

**Development & Implementation of a  
Monitoring Program for Specific Emission  
Sources to San Francisco Bay**

**Work Plan**

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San Francisco Estuary Project**

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## 1.0 Introduction

Storm water quality management programs in the San Francisco Bay Area have become increasingly concerned about air pollution as a potential “source” for pollutants of growing concern to water quality (e.g., mercury, copper, pesticides, dioxin, PCBs, PAHs). As a result, there is a growing need for information about airsheds and their potential impact to watersheds in the San Francisco Bay Area. Recognizing this need, the Bay Area Stormwater Management Agencies Association (BASMAA) – a consortium of seven municipal storm water programs – performed a preliminary review of air monitoring activities conducted by the Bay Area Air Quality Management District (BAAQMD), California Air Resources Board (CARB), US Geological Survey (USGS) and other agencies to determine if current air quality monitoring is adequate for the needs of BASMAA agencies (BASMAA, 1998). The results of this scoping study indicate that the current air monitoring network and the data it generates do not help water quality agencies in identifying the relative magnitude of this pollutant transport pathway or possible control strategies. BASMAA’s study includes recommendations for cooperative efforts between water quality and air quality agencies, including new or additional sampling and analyses.

Based on its study, BASMAA, in partnership with the San Francisco Estuary Project (SFEP), submitted a proposal to USEPA’s Great Waters Program, which is part of the National Estuary Program (NEP). USEPA awarded an \$80,000 1-year grant to BASMAA and SFEP to develop and implement a monitoring program for specific emission sources to storm water runoff.

Concurrently, the City of San Jose allocated significant resources to collaborate with the San Francisco Estuary Institute (SFEI), the scientific arm of the Estuary Project, in a three-year pilot aerial deposition study to determine, on a gross scale, the magnitude of air deposition as a source of pollutant loadings to San Francisco Bay (SFEI, 1998). Through the Regional Monitoring Program (RMP), which SFEI manages, sixty-eight local participants contribute funding to this effort to design, set up, and run a monitoring network for trace elements and organic pollutants. Also, over the next three years, air quality agencies will be setting up a new monitoring network to measure PM<sub>2.5</sub> in order to monitor compliance with new emission standards.

## 2.0 Purpose and Approach

The purpose of the project is to implement the recommendations of the BASMAA scoping study and to supplement the RMP Pilot Aerial Deposition study with information on specific, contributing sources. It appears from the scoping study analyses that for more localized, near-

ground sources (e.g., vehicles) and non-volatile pollutants (e.g., heavy metals, particulate matter) that there is a disconnect between the pollutant levels measured in standard air monitoring stations (i.e., deposition) and the amount of these substances emitted (i.e., emissions and dispersion). The difference, in many cases, appears to be an order of magnitude and may be explained by where and how air deposition is usually sampled.

The project approach is to use a collaborative effort to investigate this issue and to develop a monitoring program that makes a more direct link between air quality and water quality – between emission sources and pollutant loadings. The intent of the project is to address some of the needs listed in the *Excerpts from Draft Research Strategy for Great Waters Program* (September 1997). Specifically, the project will focus on the fundamental questions – How does air deposition contribute to adverse health and environmental effects?; and Can specific emission sources be identified (and quantified)?

We hope to be able to identify and quantify specific, contributing emission sources in the airshed for the San Francisco Estuary. It may very well be that this effort identifies and quantifies the impacts of ubiquitous air emission sources (e.g., vehicles or other products used by a significant portion of the population) that are analogous to “nonpoint sources” in water quality terms. Data on these ubiquitous sources and the immediate fates of their pollutants will complement traditional air quality/deposition data. Provided with this new information, storm water quality management programs in the San Francisco Bay Area should be able to help address specific sources much more directly and cost-effectively than is currently possible.

Local and State agencies on our team will help address two of the current priorities listed in the *Draft Research Strategy* – investigation of cost-effective emission reduction options, and quantification of benefits associated with emission reduction efforts. These local and State agencies and organizations bring first-hand knowledge of environmental impacts, and potential control strategies to address these impacts. For example, the California Regional Water Quality Control Board–San Francisco Bay Region and SFEI conduct the RMP, a long-term monitoring program designed to assess the health of the San Francisco Estuary. In addition, local storm water programs are hands-on organizations that regularly investigate and implement various control strategies as part of their watershed management efforts.

