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Final
Aerovox
New Bedford Plant
Stormwater Study

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Table of Contents

Table of Contents
(Continued)

Figures

Table

Appendices

1.0 Introduction

1.1 Purpose

The Aerovox Stormwater Study will be performed as part of an agreement between the Environmental Protection Agency (EPA), the Massachusetts Department of Environmental Protection (DEP), and Aerovox Incorporated (Aerovox). The 1972 Federal Water Pollution Control Act (Clean Water Act) prohibits the discharge of any pollutant to waters of the U.S. from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit. As part of the Draft NPDES Permit, a stormwater study will be performed which will determine concentrations of various parameters in stormwater during all seasons of a year. Stormwater samples will be collected from various stations around the facility and analyzed for PCBs, metals (priority pollutants), pH, oil & grease, total suspended solids, and settleable solids.

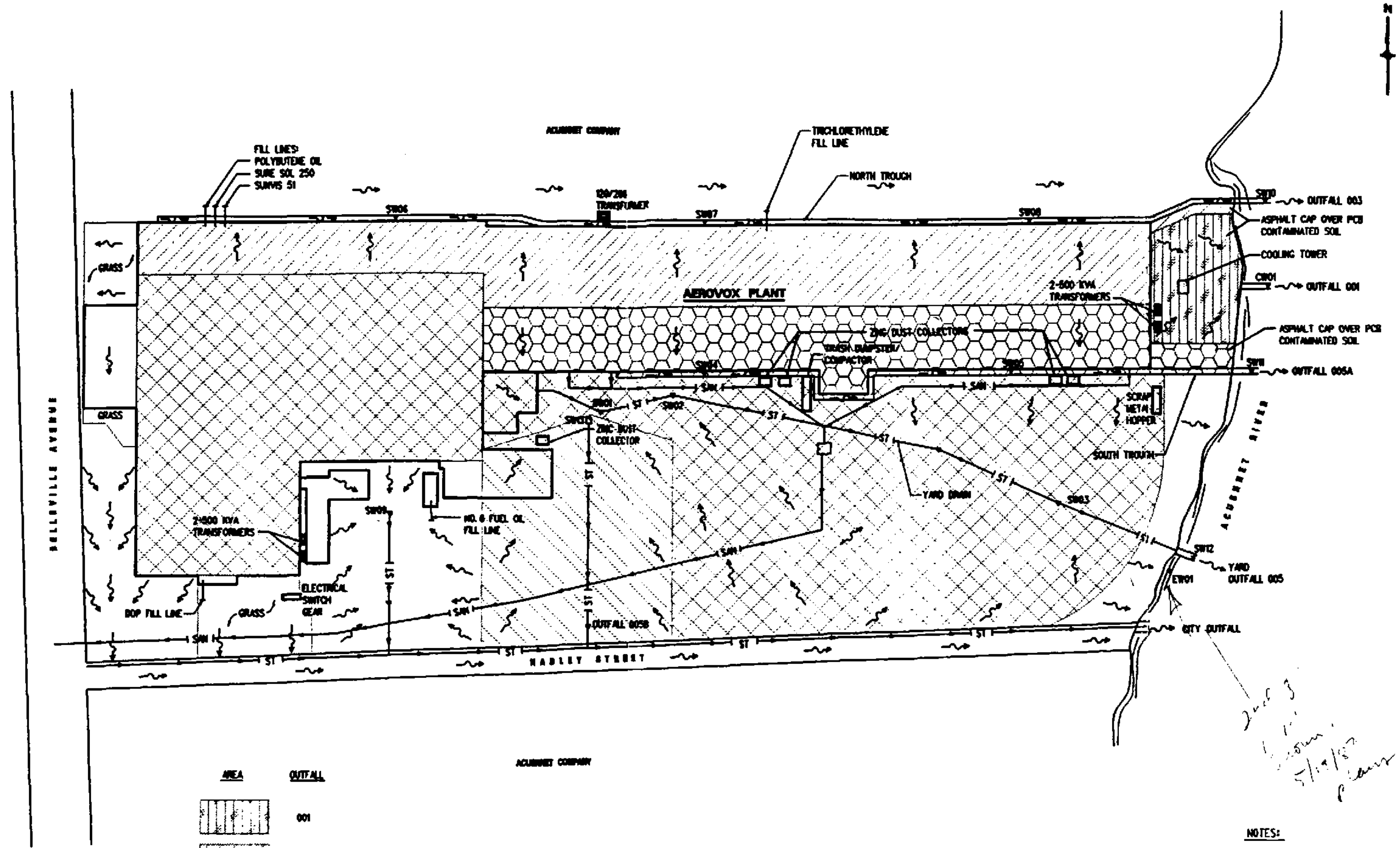
1.2 Facility Location

The Aerovox plant is located at 742 Belleville Avenue in New Bedford, MA. The facility is bordered on the west by Belleville Ave., on the south by Hadley Street, to the north by the Acushnet Company property (Graham Street), and to the east by the Acushnet River.

1.3 Facility Description

The building currently occupied by Aerovox was built circa 1916 and used as a textile mill for approximately 20 years. Aerovox Corporation purchased the site in 1938. Aerovox Incorporated has occupied the facility since 1978. The facility is used to manufacture capacitors and electronic filters. Hazardous materials used in the manufacturing processes include various capacitor impregnation oils, degreaser, and paints. PCB dielectric oils were used at the plant until October 1978 and low-level residual PCBs may remain on some plant surfaces and in site soils.

The plant consists of a single building located on a 10 acre site. A plan of the site is shown on Figure 1.



AREA	OUTFALL
(vertical hatch)	001
(diagonal hatch)	003
(cross hatch)	005
(hexagon pattern)	005A
(light diagonal hatch)	005B

—SAN— SANITARY SEWER

—ST— STORM SEWER

CW01, SW02, etc. SAMPLE LOCATION

NOTES:

1. ALL SURFACES ARE ASPHALT PAVEMENT OR ROOF UNLESS OTHERWISE NOTED
2. TAKE/SAMPLES AT SW01 AND SW09 FROM PIPE ENTERING MANHOLE
