

San Francisco Bay Ambient Water Monitoring Interim Report

prepared for
San Francisco Bay Regional Water Quality Control Board (SFBRWQCB)

submitted by
Bay Area Clean Water Agencies (BACWA)
on behalf of participating dischargers

and

Regional Monitoring Program for Trace Substances (RMP)

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Project Manager
Donald Yee
San Francisco Estuary Institute
7770 Pardee Lane, 2nd Floor
Oakland, CA 94621

Contents

1. Introduction and Purpose of the Report
 - a. Monitoring needs
 - b. Priority pollutants of interest
2. Approach
 - a. Sampling locations and times
 - b. Sample collection and handling
 - c. Analytical Methods
3. Results and Discussion
 - a. Volatile and semi-volatile organics
 - b. PCDD/PCDFs
 - c. Trace elements
 - d. TBT and cyanide
 - e. Ancillary characteristics
4. Conclusions
 - a. Results compared to objectives
 - b. Future recommendations
5. Acknowledgements

Appendix 1 – SFBRWQCB 13267 Letter (August 6, 2001)

Appendix 2- Collaborative San Francisco Bay Receiving Water Study

1. Introduction and Purpose of the Report

a. Monitoring needs

In May 2000, the USEPA published *Water Quality Standards; Establishment of Numeric Objectives for Priority Toxic Pollutants for the State of California*, commonly known as the California Toxics Rule (CTR), which established numeric water quality standards for 126 priority pollutants. Under the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (also known as the State Implementation Policy, SIP) the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) is required to establish water quality-based effluent limitations in order to achieve priority pollutant standards.

To acquire the information needed to meet these regulations, on August 6, 2001, the SFBRWQCB, as authorized under Section 1.2 of the SIP, issued a formal request for information (a Water Code Section 13267 letter) to all NPDES dischargers for data on CTR priority pollutants in effluents and receiving waters (Appendix 1). The data from dischargers to fulfill the 13267 letter are required to be of sufficient quantity and quality for the SFBRWQCB to determine whether a discharger may cause, have reasonable potential to cause, or contribute to an excursion above any applicable priority pollutant criterion or objective. The letter outlines the pollutants to be monitored and requirements for effluent and receiving water sampling (frequency and site characteristics), analyses (recommended methods and detection limit requirements), and reporting.

The 13267 letter (Appendix 1) states that the SIP “implements the provisions promulgated by the U.S. Environmental Protection Agency in the California Toxics Rule (CTR), as well as any existing water quality objectives.” Therefore for the purposes of this document “water quality criteria” (WQCs) will be used to refer both to the CTR established numeric criteria for 126 priority pollutants as well as to numeric objectives for 12 of these priority pollutants and tributyltin previously established in the San Francisco Bay Water Quality Control Plan (Basin Plan) and/or the National Toxics Rule.

A number of these priority pollutants previously were and currently are monitored by the Regional Monitoring Program for Trace Substances (RMP). The 13267 request allows for the use of current and historic data to satisfy monitoring requirements provided that the methods of sample collection and analyses meet SIP requirements, so for a number of pollutants, RMP data will meet the SFBRWQCB information needs.

For the remaining priority pollutants, several San Francisco Bay Region dischargers proposed a Collaborative San Francisco Bay Receiving Water Study to the SFBRWQCB (Appendix 2). SFBRWQCB conditionally approved the study plan on November 21, 2001. BACWA proposed to contract with San Francisco Estuary Institute to conduct the study. BACWA, SFBRWQCB, and SFEI staff met in December 2001 to finalize the study plan.

The first and second sampling events occurring in January and July of 2002 were funded by BACWA. Responsibility for funding and conducting the remainder of the study was subsequently shifted to the RMP in 2003. The third sampling event was conducted in January 2003. This report summarizes the results of the first three events.

b. Priority pollutants of interest

There are 126 priority pollutants listed in Enclosure A from the SFBRWQCB August 2001 13267 request (Appendix 1). That letter also listed numeric water quality criteria for these pollutants, suggested analytical methods, and their minimum levels (MLs) from the SIP. The RMP has previously monitored a subset of these priority pollutants. Other than the ongoing monitoring conducted as part of the RMP Status and Trends Program, data on ambient concentrations of most of the priority pollutants have been sparse. There has been monitoring of some of these other pollutants in the past under RMP (e.g. cyanide), but that data was deemed insufficient for meeting SFBRWQCB's current information needs.

For approximately one-third of all the pollutants listed, the WQCs were below the MLs of analytical methods listed in the SIP. The SIP specifies MLs to be equivalent to the lowest concentration standards used in the calibration curve. Pollutants for which alternative methods are needed to determine whether concentrations met WQCs were highlighted in the 13267 request. For those pollutants, the SFBRWQCB 13267 letter allowed the option of substituting methods not yet published by EPA nor approved through its alternative test procedure (ATP) program for ambient water monitoring. Approaches taken for collecting samples and analyzing some pollutants in this study were modifications of standard methods using non-standard sample sizes and pre-concentration techniques.

Appendix 2 (the study plan) lists the pollutant groups and ancillary data to be analyzed in the study, grouped by the analytical methodologies suggested in the 13267 letter.

2. Approach

This section describes the basis for the sampling and analytical approaches taken in the study. The spatial and temporal scope of this study is greatly reduced relative to the effort employed for monitoring other priority pollutants under the RMP.

a. Sampling locations and times

This study sampled ambient waters at three locations in the San Francisco Estuary, on two occasions in 2002 and once in 2003. The sampling sites were at historical RMP fixed sampling stations (RMP has since gone to a partially random location sampling scheme) at Dumbarton Bridge (BA30), Yerba Buena Island (BC10), and Sacramento River (BG20). These sites were selected to approximately represent the range of waters to which pollutants are discharged in the region.

The site at Yerba Buena Island, near the Golden Gate, is frequently exchanged with water from the Pacific Ocean under most conditions throughout the year. Discharges to the Central Bay are mixed and diluted in these waters, which typically possess dominantly oceanic characteristics. This is evident in the salinities and other basic water quality parameters measured at this site as well as in the concentrations of pollutants, which generally do not deviate greatly from those at the RMP site at Golden Gate located several miles offshore.

In contrast, the site at Sacramento River will largely reflect waters from inland watersheds including much of the Sierra Nevada range and the California Central Valley.

Because of the complex interconnections of the Sacramento and San Joaquin River throughout the Delta (further complicated by water management activities at dams and water export pumps upstream), this site reflects a mix of Sacramento and San Joaquin River waters, with a minor influence of San Francisco Bay/Pacific Ocean waters.

The site near Dumbarton Bridge represents a mix of oceanic waters coming through the Golden Gate, combined with freshwater inputs from surrounding watersheds and wastewater discharges. The input of fresh water is much smaller than at the Sacramento River, given the much smaller watershed area draining to the South Bay. In addition, the exchange with oceanic water is much smaller than at Yerba Buena, because of the greater distance from the Golden Gate. A model of a conservative tracer originating from a wastewater treatment plant in the South Bay (Gross 1997) estimated residence times of approximately 20 days.

b. Sample collection and handling

The sample collection and handling methods generally mirrored those employed for the RMP. Sampling materials and preparation, collection, and storage methods were chosen with the aim of minimizing potential sample contamination, loss and degradation. The parameters collected into three general categories requiring different materials and preparation and collection methods: trace elements and polar compounds, volatile and semi-volatile organic compounds (VOCs/SVOCs), and particle associated hydrophobic compounds. Sizes of the samples collected for laboratory analyses are summarized in Table 1.

Trace elements (antimony, beryllium, thallium) and the most polar organic pollutants (cyanide, tributyltin) were collected by staff from UC Santa Cruz using methods similar to those used in RMP trace element sampling; sample containers and pump tubing were cleaned by soaking in acid followed by deionized water rinses. Site water was collected with a peristaltic pump through tubing extended on a pole up-current and upwind of the boat and sampling personnel. Sample containers prepared by UCSC for analyses by their laboratory were stored with dilute acid, emptied onsite, and rinsed and filled at least three times with site water. Containers for analysis of cyanide and hardness by CCCSD were commercially pre-cleaned (I-Chem), rinsed once, and filled. Sample bottles for Caltest cleaned and prepared by their laboratory with a small aliquot (~1 mL in a 200 mL bottle) of ~1 M nitric acid as preservative were filled without rinsing. Samples were stored onboard covered in coolers with ice packs.

In the first sampling event (January 2002), PCDD/PCDFs (“dioxins”) were sampled by University of Utah Energy and Geosciences Institute (UUEGI) staff (the laboratory formerly conducting RMP sampling) using solid phase extraction (SPE) methods equivalent to those in RMP sampling in SF Estuary waters for other organic compounds. Approximately 100 liters of water (measured to within ± 0.5 liter) were pumped via organic solvent-washed tubing by an Infiltrax 300 sampling pump (Axys Analytical) through pre-cleaned wound glass filters and resin adsorbent (XAD-2) columns prepared by Axys Analytical. In the summer 2002 sampling, San Francisco Estuary Institute (SFEI) staff operated the sampling equipment, supervised by UUEGI personnel. For subsequent sampling, SFEI staff operated the sampling equipment without added supervision. Additional 4 L “split” whole water samples were collected for

Frontier Analytical using the Infiltrax pump without any filter cartridges or resin columns installed. These were not true splits, as they were collected after, rather than concurrently with the SPE samples. Collected samples were stored onboard the boat in coolers with ice packs.

The third category consisted of the volatile organic compounds (VOCs) and SVOCs, which were also pumped using the Infiltrax, but they were instead stored in tightly capped glass bottles or vials, with a minimum of headspace to prevent volatilization losses. The VOC sample vials were filled taking great care to minimize turbulence during filling and to avoid any visible air pockets. All samples were successfully collected without any headspace. VOC samples collected for Pacific Analytical contained no preservative, whereas samples for CCCSD had <0.1 g of sodium bisulfite added to each vial for dechlorination. SVOC samples for all of the laboratories had no preservatives added. Care was also taken to avoid turbulence and air bubbles in collection of SVOC samples, but any small air bubble (pea-sized, <0.2 mL) would be allowed to remain in any of the 1 L and 4 L samples collected. Samples were stored in coolers with ice packs after collection while still onboard the ship.

On return to shore, samples were transported by automobile in coolers on wet ice to Applied Marine Sciences (AMS) and SFEI. Some samples (for analytes with short holding times) were shipped immediately, and the others were stored overnight in refrigerators at <5 degrees C. Chilled samples were shipped with gel ice packs in coolers to the respective laboratories, where they were stored in laboratory refrigerators until extraction and analysis.

c. Analytical Methods

A number of laboratories indicated their ability to measure trace elements not currently included in RMP (Be, Sb, Tl) by ICP-MS at concentrations around the SIP suggested MLs and below their respective WQCs (14 and 1.7 µg/L for Sb and Tl respectively, there is no published Be criterion). Estimated MDLs provided by laboratories typically ranged from 0.3-1.0 µg/L. No laboratories indicated any likelihood of matrix interference in seawater for these pollutants, so one commercial laboratory (Caltest) and one academic laboratory (UC Santa Cruz) were selected to provide these analyses. A review article (Nozaki 1997) compiled data from the scientific literature on the concentrations of elements in the North Pacific. Beryllium is estimated in seawater at 0.21 ng/kg (ppt, approximately equivalent to ng/L), whereas thallium is found at 13 ng/kg (ppt) and antimony at around 0.2 µg/kg (ppb). These elements would therefore not be detected in measurements of uncontaminated ocean water by ICP-MS. No pre-concentrations or other special handling of samples was necessary; non detected (ND) results for these analytes, with MDLs a minimum factor of approximately 2-3 times lower than the CTR WQC for thallium, and 10-20 times lower for antimony, would indicate with a high degree of certainty that the WQCs were not exceeded.

For the more abundant VOCs and SVOCs, a large percentage of the analytical laboratories contacted indicated that they could measure most of these compounds using the standard EPA Methods 624 and 625. Using those methods as published would leave a number of pollutants with MDLs (with yet higher reporting limits and MLs) above their WQCs. EPA published a set of revised methods (1624/1625, similar to 624/625, but

using isotope dilution methods for quantification) with greater accuracy and less susceptibility to interferences. A validation study commissioned by EPA for these methods included approximately 10 commercial laboratories on a list provided by EPA staff (EPA and Dyncorp 2001). However, in the years since that study was conducted, almost no laboratories in that study maintained the capability to perform the analyses due to lack of demand, and only one laboratory (Pacific Analytical) was willing to analyze a small set of samples (~6-8 per year with the proposed study design). In the end, that laboratory and one publicly owned treatment works (POTW) laboratory (Central Contra Costa Sanitary District, CCCSD) each agreed to analyze samples for VOCs and SVOCs. Both laboratories modified the methods in a similar manner. Neither laboratory had the high-resolution gas chromatograph / high-resolution mass spectrometer (HRGC/HRMS) instrument needed to measure these compounds with ultra-low MDLs by either the 624/625 or 1624/1625 methods. They therefore elected to increase their detection sensitivity by preconcentrating more than specified in the standard EPA methods (using a larger initial sample volume) and using selected ion monitoring (SIM) mode to increase instrument sensitivity on their existing instruments. For the modified methods (624/1624"mod"), although VOC collected sample sizes (40 mL) remained the same, pre-concentration was increased by using a larger purge volume. For SVOC samples, Pacific modified the method only by using SIM, whereas CCCSD modified samples both used SIM and larger sample volumes (4 L) in the 2002 samples, dropping down to 1 L samples for 2003.

For the first sampling event (January 2002), Axy's Analytical, a laboratory that had previously demonstrated capability in measuring PCDD/PCDFs in municipal wastewater effluents in another study in this region (Yee et al. 2001), was selected to conduct the analyses. This laboratory employed HRGC/HRMS. By using very large volume (100 L) solid phase extraction samples, Axy's ensured that ultra-trace concentrations of PCDD/PCDFs would be detectable. After Axy's found PCDD/PCDFs in samples from the January 2002 event at concentrations higher than the MDLs indicated by some other commercial laboratories for 4 L samples, one of those labs, Frontier Analytical, was contracted to analyze them in "split" whole water samples (~4 L each) collected in the summer. The differences in collection methods raise some concerns about the comparability of results, which is addressed in the discussion.

3. Results and Discussion

a. VOCs/SVOCs

i. QA results

Results on QA samples were generally within targets for the VOCs and SVOCs analyzed in this study, with most of these compounds not detected in blanks. In a few instances (e.g., for some phthalates), contamination was found in the laboratory blanks and thus potentially affected the field samples. Although sample containers were primarily made of glass to minimize leaching of phthalates into samples, items such as bottle caps, laboratory gloves, and other plasticized items may have introduced these compounds into samples. Although one of the laboratories (PAI) had indicated sporadic problems with phthalate contamination in blanks and low-level samples, a decision was made to proceed with this laboratory for lack of any alternative laboratories that indicated

any ability or desire to modify EPA Methods 624 and 625 to achieve lower MDLs for compounds with lower WQCs.

Matrix spike results (spiked either to a clean matrix like the procedural blank or a ambient matrix such as excess sample material) were also generally within target (within ~30% of the expected value). Because quantities of analytes spiked need to be sufficiently above MDLs to generate quantitative results, spiked concentrations were larger than the concentrations of analytes found in ambient samples in this study, which were generally near or below their respective detection limits.

ii. Ambient sample results

Results from the analyses of ambient samples for VOCs and SVOCs are shown in Table 2. The majority of these compounds were not detected in any of the collected samples analyzed by either of the analyzing laboratories. Generally, when a laboratory detected one of the VOCs or SVOCs in samples from any one site, it also found that compound in samples from the other sites.

For the few volatile and semivolatile organic compounds that were detected, many are likely the result of contamination from the sampling containers, reagents, or the laboratory environment. Acrylonitrile, carbon tetrachloride, and methylene chloride, found by CCCSD in some of their samples, are commonly used as laboratory solvents for organic analyses. These compounds were not detected in laboratory blanks for this study, so the results may represent actual environmental concentrations rather than laboratory contamination. Nevertheless, the detected concentrations of these compounds were well below their WQCs of 0.66, 4.4, and 1600 $\mu\text{g/L}$, respectively.

The other pollutants likely originating from the sampling materials or laboratory sources, assorted phthalates, were also found in some samples. Bis(2-ethylhexyl)phthalate was found in samples from both winter and summer samples by Pacific Analytical at concentrations above their MDL (10 $\mu\text{g/L}$, which is in turn above the WQC of 5.9 $\mu\text{g/L}$), whereas CCCSD found this compound only at maximum concentrations of less than 1 $\mu\text{g/L}$ in winter 2002 samples. CCCSD also found di-n-butyl phthalate in one blank and in samples at concentrations up to around 2 $\mu\text{g/L}$, but the WQC for this compound much higher yet, at 12,000 $\mu\text{g/L}$. The Pacific Analytical MDL for di-n-butyl phthalate is 10 $\mu\text{g/L}$, so no detection would be expected in the split samples. The lack of concurring results from the second analyzing laboratory when the MDL is sufficiently low that a result should be found suggests either a laboratory analysis or contamination problem.

The detection of a given compound by both analyzing laboratories would have provided more confidence in the certainty of results, even had they differed quantitatively. With results for an analyte from only one laboratory, one possibility is that the laboratory's method is sufficiently much more sensitive that detection only by that laboratory would be expected given the concentrations found. This can be seen in the results for some of the other pollutants, which will be discussed later, but for most of the SVOCs/VOCs, quantities found by one laboratory were generally high enough that detection by the other laboratory measuring would have been expected.

Another possibility is contamination of samples during sample collection, storage, or analysis. Contamination during field operations would likely have affected samples

provided to both laboratories, which was generally not found in this study. Contaminants in sampling supplies cannot be ruled out, as the analyzing laboratories independently obtained and/or prepared containers for samples from different sources. Procedural contamination during laboratory handling and analysis is also unlikely to be the primary cause of the apparent detections, as contamination introduced in the laboratory would likely affect the blanks as well.

The compounds found in the samples and some blanks by both laboratories analyzing for SVOCs were the phthalates, commonly used as plasticizers and release agents for the fabrication of plastic and various other polymer items. The analytical laboratories of CCCSD and PAI found different phthalates in their analyses, suggesting that it was contamination originating from the sampling containers (as the laboratories obtained their sample bottles from different sources) or from the respective laboratory environments, in which phthalates might come from any number of sources.

These volatile and semi-volatile organic compounds were not detected in most samples, and the few compounds detected were generally measured only either by one laboratory or the other in all their samples, so it is difficult to draw any conclusions regarding their spatial or temporal distributions in ambient surface waters. These compounds were detected at concentrations well below their WQCs, with the exception of bis(2-ethylhexyl)phthalate. However, the lack of corroborating detection of this compound by the second laboratory even though their MDL was well below the first laboratory's result suggests contamination or some other analytical problem.

The lack of detected results for many of the VOCs and SVOCs is not surprising given their physical properties. Low molecular weight non-polar organic compounds in surface waters will readily volatilize and exchange with the atmosphere, so unless 1) atmospheric concentrations are high enough to result in net flux to the water or 2) a sample is taken from near a source of these compounds, measurable aqueous concentrations in ambient surface water samples will seldom be encountered. Table 3 lists several of the VOCs and SVOCs included on the CTR list, with their estimated volatilization half lives in surface waters at 20 degrees C (Lyman et al. 1990). The majority of the VOCs have half-lives on the order of 4 hours or less. Therefore, assuming their atmospheric concentrations were approximately zero, within 24 hours, many of these compounds would be present at 1% of their initial concentrations in surface waters, even without considering dilution at the point of discharge. Nitrobenzene in contrast, with a half-life of 45 hours, would volatilize to 1% of its initial concentration after about 12 days. Surface water temperatures in the San Francisco Estuary are generally around 20 degrees C in the summer, but drop to around 10 degrees in the winter. Henry's Law constants generally decrease by approximately a factor of two with this decrease in temperature, but these lower volatilization rates and thus longer half-lives would still be measured in hours rather than days for a majority of these compounds.

Additional losses from estuarine surface waters can occur through advective exchange with ocean water (dilution), photodegradation, biodegradation, and partitioning to sediments, among other processes. Quantitation of the relative importance of these processes is difficult, given that most of the analytes in question are not currently measurable in ambient surface waters of San Francisco Bay. However, these processes

would only serve to speed the removal of these pollutants from surface waters to concentrations below method detection limits.

b. PCDD/PCDFs

i. QA results

Results on QA samples were generally within targets for the PCDD and PCDF compounds analyzed in this study. Axys Analytical found detectable concentrations of PCDD/PCDFs in the blank for the January 2002 sample. Because of the large degree of sample pre-concentration involved in the Axys method, the effective (ambient) concentration of the analytes was still generally low (pg/L, parts per quadrillion or less). For Frontier Analytical, concentrations of the target analytes in blanks were all below the method detection limits (about 0.2-1.4 pg/L). None of the amounts of contamination in the Axys blanks would have been found in analyses by Frontier Analytical, as the concentrations (all <0.1 pg/L) were below the Frontier Analytical's higher detection limits. Frontier Analytical indicated that they also took extra precautions to eliminate contamination (generally OCDD) occasionally found in blanks measured by other laboratories (B. Silverbush, Frontier Analytical, personal communication) performing the conventional EPA Method 1613 for PCDD/PCDFs.

Matrix spike results ("ongoing precision and recovery" samples spiked to a clean laboratory matrix similar to the procedural blank) were also generally within target for both Axys and Frontier Analytical. Axys' matrix spike results were generally within 20% of their target values. Frontier Analytical's results were within 10% of their target values.

ii. Ambient sample results

Results from analyses of ambient water samples for PCDD/PCDFs are presented in Table 4. Axys found detectable concentrations of more individual compounds, primarily because the larger sample pre-concentration resulted in lower method detection limits. No samples were collected for measurement by Frontier Analytical in January 2002. The Frontier Analytical results for even the more abundant isomers (OCDD, OCDF, and 1,2,3,4,6,7,8-HpCDD) still fall below their MLs (lowest calibration points), adjusted for the degree of pre-concentration from 4 L samples. Therefore, although these compounds were detected in samples, their quantitative concentrations are uncertain and labeled with an "e" qualifier to indicate they are estimated quantities. For all the analyzing laboratories, the hepta- and octachloro isomers were most abundant (Figures 1-2).