Implementation of the project will help accomplish the following actions listed in the Comprehensive Conservation and Management Plan (CCMP) for the San Francisco Estuary (SFEP, 1993): Improve the management and control of urban runoff from public and private sources (PO-2.4); Develop control measures to reduce pollutant loadings from energy and transportation systems (PO-2.5); Work to fund and support existing and new public involvement, education, research, and monitoring activities that seek to fulfill the goals of the

CCMP (PI-4.2); Ensure that a technical/scientific/academic entity has responsibility to promote scientific research on and monitoring of the Estuary and provide advice and guidance related to those activities (PI-4.3).

### 3.0 Background Research

In October 1998, USEPA invited Great Waters Program grant recipients to a workshop on air deposition to learn about the state of this work and to provide grant recipients with information to complete their work plans. Although the information provided by the air deposition researchers was very informative, it became clear that the purpose and approach to their research was quite different from BASMAA and SFEP's interests, which can be characterized by the following attributes:

- emissions and dispersion (as opposed to deposition)
- mobile/local sources
- metals, toxics
- near-ground pollution (close to source as possible)
- controlling sources

As a result, BASMAA/SFEP had to seek additional help in designing their project.

Despite these differences, USEPA specifically funded this project because it deals with emerging issues, some of which may have national applicability. In fact, the Tampa Bay National Estuary Program (NEP) has been doing some work that tries to tie the results back to management decisions and in particular the need for storm water BMPs but they are relatively unique in that focus. Many of the other NEPs who are receiving Great Waters Program funds for the first time (like San Francisco Bay) also expressed interest in getting help in identifying sources as opposed to the characterization-type work that has been funded to-date. These NEPs include Long Island, Sarasota Bay, Mobile Bay, and Casco Bay.

After the fall 1998 workshop, BASMAA initiated a shared fact finding exercise to determine the most critical and useful information needs related to air quality and urban runoff. Numerous and disparate reports and web sites were reviewed and many organizations including CARB, BAAQMD, UC Riverside, Brake Manufacturers Council, Brake Pad Partnership, USEPA Office of Pesticide Programs, and USEPA Office of Mobile Sources were contacted. Bay Area air quality and water quality researchers and managers were surveyed about their understanding and perspective on six potential pollutants of concern to water quality that may have a significant presence in air emissions or deposition. These pollutants were:

- copper,
- diazinon,

- dioxin,
- mercury,
- PAHs, and
- PCBs.

In addition, the following criteria were developed to identify the most critical and useful information needs related to air quality and urban runoff.

- Defined problem (i.e., 303(d) listing, water quality standards exceedances)
- Urban runoff identified as significant pathway
- Air emissions/deposition identified as significant pathway
- Source identification/characterization information needed

Based on these criteria and input from researchers and managers, the two pollutants that seem to have the most critical and useful information needs related to air quality and urban runoff are:

- mercury in diesel exhaust
- copper in brake pad wear debris

For both pollutants, a single major source has been identified (i.e., 80% of the load to urban runoff in both cases), and yet, as described below, the basis for these determinations is in question. Therefore, both pollutants have vital source identification/characterization needs that must be met before major policy and management decisions are made.

### 3.1 Mercury in Diesel Exhaust

The *Metals Control Measures Plan (Volume 1)* (SCVURPPP, 1997), is a report that identifies sources of metals of concern within the Santa Clara Valley watershed, and estimates relative contributions of metals from these sources to South San Francisco Bay. The plan listed diesel tailpipe emissions as contributing 33% of the mercury loading to San Francisco Bay. Except for reservoir spills and natural erosion (44%), diesel tailpipe emissions were by far the single largest source identified (mining = 11%). The plan listed diesel tailpipe emissions as the source of 80% of the mercury in urban runoff.

In mid-1999, staff at USEPA's Office of Mobile Sources (McDonald, 1999) reviewed the source document referenced in the *Metals Control Measures Plan* that identified mercury concentrations in diesel fuel. USEPA staff noted three major concerns with the source document—*Air Emissions Species Manual, Volume II: Particulate Matter Species Profiles*, (USEPA, 1990):

- mercury quantities reported are likely below the minimum detectable levels for the analytical procedure (X-ray fluorescence) cited

- mercury mass only showed up in the larger size fractions, despite mercury being combustion aerosol
- measurements exhibited high uncertainty and poor repeatability

Based on these significant concerns, USEPA Office of Mobile Sources staff have recommended checking the results presented in the *Metals Control Measures Plan* by measuring mercury in representative samples of diesel fuel and lubricants (McDonald, 1999).

### 3.2 Copper in Brake Pad Wear Debris

For copper, the *Metals Control Measures Plan (Volume 1)* (SCVURPPP, 1997) listed brake pads as contributing 42% of the loading to San Francisco Bay. Brake pads were the single largest source identified (point sources = 28%). The plan listed brake pads as the source of 80% of the copper in urban runoff.

