASMAA Review &amp; feedback</td>
<td>Tue 2/2/10</td>
<td>Mon 2/15/10</td>
</tr>
<tr>
<td>5</td>
<td>Monitoring Plan and QAPP final</td>
<td>Tue 2/16/10</td>
<td>Tue 3/16/10</td>
</tr>
<tr>
<td>6</td>
<td>Monitoring &amp; chemical analysis, round 1</td>
<td>Wed 3/17/10</td>
<td>Wed 9/1/10</td>
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<tr>
<td>7</td>
<td>Draft report</td>
<td>Wed 9/15/10</td>
<td>Wed 9/15/10</td>
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<tr>
<td>8</td>
<td>Monitoring &amp; chemical analysis, round 2 (implementation trials)</td>
<td>Tue 11/16/10</td>
<td>Mon 10/31/11</td>
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<td>9</td>
<td>Final report</td>
<td>Wed 11/16/11</td>
<td>Wed 11/16/11</td>
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<tr>
<td>10</td>
<td>Develop written BMPs and Model Implementation Process (IP)</td>
<td>Mon 12/21/09</td>
<td>Fri 10/14/11</td>
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<td>11</td>
<td>Complete RFP (AH writes, BASMAA reviews)</td>
<td>Mon 12/21/09</td>
<td>Tue 1/12/10</td>
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<tr>
<td>12</td>
<td>Hire contractor</td>
<td>Mon 3/15/10</td>
<td>Mon 3/15/10</td>
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<td>13</td>
<td>Research existing regulatory controls/policies re haz matls in demo</td>
<td>Tue 3/16/10</td>
<td>Mon 7/19/10</td>
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<td>14</td>
<td>Convene stakeholder group</td>
<td>Thu 4/1/10</td>
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<tr>
<td>15</td>
<td>Stakeholder group meets- feedback on prelim BMPs, MIP</td>
<td>Wed 8/25/10</td>
<td>Wed 8/25/10</td>
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<tr>
<td>16</td>
<td>Draft BMPs complete</td>
<td>Fri 4/2/10</td>
<td>Wed 9/15/10</td>
</tr>
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<td>17</td>
<td>Revise BMPs</td>
<td>Thu 9/16/10</td>
<td>Fri 10/15/10</td>
</tr>
<tr>
<td>18</td>
<td>Draft IP, model reg ctrls/policies, training matls</td>
<td>Fri 4/2/10</td>
<td>Fri 10/15/10</td>
</tr>
<tr>
<td>19</td>
<td>Revised IP, model reg ctrls/policies, TMIs</td>
<td>Mon 10/18/10</td>
<td>Mon 11/15/10</td>
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<tr>
<td>20</td>
<td>Implementation trials for BMPs/IP</td>
<td>Tue 11/16/10</td>
<td>Thu 9/15/11</td>
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<tr>
<td>21</td>
<td>Final BMPs, IP, Tr Matls, and checklists</td>
<td>Fri 9/16/11</td>
<td>Fri 10/14/11</td>
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<tr>
<td>22</td>
<td>Tech transfer</td>
<td>Mon 10/17/11</td>
<td>Wed 11/16/11</td>
</tr>
<tr>
<td>23</td>
<td>Effectiveness evaluation (per PAEP)</td>
<td>Thu 12/1/11</td>
<td>Thu 12/1/11</td>
</tr>
</tbody>
</table>

**Project Summary**

- **AH**: Project Leader
- **SFEI**: Project Manager
- **BASMAA**: Technical Advisor
- **Ctrctr**: Contractor
- **Ctct**: Contact person

**Timeline**

- **2009**: Qtr 1, 2009, Qtr 2, 2009, Qtr 3, 2009, Qtr 4, 2009
- **2010**: Qtr 1, 2010, Qtr 2, 2010, Qtr 3, 2010, Qtr 4, 2010
- **2011**: Qtr 1, 2011, Qtr 2, 2011, Qtr 3, 2011, Qtr 4, 2011

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**Task Split**

- | Task | Progress | Milestone |
- |------|----------|-----------|
- |      |          |           |
PROJECT ACTIVITIES AND TASKS

Specific project tasks are listed below. These are taken from the grant agreement and are identified by grant task number.

7.5 Decrease Polychlorinated biphenyl (PCB) Contamination in Urban Runoff

7.5.1 Workplan Revision
   7.5.1.1 Revise workplan and submit to Project Manager for review.
   [this document]
   7.5.1.2 Complete final workplan in accordance with Project Manager comments.

7.5.2 Obtain Bay Area specific estimates on PCB loadings to urban runoff from historic building materials.
   7.5.2.1 Define procedures to identify structures that contain PCBs in their building materials.
   7.5.2.2 Conduct field sampling and chemical analysis, as possible.
   7.5.2.3 Analyze data and estimate PCB loadings from representative types of structures.
   7.5.2.4 Produce draft report and submit for Project Manager review.
   7.5.2.5 Complete final report in accordance with Project Manager comments.

7.5.3 Develop written BMP’s and Model Implementation Process
   7.5.3.1 Convene stakeholder implementation work group comprised of partner representatives, municipal staff, and regulatory agency staff tasked with providing guidance and reviewing drafts of Project deliverables.
   7.5.3.2 Research existing regulatory controls/policies related to managing wastes and hazardous materials during building demolition/remodeling programs.
   7.5.3.3 Develop proposed best management practices (BMPs) to reduce or prevent discharge of PCBs during building demolition/remodeling. The BMPs will focus on methods to identify PCB-containing building materials and properly manage those materials through aspects such as handling, containing, transport, and disposal. Provide draft BMPs to work group and Project Manager for review.
   7.5.3.4 Finalize BMPs in accordance with comments received and submit to Project Manager.
   7.5.3.5 Develop implementation process and define circumstances that would trigger BMP implementation including model municipal regulatory controls/policies/ordinances. Develop training materials, including checklist(s), for building inspectors or other municipal staff who will be implementing BMPs. Provide implementation process and training materials to work group and Project Manager for review.
   7.5.3.6 Revise implementation process, training materials, and checklist(s) in accordance with comments received and submit to Project Manager.
7.5.4 Implement up to five (5) trials using the BMPs and implementation process developed.
    7.5.4.1 Identify up to five (5) municipalities willing to work with Project staff and Bay Area Stormwater Management Agencies Association (BASMAA) to perform trials of the implementation process and BMPs, as possible.
    7.5.4.2 Implement trials to test and evaluate the BMPs and implementation process, as possible.
    7.5.4.3 Include status reports on trials in quarterly progress reports.

7.5.5 Prepare for phased region-wide BMP implementation by providing technology transfer to municipalities and other appropriate parties and stakeholders.
    7.5.5.1 Revise BMPs implementation process, and training materials based on the lessons learned during the work item 7.5.4 trials. Provide revised BMPs and implementation process to work group and Project Manager for review.
    7.5.5.2 Finalize revised BMPs, implementation process, and training materials in accordance with comments received and submit to Project Manager.
    7.5.5.3 To prepare for phased region-wide implementation, provide technology transfer to municipalities and other appropriate parties and stakeholders. Submit technology transfer materials to Project Manager.

7.5.6 Conduct effectiveness evaluation in accordance with PAEP and submit to Project Manager.

PROJECT SCHEDULE AND DELIVERABLES

The table below reflects the project schedule and deliverables listed in the grant agreement (with date modifications as proposed). SFEP submitted proposed modifications of several due dates in the contract to the Grant Manager in early December 2009. The request included moving out the final deliverables from June 2011 to December 2011. The additional six months are needed to allow for meaningful trials of the BMPs developed in the early phases of the project. Though enrolling project partners is no longer impossible, it will likely remain difficult, since partners will incur additional costs and liability concerns. The additional time will also help us make robust efforts to secure sampling partners.

The vision for the project is to create a foundation for a majority of Bay Area cities to adopt ordinances or policies requiring the use of the BMPs and implementation process developed in this pilot. We believe the date modifications are essential to creating BMPs which can provide meaningful reductions in PCB loading to San Francisco Bay under the PCBs TMDL and which also can be adopted widely in the future rather than shelved because they are considered overly onerous.
<table>
<thead>
<tr>
<th>Item</th>
<th>DESCRIPTION</th>
<th>ESTIMATED DUE DATE</th>
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</thead>
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<td>7.5.1.1</td>
<td>Draft and Final Workplans - Revision</td>
<td>December 2009</td>
</tr>
<tr>
<td>7.5.2.4</td>
<td>Draft Report on PCBs in building materials</td>
<td>September 2010</td>
</tr>
<tr>
<td>7.5.2.5</td>
<td>Final Report on PCBs in building materials</td>
<td>November 2011</td>
</tr>
<tr>
<td>7.5.3.3</td>
<td>Draft and Final Preliminary BMPs for PCBs in building materials</td>
<td>September and October 2010</td>
</tr>
<tr>
<td>7.5.3.4</td>
<td>Draft and Final Preliminary implementation process; model regulatory controls and/or policies; training materials for PCBs in building materials</td>
<td>October and November 2010</td>
</tr>
<tr>
<td>7.5.4.3</td>
<td>Status reports on PCB implementation trials</td>
<td>Quarterly</td>
</tr>
<tr>
<td>7.5.5.1</td>
<td>Draft and Final Revised BMPs, implementation process, training materials for PCBs</td>
<td>September and October 2011</td>
</tr>
<tr>
<td>7.5.5.2</td>
<td>Draft and Final Revised BMPs, implementation process, training materials for PCBs</td>
<td>September and October 2011</td>
</tr>
<tr>
<td>7.5.5.3</td>
<td>Technology transfer materials for PCBs</td>
<td>November 2011</td>
</tr>
<tr>
<td>7.5.6</td>
<td>Effectiveness evaluation</td>
<td>December 2011</td>
</tr>
</tbody>
</table>

**PROJECT EVALUATION**

The Project Assessment and Evaluation Plan (May 2007) provides a plan for evaluating project successes. Evaluation is based on both output and outcome indicators. Output indicators are designed to provide low-cost, easy to measure, quick-response tracking of project activity levels. Outcome indicators involve monitoring of environmental and other types of data that link directly to the goals of each TMDL being implemented. SFEP will report on output indicators in each quarterly project report. Outcome indicators will be assessed at the end of the project; the project outcome evaluation will be included in the final project report.

**CONCLUSION**

This concludes the revised workplan. The original workplan narrative and timeline graphics are included next for reference.
STRUCTURAL PCBs PROJECT WORKPLAN

TAKING ACTION FOR CLEAN WATER:
BAY AREA TMDL IMPLEMENTATION

Agreement #06-342-552-0
between the State Water Resources Control Board
and the Association of Bay Area Governments

Prepared by:
TDC Environmental, LLC and the San Francisco Estuary Project

July 2007
STRUCTURAL PCBs PROJECT WORKPLAN

INTRODUCTION

This is a workplan for the polychlorinated biphenyls (PCBs)-related actions that comprise a portion of a larger San Francisco Estuary Project (SFEP) grant-funded program, the Taking Action for Clean Water Project. The Taking Action for Clean Water Project will implement water quality improvement actions to protect California coastal waters with Proposition 50 Coastal Nonpoint Source funding. Among the actions to be implemented under the Taking Action for Clean Water Project are activities to improve management of PCBs that remain in Bay Area structures to prevent release into urban runoff; these actions are called the “Structural PCBs Project.”

PROJECT OVERVIEW

Background. Elevated PCB levels threaten the health of people and wildlife consuming fish from San Francisco Bay. A TMDL to address PCB impairment of all segments of San Francisco Bay is in development. The San Francisco Bay PCBs TMDL Project Report found that urban runoff was one of the major sources of PCBs loads to the Bay and concluded that controlling PCBs sources in urban runoff was one of two top priorities for TMDL implementation.¹

Based on this conclusion, the Clean Estuary Partnership (CEP) evaluated available data on sources of PCBs in urban runoff and recommended approaches for addressing past PCBs releases that have contaminated soil and sediments and PCB-containing historic building materials, specifically uncontained materials like sealants, caulking and paint.² This project builds on the structural PCBs portion of the CEP report.

The CEP report found that when PCB-containing building materials fail or structures are remodeled or demolished, PCBs are released onto the ground and can be washed off by urban runoff. A survey by the Swiss government of 1,348 buildings constructed between 1950 and 1980 found that almost half of the buildings contained PCBs; almost 10% contained sealants with PCB concentrations exceeding 10% by weight; and that the total PCBs reservoir was an estimated 50-150 metric tons.³ A less rigorous study was conducted in Boston with similar findings.⁴ A Swedish study found that significant quantities of PCBs were released into soil and water runoff during building remodeling.⁵

Management practices have been developed that can prevent PCBs releases from structural materials into urban runoff.⁶ Both the Swiss and Swedish governments have developed active programs to manage PCB-containing building materials in response to

⁶ These procedures are in German, French, and Swedish; they have been reviewed and will be translated as appropriate.
public health concerns (related both to direct exposures and to the adverse effect of PCBs on Europe’s fisheries).

**Project Team.** To complete the Structural PCBs Project, SFEP will partner with BASMAA (Bay Area Stormwater Management Agencies Association) and the San Francisco Estuary Institute (SFEI) to develop and implement a best management practices (BMPs)-based source reduction program to prevent release of PCBs from building materials into urban runoff. TDC Environmental, LLC is providing technical support to SFEP and stakeholders to facilitate effective project implementation based on the latest scientific information. SFEP will convene a stakeholder group that it will engage in the project.

**Four Project Phases.** The Structural PCBs Project will be implemented in four phases.

- In the first phase (the “Local Information Phase”), the San Francisco Estuary Institute will obtain Bay Area specific information on the presence of PCBs in historic building materials. Obtaining Bay Area-specific information will allow management actions to be targeted specifically to the structures most likely to contain PCBs that threaten water quality.
- Using the Swiss and Swedish management practices as a guide, the Taking Action for Clean Water Project will partner with the Bay Area Stormwater Management Agencies Association (BASMAA) and its member cities to develop Bay Area-specific best management practices (BMPs) and a model implementation process (MIP) to prevent release of PCBs from unregulated, uncontained building materials (such as sealants and paints) into urban runoff (the “BMP Development Phase”).
- In the “Pilot Project Phase,” BMPs will be piloted in 3-5 municipalities.
- Subsequently, regionwide phased implementation will be pursued (the “Regional Implementation Phase”), with a long-term target of achieving a 10% reduction in PCBs stormwater loads to the Bay.
- At the end of the grant-funded portion of the project, SFEP will evaluate project outcomes and complete a final project report.

Please note that some overlap may exist between these phases; for example, SFEP and its partners may begin working with potential sites for the pilot phase of the project before the BMP Development Phase is complete. The attached Structural PCBs Project Overview figure provides the framework for the project, lays out the overall project schedule, and shows how the project relates to pre-project activities funded by other agencies.

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7 This target is based on information in Larry Walker Associates, TDC Environmental, and Ann Blake (2006).
PROJECT ACTIVITIES AND TASKS

Specific project tasks are listed below. These are taken from the grant agreement and are identified by grant task number.

6.1 Develop Workplan for Task 6 [This document]
   6.1.1 Prepare draft workplan and submit for Grant Manager review and approval.
   6.1.2 Complete final workplan in accordance with Grant Manager comments.

6.2 Obtain Bay Area specific information on PCB loadings to urban runoff from historic building materials.
   6.2.1 Define procedures to identify structures that contain PCBs in their building materials.
   6.2.3 Conduct field sampling and chemical analysis.
   6.2.4 Analyze data and estimate PCB loadings from representative types of structures.
   6.2.5 Produce draft report and submit for Grant Manager review and approval.
   6.2.6 Complete final report in accordance with Grant Manager comments.

6.3 Develop written BMP’s and Model Implementation Process
   6.3.1 Convene stakeholder implementation work group comprised of partner representatives, municipal staff, and regulatory agency staff tasked with providing guidance and reviewing drafts of project deliverables.
   6.3.2 Research existing regulatory controls/policies related to managing wastes and hazardous materials during building demolition/remodeling programs. Task may include review of regulations re: PCBs in solid waste.
   6.3.3 Develop proposed best management practices (BMPs) to reduce or prevent discharge of PCBs during building demolition/remodeling. The BMPs will focus on methods to identify, handle, contain, transport, and properly dispose of PCB-containing building materials. Task may include collecting and reviewing existing dust control BMPs. Provide draft BMPs to work group and Grant Manager for review.
   6.3.4 Finalize BMPs in accordance with comments received and submit for Grant Manager approval.
   6.3.5 Develop implementation process to define circumstances that would trigger BMP implementation including model municipal regulatory controls/policies. Develop training materials, including checklist(s), for building inspectors or other municipal staff who will be implementing BMPs. Provide implementation process and training materials to work group and Grant Manager for review.
6.3.6 Revise implementation process, training materials, and checklist(s) in accordance with comments received and submit for Grant Manager approval.

6.4 Implement three (3) to five (5) trials using the BMP’s and implementation process developed.
6.4.1 Identify three (3) to five (5) municipalities willing to work with project staff and BASMAA to perform trials of the implementation process and BMPs.
6.4.2 Implement trials to test and evaluate the BMPs and implementation process.
6.4.3 Include status reports on trials in quarterly progress reports.

6.5 Conduct phased region-wide implementation and provide technology transfer to municipalities and other appropriate parties and stakeholders.
6.5.1 Revise BMPs implementation process, and training materials based on the lessons learned during the work item 6.4 trials. Provide revised BMPs and implementation process to work group and Grant Manager for review.
6.5.2 Finalize revised BMPs, implementation process, and training materials in accordance with comments received and submit for Grant Manager approval.
6.5.3 Conduct phased region-wide implementation and provide technology transfer to municipalities and other appropriate parties and stakeholders. Task may include providing information to the California Stormwater Quality Association and CalTrans, both of which have construction BMP manuals.

6.6 Conduct effectiveness evaluation in accordance with Project Assessment and Evaluation Plan (PAEP) and submit to Grant Manager.

**KEY DECISION POINTS**

The project involves an estimated eleven key decision points. Four attached figures (Structural PCBs Project Key Decision Points) identify key decisions and their anticipated timing, by project phase, for the entire project.

**STAKEHOLDER GROUP**

The stakeholder process for the Structural PCBs Project will include a workgroup convened by SFEP to assist with project implementation. The workgroup will meet periodically to provide guidance during key steps of the project. The workgroup is anticipated to include (but is not limited to) representatives from the following organizations and interest groups:
• BASMAA
• San Francisco Bay Area municipalities
• San Francisco Bay Regional Water Board
• California Department of Transportation (Caltrans)
• California Department of Toxic Substances Control
• California Integrated Waste Management Board
• California Office of Environmental Health Hazard Assessment
• U.S. EPA Region 9
• Construction industry
• Environmental nonprofits

The Estuary Project will also involve other stakeholders to the extent appropriate, such as the Bay Area Air Quality Management District, the California Department of Health Services, and Cal –OSHA. The attached Structural PCBs Project Overview – Key Times for Stakeholder Engagement figure shows, by calendar quarter, when stakeholder engagement is anticipated. Stakeholder review and input to project work products will also be sought; the attached figure also lists work products for stakeholder input at each project phase.

PROJECT EVALUATION

The Project Assessment and Evaluation Plan (Draft, May 2007) provides a plan for evaluating project successes. Evaluation is based on both output and outcome indicators. Output indicators are designed to provide low-cost, easy to measure, quick-response tracking of project activity levels. Outcome indicators involve monitoring of environmental and other types of data that link directly to the goals of each TMDL being implemented. SFEP will report on output indicators in each quarterly project report. Outcome indicators will be assessed at the end of the project; the project outcome evaluation will be included in the in the final project report.

PROJECT SCHEDULE AND DELIVERABLES

The table on the next page reflects the project schedule and deliverables listed in the grant agreement. The anticipated project schedule shown in the attached figures is somewhat more aggressive than the schedule required by the grant because SFEP would prefer to have as long as possible for the pilot project and regional implementation phases.
Structural PCBs Project Overview

Q1 2007 | Q1 2008 | Q1 2009 | Q1 2010
---|---|---|---

**Project Management (SFEP)**

**Establish Stakeholder Group (SFEP)**

**Grant Ends 3/10**

<table>
<thead>
<tr>
<th>Pre-grant background information gathering (AMS, LWA, TDC, SFEI)</th>
</tr>
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**Set priorities & identify structures for data collection**

**Go/No-Go decision based on preliminary results from SFEI**

**Identify pilot municipalities**

**Reassess project & plan next steps**

<table>
<thead>
<tr>
<th>Data collection - Bay Area structures (SFEI) - SAP, QAPP, sampling, chemical analysis, draft report</th>
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**Select BMP Contractor**

<table>
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<tr>
<th>PCBs in Building Materials Report (SFEI)</th>
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**Preliminary BMPs, MIP, & training material**

<table>
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<tr>
<th>Revised BMPs, MIP, &amp; training material</th>
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</thead>
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**Grant Project Effectiveness Evaluation**

**Encourage region-wide implementation of BMPs (Training/Outreach)**

<table>
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<th>Grant Report</th>
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**Key:**

- Funded by ACCWP & CEP
- Funded by SWRCB Grant

5/17/07
Structural PCBs Project Key Decision Points - Local Information Phase

<table>
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<th>Q1 2007</th>
<th>Q1 2008</th>
<th>Q1 2009</th>
<th>Q1 2010</th>
</tr>
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</table>

**Local Information Phase**

- **Establish Stakeholder Group (SFEP)**
  - Data collection - Bay Area structures (SFEI) - SAP, QAPP, sampling, chemical analysis, draft report

- **Develop BMPs & Model Implementation Process (MIP)**
  - Pilot BMPs with municipalities

- **Encourage region-wide implementation of BMPs (Training/Outreach)**

**Go/No-Go Decision**

Make a go/no-go decision on proceeding with the remainder of the project. The decision will be made with stakeholder input on the basis of preliminary results from SFEI.

Complete: Q4 2007

*Note: If “no-go” is the decision, SFEP will consult with the Water Board to determine appropriate use of unspent funds consistent with the purposes of the grant.*

**Set priorities & identify structures for data collection**

- **Materials to be Sampled**
  - Select material types to be sampled. This decision will be made with stakeholder input based on review of recommended priorities in the Technical Memorandum for SAP Support, being prepared with CEP funds
  - Establish priorities for sample groupings (e.g., ages, structure types). This decision will be made with stakeholder input based on review of recommended priorities in the Technical Memorandum for SAP Support. Considerations include ability to obtain data to differentiate/group structures, cost, priorities for information for BMP implementation, and priorities for information for load estimation.

- **Sampling/Analysis Methods**
  - Select chemical analysis method(s). This decision will be made with stakeholder input based on review of analytical options in the Technical Memorandum for SAP Support. Considerations may include minimum requirements for detection limits, the concentration below which PCBs are “negligible,” costs, which laboratory to use (e.g., EBMUD), and priorities for analytical budget (i.e., is a large number of samples with less analytical precision desired, or vice versa).

- **Sampling Schedule**
  - Determine if a single or multiple rounds of sampling will be conducted.
  - Decide if a contingency should be set aside for sampling in later project phases (e.g., for confirmatory sampling or to support load estimates.)

- **Sampling Sites**
  - Identify specific structures that contain target materials & obtain access for sampling. BASMAA and the stakeholder group are anticipated to play a key role in this step.

Complete: Q3 2007
Structural PCBs Project Key Decision Points - BMP Development Phase

Q1 2007  Q1 2008  Q1 2009  Q1 2010

BMP Development Phase

Data collection - Bay Area structures (SFEI) - SAP, QAPP, sampling, chemical analysis, draft report

Develop BMPs & Model Implementation Process (MIP)

Pilot BMPs with municipalities

Encourage region-wide implementation of BMPs (Training/Outreach)

Establish Stakeholder Group (SFEP)

Select Structure Types

Select structure types to be included in model implementation program. This decision will be made with stakeholder input based on Bay Area-specific building material information and information from the literature about sources not sampled (e.g., electrical equipment) from the literature. Single or multiple categories may be selected.

Complete: Q1 2008

Select Material Types

Select PCB-containing material types to be included in BMPs. This decision will be made with stakeholder input based on Bay Area-specific building material information and information from the literature about sources not sampled (e.g., electrical equipment)

Complete: Q1 2008

Identify pilot municipalities

Identify 3 to 5 municipalities willing to work with project staff and BASMAA to perform trials of the implementation process and BMPs. Pilot municipalities will ideally come from among the membership of the stakeholder group. Pilot municipalities will be selected based on stakeholder input.

Complete: Q2 2008

Prioritize MIP Options

Identify preferred model implementation process design options. This decision will be made with stakeholder input based on model implementation process options to be developed by the BMP consultant.

