4.0
NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

The results of the chemical analyses for the samples collected during the RI investigation are presented in this section. Analytical results for the subsurface and surface soil, monitoring wells, seeps, surface water, sediments, fish/shellfish, air, potable water, and community basement water samples are presented along with discussions on the distribution of chemicals in each media, a summary of the compounds detected and their comparison to the appropriate criteria, and conclusions regarding the nature and extent of contamination in each media. A summary section at the end of this chapter discusses the nature and extent of contamination associated with the entire site. Tables presented in this section include summarized data only. A complete listing of samples, analytes for which they were analyzed, detection limits, and concentrations detected is provided in Appendix V.

4.2 SOIL

Analytical results for soil samples collected from soil borings, air monitoring station locations, and from the former community garden are discussed in this section. All of the soil analytical data are summarized in Tables 4-1 through 4-18.

As part of NYSDEC Standards, Criteria, and Guidelines, the Division of Hazardous Waste Remediation has recently issued guidelines in a Technical and Administrative Guidance Memorandum (NYSDEC, November 1992) for the determination of soil cleanup levels at hazardous waste sites. This document provides a listing of recommended cleanup objectives for individual organic and inorganic contaminants. However, since the determination of site-specific cleanup levels is a process that takes numerous factors into account (such as analyses, urban/rural setting, groundwater considerations, etc.) the listed cleanup objectives may not necessarily be applicable for a given site. Therefore, a different approach is used in this section to discuss the analytical data before a set of cleanup standards have been developed specifically for the landfill.

For discussion purposes, the analytical results of soil samples collected from the location of monitoring well MW-124 (soil samples SB-124S1 and SB-124S2) are here used as comparison data for the rest of the on-site and off-site soil samples. This well is located in Pelham Bay Park, about 300 ft south of the edge of the landfill in a hydraulically upgradient direction (i.e., groundwater does not flow from the landfill to this area). It is located in a grassy and wooded area of the park, relatively distant from vehicular traffic. A review of aerial photographs dating back to 1955 and a review of topographic maps dating back to 1922 suggests that this area has been relatively undisturbed since that time. Therefore, the chemical results of the soil samples collected from this boring may reflect natural, or background conditions, and can serve as a reference point for the other samples.

In addition, because of the urban setting of the landfill area and because of the tendency for lead to accumulate in such a setting, NYSDEC and NYSDOH verbally provided a 200 milligrams per kilogram (mg/kg) reference guideline for lead (January 13, 1993 meeting).

In the following discussion, detected organic compounds and inorganic analytes that are attributed to blank contamination are not discussed in the text. These compounds, however, are included in the data summary tables and they are identified by a "R" or "R#" qualifier.

4.2.1 Soil Boring Samples

Twenty-four soil boring samples were submitted for CLP organic and inorganic analyses following ASP 1989 Protocols. Sample locations are shown in Figures 4-1 through 4-4. Analytical results for VOCs, SVOs, pesticides and PCBs, and inorganics are presented in Tables 4-1 through 4-4, respectively. The sample designation shown in the tables, for example SB-113S2, indicates the sample location (soil boring location SB-113) and the relative depth of the sample (sample S2 indicates it is the deeper of the two samples collected from each boring). The actual sample depth is shown below the date of collection. The results for each analytical group are discussed below separately.

4.2.1.1 Volatile Organic Compounds

A summary of the VOC analytical results for soil boring samples is presented in Table 4-1. Sixteen of the twenty-four soil boring samples did not have detectable levels of VOCs. The remaining eight samples, including two samples collected from the off-site borings, contained detectable levels of VOCs. The highest concentration was 3,713 micrograms per kilogram (μg/kg). The locations of samples having detectable levels of VOCs are shown in Figure 4-1.

Relatively high VOC levels were detected in soil samples SB-119S2 (3,713 μg/kg), SB-118S2 (1,426 μg/kg), and SB-12052 (1,210 μg/kg). The totals consisted primarily of 2-propanone (acetone).

Samples SB-PZ3BS1 and SB-12152 had the next highest VOC concentrations (117 μg/kg and 162 μg/kg total VOCs), consisting primarily of 2-propanone with lesser amounts of chlorobenzene, toluene, and carbon disulfide.

The other three soil samples had VOC concentrations that ranged from 11 μg/kg (SB-12551) to 23 μg/kg (SB-12151).

The two off-site reference samples, SB-124S1 and SB-124S2, did not have detectable levels of VOCs.

4.2.1.2 Semi-volatile Organic Compounds

A summary of the SVO analytical results for soil boring samples is presented in Table 4-2. Four groups of SVOs were detected: polycyclic aromatic hydrocarbons (PAHs), phenols, phthalates, and chlorinated hydrocarbons. The location of samples having detectable levels of these SVO groups are shown in Figure 4-2.

PAHs

Eighteen PAH compounds were detected in the soil borings. Twenty-one of the twenty-four soil samples contained PAHs. The detected PAH totals ranged from 45 μg/kg (SB-120S2) to 224,300 μg/kg (SB-118S2D).

The shallow reference sample had a total PAH level of 2,059 μg/kg while the deeper sample had no detectable levels.

Phenols

Only three samples had detectable levels of phenols. The compound 4-methylphenol was detected in samples SB-CB1S2 (140 μg/kg) and SB-P3BS2 (150 μg/kg), and 4-nitrophenol was detected in SB-PZ3BS1 (61 μg/kg).

Phthalates

Four phthalate compounds were detected in the soil borings. Twenty samples contained detectable levels of phthalates, with concentrations ranging from 73 μg/kg (SB-121S1) to 5,570 μg/kg (SB-118S1 RE).

The shallow reference sample and the deeper reference sample had no detectable levels of phthalates.

Chlorinated Hydrocarbons

Only one sample contained a chlorinated hydrocarbon compound. Sample SB-118S2 contained 1,4-dichlorobenzene at a concentration of 1,600 μg/kg.

4.2.1.3 Pesticides and PCBs

A summary of the pesticides and PCBs analytical results for soil boring samples is contained in Table 4-3. Pesticides were detected in 15 soil samples. The concentrations ranged from about 1 μg/kg to 2,676 μg/kg. The highest levels occurred in the two soil samples collected from location MW-123, located off site at the entrance to Pelham Bay Park. With the exception of these samples, pesticide levels did not exceed 600 μg/kg. The shallow sample had a pesticide level of 1.1 μg/kg. The deep reference sample did not have detectable levels of pesticides. The locations of samples having detectable concentrations of pesticides are shown in Figure 4-3.

PCBs were detected in seven soil samples. The detected PCB levels ranged from 130 μg/kg to 430 μg/kg. PCB compounds were not detected in the reference samples. Samples having detectable concentrations of PCBs are shown in Figure 4-3.

4.2.1.4 Inorganics

The analytical results of inorganics detected in the soil boring samples are presented in Table 4-4. For the purposes of the discussion presented below, the highest concentration of a particular analyte found in either of the two reference samples was used for a reference number. Generally, concentrations of a given inorganic is higher in the shallow sample, but this is not always the case. The locations of all samples with inorganic analyte concentrations which exceeded reference concentrations are presented in Figure 4-4.

Cyanide and silver were not detected in any of the samples. In all samples, aluminum concentrations were below the reference level of 16,800 mg/kg.

Antimony was undetected in all samples, except for the shallow reference sample (9.1 mg/kg).

