AN EXAMINATION OF MERCURY LEVELS AT CLEAN WATER AGENCIES 2003-2006

NATIONAL ASSOCIATION OF CLEAN WATER AGENCIES
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To the Reader:

The National Association of Clean Water Agencies (NACWA) represents the interests of the nation's publicly-owned wastewater treatment utilities. NACWA's members treat wastewater from the majority of the sewered population in the country and work to ensure that their discharges meet all applicable limits and help to achieve water quality standards. NACWA's Mercury Workgroup was formed more than a decade ago to work on the issue of mercury in municipal wastewater effluent and biosolids. With over 60 members from the municipal wastewater community across the country, this Workgroup has since developed several critical resources on the subject and continues its dedicated work to assist POTWs in controlling mercury discharges.

This study, the Workgroup's most recent effort, was designed to examine the effectiveness of practical and reasonable measures of controlling mercury discharged to the POTW collection system, such as dental amalgam separator installation, on the ability of POTWs to meet strict effluent mercury limits. For this study, the influent, effluent, and biosolids mercury concentrations from twelve U.S. and Canadian POTWs that were in various stages of requiring dental facilities to install amalgam separators were measured on a monthly basis from July 2003 through July 2006 to evaluate the impact of separator installation and other potential factors. Information on other source control efforts and operational activities at the sampled POTWs was also collected in an effort to shed light on numerous issues related to controlling mercury releases by POTWs to the environment.

The results from the study are briefly summarized in the Executive Summary:

> *According to the results, separator installation does not generally appear, at least within the timeframe of this study, to significantly reduce effluent mercury concentrations. However, amalgam separator installation does generally appear to result in reductions in biosolids mercury concentrations. Therefore, despite the variability and uncertainties described in this report, the data strongly support a conclusion that the use of separators can decrease the amount of particulate mercury entering POTWs, thereby decreasing the amount of mercury that would be removed by plant processes and deposited in the biosolids.*

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Overall, the results of the study indicate that many factors, not just amalgam separator installation, influence mercury concentrations at POTWS. Factors including legacy contributions of mercury from historic discharges will make it difficult for a facility to predict with certainty that amalgam separators will decrease mercury concentrations without also exploring the other potential contributors to current mercury levels. Though the study results indicate that even POTWs with demonstrably successful amalgam separator programs may not be able to consistently meet current or imminent effluent limits (e.g., 1.3 nanograms per liter in the Great Lakes), these local efforts do appear to be having a measurable effect on the quantity of mercury being discharged to POTWs.

NACWA's Mercury Workgroup will be considering further work based on the results of this study in an effort to shed more light on this complex issue.

For more information on the study, please contact Chris Hornback, NACWA at 202/833-9106 or chornback@nacwa.org.

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An Examination of Mercury Levels at Clean Water Agencies: 2003-2006

LIST OF FIGURES

EXECUTIVE SUMMARY

The degree to which mercury concentrations at publicly-owned treatment works (POTWs) can be reduced by controlling potentially significant sources, such as dental clinics, is not well known. Therefore, the National Association of Clean Water Agencies (NACWA) funded a study to examine the effect of practical and reasonable measures of controlling mercury discharged to the POTW collection system, such as dental amalgam separator installation, on the ability of POTWs to reduce influent, effluent, and biosolids mercury levels.

This study provides insight into the effect of amalgam separator installation and other factors on mercury concentrations at POTWs, but it does not, and was not intended to, address all the uncertainty surrounding such factors. Although the data collected during the course of the sampling project provide useful information, this report's evaluations of the collected data illustrate the limitations of the study and, in many cases, highlight the need for further research. A considerable limitation is the inability to identify and account for all the variation that necessarily exists among POTWs. POTWs are designed to accomplish the same basic goals, but they achieve these goals differently, making some interfacility comparisons difficult. Among the potential sources of uncertainty are temporal variations in influent mercury concentrations, differences in sampling techniques, inconsistent methods of counting dentists and dental facilities, and varying chemical use by POTWs. It is these variables and others that lead to the implications for further research presented later in the report. Such additional research may allow a better understanding of the factors affecting mercury levels at POTWs, including the installation of amalgam separators.

The influent, effluent, and biosolids mercury concentrations from twelve POTWs in the United States and Canada, in various stages of requiring dental facilities to install amalgam separators, were measured on a monthly basis from July 2003 through July 2006 to evaluate the impact of separator installation and other potential factors. Information on other source control efforts and operational activities at the sampled POTWs was also collected in an effort to shed light on numerous issues related to controlling mercury releases by POTWs to the environment.

The influent mercury concentrations at the POTWs in the study were found to be highly variable within each facility as well as among facilities. Consistent with this variation, when considering facilities individually, some exhibited decreases in their influent mercury concentrations over the course of the sampling project, while others had apparent increases. Thus, a great deal of uncertainty surrounds the influent sampling data, and it may not be prudent to draw conclusions based solely on the limited influent data. Effluent mercury concentrations also exhibited variability between plants but less variability within plants. For the biosolids, there was some variability both within and among the plants. However, neither the effluent nor the biosolids mercury data were nearly as variable as the influent mercury data.

The mercury removal efficiency from plant influent to plant effluent was generally greater than ninety percent. While the POTWs were similar in this aspect, in other ways they were not. For instance, the percentage of effluent mercury that was dissolved was found to vary based on the POTW. Additionally, at eight of the POTWs, there appeared to be a direct relationship between

effluent mercury concentration and effluent total suspended solids concentration while, at the remaining five POTWs, this relationship did not appear to exist.

The study results strongly suggest that the density of dentists in a POTW's collection system is positively correlated with mercury concentrations at the wastewater treatment plant. A higher number of dentists per flow was related to higher influent and effluent mercury concentrations. There was no relationship, however, between numbers of dentists per flow and biosolids mercury concentrations. This may be due to amalgam separators being installed by dentists in many of the sampled POTWs' service areas. Importantly, though, it was found that, collectively, higher numbers of dentists without amalgam separators per flow were related to higher biosolids mercury levels. This relationship was highly significant statistically and among the most significant relationships observed in the study.

Conversely, the effluent mercury concentration was found to be negatively correlated to the number of dentists without separators per flow, indicating that increasing amalgam separator installations does not necessarily lead to a decrease in effluent mercury concentrations. This result could be due, in part, to the limited number of amalgam separator installations occurring at the POTWs with generally lower effluent mercury concentrations at the study's outset.

For individual plants, the installation of separators did not always lead to a decrease in biosolids mercury. It may be that amalgam separator installation alone is not enough to result in permanent mercury reductions. Some of the plants that did show decreases in mercury have programs in place to ensure that the separators are well-operated and maintained, and this may be a factor. It is also thought that mercury reductions following separator installations can take several years or even longer to demonstrate significant trends. Therefore, this study may not have been long enough to determine significant trends for some POTWs whose dental facilities were in the process of installing amalgam separators during the course of the study. It is further possible that, on an individual-facility basis, apparent reductions or the lack thereof could be the result of other impacting factors such as previously elevated loadings related to sewer cleaning, construction activities, or historic depositions of mercury in the collection system.

Some of the treatment plants exhibited mercury reductions even without an increase in amalgam separator installation. These reductions may have resulted from changes in treatment processes or the implementation of best management practices at dental facilities. Therefore, on a facility-specific basis, the effectiveness of amalgam separators in reducing mercury should be examined in light of other activities that are occurring within the POTW and its service area to determine which factors are actually contributing to an observed reduction.

In addition to the presence of dentists within a POTW's collection area, several other factors were found to exhibit relationships with mercury levels at treatment plants. These included the discharge of effluent to marine waters and sewer cleaning projects occurring within the POTW's collection system, which were each related to higher effluent mercury levels, and higher industrial flow and the use of iron salts, which were each related to lower effluent mercury levels.

Factors that were examined but not found to be related to mercury levels were higher plant flow, population density, whether the POTW accepts hauled-in wastes, and whether the collection system is comprised of combined or separate sewers.

Overall, the results of this study indicate that many factors, not just amalgam separator installation, influence mercury concentrations. While separators have been shown to reduce mercury loadings at dental offices, it should be recognized that the installation and use of separators may not result in demonstrable and immediate reductions at the receiving treatment facility due, at least in part, to the legacy issues from historic mercury contributions. Therefore, a facility cannot predict with certainty that amalgam separators will decrease mercury concentrations without also exploring the other potential contributors to current mercury levels. Additionally, it should be noted that, even at those POTWs with demonstrably successful amalgam separator programs, effluent mercury concentrations were not low enough to consistently meet current and imminent effluent limits faced by some POTWs (*e.g.*, 1.3 nanograms per liter in the Great Lakes).

According to the results, separator installation does not generally appear, at least within the timeframe of this study, to significantly reduce effluent mercury concentrations. However, amalgam separator installation does generally appear to result in reductions in biosolids mercury concentrations. Therefore, despite the variability and uncertainties described in this report, the data strongly support a conclusion that the use of separators can decrease the amount of particulate mercury entering POTWs, thereby decreasing the amount of mercury that would be removed by plant processes and deposited in the biosolids.

1. INTRODUCTION

The National Association of Clean Water Agencies (NACWA) represents the interests of more than three hundred of the nation's publicly owned treatment works (POTWs) and other similar organizations. NACWA is recognized as a national leader in environmental policy and as a technical resource for many water quality issues. The organization has been crucial in the development of environmental legislation and has worked with Federal regulatory agencies in implementing environmental programs since the early 1970s. NACWA is currently involved with all aspects of water quality protection from point and nonpoint source control to the protection of endangered species and is a key stakeholder in both the legislative and regulatory arenas.

Mercury has been identified as one of NACWA's priorities. Therefore, the NACWA Mercury Workgroup began identifying information gaps regarding both the short-term and long-term abilities of POTWs to comply with anticipated mercury limits after implementing practical and reasonable measures to control sources of mercury at the treatment facilities and within the collection systems. This led to the realization that the relationship between mercury contributions to sewer systems and mercury concentrations in POTW effluents is not well understood. The degree to which influent, effluent and biosolids mercury concentrations can be reduced by controlling potentially significant sources, such as dental clinics, is unknown. Therefore, NACWA has funded an attempt to better understand the impact of controlling mercury discharged from dental clinics on the ability of POTWs to meet stringent effluent limitations and biosolids requirements.

This study presents an opportunity to build a database depicting baseline mercury levels and trends that may occur as mercury control programs at POTWs progress. Due to their use of dental amalgam, both in the placement and removal of dental fillings containing mercury amalgam, dental facilities are significant sources of mercury to wastewater treatment plants. Amalgam separators are treatment devices that can be installed in the plumbing of a dental clinic to remove some quantity of dental amalgam from the wastestream tributary to a POTW. Amalgam separators remove more amalgam from the wastestream than the typical chairside traps and vacuum filters found in a dental office.

This study was designed to examine the effect of practical and reasonable measures of controlling significant sources of mercury to the POTW collection system on the ability of POTWs to comply with anticipated effluent limitations and address concerns regarding mercury in plant influent and biosolids. In an attempt to quantify the amount of dental amalgam removed from the wastestream by dental amalgam separators, the influent, effluent, and biosolids mercury concentrations, as well as other parameters, from POTWs in the United States and Canada already having implemented regulations requiring dental clinics to install amalgam removal equipment, were evaluated on a monthly basis from July of 2003 through July of 2006. POTWs that do not have these regulatory requirements were also evaluated.

Twelve POTWs were each sampled at least one time per month for the duration of the study. The sampled POTWs were in various stages of requiring dental facilities to install amalgam separators to capture particulate amalgam waste. Table 1.1 shows the percentage of dental facilities/dentists with operating dental amalgam separators, i.e., amalgam separator units (ASU), for each POTW throughout the study. Samples from each POTW were analyzed for influent, effluent, and biosolids total mercury concentrations as well as influent and effluent total suspended solids concentrations. POTWs were also asked to monitor effluent turbidity and to collect a limited amount of effluent dissolved mercury concentration data. As some facilities joined the project partway through the course of study, not every POTW was able to provide these additional data.

Table 1.1: Percentage of Dental Facilities/Dentists Operating Dental Amalgam Separators

	July 1, 2003	January 1, 2004	July 1, 2004	January 1, 2005	July 1, 2005	January 1, 2006	July 1, 2006
POTW "A"	0	0	0	98	100	100	100
POTW "B"	5	6	7	8	9	9	9
POTW "C"	6	6	6	6	6	6	6
POTW "D"	0.6	1.5	6.1	16	26	32	38
POTW "E"	0.6	1.5	6.1	16	26	32	38
POTW "F"	0	0	0	0	2	12	20
POTW "G"	44	86	95	98	100	100	100
POTW "H"*	unknown	60	89	95	95	98	98
POTW "I"	93	93	93	93	93	93	93
POTW "J"	94	97	97	97	97	97	98
POTW "K"	94	97	97	97	97	97	98
POTW "L"	unknown	unknown	unknown	unknown	unknown	unknown	11

* The percentages for POTW "H" also include other approved control technologies.

Recognizing that such data can also be impacted by other source control efforts and operational activities at POTWs, NACWA collected key information about the agencies and communities participating in the study. This information was utilized in an effort to shed light on numerous issues related to controlling mercury discharges to the environment. It is intended that the findings of this report can be used to assist agencies in making informed management decisions about controlling mercury discharges to POTWs and the environment.

2. METHODS

One of the most critical aspects of this study was the collection of data. It was necessary for the data to be sensitive enough to determine with confidence whether effluent concentrations can be reduced to very low levels. The sampling and analytical methods historically used for the quantification of mercury were inadequate for the measurement of mercury concentrations at the low levels typically found in wastewater treatment plant effluents. Therefore, the USEPA developed a more sensitive analytical method, Method 1631, for analysis of mercury concentrations at low levels. When analyzing for mercury at such low concentrations, there is significant potential for contamination of the samples. USEPA also provides guidance in Method 1669, clean sampling techniques for collecting samples to be analyzed with low-level methods. For the reliability of effluent data produced by this study, it was necessary to use these clean sampling techniques and low-level analytical methods. In most cases, the laboratory typically utilized by the POTW was not capable of analyzing for mercury at this low level. Therefore, a NACWA member laboratory was enlisted to perform the low-level mercury analysis for the study, when needed. The following parameters were analyzed for and reported from each POTW:

- Influent/Effluent Flow, million gallons per day (MGD);
- Influent Total Recoverable Mercury, nanograms per liter (ng/L);
- Influent Dissolved Mercury, ng/L;
- Effluent Total Recoverable Mercury, ng/L;
- Effluent Dissolved Mercury, ng/L;
- Biosolids Mercury, mg/kg (dry weight);
- Influent Total Suspended Solids (TSS), mg/L;
- Effluent Turbidity, NTU; and
- Effluent TSS, mg/L.

2.1 Sampling Methods

Sample points were chosen to be representative of the influent and/or effluent. Samples were collected by POTW personnel at each plant during conditions that were most representative of normal operating conditions. Each facility was to identify normal operating conditions based on a 95% confidence interval of the previous two years of effluent flow, total suspended solids, and turbidity. It was vital to the integrity of the study that samples collected were representative of the process stream being sampled. Therefore, sampling was not to occur during the following conditions:

- Atypical plant flow;
- Unusual loss of solids in the effluent;
- Plant upset conditions;
- Receiving an unusual industrial discharge;
- Significant diversion of flow; or
- Atypical applications of chemical treatments.

Because of differences in operating procedures between treatment facilities, single grab, multiple grab, or composite samples could be collected throughout the study. Once the decision was made on sampling protocol, the facility's continuing to use the same protocol for the duration of the study was preferred. Composite samples for total recoverable and dissolved mercury were collected from the influent at POTWs A, D, E, F, G, and H; the remaining facilities collected influent grab samples. Composite samples for total recoverable and dissolved mercury were collected from the effluent at POTWs A, G, H, and L; the remaining facilities collected effluent grab samples. Samples were collected utilizing U.S. EPA Method 1669 and other clean sampling protocols to minimize potential contamination introduced during sampling and, where the NACWA member laboratory providing analytical services was utilized, the samples were shipped on ice overnight. A study plan and scope of work, which includes sampling protocols, was developed by this laboratory to be used by participating POTWs, as needed. This study plan is included as Appendix D.

To reduce the potential for contamination, sampling protocols and equipment were specifically designed for each individual sample location. To reduce variability, the NACWA member laboratory providing analytical services offered to provide necessary sampling equipment to the POTWs requiring outside laboratory services. In order to reduce contamination associated with grab sample collection, handling, and analysis, the "clean hands / dirty hands" technique was used. The individual designated as "dirty" hands provided support, and only the person designated "clean hands" could touch the sample bottles and anything that may have come into contact with the bottle.

2.2 Analytical Methods

Influent and effluent samples were analyzed for total recoverable mercury, dissolved mercury, and total suspended solids by either the NACWA member laboratory providing analytical services or the laboratory typically used by the POTW. All effluent mercury analysis, both total and dissolved, was done according to U.S. EPA Method 1631, Revision E. This method was necessary to detect the extremely low concentrations of mercury often present in treated effluent. Method 1631, Revision E is for the determination of mercury in filtered and unfiltered water by oxidation, purge and trap, desorption, and cold-vapor atomic fluorescence spectrometry. For dissolved mercury analysis, the method specifies that samples are to be filtered through a 0.45µm capsule filter. Mercury analysis on influent samples was performed using the least sensitive method that resulted in a quantifiable result. Table 2.2A indicates the analytical methods and the detection limits most commonly used for the aqueous and solid samples.

Table 2.2A: Analytical Methods

PARAMETER	REFERENCE METHOD	METHOD DETECTION LIMIT
Hg (total recoverable and dissolved)	EPA Method 1631, Rev. E	0.3 ng/L
Hg (total recoverable and dissolved)	EPA Method 245.7	0.7 ng/L
Total Recoverable Hg	EPA Method 245.2	30 ng/L
Total Recoverable Hg	EPA Method 245.5 or SW-846 7441A	0.06 mg/L (TS values used for conversion to mg/Kg)
TSS	SM 2540D	1 mg/L

Throughout the analytical process, clean protocols were adhered to at all times for the effluent mercury samples. All sample preservation, preparation, and analyses were performed in special clean areas. Appropriate measures were taken to limit potential contamination of samples and labware. All of the data from each POTW in the study are located in Appendix A.

A total of 2,283 mercury analysis results were submitted for the study: 716 for influent total mercury; 120 for influent dissolved mercury; 458 for effluent total mercury; 151 for effluent dissolved mercury; and 838 for biosolids mercury. In each case, the entities assuming responsibility for sample collection and analysis were relied upon to comply with quality assurance/quality control (QA/QC) protocols specified in the study plan that was prepared at the study's outset by the NACWA member laboratory that provided analytical services (Appendix D) and/or specified in the respective method documents for the particular analytical methods utilized and listed in Appendix A. Data reported as not compliant with the applicable QA/QC protocols were excluded with the sole exceptions of two (of the 458) effluent total mercury data points which were reported as lacking associated field blank data but which exhibited concentrations fully consistent with the relevant comparable data.

2.3 Statistical Methods

To determine the strength of associations between pairs of variables measured at individual POTWs during the study, the non-parametric, Mann-Kendall test for trend was selected. Many of the distributions from the NACWA Mercury Sampling Project were skewed to the right (*i.e.*, at higher mercury concentrations, there were fewer occurrences and outliers were very common. This indicates these variables were not derived from normal distributions. In addition, examination of plots of pairs of variables indicated that the relationships between many of them were not linear. Therefore the assumptions of parametric statistical tests (such as Pearson's r) were often not met. This led to a choice between methods: the variables could be transformed to meet the assumption of the parametric tests or nonparametric tests, such as the Mann-Kendall test, could be used instead. The Mann-Kendall test, which uses Kendall's τ (tau) as the test statistic, is a rank-based procedure that is resistant to the effect of outliers in the dataset. This test measures the strength of the monotonic relationship between two variables; therefore the relationship could be curved or linear and still be detected by this test. The use of the Mann-Kendall test is well-suited to data from skewed distributions, such as the lognormal distributions often used to model water-quality variables. It was decided that use of nonparametric tests would be preferable to the extensive checking of assumptions and transformation of variables that would be required by use of the parametric techniques. A summary of the results of the Mann-Kendall tests for the combined data is located in Appendix B; more detailed, computer-generated results for all statistical analyses are located in Appendix C. Appendix C is provided for readers who are familiar with the software employed and are interested in further examination of the data.

For the present analyses, α was set at 0.05. That is, the null hypothesis of no correlation ($\tau = 0$) was rejected when the test resulted in a p-value that was ≤ 0.05. In such cases, the alternate hypothesis that the two variables are correlated ($\tau \neq 0$) was accepted. Using a value of 0.05 means that there is a 5% probability that the null hypothesis will be rejected when it is actually true. There were a few instances in which relationships were not significant at the 0.05 level, but were so at the 0.10 level. Even though there is a slightly greater probability that the null hypothesis will be falsely rejected at this level, these instances are included because it is thought that they still identify meaningful relationships.

Much of the data collected during the study are presented as box-and-whisker plots. These plots show the range of the data as well as the 25^{th}, 50^{th}, and 75^{th} percentiles. While the data for the individual POTWs are plotted in six-month increments, the Mann-Kendall tests were performed utilizing every sample result. For the collective data, the Mann-Kendall tests were performed on the six-month median results to address sample variability, to correspond with the twice-yearly determinations of the number of dentists with separators installed, and to provide a more manageable quantity of data.

3. INDIVIDUAL POTW RESULTS AND DISCUSSION

Results from the study were analyzed in terms of both individual POTWs and as overall results combining all of the data from each POTW. For the individual POTW results, mercury concentrations at the treatment plant were examined and then related to individual plant characteristics and activities. The Mann-Kendall test was used to determine the statistical significance of trends; those related to effluent mercury, biosolids mercury, and TSS concentrations are presented. Influent and effluent mercury loading results are also presented, although the statistical significance of trends related to these two parameters was not determined. For the combined results, potential factors influencing mercury concentrations were examined to determine any overall relationships common to all or a portion of the treatment plants.

3.1 POTW "A"

PLANT PROCESSES

POTW "A" treats an average of 42.5 million gallons of wastewater per day (MGD). However, the capacity of the plant is such that 200 million gallons could receive preliminary and primary treatment and 65 million gallons could receive secondary treatment, if necessary. Treatment at POTW "A" consists of screenings removal, grit removal, primary treatment, aeration, secondary clarification, disinfection, and dechlorination. Hauled-in wastes are not accepted for treatment, at POTW "A". Bar racks are employed for screenings removal and grit is removed via aerated grit chambers. The grit slurry is then separated using a screw degritter and disposed of in a landfill along with the debris removed by the bar racks. Approximately 1,000 wet tons of grit is removed annually. The primary and secondary treatments at POTW "A" include complete mix, fine-bubble diffused aeration and secondary clarification. The primary sludge and waste activated sludge are settled in gravity thickeners and then blended with fats, oil, and grease. This mixture is then dewatered by filter presses. The dewatered sludge and fats, oil, and grease mixture was either incinerated in a multiple hearth incinerator or stabilized with hydrated lime and disposed of in a landfill. The scrubber water effluent from the multiple hearth incinerator was discharged into the grit tank effluent. This biosolids incineration process ended on November 30, 2005. Thickened sludge blended with fats, oils, and grease is now collected and handled on site by a contractor for offsite disposal or composting. POTW "A" produces approximately 9000 dry tons of biosolids each year. Final effluent treatment includes disinfection with hypochlorite and dechlorination using sodium bisulfite. The following treatment chemicals are utilized at POTW "A":

- Sodium hypochlorite is used for disinfection of the final effluent, disinfection of the wet weather treatment tank influent, odor control in the gravity thickeners, odor control in the press room, and for the control of filamentous bacteria in the return activated sludge;
- Sodium bisulfite is used for dechlorination of the final effluent;
- Liquid cationic polymer is used to promote flocculation of the thickened sludge;
- Hydrated lime is added to dewatered sludge intended for the landfill;
- Caustic soda is used in unclogging grease lines.

SAMPLE COLLECTION

Composite influent samples were collected downstream of the bar racks, just prior to the grit removal chambers. Teflon suction tubing was used in a peristaltic pump along with clean methods. The effluent samples were flow-paced composite samples of dechlorinated final effluent. (Flow-paced composite samples are those in which the interval between samples is a specified volume of effluent that has passed a measuring point in the flow stream.) Biosolids were sampled by conducting manual grab samples that were composited to obtain a sample that represented a 24-hour period.

COLLECTION SYSTEM INFORMATION

POTW "A" is a marine discharger that treats portions of ten communities. The service area for POTW "A" covers approximately 50 square miles and has approximately 360,000 residents. Fifty percent of the collection system is combined sewer area and the remaining is separate sewer area. The combined sewer area contains sixty-seven combined sewer overflows. Approximately ninety-one percent of the influent flow at POTW "A" is from residential sources and approximately six percent is due to commercial uses. The remaining three percent of the influent flow is from industrial users. While none have been identified as significant sources of mercury, the types of industrial discharges are listed in Table 3.1A.

Table 3.1A: Types of Significant Industrial Users (SIUs) in POTW "A" Service Area

TYPE OF SIU	NUMBER	APPROXIMATE TOTAL DAILY FLOW, GALLONS PER DAY (GPD)
Electroplaters / Metal Finishers	61	1,069,305
Metal Molding & Casting	2	13,883
Metal Formers	1	2,000
Chemical Manufacturers	5	18,197
Printers	1	1,000
Specialty Paper Coaters	1	19,800
Electric Companies	1	93,000
Central Treatment Facilities	1	18,210

During the study period, POTW "A" was conducting an interceptor sewer cleaning program that consisted of using a water jet to force grit contained in the larger sewer pipes of the collection system to manholes where it could be removed. This operation had the potential to suspend mercury that had accumulated in the sewers over many years and flush this mercury to the headworks of the POTW. This work was conducted at various points throughout the collection system. The amount of suspended mercury that reached the headworks of the POTW was a function of the distance from the cleaning operation to the POTW and the specific flow conditions in that interceptor. The cleaning activities, which at times also included releasing grit removed from the sewer lines directly into the headworks of the plant, may have occurred on days while sampling for this study was being conducted.

In July 2003, POTW "A" began construction of a large underground storage tunnel to eliminate or reduce combined sewer overflows. This construction project generated a large amount of mining/groundwater that was discharged to the headworks of the POTW. Flow rates from this project changed dramatically over the course of the project. Prior to May 2004, the flow rate was less than 0.5 MGD. Between May 2004 and December 2005, the flow rate increased to a steady maximum of just over 3.5 MGD. After December 2005, the flow rate from the tunnel project decreased to 2.25 MGD. The characteristics of the wastewater from this project also changed. When mining was occurring, the wastewater contained a significant amount of mineral grit. The mining ceased on December 1, 2005, and after this date the amount of TSS in the wastewater from the tunnel decreased.

MERCURY CONTROL PROGRAM

In late 2003, POTW "A" began implementation of a best management practice program for dental facilities. The program incorporates two options for the dental facilities. A dental facility may opt to install and maintain an ISO Certified Amalgam Separator and follow best management practices or the facility may construct a sampling location that collects all amalgam waste, routinely sample this wastestream and maintain full compliance with a mercury limit of 0.005 parts per million. There are 100 dental facilities/dentists located in the service area. At the beginning of the sampling project, none of the facilities/dentists had installed amalgam separators. However by the culmination of the project, all of facilities/dentists had installed them accordingly. The amalgam separator status at this POTW is shown in Table 3.1B.

Table 3.1B: Amalgam Separator Status at POTW "A"

DATE	PERCENT OF DENTAL FACILITIES/DENTISTS OPERATING DENTAL AMALGAM SEPARATORS
July 1, 2003	0
January 1, 2004	0
July 1, 2004	0
January 1, 2005	98
July 1, 2005	100
January 1, 2006	100
July 1, 2006	100

RESULTS

As Figures 3.1A and 3.1B indicate, effluent mercury concentrations decreased significantly ($p < 0.05$) from July 2003 to July 2006. At the start of the study, the 6-month median effluent total mercury concentration was 10.7 ng/L and, by the culmination of the study, the 6-month median effluent total mercury concentration was 5.7 ng/L. This statistically significant decrease in effluent mercury concentration may be related to amalgam separator installation. The concentration of mercury in the biosolids, as shown in Figure 3.1A, appears to have remained constant throughout the course of the study, possibly indicating that the effects of amalgam separator installation are being masked by the effects of the interceptor cleaning activities and the tunneling project. Figure 3.1B indicates that, while the effluent mercury concentrations were decreasing, the effluent TSS was increasing as a result of the tunneling project and/or the interceptor cleaning activities. At the beginning of the study, the 6-month median effluent TSS concentration was 9 mg/L and, by the culmination of the project, the 6-month median effluent TSS concentration was 14 mg/L. The increase in effluent TSS concentration was not found to be statistically significant at the α = 0.05 level, but it was so at the 0.10 level. The influent mercury loading was variable and the effluent loading remained relatively constant throughout the course of the study, as depicted in Figure 3.1C. The high variability in influent mercury loading is believed to be partly the result of drain line cleaning and drain trap replacements occurring at dental facilities as a required part of the installation of amalgam separators. It may further be due to the tunneling project and the ongoing interceptor sewer cleaning activities.

POTW "A" also collected additional influent and effluent samples during the course of the three-year NACWA Mercury Sampling Project. The results from these samples may demonstrate a decline in both the influent and effluent mercury loading over the course of the study. The amount of data collected by POTW "A" is substantial and would lend further support to the conclusion that the effluent mercury concentrations are decreasing at POTW "A." However, these additional samples were not collected or analyzed using the same methods as in the NACWA Mercury Sampling Project and therefore are not presented here.

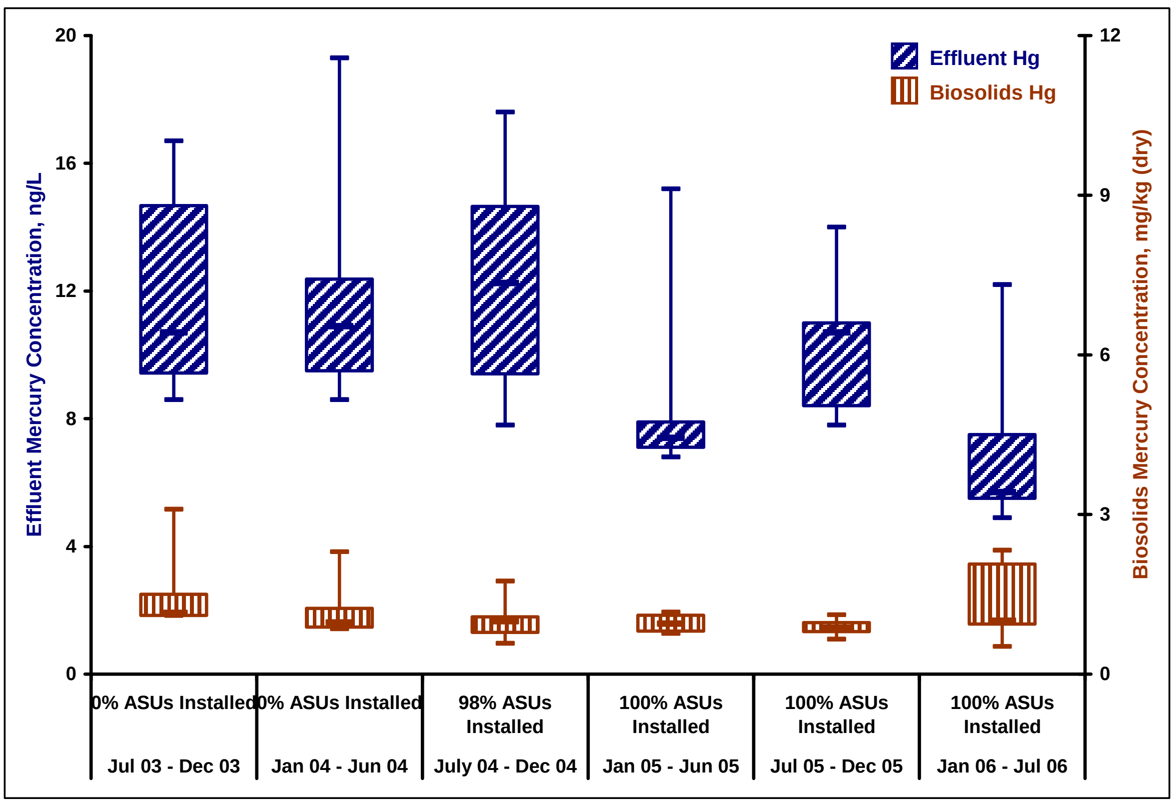

Figure 3.1A: Effluent and Biosolids Mercury Concentrations at POTW "A"

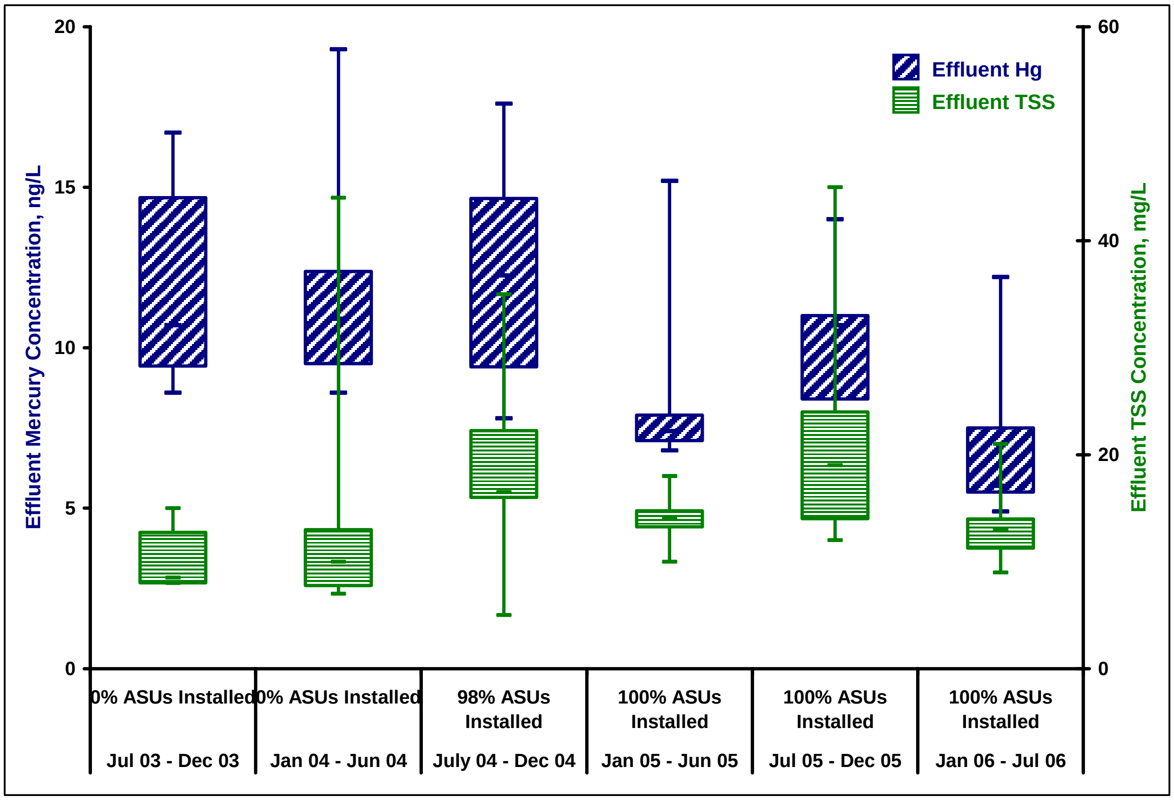

Figure 3.1B: Effluent Mercury and TSS Concentrations at POTW "A"

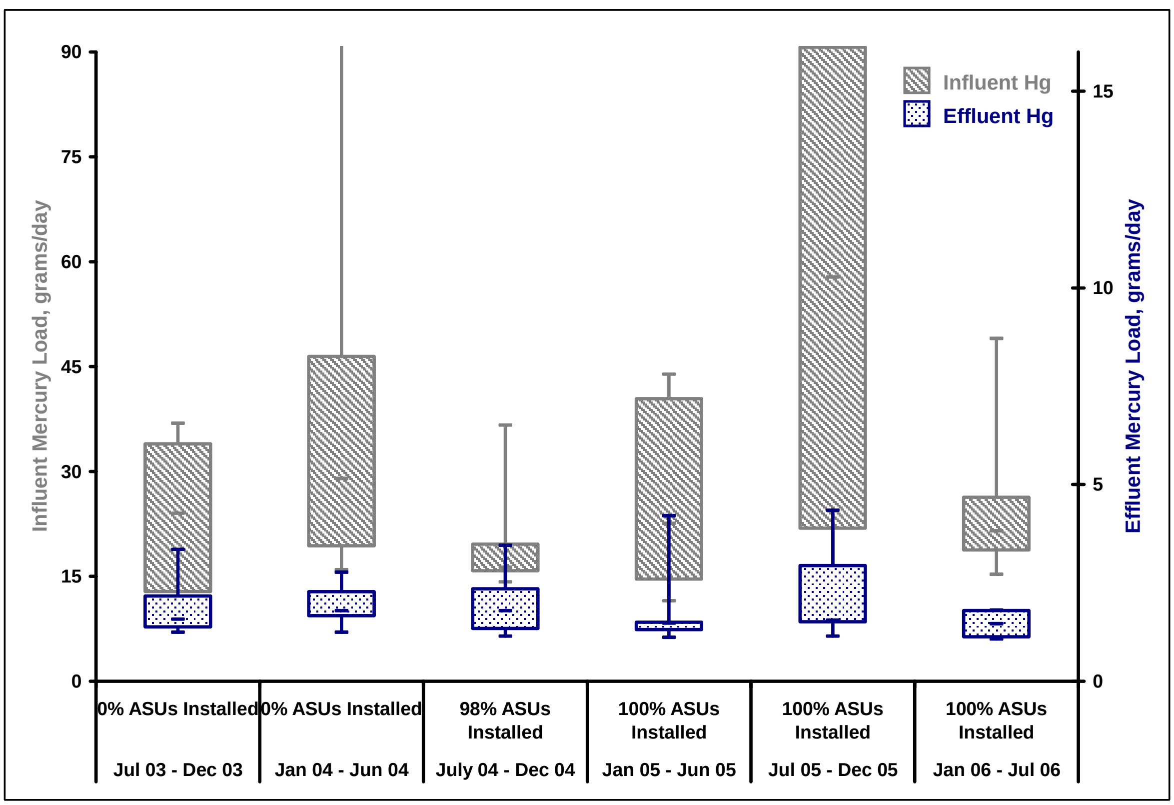

Figure 3.1C: Influent and Effluent Mercury Load at POTW "A"

3.2 POTW “B”

PLANT PROCESSES

The wastewater treatment at POTW “B” consists of preliminary, primary, and secondary treatment, including disinfection and phosphorus removal. The preliminary treatment consists of mechanical bar screens followed by grit removal in non-aerated detritus tanks. The grit is landfilled in an approved landfill. The primary treatment is made up of settling tanks where the surface scum is skimmed and the biosolids are settled out and pumped from the bottom. Ferric chloride or “pickle liquor” is added during primary treatment to aid in the removal of phosphorus. (POTW “B” began using ferric chloride exclusively in July 2005). The skimmings are incinerated in an on-site grease reactor. The scrubber water from the grease reactor is reintroduced into the treatment process immediately before the primary settling tanks. No biosolids processing occurs at POTW “B”; all biosolids are pumped via a force main to another facility for processing. Aeration basins and settling tanks make up the secondary treatment of the activated sludge process. POTW “B” produced 25,967 dry tons of biosolids in 2002. The final step in the treatment process at POTW “B” is chlorination by means of liquid sodium hypochlorite and dechlorination of the effluent with sodium bisulfite. The following treatment chemicals are utilized at POTW “B”:

- Sodium hydroxide is used for pH control;
- Sodium hypochlorite is used in the disinfection of the final effluent;
- Sodium bisulfite is used for removal of chlorine residual;
- Ferric chloride (or “pickle liquor” from local industry) is used in the reduction of phosphorus.

SAMPLE COLLECTION

Influent grab samples were obtained after the screening and degritting process. The sample location was prior to the recycle stream return, and the samples were collected using clean procedures. The effluent sample was a monthly grab sample that was collected after dechlorination, also using clean procedures. The sludge samples were collected prior to transfer of the sludge to another facility for further processing.

COLLECTION SYSTEM INFORMATION

POTW “B” is owned and operated by a regional utility that owns and operates two other POTWs. The average flow at POTW “B” is approximately 100 MGD; however, the plant has a design flow of 155 MGD and the capability to provide secondary treatment of up to 330 MGD during wet weather. POTW “B” serves a population of over 334,000 people. This POTW does not accept hauled-in wastes for treatment. The service area for POTW “B” is approximately 76 square miles. In the entire service area operated by the regional utility, there are 75 square miles of combined sewer service area and 280 square miles of separate sewer service area. Forty percent of the service area at POTW “B” is combined and sixty percent is separate. The major classifications of industrial users for the entire regional facility are provided in Table 3.2A.

Table 3.2A: TYPES OF SIUs IN POTW "Regional Utility" SERVICE AREA

Type of SIU	Number	Approximate Total Daily Flow, MGD
Industry Subject to Categorical Pretreatment Standards	137	5.63 MGD
Industrial Users Discharging>25,000 gpd of Process Wastewater	26	3.24 MGD
>5% of the organic load	0	0
>5% of the hydraulic load	0	0
Others Designated by Control Authority	20	0.15 MGD

Mercury Control Program

In 2002, a narrative local limit for mercury was developed and incorporated into the local sewer use code. This local limit requires industrial sources of mercury to implement best management practices (BMPs) to minimize discharges of mercury to the system. All significant industrial users were required to conduct mercury analysis to identify significant sources of mercury. Certain industrial users that were identified as significant sources of mercury, which include dental facilities, must submit and implement BMP plans for mercury discharge minimization.

Implementation of the mercury BMP Program for dental facilities began in April of 2002. This program required all facilities that provide dental care to design, submit, and implement BMP plans by December 31, 2002. Certain BMPs were mandated while others were recommended. The mandatory BMPs did not include installation of amalgam separators in dental clinics; however, some dental clinics have voluntarily installed amalgam separators. The regional utility's service area has 546 known dental facilities; 219 of them are in the POTW "B" service area. The amalgam separator status at this POTW is shown in Table 3.2B.

Table 3.2B: Amalgam Separator Status at POTW "B"

Date	Percent of Dental Facilities Operating Dental Amalgam Separators
July 1, 2003	5
January 1, 2004	6
July 1, 2004	7
January 1, 2005	8
July 1, 2005	9
January 1, 2006	9
July 1, 2006	9

Results

As indicated by Figures 3.2A and 3.2B, POTW "B" exhibited a slight decrease in median effluent total mercury concentrations. At the start of the study, the 6-month median effluent total mercury concentration was 3.21 ng/L but, by the culmination of the study, the 6-month median effluent total mercury concentration had decreased to 2.64 ng/L. The decrease in effluent mercury concentration, though, was not found to be statistically significant ($p > 0.10$). However, the biosolids mercury concentrations exhibited a statistically significant increase ($p < 0.05$) from July 2003 to July 2006. A study was conducted by the regional entity during the late summer and fall of 2005 to determine the cause of these elevated biosolids mercury concentrations. It was concluded that the elevated biosolids concentrations were the result of cleaning operations that took place from June 2003 through November 2005 in two large interceptor sewers. The removal of grit and debris from the interceptors during cleaning may have caused settled mercury and other heavy substances within the interceptors to be re-suspended and transported to POTW "B." Throughout the course of the study, the effluent TSS concentrations and effluent mercury loading remained relatively constant (Figure 3.2B and 3.2C). As shown in Figure 3.2C, the influent mercury loading was highly variable.