Complete: Q2 2008

Identify Training Target Audiences

Identify target audiences for training materials. Set priorities among potential target audiences. These decisions will be made with stakeholder input based on preferred model implementation process options.

Complete: Q2 2008

Plan Pilot Phase Management

Determine who will do what, budget, and tracking for pilot phase.

Complete: Q2 2008

Plan Next Steps

Reassess project; plan next steps.

Complete: Q2 2008
Structural PCBs Project Key Decision Points - Pilot Project Phase

- **Establish Stakeholder Group (SFEP)**
- **Data collection - Bay Area structures (SFEI) - SAP, QAPP, sampling, chemical analysis, draft report**
- **Develop BMPs & Model Implementation Process (MIP)**
- **Pilot BMPs with municipalities**
- **Encourage region-wide implementation of BMPs (Training/Outreach)**

**Pilot Project Phase**

**Determine Pilot Quantification Approach**
Determine what parameter(s) will be tracked by pilot municipalities to use to estimate benefits of BMP implementation. More than one tracking method may be piloted. This decision will be made with stakeholder input based on experience from pilot projects, implementation process options selected by pilot municipalities, and options for load estimation to be developed by the BMP consultant.
Complete: Q3 2008

**Determine Regional Training Approach**
Identify regional training approach to support region-wide implementation of BMPs. This decision will be made with stakeholder input based on experience from pilot projects and SFEP and stakeholder experience with similar efforts.
Complete: Q2 2009

**Determine Regional Outreach Approach**
Identify regional outreach approach to promote region-wide implementation of BMPs. This decision will be made with stakeholder input based on experience from pilot projects and SFEP.
Complete: Q2 2009

**Plan Next Steps**
Reassess project; plan next steps.
Complete: Q2 2009

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Regional Implementation Phase

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**Establish Stakeholder Group (SFEP)**
Data collection - Bay Area structures (SFEI) - SAP, QAPP, sampling, chemical analysis, draft report

**Develop BMPs & Model Implementation Process (MIP)**

**Pilot BMPs with municipalities**

**Encourage region-wide implementation of BMPs (Training/Outreach)**

**Determine Project Future**
Determine if the project merits continuation beyond the period of the grant. If so, identify a project partner and/or a funding source to support continued project implementation until remaining quantities of PCBs in structures are negligible. This decision will be made with stakeholder input based on experience from pilot projects.

Complete: Q1 2010
**Local Information Phase**
- Review draft SAP & QAPP
- Assist with selecting BMP contractor

**BMP Development Phase**
- Review preliminary draft BMPs, MIP, & training material
- Review draft PCBs in building materials report

**Pilot Project Phase**
- Review draft revised BMPs, MIP, & training material

**Regional Implementation Phase**
- Provide information for project effectiveness evaluation

**Structural PCBs Project Overview - Key Times for Stakeholder Engagement**

- Q1 2007: Establish Stakeholder Group (SFEP)
- Q2 2007: Data collection - Bay Area structures (SFEI) - SAP, QAPP, sampling, chemical analysis, draft report
- Q3 2007: Review draft revised BMPs, MIP, & training material
- Q3 2007: Review preliminary draft BMPs, MIP, & training material
- Q4 2007: Go/No-Go Decision
- Q1 2008: Select material & structure types, review BMP approaches
- Q2 2008: Prioritize MIP options, identify training target audiences, identify pilot municipalities
- Q3 2008: Determine pilot quantification approach
- Q2 2009: Determine regional outreach & training approaches
- Q1 2010: Determine project future
Field Sampling and Chemical Analysis Plan for the PCBs in Caulk Project (Taking Action for Clean Water Bay Area TMDL Implementation)
Subcontract for SWRCB Agreement No. 09-305-550-1 with Association of Bay Area Governments

Prepared by
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San Francisco Estuary Institute

July 2010

San Francisco Estuary Institute
7770 Pardee Lane, 2nd Floor
Oakland, CA 94621
Taking Action for Clean Water

Field Sampling and Chemical Analysis Plan

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1. Project Management

1.1 Project Background

Elevated polychlorinated biphenyl (PCB) levels threaten the health of people and wildlife consuming fish from San Francisco Bay (RWQCB, 2008). A Total Maximum Daily Load (TMDL) to address PCB impairment of all segments of San Francisco Bay was adopted by the San Francisco Bay Regional Water Quality Control Board in February 2008. The San Francisco Bay PCBs TMDL Project Report (RWQCB 2004) found that urban runoff was one of the major sources of PCB loads to the Bay and concluded that controlling sources of PCBs to urban runoff was one of two top priorities for TMDL implementation. Based on this recommendation, the Clean Estuary Partnership (CEP) evaluated available data on sources of PCBs in urban runoff and recommended approaches for addressing two potentially significant sources, past PCB releases that have contaminated soil and sediments and PCB-containing historic building materials, specifically uncontained materials like sealants, caulking and paint (LWA et al. 2006). When the building materials fail or buildings are remodeled, residues can be transported away from the building during rainstorms, through landscape irrigation overflows, or by pavement washing (forecourts and footpaths surrounding the buildings) and find their way into the stormwater drainage system. In addition, when buildings are demolished, PCBs may be released onto the ground and can be washed off into stormwater drains by rainfall. While these are logical pathways, we lack data to determine which buildings have PCBs at levels that may be concerning, the magnitude of losses to stormwater, or how PCBs in buildings could be better managed.

A survey of 1,348 buildings in Switzerland constructed between 1950 and 1980 found that almost half of the buildings contained PCBs, almost 10% of the buildings contained sealants with PCB concentrations exceeding 10% by weight, and the total PCBs reservoir in Switzerland was an estimated 50-150 metric tons (Kohler et al. 2005). Less rigorous studies have been conducted in Boston (Herrick et al. 2004) and Toronto (Melymuk et al. 2008) with similar findings; however no such evaluation is known for California. A Swedish study also found that significant quantities of PCBs were released into soil and water runoff during building remodeling (Astebro et al. 2000). Both the Swiss and Swedish governments have developed active programs to manage PCB-containing building materials in response to public health concerns, which relate to both direct exposures and the adverse effect of PCBs on Europe’s fisheries.

In 2007 the California State Water Resources Control Board awarded the Association of Bay Area Governments (ABAG) a grant that includes several tasks for implementation of Bay Area Total Maximum Daily Loads (TMDLs). The project was halted under the state bond freeze in December 2008 and restarted under the American Recovery and Reinvestment Act of 2009 (ARRA) through the State Revolving Fund in August of 2009. One of the tasks in the master grant is the PCBs in Caulk Project (referred to herein as the Project), which includes characterizing the use of PCBs in historic building materials in the San Francisco Bay Area. The San Francisco Estuary Institute (SFEI) is the subcontractor for Task 7.5.2.2 of SWRCB Agreement No. 09-305-550-01. This Field Sampling and Chemical Analysis Plan (SAP) outlines procedures to be followed by project personnel to insure usability and representativeness of data.
collected through the Project implementation. The SAP will be submitted to the State Water Resources Control Board (SWRCB) as part of the work to complete Task 7.5.2.2 of the master agreement, and under Task 1 of SFEI’s subcontract under that agreement, which has a term of January 27, 2010 through December 1, 2011.

1.2 Project Description

The objective of this element of the PCBs in Caulk Project is to obtain Bay Area-specific estimates on PCB loadings to urban runoff from historic building materials. While many structures were historically built with a variety of materials known to contain PCBs, including caulking/sealants, grouts, paints, and flame retardant coatings of acoustic ceiling tiles, the focus of this Project is caulking/sealants that were used between rigid components of buildings and other structures. The results from implementing this SAP will inform the development of BMPs for the handling of PCB-contaminated caulking. This SAP contains information on the data-collection phase of the Project, which will obtain Bay Area-specific information on the presence of PCBs in sealants used in historic buildings and other structures.

In collaboration with Bay Area Stormwater Management Agencies Association (BASMAA), the San Francisco Bay Regional Water Quality Control Board (Water Board), and local municipalities, the San Francisco Estuary Institute (SFEI) will test or sample structures that have the potential to contain PCBs in their exterior sealants or caulking (herein referred to as only ‘sealants’). Other members of the Project team will identify buildings and secure permission to test a minimum of ten Bay Area structures. Structures to be tested or sampled will be identified based on structure type, year of construction, and whether or not the sealants have been replaced or renovated since the original date of construction. Based on the results of this identification process, and in cooperation with structure owners, this SAP will be implemented to obtain Bay Area-specific information on the PCB content of sealants. As appropriate, data generated from the sampling phase will be used to support BMP development and implementation. All testing and sampling conducted during the above-mentioned activities will be in compliance with this SAP.

It is likely that sealant testing in participating buildings or structures will occur through the use of a portable X-ray fluorescence (XRF) detector to estimate PCB concentrations. If permission is granted, physical sealant samples will be collected from structures and sent to a qualified analytical laboratory for confirmation of PCB content according to the Project Quality Assurance Project Plan (QAPP).

1.3 Project Organization and Responsibilities

The 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. SWRCB Project Manager (Kari Holmes, California State Water Resources Control Board)
The SWRCB Project Manager oversees performance of the project agreement and monitors progress of the project. Technical review will be delegated to Jan O’Hara at the San Francisco Bay Regional Water Quality Control Board.

1.3.2 Project Manager (Athena Honore, ABAG/SFEP)

The Project Manager will be responsible for ensuring that all work performed through the Project is consistent with the project proposal and objectives, and for oversight of all efforts associated with the project. Additionally, the Project Manager will act as the liaison between the Contractor and the SWRCB Project Manager.

1.3.3 Contractor (SFEI)

The Contractor will be responsible for all efforts associated with the data collection phase, including SAP and QAPP development, data and sample collection, data management and interpretation, and reporting. The Contractor is also responsible for oversight of the subcontractor performing the laboratory analysis.

1.3.4 Contractor Project Manager (Susan Klosterhaus, SFEI)

The Contractor Project Manager will be responsible for ensuring that testing and sampling personnel adhere to the provisions of the QAPP and SAP. The Contractor Project Manager is also responsible for custody of any samples collected until receipt by the analytical laboratory.

1.3.5 Data Manager (Don Yee or Jay Davis, SFEI)

The Data Manager will be responsible for receipt and review of all project related documentation and reporting associated with laboratory PCB analysis. The Data Manager will serve as the project quality assurance officer and will be responsible for verifying compliance of all analytical data with the requirements established by the Project QAPP before its use for interpretive purposes.

1.3.6 Project Chemist (Francois Rodigari, East Bay Municipal Utility District)

The Project Chemist at the selected analytical laboratory will be responsible for ensuring that the laboratory's quality assurance program and standard operating procedures are consistent with the Project QAPP, and that laboratory analyses meet all applicable requirements or explain any deviations. The Project Chemist will also be responsible for coordinating with the Data Manager and Project Manager as required for the project. All laboratory analyses will be performed by the East Bay Municipal Utility District, Oakland, CA.

1.3.7 Other Collaborators (Bay Area Stormwater Management Agencies Association, SF Bay Regional Water Quality Control Board)

Bay Area Stormwater Management Agencies Association (BASMAA) and Water Board staff will be involved in the design and implementation of the Project. BASMAA and the Water
Board will coordinate their involvement through the Project Manager, and will be given the opportunity to review and comment on all relevant project documents, including, but not limited to, the project QAPP, SAP, and draft and final reports. BASMAA will serve as liaison between the municipalities and the Project Manager by providing summary information about the project and its objectives to the municipalities that may wish to participate in the project. BASMAA will also attempt to identify structures that meet the structure criteria within each municipality that may be available for testing and/or sampling and will attempt to secure permission from structure owners for testing or sampling.

2. Information Sources

2.1 Prior Investigations of PCBs in Sealants

A technical memorandum prepared for the Project summarized the available information on the use of PCBs in building materials (Moran et al. 2007). Based on information from these assessments, the memorandum made a number of recommendations for the Project, including the following:

- The project should focus on (1) caulking and sealants and (2) paints and coatings, with the caulking and sealants being the higher priority building material of the two.
- A combination of field screening with XRF and confirmation sampling with PCB measurements by an analytical laboratory (using gas chromatography-mass spectrometry or GC-MS) should be used in the investigation of PCB content in the building materials.
- The Project should initially focus its efforts on exterior caulking and sealants used in concrete and masonry structures constructed or substantially remodeled between 1957 and 1977. Testing and sampling should be designed to confirm and narrow the construction date range to ensure that the BMPs developed at a later stage in the Project target the appropriate structure types.

2.2 Use of portable X-Ray Fluorescence (XRF) to Estimate PCB Concentrations in Sealants

A pilot study was conducted in 2009 to determine if a portable XRF analyzer, which estimates the elemental composition of a substance (e.g. chlorine or Cl, not PCBs specifically) can be used as a screening tool to estimate PCB concentrations in sealants. In this study, 20 sealant samples were obtained from buildings predicted to have measurable concentrations of PCBs and analyzed for Cl content using XRF and a suite of PCB congeners using gas-chromatography-mass spectrometry (GC-MS). The results indicated that portable XRF may be most useful for ruling out sealants that do not contain high concentrations of PCBs (≥1%). When XRF did not detect Cl (detection limit average ~0.1%), PCBs were present at concentrations less than than ~0.1% in the sealants. However, in general, the pilot study results suggested that use of portable XRF alone is not a good indicator of PCB content due to a high rate of ‘false positives’. That is, when XRF detected elevated Cl (~>0.1%), PCBs were present in only ~20% of the samples (i.e. 20% specificity), indicating the presence of other chlorinated compounds in the sealant samples. When PCBs were present, the relationship between XRF measured Cl and GC-MS measured
PCBs was sufficient such that an adjustment factor could be applied to the XRF Cl data to provide a good estimate of PCB content.

In February and March 2010, a preliminary field survey of ~25 Bay Area structures was conducted in which portable XRF was used to screen intact sealants for Cl content. Cl was detected in eight out of the ten structures surveyed that were thought to have been constructed during the time period when PCBs were commonly added to structural sealants; confirmation of construction dates and the status of sealant renovation was not readily available, however. Cl was also detected in at least one location on all three structures known to have been constructed in the 1990s and 2000s and in three out of five structures with unknown construction dates. These results suggest that chlorinated compounds are prevalent in sealants used in Bay Area building structures that were constructed not only during the time period of known PCB use, but also those constructed over the last thirty years, following the PCB ban in the late 1970s.

In addition to the potential high rate of ‘false positives’, ‘false negatives’ are also a concern with the use of portable XRF in this application. In the preliminary field survey conducted in 2010, method detection limits (MDLs) for Cl fluctuated between 728 and 12,795 ppm (0.07 to 1.3%), with a mean MDL of 4095 ppm (~0.4%). The cause of the MDL variability is unknown but is thought to be the result of interference with other elements present in the sample and/or matrix effects. In this context, ‘false negatives’ may occur when PCBs are present at a concentration below the elevated MDL for Cl (~1%) but above the average MDL (~0.4%). Use of a more sensitive portable XRF instrument would likely reduce the average MDL for Cl to 200 ppm, though it is uncertain at this time whether this instrument will be available for use in this Project.

3. Sample Types and Other Data Collection

3.1 Sampling Design

Preliminary information suggests that the primary use of XRF in this Project will be to rule out sealants that do not contain PCBs in concentrations ≥1% (see section 2.2). XRF may therefore be used to rule out structures from which samples will not be collected for analysis of PCBs by GC-MS.

Exterior sealants from a minimum of ten Bay Area structures will be tested for Cl using a portable XRF analyzer. The number of structures and sites selected is based on the requirement in section C.12.b in the Municipal Regional Stormwater NPDES Permit, which this project seeks to implement. Other members of the Project team, in collaboration with SFEI, will identify structures for testing using the criteria outlined in the technical memo (Moran et al. 2007) and secure permission to test them. If permission is granted, physical sealant samples will also be obtained from structures and sent to a qualified laboratory for PCB analysis according to the Project QAPP. Project budget constraints and the number of structures for which permission to sample is received determine the number of structures to be sampled during the Project.

Testing and sampling will focus on structures constructed between 1957 and 1977, the era when structures are most likely to contain PCB in their sealants (Moran et al. 2007) and, to the extent
feasible and supporting data are available, on sealants used on structure exteriors and those that have not been renovated or remodeled since construction. Structures may include, but are not limited to, transportation infrastructure (e.g. roads, bridges, sidewalks) and/or privately- or publicly-owned buildings. An estimate of the volume and surface area of the sealant on the exterior of each structure will also be determined to estimate the total mass of PCBs in the structure’s sealants. This information, along with other site characteristics such as imperviousness, slope, and flow paths to the stormwater system, will be used to estimate potential PCB loadings from structural sealants to urban stormwater runoff.

3.2 Portable X-Ray Fluorescence (XRF) Data

A portable XRF analyzer will be used to estimate the concentration of Cl and other trace elements in sealants on each structure selected for inclusion in the Project. Sealants used around windows, at building/walkway interfaces, and in expansion joints between two abutting pieces of concrete will be targeted since sealants in these locations are most likely to contain PCBs (Moran et al. 2007). A preliminary validation study (section 2) indicated that XRF may be a useful screening tool for PCBs in sealants because it detected Cl when PCBs were present at percent levels in sealants and did not detect Cl when PCBs were less than than ~0.1%. XRF analysis can be conducted on either intact sealant or a sealant sample removed from the structure. However, analysis of a sample removed from the structure may be more reliable due to the difficulty of accessing intact sealants with the XRF (i.e. sealant location often prevents flush contact of XRF with the sealant) and the potential for analytical interference due to the presence of unknown materials behind the sealant (e.g. if the sealant thickness is less than the X-ray penetration depth, the presence of mortar or other material behind the sealant may affect the analysis); the extent to which these situations influence the analysis is unknown. In addition to Cl, other elemental data will be collected for possible determination of an elemental ‘fingerprint’ for PCBs using portable XRF. The pilot study conducted in 2009 (section 2.2) suggested, however, that the existence of a fingerprint is unlikely.

3.3 Sealants

If permission is granted, sealant samples for PCB analysis using GC-MS will be collected from one or more locations on the structure. Collection of one sealant sample per sealant type on each structure is desirable to fully characterize the PCB content in the structure’s sealants. Sampling location(s) and procedures for replacement of the sealant will be conducted with concurrence from the municipality or structure owner. Alternatively, sealant samples may be obtained from structures via ‘blind’ sampling (i.e. not collected by SFEI). This may involve anonymously transmitting the sealant samples and the corresponding structure information (i.e. structure age and other characteristics but not geographical location) to SFEI.

Budget limitations may prevent the analysis of all sealant samples collected. If necessary, the Project team will select a sub-set of samples for PCB analysis using GC-MS once all samples have been collected.
3.4 QC Blanks (Field Blanks)

Collection of sealant field blank samples has been deemed unnecessary due to the difficulty in collection and interpretation of representative blank samples and the use of precautions that minimize contamination of the samples. Additionally, PCBs have been reported to be present in percent concentrations when used in sealants; therefore any low level contamination (at ppb or even ppm level) due to sampling equipment and procedures is not expected to affect data quality because it would be many orders of magnitude lower than the concentrations deemed to be a positive PCB signal.

3.5 QC Samples (Field Duplicates)

Assessment of within-structure variability of PCB concentrations in sealants is not a primary objective of the Project, therefore field duplicate samples will not be collected. Due to budget limitations, GC-MS analysis of only one sealant sample per sealant type on each structure will maximize the number of Bay Area structures and structure types that may be analyzed in the Project. The selected laboratory will conduct a number of quality assurance analyses (see Project QAPP), including a limited number of sample duplicates, to evaluate laboratory and method performance as well as variability of PCB content within a sample.

4. Field Documentation

Proper documentation of testing and sampling locations and methods is important to interpretation of project results. Data documentation at each location will include information recorded on field data sheets and photographic documentation. If permission is granted to collect physical samples of sealants, information will also be recorded on sample labels.

4.1 Field Data Sheets

A field data sheet will be completed for each structure tested (‘Structure Information’ form) and each sealant type screened on each structure (‘Sealant Information’ form; see forms in the Appendix). The ‘Structure Information’ form will include the type of structure (e.g. commercial building, school, etc.), County in which the structure is located, and the date of construction, if known. The ‘Sealant Information’ form will include the location/function of the sealant on the structure (e.g. around window or between concrete blocks), whether or not the sealant has been renovated since construction, physical characteristics of the sealant (i.e., level of deterioration, color), as well as all XRF tests for chlorine conducted on the sealant. If physical samples of sealant are collected, the sample ID and post-collection XRF chlorine tests will also be recorded on the ‘Sealant Information’ form. All information will be recorded in permanent ink. Any changes made to the recorded information will be made using single strike-through and will be initialed and dated by the person making the change.

4.2 Photographic Documentation

A photograph of each type of sealant tested or sampled on each structure will be taken. Photographs of the testing and sample collection process may also be taken. Care will be taken to
avoid capturing information in the photo that could be used to identify the structure location; only close-up photos that record the physical appearance/condition of the material and the material function (e.g. sealing cement blocks in a walkway or joining cement blocks in a building) are necessary. The photo number will be recorded on each corresponding testing or sample collection data sheet. All photographs will be stored on the SFEI file server for the project duration.

4.3 Sample Identification

Sealant samples will be assigned unique sample identification codes to provide a method for tracking each sample, and codes will be recorded on sample labels (Appendix). Each sample will be identified by a unique code that indicates the sampling date, structure ID, and sample number. The following is an example of the sample identification code for the samples:

100504-03-1

where: 100504 indicates the sampling date, May 4, 2010;
03 indicates structure #3, which will start at '1' and increase by one in chronological order of sampling;
1 indicates the sample number, which will start at '1' and increase by one consecutively with each sample collected on each structure.

5. Testing and Sampling Procedures

The following section describes the field testing and sampling techniques that will be used in the Project. Procedures for testing sealants using portable X-Ray fluorescence (XRF) and collecting sealant samples are not standardized and minimal detail on sealant sample collection is available in peer-reviewed publications. Sealant sampling procedures were therefore developed in consultation with the XRF company representative and researchers with experience using the XRF on sealants and plastics. Professional judgment was used to develop sealant sample collection methods.

5.1 Sealant Testing and Sampling Procedures

Once a structure has been identified as meeting the selection criteria and permission is granted to perform the testing or collection of sealant samples, an on-site survey of the structure will be used to identify sealants and sealant locations on the structure to be tested or sampled. It is expected that sealants from a number of different locations on each structure may be tested; however, inconspicuous locations on the structure will be targeted for any physical sealant sampling.

5.1.1 Sealant Testing Using Portable X-Ray Fluorescence (XRF)

A portable XRF analyzer (Innov-X Systems, Woburn, MA) will be used as a screening tool to estimate the concentration of chlorine (Cl) and other elements in sealants in many locations on each structure. The analyzer will also be calibrated for Cl using plastic pellet European reference materials (EC680 and EC681) upon first use. The XRF analyzer will be ‘standardized’ using
procedures recommended by the Innov-X representative each time the instrument is turned on and prior to any sealant monitoring. A 30 second measurement in soil/light element analytical program (LEAP) mode will be used. Field personnel will wipe the sealant surface to be sampled with a laboratory tissue to remove any debris that may potentially interfere with the XRF analysis. At least one XRF reading will be collected from each type of sealant present on the structure (e.g., window sealant, joint between concrete blocks, and joint between concrete at base of building and surrounding concrete surface). If Cl is detected, a minimum of two additional readings will be conducted at the same location on the structure to determine analytical variability and at other locations on the structure to determine variability in Cl concentration within sealant type on each structure. The XRF analyzer will record the estimated concentration of a variety of elements in the sealant and the Cl concentration will be recorded on field datasheets. XRF analysis will also be conducted on any sealant samples following their collection from the structure.

5.1.2 Sealant Sampling for Laboratory Analysis

Where permission is granted to collect sealant samples, selection of the appropriate samples to collect will be made at the time of sampling by the Project Manager in consultation with the structure owner. Following XRF analysis on the intact material, a one inch strip (or ~10 g) of the sealant sample will be removed from the structure using a utility knife with a solvent-rinsed, stainless-steel blade. Field personnel will wear Nitrile gloves during sample collection to prevent sample contamination. The sample will be placed on a clean surface, where it will undergo a second XRF analysis. The sample will then be placed in a labeled, laboratory-cleaned glass jar. The samples will be kept in a chilled cooler until returned to SFEI, where the samples will be refrigerated pending delivery under chain-of-custody (COC) to the analytical laboratory. The procedure for replacement of the sealant will be coordinated with each municipality or structure owner.