Although the CTR specifies a WQC for 2,3,7,8-TCDD (of 14 fg/L), it is a common practice that toxic equivalent (TEQ) factors are applied to concentrations of various PCDD/PCDF isomers with similar structure and activity to derive overall toxicity equivalents (2,3,7,8-TCDD equivalents) for a given sample. Using the guidance of the SFRWQCB from previous studies (Yee et al. 2001), TEQs from the World Health Organization (a.k.a. WHO-98 TEQs) were applied to measured PCDD/PCDF concentrations to calculate total TEQs. Table 5 shows results of that calculation.

The TEQ calculations show the strong dependence of those results on the concentrations of several less abundant PCDD/PCDF isomers (primarily the tetra- and pentachloro isomers) with high TEQs. Although the concentrations of the more abundant

OCDD and HpCDD isomers found by Axys were generally below those found by Frontier Analytical, using the SIP methodology for calculating TEQs (where concentrations below detection limits are assigned values of zero), the calculated TEQs using the Axys results were higher than those using Frontier's results.

The sample results between sites, seasons, and analytical laboratories for these compounds are generally within an order of magnitude, as would be expected given that they originate from diffuse and diverse (primarily combustion) sources and that sample sites were located in channels to characterize a general area in the Estuary rather than any particularly contaminated patches. The Frontier Analytical results suggest that there may be differences between the Yerba Buena Island site and the Sacramento River location, although not at the commonly used 95% confidence level ($p = 0.099$, using a paired 2-tailed T-test on the OCDD results). Differences with Dumbarton Bridge could not be evaluated because the sample was lost due to shipping damage. However, the relative concentrations between the two sites are consistent with increased mixing and exchange with oceanic water through the Golden Gate seen at Yerba Buena. Water from the ocean and in deeper sections of the Bay generally have lower suspended particulate material concentrations, and thus pollutants such as the PCDD/PCDFs, which partition to the organic phase of small particles, will tend to be at lower concentrations in waters from such areas.

c. Trace Elements

i. QA results

The trace elements antimony, beryllium, and thallium were not detected in blanks analyzed by either laboratory (Table 6). Caltest used matrix spikes (of blank water) to quantify measurement accuracy and measured recoveries within 25% of the target values or better. UCSCDET measured the trace elements in the NIST 1643d standard reference material, and found concentrations within 20% of the certified values. Method detection limits (MDLs) for these compounds were generally at least a factor of 10 lower than the applicable WQC; although beryllium has no numerical WQC, the highest MDL was still nearly a factor of 10 below the detection level sought in the SIP. The methods employed were therefore more than adequately sensitive for these elements.

ii. Ambient sample results

Caltest did not detect beryllium or thallium in any of the samples. Antimony was measurable in several of the samples but was below the limits of quantification and thus "estimated" values. However, even the highest of these estimated concentrations was less than 15% of the WQC. Assuming that antimony concentrations in sampled waters are either normally or log-normally distributed, the combined Caltest data (assigning one half MDL (= 0.1 $\mu\text{g/L}$) to non-detects, as 0 results are not log-transformable) indicate that the probability of finding a result over the WQC of 14 $\mu\text{g/L}$ is less than 1%.

Further evidence that the "true" ambient concentrations are below the WQC are found in results of the other laboratory. UCSCDET measured antimony and thallium in all the samples, as their MDLs were generally lower. However, like the results from Caltest, these concentrations were generally a small fraction of the respective WQCs. Beryllium was not detected by UCSCDET in any of the January 2003 samples and in only one of the January 2002 samples. The measured quantities were generally below the

minimum levels sought in the SIP and below the low calibration standard used in the analysis, and thus would also be considered “estimated” quantities under typical requirements for compliance monitoring.

d. TBT and Cyanide

i. QA results

Tributyltin tin (TBT) MDLs were 0.005 µg/L or less for both of the laboratories, at least half the WQC. There is therefore a low probability that an exceedance of the WQC could occur without detection. TBT was not detected in any of the method blanks analyzed by either laboratory (EBMUD and Toxscan) in this study. Both laboratories used matrix spikes as indicators of measurement accuracy. Matrix spike recoveries were acceptable (within 30% of target values).

Cyanide was measured only by one laboratory, CCCSD, with an MDL of 0.4 µg/L, about half the WQC of 1 µg/L. It was not found in blanks, given that a reagent blank was used as the baseline reference in the spectrophotometer, a common practice for colorimetric methods. Although reagent contamination could potentially swamp any signal from an ambient sample, this would also affect variability in blanks and low-level control samples and thus would appear in the form of a higher MDL. Since the MDL here is sufficiently low to allow detection at the WQC, this is likely not a problem for these analyses. Matrix spikes were used as indicators of measurement accuracy and were within 60-180 % of target values, with exception of Yerba Buena Island matrix samples in January 2003. Spike recoveries for those samples ranged from 20-210%, and insufficient sample remained for repeat analyses, so results are not reported for that site and sampling event combination.

ii. Ambient sample results

Tributyltin tin (TBT) was not detected in any of the ambient samples analyzed by either laboratory (Table 7). Cyanide was only found in one sample at 0.5 µg/L, taken from the Sacramento River site in January 2003. These compounds were either not detected or measured near the MDL, so even using worst-case assumptions, they are at most half of the WQC.

e. Ancillary parameters

The ancillary water quality parameters of hardness and total solids were measured in samples from all sites (Table 8). As these are not pollutant analytes, there are no WQCs. However, these analytes are useful for determining whether saltwater or freshwater objectives are more appropriate for particular sampling sites and seasons. As was expected, both hardness and total solids were much lower at the Sacramento River site than at Dumbarton Bridge and Yerba Buena Island for both wet and dry season samples, given the greater contribution of oceanic water to the conditions at the latter two sites. The increased contribution of freshwater inputs from the Sacramento River and local watersheds during wet season sampling is also apparent in these ancillary parameters. As expected at all sites, both total solids and hardness in the wet season are lower than in dry season samples.

4. Conclusions

a. Results compared to objectives

Ambient concentrations were below the respective MDLs for most of the pollutants included in this study. Because MDLs in turn were generally below the WQCs, sometimes by several orders of magnitude, the lack of detected results was often sufficient to indicate that ambient concentrations were below the WQCs at the sample sites.

Since a large number of these pollutants are volatile or semi-volatile compounds, the scarcity of detected results is not surprising. The sample sites selected were not near any known sources, and with volatilization half lives of hours to days and dilution by clean ocean water, many of the target compounds would be expected to rapidly drop below currently achievable detection limits in the ambient Estuary environment.

The only organic pollutants found on a regular basis by more than one laboratory were the PCDD/PCDFs. The ability of both analyzing laboratories to measure the more abundant hepta- and octachloro isomers was good indication of the presence of these compounds. The measurement of these compounds by both laboratories at concentrations generally within a factor of 2 or 3 of one another provides some confidence in the relative accuracy of the measurements, considering the different collection methods used.

However, given the higher MDLs of Frontier Analytical (due to smaller sample sizes), particularly for the isomers with higher TEQs, their total TEQs were generally below those calculated from Axys results. Assuming results not detected were concentrations of zero (as specified in the SIP) resulted in TEQs that were lower for samples analyzed by Frontier Analytical. Using the standard EPA Method 1613 with 1 L samples would result in yet higher MDLs, with more isomers not detected (particularly HpCDD), and thus lower calculated TEQs.

Researchers (Tan et al. 2002) have compiled data on relative isomer abundances for PCDD/PCDFs in order to predict theoretical distributions of these compounds in emissions, and the tetra- and pentachloro isomers typically were found at concentrations less than 10% those of the heptachloro isomers. Thus even if any TCDD or PeCDD were present, they would generally be at concentrations below their MDLs using either the modified EPA Method 1613 with 4 L samples or the standard method with 1 L samples.

Quantitative measurement of the tetra- and pentachloro isomers therefore is critical to the ability to calculate PCDD/PCDF TEQs at a range useful for comparison to the WQC for 2,3,7,8 TCDD. Analyses of larger samples (through in field solid phase extraction, or laboratory combinations of multiple extractions) are currently the only way to consistently achieve sufficiently low MDLs for real quantitative results for all isomers.

TBT was not found in any samples, and cyanide was found only in one sample above the MDL, which was still only half the WQC of 1 µg/L. Some of the trace elements were also occasionally detected, particular antimony, which was found at concentrations above their respective MDLs by both laboratories, but these concentrations still were far below the WQC.

b. Future recommendations

Few of the pollutants measured in this study will require frequent monitoring to ensure that ambient concentrations are below WQC. Trace elements were found at

concentrations well below their respective WQCs, and tributyltin was not found in any samples. However, USEPA has proposed a new criterion for tributyltin of 0.001 µg/L, which is below the MDL of either laboratory analyzing samples in this study. Should that rule be adopted, additional method development to reduce MDLs and ambient measurements using that new method may be needed.

Although cyanide was only found in one sample and at a concentration below the WQC, the MDL is 40% of the WQC. The range of matrix spike recoveries found by the laboratory for cyanide analyses indicates that there may be analytical or matrix interferences that need to be resolved. Further work to improve the detection limit and reliability of the analytical method will be needed to increase confidence that ambient cyanide concentrations are consistently below the WQC.

The lack of concurrence between results of different laboratories for VOCs and SVOCs highlights some of the difficulties for analyses that are not commonly performed at trace concentrations. More extensive studies for identification and elimination of contamination and matrix interference problems are undertaken in a laboratory when they interfere with the analyses commonly performed by that laboratory. Once a particular analytical method becomes commonplace for a laboratory, it becomes far more likely that the necessary effort will be made for optimizing that analysis.

For the VOCs and SVOCs listed as CTR priority pollutants, most are detectable at concentrations below their respective WQCs using conventional EPA Methods 624 and 625. None of these compounds were found at concentrations above their WQCs. For the remaining VOCs and SVOCs that required modification of the standard methods to achieve MDLs below their WQCs, none were consistently found at concentrations exceeding their objectives. The few that were found are possibly laboratory or container contamination. Although commercially available sample containers are analyzed and certified for a number of contaminants, for some compounds no analyses are performed. Sample container contamination can be reduced through use of bottles with lid liners of Teflon or other non-leaching inert materials and more extensive (muffle furnace) preparation.

Given their volatility, it is unlikely that any of these compounds will exceed their WQCs in ambient waters unless there are large changes in use and disposal patterns. Although continued meeting of WQCs for VOCs and SVOCs can be ensured through repeated monitoring for these compounds in ambient waters and/or discharges, the level of intensity appropriate for such an effort needs to be considered by environmental managers; other priority pollutants which are documented to currently exceed their WQCs and other environmental challenges also face the region.

As mentioned in the previous section, TEQs calculated for the PCDD/PCDFs, a.k.a. dioxins, may often exceed the 2,3,7,8 TCDD WQC. In some cases, whether calculated TEQs meet or exceed that WQC depends in large part on the sample collection and analysis methods chosen (and thus MDLs) and the assumptions used for assigning concentrations to analytes not quantified (in the SIP concentrations are assumed to be zero).

In order for all the various PCDD/PCDFs isomers to be detected around the concentrations found (to date) in ambient waters of the San Francisco Estuary, samples collected need to be at least about 40 L each, just under half the volume collected by SPE

for the analyses by Axys. Frontier Analytical's MDLs are comparable to or better than those of many other labs, so a similar sample size would be required for other labs as well. However, field collection and handling and transport to the laboratory of such large volume liquid samples would be logistically difficult and therefore are generally to be avoided where possible. There are WQCs established for TCDD, but for that compound and other PCDD/PCDFs, the primary ecological and human health impacts result from bioaccumulation. Therefore, although comparisons of water column TEQs to the TCDD WQC are useful as supporting evidence of potential concerns with PCDD/PCDFs, more direct indicators such as concentrations of these pollutants in fish tissue from San Francisco Bay analyzed in previous and continuing studies (SFEI 1999) are most appropriate for evaluating potential impacts from these compounds. Other bioaccumulative pollutants such as a number of PCB congeners also have dioxin-like activity and contribute over 80% of the TEQs for some fish in the Bay (SFEI 1999), and these should also be considered in evaluations of ecological risk.

5. Acknowledgements

We would like to thank BACWA for providing funding in the first year of this study and to the RMP for continued funding in 2003. Thanks also go out to various staff at AMS, SFEI, UCSC, UUEGI, for field coordination and sampling and to the analytical laboratories (Axys, Caltest, CCCSD, EBMUD, Frontier Analytical, Pacific Analytical, Toxscan, UCSCDET) for working to improve analyses of trace pollutants.

Table 1. Samples Collected for Ambient Water Monitoring

Laboratory	Analyte	Sample size
Axys Analytical	PCDD/PCDFs	100 L (SPE)
Caltest	Be, Sb, Tl	250 mL
CCCSD	cyanide	1 L
	hardness	500 mL
	SVOCs	1 L
	SVOCs (modified)	4 L (1 L in Jan 2003)
	total solids	500 mL
	VOCs	40 mL
	VOCs (modified)	40 mL
EBMUD	tributyltin	1 L
Frontier Analytical (FAL)	PCDD/PCDFs	4 L
Pacific Analytical (PAI)	SVOCs	1 L
	SVOCs (modified)	1 L
	VOCs	40 mL
	VOCs (modified)	40 mL
Toxscan	tributyltin	1 L
UCSCDET	Be, Sb, Tl	1 L

Table 2. VOCs and SVOCs in SF Estuary Water Samples, January 2002

.. = not analyzed, < = not detected, U = unspecified.

LAB	METHOD	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB_MDL	TARGET_ML	WQO/WQC
			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
		2002-01	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
CCCSD	EPA 624	1,1,1-Trichloroethane	<	<	<	<	0.7	0.5	U
CCCSD	EPA 624	1,1,2,2-Tetrachloroethane	<	<	<	<	1.1	0.5	11
CCCSD	EPA 624	1,1,2-Trichloroethane	<	<	<	<	0.7	0.5	42
CCCSD	EPA 624	1,1-Dichloroethane	<	<	<	<	0.5	0.5	U
CCCSD	EPA 624	1,1-Dichloroethylene	<	<	<	<	1	0.5	3.2
CCCSD	EPA 625	1,2,4-Trichlorobenzene	<	<	<	<	0.32	2	U
CCCSD	EPA 624	1,2-Dichlorobenzene	<	<	<	<	1.3	1	17000
CCCSD	EPA 625	1,2-Dichlorobenzene	<	<	<	<	0.33	1	17000
CCCSD	EPA 624	1,2-Dichloroethane	<	<	<	<	0.4	0.5	99
CCCSD	EPA 624MOD	1,2-Dichloroethane	0.04	0.04	0.04	0.03	0.03	0.5	99
CCCSD	EPA 624	1,2-Dichloropropane	<	<	<	<	0.6	0.5	39
CCCSD	EPA 625	1,2-Diphenylhydrazine	<	<	<	<	0.17	1	0.54
CCCSD	EPA 625MOD	1,2-Diphenylhydrazine	0.0087	0.0037	0.0053	<	0.002	1	0.54
CCCSD	EPA 624	1,2-Trans-Dichloroethylene	<	<	<	<	1	0.5	140000
CCCSD	EPA 624	1,3-Dichlorobenzene	<	<	<	<	1.5	1	2600
CCCSD	EPA 625	1,3-Dichlorobenzene	<	<	<	<	0.33	1	2600
CCCSD	EPA 624	1,4-Dichlorobenzene	<	<	<	<	1.3	1	2600
CCCSD	EPA 625	1,4-Dichlorobenzene	<	<	<	<	0.33	1	2600
CCCSD	EPA 625	2,4,6-Trichlorophenol	<	<	<	<	1.34	1	6.5
CCCSD	EPA 625	2,4-Dichlorophenol	<	<	<	<	1.54	1	790
CCCSD	EPA 625	2,4-Dimethylphenol	<	<	<	<	3.57	1	2300
CCCSD	EPA 625	2,4-Dinitrophenol	<	<	<	<	1.44	5	14000
CCCSD	EPA 625	2,4-Dinitrotoluene	<	<	<	<	0.27	1	9.1
CCCSD	EPA 625	2,6-Dinitrotoluene	<	<	<	<	0.29	1	U
CCCSD	EPA 624	2-Chloroethylvinyl Ether	<	<	<	<	0.8	1	U
CCCSD	EPA 625	2-Chloronaphthalene	<	<	<	<	0.32	1	4300
CCCSD	EPA 625	2-Chlorophenol	<	<	<	<	1.71	1	400
CCCSD	EPA 625	2-Methyl-4,6-Dinitrophenol	<	<	<	<	1.34	5	765
CCCSD	EPA 625	2-Nitrophenol	<	<	<	<	1.47	1	U
CCCSD	EPA 625	3,3'-Dichlorobenzidine	<	<	<	<	4.37	5	0.077
CCCSD	EPA 625MOD	3,3'-Dichlorobenzidine	<	<	<	<	0.001	5	0.077
CCCSD	EPA 625	3-Methyl-4-Chlorophenol	<	<	<	<	1.53	1	U
CCCSD	EPA 625	4-Bromophenyl Phenyl Ether	<	<	<	<	0.23	1	U
CCCSD	EPA 625	4-Chlorophenyl Phenyl Ether	<	<	<	<	0.31	1	U
CCCSD	EPA 625	4-Nitrophenol	<	<	<	<	1.81	5	U
CCCSD	EPA 624	Acrolein	<	<	<	<	2.8	10	780
CCCSD	EPA 624	Acrylonitrile	<	<	<	<	1.1	2	0.66
CCCSD	EPA 624MOD	Acrylonitrile	<	0.03	<	<	0.03	2	0.66
CCCSD	EPA 624	Benzene	<	<	<	<	0.3	0.5	71
CCCSD	EPA 625	Benzidine	<	<	<	<	12.45	5	0.00054
CCCSD	EPA 625MOD	Benzidine	<	<	<	<	0.0015	5	0.00054

CCCSD		bis(2-chloroethoxy)methane	..	..	..	..
CCCSD	EPA 625	Bis2-ChloroethylEther	<	<	<	<	0.32	1	1.4
CCCSD	EPA 625	Bis2-EthylhexylPhthalate	0.68	<	0.93	<	0.67	5	5.9
CCCSD	EPA 624	Bromoform	<	<	<	<	1.2	0.5	360
CCCSD	EPA 625	Butylbenzyl Phthalate	<	<	<	<	0.52	5	5200
CCCSD	EPA 624	Carbon Tetrachloride	<	<	<	<	0.8	0.5	4.4
CCCSD	EPA 624MOD	Carbon Tetrachloride	0.06	0.06	0.07	0.06	0.03	0.5	4.4
CCCSD	EPA 624	Chlorobenzene	<	<	<	<	0.9	0.5	21000
CCCSD	EPA 624	Chlorodibromomethane	<	<	<	<	0.9	0.5	34
CCCSD	EPA 624	Chloroethane	<	<	<	<	1.1	0.5	U
CCCSD	EPA 624	Chloroform	<	<	<	<	0.8	0.5	U
CCCSD	EPA 624	Dichlorobromomethane	<	<	<	<	0.9	0.5	46
CCCSD	EPA 625	Diethyl Phthalate	<	<	0.3	<	0.24	2	120000
CCCSD	EPA 625	Dimethyl Phthalate	<	<	<	<	0.24	1	2900000
CCCSD	EPA 625	Di-n-Butyl Phthalate	1.72	<	2.2	1.61	1.07	5	12000
CCCSD	EPA 625	Di-n-Octyl Phthalate	<	<	<	<	0.38	1	U
CCCSD	EPA 624	Ethylbenzene	<	<	<	<	0.5	0.5	29000
CCCSD	EPA 625	Hexachlorobutadiene	<	<	<	<	0.34	5	50
CCCSD	EPA 625	Hexachlorocyclopentadiene	<	<	<	<	0.31	5	17000
CCCSD	EPA 625	Hexachloroethane	<	<	<	<	0.4	1	8.9
CCCSD	EPA 625	Isophorone	<	<	<	<	0.38	5	600
CCCSD	EPA 624	Methyl Bromide	<	<	<	<	1.2	0.5	4000
CCCSD	EPA 624	Methyl Chloride	<	<	<	<	1	0.5	U
CCCSD	EPA 624	Methylene Chloride	<	<	<	<	1	1.2	1600
CCCSD	EPA 625	Nitrobenzene	<	<	<	<	0.25	1	1900
CCCSD	EPA 625	N-Nitrosodimethylamine	<	<	<	<	0.33	5	8.1
CCCSD	EPA 625	N-Nitrosodi-n-Propylamine	<	<	<	<	0.4	1	1.4
CCCSD	EPA 625MOD	N-Nitrosodi-n-Propylamine	<	<	<	<	0.001	1	1.4
CCCSD	EPA 625	N-Nitrosodiphenylamine	<	<	<	<	0.19	1	16
CCCSD	EPA 625	Pentachlorophenol	<	<	<	<	1.28	1	7.9
CCCSD	EPA 625	Phenol	<	<	<	<	1.68	1	4600000
CCCSD	EPA 624	Tetrachloroethylene	<	<	<	<	1.3	0.5	8.85
CCCSD	EPA 624	Toluene	<	<	<	<	0.3	0.5	200000
CCCSD	EPA 624	Trichloroethylene	<	<	<	<	0.8	0.5	81
CCCSD	EPA 624	Vinyl Chloride	<	<	<	<	1	0.5	525

Table 2. VOCs and SVOCs in SF Estuary Water Samples, July 2002

LAB	METHOD	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB_MDL	TARGET_ML	WQO/WQC
		2002-07	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
CCCSD	EPA 624	1,1,1-Trichloroethane	<	<	<	<	0.5	0.5	U
CCCSD	EPA 624	1,1,2,2-Tetrachloroethane	<	<	<	<	0.5	0.5	11
CCCSD	EPA 624	1,1,2-Trichloroethane	<	<	<	<	0.5	0.5	42
CCCSD	EPA 624	1,1-Dichloroethane	<	<	<	<	0.5	0.5	U
CCCSD	EPA 624	1,1-Dichloroethylene	<	<	<	<	0.5	0.5	3.2
CCCSD	EPA 625	1,2,4-Trichlorobenzene	<	<	<	<	0.32	2	U
CCCSD	EPA 624	1,2-Dichlorobenzene	<	<	<	<	0.5	1	17000
CCCSD	EPA 625	1,2-Dichlorobenzene	<	<	<	<	0.33	1	17000
CCCSD	EPA 624	1,2-Dichloroethane	<	<	<	<	0.5	0.5	99
CCCSD	EPA 624MOD	1,2-Dichloroethane	<	<	<	<	0.03	0.5	99
CCCSD	EPA 624	1,2-Dichloropropane	<	<	<	<	0.5	0.5	39
CCCSD	EPA 625	1,2-Diphenylhydrazine	<	<	<	<	0.17	1	0.54
CCCSD	EPA 625MOD	1,2-Diphenylhydrazine	<	<	<	<	0.002	1	0.54
CCCSD	EPA 624	1,2-Trans-Dichloroethylene	<	<	<	<	0.5	0.5	140000
CCCSD	EPA 624	1,3-Dichlorobenzene	<	<	<	<	0.5	1	2600
CCCSD	EPA 625	1,3-Dichlorobenzene	<	<	<	<	0.33	1	2600
CCCSD	EPA 624	1,4-Dichlorobenzene	<	<	<	<	0.5	1	2600
CCCSD	EPA 625	1,4-Dichlorobenzene	<	<	<	<	0.33	1	2600
CCCSD	EPA 625	2,4,6-Trichlorophenol	<	<	<	<	1.34	1	6.5
CCCSD	EPA 625	2,4-Dichlorophenol	<	<	<	<	1.54	1	790
CCCSD	EPA 625	2,4-Dimethylphenol	<	<	<	<	3.57	1	2300
CCCSD	EPA 625	2,4-Dinitrophenol	<	<	<	<	1.44	5	14000
CCCSD	EPA 625	2,4-Dinitrotoluene	<	<	<	<	0.27	1	9.1
CCCSD	EPA 625	2,6-Dinitrotoluene	<	<	<	<	0.29	1	U
CCCSD	EPA 624	2-Chloroethylvinyl Ether	<	<	<	<	0.5	1	U
CCCSD	EPA 625	2-Chloronaphthalene	<	<	<	<	0.32	1	4300
CCCSD	EPA 625	2-Chlorophenol	<	<	<	<	1.71	1	400
CCCSD	EPA 625	2-Methyl-4,6-Dinitrophenol	<	<	<	<	1.34	5	765
CCCSD	EPA 625	2-Nitrophenol	<	<	<	<	1.47	1	U
CCCSD	EPA 625	3,3'-Dichlorobenzidine	<	<	<	<	4.37	5	0.077
CCCSD	EPA 625MOD	3,3'-Dichlorobenzidine	<	<	<	<	0.001	5	0.077
CCCSD	EPA 625	3-Methyl-4-Chlorophenol	<	<	<	<	1.53	1	U
CCCSD	EPA 625	4-Bromophenyl Phenyl Ether	<	<	<	<	0.23	1	U
CCCSD	EPA 625	4-Chlorophenyl Phenyl Ether	<	<	<	<	0.31	1	U
CCCSD	EPA 625	4-Nitrophenol	<	<	<	<	1.81	5	U
CCCSD	EPA 624	Acrolein	<	<	<	<	1.5	10	780
CCCSD	EPA 624	Acrylonitrile	<	<	<	<	1.4	2	0.66
CCCSD	EPA 624MOD	Acrylonitrile	<	<	<	<	0.03	2	0.66
CCCSD	EPA 624	Benzene	<	<	<	<	0.5	0.5	71
CCCSD	EPA 625	Benzidine	<	<	<	<	12.45	5	0.00054
CCCSD	EPA 625MOD	Benzidine	<	<	<	<	0.0015	5	0.00054
CCCSD		bis(2-chloroethoxy)methane	..	..	..	..