Arsenic levels slightly exceeded the reference concentration (4.4 mg/kg - SB-124S1) in eight samples. The highest arsenic concentration was found off site in sample SB-123S1 (11 mg/kg). The highest on-site arsenic concentration was 8.8 mg/kg, contained in sample SB-113S1.

Barium concentrations were greater than the reference concentrations of 76.3 mg/kg in fifteen samples. The maximum barium concentration, 371 mg/kg, was detected in sample SB-122S1.

Beryllium was detected in eight samples. Of these eight samples, only sample SB-116S1, with a concentration of 0.45 mg/kg, slightly exceeded the reference concentration of 0.39 mg/kg.

Cadmium was detected in four soil boring samples, but was not detected at the reference location. The maximum cadmium concentration (2.6 mg/kg) was detected in sample SB-119S2.

The calcium concentrations exceeded reference concentrations in all soil boring samples. The highest calcium concentration, 40,100 mg/kg, was found in sample SB-118S2.

Chromium concentrations exceeded reference concentrations in eight soil samples. The maximum chromium concentration, 93.7 mg/kg, was contained in on-site sample SB-113S2.

Cobalt concentrations exceeded reference concentrations in three samples. The maximum cobalt concentration, 17.5 mg/kg, was present in sample SB-113S2.

Copper concentrations exceeded reference concentrations in fifteen soil boring samples. The reference sample contained 24.6 mg/kg of copper. The maximum copper concentration of 126 mg/kg was present in sample SB-117S1.

Iron concentrations exceeded the reference concentrations of 19,900 mg/kg in eight samples. The highest iron concentration, 30,400 mg/kg, was found in sample SB-122S1.

Lead results were rejected in six samples through the data validation process. Of the remaining 18 samples, lead concentrations exceeded the reference concentration of 200 mg/kg in only two samples. The highest concentration of lead, 411 mg/kg, was detected in off-site sample SB-123S1. On site, the highest lead concentration was contained in sample SB-122S1 (211 μg/kg).

Sixteen samples contained magnesium concentrations that exceeded the reference concentration of 3,810 mg/kg. The highest concentration of magnesium, 10,700 mg/kg, was detected in sample SB-114S1.

Manganese results were rejected in four samples through the data validation process. Of the remaining twenty samples, only sample SB-116S1, with a manganese concentration of 549 mg/kg, exceeded the reference manganese concentration of 479 mg/kg.

Nineteen samples contained detectable levels of mercury. The reference samples contained up to 0.39 mg/kg of mercury. Six samples contained mercury levels that slightly exceeded this concentration. The maximum level of 1.3 mg/kg was present in SB-122S2 (5,760 mg/kg).

Nickel concentrations exceeded the reference concentration of 49.5 mg/kg in four samples. The maximum nickel concentration of 123 mg/kg was detected in sample SB-113S2.

Sixteen soil samples contained concentrations of potassium that exceeded the reference concentration of 1,180 mg/kg. The highest potassium concentration, 5,760 mg/kg, was detected in sample SB-113S2.

Selenium was detected in only one soil boring sample. A concentration of 0.48 mg/kg selenium was contained in sample SB-119S1.

Sodium concentrations exceeded the reference concentration of 121 mg/kg in all but three samples. A maximum sodium concentration of 8,270 mg/kg was present in sample SB-CB1S2.

One thallium results was rejected in the data validation process. Six other samples contained thallium. Thallium concentrations slightly exceeded the reference concentrations of 0.5 mg/kg in four samples. The highest thallium concentration, 0.63 mg/kg, was present in sample SB-117S1.

Vanadium concentrations exceeded the reference concentration of 34.4 mg/kg in nine soil boring samples. The highest vanadium concentration, 83.2 mg/kg, was detected in sample SB-122S1.

Fifteen soil boring samples contained zinc concentrations that exceeded the reference concentration of 48.8 mg/kg. A maximum zinc concentration of 500 mg/kg was present in sample SB-117S1.

4.2.2 Air Sampling Location Soil Samples

Shallow surface soil samples were collected from fifteen off-site and on-site air monitoring locations. The sample locations are shown in Figures 4-5 through 4-12. The analytical data for these samples is summarized in Tables 4-5 through 4-9.

4.2.2.1 Volatile Organic Compounds

VOCs were only detected in four on-site samples (Table 4-5). The locations of soil samples having detectable levels of VOCs are shown in Figure 4-5.

The highest levels occurred in sample SS-HD and SS-HD DUP (a QA/QC duplicate sample of SS-HD), with a total VOC concentration of nearly 360 μg/kg. Monocyclic aromatic compounds, such as benzene and chlorobenzene, were the principle contaminants in this sample. The two other samples both had VOC levels of 3 μg/kg.

The two off-site reference samples, SB-124S1 and SB-124S2, did not have detectable levels of VOCs.

4.2.2.2 Semi-volatile Organic Compounds

SVOs were detected in all soil samples with total concentrations ranging from 706 μg/kg to 74,860 μg/kg (Table 4-6). Five groups of SVOs were detected in the soil boring samples. They were PAHs, phenols, phthalates, chlorinated hydrocarbons, and a miscellaneous group of compounds. On-site and off-site soil samples having detectable levels of these SVO groups are shown in Figures 4-6 and 4-7, respectively.

PAHs

PAHs were detected in all samples at levels ranging from 619 μg/kg to 74,400 μg/kg. The highest levels were found in samples SS-H1 (74,400 μg/kg), SS-HF (28,005 μg/kg), and SS-H6 (20,434 μg/kg). The lowest PAH levels were found in samples SS-HC (619 μg/kg) and SS-HD (804 μg/kg).

The shallow reference sample had a total PAH concentration of 2,059 μg/kg while the deeper sample did not have detectable levels of PAH compounds.

Phenols

Phenols were detected in only two samples, SS-HD (130 μg/kg) and the duplicate sample SS-HD DUP (220 μg/kg).

Phenols were not detected in the reference samples.

Phthalates

Phthalates were detected in all soil samples at levels ranging from 55 μg/kg (SS-HG) to 40,170 μg/kg (SS-HB). Phthalate concentrations, however, were less than 500 μg/kg in all but two other samples.

Phthalates were not detected in the reference samples.

Chlorinated Hydrocarbons

Chlorinated hydrocarbons were detected in four samples. They are SS-HB, SS-HD and its duplicate sample, and SS-HF. These are all on-site samples. The detected levels ranged from 98 μg/kg to 530 μg/kg.

Chlorinated hydrocarbons were not detected in the reference samples.

Miscellaneous Semi-volatile Compounds

Two miscellaneous compounds, benzoic acid and n-nitrosodi-n-propylamine, were detected in two off-site and three on-site samples. The concentrations ranged from 60 μg/kg to 420 μg/kg.

Miscellaneous compounds were not detected in the reference samples.

4.2.2.3 Pesticides and PCBs

Pesticides were detected in all samples except SS-HC (Table 4-7). Up to nine pesticide compounds were detected. The highest levels were found in sample SS-H6 (1,751 μg/kg). The lowest total pesticide concentration was contained in sample SS-H4 (17.33 μg/kg). On-site and off-site soil samples having detectable pesticide concentrations are shown in Figures 4-8 and 4-9, respectively.

The shallow reference sample contained a total pesticide level of 1.1 μg/kg. Pesticides were not detected in the deep reference sample. The PCB Aroclor-1254 was detected in two samples, SS-HE and SS-HF. Both samples were collected on site. The PCB levels were 830 μg/kg and 770 μg/kg, respectively. On-site sample concentrations of PCBs are shown in Figure 4-8.

PCBs were not detected in the reference samples.