3. TAKE STORMWATER SAMPLES AT SW02, SW03, AND SW09 FROM PARKING LOT RUNOFF FALLING INTO MANHOLE

1.1 cm = 50'

AT FULL SIZE
0 1 2 3 IN
0 1 2 3 4 5 6 7 8 cm

NO.	REVISIONS	DRAWN	APPROVED	APPROVED	DATE	NO.	REVISIONS	DRAWN	APPROVED	APPROVED	DATE

DESIGNED
DRAWN
CHECKED
APPROVED
APPROVED
DATE

STANLEY CONSULTANTS
INTERNATIONAL CONSULTANTS IN ENGINEERING, ARCHITECTURE, PLANNING, AND MANAGEMENT

AEROVOX NEW BEDFORD PLANT
STORMWATER BEST MANAGEMENT PRACTICES PLAN

FIGURE 1- SITE STORMWATER DRAINAGE PLAN & SAMPLING LOCATIONS

SCALE 1"=50'
NO.
REV.

No process wastewater is generated at this facility. A closed loop recirculating system is used for noncontact cooling water. Nonprocess sanitary wastes generated at the site are discharged to the municipal sanitary sewer.

Stormwater runoff from the site generally flows east to the Acushnet River via stormwater Outfalls 001, 003, 005, 005A, and 005B as shown on Figure 1. Discharge from Outfall 001, consists of stormwater runoff from the area east of the building as well as overflow from the noncontact cooling water system. In the event of a failure within the closed loop cooling water system, this outfall could discharge noncontact cooling water to the Acushnet River. Discharge from Outfall 003 consists of stormwater runoff from the north portion of the building roof. The area just north of the building drains east along the roadway to the Acushnet River. Discharge from Outfall 005 consists of stormwater runoff from the southwest portion of the building roof and the east end of the area south of the building. Discharge from Outfall 005A consists of stormwater runoff from the southeast portion of the building roof and the east end of the area immediately south of the building. Discharge from Outfall 005B consists of stormwater runoff from the west-central portion of the paved area south of the building. Stormwater runoff from the area west of the building and south of the building at the west end of the site flows to Hadley Street and then to the Acushnet River via the Hadley Street storm sewer.

The outfall elevations are within the tidal influence of the Acushnet River level. Outfalls 005 and 005B are completely submerged at high tide.

Catchbasins are located on the sewers leading to Outfalls 005 and 005B. These catchbasins remove some sediment and debris from the stormwater. There are no other stormwater discharge treatment facilities at the site.