5.2 Decontamination Procedures

5.2.1 Initial Equipment Cleaning

The sampling equipment that is pre-cleaned includes:
- Glass sample jars
- Utility knife, extra blades
- Stainless-steel spatulas, forceps

Prior to sealant sampling, all equipment will be thoroughly cleaned. Glass sample containers will be factory pre-cleaned (Quality Certified™, ESS Vial, Oakland, CA) and delivered to SFEI at least one week prior to the start of sample collection. Sample containers will be pre-labeled and kept in their original boxes, which will be transported in coolers. Utility knife blades, spatulas, and forceps will be pre-cleaned with Alconox, Liquinox, or similar detergent, and then rinsed with deionized water and methanol. The cleaned equipment will then be wrapped in methanol-rinsed aluminum foil and stored in clean Ziploc bags until used in the field.
5.2.2 Field Cleaning Protocol

Between each use the utility knife blade, spatulas, and forceps will be rinsed with methanol and then deionized water, and inspected to ensure all visible sign of the previous sample have been removed. The clean utility knife, extra blades, spatulas, and forceps will be kept in methanol-rinsed aluminum foil and stored in clean Ziploc bags when not in use.

5.3 Collection of Samples for Archiving

Archive samples will not be collected for this project. The sample size collected will be enough to support additional analyses if QAQC issues arise. Once quality assurance is certified by the QA officer, the laboratory will be instructed to dispose of any leftover sample materials.

6. Sample Handling Procedures

The following protocols were developed to maximize the likelihood that collected samples are representative of the structural sealant’s current condition.

6.1 Sample Containers

Where permission is granted, a minimum of one sealant sample will be collected at each structure location. The sealant sample will be transferred into appropriate factory pre-cleaned containers using pre-cleaned forceps.

6.2 Sample Preservation and Storage

At the conclusion of sample processing at each site, all sample containers will be placed in the original container shipping box in a chilled cooler. At the conclusion of each sampling day, all samples will be refrigerated until delivery to the analytical laboratory.

6.3 Sample Custody and Shipment

At appropriate intervals or following the conclusion of sample collection for the Project, samples will be hand-delivered to the analytical laboratory with itemized chain-of-custody (COC) forms. Sufficient sampling information will be recorded in the field that allows tracking sample shipments from field to laboratory and from laboratory through data processing. All samples will be delivered in accordance with laboratory procedures. The following instructions are the most stringent requirements associated with analytical laboratories used for the Regional Monitoring Program for Water Quality in San Francisco Estuary (RMP):

Personnel delivering the samples should ensure COCs (example in Appendix) are filled out completely and legibly and that:

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

Glass jars holding sealant samples will be transported in the factory provided box. Glass jars will be cushioned to avoid damaging the containers while in transit. The shipping personnel will notify the laboratory in advance of sample delivery. The Project Manager will follow up with the laboratory to verify the shipment was received.

6.4 Laboratory Chain of Custody Procedures

Sample custody transfers to the analytical laboratory at the time of receipt. Upon receipt of the samples, the 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

Upon completion of the project, the analytical laboratory will dispose of sampling residuals containing ≥50 ppm PCBs following the procedures outlined by the Toxic Substances Control Act (TSCA) for bulk product waste. The disposal of PCB bulk product waste is regulated under 40 CFR § 761.62 of TSCA. Under this provision, PCB bulk product waste must be disposed of in one of two ways: disposal in a permitted solid waste landfill or via a risk-based disposal approval process.

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

8. Quality Control for Field Operations

Field personnel will strictly adhere to the Project protocols to ensure the collection of representative, uncontaminated samples. 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., uncleaned knife).
- Containers and tools that come in direct contact with the sample will be made of non-contaminating materials (e.g., glass, stainless-steel) and will be thoroughly cleaned between samples.
- Sample containers will be pre-cleaned and of the recommended type
- Field personnel will wear Nitrile gloves and safety eyeglasses when collecting physical sealant samples and cleaning sample collection equipment.

9. Laboratory Analysis

9.1 Laboratory Analytical Methods

Though every effort will be made to collect only those samples which will be analyzed for PCBs, a potential outcome of the project is that, due to budget constraints, not all of the samples collected will be analyzed by the laboratory. The number and types of structures that will be available for collection of sealant samples are not currently known and it is anticipated that not all of the municipalities and/or structure owners may have the opportunity to respond to the request for permission to collect samples prior to the initiation of field sampling. Sampling may therefore occur on an opportunistic basis, potentially resulting in a number of samples that cannot be analyzed for PCBs due to budget constraints (i.e. ‘oversampling’). Samples that represent sealants from a variety of structure types and construction years will be selected for PCB analysis, consistent with project goals.

The samples will be analyzed for PCBs using a modified EPA 8270 protocol (semi-volatile organic compounds by gas chromatography-mass spectrometry). Hold times will follow EPA method 1668 (i.e. one year to extract and one year for extracts if samples and extracts are stored at -10 °C). Samples will be stored in 60 ml or 125 ml wide mouth glass jars until analysis. The minimum sample size is 10 g dry weight. PCB analytical results will be reported as IUPAC congeners. The congener list will include:
Taking Action for Clean Water  Field Sampling and Chemical Analysis Plan

- the 40 congeners routinely monitored by the RMP (PCBs 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, and 203),
- PCB 11, a non-Aroclor congener commonly detected in wastewater effluent and environmental samples (Rodenburg et al. 2010),
- the coplanar PCBs 77, 126, and 169, ‘dioxin-like’ congeners which contribute substantially to the dioxin toxic equivalents observed in San Francisco Bay sport fish.

9.2 Sample Tracking

Sufficient sampling information must be recorded in the field 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 criteria were met or acceptable deviations explained) for each batch of samples before proceeding with the analysis of a subsequent batch. In addition, the laboratory will establish a system for detecting and reducing transcription and/or calculation errors prior to reporting data. 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 re-analyzed when possible. Only the results of the re-analysis will be submitted, provided they are acceptable.

10. Refinements to the Planned Monitoring

Additional details regarding the planned monitoring will be developed in the future when further information becomes available on realistic sampling sites and scenarios. This will include estimating the numbers of samples anticipated to be sent to a laboratory for PCB analysis during both the characterization and implementation trial phases of the project and associated budget projections (e.g., numbers of samples and associated costs).

The overall objective of the monitoring is to obtain Bay Area-specific information on the presence of PCBs in sealants used in historic buildings and other structures and thereby inform development and testing of BMPs to properly identify, handle and dispose of these materials during renovation and demolition projects. Ancillary objectives may be articulated as further information becomes available, such as developing a relationship between XRF field screening and laboratory analysis results.
11. References


12. Appendix

Examples of field documentation associated with the Structural PCBs Project. Examples of the following are shown:

- Structure Information form
- Sealant Information form
- Chain of Custody (COC) form
Structural PCBs Project — Structure Information Form

Structure ID# ______________

Sampling Date ______________

Year of construction (Estimate if date cannot be provided: pre-1950, 1950-59; 1960-69; 1970-79; post-1979) __________________________________________________________________________

Construction type:

☐ Light wood-frame residential and commercial building smaller than or equal to 5,000 square feet (W1)

☐ Light wood-frame building larger than 5,000 square feet (W2)

☐ Steel moment-resisting frame building (S1)

☐ Braced steel frame building (S2)

☐ Light metal building (S3)

☐ Steel frame building with cast-in-place concrete shear walls (S4)

☐ Steel frame building with unreinforced masonry infill walls (S5)

☐ Concrete moment-resisting frame building (C1)

☐ Concrete shear-wall building (C2)

☐ Concrete frame building with unreinforced masonry infill walls (C3)

☐ Tilt-up building (PC1)

☐ Precast concrete frame building (PC2)

☐ Reinforced masonry building with flexible floor and roof diaphragms (RM1)

☐ Reinforced masonry building with rigid floor and roof diaphragms (RM2)

☐ Unreinforced masonry bearing-wall building (URM)

☐ Other __________________________________________________________________________

Total # of sealant types/locations screened on the structure _________________________

Total # of sealant samples collected from structure _____________________________
Structural PCBs Project — Sealant Information Form

Structure ID# _______________
Sampling Date ____________

Sealant function/location on structure:
___ Around window
___ Around doorway
___ Between concrete blocks and base of structure
___ Between concrete blocks on structure wall
___ Other ________________________________

Has the sealant been replaced since the structure construction date?
___ Yes  ___ No  ___ Unknown  If yes, what year? _______________________

What is the physical condition of the sealant?
___ Good (not cracked or deteriorating)
___ Fair (some cracking/deterioration)
___ Poor (very deteriorated, noticeably falling apart)

What color is the sealant?
White ____  Light grey ____  Dark grey ____  Black ____  Brown ____
Other, please specify ______________________________________________

XRF tests on intact sealant
% Cl _____________ XRF ID# _____________ Photo#________
% Cl _____________ XRF ID# _____________ Photo#________
% Cl _____________ XRF ID# _____________ Photo#________
Sealant volume estimate on the structure
Height of sealant strip ____________________________________________________________
Number of stories on the structure (i.e., structure height) _______________________________
Approximate dimensions of structure (i.e. length, width) ________________________________
If applicable, number of doors and/or windows on the structure __________________________

Was a physical sealant sample collected from this location on the structure?
Yes ____ No ____

Sealant sample ID# ____________________________________________________________

XRF tests on sealant (post collection from structure)
% Cl _____________ XRF ID# ___________ Photo# ______________
% Cl _____________ XRF ID# ___________ Photo# ______________
% Cl _____________ XRF ID# ___________ Photo# ______________

<<Where sealant sample collections are possible, there will be a ‘Sealant Information’ form completed for each type of sealant on the structure, in addition to the ‘Structure Information’ form.>>
# Chain of Custody Record

**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**

## Sampler(s) Signature(s)

<table>
<thead>
<tr>
<th>Sample ID No.</th>
<th>Sampled Date</th>
<th>Sampled Time</th>
<th>Grab or Composite (see codes)</th>
<th>Matrix Number/Size/Type of Containers</th>
<th>Preservatives (see codes)</th>
<th>Analyses Requested</th>
<th>Project Name</th>
<th>Remarks</th>
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**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)
Quality Assurance Project Plan for the PCBs in Caulk Project (Taking Action for Clean Water Bay Area TMDL Implementation)
Subcontract for SWRCB Agreement No. 09-305-550-1 with Association of Bay Area Governments

Prepared by
Susan Klosterhaus
San Francisco Estuary Institute

July 2010

San Francisco Estuary Institute
7770 Pardee Lane, 2nd Floor
Oakland, CA 94621
Quality Assurance Project Plan for the
PCBs in Caulk Project (Taking Action for Clean
Water Bay Area TMDL Implementation)
Subcontract for SWRCB Agreement No. 09-305-550-1 with
Association of Bay Area Governments

Approvals*

Bill Ray, QA Officer, State Water Resources Control Board
Signature: ________________________________ Date: ____________

San Francisco Estuary Partnership
Signature: ________________________________ Date: ____________

San Francisco Estuary Institute
Signature: ________________________________ Date: ____________

*Signature implies that the signatory has reviewed the document, has no exceptions to its content, and agrees with the description of their agency’s role in the project
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1. Project Management

1.1. Project Background

Elevated polychlorinated biphenyl (PCB) levels threaten the health of people and wildlife consuming fish from San Francisco Bay (RWQCB, 2008). A Total Maximum Daily Load (TMDL) to address PCB impairment of all segments of San Francisco Bay was adopted by the San Francisco Bay Regional Water Quality Control Board in February 2008. The San Francisco Bay PCBs TMDL Project Report (RWQCB 2004) found that urban runoff was one of the major sources of PCB loads to the Bay and concluded that controlling sources of PCBs to urban runoff was one of two top priorities for TMDL implementation. Based on this recommendation, the Clean Estuary Partnership (CEP) evaluated available data on sources of PCBs in urban runoff and recommended approaches for addressing two potentially significant sources, past PCBs releases that have contaminated soil and sediments and PCB-containing historic building materials, specifically uncontained materials like sealants, caulking and paint (LWA et al. 2006). When the building materials fail or buildings are remodeled, residues can be transported away from the building during rainstorms, through landscape irrigation overflows, or by pavement washing (forecourts and footpaths surrounding the buildings) and find their way into the stormwater drainage system. In addition, when buildings are demolished, PCBs may be released onto the ground and can be washed off into stormwater drains by rainfall. While these are logical pathways, we lack data to determine which buildings have PCBs at levels that may be concerning, the magnitude of losses to stormwater, or how PCBs in buildings could be better managed.

A survey of 1,348 buildings in Switzerland constructed between 1950 and 1980 found that almost half of the buildings contained PCBs, almost 10% of the buildings contained sealants with PCB concentrations exceeding 10% by weight, and the total PCBs reservoir in Switzerland was an estimated 50-150 metric tons (Kohler et al. 2005). Less rigorous studies have been conducted in Boston (Herrick et al. 2004) and Toronto (Melymuk et al. 2008) with similar findings; however no such evaluation is known for California. A Swedish study also found that significant quantities of PCBs were released into soil and water runoff during building remodeling (Astebro et al. 2000). Both the Swiss and Swedish governments have developed active programs to manage PCB-containing building materials in response to public health concerns, which relate to both direct exposures and the adverse effect of PCBs on Europe’s fisheries.

In 2007 the California State Water Resources Control Board awarded the Association of Bay Area Governments (ABAG) a grant that includes several tasks for implementation of Bay Area Total Maximum Daily Loads (TMDLs). The project was halted under the state bond freeze in December 2008 and restarted under the American Recovery and Reinvestment Act of 2009 (ARRA) through the State Revolving Fund in August of 2009. One of the tasks in the master grant is the PCBs in Caulk Project (referred to herein as the Project), which includes characterizing the use of PCBs in historic building materials in the San Francisco Bay Area. The San Francisco Estuary Institute (SFEI) is the subcontractor for Task 7.5.2.2 of SWRCB Agreement No. 09-305-550-01.
1.2. Project Description

The objective of this element of the PCBs in Caulk Project is to obtain Bay Area-specific estimates on PCB loadings to urban runoff from historic building materials. While many structures were historically built with a variety of materials known to contain PCBs, including caulking/sealants, grouts, paints, and flame retardant coatings of acoustic ceiling tiles, the focus of this Project is caulking/sealants that were used between rigid components of buildings and other structures. The results from implementing this SAP will inform the development of BMPs for the handling of PCB-contaminated caulking. This SAP contains information on the data-collection phase of the Project, which will obtain Bay Area-specific information on the presence of PCBs in sealants used in historic buildings and other structures.

In collaboration with Bay Area Stormwater Management Agencies Association (BASMAA), the San Francisco Bay Regional Water Quality Control Board (Water Board), and local municipalities, the San Francisco Estuary Institute (SFEI) will test or sample structures that have the potential to contain PCBs in their exterior sealants or caulking (herein referred to as only ‘sealants’). Other members of the Project team will identify buildings and secure permission to test a minimum of ten Bay Area structures. Structures to be tested or sampled will be identified based on structure type, year of construction, and whether or not the sealants have been replaced or renovated since the original date of construction. Based on the results of this identification process, and in cooperation with structure owners, this SAP will be implemented to obtain Bay Area-specific information on the PCB content of sealants. As appropriate, data generated from the sampling phase will be used to support BMP development and implementation. All testing and sampling conducted during the above-mentioned activities will be in compliance with this SAP.

It is likely that sealant testing in participating buildings or structures will occur through the use of a portable X-ray fluorescence (XRF) detector to estimate PCB concentrations. If permission is granted, physical sealant samples will be collected from structures and sent to a qualified analytical laboratory for confirmation of PCB content according to the this Quality Assurance Project Plan (QAPP).

1.3. Quality Assurance Project Plan Description (QAPP)

This QAPP outlines procedures to be followed by project personnel to insure usability and representativeness of data collected through the Project implementation. The QAPP will be submitted to the State Water Resources Control Board (SWRCB) as part of the work to complete Task 7.5.2.2 of the master agreement, and under Task 1 of SFEI’s subcontract under that agreement, which has a term of January 27, 2010 through December 1, 2011.

This QAPP is based largely on the QAPP produced for the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP; Lowe et al. 1999) and the State of California Surface Water Ambient Monitoring Program (SWAMP; Puckett 2002). Though samples collected and analyzed in the Project are very different from those collected by the RMP, the field sampling control and laboratory control procedures contained within this QAPP were
developed to be consistent with those of the RMP to ensure consistency with datasets of potential comparative value, mainly the RMP and other SFEI datasets and the datasets developed by other Bay Area programs collected in conformance with Water Board data requests.

Making environmental management decisions in a scientifically defensible way depends on the sensitivity of the measurement system and the levels of confidence and certainty in the data. The purpose of this document is to maximize the probability that environmental data collected through the Project will meet the expectations of the data users. The Data Quality Objectives (DQOs) presented in this QAPP are intended to maximize the probability that the data actually represent conditions in the environment while minimizing artifacts due to sample collection and processing.

1.4. **Project Organization and Responsibilities**

The 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.

1.4.1 *SWRCB Project Manager (Kari Holmes, California State Water Resources Control Board)*

The SWRCB Project Manager oversees performance of the project agreement and monitors progress of the project. Technical review will be delegated to Jan O’Hara at the San Francisco Bay Regional Water Quality Control Board.

1.4.2 *Project Manager (Athena Honore, ABAG/SFEP)*

The Project Manager will be responsible for ensuring that all work performed through the Project is consistent with the project proposal and objectives, and for oversight of all efforts associated with the project. Additionally, the Project Manager will act as the liaison between the Contractor and the SWRCB Project Manager.

1.4.3 *Contractor (SFEI)*

The Contractor will be responsible for all efforts associated with the data collection phase, including SAP and QAPP development, data and sample collection, data management and interpretation, and reporting. The Contractor is also responsible for oversight of the subcontractor performing the laboratory analysis.

1.4.4 *Contractor Project Manager (Susan Klosterhaus, SFEI)*
The Contractor Project Manager will be responsible for ensuring that testing and sampling personnel adhere to the provisions of the QAPP and SAP. The Contractor Project Manager is also responsible for custody of any samples collected until receipt by the analytical laboratory.

1.4.5 Data Manager (Don Yee or Jay Davis, SFEI)

The Data Manager will be responsible for receipt and review of all project related documentation and reporting associated with laboratory PCB analysis. The Data Manager will serve as the project quality assurance officer and will be responsible for verifying compliance of all analytical data with the requirements established by the Project QAPP before its use for interpretive purposes.

1.4.6 Project Chemist (Francois Rodigari, East Bay Municipal Utility District)

The Project Chemist at the selected analytical laboratory will be responsible for ensuring that the laboratory's quality assurance program and standard operating procedures are consistent with the Project QAPP, and that laboratory analyses meet all applicable requirements or explain any deviations. The Project Chemist will also be responsible for coordinating with the Data Manager and Project Manager as required for the project. All laboratory analyses will be performed by the East Bay Municipal Utility District, Oakland, CA.

1.4.7 Other Collaborators (Bay Area Stormwater Management Agencies Association, SF Bay Regional Water Quality Control Board)

Bay Area Stormwater Management Agencies Association (BASMAA) and Water Board staff will be involved in the design and implementation of the Project. BASMAA and the Water Board will coordinate their involvement through the Project Manager, and will be given the opportunity to review and comment on all relevant project documents, including, but not limited to, the project QAPP, SAP, and draft and final reports. BASMAA will serve as liaison between the municipalities and the Project Manager by providing summary information about the project and its objectives to the municipalities that may wish to participate in the project. BASMAA will also attempt to identify structures that meet the structure criteria within each municipality that may be available for testing and/or sampling and will attempt to secure permission from structure owners for testing or sampling.

1.5 Documentation and Records

All appropriate project-related materials (e.g., field notes, reports, photographs, laboratory reports, etc.) will be delivered to and maintained by the Contractor Project Manager or the Data Manager for the project duration. A discussion of some of the key parts of the documentation process is shown below.

1.5.1 Laboratory Data Reduction and Review
The laboratory analyst who performs the analysis is responsible for reviewing the initial dataset for accuracy and acceptability. Where calculations are not performed by a validated software system, a second reviewer should verify a minimum of 10% of the calculations. The Project Chemist should also check the data report for completeness and errors prior to submission to the Data Manager.

The analytical laboratory will report the analytical data via an analytical report consisting of, at a minimum:

- letter of transmittal
- analytical results in SWAMP format
- quality control results
- chain of custody information
- case narrative
- copies of all raw data

In addition to the printouts supplied by the analytical laboratory, test results should also be delivered to the Data Manager in MS Excel compatible electronic format.

1.5.2 Procedures to Verify Data Integrity

The integrity of the data generated in the laboratory is assessed through the evaluation of the results of the analysis of various quality control (QC) samples by the Data Manager. The numerical criteria for evaluation of these QC samples is specific to the analysis being performed and shall be consistent with laboratory Standard Operating Procedures (SOPs).

1.5.3 Treatment of Outliers

Only data that have met data quality criteria, or data that have acceptable deviations explained, will be submitted by the Project Chemist to the Data Manager. 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.

1.5.4 Data Management

The Data Manager will review the data deliverables provided by the Project Chemist for completeness and errors. Data will be validated according to this QAPP to ensure that Data Quality Objectives (DQOs) are met. Data will be delivered to the Data Manager or Contractor Project Manager in SWAMP format.

2. Field Sampling

2.1 Sampling Design

Exterior sealants from a minimum of ten Bay Area structures will be tested for Cl using a portable XRF analyzer. The number of structures and sites selected is based on the requirement
in section C.12.b in the Municipal Regional Stormwater NPDES Permit, which this project seeks to implement. Other members of the Project team, in collaboration with SFEI, will identify structures for testing using the criteria outlined in the technical memo (Moran et al. 2007) and secure permission to test them. If permission is granted, physical sealant samples will also be obtained from structures and sent to a qualified laboratory for PCB analysis according to this QAPP. Project budget constraints and the number of structures for which permission to sample is received determine the number of structures to be sampled during the Project.

Testing and sampling will focus on structures constructed between 1957 and 1977, the era when structures are most likely to contain PCB in their sealants (Moran et al. 2007) and, to the extent feasible and supporting data are available, on sealants used on structure exteriors and those that have not been renovated or remodeled since construction. Structures may include, but are not limited to, transportation infrastructure (e.g. roads, bridges, sidewalks) and/or privately- or publicly-owned buildings. An estimate of the volume and surface area of the sealant on the exterior of each structure will also be determined to estimate the total mass of PCBs in the structure’s sealants. This information, along with other site characteristics such as imperviousness, slope, and flow paths to the stormwater system, will be used to estimate potential PCB loadings from structural sealants to urban stormwater runoff. Additional information on the sampling design can be found in the ‘Field Sampling and Analysis Plan’ for the Project.

2.2 Sampling Procedures

Once a structure has been identified as meeting the selection criteria and permission is granted to perform the testing or collection of sealant samples, an on-site survey of the structure will be used to identify sealants and sealant locations on the structure to be tested or sampled. It is expected that sealants from a number of different locations on each structure may be tested; however, inconspicuous locations on the structure will be targeted for any physical sealant sampling.

2.2.1 Sealant Testing Using Portable X-Ray Fluorescence (XRF)

A portable XRF analyzer (Innov-X Systems, Woburn, MA) will be used as a screening tool to estimate the concentration of chlorine (Cl) and other elements in sealants in many locations on each structure. The analyzer will also be calibrated for Cl using plastic pellet European reference materials (EC680 and EC681) upon first use. The XRF analyzer will be ‘standardized’ using procedures recommended by the Innov-X representative each time the instrument is turned on and prior to any sealant monitoring. A 30 second measurement in soil/light element analytical program (LEAP) mode will be used. Field personnel will wipe the sealant surface to be sampled with a laboratory tissue to remove any debris that may potentially interfere with the XRF analysis. At least one XRF reading will be collected from each type of sealant present on the structure (e.g., window sealant, joint between concrete blocks, and joint between concrete at base of building and surrounding concrete surface). If Cl is detected, a minimum of two additional readings will be conducted at the same location on the structure to determine analytical variability and at other locations on the structure to determine variability in Cl concentration within sealant type on each structure. The XRF analyzer will record the estimated concentration
of a variety of elements in the sealant and the Cl concentration will be recorded on field datasheets. XRF analysis will also be conducted on any sealant samples following their collection from the structure.