4.2.2.4 Inorganics

On two separate occasions, soils from seven on-site air sampling locations were collected for inorganic analyses. The first sampling event occurred in May, 1992 and the second event occurred in August, 1992 (see Section 2.2.5.2 for explanation). A total of seventeen samples were analyzed. The analytical results are presented in Tables 4-8 and 4-9. On-site samples from the May, 1992 and August, 1992 events having inorganic analyte concentrations which exceeded reference concentrations (SB-124S1 and SB-124S2) are shown in Figures 4-10 and 4-11, respectively.

On-site Samples

Cadmium, cyanide and silver were not detected in any samples. In all samples concentrations of aluminum were below the reference concentration of 16,800 mg/kg. For all samples, mercury was either undetected or present in concentrations below the reference concentration of 0.39 mg/kg.

Antimony was undetected in all samples, although one antimony result was rejected during the data validation process.

Arsenic levels slightly exceeded the reference concentration of 4.4 mg/kg in five soil samples. For both sampling events, samples from location D contained the maximum arsenic concentrations with 9.4 mg/kg (May, 1992) and 9.2 mg/kg (August, 1992).

Eight samples contained barium concentrations which exceeded the reference concentration of 76.3 mg/kg. In May, 1992, a maximum barium concentration of 111 mg/kg was detected in sample SS-B. In August, 1992, a maximum barium concentration of 845 mg/kg was detected in sample SS-HF.

Beryllium concentrations slightly exceeded the reference concentration of 0.39 mg/kg in two samples collected during the May, 1992 sampling event. The highest beryllium concentration, 0.52 mg/kg, was contained in sample SS-C. From the August, 1992 sampling event, beryllium was undetected in two samples. In all other samples the beryllium concentrations did not exceed the reference concentrations.

All of the samples (except SS-D, -HD, and -HD DUP) exceeded the calcium reference concentration of 1,340 mg/kg. From the May, 1992 sampling round, the highest calcium concentration (69,900 mg/kg) was detected in sample SS-A. From the August, 1992 sampling round, a maximum calcium concentration of 103,000 mg/kg was detected in sample SS-HE.

Chromium, manganese, and nickel levels exceeded reference concentrations in only two samples. Both of these samples were collected from location SS-HC. Samples collected during the two sampling rounds contained chromium concentrations of 84 mg/kg and 117 mg/kg, a manganese concentration of 542 mg/kg and nickel concentrations of 234 mg/kg and 477 mg/kg. The manganese results, however, for the May 1992 sampling round were rejected during the data validation process.

Three samples (SS-C, -HC, and -HB) slightly exceeded the cobalt reference concentration of 10.5 mg/kg. The maximum cobalt concentration was detected in sample SS-HC (26 mg/kg).

Copper concentrations exceeded the reference concentration of 24.6 mg/kg in seven samples. The maximum concentration, 98.2 mg/kg, was detected in sample SS-HB.

Three samples (SS-C, -HC, and -HB) exceeded the reference concentration of 19,900 mg/kg for iron. The maximum iron concentration, 23,500 mg/kg, was detected in sample SS-HB (August, 1992). All other samples did not exceed the reference concentration.

Two samples exceeded the lead reference concentration of 200 mg/kg. The maximum lead concentration, 1,130 mg/kg, was found in sample SS-HB (August, 1992).

Magnesium concentrations exceeded the reference concentrations of 3,810 mg/kg in eight samples. For both sampling events, the highest magnesium sample concentrations were detected in the sample collected at location SS-HA. The maximum magnesium concentration, 33, 400 mg/kg, was detected in sample SS-HA (May, 1992).

Potassium levels were below the reference concentration of 1,180 mg/kg in all samples collected during the May, 1992 sampling round. Two samples from the August, 1992 sampling event had potassium concentrations above reference concentrations. The highest potassium concentration, 1,740 mg/kg, was detected in sample SS-HE (August, 1992).

Selenium was not detected in all but one sample. Sample SS-HG (August, 1992) contained selenium at a concentration of 0.5 mg/kg. Selenium was not detected in the reference samples.

Sodium concentrations in samples SS-A, -ADUP, -HA, and -HB exceeded the reference concentration of 121 mg/kg. The highest sodium concentration, 453 mg/kg, was detected in sample SS-A DUP (May, 1992). This sample also had the only detectable level of thallium. This thallium concentration, 0.55 mg/kg, slightly exceeded the reference concentration of 0.5 mg/kg.

Vanadium concentrations slightly exceeded the reference concentration of 34.4 mg/kg in three samples. A maximum vanadium concentration of 40.1 mg/kg was present in sample SS-HG (August, 1992).

Zinc concentrations exceeded the reference concentration of 48.8 mg/kg in eleven samples. The maximum zinc concentration, 530 mg/kg, was detected in sample SS-HF (August, 1992).

Off-site Samples

Eight soil samples were collected from off-site air monitoring locations. The inorganic analytical results are presented in Table 4-8. Off-site soil samples having concentrations which exceeded reference concentrations (SB-124S1 and SB-124S2) are shown in Figure 4-12.

Cadmium, cyanide and thallium were undetected in all samples. In addition, all samples contained concentrations of aluminum, beryllium, cobalt, iron, manganese, and nickel below the reference concentrations.

Concentrations of calcium and zinc exceeded reference concentrations (1,340 mg/kg and 48.8 mg/kg, respectively) in all samples. The maximum calcium concentration, 20,000 mg/kg was detected in sample SS-H8. A maximum zinc concentration of 486 mg/kg was detected in sample SS-H6.

The lead reference level of 200 mg/kg was exceeded in three samples. The maximum lead level was contained in sample SS-H8 (1,350 mg/kg).

Antimony was detected in only two samples. Sample SS-H2 contained 11.2 mg/kg and sample SS-H8 contained 10.6 mg/kg of antimony. Both samples contained levels that slightly exceeded the reference concentration of 9.1 mg/kg

Four soil samples had arsenic concentrations which exceeded the reference concentration of 4.4 mg/kg. The highest arsenic concentration, 29.1 mg/kg, was contained in sample SS-H8.

Barium and copper concentrations exceeded reference concentrations (76.3 mg/kg and 24.6 mg/kg, respectively) in six samples. The maximum barium concentration was 204 mg/kg contained in sample SS-H6. The maximum copper concentration, 178 mg/kg, was detected in sample SS-H8.

Chromium concentrations exceeded the reference concentration of 31.4 mg/kg in only one sample. Sample SS-H6 contained 150 mg/kg chromium.

Magnesium concentrations exceeded the reference concentration of 3,810 mg/kg in three samples. The maximum magnesium concentration, 10,900 mg/kg, was detected in sample SS-H8.

Mercury was detected in four soil samples. Only one sample, SS-H6, contained a mercury concentration, 0.51 mg/kg, which slightly exceeded the reference concentration of 0.39 mg/kg.

Three samples contained potassium concentrations that exceeded the reference concentration of 1,180 mg/kg. The highest potassium concentration, 1,620 mg/kg, was detected in sample SS-H7.

Selenium and silver were not detected in the reference samples. They were detected, however, in several soil samples. Sample SS-H1 contained 0.54 mg/kg selenium. Sample SS-H2 contained 0.78 mg/kg silver. Sample SS-H6 contained 1.3 mg/kg silver. Sample SS-H8 contained 0.55 mg/kg of selenium and 0.87 mg/kg of silver.

Sodium sample concentrations exceeded the reference concentration of 121 mg/kg in three samples. The maximum sodium concentration, 187 mg/kg, was detected in sample SS-H5.