1.4 Summary of Existing Sampling Data

Stormwater runoff from the Aerovox facility has been sampled and tested for PCBs since 1983. The level of PCBs has varied from a minimum of zero to a maximum of 1080 parts per billion (ppb). The highest level detected since the construction of a cap at the site in 1984 was 130 ppb. A review of existing stormwater data prepared in December 1990 is included in Appendix A.

2.0 Objectives and Scope

The objective of this study is to determine concentrations, sources and patterns of PCBs and other parameters in stormwater runoff from the Aerovox facility during the course of a year. The scope of this study consists of determination of sampling requirements, performance of stormwater sampling, analyses of the samples, data evaluation and interpretation.

2.1 Parameters to be Tested

All analyses will be performed using USEPA Methods for Chemical Analysis of Water and Wastes, EPA/600/4-79-020 or Standard Methods for the Examination of Water and Wastewater. 18th Edition.

Samples will be analyzed for the following constituents:

Polychlorinated Biphenyls (PCBs)
Metals Copper Lead Zinc
Total Suspended Solids (TSS)
Settleable Solids
pH
Oil and Grease

2.2 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements which specify the quality of the data required to support decisions made during the study and are based on the end uses of the data to be collected. As such, different data uses may require different levels of data quality. Five analytical levels are generally used to address various data uses, the QA/QC effort and methods required to achieve the desired level of quality. To meet the requirements of the permit, Level II data will be utilized.

Level II data methodologies and associated quality control will be required of the analytical laboratory. Level II data can be used for site characterization, evaluation of alternatives, engineering design and monitoring during implementation. Level II data should include:

- Individual sample test results sheets with full sample I.D., sample collection date, sample receipt data, sample collector, test results, and date of analysis;
- Chain of Custody (COC);
- Results of spikes and duplicates for inorganic analysis, and surrogate recoveries for organic analyses;
- Cover page with methods, description of any technical problems, and manager sign-off;
- "Flag" sheet describing any data qualifiers used;
- Sample data summaries including laboratory blanks;
- Tentatively Identified Compounds (TICs) for analyses done by GC/MS.

2.3 Storm Event Criteria

For the purpose of the stormwater study, ten storm events will be sampled over the course of four seasons. Stormwater discharge permit application requirements establish specific criteria for the type of storm event that can be sampled:

- the depth of the storm must be greater than 0.1 inch accumulation
- the storm must be preceded by at least 72 hours of dry weather
- where feasible, the depth of rain and duration of the event should not vary by more than 50 percent from the average depth and duration.

In determining whether a storm is representative, there are two important steps to take. First data on local weather patterns should be collected and analyzed to determine the range of representative storms for a particular area. Second, these results should be compared to measurements of duration, intensity, and depth to ensure that the storm to be sampled fits the representativeness criteria.

2.3.1 Obtaining Rainfall Data

Several sources provide accurate local weather information for both determination of a representative storm event for a particular area, and assessment of expected storm events to determine whether a predicted rain fall will be "representative," and thus, meet the requirements for stormwater sampling.

Sources of information for rainfall data include the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center's (NCDC's) Climate Services Branch, The National Weather Service (NWS) of NOAA, cable TV weather stations, local airports, and NOAA weather radio.

Data on hourly, daily and monthly precipitation data for each NCDC monitoring station are available on computer diskette, microfiche or hard copy. Orders can be place by calling (704)259-0682, by fax at (704)259-0876 or by writing to NCDC, Climate Services Branch, The Federal Building, Asheville, NC 28071-2733.

The National Weather Service (NWS) of NOAA can also provide information on historic, current,and future weather conditions. Local NWS numbers for the New Bedford area can be obtained from the NWS Public Affairs Office at (301)713-0622. The NOAA NWS Weather Radio, provides continuous broadcasts of the most current weather information. This broadcast can be accessed with radio that has a weather band feature.

Local NOAA frequencies for the New Bedford area are:

- Boston, MA NOAA frequency 3
- Hyannis, MA NOAA frequency 1
- Providence, RI NOAA frequency 2

Telephone recordings of weather conditions are also provided by most NWS offices.

Rainfall data from each storm event which is sampled shall be recorded using a rain gauge. Sample team members will record: time of start and end of storm event, hourly rainfall measurements, total rainfall measurements. Rainfall data will be recorded on the Data Sheet (Appendix B).