2.2.2 Sealant Sampling for Laboratory Analysis

Where permission is granted to collect sealant samples, selection of the appropriate samples to collect will be made at the time of sampling by the Project Manager in consultation with the structure owner. Following XRF analysis on the intact material, a one inch strip (or ~10 g) of the sealant sample will be removed from the structure using a utility knife with a solvent-rinsed, stainless-steel blade. Field personnel will wear Nitrile gloves during sample collection to prevent sample contamination. The sample will be placed on a clean surface, where it will undergo a second XRF analysis. The sample will then be placed in a labeled, laboratory-cleaned glass jar. The samples will be kept in a chilled cooler until returned to SFEI, where the samples will be refrigerated pending delivery under chain-of-custody (COC) to the analytical laboratory. The procedure for replacement of the sealant will be coordinated with each municipality or structure owner.

2.3 Sample Handling and Custody Procedures

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 the analytical laboratory. Samples will be kept under refrigeration (4 degrees Celsius) until delivery to the laboratory. Samples will be transported to the laboratory in a chilled cooler.

2.4 Field Performance Measurements

Following is a list of field performance measurements that are typically included in sampling protocols.

2.4.1 Field Duplicates

The analysis of field duplicate samples would evaluate within-structure variability of PCB concentrations in sealants, which has not been previously documented. Sealant PCB concentrations have the potential to vary spatially within each structure due to variability in the volume of Aroclor mixture(s) and the type of Aroclor mixture(s) added in each batch of sealant prepared on site during construction.

Assessment of within-structure variability of PCB concentrations in sealants is not a primary objective of the Project, therefore field duplicate samples will not be collected. Due to budget limitations, GC-MS analysis of only one sealant sample per sealant type on each structure will maximize the number of Bay Area structures and structure types that may be analyzed in the Project.

2.4.2 Field Blanks
Collection of sealant field blank samples has been deemed unnecessary due to the difficulty in collection and interpretation of representative blank samples and the use of precautions that minimize contamination of the samples. Additionally, PCBs have been reported to be present in percent concentrations when used in sealants; therefore any low level contamination (at ppb or even ppm level) due to sampling equipment and procedures is not expected to affect data quality because it would be many orders of magnitude lower than the concentrations deemed to be a positive PCB signal.

3. Analytical Methods

3.1 Laboratory Analytical Methods

The samples will be analyzed for PCBs using a modified EPA 8270 protocol (semi-volatile organic compounds by gas chromatography-mass spectrometry). The full analytical method is attached in the Appendix. Hold times will follow EPA method 1668 (i.e. one year to extract and one year for extracts if samples and extracts are stored at -10 °C). Sealant samples will be stored in refrigerators at 4°C in wide mouth glass jars (30, 60, or 125 ml) until analysis. The minimum sample size is 10 g dry weight. PCB analytical results will be reported as IUPAC congeners. The congener list will include:

- the 40 congeners routinely monitored by the RMP (PCBs 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, and 203),
- PCB 11, a non-Aroclor congener commonly detected in wastewater effluent and environmental samples (Rodenburg et al. 2010),
- the coplanar PCBs 77, 126, and 169, ‘dioxin-like’ congeners which contribute substantially to the dioxin toxic equivalents observed in San Francisco Bay sport fish.

A summary of sampling and analysis specifics are shown in Table 1.

<table>
<thead>
<tr>
<th>Matrix</th>
<th>Analyte</th>
<th>Extraction Method</th>
<th>Extraction Hold Time</th>
<th>Analytical Method</th>
<th>Hold Time (after extraction)</th>
<th>Container Type</th>
<th>Min. Sample Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid</td>
<td>PCBs</td>
<td>EPA 8270</td>
<td>365 days</td>
<td>Modified EPA 8270D</td>
<td>365 days</td>
<td>Glass jar</td>
<td>10 g dry weight</td>
</tr>
</tbody>
</table>

3.2 Data Quality Objectives

Data Quality Objectives (DQOs) and their associated data quality indicators (DQIs, e.g. method blank and matrix spike) for the Project are listed in Table 3 (‘Batch QC Requirements) of the Appendix. Information on certified reference materials (CRMs) and the analysis of laboratory
replicate samples is not included in Table 3. A CRM for PCBs in sealants does not exist, therefore a CRM will not be analyzed. Regarding laboratory replicates, a minimum of one per batch of 20 or fewer samples will be analyzed in duplicate and the target performance criteria for these is a relative percent difference (RPD) of <35%. If duplicate samples have a RPD >35%, selected samples may be re-analyzed to investigate variability in PCB concentrations within a sample.

3.3 Analytical and Statistical Control Parameters

3.3.1 Analytical Batches

Samples will be processed in analytical batches, not to exceed twenty samples per any one batch. Laboratory personnel will review the results for the various QA/QC samples immediately following the analysis of each sample batch. These results will then be used to determine when data quality criteria have not been met, and corrective actions will be taken before processing a subsequent sample batch. When data quality criteria are not met, specific corrective actions are required before the analyses may proceed.

3.3.2 Accuracy

Accuracy describes how closely the reported analytical concentration relates to its true environmental value. The “absolute” accuracy of an analytical method can be assessed using Certified Reference Materials (CRMs) only when certified values are available for the analytes of interest. Nevertheless, the concentrations of many analytes of interest may be provided only as non-certified values in some of the more commonly used CRMs. A laboratory fortified sample matrix (commonly called a matrix spike, or MS) and a laboratory fortified sample matrix duplicate (commonly called a matrix spike duplicate, or MSD) will be used both to evaluate the effect of the sample matrix on the recovery of the compound(s) of interest. Therefore, control limit criteria are based on “relative accuracy,” which is evaluated for each analysis of the CRM or Matrix Spike by comparison of a given laboratory’s values to the “true” or “accepted” and the expected values. In the case of CRMs, this includes both certified and noncertified values. The “true” values are defined as the 95% confidence intervals of the mean.

3.3.3 Precision

The precision of data is a measure of the reproducibility of an analytical measurement when an analysis is repeated. It is reported in Relative Percent Difference (RPD) or Relative Standard Deviation (RSD). Laboratory replicate samples and MS/MSD samples will be run according to the frequency outlined in Table 3 of the Appendix. The Relative Percent Difference (RPD) will be calculated as a measure of precision.

1 Certified reference materials (CRMs) are samples in which chemical concentrations have been determined accurately using a variety of technically valid procedures; these samples are accompanied by a certificate or other documentation issued by a certifying body (e.g., agencies such as the National Research Council Canada (NRCC), US EPA, US Geological Survey, etc.). Standard Reference Materials (SRMs) are CRMs issued by the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS).
3.3.4 Sensitivity of the Analytical Method

The method detection limit (MDL) is the ability of a method to distinguish between the analytical noise and the measurement signal and can be used to define the analytical limit of detectability. The MDL represents a quantitative estimate of low-level response detected at the maximum sensitivity of a method.

3.3.5 Completeness

Completeness is defined as “a measure of the amount of data collected from a measurement process compared to the amount that was expected to be obtained under the conditions of measurement” (Stanley and Verner, 1985). Ideally, 100% of the data would be available for interpretation. However, the possibility of data becoming unavailable, for example, due to laboratory error, insufficient sample volume, or samples broken in shipping must be expected. For this project, the target for completeness is 95%.

3.3.6 Representativeness

The representativeness of data is the ability of the sampling locations and the sampling procedures to adequately represent the true condition of the sample sites. Field personnel will strictly adhere to the field sampling protocols to ensure the collection of representative, uncontaminated samples. The most important aspects of quality control associated with chemistry 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, insufficient field cleaning).
- Samplers and utensils that come in direct contact with the sample will be made of non-contaminating materials (e.g., glass, stainless steel, and/or inert chemical coatings) and will be thoroughly cleaned between sampling stations.
- Sample containers will be pre-cleaned and of the recommended type.

3.3.7 Comparability

Comparability is the degree to which data can be compared directly to other relevant studies. For this investigation, sampling and analytical methods were designed to be comparable to those employed in other studies of PCBs in sealants (references listed in section 1.1 of the ‘Field Sampling and Chemical Analysis Plan’ for this Project).
4. Laboratory Quality Assurance and Control

4.1 Laboratory Requirements

The analytical laboratory for the Project has the appropriate facilities to store, prepare, and process samples. Moreover, appropriate instrumentation and staff to provide data of the required quality within the project schedule are also required. Laboratory operations must include the following procedures:

- A program of scheduled maintenance of analytical balances, laboratory equipment, and instrumentation.
- Checking and recording the composition of fresh calibration standards against the previous lot, wherever possible. Acceptable comparisons are < 2% of the previous value.
- Recording all analytical data in bound (where possible) logbooks, with all entries in ink, or electronic format.
- Monitoring and documenting the temperatures of cold storage areas and freezer units once per week.
- Verifying the efficiency of fume hoods.
- Having a source of reagent water meeting ASTM Type I specifications available in sufficient quantity to support analytical operations. The conductivity of the reagent water will not exceed 18 megaohms at 25°C. Alternately, the resistivity of the reagent water will exceed 10 mmhos/cm.
- Labeling all containers used in the laboratory with date prepared, contents, initials of the individual who prepared the contents, and other information, as appropriate.
- Dating and safely storing all chemicals upon receipt. Proper disposal of chemicals when the expiration date has passed.
- Having QAPP, SOPs, analytical methods manuals, and safety plans readily available to staff.
- Having raw analytical data, such as chromatograms, accessible so that they are available upon request. Laboratories will be able to provide information documenting their ability to conduct the analyses with the required level of data quality. Such information might include results from interlaboratory comparison studies, control charts and summary data of internal QA/QC checks, and results from certified reference material analyses. That laboratory should maintain all project related data for a minimum of five years.

4.2 Laboratory Personnel, Training, and Safety

Each laboratory providing analytical support for this project must have a designated on-site QC Officer for the particular analytical component(s) performed at that laboratory. This individual will serve as the point of contact for project staff in identifying and resolving issues related to data quality.
Personnel in any laboratory performing analyses for the project will be well versed in good laboratory practices, including standard safety procedures. It is the responsibility of the particular analytical component project officer, laboratory manager, and/or supervisor to ensure that safety training is mandatory for all laboratory personnel. Each laboratory is responsible for maintaining a current safety manual in compliance with the Occupational Safety and Health Administration (OSHA), or equivalent state or local regulations. The safety manual will be readily available to laboratory personnel. Proper procedures for safe storage, handling, and disposal of chemicals will be followed at all times; each chemical will be treated as a potential health hazard and good laboratory practices will be implemented accordingly.

4.3 Quality Assurance Documentation
The chemical laboratory will be provided with the Project QAPP. In addition, the following documents and information will be current, and will be available to all laboratory personnel participating in the processing of samples:

- Laboratory QA Plan: Clearly defined policies and protocols specific to a particular laboratory, including personnel responsibilities, laboratory acceptance criteria and corrective actions to be applied to the affected analytical batches, qualification of data, and procedures for determining the acceptability of results.
- Laboratory Standard Operating Procedures (SOPs): Containing instructions for performing routine laboratory procedures.
- Laboratory Analytical Methods Manual: Step-by-step instructions describing exactly how a method is implemented in the laboratory for a particular analytical procedure.
- Instrument Performance Information: Information on instrument baseline noise, calibration standard response, analytical precision and bias data, detection limits, etc. This information may be recorded in logbooks or laboratory notebooks or stored electronically.
- Control Charts: Control charts are useful in evaluating internal laboratory procedures and are helpful in identifying and correcting systematic error sources. Contract laboratories are encouraged to develop and maintain control charts whenever they may serve in determining sources of analytical problems.

4.4 Laboratory Performance Audits/Corrective Action
No additional performance audits will be required as part of this Project. However, participation in performance audits or other intercomparison studies are encouraged.

4.5 Laboratory Performance Measurements
Laboratory performance measurements (also known as Data Quality Indicators) are designed to determine whether data quality criteria are met, as defined below.
4.5.1 Method Blanks

Also called laboratory reagent blanks or preparation blanks, method blanks account for contaminants present in the solvents, preservatives, analytical solutions, or other laboratory equipment used during the quantification of the parameter.

4.5.2 Internal Standards

Internal standards account for error introduced by the analytical instrument.

4.5.3 Replicate Samples

Replicate samples of the raw material can be extracted and analyzed to measure laboratory precision or variability of a chemical in the material.

4.5.4 Laboratory Replicate Samples

Laboratory replicate samples are replicates of extracted material that assess the measurement precision.

4.5.5 Matrix Spike Replicate Samples

Matrix spike replicate samples are used to assess both measurement precision and accuracy. They are especially useful when field samples may not contain many of the target compounds because measuring non-detects in replicates does not allow the data reviewer to measure the precision or the accuracy of the data in an analytical batch.

4.5.6 Matrix Spike Samples

Matrix spike samples are field samples to which a known amount of contaminant is added and measured to determine potential analytical interference present in the field sample.

4.5.7 Certified Reference Materials (CRMs)

Analysis of CRMs is another way of determining measurement accuracy, especially if a CRM contains a certified value at concentrations similar to those expected in the samples to be analyzed. These types of samples serve to check if errors are introduced during the analysis process and at what step(s) and at what magnitude(s).

4.6 Laboratory Quality Control Procedures

The performance-based protocols for analytical chemistry laboratories consist of several elements, as follow:
4.6.1 Instrument Calibration

Upon initiation of an analytical run, after each major equipment disruption, and whenever on-going calibration checks do not meet recommended DQIs (Table 3, Appendix), the system will be calibrated with a full range of analytical standards. Immediately after this calibration procedure, the initial calibration must be verified through the analysis of a standard obtained from a source different from the standards used to initially calibrate the instrumentation. This second standard must be prepared independently and should ideally have certified concentrations of target analytes. Frequently, calibration standards are included as part of a run, interspersed with actual samples. However, this practice does not document the stability of the calibration and is incapable of detecting degradation of individual components, particularly pesticides, in standard solutions used to calibrate the instrument. The calibration curve is acceptable if it has a \( r^2 \) of 0.990 or greater for all analytes present in the calibration mixtures. If not, the calibration standards, as well as all the samples in the batch must be re-analyzed. All calibration standards will be traceable to a recognized organization for the preparation and certification of QA/QC materials (e.g., National Institute of Standards and Technology (NIST), National Research Council Canada (NRCC), US EPA, etc.).

Calibration curves will be established for each type of analyte and batch analysis from a calibration blank and a minimum of three analytical standards of increasing concentration, covering the range of expected sample concentrations. Only data from quantification within the demonstrated working calibration range may be reported by the laboratory (i.e., quantification based on extrapolation is not acceptable). Alternatively, if the instrument response is linear over the concentration ranges to be measured in the samples, the use of a calibration blank and one single standard that is higher in concentration than the samples may be appropriate. Samples outside the calibration range will be diluted or concentrated, as appropriate, and reanalyzed.

4.6.2 Documentation of Method Detection Limits

The method detection limit (MDL) is the ability of a method to distinguish between the analytical noise and the measurement signal and can be used to define the analytical limit of detectability. The MDL represents a quantitative estimate of low-level response detected at the maximum sensitivity of a method. The Code of Federal Regulations (40 CFR Part 136) gives the following definition: “The MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.” MDLs will initially be determined according to 40 CFR 136.2 (f) and Appendix B of 40 CFR 136. Determining the MDL with this procedure is elaborate and need not be determined annually provided that:

- No process or method changes have been made.
- Check samples containing an analyte spike at about 2x MDL indicate that the sample is detected. The required frequency of check samples is quarterly. The matrix and the amount of sample (i.e., dry weight of sediment) used in calculating the MDL will match as closely as possible the matrix of the actual field samples and the amount of sample typically used. In order to ensure comparability of results among different laboratories,
target MDL values for the initial chemical analytes have been established for the project. Most are considerably lower than water quality objectives or sediment quality guidelines and provide the foundation for having a high level of certainty in the data.

Laboratories will confirm the ability to analyze low-level samples with each batch. This will be accomplished by analyzing a method blank spiked at 3 to 5 times the method detection limit. Recoveries for organic analyses shall be between 50 and 150% for at least 90% of the target analytes.

4.6.3 Limits of Quantitation

Taylor (1987) states that “a measured value becomes believable when it is larger than the uncertainty associated with it.” The uncertainty associated with a measurement is calculated from the standard deviation of replicate measurements of a low concentration standard or a blank. Normally, the MDL is set at three times the standard deviation of replicate measurements, as it is at this point that the uncertainty of a measurement is approximately ±100% at the 95% level of confidence. Values at the MDL may not reflect a signal much above zero and, therefore, are quantitatively not very meaningful. The limit of quantitation (LOQ), as established by the American Chemical Society, is normally ten times the standard deviation of replicate measurements, which corresponds to a measurement uncertainty of ±30% (see Taylor, 1987). By these standard definitions, measurements below the MDL are not believable, measurements between the MDL and LOQ are only semi-quantitative, and confidence in measurements above the LOQ is high. Target MDLs for PCBs in sealant samples are shown in Table 2.

### Table 2. Target Method Detection Limits (MDLs) for PCBs in Sealant Samples

<table>
<thead>
<tr>
<th>Synonym</th>
<th>Analyte</th>
<th>Target MDL (g/kg dry weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUPAC#8</td>
<td>2,4’-DICB</td>
<td>3.6</td>
</tr>
<tr>
<td>IUPAC#18</td>
<td>2,2’,5-TRCB</td>
<td>6.7</td>
</tr>
<tr>
<td>IUPAC#28</td>
<td>2,4,4’-TRCB</td>
<td>1.8</td>
</tr>
<tr>
<td>IUPAC#31</td>
<td>2,4’,5-TRCB</td>
<td>1.6</td>
</tr>
<tr>
<td>IUPAC#33</td>
<td>2’,3,4-TRCB</td>
<td>2</td>
</tr>
<tr>
<td>IUPAC#44</td>
<td>2,2’,3,5’-TECB</td>
<td>2</td>
</tr>
<tr>
<td>IUPAC#49</td>
<td>2,2’,4,5’-TECB</td>
<td>0.64</td>
</tr>
<tr>
<td>IUPAC#52</td>
<td>2,2’,5,5’-TECB</td>
<td>1.6</td>
</tr>
<tr>
<td>IUPAC#56</td>
<td>2,3,3’,4’-TECB</td>
<td>0.78</td>
</tr>
<tr>
<td>IUPAC#56/60</td>
<td>2,3,3’,4’/2,3,4,4’-TECB</td>
<td>2</td>
</tr>
<tr>
<td>IUPAC#60</td>
<td>2,3,4,4’-TECB</td>
<td>1.2</td>
</tr>
<tr>
<td>IUPAC#66</td>
<td>2,3’,4,4’-TECB</td>
<td>0.92</td>
</tr>
<tr>
<td>IUPAC#70</td>
<td>2,3’,4,5-TECB</td>
<td>1.1</td>
</tr>
<tr>
<td>IUPAC#74</td>
<td>2,4,4’,5-TECB</td>
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<td>IUPAC#77</td>
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<td>IUPAC#87</td>
<td>2,2’,3,4,5’-PECB</td>
<td>2</td>
</tr>
<tr>
<td>IUPAC#87/97</td>
<td>2,2’,3,4,5’/2,2’,3’,4,5-PECB</td>
<td>4.8</td>
</tr>
</tbody>
</table>
4.6.4 Record of Certified Reference Material

As CRMs are routinely included in analysis of batches of reputable laboratories, the historical record of results may also serve as a suitable performance indicator.

4.6.5 Routine Analysis of Certified Reference Materials or Laboratory Control Materials

A laboratory control material (LCM) is similar to a certified reference material in that it is a homogeneous matrix that closely matches the samples being analyzed. A “true” LCM is one that is prepared (i.e., collected, homogenized, and stored in a stable condition) strictly for use in-house by a single laboratory. Alternately, the material may be prepared by a central laboratory and distributed to others (so-called regional or program control materials). Unlike CRMs, concentrations of the analytes of interest in LCMs are not certified but are based upon a statistically valid number of replicate analyses by one or several laboratories. In practice, this
material can be used to assess the precision (i.e., consistency) of a single laboratory, as well as to determine the degree of comparability among different laboratories. If available, LCMs may be preferred for routine (i.e., day to day) analysis because CRMs are relatively expensive. As noted in section 3.2, CRMs can not be analyzed in this Project.

4.7 Precision Criteria

Each laboratory is expected to maintain control charts for use by analysts in monitoring the overall precision of the CRM or LCM. Upper and lower control chart limits (e.g., warning limits and control limits) will be continually updated; control limits based on 99% confidence intervals around the mean are recommended. The relative standard deviation (RSD) will be calculated for each analyte of interest in the CRM based on the last 7 CRM analyses. However, as noted in section 3.2, CRMs can not be analyzed in this Project. Precision will be monitored by the analysis of replicate samples and continuing calibration check solutions (Table 3, Appendix).

4.8 Laboratory Replicates for Precision

A minimum of one sealant sample per batch of 20 samples or fewer will be processed and analyzed in duplicate for precision. The relative percent difference between two replicate samples or the relative standard deviation between more than two replicate samples (RPD or RSD respectively) will be less than the DQIs listed in Table 3 of Appendix B for each analyte of interest. Following are the calculations:

\[
\text{RPD} = \frac{\text{ABS} (\text{rep 1} - \text{rep 2}) \times 100}{\text{Average (rep 1, rep 2)}}
\]

\[
\text{RSD} = \frac{\text{STDEV (all replicate samples)} \times 100}{\text{Average (all replicate samples)}}
\]

ABS — absolute value
STDEV — standard deviation

If results for any analytes do not meet the DQI for the RPD or RSD, calculations and instruments will be checked. A repeat analysis may be required to confirm the results. Results that repeatedly fail to meet the objectives indicate sample non-homogeneity, unusually high concentrations of analytes, or poor laboratory precision. In this case, the laboratory is obligated to halt the analysis of samples and investigate the source of the imprecision before proceeding. Due to the nature of the samples, sample homogeneity is likely to be the source of such imprecision.

4.9 Accuracy Criteria

Based on typical results attained by experienced analysts in the past, accuracy control limits have been established both for individual compounds and combined groups of compounds (see matrix spike and continuing calibration check solutions, Table 3 in the Appendix). Due to the inherent
variability in analyses near the method detection limit, control limit criteria for relative accuracy only apply to analytes with true values that are >3 times the MDL established by the laboratory.

### 4.10 Continuing Calibration Checks

Calibration check solutions traceable to a recognized organization must be inserted as part of the sample stream. The source of the calibration check solution shall be independent from the standards used for the calibration. Calibration check solutions used for the continuing calibration checks will contain all the analytes of interest. The frequency of these checks is dependent on the type of instrumentation used and, therefore, requires considerable professional judgment. All organic analyses shall be bracketed by an acceptable calibration check. A calibration check standard shall be run every 12 hours at a minimum.

If the control limits for analysis of the calibration check solution (set by the laboratories) are not met, the initial calibration must be repeated. The calibration check for 90% of the analytes shall not deviate more than ±20% for PCBs. If possible, the samples analyzed before the calibration check solution that failed the DQIs will be reanalyzed following recalibration. The laboratory will begin by reanalyzing the last sample analyzed before the calibration check solution that failed. If the RPD between the results of this reanalysis and the original analysis exceeds precision DQIs (Table 3, Appendix), the instrument is assumed to have been out of control during the original analysis. If possible, reanalysis of samples will progress in reverse order until it is determined that the RPD between initial and reanalysis results are within DQIs. The laboratory will report only the re-analysis results. If it is not possible or feasible to perform reanalysis of samples, all earlier data (i.e., since the last successful calibration control check) are suspect. In this case, the laboratory will prepare a narrative explanation to accompany the submitted data.

### 4.11 Laboratory Reagent Blanks

Laboratory reagent blanks (also called method blanks, extraction blanks, procedural blanks, or preparation blanks) are used to assess laboratory contamination during all stages of sample preparation and analysis. For PCB analyses, one laboratory reagent blank will be run in every sample batch. The reagent blank will be processed through the entire analytical procedure in a manner identical to the samples. Reagent blanks should be less than the MDL. A reagent blank concentration > 2x the MDL or > 10% of the lowest reported sample concentration for one or more of the analytes of interest will require corrective action to identify and eliminate the source(s) of contamination before proceeding with sample analysis. If eliminating the blank contamination is not possible, all impacted analytes in the analytical batch shall be flagged. In addition, a detailed description of the contamination source and the steps taken to eliminate or minimize the contamination shall be included in the narrative. Subtracting method blank results from sample results is not permitted.

### 4.12 Surrogates

The usage of the terms “surrogate,” “injection internal standard,” and “internal standard” varies considerably among laboratories. Surrogates are compounds chosen to simulate the analytes of
interest in organics analyses. Surrogates are used to estimate analyte losses during the extraction and clean-up process and must be added to each sample, including QA/QC samples, prior to extraction. Each laboratory must report the percent recovery of the surrogate(s) along with the target analyte data for each sample.