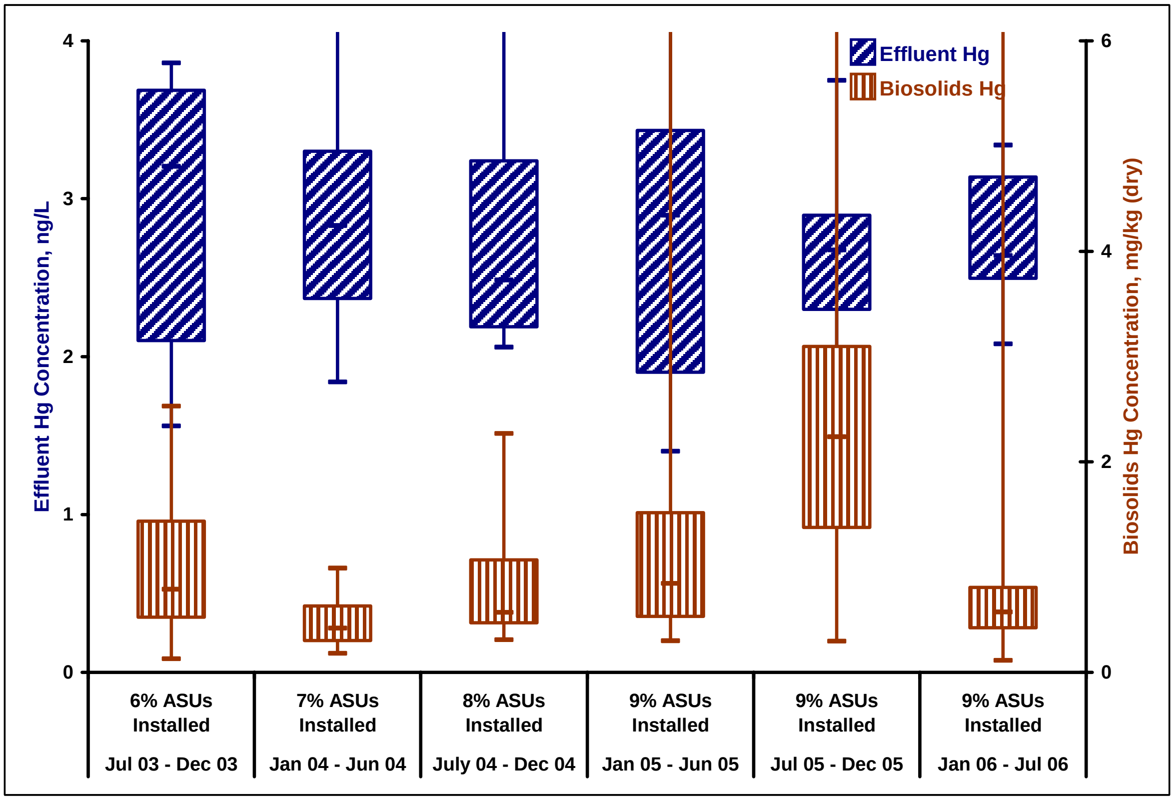

Figure 3.2A: Effluent and Biosolids Mercury Concentrations at POTW "B"

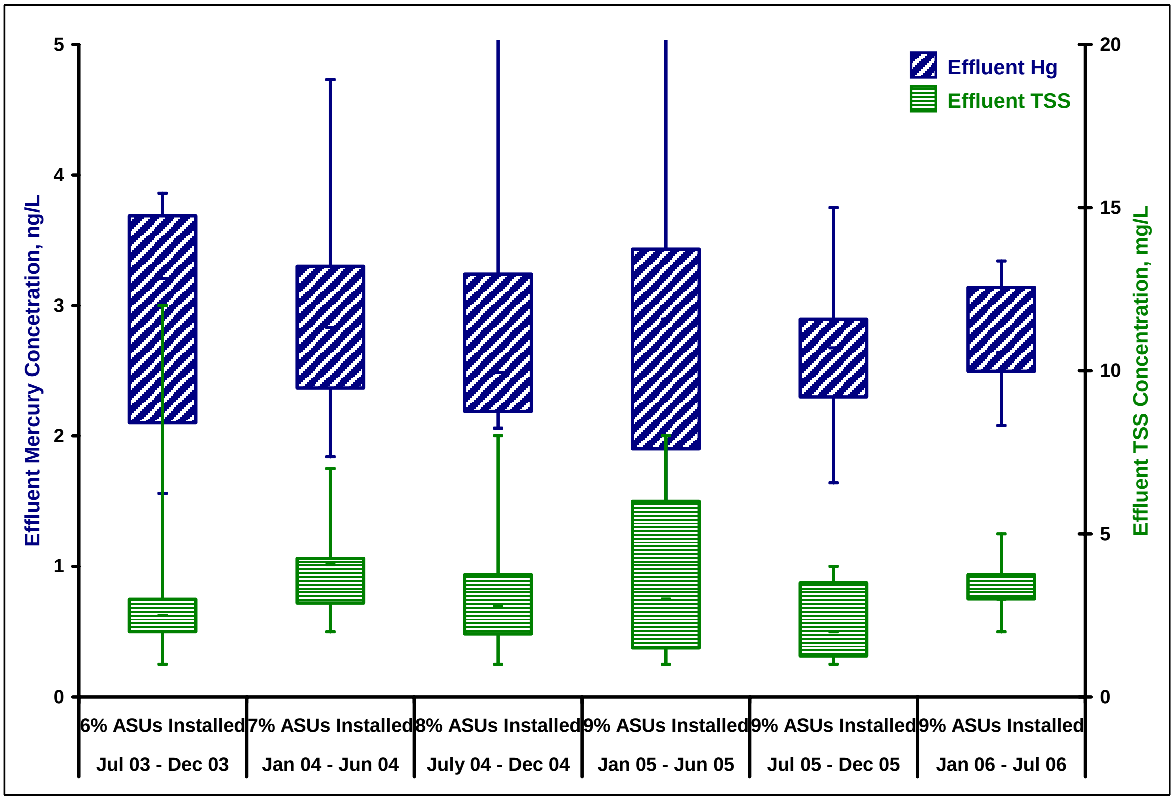

Figure 3.2B: Effluent Mercury and TSS Concentrations at POTW "B"

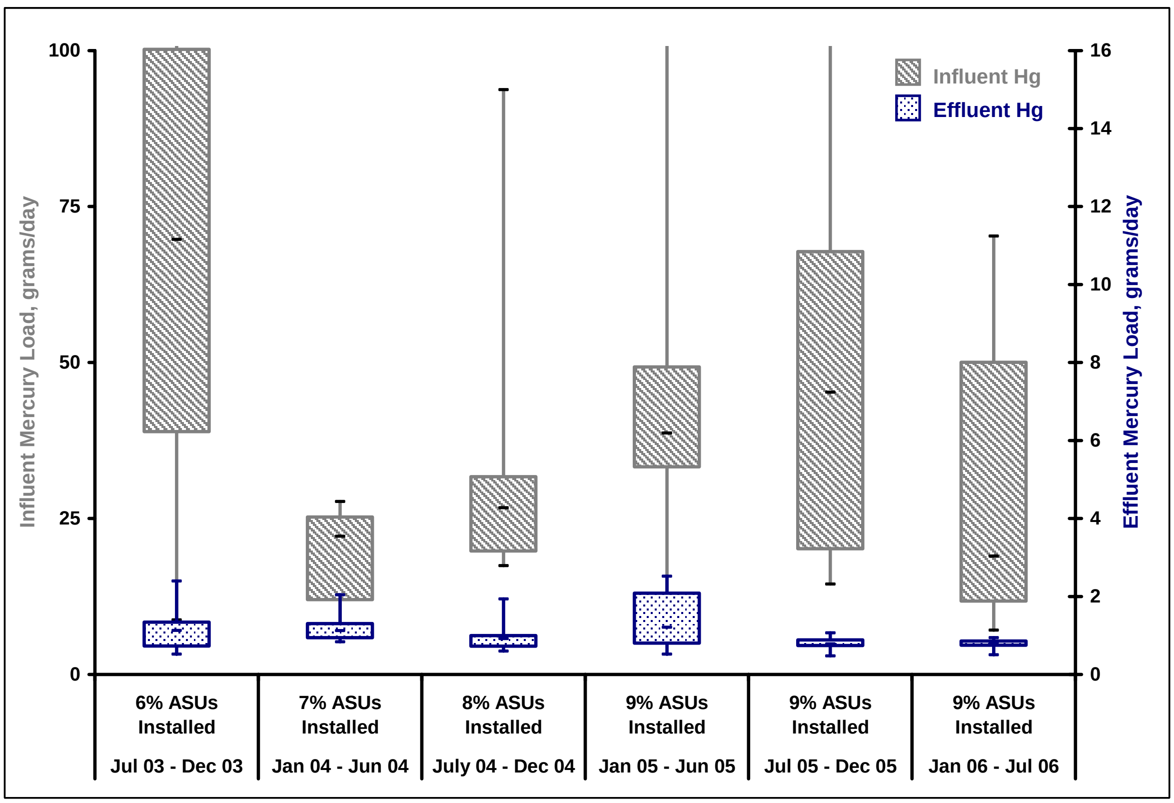

Figure 3.2C: Influent and Effluent Mercury Load at POTW "B"

3.3 POTW "C"

PLANT PROCESSES

POTW "C" uses a trickling filter/solids-contact biological process. The preliminary treatment consists of climber bar screens and aerated grit tanks. The grit is landfilled at an approved landfill. The primary treatment occurs in primary settling tanks. The skimmings generated are incinerated off-site. Secondary treatment consists of trickling filters, solids contact tanks, aeration, and final settling tanks. Biosolids are treated via gravity thickening and centrifugal dewatering with cationic polymer addition prior to onsite incineration. The resulting dry ash is transported to an approved landfill. The scrubber water from the incinerator is reintroduced into the plant's influent prior to the grit channels. This is followed by disinfection using sodium hypochlorite and dechlorination using sodium bisulfite. Hauled-in wastes are not accepted for treatment. The following treatment chemicals are utilized at POTW "C":

- Sodium hypochlorite is used in the disinfection of the final effluent;
- Sodium bisulfite is used for residual chlorine removal;
- Ferric chloride is used for phosphorus removal;
- Sodium hydroxide is used for pH control;
- Cationic polymer is used in dewatering.

SAMPLE COLLECTION

Influent grab samples were initially obtained from an influent diversion chamber before the flow actually reached the plant, and therefore, prior to grit removal. In early 2004, the influent sampling location was relocated to a location within the plant; however the sampling location remained prior to grit removal. This sampling location was also prior to recycle stream return. The influent samples were collected using clean procedures. The effluent grab samples were collected after chlorination, but prior to dechlorination, adhering to clean procedures. The sludge samples were collected from the sludge handling facility after the addition of polymer.

COLLECTION SYSTEM INFORMATION

POTW "C" is owned and operated by a regional utility that also owns and operates two other POTWs. POTW "C" has a design flow of 70 MGD and treats an average 26.3 MGD that includes wastewater from over 103,000 residents. The service area for POTW "C" is approximately 10 square miles. In the entire service area operated by the regional utility, there are 75 square miles of combined sewer service area and 280 square miles of separate sewer service area. Eighty-five percent of the service area at POTW "C" is combined and fifteen percent is separate. The major classifications of industrial users in the entire regional service area are identified in Table 3.3A.

Table 3.3A: Types of SIUs in POTW "Regional Utility" Service area

TYPE OF SIU	NUMBER	APPROXIMATE TOTAL DAILY FLOW, MGD
Industry Subject to Categorical Pretreatment Standards	137	5.63 MGD
Industrial Users Discharging>25,000 gpd of Process Wastewater	26	3.24 MGD
>5% of the organic load	0	0
>5% of the hydraulic load	0	0
Others Designated by Control Authority	20	0.15 MGD

MERCURY CONTROL PROGRAM

In 2002, a narrative local limit was developed and incorporated into the local sewer use code. This local limit requires industrial sources of mercury to implement best management practices (BMPs) to minimize discharges of mercury to the system. All significant industrial users were required to conduct mercury analysis to identify significant sources of mercury. Certain industrial users that were identified as significant sources of mercury, which include dental facilities, must submit and implement BMP plans for mercury discharge minimization.

Implementation of the mercury BMP Program began in April of 2002. This program required all facilities that provide dental care to design, submit, and implement BMP plans by December 31, 2002. Certain BMPs were mandated while others were recommended. These mandatory BMPs did not include installation of amalgam separators in dental clinics; however some dental clinics have voluntarily installed amalgam separators. The regional utility's service area has 546 known dental facilities; 18 of them are in the POTW "C" service area. Table 3.3B indicates the percent of the dental facilities that have installed amalgam separators.

Table 3.3B: Amalgam Separator Status at POTW "C"

DATE	PERCENT OF DENTAL FACILITIES OPERATING DENTAL AMALGAM SEPARATORS
July 1, 2003	6
January 1, 2004	6
July 1, 2004	6
January 1, 2005	6
July 1, 2005	6
January 1, 2006	6
July 1, 2006	6

RESULTS

Throughout the course of the study, there was no statistically significant trend ($p > 0.10$) found in the effluent mercury concentrations at POTW "C" (as shown in Figure 3.3A). The same was found for the biosolids mercury and effluent TSS concentrations (Figures 3.3A and 3.3B).

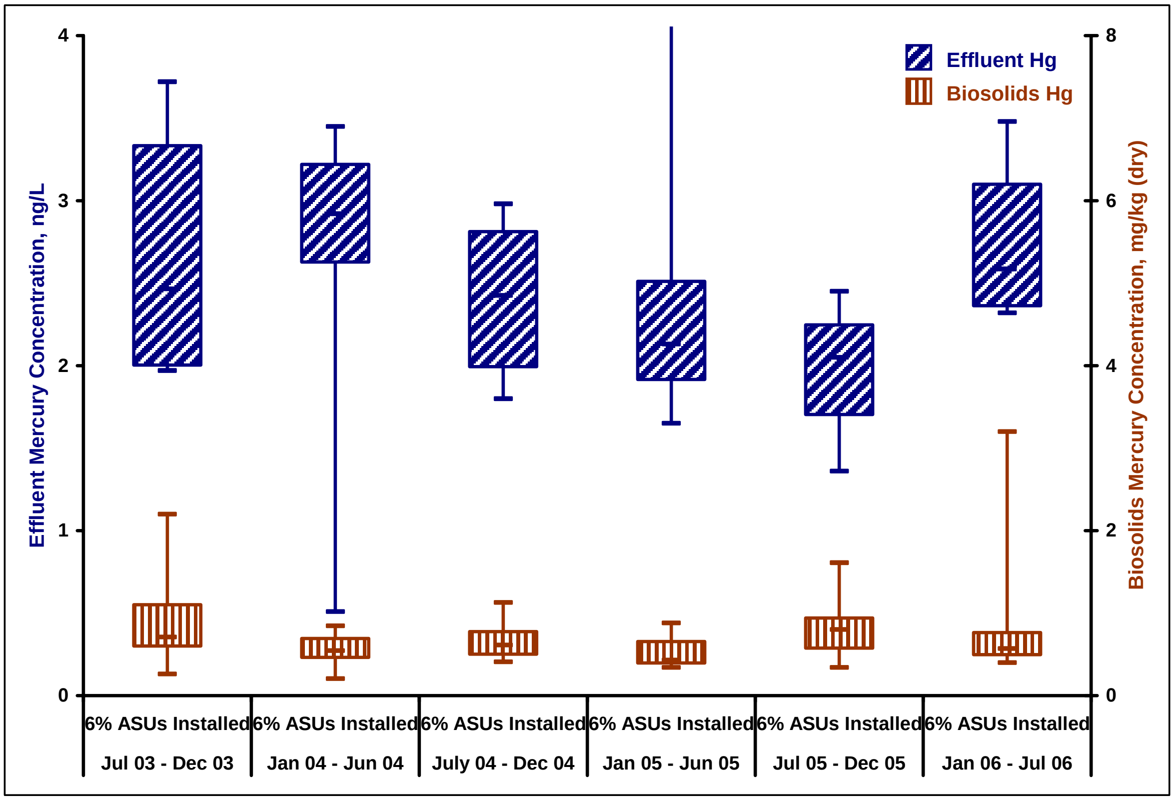

Figure 3.3A: Effluent and Biosolids Mercury Concentrations at POTW "C"

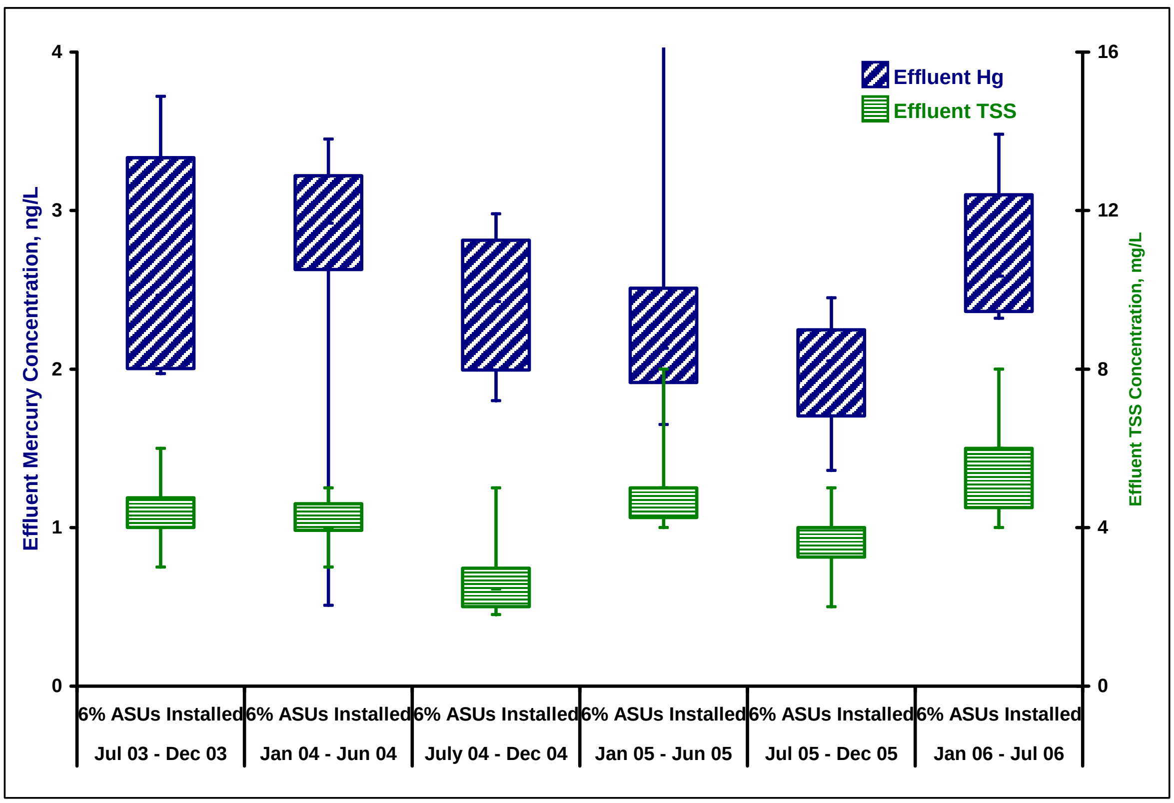

Figure 3.3B: Effluent Mercury and TSS Concentrations at POTW "C"

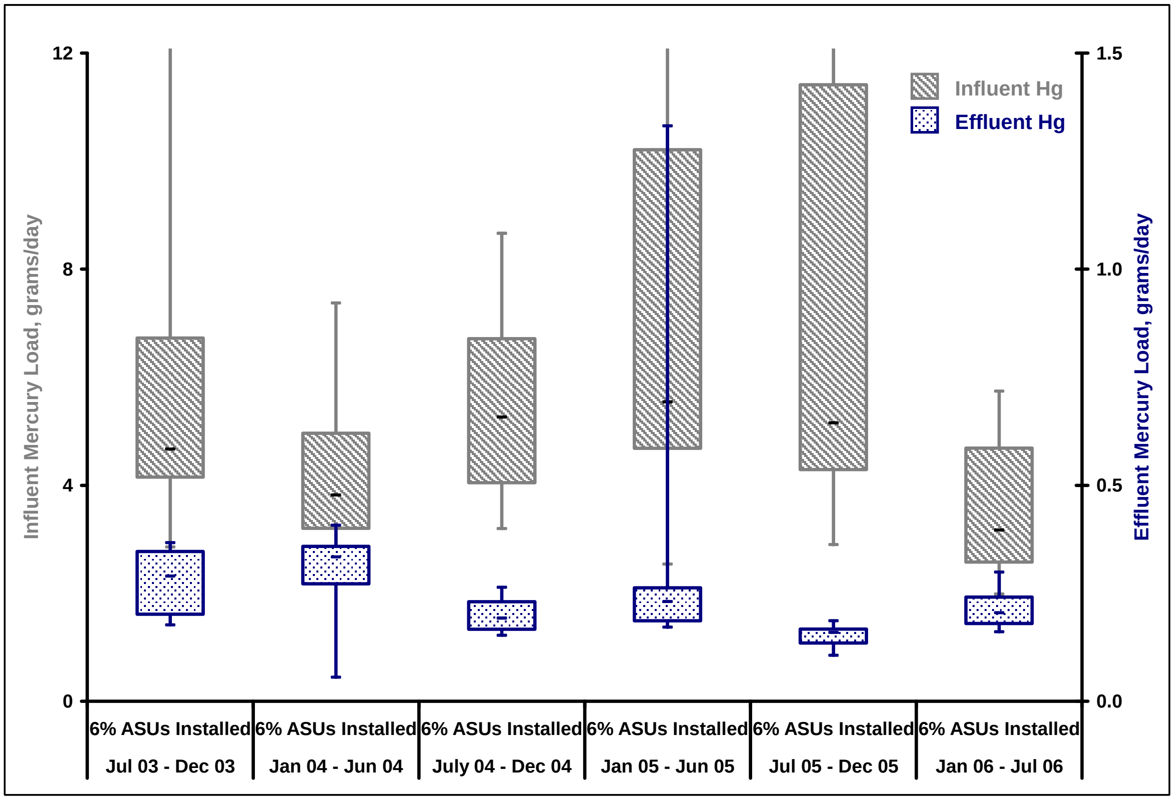

Figure 3.3C: Influent and Effluent Mercury Load at POTW "C"

3.4 POTWs "D" and E"

PLANT PROCESSES

POTWs "D" and "E" are operated by a regional agency. POTW "D" has a design flow of 300 MGD and an actual average flow of 90 MGD. POTW "E" has design and actual average flows of 390 and 83 MGD, respectively. These two POTWs are connected to each other in two ways. At several locations in the collection system, flows may be diverted to either plant. The plants are also directly connected by pipeline. This allows transfer of sewage, biosolids, or both. Hauled-in waste that includes leachate from a landfill and airplane de-icing fluid are accepted for treatment at POTW "D," however no hauled-in wastes are accepted at POTW "E."

The two plants provide traditional secondary treatment. Wastewater is subjected to coarse screening, grit removal, primary settling, aeration, secondary settling, and hypochlorite and bisulfite addition prior to being discharged to a freshwater environment. Iron salts are also added to aid in treatment at both facilities. For POTW "D," this occurs following grit removal, while for POTW "E," it takes place after primary settling.

Biosolids processing at POTW "D" consists of anaerobic digestion, gravity belt thickening, and occasional plate-and-frame dewatering. Processing of biosolids at POTW "E" involves gravity belt thickening followed by heat drying. In addition, a biosolids pipeline connects the two treatment plants. It may operate in either direction to maximize production of the preferred product. In most cases, biosolids flow from POTW "D" to "E." The following chemicals are used at the two treatment plants:

- Sodium hypochlorite is used for chlorination;
- Sodium bisulfite is used for dechlorination; and
- Ferric chloride is used for phosphorus removal.

SAMPLE COLLECTION

Flow-proportionate composite influent samples were collected prior to the coarse screens and grit removal. The effluent samples were collected as grab samples taken after chlorination and dechlorination. Biosolid samples collected for analysis were weekly composites of the final product.

COLLECTION SYSTEM INFORMATION

The collection system for POTWs "D" and "E" encompasses 420 square miles and serves a population of 1.2 million people in twenty-eight communities. The system for POTW "D" consists of only separated sewers, while that for POTW "E" is mostly combined sewers.

MERCURY CONTROL PROGRAM

An amalgam program has been established by the agency that operates POTWs "D" and "E" as part of a mercury minimization program. A rule was adopted in 2004 that requires best management practices (BMPs) and amalgam separators in dental facilities. BMPs were mandatory as of the date of adoption of the rule. A certification from all dental offices with amalgam was due in 2005. All facilities with amalgam must install amalgam separators by February 1, 2008. As shown in Table 3.4A, by the conclusion of the study in July 2006, approximately 38% of dental facilities in the total service area of POTWs "D" and "E" had done so. The number of dental facilities that have installed amalgam separators in the individual service areas is not known.

Table 3.4A: Amalgam Separator Status at POTWs "D" and "E"

DATE	PERCENT OF DENTAL FACILITIES OPERATING DENTAL AMALGAM SEPARATORS
July 1, 2003	0.6
January 1, 2004	1.5
July 1, 2004	6
January 1, 2005	16
July 1, 2005	26
January 1, 2006	32
July 1, 2006	38

RESULTS

At POTW "D," there was an apparent decrease, not found to be statistically significant ($p > 0.10$), in effluent mercury concentration over the course of the study. This is depicted in Figure 3.4A. However, the effluent mercury loading remained about the same throughout the study (Figure 3.4C). The biosolids mercury and effluent TSS concentrations also exhibited no changes during the study (Figures 3.4A and 3.4B).

Similar to POTW "D," the effluent mercury concentrations for POTW "E" also showed an apparent, but not statistically significant (p >0.10), decrease over the course of the study (Figure 3.4D). The 6-month median effluent concentration at the start of the study was 2.6 ng/L, compared to 1.8 ng/L at the end of the study. The biosolids mercury concentration and effluent loading showed no apparent trends at POTW "E" (Figures 3.4D and 3.4F). Contrary to POTW "D," though, the TSS appeared to increase throughout the study as seen in Figure 3.4E. It should be noted, however, that this apparent trend was not found to be statistically significant (p >0.10).

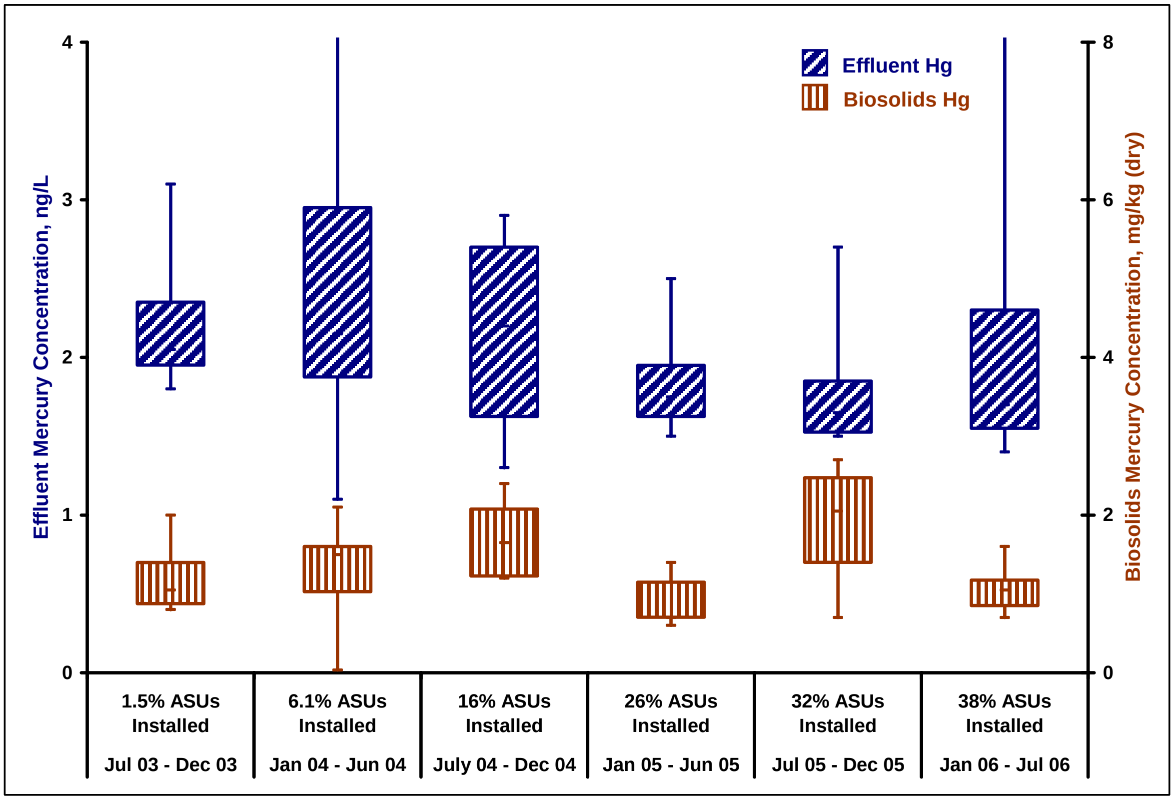

Figure 3.4A: Effluent and Biosolids Mercury Concentrations at POTW "D"

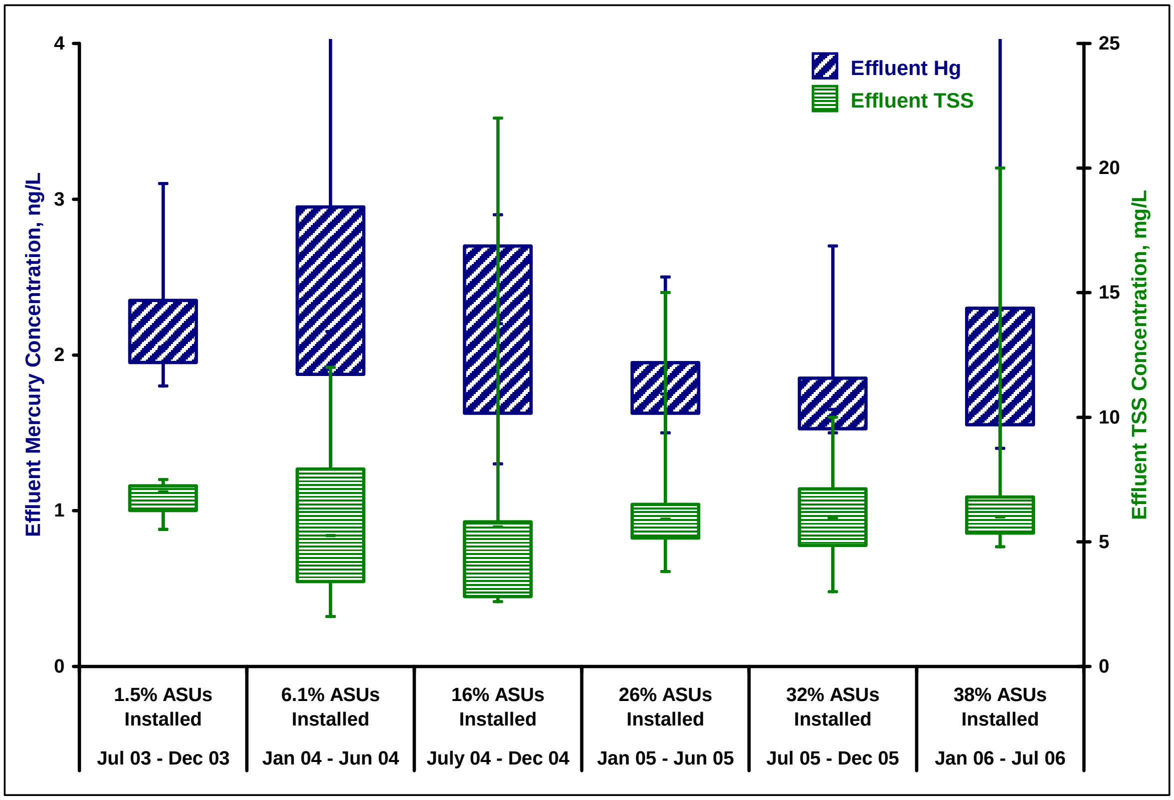

Figure 3.4B: Effluent Mercury and TSS Concentrations at POTW "D"

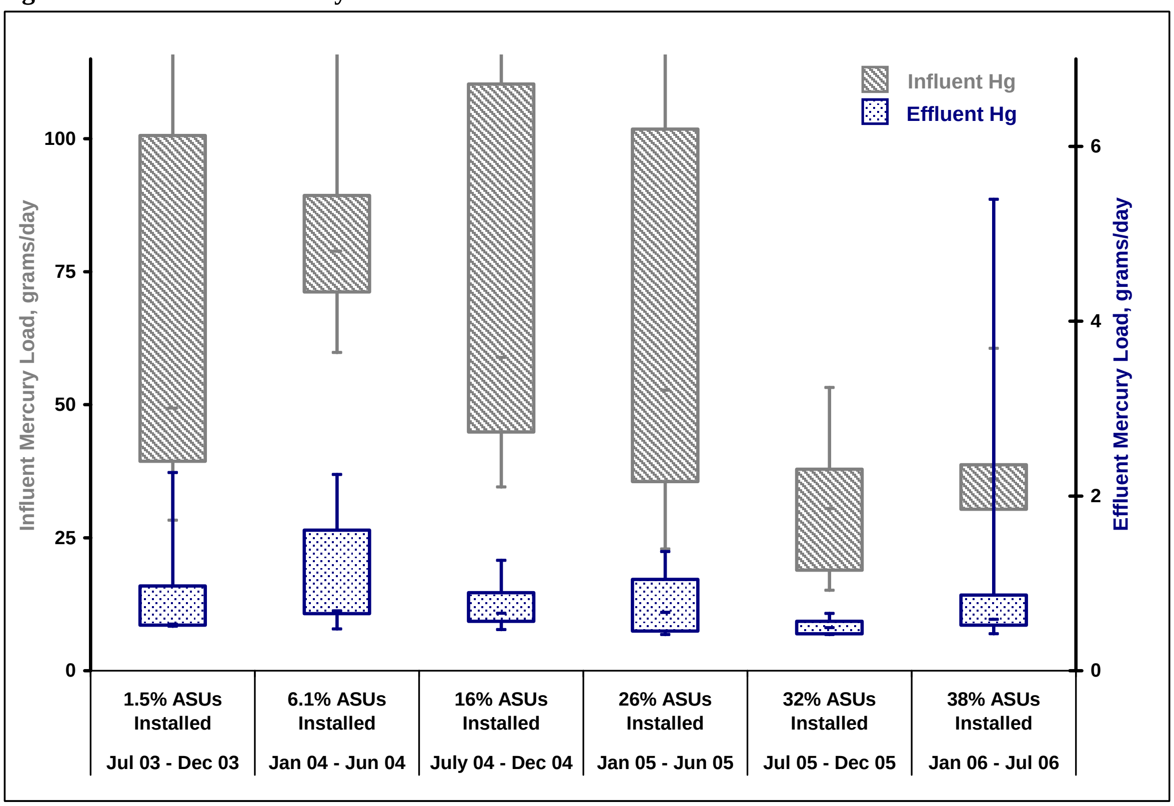

Figure 3.4C: Influent and Effluent Mercury Load at POTW "D"

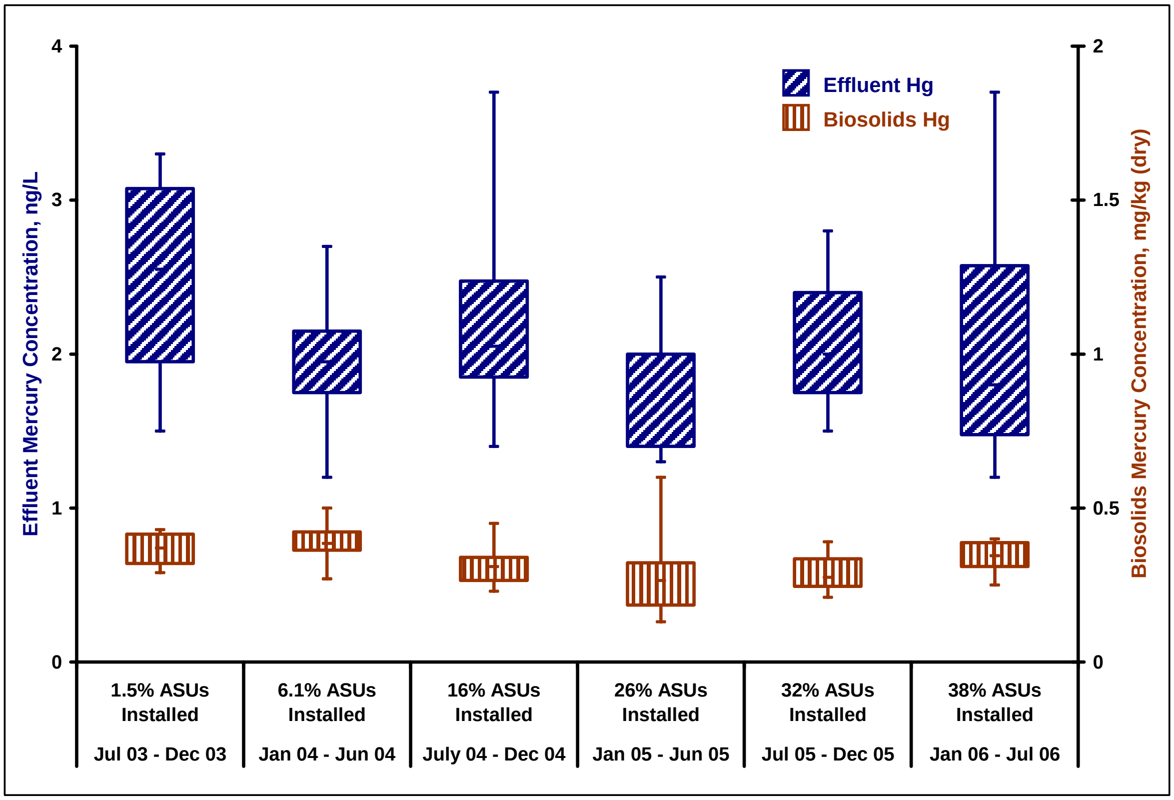

Figure 3.4D: Effluent and Biosolids Mercury Concentrations at POTW "E"

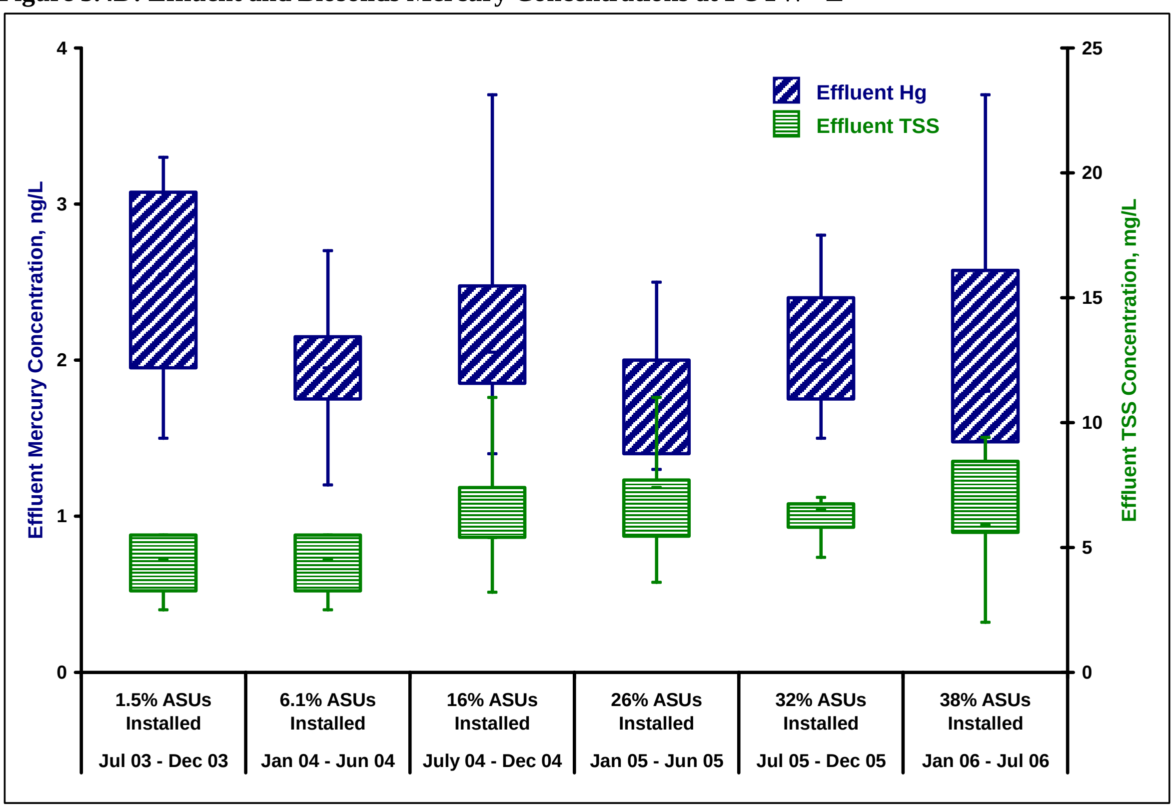

Figure 3.4E: Effluent Mercury and TSS Concentrations at POTW "E"

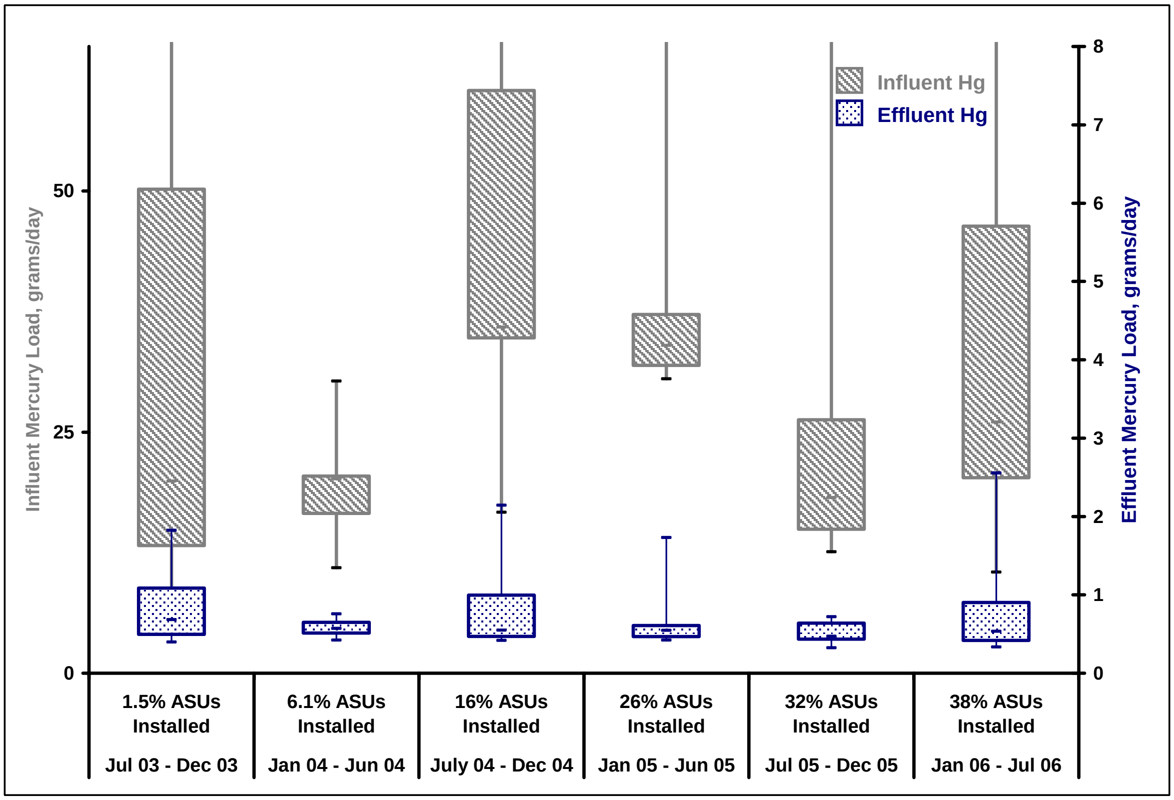

Figure 3.4F: Influent and Effluent Mercury Load at POTW "E"

3.5 POTW "F"

PLANT PROCESSES

Treatment at POTW "F" consists of solids removal, settling, aeration, clarification, sludge processing, and ultraviolet disinfection. Grit chambers are used to remove heavy solids. The grit is disposed of in a sanitary landfill. Primary and secondary treatment processes consist of primary settling, aeration, secondary nitrification, biological phosphorus removal, and final clarification. The effluent from the secondary treatment process is disinfected in ultraviolet light chambers. The primary sludge is treated in gravity sludge thickeners, and waste activated sludge is treated in dissolved air flotation thickeners. After thickening, the biosolids are digested in anaerobic digesters and thickened on a gravity belt thickener and then stored prior to hauling to local farm land for application as fertilizer. The following chemicals are used to aid in treatment processes at POTW "F":

- Ferric chloride for biosolids processing;
- Polymer for biosolids gravity belt thickening;
- Sodium hypochlorite to disinfect effluent for internal reuse.

SAMPLE COLLECTION

Composite influent samples were collected prior to grit removal, using four automatic samplers that contribute to a single daily composite sample, and analyzed for mercury one day per month. Effluent samples were collected as grab samples one day per month, adhering to clean sampling protocols. Grab samples of gravity belt thickened sludge were collected approximately four times per week. A monthly composite was prepared from these grab samples and analyzed for mercury.

COLLECTION SYSTEM INFORMATION

POTW "F" is a freshwater discharger that serves a population of more than 320,000. The service area occupies 176 square miles. This POTW treats approximately 40 million gallons of wastewater each day. The collection system is separate from the stormwater system. Over 130 pumping stations are required to pump wastewater to the POTW. The percentage of each type of flow entering the plant is shown in Table 3.5A.

Table 3.5A: Percentage of Flow at POTW "F"

	FLOW (MGD)	PERCENTAGE OF TOTAL
Residential	23.1	58.9
Commercial	11.3	28.7
Industrial	3.0	7.5
Infiltration	1.9	4.8

MERCURY CONTROL PROGRAM

Since 1997, POTW "F" has been voluntarily working to minimize mercury use in the community through outreach and education, focusing on dental facilities, hospitals, schools, and industry. Dental facilities within the service area have been encouraged to voluntarily install amalgam separators. The amalgam separator status at this POTW is shown in Table 3.5B.

Table 3.5B: Amalgam Separator Status at POTW "F"

DATE	PERCENT OF DENTAL FACILITIES OPERATING DENTAL AMALGAM SEPARATORS
July 1, 2003	0
January 1, 2004	0
July 1, 2004	0
January 1, 2005	0
July 1, 2005	2
January 1, 2006	12
July 1, 2006	20

RESULTS

POTW "F" joined the sampling project after the project had already started, and therefore results are not available for the first six-month period. The results from POTW "F" indicate relatively constant mercury concentrations in the effluent, but a statistically significant decrease ($p < 0.05$) in biosolids mercury concentrations as depicted in Figure 3.5A. The effluent TSS concentrations remained about the same throughout the study and can be seen in Figure 3.5B. The influent and effluent loadings are shown in Figure 3.5C. Amalgam separators may be a factor in the decrease seen in the biosolids mercury concentrations; at the start of the study there were no separators installed within POTW "F's" service area, but by the conclusion of the study, 20% of dental facilities had installed amalgam separators.

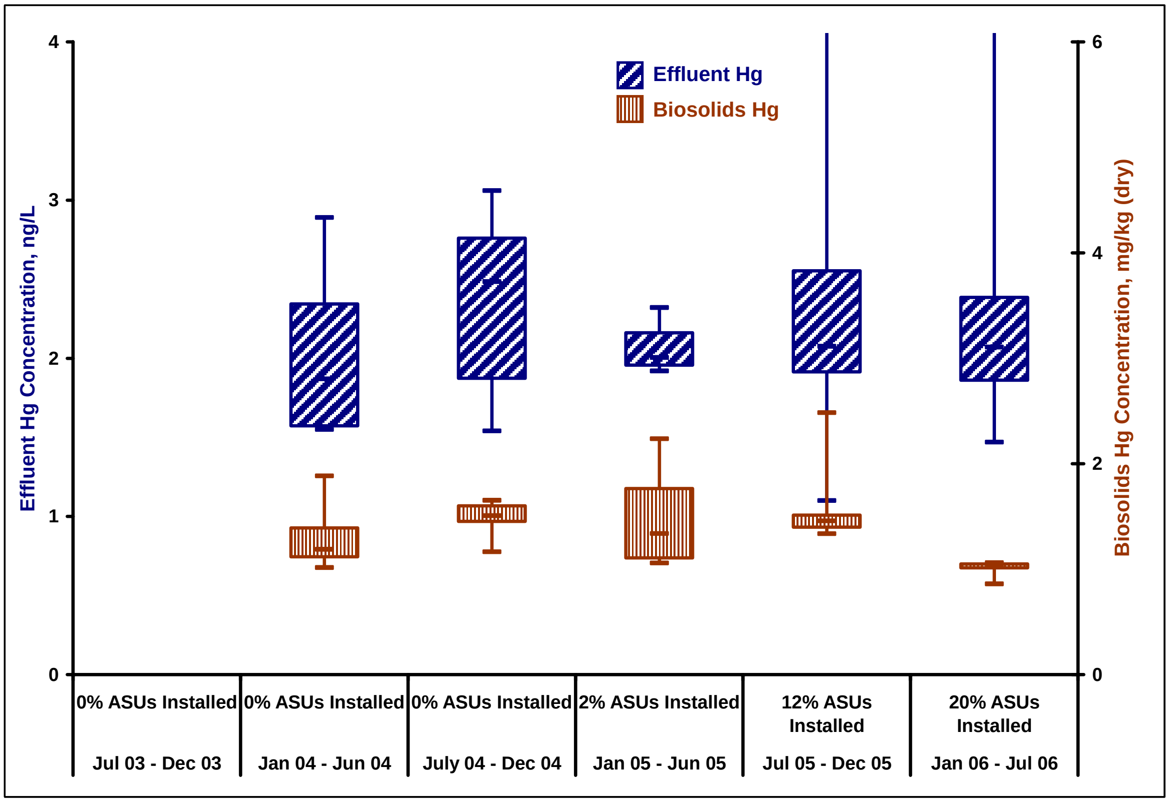

Figure 3.5A: Effluent and Biosolids Mercury Concentrations at POTW "F"

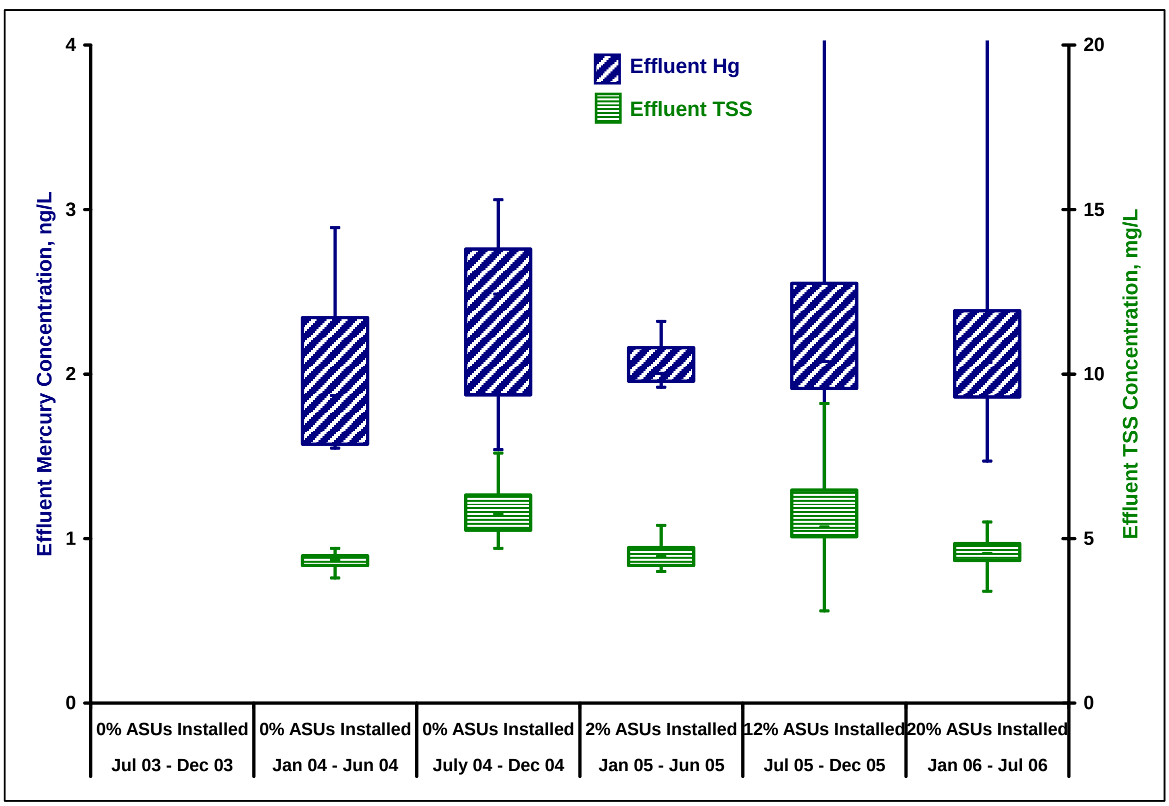

Figure 3.5B: Effluent Mercury and TSS Concentrations at POTW "F"

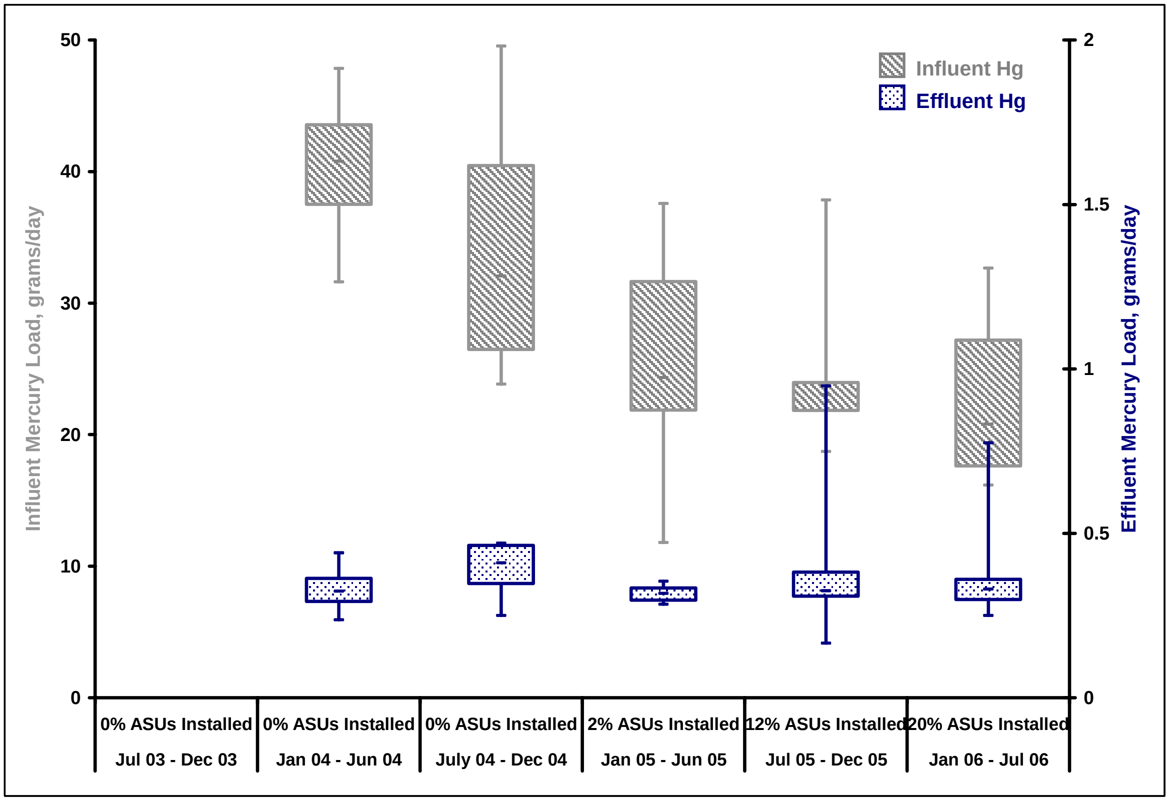

Figure 3.5C: Influent and Effluent Mercury Load at POTW "F"

3.6 POTW "G"

Plant Processes

POTW "G" has a design flow of 48.4 MGD, with an actual average flow of 38.2 MGD. Treatment consists of preliminary, secondary, and tertiary processes. Hauled-in wastes are accepted at the plant. Preliminary treatment at POTW "G" includes bar screens followed by two detritor-type grit tanks. Due to the significant industrial flow, primary treatment is not necessary. Secondary treatment includes biological treatment using high-purity oxygen-activated sludge aeration tanks and secondary clarifiers. This is followed by flocculation tanks and dual media filters. Secondary sludge is thickened using dissolved air flotation thickeners followed by thermophilic and mesophilic anaerobic digesters. Digested sludge tanks hold the digested sludge until it is dewatered for land application by one of two centrifuges. The following treatment chemicals are utilized at POTW "G":

- Polymer is used in sludge treatment;
- Ferric Chloride is used for nutrient removal;
- Anti-foam solution is used when needed.