Four samples contained vanadium concentrations which slightly exceeded the reference concentration of 34.4 mg/kg. The highest vanadium concentration, 47.3 mg/kg, was detected in sample SS-H5.

4.2.3 Former Community Garden

Five soil samples were collected from the area of the former community garden. Four samples were collected from the surface and one sample was collected from the 1 ft to 2 ft depth interval. Sampling locations are shown in Figures 4-13 through 4-16. Analytical data are summarized in Tables 4-10 through 4-13.

4.2.3.1 Volatile Organic Compounds

VOCs were detected in two samples, one shallow and one deep (Table 4-10). Sample SS-GAR3 had 1 μg/kg of chloroform and sample SB-GAR5 had 1 μg/kg of toluene. Samples with detectable levels of VOCs are shown in Figure 4-13.

VOCs were not detected in the reference samples.

4.2.3.2 Semi-volatile Organic Compounds

Three groups of SVOs were detected in the samples. Total SVO concentrations ranged from 4,226 μg/kg (SB-GAR5) to 18,515 μg/kg (SS-GAR2). The SVO data is summarized in Table 4-11. The locations of samples with detectable levels of these SVO groups are shown in Figure 4-14.

PAHs

PAHs were detected in all samples at concentrations ranging from 4,101 μg/kg (SB-GAR5) to 17,835 μg/kg (SS-GAR2).

The shallow reference sample had a total PAH concentration of 2,059 μg/kg while the deeper sample had no detectable levels.

Phthalates

Phthalates were detected in all samples at levels ranging from 36 μg/kg (SB-GAR5) to 440 μg/kg (SS-GAR3).

Phthalates were not detected in the reference samples.

Miscellaneous Semi-volatile Compounds

Only one miscellaneous SVO compound, benzoic acid, was detected. It was found in all five samples at concentrations ranging from 89 μg/kg to 670 μg/kg.

4.2.3.3 Pesticides and PCBs

Up to nine pesticide compounds were detected in all of the samples (Table 4-12). The total pesticide concentrations ranged from 19.6 μg/kg in sample SB-GAR5 to 775.7 μg/kg in sample SS-GAR1. The locations of samples having detectable pesticide levels are shown in Figure 4-15.

The shallow reference sample contained pesticide levels of 1.1 μg/kg. Pesticides were not detected in the deep reference sample.

The PCB Aroclor-1254 was detected in all of the samples with concentrations ranging from 53 μg/kg (SB-GAR5) to 1,100 μg/kg (SS-GAR1). These samples are shown in Figure 4-15.

PCBs were not detected in the reference samples.

4.2.3.4 Inorganics

The five soil samples that were collected from the former garden area were analyzed for inorganic chemicals. The inorganic analytical results are summarized in Table 4-13. Soil samples with inorganic analyte concentrations which exceed reference concentrations (SB-124S1 and SB-124S2) are shown in Figure 4-16.

Antimony, cadmium, cyanide, and selenium were not detected in the samples. All samples contained levels of aluminum, beryllium, cobalt, iron, manganese, nickel and vanadium that were below reference concentrations.

Arsenic levels exceeded the 4.4 mg/kg reference concentration is all samples except SB-GAR5 (2 mg/kg). The highest level was found in SS-GAR2 (7.8 mg/kg).

Three samples contained concentrations of barium which exceeded the reference concentration of 76.3 mg/kg. The maximum barium concentration, 338 mg/kg, was contained in sample SS-GAR3.

Calcium levels exceeded the reference concentration of 1,340 mg/kg in all five soil samples. The highest calcium concentration, 23,000 mg/kg, was detected in sample SS-GAR1.

Sample SS-GAR2, with a chromium concentration of 38.1 mg/kg, was the only soil sample from the former garden area to exceed the reference chromium concentration of 31.4 mg/kg.

All samples except SB-GAR5 contained copper, magnesium and zinc concentrations which exceeded reference concentrations. Lead levels were exceeded in all samples except SS-GAR4 and SB-GAR5. The maximum copper and lead concentrations, 72.2 mg/kg and 293 mg/kg, respectively, were detected in sample SS-GAR1. The maximum magnesium concentration, 7,200 mg/kg, was contained in soil sample SS-GAR2. Sample SS-GAR3, contained the highest level of zinc (319 mg/kg).

Mercury concentrations exceeded the reference concentration of 0.39 mg/kg in four samples. The highest mercury concentration, 1.3 mg/kg, was present in sample SS-GAR1.

Potassium concentrations exceeded the reference concentration of 1,180 mg/kg in only one soil sample. The highest potassium concentration, 1,230 mg/kg, was contained in soil sample SS-GAR3.

Silver was not detected in the reference samples. It was, however, detected in former garden area samples SS-GAR1, SS-GAR2 and SS-GAR4. Silver concentrations were 1.1 mg/kg, 0.72 mg/kg and 0.81 mg/kg, respectively.

Sodium concentrations slightly exceeded the reference concentration of 121 mg/kg in two samples. The maximum sodium concentration, 194 mg/kg, was detected in sample SS-GAR2.

Although undetected in all four shallow samples, the deeper sample SB-GAR5 contained 0.67 mg/kg of thallium. This thallium concentration was slightly above the reference thallium concentration of 0.5 mg/kg.

4.2.4 Tentatively Identified Compounds

This section discusses the tentatively identified compounds (TICs) that were detected in the soil samples. Following 1989 ASP protocols, a maximum of 10 VOC TICs and 20 SVO TICs were reported by the laboratory. The TIC data are summarized in Tables 4-14 through 4-18.

For data presentation, the TICs found in any given sample were grouped in the summary tables on the basis of their similarity, and not by chemical composition. For example, if the laboratory identified several compounds as "unknown hydrocarbons", the compounds were grouped together even though their chemical composition may not be the same.

Soil Borings

Six groups of VOC TICs and fifty groups of SVO TICs were detected in soil samples collected from the on- and off-site borings. Tables 4-14 and 4-15 show the concentrations of the individual TICs detected in the samples.

VOC TICs were detected in seven samples. The number of detected TICs varied from one to three. The concentrations of detected VOC TICs ranged from 11 μg/kg (SB-CB1S2) to 1,090 μg/kg (SB-119S2). VOC TICS were not detected in the reference samples.

SVO TICs were detected in all samples. The number of detected TICs varied from three to nineteen. The concentrations of detected semi-volatile TICs ranged from 530 μg/kg (SB-113S2) to 90,800 μg/kg (SB-118S2 DL). SVO TICS were detected in the reference samples at concentrations ranging from 5,950 μg/kg (SB-124S1) to 8,300 μg/kg (SB-124S2).

On-Site Air Monitoring Locations

Five groups of volatile organic TICs and twenty-two groups of semi-volatile organic TICs were detected in the soil samples collected from the on-site air sampling locations. Table 4-16 shows the concentrations of the individual TICs detected in the samples.

VOC TICs were detected in three samples. The number of detected TICs varied from two to five. The concentrations of detected VOC TICs ranged from 27 μg/kg (SS-HF) to 279 μg/kg (SS-HC). VOC TICS were not detected in the reference samples.

SVO TICs were detected in all samples. The number of detected TICs varied from four to nineteen. The concentrations of detected compounds ranged from 3,370 μg/kg (SS-HE) to 22,570 μg/kg (SS-HF). SVO TICS were detected in the reference samples at concentrations ranging from 5,950 μg/kg (SB-124S1) to 8,300 μg/kg (SB-124S2).