2.3.2 New Bedford Area Rainfall Data

Rainfall statistics for the northeast coastal region are:

- Annual number of storms - 70
- Annual precipitation - 41.4 inches
- Average duration of a storm event - 11.7 hours
- Average intensity of a storm event - 0.071 inches per hour
- Average depth of rainfall during a storm event - 0.66 inches
- Average interval between storm midpoints - 140 hours

2.3.3 Determination of Representativeness

The criteria for determining which storm events are representative are that the depth of rain and duration of the event should not vary by more than 50 percent from the average depth and duration. For the northeast costal region, the 50 percent variance is calculated below:

Event Type	Duration (hrs)	Depth (in)
Average Event	11.7	0.66
50 percent average event	5.9	0.33
150 percent average event	17.6	1.00

Therefore, a representative storm in both duration and depth for the northeast costal area will fall between 5.9 and 17.6 hours in duration, and 0.33 and 1.00 inches in volume.

The NPDES Permit for the Aerovox New Bedford plant requires a single grab sample during steady flow. Composite sampling during the course of the storm event is not required. Consequently, the duration of the storm event and the maximum depth are not of concern when determining representativeness for sampling. The criteria for obtaining a representative sample during steady flow is that the start of sampling for each storm event shall be at a minimum rainfall of 0.1 inch and a maximum of 0.3 inches.

3.0 Field Sampling Plan

3.1 Sample Locations

During each sampling event, stormwater samples will be collected from the locations listed in Table 3-1 and shown in Figure 1.

3.2 Sampling Procedures

To comply with the requirements of the NPDES permit, the sample type will be collected in accordance with 40 CFR 122.21(g)(7) and 40 CFR 136. Grab samples are required to be collected for purposes of this study and compliance sampling. A grab sample is a discrete, individual sample taken within a short period of time (usually less than 15 minutes). Analysis of grab samples characterizes the quality of a stormwater discharge at a given time of the discharge.

In general, a manual grab sample is collected by inserting a sampling device under or downcurrent of a stormwater stream with the container opening facing downstream. The sampling device (dipper) used for the stormwater study and compliance sampling will be constructed of a nonreactive material such as stainless steel, polypropylene or Teflon. The device will have a capacity of at least 500 ml to minimize the number of times the liquid must be disturbed. Recommended sampling devices are located in Appendix C. Any sampling device may contribute contaminants to a sample, thus proper decontamination techniques should be utilized (see QAPP Section 2.0).

3.2.1 Trough Samples

Samples collected from the north and south troughs can be readily collected with the use of a sample device. Sample numbers SW04, 05, 06, 07, 08 will be collected using this technique. To collect samples, place dipper in flow stream and transfer directly to sample containers. The device's mouth should be positioned so that it faces downstream. Sample containers will be filled using multiple submergences of the dipper. If a sample container becomes visibly contaminated with suspended sediment replace with new container and resample. If it is necessary for the study team member to be in contact with the water stream, they should stand downstream to minimize agitation of any sediments that may contaminate the sample.

Table 3-1
Stormwater Sample Locations, Numbers, and Types

Sample Location Number	Sample Location	Grab or Composite	Parameters Analyzed
SW01	West Roof drain outfall into yard drain	G	PCBs,TSS,SS
SW02	Yard Drain Inlet	G	PCBs,TSS,SS
SW03	Yard Drain Inlet	G	PCBs,TSS,SS
SW04	South Trough (upstream)	G	PCBs,TSS,SS
SW05	South Trough (downstream)	G	PCBs,TSS,SS
SW06	North Trough (upstream)	G	PCBs,TSS,SS
SW07	North Trough (midstream)	G	PCBs,TSS,SS
SW08	North Trough (downstream)	G	PCBs,TSS,SS
SW09	City Drain Inlet	G	PCBs,TSS,SS
SW10	North Trough Outfall (005)	G	PCBs, Metals, pH, TSS, SS, O&G
SW11	South Trough Outfall (003)	G	PCBs, Metals, pH, TSS, SS, O&G
SW12	Yard Drain Outfall (005A)	G	PCBs, Metals, pH, TSS, SS, O&G
SW13	City Drain Outfall (005B)	G	PCBs, Metals, pH, TSS, SS, O&G
CW01	Cooling Water Overflow Outfall (001)	G	PCBs, Metals, pH, TSS, SS, O&G
EW01	Estuary Water	G	PCBs
MS/MSD	Matrix Spike	G	PCBs
FB	Field Blank	G	PCBs, Metals, pH, TSS, SS, O&G

In general, samples should be collected where the stormwater is well mixed. Samples should be collected near the center of the trough, at 0.4 - 0.6 total depth, where the turbulence is at a maximum and the possibility of solids settling is minimized. Skimming of the water surface or dragging the sample device on the bottom should be avoided.