Each laboratory will set its own warning limit criteria based on the experience and best professional judgment of the analyst. It is the responsibility of the analyst to demonstrate that the analytical process is always “in control” (i.e., highly variable surrogate recoveries are not acceptable for repeat analyses of the same certified reference material and for the matrix spike/matrix spike duplicate).

4.13 Internal Standards

For gas chromatography (GC) analysis, internal standards (also referred to as “injection internal standards” by some analysts) are added to each sample extract just prior to injection to enable optimal quantification, particularly of complex extracts subject to retention time shifts relative to the analysis of standards. Internal standards are essential if the actual recovery of the surrogates added prior to extraction is to be calculated. The internal standards can also be used to detect and correct for problems in the GC injection port or other parts of the instrument. The compounds used as internal standards will be different from those used as surrogates. The analyst will monitor internal standard retention times and recoveries to determine if instrument maintenance, repair, or changes in analytical procedures are indicated. Corrective action will be initiated based on the judgment of the analyst. Instrument problems that may have affected the data or resulted in the reanalysis of the sample will be documented properly in logbooks and internal data reports and used by the laboratory personnel to take appropriate corrective action.

4.14 Dual-Column Confirmation

Dual-column chromatography is required for analyses using GC-ECD due to the high probability of false positives arising from single-column analyses. GC-ECD will not be used in this Project, however.

4.15 Matrix Spikes and Matrix Spike Duplicates

A laboratory-fortified sample matrix (a matrix spike, or MS) and a laboratory fortified sample matrix duplicate (a matrix spike duplicate, or MSD) will be used both to evaluate the effect of the sample matrix on the recovery of the compounds of interest and to provide an estimate of analytical precision. A minimum of 5% of the total number of samples submitted to the laboratory will be selected at random for analysis as matrix spikes and matrix spike duplicates. A field sample is first homogenized and then split into three subsamples. Two of these subsamples are fortified with the matrix spike solution and the third subsample is analyzed to provide a background concentration for each analyte of interest. The final spiked concentration of each analyte in the sample will be at least 10 times the MDL for that analyte, as previously calculated by the laboratory. Additionally, the total number of spikes should cover the range of expected concentrations. Recovery is the accuracy of an analytical test measured against a known analyte addition to a sample. Recovery is calculated as follows:
Recovery data for the fortified compounds ultimately will provide a basis for determining the prevalence of matrix effects in the samples analyzed during the project. If the percent recovery for any analyte in the MS or MSD is less than the recommended warning limit of 50 percent, the chromatograms and raw data quantitation reports will be reviewed. If an explanation for a low percent-recovery value is not discovered, the instrument response may be checked using a calibration standard. Low recoveries of matrix spikes may result from matrix interferences and further instrument response checks may not be warranted. This is especially true if the low recovery occurs in both the MS and MSD, and the other QC samples in the batch indicate that the analysis was “in control.” An explanation for low percent-recovery values for MS/MSD results will be discussed in the narrative accompanying the data package. Corrective actions taken and verification of acceptable instrument response will be included. Analysis of the MS/MSD is also useful for assessing laboratory precision. The RPD between the MS and MSD results should be less than the target criterion listed in Table 3 of the Appendix for each analyte of interest.

4.16 Field Replicates

The analysis of field replicates and field splits can provide an assessment of both inter-and intra-laboratory precision and variance in the sample matrix at the field site. Field replicates will not be analyzed in this Project (see ‘Field Sampling and Chemical Analysis Plan’ for more information).

5. Assessments and Project Oversight

5.1 Contractor Quality Control

The Project Manager will ensure that qualified personnel are employed in all phases of project implementation and that all personnel receive appropriate training to complete assigned tasks consistent with project workplans.

5.2 Assessments and Response Actions

No audits of sampling personnel will be required as part of this project. However, before any field sampling is conducted, the Contractor Project Manager will verify that proper equipment is available for all field personnel. This includes sampling equipment, safety equipment, and field measurement equipment (if appropriate). It will also be verified that all personnel involved in field activities have received sufficient training and are able to properly use the equipment and follow procedures. The Project Manager may also verify the application of procedures and equipment periodically. If the Project Manager or Field Program Manager finds any deficiencies, corrective actions will be put in place and reported, and follow-on inspections will be performed to ensure the deficiencies have been addressed.

No audits of analytical laboratories will be performed as part of this project. However, it is
expected that regularly performed audits of the analytical laboratory are conducted through other quality assurance programs (e.g., RMP). The analytical laboratory is responsible for making any corrections needed to address data quality issues relevant to the project and to report these corrective actions to the Data Manager.

5.3 Reports to Management

In addition to the QAPP, the Field Sampling and Chemical Analysis Plan, and reports produced through the implementation of the project, quarterly progress reports will be developed and submitted to the Project Manager by the contractor. These progress reports will document project status, any significant field or laboratory issues, timeliness of scheduled field and analytical activities, any significant QA problems, or other issues, and provide recommended solutions, if applicable.

6. Data Validation and Usability

Data verification and data validation are key steps in the completion of the Project. The Project incorporates the following definitions:

6.1 Data Verification

Data verification is confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements.

6.2 Data Validation

Data validation is confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Data validation is an analyte-and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set.

6.3 Reconciliation with User Requirements

For laboratory data, when the data are reported to the Data Manager, if there is an outlier, data fails to meet DQIs, or other question arises with the data, the Data Manager is responsible for determining the acceptability of the data in question. Usually, the Project Chemist is contacted directly to resolve any questions. When the Data Manager is satisfied with the accuracy of the laboratory data in question, the data is considered acceptable and may be used as part of the overall dataset.
7. References


8. Appendix: Analytical Method for PCBs in Sealants
PCB CONGENERS BY GC/MS

1.0 SCOPE, APPLICATION, AND METHOD CAPABILITIES

1.1 This method is used for the determination of chlorinated biphenyl congeners (PCBs) in sediments, soils, and miscellaneous samples by gas chromatography/mass spectrometry.

1.2 The target analytes and current method detection limit (MDL) values can be reviewed on the Laboratory Service Division web site.

2.0 SUMMARY OF METHOD

2.1 Samples are homogenized and a sub-sample removed for moisture determination.

2.2 Samples (10 g wet weight) are spiked with a surrogate spiking solution and are extracted with 1:1 acetone/dichloromethane using a Dionex ASE extractor (SOP 325).

2.3 The extract is then dried through a sodium sulfate column and concentrated using a J2 Scientific AccuVap. An internal standard is then added to each extract and cleaned up with a one-step GPC.

2.4 An aliquot of the final extract is injected into the gas chromatograph (GC). The analytes are separated by the GC and detected by a mass spectrometer.

3.0 SAMPLE COLLECTION, PRESERVATION AND HOLDING TIMES

3.1 All samples must be iced or refrigerated at <4°C from time of collection until delivery to the laboratory. Store samples in the dark at <-10°C.

3.2 There are no demonstrated maximum holding times associated with the PCBs in solid or other sample matrices. If stored in the dark at <-10°C, solid samples may be stored for up to one year.

4.0 COMMENTS

4.1 Raw data from all blanks, samples, and spikes must be evaluated for interference. Determine if the source of interference is in the preparation and/or cleanup of the samples and take corrective action to eliminate the problem.

4.2 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, thoroughly wash and rinse glassware, vessels, and syringes between samples. Whenever an unusually concentrated sample is encountered, it
should be followed by the analysis of solvent to check for cross contamination.

5.0 SAFETY

5.1 General laboratory practices for handling organic solvents apply to working with dilute PCB standards. In accordance with Safety SOP 214, use approved eye protection and wear nitrile gloves. Prepare dilutions and spiked samples in a fume hood.

5.2 Chemical and other safety relation information is contained in the Material Safety Data Sheets (MSDS) that are maintained in the Laboratory Library and are available on-line at http://hazard.com/msds/ and http://msds.ehs.cornell.edu/msdssrch.asp.

6.0 INSTRUMENTATION/EQUIPMENT

6.1 Dionex Accelerated solvent extraction (ASE) system - pre-extracted

6.2 Whatman 19.8 mm glass fiber filter (Dionex P/N 047017), or equivalent muffled.

6.3 Aluminum weighing dishes (VWR 25433-008 or equivalent)

6.4 Chromatography columns w/o reservoir, solvent rinsed stopcocks

6.5 Disposable Pasteur pipettes

6.6 Gel-permeation chromatography system - an HPLC pump, an auto sampler, and a fraction collector.

6.6.1 GPC- Chromatographic column - Envirogel GPC Cleanup Column 19mm ID x 300mm Methylene Chloride (WAT036554, or equivalent)

6.7 GC columns - suggested 30 m x 0.25 mm ID 0.25 μm film SPB-octyl capillary column (Supelco 2-4218, or equivalent). Retention time specified in Table 2 must be met prior to performing analyses.

6.8 Automated concentration system – AccuVap Inline & FLX Concentration System or AccuVap EVS

6.9 Perkin Elmer Clarus 500 GCMS, or equivalent, capable of scanning from 50 to 600 amu.

7.0 REAGENTS AND STANDARDS

7.1 Organic-free reagent water - All references to water in this method refer to organic-free reagent water produced by a Millipore Milli-Q system.
7.2 Native congener mix stock solutions for separation of individual congeners on the SPB-octyl column. Purchase Accustandard M1668A-1, M1668A-2, M1668A-3, M1668A-4, M1668A-5, or equivalent. The five solutions, measured individually, allow resolution of all 209 congeners to establish retention times for each congener.

7.3 Individual stock solutions of congeners of interest (Accustandard and Ultra Scientific).

7.4 Internal Standard: Tetrachloro-m-xylene Accustandard S-279-5x

7.5 Surrogate Solution: IUPAC #103 & #198 100ug/mL in isoctane. Accustandard C-103S-TP and C-198S-TP.

7.6 Acetone, methylene chloride and other appropriate solvents - Pesticide quality or equivalent.

7.7 Pelletized diatomaceous earth. Varian 0019-8003 or equivalent. Muffled.

7.8 Sodium sulfate. Muffled.

7.9 Ottawa sand. Muffled.

7.10 Glass Wool. Muffled.

8.0 PROCEDURE

8.1 Instrument Operating Conditions

Initial temperature: 75 °C, hold for 2 minutes
Temperature program: 15 °C/min to 150 °C, 2.5 °C/min to 290 °C, hold 1 min.
Sample volume: 2.5 μL
Injector temperature: 260 °C
Interface temperature: 250 °C
Flow: 1.0 ml/min
Scan Range: 10-62 min at 181-508 amu
Scan Time: 0.35 second

The GC conditions may be optimized for compound separation and sensitivity. Once optimized, the same GC conditions must be used for the analysis of all standards, blanks, and QC samples.

8.2 Preparation of Calibration and Check Standards

8.2.1 Combine and dilute the solutions in section 7.2 to produce at least 5 calibration solutions of the individual PCBs between 50 and 3770 ng/mL or higher if necessary.
8.2.2 A check standard (CCC), containing all congeners of interest is prepared at a concentration of 1000 ng/mL for native compounds and 500 ng/mL for the internal standard and surrogates (IUPAC 103&198).

8.3 Preparation of QC Samples

8.3.1 Spike/LCS standards - Prepare a standard solution containing all the PCBs of interest at concentrations of 1.0 µg/mL. Use 1.0 mL of the 1.0 µg/mL solution for spike blank and matrix spike samples. Use 150 µL for the LCS samples.

8.3.2 Surrogate solution - This solution is added to every sample (client and QC) before extraction. The solution contains congeners 103 and 198 at 0.50 µg/ml. Spike each sample with 1.0 mL.

8.4 Sample Preparation

8.4.1 Samples, duplicates, and matrix spikes are homogenized and a 10 gram subsample is weighed for extraction. Use a smaller sample size if the sample matrix is expected to be dirty or contains very high concentrations of PCBs. An additional subsample of each sediment samples is weighed for% solid determination. The sample for extraction, after weighing, is mixed with pelleted diatomaceous earth until a dry, free-flowing mixture is obtained. This mixture is then placed into an ASE extraction cell. Add the surrogate solution (1.0 mL of 8.3.2) and, if needed, the appropriate amount of spiking standard (8.3.1) to the ASE vessels. Extract the sample with 1:1 acetone/dichloromethane at elevated temperature and pressure. Total extraction time is ~ 30 min. See SOP 325 for operational details.

8.4.2 The method blank, LCS, and spike blank samples are prepared with 10 grams of muffled Ottowa sand.

8.4.3 The extracts are dried with muffled granular Na₂SO₄.

8.4.4 If an aqueous layer is visible in the extract, slowly add about 16.5 gm of muffled Na₂SO₄ to extract and mix well prior to pouring extract into drying column.

8.4.5 Dried extracts are to be evaporated to dryness and diluted to 2.5 mL of MeCl₂ for GPC using an AccuVap.

8.4.6 Prior to GPC, filter the 2.5 mL extract through a 0.45µ PVDF Captiva 3mL columns if necessary.

8.4.7 Add 10 µL of internal standard into every extract. Bring volume to 2.5 mL.

8.4.8 Set up GPC clean-up with inline evaporation per SOP 356.

8.4.9 Remove final extracts promptly upon completion of GPC cleanup and concentration. Replace slit septa caps with crimp caps.
9.0 CALIBRATION

9.1 Mass spectrometer calibration

9.1.1 Supelco SPB-Octyl fused silica capillary column (C/N 24218-U 30m x 0.25mm x 0.25μm film thickness) or comparable should be used.

9.1.2 The GC/MS system must be hardware-tuned to meet the criteria in Table 1 for a 50 ng injection of DFTPP. Analyses should not begin until all these criteria are met. Background subtraction should be straightforward and designed only to eliminate column bleed or instrument background ions.

<table>
<thead>
<tr>
<th>Mass</th>
<th>Ion Abundance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>30-60% of base peak of mass 198</td>
</tr>
<tr>
<td>68</td>
<td>&lt; 2% of mass 69</td>
</tr>
<tr>
<td>70</td>
<td>&lt; 2% of mass 69</td>
</tr>
<tr>
<td>127</td>
<td>40-60% of base peak</td>
</tr>
<tr>
<td>197</td>
<td>&lt; 1% of mass 198</td>
</tr>
<tr>
<td>198</td>
<td>Base peak, defined as 100%</td>
</tr>
<tr>
<td>199</td>
<td>5-9% of mass 198</td>
</tr>
<tr>
<td>275</td>
<td>10-30% of mass 198</td>
</tr>
<tr>
<td>365</td>
<td>&gt; 1% of base peak</td>
</tr>
<tr>
<td>441</td>
<td>Present but less than mass 443</td>
</tr>
<tr>
<td>442</td>
<td>&gt; 40% of mass 198</td>
</tr>
<tr>
<td>443</td>
<td>17-23% of mass 442</td>
</tr>
</tbody>
</table>

9.2 Quantitative analysis

9.2.1 When a compound has been identified, the quantitation of that compound will be based on the integrated abundance of the primary ions (Table 2).

9.2.2 If the %RSD of a compound's relative response factor (initial calibration) is 15% or less, then the concentration in the extract may be determined using the average response factor from the initial calibration data. Alternatively, a linear or quadratic regression with a coefficient of variance >0.998 may be used.

9.2.3 Use the data system to compute the concentration of the analyte in the sample, using an internal standard calibration. Calculate the concentration of the analyte in the initial sample.
Table 2 – Target Analytes, Retention Times, Selected Ions, and References

<table>
<thead>
<tr>
<th>Compound</th>
<th>Retention Time</th>
<th>m/z</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetrachloro-m-xylene</td>
<td>15.90</td>
<td>242+244</td>
<td>Internal Standard</td>
</tr>
<tr>
<td>IUPAC 103 (Surrogate)</td>
<td>28.37</td>
<td>324+326</td>
<td>Tetrachloro-m-xylene</td>
</tr>
<tr>
<td>IUPAC 198 (Surrogate)</td>
<td>47.89</td>
<td>428+430</td>
<td>Tetrachloro-m-xylene</td>
</tr>
<tr>
<td>IUPAC 8</td>
<td>16.96</td>
<td>222+224</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 18</td>
<td>19.18</td>
<td>256+258</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 28</td>
<td>23.24</td>
<td>256+258</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 31</td>
<td>22.93</td>
<td>256+258</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 33</td>
<td>23.46</td>
<td>256+258</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 44</td>
<td>26.10</td>
<td>290+292</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 49</td>
<td>25.58</td>
<td>290+292</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 52</td>
<td>25.08</td>
<td>290+292</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 56</td>
<td>31.03</td>
<td>290+292</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 60</td>
<td>31.25</td>
<td>290+292</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 66</td>
<td>30.34</td>
<td>290+292</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 70/74</td>
<td>30.01</td>
<td>290+292</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 87/97</td>
<td>33.30</td>
<td>326+328</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 95</td>
<td>29.08</td>
<td>326+328</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 99</td>
<td>32.67</td>
<td>326+328</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 101</td>
<td>32.08</td>
<td>326+328</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 105</td>
<td>38.42</td>
<td>326+328</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 110</td>
<td>34.12</td>
<td>326+328</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 118</td>
<td>37.18</td>
<td>326+328</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 126</td>
<td>41.64</td>
<td>326+328</td>
<td>IUPAC 103</td>
</tr>
<tr>
<td>IUPAC 128</td>
<td>41.65</td>
<td>358+360+362</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 132</td>
<td>39.05</td>
<td>358+360+362</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 138</td>
<td>40.34</td>
<td>358+360+362</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 141</td>
<td>39.26</td>
<td>358+360+362</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 149</td>
<td>35.96</td>
<td>358+360+362</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 151</td>
<td>35.00</td>
<td>358+360+362</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 153</td>
<td>37.26</td>
<td>358+360+362</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 156</td>
<td>44.59</td>
<td>358+360+362</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 158</td>
<td>40.73</td>
<td>358+360+362</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 170</td>
<td>47.28</td>
<td>394+396+322+324+326</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 174</td>
<td>42.30</td>
<td>394+396+322+324+326</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 177</td>
<td>43.01</td>
<td>394+396+322+324+326</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 180</td>
<td>45.98</td>
<td>394+396+322+324+326</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 183</td>
<td>42.30</td>
<td>394+396+322+324+326</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 187</td>
<td>41.67</td>
<td>394+396+322+324+326</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 194</td>
<td>52.56</td>
<td>428+430+432+356+358+360</td>
<td>IUPAC 198</td>
</tr>
<tr>
<td>IUPAC 195</td>
<td>50.17</td>
<td>428+430+432+356+358+360</td>
<td>IUPAC 198</td>
</tr>
</tbody>
</table>
10.0 QA/QC REQUIREMENTS

10.1 The batch QC Requirements are outlined in Table 3.

10.2 No more than 20 client samples can be included in an analytical batch.

10.3 Compute the percent recovery of the surrogate standard spiking solution using an internal standard calibration method.

10.4 Analyze the method blank immediately after the LCS to analyze freedom from contamination and carryover from the LCS.

Table 3 – Batch QC Requirements

<table>
<thead>
<tr>
<th>QC Type</th>
<th>Batch Requirement</th>
<th>Acceptance Criteria</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS tuning check</td>
<td>Prior to analyzing samples</td>
<td>See Table 1 and section 8.5</td>
<td>Retune and adjust the MS</td>
</tr>
<tr>
<td>Calibration</td>
<td>Acceptable calibration</td>
<td>RF &lt;20% RSD, or if using 1st or 2nd order regression, =/&gt; 0.998</td>
<td>Correct instrument or standard problem. Recalibrate.</td>
</tr>
<tr>
<td>Spike Blank</td>
<td>Fortify at same concentration as MS samples</td>
<td>+/- 30% recovery</td>
<td>Requires reextraction and reanalysis if more than 10% of the analytes fail to meet acceptance criterion.</td>
</tr>
<tr>
<td>Continuing Calibration Check</td>
<td>1 at the beginning of each analytical run, every 12 hrs and at the end of the run. Concentration at cal mid-range.</td>
<td>+/- 20% recovery.</td>
<td>Recalibrate. Rerun with fresh standard if CCC continues to fail. If recoveries are outside of the control limits flag sample with “N”.</td>
</tr>
<tr>
<td>Low Level Spike Blank (LCS)</td>
<td>1 per batch. Concentration at lowest calibration level.</td>
<td>+/- 50% recovery.</td>
<td>If recoveries are outside of the control limits flag sample with “N”.</td>
</tr>
<tr>
<td>Method Blank</td>
<td>1 per batch. Target analytes below MDL.</td>
<td></td>
<td>Reanalyze method blank to confirm. May require re-extraction and reanalysis. Flag detected compounds in samples that are also present in the blank with a “B”.</td>
</tr>
<tr>
<td>QC Type</td>
<td>Batch Requirement</td>
<td>Acceptance Criteria</td>
<td>Corrective Action</td>
</tr>
<tr>
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</tr>
<tr>
<td>Matrix Spike</td>
<td>1 per batch or 10% of samples. Spike concentration set at the calibration mid-level.</td>
<td>±35% recovery</td>
<td>Flag spiked sample and base with &quot;N&quot;, if recoveries are outside control limits.</td>
</tr>
<tr>
<td>Matrix Duplicate</td>
<td>1 per batch or 10% of samples.</td>
<td>Acceptance Criteria &lt; 50 % RPD for concentrations &gt; 10 MDL for 90% of analytes</td>
<td>Flag outliers with &quot;**&quot;, samples &lt; 10 MDL flagged with a V. Requires re-extraction and re-analysis if more than 10% of the analytes fail to meet the acceptance criterion.</td>
</tr>
</tbody>
</table>

### 11.0 REFERENCES


RMP Special Study Proposal: Synthesis of Information on PCBs

Estimated Cost: $53,000

Oversight Group: TRC, CFWG

Proposed by: Jay Davis, SFEI

PROPOSED DELIVERABLES AND TIME LINE

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Due Date</th>
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</thead>
<tbody>
<tr>
<td>Draft outline</td>
<td>December 2010</td>
</tr>
<tr>
<td>Draft report</td>
<td>May 2011</td>
</tr>
<tr>
<td>Final report</td>
<td>August 2011</td>
</tr>
</tbody>
</table>

BACKGROUND AND JUSTIFICATION

The RMP PCB Strategy Team formulated a PCB Strategy in 2009. The Team recognized that a significant body of new information has been generated since the PCBs TMDL Staff Report was prepared. Some of the important new datasets include:

- Surface sediment data obtained using more accurate analytical methods (high resolution mass spectrometry) and the randomized sampling design
- Water data from the new random design
- Additional trend data from sport fish, bivalves, and bird eggs
- Surprising data from small fish showing higher than expected concentrations
- Additional data suggesting the possibility of toxic effects on avian embryos
- Information on a “new” PCB (PCB 11) that is abundant and ubiquitous
- Information on the entire suite of 209 congeners, now available for several matrices in the Bay

The RMP PCB Strategy has articulated management questions to guide a long-term program of studies to support reduction of PCB impairment in the Bay (see below). The PCB Team recommended two studies to begin addressing these questions. The first recommended study was to take advantage of an opportunity to piggyback on the final year of the three-year small fish mercury sampling in 2010. The second study recommended was a synthesis and conceptual model update based on the information that has been generated since the writing of the TMDL Staff Report. The Team considered this a prudent next step to ensure effective use of RMP funds and to form the basis for a plan for the next few years of PCB studies. The Team outlined the scope for this synthesis effort (see below).

APPLICABLE RMP MANAGEMENT QUESTIONS

The most relevant questions for this synthesis are the questions articulated specifically for the PCB Strategy.

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

OBJECTIVES AND APPROACH

The goal of the synthesis effort will be to produce a technical report that answers, to the extent possible, the PCB Strategy questions based on the information that has accumulated to date. Other questions may also be addressed. Stakeholder input on an outline of the report will be obtained as a first step in the project.

A considerable body of information generated by the RMP and other programs has accumulated in recent years. Some of the datasets to be covered in the review are listed below.

- Status and Trends: RMP (Sport fish, Bivalves, Avian eggs, Sediment, Water)
- RMP PCB Strategy: Small fish
- Effects: USFWS Avian egg work, UC Davis Effects on fish
- Fate: RMP (cores, multibox model)
- Loading Studies: Central Valley loads (RMP), Small tributaries (loading studies, BMP study), atmospheric deposition (global, local), POTWs (Region 2)

Stakeholder suggestions on additional datasets to include will also be encouraged.

The PCB Team also recommended reviewing and making recommendations related to several other sources of information.