Off-Site Air Monitoring Locations

One volatile organic TIC and sixteen groups of semi-volatile organic TICs were detected in the soil samples collected at the off-site air sampling locations. Table 4-17 shows the concentrations of the individual TICs detected in the samples.

One VOC TIC was identified in sample SS-H4 at a concentration of 6 μg/kg. VOC TICS were not detected in the reference samples.

SVO TICs were detected in all samples at concentrations ranging from 4,040 μg/kg (SS-H5) to 39,460 μg/kg (SS-H1). The number of detected TICs varied from five to eighteen. SVO TICS were detected in the reference samples at concentrations ranging from 5,950 μg/kg (SB-124S1) to 8,300 μg/kg (SB-124S2).

Former Community Garden

Two volatile organic TICs and eleven groups of semi-volatile organic TICs were detected in the soil samples collected from the former community garden area. Table 4-18 shows the concentrations of the individual TICs detected in the samples.

VOC TICs were detected in samples SS-GAR1 and SS-GAR4. Both samples had a total TIC concentration of 8 μg/kg. VOC TICs were not detected in the reference samples.

SVO TICs were detected in all samples at concentrations ranging from 1,590 μg/kg (SB-GAR5) to 48,620 μg/kg (SS-GAR4). The number of detected TICs varied from six to eighteen. SVO TICS were detected in the reference samples at concentrations ranging from 5,950 μg/kg (SB-124S1) to 8,300 μg/kg (SB-124S2).

4.3 GROUNDWATER/LEACHATE SEEPS

This section includes the presentation of analytical data from the monitoring well and seep samples collected for the RI; a comparison of these data to NYSDEC Groundwater Standards, draft effluent limitations, and the Phase I data; evaluation of the data with regard to ionic distribution; and a summary and conclusions regarding the nature and extent of groundwater contamination.

4.3.1 Monitoring Well Sample Results

This section contains a summary of the analytical results obtained from sampling monitoring wells.

4.3.1.1 Volatile Organic Compounds

Forty monitoring well samples and two blind duplicates (MW-DUP-1, duplicate of MW-115 and MW-DUP-2, duplicate of MW-126), were analyzed for VOCs using the NYSDEC ASP 1989 methods with a holding time of 7 days. The validated results of these analyses are summarized in Table 4-19 and graphically on Figure 4-17 next to the monitoring wells. No VOCs were detected in MW-103, -107, -114B, -117B, -118, -119, -120B, and -123. Methylene chloride, which was detected in many of the samples, is a common laboratory contaminant, and these restuls were rejected during validation.

The additional VOC samples that were taken in MW-120 at the end of the pumping test, one at high tide, MW-120H, and one at low tide, MW-120L, show similar results when compared to the MW-120 sample. These samples contained benzene, chlorobenzene, ethylbenzene, toluene, and xylenes at levels similar to the MW-120 sample. One VOC sample was taken from MW-115 and MW-115B at the end of the pumping tests (the sample taken from MW-115 was labeled as MW-115P, and the sample taken from MW-115B was labeled as MW-115BP). These were taken for comparison with the pre-test samples and show essentially no differences in results. Also, the two duplicate samples showed consistently similar results when compared to their corresponding well sample detections.

The following is a summary of the VOCs detected.

> Halogenated Aliphatic Compounds. Very few halogenated aliphatic compounds were detected in the monitoring well samples. Chloroform and 1,2-dichloroethylene are the most frequently detected compounds. Chloroform was detected in three samples from 2 micrograms per liter (μg/L) to 20 μg/L and 1,2-dichloroethylene was detected in two samples at 1 μg/L. Only the sample from MW-116B contained tetrachloroethylene and trichloroethylene at 6 μg/L and 5 μg/L, respectively.

Ketones. 2-propanone (acetone) was detected in 12 samples at concentrations ranging from 8 μg/L to 2,100 μg/L. The highest concentrations of 2-proponone were found in MW-121B and MW-119B.

Monocyclic Aromatic Hydrocarbons. This group of compounds was the most prevalent of the VOCs detected. Benzene, chlorobenzene, ethylbenzene, toluene, and xylenes were detected in the following frequency and concentration range:

benzene	15 samples	1 μg/L to 62 μg/L
chlorobenzene	17 samples	1 μg/L to 46 μg/L
ethylbenzene	11 samples	3 μg/L to 36 μg/L
toluene	8 samples	1 μg/L to 230 μg/L
xylenes	6 samples	5 μg/L to 200 μg/L

The highest total concentration of monocyclic aromatic hydrocarbons was found in MW-116B (528 μg/L). The next highest total concentrations of these five compounds were found in MW-119B (50 μg/L), MW-120 (37 μg/L), MW-111 (23 μg/L), MW-113B (31 μg/L), MW-122 (35 μg/L), and MW-122B (56 μg/L).

4.3.1.2 Semi-volatile Organic Compounds

Thirty-five monitoring well samples were analyzed for semi-volatile organic compounds using the NYSDEC ASP 1989 methods with a holding time of five days to extraction and forty days for analysis after extraction. The results of these analyses are presented in Table 4-20, and graphically on Figure 4-18 next to the monitoring wells.

No semi-volatile organic compounds were detected in MW-110, -111, -113, -114, -114B, --115B, -125 or -125B. Samples MW-105 and MW-126 contained the most semi-volatile organic compounds. The following is a summary of the SVO compounds detected.

Polycyclic Aromatic Hydrocarbons (PAHs). PAH compounds were detected in nine monitoring well samples with total concentrations ranging from 6 μg/L to 282 μg/L. MW-105 contained the most PAH compounds and highest total concentration. MW-120 and MW-126 were the next highest in total concentration (56 μg/L and 118 μg/L, respectively). Unlike VOCs which were detected in the highest concentration in the bedrock wells, PAHs are limited to the fill and till units, with the exception of 10 μg/L in MW-116B and 8 μg/L in MW-119B.

Naphthalene was detected at the highest concentration (140 μg/L in MW-105) of the PAHs. Other PAHs detected include 2-methylnaphthalene, acenaphthylene, acenaphthene, anthracene, chrysene, benzo (a) anthracene, dibenzofuran, fluoranthene, fluorene, phenanthrene, and pyrene.

Phenols. Phenolic compounds were detected in five monitoring well samples with total concentrations ranging from 4 μg/L to 339 μg/L. Wells MW-105, -120, and -126 contained 2-methylphenol and 2,4-dimethylphenol at 73 μg/L, 119 μg/L, and 339 μg/L, respectively.

Phthalates. Bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, and di-n-octylphthalate were detected in 13 samples at concentrations ranging from 2 μg/L to 48 μg/L. The highest levels of phthalates were found in MW-126. Only three other samples had phthalates detected above 6 μg/L. They are MW-105 (13 μg/L), MW-118B (32 μg/L) and MW-119B (17 μg/L).

Other Semi-volatiles. Very low concentrations of bis (2-chloroisopropyl) ether, 1,4-dichlorobenzene, N-nitrosodi-n-propylamine, and N-nitrosodiphenylamine were detected in wells MW-109, -113B, -117B, -118, -118B, -119B, -120, and -121B.

4.3.1.3 Pesticides and PCBs

Pesticide compound detections are summarized in Table 4-21. Pesticides were detected in 27 wells at concentrations ranging from 0.0082 μg/L to 21 μg/L. The highest concentrations and most frequent detections are in the MW-105 sample. In all samples other than MW-105, the pesticide detections are flagged with a J indicating that the compounds were detected below the Contract Required Detection Limit. Most pesticide results are also flagged with a V indicating that the reported results could not be verified during data validation.