3.2.2 Manhole Inlet Samples

Grab samples collected at the manhole inlets of the yard drain will be collected using a dipper. Sample locations SW01, SW02, SW03, SW09, and SW13 will be collected using this technique. Before sampling remove grate. To avoid removing the grate, a dipper that can be inserted through the grate may be used. To collect each sample, submerge the sampling device under the stream falling into the manhole at various locations around the manhole to collect a representative sample of the runoff. the marked location. The selected manholes represent flows from predetermined areas. Figure 1 shows the stormwater area flows for each manhole inlet.

3.2.3 Outfall Samples

Samples collected from the outfalls can be collected using a dipper or by placing the sample container under the outfall. Sample numbers SW11, SW12, SW14 and CW01 will be collected using this technique. To collect samples, sample team member should place the dipper under the outfall to collect samples of the stream. The dipper should be filled and directly transferred to sample container. This process should be repeated until all sample containers are filled. When Outfall 005 is submerged by high tides, samples will be collected from the manhole directly upstream from the outfall. Samples will be collected by dipping the sampler directly into the stream through the manhole.

Oil & grease samples will be collected directly into the sample container. Section 3.4 details the procedure for oil & grease sample collection.

3.5 Field Measurements

In a separate, clean beaker measure the pH and temperature of the water at the sampling location. Record all measurements on the Stormwater Sample Data Sheet (Appendix B). Specific procedures for temperature and pH measurement are outlined in the Aerovox QAPP.

3.6 Sampling Analyses

Samples collected during each sampling round will be analyzed using methods defined by USEPA Methods for Chemical Analysis of Water and Wastes, EPA/600/4-79-020, or Standard Methods for the Examination of Water and Wastewater, 18th Edition. The laboratory shall provide necessary containers and preservatives for the samples sent for analyses.

3.7 Flow Estimation

3.7.1 Estimating Total Flow Volumes for the Sampled Rain Event

For the purposes of performing the storm water and compliance sampling, stormwater flows will be estimated using the rational method. Although not as accurate as other methods, the rational method is inexpensive and relatively simple. The accuracy of this method is adequate for the purpose of compliance sampling.

The rational method uses runoff coefficients for the drainage areas which represent the fraction of total rainfall that will end up as stormwater runoff. Runoff coefficients take into consideration the ground surface or cover material to estimate the portion of storm water flow which will not infiltrate but rather runoff as a discharge. It is estimated that paved areas and other impervious surfaces, such as roofs, have a runoff coefficient of 0.90 (i.e., 90 percent of the rainfall leaves the area as runoff). For unpaved surfaces, a runoff coefficient of 0.50 is frequently assumed. Since nearly all of the site area consists of pavement or roof, a runoff coefficient of 0.90 will be used.

Discharge volumes are easily estimated using the area of the drainage basin contributing to the outfall, the rainfall accumulation, and runoff coefficient. The formula used to compute the volume of runoff is as follows:

$$V_t = 0.0272 \times R_t \times A \times C_{runoff}$$

where: V_t = the total runoff volume in millions of gallons

R_t = the total rainfall measured in inches

A = the area within the drainage basin in acres

c_{runoff} = 0.90; the specific runoff coefficient (no units) estimated for this site

The area in acres contributing stormwater runoff to each of the five outfalls is estimated below.