CCCSD	EPA 625	Bis2-ChloroethylEther	<	<	<	<	0.32	1	1.4
CCCSD	EPA 625	Bis2-EthylhexylPhthalate	<	<	<	<	0.67	5	5.9
CCCSD	EPA 624	Bromoform	<	<	<	<	0.5	0.5	360
CCCSD	EPA 625	Butylbenzyl Phthalate	<	<	<	<	0.52	5	5200
CCCSD	EPA 624	Carbon Tetrachloride	<	<	<	<	0.5	0.5	4.4
CCCSD	EPA 624MOD	Carbon Tetrachloride	<	<	<	<	0.03	0.5	4.4
CCCSD	EPA 624	Chlorobenzene	<	<	<	<	0.5	0.5	21000
CCCSD	EPA 624	Chlorodibromomethane	<	<	<	<	0.5	0.5	34
CCCSD	EPA 624	Chloroethane	<	<	<	<	0.9	0.5	U
CCCSD	EPA 624	Chloroform	<	<	<	<	0.5	0.5	U
CCCSD	EPA 624	Dichlorobromomethane	<	<	<	<	0.5	0.5	46
CCCSD	EPA 625	Diethyl Phthalate	<	<	<	<	0.24	2	120000
CCCSD	EPA 625	Dimethyl Phthalate	<	<	<	<	0.24	1	2900000
CCCSD	EPA 625	Di-n-Butyl Phthalate	<	<	<	<	1.07	5	12000
CCCSD	EPA 625	Di-n-Octyl Phthalate	<	<	<	<	0.38	1	U
CCCSD	EPA 624	Ethylbenzene	<	<	<	<	0.5	0.5	29000
CCCSD	EPA 625	Hexachlorobutadiene	<	<	<	<	0.34	5	50
CCCSD	EPA 625	Hexachlorocyclopentadiene	<	<	<	<	0.31	5	17000
CCCSD	EPA 625	Hexachloroethane	<	<	<	<	0.4	1	8.9
CCCSD	EPA 625	Isophorone	<	<	<	<	0.38	5	600
CCCSD	EPA 624	Methyl Bromide	<	<	<	<	1.1	0.5	4000
CCCSD	EPA 624	Methyl Chloride	<	<	<	<	0.5	0.5	U
CCCSD	EPA 624	Methylene Chloride	<	0.5	<	<	0.5	1.2	1600
CCCSD	EPA 625	Nitrobenzene	<	<	<	<	0.25	1	1900
CCCSD	EPA 625	N-Nitrosodimethylamine	<	<	<	<	0.33	5	8.1
CCCSD	EPA 625	N-Nitrosodi-n-Propylamine	<	<	<	<	0.4	1	1.4
CCCSD	EPA 625MOD	N-Nitrosodi-n-Propylamine	<	<	<	<	0.001	1	1.4
CCCSD	EPA 625	N-Nitrosodiphenylamine	<	<	<	<	0.19	1	16
CCCSD	EPA 625	Pentachlorophenol	<	<	<	<	1.28	1	7.9
CCCSD	EPA 625	Phenol	<	<	<	<	1.68	1	4600000
CCCSD	EPA 624	Tetrachloroethylene	<	<	<	<	0.5	0.5	8.85
CCCSD	EPA 624	Toluene	<	<	<	<	0.5	0.5	200000
CCCSD	EPA 624	Trichloroethylene	<	<	<	<	0.5	0.5	81
CCCSD	EPA 624	Vinyl Chloride	<	<	<	<	0.5	0.5	525

Table 2. VOCs and SVOCs in SF Estuary Water Samples, January 2003

LAB	METHOD	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB_MDL	TARGET_ML	WQOWQC
			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
		2003-01							
CCCSD	EPA 624	1,1,1-Trichloroethane	<	<	<	<	0.5	0.5	U
CCCSD	EPA 624	1,1,2,2-Tetrachloroethane	<	<	<	<	0.5	0.5	11
CCCSD	EPA 624	1,1,2-Trichloroethane	<	<	<	<	0.5	0.5	42
CCCSD	EPA 624	1,1-Dichloroethane	<	<	<	<	0.8	0.5	U
CCCSD	EPA 624	1,1-Dichloroethylene	<	<	<	<	0.5	0.5	3.2
CCCSD	EPA 625	1,2,4-Trichlorobenzene	<	<	<	<	0.3	2	U
CCCSD	EPA 625	1,2-Dichlorobenzene	<	<	<	<	0.3	1	17000
CCCSD	EPA 624	1,2-Dichlorobenzene	<	<	<	<	0.5	1	17000
CCCSD	EPA 624MOD	1,2-Dichloroethane	<	<	<	<	0.02	0.5	99
CCCSD	EPA 624	1,2-Dichloroethane	<	<	<	<	0.5	0.5	99
CCCSD	EPA 624	1,2-Dichloropropane	<	<	<	<	0.5	0.5	39
CCCSD	EPA 625MOD	1,2-Diphenylhydrazine	<	<	<	<	0.002	1	0.54
CCCSD	EPA 625	1,2-Diphenylhydrazine	<	<	<	<	0.3	1	0.54
CCCSD	EPA 624	1,2-Trans-Dichloroethylene	<	<	<	<	1.5	0.5	140000
CCCSD	EPA 625	1,3-Dichlorobenzene	<	<	<	<	0.3	1	2600
CCCSD	EPA 624	1,3-Dichlorobenzene	<	<	<	<	0.5	1	2600
CCCSD	EPA 625	1,4-Dichlorobenzene	<	<	<	<	0.3	1	2600
CCCSD	EPA 624	1,4-Dichlorobenzene	<	<	<	<	0.5	1	2600
CCCSD	EPA 625	2,4,6-Trichlorophenol	<	<	<	<	1.3	1	6.5
CCCSD	EPA 625	2,4-Dichlorophenol	<	<	<	<	1.3	1	790
CCCSD	EPA 625	2,4-Dimethylphenol	<	<	<	<	1.3	1	2300
CCCSD	EPA 625	2,4-Dinitrophenol	<	<	<	<	0.7	5	14000
CCCSD	EPA 625	2,4-Dinitrotoluene	<	<	<	<	0.4	1	9.1
CCCSD	EPA 625	2,6-Dinitrotoluene	<	<	<	<	0.3	1	U
CCCSD	EPA 624	2-Chloroethylvinyl Ether	<	<	<	<	0.5	1	U
CCCSD	EPA 625	2-Chloronaphthalene	<	<	<	<	0.3	1	4300
CCCSD	EPA 625	2-Chlorophenol	<	<	<	<	1.2	1	400
CCCSD	EPA 625	2-Methyl-4,6-Dinitrophenol	<	<	<	<	1.2	5	765
CCCSD	EPA 625	2-Nitrophenol	<	<	<	<	1.3	1	U
CCCSD	EPA 625MOD	3,3'-Dichlorobenzidine	<	<	<	0.13	0.001	5	0.077
CCCSD	EPA 625	3,3'-Dichlorobenzidine	<	<	<	<	5.2	5	0.077
CCCSD	EPA 625	3-Methyl-4-Chlorophenol	<	<	<	<	1.1	1	U
CCCSD	EPA 625	4-Bromophenyl Phenyl Ether	<	<	<	<	0.3	1	U
CCCSD	EPA 625	4-Chlorophenyl Phenyl Ether	<	<	<	<	0.3	1	U
CCCSD	EPA 625	4-Nitrophenol	<	<	<	<	1.6	5	U
CCCSD	EPA 625	Acenaphthene	<	<	<	<	0.3	0.2	2700
CCCSD	EPA 625	Acenaphthylene	<	<	<	<	0.3	0.2	U
CCCSD	EPA 624	Acrolein	<	<	<	<	0.5	10	780
CCCSD	EPA 624MOD	Acrylonitrile	<	<	<	<	0.02	2	0.66
CCCSD	EPA 624	Acrylonitrile	<	<	<	<	0.5	2	0.66
CCCSD	EPA 625	Anthracene	<	<	<	<	0.4	0.2	110000
CCCSD	EPA 625	Benz(a)anthracene	<	<	<	<	0.4	5	0.049
CCCSD	EPA 624	Benzene	<	<	<	<	0.5	0.5	71

CCCSD	EPA 625MOD	Benzidine	<	<	<	<	0.002	5	0.00054
CCCSD	EPA 625	Benzidine	<	<	<	<	24.7	5	0.00054
CCCSD	EPA 625	Benzo(a)pyrene	<	<	<	<	0.3	2	0.049
CCCSD	EPA 625	Benzo(b)fluoranthene	<	<	<	<	0.4	10	0.049
CCCSD	EPA 625	Benzo(ghi)perylene	<	<	<	<	0.3	1	U
CCCSD	EPA 625	Benzo(k)fluoranthene	<	<	<	<	0.3	2	0.049
CCCSD	EPA 625	Bis(2-chloroethoxy)methane	<	<	<	<	0.3	1	U
CCCSD	EPA 625	Bis2-ChloroethylEther	<	<	<	<	0.3	1	1.4
CCCSD	EPA 625	Bis2-EthylhexylPhthalate	<	<	<	<	0.5	5	5.9
CCCSD	EPA 624	Bromoform	<	<	<	<	0.5	0.5	360
CCCSD	EPA 625	Butylbenzyl Phthalate	<	<	<	<	0.7	5	5200
CCCSD	EPA 624MOD	Carbon Tetrachloride	<	<	<	<	0.02	0.5	4.4
CCCSD	EPA 624	Carbon Tetrachloride	<	<	<	<	0.5	0.5	4.4
CCCSD	EPA 624	Chlorobenzene	<	<	<	<	0.5	0.5	21000
CCCSD	EPA 624	Chlorodibromomethane	<	<	<	<	0.5	0.5	34
CCCSD	EPA 624	Chloroethane	<	<	<	<	0.5	0.5	U
CCCSD	EPA 624	Chloroform	<	<	<	<	0.5	0.5	U
CCCSD	EPA 625	Chrysene	<	<	<	<	0.3	5	0.049
CCCSD	EPA 625	Dibenz(a,h)anthracene	<	<	<	<	0.3	0.1	0.049
CCCSD	EPA 624	Dichlorobromomethane	<	<	<	<	0.5	0.5	46
CCCSD	EPA 625	Diethyl Phthalate	<	<	<	<	0.5	2	120000
CCCSD	EPA 625	Dimethyl Phthalate	<	<	<	<	0.3	1	2900000
CCCSD	EPA 625	Di-n-Butyl Phthalate	<	<	<	<	0.5	5	12000
CCCSD	EPA 625	Di-n-Octyl Phthalate	<	<	<	<	0.5	1	U
CCCSD	EPA 624	Ethylbenzene	<	<	<	<	0.5	0.5	29000
CCCSD	EPA 625	Fluoranthene	<	<	<	<	0.4	1	370
CCCSD	EPA 625	Fluorene	<	<	<	<	0.3	1	14000
CCCSD	EPA 625	Hexachlorobenzene	<	<	<	<	0.3	1	0.00077
CCCSD	EPA 625	Hexachlorobutadiene	<	<	<	<	0.3	5	50
CCCSD	EPA 625	Hexachlorocyclopentadiene	<	<	<	<	0.8	5	17000
CCCSD	EPA 625	Hexachloroethane	<	<	<	<	0.2	1	8.9
CCCSD	EPA 625	Indeno(1,2,3-cd)pyrene	<	<	<	<	0.3	0.05	0.049
CCCSD	EPA 625	Isophorone	<	<	<	<	0.3	5	600
CCCSD	EPA 624	Methyl Bromide	<	<	<	<	0.5	0.5	4000
CCCSD	EPA 624	Methyl Chloride	<	<	<	<	0.5	0.5	U
CCCSD	EPA 624	Methylene Chloride	<	<	<	<	0.5	1.2	1600
CCCSD	EPA 625	Naphthalene	<	<	<	<	0.3	1	U
CCCSD	EPA 625	Nitrobenzene	<	<	<	<	0.3	1	1900
CCCSD	EPA 625	N-Nitrosodimethylamine	<	<	<	<	0.3	5	8.1
CCCSD	EPA 625	N-Nitrosodi-n-Propylamine	<	<	<	<	0.3	1	1.4
CCCSD	EPA 625MOD	N-Nitrosodiphenylamine	<	<	<	<	0.001	1	16
CCCSD	EPA 625	N-Nitrosodiphenylamine	<	<	<	<	0.3	1	16
CCCSD	EPA 625	Pentachlorophenol	<	<	<	<	1	1	7.9
CCCSD	EPA 625	Phenanthrene	<	<	<	<	0.4	1	U
CCCSD	EPA 625	Phenol	<	<	<	<	1.3	1	4600000
CCCSD	EPA 625	Pyrene	<	<	<	<	0.4	11	11000
CCCSD	EPA 624	Tetrachloroethylene	<	<	<	<	0.5	0.5	8.85
CCCSD	EPA 624	Toluene	<	<	<	<	0.5	0.5	200000
CCCSD	EPA 624	Trichloroethylene	<	<	<	<	0.5	0.5	81
CCCSD	EPA 624	Vinyl Chloride	<	<	<	<	0.9	0.5	525

Table 2. VOCs and SVOCs in SF Estuary Water Samples, January 2002

.. = not analyzed, < = not detected, U = unspecified, e=estimated value.

LAB	METHOD	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB_MDL	TARGET_ML	WQO/WQC
		2002-01	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
PAI	EPA 1624	1,1,1-Trichloroethane	<	<	<	<	2	0.5	U
PAI	EPA 1624MOD	1,1,2,2-Tetrachloroethane	<	<	<	<	0.05	0.5	11
PAI	EPA 1624MOD	1,1,2-Trichloroethane	<	<	<	<	0.05	0.5	42
PAI	EPA 1624MOD	1,1-Dichloroethane	<	<	<	<	0.05	0.5	U
PAI		1,1-Dichloroethylene	..	..	..			0.5	3.2
PAI	EPA 1625	1,2,4-Trichlorobenzene	<	<	<	<	10	2	U
PAI	EPA 1625	1,2-Dichlorobenzene	<	<	<	<	10	1	17000
PAI		1,2-Dichlorobenzene	..	..	..			1	17000
PAI	EPA 1624MOD	1,2-Dichloroethane	<	<	<	<	0.05	0.5	99
PAI		1,2-Dichloroethane	..	..	..			0.5	99
PAI	EPA 1624MOD	1,2-Dichloropropane	<	<	<	<	0.05	0.5	39
PAI	EPA 1625MOD	1,2-Diphenylhydrazine	<	<	<	<	0.002	1	0.54
PAI		1,2-Diphenylhydrazine	..	..	..			1	0.54
PAI		1,2-Trans-Dichloroethylene	..	..	..			0.5	140000
PAI	EPA 1625	1,3-Dichlorobenzene	<	<	<	<	10	1	2600
PAI		1,3-Dichlorobenzene	..	..	..			1	2600
PAI	EPA 1625	1,4-Dichlorobenzene	<	<	<	<	10	1	2600
PAI		1,4-Dichlorobenzene	..	..	..			1	2600
PAI	EPA 1625	2,4,6-Trichlorophenol	<	<	<	<	10	1	6.5
PAI	EPA 1625	2,4-Dichlorophenol	<	<	<	<	10	1	790
PAI	EPA 1625	2,4-Dimethylphenol	<	<	<	<	10	1	2300
PAI	EPA 1625	2,4-Dinitrophenol	<	<	<	<	10	5	14000
PAI	EPA 1625	2,4-Dinitrotoluene	<	<	<	<	10	1	9.1
PAI	EPA 1625	2,6-Dinitrotoluene	<	<	<	<	10	1	U
PAI	EPA 1624	2-Chloroethylvinyl Ether	<	<	<	<	2	1	U
PAI	EPA 1625	2-Chloronaphthalene	<	<	<	<	10	1	4300
PAI	EPA 1625	2-Chlorophenol	<	<	<	<	10	1	400
PAI	EPA 1625	2-Methyl-4,6-Dinitrophenol	<	<	<	..	10	5	765
PAI	EPA 1625	2-Nitrophenol	<	<	<	<	10	1	U
PAI	EPA 1625MOD	3,3'-Dichlorobenzidine	<	<	<	<	0.004	5	0.077
PAI		3,3'-Dichlorobenzidine	..	..	..			5	0.077
PAI	EPA 1625	3-Methyl-4-Chlorophenol	<	<	<	..	10	1	U
PAI	EPA 1625	4-Bromophenyl Phenyl Ether	<	<	<	..	10	1	U
PAI	EPA 1625	4-Chlorophenyl Phenyl Ether	<	<	<	..	10	1	U
PAI	EPA 1625	4-Nitrophenol	<	<	<	<	10	5	U
PAI		Acrolein	..	..	..			10	780
PAI	EPA 1624MOD	Acrylonitrile	<	<	<	<	0.05	2	0.66
PAI		Acrylonitrile	..	..	..			2	0.66
PAI	EPA 1624MOD	Benzene	<	<	<	<	0.05	0.5	71
PAI	EPA 1625MOD	Benzidine	<	<	<	<	0.01	5	0.00054
PAI		Benzidine	..	..	..			5	0.00054
PAI	EPA 1625	bis(2-chloroethoxy)methane	<	<	<	..	10	1	U

PAI	EPA 1625	Bis2-ChloroethylEther	<	<	<	<	10	1	1.4
PAI	EPA 1625	Bis2-EthylhexylPhthalate	<	26.8	15.2	..	10	5	5.9
PAI	EPA 1624	Bromoform	<	<	<	<	2	0.5	360
PAI	EPA 1625	Butylbenzyl Phthalate	<	<	<	..	10	5	5200
PAI	EPA 1624MOD	Carbon Tetrachloride	<	<	<	<	0.05	0.5	4.4
PAI		Carbon Tetrachloride	..	..	..			0.5	4.4
PAI	EPA 1624	Chlorobenzene	<	<	<	<	2	0.5	21000
PAI	EPA 1624MOD	Chlorodibromomethane	<	<	<	<	0.05	0.5	34
PAI	EPA 1624	Chloroethane	<	<	<	<	2	0.5	U
PAI	EPA 1624	Chloroform	<	<	<	<	2	0.5	U
PAI	EPA 1624MOD	Dichlorobromomethane	<	<	<	..	0.05	0.5	46
PAI	EPA 1625	Diethyl Phthalate	<	<	<	..	10	2	120000
PAI	EPA 1625	Dimethyl Phthalate	<	<	<	<	10	1	2900000
PAI	EPA 1625	Di-n-Butyl Phthalate	<	<	<	..	10	5	12000
PAI	EPA 1625	Di-n-Octyl Phthalate	<	<	<	..	10	1	U
PAI	EPA 1624	Ethylbenzene	<	<	<	<	2	0.5	29000
PAI	EPA 1625	Hexachlorobutadiene	<	<	<	<	10	5	50
PAI	EPA 1625	Hexachlorocyclopentadiene	<	<	<	<	10	5	17000
PAI	EPA 1625	Hexachloroethane	<	<	<	<	10	1	8.9
PAI	EPA 1625	Isophorone	<	<	<	<	10	5	600
PAI	EPA 1624	Methyl Bromide	<	<	<	..	2	0.5	4000
PAI	EPA 1624	Methyl Chloride	<	<	<	..	2	0.5	U
PAI		Methylene Chloride	..	..	..			1.2	1600
PAI	EPA 1625	Nitrobenzene	<	<	<	<	10	1	1900
PAI	EPA 1625	N-Nitrosodimethylamine	<	<	<	<	10	5	8.1
PAI	EPA 1625MOD	N-Nitrosodi-n-Propylamine	<	<	<	<	0.005	1	1.4
PAI		N-Nitrosodi-n-Propylamine	..	..	..			1	1.4
PAI	EPA 1625	N-Nitrosodiphenylamine	<	<	<	<	10	1	16
PAI	EPA 1625	Pentachlorophenol	<	<	<	<	10	1	7.9
PAI	EPA 1625	Phenol	<	<	<	<	10	1	4600000
PAI	EPA 1624MOD	Tetrachloroethylene	<	<	<	..	0.05	0.5	8.85
PAI	EPA 1624	Toluene	<	<	<	<	2	0.5	200000
PAI	EPA 1624	Trichloroethylene	<	<	<	..	2	0.5	81
PAI	EPA 1624	Vinyl Chloride	<	<	<	<	2	0.5	525