- TMDLs and abatement actions from elsewhere to evaluate lessons learned and whether there are rules or thumb for what works and what doesn’t work.
- Information on PCB 11. A related issue is the most appropriate index of total PCBs – whether to include PCB 11 and how many congeners to include in routine measurements and sums.
- The linkage between sediment and sport fish, including an evaluation of why concentrations appear to have declined in bivalves and sediments, but not in sport fish.
- Evaluation of sources using congener profiles.
- Updated estimates of nearshore ambient average concentrations and the inventory of PCBs in various compartments of the Bay ecosystem.
- An update of the Gobas food web model using the new sediment data.
- A review of literature on estuarine degradation rates, which have a large influence on predictions of the rate of recovery of the Bay.
A review of literature on rates of attenuation of PCB loads from watersheds, which also have a large influence on Bay recovery.

The synthesis will also evaluate progress relative to the report: PCBs in San Francisco Bay: Impairment Assessment/Conceptual Model Report developed by SFEI for the Clean Estuary Partnership (Davis et al. 2006).

LITERATURE CITED


BUDGET

The estimated budget for this task is $53,000, all for SFEI labor. The hours allocated for each staff person are indicated below.

<table>
<thead>
<tr>
<th>Hours</th>
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<tbody>
<tr>
<td>Jay Davis</td>
</tr>
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<td>Don Yee</td>
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<tr>
<td>Ben Greenfield</td>
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<tr>
<td>Jon Leatherbarrow</td>
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<tr>
<td>Lester McKee</td>
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<tr>
<td>John Ross</td>
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<tr>
<td>Rachel Allen</td>
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</table>
Dedicated Decade: An Update on the Brake Pad Partnership

From the Bay to the boardroom, the lab to the Legislature, Sustainable Conservation’s Brake Pad Partnership has come a long way since its inception over a decade ago. For years, the Partnership — an uncommon alliance of brake manufacturers, stormwater agencies and environmental groups — has worked tirelessly to identify and address the environmental consequences of copper from automobile brake pads. Beyond its specific project scope, the Partnership is a remarkable example of where Sustainable Conservation has been and where we’re going.

COPPER 101

Each time drivers step on their brakes, small amounts of debris are released onto streets, into the air and, eventually, into waterways. No big deal, right? Wrong. California drivers hit their brakes hundreds of millions of times a day — which adds up to a substantial quantity of debris, much of which contains copper. Copper that ends up in streams, rivers and coastal waters is toxic to phytoplankton and disrupts the aquatic food chain. Elevated copper levels are also one of the factors contributing to the decline of salmon populations. What’s worse, once copper has been deposited into water, it is extremely difficult — and extremely expensive — to get it out.

High levels of copper are found in urban watersheds across California. Through maximum allowable limits for copper pollution mandated by the State Water Resources Control Board, municipalities within these watersheds are now responsible for taking onerous and costly clean-up measures — and they have to demonstrate significant progress toward compliance by 2018.

Could brake pads be the culprit? Moreover, could they provide the key to an economically viable solution to the problem? Sustainable Conservation set out to investigate.

A COLLABORATIVE APPROACH

Instead of polarizing environmental and industry interests by heading straight to the courtroom, we convinced the various stakeholders to try a

(continued)

“By banning the use of copper in vehicle brake pads, California has the opportunity to again lead the nation in protecting our environment.”

Senator Christine Kehoe (D-San Diego), author of Senate Bill (SB) 346
An Update on the Brake Pad Partnership

In 1996, Sustainable Conservation convened the Partnership to understand the impact of copper from brake pads on water quality. When joining the Partnership, industry representatives agreed that if science showed copper in brake pads was indeed a significant contributor to water quality degradation, they would voluntarily reduce copper in brake pad formulations.

**PIVOTAL OUTCOMES**

Over the years that followed, the Partnership conducted rigorous scientific studies to determine the role brake pads play in elevated copper levels within San Francisco Bay Area watersheds. The results of these studies indicate that copper from brake pads accounts for the majority of the human-generated copper in highly urbanized watersheds. With this news, the industry was ready to honor its commitment AND raise the stakes on behalf of the Golden State's environmental and economic health.

**NEW DIRECTIONS**

By recommending the introduction of state legislation to limit the amount of copper in brake pads, the industry helped steer the Partnership – and Sustainable Conservation – into the policy realm. This initially surprising recommendation ultimately makes great sense: legislation would address environmental and economic concerns by maximizing positive impact on water quality and guaranteeing a level playing field for all brake pad manufacturers. Dynamic solutions are the name of the game at Sustainable Conservation, and the Partnership's willingness to adapt its strategy accordingly speaks to the importance of persistence and flexibility in effecting powerful environmental change.

In early 2009, Sustainable Conservation introduced Senate Bill (SB) 346, authored by Senator Christine Kehoe (D-San Diego), to reduce and eventually remove copper from brake pads sold in California, thereby addressing a serious threat to aquatic health and allowing local governments to meet their obligations under the Clean Water Act. The bill also requires that new brake pads meet all applicable safety and performance standards, and includes provisions to ensure that copper will not be replaced by materials containing other harmful substances.

**VICTORY, REGROUPING**

SB 346 passed out of the California State Senate on June 3 – a very exciting day! To bolster our chances at success in the State Assembly, the Partnership decided to make SB 346 a two-year bill. For now, the bill is being held in the Assembly Committee on Environmental Safety and Toxic Materials, with the goal of taking it up again in the 2010 legislative session. This additional time will allow the Partnership to further clarify and strengthen the bill, and conduct outreach with and ally concerns for those individuals and organizations currently opposed to the bill (including the car companies). The coming months will also provide an opportunity to formalize implementation and enforcement specifics for the copper reduction program.

**THE ROAD AHEAD**

Building on a decade of sound science and balanced problem-solving, the Partnership has made extraordinary progress on behalf of California's water quality in 2009. By raising consciousness about the power of our cooperative approach, Sustainable Conservation has already set a positive precedent in the Legislature. In 2010, we hope California will take the next big step by approving and signing SB 346 – a truly collaborative solution to a serious environmental problem.

To learn more, visit www.suscon.org/bpp.

After passing out of the California State Senate, SB 346, which aims to effectively eliminate all copper in brake pads sold in California, will go before the State Assembly in 2010.
An act to add Article 13.5 (commencing with Section 25250.50) to Chapter 6.5 of Division 20 of the Health and Safety Code, relating to hazardous materials.

LEGISLATIVE COUNSEL’S DIGEST


(1) Existing law establishes the Department of Toxic Substances Control in the California Environmental Protection Agency, with powers and duties regarding the management of hazardous waste. Existing law, administered by the department, prohibits the management of hazardous waste except in accordance with the hazardous waste control laws, including laws governing the removal of any mercury-containing vehicle light switch from a vehicle, and the regulations adopted by the department. A violation of the hazardous waste control laws is a crime.
The bill, commencing on January 1, 2014, would prohibit the sale of any motor vehicle brake friction materials containing specified constituents in amounts that exceed certain concentrations. The bill, commencing on January 1, 2025, would prohibit motor vehicle brake friction materials exceeding 0.5% copper by weight from being sold in California. The bill, commencing on January 1, 2014, would require all manufacturers of motor vehicle brake friction materials that are sold in this state to obtain a certification of compliance with these requirements from a 3rd-party testing certification agency, and to mark proof of certification on the friction materials. The bill would require a manufacturer of brake friction materials to file a copy of the 3rd-party certification with the department and to pay a reasonable filing fee. A violation of these provisions would be subject to a civil fine of up to $10,000 per violation. Because a violation of these provisions would also be a crime pursuant to the hazardous waste control laws, the bill would impose a state-mandated local program.

(2) Existing law requires the department to adopt regulations to establish a process to identify and prioritize chemicals of concern in consumer products. As part of this process, the department is required to adopt regulations for the evaluation of chemicals of concern in consumer products, including a process for evaluating alternatives.

This bill would direct the department to require vehicle brake manufacturers to comply with the regulations for the department’s evaluation of chemicals of concern and, before those regulations are adopted, to ensure that formulations developed to comply with the above content requirements are less harmful to health and the environment.

(2)

(3) The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for a specified reason.


The people of the State of California do enact as follows:

1 SECTION 1. The Legislature finds and declares all of the following:
(a) Friction materials are an essential component of motor vehicle brake systems and of critical importance to transportation safety and the public safety in general.

(b) Debris from friction materials containing copper in all of its forms, including, but not limited to, elemental copper and all of its alloys and compounds, are generated and released to the surrounding environment in the course of normal brake system operation.

(c) Tens of thousands of pounds of copper and other substances released from brake friction materials enter California’s streams, rivers, and marine environment every year.

(d) Copper is toxic to many aquatic organisms, including salmon.

(e) Limits on the copper content of brake friction materials are essential for California cities, counties, and industries to comply with federal Clean Water Act (33 U.S.C. Sec. 1251 et seq.) mandates, including copper water quality standards and copper total maximum daily loads in California’s urban watersheds.

(f) Without limits on the copper content of brake friction materials, California taxpayers face billions of dollars in federal Clean Water Act compliance costs.

(g) Changes in the composition of brake friction materials made to comply with copper water quality standards and successfully implement copper total maximum daily loads in California’s urban watersheds should meet all applicable safety standards.

SEC. 2. Article 13.5 (commencing with Section 25250.50) is added to Chapter 6.5 of Division 20 of the Health and Safety Code, to read:

Article 13.5. Motor Vehicle Brake Friction Materials

25250.50. For purposes of this article, the following definitions apply:

(a) “Board” means the State Water Resources Control Board.

(b) “Department” means the Department of Toxic Substances Control.

(c) “Motor vehicle” has the same meaning as “vehicle” is defined in Section 670 of the Vehicle Code.

(d) “Testing certification agency” means an agency approved by the department as qualified and equipped for the certification
of testing of products, materials, equipment, and installations in accordance with nationally recognized standards.

25250.52. On and after January 1, 2025, any motor vehicle brake friction materials exceeding 0.5 percent copper by weight shall not be sold in this state.

25250.54. On and after January 1, 2014, any motor vehicle brake friction materials containing any of the following constituents in an amount that exceeds the following concentrations shall not be sold in this state:

(a) Cadmium and its compounds: 0.01 percent by weight.
(b) Chromium(VI)-salts: 0.1 percent by weight.
(c) Lead and its compounds: 0.1 percent by weight.
(d) Mercury and its compounds: 0.1 percent by weight.
(e) Asbestiform fibers: 0.1 percent by weight.

25250.56. (a) The department shall require vehicle brake manufacturers to comply with the regulations adopted pursuant to subdivision (a) of Section 25253 in their development of brake friction materials that comply with Sections 25250.52 and 25250.54. In the process of complying with the regulations adopted pursuant to subdivision (a) of Section 25253, a manufacturer shall give specific consideration to the cumulative impacts on health and the environment of alternatives that increase the use of nickel, zinc, and antimony.

(b) This section does not authorize the department to modify or disregard the requirements in Section 25250.52 or 25250.54.

(c) Prior to the enactment of regulations implementing Section 25253, a vehicle brake friction material manufacturer shall exercise due diligence to ensure that formulations developed to comply with Sections 25250.52 and 25250.54 are less harmful to health and the environment.

25250.58. The following motor vehicle classes and brakes are exempt from this article:

(a) Military combat vehicles.
(b) Vehicles employing internal closed oil immersed brakes, or a similar brake system that is fully contained and emits no copper, other debris, or fluids under normal operating conditions.
(c) Brakes designed for the primary purpose of holding the vehicle stationary and not designed to be used while the vehicle is in motion.
(d) Motorcycles.

25250.60. (a) Commencing on January 1, 2014, all manufacturers of friction materials used in brakes on new motor vehicles, or as replacement parts, that are sold in this state shall obtain certification from a third-party testing certification agency that each of their formulations for brake friction materials complies with Section 25250.54. A certification shall be valid for no more than three years. Manufacturers shall mark proof of certification on all brake friction materials.

(b) Commencing on January 1, 2025, all manufacturers of friction materials used in brakes on new motor vehicles, or as replacement parts, that are sold in this state shall obtain certification from a third-party testing certification agency that each of their formulations for brake friction materials complies with Sections 25250.52 and 25250.54. A certification shall be valid for no more than three years. Manufacturers shall mark proof of certification on all brake friction materials.

(c) Prior to its products being sold in this state, a manufacturer of friction materials used in brakes on new motor vehicles, or as replacement parts, shall file a copy of the third-party certification of each of its brake friction materials formulations with the department. The department shall charge a reasonable filing fee upon the filing of a copy.

(d) Manufacturers of friction materials used for brakes on new motor vehicles, or as replacement parts, may obtain certification of compliance with the requirements of Section 25250.52 or Section 25250.54 at any time prior to the dates specified in those sections.

(e) The department, in consultation with all interested parties, and on or before January 1, 2012, shall develop all certification and marking criteria required pursuant to this section.

(f) Commencing on January 1, 2014, vehicle manufacturers and retailers of friction materials shall ensure that only brakes certified for sale in this state are offered for sale in this state.

25250.62. (a) A violation of this article, including, but not limited to, offering brake friction materials for sale without first complying with subdivision (c) of Section 25250.60 or the falsification of third-party certification, by vehicle manufacturers, brake friction materials manufacturers, distributors, or retailers,
shall be subject to a civil fine of up to ten thousand dollars ($10,000) per violation.

(b) The department shall enforce this article. The department shall remove from sale in this state any replacement brake friction materials determined to be not in compliance with this article.

(c) In enforcing this article, the department shall not recall automobiles fitted with brake friction materials that do not comply with this article, but the department may impose fines and penalties authorized pursuant to subdivision (a) on automobile manufacturers whose vehicles are fitted with brake friction materials that do not comply with this article.

25250.64. This article does not limit, supersede, duplicate, or otherwise conflict with the authority of the department to fully implement Article 14 (commencing with Section 25251), including the authority to include products in a product registry established pursuant to the regulations adopted pursuant to that article or any testing or labeling requirements imposed pursuant to that article if those requirements are more protective of the public health and environment than those prescribed by this article. Notwithstanding subdivision (c) of Section 25257.1, vehicle brake pads shall not be considered as a product category already regulated or subject to pending regulation for purposes of Article 14 (commencing with Section 25251).

SEC. 3. No reimbursement is required by this act pursuant to Section 6 of Article XIIIB of the California Constitution because the only costs that may be incurred by a local agency or school district will be incurred because this act creates a new crime or infraction, eliminates a crime or infraction, or changes the penalty for a crime or infraction, within the meaning of Section 17556 of the Government Code, or changes the definition of a crime within the meaning of Section 6 of Article XIII B of the California Constitution.
Reducing Water Pollution Caused by Vehicle Brake Pads

Brake Pad Copper Control and Total Maximum Daily Loads

- Copper from vehicle brake pads is polluting California’s urban waterways.
- There are limited options for intercepting or treating copper pollution.

As of 2006, 51 water bodies across California exceeded the amount for copper allowed under state and federal regulations. The vast majority of this copper comes from vehicle brake pads.

Local agencies, especially financially strapped cities like San Diego, Los Angeles, Sacramento, and San Francisco Bay Area cities, are being forced to deal with this pollution under the U.S. Environmental Protection Agency’s Total Maximum Daily Load (TMDL) mandates imposed through regional water quality control boards.

Several municipalities are already facing aggressive TMDL requirements and deadlines for achieving drastic reductions in copper pollution in 18 specific water bodies. Similar requirements are being drafted and are soon expected for all of California’s urban areas.

Carefully Crafted Regulation is Imperative

Senator Christine Kehoe has proposed Senate Bill (SB) 346 that would phase out the use of copper in motor vehicle brake pads and would also limit the use of other harmful water pollutants such as lead, mercury, zinc, cadmium and asbestos in brake pads.

- Senator Kehoe’s bill is essential for municipal agencies facing tough copper TMDL requirements.

Costly infiltration basins and land-use intensive vegetated strips and swales are the only runoff treatment measures that can remove sufficient amounts of copper to comply with copper TMDLs. High costs and the very large land areas required make these options rarely available in California’s highly urbanized areas. As a result, treating runoff to remove copper is many times more expensive than treatment for other pollutants. Installing urban runoff copper treatment measures like these would cost California municipalities billions of dollars. Regulating copper content in brake pads is a better and safer alternative.
The Cost of Waiting is Just Too Great

- Any delay in adopting or implementing SB 346 will put municipal agencies at risk.

Unless brake pad copper pollution reduction begins soon, non-compliance with TMDL requirements will be unavoidable. The potential fines for non-compliance are staggering, and many regional water quality control boards have shown a willingness to impose them if they believe no meaningful effort is being made to comply. The risk to municipalities is real – and not one they are willing to take.

Vehicle brake pads are the single largest source of copper in highly urbanized watersheds in California. To achieve compliance with Total Maximum Daily Loads (TMDLs), significant reductions in copper concentrations must occur. Compliance with TMDLs cannot be achieved without the brake pad source control proposed by Senator Kehoe.

SB 346 Protects Residents and Industry

Municipalities have been working for years to encourage manufacturers and other automotive industry leaders to reduce and eventually eliminate copper from brake pads. Those discussions have been productive but have fallen short of any substantive agreement regarding the timelines and leadership necessary to reduce brake pad copper pollution.

SB 346 is necessary to move this critical effort forward.

Domestic and international competition will undercut any attempt to voluntarily reduce copper in brake pads. Manufacturers would be left without the incentives to take advantage of alternative brake pad formulations. Protecting our watersheds from copper pollution through regulated source reduction is the only technically feasible and fiscally responsible solution. Regulation will ensure that source reduction is initiated in a timely fashion.

Senator Kehoe’s bill:

- Levels the playing field between all domestic and foreign manufacturers;

- Provides cost-effective means for improving water quality and avoiding far more costly treatment alternatives; and

- Is the only realistic and fair solution to a complicated threat to our state’s water quality.

Lobbyist Contact: Moira Topp, City of San Diego Legislative Advocate, Sloat Higgins Jensen & Associates (916) 446-3007 or mtopp@shjlobby.com
FACT SHEET
SB 346 (KEHOE) – Hazardous materials: motor vehicle brake friction materials
As amended June 7, 2010

PROBLEM: Elevated copper levels occur in urban watersheds across California. Dissolved copper is toxic to phytoplankton (the base of the aquatic food chain). It also impairs salmon’s ability to avoid predators and return to their home streams to spawn. Scientific studies have shown that the primary source of copper in highly urbanized watersheds is the fine dust generated by the use of vehicle brake pads.

Pursuant to the requirements of the federal Clean Water Act, the Regional Water Quality Control Boards in Los Angeles and San Diego have already imposed severe copper Total Maximum Daily Loads (TMDLs). Similar TMDLs are expected to be imposed on other urban watersheds across the state in the near future. The only technically and economically feasible way for municipalities to comply with these TMDLs is to eliminate copper pollution at its source – vehicle brake pads – no later than 2025. Any attempt to try and remove copper already dissolved in stormwater in highly urbanized areas would most likely require condemnation of large tracts of land and construction of elaborate infrastructure and cost already fiscally strapped local governments billions of dollars statewide with no guarantee that these methods would actually succeed.

SOLUTION: SB 346 would require brake pad manufacturers to reduce the use of copper in brake pads sold in California to no more than 0.5% by 2025. The bill also: 1) creates limits for other brake pad materials, 2) establishes a certification process by a third-party testing agency for compliance and requires the Department of Toxic Substances Control (DTSC) to charge a fee to cover the costs; 4) establishes civil penalties for violations; and 5) creates a Brake Friction Materials Water Pollution Fund into which any fines, penalties, and fees would be deposited. Funds collected would be used to implement the bill, upon appropriation by the Legislature. The goal is to improve California’s water quality and allow California stormwater agencies to meet their TMDLs in a timeframe that is aggressive but realistic for brake and vehicle manufacturers.

BACKGROUND INFORMATION:

The bill is sponsored by the City of San Diego and Sustainable Conservation, and is the result of a 15-year effort to understand and address the impact on the environment of brake pad wear debris generated during the use of motor vehicles. A series of interlinked, peer-reviewed laboratory, environmental monitoring, and environmental modeling studies established that brake pads are by far the most significant source of copper in runoff from urban watersheds. Details of these studies can be found at www.suscon.org/brakepad.

SB 346 provides industry with a generous timeline within which to develop and distribute safe and effective copper-free brake friction materials, gives cities and counties the ability to demonstrate that they will meet their copper TMDLs in a timely manner, and removes a serious threat to the health of salmon and other aquatic life in California’s urban watersheds.

For further information, please contact Linda Barr at (916) 651-4477 or by email at linda.barr@sen.ca.gov, or Justin Malan at (916) 448-1015 or by email at Justin@ecoconsult.biz.
Supporters:

Sustainable Conservation (co-sponsor)
City of San Diego (co-sponsor)
California Stormwater Quality Association
TDC Environmental
Coalition for Practical Regulation (representing 40 cities)
League of California Cities
Bay Area Stormwater Management Agencies Association (representing 84 cities and 7 counties)
California State Association of Counties
San Diego Coastkeeper
UC San Diego
Port of San Diego
U.S. Navy
Environmental Entrepreneurs
Sierra Club California
Natural Resources Defense Council
Center for Environmental Health
California Association of Environmental Health Administrators
California Product Stewardship Council
Forests Forever
Heal the Bay
Clean Water Action
Planning and Conservation League
California League of Conservation Voters
StopWaste.Org
City of Signal Hill
City of Lynwood
City of Carson
City of Whittier
City of Downey
City of Cerritos
City of Vista
City of Torrance
Los Angeles County Flood Control District
City of Arcadia
City of Los Angeles
City of Rolling Hills
City of Vernon
Ventura Countywide Stormwater Quality Management Program
City of Duarte
City of Sante Fe Springs
City of Lakewood
City of Camarillo
Coastal Environmental Rights Foundation
City of Commerce
Supporters:

City of Covina
Industrial Environmental Association
City of San Jose
City of Thousand Oaks
City of Monterey Park
City of Bellflower
City of Paramount
City and County of San Francisco
Alameda County Board of Supervisors
Ventura County Board of Supervisors
City of Santa Marina
City of Long Beach
City of Ventura
MRP Regional Supplement for POCs and Monitoring
Appendix A
June 3, 2010

The Honorable Pedro Nava
Chair, Assembly Committee on Environmental Safety & Toxic Materials
State Capitol, Room 2148
Sacramento, CA 95814

Subject: SB 346 (Kehoe) – Source Control of Copper Water Pollution – Support As Proposed To Be Amended

Dear Assemblymember Nava:

The Bay Area Stormwater Management Agencies Association (BASMAA)\(^1\) strongly supports SB 346 (Kehoe), which will provide California’s cities and counties with the tool they need to comply with stringent federal and state water quality mandates and avoid billions of dollars in costs and penalties. SB 346 requires that copper, an extremely significant aquatic pollutant, be reduced to a *de minimis* 0.5% by weight in vehicle brake pads sold in California by 2025. Peer-reviewed scientific studies have established that by far the most significant source of copper in urban watersheds is the fine dust generated from the use of brake pads.

Pursuant to the requirements of the federal Clean Water Act, the Regional Water Quality Control Boards in Los Angeles and San Diego have already imposed severe copper Total Maximum Daily Loads (TMDLs). Similar TMDLs are expected to be imposed on other urban watersheds across the state in the near future. The only technically and economically feasible way for municipalities to comply with these looming deadlines is to eliminate copper pollution at its source – vehicle brake pads – no later than 2025. Any attempt to try and remove copper already dissolved in stormwater in highly urbanized areas would most likely require condemnation of large tracts of land and construction of elaborate infrastructure. This could easily cost already fiscally strapped local governments billions of dollars statewide with no guarantee that these methods would actually succeed.

SB 346 provides industry with a generous timeline within which to develop and distribute safe and effective copper-free brake friction materials while also giving cities and counties the ability to demonstrate that they will meet their copper TMDLs in a timely manner without having to spend billions of dollars to do so. BASMAA and its 96 member agencies are pleased to support SB 346.

Very truly yours,

James Scanlin, Chair
Bay Area Stormwater Management Agencies Association

cc: Senator Christine Kehoe
Assemblymember Ira Ruskin

---

\(^1\) BASMAA is a consortium of nine municipal stormwater programs in the San Francisco Bay Area representing 96 agencies, including 84 cities and 7 counties. The members of BASMAA are responsible for complying with the requirements of municipal separate storm sewer system (MS4) National Pollutant Discharge Elimination System (NPDES) permits issued by the San Francisco Bay Regional Water Quality Control Board (Water Board).
Impact of dissolved copper on the olfactory system of seawater-phase juvenile salmon

**Estimated cost:** $36,767

**Oversight Group:** Exposure and Effects Workgroup

**Proposed by:** David Baldwin, Environmental Conservation Division, NOAA Northwest Fisheries Science Center

**PROPOSED DELIVERABLES AND TIMELINE**

Setup, exposures, electrophysiological recordings, and data analysis  
**June – Sept, 2011**

Preparation of report  
**Sept – Nov, 2011**

**BACKGROUND**

Copper is a ubiquitous contaminant of aquatic systems in urbanized and agricultural areas. In the San Francisco Bay estuary, elevated ambient copper concentrations result from a multitude of anthropogenic sources including, in decreasing order, erosion of buried sediments, inflow from the Sacramento and San Joaquin Rivers, urban and non-urban runoff, anti-fouling marine coatings, urban wastewater, atmospheric deposition, and industrial discharge (CRWQB 2007). Although the source of copper entering the Bay from the Sacramento and San Joaquin Rivers has not been assessed, one possible source is the application of copper-containing pesticides (data available online from the California Department of Pesticide Regulation Pesticide Use Reporting Program www.cdpr.ca.gov/docs/pur/purmain.htm).