Sample Collection

Influent samples were collected prior to screening and grit removal and composited every 15 minutes over 24 hours using an automatic sampler. Effluent grab samples were collected twice per month at a sampling location following all plant processes. Biosolids samples were collected after the digested sludge was dewatered by compositing three grab samples in a 24-hour period.

COLLECTION SYSTEM INFORMATION

The population served by POTW "G" is 110,000. The service area for POTW "G" is approximately 80 square miles and is served by a completely separate collection system. Approximately 7 percent of the influent flow can be attributed to infiltration and inflow and 52 percent of the influent at POTW "G" is attributed to industrial flow. The major classifications of industrial users in the POTW "G" service area are provided in Table 3.6A.

Table 3.6A: Types of SIUs in POTW "G" Service Area

TYPE OF SIU	NUMBER	APPROXIMATE TOTAL DAILY FLOW, GPD
Pulp & Paper	2	18,820,000
Metal Finishing	3	4100
Organic Chemical	1	3900
Other	11	1,010,000

MERCURY CONTROL PROGRAM

POTW "G" has worked with local and state dental associations and the American Dental Association (ADA) to develop best management practices for waste management for the 100 dentists in the service area, which included the voluntary installation of amalgam separators. A majority of the amalgam separator installations were funded either directly by POTW "G" or by a grant received by POTW "G" and the local dental society prior to the start of the NACWA Mercury Sampling Project. Waste amalgam disposal infrastructure is also offered through a small business/household hazardous waste program. Broad outreach programs to the general public, dentists, colleges, and high schools have been conducted. These have included fever thermometer and high school and college laboratory mercury exchanges. The amalgam separator status at this POTW is shown in Table 3.6B.

Table 3.6B: Amalgam Separator Status at POTW "G"

DATE	PERCENT OF DENTISTS OPERATING DENTAL AMALGAM SEPARATORS
July 1, 2003	44
January 1, 2004	86
July 1, 2004	94
January 1, 2005	98
July 1, 2005	100
January 1, 2006	100
July 1, 2006	100

RESULTS

At the start of the study, POTW "G" had a relatively high percentage of dentists with amalgam separators installed and low mercury concentrations in the effluent and biosolids. There were no statistically significant changes ($p > 0.10$) in these mercury concentrations or in effluent TSS concentrations over the course of the study, as depicted in Figures 3.6A and 3.6B, respectively. The influent and effluent loadings at POTW "G" are shown in Figure 3.6C.

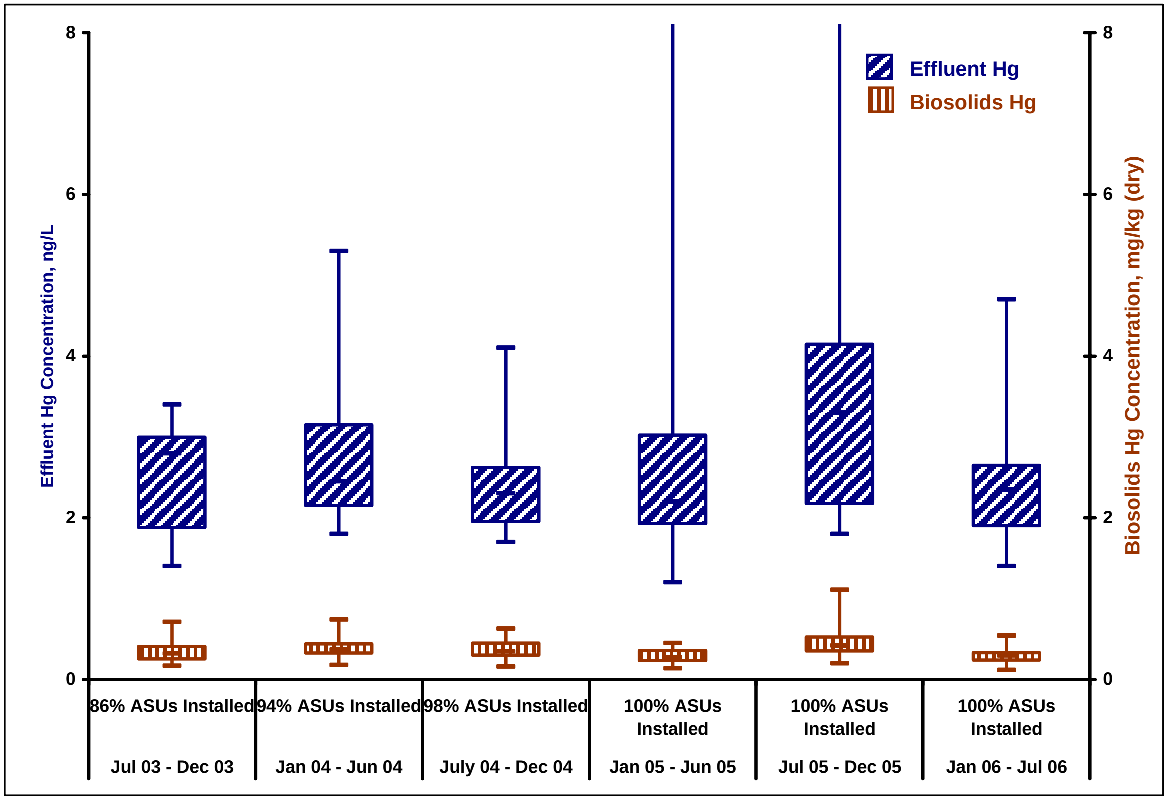

Figure 3.6A: Effluent and Biosolids Mercury Concentrations at POTW "G"

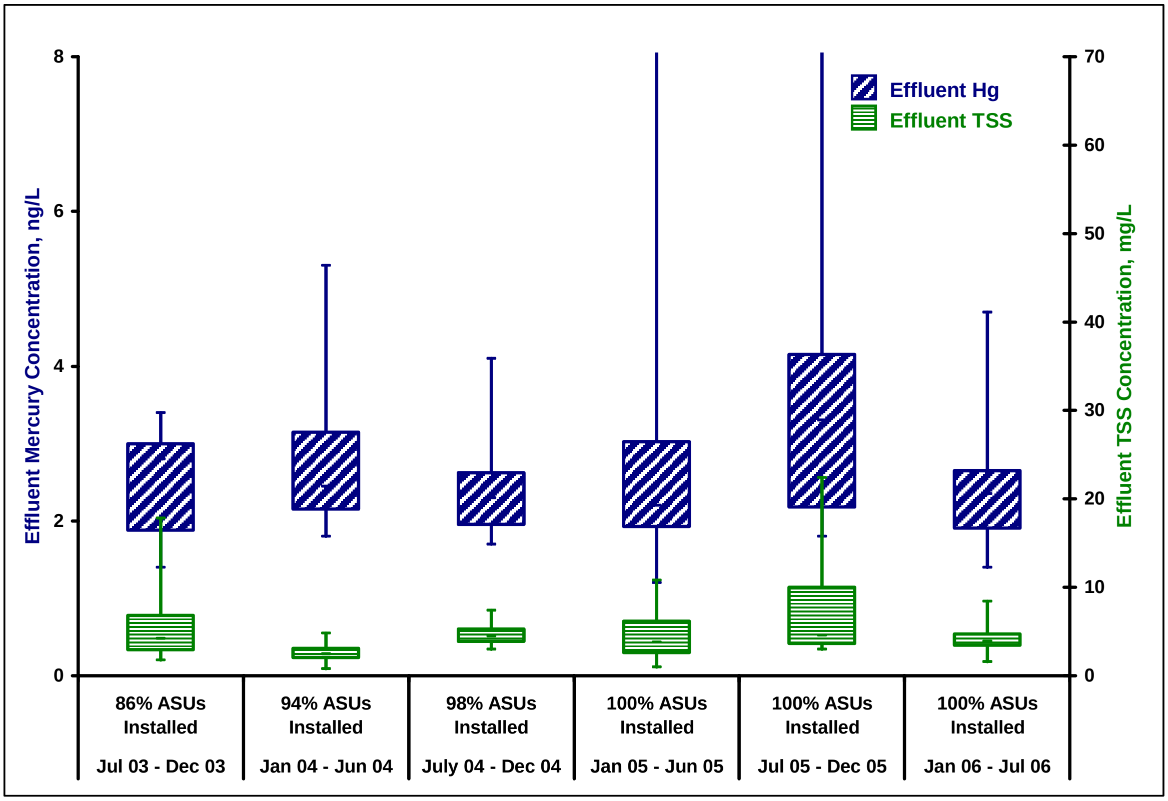

Figure 3.6B: Effluent Mercury and TSS Concentrations at POTW "G"

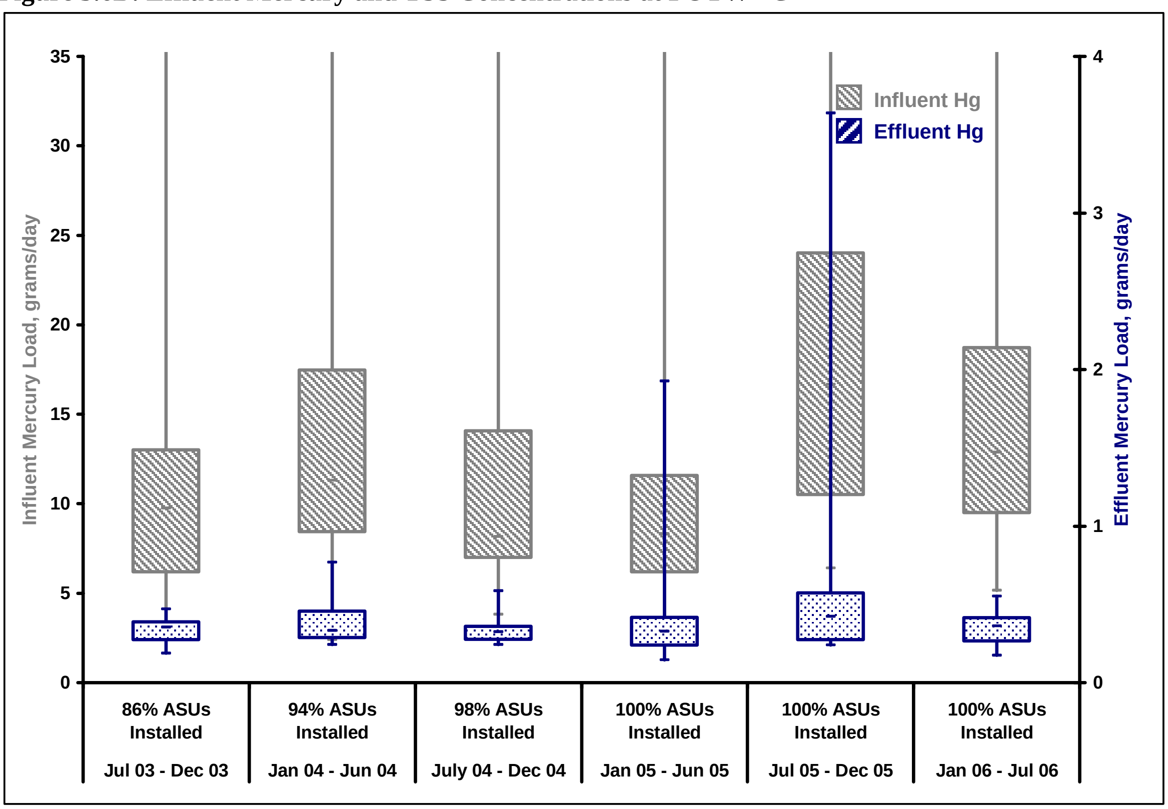

Figure 3.6C: Influent and Effluent Mercury Load at POTW "G"

3.7 POTW "H"

PLANT PROCESSES

POTW "H" is one of four POTWs operated by a large regional agency. The plant has a design flow of 54.4 MGD, but an actual average flow of approximately 35 MGD. Hauled-in wastes are accepted for treatment at the plant, with 90% of the hauled waste being domestic sewage. POTW "H" consists of two separate influent streams that combine at secondary treatment. The wastewater treatment at POTW "H" consists of preliminary, primary, secondary and advanced wastewater treatment, including disinfection prior to discharge. Preliminary treatment consists of trash removal at bar screens, followed by cyclone grit removal at the headworks. From the grit chamber, wastewater passes into primary clarifiers, where gravity settling separates the solid materials from the water. The primary sludge is screened and pumped to a dissolved air floatation thickener, where it is blended and then pumped into anaerobic digesters. Digested biosolids are then pumped to belt filter presses where polymer is added and excess water is pressed out. The dewatered biosolids are then trucked to a storage facility where they are stored prior to being applied to agricultural land as a soil supplement. Secondary treatment is completed using trickling filters followed by clarifiers. Solids from the secondary clarifiers are returned to the beginning of the treatment process. The secondary effluent is then pumped to activated sludge basins. Following final clarification, the treated wastewater is disinfected using ultraviolet light disinfection. Treated effluent from POTW "H" is discharged to a river. The following treatment chemicals are utilized at POTW "H":

- Ferrous sulfate is used for odor control; and
- Polymer is used for sludge thickening.

SAMPLE COLLECTION

Influent samples were collected and flow-composited at the wet-well at the headworks of each influent stream, prior to grit removal. Effluent samples were collected and time-composited after the oxychargers prior to discharging to the river. Biosolids were collected after the belt filter press prior to being trucked to the biosolids storage facility.

COLLECTION SYSTEM INFORMATION

The population served by the POTW is 350,000, encompassing a service area of 165 square miles. The sanitary sewer system for the entire service area is completely separate from the storm drain system. Approximately 10% of the total flow to POTW "H" is from industrial dischargers. The major classifications of industrial users in the POTW "H" service area are provided in Table 3.7A.

Table 3.7A: Types of SIUs in POTW "H" Service Area

TYPE OF SIU	NUMBER	APPROXIMATE TOTAL DAILY FLOW, GPD
Electroplaters	6	225,000
Metal Finishers	32	5,629,300
Centralized Waste Treatment	2	25,000
Transportation Equipment and Cleaning	1	8,000
Petroleum Refining	1	102,000

MERCURY CONTROL PROGRAM

In 2000, a mercury code of management practices program was implemented by POTW "H." This is a voluntary program designed to decrease mercury levels entering the POTW through cooperation with mercury dischargers. Among other actions, the program phased in guidelines for the 200 dentists in the service area to comply, in Phase 1, by installing treatment systems to remove at least 50% of the mercury discharged from their facilities. In Phase 2, which began in 2002, dental offices installed ISO-certified amalgam separators for which removal efficiencies of at least 95% had been indicated. The dentists are also required to perform annual wastewater monitoring and periodically submit compliance documentation. Approximately 98% of the dentists in the service area have complied with the program by installing amalgam separators, particle traps or other technologies. Inspections and maintenance of the dental offices were not mandated, resulting in POTW staff periodically conducting non-regulatory inspections. Annual submittal of self-monitoring reports was requested by the POTW. These reports included pre- and post-treatment mercury analyses and best management practices performed by the dental office. The amalgam separator status at this POTW is shown in Table 3.7B.

Table 3.7B: Amalgam Separator Status at POTW "H"

DATE	PERCENT OF DENTISTS OPERATING DENTAL AMALGAM SEPARATORS
July 1, 2003	unknown
January 1, 2004	60
July 1, 2004	89
January 1, 2005	95
July 1, 2005	95
January 1, 2006	98
July 1, 2006	98

RESULTS

There was no apparent trend in either the effluent mercury or TSS concentrations at POTW "H" during the course of the study, as depicted in both Figures 3.7A and 3.7B. There was, however, a statistically significant increase ($p < 0.05$) in biosolids mercury concentrations as shown in Figure 3.7A. The influent and effluent mercury loadings are shown in Figure 3.7C. In mid-2005, the POTW lost key staff members who had been responsible for the mercury source control program. This resulted in limited staff and resources available to oversee the dental office program. The absence of POTW staff reviewing the program performance resulted in several of the dental offices failing to maintain their amalgam separators, potentially increasing the mercury loadings. Also, between June 2005 and April 2006, POTW "H" underwent a construction upgrade that resulted in combining the two influent streams into one. This major construction project resulted in changing the entire primary treatment phase, and relocating influent transmission lines. This construction activity may have resulted in resuspension of mercury particles that may have been residing in various stages of the treatment plant, thereby potentially contributing to the increase in biosolids mercury concentrations.

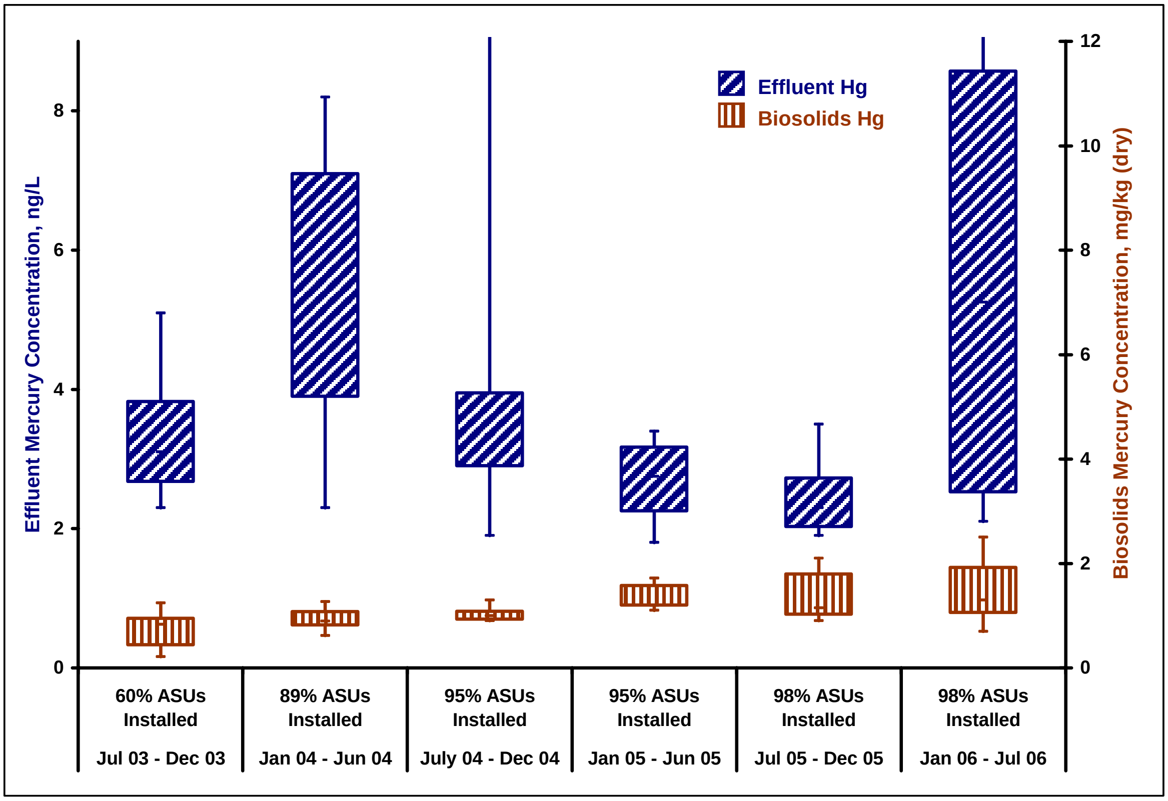

Figure 3.7A: Effluent and Biosolids Mercury Concentrations at POTW "H"

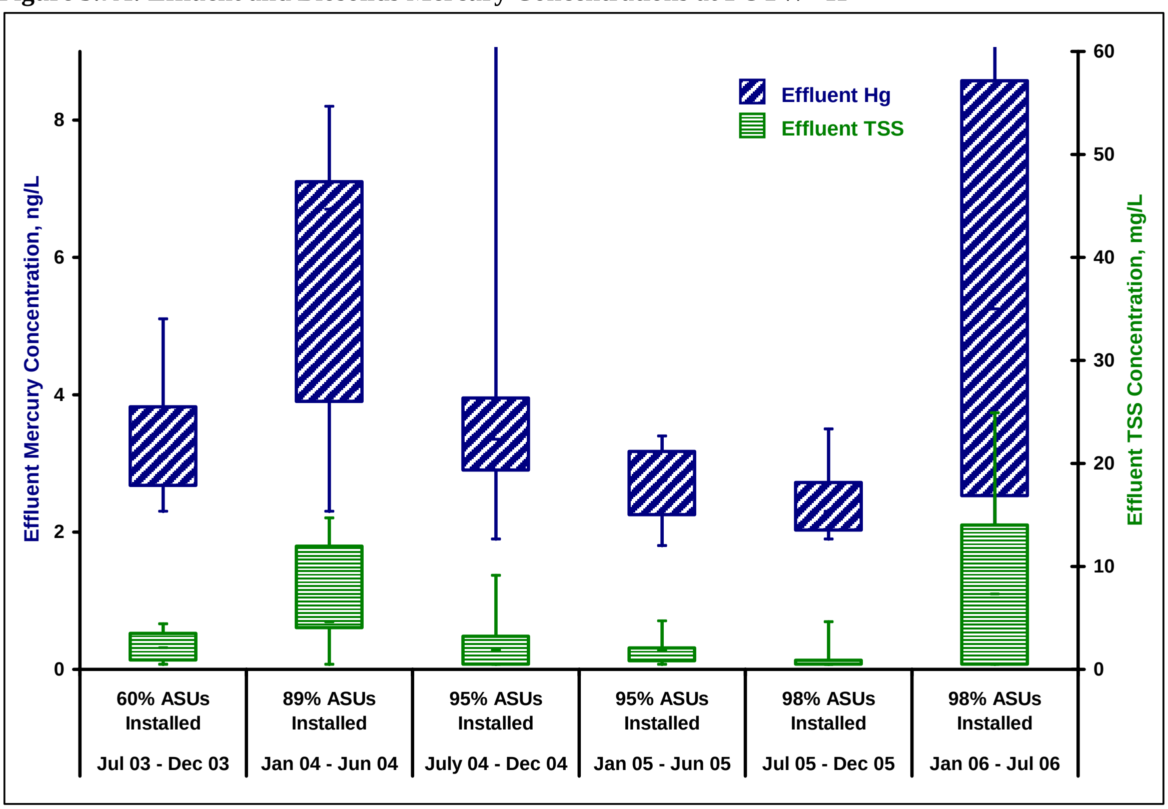

Figure 3.7B: Effluent Mercury and TSS Concentrations at POTW "H"

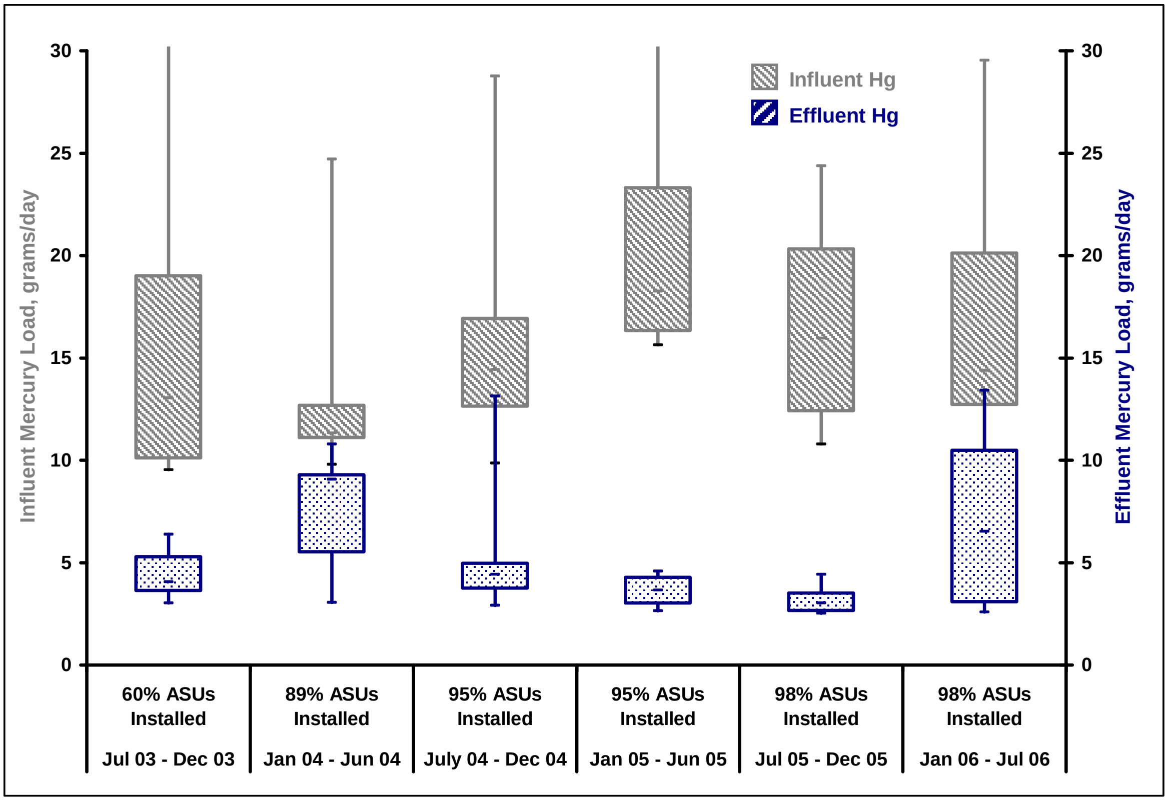

Figure 3.7C: Influent and Effluent Mercury Load at POTW "H"

3.8 POTW "I"

PLANT PROCESSES

POTW "I" treats an average of 2.38 MGD but is designed for 4.79 MGD. No hauled-in waste is accepted at the treatment plant. POTW "I" is an activated sludge secondary treatment plant. The grit is removed at gravity grit removal stations located in the trunk sewers and hauled to a sanitary landfill. At the headworks of the plant, the sewage is screened through six-millimeter traveling screens. The liquid is then processed in primary clarifiers, secondary aeration tanks, and finally, in secondary clarifiers. Solids are removed from both clarifiers. The secondary sludge is thickened in a gravity belt thickener and added to the primary sludge. The combined sludge is then de-watered in a rotary press, pasteurized and stabilized with heat and lime in an RDP thermo-blender. Lime-stabilized, non-heat treated sludge is also produced for use in composting. The sludge produced during the three-year study period was applied to farmland, used for top cover at the sanitary landfill, composted or buried. The landfilled material is usually de-watered sludge that has not been treated with lime or heat. The following treatment chemicals are utilized at POTW "I":

- Bioxide is used for odor control;
- Polymer (Hydrofloc 1620) is used for thickening; and
- Lime is used for pasteurization and stabilization.

SAMPLE COLLECTION

Influent samples were collected from the combined influent line after the trunk sewer grit removal stations, but before six-millimeter traveling screens. Effluent samples were collected upstream of a Parshall Flume on the plant's final effluent, which is discharged to the environment through a marine outfall. The lime-stabilized sludge samples were composites comprised of daily grabs from the sludge bin collected over a 3-4 week period.

COLLECTION SYSTEM INFORMATION

POTW "I" serves a population of approximately 30,000 people and covers approximately 12 square miles. The entire service area is comprised of separate sanitary sewers. Approximately 4% of daily flow to POTW "I" is from industrial users.

MERCURY CONTROL PROGRAM

There are 15 dental clinics that handle mercury amalgam and discharge wastewater to the sewer located within the service area for POTW "I." These account for approximately 50% of the total mercury load to the POTW, based on estimates made in a 1997 study. Eleven regulatory codes of practice have been developed and implemented within the service area since 1999, including codes for dental offices and laboratories. The dental code of practice (mandating separator installation) became effective throughout the service area in July 2001. All but one of the dental facilities in the collection area had amalgam separators installed throughout the study period. There have been no significant industrial mercury sources identified in the collection area.

RESULTS

POTW "I" had amalgam separators installed for 93% of the dental facilities at the start of the study. The effluent mercury and TSS concentrations indicated no apparent trends throughout the study, as shown in both Figures 3.8A and 3.8B. The influent and effluent loadings for POTW "I" are depicted in Figure 3.8C. The biosolids mercury concentration exhibited a statistically significant decrease ($p < 0.05$) throughout the study. At the start of the study, the 6-month median biosolids mercury concentration was 1.0 mg/kg, but had decreased to 0.1 mg/kg by the end of the study. These results indicate that the use of amalgam separators may have more of an effect in reducing the amount of mercury that ends up in the biosolids as opposed to the effluent. The data also indicate that mercury reductions following separator installation may take several years, as the dental facilities had installed separators two years before the start of the study.

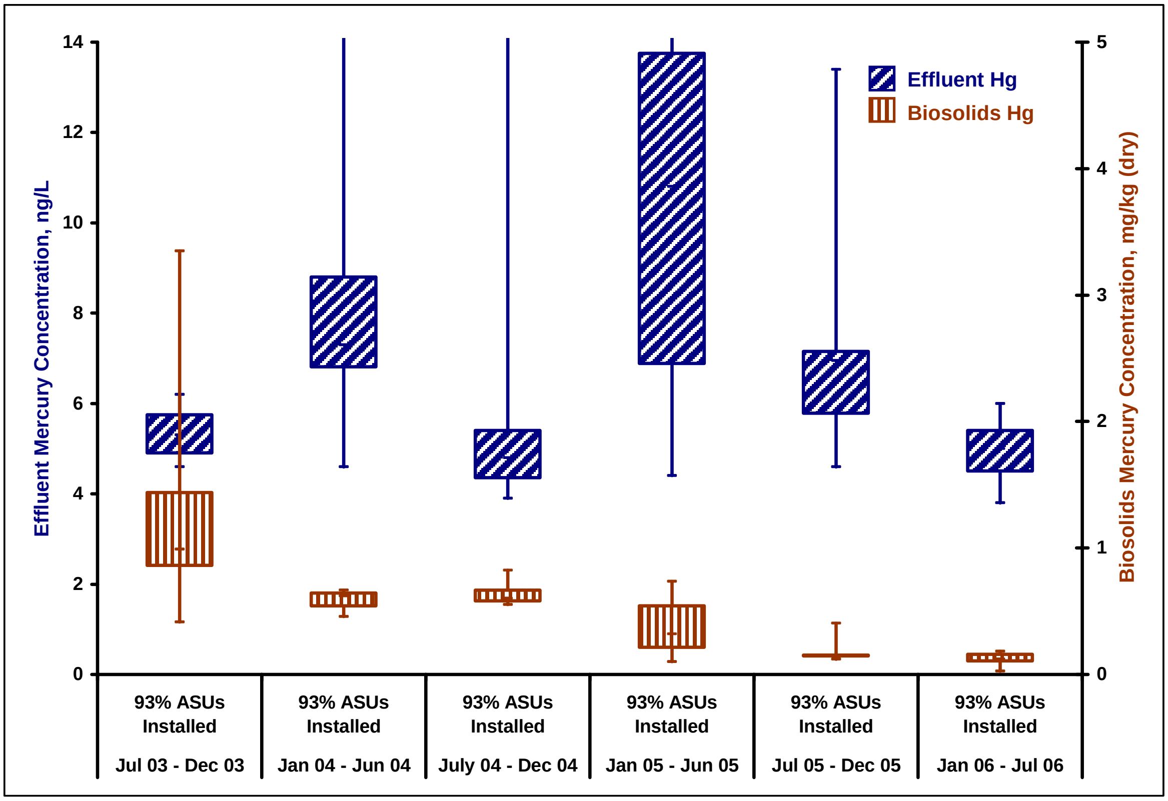

Figure 3.8A: Effluent and Biosolids Mercury Concentrations at POTW "I"

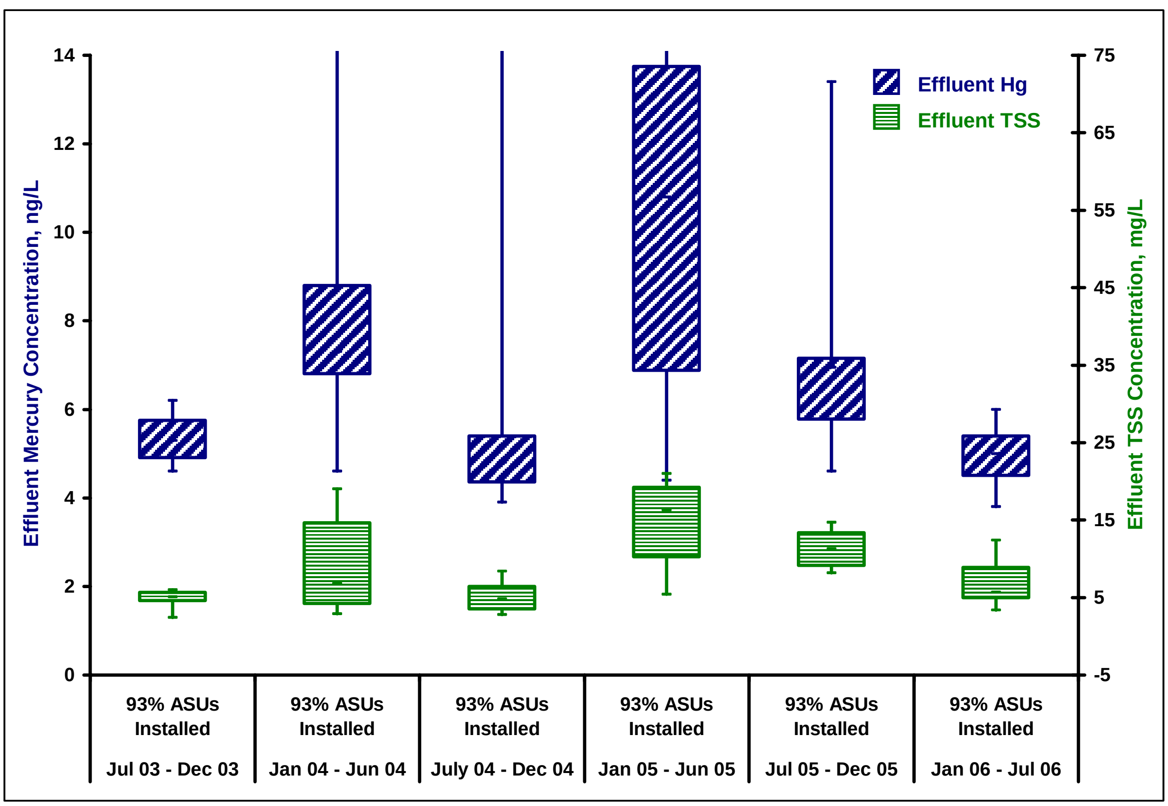

Figure 3.8B: Effluent Mercury and TSS Concentrations at POTW "I"

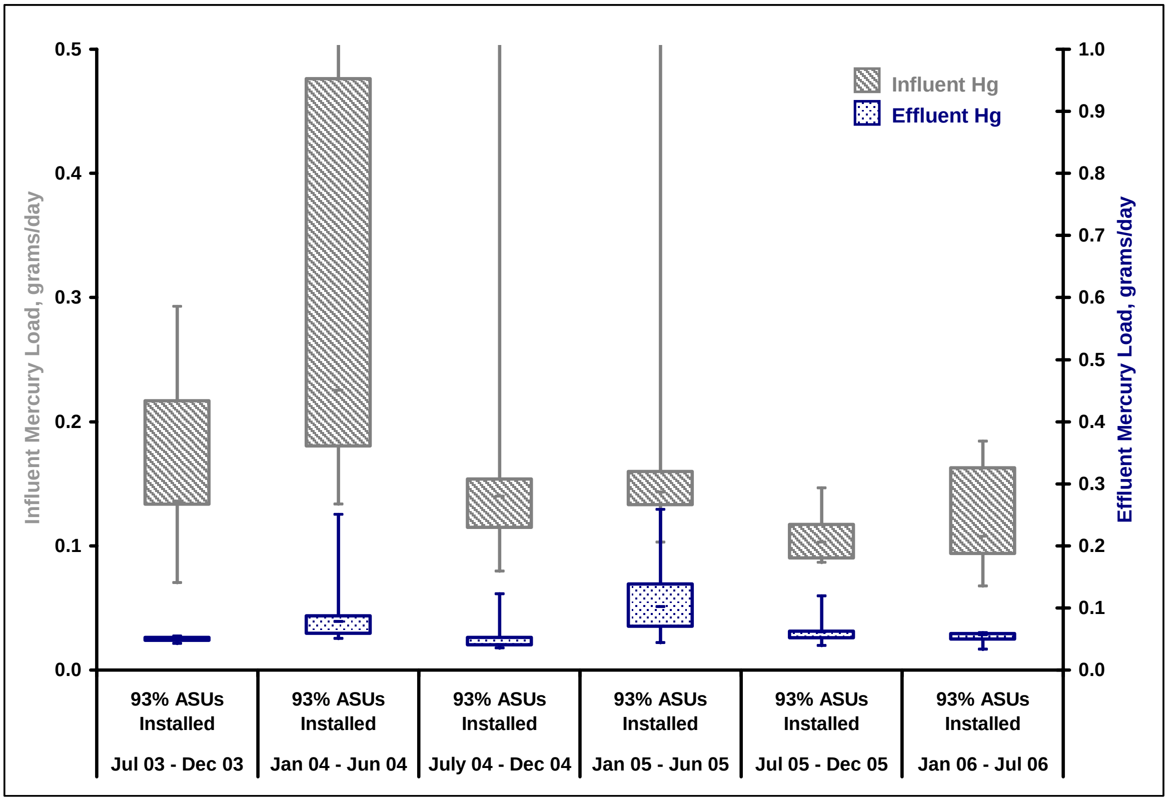

Figure 3.8C: Influent and Effluent Mercury Load at POTW "I"

3.9 POTWs "J" and "K"

Plant Processes

POTWs "J" and "K" are two of three treatment plants operated by one agency that discharge to a saltwater estuary. They serve a population of approximately 1.4 million people. POTW "J" treats an average of 81.3 MGD but is designed for an average of 115 MGD. POTW "K" treats an average of 119.3 MGD, with a design flow of 133 MGD. Treatment at both POTWs includes preliminary, primary, secondary, and disinfection processes. Preliminary treatment consists of bar screens followed by aerated grit chambers. The debris and grit removed during this process are trucked to a landfill. After preliminary treatment, the wastewater settles in primary sedimentation tanks. The skimmings and sludge from this process are then sent to the solids handling process, which includes blending and thickening in a dissolved air flotation tank followed by anaerobic digestion. Secondary treatment involves the use of aeration tanks and secondary clarifiers. The secondary effluent is then disinfected using chlorine. Some of the secondary effluent also undergoes advanced treatment (coagulation, filtration, disinfection) and is then reused on-site in plant processes.

Sample Collection

For both POTWs, influent samples were collected between the bar screens and grit removal at a point after chlorine had been added for odor control. Samples were not collected if recycled streams from maintenance of process tanks had been introduced into the system. Effluent grab samples were collected downstream of chlorine addition. Biosolids samples were 24-hour composites collected after dewatering.

COLLECTION SYSTEM INFORMATION

The treatment plants serve a total area of 64.7 square miles. The service area for POTW "J" consists of only separate sewers. In the POTW "K" service area, there are mostly combined sewers, with a total of 176 combined sewer overflows. For POTW "J," 43% of incoming flow to the plant during the winter is residential, 17% is commercial, and 3% is industrial. The remaining flow comes from stormwater inflow and groundwater infiltration. At POTW "K," 36% of incoming flow during the winter is residential, 19% is commercial, 1% is industrial, and 44% is from stormwater inflow and groundwater infiltration. POTW "K" participates in a "flow swap" program from May through October. During this time period the POTW receives approximately 2.0 MGD from an area over which it does not have pretreatment control.

MERCURY CONTROL PROGRAM

In July 2001, POTWs "J" and "K" informed dental facilities that they needed to comply with local discharge limits for mercury. This limit was set at 0.2 mg/L. The dentists were given until July 2003 to be in compliance. A letter and a fact sheet were sent to each dental practice with instructions on how to comply with the discharge limits. Inspectors then visited dental offices in the service area to explain the regulations and assist dentists in getting their practices into compliance. The POTWs completed their informational visits in August 2003 and then started a program to inspect a portion of dental practices each year for compliance with the regulations. From 2004 through 2006, approximately 10 % of the offices were inspected each year. A dental facility in the service area can demonstrate that it is in compliance with sewer limits if it (a) follows best management practices (BMPs) for amalgam wastes (detailed in a fact sheet), (b) properly handles used X-ray fixer, and (c) installs an approved amalgam separator—or has demonstrated that it meets the local limits through sampling and has obtained a permit to discharge. Currently, only one dental office has elected to receive a permit and perform routine sampling rather than install an approved separator. The percentage of dental facilities that have installed amalgam separators in the total service area is shown in Table 3.9A. The number of dental facilities that have installed amalgam separators in the individual service areas is not known.

Table 3.9A: Amalgam Separator Status at POTWs "J" and "K"

DATE	PERCENT OF DENTAL FACILITIES OPERATING DENTAL AMALGAM SEPARATORS
July 1, 2003	94
January 1, 2004	97
July 1, 2004	97
January 1, 2005	97
July 1, 2005	97
January 1, 2006	97
July 1, 2006	98

These POTW's have specifically exempted certain specialties from the requirement of installing amalgam separators or obtaining a permit. These specialties are: periodontics, orthodontics, oral pathology/oral medicine; oral and maxillofacial surgery; radiology; prosthodontists and endodontists that do not place and remove amalgam as a courtesy for their clients. Dentists, such as some pediatric dentists, that place or remove amalgam on three days or fewer per year are also exempt from these requirements. If any of these exemptions applies to the dental office, it does not need to install separator or apply for a permit. However, it still needs to follow BMPs for waste amalgam and may be inspected for compliance.

In May 2005, POTW "J" stopped accepting septage waste from dental offices without prior screening and evaluation of mercury concentration levels.

RESULTS

For both treatment plants, there was a statistically significant decrease ($p < 0.05$) in effluent and biosolids mercury concentrations throughout the study (Figures 3.9A and 3.9D). POTW "J" also had a statistically significant ($p < 0.05$) effluent TSS decrease, while POTW "K" did not (Figures 3.9B and 3.9E). Both plants showed an apparent decrease in effluent mercury loadings, as seen in Figures 3.9C and 3.9F. The effluent mercury concentrations showed a greater decrease than the biosolids mercury concentrations. This may be due to the relatively high mercury concentrations present in the effluent at the beginning of the study and the decreases in effluent TSS throughout the study period. Since a large percentage of dental facilities had amalgam separators installed for the duration of the study (97% at beginning and 98% at end), it could be that reductions in mercury gained through the installation of separators may not occur immediately. It is also possible that the apparent reductions in mercury may also be the result of improvements to treatment processes suggested by the effluent TSS decreases or due to other activities occurring within the service area, such as implementation of BMPs recommended by the mercury control program.