The PCB Aroclors 1016 and 1260 were the only PCB compounds detected. These detections were limited to MW-105 where PCB 1016 was 0.84 μg/L and PCB 1260 was 1 μg/L.

4.3.1.4 Inorganics

Thirty-eight samples were submitted for inorganic analyses using the NYSDEC ASP 1989 methods. Holding times varied for each analyte as stated in the QAPP (WCCI, 1991c). The results of the inorganic analyses are presented in Table 4-22. Selected analytes are also displayed graphically on Figure 4-19. All monitoring well samples contained inorganic analytes. All inorganics analyzed were detected with the exception of beryllium and selenium. The following is a summary of the results.

Arsenic. Arsenic was detected in twenty seven of the monitoring well samples ranging in concentration from 2 μg/L in MW-112 to 63.4 μg/L in MW-126. Arsenic detections that were greater than 10 μg/L are in the MW-107, -117, -118B, -119B, -121, -122, and -126 samples.

Barium. Barium was detected in all 38 of the monitoring well samples ranging in concentration from 164 μg/L in MW-114 to 3,090 μg/L in MW-126.

Cadmium. Cadmium was detected in seven samples ranging from 5.2 μg/L in MW-125 to 9.6 μg/L in MW-126.

Chromium. Chromium was detected in all samples except MW-103, -109, -114B, -117B, -120B, and -124B ranging in concentration from 11.1 μg/L in MW-115 to 1,240 μg/L in MW-126.

Cyanide. Cyanide was detected in five monitoring well samples, MW-104 at 10.8 μg/L and MW-106 at 24.6 μg/L, MW-113 at 22.6 μg/L, MW-118 at 267 μg/L and MW-126 at 30.4 μg/L. Cyanide was not analyzed in many of the other samples because the pH of the water was too low to preserve the analyte. These samples are specified in the data useability reprot (Appendix B).

Iron. Iron was detected in all monitoring well samples ranging from 165 μg/L in MW-117B to 194,000 μg/L in MW-118B. All iron concentrations except for MW-117B are greater than 300 μg/L, the NYSDEC standard. This comparison is presented in Section 4.3.4.1.

Lead. Lead was detected in 25 of the monitoring well samples ranging in concentration from 1.2 μg/L in MW-114B to 423 μg/L in MW-126. Eleven samples had lead concentrations greater than 25 μg/L (MW-103, -104, -105, -110, -113, -113B, -116B, -118B, -119, -119B, -121B, and -126).

Mercury. Mercury was detected in six of the monitoring well samples ranging in concentration from 0.2 μg/L in MW-106 to 1.1 μg/L in MW-126.

Vanadium. Vanadium was detected in all of the monitoring well samples except MW-109, -114B, -115B, and -117B ranging in concentration from 5.2 μg/L in MW-112 to 2,860 μg/L in MW-126.

Zinc. Zinc was detected in all monitoring well samples except MW-111, -112, -115, -115B, -117, and -123. Concentrations ranged from 20.2 μg/L in MW-120B to 7,110 μg/L in MW-118B.

Other inorganic analytes that were detected in the monitoring well samples were: aluminum ranging in concentration from 48.7 μg/L in MW-115B to 46,200 μg/L in MW-118B; calcium ranging in concentration from 7,740 μg/L in MW-116 to 2,752,000 μg/L in MW-118B; cobalt ranging in concentration from 8.1 μg/L in MW-118B to 77.3 μg/L in MW-126; copper ranging in concentration from 7.3 μg/L in MW-114 to 1130 μg/L in MW-118B; magnesium ranging in concentration from 5,290 μg/L in MW-116 to 1,936,000 μg/L in MW-118B; manganese ranging in concentration from 75.8 μg/L in MW-105 to 29,600 μg/L in MW-118B; nickel ranging in concentration from 47.4 μg/L in MW-117B to 414 μg/L in MW-122; potassium ranging in concentration from 2,950 μg/L in MW-116 to 1,431,000 μg/L in MW-126; and sodium ranging in concentration from 10,700 μg/L in MW-124B to 8,000,000 μg/L in MW-118.

4.3.1.5 Conventional Parameters

Thirty-nine monitoring well samples were analyzed for a modified Bureau of Municipal Waste (BMW) list of conventional parameters which included: alkalinity as carbonate, alkalinity as bicarbonate, TDS, chloride, nitrate-N, sulfate, chemical oxygen demand

(COD), total Kjeldahl nitrogen (TKN), and ammonia-N. Samples were analyzed for conventional parameters for two reasons: 1) to aid in evaluating the nature and extent of contamination associated with the landfill, and 2) to compare the ionic distribution in the groundwater samples with the surface water and seep samples. The BMW recommends a list of analytes for analytes for landfill sites. Of this list, these nine compounds were selected as most appropriate for evaluating nature and extent of contamination and ionic distribution.

Monitoring well samples were analyzed using the specific EPA methods presented in the QAPP (WCCI, 1991c). Compounds detected are listed in Table 4-23. The distribution of selected compounds is shown on Figure 4-20. A description of specific parameters detected in the monitoring well samples is presented in the following sections.

Ammonia-N. Ammonia-N was detected in 30 of the monitoring well samples ranging in concentration from 0.17 mg/L in MW-116B to 1,260 mg/L in MW-126.

Chloride. Chloride was detected in all of the monitoring well samples ranging in concentration from 11 milligrams per liter (mg/L) in MW-124B to 13,560 mg/L in MW-120B. Chlorides are discussed in detail in Section 4.3.8.1.

Nitrate-N. Nitrate-N was detected in 18 of the monitoring well samples ranging in concentration from 0.01 mg/L in MW-124B to 23 mg/L in MW-118.

Sulfate. Sulfate was detected in all of the monitoring well samples ranging in concentration from 30 mg/L in MW-123 to 1,680 mg/L in MW-119.

Other conventional parameters that were detected in the monitoring well samples were: alkalinity as carbonate ranging in concentration from 6 mg/L in MW-124 to 900 mg/L in MW-126; alkalinity as bicarbonate ranging in concentration from 35 mg/L in MW-118B to 5,880 mg/L in MW-105; TDS ranging in concentration from 30 mg/L in MW-123 to 28,300 mg/L in MW-120B; COD ranging from 170 mg/L in MW-121B to 8,170 mg/L in MW-126; and total Kjeldahl-N ranging in concentration from 0.28 mg/L in MW-123 to 1,010 mg/L in MW-105.

4.3.2 Seep Sample Results

This section contains the summary of the analytical results obtained from sampling the seeps.

4.3.2.1 Volatile Organic Compounds

Eight seep samples and one blind duplicate sample of LS-2 (LS-2 DUP) were analyzed for volatile organic compounds using the NYSDEC ASP 1989 methods with a holding time of seven days.

Each of the volatile organic compounds detected are presented in Table 4-24 and shown graphically near their respective sampling locations on Figure 4-21. No VOCs were detected in seep samples LS-3 and LS-7. The highest concentrations of VOCs were detected in samples LS-1, -9, and -10. The following is a summary of the VOC results.

Halogenated Aliphatic Compounds. There were no halogenated aliphatic compounds detected. Methylene chloride detections were negated in the laboratory data validation process.

Ketones. 2-propanone (acetone) was detected in LS-9 (12 μg/L) and 2-butanone was detected in LS-1 at 62 mg/L.