In fish, exposures to dissolved copper concentrations that are sublethal are, nonetheless, known to be able to impair peripheral sensory systems (e.g. gustation, mechanosensation, and olfaction). For example, freshwater studies have shown that copper is toxic to fish mechanosensory (Hernandez et al. 2006; Linbo et al. 2006) and olfactory (Hansen et al. 1996; Baldwin et al. 2003) receptor neurons. Furthermore, inhibition of olfactory function is highly correlated with reduced ability to respond to an olfactory alarm cue that triggers anti-predation behavior in juvenile coho salmon (*Oncorhynchus kisutch*, Sandahl et al. 2007). In experiments with predatory cutthroat trout (*Oncorhynchus clarki*), survival of juvenile coho salmon was reduced 3- to 5-fold (McIntyre et al. in prep.). Significantly, these effects on the olfactory system can occur following exposure periods of as little as 30 minutes and increases in dissolved copper concentrations of as little as 3 µg/L (e.g. Baldwin et al. 2003; see Figure).

Current site-specific copper objectives (SSOs) for San Francisco Bay were derived, in large part, from 96-hour tests on the development of larval *Mytilus edulis*. As per EPA guidance, toxicity tests in site water and standard laboratory waters were compared to account for the local influence of water chemistry on the bioavailability of copper to...
relevant ligands in this organism. When considering copper neurotoxicity to peripheral sensory systems of sensitive fish taxa, it is important to realize that water chemistry may not have the same influence as on the development of larval *Mytilus edulis*. In tests on peripheral sensory systems in freshwater fishes, hardness and alkalinity provided little to no protection from copper neurotoxicity (McIntyre et al. 2008; Linbo et al. 2009). This differs from the conventional understanding of the influence of water quality on copper toxicity derived from the Biotic Ligand Model (BLM). Dissolved organic matter (DOC) provided some protection against copper neurotoxicity, but not to the extent expected from BLM-based predictions. These results are likely because the copper dynamics modeled by the BLM are based on interactions with ligands at the fish gill, not at sensory epithelia.

Currently, the copper SSOs are higher than concentrations at which effects on olfactory neurophysiology (Baldwin et al. 2003) and behaviour (Sandahl et al. 2007; McIntyre et al. in prep.) were seen in juvenile coho salmon. However, studies on copper neurotoxicity to peripheral sensory systems have thus far been conducted exclusively in freshwater. Given the uncertainty about the protectiveness of seawater from copper olfactory neurotoxicity, it is difficult to extrapolate effects thresholds to the different water chemistry of marine and estuarine waters. Additionally, differences between the biology of freshwater-phase versus seawater-phase juvenile salmon produce another source of uncertainty. The goal of this study is to determine the impacts of dissolved copper of the olfactory system of seawater-phase juvenile salmon in order to compare these effects to those known for freshwater-phase juvenile salmon and the copper SSOs for the San Francisco Bay estuary.

**APPLICABLE RMP OBJECTIVES AND MANAGEMENT QUESTIONS**

4.3 *What ecological risks are caused by pollutants of concern?* This study will determine what levels of dissolved copper pose a risk to the olfactory system of seawater-phase juvenile salmon.

4.6 *Which forms of pollutants cause impairment?* In addition to being present as free copper ions ($\text{Cu}^{2+}$), dissolved copper will form complexes (i.e. species) with other constituents of water (e.g. hydroxyl ions, carbonates, and dissolved organic molecules). These other species are considered to be much less toxic with respect to acute mortality and development. However, some of them may still be toxic to the olfactory system. The ability of seawater to form copper complexes, therefore, may provide less protection to the olfactory system of salmon than expected based on acute mortality.

5.1 *What percentage of the Estuary is supporting beneficial uses?* This study will address whether copper SSOs are likely to protect the olfactory system of juvenile salmon in the SF Bay estuary from sublethal impairment.

**APPROACH AND OBJECTIVE**

This study will be based on previous NOAA studies that measured copper olfactory toxicity in freshwater-phase juvenile salmon (Baldwin et al. 2003; Sandahl et al. 2007; McIntyre et al. 2008). As was done in these previous studies, the impact of copper exposure on the sensitivity of the salmon olfactory system to odors will be measured using direct electrophysiological recordings (electroolfactograms; EOGs) from the olfactory epithelium (Baldwin et al. 2003). While the effect of copper on the EOGs of seawater-phase salmon has not been measured, the methods have been adapted to record EOGs in seawater-phase cutthroat trout (Labenia et al. 2007). The experiments will be performed at the Northwest Fisheries Science Center’s (NWFSC) Mukilteo Field Station (Mukilteo, WA) using Chinook salmon (*Oncorhynchus tshawytscha*). Fertilized eggs will be obtained from a local hatchery and reared in freshwater at Mukilteo until fish are the appropriate age for smolting. The majority of the fish will then be transitioned to seawater and maintained in seawater for the duration of the experiment, while a subset will remain housed in freshwater. Water samples will be collected for analyses of water chemistry parameters (e.g. salinity and DOC) and copper concentrations.
Determine the threshold for effects of dissolved copper on the olfactory system of seawater-phase juvenile salmon. The proposed studies are expected to be initiated in June 2011 and should be complete by the end of the fiscal year (October 2011). To determine the effect of copper on the olfactory system, odor-evoked EOGs will be obtained from fish using a standard odorant, the amino acid L-serine. Fish will be either unexposed to copper (controls) or exposed for a short period (30 minutes) to one of at least 3 copper concentrations (ranging from 2-20 µg/L, but higher if needed). Copper-induced changes in the sensitivity of the olfactory system will be measured as a dose-dependent reduction in the amplitude of the odor-evoked EOGs from which an effect threshold for copper can be determined (e.g. see figure above). While the focus of the EOG recordings will be on seawater-phase juvenile Chinook salmon, fish that weren’t smolted will be available, if necessary, to confirm the impact of copper on the olfactory system of freshwater-phase Chinook.

Since DOC is known to affect the toxicity of copper to the olfactory system (McIntyre et al. 2008), exposures will be performed at three different DOC concentrations representative of the SF Bay (e.g. 2, 4, and 6 mg/L). To the extent possible, the source of DOC used to amend the local seawater (which is ~2 mg/L DOC) will have copper binding properties similar to that of DOC from the SF estuary. The aim of the study will be to determine the effects threshold for the olfactory toxicity of copper in seawater-phase juvenile salmon at various DOC concentrations in order to compare this with thresholds measured from freshwater-phase salmon and with the copper SSOs in the SF Bay estuary.

**REQUESTED BUDGET:**

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NOAA contributions will include fish, fish husbandry, additional equipment and salary support (e.g. technicians and PI).

**Cited literature:**


MRP Regional Supplement for POCs and Monitoring
Appendix B
# DRAFT

## BASMAA REGIONAL MONITORING COALITION

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<sup>a</sup>Although contributors to the RMP under the umbrella category of "stormwater", during FY 2009-10 these entities were not members of BASMAA or subject to the MRP.
MRP Regional Supplement for POCs and Monitoring
Appendix B
RMP
Small Tributaries Loading Strategy

SFEI Contribution #585
This report should be cited as:
San Francisco Estuary Institute, (SFEI) 2009. RMP Small Tributaries Loading Strategy.
SFEI Contribution #585. San Francisco Estuary Institute, Oakland, CA.
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Introduction

The overarching goal of the RMP, and the intent of the Small Tributaries Loading Strategy (STLS), is to provide information needed to support water quality management decisions. The STLS was developed to ensure that the RMP is providing the information most urgently needed by managers to reduce loads and impacts of pollutants of concern (POC) entering the Bay from small tributaries.

The objective of this document is to present a planning framework for small tributary loads monitoring within the RMP that is consistent with and complemented by monitoring that will be completed in compliance with the Municipal Regional Permit for stormwater agencies (MRP). Water Board staff have affirmed that MRP provisions relating to POC and sediment loads monitoring would be revised to be compatible with the final version of this Strategy. Ideally, the strategy will be incorporated into the permit requirements so that coordination between BASMAA efforts and RMP efforts can be achieved. If the MRP development process is completed after development of this Strategy, the methods and studies outlined in this Strategy can be incorporated in the MRP language by reference. Implementing this Strategy will also consistent with the other RMP Strategies (Mercury, Dioxins, Modeling, and PCBs). These linkages are highlighted throughout.

Small tributaries have been identified in the mercury and PCB TMDLs as contributing significant and controllable loads of pollutants to San Francisco Bay. While mercury, methylmercury and PCBs remain the top priority and the focus of the majority of resources, the Sources Pathways and Loadings Workgroup (SPLWG) has ranked PBDEs as a high priority, and pyrethroids, dioxins (see the RMP Dioxin Strategy), selenium, OC pesticides, copper, nickel, and PAHs as medium priority for loads information. There are additional analytes listed in the February 2009 draft tentative order of the MRP that will also be considered (Category 1: CuD, POC; Category 2: SeT, SeD, NOx, total P and phosphate (PO4\(^{3-}\)). In addition, it is recognized this POC list might evolve year-to-year as more information is gained through, for example, the emerging contaminants workgroup (ECWG) of the RMP. For all these POCs there remain uncertainties in:

- the magnitude of total regional loads,
- which watersheds contribute disproportionately to loads and impacts on local and regional scales,
- the relative importance of atmospheric deposition versus local sources contributing to watershed loads,
- how management can reduce loads, and
- trends in loads.

A premise of this Strategy is that it is possible to identify small tributaries that exert a disproportionately large influence on loads and impacts (consistent with the PCB and Hg strategies). Older industrial areas in local watersheds are presently hypothesized to be more polluted with PCBs than other parts of the urban landscape, whereas for
mercury, a broader distribution is hypothesized that includes industrial and commercial areas with higher imperviousness, and older urban areas. This more even distribution is partly because regionally it is estimated that about one third of the mercury load in urban stormwater is derived from atmospheric deposition. An additional premise of this Strategy is that the process of identification of sources and control of Hg and PCBs will also help to control other particle bound POCs. If these premises are correct, it will be possible to focus attention on contaminated tributaries and areas within watersheds and reduce mercury, PCB and other POC loads to the Bay and ultimately reduce beneficial use impacts in a cost-effective manner.

The RMP has already conducted loads monitoring for mercury, PCBs, and other POCs in three tributaries (Sacramento River, Guadalupe River, and Zone 4 Line A, a small tributary in Hayward). This Strategy aims to build on existing efforts and increase the amount and cost-effectiveness of information generated to answer key management questions while at the same time coordinating with BASMAA studies in relation to MRP compliance.

Management Questions and Priorities

1) Impairment
   Which are the “high-leverage” small tributaries that contribute or potentially contribute most to Bay impairment by pollutants of concern?
   An understanding of the POC load contributions of individual watersheds to impairment will be essential to developing cost-effective strategies for reducing loads and monitoring progress in load reductions in the context of sensitive areas on the Bay margin and food web uptake. This question ties closely with the RMP Mercury and PCB Strategies which identify the need to determine which processes, sources, and pathways disproportionately contribute to food web accumulation. It is anticipated that a focus on linking loads to impairment will help ensure that load reductions actually lead to reductions in exposure and impacts in target species. Implicitly, to answer this question, information will needed that links concentrations or loads from watersheds with key biological processes in the near-field habitats on Bay margin. Before that can be done however, we must first make decisions about which watersheds to study using a ranking derived from the combination of all available information on POC sources, atmospheric deposition, sediment concentrations in stormwater conveyances, and POCs in Bay margin sediment and biota.

2) Loads
   What are the loads or concentrations of pollutants of concern from small tributaries to the Bay?
   The TMDLs for mercury and PCBs include an allocation for the aggregate loads from urban stormwater runoff. Data collected in compliance of provision C.8.f of the MRP will inform improved measurements of single watershed loads and regional estimates. While load information will be developed for single watersheds, we are emphasizing understanding loading and impairment at the regional scale. This information will be
useful for input into models of the Bay process and recovery time (see the RMP Modeling Strategy). A combination of field studies and modeling will be needed to answer this question. There are a few key intermediate questions to be answered. For example, what sampling design is needed (how many samples under what kind of field conditions should be taken to generate loads information)? How many categories of watersheds are there in the Bay Area? How many watersheds in each category should be studied? Which categories should be prioritized for collection sooner than others? What sampling design is needed to characterize loads associated within each watershed category? Although Hg and PCBs are the most urgent and data rich POCs to build a framework of investigation from, like all other components of this Strategy, it is assumed that there will be benefits for other POCs.

3) Trends
   How are loads or concentrations of pollutants of concern from small tributaries changing on a decadal scale?
Understanding long-term trends in loads is essential to tracking progress toward TMDL wasteload allocations. Provision C.8.d and C.8.f of the MRP describe the intent to track trends through water quality sampling in urban stormwater. Answering this question will require the collection of systematic data in fixed locations. Power analysis will be needed to determine the amount of data needed to see a trend of a given magnitude given reasonable expectations of management effort and environmental variability.

4) Support for Management Actions
   What are the projected impacts of management actions on loads or concentrations of pollutants of concern from the high-leverage small tributaries and where should management actions be implemented in the region to have the greatest impact?
Answering this question will require conceptual, and ideally quantitative models of the behavior of POCs in the watersheds, along with an adequate foundation of empirical information (see the RMP Modeling Strategy (Question 4)). Data will be needed to populate the internal structure of the models (for example concentrations and loads of POCs associated with land use or source categories) as well as for calibration and verification (e.g., single location time continuous flow and concentration data). In addition to model input data, information on anticipated management actions will be needed: when, where, and what?

Guiding Principles

- Focus on what should be done, rather than what can be done. Implement control measures where they are most likely to impact Bay water quality impairments.
- Seek opportunities for obtaining information on multiple pollutants in a cost-effective manner (e.g., piggybacking).
- Seek areas where collaboration can be maximized.
Definitions

- Small tributary: Rivers, creeks, and storm drains that enter the Bay downstream of the confluence of the Sacramento and San Joaquin rivers.
- Pollutants of concern (POC): Use SPLWG prioritized list and the list provided in provision C.8.f of the MRP and apply budget disproportionately to higher ranked POCs.

Implementation of the STLS

The largest challenge that is unique to the STLS in contrast to the other RMP strategies is the close coordination with the monitoring components in the MRP. We envisage the need for a consensus between the RMP Steering Committee, the Water Board, and BASMAA on which parts of the STLS will fulfill permit requirements and what kind of reporting will be needed by the STLS team in that regard. This decision will provide the general conceptual framework for partitioning activities between RMP work and BASMAA work under the MRP. Although conceptually there will be a need each year to review that decision and alter it as needed, the success of this Strategy and the resulting program of observation and information development will be largely reliant on consistency and predictability for staffing and equipment.

Like any planning document, this Strategy will require periodic updating as management needs evolve and questions are answered or new questions are generated. In addition, stakeholders are interested in periodic reports that synthesize the data and information developed as a WHOLE. Lastly, stakeholder meetings will be required periodically to inform interested parties of results and make adjustments to the field components of the strategy.

Proposed Tasks to Answer the Management Questions

Task 1: Guadalupe River Model

Funded in 2008 and 2009 - $150,000 over two years. Proposed funding 2011 - $75,000

In 2009 the RMP funded the 2nd year of a two year modeling effort in the data rich Guadalupe River Watershed as a first step towards developing a regional scale model. Guadalupe was chosen because of the abundance of rainfall and runoff data collected by the SCVWD, the abundance of Hg sediment data collected by a number of agencies beginning 1988, and the abundance of suspended sediment and bed load data collected by the USGS. In addition, the RMP/CEP/SCVWD/SCVURPPP has funded SFEI to collect 4 years of Hg, PCB and other POC data during storms. While the model may have local stakeholder uses, the overall intention is to use Guadalupe as a starting point for the development of other watershed models and ultimately a regional scale model. In 2011, the model will be rerun to answer questions like:
Long term average loads (Strategy Question 2)
Predicting the effects of various BMP scenarios (Strategy Question 4)
Predicting the time to observe trends (Note this would help to refine the sampling plan (Task 3))

Year 1 – Model stormwater flow (Lent and Oram, 2009)
Year 2 – Model suspended sediment, Hg, and PCBs
Year 3 – Model BMPs and loads trends.

Objectives: Improve load estimates for Guadalupe River, develop and calibrate a model for testing BMP scenarios and predicting load trends, and provide tested parameterization of the model to expand the use to other watersheds in the regional context.

Task 2: Z4LA Small Tributaries Loading Study
Funded Water Years 2007, 2008, 2009 - $400,000 over three years.

Beginning in 2007, the RMP funded a second small tributaries loading study in a small urban watershed in Hayward. The intent of this study was to understand loads of POCs entering the Bay from a small industrialized tributary near the Bay margin. This watershed was chosen because it contrasts with Guadalupe River in size, land use, rainfall variation, soil types, and location on the Bay margin. The study uses an intensive single station design employing 5 minute interval stage, rainfall, and turbidity measurement and storm focused ISCO pump sampling and depth-integrated point sampling. So far this study has been funded for three relatively dry years. Preliminary comparisons to Guadalupe reveal similarity of most POC loads normalized to areas during dry years with the exception of Hg, Cr, and Ni which have greater concentrations and loads in the Guadalupe system most likely due to historic mining.

Objective: Improve regional loads estimates for the class of smaller industrial watersheds near the Bay margin.

Task 3: Develop Multi-Year Watershed Loading Sampling Plan
Funded 2009 - $10,000

In order to cost effectively and systematically gather data to answer the Strategy questions, a multi-year sampling plan is needed to guide both the RMP and MRP data collection efforts. The aim of this task is to provide the rationale and plan for sampling to address the Strategy questions. This document will have strong linkages to provision C.8.d and C.8.f of the MRP. The sampling plan will need to be updated periodically as management needs change.

Three subtasks will contribute to development of the sampling plan. The sampling plan will reflect the present consensus obtained through ongoing discussions between the Water Board and BASMAA with scientific advisory input.
Objective: Write a sampling plan for small tributaries loads that represents consensus and guides RMP and MRP studies over the next 3-5 years.

Task 3a: Develop Criteria and Rank Watersheds
Funded 2009 - $25,000

The premise of the STLS is that it is possible to identify tributaries where there are controllable sources that exert a disproportionately large influence on loads and impacts. Two key questions in relation to this Strategy, and before the Water Board and BASMMAA in relation to the MRP, are how many types of watersheds do we have and how many watersheds should be studied to answer the key management questions? A key long-standing recommendation of the SPLWG is to stratify watersheds into broad categories and then to sample one or two watersheds in each category; however due to budget limitations this has never been done. To answer these questions, a list of “representative watersheds” or which in the past have been called “observation watersheds” (Davis et al., 2000) or which in southern California are called “mass emissions sites” (Tiefenthaler et al., 2008) needs to be developed. Data on concentrations in Bay sediment, water, and tissue will be used along with physical parameters such as water depth and circulation patterns to characterize and rank Bay margins. To characterize and rank watersheds, information on PCB and Hg sources and “emission factors” and low and high flow hydrology and loads (McKee and Gilbreath in preparation) will be combined with recent new estimates of watershed specific sediment loads (Lewicki and McKee et al., 2009) to provide hypotheses of sediment concentrations. A weight-of-evidence approach will be used during the ranking process, along with knowledge of opportunities for collaboration, and benefits for multiple pollutants.

Objective: To develop a list of representative watersheds for focused study.

Task 3b: Optimize Sampling Methods for Loadings and Trends
Funded 2009 - $45,000

Management questions and associated hypotheses that are tested by environmental field data require an appropriate field sampling design that is cost effective and achieves the desired outcomes with appropriate confidence. Over the past eight years the SPLWG has implemented loads studies at Mallard Island, the Guadalupe River, and Zone 4 Line A with the objective of increasing our understanding of the sources and processes of sediment and pollutant transport and calculating accurate and precise loads of particle associated POCs. Given increasing costs, the need to estimate loads at more locations in any given year, and the need to show trends (over 5 or more years) as one tool for evaluating whether the TMDL objectives are being met (see provision C.8.f of the February 2009 draft tentative order of the Municipal Regional Permit (MRP)), there is a clear need to evaluate our sampling design and reformulate it as necessary. Using data collected at the three existing load stations, an analysis will be performed to assess the optimal number of samples and style of sampling coupled with loads calculation techniques for assessing loads and determining trends. Methods
similar to those outlined in published works (Leecaster et al., 2002; Ma et al., 2009) will be used. We will also make a cost analysis of each combination so that local managers can assess accuracy versus cost. The simulated sampling techniques will be decided during review of a work plan or, if needed, at a special subcommittee meeting of the SPLWG.

Objective: To determine the optimal sampling design for both loads monitoring and trends detection.

**Task 3c: Develop Spreadsheet Model for Regional Loadings Estimates**

Proposed funding 2010 - $35,000, $10,000 each year thereafter

“Spreadsheet models” provide a useful and inexpensive tool for organizing data to estimate regional scale watershed loads, our second key management question. They are based on the simplifying assumption that unit area runoff for homogeneous sub-catchments has constant concentrations and thus have advantages over models such as HSPF and SWMM that require large calibration data sets which take money and time to collect. Such a model was developed for the Bay Area previously (Davis et al., 2000) however, at that time, there was only local land use specific data on POCs for a drought period late 1980s and early 1990s, and there were no data on Hg and PCBs. In this task, a GIS based “spreadsheet model” will be developed using more recent local data on land use based concentrations and mass emissions collected in the Bay Area (augmented using recent stormwater literature) and updated annually as more and more data becomes available through implementation of this Strategy. The model structure will be based on the published work by Ha and Stenstrom (2008) and is more sophisticated than the SIMPLE model used by Davis et al (2000) because it contains calibration steps.

Objective: Develop a calibrated tool to make regional scale loads estimates of current and future POCs that can be updated annually as new information is developed.

**Task 4: Pollutants of Concern Monitoring at a Subset of Representative Watersheds**


Provision c.8.f of the revised tentative order of the MRP (February 2009) calls for monitoring to assess inputs of POCs to the Bay from specific local tributaries and urban runoff, to assess progress toward achieving wasteload allocations (WLAs) for TMDLs, and for helping to resolve uncertainties associated with loads estimates for POCs at the regional scale (whole Bay). The objective of this task is to carry out monitoring that achieves these same goals, and addresses Strategy questions 1 and 2. An efficient approach to conducting this monitoring will be developed through SPLWG discussions and guided by the multiyear watershed sampling plan (Task 3). With an efficient approach, it should be possible to establish three small tributaries load monitoring stations at a $250,000 / year level of funding but the cost estimate will necessarily be refined after the completion of Task 3b (above). The locations would be decided through
consultation with BASMAA and the Water Board and based partly on Task 3a (Develop criteria and rank watersheds). In year 1, we would install discharge and sediment monitoring equipment at three locations and begin sampling. In year two, the majority of the funds would be applied to collecting field data when all the start up costs would have been expended in the first year. Technical reports would be written in year 3 and year 5 only, to minimize reporting costs.

Objective: Determine loads entering the Bay from representative watersheds and improve regional loads estimates.

Task 4a: Pollutants of Concern Monitoring (Guadalupe River)
Proposed funding 2010 - $43,000. 2013 - $65,000 (if selected for ongoing monitoring)

Data collected previously in the Guadalupe River Watershed left a number of unanswered questions and hypotheses. During the first sampling year, a 1:5 year return storm event occurred. From December 16\textsuperscript{th} 2002 mercury concentrations were elevated for the remainder of the WY. The data supported a number of hypotheses about the causes of high concentrations but the watershed was never sampled under similar conditions. Additionally, the original sampling design did not allow an estimate of Hg or PCBs from urban sources alone. In response to remaining unanswered questions and also the need to carry out systematic repeated sampling to assess trends, the RMP has budgeted funding for sampling every three years. Recently, the RMP began modeling Guadalupe using the HPSF numerical model to understand the source, release, and transport of sediment and contaminants to San Francisco Bay. The Guadalupe River was chosen primarily because of existing data richness and secondarily because of imminent management aimed at reaching loads targets imposed by the Hg TMDLs. Despite data richness, the weakest POC data set is land use specific data during flood flow; more of this kind of data will be collected in Task 4e and are necessary for calibrating the land use specific components of loading models and improving model performance for simulating BMPs.