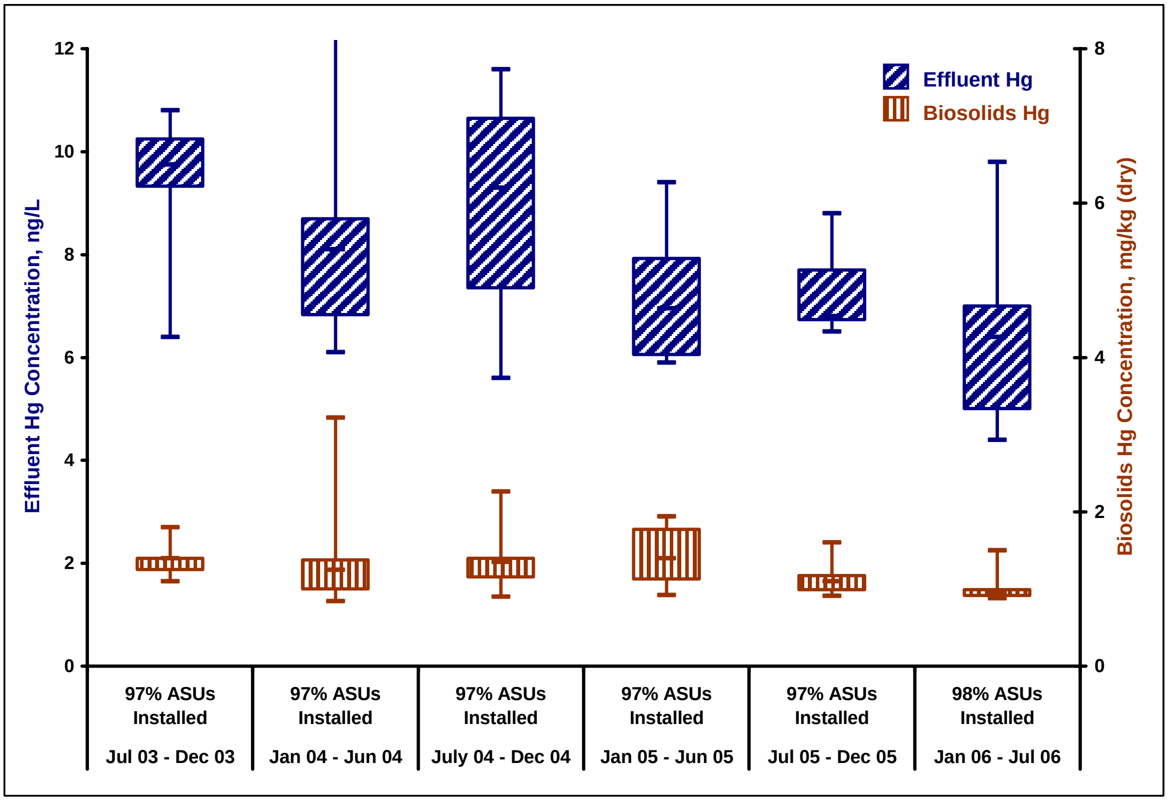

Figure 3.9A: Effluent and Biosolids Mercury Concentrations at POTW "J"

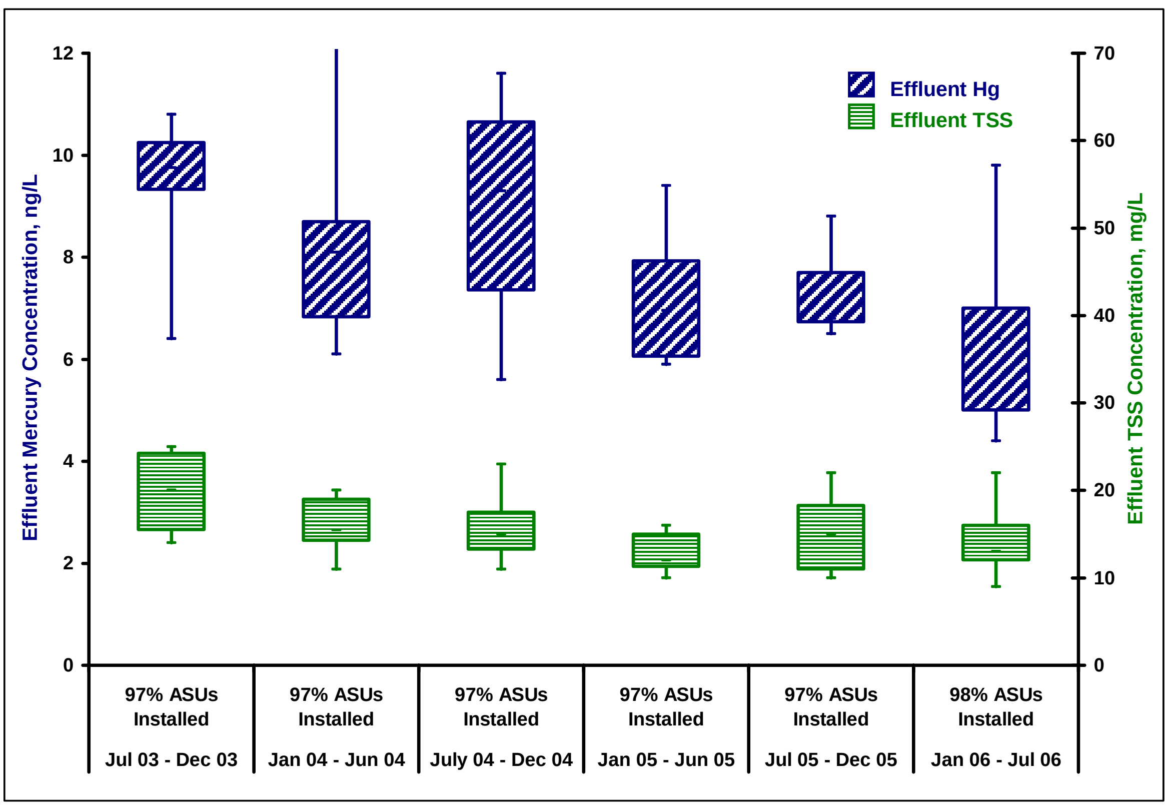

Figure 3.9B: Effluent Mercury and TSS Concentrations at POTW "J"

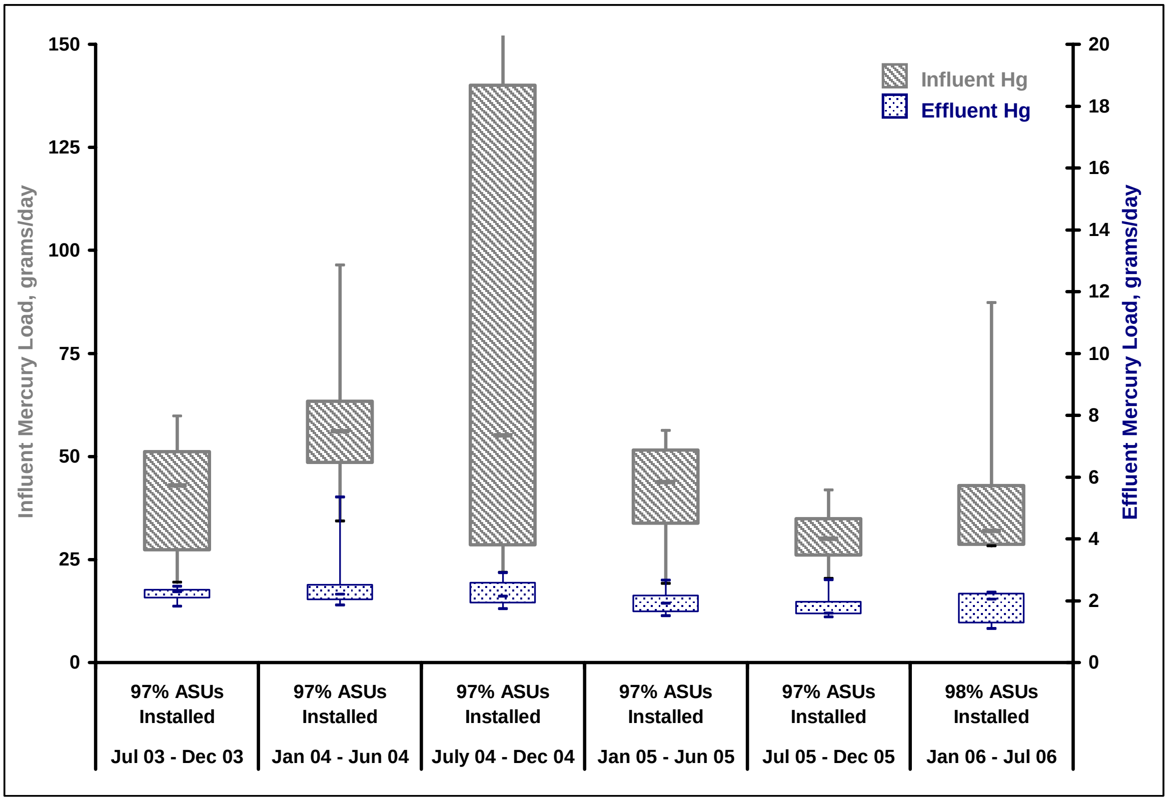

Figure 3.9C: Influent and Effluent Mercury Load at POTW "J"

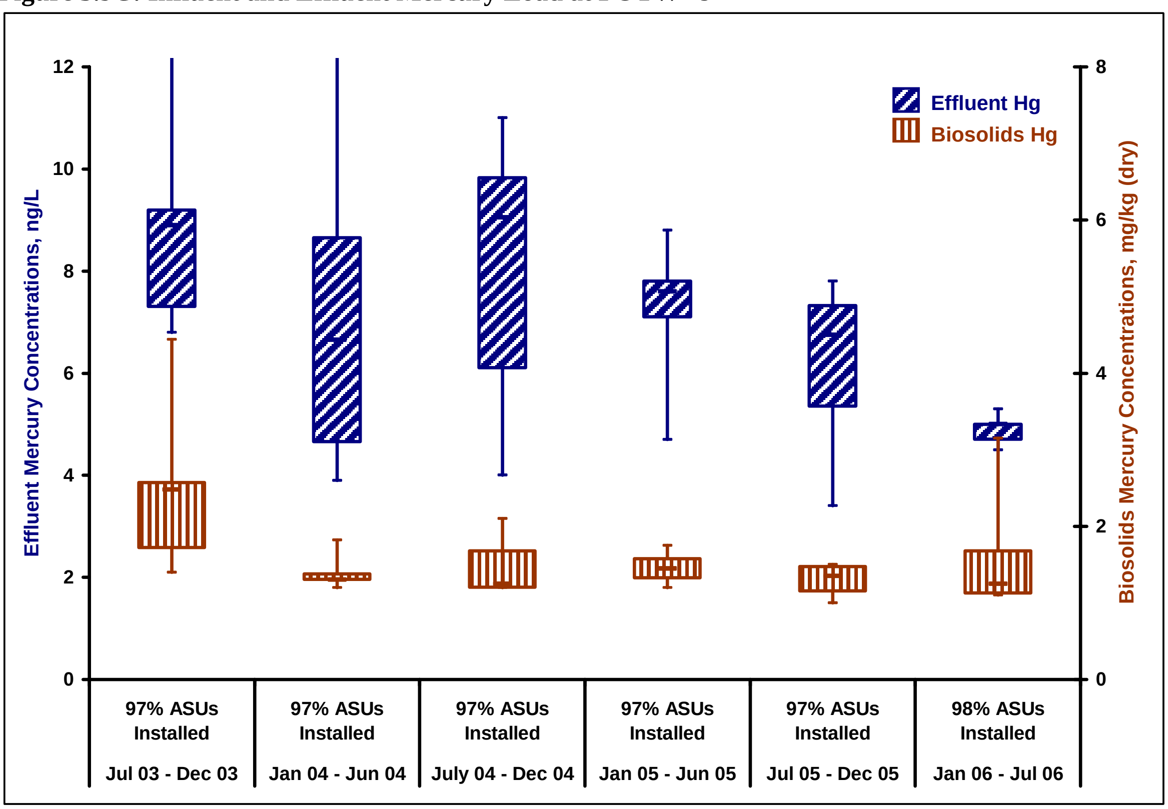

Figure 3.9D: Effluent and Biosolids Mercury Concentrations at POTW "K"

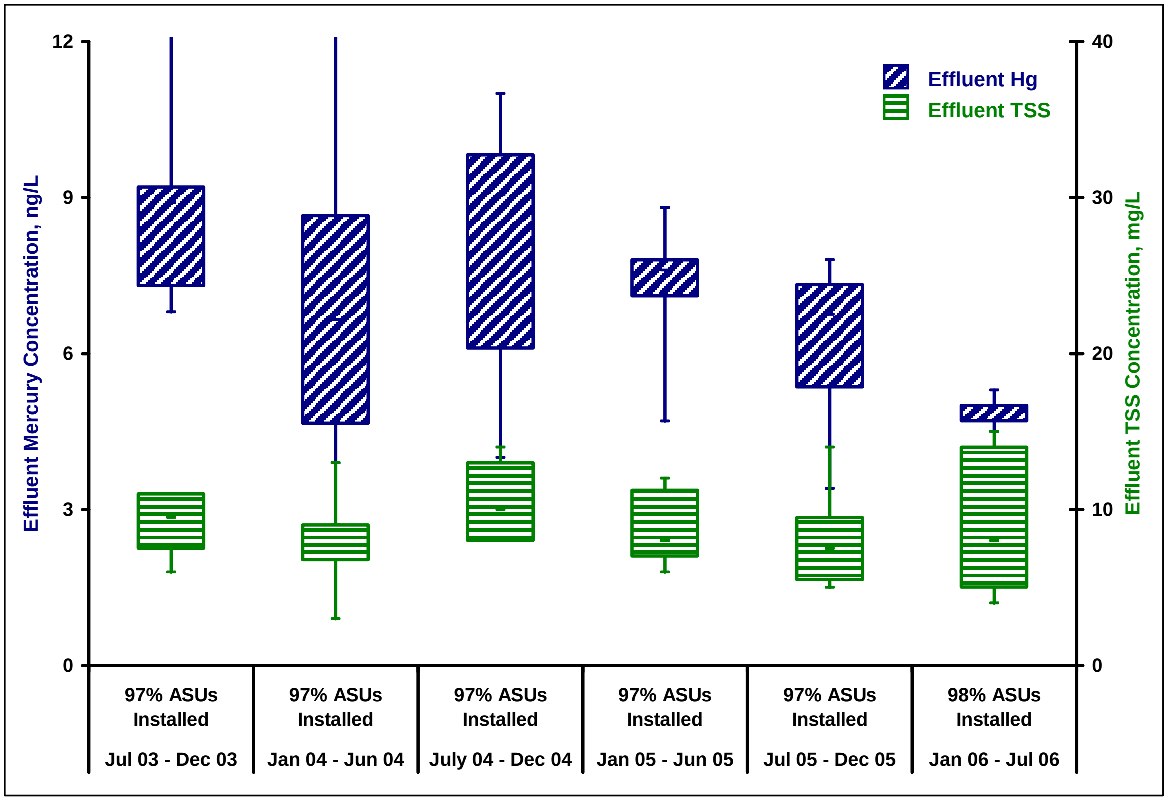

Figure 3.9E: Effluent Mercury and TSS Concentrations at POTW "K"

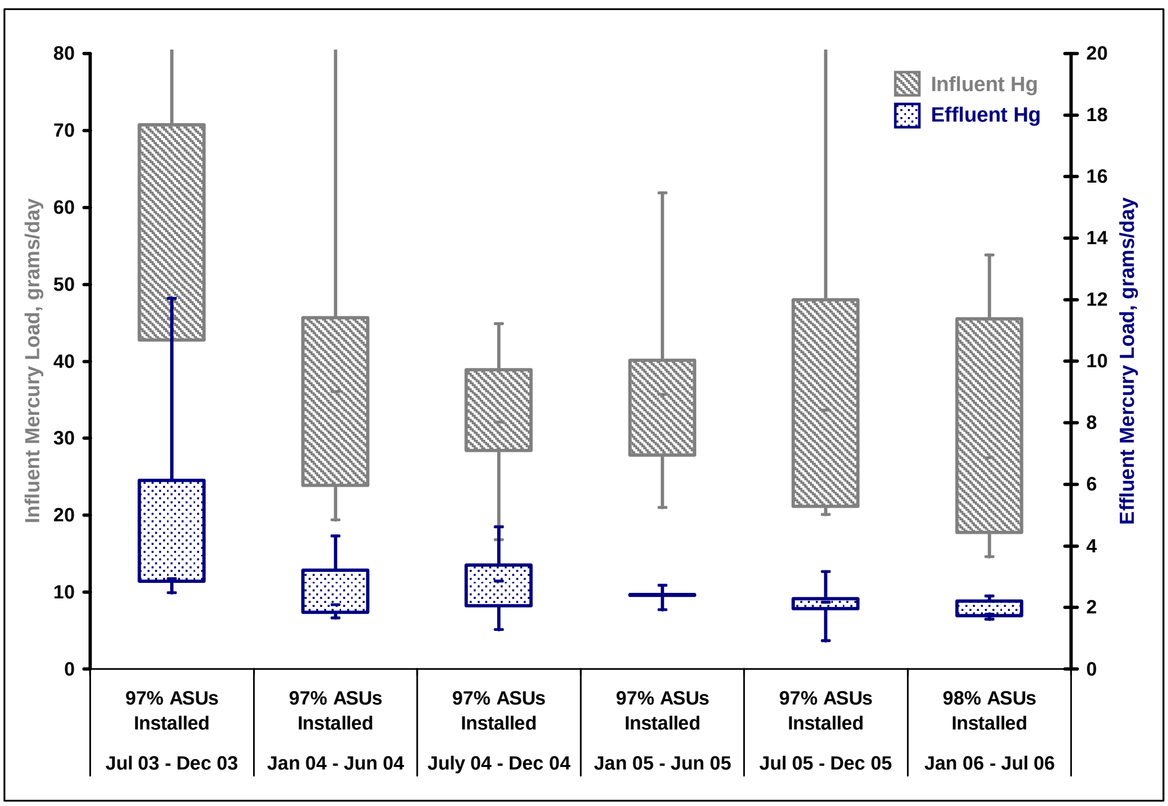

Figure 3.9F: Influent and Effluent Mercury Load at POTW "K"

3.10 POTW "L"

PLANT PROCESSES

POTW "L" is designed to treat 55 MGD, and has an actual average flow of 46 MGD. The treatment process at POTW "L" includes grit removal, primary and secondary treatment, and UV disinfection. Hauled-in wastes are accepted for treatment at this POTW. Preliminary treatment includes bar screens and preaeration tanks to remove grit. Primary sludge is blended with Dissolved Air Flotation Unit-thickened waste activated sludge and centrifuged. The cake is incinerated and the centrate and wet scrubber water are returned as influent to the secondary process. Following secondary treatment, the wastewater is disinfected using ultraviolet lightbulbs. A small portion of final effluent flow is sent to the dual-media filter plant and chlorinated for recycled water use. The backwash water from dual-media filter plant returns as influent to the headworks. Hauled-in wastes, which include residential septage, portable toilet waste, domestic septage from non-residential sites, and restaurant grease, are introduced into the plant at the headworks. The following chemicals are used in treatment processes at POTW "L":

- Hydrogen peroxide – odor control;
- Sodium hypochlorite;
- Carbide lime; and
- Polymer.

SAMPLE COLLECTION

Influent grab samples were taken from the headworks, prior to grit removal. These included some recycled flows from both the treatment plant and the filter plant. Effluent composite samples were taken at a point after UV disinfection. Biosolids samples were sludge cake, taken prior to incineration. Certain sidestreams carrying non-negligible concentrations of mercury are returned as influent to the headworks. These sometimes include wet scrubber water and filter backwash water. On the days on which influent grab samples for this study were taken, none of these flows were being recycled. However, as a result of the customary recycling to the secondary process influent of incinerator wet scrubber water, it is believed that effluent mercury concentrations on a day-to-day basis are affected.

COLLECTION SYSTEM INFORMATION

POTW "L" is an estuarine discharger that serves a population of 450,000. The service area encompasses approximately 143 square miles.

MERCURY CONTROL PROGRAM

As part of the mercury control program at POTW "L", about 23 industrial users are monitored up to four times per year for mercury: once or twice by the POTW and the rest through self-monitoring. Dentists are encouraged to install amalgam separators, but there is no mandatory program requiring separators. In the future, POTW "L" will be implementing a requirement for amalgam separators. Influent mercury concentrations are anticipated to decline; the effect on the effluent concentrations will be evaluated. Household hazardous wastes and small quantity generator mercury waste is accepted at the Household Hazardous Waste Collection Facility, where they are sequestered and hauled away for proper disposal. In addition, best management practices information has been distributed to all hospitals in the service area.

RESULTS

At POTW "L", the effluent mercury concentration ranged from 10.4 ng/L to 205 ng/L, effluent mercury loading ranged from 1.9 grams/day to 33.8 grams/day, and effluent TSS concentrations ranged from 3 mg/L to 29 mg/L, as shown in Figures 3.10A and 3.10B. No statistically-significant trends ($p > 0.10$) are evident for any of these variables. The biosolids mercury concentration remained relatively constant throughout the sampling (Figure 3.10A). The influent and effluent loadings are depicted in Figure 3.10C. By the end of the study, an estimated 11% of the dental facilities/dentists in the service area of POTW "L" had installed separators.

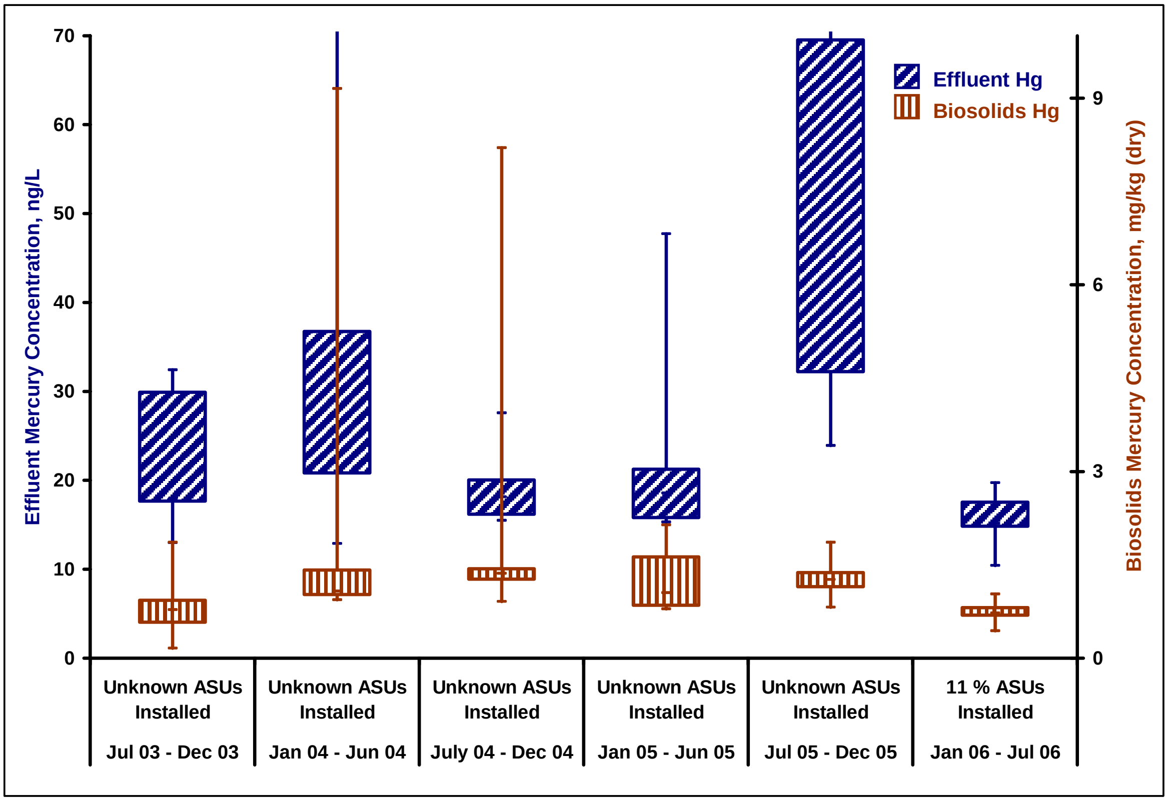

Figure 3.10A: Effluent and Biosolids Mercury Concentrations at POTW "L"

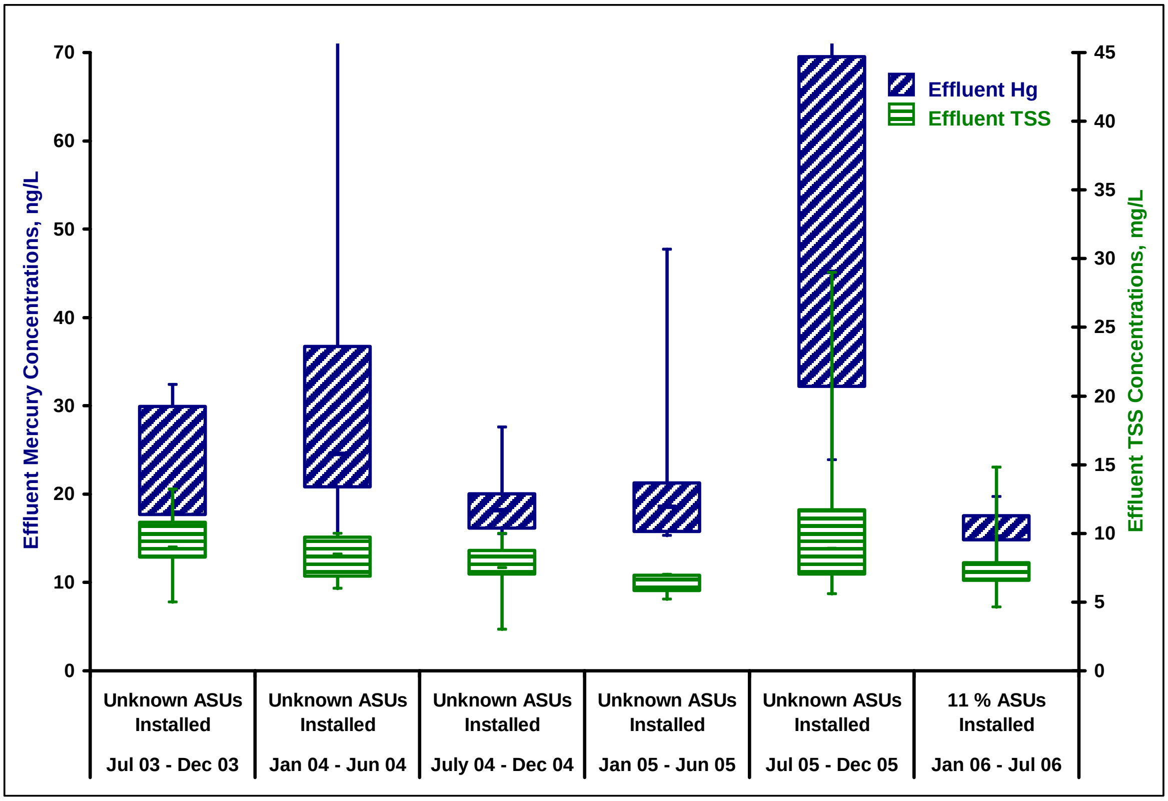

Figure 3.10B: Effluent Mercury and TSS Concentrations at POTW "L"

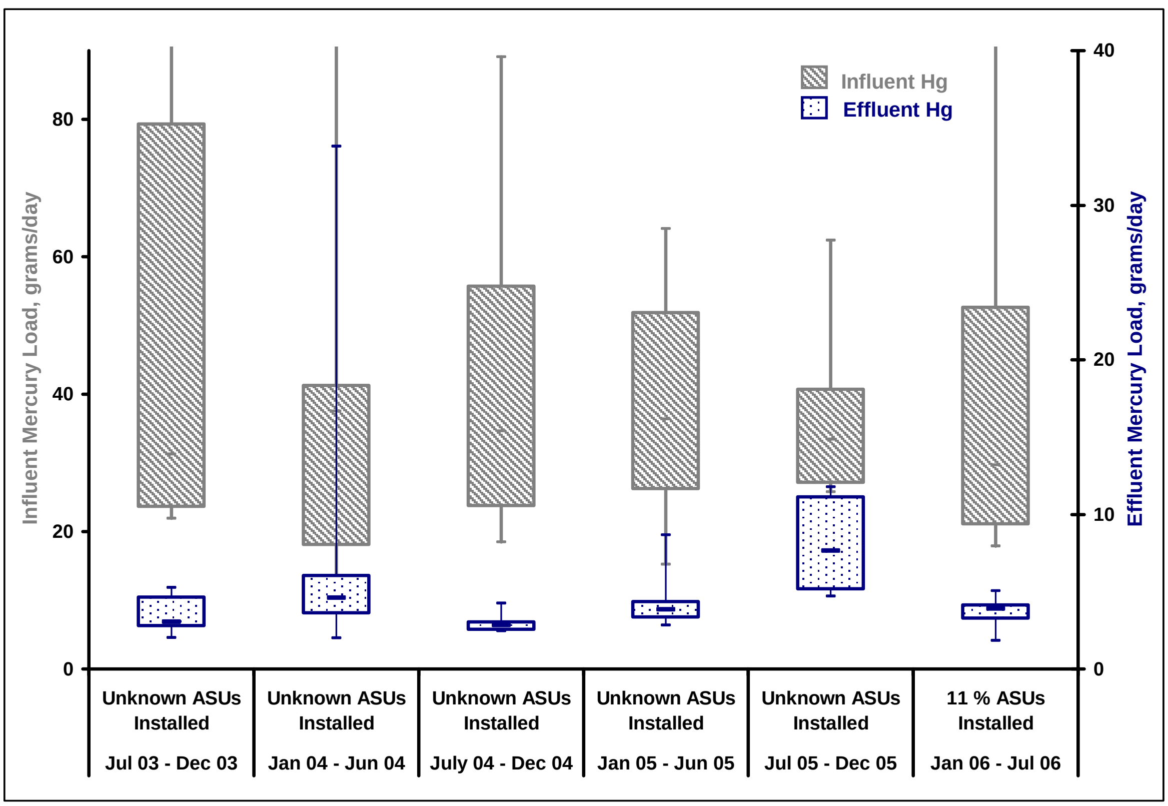

Figure 3.10C: Influent and Effluent Mercury Load at POTW "L"

4. COMBINED RESULTS AND DISCUSSION

In addition to those for individual plants, trends were also examined by combining the results from all of the POTWs. A variety of potential factors that may be influencing mercury concentrations at POTWs were examined. Excluded from this analysis were those factors in which there were too many variables to effectively establish a relatively conclusive relationship.

4.1 INFLUENT, EFFLUENT, AND BIOSOLIDS

Figure 4.1A depicts, with a logarithmic y-axis, the influent total mercury concentrations, for each facility, in six-month increments. There is clearly a high degree of variability in the influent mercury concentrations within each facility as well as between the facilities. POTWs B, C, I, J, K and L collected influent samples as grab samples while POTWs A, D, E, F, G, and H collected influent composite samples. Using composite sampling techniques to monitor influent mercury concentrations potentially reduces variability to some degree. The high variability in influent concentrations is most likely due to the inconsistent nature of the influent and the fact that, because the samples have varying amounts of solid particles, a truly representative influent sample is virtually impossible to collect. Much of the mercury entering a POTW is thought to be in the particulate form and would be contained within these solids. In light of this inherent variability, the ability to use influent mercury concentrations to determine impacts from potential mercury reduction techniques in the collection system is limited.

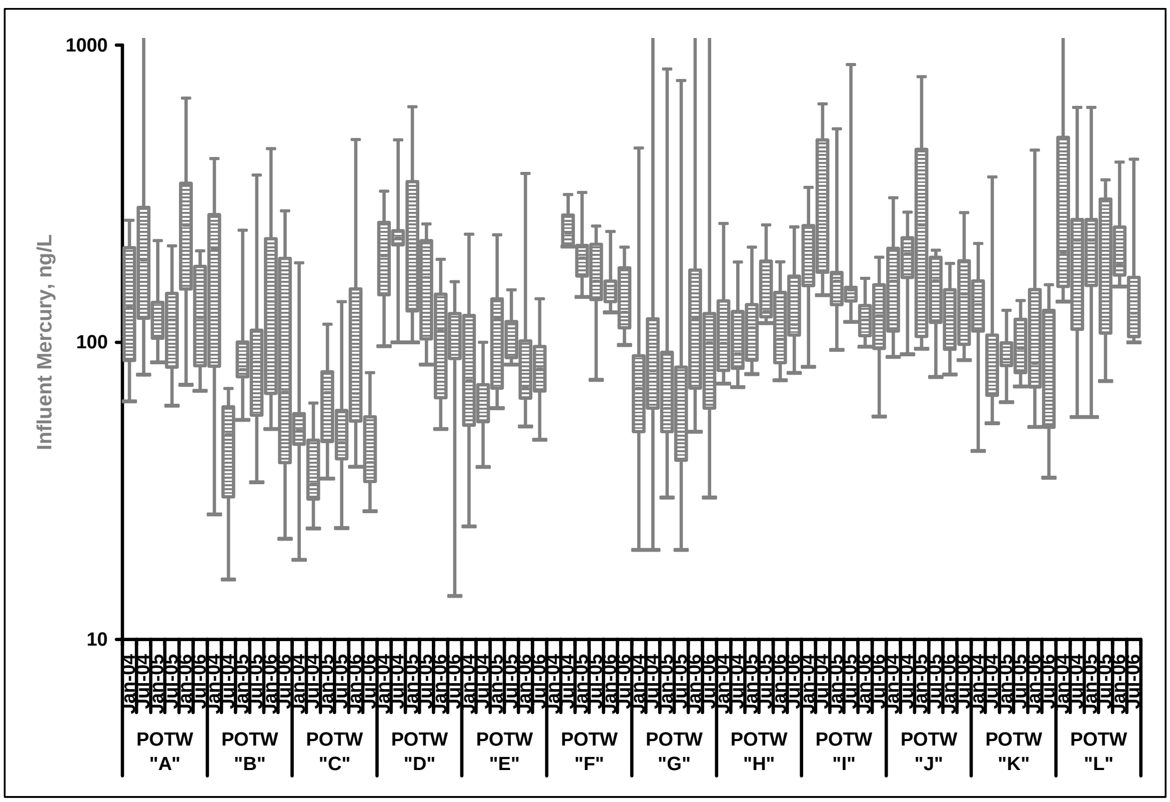

Figure 4.1A: Influent Mercury Concentrations

POTWs "B" and "I" collected influent samples after grit removal while the remaining POTWs collected influent samples prior to grit removal. Influent that contains a high amount of particulate matter is suspected to also contain a high amount of particulate mercury. However, as shown in Figure 4.1B, no difference is clearly evident in influent mercury concentrations between those facilities where influent samples were collected prior to grit removal and those facilities where influent samples were collected after grit removal processes.

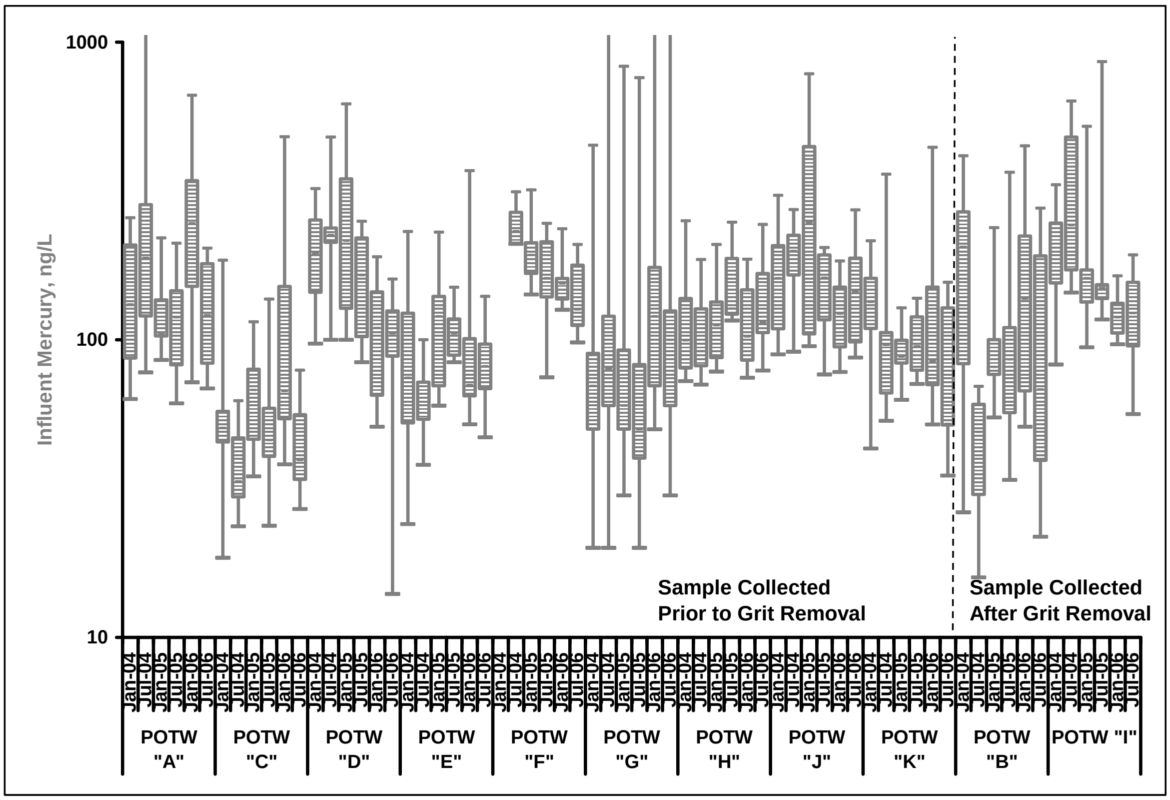

Figure 4.1B: Influent Mercury Concentrations and Sample Collection Location

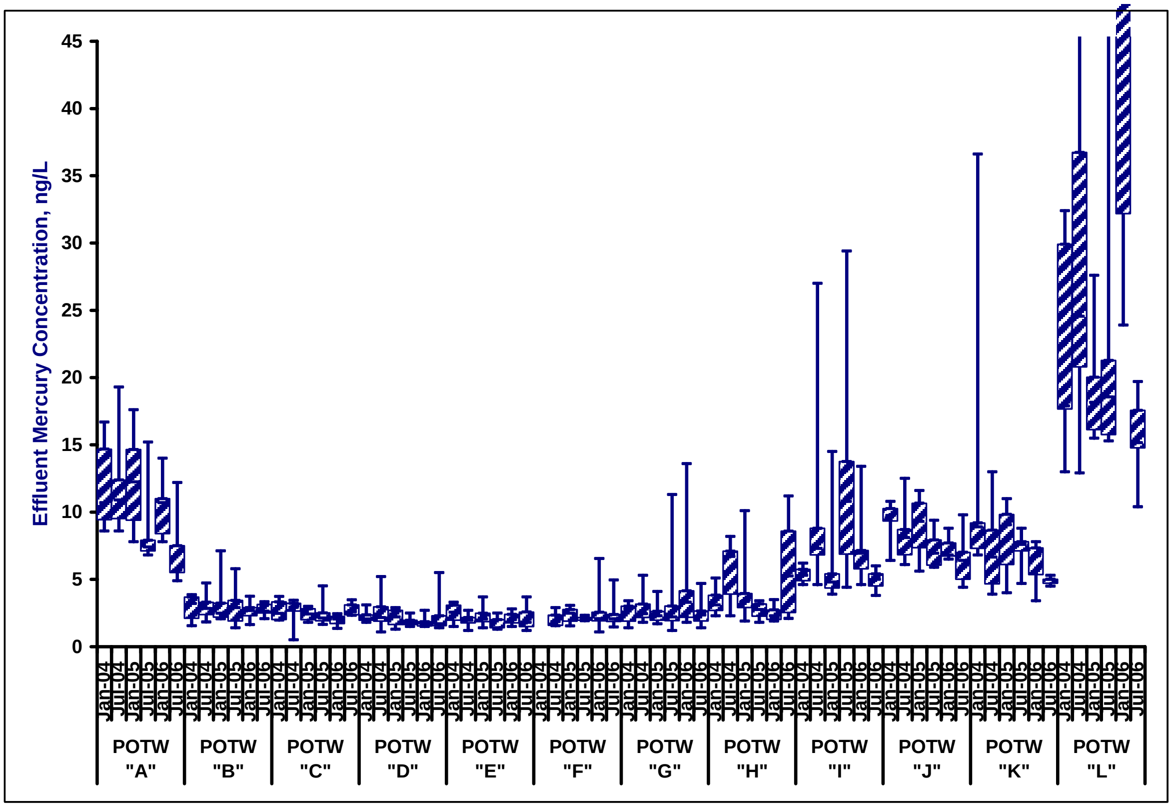

Figure 4.1C: Effluent Mercury Concentrations

Figure 4.1C depicts the effluent mercury concentrations, in six-month increments, at each facility during the course of the sampling project. Similar to the influent mercury concentrations, there is a high degree of variability in effluent mercury concentrations between different POTWs. Effluent mercury concentrations are generally higher at POTWs A, I, J, K, and L than they are at POTWs B, C, D, E, F, G, and H. Speculations as to the potential causes of these differences are examined in later sections of this report. However, unlike the influent concentrations, the effluent mercury concentrations are more consistent at individual facilities. Some facilities, particularly POTW "E", exhibited very little variability in effluent mercury concentrations. The decreased variability within individual POTWs indicates that, generally speaking, each individual POTW is consistently performing to the same level.

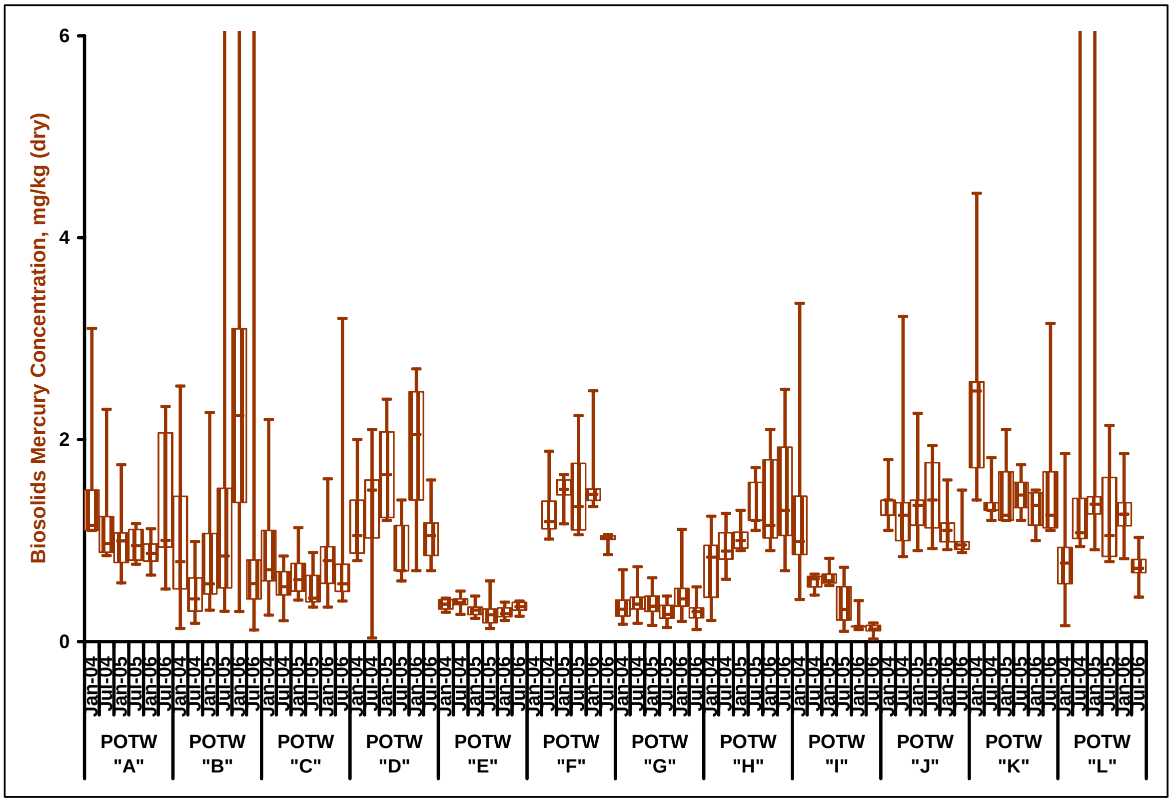

Figure 4.1D: Biosolids Mercury Concentrations

Similar to both the influent and the effluent mercury concentrations, the effluent biosolids concentrations exhibit considerable variability from POTW to POTW, as depicted in Figure 4.1D. It is also clear from this figure that some facilities have higher variability within their biosolids mercury concentrations than do other facilities. Potential causes of this are examined further in later sections of this report. POTW "E" demonstrates a very small degree of variability, while POTWs "B" and "L" each display a very high degree of variability. At POTW "B" the high variability is attributable to the interceptor cleaning activities that were discussed in Section 3.2 of this report.

4.2 Removal Efficiency

The mercury removal efficiency calculated from the median of each facility's influent concentrations and the median of each facility's effluent concentrations measured during the study was examined to determine if there were differences in the abilities of individual POTWs to remove mercury from the wet stream. As shown by Figure 4.2A, the treatment plants had median removal efficiencies ranging from 89% at POTW "L" to 99% at POTW "D." It should be noted that POTW "D" is connected to POTW "E" via pipeline and it is likely that concentrations at POTW "D" are strongly affected by concentrations at POTW "E." However, at POTW "F", which has the second highest median removal efficiency and where results are not affected by those of another treatment facility, the median removal efficiency of 98.75% is only slightly lower that that of POTW "D".

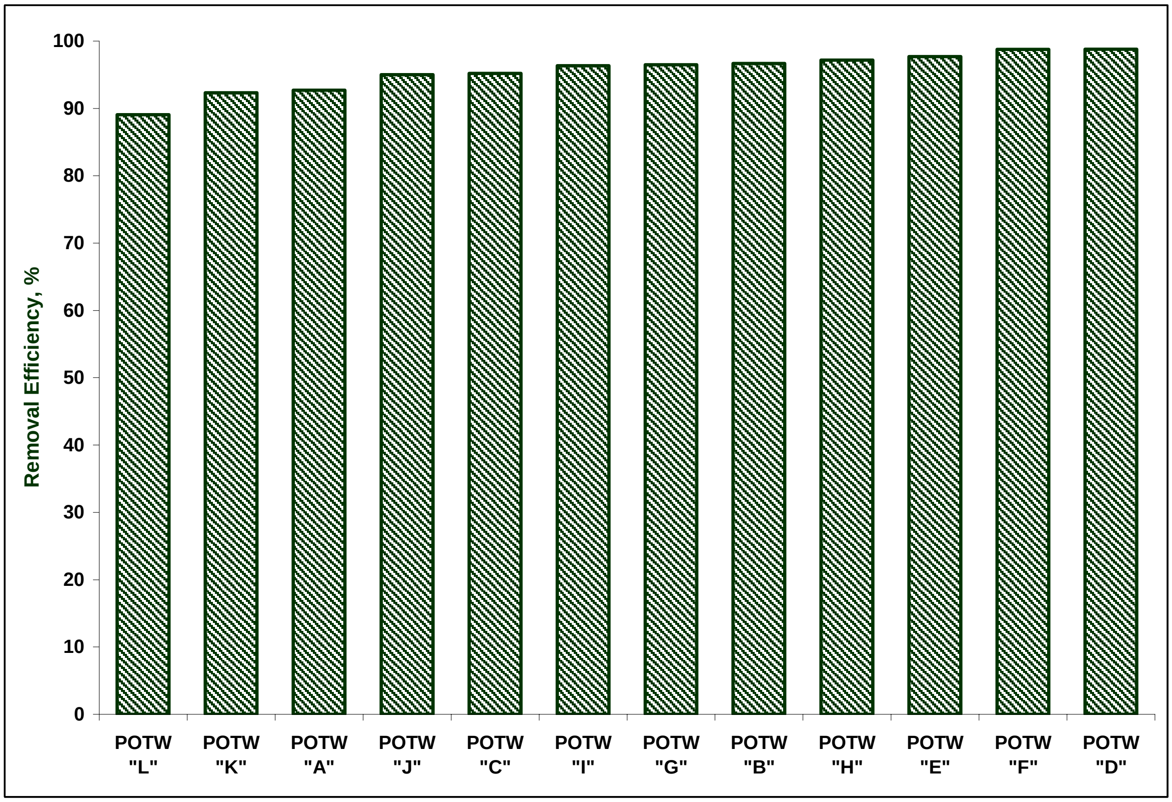

Figure 4.2A: Median Mercury Removal Efficiency

4.3 DISSOLVED MERCURY

A key factor often thought to affect the ability of a POTW to remove mercury and the resulting effluent mercury concentration is the extent to which the mercury is in the dissolved or particulate form. Most of the particulates are expected to settle in the collection system or be removed during treatment processes. The dissolved form may pass through the treatment system, impacting effluent concentrations. A limited amount of sampling was performed in order to attempt to quantify the amount of dissolved mercury in the effluent. Dissolved mercury analysis was performed at all POTWs except POTWs "D," "E," and "F" during the first quarter of the study. POTWs "D," "E," and "F" volunteered to submit their data for consideration in the study well after the study had begun and had not been aware of the plan to collect dissolved mercury data.