Outfall	Area, (acres)
001	0.21
003	1.56
005	4.08
005A	0.92
005B	0.81

3.8 Documentation

3.8.1 Log Books

All pertinent information regarding the site and sampling procedures must be documented. Notations should be made in log book fashion, noting the time and data of all entries. Information recorded in the logbook or data sheets should include, but not limited to, the following:

- names
- date and time
- field instrument calibration information
- number of samples collected at each sample point
- methods used to collect samples and any factors that may affect quality
- all sample identification numbers
- description of samples
- weather conditions (severity of storm, inches of precipitation, etc.)
- other factors which could affects results

Appendix A

Review of Existing Stormwater Data, December 1990

REVIEW OF EXISTING STORM WATER DATA

AEROVOX FACILITY NEW BEDFORD, MA

Prepared by:
B&V Waste Science and Technology Corp.
December, 1990

INTRODUCTION

During a September 1990 meeting, Aerovox asked B&V Waste Science and Technology Corp. (BVWST) to review existing storm water data to determine whether their New Bedford facility could achieve current and proposed storm water permit limits for PCBs.

The Aerovox draft permit requires that effluent discharge be limited to a maximum daily concentration of 10 micro grams per liter (ug/l) of PCBs in storm water during steady flow for each distinct flow event. The permit monitoring requirements call for two grab samples per month to demonstrate compliance with the discharge limitation. Therefore, compliance will weigh heavily on determining the appropriate flow and time to take the samples.

Our review consisted of determining existing average storm water concentration and the variation of concentration for several groupings of data. The data were divided into several groups to identify any trends in average concentration or variation that could be associated with different outfalls, time periods, or laboratories.

In order to consistently meet the permitted concentration the steady-state average concentration plus some assumed variation should approximately equal 10 ug/l. Therefore, we are attempting to find the conditions that will eliminate the sources of special variation[1] (variation due to unusual occurrences such as sampling or laboratory errors) and reduce the amount of common variation (variation do to routine occurrences such as those associated with the accuracy of the analytical equipment or techniques) to yield a consistent maximum concentration at or below 10 ug/l.

The existing data set, "Chronological History of Outfalls PCB Readings" was input into a Lotus 1-2-3 Spreadsheet and the following standard Lotus statistics were performed on the data for each outfall:

- Sample Count;
- Maximum Concentration;
- Minimum Concentration;
- Average Concentration;
- Standard Deviation;
- Variance; and
- Coefficient of Variation

The data set was than grouped into the following categories and statistics were recalculated for each grouping:

1) Differing Time Periods
    - Post Construction Data;
    - 1989-1990 Data; and
    - Qualified 1989-1990 Data.

2) Differing Laboratories
- Aerovox Laboratory Data;
- Lycott Laboratory Data;
- CompuChem Laboratory Data:
- Toxicon Laboratory Data; and
- AquaTech Laboratory Data.

The results of the review are detailed in the following sections.

COMPLETE STORM WATER DATA SET

The statistics for the complete data set (Table 1) show average PCB in water concentrations ranging from 12.55 to 41.18 ug/l. A good measure of the data variation relative to the mean is the coefficient of variation[2]. For the complete data set, the coefficient of variation for each outfall is extremely high ranging from 146% to 531%.

Because of the high variance, the data was broken into two smaller time periods to try and eliminate any variance due to differing site conditions or widely varying sampling and analysis procedures. The first time period includes all data since the construction of the cap at the rear of the facility. The second time period includes only data from 1989-1990.

DIFFERING TIME PERIODS

Post Construction (after February 1984)

During the initial data review, several unusually high concentrations of PCBs were seen in the North and South Trough during the 1983-84 winter months. A review of the site history revealed that a cap was being constructed at this time over PCB contaminated soils located between the North and South Troughs. Because the construction probably caused the unusually high concentrations and the cap probably decreases the amount of mobile PCB-laden soil, the data prior to and directly after the construction is not representative of current conditions. Therefore, post construction data was evaluated separately.

The statistics for the post construction data set (Table 2) showed average PCB in water concentrations ranging from 8.28 to 13.35 ug/l. These average concentrations were significantly lower than those for the total data set. While the coefficients of variation dropped, they were still very high (117% to 241%).

1989-1990 Data

Further review of the data showed that sampling prior to 1989 was scattered and sporadic. Only nineteen sampling events occurred between June 1984 and December 1987. In contrast, 1989 and 1990 data appear to be more frequent and more directed. Forty three sampling events occurred between January 1989 and July 1990. Therefore, this grouping only considered 1989 through 1990 data.