In contrast to this information, BASMAA's *Scoping Study of Air Deposition Monitoring Information Relevant to Water Quality of San Francisco Bay* (BASMAA, 1998) noted that only 10% of the total copper loading in runoff seems to originate from atmospheric deposition. The BASMAA report was unable to match indirect deposition estimates of copper with independent copper loading estimates, particularly with brake pad linings as the source. This difference, if it is substantiated by empirical data, indicates that there is a large amount of deposition on roads of particles that never move high enough above the ground to be detected by air monitors. Based on this apparent information gap, the BASMAA report recommended more work be done on estimating specific emissions sources.

## 4.0 Scope

Because two critical needs have been identified, the scope of work is divided into general tasks applicable to both needs, and specific tasks for studying mercury in diesel exhaust and copper in brake pad wear debris.

### 4.1 General

#### Task 1: Advisory Committee

BASMAA and SFEP will set up and use an Advisory Committee to help with project development and implementation. The Advisory Committee will consist of project partners such as the U.S. Environmental Protection Agency, San Francisco Estuary Institute, California Regional Water Quality Control Board—San Francisco Bay Region, Bay Area Air Quality Management District, and the Santa Monica Bay Restoration Project (SMBRP). The Committee

will also be comprised of technical experts for both of the major foci – mercury in diesel exhaust and copper in brake pad wear debris.

### **Task 2: Technical Information Transfer**

In addition to forming an advisory committee to facilitate information and data sharing on a regional basis, BASMAA and SFEP plan to conduct a seminar to exchange data and to discuss its implications for future efforts. In addition, we expect that some of the data will provide the basis for a more specific and targeted public education effort about the linkages between air quality and water quality.

### **Task 3: Status Reports**

In addition to an end-of-year report, BASMAA and SFEP will submit quarterly status reports that provide a complete description of progress made in implementing the work plan.

## **4.2 Specific**

### **Task 4: Mercury in Diesel Exhaust**

**Objective** – To determine the amount of mercury in diesel fuels and lubricants. Assuming mercury is present in some of these products, determine the gram-per-mile emission rate for mercury from tailpipe emissions and the chemical characteristics of mercury in tailpipe emissions.

**Description** – A representative sample of diesel fuels and lubricants will be tested using standard product testing protocols and the lowest detection limits feasible. For those products that have detectable mercury, measurements will be made of exhaust emissions and the amount and form of mercury downstream of the combustion chamber will be determined. Based on this information, the relative contribution of mercury from combustion of diesel fuel and lubricants to tailpipe emissions and to urban runoff loading will be calculated

**Products** – Product concentration data; Emissions data (tentative); Final report

### **Task 5: Copper in Brake Pad Wear Debris**

The following scope of work borrows from elements of a project initially planned for by the CARB in FY 98/99 (CARB, 1999). The only proposal received by CARB was unresponsive to the RFP, and the project is not listed on the CARB research list for FY 99/00. Despite this,



CARB staff identified a significant information need as evidenced by the following excerpts from the FY 98/99 project description:

*Up to one-third of all directly emitted particulate matter from on-road motor vehicles has been attributed to either tire or brake wear; however, these emission estimates have not been updated in over a decade.*

*The information regarding tire and brake wear for PM<sub>2.5</sub> emissions is in need of revision, and is poorly documented. Emission factors for PM<sub>2.5</sub> are currently not available for both brake wear and tire wear. Since PM<sub>2.5</sub> goes deeper into the lungs and there is now a Federal PM<sub>2.5</sub> ambient air quality standard, it is necessary to determine PM<sub>2.5</sub> emissions from tire and brake wear.*

*Previous analyses have been performed on a limited number of vehicles, yielding...a single gram-per-mile emission rate for brake wear.*

Objective - To determine the gram-per-mile emission rate for copper from brake pad wear, the particle size distribution in these emissions, the initial dispersion of brake pad wear debris, and the chemical characteristics of copper in brake pad wear debris.

Description - A representative number of vehicles will be tested with various brake configurations in an evaporative emissions running loss enclosure adapted to sample ambient concentrations of brake pad wear debris. Measurements will be made of the amount and size of wear debris generated, the initial fate of wear debris (i.e., air, wheel, wheel well, tire), and the amount and form of copper in wear debris. Based on this information, the relative contribution of brake pad wear to the air emissions inventory and to urban runoff loading will be determined.

Products - Methods development information (i.e., equipment, protocols); Emissions and dispersion data; Final report

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