Some POTWs provided additional dissolved mercury data as well. These data were used to observe the ratio of dissolved mercury to total mercury in the effluent of the participating POTWs. Figure 4.3A shows the median percent of the effluent total mercury that is dissolved for each facility with available data. The percent of effluent total mercury that was dissolved was found to vary based on the POTW. The highest median dissolved mercury occurred at POTW "G" at 59%, while the lowest median was at POTW "A" at 22%.

It has been hypothesized that recycled incinerator scrubber water flow within a POTW can increase the amount of dissolved mercury in the POTW effluent. Figure 4.3B indicates that, for the POTWs in the study, there does not appear to be a relationship between the presence of recycle scrubber water flows and the percentage of the effluent mercury concentration that is dissolved.

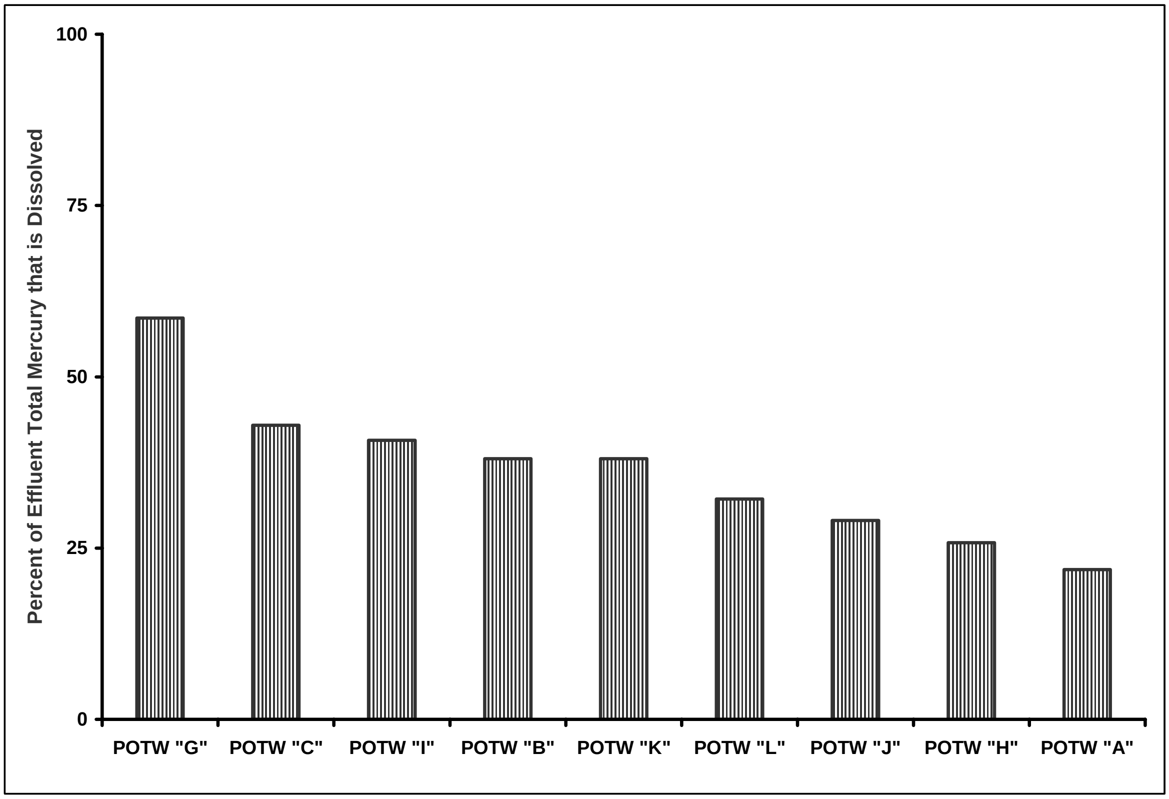

Figure 4.3A: Median Percent of Effluent Total Mercury that is Dissolved

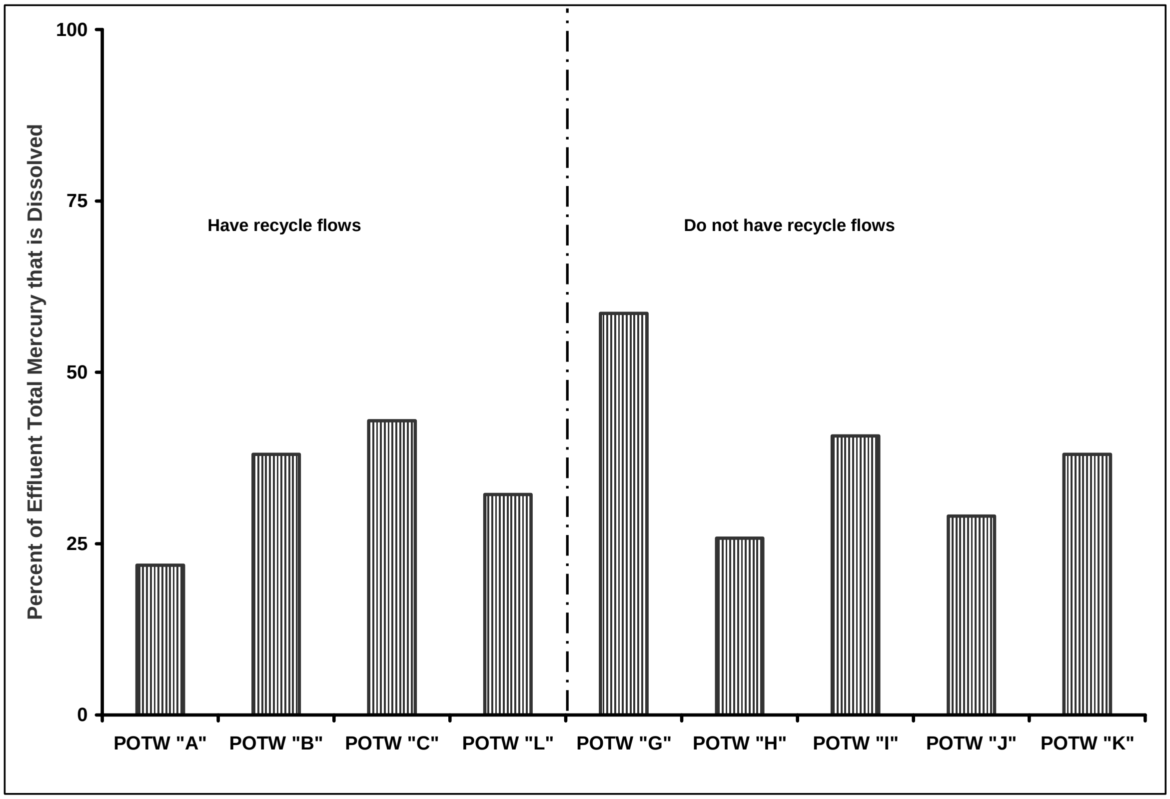

Figure 4.3B: Presence of Recycle flows and the Median Percent of Effluent Total Mercury that is Dissolved
*Scrubber water flow at POTW “A” did not occur during the final seven months of the sampling project

4.4 Total Suspended Solids

It has been hypothesized that the quantity of TSS in POTW effluent can provide an indication of the amount of mercury that is found in the effluent. Figure 4.4A shows that, when the effluent mercury concentration is plotted versus effluent TSS concentration for all POTWs, there is a positive linear relationship. However, the R^2 value indicates the ability to predict the mercury concentration using TSS concentrations is very low. The relationship between effluent mercury concentration and TSS concentrations were also examined at the individual POTWs. Table 4.4A provides the equation of the linear trendlines and the associated R^2 values obtained from this analysis. For many of the POTWs, there was a strong positive linear relationship between effluent mercury concentrations and effluent TSS concentrations, and the R^2 values were higher. At POTWs “C”, “E”, “K”, and “L”, however, the predictive ability of the equation was low. The use of various chemicals, especially iron salts, may have an impact on the relationship between TSS and mercury concentrations. Because of this, POTWs that use iron salts were compared to those that do not. It was found that there was no clear relationship between the use of iron salts and the ability to predict effluent mercury concentrations from effluent TSS concentrations. Therefore, it is unknown why, at some POTWs, effluent TSS concentration appears to be an adequate predictor of effluent mercury concentration and, at others, it is not.

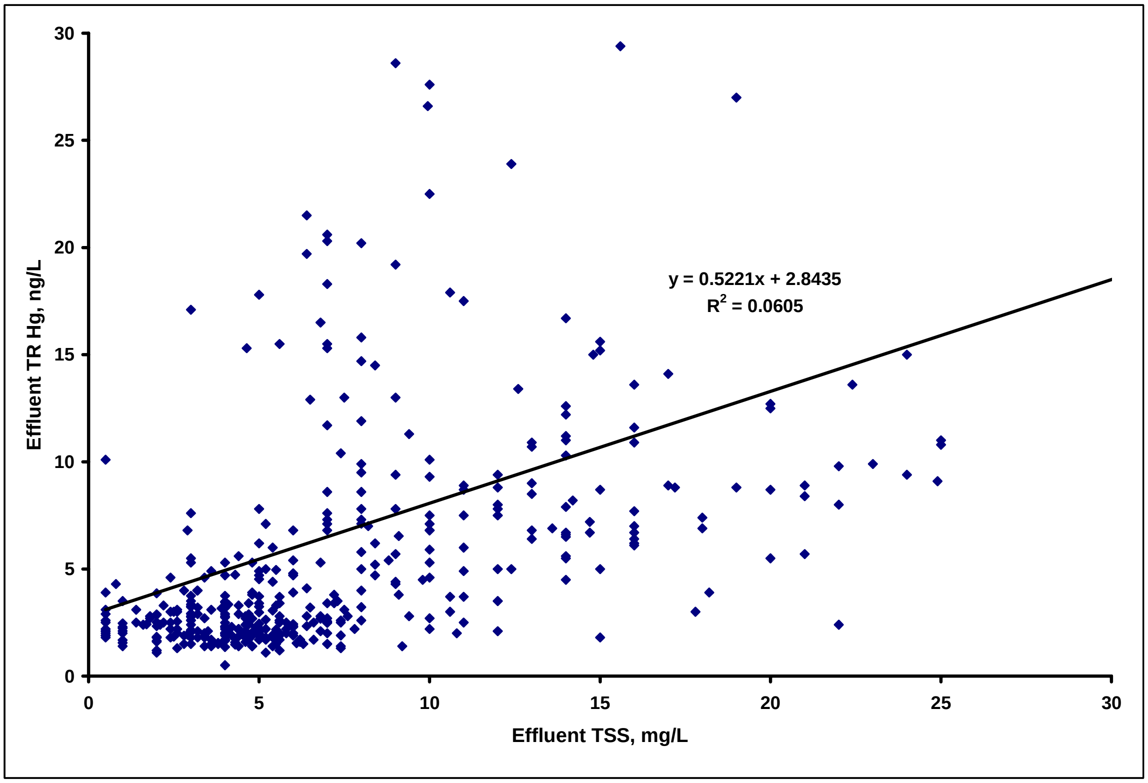

Figure 4.4A Effluent Mercury Concentrations versus Effluent TSS Concentrations

Table 4.4A. Trendline Equations and R^2 Values for Effluent Mercury Concentrations versus Effluent TSS Concentrations

POTW	Equation	R^2 Value
POTW “A”	y = 0.2105x + 7.2324	0.3004
POTW “B”	y = 0.2774x + 1.9742	0.3281
POTW “C”	y = 0.1084x + 2.0188	0.0434
POTW “D”	y = 0.1155x + 1.3448	0.2837
POTW “E”	y = 0.089x + 1.5362	0.0711
POTW “F”	y = 0.5491x - 0.4202	0.4194
POTW “G”	y = 0.2649x + 1.5544	0.2964
POTW “H”	y = 0.3133x + 2.6572	0.4879
POTW “I”	y = 0.6743x + 1.937	0.3848
POTW “J”	y = 0.2407x + 4.1588	0.2821
POTW “K”	y = 0.2199x + 4.8325	0.0998
POTW “L”	y = 1.0615x + 21.401	0.0181

4.5 Dentists per Flow

In order to establish whether the density of dental facilities has an impact on mercury levels in treatment plants, the numbers of dentists per plant flow were examined in comparison to influent, effluent, and biosolids mercury concentrations. POTWs “D”, “E”,”J”, and “K” were excluded because the number of dentists for their individual service areas was not known. Most POTWs track the number of dentist facilities within the service area, however some count the number of dentists, and it is not known, for every POTW, whether they counted the total number of dentists or excluded facilities that do not use amalgam. A further complication is that many dentists who do not place amalgam restorations nonetheless remove amalgam-containing restorations, and this is a significant contributor to dental mercury discharges. Although limitations of doing so are recognized, for the purposes of this analysis, the number of facilities and the number of dentists are used interchangeably. As seen in Figures 4.5A and 4.5B, a decrease in the number of dentists per million gallons per day (MGD) was related to a general decrease in both influent and effluent mercury concentrations. Both of these relationships were found to be statistically significant ($p < 0.05$) despite the limitations noted above. The median influent mercury concentration and the number of dentists per MGD resulted in a p-value of 0.00007, indicating that the median influent mercury concentration at a POTW is very highly correlated to the number of dentists per MGD. The median effluent mercury concentration was also highly correlated to the number of dentists per MGD with a p-value of 0.002.

There was no relationship found between dentists per MGD and median biosolids mercury concentrations (Figures 4.5C). This was unexpected since a major portion of the mercury released by dentists is thought to be removed during treatment in the POTW and, therefore, would end up in the biosolids. One possible reason for these results may be that the number of dentists with amalgam separators installed changed throughout the study. Therefore, reductions in mercury gained in areas where more separators were being installed may have offset the general trend of increasing mercury resulting from an increase in the number of dentists. This finding may also reflect that biosolids mercury is more affected by separator installation than is effluent mercury.

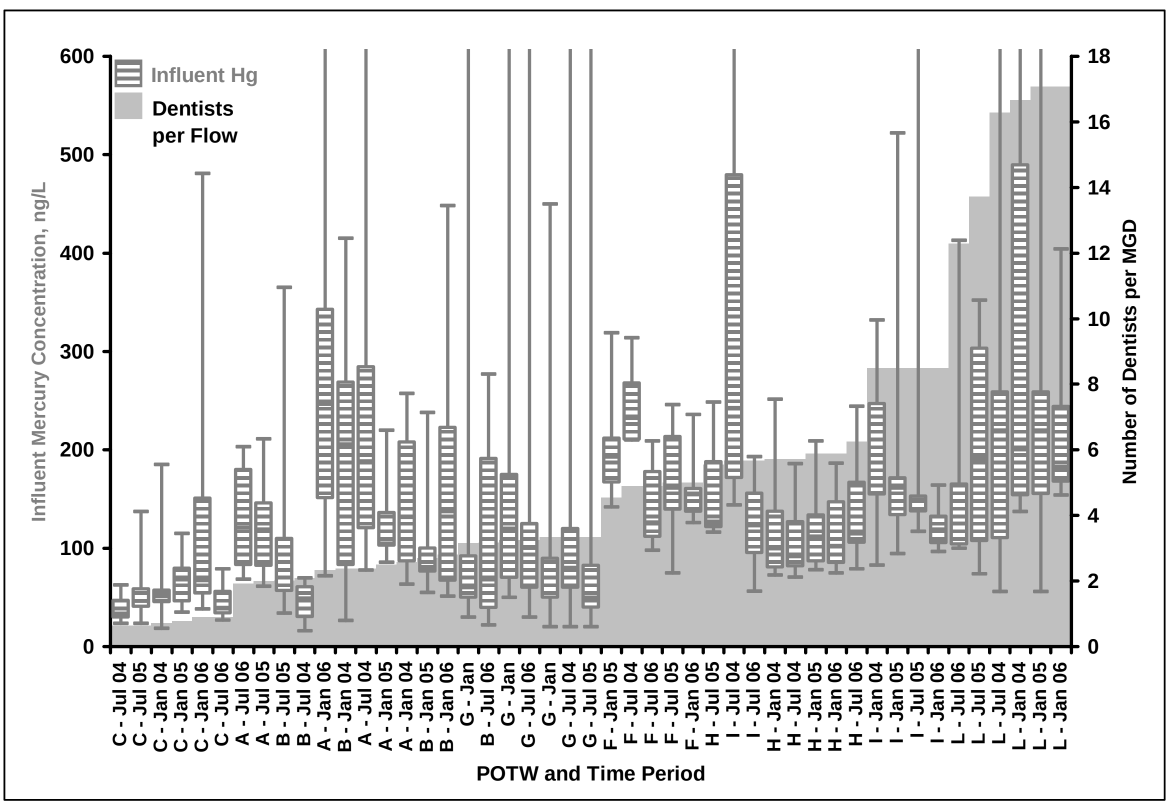

Figure 4.5A: Influent Mercury Concentration and Dentists per Flow

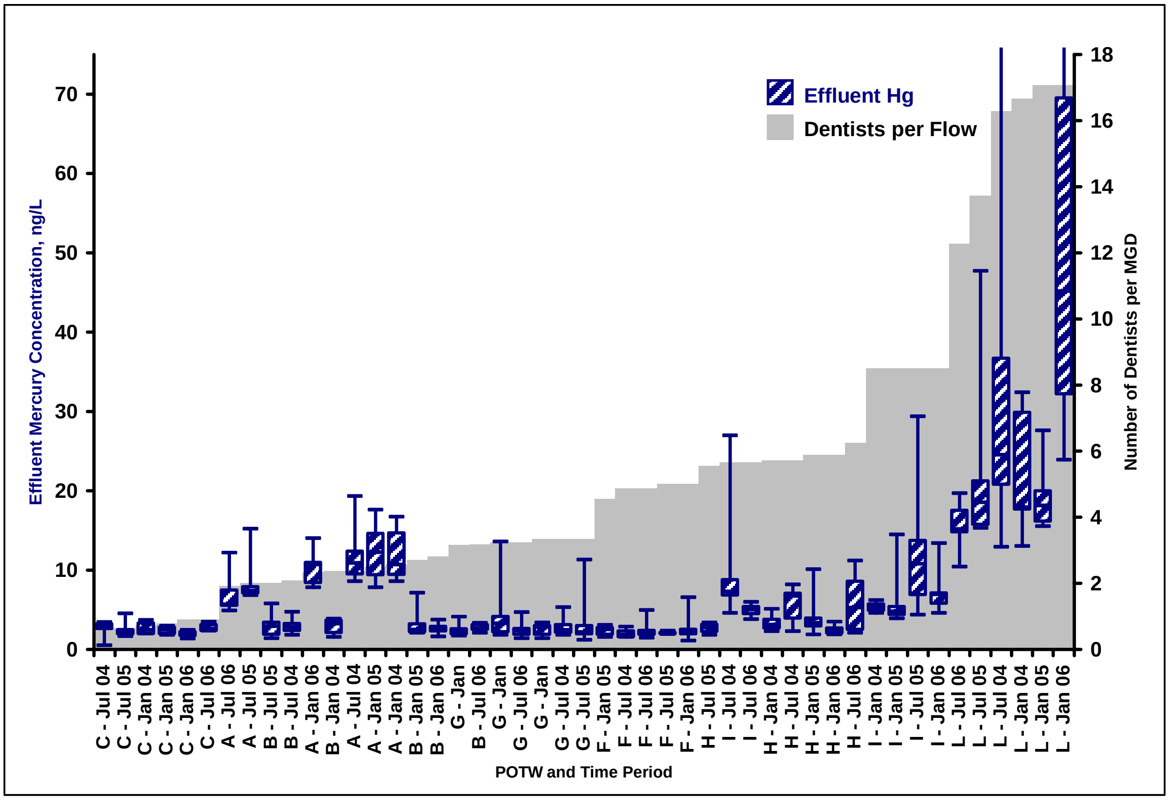

Figure 4.5B: Effluent Mercury Concentration and Dentists per Flow

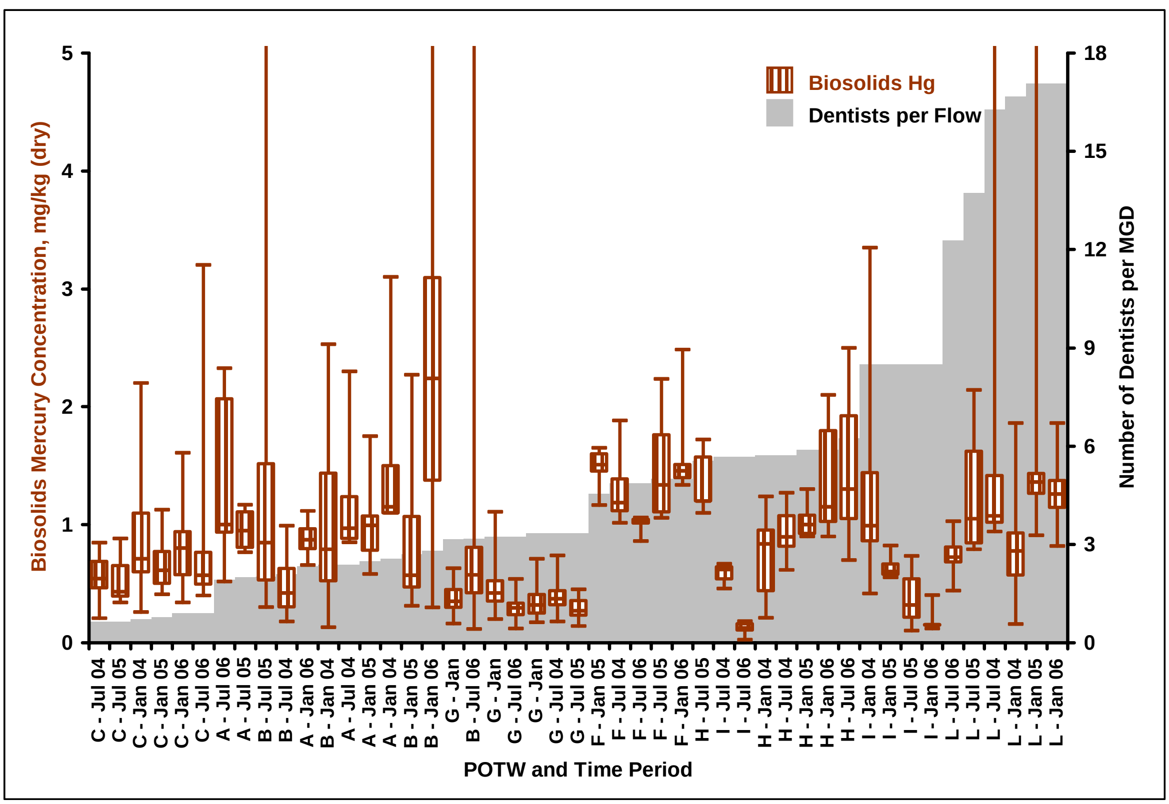

Figure 4.5C: Biosolids Mercury Concentration and Dentists per Flow

4.6 Dentists Without Separators per Flow

Once it was determined that a potential positive relationship between the numbers of dentists and mercury levels at POTWs exists, whether the use of amalgam separators by dentists also impacts mercury levels was examined. The number of dentists at each treatment plant that did not have separators installed was first determined. This number was then divided by total flow to the plant. In doing so, it was found that there is no statistically significant relationship between this value and the median influent mercury concentration as shown in Figure 4.6A.

The median effluent mercury concentration is negatively correlated to the number of dentists without separators per flow (Figure 4.6B). This negative correlation was highly significant with a p-value of 0.004. This clearly indicates that increasing amalgam separator installations did not necessarily lead to a decrease in effluent mercury concentrations at the POTWs in the project. This result could be due, in part, to the limited number of amalgam separator installations that occurred at the POTWs with generally lower effluent mercury concentrations at the study's outset.

For biosolids, there was a statistically significant increase in the median mercury concentration with an increase in the number of dentists per flow that do not have separators installed (Figure 4.6C). With a p-value of 0.0002, this correlation is highly statistically significant. In fact, of the relationships examined in the analysis of the data collected during the sampling project, the strength of this relationship is second only to that of the relationship between influent total mercury concentrations and the number of dentists per MGD. Since the use of separators is expected to reduce particulate mercury entering wastewater treatment plants, this relationship strongly supports the hypothesis that amalgam separators can reduce the quantity of mercury entering treatment plants.

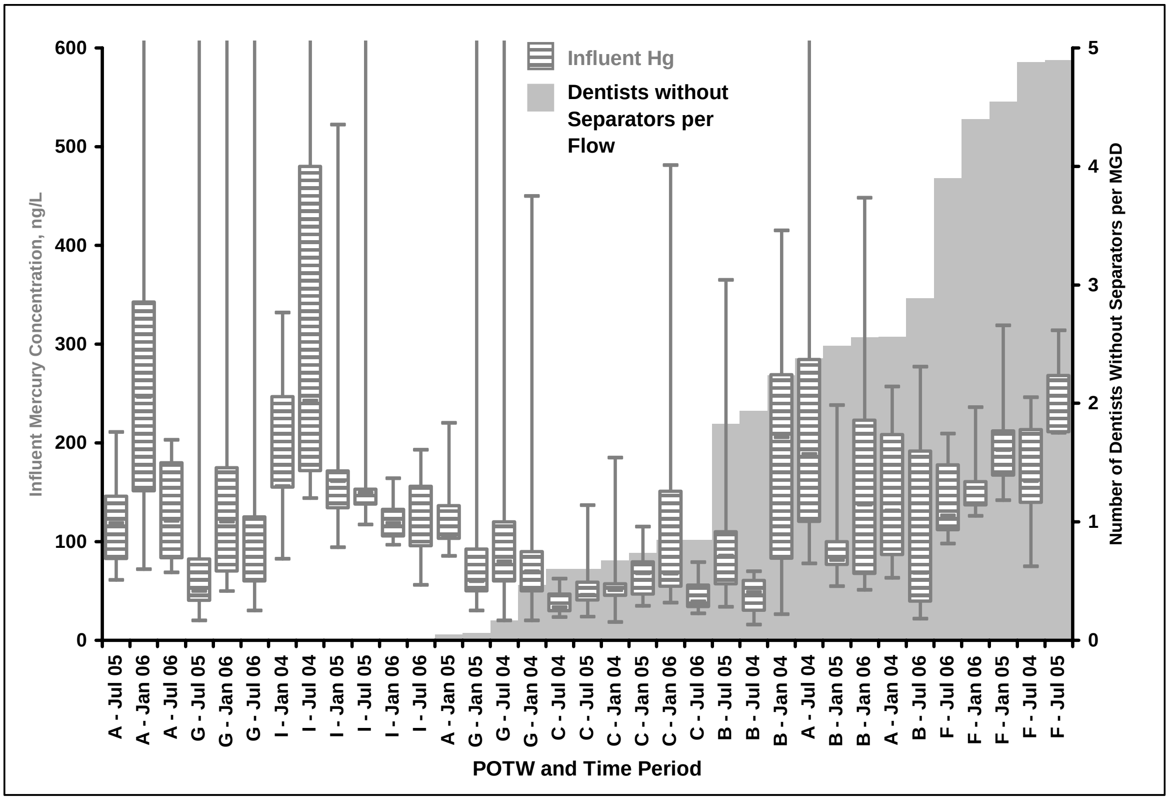

Figure 4.6A: Influent Mercury Concentration and Dentists without Separators per Flow

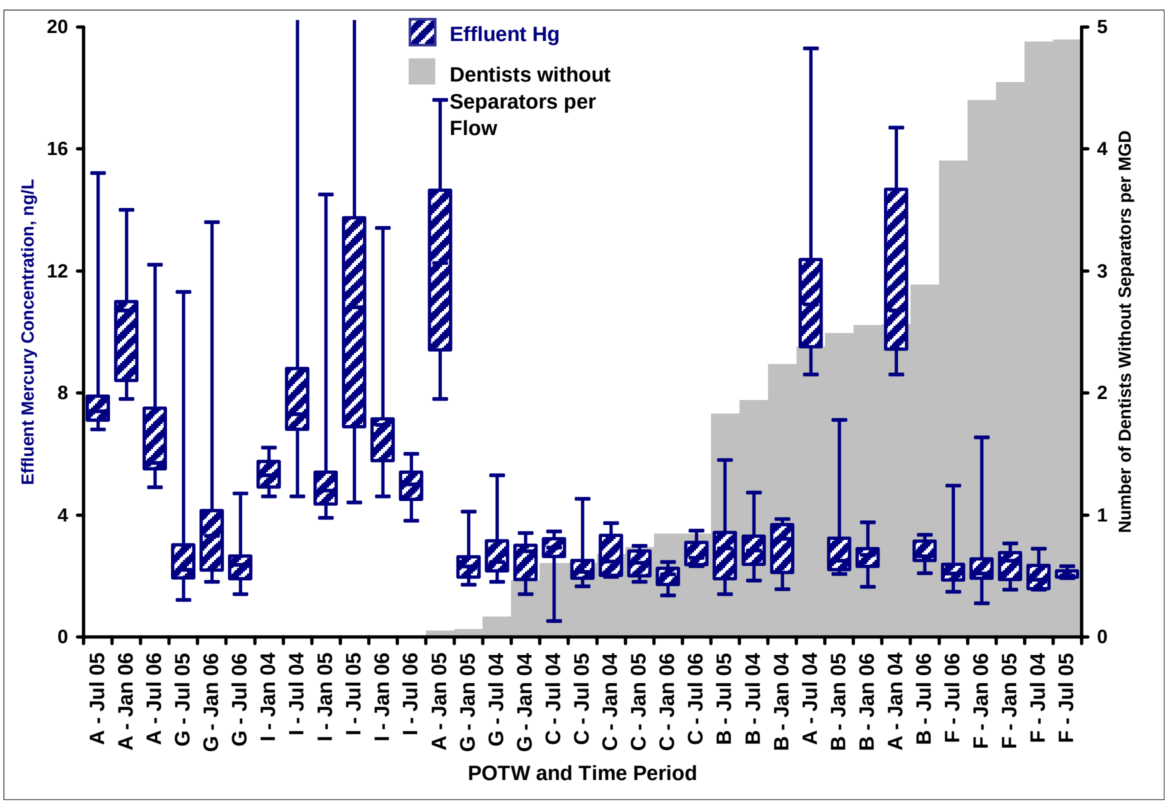

Figure 4.6B: Effluent Mercury Concentration and Dentists without Separators per Flow

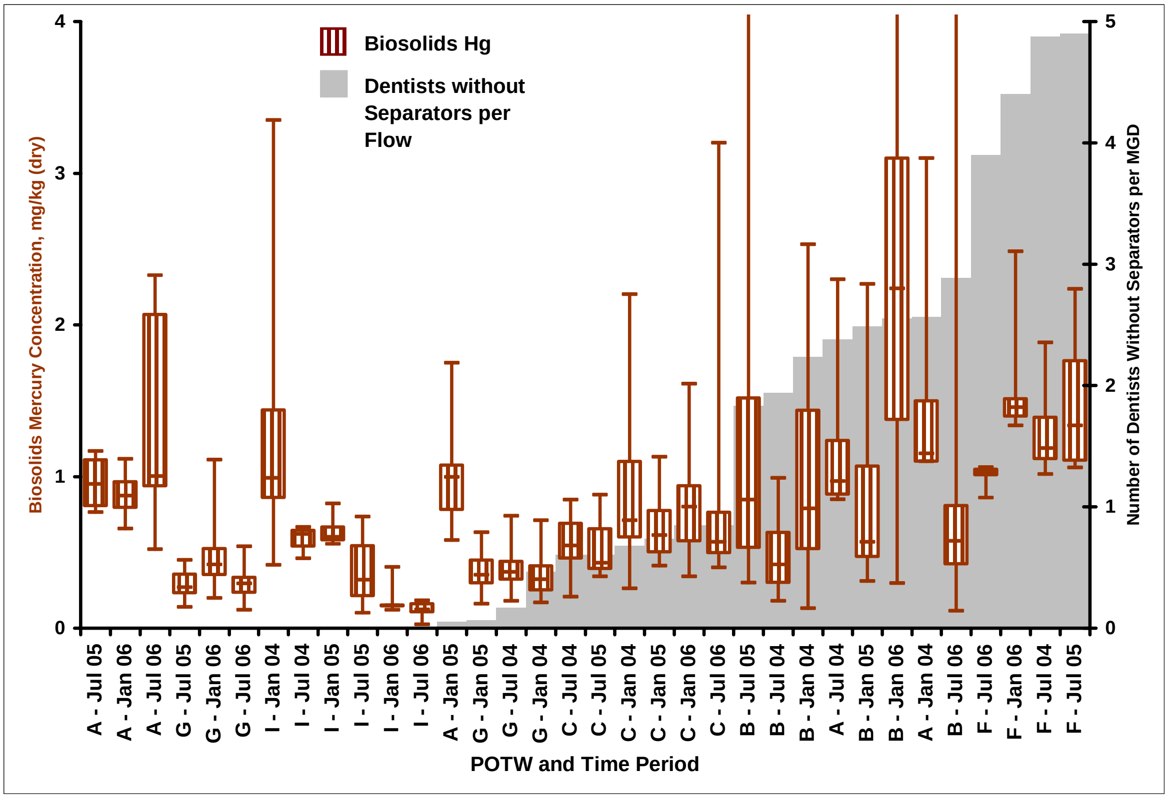

Figure 4.6C: Biosolids Mercury Concentration and Dentists without Separators per Flow

4.7 Plant Flow

An examination of plant flow as it is related to median mercury concentrations in POTW influent, effluent and biosolids revealed no statistically significant ($p > 0.10$) correlations. These relationships are shown in Figures 4.7A through 4.7C.

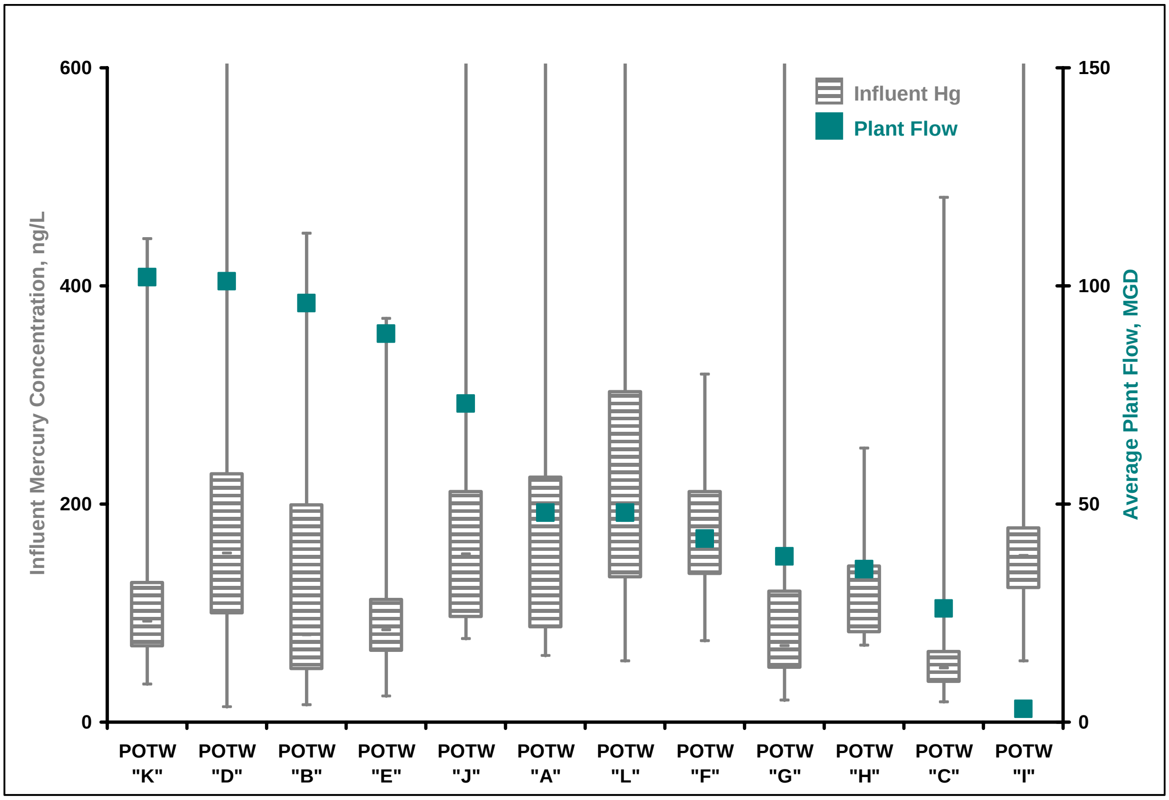

Figure 4.7A: Influent Mercury Concentration and Average Plant Flow

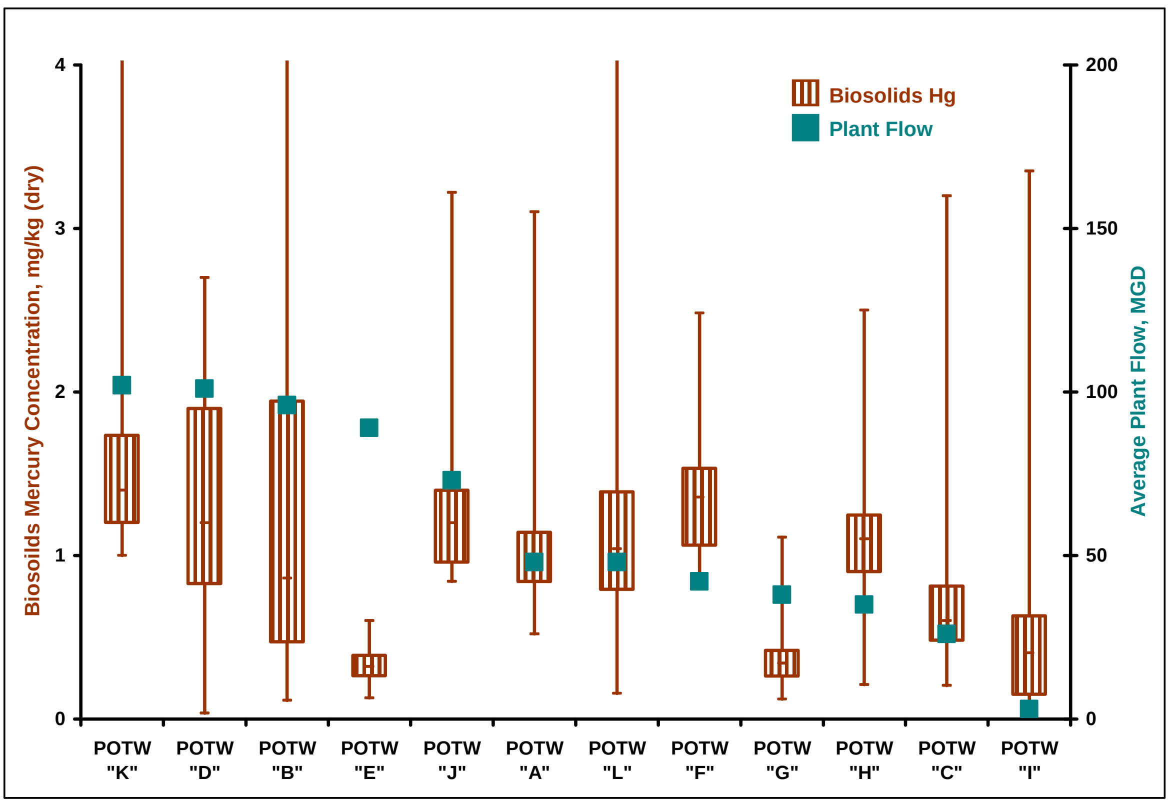

Figure 4.7B: Biosolids Mercury Concentration and Average Plant Flow

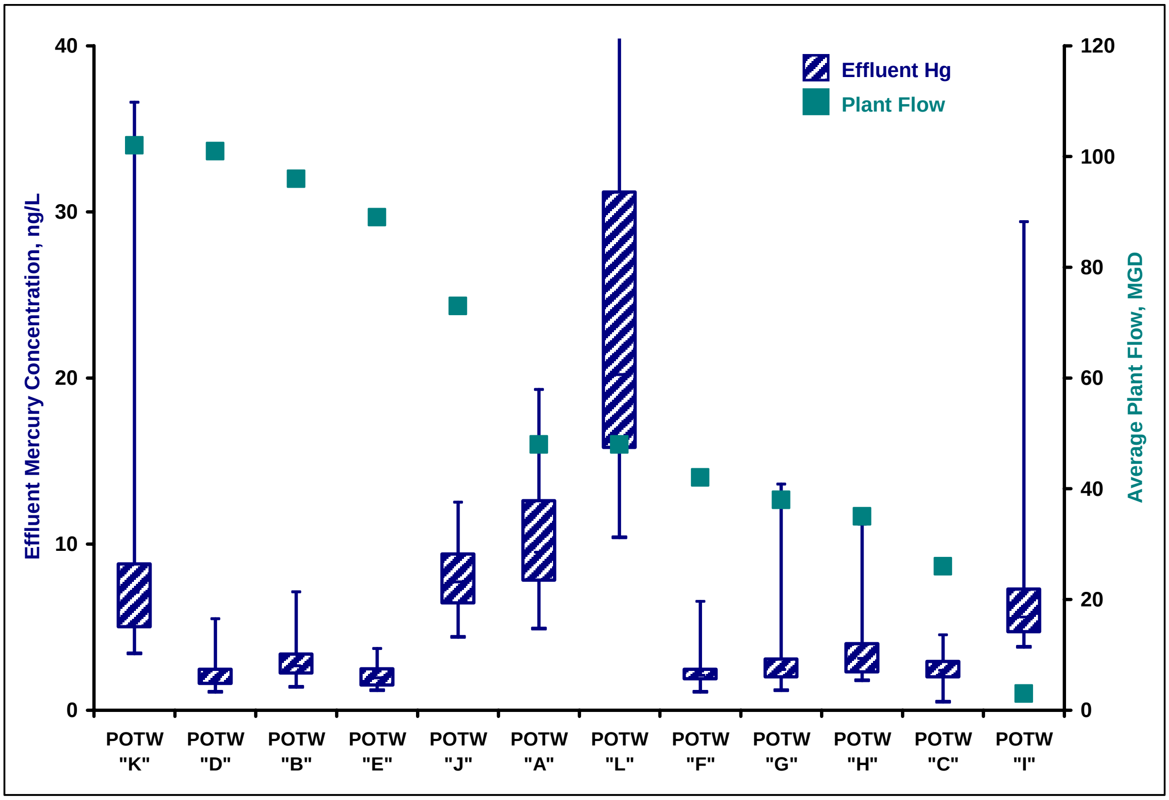

Figure 4.7C: Effluent Mercury Concentration and Average Plant Flow

4.8 NON-INDUSTRIAL FLOW

Another factor that was examined to determine the effects on mercury concentrations was the percentage of industrial flow. POTWs "D" and "E" were excluded because the percent of the influent from industrial sources is not known. POTW "B" was excluded because the effects of the interceptor cleaning project could skew the results. The data collectively indicated that there is an increase in influent, effluent, and biosolids mercury concentrations with an increase in relative non-industrial flow (Figures 4.8A through 4.8C). Although influent and biosolids mercury concentrations appear to be more strongly related to non-industrial flow than effluent concentrations do, the correlations for median influent and median biosolids are not statistically significant ($p > 0.05$), while that for median effluent is, with a p-value of 0.036.

However, included within these results are those for both combined and separate sewer systems. If the stormwater included in the combined systems had a lower mercury concentration than other non-industrial flows did, the strength of these relationships may have been influenced. To eliminate this variable, only the results from POTWs with solely separate sewer systems were examined (Figures 4.8D through 4.8F). The correlations between influent, effluent, and biosolids median mercury concentrations and percentage of non-industrial flow were all found to be statistically non-significant at the $\alpha = 0.05$ level. However, these correlations for median influent and median effluent, but not median biosolids, mercury concentrations were significant at the $\alpha = 0.10$ level. Considering all of these results, it is possible that industrial flow generally contains less mercury than other wastewaters, thereby providing dilution when it is present. This is consistent with the findings of a 2000 NACWA (formerly Association of Metropolitan Sewerage

Agencies) report titled "Evaluation of Domestic Sources of Mercury" that demonstrated that domestic wastewater is a significant source of mercury at POTWs.