Table 2. VOCs and SVOCs in SF Estuary Water Samples, July 2002

LAB	METHOD	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB_MDL	TARGET_ML	WQO/WQC
			ug/L	ug/L	ug/L				
		2002-07	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
PAI	EPA 1624	1,1,1-Trichloroethane	<	<	<	<	2	0.5	U
PAI	EPA 1624MOD	1,1,1,2-Tetrachloroethane	<	<	<	<	0.05	0.5	11
PAI	EPA 1624MOD	1,1,2-Trichloroethane	<	<	<	<	0.05	0.5	42
PAI	EPA 1624MOD	1,1-Dichloroethane	<	<	<	<	0.05	0.5	U
PAI		1,1-Dichloroethylene	..	:	..			0.5	3.2
PAI	EPA 1625	1,2,4-Trichlorobenzene	<	<	<	<	10	2	U
PAI	EPA 1625	1,2-Dichlorobenzene	<	<	<	<	10	1	17000
PAI		1,2-Dichlorobenzene	..	:	..			1	17000
PAI	EPA 1624MOD	1,2-Dichloroethane	<	<	<	<	0.05	0.5	99
PAI		1,2-Dichloroethane	..	:	..			0.5	99
PAI	EPA 1624MOD	1,2-Dichloropropane	<	<	<	<	0.05	0.5	39
PAI	EPA 1625MOD	1,2-Diphenylhydrazine	<	<	<	<	0.002	1	0.54
PAI		1,2-Diphenylhydrazine	..	..	..			1	0.54
PAI		1,2-Trans-Dichloroethylene	..	..	..			0.5	140000
PAI	EPA 1625	1,3-Dichlorobenzene	<	<	<	<	10	1	2600
PAI		1,3-Dichlorobenzene	..	:	..			1	2600
PAI	EPA 1625	1,4-Dichlorobenzene	<	<	<	<	10	1	2600
PAI		1,4-Dichlorobenzene	..	..	..			1	2600
PAI	EPA 1625	2,4,6-Trichlorophenol	<	<	<	<	10	1	6.5
PAI	EPA 1625	2,4-Dichlorophenol	<	<	<	<	10	1	790
PAI	EPA 1625	2,4-Dimethylphenol	<	<	<	<	10	1	2300
PAI	EPA 1625	2,4-Dinitrophenol	<	<	<	<	10	5	14000
PAI	EPA 1625	2,4-Dinitrotoluene	<	<	<	<	10	1	9.1
PAI	EPA 1625	2,6-Dinitrotoluene	<	<	<	<	10	1	U
PAI	EPA 1624	2-Chloroethylvinyl Ether	<	<	<	<	2	1	U
PAI	EPA 1625	2-Chloronaphthalene	<	<	<	<	10	1	4300
PAI	EPA 1625	2-Chlorophenol	<	<	<	<	10	1	400
PAI	EPA 1625	2-Methyl-4,6-Dinitrophenol	<	<	<	<	10	5	765
PAI	EPA 1625	2-Nitrophenol	<	<	<	<	10	1	U
PAI	EPA 1625MOD	3,3'-Dichlorobenzidine	<	<	<	<	0.004	5	0.077
PAI		3,3'-Dichlorobenzidine	..	..	..			5	0.077
PAI	EPA 1625	3-Methyl-4-Chlorophenol	<	<	<	<	10	1	U
PAI	EPA 1625	4-Bromophenyl Phenyl Ether	<	<	<	<	10	1	U
PAI	EPA 1625	4-Chlorophenyl Phenyl Ether	<	<	<	<	10	1	U
PAI	EPA 1625	4-Nitrophenol	<	<	<	<	10	5	U
PAI		Acrolein	..	..	..			10	780
PAI	EPA 1624MOD	Acrylonitrile	<	<	<	<	20	2	0.66
PAI		Acrylonitrile	..	..	..			2	0.66
PAI	EPA 1624MOD	Benzene	<	<	<	<	0.05	0.5	71
PAI	EPA 1625MOD	Benzidine	<	<	<	<	0.01	5	0.00054
PAI		Benzidine	..	..	..			5	0.00054

PAI	EPA 1625	bis(2-chloroethoxy)methane	<	<	<	<	10	1	U
PAI	EPA 1625	Bis2-ChloroethylEther	<	<	<	<	10	1	1.4
PAI	EPA 1625	Bis2-EthylhexylPhthalate	26.8	15.2	<	<	10	5	5.9
PAI	EPA 1624	Bromoform	<	<	<	<	2	0.5	360
PAI	EPA 1625	Butylbenzyl Phthalate	<	<	<	<	10	5	5200
PAI	EPA 1624MOD	Carbon Tetrachloride	<	<	<	<	2	0.5	4.4
PAI		Carbon Tetrachloride	..	..	..			0.5	4.4
PAI	EPA 1624	Chlorobenzene	<	<	<	<	2	0.5	21000
PAI	EPA 1624MOD	Chlorodibromomethane	<	<	<	<	0.05	0.5	34
PAI	EPA 1624	Chloroethane	<	<	<	<	2	0.5	U
PAI	EPA 1624	Chloroform	<	<	<	<	2	0.5	U
PAI	EPA 1624MOD	Dichlorobromomethane	<	<	<	<	0.05	0.5	46
PAI	EPA 1625	Diethyl Phthalate	<	<	<	<	10	2	120000
PAI	EPA 1625	Dimethyl Phthalate	<	<	<	<	10	1	2900000
PAI	EPA 1625	Di-n-Butyl Phthalate	<	<	<	<	10	5	12000
PAI	EPA 1625	Di-n-Octyl Phthalate	<	<	<	<	10	1	U
PAI	EPA 1624	Ethylbenzene	<	<	<	<	2	0.5	29000
PAI	EPA 1625	Hexachlorobutadiene	<	<	<	<	10	5	50
PAI	EPA 1625	Hexachlorocyclopentadiene	<	<	<	<	10	5	17000
PAI	EPA 1625	Hexachloroethane	<	<	<	<	10	1	8.9
PAI	EPA 1625	Isophorone	<	<	<	<	10	5	600
PAI	EPA 1624	Methyl Bromide	<	<	<	<	2	0.5	4000
PAI	EPA 1624	Methyl Chloride	<	<	<	<	2	0.5	U
PAI		Methylene Chloride	..	..	..			1.2	1600
PAI	EPA 1625	Nitrobenzene	<	<	<	<	10	1	1900
PAI	EPA 1625	N-Nitrosodimethylamine	<	<	<	<	10	5	8.1
PAI	EPA 1625MOD	N-Nitrosodi-n-Propylamine	<	<	<	<	0.005	1	1.4
PAI		N-Nitrosodi-n-Propylamine	..	..	..			1	1.4
PAI	EPA 1625	N-Nitrosodiphenylamine	<	<	<	<	10	1	16
PAI	EPA 1625	Pentachlorophenol	<	<	<	<	10	1	7.9
PAI	EPA 1625	Phenol	<	<	<	<	10	1	4600000
PAI	EPA 1624MOD	Tetrachloroethylene	<	<	<	<	0.05	0.5	8.85
PAI	EPA 1624	Toluene	<	<	<	<	2	0.5	200000
PAI	EPA 1624	Trichloroethylene	<	<	<	<	2	0.5	81
PAI	EPA 1624	Vinyl Chloride	<	<	<	<	2	0.5	525

Table 2. VOCs and SVOCs in SF Estuary Water Samples, January 2003

LAB	METHOD	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB_MDL	TARGET_ML	WQOWQC
			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
		2003-01							
PAI	EPA 1624	1,1,1-Trichloroethane	<	<	<	<	2	0.5	U
PAI	EPA 1624MOD	1,1,2,2-Tetrachloroethane	<	<	<	<	0.05	0.5	11
PAI	EPA 1624MOD	1,1,2-Trichloroethane	<	<	<	<	0.05	0.5	42
PAI	EPA 1624MOD	1,1-Dichloroethane	<	<	<	<	0.05	0.5	U
PAI	EPA 1624	1,1-Dichloroethylene	<	<	<	..	2	0.5	3.2
PAI	EPA 1625	1,2,4-Trichlorobenzene	<	<	<	<	10	2	U
PAI	EPA 1625	1,2-Dichlorobenzene	<	<	<	<	10	1	17000
PAI									
PAI	EPA 1624MOD	1,2-Dichloroethane	<	<	<	<	0.05	0.5	99
PAI									
PAI	EPA 1624MOD	1,2-Dichloropropane	<	<	<	<	0.05	0.5	39
PAI	EPA 1625MOD	1,2-Diphenylhydrazine	<	<	<	e 0.286	0.002	1	0.54
PAI									
PAI									
PAI	EPA 1625	1,3-Dichlorobenzene	<	<	<	<	10	1	2600
PAI									
PAI	EPA 1625	1,4-Dichlorobenzene	<	<	<	<	10	1	2600
PAI									
PAI	EPA 1625	2,4,6-Trichlorophenol	<	<	<	<	10	1	6.5
PAI	EPA 1625	2,4-Dichlorophenol	<	<	<	<	10	1	790
PAI	EPA 1625	2,4-Dimethylphenol	<	<	<	<	10	1	2300
PAI	EPA 1625	2,4-Dinitrophenol	<	<	<	<	10	5	14000
PAI	EPA 1625	2,4-Dinitrotoluene	<	<	<	<	10	1	9.1
PAI	EPA 1625	2,6-Dinitrotoluene	<	<	<	<	10	1	U
PAI	EPA 1624	2-Chloroethylvinyl Ether	<	<	<	<	2	1	U
PAI	EPA 1625	2-Chloronaphthalene	<	<	<	<	10	1	4300
PAI	EPA 1625	2-Chlorophenol	<	<	<	<	10	1	400
PAI	EPA 1625	2-Methyl-4,6-Dinitrophenol	<	<	<	<	10	5	765
PAI	EPA 1625	2-Nitrophenol	<	<	<	<	10	1	U
PAI	EPA 1625MOD	3,3'-Dichlorobenzidine	<	<	<	<	0.004	5	0.077
PAI									
PAI	EPA 1625	3-Methyl-4-Chlorophenol	<	<	<	<	10	1	U
PAI	EPA 1625	4-Bromophenyl Phenyl Ether	<	<	<	<	10	1	U
PAI	EPA 1625	4-Chlorophenyl Phenyl Ether	<	<	<	<	10	1	U
PAI	EPA 1625	4-Nitrophenol	<	<	<	<	10	5	U
PAI	EPA 1625	Acenaphthene	<	<	<	<	10	0.2	2700
PAI	EPA 1625	Acenaphthylene	<	<	<	<	10	0.2	U
PAI									
PAI	EPA 1624MOD	Acrylonitrile	<	<	<	<	0.05	2	0.66
PAI	EPA 1624	Acrylonitrile	<	<	<	..	20	2	0.66
PAI	EPA 1625	Anthracene	<	<	<	<	10	0.2	110000
PAI	EPA 1625	Benz(a)anthracene	<	<	<	<	10	5	0.049
PAI	EPA 1624MOD	Benzene	<	<	<	<	0.05	0.5	71

PAI	EPA 1625MOD	Benzidine	<	<	<	<	0.01	5	0.00054
PAI									
PAI	EPA 1625	Benzo(a)pyrene	<	<	<	<	10	2	0.049
PAI	EPA 1625	Benzo(b)fluoranthene	<	<	<	<	10	10	0.049
PAI	EPA 1625	Benzo(ghi)perylene	<	<	<	<	10	1	U
PAI	EPA 1625	Benzo(k)fluoranthene	<	<	<	<	10	2	0.049
PAI	EPA 1625	Bis(2-chloroethoxy)methane	<	<	<	<	10	1	U
PAI	EPA 1625	Bis2-ChloroethylEther	<	<	<	<	10	1	1.4
PAI	EPA 1625	Bis2-EthylhexylPhthalate	<	<	<	<	10	5	5.9
PAI	EPA 1624	Bromoform	<	<	<	<	2	0.5	360
PAI	EPA 1625	Butylbenzyl Phthalate	<	<	<	<	10	5	5200
PAI	EPA 1624MOD	Carbon Tetrachloride	<	<	<	<	0.05	0.5	4.4
PAI	EPA 1624	Carbon Tetrachloride	<	<	<	..	2	0.5	4.4
PAI	EPA 1624	Chlorobenzene	<	<	<	<	2	0.5	21000
PAI	EPA 1624MOD	Chlorodibromomethane	<	<	0.057	<	0.05	0.5	34
PAI	EPA 1624	Chloroethane	<	<	<	<	2	0.5	U
PAI	EPA 1624	Chloroform	<	<	<	<	2	0.5	U
PAI	EPA 1625	Chrysene	<	<	<	<	10	5	0.049
PAI	EPA 1625	Dibenz(a,h)anthracene	<	<	<	<	10	0.1	0.049
PAI	EPA 1624MOD	Dichlorobromomethane	<	<	<	<	0.05	0.5	46
PAI	EPA 1625	Diethyl Phthalate	<	<	<	<	10	2	120000
PAI	EPA 1625	Dimethyl Phthalate	<	<	<	<	10	1	2900000
PAI	EPA 1625	Di-n-Butyl Phthalate	<	<	<	<	10	5	12000
PAI	EPA 1625	Di-n-Octyl Phthalate	<	<	<	<	10	1	U
PAI	EPA 1624	Ethylbenzene	<	<	<	<	2	0.5	29000
PAI	EPA 1625	Fluoranthene	<	<	<	<	10	1	370
PAI	EPA 1625	Fluorene	<	<	<	<	10	1	14000
PAI	EPA 1625	Hexachlorobenzene	<	<	<	<	10	1	0.00077
PAI	EPA 1625	Hexachlorobutadiene	<	<	<	<	10	5	50
PAI	EPA 1625	Hexachlorocyclopentadiene	<	<	<	<	10	5	17000
PAI	EPA 1625	Hexachloroethane	<	<	<	<	10	1	8.9
PAI	EPA 1625	Indeno(1,2,3-cd)pyrene	<	<	<	<	10	0.05	0.049
PAI	EPA 1625	Isophorone	<	<	<	<	10	5	600
PAI	EPA 1624	Methyl Bromide	<	<	<	<	2	0.5	4000
PAI	EPA 1624	Methyl Chloride	<	<	<	<	2	0.5	U
PAI									
PAI	EPA 1625	Naphthalene	<	<	<	<	10	1	U
PAI	EPA 1625	Nitrobenzene	<	<	<	<	10	1	1900
PAI	EPA 1625	N-Nitrosodimethylamine	<	<	<	<	10	5	8.1
PAI	EPA 1625MOD	N-Nitrosodi-n-Propylamine	<	<	<	<	0.005	1	1.4
PAI	EPA 1625	N-Nitrosodiphenylamine	<	<	<	<	10	1	16
PAI									
PAI	EPA 1625	Pentachlorophenol	<	<	<	<	10	1	7.9
PAI	EPA 1625	Phenanthrene	<	<	<	<	10	1	U
PAI	EPA 1625	Phenol	<	<	<	<	10	1	4600000
PAI	EPA 1625	Pyrene	<	<	<	<	10	11	11000
PAI	EPA 1624MOD	Tetrachloroethylene	<	<	<	<	0.05	0.5	8.85
PAI	EPA 1624	Toluene	<	<	<	<	2	0.5	200000
PAI	EPA 1624	Trichloroethylene	<	<	<	<	2	0.5	81
PAI	EPA 1624	Vinyl Chloride	<	<	<	<	2	0.5	525

Table 3. Volatilization Half-Lives of Selected VOCs And SVOCs in Surface Water, 20 C (Lyman 1990)

VOCs	Half-life (hrs)
1,1,1Trichloroethane	3.7
Benzene	2.7
Bromomethane	3.1
CarbonTetrachloride	3.7
Chlorobenzene	4.6
Chloroform	3.7
Chloromethane	2.4
Dichloromethane	3
Ethylbenzene	3.1
Toluene	2.9
Trichloroethene	3.4
VinylChloride	2.5

SVOCs	Half-life (hrs)
Naphthalene	4.1
Nitrobenzene	45
Pentachlorophenol	406
Phenanthrene	31

Table 4. PCDD/PCDFs in SF Estuary Water Samples (January 2002)

.. = not analyzed, < = not detected, E = estimate not quantifiable .

LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL
	2002-01	pg/L	pg/L	pg/L	pg/L	pg/L
AXYS	2,3,7,8-TCDD	0.0065	E	0.024	E	0.0019
AXYS	1,2,3,7,8-PeCDD	E	0.011	0.051	E	0.0006
AXYS	1,2,3,4,7,8-HxCDD	0.009	0.012	0.054	<	0.006
AXYS	1,2,3,6,7,8-HxCDD	E	0.048	0.190	<	0.006
AXYS	1,2,3,7,8,9-HxCDD	0.028	0.035	0.158	E	0.006
AXYS	1,2,3,4,6,7,8-HpCDD	0.470	0.580	2.830	0.012	0.006
AXYS	OCDD	3.35	3.46	17.1	E	0.0001
AXYS	2,3,7,8-TCDF	0.020	0.036	0.230	<	0.005
AXYS	1,2,3,7,8-PeCDF	E	0.013	0.070	E	0.003
AXYS	2,3,4,7,8-PeCDF	0.015	0.020	0.120	E	0.003
AXYS	1,2,3,4,7,8-HxCDF	0.017	0.017	0.072	E	0.003
AXYS	1,2,3,6,7,8-HxCDF	0.009	0.011	0.060	E	0.003
AXYS	1,2,3,7,8,9-HxCDF	E	0.004	0.013	E	0.003
AXYS	2,3,4,6,7,8-HxCDF	E	0.012	0.069	0.004	0.003
AXYS	1,2,3,4,6,7,8-HpCDF	0.106	0.141	0.639	<	0.0012
AXYS	1,2,3,4,7,8,9-HpCDF	0.0105	0.010	E	<	0.0012
AXYS	OCDF	0.216	0.272	1.190	0.0107	0.0014
AXYS	Total Hepta-Dioxins	1.04	1.48	7.61	0.016	0.006
AXYS	Total Hepta-Furans	0.272	0.362	1.620	<	0.0012
AXYS	Total Hexa-Dioxins	0.149	0.456	2.310	<	0.006
AXYS	Total Hexa-Furans	0.127	0.239	1.400	0.004	0.003
AXYS	Total Penta-Dioxins	0.0183	0.063	0.553	0.0010	0.0006
AXYS	Total Penta-Furans	0.101	0.249	1.630	<	0.003
AXYS	Total Tetra-Dioxins	0.222	0.159	1.060	<	0.0019
AXYS	Total Tetra-Furans	0.139	0.238	1.740	<	0.004

Table 4. PCDD/PCDFs in SF Estuary Water Samples (July 2002)

.. = not analyzed, < = not detected, e=estimated quantity, b=blank < 33% sample, B= blank>33% sample.

LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL
		pg/L	pg/L	pg/L		
FAL	2,3,7,8-TCDD	<	<	<	<	0.355
FAL	1,2,3,7,8-PeCDD	<	<	<	<	0.475
FAL	1,2,3,4,7,8-HxCDD	<	<	<	<	0.758
FAL	1,2,3,6,7,8-HxCDD	<	<	<	<	0.815
FAL	1,2,3,7,8,9-HxCDD	<	<	<	<	0.798
FAL	1,2,3,4,6,7,8-HpCDD	e 1.9	e 0.9	e 1.1	<	0.535
FAL	OCDD	e 10.8	e 4.9	e 6.2	<	1.380
FAL	2,3,7,8-TCDF	<	<	<	<	0.255
FAL	1,2,3,7,8-PeCDF	<	<	<	<	0.380
FAL	2,3,4,7,8-PeCDF	<	<	<	<	0.365
FAL	1,2,3,4,7,8-HxCDF	<	<	<	<	0.365
FAL	1,2,3,6,7,8-HxCDF	<	<	<	<	0.370
FAL	1,2,3,7,8,9-HxCDF	<	<	<	<	0.450
FAL	2,3,4,6,7,8-HxCDF	<	<	<	<	0.435
FAL	1,2,3,4,6,7,8-HpCDF	<	<	<	<	0.472
FAL	1,2,3,4,7,8,9-HpCDF	<	<	<	<	0.468
FAL	OCDF	e 1.0	<	e 1.0	<	1.030
AXYS	2,3,7,8-TCDD	B	B	B	e 0.005	0.0009
AXYS	1,2,3,7,8-PeCDD	B	b 0.017	b,e 0.015	e 0.004	0.0008
AXYS	1,2,3,4,7,8-HxCDD	0.0098	b,e 0.018	b 0.014	e 0.002	0.0008
AXYS	1,2,3,6,7,8-HxCDD	b 0.034	b,e 0.066	b 0.057	e 0.005	0.0008
AXYS	1,2,3,7,8,9-HxCDD	0.0294	b,e 0.039	b 0.053	0.0035	0.0008
AXYS	1,2,3,4,6,7,8-HpCDD	b 0.414	b 0.878	b 0.826	0.0077	0.0008
AXYS	OCDD	b 2.740	b 5.720	b 5.190	0.0279	0.0013
AXYS	2,3,7,8-TCDF	e 0.32	0.059	0.070	e 0.001	0.0010
AXYS	1,2,3,7,8-PeCDF	B	b,e 0.019	b 0.020	0.0038	0.0010
AXYS	2,3,4,7,8-PeCDF	B	b 0.036	b 0.041	e 0.006	0.0010
AXYS	1,2,3,4,7,8-HxCDF	b 0.015	b 0.021	b 0.023	e 0.003	0.0007
AXYS	1,2,3,6,7,8-HxCDF	0.0104	0.020	e 0.017	<	0.0007
AXYS	1,2,3,7,8,9-HxCDF	B	B	<	e 0.002	0.0007
AXYS	2,3,4,6,7,8-HxCDF	b 0.009	b 0.017	b 0.019	e 0.003	0.0007
AXYS	1,2,3,4,6,7,8-HpCDF	0.120	0.220	0.208	<	0.0007
AXYS	1,2,3,4,7,8,9-HpCDF	B	b,e 0.015	b,e 0.015	0.0022	0.0007
AXYS	OCDF	b 0.221	b 0.448	b 0.319	e 0.008	0.0019
AXYS	Total Hepta-Dioxins	b 1.010	b 2.260	b 2.130	0.0123	0.0008
AXYS	Total Hepta-Furans	b 0.261	b 0.508	b 0.451	0.0022	0.0007
AXYS	Total Hexa-Dioxins	b 0.244	b 0.526	b 0.605	0.0035	0.0008
AXYS	Total Hexa-Furans	0.139	0.363	0.319	<	0.0007
AXYS	Total Penta-Dioxins	0.0177	0.097	0.076	<	0.0008
AXYS	Total Penta-Furans	b 0.132	b 0.383	b 0.472	0.0038	0.0010
AXYS	Total Tetra-Dioxins	0.373	0.294	0.275	<	0.0009
AXYS	Total Tetra-Furans	b 0.145	b 0.502	b 0.509	0.0034	0.0010

Table 4. PCDD/PCDFs in SF Estuary Water Samples (January 2003)

LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL
		pg/L	pg/L	pg/L	pg/L	pg/L
FAL	2,3,7,8-TCDD	<	<	NA	<	0.355
FAL	1,2,3,7,8-PeCDD	<	<	NA	<	0.475
FAL	1,2,3,4,7,8-HxCDD	<	<	NA	<	0.758
FAL	1,2,3,6,7,8-HxCDD	<	<	NA	<	0.815
FAL	1,2,3,7,8,9-HxCDD	<	<	NA	<	0.798
FAL	1,2,3,4,6,7,8-HpCDD	e 1.31	<	NA	<	0.535
FAL	OCDD	e 9.77	e 5.50	NA	<	1.380
FAL	2,3,7,8-TCDF	<	<	NA	<	0.255
FAL	1,2,3,7,8-PeCDF	<	<	NA	<	0.380
FAL	2,3,4,7,8-PeCDF	<	<	NA	<	0.365
FAL	1,2,3,4,7,8-HxCDF	<	<	NA	<	0.365
FAL	1,2,3,6,7,8-HxCDF	<	<	NA	<	0.370
FAL	1,2,3,7,8,9-HxCDF	<	<	NA	<	0.450
FAL	2,3,4,6,7,8-HxCDF	<	<	NA	<	0.435
FAL	1,2,3,4,6,7,8-HpCDF	<	<	NA	<	0.472
FAL	1,2,3,4,7,8,9-HpCDF	<	<	NA	<	0.468
FAL	OCDF	<	<	NA	<	1.030

Table 5. TEQs in SF Estuary Water Samples (January 2002)

	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL
AXYS 2002-01	pg/L	pg/L	pg/L	pg/L	pg/L
2,3,7,8-TCDD	0.006		0.024		0.002
1,2,3,7,8-PeCDD		0.011	0.051		0.001
1,2,3,4,7,8-HxCDD	0.001	0.001	0.005		0.001
1,2,3,6,7,8-HxCDD		0.005	0.019		0.001
1,2,3,7,8,9-HxCDD	0.003	0.003	0.016		0.001
1,2,3,4,6,7,8-HpCDD	0.005	0.006	0.028	0.0001	0.0001
OCDD	0.00034	0.00035	0.00171		0.00000001
2,3,7,8-TCDF	0.002	0.004	0.023		0.001
1,2,3,7,8-PeCDF		0.001	0.003		0.0002
2,3,4,7,8-PeCDF	0.007	0.010	0.060		0.002
1,2,3,4,7,8-HxCDF	0.002	0.002	0.007		0.0003
1,2,3,6,7,8-HxCDF	0.001	0.001	0.006		0.0003
1,2,3,7,8,9-HxCDF		0.000	0.001		0.0003
2,3,4,6,7,8-HxCDF		0.001	0.007	0.0004	0.0003
1,2,3,4,6,7,8-HpCDF	0.001	0.001	0.006		0.00001
1,2,3,4,7,8,9-HpCDF	0.000	0.000			0.00001
OCDF	0.00002	0.00003	0.00012	0.0000	0.0000001
sum TEQs	0.029	0.046	0.259	0.001	0.008

Table 5. TEQs in SF Estuary Water Samples (July 2002)

	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL
FAL 2002-07	pg/L	pg/L	pg/L	pg/L	pg/L
2,3,7,8-TCDD					0.355
1,2,3,7,8-PeCDD					0.475
1,2,3,4,7,8-HxCDD					0.076
1,2,3,6,7,8-HxCDD					0.082
1,2,3,7,8,9-HxCDD					0.080
1,2,3,4,6,7,8-HpCDD	0.019	0.009	0.011		0.005
OCDD	0.0011	0.0005	0.001		0.0001
2,3,7,8-TCDF					0.026
1,2,3,7,8-PeCDF					0.019
2,3,4,7,8-PeCDF					0.183
1,2,3,4,7,8-HxCDF					0.037
1,2,3,6,7,8-HxCDF					0.037
1,2,3,7,8,9-HxCDF					0.045
2,3,4,6,7,8-HxCDF					0.044
1,2,3,4,6,7,8-HpCDF					0.005
1,2,3,4,7,8,9-HpCDF					0.005
OCDF	0.0001		0.0001		0.0001
sum TEQs	0.020	0.009	0.012		1.47
AXYS 2002-07	pg/L	pg/L	pg/L	pg/L	pg/L
2,3,7,8-TCDD				0.005	0.001
1,2,3,7,8-PeCDD		0.017	0.015	0.004	0.001
1,2,3,4,7,8-HxCDD	0.001	0.002	0.001	0.000	0.0001
1,2,3,6,7,8-HxCDD	0.003	0.007	0.006	0.000	0.0001
1,2,3,7,8,9-HxCDD	0.003	0.004	0.005	0.000	0.0001
1,2,3,4,6,7,8-HpCDD	0.004	0.009	0.008	0.000	0.00001
OCDD	0.00027	0.00057	0.00052	0.000	0.0000001
2,3,7,8-TCDF	0.032	0.006	0.007	0.000	0.0001
1,2,3,7,8-PeCDF		0.001	0.001	0.000	0.0001
2,3,4,7,8-PeCDF		0.018	0.021	0.003	0.001
1,2,3,4,7,8-HxCDF	0.001	0.002	0.002	0.000	0.0001
1,2,3,6,7,8-HxCDF	0.001	0.002	0.002		0.0001
1,2,3,7,8,9-HxCDF				0.000	0.0001
2,3,4,6,7,8-HxCDF	0.001	0.002	0.002	0.000	0.0001
1,2,3,4,6,7,8-HpCDF	0.001	0.002	0.002		0.00001
1,2,3,4,7,8,9-HpCDF		0.000	0.000	0.000	0.00001
OCDF	0.00002	0.00004	0.00003	0.000	0.0000002
sum TEQs	0.048	0.071	0.073	0.014	0.003

Table 5. TEQs in SF Estuary Water Samples (January 2003)

	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL
	pg/L	pg/L	pg/L	pg/L	pg/L
FAL 2003-01					
2,3,7,8-TCDD					0.355
1,2,3,7,8-PeCDD					0.475
1,2,3,4,7,8-HxCDD					0.0758
1,2,3,6,7,8-HxCDD					0.0815
1,2,3,7,8,9-HxCDD					0.0798
1,2,3,4,6,7,8-HpCDD	0.013				0.00535
OCDD	0.0010	0.0006			0.0001380
2,3,7,8-TCDF					0.0255
1,2,3,7,8-PeCDF					0.0190
2,3,4,7,8-PeCDF					0.183
1,2,3,4,7,8-HxCDF					0.0365
1,2,3,6,7,8-HxCDF					0.0370
1,2,3,7,8,9-HxCDF					0.0450
2,3,4,6,7,8-HxCDF					0.0435
1,2,3,4,6,7,8-HpCDF					0.00472
1,2,3,4,7,8,9-HpCDF					0.00468
OCDF					0.0001030
sum TEQs	0.014	0.0006	0.000		1.471

Table 6. Trace Elements in SF Estuary Water Samples

CRUISE_#	LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	BLANK	LAB MDL	TARGET_ML	WQOWQC
			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
2002-01	CALTEST	Be	<	<	<	<	0.06	0.5	U
2002-01	CALTEST	Sb	e 0.2	<	<	<	0.01	0.5	14
2002-01	CALTEST	Tl	<	<	<	<	0.03	1	1.7
2002-07	CALTEST	Be	<	<	<	<	0.06	0.5	U
2002-07	CALTEST	Sb	e 0.3	e 1.8	e 1.3	<	0.2	0.5	14
2002-07	CALTEST	Tl	<	<	<	<	0.03	1	1.7
2003-01	CALTEST	Be	<	<	<	<	0.06	0.5	U
2003-01	CALTEST	Sb	<	e 1.3	e 0.7	<	0.2	0.5	14
2003-01	CALTEST	Tl	<	<	<	<	0.03	1	1.7
2002-01	UCSCDET	Be	0.126	<	0.107	<	0.010	0.5	U
2002-01	UCSCDET	Sb	0.098	0.353	0.615	<	0.011	0.5	14
2002-01	UCSCDET	Tl	0.14	0.02	0.06	<	0.004	1	1.7
2002-07	UCSCDET	Be	0.045	0.215	0.016	<	0.010	0.5	U
2002-07	UCSCDET	Sb	0.337	0.504	0.638	<	0.011	0.5	14
2002-07	UCSCDET	Tl	0.04	0.21	0.04	<	0.004	1	1.7
2003-01	UCSCDET	Be	<	<	<	<	0.010	0.5	U
2003-01	UCSCDET	Sb	0.099	0.309	0.4	<	0.011	0.5	14
2003-01	UCSCDET	Tl	0.0044	0.01	0.01	<	0.004	1	1.7

Table 7. Tributyl Tin (TBT) and Cyanide in SF Estuary Water Samples

R= matrix spike recovery variable, not quantified

CRUISE #	LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL	TARGET_ML	WQOWQC
			ug/L	ug/L	ug/L				
2002-01	EBMUD	TBT	<	<	<	<	0.0046	..	0.01
2002-07	EBMUD	TBT	<	<	<	..	0.0046	..	0.01
2003-01	EBMUD	TBT	<	<	<	<	0.0046	..	0.01
2002-01	TOXSCAN	TBT	<	<	<	<	0.001	..	0.01
2002-07	TOXSCAN	TBT	<	<	<	<	0.002	..	0.01
2003-01	TOXSCAN	TBT	<	<	<	<	0.002	..	0.01
CRUISE	LAB	PARAMETER	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
2002-01	CCCSD	CN	<	<	<	<	0.4	5	1
2002-07	CCCSD	CN	<	<	<	<	0.4	5	1
2003-01	CCCSD	CN	0.5	R	<	<	0.4	5	1

Table 8. Water Quality Parameters of SF Estuary Water Samples

CRUISE_NUMBER	LAB	PARAMETER	UNIT	Sacramento River	Yerba Buena Island	Dumbarton Bridge	LAB_MDL
2002-01	CCCSD	% Total Solids	%	0.06	2.9	2.6	0.02
2002-07	CCCSD	% Total Solids	%	0.2	3.5	3.3	0.02
2003-01	CCCSD	% Total Solids	%	<	2.3	2.4	0.02
2002-01	CCCSD	Hardness	mg/L	130	4580	4260	6.7
2002-07	CCCSD	Hardness	mg/L	342	5840	5560	6.7
2003-01	CCCSD	Hardness	mg/L	75	3950	3810	2

Figure 1. Distribution of PCDD/PCDF Isomers, Axys

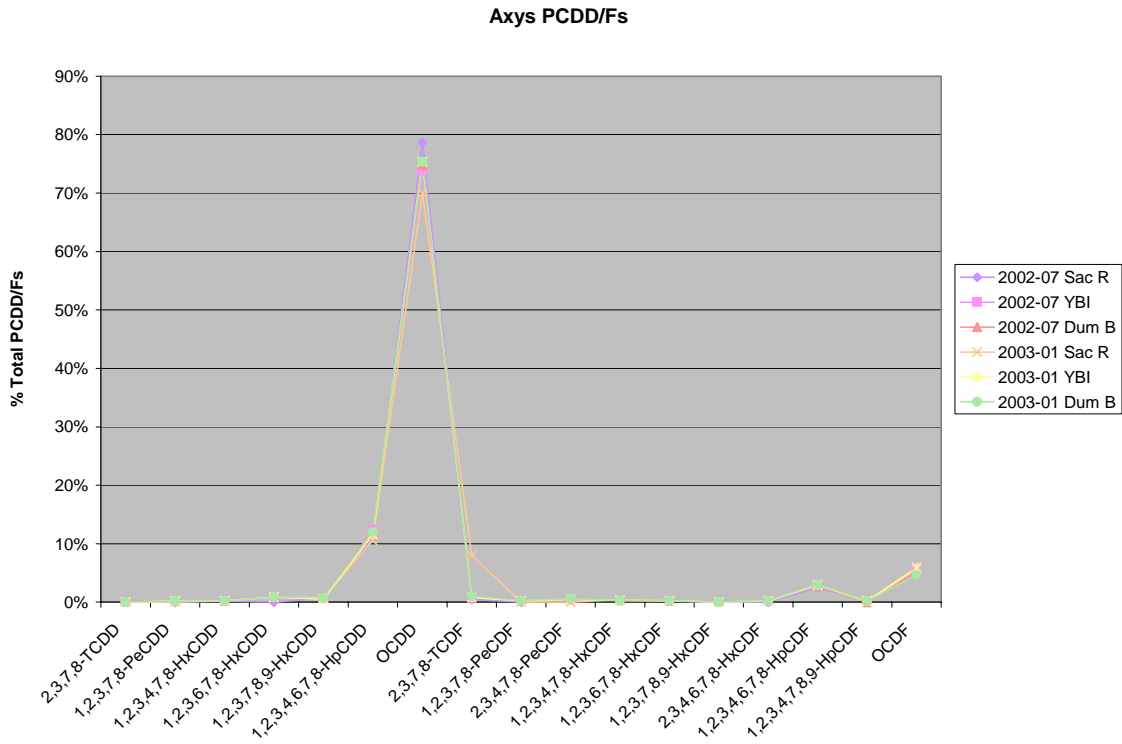
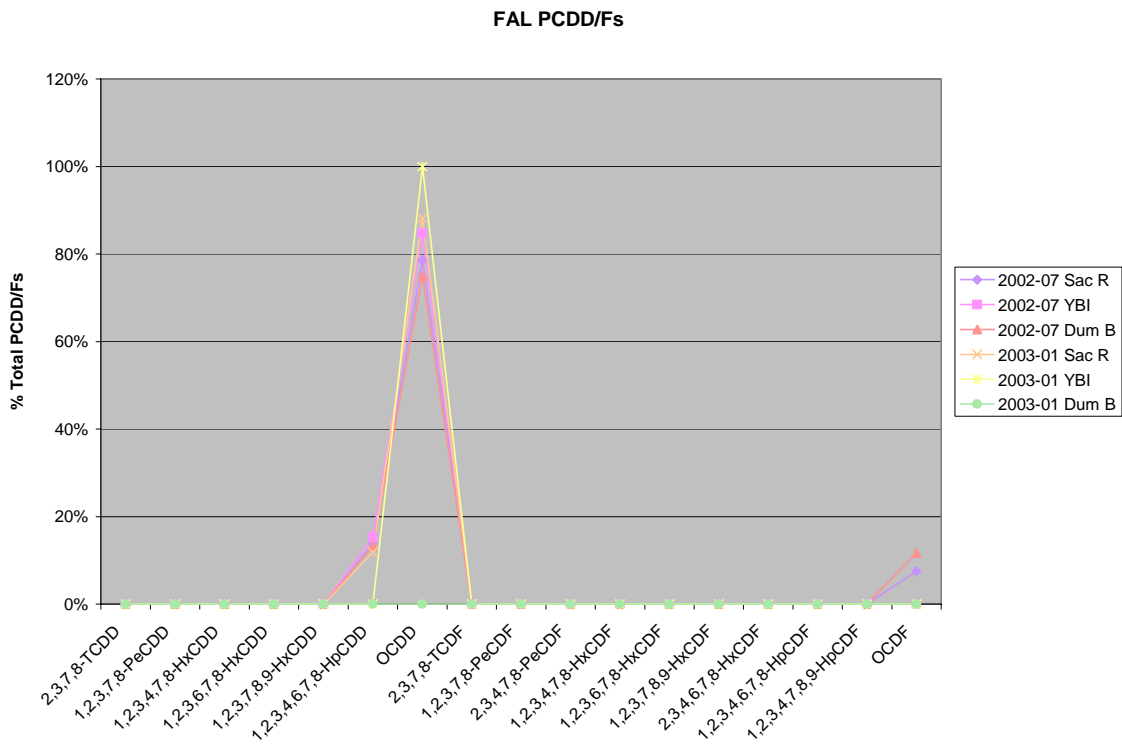


Figure 2. Distribution of PCDD/PCDF Isomers, Frontier



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Appendix 1. SFBRWQCB 13267 Letter



California Regional Water Quality Control Board

San Francisco Bay Region



Gray Davis
Governor

Winston H. Hickox
Secretary for
Environmental
Protection

Internet Address: <http://www.swrcb.ca.gov>
1515 Clay Street, Suite 1400, Oakland, California 94612
Phone (510) 622-2300 • FAX (510) 622-2460

August 6, 2001

TO: Permitted Wastewater Dischargers (attached list)

SUBJECT: Requirement for Monitoring of Pollutants in Effluent and Receiving Water to Implement New Statewide Regulations and Policy

This letter is a requirement for technical information pursuant to Section 13267 of the California Water Code. The information we request you to submit is effluent and receiving water data on priority pollutants (Enclosure A), and a sampling plan to collect those data. The sample plan is due by October 1, 2001. An interim report presenting the data is due May 18, 2003, with a final report due 180 days prior to expiration of your permit. The remainder of this letter describes the reason and justification for the request, and further details about this requirement. Due to its length, a table of contents is provided.

Please direct your questions to Chris Moore at 1-800-404-8919, or by e-mail at camonitoringquestions@tetrattech-ffx.com, or Lila Tang at (510) 622-2425.

You should be aware that this is a formal requirement for technical information pursuant to California Water Code Section 13267. Failure to respond or late response may subject you to civil liability imposed by the Board to a maximum amount of \$1,000 per day. Any revisions of the request set forth must be confirmed in writing by Board staff.

CONTENTS

Applicability	2
Purpose and Basis of Requirement	2
Parameters to Monitor	3
Shortening the List of Pollutants	
Analytical Methodology	3
Effluent Monitoring	5
Major Dischargers	
Minor Dischargers	
Receiving Water Monitoring	6
Dischargers to Bays through Deep Water Diffusers	
Dischargers to Estuarine/Tidal Areas of Rivers and Sloughs	
Dischargers to Upland Freshwater Rivers and Streams	
Applicability of Historic Discharge Data	7
Data Reporting Requirements	7
Sampling Plan	8
Interim and Final Reports	8
Table 1 – Summary of Minimum Effluent Monitoring Requirements	
Enclosure A – List of Monitoring Parameters and Analytical Methods	
Enclosure B – Data Reporting Requirements	
Enclosure C – Dischargers with Permit Monitoring Requirements	
Amended by this Letter	
Enclosure D – Example Outline for Sampling Plan	
Enclosure E – Mailing List	

Applicability

The requirements in this letter are intended for and applicable to all dischargers under a NPDES¹ permit with the following exceptions: discharges to ocean waters, discharges consisting solely of storm water runoff, and discharges covered under general permits such as for solvent and fuels groundwater cleanup.

In the past 12 months, the Board has reissued permits that contain provisions for monitoring similar to what is required by this letter. For these dischargers (Enclosure C), please note that this letter does not change the deadlines specified in those Permits. However, this letter does change some of the Self-Monitoring Program specifications concerning the elements below:

- addition of a grab for Total Solids (Standard Methods 2540B) concurrent with organics pollutant samples,
- addition of organophosphate pesticides and tributyltin,
- type of sample (grab verse composite),
- minimum sampling frequency, and
- analytical methodology.

With respect to these specific sampling elements, this letter serves as an amendment of the self-monitoring programs for those specific dischargers listed in Enclosure C.

Purpose and Basis of Requirement

The necessity for these studies comes from new regulations promulgated last year by the State Water Resources Control Board. The purpose of this requirement is to provide discharge and receiving water data that are sufficient for the Regional Board to:

- determine if water quality-based effluent limitations for priority pollutants are required;
- calculate effluent limitations (including interim performance based limits), if required; and
- determine if immediate compliance is feasible.

The first step is to determine if a discharge has a “reasonable potential” to cause or contribute to an exceedance of water quality standards. The second step involves deriving effluent limits for pollutants with “reasonable potential.” The third step is to determine if the existing discharge can comply with these new limits. If not, discharge data are necessary to calculate interim limits based on facility performance. Each step requires accurate data on the discharge; the first two steps also require data on the receiving water.

The new regulations are contained in the State Water Resources Control Board’s (SWRCB) Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (the Policy²). The Policy implements the provisions promulgated by the U.S. Environmental Protection Agency in the California Toxics Rule³ (CTR), as well as any existing water quality objectives. The CTR established numeric criteria for 126 priority pollutants. Numeric objectives for 12 of these

¹ National Pollutant Discharge Elimination System

² The State Implementation Policy can be viewed and downloaded from www.swrcb.ca.gov/water_quality

³ The California Toxics Rule can be downloaded from www.epa.gov/region09/water

priority pollutants and tributyltin were previously established in the San Francisco Bay Water Quality Control Plan (Basin Plan⁴) and/or the National Toxics Rule.

The Policy stipulates that the Regional Board shall issue letters to all dischargers requiring submittal of data sufficient for the purposes stated above. The Policy further stipulates that data must be submitted no later than May 18, 2003. These data requirements are in section 1.2 of the Policy. Section 3 of the Policy specifically addresses data for dioxins and furans. These requirements are mandatory statewide and other Regions in the State have issued similar requirements.