Monocyclic Aromatic Hydrocarbons. As in the monitoring well samples, this group of compounds were the most frequently detected VOCs. Monocyclic aromatics were highest in LS-1 (170 μg/L total).

Benzene was detected in LS-1, -9, and -10 at 2 to 4 μg/L. Chlorobenzene was present in LS-1, -2, -4, -5, -9, and -10 from 2 μg/L to 12 μg/L. Ethylbenzene was found in LS-1, -5, -9, and -10 from 1 μg/L to 15 μg/L. Toluene was detected in LS-1 at 81 μg/L and LS-9 at 7μg/L, and xylenes were found in LS-1, -9, and -10 at 4 μg/L to 65 μg/L.

4.3.2.2 Semi-volatile Organic Compounds

Eight seep samples and one blind duplicate sample (LS-2 DUP) were analyzed for SVOs using the NYSDEC ASP 1989 methods with a holding time of five days for extraction and forty days for analysis after extraction. The SVO results are summarized in Table 4-25 and shown graphically on Figure 4-22 next to their respective sampling locations.

No SVOs were detected in LS-3, -5 or -7. Samples LS-1 and LS-9 contained the most SVOs. The following is a summary of some of the detected SVOs.

> Polycyclic Aromatic Hydrocarbons. PAHs were detected in LS-1, -2, -9, and -10 from 3 μg/L in LS-10 to 74 μg/L total in LS-1. The LS-1 sample contained seven PAH compounds with the highest concentration being phenanthrene at 24 μg/L. LS-2 only contained dibenzofuran (10 μg/L), and LS-10 had 3 μg/L of naphthalene only.
>
> Phenols. LS-1, -2, and -9 contained phenolic compounds at 15 μg/L, 4 μg/L, and 51 μg/L, respectively.
>
> Phthalates. Phthalates were detected in LS-1, -2, -9, and -10 at 5 μg/L to 15 μg/L (LS-1).
>
> Chlorinated Hydrocarbons. Dichlorobenzene compounds were detected in LS-4 at 19 μg/L total. Sample LS-9 also had 4 μg/L of 1,4-dichlorobenzene.
>
> Other Semi-volatiles. Benzonic acid was found in LS-2 at 33 μg/L.

4.3.2.3 Pesticides and PCBs

Eight seep samples and one blind duplicate (LS-2 DUP) were analyzed for pesticide and PCB compounds using the NYSDEC ASP 1989 methods with a holding time of five days to extraction and forty days for analysis after extraction.

A summary of the pesticide and PCB compounds detected is given in Table 4-26 and in Figure 4-23 next to the sampling location. No pesticide or PCB compounds were detected in sample LS-3. Samples LS-2 and LS-5 contained the most pesticide/PCB compounds. All pesticide results are flagged with a V indicating that the reported results could not be verified during data validation.

Dieldrin was detected in four of the seep samples ranging in concentration from 0.024 µg/L in LS-2 DUP to 0.64 µg/L in LS-10. Endrin was detected in two of the seep samples, 0.023 µg/L in LS-1 and 0.062 µg/L in LS-10. Endosulfan II was detected in LS-9 at 1.5 µg/L. Aroclor-1016 was detected in LS-2 at 0.88 µg/L.

Other pesticides compounds that were detected in the seep samples were: beta-BHC in LS-2 at 0.033 µg/L; delta-BHC ranging in concentration from 0.01 µg/L in LS-7 to 0.047 µg/L in LS-2; 4,4'-DDE from 0.026 µg/L in LS-5 to 0.078 µg/L in LS-10; 4,4'-DDD in LS-2 (0.042 µg/L) and LS-5 (0.015 µg/L); methoxychlor in LS-10 at 0.65 µg/L; and alpha-chlordane in LS-2 at 0.025 µg/L.

4.3.2.4 Inorganics

Eight seep samples and one blind duplicate sample (LS-2 DUP) were analyzed for inorganic analytes using the NYSDEC ASP 1989 methods. Holding times differed for each analyte as detailed in the QAPP (WCCI, 1991c). A summary of the inorganics detected are presented in Table 4-27 and on Figure 4-24 next to the sampling location. The discussions below summarize the location and concentration ranges for the inorganics detected.

> Arsenic. Arsenic was detected in seven seep samples ranging in concentration from 1.6 µg/L in LS-2 DUP to 89.1 µg/L in LS-5.
>
> Barium. Barium was detected in all of the seep samples ranging in concentration from 104 µg/L in LS-3 to 8,470 µg/L in LS-2 DUP.
>
> Boron. Boron was detected in all of the seep samples ranging in concentration from 1,570 µg/L in LS-4 to 8,900 µg/L in LS-1.
>
> Chromium. Chromium was detected in eight of the seep samples (all but LS-3) ranging in concentrations from 26 µg/L in LS-7 to 483 µg/L in LS-2 DUP.

Chromium (hexavalent). Hexavalent chromium (see Table 4-28) was detected in eight seep samples ranging in concentrations from <10 μg/L in LS-3 to 560 μg/L in LS-9.

Lead. Lead was detected in each of the seep samples ranging in concentrations from 3 μg/L in LS-4 to 2,780 μg/L in LS-2 DUP.

Mercury. Mercury was detected in four of the seep samples at concentrations of 0.34 μg/L in LS-2, 1.6 μg/L in LS-2 DUP, 2 μg/L in LS-5, and 5 μg/L in LS-9.

Vanadium. Vanadium was detected in all of the seep samples ranging in concentration from 4.9 μg/L in LS-3 to 822 μg/L in LS-9.

Zinc. Zinc was detected in all of the seep samples ranging in concentration from 28.1 μg/L in LS-7 to 1,330 μg/L in LS-5.

Other inorganic compounds that were detected in the seep samples were aluminum in eight samples ranging in concentration from 501 μg/L in LS-7 to 658,000 μg/L in LS-5, antimony in LS-5 at 70.3 μg/L, beryllium in LS-5 at 1 μg/L and LS-2 DUP at 1.2 μg/L, and calcium in all samples ranging in concentration from 35,600 μg/L in LS-1 to 301,000 μg/L in LS-2 DUP. Cobalt was detected in seven samples ranging in concentration from 12.5 in LS-4 μg/L to 61.7 μg/L in LS-5. Copper was detected in all of the samples ranging in concentration from 6.1 μg/L in LS-4 to 997 μg/L in LS-5. Iron was detected in all the samples from 2,970 μg/L in LS-7 to 860,000 μg/L in LS-2 DUP. Magnesium was detected in all eight of the samples ranging in concentration from 46,300 μg/L at LS-4 to 899,000 in LS-3. Manganese was detected in all of the samples ranging in concentration from 130 μg/L in LS-1 to 4,290 μg/L in LS-2 DUP. Nickel was detected in seven of the samples ranging in concentration from 25.4 μg/L in LS-2 to 161 μg/L in LS-2 DUP. Potassium was detected in all of the samples ranging in concentration from 101,000 μg/L in LS-4 to 650,000 μg/L in LS-1. Silver was detected in one sample, LS-5 at 12.1 μg/L. Sodium was detected in all of the samples ranging in concentration from 672,000 μg/L in LS-2 DUP to 7,912,000 μg/L in LS-3. Thallium was detected in one sample, LS-7 at 16.77 μg/L. Cyanide was detected in LS-2 at 20.4 μg/L and LS-2 DUP at 26.2 μg/L.