Objectives: To collect land use specific PCB data at two locations, one mostly non-urban and upstream and one mostly urban and downstream to calibrate the land use components of the HSPF model and provide recommendations for similar efforts elsewhere in the Bay Area.

Task 4b: Pollutants of Concern Monitoring at a Subset of Representative Watersheds – Zone 4 Line A – year 4
Proposed funding 2010 - $150,000

Beginning in 2007, the RMP funded a second small tributaries loading study in a small urban watershed in Hayward. The intent of this study was to understand loads of POCs entering the Bay from a small industrialized tributary near the Bay margin. This watershed was chosen because it contrasts with Guadalupe River in size, land use, rainfall variation, soil types, and location on the Bay margin. The study uses an intensive single station design employing 5 minute interval stage, rainfall, and turbidity.
measurement and storm focused isco pump sampling and depth-integrated point 
sampling. So far this study has been funded for three relatively dry years. Preliminary 
comparisons to Guadalupe reveal similarity of most POC loads normalized to areas 
during dry years with the exception of Hg, Cr, and Ni which have greater concentrations 
and loads in the Guadalupe system most likely due to historic mining.

Objective: Improve regional loads estimates for the class of smaller industrial 
watersheds near the Bay margin.

**Task 4c: Pollutants of Concern Monitoring at a Subset of Representative 
Watersheds – Reconnaissance**

Proposed funding 2010 - $12,000

Conducting loads studies in “observation” watersheds is a long standing 
recommendation of the SPLWG (see Davis et al., 2001). Recent TMDL reports on 
PCBs and Hg emphasize the influence of local small tributaries on water quality in the 
Bay and call for reduced loadings from urban areas. Provision C.8.f of the February 
2009 draft tentative order of the Municipal Regional Permit (MRP) describes the need 
for Permittees to monitor eight watersheds to generate loads information. The watershed 
ranking study (Task 3a) planned for completion in early 2010, will provide a list of 
prioritized watersheds for study. Given logistical constraints such as channel form and 
safety that restrict the practical implementation of a loads monitoring study, a 
reconnaissance study will be carried out to investigate the potential for safe and 
successful sampling in the top ranked watersheds in the context of management 
questions. Note it is possible that some of these locations could overlap with the list of 
locations developed in Task 4d.

Objective: Document technically feasible and “safe” locations for consideration for future 
small tributary loads monitoring.

**Task 4d: Pollutants of Concern Monitoring at Representative Land Use sites – 
Rationale Development and Reconnaissance**

Proposed funding 2011 - $30,000

In order to develop models capable of testing and forecasting the effects of best 
management practices (BMPs) on POC trends (management question 4), data must be 
collected on land use based concentrations and mass emissions to provide a regional 
calibration data set. In this task we will refine the rationale for such an effort by 
reviewing literature and discussing potential modeling questions with local agencies. We 
will identify land use categories of interest in relation to our POC list. Those presently 
proposed based on the SoCal experience and discussions at strategy team meetings 
are a) Agriculture , b) Commercial, c) High density residential, d) Industrial, e) Low 
density residential, f) Open space, g) Recreational, and h) Transportation. There was 
also discussion of adding a “land use condition” factor such as age and conditions of 
roads and drainage systems). A list of potential sampling locations will be developed 
through a review locations sampled by BASMAA agencies in 1989-1995 and use GIS
and aerial photographs to investigate possible locations in high ranking watersheds (Task 3a) taking into consideration the decisions on land use categories to focus on. Lastly, we will carry out a field reconnaissance to investigate the potential for safe and successful sampling. Note it is possible that some of these locations could overlap with the list of locations developed in Task 4c.

Objective: Provide written documentation of the rationale for land use based sampling and a list of potential sampling locations.

Task 4e: Pollutants of Concern Monitoring at Representative Land Use sites
Proposed funding 2012, 2013, 2014, and 2015 - $100,000/year

In order to develop models capable of testing and forecasting the effects of best management practices (BMPs) on POC trends (management question 4), data must be collected on land use based concentrations and mass emissions to provide a regional calibration data set. We propose to follow the published methods of Tiefenthaler et al. (2008) after an initial assessment of data needs based on what is learned from the Guadalupe River model (see task above), and assessment of the usefulness of existing local data (BASMAA 1996; Soller et al, 2003/SCVURPPP 1998/99; McKee unpublished; EBMUD, 2009). Note the budget for this task depends on POC list, number of sites, and proximity to other loads monitoring sites. The cost proposal will be revised based on the outcomes of Task 3a, 3b, 4c, and 4d. The proposed budget would cover the following tasks:

- Purchasing and installing sampling equipment.
- Sampling storm events at each land use site following the outcomes of Task 3b above (sampling method (discrete or composit; number of samples per storm; number of storms per site).

Objective: Characterize land use specific concentrations and loads as basic data for model development and calibration.

Task 5: Dynamic Modeling in a 2nd Selected Representative Watershed
Proposed funding 2012 - $150,000

The Strategy calls for developing regional estimates of loads, tracking progress towards loads reductions, and determining the effectiveness of management towards TMDL goals. The completion of the Guadalupe Model (Task 1) will address all these questions but only for one large mercury contaminated watershed. The objective of this task is to address the answers to these key Strategy questions in another watershed (likely focusing on one adjacent to a known “high leverage contaminated Bay Margin”). A key outcome will be an assessment of how management might be able to reduce loads in the context of linkage to the processes of uptake on the Bay margin. This task will necessarily need data provided by Task 4a, 4b, and 4c (POC Monitoring at a Subset of Representative Watersheds and Task 4d and 4e (POC Monitoring in Representative Land Use sites). At this time, we propose to use the HSPF modeling platform but there
now exists modified spreadsheet models (annual average time step) that might be considered (e.g., Ha et al in review).

Objective: Expand our modeling capability to test BMPs and predict trends in other representative watersheds.

References


McKee and Gibbreath in preparation. Estimates of flow and contaminant loads entering the Bay under selected rainfall and runoff conditions in relation to the potential for routing to wastewater treatment.


Table 1. Study elements, questions and budget allocations small tributaries loadings studies and monitoring proposed for the RMP from 2009 to 2015. Numbers indicate proposed budget allocations in $1,000s. With the exception on those costs that are marked by an asterisk, all other tasks and costs are subject to funding availability and TRC/SC approval.

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Question</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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<td>1</td>
<td>Guadalupe River Model (2008 and 2009)</td>
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<td>Z4LA Small Tributaries Loading Study (Water Years 2007, 2008, 2009)</td>
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<td>3</td>
<td>Develop Multi-year Watershed Loading Sampling Plan</td>
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<td>3a</td>
<td>Develop Criteria and Rank Watersheds</td>
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<td></td>
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<td>3b</td>
<td>Optimize Sampling Methods for Loading and Trends</td>
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<td>3c</td>
<td>Develop/Update Spreadsheet model for Regional Loadings Estimates</td>
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<td>POC Load Monitoring in Representative Watersheds</td>
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<td>Guadalupe</td>
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<td>4c</td>
<td>Watersheds to Be Named Later (reconnaissance)</td>
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<td>4d</td>
<td>Pollutants of Concern Monitoring at Representative Land Use sites – Rationale Development and Reconnaissance</td>
<td>2,3,4</td>
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<td>4e</td>
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<td>100?</td>
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<td>Dynamic Modeling in a 2nd Selected Representative Watershed</td>
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<td>270</td>
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<td>510</td>
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* Already incorporated into a preexisting proposed budget.
## Appendix 1: Water Board Priorities for Loads Monitoring

This table contains Water Board decisions or management questions and SPLWG activities that might be needed to address these decisions/questions. The priorities are the same as those identified in the Sources Pathways and Loading Workgroup 5-year plan and have been developed through a consensus based discussions by the Work Group during 2007 and 2008.

<table>
<thead>
<tr>
<th>SPLWG Priority</th>
<th>Pollutant</th>
<th>Near-term Decision or Management Question (5 years)</th>
<th>Modeling or Monitoring Needs for 5 years</th>
<th>Long-term Decision or management question (10 years)</th>
<th>Modeling or Monitoring Needs for 10 years</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>Mercury, methylmercury</td>
<td>What is the contribution of local tributaries and storm drains to localized problems at the BayMargins. What is the rate of progress toward TMDL load allocations. MRP requires monitoring of methyl mercury loads from urban runoff.</td>
<td>Local tribs monitoring studies designed to support Bay Margin modeling. Need local trib monitoring and beginning of model development to be able to estimate full watershed loads to assess TMDL progress.</td>
<td>Is the urban runoff (tribs/storm drains) total mercury load from all being reduced consistent with the TMDL load allocations for urban runoff. What is the spatial pattern of such load reductions to guide where more progress is needed.</td>
<td>Need sufficient and representative local tribs monitoring plus development of predictive model to provide refined assessment of loads from all watersheds/storm drains and determine spatial and perhaps temporal patterns?</td>
<td>The overarching issues are: 1) determining progress toward meeting Bay-wide load allocations; 2) determining if there are local impacts from some tribs that would require special attention; and 3) being able to distinguish local tribs/storm drains that contribute disproportionately either to Bay-wide loads or localized impacts at the margins. The modeling and monitoring should be directed at these issues. See narrative sheet as well.</td>
</tr>
<tr>
<td>Top</td>
<td>PCBs</td>
<td>What is the contribution of local tributaries and storm drains to localized problems at the Bay Margins. We also need to understand loads to various segments and gain understanding if those segment-specific loads matter to Bay impairment.</td>
<td>Local tribs monitoring studies designed to support Bay Margin strategy. Need local trib monitoring and beginning of model development to be able to assess full watershed loads and loads by Bay segment.</td>
<td>Are loads of PCBs from all watersheds being reduced consistent with the TMDL load allocations for urban runoff.</td>
<td>Need sufficient and representative local tribs monitoring plus development of predictive model to provide refined assessment of loads from all watersheds/storm drains and determine spatial and perhaps temporal patterns?</td>
<td>See mercury comments.</td>
</tr>
<tr>
<td>SPLWG Priority</td>
<td>Pollutant</td>
<td>Near-term Decision or Management Question (5 years)</td>
<td>Modeling or Monitoring Needs for 5 years</td>
<td>Long-term Decision or management question (10 years)</td>
<td>Modeling or Monitoring Needs for 10 years</td>
<td>Comments</td>
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<tr>
<td>High</td>
<td>PBDEs</td>
<td>What is the contribution of local tributaries and storm drains to localized problems at the Bay Margins. What are the loads of PBDEs from all stormdrains and local tribes. We will need baseline loads to track future loading trends. We also would like to gain the understanding of loads by Bay segment as for PCBs.</td>
<td>Local trib monitoring studies designed to support Bay Margin modeling. Need local trib monitoring and beginning of model development to be able to assess full watershed loads.</td>
<td>Need trends in PBDE loads. If TMDL is developed, we would need refined load estimates for TMDL.</td>
<td>May need similar information as for mercury or PCBs if PBDE TMDL is developed. Otherwise, we would need less detailed information but sufficient monitoring and modeling to PBDE loading trend.</td>
<td>Look for &quot;piggy-back&quot; opportunities in course of doing work on PCBs. We are not sure what the form of the TMDL will look like, but we know that we will need to be confirming loading trajectory at the very least.</td>
</tr>
<tr>
<td>SPLWG Priority</td>
<td>Pollutant</td>
<td>Near-term Decision or Management Question (5 years)</td>
<td>Modeling or Monitoring Needs for 5 years</td>
<td>Long-term Decision or management question (10 years)</td>
<td>Modeling or Monitoring Needs for 10 years</td>
<td>Comments</td>
</tr>
<tr>
<td>Medium</td>
<td>Pyrethroids</td>
<td>Are these compounds being detected and causing toxicity? How widespread is this toxicity? Are these pesticides found in runoff at levels that would impact Bay margins in terms of toxicity?</td>
<td>Need some level of monitoring and trend assessment - coarse assessment and evaluation of Bay Margin load and toxicity.</td>
<td>Are these compounds being detected and causing toxicity?</td>
<td>Need some level of monitoring and trend assessment - coarse assessment.</td>
<td>Potential emerging replacement class of pesticides. Needs: characterize and track possible impacts per implementation plan of Urban Creeks TMDL for pesticide-related toxicity.</td>
</tr>
<tr>
<td>Medium</td>
<td>Dioxins</td>
<td>What is the contribution of local tributaries and storm drains to localized problems at the Bay Margins. We may need rough cut loading estimate to Bay. There may be a need to understand role of atmospheric deposition contributions to trib/storm drain loads. We need improved understanding of presence in runoff and spatial distribution and how relevant are small trib to Bay impairment.</td>
<td>some similarity to above pollutants plus air deposition monitoring/modeling connection.</td>
<td>The long term needs depend heavily on the nature of the TMDL. If there is a TMDL, we would need at least some assessment of loading trends.</td>
<td>Need some level of monitoring and trend assessment - coarse assessment.</td>
<td>Impairment listing for Bay, assumed benefit from PCB actions. Needs: fill gaps in conceptual model/impairment assessment, including sources, loads; also determine benefits from PCB actions? May eventually need refined load estimates for all types of dioxins (dioxin-like PCBs and the furans). Here too - look for piggy-back opportunities on top of PCB studies. For dioxin: is the loading coming from local or global sources? We will need evidence about this question for TMDL.</td>
</tr>
<tr>
<td>Medium</td>
<td>Selenium</td>
<td>We need refined load estimates from local tributaries, probably much more focused on extreme S. Bay at the moment. There could be impairment there and need to understand small trib contribution.</td>
<td>monitoring studies for small trib in S. Bay to get loading estimates.</td>
<td>Update on local trib load estimates.</td>
<td></td>
<td>North Bay TMDL in development. Needs: refine load estimates from local tributaries. Main focus of monitoring should be S. Bay unless data gaps emerge from N. Bay TMDL development. This is unknown right now.</td>
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<tr>
<td>SPLWG Priority</td>
<td>Pollutant</td>
<td>Near-term Decision or Management Question (5 years)</td>
<td>Modeling or Monitoring Needs for 5 years</td>
<td>Long-term Decision or Management Question (10 years)</td>
<td>Modeling or Monitoring Needs for 10 years</td>
<td>Comments</td>
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<tr>
<td>Medium</td>
<td>DDT, chlordane, dieldrin</td>
<td>What is the contribution of local tributaries and storm drains to localized problems at the Bay Margins. We also need loading baseline to track trends. Can we do anything to assist recovery that appears to be taking place (any areas needing attention?)? Similar strategy to PBDEs.</td>
<td>Find local sources or major small trib pathways.</td>
<td>Are we still recovering?</td>
<td>Bay TMDL in development. Needs: refined data to clarify impairment assessment and forecasts. Additionally, characterize loads to Bay in vicinity of areas of elevated legacy pesticides contamination to support Bay Margin modeling strategy. Look for piggy-back opportunities on other work (PCBs). Strategy has many similarities to PBDEs because of phase out of uses and presumed decreasing trends. TMDL may seek to use simple linkage (from PCB?) and largely be based on confirming recovery is underway. Information needs center around needing to confirm that this simple linkage is justified and appropriate and to confirm what additional actions, if any, are needed to assist recovery of the Bay.</td>
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<tr>
<td>SPLWG Priority</td>
<td>Pollutant</td>
<td>Near-term Decision or Management Question (5 years)</td>
<td>Modeling or Monitoring Needs for 5 years</td>
<td>Long-term Decision or Management Question (10 years)</td>
<td>Modeling or Monitoring Needs for 10 years</td>
<td>Comments</td>
</tr>
<tr>
<td>Medium</td>
<td>Copper</td>
<td>Monitor local trib copper load trends. If copper is going up, we would want to know something about spatial pattern. Lower intensity monitoring here is OK. Additional monitoring triggered by increasing Bay trend though.</td>
<td>What is the trend of copper loads from local trib?</td>
<td>Need some level of monitoring and trend assessment - coarse assessment.</td>
<td>Site-Specific Objectives (SSOs) for all Bay (copper) Need: periodic load confirmations, especially copper, from local tributaries per SSO implementation plan. If Bay levels increase, need more intensive small trib monitoring perhaps in portion of Bay seeing increase. We may want to look at historical loading data from 90s to see if trend insights possible.</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>PAHs</td>
<td>What is the contribution of local tributaries and storm drains to localized problems at the Bay Margins. See dioxin row - very similar approach.</td>
<td></td>
<td></td>
<td>Impairment listing for some portions of Bay or tributaries. Probably need refined load estimates eventually. There is a possibility that threshold of impairment will be driven downward by NOAA. If so, we will have widespread listings. Strategy is similar to dioxins: distinguish local from global sources and ID local sources. Local sources thought to play a big role for this pollutant, though.</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Other trace metals (Ag, As, Cd, Cr, Ni, Pb, Zn)</td>
<td>No specific info needs. Can monitoring these provide insights and understanding of loads of other contaminants.</td>
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<td></td>
<td>Some local impairment listings. No urgent data needs at present.</td>
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<td>SPLWG Priority</td>
<td>Pollutant</td>
<td>Near-term Decision or Management Question (5 years)</td>
<td>Modeling or Monitoring Needs for 5 years</td>
<td>Long-term Decision or Management Question (10 years)</td>
<td>Modeling or Monitoring Needs for 10 years</td>
<td>Comments</td>
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<td></td>
<td>OP pesticides</td>
<td>Are these compounds being detected and causing toxicity? Low level effort is probably OK here.</td>
<td></td>
<td>Are these compounds being detected and causing toxicity? Confirm trends, assumed decreasing.</td>
<td></td>
<td>Need: ongoing checks of toxicity presence per implementation plan of Urban Creeks TMDL for pesticide-related toxicity</td>
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<tr>
<td></td>
<td>Nutrients</td>
<td>What are the loads and speciation of those loads (ammonia etc.) from local tributaries in comparison to other sources like POTWs and big rivers? Are these loads causing localized impairments like algal blooms or toxicity? Also, if Bay becomes clearer, might nutrients lead to some eutrophication problems? Finally, how do nutrients impact localized methylation at Bay Margins? Probably good idea to begin building knowledge base with monitoring and modeling.</td>
<td>Monitoring studies to answer the questions posed.</td>
<td>What is the status of the loads from local tribus? Long-range questions are up in the air right now.</td>
<td></td>
<td>We do not know the impairment status for nutrients so there are no imminent regulatory actions. Some loading data may be needed to support development of conceptual model/impairment assessment. There is a possibly linkage to MeHg loads and/or production in receiving waters. They may play an increasingly important role in Bay trophic status if there are long-term Bay changes in terms of clarity from other causes.</td>
</tr>
</tbody>
</table>
## Appendix 2 Tools and Methods Applied to-date for Answering Management Questions

This summary was developed to aid discussions in the early meetings of the Small Tributaries Loading Strategy Team

<table>
<thead>
<tr>
<th>Tools and methods</th>
<th>Previous uses</th>
<th>Spatial and temporal scale</th>
<th>Planned or in progress in the Bay Area</th>
<th>Technical considerations</th>
<th>Stakeholder / implementation concerns</th>
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<td><strong>Field monitoring methods</strong></td>
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<tr>
<td><em>Bed sediment surveys</em> (combining bed sediment concentration with estimates of selected watershed sediment loads)</td>
<td>Used to identify and rank drainage systems with regards to POC concentrations. Combined with estimates of sediment loads to make local and aggregate regional estimates of POC load.</td>
<td>Region wide representing &quot;average conditions&quot;</td>
<td>Yes 1. SFEI prop 13 project, 2. Street sweeping studies, 3. City of Richmond source tracking and solution development</td>
<td>Grain size, there is no reliable relationship between POC in deposited sediment and POCs in water column</td>
<td>Cheap but reliability unknown</td>
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<tr>
<td><strong>Field based loads studies</strong> (combining high resolution flow, automated field sampling (ISCO), lab analysis, averaging estimator)</td>
<td>BASMMA load studies for metals and some organics (1989-1991) that also used SWMM modeling to estimate loads (some monitoring continued during 1990's, see SWMM below)</td>
<td>Single tributaries. Selected climatic years measured. Other climatic year estimated using long term sediment or climatic data</td>
<td>Trial planned for Z4LA in WY 2009</td>
<td>If samples are composites will loose information on concentration variation during floods, loads will be less accurate and it will be unknown if each POC load is bias high or low</td>
<td>Cheaper than surrogate method but reliability unknown. If SSC used instead of TSS, logistic and cost issues apply.</td>
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<tr>
<td>Tools and methods</td>
<td>Previous uses</td>
<td>Spatial and temporal scale</td>
<td>Planned or in progress in the Bay Area</td>
<td>Technical considerations</td>
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<tr>
<td><strong>Extrapolation methods</strong></td>
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<tr>
<td>Area based extrapolation</td>
<td>Used in PCB TMDL to estimate regional aggregate stormwater loads based on Guadalupe and Coyote Creek data</td>
<td>Region wide representing &quot;average conditions&quot;</td>
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<td>Assumes that Guadalupe is characteristic (has average hydrology and land use of the entire Bay Area)</td>
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<tr>
<td>Sediment based extrapolation</td>
<td>Used in the Hg TMDL to estimate regional aggregate stormwater loads based on BASMAA bed sediment data</td>
<td>Region wide representing &quot;average conditions&quot;</td>
<td></td>
<td>Assumes that all sediment is sources from the same places in the landscape regardless of watershed geology, hydrology and land use</td>
<td>Cheap but reliability unknown</td>
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<td><strong>Modeling methods</strong></td>
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<tr>
<td>SIMPLE model</td>
<td>Used to estimate stormwater loads to coastal waters in 2000</td>
<td>Region wide representing &quot;average conditions&quot;</td>
<td></td>
<td>Assumes empirical relationships between climate land use and POC generation. No consideration for physical processes</td>
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<tr>
<td>Hydrologic Simulation Program- Fortran (HSPF)</td>
<td>Calibration/validation studies in a few selected watersheds by some BASMAA agencies. Being applied by Brake Pad Partnership for modeling Cu aggregate loads to Bay.</td>
<td>Single tributaries. Selected climatic years measured. Other climatic year estimated using long term sediment or climatic data</td>
<td>Guadalupe (sophisticated level for investigating BMPs), Z4LA (simple for estimating long term hydrology)</td>
<td>Requires a lot of input data some of which many not be available at desired resolutions making calibration challenging. Handles non-urban land use well</td>
<td>Expensive, but can be used for testing management scenarios and predicting future loads. What is the tradeoff between cost and achievable sensitivity in forecasting compared to mass balance models?</td>
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<td><strong>Modeling methods</strong></td>
<td><strong>Stormwater Management Model (SWMM).</strong>&lt;br&gt;A watershed scale sub-catchment based conceptual model with routing designed for urban areas.</td>
<td>Single tributaries, selected climatic years measured. Other climatic year estimated using long term sediment or climatic data</td>
<td>Requires a lot of input data some of which may not be available at desired resolutions making calibration challenging. Handles urban land use well, less flexible for undeveloped (pervious) or mixed watersheds.</td>
<td>Expensive, but can be used for testing management scenarios and predicting future loads.</td>
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<td><strong>Statistical methods</strong></td>
<td><strong>Power Analysis using a Monte Carlo simulation developed in Matlab.</strong>&lt;br&gt;Determine the power to detect user defined trends (e.g. 90% in 20 years) in suspended sediment or contaminant concentration.</td>
<td>Single tributaries. Selected climatic years measured.</td>
<td>Yes (perhaps 2008 for suspended sediments in Guadalupe if funding approved)</td>
<td>Many assumptions such as no change in data distributions, no change in source characteristics, no change in dilution effects.</td>
<td>Low cost. Useful to inform the debate on sampling design.</td>
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<td><strong>Lake Core analysis.</strong>&lt;br&gt;Uses paleoecology to identify trends in contaminants in urban and pristine (reference) settings at the multi-decadal scale (50 years).</td>
<td>USGS National Urban Runoff Program studies for understanding national scale trends in environmental quality.</td>
<td>Single tributaries but perhaps regional if atmospheric load is the main source. Decadal (50 years)</td>
<td>Yes 2009 (for multi-contaminants if TRC approves funding)</td>
<td>Decadal time scale - regional in scale if atmospheric load is the main signal. Limited to where there are lakes - not at bottom of watershed.</td>
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