Parameters to Monitor

Data should be collected on all 126 priority pollutants, total solids (SM 2540 B), and the discharge flow rate at the time of the sampling. Additionally, municipal sewage treatment plant effluent dischargers should include tributyltin, diazinon, and chlorpyrifos. Dischargers of cooling tower blowdown should include tributyltin. These pollutants are listed in Enclosure A of this letter.

In some cases, receiving water monitoring should also include pH, hardness, salinity, and stream flow rate measurements at the time of sampling for the toxic pollutants. Factors to consider when these should be measured are described below under Receiving Water Monitoring.

Shortening the List of Pollutants

Dischargers may propose a shorter list of pollutants than the list above, if they can certify to the absence of a pollutant on a pollutant-by-pollutant basis. This certification must be substantiated with both of the following:

- analytical data showing that the pollutant is not present in the influent water at levels above the lowest applicable criterion, or the lowest MLs listed in Enclosure A; and
- if chemicals are used in the treatment process, or other process after the influent point, these chemicals do not add the pollutant to the effluent discharged.

Analytical Methodology

Enclosure A lists the pollutants and parameters to monitor in the effluent and receiving water, along with suggested analytical methods for the 126 priority pollutants, and other toxic pollutants. In summary, the methods are:

- GFAA for antimony, beryllium, nickel, silver and thallium
- ICP for cadmium and zinc
- SPGFAA for copper and lead
- EPA Method 1631 for mercury⁵,
- Gas Hydride generation AA for arsenic and selenium
- Standard Methods 3500 (colorimetric) for hexavalent chromium. Analysis for total chromium may be substituted if the level measured is below the criterion for hexavalent chromium (11 ug/l).
- Standard Method 4500-CN⁻ C, or 4500-CN⁻ I for cyanide,

⁴The Basin Plan can be downloaded from www.swrcb.ca.gov/~rwqcb2

⁵Please refer to our letters of August 19, 1999, and October 22, 1999, concerning use of ultra-clean techniques for monitoring of effluent and receiving waters. Ultra-Clean techniques minimize contamination of samples from common sampling and analytical practices. The letters are available on our website at www.swrcb.ca.gov/~rwqcb2 under Basin Plan, Current Issues.

- EPA Method 1613 for dioxins and furans
- EPA Methods 601, and 602 for volatile organics, or EPA 624 if the method detection limits (MDL) can be demonstrated to fall below the minimum levels (ML) listed in Enclosure A for the GC methods (EPA 601 and 602)
- EPA Methods 603, 604, 610 (HPLC), and 606 for semi-volatiles, or EPA 625 if the MDLs can be demonstrated to fall below the MLs listed in Enclosure A for GC or HPLC methods (EPA 603, 604, 610 and 606)
- EPA Method 625 for other semi-volatiles
- EPA Method 608 for chlorinated pesticides and PCBs
- EPA Method 614 for organophosphate pesticides (required only for municipal sewage)
- For tributyltin, Batelle N-0959-2606 or an alternate method approved for treated wastewater (required only for cooling tower blowdown, and municipal sewage)

You have the option of substituting another method for those listed above or in Enclosure A, but only if that method has a level of quantification below the applicable criterion or below the lowest ML listed in Enclosure A. For effluent monitoring, this alternate method must also be U.S. EPA approved (such as the 8000 or 1600 series) or one of those listed in Enclosure A. For receiving water monitoring, you have more flexibility in selection of methods. You may use these EPA methods, or you may use another method that has been scientifically peer reviewed, such as those methods employed in the Regional Monitoring Program⁶, provided that method has a level of quantification below the applicable criterion or the lowest ML listed in Enclosure A.

For some organic pollutants, the currently available analytical detection limit is not low enough for the purposes stated earlier. These are marked with an asterisk in Enclosure A. Concerning these pollutants, you have two options, **either**:

- use the available EPA Method, **or**
- participate in a study with other dischargers, through the RMP, to investigate the feasibility and reliability of different methods of increasing the sample volumes to lower the detection limits for a subset of these pollutants, and present the preferred method for approval by the U.S. EPA, Region 9. The methodology to investigate for increasing sample volumes is a research method developed by the University of Utah and currently used for ambient bay water sampling in the RMP. A similar methodology was developed by a contract laboratory, Axys Analytical Laboratories in Vancouver, Canada.

If you choose the first option and get non-detect results, these non-detects will not show conclusively that the pollutant is not in the effluent at levels of concern, because the detection limit is above of the criterion. More monitoring will be required in this case.

The second option is more involved and will require coordination with many other parties. However, if successful, it has good potential to allow measurements at the levels needed for regulatory purposes. This could lead to a finding that the pollutants are not present at levels of concern and thus no need for future monitoring.

⁶ San Francisco Estuary Regional Monitoring Program for Trace Substances is an ongoing monitoring program funded by major dischargers to San Francisco Bay to characterize contaminant concentration and distribution, determine general sources and loadings of contaminants, and assess contaminant effect of selected parts of the estuary. This program is managed by the San Francisco Estuary Institute (www.sfei.org).

We appreciate that development of alternate test procedures may be an involved process. In consideration of this, it will be acceptable to develop procedures for just a subset of pollutants as a pilot project. We suggest the chlorinated pesticides in EPA 608 as this subset, because a few of them are on the list of pollutants impairing the Bay (chlordane, 4,4'-DDT, and dieldrin). Such an effort will also contribute to the development of Total Maximum Daily Loads for these impairing pollutants.

If you choose to participate in this pilot project, you will not have to run EPA Methods 625 and 608, but the other methods are required at this time. We will also allow additional time beyond the final report submittal date of 180 days before permit expiration, for submittal of data on these pollutants. However, dischargers with effluent limits for 4,4'-DDE and dieldrin should monitor their effluent with EPA 608 at the minimum frequency of once every five years.

Please note that this pilot project is an option only. You may choose to not pursue it and simply run the standard EPA methods. However, in the interest of furthering discharge characterization and TMDL development, we encourage that you re-direct some of your analytical resources towards pursuing the option of developing a lower detection limit study.

Effluent Monitoring

To fulfill the requirement of this letter for effluent monitoring, the data you submit must be sufficient to characterize the concentration of each toxic pollutant in the effluent at the point of discharge. Please consider the following minimum requirements when preparing your sampling plans for effluent monitoring. These are summarized on Table 1 (attached).

Major Dischargers

- Frequency of monitoring should be determined after considering the variability of the discharge. Factors that can cause variability are influent composition, treatment plant design and operation, and rainfall.
 - For metals and cyanide, we believe the minimum frequency is once each month. If your Permit specifies more frequent monitoring, then that should be the frequency.
 - For organics (including tributyltin), the minimum frequency is twice each year. If your discharge may be influenced by wet weather, the samples should be timed for once in the dry season (May to September) and once in the wet season (October to April).
 - Additionally, we suggest including a provision for accelerating the frequency to collect more data for a pollutant if that pollutant is measured close to or above its applicable criterion (see Enclosure A). The intent of this is to allow characterization of the effluent for the purpose of determining performance based interim limits should that be necessary.
- Type of sample (i.e., grab versus composite), sample preservation and handling should follow U.S. EPA regulations (40 CFR 136.3⁷) and other practices as described in the Standard Methods for the Examination of Water and Wastewater.
 - In determining the type of sample---grab v. composite---you should consider the variability of the effluent during the day.
 - In general, a flow-weighted composite over a 24-hour period is preferable.
 - Grab samples instead of automatic compositors should be used for constituents that are somewhat volatile, chemically unstable, or are hydrophobic.

⁷ This can be viewed at http://www.access.gpo.gov/nara/cfr/cfrhtml_00/Title_40/40cfr136_00.html

- This is to minimize loss of the constituent through volatilization during compositing, and/or losses through adsorption onto tubing and other compositor equipment.
- These include mercury, hexavalent chromium, cyanide, volatile organics (EPA 601, 602), semi-volatile organics (EPA 603, 604, 606) and hydrophobic organics (EPA 610, 625, 608, 1631).
- A grab sample for Total Solids analysis should be collected coincident with each grab sample for the hydrophobic organics.
- 24-hour composites may be made up of discrete grabs collected over the course of a day and volumetrically or mathematically flow-weighted. Samples for inorganic pollutants may be combined prior to analysis. Samples for organic pollutants should be analyzed separately. If only one grab sample will be collected, it should be collected during periods of maximum peak flows.

Minor Dischargers

- Frequency of monitoring should be determined after considering the variability of the discharge. Factors that can cause variability are influent composition, treatment plant design and operation, and weather.
 - For metals, the minimum frequency is once each calendar quarter for the next two years. If your Permit specifies more frequent monitoring, then that should be the frequency.
 - For organic pollutants from minor sewage treatment facilities, the minimum frequency is once in the dry season (May to September), and once in the wet season (October to April) for the next two years, except for dioxins and furans (EPA 1613). For dioxins and furans, in consideration of cost, this wet and dry season sampling is required for only one out of the next two years.
 - For organic pollutants from other facility types, the minimum frequency is once in the dry season (May to September) and once in the wet season (October to April) for just one out of the next two years. Dischargers with facilities of similar types and nature of discharge may coordinate in a group effort to characterize the effluent for that type of discharge (ex. rock quarry operations, same reclamation, reverse osmosis brine).
 - For all discharge types, we suggest including a provision for accelerating the frequency to collect more data for a pollutant if that pollutant is measured close to or above its applicable criterion (see Enclosure A). The intent of this is to allow characterization of the effluent for the purpose of determining performance based interim limits should that be necessary.
- Type of sample. Please refer to the discussion above under Major Dischargers.

Receiving Water Monitoring

To fulfill this requirement, the data you submit must be sufficient to characterize the concentration of each toxic pollutant in the ambient receiving water. The data on the conventional water quality parameters (pH, salinity, and hardness) should also be sufficient to characterize these parameters in the ambient receiving water at a point after the discharge has mixed with the receiving waters.

The frequency of monitoring should consider seasonal variability of the receiving water. Please consider the following minimum requirements when preparing your sampling plan for receiving water monitoring:

Dischargers to Bays through Deep Water Diffusers

- the concentration of each pollutant listed in Enclosure A in the receiving water that provides dilution for the discharge. Because of the dominance of tidal flushing in San Francisco Bay, it would be acceptable to select stations representative of incoming ocean waters.

Dischargers to Estuarine/Tidal Areas of Rivers and Sloughs

- the concentration of each constituent listed in Enclosure A in the receiving water that provides dilution for the discharge. As for dischargers to the Bay, tidal flushing may also be considered in selection of sampling sites. However, the site-specific relative significance of tidal flushing verses riverine outflow should be assess and provided to justify selection of the sampling sites.
- the pH, hardness, and salinity in the receiving water downstream of the point of discharge after the discharge has mixed with the receiving water;

Dischargers to Upland Freshwater Rivers and Streams

- the concentration of each constituent listed in the Enclosure A in the receiving water upstream of the point of discharge.
- the flow rate of the river at the time of sampling upstream of the point of discharge.
- the pH, hardness, and salinity in the receiving water downstream of the point of discharge;

For receiving water monitoring in the Bay and its estuarine fringe, whenever feasible, we encourage the dischargers to participate in a group effort utilizing monitoring mechanisms that are already in place such as the Regional Monitoring Program. For dischargers to upland creeks or streams, you may also coordinate with other dischargers in your area to collect the necessary receiving water data. When a group effort is used, we will accept the sampling plan from the group in lieu of individual plans. This group plan should list the dischargers in the group, and describe the justification for why the receiving water data gathered will be relevant and applicable to each of the listed dischargers.

Applicability of Historic Discharge Data

You may use priority pollutant data that you collected in the past to comply with, or to supplement, the requirements of this letter, provided all the following conditions are met:

- The historic data were based on samples collected and analyzed using approved methodology;
- The quantification limits (or MLs) for the historic data are as low as the lowest MLs in Enclosure B.
- The historic data are representative of current discharge (i.e., treatment system has not changed, and influent sources have not substantially changed).

If you plan to use historic data, please state this intend in the Sampling Plan with a justification of the representativeness of the data. In this case, the requirement for a concurrent total solids (SM 2540 B) analysis is waived for the historic data. You should also present the historic data together with any new data in the final report due 180 days prior to permit expiration.

Reporting Requirements

Reporting requirements for the data are contained in Enclosure B of this letter. These requirements are based on the State Implementation Policy and are summarized below:

- Report the measured (or estimated) concentration for each pollutant.
- Report the quantifiable limit (Minimum Level), and the Method Detection Limit for each pollutant.
- Report the dioxin TEQ for each sample.
 - TEQ = sum of the measured or estimated concentration for each congener multiplied by its respective TEF (see Enclosure B). Assume zero for congeners that are below the method detection limit (MDL), and use estimated and measured values in the calculation.
- Report effluent monitoring data as part of the routine self-monitoring reports.
- By May 18, 2003, compile the data collected to date into a report, and submit the report to the Regional Board. If group efforts are used such as for receiving water monitoring, one report for the group is acceptable.
- 180 days prior to permit expiration (after May 18, 2003), submit a final report with the data to the Regional Board with the application for NPDES permit reissuance. This includes any influent or historic data you used as justification for reducing the monitoring requirements. If group efforts are used for receiving water monitoring, reference to that data is sufficient.

Sampling Plan

You must submit by October 1, 2001, a sampling plan for the above monitoring that is acceptable to the Executive Officer. The sampling plan should specify sampling parameters, monitoring frequencies, locations, and analytical methods to be used. Your cover letter should certify that the proposed sampling plan will yield data that adequately characterize the effluent and receiving water for the purposes stated above, and provide justification.

When a group effort is used, we will accept the sampling plan from the group in lieu of individual plans. This group plan should list the dischargers in the group, and describe the justification for why the data gathered will be relevant and applicable to each of the dischargers on the list.

Interim and Final Reports

An interim report is due on May 18, 2003. The report should summarize the data collected to date, and describe future monitoring to take place. You should submit a final report that presents all the data 180 days prior to your facility's permit expiration date. This final report should be submitted with the application for permit reissuance. For dischargers with permits that expire before May 18, 2003, the final report is due with the application that is due after May 18, 2003.

For questions regarding this letter, please refer to the contact information indicated on the first page of this letter.

Sincerely,

Loretta K. Barsamian
Executive Officer

Enclosures

Table 1. Summary of Minimum Effluent Monitoring Requirements¹

	Constituent	Suggested Analytical Method	Minimum Frequency ²	Sample Type
Major Dischargers	Metals (except mercury, and hexavalent chromium)	GFAA or ICP, and Gas hydride AA for As and Se	Once each month	24 hr composite
	Hexavalent chromium ³	Standard Method 3500	Once each month	grab
	Mercury	EPA 1631	Once each month	grab
	Cyanide	Standard Method 4500-CN ⁻ C or I	Once each month	grab
	Dioxins and Furans (with total solids) ⁴	EPA 1613	Once in summer, once in winter	grab
	Volatile and semi-volatile organics	EPA 601, 602, 603, 604, 606, 610 (HPLC) or equivalent GC/MS method ⁵	Once in summer, once in winter	grab
	Other organics, chlorinated pesticides and PCBs (w/ TS) ⁴	EPA 625, 608	Once in summer, once in winter	grab
Major municipal sewage treatment plants only	Organophosphate pesticides	EPA 614	Once in summer, once in winter	24-hr composite
Cooling tower blowdown, and major municipal sewage treatment plants	Tributyltin	Batelle N-0959-2606 or EBMUD method for treated wastewater ⁶	Once in summer, once in winter	grab
Minor Dischargers	Metals (except mercury and hexavalent chromium)	GFAA or ICP, and Gas hydride AA for As and Se	Once each calendar quarter	24-hr composite
	Hexavalent chromium ³	Standard Method 3500	Once each calendar quarter	grab
	Mercury	EPA 1631	Once each calendar quarter	grab
	Cyanide	Standard Method 4500-CN ⁻ C or I	Once each calendar quarter	grab
	Dioxins and Furans (with total solids) ⁴	EPA 1613	Once during the summer, once during the winter for one out of the next two years.	grab
	Volatile and semi-volatile organics	EPA 601, 602, 603, 604, 606, 610 (HPLC) or equivalent GC/MS method ⁵	Once during the summer, once during the winter	grab
	Other organics, chlorinated pesticides and PCBs (w/ TS) ⁴	EPA 625, 608	Once during the summer, once during the winter	grab
Dischargers to MUN⁶ designated receiving waters	Asbestos	EPA 100.2 (EPA 600/R-94-134, June 1994)	Once during the term of this study	24-hr composite

¹ The discharge flow should be measured during sampling for toxic pollutants.

² We suggest increasing the frequency above this minimum for a pollutant if that pollutant is measured close to or above its criterion in Enclosure A.

³ Total Chromium may be substituted to for Hexavalent Chromium at the discharger's discretion.

⁴ A grab sample for total solids analysis (SM 2540B) should be collected coincident with each grab sample for EPA 1613 (dioxins/furans), and 608.

⁵ The equivalent GC/MS method must be able to quantify to an equivalent level as the GC methods listed above.

⁶ MUN = Municipal and Domestic Supply. This designation, if applicable, is in the Findings of the NPDES Permit.

Enclosure A

List of Monitoring Parameters and Analytical Methods

CTR No.	Pollutant/Parameter	Criterion Approx. ¹ µg/l	Analytical Method ²	Optional Lower DL Study ³	Minimum Levels ⁴ µg/l											
					GC	GCMS	LC	Color	FAA	GFAA	ICP	ICP MS	SPGFAA	HYD RIDE	CVAA	DCP
1.	Antimony	14	204.2						10	5	50	0.5	5	0.5		1000
2.	Arsenic	36	206.3				20		2	10	2	2	2	1		1000
3.	Beryllium								20	0.5	2	0.5	1			1000
4.	Cadmium	2.2	200 or 213				10	0.5	10	0.25	0.5					1000
5a.	Chromium (III)	180	SM 3500													
5b.	Chromium (VI)	11	SM 3500				10	5								1000
6.	Copper	3.1	200.9					25	5	10	0.5	2				1000
7.	Lead	2.5	200.9					20	5	5	0.5	2				10,000
8.	Mercury	0.025	1631 (note 5)								0.5				0.2	
9.	Nickel	7.1	249.2					50	5	20	1	5				1000
10.	Selenium	5	SM 3114B or C						5	10	2	5	1			1000
11.	Silver	1.2	272.2					10	1	10	0.25	2				1000

¹ The criterion serves only as a point of reference for the selection of the appropriate analytical method.

- Some metals are hardness dependent and are expressed as dissolved values. The above listed criteria have not been translated to total values and may be too low or too high depending on the actual hardness of your receiving water.
- Two criteria are listed for some organics. The value in parentheses are applicable only to those dischargers who discharge to MUN designated receiving waters (Municipal and Domestic Supply).

² The suggested method is the U.S. EPA Method unless otherwise specified (SM = Standard Methods). The discharger may use another U.S. EPA approved or recognized method if that method has a level of quantification below the applicable criterion. Where no method is suggested, the discharger has the discretion to use any standard method.

³ Constituents where this column is asterisked "*" indicates that the currently available analytical technique is not low enough for the stated purpose of this letter requirement. The discharger has the option of 1) going forth with the current U.S. EPA analytical method, or 2) participating in a regional study to investigate the feasibility and reliability of increasing sample volumes to lower the detection limits.

⁴ Minimum levels are from the State Implementation Policy. They are the concentration of the lowest calibration standard for that technique based on a survey of contract laboratories. Laboratory techniques are defined as follows: GC = Gas Chromatography; GCMS = Gas Chromatography/Mass Spectrometry; LC = High Pressure Liquid Chromatography; Color = Colorimetric; FAA = Flame Atomic Absorption; GFAA = Graphite Furnace Atomic Absorption; Hydride = Gaseous Hydride Atomic Absorption; CVAA = Cold Vapor Atomic Absorption; ICP = Inductively Coupled Plasma; ICPMS = Inductively Coupled Plasma/Mass Spectrometry; SPGFAA = Stabilized Platform Graphite Furnace Atomic Absorption (i.e. U.S. EPA 200.9); DCP = Direct Current Plasma.

⁵ The Minimum level for mercury is 2 ng/l (or 0.002 ug/l) pursuant to Regional Board letters dated August 4, 1999, and October 22, 1999.

CTR No.	Pollutant/Parameter	Criterion Approx. ¹ µg/l	Analytical Method ²	Optional Lower DL Study ³	Minimum Levels ⁴ µg/l											
					GC	GCMS	LC	Color	FAA	GFAA	ICP	ICP MS	SPGFAA	HYD RIDE	CVAA	DCP
12.	Thallium	1.7	279.2						10	2	10	1	5			1000
13.	Zinc	58	200 or 289						20		20	1	10			
14.	Cyanide	1	SM 4500 CN ⁻ C or I	*				5								
15.	Asbestos (only required for dischargers to MUN waters ²)	7,000,000 fibers/L	0100.2 ⁶													
16.	2,3,7,8-TCDD, 17 congeners (Dioxin)	0.13E-07	1613	*												
17.	Acrolein	320	603		2.0	5										
18.	Acrylonitrile	0.059	603	*	2.0	2										
19.	Benzene	1.2	602		0.5	2										
33.	Ethylbenzene	3100	602		0.5	2										
39.	Toluene	6,800	602		0.5	2										
20.	Bromoform	4.3	601	*	0.5	2										
21.	Carbon Tetrachloride	0.25	601	*	0.5	2										
22.	Chlorobenzene	680	601		0.5	2										
23.	Chlorodibromomethane	34(0.401)	601	(*)	0.5	2										
24.	Chloroethane		601		0.5	2										
25.	2-Chloroethylvinyl Ether		601		1	1										
26.	Chloroform		601		0.5	2										
75.	1,2-Dichlorobenzene	2700	601		0.5	2										
76.	1,3-Dichlorobenzene	400	601		0.5	2										
77.	1,4-Dichlorobenzene	400	601		0.5	2										
27.	Dichlorobromomethane	0.56	601		0.5	2										
28.	1,1-Dichloroethane		601		0.5	1										
29.	1,2-Dichloroethane	0.38	601	*	0.5	2										
30.	1,1-Dichloroethylene or 1,1-Dichloroethene	3.2(0.057)	601	(*)	0.5	2										
31.	1,2-Dichloropropane	0.52	601		0.5	1										
32.	1,3-Dichloropropylene or 1,3-Dichloropropene	10	601		0.5	2										
34.	Methyl Bromide or Bromomethane	48	601		1.0	2										
35.	Methyl Chloride or Chloromethane		601		0.5	2										
36.	Methylene Chloride or Dichloromethane	4.7	601		0.5	2										
37.	1,1,2,2-Tetrachloroethane	11(0.17)	601	(*)	0.5	1										

⁶ Determination of Asbestos Structures over 10 [micrometers] in Length in Drinking Water using MCE filters, U.S. EPA 600/R-94-134, June 1994.