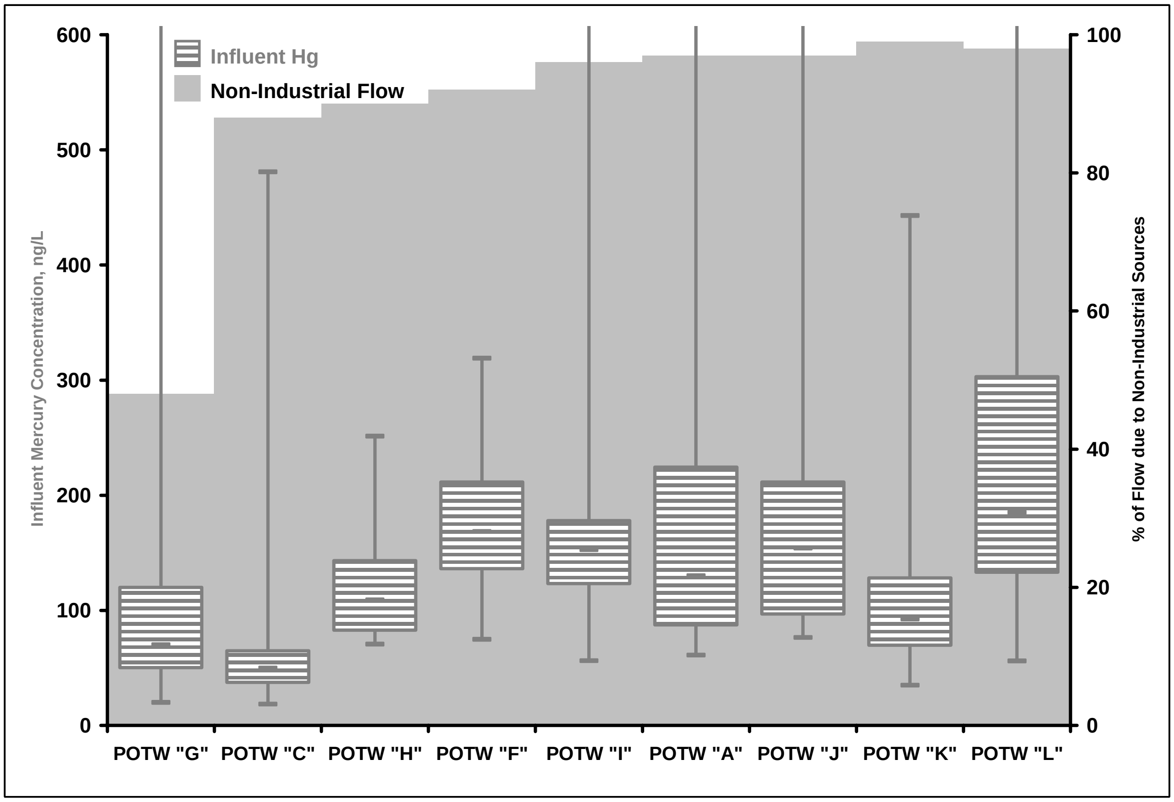

Figure 4.8A: Influent Mercury Concentration and Non-Industrial Flow

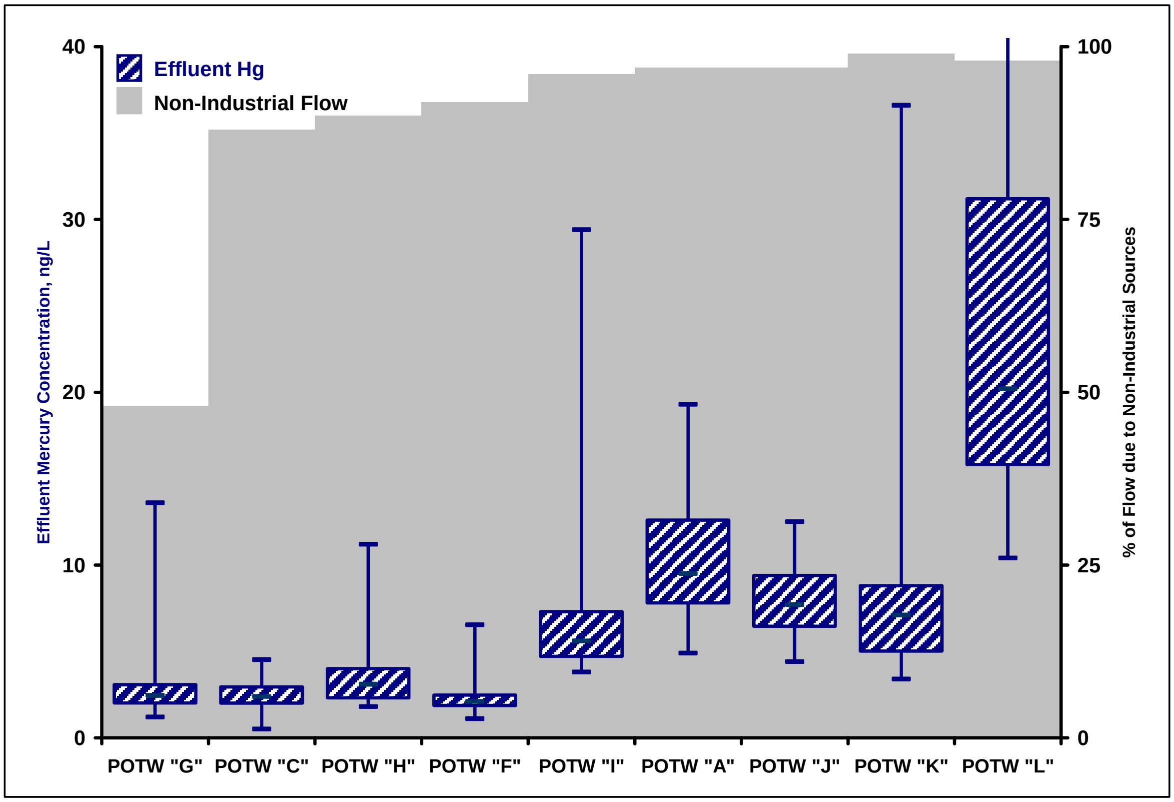

Figure 4.8B: Effluent Mercury Concentration and Non-Industrial Flow

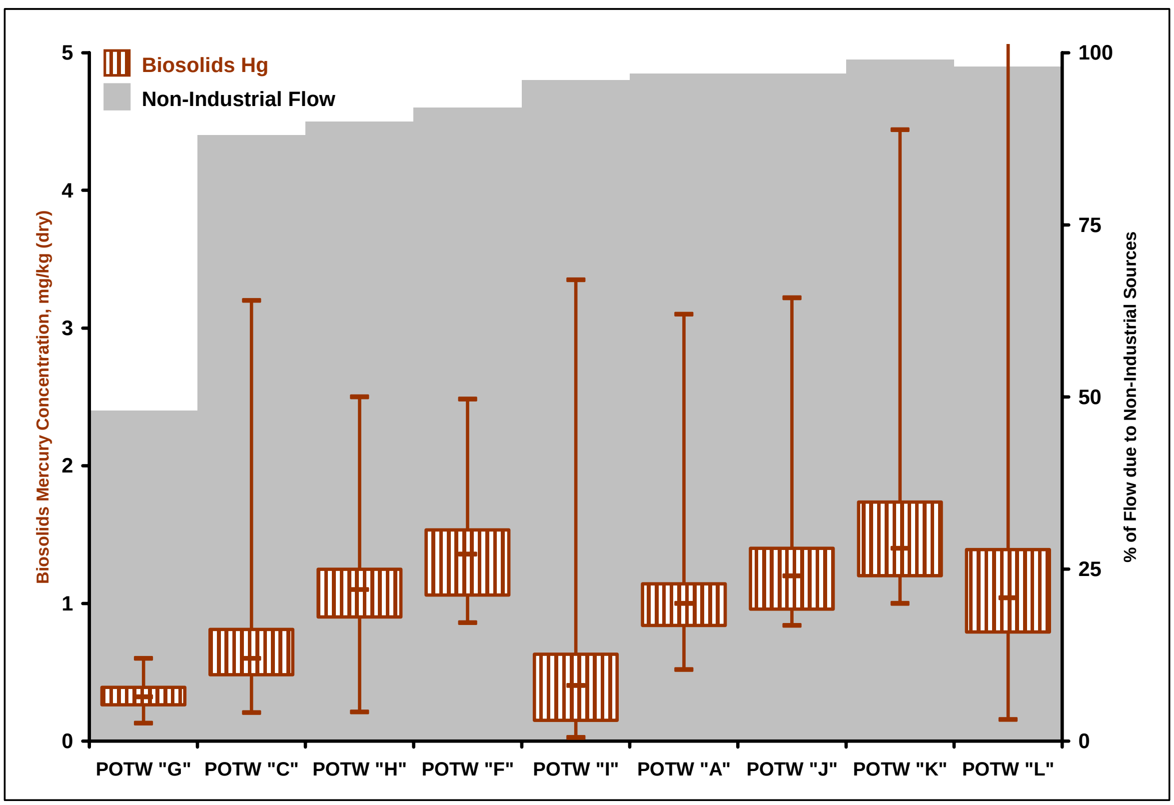

Figure 4.8C: Biosolids Mercury Concentration and Non-Industrial Flow

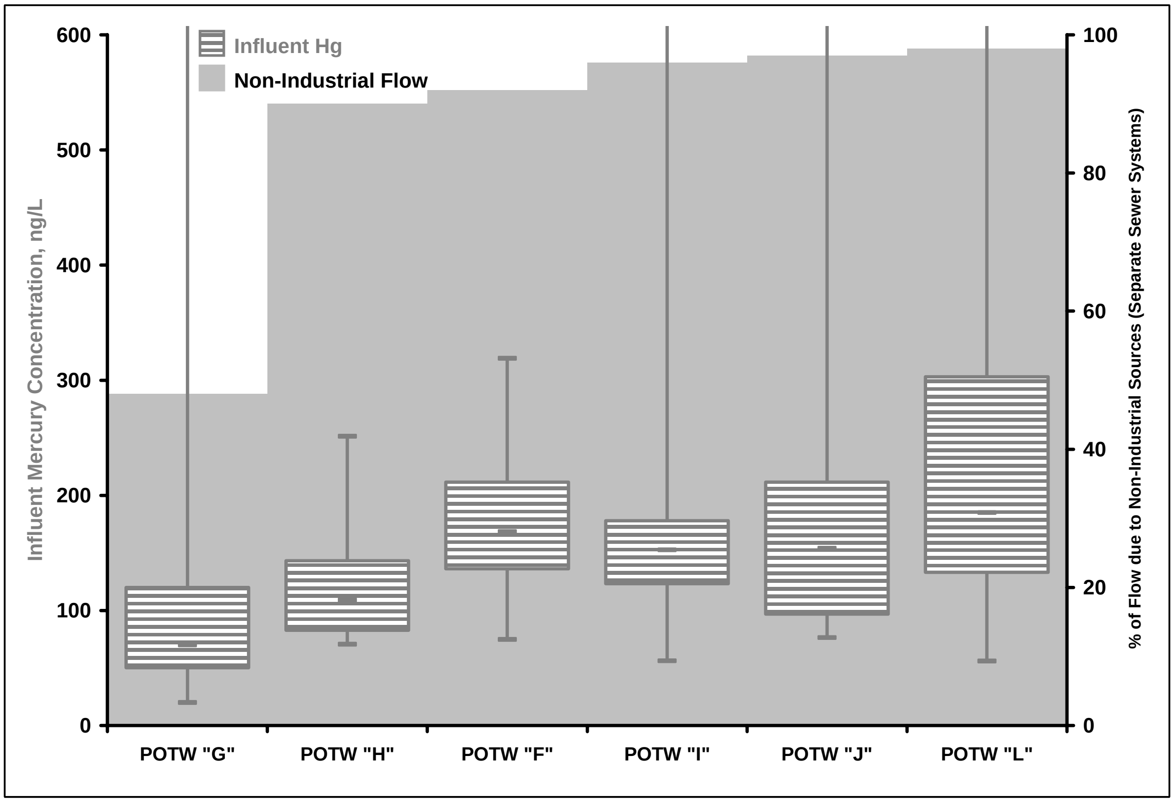

Figure 4.8D: Influent Mercury Concentration and Non-Industrial Flow in Separate Sewer Systems

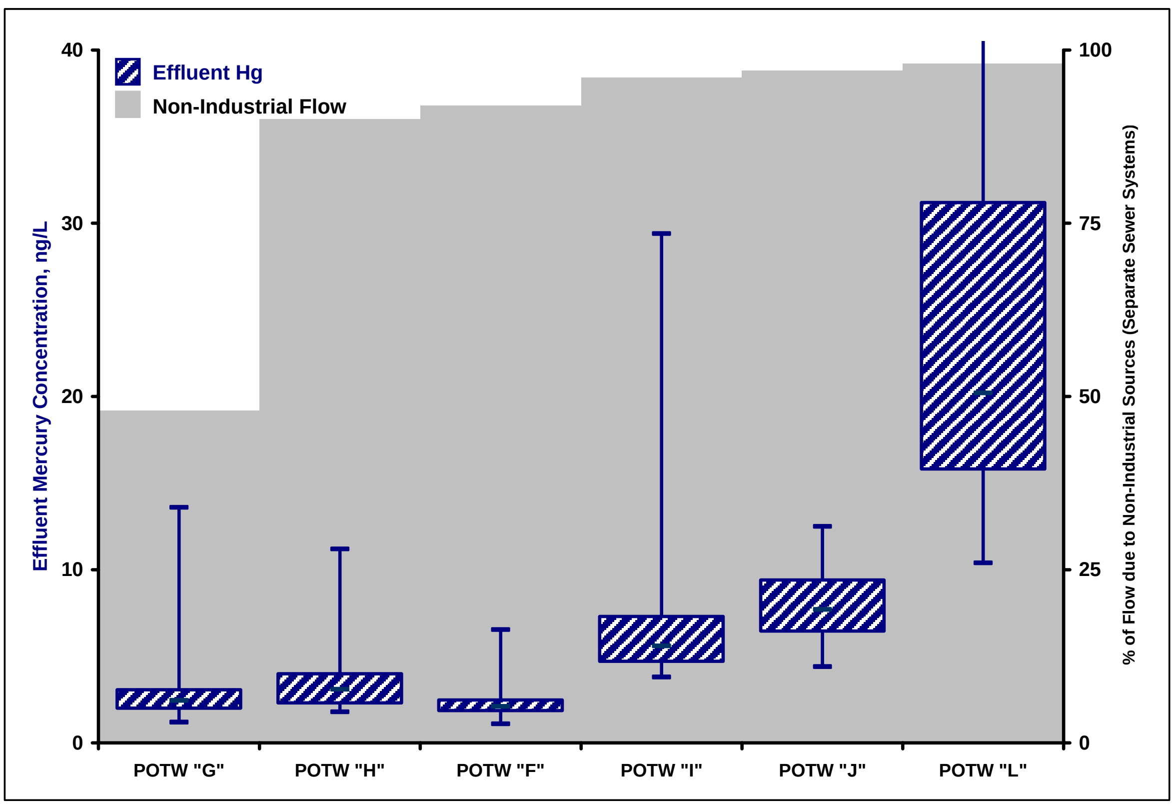

Figure 4.8E: Effluent Mercury Concentration and Non-Industrial Flow in Separate Sewer Systems

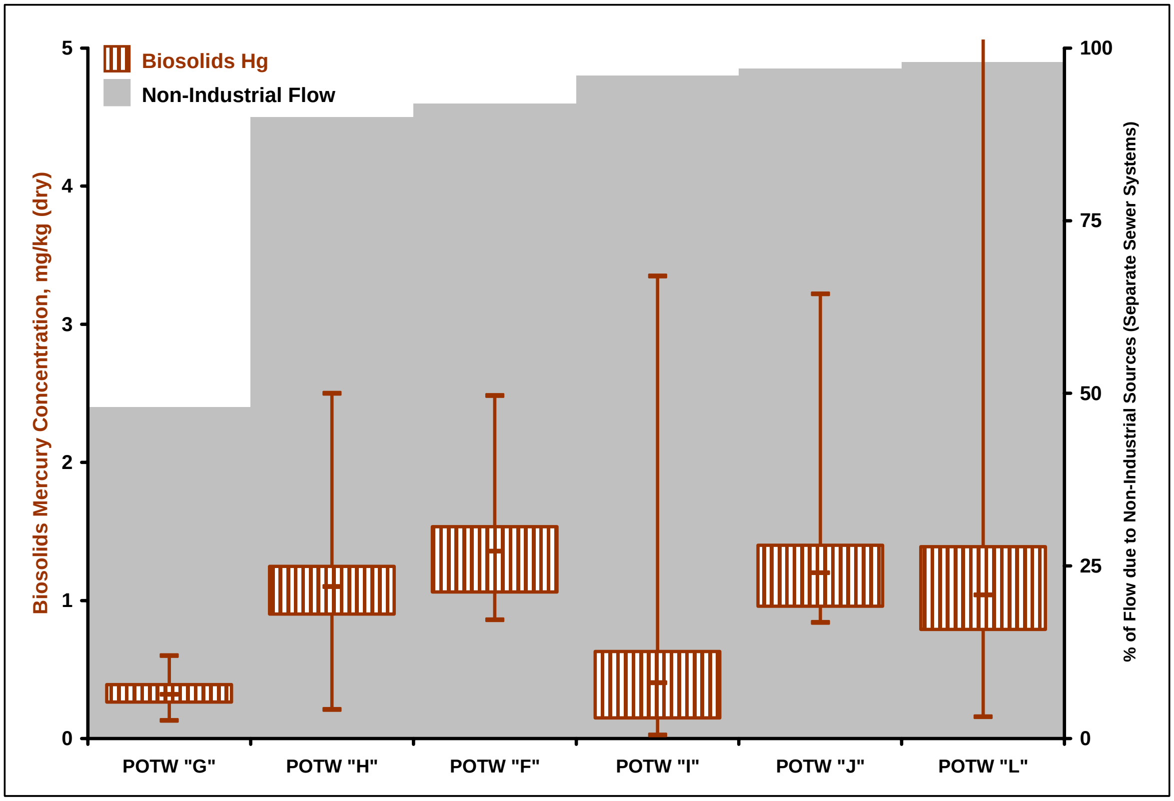

Figure 4.8F: Biosolids Mercury Concentration and Non-Industrial Flow in Separate Sewer Systems

4.9 Freshwater vs. Marine/Estuarine Dischargers

A comparison was made between the POTWs that have freshwater discharges and those with marine or estuarine discharges. There are no clear differences between these two categories of treatment plants for both influent and biosolids mercury concentrations (Figures 4.9A and 4.9C). It was found, however, that POTWs with discharges to freshwater generally have lower effluent mercury concentrations than did their saltwater counterparts (Figure 4.9B). The reason for this difference is unclear and should be further examined. It is possible that POTWs that discharge to freshwater are providing different levels of treatment than POTWs that discharge to marine/estuarine waters for the removal of wastewater constituents with which effluent mercury concentrations are incidentally lowered.

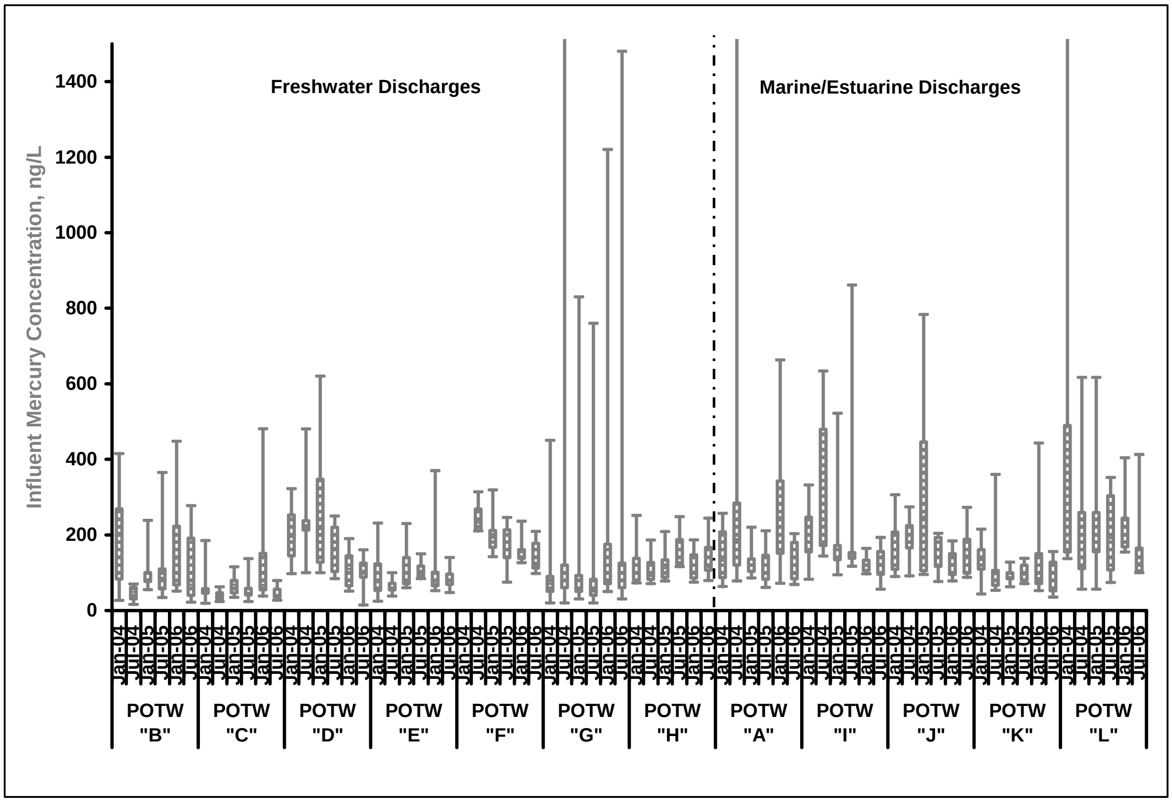

Figure 4.9A: Influent Mercury Concentration and Receiving Water Type

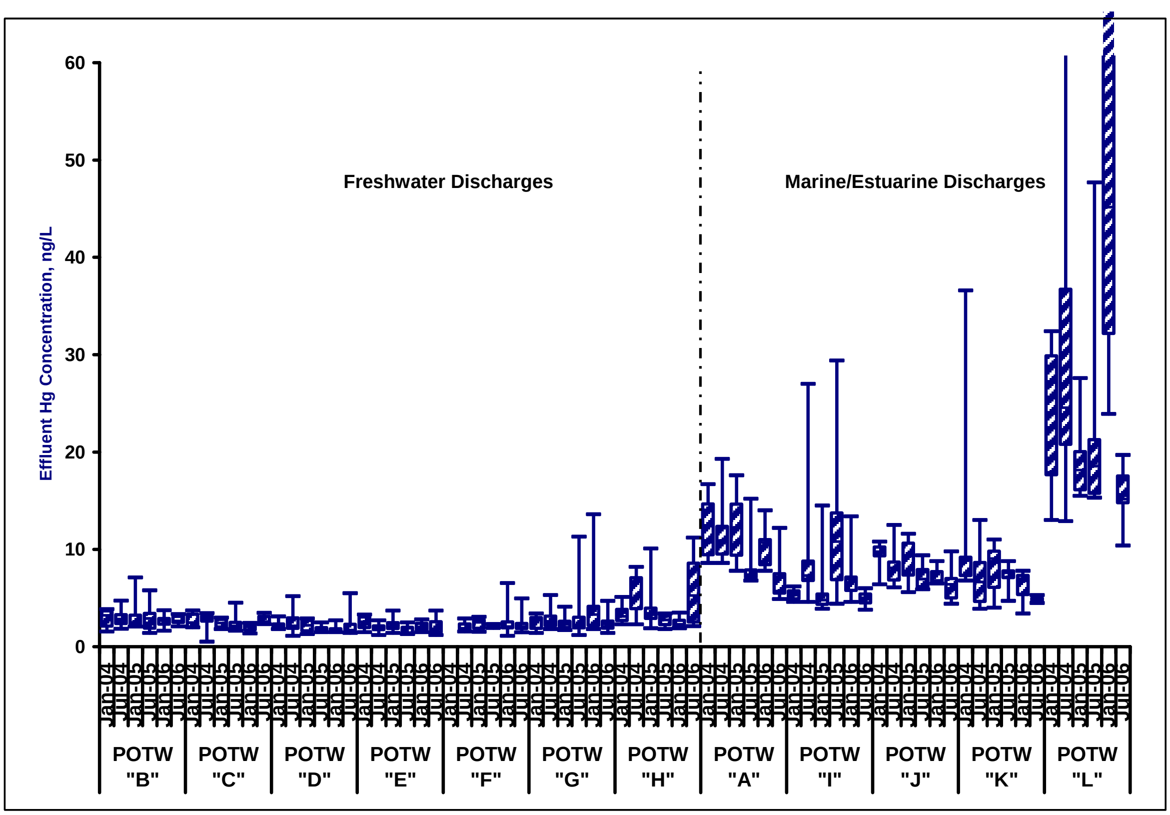

Figure 4.9B: Effluent Mercury Concentration and Receiving Water Type

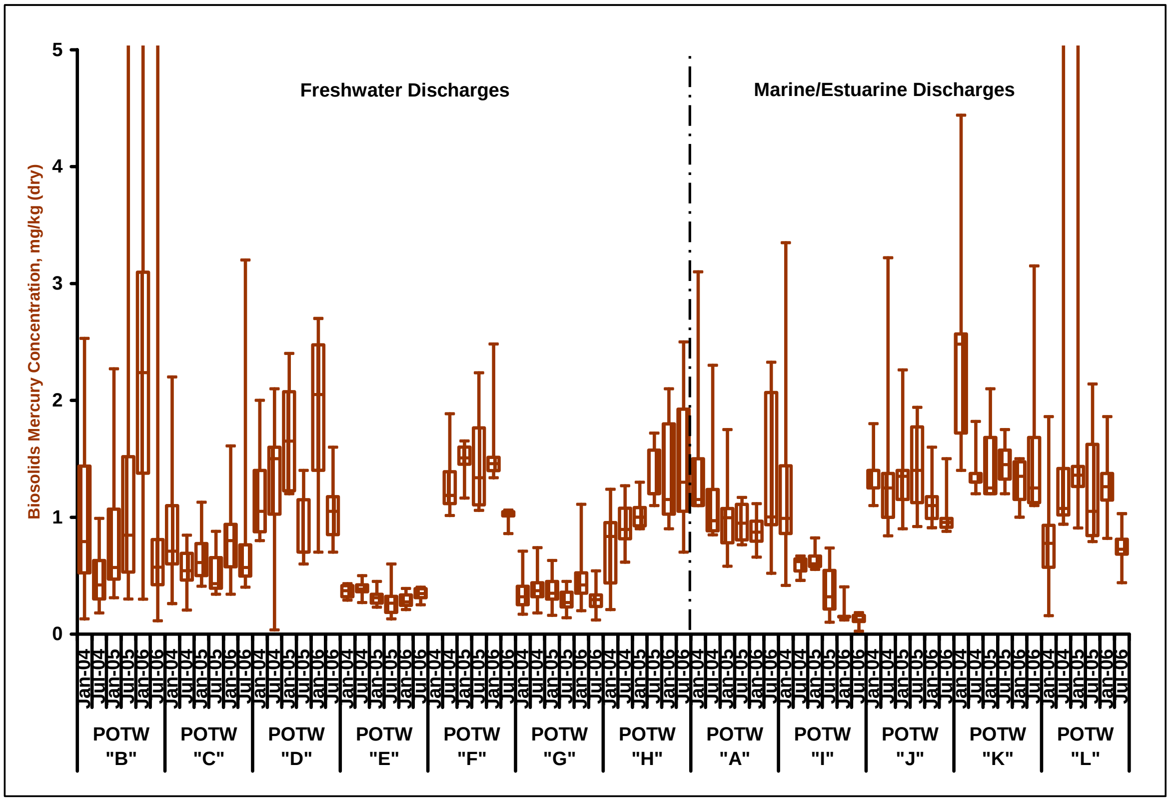

Figure 4.9C: Biosolids Mercury Concentration and Receiving Water Type

4.10 IRON SALTS

The results from the sampling indicate that those POTWs that do not use iron salts (e.g., ferric chloride, ferrous sulfate) have generally higher effluent mercury concentrations (Figure 4.10A). Since iron salts are used as flocculants, especially for metals removal, this trend is not unexpected. The POTWs that use iron salts are the same as the POTWs with freshwater discharges. This may help to explain the difference in effluent mercury concentrations that was observed when freshwater discharges were compared to saltwater/estuarine discharges. There was no relationship found between use of iron salts and biosolids mercury concentrations (Figure 4.10B). This finding suggests that effluent mercury levels may be affected by iron salt addition, while its impact on biosolids mercury levels is not significant. This would be consistent with the relative magnitude of effluent versus biosolids mercury quantities.

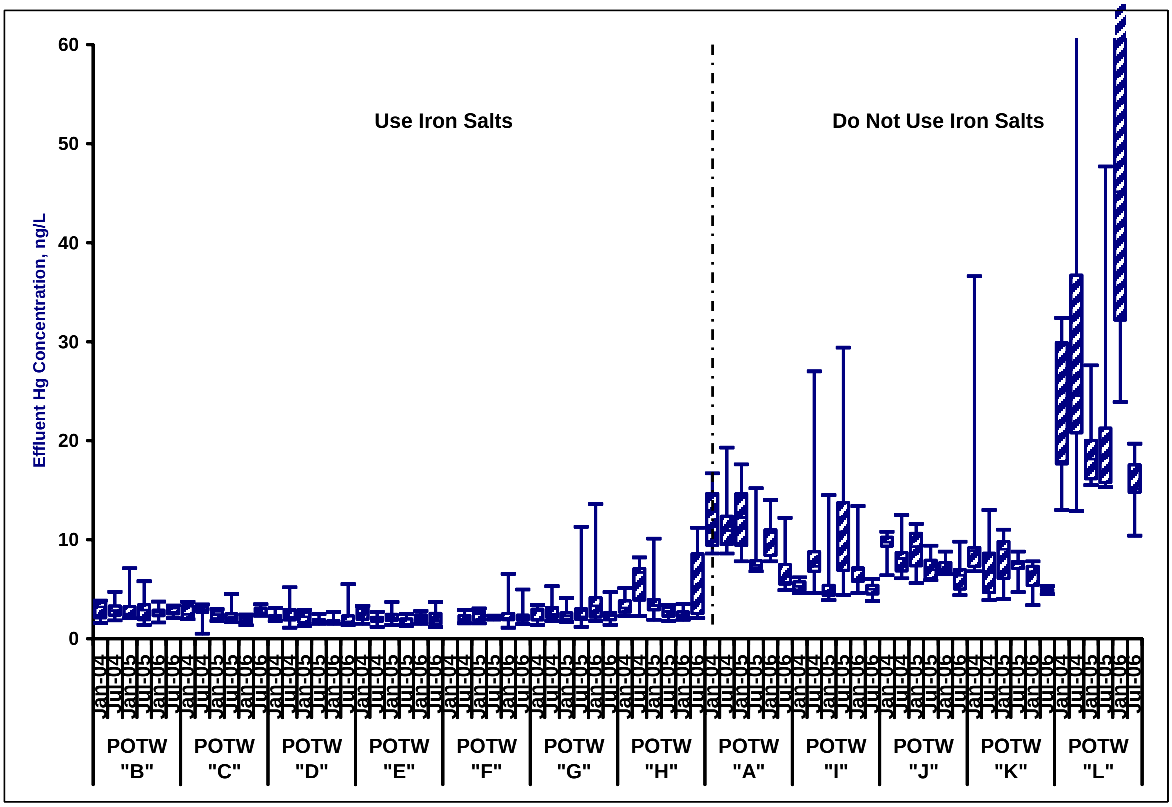

Figure 4.10A: Effluent Mercury Concentration and Use of Iron Salts

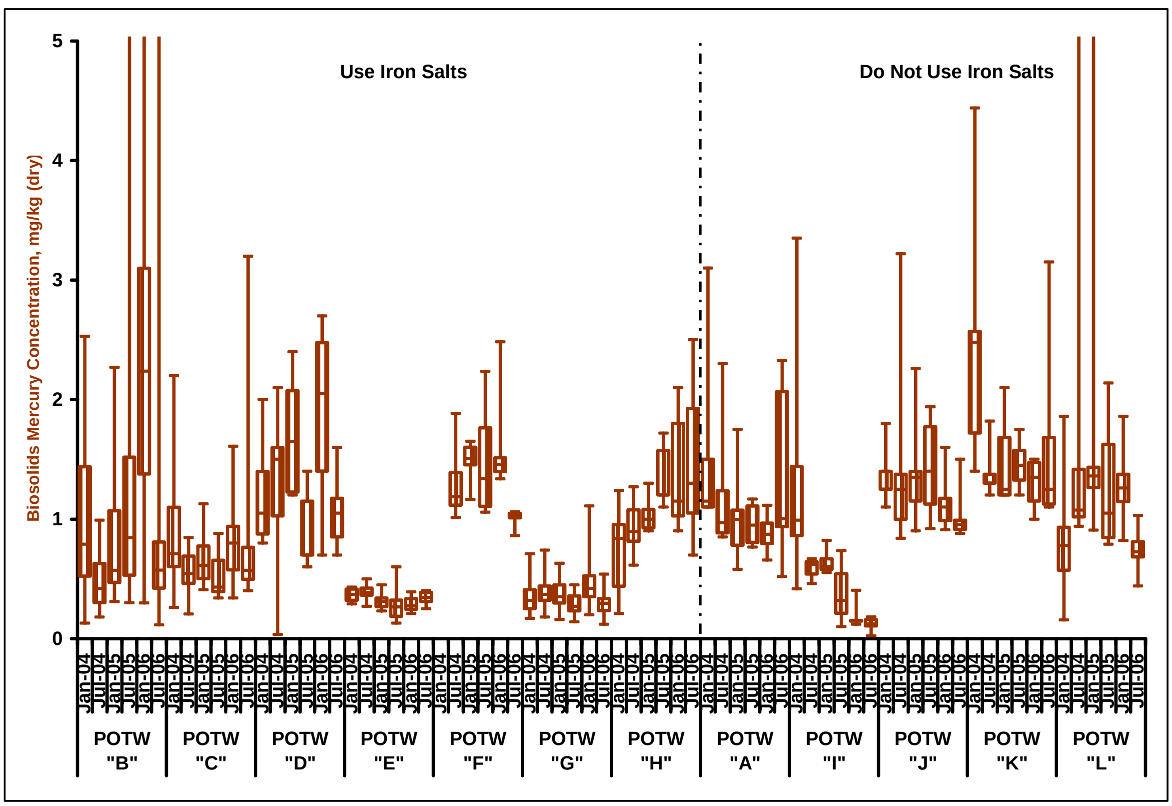

Figure 4.10B: Biosolids Mercury Concentration and Use of Iron Salts

4.11 HAULED-IN WASTES

POTWs that accept hauled-in wastes were examined to determine if they have higher influent, effluent, and biosolids mercury concentrations. No differences were found in these three parameters between plants that do and do not accept hauled-in waste (Figures 4.11A through 4.11C).

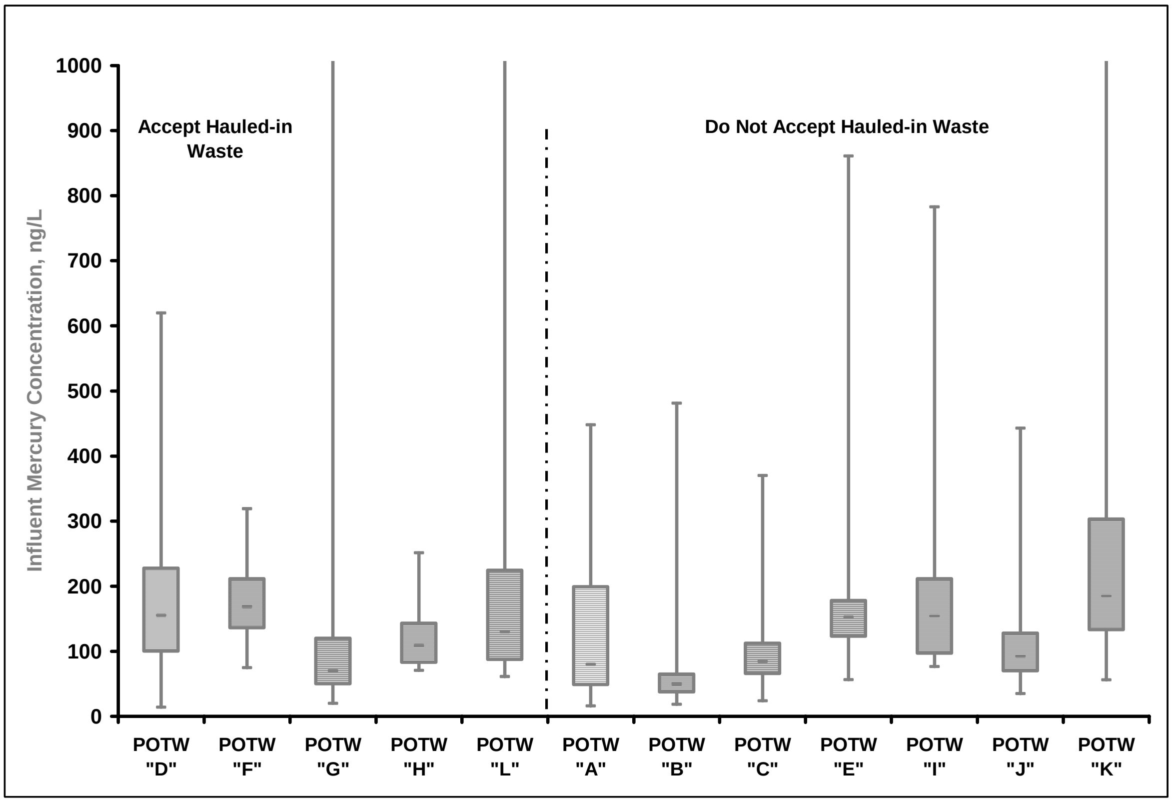

Figure 4.11A: Influent Mercury Concentrations and Hauled-in Waste

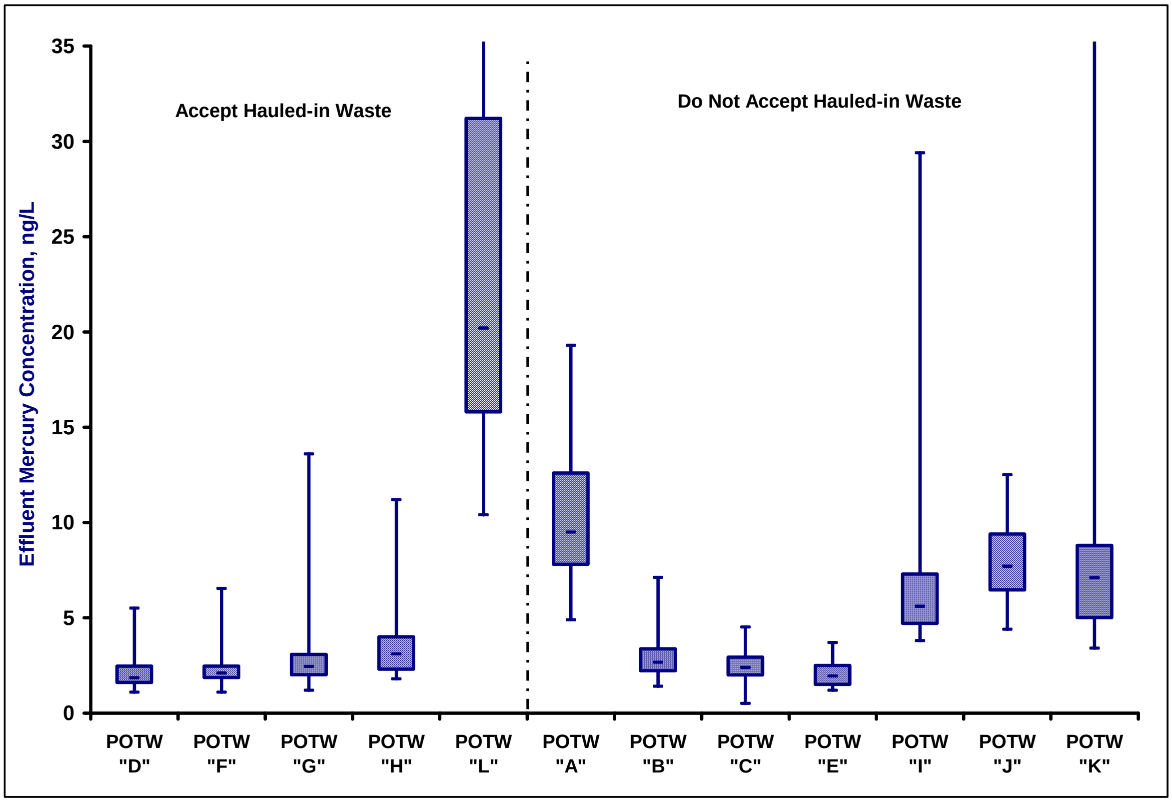

Figure 4.11B: Effluent Mercury Concentrations and Hauled-in Waste

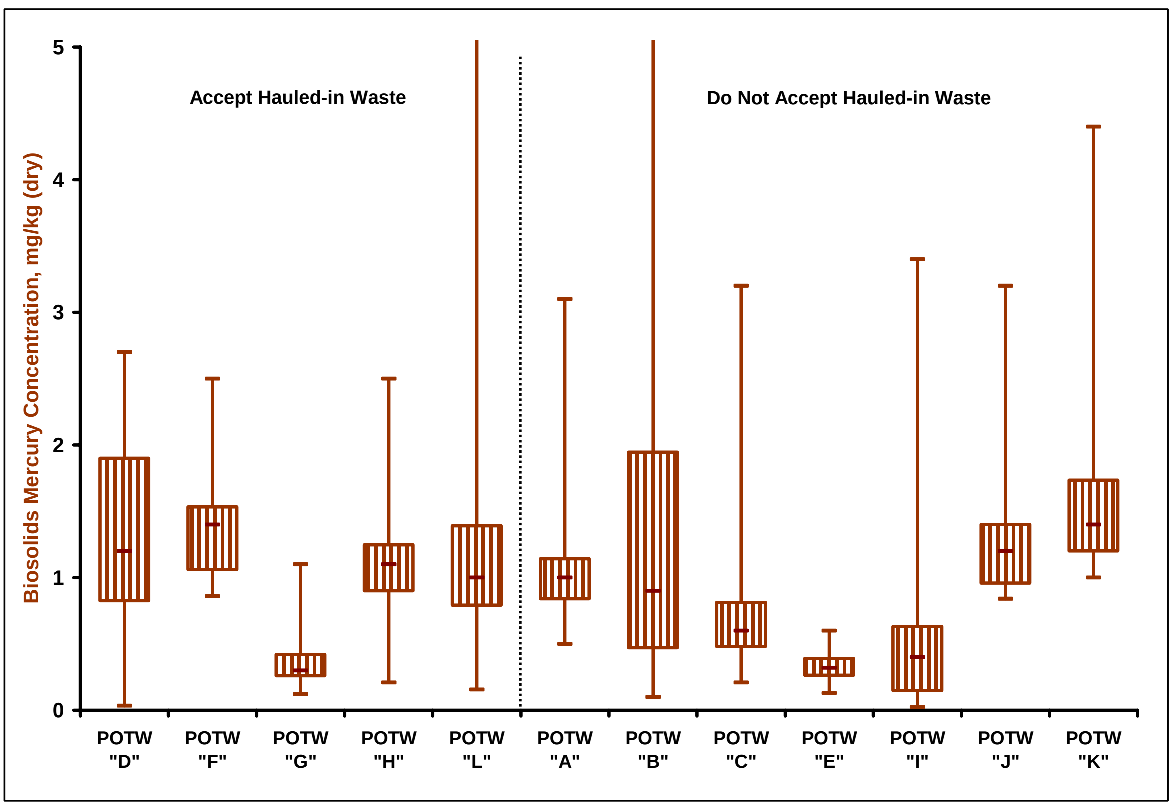

Figure 4.11C: Biosolids Mercury Concentrations and Hauled-in Waste

4.12 POPULATION DENSITY

Population density within each POTW's service area was also examined to determine if there was a correlation with mercury concentrations. It was found that there is no clear trend between an increasing number of persons per square mile and the influent, effluent, or biosolids mercury concentrations (Figures 4.12A through 4.12C). A more in-depth examination of influent trends, such as decreasing flow due to water conservation activities, could provide more insight.

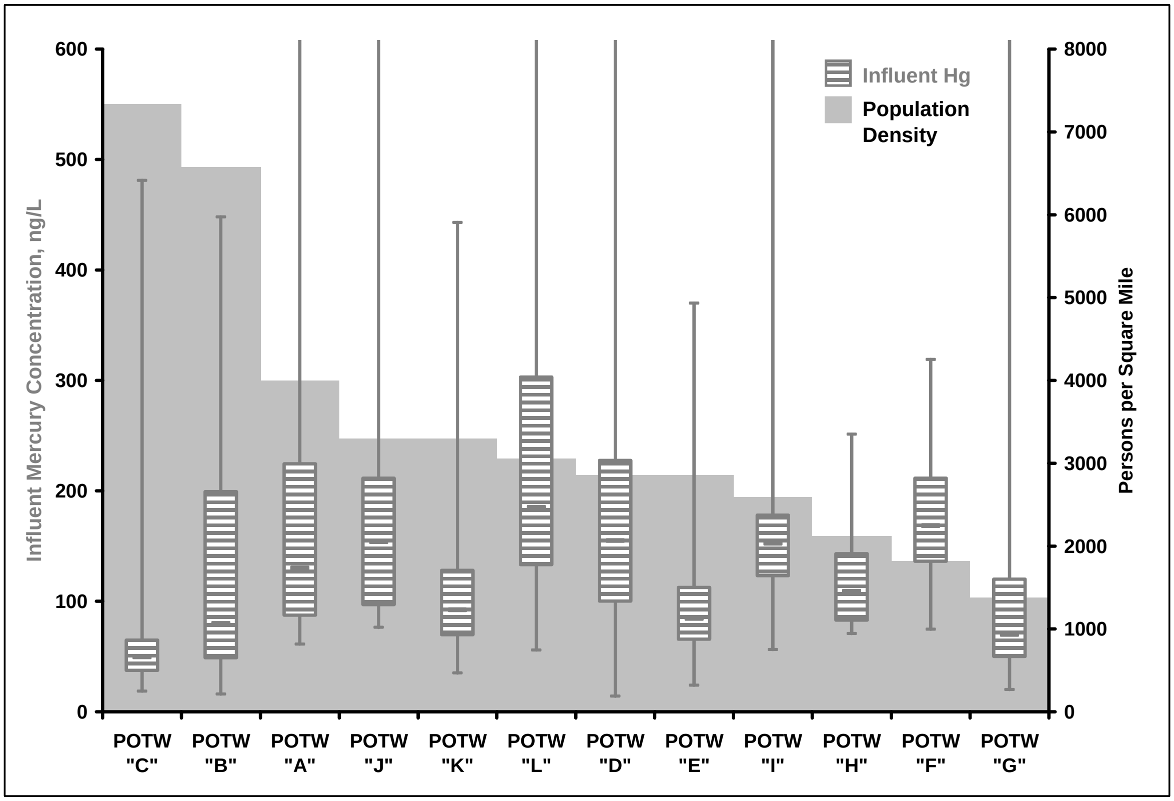

Figure 4.12A: Influent Mercury Concentration and Population Density

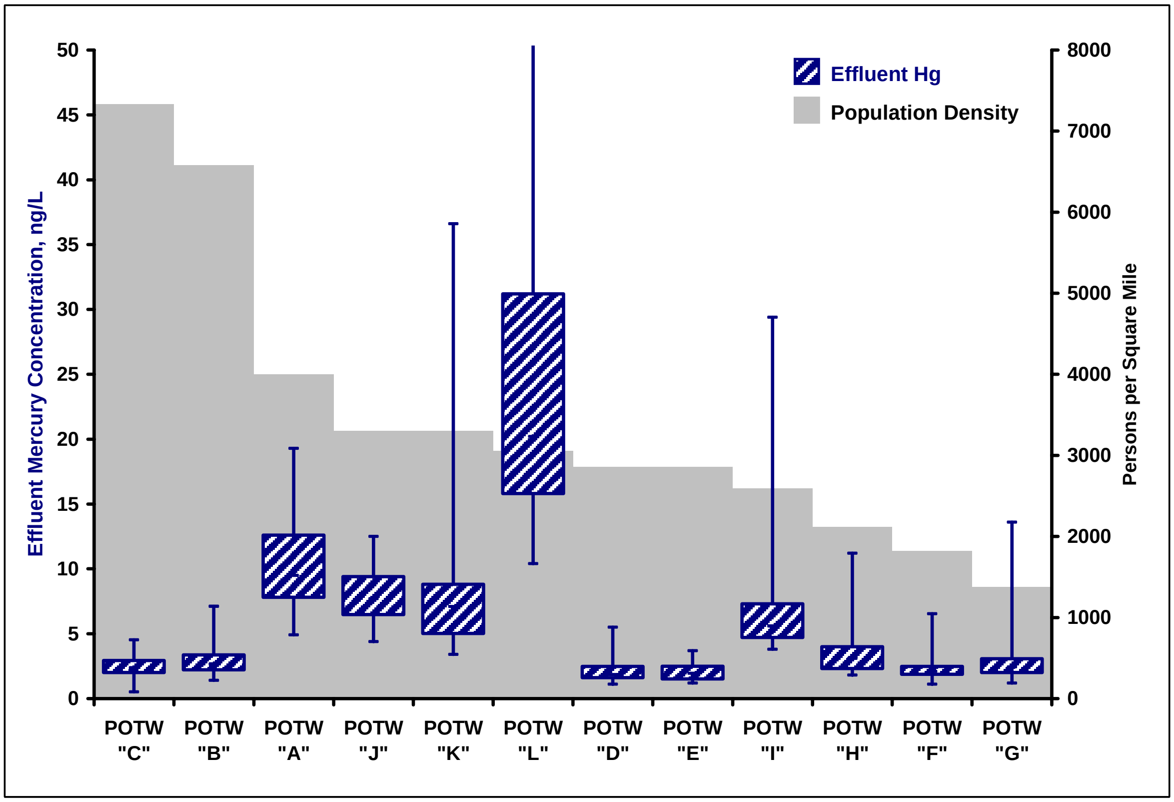

Figure 4.12B: Effluent Mercury Concentration and Population Density

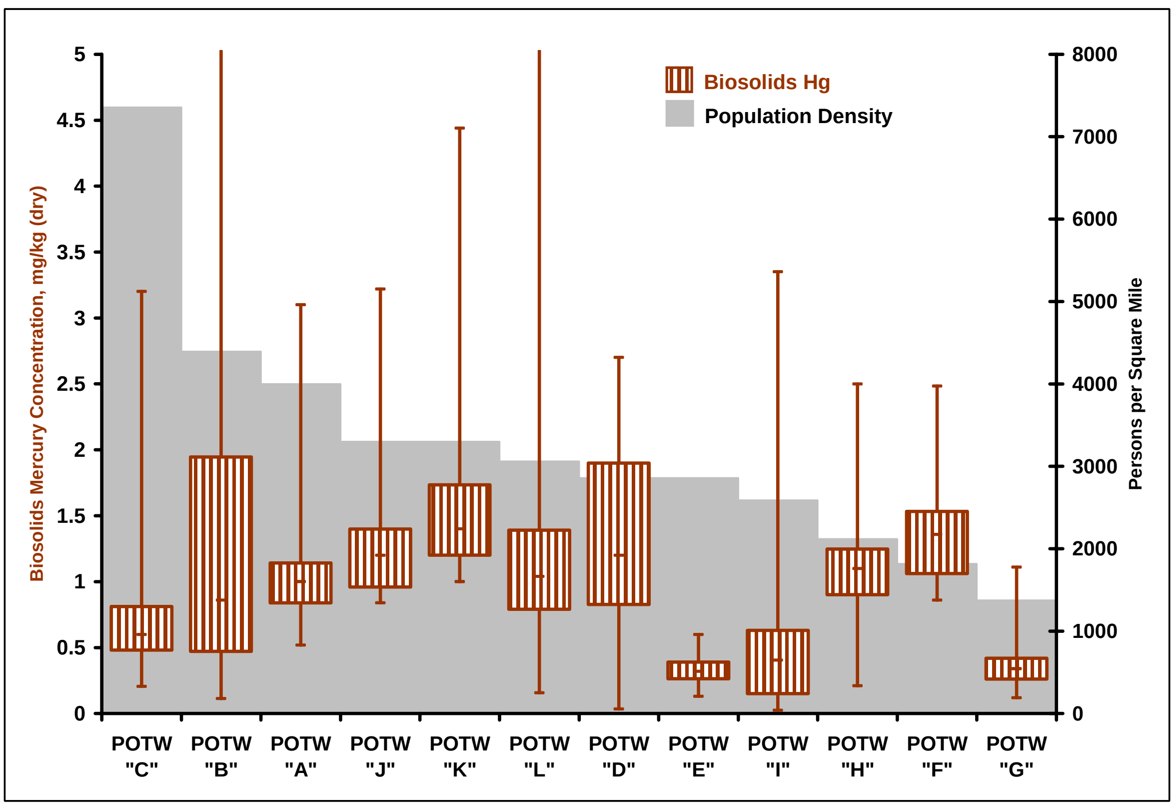

Figure 4.12C: Biosolids Mercury Concentration and Population Density

4.13 COMBINED OR SEPARATE COLLECTION SYSTEMS

Mercury concentrations at POTWs with combined collection systems were compared to those with separate collection systems. As shown in Figures 4.13A through 4.13C, there was not a clear difference between those areas with combined sewers versus those with separate sewers.