TABLE 1

AEROVOX STORM WATER DATA

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	66.00	60.00	41.00	42.00
Maximum	965.80	1080.00	73.90	176.60
Minimum	0.00	0.00	0.70	0.00
Average	41.18	26.04	12.55	13.32
Std. Dev.	137.54	138.32	18.31	32.07
Variance	18916.94	19132.74	335.39	1028.18
Coef. of Variation	334%	531%	146%	241%

TABLE 2

POST CONSTRUCTION STORM WATER DATA

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	60.00	57.00	38.00	42.00
Maximum	93.10	130.00	73.90	176.60
Minimum	0.00	0.00	0.70	0.00
Average	13.35	8.28	9.68	13.32
Std. Dev.	15.62	17.89	13.47	32.07
Variance	243.92	320.08	181.53	1028.18
Coef. of Variation	117%	216%	139%	241%

The statistics for the 1989-1990 data set (Table 3) showed average PCB in water concentrations ranging from 9.45 to 17.00 ug/l. These average concentrations were significantly lower than those for the total data set. While the coefficients of variation continued to drop, they were still high (89% to 147%).

Qualified 1989-1990 Data

In addition to a comparatively larger amount of data, the 1989-1990 data set includes many split samples. A review of these split samples showed that some splits were significantly different. Therefore, to eliminate the possible variation introduced by samplers or laboratories, all split sample results that were not within an assumed range of variation of each other were eliminated.

Assuming a normal distribution of the data the following can be said about the data set:

- 68.26% of the data lie within the range of the mean plus or minus one standard deviation;
- 95.46% of the data lie within the range of the mean plus or minus 2 ~~one~~ standard deviation; and
- 99.73% of the data lie within the range of the mean plus or minus 3 one standard deviation[3].

Further assuming that 95 percent compliance with the permit limits is acceptable, the acceptable range of variation will be two standard deviations.

The statistics for the Qualified 1989-1990 data set (Table 4) showed average PCB in water concentrations ranging from 5.90 to 9.97 ug/l. These average concentrations were significantly lower than those for the total data set. While the coefficients of variation continued to drop, they were still high (63% to 147%).

DIFFERING LABORATORIES

The data sets from each laboratory were evaluated individually to determine the potential variation associated with each laboratory. Some amount of common variation is expected among differing samples; however, by identifying the laboratories with the lowest common variation, it is possible to lower the total variation of future results.

Aerovox Laboratory Data

The statistics for the Aerovox Laboratory data set (Table 5) showed average PCB in water concentrations ranging from 5.77 to 72.75 ug/l. This range of average concentrations was larger than that for the complete data set. In addition, the coefficients of variation were also larger (149% to 427%).

TABLE 3

1989-1990 STORM WATER DATA

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	43.00	42.00	29.00	31.00
Maximum	59.10	130.00	73.90	176.60
Minimum	1.71	0.00	0.70	0.32
Average	10.66	9.45	9.97	17.00
Std. Dev.	9.44	20.21	14.64	36.57
Variance	89.18	408.40	214.29	1337.30
Coef. of Variation	89%	214%	147%	215%

TABLE 4

QUALIFIED 1989-1990 STORM WATER DATA

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	41.00	40.00	29.00	21.00
Maximum	25.56	38.30	73.90	13.90
Minimum	1.71	0.00	0.70	0.32
Average	9.48	6.60	9.97	5.90
Std. Dev.	5.93	7.51	14.64	3.77
Variance	35.14	56.33	214.29	14.23
Coef. of Variation	63%	114%	147%	64%

Lycott Laboratory Data

The statistics for the Lycott Laboratory data set (Table 6) showed average PCB in water concentrations ranging from 5.23 to 10.98 ug/l. This range of average concentrations was significantly smaller than the complete data set or the Aerovox Laboratory data set. In addition, the coefficients of variation were also significantly smaller (50% to 93%).

CompuChem Laboratory Data

The statistics for the CompuChem Laboratory data set (Table 7) showed average PCB in water concentrations ranging from 5.46 to 11.40 ug/l. This range of average concentrations was similar to the Lycott data and was significantly smaller than the complete data set or the Aerovox Laboratory data set. In addition, the coefficients of variation were also significantly smaller than all other data sets including Lycott (31% to 76%).

Toxicon Laboratory Data

The statistics for the Toxicon Laboratory data set (Table 8) showed average PCB in water concentrations ranging from 4.43 to 27.81 ug/l. This range of average concentrations was significantly smaller than the complete data set or the Aerovox Laboratory data set but was greater than both the Lycott and CompuChem data sets. The coefficients of variation were large (82% to 204%).