CTR No.	Pollutant/Parameter	Criterion Approx. ¹ µg/l	Analytical Method ²	Optional Lower DL Study ³	Minimum Levels ⁴ µg/l											
					GC	GCMS	LC	Color	FAA	GFAA	ICP	ICP MS	SPGFAA	HYD RIDE	CVAA	DCP
81.	Di-n-Butyl Phthalate	2,700	606 or 625			10										
84.	Di-n-Octyl Phthalate		606 or 625			10										
59.	Benzidine	0.00012	625	*		5										
65.	Bis(2-Chloroethoxy) Methane		625			5										
66.	Bis(2-Chloroethyl) Ether	1.4(0.031)	625	(*)	10	1										
67.	Bis(2-Chloroisopropyl) Ether	1,400	625		10	2										
69.	4-Bromophenyl Phenyl Ether		625		10	5										
71.	2-Chloronaphthalene	1,700	625	*		10										
72.	4-Chlorophenyl Phenyl Ether		625			5										
73.	Chrysene	0.0044	625	*		10	5									
78.	3,3'-Dichlorobenzidine	0.04	625	*		5										
82.	2,4-Dinitrotoluene	9.1(0.11)	625	(*)	10	5										
83.	2,6-Dinitrotoluene		625			5										
85.	1,2-Diphenylhydrazine (note 7)	0.04	625	*		1										
88.	Hexachlorobenzene	0.00075	625	*	5	1										
89.	Hexachlorobutadiene	50(0.44)	625	(*)	5	1										
90.	Hexachlorocyclopentadiene	240	625		5	5										
91.	Hexachloroethane	8.9(1.9)	625		5	1										
93.	Isophorone	8.4	625		10	1										
94.	Naphthalene		625		10	1	0.2									
95.	Nitrobenzene	17	625		10	1										
96.	N-Nitrosodimethylamine	8.1(0.00069)	625	(*)	10	5										
97.	N-Nitrosodi-n-Propylamine	0.005	625	*	10	5										
98.	N-Nitrosodiphenylamine	5	625		10	1										
99.	Phenanthrene		625			5	0.05									
101.	1,2,4-Trichlorobenzene		625		1	5										
102.	Aldrin	0.00013	608	*	0.005											
103.	α-BHC	0.0039	608	*	0.01											
104.	β-BHC	0.014	608		0.005											
105.	γ-BHC (Lindane)	0.019	608	*	0.02											
106.	δ-BHC		608		0.005											
107.	Chlordane	0.00057	608	*	0.1											
108.	4,4'-DDT	0.00059	608	*	0.01											

⁷ Measurement for 1,2-Diphenylhydrazine may use azobenzene as a screen: if azobenzene measured at >1 ug/l, then analyze for 1,2-Diphenylhydrazine.

CTR No.	Pollutant/Parameter	Criterion Approx. ¹ µg/l	Analytical Method ²	Optional Lower DL Study ³	Minimum Levels ⁴ µg/l											
					GC	GCMS	LC	Color	FAA	GFAA	ICP	ICP MS	SPGFAA	HYD RIDE	CVAA	DCP
109.	4,4'-DDE	0.00059	608	*	0.05											
110.	4,4'-DDD	0.00083	608	*	0.05											
111.	Dieldrin	0.00014	608	*	0.01											
112.	Endosulfan (alpha)	0.0087	608	*	0.02											
113.	Endosulfan (beta)	0.0087	608	*	0.01											
114.	Endosulfan Sulfate	110	608		0.05											
115.	Endrin	0.0023	608	*	0.01											
116.	Endrin Aldehyde	0.76	608		0.01											
117.	Heptachlor	0.00021	608	*	0.01											
118.	Heptachlor Epoxide	0.0001	608	*	0.01											
119-125	PCBs: Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260	0.00017	608	*	0.5											
126.	Toxaphene	0.00073	608	*	0.5											
	Tributyltin	0.01	(see note 8)	Tributyltin is only required for sewage treatment plant discharges, and cooling tower blowdown discharges.												
	Chlorpyrifos	0.0056	614	Chlorpyrifos and Diazinon are only required for sewage treatment plant discharges												
	Diazinon	0.05	614	Chlorpyrifos and Diazinon are only required for sewage treatment plant discharges												
	Total Solids		SM 2540B	Grab sample at the same time as samples for dioxins and furans, and PCBs												
	pH			Required only for discharges to estuarine or fresh water rivers or streams, at a location upstream of the point of discharge.												
	Stream Flow Rate, upstream			Required only for discharges to estuarine or fresh water rivers or streams, at a location upstream of the point of discharge.												
	Hardness			Required only for discharges to estuarine or fresh water rivers or streams, at a location downstream of the point of discharge.												
	Salinity			Required for all discharges at a location downstream of the point of discharge.												

⁸ Battelle technical article N-0959-2602, or East Bay Municipal Utilities District method for wastewaters

Enclosure B

Data Reporting Requirements

1. Sample results greater than or equal to the laboratories reported minimum levels (ML), shall be reported as measured by the laboratory.
2. Sample results less than the reported ML, but greater than or equal to the laboratory's method detection limit (MDL), shall be reported as "detected, but not quantified" or DNQ. The estimated concentration of the sample shall be reported and may be qualified by a notation as an estimated value measured below the lowest calibration standard.
3. Sample results less than the laboratory's method detection limit (MDL) shall be reported as "not detected" or ND. The MDL is determined by the procedure in 40CFR136. This MDL value shall be reported.
4. For Chlorinated dibenzodioxin (CDD) and chlorinated dibenzofuran (CDF), report the TEQ for each sample. TEQ = sum of the measured or estimated concentration for each congener multiplied by its respective TEF (shown below). Assume zero for congeners that are below the method detection limit, and use estimated and measured values in the calculation.

<u>Congener</u>	<u>World Health Organization 1998 Toxicity Equivalence Factor (TEF)</u>
2,3,7,8-tetra CDD	1
1,2,3,7,8-penta CDD	1
1,2,3,4,7,8-hexa CDDs	0.1
1,2,3,6,7,8-hexa CDDs	0.1
1,2,3,7,8,9-hexa CDDs	0.1
1,2,3,4,6,7,8-hepta CDD	0.01
octa CDD	0.0001
2,3,7,8-tetra CDF	0.1
1,2,3,7,8-penta CDF	0.05
2,3,4,7,8-penta CDF	0.5
1,2,3,4,7,8-hexa CDFs	0.1
1,2,3,6,7,8-hexa CDFs	0.1
2,3,4,6,7,8-hexa CDFs	0.1
1,2,3,4,6,7,8-hepta CDFs	0.01
1,2,3,4,7,8,9-hepta CDFs	0.01
octa CDF	0.0001

5. If you are submitting self-monitoring data electronically under the Electronic Reporting System, you may submit the effluent data as part of your routine self-monitoring reports. In this case, we waive the requirement to submit a final report of the results on effluent monitoring. However, you must still submit a report of the receiving water monitoring on May 18, 2003.

Enclosure C

Dischargers with Permit Monitoring Requirements Amended by Letter

For dischargers with permit that the Board has reissued within the last year contain provisions for similar monitoring as required by this letter, please note that this letter does not change the deadlines specified in those Permits. However, this letter does change some of the Self-Monitoring Program specifications specifically concerning the elements below:

1. addition of a grab for Total Solids (Standard Methods 2540B) concurrent with organics pollutant samples,
2. addition of organophosphate pesticides and tributyltin,
3. type of sample (grab verse composite),
4. minimum sampling frequency, and
5. analytical methodology.

With respect to these specific sampling elements, this letter serves as amendment of the self-monitoring programs for the dischargers listed below:

1. Napa Sanitation District
2. Mountain View Sanitary District
3. East Bay Dischargers Authority, Cities of Hayward and San Leandro, Oro Loma/Castro Valley Sanitary Districts, Union Sanitary District, and Livermore-Amador Valley Water Management Agency
4. Dublin San Ramon Services District and Livermore-Amador Valley Water Management Agency
5. City of Livermore and Livermore-Amador Valley Water Management Agency
6. USS-PPSCO Industries
7. City of Calistoga, Wastewater Treatment Plant
8. South Bayside System Authority
9. Chevron U.S.A., Inc., Richmond Refinery
10. Sewage Agency of Southern Marin
11. East Bay Municipal Utilities District
12. City of San Mateo, Water Quality Control Plant
13. Central Contra Costa Sanitary District

Enclosure D Sampling Plan Outline

Introduction

The introduction section should include the information listed below:

- Facility Name
- Discharge Volume
- Description of discharge outfall location(s)
- NPDES Permit Number
- Board Order Number

Certification of Adequacy of Sampling Plan

Based on your assessment of the variability of the effluent, there should be a statement that sampling in accordance with the proposed plan should yield data that adequately characterize the effluent and receiving water for the purposes stated on page 2 of the letter.

Sampling Locations

Include a map of appropriate scale showing the locations of the discharge(s), and the locations of the receiving water sampling stations.

Sampling Logistics

Paragraph one should indicate the dates and times that sampling is expected to take place. This information can be summarized in a table such as, Example Table 1 shown below.

Paragraph two should discuss sampling techniques that will be employed during this sampling effort. Special attention should be given to the ultra clean techniques that will be employed for specific analytes.

Please Note: There are specific requirements for monitoring both effluent and receiving water. Sampling logistics for both of these areas should be noted in this section.

Example Table 1. Sampling Information

Constituent	Sampling Frequency	Sample Type
Mercury (Hg)	Once per month	Grab
Organophosphate pesticides	Twice per year (summer & winter)	24-hr composite
Asbestos	Summer 2002	24-hr composite

Sample Analysis

A brief description of the laboratories involved and their current certifications is sufficient. Any special circumstances concerning specific analytes or laboratories should be noted. An example of this type of

circumstance would be the substitution of a similar method for one of the ones listed. Example Table 2, shown below can be used to easily shown the laboratories completing the analyses.

Example Table 2. Laboratory Information

Constituent	Laboratory	Analysis Method
Mercury (Hg)	ABC Laboratories	EPA 1631
Organophosphate pesticides	California Analysis Laboratories	EPA 614
Asbestos	California Analysis Laboratories	EPA 0100.2

Personnel and Contact Information

This section should discuss who is involved with this sampling and analysis effort and each person’s responsibilities. An example of how the contact information for each person could be listed is shown below.

Facility Contact Facility Contact Facility Contact Facility Contact

Steve Jackoviac
 Harrieta WWTP
 6801 W 30 Road
 Harrietta, CA 00638
 (510) 389-2211
 (510) 389-2910 (fax)
 jackovis@harriettawwtp.com

Sampling Contact

Charles Moore
 Harrieta WWTP
 6801 W 30 Road
 Harrietta, CA 00638
 (510) 389-2212
 (510) 389-2910 (fax)
 moorec@harriettawwtp.com

Analytical Laboratory Contacts Analytical Laboratory Contacts Analytical Laboratory Contacts Analytical Laboratory Contacts

Metals
 Chris Brown
 ABC Laboratories
 10306 Eaton Place, Suite 340
 Fairfax, CA 00030
 (510) 385-6000
 (510) 385-6007 (fax)
 chris.brown@abclabs.com

Organics

Jim Loving

California Analysis Laboratories

6101 Stevenson Avenue

Alexandria, CA 003304

(510) 461-2350

(510) 461-8156 (fax)

jloving@cal.org

Appendix 2. Study Plan

Bay Area Clean Water Agencies Collaborative Receiving Water Sampling Plan

INTRODUCTION

The August 6, 2001 letter from Regional Board Executive Officer Loretta Barsamian to San Francisco Bay dischargers titled “Requirement for Monitoring of Pollutants in Effluent and Receiving Water to Implement New Statewide Regulations and Policy” (13267 letter) requires submission of ambient receiving water data on priority pollutants and a sampling plan to collect those data. The requirements of the 13267 letter take precedent over any existing permit requirements for ambient monitoring (except for deadlines), and the letter requires submission of the sampling plan by October 1, 2001. The San Francisco Bay dischargers in Region 2 are pursuing a collaborative sampling program. This study plan reflects that intent, and is therefore submitted in lieu of individual plans. However, if any municipal bay discharger submits a separate study plan to the Regional Board, it is intended that the separate plan will serve to supersede the involvement of that discharger in the study plan contained herein.

Summary information for each discharger is provided in Table 1. Permit numbers and corresponding Regional Board Order numbers are only provided for the principal facility for each agency. However, it is intended that all facilities and/or permits within each agency that involve a discharge to San Francisco Bay are covered by this work plan for the purposes of complying with the 13267 Letter. In addition, if other minor dischargers to the bay that are subject to the 13267 letter wish to join this study plan, they can do so by notifying the Regional Board and the San Francisco Estuary Institute that they want to be covered.

Table 1. Summary Information for San Francisco Bay Municipal Dischargers

Facility Name	NPDES Permit #	Board Order #	Design ADWF
American Canyon, City of	CA0038768	00-003	2.5 mgd
Benicia, City of	CA0038091	01-096	4.5 mgd
Burlingame, City of	CA0037788	95-208	5.5 mgd
Calistoga, City of	CA0037966	00-131	0.84 mgd
CCC Sanitary District	CA0037648	01-068	45 mgd
Central Marin Sanitation Agency	CA0038628	01-105	10 mgd
Contra Costa Co. S.D. No. 5			0.01 mgd
Delta Diablo Sanitation District	CA0038547	93-142	16.5 mgd
East Bay Dischargers Authority	CA0037869	00-087	77.1 mgd
East Bay Municipal Utilities District	CA0037702	01-072	120 mgd
Fairfield-Suisun Sewer District	CA0038024	98-077	17.5 mgd
Hayward Shoreline Marsh	CA0038636	99-024	20 mgd
Las Gallinas Valley Sanitary Dist.	CA0037851	98-112	2.92 mgd
Livermore, City of	CA0038008	00-089	8.5 mgd
Dublin San Ramon S.D.	CA0037613	00-088	11.5 mgd

Facility Name	NPDES Permit #	Board Order #	Design ADWF
Marin County Sanitary District #5	CA0037427	92-033	0.98 mgd
Millbrae, City of	CA0037532	94-048	3.0 mgd
Mt. View Sanitary District	CA0037770	00-086	2.4 mgd
Napa Sanitation District	CA0037575	00-059	15.4 mgd
Novato Sanitary District	CA0037958	99-036	6.55 mgd
Palo Alto, City of	CA0037834	98-054	39 mgd
Petaluma, City of	CA0037810	98-076	5.2 mgd
Pinole-Hercules	CA0037796	01-106	4.06 mgd
Rodeo Sanitary District	CA0037826	01-107	1.14 mgd
San Francisco, City & County (SE)	CA0037664	96-116	85.4 mgd
San Francisco Airport	CA0038318	95-054	2.2 mgd
San Jose/Santa Clara	CA0037842	98-052	167 mgd
San Mateo, City of	CA0037541	01-071	13.6 mgd
Sausalito-Marín City San. District	CA0038067	00-060	1.8 mgd
Sewerage Agency of Southern Marin	CA0037711	01-070	3.6 mgd
Sonoma Valley County San. District	CA0037800	98-111	3.0 mgd
South Bayside System Authority	CA0038369	01-012	29.0 mgd
South San Francisco	CA0038130	97-086	13 mgd
St. Helena, City of	CA0038016	92-006	0.50 mgd
Sunnyvale, City of	CA0037621	98-053	29.5 mgd
Vallejo San. & Flood Control District	CA0037699	00-026	15.5 mgd
West County Agency	CA0038539	94-014	28.5 mgd
Yountville, Town of	CA0038121	93-157	0.55 mgd

CERTIFICATION OF ADEQUACY OF SAMPLING PLAN

Sampling in accordance with the proposed plan should yield data that adequately characterizes the receiving water for purposes of performing future Reasonable Potential Analyses (RPAs) and calculating required numeric effluent limitations using procedures in the 2000 State Water Resources Control Board Policy for the Implementation of Toxic Standards for Inland Surface Waters, Enclosed Bays, and Estuaries (State Implementation Plan, or SIP).

SAMPLING LOCATIONS

All agencies listed in the above table are part of the group effort to characterize the receiving water. The sampling will be conducted during the Regional Monitoring Program (RMP) sampling runs using the Richardson Bay and Yerba Buena Island stations, the two stations which are currently recognized by the Regional Water Quality Control Board (Regional Board) as representative of ambient conditions in the San Francisco Bay. The sampling stations should therefore continue to be appropriate as the sampling stations for a coordinated background ambient sampling program for all the Region 2 Bay dischargers. A map of the discharge and RMP sampling locations is shown in Figure 1.

SAMPLING LOGISTICS

Constituents to be Sampled

The samples will be analyzed for pollutants listed in Enclosure A of the 13267 Letter except for the following: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, polyaromatic hydrocarbons (PAHs), PCBs, diazinon, chlorpyrifos, pH, hardness, and salinity. The reason for the exceptions is that these constituents have been well characterized at both selected sampling stations by the RMP.

Sampling Schedule

Samples from Richardson Bay and Yerba Buena Island stations will be taken twice per year, coinciding with RMP sampling. The first event will take place in February, 2002. To consider seasonal variability of the receiving water and to cover both wet and dry weather conditions, sampling will be conducted in July and February. A minimum of three sampling events will occur.

Sampling Techniques

All samples from the receiving water stations will be collected following RMP sample collection, preservation, and handling procedures as outlined in the Field Sampling Manual for the Regional Monitoring Program for Trace Substances, prepared by SFEI, and Applied Marine Sciences, February, 2001. Field personnel will follow appropriate EPA ultra-clean sampling protocols for the collection of all samples for trace metals and trace organic constituent determination.

All sample bottles will meet material and cleaning specifications specified by each analytical method. Additionally, all samples will be preserved as specified by analytical methods, and kept cool from the time of sample collection to the time of delivery to the analytical laboratory.

SAMPLE ANALYSIS

The constituents to be analyzed and the analytical methods are outlined in Table 2.

Table 2. Laboratory and Analytical Information

Constituent	Analytical Method	Laboratory	Achievable Minimum Level
Antimony, Beryllium, Thallium	ICP/MS	RMP Contract Lab	0.5 µg/L for Antimony, Beryllium and 1.0 µg/L for Thallium
Cyanide *	SM 4500-CN ⁻ I	RMP Contract Lab	0.2 µg/L
Dioxins and Furans	USEPA 1613	RMP Contract Lab	May require sample concentration
Semi-volatile organics	USEPA 625/1625	RMP Contract Lab	May require sample concentration
Volatile organics	USEPA 624/1624	RMP Contract Lab	May require sample concentration
Other organics, chlorinated pesticides	USEPA 608	RMP Contract Lab	May require sample concentration
Tributyltin	Batelle N-0959-2606	RMP Contract Lab	1 ng/L
Total Solids	SM 2540 B	RMP Contract Lab	--

* A concurrent study is underway for sampling cyanide under the work associated with developing a site-specific objective (SSO). It is not the intent of this receiving water work plan to duplicate that sampling effort. The work plan for the SSO development is currently underway, and it is expected that the sampling associated with that effort will be more extensive than the sampling presented in this work plan. If so, the SSO effort will supercede the sampling stated for cyanide in this work plan.

PERSONNEL AND CONTACT INFORMATION

This section includes a list of the individuals who will be involved with this sampling and analysis effort and each person's responsibilities.

Facility Contacts

Chuck Weir
Chair, Bay Area Clean Water Agencies BACWA
East Bay Dischargers Authority
2651 Grant Avenue
San Lorenzo, CA 94580
(510) 278-5910 phone
(510) 278-6547 fax
cweir@ebda.org

Bupinder Dhaliwal
Chair, BACWA Laboratory Committee
Central Contra Costa Sanitary District
5019 Imhoff Place
Martinez, CA 94553
(925) 229-7237 phone
(925) 689-1232 fax
dhaliwal@centralsan.dst.ca.us

Ben Horenstein
Chair, BACWA Permits Committee
East Bay Municipal Utilities District
375 11th Street, M/S 702
Oakland, CA 94607
(510) 287-1846 phone
(510) 287-1530 fax
bhorenst@ebmud.com

Sampling and Laboratory Contacts

Don Yee
Regional Monitoring Program
1325 South 46th Street
Richmond, CA 94804
(510) 231-9539 phone
(510) 231-9414 fax

Note: SFEI is in the process of relocating their office as of 10/1/01 to

7700 Pardee Lane, 2nd Flr
Oakland, CA 94621-1424
(Phone numbers not yet available)

Appendix 3: San Francisco Bay Ambient Water Monitoring: Final CTR Sampling Update

prepared for
San Francisco Bay Regional Water Quality Control Board (SFBRWQCB)

submitted by
Bay Area Clean Water Agencies (BACWA)
on behalf of participating dischargers

and

Regional Monitoring Program for Trace Substances (RMP)

June 15, 2004



Project Manager
Donald Yee
San Francisco Estuary Institute
7770 Pardee Lane, 2nd Floor
Oakland, CA 94621

This appendix supplements the “San Francisco Bay Ambient Water Monitoring Interim Report” on monitoring for California Toxics Rule (CTR) pollutants of May 15, 2003. At that time, the last sampling for the monitoring of selected CTR pollutants (those not previously monitored by the San Francisco Estuary Regional Monitoring Program for Trace Substances, RMP) had not yet been conducted, and some lab analyses were not completed in time for reporting in that document.

The final sampling event was conducted during the RMP cruise in August 2003. Samples were taken at the previous monitoring stations on days when the cruise vessel sampled nearby RMP sites. Samples taken were for the same analyses as in previous sampling, with the exception of samples collected specifically for analysis of phthalates, which were taken in lieu of a second (field split) S/VOC sample taken in previous cruises (Table A3-1). Samples were taken specifically for phthalate on this occasion because previous samples analyzed for SVOCs had shown high MDLs for bis-2-(hexylethyl) phthalate with some measurements including blanks above both that MDL and the CTR criterion. Sampling and analyzing specifically for phthalates using a method with more specificity and sensitivity would allow us to determine if previously detected samples were actually ambient concentrations above the CTR criterion or from contamination in the laboratory preparation and sampling supplies.