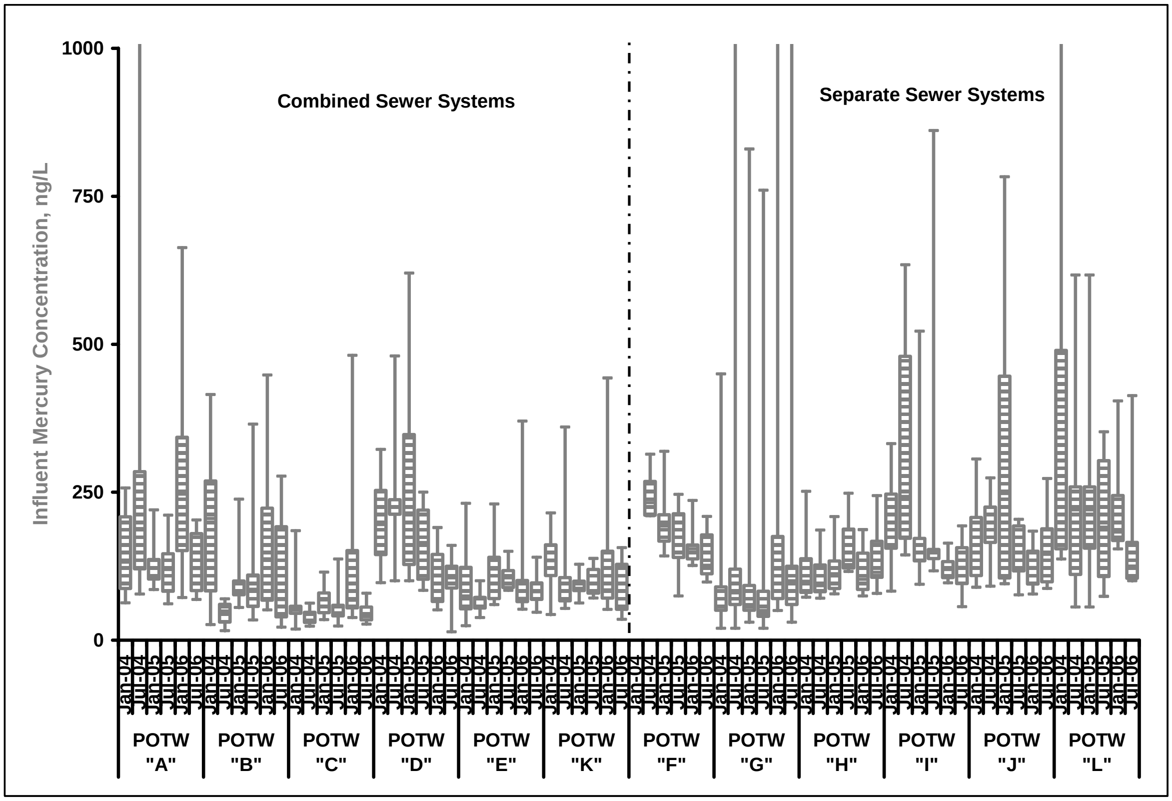

Figure 4.13A: Influent Mercury Concentrations and Sewer System Type

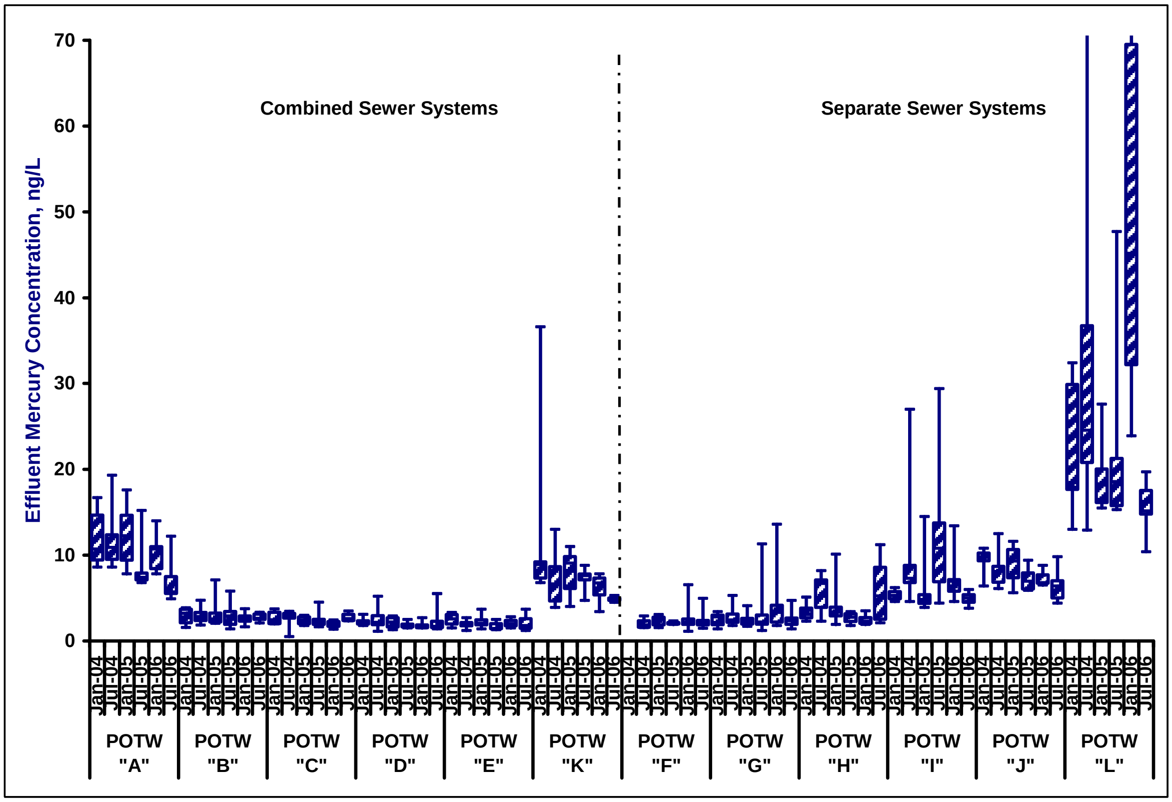

Figure 4.13B: Effluent Mercury Concentrations and Sewer System Type

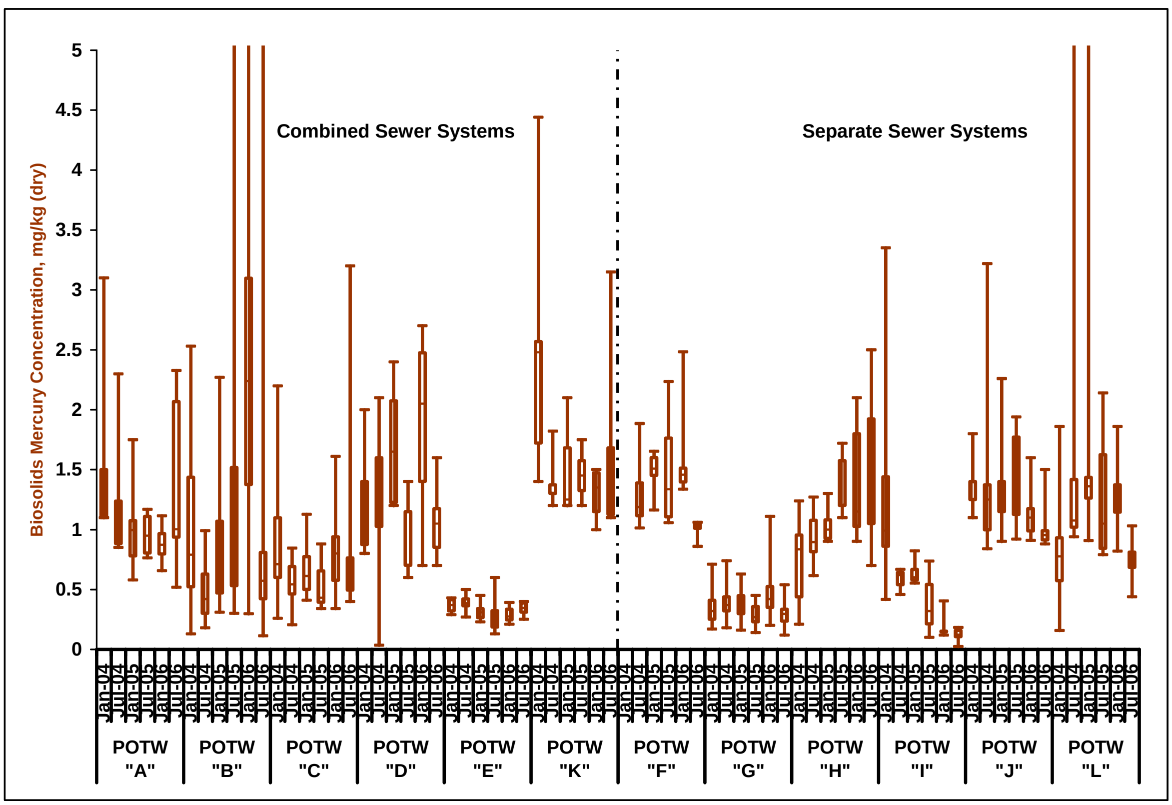

Figure 4.13C: Biosolids Mercury Concentrations and Sewer System Type

5. SUMMARY AND CONCLUSIONS

An objective of this study was to examine the effect of practical and reasonable measures of controlling significant sources of mercury to the POTW collection system, such as installing dental amalgam separators, on the ability of POTWs to comply with anticipated effluent limitations. Mercury levels at various POTWs were monitored for a three-year period. These levels were then compared to amalgam separator use in the treatment plant's service area and various other factors to determine which were most strongly related.

Collectively, the influent mercury concentrations at the POTWs in the study were found to be highly variable, ranging from 14 ng/L to 3080 ng/L. When considering facilities individually, some exhibited decreases in their influent mercury concentrations over the course of the sampling project, while others had apparent increases. Effluent mercury concentrations also exhibited variability between plants but less variability within plants. For six-month periods, median effluent mercury concentrations were as low as 1.4 ng/L and as high as 45.15 ng/L. For the biosolids, there was variability both within and among the plants. For six-month periods, median biosolids concentrations were as low as 0.1 mg/kg and as high as 2.5 mg/kg.

For the most part, the mercury removal efficiency from influent to effluent was relatively the same at each of the treatment plants and generally greater than 90%. While the POTWs were similar in this aspect, in other ways they were not. For instance, the percent of effluent mercury that was dissolved was found to vary based on the POTW. The highest median effluent dissolved mercury percentage occurred at POTW "G" (59%), while the lowest was at POTW "A" (22%). Additionally, at eight of the POTWs, there appeared to be a direct relationship between effluent mercury concentration and effluent TSS concentration while, at the remaining four POTWs, this relationship did not appear to exist. It is unclear as to why effluent TSS concentrations appear to be a good predictor of effluent mercury concentrations at some POTWs but not at others.

Since a primary an objective for this study was to determine whether the installation of amalgam separators in dentists' offices impacts mercury concentrations at treatment plants, it was first demonstrated that the mercury discharged by dentists impacts the amounts of mercury observed at the plants. Collectively, the study results indicate that the presence of dentists in a POTW's collection system influences mercury concentrations at the plant. An increase in dentists per flow was significantly related to higher influent and effluent mercury concentrations. There was no relationship, however, between numbers of dentists and biosolids mercury concentrations. This may be due to amalgam separators being installed by dentists in many of the POTWs' service areas.

It was found that, collectively, an increase in the number of dentists without amalgam separators installed resulted in higher biosolids mercury, indicating that amalgam separators could be reducing biosolids mercury concentrations. However, at individual plants, the installation of separators did not always lead to a decrease in biosolids mercury concentrations. It may be that the amalgam separator installation alone is not enough to result in permanent mercury reductions. Some of the plants that showed decreases in mercury also have programs in place to ensure that the separators are well operated and maintained. It is also possible that, on an individual-facility basis, apparent reductions or the lack thereof could be the result of other impacting factors such as previous elevated loadings related to sewer cleaning, construction activities, or historic depositions of mercury in the collection system.

Effluent mercury concentrations were found to decrease at several POTWs as the percentage of dentists with amalgam separators increased. The POTWs that exhibited reductions all had relatively high effluent concentrations at the start of the study. It is possible that there were also reductions at the other POTWs, but these reductions were too small to be distinguished due to plant variability. Collectively, there was a negative correlation between the number of dentists without separators per flow and effluent mercury concentration. This may partly be a result of the limited number of amalgam separator installations that occurred at the POTWs that had generally lower effluent mercury concentrations at the study's outset.

In addition, based mostly on the results from POTW "I," where 93% of the dental facilities had dental amalgam separators installed up to two years prior to the start of the study, it may be hypothesized that mercury reductions following separator installations can take several years or even longer to demonstrate significant trends. If so, this is likely due to the amount of time that is necessary to flush accumulated amalgam particles from the collection system. The timeframe of this study may not have been long enough to determine significant trends for POTWs whose dental facilities were in the process of installing amalgam separators during the course of the study.

It should also be noted that some of the treatment plants exhibited reductions even without an increase in amalgam separator installation. These reductions may have come from changes in treatment processes or the implementation of BMPs. Therefore, on a facility-specific basis, the effectiveness of amalgam separators in reducing mercury should be examined in light of other activities that are occurring within the POTW and its service area to determine which factors are actually contributing to an observed reduction.

In addition to the presence of dentists within a POTW's collection area, several other factors were found to exhibit relationships with mercury levels at treatment plants. Those POTWs that use iron salts and those that discharge to freshwater systems were generally found to have lower effluent mercury concentrations than those that did not. Iron salts such as ferric chloride are typically used at wastewater treatment facilities as flocculants to increase settling; therefore, it is possible that iron salts lead to increased amounts of mercury settling out of the wastewater.

Based on individual results found at POTW "A" and POTW "B", sewer cleaning projects can have significant effects on biosolids mercury levels and potentially on influent and effluent mercury levels. This is because sewer cleaning likely resuspends particles that have settled in the sewer collection system, enabling them to migrate to the POTWs.

Effluent and biosolids mercury concentrations at a treatment plant were also found to be related to industrial flow, although the statistical significance of this relationship was less than for other factors. An increase in the percent of non-industrial flow to a plant mostly resulted in increasing mercury levels. This likely reflects the fact that industrial flow generally has lower mercury concentrations than other types of collection system flow and therefore, when it is present, tends to dilute wastewater mercury from other sources.

Other factors that were examined but not found to be related to mercury levels were plant flow, population density, whether the POTW accepts hauled-in wastes, and whether the collection system is comprised of combined or separate sewers.

Overall, the results of this study indicate that many factors, not just amalgam separators, influence mercury concentrations. Therefore, a facility cannot predict with certainty that amalgam separators will decrease mercury concentrations without also exploring the other potential contributors to current mercury levels. Without this, the benefits resulting from dental amalgam separator installation cannot be reliably predicted. Each facility must look at its own individual conditions to determine the potential benefit of amalgam separator installation. Additionally, it should be noted that, even in those POTWs with demonstrably successful amalgam separator programs, effluent mercury concentrations were not low enough to consistently meet current and imminent effluent limits faced by some POTWs (e.g., 1.3 ng/L in the Great Lakes).

While installing amalgam separators does not generally appear, at least within the timeframe of this study, to significantly reduce effluent mercury concentrations, a resulting reduction in biosolids mercury concentrations does appear to be likely according to the results. The data collected during the study do support a conclusion that the use of separators can decrease the amount of particulate mercury entering POTWs, thereby decreasing the amount of mercury that would be removed by plant processes and deposited in the biosolids.

6. IMPLICATIONS FOR FURTHER RESEARCH

Evaluations of the data resulting from this study have revealed several implications for further research. The apparent gaps, if filled, may lead to a better understanding of mercury at POTWs and the effects of installing amalgam separators. Additional work could be conducted by using the data that was collected during the sampling project and supplementing it with additional data and information collection.

Only limited dissolved mercury analysis was conducted during the sampling project. Further quantification of dissolved mercury levels would lead to a better understanding of the relative levels of particulate mercury verses dissolved mercury. This would be helpful since, at this point, it appears that amalgam separators mostly influence particulate mercury.

This sampling project indicates that the results of influent sampling for mercury concentrations at POTWs is highly variable within each facility as well as between facilities. It has been suggested that influent loading, enabling an analysis of the overall quantity of mercury entering a POTW regardless of flow, would be a more useful indicator of the effectiveness of amalgam separator installation. However, the amount of data collected during the sampling project was too limited to address the influent variability and therefore believed to be not robust enough for influent loading calculations to provide insight. More influent data could be collected that would enable in-depth examinations of influent loadings, including day-to-day and seasonal variability and the potential effects of water conservation activities.

In addition, biosolids loadings could not be determined with the information collected from the POTWs during the study. Further information collection that includes biosolids generation and/or disposal quantities would allow for the calculation of these loadings. While amalgam separators may not enable facilities to meet part-per-trillion-level effluent limits, they are likely reducing the overall loading to the POTW as reflected in biosolids mercury concentrations. Considering the interfacility differences in biosolids characteristics, calculations of biosolids loadings would be a better measure than concentrations and could confirm this. It is hypothesized that the observed significance of the relationship between dental amalgam separator installation and biosolids mercury levels could be improved even further if loadings were evaluated instead of concentrations. Such further evaluation may be possible with existing data and is therefore highly recommended as an addendum to this study.

This sampling project indicates a clear difference in effluent mercury concentrations between facilities that discharge to freshwaters and facilities that discharge to marine environments. The possible reason(s) for this, including the use of iron salts, should be further explored. Looking at NPDES permit limits for parameters could provide some insight. However, often POTWs provide a higher level of treatment than what is required by NPDES permits; therefore, it is likely to be more useful to look at actual discharge concentrations.

Each POTW in the study provided a list of chemicals used for treatment of wastewater. However, only limited information is currently available regarding the mercury concentrations in the chemicals used at these particular facilities. Previous unpublished work by some POTWs in the study has indicated that the mercury concentrations in such chemicals typically constitute negligible contributions to POTW effluent and biosolids mercury concentrations, but further research in this area is warranted. If, for example, chemical addition associated with chlorination/dechlorination at a particular treatment plant is found to potentially impact effluent mercury concentrations, a comparison between effluent samples collected before dechlorination and those collected after dechlorination could be necessary.

Each POTW in the study collected its own influent, effluent, and biosolids samples. Some facilities collected manual samples, while other facilities used automatic samplers. Samples were also either grab samples or composite samples (both time- and flow-paced). The potential effect of these varying sampling techniques on the data is uncertain. A comparison of the different techniques may be warranted in the future, or further research may require all facilities to use the same sampling method.

It is also possible that temporal differences exist within the data. Further data collection and analysis could be conducted to establish whether seasonal, daily or hourly differences exist in the mercury concentrations in POTW influent, effluent, and biosolids.

No comparisons were made between the data collected from this study and other projects. By doing so, a more complete picture of mercury flux at POTWs could be seen. It may also clarify whether the variability that was seen in this project is common to mercury sampling in general.

Finally, this sampling project clearly warrants follow-up sampling and data analysis. It would be useful to examine mercury levels at each of the studied POTWs in the future to determine whether trends seen in the current study have continued or whether trends not previously apparent have developed. In addition, the results from future sampling could also be compared with how well amalgam separators are operated and maintained to establish the extent to which this may be a key factor for continuing mercury reductions.

APPENDIX A: DATA

	Influent			Effluent				Biosolids
Sample Date	**Flow (MGD)**	**TR Hg (ng/L)**	**TSS (mg/L)**	**TR Hg (ng/L)**	**Dissolved Hg (ng/L)**	**Turbidity (NTU)**	**TSS (mg/L)**	**Hg (mg/kg, dry)**
7/15/2003	42	232	157	8.6	4.8	n/a	8	1.2
8/29/2003	39	126	137	9.5	2		8	3.1
9/24/2003	39	73.7	137	11.9	2.6		8	1.1
10/8/2003	35	63.2	102	9.4			9	1.1
11/18/2003	36.44	257	219	16.7			14	1.6
12/16/2003	56.73	137	106	15.6			15	1.1
1/13/2004	44.05	297	183	10.1			10	1.0
2/12/2004	39.81	247	161	12.6			14	1.0
3/10/2004	37.96	3080	641	19.3			44	2.3
4/21/2004	54.19	77.7	173	11.7			7	1.3
5/12/2004	46.91	117	260	9.3			10	0.9
6/16/2004	38.32	130	265	8.6			7	0.9
7/21/2004	37.16	146	214	13.6			16	0.7
8/10/2004	36.38	103	291	8.9			17	1.8
9/15/2004	40.57	103	211	10.9			16	0.6
10/13/2004	38.9	107	185	7.8			5	1.0
11/16/2004	43.97	220	135	15			24	1.1
12/15/2004	51.83	85.5	138	17.6			35	0.99
1/27/2005	46.78	82.3	140	7.4			18	0.808
2/22/2005	54.97	211	119	7.1			10	1.168
3/17/2005	49.69	61.1	182				14	0.765
4/19/2005	50.12	119	139	7.9	<1.0		14	0.8035
5/25/2005	73.09	146	128	15.2	2.9		15	1.1165
6/22/2005	43.35		231	6.8	2.2		13	1.0895
7/26/2005	38.88	229	257	7.8			12	0.828
8/30/2005	72.51	369	134	10.7			13	0.784
9/28/2005	37.88	125	263				17	0.9165
10/5/2005	37.29	663	221	11.0			25.0	0.984
11/9/2005	81.96	264	194	14			45	0.657
12/13/2005	47.5	71.9	127	8.4			21	1.116
1/10/2006	49.64	81.4	137	5.7			21	0.519
2/7/2006	63.77	203	94	7.5			12	0.935
3/28/2006	38.95	153	167	12.2			14	2.327
4/18/2006	38.52	189	153		1.4		9	2.067
5/23/2006	54.09	88.9	139	5.5	1.1		14	1.002
6/27/2006	78.79	68.6	71	4.9	1.2		11	

	Percent of Dental Facilities/Dentists Operating Dental Amalgam Separators
July 1, 2003	0
January 1, 2004	0
July 1, 2004	0
January 1, 2005	98
July 1, 2005	100
January 1, 2006	100
July 1, 2006	100

Analytical Methods	
Influent Mercury	EPA 245.7
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	SW-846 7471A
Effluent Turbidity	n/a
Influent TSS	2540D (Std. Methods 18th Ed.)
Effluent TSS	2540D (Std. Methods 18th Ed.)

	Influent			**Effluent**			
Sample Date	**Flow (MGD)**	**TR Hg (ng/L)**	**TSS (mg/L)**	**TR Hg (ng/L)**	**Dissolved Hg (ng/L)**	**Turbidity (NTU)**	**TSS (mg/L)**
07/09/03	181	46.4	166	3.50	1.06		12
08/07/03	88	26.3	126	1.56	0.92		1
09/04/03	87	415	130	1.83	0.89		2
10/02/03	96	218	69	3.86	1.05	2.95	2
11/06/03	82.4	193	136	3.75	1.16	9.02	3
12/03/03	99	286	83	2.91	0.515	2.5	3
01/08/04	104	24.3	87	3.34	0.927	5.88	4.1
02/05/04	104	15.9	59	2.48	1.05	3.4	7
03/04/04	133	50.2	110	1.84	1	2	2.5
04/06/04	114	64.2	140	4.73	1.06	3.01	4.3
05/06/04	106	47.8	174	3.18	1.07	2.07	4
06/03/04	95	69.8	100	2.33	0.916	1.99	2
07/07/04	106	79.6	110	2.42	0.978	2.24	1.7
08/05/04	104	238	165	2.55	1.02	2.24	2.6
09/13/04	72	82.7	159	7.11	1.23	7.03	8
10/07/04	66	75.4	135	3.47	1.07	11.1	4
11/10/04	77	106	112	2.06	0.805	1.4	3
12/08/04	84	54.8	119	2.11	0.82	1.28	1
01/05/05	206	49	60	3.23	0.95	1.99	3
02/02/05	95	33.8	83	2.56	0.933	2.01	7
03/03/05	104	80.3	185	5.79	0.93	3.52	8
04/06/05	120	116	80	1.68	0.98	1.55	1
05/03/05	113	91.5	116	3.50	1.06	4.86	3
06/13/05	98	365	123	1.40	0.777	0.95	1
07/07/05	77	59.5	99	1.64	0.971	1	2
08/03/05	89	184	110	2.24	0.97	1.26	1
09/13/05	78	236	172	2.47	0.9	0.91	1
10/05/05	75	448	150	2.88	1	1.37	2
11/02/05	75	51	108	3.75	1	2.1	4
12/08/05	83	90.5	121	2.90	1.09	1.87	4
01/12/06	86	21.8	58	2.51	84	1.28	2
02/09/06	100	37.35	55	2.49	0.96	2.8	4
03/06/06	69	225	503	3.34	1.78	2.56	3
4/6/2006	69	91.15	93	2.77	0.93	2.2	3
5/3/2006	64	45.15	91	2.08	1.08	2.14	5
6/7/2006	67	277	102	3.26	1.24	2.65	3

Biosolids		Biosolids		Biosolids		Biosolids	
Sample Date	Hg (mg/kg, dry)	Sample Date	Hg (mg/kg, dry)	Sample Date	Hg (mg/kg, dry)	Sample Date	Hg (mg/kg, dry)
07/01/03	1.7	8/3/2004	0.57	8/2/2005	0.88	11/1/2005	1.11
07/08/03	2.1	8/10/2004	1.11	8/9/2005	4.96	11/8/2005	2.30
07/15/03	0.9	8/17/2004	2.09	8/16/2005	1.93	11/15/2005	1.07
07/22/03	1.6	8/24/2004	1.25	8/21/2005	3.30	11/22/2005	0.46
08/05/03	0.5	8/31/2004	0.91	8/22/2005	3.09	11/29/2005	2.27
08/12/03	1.0	9/7/2004	0.36	8/23/2005	2.22	12/6/2005	0.36
08/19/03	0.2	9/14/2004	0.49	8/24/2005	2.60	12/11/2005	0.35
08/26/03	0.9	9/21/2004	0.88	8/25/2005	2.05	12/12/2005	0.31
09/02/03	1.9	9/28/2004	1.55	8/26/2005	2.69	12/13/2005	0.58
09/09/03	1.6	10/5/2004	0.56	8/27/2005	5.10	12/14/2005	0.38
09/16/03	1.3	10/12/2004	0.55	8/28/2005	5.22	12/15/2005	0.36
09/23/03	2.5	10/19/2004	1.74	8/29/2005	4.51	12/20/2005	0.53
09/30/03	0.8	10/26/2004	0.42	8/30/2005	1.87	12/27/2005	0.30
10/07/03	0.9	11/2/2004	0.47	9/1/2005	4.78	1/3/2006	0.56
10/14/03	0.1	11/9/2004	1.07	9/2/2005	3.00	1/24/2006	0.14
10/21/03	0.5	11/16/2004	0.42	9/3/2005	2.00	2/7/2006	0.61
10/28/03	0.7	11/23/2004	0.56	9/4/2005	1.75	2/14/2006	0.91
11/04/03	0.74	11/30/2004	1.00	9/5/2005	2.60	2/21/2006	38
11/11/03	0.70	12/7/2004	0.46	9/6/2005	5.02	2/28/2006	25.25
11/18/03	0.70	12/14/2004	0.51	9/7/2005	3.45	3/7/2006	1.76
11/25/03	0.70	12/21/2004	0.44	9/8/2005	14.02	3/14/2006	1.39
12/02/03	0.40	12/28/2004	0.70	9/9/2005	2.60	3/21/2006	0.56
12/09/03	0.37	1/11/2005	0.65	9/10/2005	10.68	3/28/2006	0.59
12/16/03	0.56	1/18/2005	0.73	9/11/2005	1.62	04/02/06	4.39
12/23/03	1.49	1/25/2005	0.30	9/12/2005	2.73	04/03/06	0.57
12/30/03	0.45	2/1/2005	0.36	9/13/2005	3.17	04/04/06	0.43
01/06/04	0.42	2/8/2005	1.32	9/14/2005	2.67	04/05/06	1.25
01/13/04	0.28	2/15/2005	1.12	9/15/2005	3.58	04/06/06	0.42
01/20/04	0.60	2/22/2005	0.44	9/16/2005	1.24	04/11/06	0.66
01/27/04	0.27	3/1/2005	0.97	9/17/2005	1.13	04/18/06	1.46
02/03/04	0.40	3/8/2005	0.77	9/18/2005	1.19	04/23/06	0.12
02/10/04	0.30	3/15/2005	0.65	9/19/2005	0.88	04/24/06	0.46
02/17/04	0.42	3/22/2005	0.36	9/20/2005	1.43	04/25/06	0.37
02/24/04	0.59	3/29/2005	0.72	9/21/2005	5.21	04/26/06	0.11
3/2/2004	0.36	4/5/2005	0.42	9/22/2005	1.61	04/27/06	0.30
3/9/2004	0.28	4/12/2005	0.81	9/23/2005	1.69	04/28/06	0.18
3/16/2004	0.29	4/19/2005	1.54	9/24/2005	2.15	04/29/06	0.26
3/23/2004	0.18	4/26/2005	0.50	9/25/2005	1.48	5/2/2006	0.46
3/30/2004	0.45	5/3/2005	0.88	9/26/2005	1.83	5/9/2006	0.38
4/6/2004	0.33	5/10/2005	1.45	9/27/2005	1.96	5/16/2006	0.25
4/13/2004	0.71	5/17/2005	0.48	9/28/2005	2.49	5/21/2006	1.64
4/20/2004	0.62	5/24/2005	0.64	9/29/2005	5.27	5/22/2006	0.46
4/27/2004	0.55	5/30/2005	0.54	9/30/2005	4.00	5/23/2006	0.43
5/4/2004	0.30	6/7/2005	1.44	10/1/2005	2.83	5/24/2006	0.73
5/11/2004	0.29	6/14/2005	5.54	10/2/2005	2.32	5/25/2006	0.41
5/18/2004	0.63	6/14/2005	3.56	10/3/2005	1.32	5/26/2006	0.67
5/25/2004	0.67	6/14/2005	3.76	10/4/2005	1.81	5/27/2006	0.57
6/1/2004	0.38	6/15/2005	1.51	10/5/2005	2.61	5/30/2006	0.81
6/8/2004	0.86	6/16/2005	2.50	10/6/2005	1.74	6/6/2006	1.07
6/15/2004	0.73	6/17/2005	18.49	10/7/2005	1.88	6/13/2006	0.80
6/22/2004	0.63	6/18/2005	0.45	10/8/2005	2.68	6/18/2006	0.59
6/25/2004	0.5	6/19/2005	5.61	10/9/2005	2.70	6/19/2006	0.54
6/26/2004	0.99	6/21/2005	0.90	10/10/2005	2.24	6/20/2006	0.34
6/27/2004	0.84	6/28/2005	2.27	10/11/2005	2.64	6/21/2006	0.73
6/29/2004	0.40	7/5/2005	1.17	10/12/2005	5.32	6/22/2006	0.66
7/14/2004	0.60	7/13/2005	0.88	10/13/2005	2.94	6/23/2006	0.68
7/21/2004	0.31	7/20/2005	4.96	10/18/2005	3.72	6/24/2006	6.11
7/28/2004	2.27	7/27/2005	1.93	10/25/2005	3.11	6/27/2006	0.57

	Percent of Dental Facilities Operating Dental Amalgam Separators
July 1, 2003	5
January 1, 2004	6
July 1, 2004	7
January 1, 2005	8
July 1, 2005	9
January 1, 2006	9
July 1, 2006	9

Analytical Methods	
Influent Mercury	EPA 1631, Rev. E
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	EPA 245.1
Effluent Turbidity	2130B (Std. Methods 18th Ed.)
Influent TSS	2540D (Std. Methods 18th Ed.)
Effluent TSS	2540D (Std. Methods 18th Ed.)

	Influent			Effluent			
Sample Date	**Flow (MGD)**	**TR Hg (ng/L)**	**TSS (mg/L)**	**TR Hg (ng/L)**	**Dissolved Hg (ng/L)**	**Turbidity (NTU)**	**TSS (mg/L)**
07/09/03	40.8	18.5	102	2	0.86		6
08/07/03	23.4	54.6	116	2.01	1.33		4
09/04/03	23.7	44.9	123	1.97	0.9		4
10/02/03	33.2	58.5	75	2.92	0.894	3.99	3
11/06/03	20.6	185	189	3.47	1.04	3.33	4
12/03/03	25.5	46.6	83	3.72	1.27	3.96	5
01/08/04	27.8	50.0	77	3.16	1.04	5.46	3.9
02/05/04	27.4	29.6	84	3.24	1.12	3.2	5
03/04/04	36.1	29.7	111	2.68	0.967	3.18	4.8
04/06/04	31.2	62.4	146	3.45	1.26	3.35	4
05/06/04	28.9	23.6	110	0.51	0.415	2.47	4
06/03/04	25.4	37.2	85	2.61	1.06	3.14	3
07/07/04	24.3	34.75	80	1.94	0.973	1.58	2.9
08/05/04	23.3	80	117	2.70	1.16	1.99	1.8
09/13/04	22.4	57	88	1.80	0.97	2.14	2
10/07/04	19.9	115	119	2.15	1	2.66	3
11/10/04	19.1	78.7	129	2.85	1.01	1.9	2
12/08/04	23.4	42.7	67	2.98	0.94	3.3	5
01/05/05	77.8	39.8	54	4.52	0.86	3.44	5
02/02/05	24.1	62.1	90	1.88	0.892	3.86	5
03/03/05	27.5	42.6	110	2.60	0.78	4.23	8
04/06/05	28.9	49.5	68	2.02	0.96	2.89	4
05/03/05	28.3	23.7	71	2.24	0.86	3.43	5
06/13/05	27.9	137	117	1.65	0.851	2.1	4
07/07/05	20	177.5	291	2.12	1	1.26	3
08/03/05	20.6	481	70	1.36	0.78	1.31	4
09/13/05	20.8	51.5	250	1.61	0.98	1.73	2
10/05/05	19.5	72.2	146	2.29	1.07	2.06	4
11/02/05	21.1	62.3	123	1.98	0.85	2	4
12/08/05	20.1	38.1	119	2.45	1.3	3.09	5
01/12/06	22.1	60.9	82	2.43	0.95	2.68	6
02/09/06	24.5	37.3	60	3.22	0.92	3.3	8
03/06/06	19.4	27	90	2.34	0.82	4.05	6
04/06/06	19.9	32.8	68	2.74	1.05	2.3	4
5/3/2006	18.3	41.55	92	2.32	1.2	2.37	6
6/7/2006	19.2	79	103	3.48	1.38	2.38	4

Biosolids		Biosolids		Biosolids		Biosolids	
Sample Date	**Hg (mg/kg, dry)**	**Sample Date**	**Hg (mg/kg, dry)**	**Sample Date**	**Hg (mg/kg, dry)**	**Sample Date**	**Hg (mg/kg, dry)**
07/07/03	0.6	03/15/04	0.5	12/13/2004	0.5	9/12/2005	0.6
07/14/03	0.6	03/22/04	0.7	12/20/2004	0.4	9/19/2005	0.8
07/21/03	2.2	04/05/04	0.4	12/27/2004	0.8	9/26/2005	0.85
08/04/03	1.1	04/12/04	0.6	1/3/2005	0.5	10/10/2005	1.61
08/11/03	0.7	04/19/04	0.6	1/10/2005	0.5	10/17/2005	0.58
08/18/03	0.5	04/26/04	0.8	1/17/2005	0.4	10/24/2005	1.13
08/25/03	1.5	05/03/04	0.5	1/24/2005	0.4	11/7/2005	0.68
09/01/03	1.3	05/10/04	0.5	2/7/2005	0.8	11/14/2005	0.46
09/08/03	0.9	05/17/04	0.7	2/14/2005	0.4	11/21/2005	0.62
09/15/03	0.6	05/24/04	0.7	2/21/2005	0.4	11/29/2005	0.82
09/22/03	1.2	5/31/2004	0.8	3/7/2005	0.5	12/5/2005	0.75
09/29/03	0.9	6/7/2004	0.3	3/14/2005	0.4	12/12/2005	0.57
10/06/03	0.9	6/14/2004	0.5	3/21/2005	0.8	12/19/2005	0.47
10/13/03	0.6	6/22/2004	0.6	3/28/2005	0.4	12/26/2005	0.34
10/20/03	0.6	7/5/2004	0.6	4/11/2005	0.4	1/2/2006	0.49
10/27/03	0.6	7/19/2004	0.8	4/11/2005	0.4	1/16/2006	0.74
11/03/03	0.7	7/26/2004	0.6	4/18/2005	0.4	1/23/2006	0.59
11/10/03	0.8	8/2/2004	0.8	4/25/2005	0.3	2/6/2006	0.7
11/17/03	0.7	8/9/2004	0.7	5/2/2005	0.4	2/13/2006	0.48
11/24/03	1.1	8/16/2004	0.5	5/9/2005	0.4	2/20/2006	1.14
12/01/03	0.7	8/23/2004	1.1	5/16/2005	0.9	3/6/2006	0.43
12/08/03	0.4	9/6/2004	0.5	5/23/2005	0.4	3/13/2006	0.4
12/15/03	0.3	9/13/2004	0.8	6/6/2005	0.7	3/20/2006	0.56
12/22/03	0.9	9/20/2004	0.9	6/13/2005	0.73	3/27/2006	0.48
12/29/03	1.3	9/27/2004	0.6	6/20/2005	0.88	4/3/2006	0.85
01/05/04	0.8	10/4/2004	0.7	7/4/2005	0.5	4/10/2006	0.68
01/12/04	0.2	10/11/2004	1.0	7/11/2005	0.9	4/24/2006	0.56
01/19/04	0.7	10/18/2004	0.5	7/18/2005	0.8	5/1/2006	0.5
01/26/04	0.5	10/25/2004	0.9	7/25/2005	1.2	5/8/2006	0.79
02/02/04	0.4	11/1/2004	0.5	8/1/2005	1.1	5/15/2006	0.57
02/09/04	0.5	11/8/2004	0.5	8/8/2005	0.5	5/22/2006	0.52
02/23/04	0.5	11/15/2004	0.5	8/15/2005	0.8	6/19/2006	3.2
03/01/04	0.7	11/22/2004	0.6	8/22/2005	1.1	6/26/2006	1.01
03/08/04	0.2	12/6/2004	0.5	9/5/2005	1.0		

	Percent of Dental Facilities Operating Dental Amalgam Separators
July 1, 2003	6
January 1, 2004	6
July 1, 2004	6
January 1, 2005	6
July 1, 2005	6
January 1, 2006	6
July 1, 2006	6

Analytical Methods	
Influent Mercury	EPA 1631, Rev. E
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	SW-846 7471A
Effluent Turbidity	2130B (Std. Methods 18th Ed.)
Influent TSS	2540D (Std. Methods 18th Ed.)
Effluent TSS	2540D (Std. Methods 18th Ed.)

	Influent			Effluent				Biosolids	
Sample Date	Flow (MGD)	TR Hg (ng/L)	TSS (mg/L)	TR Hg (ng/L)	Dissolved Hg (ng/L)	Turbidity (NTU)	TSS (mg/L)	Sample Date	Hg (mg/kg, dry)
9/17/2003	64	230	420	2.1	n/a	n/a	NA	9/8/2003	2
10/6/2003	71	160	310	2.0			7.0	10/6/2003	0.8
11/5/2003	193	322	260	3.1			7.5	11/3/2003	0.9
12/2/2003	77	97	360	1.8			5.5	12/8/2003	1.2
1/12/2004	83	230	230	2.2			4.0	1/7/2004	1.4
2/4/2004	85	220	310	2.1			12	2/2/2004	1.6
3/3/2004	158	100	160	3.2			6.5	3/1/2004	0.9
4/7/2004	114	210	300	5.2			8.4	4/6/2004	1.6
5/5/2004	94	240	270	1.8			3.2	5/3/2004	2.1
6/7/2004	115	480	240	1.1			2.0	6/7/2004	0.035
7/14/2004	116	100	380	1.3			2.6	7/7/2004	1.2
8/2/2004	83	110	240	1.5			2.8	8/2/2004	1.3
9/8/2004	74	250	280	2.0			5.8	9/7/2004	1.2
10/13/2004	70	180	340	2.8			5.6	10/4/2004	2.4
11/3/2004	86	380	NA	2.9			NA	11/1/2004	2.1
12/7/2004	139	620	250	2.4			22	12/6/2004	2
1/12/2005	122	250	240	1.8			15	1/3/2005	0.7
2/1/2005	73	220	280	1.5			3.8	2/8/2005	1.3
3/7/2005	180	220	88	2.0			5.6	3/7/2005	0.7
4/11/2005	118	100	200	2.5			6.6	4/4/2005	1.4
5/9/2005	72	84	210	1.6			6.2	5/2/2004	0.7
6/8/2005	78	110	390	1.7			5.0	6/6/2005	0.6
7/6/2005	73	89	170	1.5			3.0	7/5/2005	2.1
8/1/2005	70	57	320	1.6			4.6	8/1/2005	1.2
9/1/2005	78	130	590	1.9			7.4	9/6/2005	2
10/3/2005	74	190	340	1.5			6.3	10/3/2005	2.7
11/2/2005	64	150	650	2.7			10	11/7/2005	0.7
12/1/2005	88	51	350	1.7			5.6	12/5/2005	2.6
1/16/2006	90	84	250	1.5			7.0	1/3/2006	0.7
2/15/06	80	130	220	1.4			4.8	2/6/2006	1
3/8/06	97	100	190	1.7			6.2	3/6/2006	0.80
4/4/06	259	14	64	5.5			20	4/3/2006	1.20
5/4/06	100	160	120	2.5			5.8	5/1/2006	1.10
6/7/2006	85	110	300	1.7			5.2	6/5/2006	1.6

	Percent of Dental Facilities Operating Dental Amalgam Separators
July 1, 2003	0.6
January 1, 2004	1.5
July 1, 2004	6.1
January 1, 2005	16
July 1, 2005	26
January 1, 2006	32
July 1, 2006	38

Analytical Methods	
Influent Mercury	SW-846 7470A
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	SW-846 7471A
Effluent Turbidity	n/a
Influent TSS	160.2 (EPA 600/4-79-020)
Effluent TSS	160.2 (EPA 600/4-79-020)

	Influent			Effluent				Biosolids	
Sample Date	Flow (MGD)	TR Hg (ng/L)	TSS (mg/L)	TR Hg (ng/L)	Dissolved Hg (ng/L)	Turbidity (NTU)	TSS (mg/L)	Sample Date	Hg (mg/kg, dry)
9/17/2003	74	87	230	3.0			2.5	9/7/2003	0.43
10/6/2003	66	62	220	2.1			3.5	10/5/2003	0.33
11/5/2003	146	231	280	3.3			5.5	11/2/2003	0.41
12/2/2003	70	24	340	1.5			5.5	12/7/2003	0.29
1/12/2004	76	38	280	1.7			5.5	1/4/2004	0.37
2/4/2004	74	72	340	2.7			7.0	2/1/2004	0.43
3/3/2004	75	72	200	2.0			5.5	3/7/2004	0.36
4/7/2004	81	54	270	2.2			5.2	4/14/2004	0.4
5/5/2004	80	100	250	1.9			6.0	5/2/2004	0.27
6/7/2004	93		220	1.2			5.6	6/6/2004	0.5
7/14/2004	114	140	290	2.6			7.4	7/4/2004	0.31
8/2/2004	79	120	240	1.4			5.4	8/1/2004	0.31
9/8/2004	78	230	310	2.1			3.2	9/5/2004	0.35
10/13/2004	68		440	1.8			5.4	10/3/2004	0.25
11/3/2004	63	70	NA	2.0			NA	11/7/2004	0.45
12/7/2004	153	60	150	3.7			11	12/5/2004	0.23
1/12/2005	183	150	260	2.5			11	1/2/2005	0.17
2/1/2005	70	120	260	2.2			7.8	2/6/2005	0.3
3/7/2005	117	85	220	1.4			7.4	3/6/2005	0.13
4/11/2005	85	100	200	1.4			4.8	4/3/2005	0.6
5/9/2005	86	110	420	1.3			7.4	5/1/2005	0.33
6/8/2005	96	84	220	1.4			3.6	6/5/2005	0.23
7/6/2005	72	74	260	2.5			5.6	7/3/2005	0.35
8/1/2005	67	64	26	1.7			6.6	8/7/2005	0.24
9/1/2005	57	67	410	1.5			7.0	9/4/2005	0.29
10/3/2005	61	370	230	1.9			4.6	10/2/2005	0.21
11/2/2005	64	52	320	2.1			6.8	11/6/2005	0.26
12/1/2005	68	110	250	2.8			6.4	12/4/2005	0.39
1/16/2006	59	47	400	1.7			6.2	1/15/2006	0.31
2/15/06	76	66	250	1.9			5.6	2/19/2006	0.39
3/8/06	99	140	390	1.4			9.2	3/19/2006	0.38
4/4/06	241	76	170	2.8			9.4	4/16/2006	0.4
5/4/06	74	100	92	1.2			2.0	5/21/2006	0.25
6/7/2006	73	87	370	3.7			5.6	6/18/2006	0.31

	Percent of Dental Facilities Operating Dental Amalgam Separators
July 1, 2003	0.6
January 1, 2004	1.5
July 1, 2004	6.1
January 1, 2005	16
July 1, 2005	26
January 1, 2006	32
July 1, 2006	38

Analytical Methods	
Influent Mercury	SW-846 7470A
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	SW-846 7471A
Effluent Turbidity	n/a
Influent TSS	160.2 (EPA 600/4-79-020)
Effluent TSS	160.2 (EPA 600/4-79-020)

	Influent			Effluent					Biosolids	
Sample Date	Flow (MGD)	TR Hg (ng/L)	TSS (mg/L)	Sample Date	TR Hg (ng/L)	Dissolved Hg (ng/L)	Turbidity (NTU)	TSS (mg/L)	Sample Date	Hg (mg/kg, dry)
3/2/2004	41.18	253	287	3/2/2004	2.16			4.4	3/1/2004	1.014
4/6/2004	39.57	211	271	4/6/2004	1.58			4.3	4/1/2004	1.149
5/4/2004	40.24	314	255	5/4/2004	2.89			4.7	5/1/2004	1.225
6/1/2004	52.98	210	280	6/1/2004	1.55			3.8	6/1/2004	1.884
7/13/2004	46.43	213	247	7/7/2004	2.64			5.2	7/1/2004	1.652
8/4/2004	52.39	209	252	8/3/2004	1.72			4.7	8/1/2004	1.547
9/8/2004	42.95	164	251	9/7/2004	1.54			6.1	9/1/2004	1.467
10/5/2004	41.02	319		10/5/2004	2.33			6.4	10/1/2004	1.446
11/16/2004	39.62	176	350	11/2/2004	3.06			5.4	11/1/2004	1.62
12/7/2004	44.34	142	296	12/14/2004	2.8			7.6	12/1/2004	1.164
1/4/2005	39.07	227	235	1/11/2005	1.92			5.4	1/1/2005	1.526
2/1/2005	39.41	173	248	2/1/2005	1.95			4.5	2/1/2005	1.09
3/1/2005	40.54	149	231	3/8/2005	2.2			4.4	3/1/2005	1.148
4/5/2005	41.74	74.7	252	4/12/2005	2.04			4.8	4/1/2005	2.236
5/3/2005	40.33	246	251	5/10/2005	2.32			4	5/1/2005	1.058
6/7/2005	41.78	136	245	6/7/2005	1.97			4.1	6/1/2005	1.843
7/6/2005	39.73	161	244	7/6/2005	1.1			5.2	7/1/2005	2.483
8/3/2005	40.55	149	242	8/2/2005	2.17			5.5	8/1/2005	1.462
9/14/2005	42.34	236	236	9/7/2005	1.98			5	9/1/2005	1.452
10/4/2005	42.65	133	232	10/4/2005	1.89			2.8	10/1/2005	1.336
11/1/2005	38.3	160	265	11/2/2005	6.54			9.1	11/1/2005	1.529
12/7/2005	39.24	126	232	12/13/2005	2.68			6.8	12/1/2005	1.378
1/10/2006	38.81	110	265	1/11/2006	2.28			4.9	1/1/2006	1.04
2/7/2006	41.26	209	231	2/7/2006	4.96			5.5	2/1/2006	1.01
3/7/2006	41.06	136	257	3/7/2006	1.86			4.4	3/1/2006	1.01
4/4/2006	46.12	117	226	4/4/2006	1.86			3.4	4/1/2006	1.05
5/2/2006	44.95	97.9	241	5/2/2006	1.47			4.3	5/1/2006	0.86
6/13/2006	40.17	192	235	6/13/2006	2.42			4.7	6/1/2006	1.06

	Percent of Dental Facilities Operating Dental Amalgam
July 1, 2003	0
January 1, 2004	0
July 1, 2004	0
January 1, 2005	0
July 1, 2005	2
January 1, 2006	12
July 1, 2006	20

Analytical Methods	
Influent Mercury	EPA 245.7
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	SW-846 7471A
Effluent Turbidity	n/a
Influent TSS	2540D (Std. Methods 18th Ed.)
Effluent TSS	2540D (Std. Methods 18th Ed.)