AquaTech Laboratory Data

There was only one set of samples analyzed by Aquatech. The results (Table 9) ranged from 1.26 to 176.60 ug/l.

TABLE 5

AEROVOX LABORATORY DATA

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	32.00	26.00	19.00	17.00
Maximum	965.80	1080.00	72.77	46.10
Minimum	0.00	0.00	1.00	0.00
Average	72.75	48.34	13.82	5.77
Std. Dev.	192.27	206.57	20.56	10.57
Variance	36968.92	42671.34	422.73	111.69
Coef. of Variation	264%	427%	149%	183%

TABLE 6

LYCOTT LABORATORY DATA

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	18.00	18.00	12.00	13.00
Maximum	25.56	21.56	33.60	13.40
Minimum	1.71	1.33	1.96	0.32
Average	9.87	5.23	10.98	6.43
Std. Dev.	7.15	4.71	10.20	3.22
Variance	51.12	22.16	103.94	10.38
Coef. of Variation	72%	90%	93%	50%

TABLE 7

COMPUCHEM LABORATORY DATA

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	5.00	5.00	4.00	5.00
Maximum	15.30	12.10	13.60	10.00
Minimum	6.90	2.60	1.90	3.36
Average	11.40	5.46	6.05	6.89
Std. Dev.	3.52	3.39	4.57	2.31
Variance	12.38	11.46	20.91	5.34
Coef. of Variation	31%	62%	76%	34%

TABLE 8

TOXICON LABORATORY DATA

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	10.00	10.00	5.00	6.00
Maximum	59.00	130.00	10.80	124.00
Minimum	4.70	0.70	1.90	1.04
Average	15.08	18.30	4.43	27.81
Std. Dev.	15.47	37.41	3.62	43.61
Variance	239.43	1399.80	13.11	1901.76
Coef. of Variation	103%	204%	82%	157%

TABLE 9

AQUATECH LABORATORY DATA

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	1.00	1.00	1.00	1.00
Concentration	4.36	1.26	73.90	176.60

CONCLUSIONS

Evaluation of all the data groupings identifies the individual data set or combination of data sets that produces the least overall variation. The following suggestions should eliminate the sources of special variation:

- do not use any results prior to construction of the cap and prior to the more focused sampling plan of 1989; and
- do not use any results that are not within two standard deviations of the mean.

Common variation can be reduced by selecting the laboratories with the lowest variance, Compuchem and Lycott.

A final data set incorporating the above suggestions was reviewed as a test.

Final Data Set

The statistics for the Final Data Set (Table 10) showed average PCB in water concentrations ranging from 4.54 to 9.51 ug/l. In addition, the coefficients of variation were significantly smaller than all other data sets (42% to 63%).

Estimating a normal distribution, approximately 95 percent of the data will fall within plus or minus two standard deviations of the mean. Therefore, the following range of data could be expected for each outfall:

	Low Value	Mean	High Value
North Trough	0.00	9.51	21.15
South Trough	0.00	4.54	10.24
Yard Drain	0.00	5.16	10.58
Hadley Street Manhole	0.00	6.15	11.31

Based on the above values, the South Trough, Yard Drain, and Manhole may be in compliance approximately 95 percent of the time and may not require any additional controls/treatment.

The North Trough, however, may exceeds the permit limit (10 ug/l) as much as 50 percent of the time. Therefore, the storm water discharge may require additional controls/treatment to meet the permit limit.

Overall compliance is still heavily dependent on measuring the concentration at the proper flow (steady flow). Because there is no flow data associated with the Aerovox data the above conclusions may be inaccurate. Therefore, the Storm Water Study should stress flow as well as concentration measurement. Additionally, the results of the analyses will be incorporated into the design of the storm water study.

TABLE 10

FINAL DATA SET

	N. Trough PCB Conc. (ug/l)	S. Trough PCB Conc. (ug/l)	Yard Drain PCB Conc. (ug/l)	Hadley St. PCB Conc. (ug/l)
Samples	22.00	22.00	12.00	17.00
Maximum	21.00	12.10	9.75	10.25
Minimum	1.71	1.33	1.90	0.32
Average	9.51	4.54	5.16	6.15
Std. Dev.	5.82	2.85	2.71	2.58
Variance	33.85	8.15	7.32	6.64
Coef. of Variation	61%	63%	53%	42%