Table A3-1. Samples Collected for Ambient Water Monitoring, August 2003

Laboratory	Analyte	Sample size
Axys Analytical	PCDD/PCDFs phthalates	100 L (SPE) 4 L
Caltest	Be, Sb, Tl	250 mL
CCCSD	cyanide hardness SVOCs SVOCs (modified) total solids VOCs VOCs (modified)	1 L 500 mL 1 L 1 L 500 mL 40 mL 40 mL
EBMUD	tributyltin	1 L
Frontier Analytical (FAL)	PCDD/PCDFs	4 L
Toxscan	tributyltin	1 L
UCSCDET	Be, Sb, Tl	1 L

The Dumbarton Bridge site was sampled on August 5, 2003, with the exception of the 4 liter sample for PCDD/Fs, taken on August 6. Yerba Buena Island was sampled on August 11, 2003. The Sacramento River station was sampled on August 15, 2003. Samples were collected as described previously in the interim report, with the addition of samples collected specifically for analysis of phthalates, described below.

Four liter samples for phthalate analysis were collected using the Infiltrix pump with no filter cartridges or columns installed. Narrow necked amber glass bottles were filled,

leaving less than one inch of head space. Samples were stored on ice in the field, and shipped with blue ice packs to the laboratory. Upon receipt at the laboratory, samples were spiked with deuterated phthalates as recovery standards, then extracted and analyzed by GC-MS.

Analytical results for the various CTR priority pollutants are presented in Tables A3-2 to A3-9. Results were generally similar to those found in previous sampling.

S/VOC target analytes were not found at concentrations above their respective MDLs for blanks in August 2003. Recoveries of surrogates and matrix spikes were generally within targets (50-150%), with exception of benzidine and 3,3'-dichlorobenzidine analyzed by modified EPA Method 625, which were not recovered from the spike. 3,3'-dichlorobenzidine is unstable in air (half life ~1 day) and in water exposed to light (half life ~90 seconds) which may contribute to its loss in spiked samples. Similarly, benzidine is subject to oxidation in water in the presence of common metal cations such as Fe(III) with a half life of ~1 day. Because of these degradation pathways, neither of these compounds is likely to persist for long in water samples. For quantitative analyses of these compounds, further modification of EPA Method 625 sample handling and analytical protocols would be required to reduce losses from field and spike samples.

Virtually none of the S/VOC compounds were detected in August 2003 field samples. Of the S/VOC analytes sought, only methylene chloride was found in a sample from Yerba Buena Island at a concentration (22 µg/L) above its MDL. This concentration was still well below its CTR criterion of 1600 µg/L.

Surrogate recoveries for phthalates in 4 liter water samples (for phthalate specific analyses) were generally within targets (50-150%), with the exception of the blank for d-4 bis(2-ethylhexyl)phthalate, which had 46% recovery. Phthalate compounds were consistently found in blank samples by the laboratory (Axys) at concentrations above their MDLs, generally about the same order of magnitude as concentrations found in field samples. Therefore, much of the measured concentrations in field samples is likely the result of contamination introduced in the laboratory analysis. However, even if it is assumed that measured concentrations are entirely originating from compounds present in the field, because of the lowered detection limits using 4 liter samples and phthalate specific analysis, average concentrations in field samples are significantly ($p < 0.05$) less than the water quality criteria for these phthalates.

PCDD/F concentrations in 100 liter solid phase extraction (SPE) samples for January and August 2003 were similar to previous results, with total concentrations (sum of the 17 isomer concentrations) less than 5 pg/L, and TEQs totaling 0.03-0.06 pg/L. Isomers with higher TEQs at very low concentrations contributed significantly to the TEQ totals.

Similar to results of previous sampling events, total PCDD/Fs measured in 4 liter whole water samples collected in August 2003 were found at higher concentrations (up to 14 pg/L) than in samples collected by the SPE method. However, TEQs were again lower

(0.014-0.022 pg/L) than found in SPE samples, due largely to isomers with higher TEQs not being detected.

Total trace elements (antimony, beryllium, thallium) in water were detected in some samples, but at concentrations well below the WQC for those elements. Using data from all four sampling events, the upper 99th percent confidence intervals for average concentrations in the estuary (assuming a normal distribution, with nondetects assigned a value of half their MDL) were well below the CTR criteria for all three elements.

Tributyl tin was measured by one of the analytical laboratories at approximately the MDL in all samples for August 2003. TBT was not reported by the second analytical laboratory in any samples, as the concentrations reported by the first laboratory were below the MDL for the latter.

Cyanide was not measured in any of the August 2003 samples analyzed. The MDL remained the same as in previous work, at slightly less than half the water quality criterion.

Because of the similarity of these results to those from previous sampling, recommendations made in the interim report remain unchanged.

Table A3-2. VOCs and SVOCs in SF Estuary Water Samples, August 2003

.. = not analyzed, < = not detected, U = unspecified.

LAB	METHOD	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB_MDL	TARGET_ML	WQO/WQC
		2003-08	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
CCCSD	EPA 624	1,1,1-Trichloroethane	<	<	<	<	1	0.5	U
CCCSD	EPA 624	1,1,2,2-Tetrachloroethane	<	<	<	<	2	0.5	11
CCCSD	EPA 624	1,1,2-Trichloroethane	<	<	<	<	2	0.5	42
CCCSD	EPA 624	1,1-Dichloroethane	<	<	<	<	1	0.5	U
CCCSD	EPA 624	1,1-Dichloroethylene	<	<	<	<	1	0.5	3.2
CCCSD	EPA 625	1,2,4-Trichlorobenzene	<	<	<	<	0.31	2	U
CCCSD	EPA 624	1,2-Dichlorobenzene	<	<	<	<	0.69	1	17000
CCCSD	EPA 625	1,2-Dichlorobenzene	<	<	<	<	0.69	1	17000
CCCSD	EPA 624	1,2-Dichloroethane	<	<	<	<	1.00	0.5	99
CCCSD	EPA 624MOD	1,2-Dichloroethane	<	<	<	<	0.03	0.5	99
CCCSD	EPA 624	1,2-Dichloropropane	<	<	<	<	1	0.5	39
CCCSD	EPA 625	1,2-Diphenylhydrazine	<	<	<	<	0.19	U	0.54
CCCSD	EPA 625MOD	1,2-Diphenylhydrazine	<	<	<	<	0.002	U	0.54
CCCSD	EPA 624	1,2-Trans-Dichloroethylene	<	<	<	<	1	0.5	140000
CCCSD	EPA 624	1,3-Dichlorobenzene	<	<	<	<	0.69	1	2600
CCCSD	EPA 625	1,3-Dichlorobenzene	<	<	<	<	0.69	1	2600
CCCSD	EPA 624	1,4-Dichlorobenzene	<	<	<	<	0.69	1	2600
CCCSD	EPA 625	1,4-Dichlorobenzene	<	<	<	<	0.69	1	2600
CCCSD	EPA 625	2,4,6-Trichlorophenol	<	<	<	<	1.3	1	6.5
CCCSD	EPA 625	2,4-Dichlorophenol	<	<	<	<	1.5	1	790
CCCSD	EPA 625	2,4-Dimethylphenol	<	<	<	<	4	1	2300
CCCSD	EPA 625	2,4-Dinitrophenol	<	<	<	<	1.4	5	14000
CCCSD	EPA 625	2,4-Dinitrotoluene	<	<	<	<	0.29	1	9.1
CCCSD	EPA 625	2,6-Dinitrotoluene	<	<	<	<	0.30	1	U
CCCSD	EPA 624	2-Chloroethylvinyl Ether	<	<	<	<	0.50	1	U
CCCSD	EPA 625	2-Chloronaphthalene	<	<	<	<	0.31	1	4300
CCCSD	EPA 625	2-Chlorophenol	<	<	<	<	1.7	1	400
CCCSD	EPA 625	2-Methyl-4,6-Dinitrophenol	<	<	<	<	1.3	5	765
CCCSD	EPA 625	2-Nitrophenol	<	<	<	<	1.5	1	U
CCCSD	EPA 625	3,3'-Dichlorobenzidine	<	<	<	<	4.4	U	0.077
CCCSD	EPA 625MOD	3,3'-Dichlorobenzidine	<	<	<	<	0.001	U	0.077
CCCSD	EPA 625	3-Methyl-4-Chlorophenol	<	<	<	<	1.5	1	U
CCCSD	EPA 625	4-Bromophenyl Phenyl Ether	<	<	<	<	0.23	1	U
CCCSD	EPA 625	4-Chlorophenyl Phenyl Ether	<	<	<	<	0.31	1	U
CCCSD	EPA 625	4-Nitrophenol	<	<	<	<	1.8	5	U
CCCSD	EPA 625	Acenaphthene	<	<	<	<	0.33	0.2	2700
CCCSD	EPA 625	Acenaphthylene	<	<	<	<	0.36	0.2	U
CCCSD	EPA 624	Acrolein	<	<	<	<	3	10	780
CCCSD	EPA 624	Acrylonitrile	<	<	<	<	1.00	U	0.66
CCCSD	EPA 624MOD	Acrylonitrile	<	<	<	<	0.03	U	0.66

CCCSD	EPA 625	Anthracene	<	<	<	<	0.21	0.2	110000
CCCSD	EPA 625	Benz(a)anthracene	<	<	<	<	0.21	U	0.049
CCCSD	EPA 624	Benzene	<	<	<	<	1	0.5	71
CCCSD	EPA 625	Benzidine	<	<	<	<	12	U	0.00054
CCCSD	EPA 625MOD	Benzidine	<	<	<	<	0.0015	U	0.00054
CCCSD	EPA 625	Benzo(a)pyrene	<	<	<	<	0.22	U	0.049
CCCSD	EPA 625	Benzo(b)fluoranthene	<	<	<	<	0.17	U	0.049
CCCSD	EPA 625	Benzo(ghi)perylene	<	<	<	<	0.25	1	U
CCCSD	EPA 625	Benzo(k)fluoranthene	<	<	<	<	0.13	U	0.049
CCCSD	EPA 625	Bis2-EthylhexylPhthalate	<	<	<	<	0.69	U	5.9
CCCSD		Bis(2-chloroethoxy)methane	..	..	..	..	NA	1	U
CCCSD	EPA 625	Bis2-ChloroethylEther	<	<	<	<	0.32	U	1.4
CCCSD	EPA 624	Bromoform	<	<	<	<	1	0.5	360
CCCSD	EPA 625	Butylbenzyl phthalate	<	<	<	<	0.5	5	5200
CCCSD	EPA 624	Carbon Tetrachloride	<	<	<	<	1.00	0.5	4.4
CCCSD	EPA 624MOD	Carbon Tetrachloride	<	<	<	<	0.03	0.5	4.4
CCCSD	EPA 624	Chlorobenzene	<	<	<	<	1	0.5	21000
CCCSD	EPA 624	Chlorodibromomethane	<	<	<	<	1	0.5	34
CCCSD	EPA 624	Chloroethane	<	<	<	<	5	0.5	U
CCCSD	EPA 624	Chloroform	<	<	<	<	1	0.5	U
CCCSD	EPA 625	Chrysene	<	<	<	<	0.19	U	0.049
CCCSD	EPA 625	Dibenz(a,h)anthracene	<	<	<	<	0.23	U	0.049
CCCSD	EPA 624	Dichlorobromomethane	<	<	<	<	1	0.5	46
CCCSD	EPA 625	Diethyl Phthalate	<	<	<	<	0.21	2	120000
CCCSD	EPA 625	Dimethyl Phthalate	<	<	<	<	0.21	1	2900000
CCCSD	EPA 625	Di-n-butyl phthalate	<	<	<	<	1.09	5	12000
CCCSD	EPA 625	Di-n-Octyl Phthalate	<	<	<	<	0.40	1	U
CCCSD	EPA 624	Ethylbenzene	<	<	<	<	1	0.5	29000
CCCSD	EPA 625	Fluoranthene	<	<	<	<	0.24	1	370
CCCSD	EPA 625	Fluorene	<	<	<	<	0.31	1	14000
CCCSD	EPA 625	Hexachlorobenzene	<	<	<	<	0.19	U	0.00077
CCCSD	EPA 625	Hexachlorobutadiene	<	<	<	<	0.31	5	50
CCCSD	EPA 625	Hexachlorocyclopentadiene	<	<	<	<	0.30	5	17000
CCCSD	EPA 625	Hexachloroethane	<	<	<	<	0.40	1	8.9
CCCSD	EPA 625	Indeno(1,2,3-cd)pyrene	<	<	<	<	0.28	U	0.049
CCCSD	EPA 625	Isophorone	<	<	<	<	0.40	5	600
CCCSD	EPA 624	Methyl Bromide	<	<	<	<	3	0.5	4000
CCCSD	EPA 624	Methyl Chloride	<	<	<	<	1	0.5	U
CCCSD	EPA 624	Methylene Chloride	<	22	<	<	1	1.2	1600
CCCSD	EPA 625	Naphthalene	<	<	<	<	0.35	1	U
CCCSD	EPA 625	Nitrobenzene	<	<	<	<	0.29	1	1900
CCCSD	EPA 625	N-Nitrosodimethylamine	<	<	<	<	0.31	5	8.1
CCCSD	EPA 625	N-Nitrosodi-n-Propylamine	<	<	<	<	0.40	1	1.4
CCCSD	EPA 625MOD	N-Nitrosodi-n-Propylamine	<	<	<	<	0.001	1	1.4
CCCSD	EPA 625	N-Nitrosodiphenylamine	<	<	<	<	0.20	1	16
CCCSD	EPA 625	Pentachlorophenol	<	<	<	<	1.3	1	7.9
CCCSD	EPA 625	Phenanthrene	<	<	<	<	0.18	1	U
CCCSD	EPA 625	Phenol	<	<	<	<	1.7	1	4600000
CCCSD	EPA 625	Pyrene	<	<	<	<	0.24	11	11000
CCCSD	EPA 624	Tetrachloroethylene	<	<	<	<	2	0.5	8.85

CCCSD	EPA 624	Toluene	<	<	<	<	1	0.5	200000
CCCSD	EPA 624	Trichloroethylene	<	<	<	<	1	0.5	81
CCCSD	EPA 624	Vinyl Chloride	<	<	<	<	1	0.5	525

Table A3-3. Phthalates in 4 liter SF Estuary Waters, August 2003

B = blank contamination > 30% of measured concentration, e = estimated value.

PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB_MDL	TARGET_ML	WQO/WQC
2003-08 Bis2-EthylhexylPhthalate	ug/L B,e 0.092	ug/L B,e 0.091	ug/L B,e 0.096	ug/L 0.33	ug/L 0.0012	ug/L U	ug/L 5.9
Butylbenzyl phthalate	B 0.0065	B 0.0056	B 0.0055	0.01	0.0011	5	5200
Di-n-butyl phthalate	B 0.020	B 0.016	B 0.015	0.018	0.0005	5	12000

Table A3-4. PCDD/Fs in 100 liter SF Estuary Waters January 2003

< = not detected, B = blank contamination > 30% of measured concentration, b=blank < 30% of sample, e = estimated value

LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL
Axys	2003-01 2,3,7,8-TCDD	pg/L B, e	pg/L <	pg/L <	pg/L e 0.003	pg/L 0.0009
Axys	1,2,3,7,8-PeCDD	0.011	0.008	0.019	<	0.0005
Axys	1,2,3,4,7,8-HxCDD	B, e	B	b 0.019	e 0.006	0.0013
Axys	1,2,3,6,7,8-HxCDD	b 0.035	b 0.035	b 0.064	e 0.005	0.0013
Axys	1,2,3,7,8,9-HxCDD	b,e 0.032	b 0.030	b 0.057	0.0062	0.0013
Axys	1,2,3,4,6,7,8-HpCDD	b 0.504	b 0.486	b 0.825	e 0.011	0.0025
Axys	OCDD	b 3.120	b 2.950	b 4.880	e 0.024	0.0021
Axys	2,3,7,8-TCDF	0.00995	0.035	0.071	<	0.0101
Axys	1,2,3,7,8-PeCDF	B, e	B	b,e 0.021	e 0.004	0.0012
Axys	2,3,4,7,8-PeCDF	B	B	b 0.041	0.00702	0.0012
Axys	1,2,3,4,7,8-HxCDF	B, e	b 0.015	b,e 0.028	e 0.005	0.0009
Axys	1,2,3,6,7,8-HxCDF	B	B	b 0.022	0.00414	0.0009
Axys	1,2,3,7,8,9-HxCDF	B, e	B, e	B	e 0.006	0.0009
Axys	2,3,4,6,7,8-HxCDF	B	B	b 0.021	0.00436	0.0009
Axys	1,2,3,4,6,7,8-HpCDF	b 0.109	b 0.123	b 0.203	e 0.006	0.0009
Axys	1,2,3,4,7,8,9-HpCDF	B	B	B	e 0.007	0.0009
Axys	OCDF	b 0.221	b 0.182	b 0.286	0.0124	0.0007
	total PCDD/Fs	4.0	3.9	6.6	0.11	0.03
	sum TEQs	0.025	0.026	0.079	0.011	0.004

Table A3-5. PCDD/Fs in 100 liter SF Estuary Waters August 2003

< = not detected, B = blank contamination > 30% of sample, b=blank < 30% of sample, e = estimated value, < = not detected

LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL
	2003-08	pg/L	pg/L	pg/L	pg/L	
Axys	2,3,7,8-TCDD	<	e 0.008	e 0.005	<	0.005
Axys	1,2,3,7,8-PeCDD	e 0.008	0.011	e 0.008	<	0.005
Axys	1,2,3,4,7,8-HxCDD	0.009	0.011	0.008	<	0.005
Axys	1,2,3,6,7,8-HxCDD	0.029	0.04	e 0.025	<	0.005
Axys	1,2,3,7,8,9-HxCDD	0.024	0.035	0.022	0.0050	0.005
Axys	1,2,3,4,6,7,8-HpCDD	b 0.410	b 0.500	b 0.281	e 0.012	0.005
Axys	OCDD	b 3.050	b 2.850	b 2.110	0.035	0.006
Axys	2,3,7,8-TCDF	0.032	0.054	0.046	<	0.005
Axys	1,2,3,7,8-PeCDF	0.006	e 0.016	0.009	<	0.005
Axys	2,3,4,7,8-PeCDF	0.011	0.023	0.021	0.0055	0.005
Axys	1,2,3,4,7,8-HxCDF	0.014	0.017	e 0.011	<	0.005
Axys	1,2,3,6,7,8-HxCDF	0.009	0.014	0.009	<	0.005
Axys	1,2,3,7,8,9-HxCDF	<	<	<	<	0.005
Axys	2,3,4,6,7,8-HxCDF	0.007	0.013	0.01	<	0.005
Axys	1,2,3,4,6,7,8-HpCDF	b 0.090	b,e 0.139	b 0.076	0.0071	0.005
Axys	1,2,3,4,7,8,9-HpCDF	B, e	B	B, e	0.0070	0.005
Axys	OCDF	b 0.165	b 0.205	b 0.106	0.018	0.005
	total PCDD/Fs	3.9	3.9	2.7	0.09	0.09
	sum TEQs	0.032	0.057	0.041	0.004	0.017

Table A3-6. PCDD/Fs in 4 liter SF Estuary Waters August 2003

< = not detected

LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL
	2003-08	pg/L	pg/L	pg/L	pg/L	pg/L
FAL	2,3,7,8-TCDD	<	<	<	<	0.27
FAL	1,2,3,7,8-PeCDD	<	<	<	<	0.57
FAL	1,2,3,4,7,8-HxCDD	<	<	<	<	0.73
FAL	1,2,3,6,7,8-HxCDD	<	<	<	<	0.84
FAL	1,2,3,7,8,9-HxCDD	<	<	<	<	0.74
FAL	1,2,3,4,6,7,8-HpCDD	2.05	1.3	1.53	<	0.59
FAL	OCDD	11.4	7.33	8.1	<	2.2
FAL	2,3,7,8-TCDF	<	<	<	<	0.22
FAL	1,2,3,7,8-PeCDF	<	<	<	<	0.52
FAL	2,3,4,7,8-PeCDF	<	<	<	<	0.50
FAL	1,2,3,4,7,8-HxCDF	<	<	<	<	0.20
FAL	1,2,3,6,7,8-HxCDF	<	<	<	<	0.25
FAL	1,2,3,7,8,9-HxCDF	<	<	<	<	0.19
FAL	2,3,4,6,7,8-HxCDF	<	<	<	<	0.23
FAL	1,2,3,4,6,7,8-HpCDF	<	<	<	<	0.37

FAL	1,2,3,4,7,8,9-HpCDF	<	<	<	<	0.47
FAL	OCDF	<	<	<	<	1.07
	total PCDD/Fs	13.5	8.6	9.6	<	9.98
	sum TEQs	0.022	0.014	0.016	<	1.47

Table A3-7. Trace Elements in SF Estuary Waters August 2003

e= estimated value, < = not detected

METHOD	LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	BLANK	LAB MDL	TARGET_ML	WQO/WQC
EPA 200.8	CALTEST	Be	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
			<	<	<	<	0.06	0.5	U
EPA 200.8	CALTEST	Sb	<	<	<	<	0.2	0.5	14
EPA 200.8	CALTEST	Tl	<	<	e 0.16	<	0.03	1	1.7
ICP-MS	UCSCDET	Be	2.3E-05	<	8.9E-06	<	7.1E-06	0.5	U
ICP-MS	UCSCDET	Sb	8.1E-05	6.3E-04	6.1E-04	<	6.4E-05	0.5	14
ICP-MS	UCSCDET	Tl	<	2.0E-05	1.5E-05	<	1.2E-05	1	1.7

Table A3-8. CCCSD TS, Hardness in SF Estuary Waters August 2003

--not analyzed

METHOD	LAB	PARAMETER	UNITS	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Average of Blanks
SM 2540B	CCCSD	% Total Solids	%	0.04	3.64	4.10	-
UNKNOWN	CCCSD	Hardness	mg/L	88	5,400	4,920	-

Table A3-9. TBT, CN in SF Estuary Waters August 2003

< = not detected

METHOD	LAB	PARAMETER	Sacramento River	Yerba Buena Island	Dumbarton Bridge	Blank	LAB MDL	TARGET_ML	WQO/WQC
EPA GC/FPD	TOXSCAN	TBT	0.002	0.002	0.003	<	0.002	:	0.01
GC/MS	EBMUD	TBT	<	<	<	<	0.0046	:	0.01
SM 4500-CN-I	CCCSD	CN	<	<	<	<	0.4	5	1