Influent				Influent				Influent			
Sample Date	**Flow (MGD)**	**TR Hg (ng/L)**	**TSS (mg/L)**	**Sample Date**	**Flow (MGD)**	**TR Hg (ng/L)**	**TSS (mg/L)**	**Sample Date**	**Flow (MGD)**	**TR Hg (ng/L)**	**TSS (mg/L)**
7/7/2003	78.27	50	128	1/7/2004	32.75	60	456	7/13/2004	40.68	50	146
7/9/2003	44.83	20	186	1/8/2004	31.74	60	328	7/14/2004	38.79	50	132
7/14/2003	44.91	20	172	1/12/2004	32.16	30	166	7/21/2004	38.74	50	318
7/15/2003	39.04	30	198	1/14/2004	31.77	20	174	7/22/2004	37.95	280	320
7/23/2003	38.12	40	240	1/20/2004	31.92	50	218	7/26/2004	36.28	50	244
7/24/2003	37.22	100	204	1/21/2004	32.93	70	224	7/27/2004	36.03	50	232
7/28/2003	37.29	210	328	1/28/2004	30.73	60	180	8/4/2004	35.83	70	220
7/29/2003	36.66	130	258	1/29/2004	31.69	1910	244	8/5/2004	34.64	60	206
8/6/2003	37.39	70	292	2/2/2004	31.36	90	300	8/10/2004	44.45	50	240
8/7/2003	37.24	80	260	2/5/2004	32.03	180	232	8/12/2004	41.58	40	144
8/11/2003	36.85	70	372	2/11/2004	30.92	230	200	8/16/2004	37.8	70	168
8/12/2003	36.97	30	324	2/12/2004	31.79	160	236	8/17/2004	38.37	40	110
8/19/2003	37.81	80	381	2/17/2004	29.87	100	296	8/23/2004	37.48	100	200
8/21/2003	36.30	20	358	2/18/2004	31.58	150	296	9/1/2004	37.77	80	178
8/26/2003	37.35	50	260	2/23/2004	34.22	90	242	9/7/2004	35.78	40	310
8/27/2003	36.00	50	264	2/24/2004	33.56	550	240	9/8/2004	41.21	190	310
9/3/2003	35.19	60	250	3/3/2004	36.35	80	210	9/14/2004	38.46	200	104
9/4/2003	34.75	200	296	3/4/2004	35.46	220	226	9/16/2004	37.8	150	168
9/9/2003	36.17	90	368	3/8/2004	34.92	50	300	9/20/2004	37.13	50	126
9/16/2003	35.92	170	302	3/10/2004	40.80	60	296	9/23/2004	37.48	50	200
9/17/2003	35.47	100	282	3/16/2004	34.74	70	230	9/27/2004	37.76	40	164
9/24/2003	36.99	450	366	3/17/2004	35.03	50	166	9/28/2004	35.79	60	184
9/25/2003	35.55	90	284	3/24/2004	38.73	90	126	10/5/2004	39.44	30	170
9/29/2003	35.26	90	372	3/25/2004	49.36	140	190	10/6/2004	40.11	80	268
9/30/2003	33.02	120	450	3/29/2004	68.81	50	130	10/12/2004	37.9	100	444
10/6/2003	35.75	100	754	3/30/2004	56.07	50	146	10/13/2004	35.12	140	438
10/7/2003	32.99	70	426	4/7/2004	39.75	80	218	10/18/2004	34.87	170	204
10/15/2003	34.08	90	238	4/8/2004	42.15	70	238	10/19/2004	35.74	90	202
10/16/2003	34.20	60	230	4/14/2004	37.00	60	224	10/25/2004	46.07	80	192
10/22/2003	33.31	50	298	4/15/2004	37.40	50	140	10/28/2004	41.18	90	258
10/23/2003	33.58	90	226	4/19/2004	49.79	220	116	11/3/2004	41.75	40	196
10/27/2003	32.53	90	196	4/20/2004	44.76	110	500	11/4/2004	40.53	50	208
10/28/2003	37.74	40	174	4/26/2004	37.16	100	266	11/8/2004	39.22	60	220
11/5/2003	33.77	30	156	4/27/2004	34.26	70	202	11/9/2004	38.47	90	196
11/12/2003	38.18	90	218	5/4/2004	34.38	80	262	11/15/2004	37.21	50	416
11/13/2003	35.50	90	188	5/10/2004	38.36	100	236	11/18/2004	35.71	70	200
11/17/2003	35.60	60	164	5/13/2004	37.15	90	158	11/22/2004	35.77	60	246
11/18/2003	35.94	50	204	5/19/2004	71.61	50	166	11/23/2004	34.04	60	290
11/24/2003	32.61	50	252	5/20/2004	40.52	50	118	12/1/2004	33.55	40	280
11/25/2003	32.47	50	262	5/25/2004	40.37	290	184	12/2/2004	33.74	30	300
12/1/2003	33.83	80	222	6/1/2004	56.57	50	104	12/8/2004	33.37	830	408
12/2/2003	33.30	150	232	6/2/2004	50.20	80	122	12/9/2004	33.4	130	314
12/9/2003	32.36	70	238	6/7/2004	43.33	100	188	12/13/2004	34.26	50	226
12/10/2003	31.24	210	144	6/8/2004	42.89	100	202	12/14/2004	32.83	60	224
12/17/2003	32.82	60	224	6/14/2004	39.16	190	256	12/20/2004	34.98	640	482
12/18/2003	32.53	40	234	6/17/2004	37.58	420	342	12/21/2004	33.61	30	178
12/22/2003	34.09	60	270	6/23/2004	37.17	60	194	12/27/2004	32.46	260	296
12/29/2003	26.83	50	222	6/24/2004	36.09	50	168	12/28/2004	30.98	70	586
12/30/2003	25.54	60	292	6/28/2004	34.81	70	260	1/3/2005	33.39	30	164
1/1/2004	28.94	60	484	6/29/2004	34.56	130	230	1/4/2005	33.68	50	188

Influent				Influent				Influent			
Sample Date	Flow (MGD)	TR Hg (ng/L)	TSS (mg/L)	Sample Date	Flow (MGD)	TR Hg (ng/L)	TSS (mg/L)	Sample Date	Flow (MGD)	TR Hg (ng/L)	TSS (mg/L)
1/11/2005	32.72	50	160	7/6/2005	38.97	50	164	1/10/2006	35.61	80	274
1/12/2005	32.16	30	160	7/7/2005	39.46	50	122	1/17/2006	32.49	330	298
1/19/2005	31.95	70	328	7/13/2005	38.53	130	116	1/18/2006	33.91	120	170
1/20/2005	29.97	50	226	7/14/2005	38.2	220	96	1/23/2006	35.73	140	306
1/24/2005	31.82	50	156	7/18/2005	39.78	100	302	1/26/2006	33.26	100	282
1/27/2005	32.38	50	202	7/19/2005	36.7	120	322	1/30/2006	36.05	110	296
2/1/2005	32.42	50	230	7/25/2005	35.5	160	194	2/2/2006	36.51	60	298
2/3/2005	35.72	30	238	7/26/2005	37.26	50	148	2/7/2006	34.72	100	236
2/7/2005	33.82	40	184	8/4/2005	37.76	100	378	2/8/2006	34.93	90	292
2/8/2005	33.87	20	202	8/9/2005	34.33	160	258	2/13/2006	34.28	1480	274
2/14/2005	34.26	70	156	8/10/2005	35.24	70	210	2/14/2006	33.25	60	328
2/16/2005	34.17	220	284	8/16/2005	30.32	60	240	2/22/2006	34.01	40	258
2/23/2005	32.66	70	274	8/18/2005	33.68	90	122	2/23/2006	33.00	50	334
2/24/2005	33.25	50	204	8/22/2005	35.52	120	546	3/1/2006		40	338
3/1/2005	31.59	90	210	8/29/2005	32.94	70	276	3/2/2006		120	190
3/3/2005	33.27	100	224	8/30/2005	33.81	50	262	3/9/2006		200	208
3/9/2005	35.37	240	236	9/7/2005	35.51	180	822	3/14/2006		60	294
3/10/2005	33	50	274	9/8/2005	35.38	140	298	3/15/2006		210	280
3/16/2005	31.57	50	378	9/14/2005	25.54	190	336	3/20/2006		420	292
3/17/2005	32.05	70	460	9/15/2005	25.64	250	484	3/21/2006		120	220
3/21/2005	34.37	70	326	9/19/2005	34.02	130	358	3/27/2006		60	218
3/22/2005	36.43	180	272	9/20/2005	30.95	170	220	3/29/2006		110	162
3/23/2005	37.87	50	230	9/26/2005	39.4	300	340	4/3/2006	56.94	50	316
3/24/2005	40.78	40	216	9/27/2005	37.75	220	272	4/4/2006	52.92	560	146
3/29/2005	63.98	30	462	10/3/2005	35.24	390	340	4/11/2006	42.6	40	190
4/6/2005	58.76	160	206	10/4/2005	103.97	80	126	4/12/2006	42.06	150	312
4/7/2005	46.88	40	208	10/5/2005	127.56	70	198	4/19/2006	38.49	110	212
4/12/2005	41.83	70	174	10/11/2005	39.5	110	180	4/20/2006	39.12	290	252
4/18/2005	33.66	50	252	10/12/2005	39.63	70	244	4/24/2006	32.3	90	324
4/21/2005	42.46	40	314	10/19/2005	36.69	170	202	4/25/2006	29.53	200	176
4/26/2005	39.61	90	350	10/20/2005	38.81	110	216	5/3/2006	41.99	90	184
4/27/2005	39.27	40	180	10/24/2005	37.87	90	152	5/4/2006	40.33	50	178
5/4/2005	36.67	30	194	10/25/2005	37.08	150	178	5/9/2006	47.38	350	198
5/5/2005	36.31	70	144	11/1/2005	36.47	1220	184	5/10/2006	46.93	60	170
5/10/2005	39.71	70	152	11/2/2005	36.22	570	190	5/15/2006	57.05	30	190
5/11/2005	39.5	40	148	11/8/2005	34.46	120	216	5/16/2006	49.12	50	228
5/16/2005	36.73	70	168	11/9/2005	36.36	100	166	5/22/2006	37.69	120	274
5/19/2005	66.41	30	116	11/14/2005	43.08	130	174	5/24/2006	36.71	50	350
5/23/2005	42.34	40	160	11/19/2005	40.01	60	280	6/5/2006	42.86	90	254
5/24/2005	39.78	100	224	11/21/2005	40.95	90	346	6/6/2006	42.81	130	328
6/1/2005	39.77	100	196	11/28/2005	63.00	250	232	6/7/2006	40.25	70	282
6/2/2005	39.22	90	204	12/1/2005	43.53	60	332	6/8/2006	37.83	70	258
6/7/2005	44.64	70	142	12/5/2005	39.56	70	240	6/13/2006	34.94	160	314
6/8/2005	54.61	40	129	12/6/2005	37.24	230	260	6/14/2006	34.81	70	228
6/13/2005	45.72	200	190	12/13/2005	36.01	60	188	6/20/2006	36.73	90	378
6/14/2005	55.58	210	134	12/15/2005	35.14	50	286	6/22/2006	38.84	60	208
6/20/2005	53.64	760	154	12/19/2005	34.96	180	300	6/26/2006	43.9	120	220
6/23/2005	44.25	50	198	1/4/2006	37.10	100	226	6/27/2006	47.65	100	
6/27/2005	39.91	70	174	1/5/2006	37.34	80	260				
6/28/2005	37.92	80	216	1/9/2006	36.23	120	258				

Effluent				
Sample Date	TR Hg (ng/L)	Dissolved Hg (ng/L)	Turbidity (NTU)	TSS (mg/L)
7/2/2003	1.8		2	2
7/15/2003	1.8		3	3
8/1/2003	1.9		4	4
8/15/2003	2.3		17	6
9/3/2003	1.4		5	4.4
9/15/2003	3.4		42	7
10/1/2003	3.0		50.34	17.8
10/14/2003	3.0	2.3	18.3	10.6
11/3/2003	2.8		19.55	6.8
11/17/2003	3.1		9.26	3.6
12/1/2003	3.0		9.83	2.6
12/15/2004	2.8		11.37	1.8
1/5/2004	2.2		11.4	2.4
1/15/2004	2.4		11.6	3.0
2/3/2004	2.8		11.1	4.0
2/13/2004	3.3		11.2	2.2
3/1/2004	2.5		10.0	1.4
3/15/2004	2.2		10.6	2.6
4/1/2004	3.1		2.7	1.4
4/16/2004	2.0	1.4	10.8	3.4
5/7/2004	1.8		5.9	2.4
5/18/2004	2.0		3.8	2.6
6/10/2004	4.3		6.4	0.8
6/15/2004	5.3		7.2	4.8
7/1/2004	2.6		5.92	5.6
7/23/2004	1.8	1.2	3.98	5.2
8/4/2004	2.5		3.82	7.4
8/17/2004	2.2		12.32	4.4
9/1/2004	1.7		3.1	4
9/16/2004	4.1	1.9	3.03	6.4
10/4/2004	1.8		3.17	3.4
10/18/2004	2.1		2.31	3
11/1/2004	2.0		2.51	4
11/15/2004	2.7		3.94	4.6
12/9/2004	2.8		6.94	3
12/20/2004	2.4		11.03	4.6
1/3/2005	2.0		7.14	10.8
1/19/2005	1.2		5.17	2
2/1/2005	2.2		8.73	5
2/18/2005	2.2		3.95	5.8
3/4/2005	3.1		5.5	2.6
3/15/2005	1.7		6.21	4
4/4/2005	11.3		16.7	9.4
4/18/2005	1.5		4.1	3.6
5/2/2005	3.8		8.57	7.2
5/16/2005	3.0		2.99	2.4
6/1/2005	2.6		3.85	3
6/16/2005	2.0		2.36	1

Effluent				
Sample Date	TR Hg (ng/L)	Dissolved Hg (ng/L)	Turbidity (NTU)	TSS (mg/L)
7/9/2005	1.8		4.85	4.6
7/19/2005	5.3		10.13	3
8/9/2005	2.1		12.93	4.6
8/16/2005	3.7		16.2	10.6
9/1/2005	3.2		9.63	3.2
9/15/2005	2.5		3.89	7
9/16/2005	2.2		4.76	10
10/6/2005	13.6		15.53	22.4
11/2/2005	4.9		9.14	3.6
11/17/2005	2.0		2.97	3.4
12/8/2005	3.9		40.13	18.2
12/20/2006	3.4		8.9	5.6
1/5/2006	1.9		7	4.8
1/31/2006	1.9		4.8	4.2
2/7/2006	2.5	2.2	3.4	2.4
2/23/2006	1.4	1	3.1	3.4
3/9/2006	1.8	1.2	6.2	3.4
3/27/2006	2.3	1.3	7.9	4.2
4/7/2006	2.4	1.4	6.79	1.6
4/17/2006	2.2	0.8	8.42	5.2
4/26/2006	4.7	0.8	9.31	8.4
5/3/2006	2.5	0.9	4.36	2.2
5/23/2006	1.7		4.89	3.6
6/1/2006	2.7		4.28	3.4
6/5/2006	3.4		4.57	7.2
6/7/2006	2.9		5.57	4.4

Biosolids		Biosolids		Biosolids	
Sample Date	**Hg (mg/kg, dry)**	**Sample Date**	**Hg (mg/kg, dry)**	**Sample Date**	**Hg (mg/kg, dry)**
7/9/2003	0.71	7/1/2004	0.48	7/10/2005	0.49
7/14/2003	0.32	7/12/2004	0.6	7/19/2005	0.26
7/22/2003	0.33	7/19/2004	0.63	7/25/2005	0.38
7/28/2003	0.57	7/26/2004	0.55	8/1/2005	0.35
8/4/2003	0.51	8/4/2004	0.35	8/15/2005	0.44
8/11/2003	0.27	8/9/2004	0.36	9/1/2005	0.36
8/18/2003	0.41	8/16/2004	0.20	9/7/2005	0.31
8/26/2003	0.35	8/23/2004	0.29	9/12/2005	0.35
9/1/2003	0.36	8/31/2004	0.37	9/19/2005	0.52
9/8/2003	0.32	9/8/2004	0.55	9/27/2005	0.54
9/15/2003	0.31	9/13/2004	0.34	10/4/2005	1.08
9/22/2003	0.51	9/21/2004	0.44	10/9/2005	0.66
9/29/2003	0.36	9/28/2004	0.36	10/12/2005	0.37
10/6/2003	0.28	10/5/2004	0.22	10/23/2005	0.51
10/20/2003	0.20	10/12/2004	0.41	10/24/2005	0.43
10/27/2003	0.26	10/19/2004	0.34	11/1/2005	0.66
11/4/2003	0.24	11/1/2004	0.49	11/7/2005	1.11
11/12/2003	0.17	11/15/2004	0.3	11/14/2005	0.87
11/17/2003	0.28	11/22/2004	0.35	11/21/2005	0.42
11/21/2003	0.25	11/29/2004	0.25	11/28/2005	0.37
12/1/2003	0.24	12/6/2004	0.34	12/6/2005	0.42
12/8/2004	0.71	12/13/2004	0.31	12/12/2005	0.29
12/16/2003	0.22	12/20/2004	0.27	12/19/2005	0.24
12/23/2003	0.52	12/27/2004	0.16	12/26/2005	0.20
12/29/2003	0.19	1/3/2005	0.22	1/3/2006	0.28
1/5/2004	0.18	1/10/2005	0.26	1/6/2006	0.17
1/13/2004	0.26	1/17/2005	0.24	1/16/2006	0.19
1/19/2004	0.27	1/21/2005	0.23	1/24/2006	0.17
1/28/2004	0.21	1/31/2005	0.26	1/30/2006	0.27
2/3/2004	0.34	2/7/2005	0.19	2/6/2006	0.31
2/9/2004	0.44	2/14/2005	0.23	2/13/2006	0.22
2/16/2004	0.38	2/21/2005	0.23	2/20/2006	0.26
2/23/2004	0.37	2/28/2005	0.19	2/27/2006	0.24
3/1/2004	0.36	3/7/2005	0.34	3/13/2006	0.31
3/10/2004	0.33	3/14/2005	0.29	3/20/2006	0.22
3/15/2004	0.30	3/21/2005	0.38	3/27/2006	0.24
3/22/2004	0.28	3/29/2005	0.37	4/3/2006	0.29
3/29/2004	0.32	4/4/2005	0.33	4/10/2006	0.37
4/5/2004	0.40	4/12/2005	0.24	4/17/2006	0.30
4/12/2004	0.34	4/18/2005	0.35	4/24/2006	0.12
4/20/2004	0.44	4/25/2005	0.45	5/1/2006	0.35
4/26/2004	0.50	5/2/2005	0.45	5/9/2006	0.36
5/3/2004	0.32	5/8/2005	0.39	5/23/2006	0.30
5/10/2004	0.38	5/16/2005	0.21	5/31/2006	0.30
5/17/2004	0.49	5/24/2005	0.22	6/5/2006	0.54
5/24/2004	0.38	5/30/2005	0.14	6/13/2006	0.33
5/31/2004	0.5	6/6/2005	0.37	6/19/2006	0.44
6/7/2004	0.42	6/13/2005	0.28	6/26/2006	0.42
6/15/2004	0.74	6/19/2005	0.32		
6/21/2004	0.44	6/27/2005	0.36		

	Percent of Dentists Operating Dental Amalgam Separators
July 1, 2003	44
January 1, 2004	86
July 1, 2004	95
January 1, 2005	98
July 1, 2005	100
January 1, 2006	100
July 1, 2006	100

Analytical Methods	
Influent Mercury	EPA 245.1
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	SW-846 7471A
Effluent Turbidity	2130B (Std. Methods 18th Ed.)
Influent TSS	2540D (Std. Methods 18th Ed.)
Effluent TSS	2540D (Std. Methods 18th Ed.)

		Influent		Effluent				Biosolids	
Sample Date	Total Daily Flow (MGD)	Flow Weighted Influent average TR Hg (ng/L)	Flow Weighted Influent average TSS (mg/L)	TR Hg (ng/L)	Dissolved Hg (ng/L)	Turbidity (NTU)	TSS (mg/L)	Sample Date	Hg (mg/kg, dry)
7/28/2003	34.7	72.59	257.13	2.30	1.1	0.81	1	7/28/2003	0.21
8/22/2003	35.86	112.57	283.50	3.30	1.2	2	4.4	8/22/2003	0.334
9/22/2003	36.74	251.25	335.42	4.00	1.4	3	3.19	9/22/2003	1.24
10/27/2003	36.58	146.18	303.58	2.60		2.2	<1.00	10/27/2003	0.925
11/21/2003	33.21	78.38	277.90	2.90		8	5.2	11/21/2003	0.963
12/17/2003	33.04	86.34	248.79	5.10		11.5	14.2	12/18/2003	0.746
1/26/2004	33.72	86.92	267.13	7.10		4.6	14.7	1/26/2004	0.615
2/23/2004	34.77	96.31	286.07	8.20		2.8	4	2/23/2004	0.84
3/18/2004	36.63	70.64	211.39	6.70		2	<1.00	3/18/2004	0.806
4/21/2004	35.06	186.05	351.76	2.30		2	4	4/22/2004	1.12
5/20/2004	37.39	79.99	308.49	3.90		1.2	<1.0	5/20/2004	0.951
6/16/2004	38.07	137.27	218.81			2	<1.0	6/16/2004	1.27
7/22/2004	40.42	79.67	240.78	1.90		na	3.2	Jul-04	1
8/24/2004	36.37	208.83	358.85	2.90		na	9.1	Aug-04	1.11
9/16/2004	33.14	140.27	301.84	4.00		2.3	<1.0	Sep-04	0.9
10/21/2004	33.72	108.98	321.23	3.80		2.96	3.2	Oct-04	1.3
11/30/2004	34.32	114.82	274.87	10.10		3.31	<1.0	Nov-04	1
12/21/2004	33.35	78.15	266.15	2.90		na	2	Dec-04	0.9
1/25/2005	35.54	248.27	282.88	3.10		2.6	4.7	Jan-05	1.2
3/23/2005	35.59	116.03	269.81	3.40		2.8	2.1	Feb-05	1.7
4/22/2005	34.35	127.30	351.61	2.40	<1.0	na	1.7	Mar-05	1.2
6/30/2005	38.78		234.29	1.80	<1.0	na	<1.0	Apr-05	1.72
7/27/2005	33.38	85.31	168.48	2.00		1.4	<1.0	May-05	1.2
8/17/2005	38.65		320.15	1.90		2	<1.0	Jun-05	1.1
9/13/2005	34.53	186.49	232.10	2.50		1.5	<1.0	7/27/05	1.2
10/18/2005	32.84	74.50	464.83	2.10		1.6	<1.0	8/17/05	2.1
11/14/2005	33.37	102.56	169.93	3.50		1.5	1	9/13/05	0.9
12/12/2005	34.03	147.22	237.85	2.80		5	4.6	10/18/05	2
1/18/2006	33.76	106.12	255.66	7.00		7		11/14/05	1
2/15/2006	31.08	105.50	215.70	3.5		5.5	7.3	12/12/05	1.1
3/15/2006	31.64	181.69	214.39	11.2		12.5	14	1/18/06	0.7
4/12/2006	31.94	244.15	409.05	9.1	<1.0	15.5	24.9	2/15/06	1.2
5/18/2006	32.61	123.13	384.95	2.1	<1.0	3	<1.0	3/15/06	1.4
6/28/2006	32.68	78.85	189.20	2.2	<1.0	2	<1.0	4/12/06	2.1
								5/18/06	2.5
								6/7/06	1

8/24/2004: No associated field blank

	Percent of Dentists Operating Dental Amalgam Control Technologies
July 1, 2003	n/a
January 1, 2004	60
July 1, 2004	89
January 1, 2005	95
July 1, 2005	95
January 1, 2006	98
July 1, 2006	98

Analytical Methods	
Influent Mercury	EPA 245.7
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	SW-846 7471A
Effluent Turbidity	?
Influent TSS	?
Effluent TSS	?

	Influent			Effluent				Biosolids	
Sample Date	**Flow (MGD)**	**TR Hg (ng/L)**	**TSS (mg/L)**	**TR Hg (ng/L)**	**Dissolved Hg (ng/L)**	**Turbidity (NTU)**	**TSS (mg/L)**	**Sample Date**	**Hg (mg/kg, dry)**
7/8/2003	2.33	332	228		3.7		6	7/14/2003	3.35
8/12/2003	2.32	247	108	6.2	3.7		5	8/11/2003	0.99
9/9/2003	2.30	156	111	5.6	2.2		4.4	9/15/2003	0.86
10/8/2003	2.27	155	272				5.8		
11/7/2003	2.25	82.6	234	5			5.2	11/19/2003	1.44
12/10/2003	3.00		264	4.6			2.4	12/19/2003	0.416
1/13/2004	2.92	169	186	4.6			3.4		
2/10/2004	2.61	180	212	8.8			17.2	2/9/2004	0.668
3/9/2004	2.82	538	136	7.3			7		
4/5/2004	2.45	144	160	27.0			19	4/13/2004	0.459
5/4/2004	2.28	634	188				6.6		
6/8/2004	2.28	305	244	6.8			2.9	6/14/2004	0.62
7/8/2004	2.25		216	4.8			6	7/13/2004	0.616
8/4/2004	2.27	128	232	4.7			4		
9/14/2004	1.98	172	194	5.3			6.8		
9/17/2004	2.39	171	176	3.9			4.8	9/1/2004	0.823
10/15/2004	2.23	94.2	166	14.5			8.4	10/25/2004	0.554
11/8/2004	2.64	151	114	5.5			3		
12/13/2004	3.35	522	114	4			2.8	12/13/2004	0.587
1/11/2005	2.62	861	186	4.4			5.4	1/13/2005	0.319
2/8/2005	2.98	134	126	12.7			20	1/31/2005	0.446
3/15/2005	2.32	154	218	29.4			15.6	2/28/2005	0.641
4/7/2005	2.85	151	162	6.2	2.6		8.4	3/31/2005	0.736
5/10/2005	2.32	117	208	14.1	3.2		17	4/24/2005	0.216
6/6/2005	2.36	148	206	8.9	2.7		21	5/31/2005	0.209
7/7/2005	2.35	136	204	13.4			12.6	6/30/2005	0.101
8/4/2005	2.28	123	200	6.9			13.6	7/30/2005	0.149
9/13/2005	2.25	102	234	4.6			10	8/31/2005	0.149
10/25/2005	2.29	115	242	7.2			14.7	9/30/2005	0.12
11/21/2005	2.36	164	166	7			8.2	10/31/2005	0.404
12/7/2005	2.37	96.6	176	5.4			8.8	11/30/2005	0.144
1/23/2006	2.88		242	4.5			9.8	12/28/2005	0.154
2/6/2006	3.18	56.2	134	5			12.4	1/31/2006	0.123
3/13/2006	2.59	95.3	160	6			5.4	2/28/2006	0.183
4/10/2006	2.52	193	210		3.5		3.4	3/30/2006	0.025
5/23/2006	2.76	156	180	5.4	2.2		6	4/28/2006	0.172
6/6/2006	2.31	123	230	3.8	2.1		4.8	5/31/2006	0.1
								6/30/2006	0.122

6/8/2004: No associated field blank.

	Percent of Dental Facilities Operating Dental Amalgam
July 1, 2003	93
January 1, 2004	93
July 1, 2004	93
January 1, 2005	93
July 1, 2005	93
January 1, 2006	93
July 1, 2006	93

Analytical Methods	
Influent Mercury	EPA 245.7
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	SW-846 3050B or 3051, EPA 245.7
Effluent Turbidity	n/a
Influent TSS	2540D (Std. Methods 18th Ed.)
Effluent TSS	2540D (Std. Methods 18th Ed.)

	Influent			Effluent				Biosolids	
Sample Date	**Flow (MGD)**	**TR Hg (ng/L)**	**TSS (mg/L)**	**TR Hg (ng/L)**	**Dissolved Hg (ng/L)**	**Turbidity (NTU)**	**TSS (mg/L)**	**Sample Date**	**Hg (mg/kg, dry)**
7/15/2003	58.34	172		10.1	6.2			7/14/2003	1.80
8/15/2005	51.64	306		9.3	4.8			08/18/03	1.40
9/25/2003	57.78	89.2	308	10.8	3.3	15.9	25	09/15/03	1.40
10/15/2003	63	219	290	10.3		8	14	10/13/03	1.10
11/13/2003	65.93	95.2	308	9.4		13.4	24	11/17/03	1.20
12/22/2003	84.39	150	285	6.4		6.5	16	12/08/03	1.40
1/15/2004	113.2	225	254	12.5		14	20	01/19/04	0.84
2/5/2004	99.52	91.1	220	6.1		6.3	16	02/16/04	0.93
3/11/2004	78.51	162	328	8.7		8.3	20	03/15/04	1.40
4/16/2004	74.67	174	292	6.6		6.4	14	04/19/04	1.30
5/14/2004	74.95	224	213	7.5		6.7	11	05/17/04	1.20
6/11/2004	60.7	274	312	8.7		10.8	15	06/28/04	3.22
7/9/2004	61.48	783	410	9.9		20	23	07/20/04	2.26
8/19/2004	60.82	95.1	276	11.6		7.1	16	08/09/04	1.30
9/10/2004	52.74	362	304	8.7		11.5	11	09/20/04	1.40
10/21/2004	70.36	95.1	264	10.9		8.2	13	10/18/04	1.40
11/12/2004	75.18	133	319	6.9		11	18	11/16/04	0.90
12/17/2004	90.63	474	335	5.6		6.2	14	12/13/04	1.10
1/14/2005	74.93	130	156	9.4		6.5	12	01/24/05	1.10
2/25/2005	69.36	193	316	7.7		9	16	02/14/05	1.83
3/11/2005	70.94	193	280	5.9		8	10	03/14/05	1.94
4/15/2005	72.90	204	457	8	1.5	6	12	04/18/05	1.60
5/20/2005	77.10	112	236	6.2	1.8	4.1	16	05/16/05	1.20
6/10/2005	66.40	76.4	296	6	1.9	4.1	11	06/20/05	0.92
7/15/2005	63.30	106	238	6.7		10.9	16	07/18/05	0.91
8/5/2005	61.60	139	316	6.8		6.6	10	08/15/05	0.95
9/9/2005	61.40	154	328	6.8		7.2	10	09/19/05	1.10
10/14/2005	60.00	184	384	6.5		4	14	10/17/05	1.60
11/11/2005	80.30	90.8	260	8.8		9.4	19	11/14/05	1.20
12/14/2005	69.00	77.9	280	8			22	12/12/05	1.10
			NA					01/23/06	0.96
2/17/2006	85.7	87.1	328	7		9.7	16	02/20/06	0.88
3/10/2006	84.4	273	248	6.4		6.5	13	03/13/06	1.00
4/7/2006	60.3	188	284	9.8	2	10	22	04/17/06	1.50
5/19/2006	58.1	145	358	5	1.4	8.3	12	05/15/06	0.95
6/2/2006	76.9	98.3	252	4.4	1.1	5	9	6/19/2006	0.9

	Percent of Dental Facilities Operating Dental Amalgam
July 1, 2003	94
January 1, 2004	97
July 1, 2004	97
January 1, 2005	97
July 1, 2005	97
January 1, 2006	97
July 1, 2006	98

Analytical Methods	
Influent Mercury	EPA 245.7
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	EPA 7471A (06-01-004-003)
Effluent Turbidity	?
Influent TSS	?
Effluent TSS	?

	Influent			Effluent				Biosolids	
Sample Date	**Flow (MGD)**	**TR Hg (ng/L)**	**TSS (mg/L)**	**TR Hg (ng/L)**	**Dissolved Hg (ng/L)**	**Turbidity (NTU)**	**TSS (mg/L)**	**Sample Date**	**Hg (mg/kg, dry)**
08/15/03	86.89	215	284	36.6	9.4		no data	08/18/03	4.44
09/24/03	84.21	134	276	9.2	3.5	5.8	11	09/15/03	2.48
10/15/03	181.85	161	258	8.9			11	10/13/03	1.72
11/13/03	110.28	109	203	6.8		3.32	6	11/17/03	2.57
12/22/03	89.34	43.1	119	7.3		5.47	8	12/15/03	1.4
01/15/04	136.68	90.3	143	3.9		3.01	6	01/19/04	1.4
02/05/04	108.39	53.4	118	4.3		2.66	9	02/23/04	1.82
03/11/04	87.80	58.2	163	13.0		6.41	9	03/15/04	1.30
04/16/04	76.52	102	189	5.7		4.38	9	04/19/04	1.20
05/14/04	74.35	360	295	7.6		4.99	3	05/17/04	1.30
06/11/04	105.04	107	188	9.0		9.68	13	06/21/04	1.30
07/09/04	84.04	85.6	212	9.9		4.11	8	07/20/04	2.10
08/19/04	84.78	128	241	4		2.94	8	08/16/04	1.20
09/10/04	143.32	82.7	206	8.5		6.39	13	09/20/04	1.20
10/21/04	82.77	103	173	11.0		5.69	14	10/18/04	1.81
11/12/04	70.54	62.8		9.6		5.71		11/16/04	1.30
12/17/04	93.62	89.7	180	5.3		4.82	10	12/13/04	1.20
01/14/05	84.36	106	218	7.6		4.64	7	01/24/05	1.60
02/25/05	71.8	138	179	8.8		5.12	12	02/14/05	1.75
03/11/05	71.71	77.2	202	7.1		3.58	7	03/14/05	1.20
04/15/05	152.55	71	192	4.7	3.6	3.02	6	04/18/05	1.40
5/20/2005	131.82	124	163		3.9	4.92	12	05/16/05	1.50
6/10/2005	80.70	84.3	194	7.8	2.9	6.54	9	06/20/05	1.30
7/15/2005	78.71	69.1	192	7.8		5.2	8	07/18/05	1.30
8/5/2005	73.41	443	208	6.8		4.94	7	08/15/05	1.00
9/9/2005	76.78	169	430	7.5		6.62	10	09/19/05	1.50
10/14/2005	124.72	94.5	209	6.7		4.44	14	10/17/05	1.40
11/11/2005	115.25	51.9	188	4.9		3.44	5	11/14/05	1.10
12/14/2005	70.63	75.1	234	3.4		2.95	5	12/12/05	1.50
								01/30/06	1.30
2/17/2006	93.94	128	123	5		3.77	8	02/13/06	1.20
3/10/2006	110.01	35	132	5.3		3.74	4	03/13/06	1.10
4/7/2006	90.49	51.7	206	4.7	2.9	3.12	5	04/17/06	1.10
5/19/2006	91.12	156	198	5	2.2	4.1	15	05/15/06	3.15
6/2/2006	138.89	52.2	167	4.5	1.6	3.59	14	6/19/2006	1.81

	Percent of Dental Facilities Operating Dental Amalgam
July 1, 2003	94
January 1, 2004	97
July 1, 2004	97
January 1, 2005	97
July 1, 2005	97
January 1, 2006	97
July 1, 2006	98

Analytical Methods	
Influent Mercury	EPA 245.7
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	EPA 7471A (06-01-004-003)
Effluent Turbidity	?
Influent TSS	?
Effluent TSS	?

	Influent			Effluent					Biosolids	
Sample Date	Flow (MGD)	TR Hg (ng/L)	TSS (mg/L)	Sample Date	TR Hg (ng/L)	Dissolved Hg (ng/L)	Turbidity (NTU)	TSS (mg/L)	Sample Date	Hg (mg/kg, dry)
7/29/2003	40.7	145	422	7/30/2003	17.8	6	3.1	5	7/29/2003	0.514
8/5/2003	42.3	137	189	8/6/2003	17.5	7.1	4.53	11	8/5/2003	0.629
8/18/2003	40.4	163	220	8/19/2003	28.6	10.6	5.6	9	8/19/2003	0.783
9/8/2003	41.8	676	190	9/9/2003	31.2		4.2	9	9/9/2003	0.157
10/6/2003	42.9	2040	203	10/7/2003	32.4			13.2	10/8/2003	1.86
11/3/2003	45.1	303	179	11/4/2003	17.9	6.4		10.6	11/4/2003	1.08
12/1/2003	41.28	200	189	12/2/2003	13.0			7.5	12/2/2003	0.777
1/6/2004	48.4	211	164	1/7/2004	20.2		4.41	8	1/7/2004	1.04
2/4/2004	41	77	164	2/5/2004	40.1	8.93	4.97	9	2/5/2004	1.52
3/3/2004	54.86	56	180	3/4/2004	26.6		5.49	9.95	3/4/2004	1.11
4/14/2004	41.35	269	246	4/15/2004	12.9	3.9	3.35	6.5	4/15/2004	1.01
5/3/2004	43.57	617	216	5/4/2004	205.0		4.2	6	5/4/2004	9.15
6/1/2004	42	229	246	6/2/041	22.5		5.88	10	6/1/2004	0.94
7/6/2004	42.7	226	259	7/7/2004	15.5		4.6	7	7/6/2004	0.908
8/12/2004	41.66	565	202	8/13/2004	17.1	4.32	3.36	3	8/12/2004	8.2
9/1/2004	40.7	120	196	9/2/2004	27.6		5.37	10	9/1/2004	1.33
10/7/2004	41.3	397	212	10/8/2004	15.8	3.8	4.15	8	10/7/2004	1.39
11/3/2004	41.1	210	178	11/4/2004	19.2		6.51	9	11/3/2004	1.45
12/1/2004	40	137	206	12/2/2004	20.3	2.1	8.23	7	12/1/2004	1.24
1/10/2005	72.8	103	158	1/11/2005	15.3	13.6	5.18	7	1/10/2005	0.82
2/1/2005	48.1	352	196	2/2/2005	47.7		7.99	5.2	2/1/2005	2.14
3/1/2005	56	120	165	3/2/2005	15.5		3.82	5.6	3/1/2005	0.91
4/5/2005	54.3	74	176	4/6/2005	21.5		3.1	6.4	4/5/2005	1.77
5/3/2005	45.3	317	192	5/4/2005	16.5		3.61	6.8	5/3/2005	0.79
6/1/2005	44.7	262	219	6/2/2005	20.6	6.31	3.58	7	6/1/2005	1.19
7/5/2005	41.1	264	222	7/6/2005	74	11.5	12.7	29	7/5/2005	0.82
8/1/2005	41.5	164	183	8/2/2005	34.2		4.27	6.6	8/1/2005	1.13
9/1/2005	40.8	404	230	9/2/2005	76.3	19.8	7.22	8.2	9/1/2005	1.39
10/3/2005	46.9	154	255	10/4/2005	56.1		8.09	9.6	10/3/2005	1.33
11/1/2005	39.6	180	238	11/2/2005	31.5	15.6	5.06	5.6	11/1/2005	1.86
12/1/2005	56.5	185	301	12/2/2005	23.9		6.75	12.4	12/1/2005	1.19
1/4/2006	89.2	176	89	1/5/2006	15		6.5	14.8	1/4/2006	0.72
2/6/2006	50.4	100	181	2/7/2006	19.7		3.6	6.4	2/6/2006	0.44
3/2/2006	60.4	413	118	3/3/2006	18.3	6.22	4.64	7	3/2/2006	1.03
4/2/2006	72.9	117	135	4/3/2006	14.7		5.78	8	4/2/2006	0.73
5/1/2006	53.7	133	158	5/2/2006	15.3		6	4.64	5/1/2006	0.84
6/5/2006	47.2	100	198	6/6/2006	10.4		5.97	7.4	6/5/2006	0.67

	Percent of Dental Facilities/Dentists Operating Dental Amalgam
July 1, 2003	unknown
January 1, 2004	unknown
July 1, 2004	unknown
January 1, 2005	unknown
July 1, 2005	unknown
January 1, 2006	unknown
July 1, 2006	11

Analytical Methods	
Influent Mercury	EPA 245.2
Effluent Mercury	EPA 1631, Rev. E
Biosolids Mercury	SW-846 7471A
Effluent Turbidity	2130B (Std. Methods 18th Ed.)
Influent TSS	2540D (Std. Methods 18th Ed.)
Effluent TSS	2540D (Std. Methods 18th Ed.)

APPENDIX B:
SUMMARY OF STATISTICAL ANALYSES FOR COMBINED DATA

The following are the results of correlation analyses conducted on data from all the POTWs. Kendall's tau-b was used as the measure of correlation between variables. Alpha (α) was set at 0.05 for these statistical tests.

Figure 4.5A: Median Influent Mercury Concentration versus Dentists per Flow
Kendall's tau-b = 0.405, p = 0.00007. Thus, this correlation is significant. Increasing number of dentists per MGD is associated with increasing influent mercury concentration.

Figure 4.5B: Median Effluent Mercury Concentration versus Dentists per Flow
Kendall's tau-b = 0.316, p = 0.002. Thus, this correlation is significant. Increasing number of dentists per MGD is associated with increasing effluent mercury concentration.

Figure 4.5C: Biosolids Mercury Concentration versus Dentists per Flow
Kendall's tau-b = 0.159, p = 0.121. Thus, this correlation is not significant. Number of dentists per MGD is not correlated with biosolids mercury concentration.

Figure 4.6A: Influent Mercury Concentrations versus Number of Dentists without Separators per Flow
Kendall's tau-b = 0.032, p = 0.805. Thus, this correlation is not significant. Number of dentists without separators per MGD is not correlated with influent mercury concentration.

Figure 4.6B: Effluent Mercury Concentrations versus Number of Dentists without Separators per Flow
Kendall's tau-b = -0.352, p = 0.004. Thus, this correlation is significant. Number of dentists without separators per MGD is negatively correlated with effluent mercury concentration.

Figure 4.6C: Biosolids Mercury Concentrations versus Number of Dentists without Separators per Flow
Kendall's tau-b = 0.456, p = 0.0002. Thus, this correlation is significant. Increasing number of dentists without separators per MGD is associated with increasing biosolids mercury concentration.

Figure 4.7A: Influent Mercury Concentration versus Average Plant Flow
Kendall's tau-b = 0.076, p = 0.783. Thus, this correlation is not significant. Average plant flow is not correlated with influent mercury concentration.

Figure 4.7B: Biosolids Mercury Concentration versus Average Plant Flow
Kendall's tau-b = 0.308, p = 0.191. Thus, this correlation is not significant. Average plant flow is not correlated with biosolids mercury concentration.

Figure 4.7C: Effluent Mercury Concentration versus Average Plant Flow
Kendall's tau-b = -0.107, p = 0.680. Thus, this correlation is not significant. Average plant flow is not correlated with effluent mercury concentration.

Figure 4.8A: Influent Mercury Concentration versus Non-Industrial Flow
Kendall's Tau-B = 0.366, p = 0.208. Thus, this correlation is not significant. Percent non-industrial flow is not correlated with influent mercury concentration.

Figure 4.8B: Effluent Total Mercury Concentration versus Non-Industrial Flow
Kendall's Tau-B = 0.592, p = 0.036. Thus, this correlation is significant. Increasing percent non-industrial flow is associated with increasing effluent mercury concentration.

Figure 4.8C: Biosolids Total Mercury Concentration versus Non-Industrial Flow
Kendall's Tau-B = 0.479, p = 0.093. Thus, this correlation is not significant. Percent non-industrial flow is not correlated with biosolids mercury concentration.

Figure 4.8D: Influent Total Mercury Concentration versus Non-Industrial Flow in Separate Sewer Systems
Kendall's Tau-B = 0.733, p = 0.060. Thus, this correlation is not significant. Percent non-industrial flow in separate sewer systems is not correlated with influent mercury concentration. Note that the p-value (0.06) is only slightly higher than α (0.05).

Figure 4.8E: Effluent Total Mercury Concentration versus Non-Industrial Flow in Separate Sewer Systems
Kendall's Tau-B = 0.733, p = 0.060. Thus, this correlation is not significant. Percent non-industrial flow in separate sewer systems is not correlated with effluent mercury concentration. Note that the p-value (0.06) is only slightly higher than α (0.05).

Figure 4.8F: Biosolids Total Mercury Concentration versus Non-Industrial Flow in Separate Sewer Systems
Kendall's Tau-B = 0.2, p = 0.707. Thus, this correlation is not significant. Percent non-industrial flow in separate sewer systems is not correlated with biosolids mercury concentration.

Figure 4.12A: Influent Mercury Concentration versus Population Density
Kendall's tau-b = -0.215, p = 0.370. Thus, this correlation is not significant. Population density is not correlated with influent mercury concentration.

Figure 4.12B: Effluent Mercury Concentration versus Population Density
Kendall's tau-b = 0.185, p = 0.449. Thus, this correlation is not significant. Population density is not correlated with effluent mercury concentration.

Figure 4.12C: Biosolids Mercury Concentration versus Population Density
Kendall's tau-b = -0.047, p = 0.890. Thus, this correlation is not significant. Population density is not correlated with biosolids mercury concentration.