4.3.2.5 Conventional Parameters

Eight seep samples and one blind duplicate sample were analyzed for a modified BMW list of conventional parameters which included; Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), ammonia-N, total Kjeldhal-N (TKN), alkalinity (as bicarbonate and as carbonate), hardness, chloride, sulfate, hexavalent chromium, nitrate, phenolics, total organic carbon, Total Dissolved Solids (TDS), total volatile solids, color, and odor. These samples were analyzed using the specific EPA method as described in the QAPP (WCCI, 1991c).

A summary of the conventional parameters detected is presented in Table 4-28 and in Figure 4-25 next to the sampling location. A description of the analytes detected is presented in the following sections.

Ammonia-N. Ammonia-N was detected in all of the seep samples ranging in concentration from 5.5 mg/L in LS-3 to 637 mg/L in LS-5.

Biological Oxygen Demand. Biological Oxygen Demand (BOD) in the each of the seep samples ranged in concentration from <3 mg/L in LS-3 to 227 mg/L in LS-5.

Chemical Oxygen Demand. Chemical Oxygen Demand (COD) in each of the seep samples ranged from <250 mg/L in LS-3 to 2,040 mg/L in LS-5.

Chloride. Chloride was detected in all the seep samples ranging in concentration from 1,170 mg/L in LS-4 to 11,680 mg/L in LS-7.

Nitrate-N. Nitrate-N was detected in all of the seep samples ranging in concentration from 0.06 mg/L in LS-3 to 1.02 mg/L in LS-5.

Sulfate. Sulfate was detected in all the seep samples ranging in concentration from 110 mg/L in LS-2 to 1,770 mg/L in LS-3.

Other conventional parameters that were detected in the seep samples were: total organic carbon ranging in concentration from 14 mg/L in LS-3 to 1,900 mg/L in LS-1;

total Kjeldahl-N (TKN) ranging in concentration from 6 mg/L in LS-2 to 1,110 mg/L in LS-1; alkalinity ranging in concentration from 200 mg/L in LS-3 to 6,000 mg/L in LS-2 DUP; hardness ranging in concentration from 354 mg/L in LS-4 to 4,410 mg/L in LS-3, total dissolved solids (TDS) ranging in concentration from 2,850 mg/L in LS-2 to 26,100 mg/L in LS-3; total volatile solids ranging in concentration from 307 mg/L in LS-4 to 4,500 mg/L in LS-5; and total phenolics ranging in concentration from <0.1 mg/L in LS-2 to 0.12 mg/L in LS-1.

4.3.3 Monitoring Well and Seep TIC Data

Tentatively identified compounds (TIC's) detected in the seep and monitoring well samples are summarized in Tables 4-29 through 4-32. These data are being used in a qualitative manner only since these detections cannot be quantified or completely ascertained.

The seep VOC TICs (Table 4-29) show only a limited number of unknowns with the majority found in LS-1. The seep SVO TICs (Table 4-30) contain a variety of chemical groups including acids, phthalates, phenols, camphor, PAH's, and amines. The monitoring well TIC data (Table 4-31) shows limited detections of unknowns and other compounds with all concentrations, except for an unknown cycloketone in MW-126, below 90 μg/L. The monitoring well SVO TICs (Table 4-32) contain an extensive variety of unknowns and other compounds. Detections are scattered in all samples with no trends evident with respect to the distribution or concentrations of particular compounds.

4.3.4 Comparison of the RI Monitoring Well and Seep Sample Results to the Phase I Data

The monitoring well and seep sampling locations which were sampled both in the RI and in the Phase I quarterly events were compared to determine if any trends were evident. These samples include MW-103, -104, -105, -106, -107, -109, -110, -111, -112, and LS-1, -2, and -3. The Phase I data are summarized in Section 1 of this report. A comparison of these different sampling event results shows little in the way of changes in the compounds detected or the concentrations of these compounds. VOCs were detected at similar levels in each of the sampling events with benzene, chlorobenzene, and ethylbenzene being the predominant compounds detected.

The Phase I samples also showed similar levels of SVO compounds. MW-105 consistently contained the most SVO compounds detected in each of these wells. The concentrations of many of the PAH compounds in the 1992 MW-105 sample are, however, higher than in the Phase I samples. Metal concentrations and detections were also similar in each sampling event.

4.3.5 Comparison of the Monitoring Well and Seep Sample Results to NYSDEC Groundwater Standards

Chemicals detected in the monitoring well and seep samples were compared to NYSDEC Class GA groundwater standards and guidance values (6 NYCRR Part 700-705, September 25, 1990). A list of the compounds, the NYSDEC standards and guidance value (when no standard is available), the range in which the compounds were detected in both the monitoring well and seep samples, and the list of samples where exceedances were noted, are presented in Table 4-33. The compounds that exceed the state standards are also listed on Table 4-34 for each sample location. Figure 4-25A shows a comparison of shallow well and seep sample results to the NYSDEC standards. Figure 4-25B shows the same comparison for bedrock well samples.

A comparison of the monitoring well and seep sample results to the state drinking water guidelines is necessary since all groundwater in New York is considered a potential source of drinking water. While currently there is no use of groundwater at the site and surrounding area for drinking water, this RI and FS will consider all potential end uses of the site, including the possibility of the use of groundwater for drinking water. As such, the state groundwater standards are valid for comparison purposes with the site samples. Seep samples are lumped into the groundwater category by nature of their flow (i.e. the seeps are reflective of shallow groundwater) as stated in Section 3.4.

Most of the samples contain compounds that exceed NYSDEC standards (Tables 4-33 and 4-34). The bulk of the exceedances are for inorganics, primarily iron, magnesium, sodium, TDS, ammonia, and chloride. However, standard exceedances for VOCs, SVOs, and pesticides are also found.

4.3.6 Comparison of the Monitoring Well and Seep Sample Results to NYSDEC's Pelham Bay Landfill Effluent Limitations

Effluent limits for surface water discharges of groundwater/leachate from the Pelham Bay Landfill were requested from NYSDEC as part of the FS. Draft effluent limitations for discharges of treated water were received from NYSDEC on November 23, 1992. These draft limitations are being used for a comparison basis with the monitoring well and seep sampling results since, as described in Section 3.4, the majority of the groundwater/leachate generated on site will flow into the surface water bodies surrounding the site. Thus, shallow groundwater can be viewed as a potential surface water discharge which makes comparison of the monitoring results to the effluent limitations valid.

Table 4-35 presents the NYSDEC effluent limits and the range of the same constituent concentrations detected in the monitoring well and seep samples. This table shows the constituents that have exceedances of the effluent limitations and the maximum exceedance for each chemical. Exceedances are found for benzene, toluene, xylenes, naphthalene, cyanide, aluminum, copper, chromium, hexavalent chromium, iron, lead, manganese, barium, vanadium, zinc, and ammonia. Table 4-36 lists the effluent limits and the monitoring well and seep samples that exceed the limits. The majority of the exceedances found are for inorganic compounds, particularly aluminum, iron, manganese, and ammonia.

4.3.7 Comparison of Upgradient and Downgradient Monitoring Well Results

To evaluate the impact of the landfill on groundwater quality in the vicinity of the site, a comparison was made between the sample results of wells that are hydraulically upgradient (MW-116, -123, and -124) and wells that are in a shallow groundwater flow pathway from the landfill. A separate comparison was also attempted in the bedrock.

In the shallow groundwater flow system, wells MW-116 and MW-123 only contained iron, manganese, magnesium, sodium and chloride at concentrations above the NYSDEC groundwater standards. Well MW-124 also contained chromium and TDS at levels above the groundwater standards. With the exception of chromium, the other constituents were generally at lower levels in the off-site wells than in many of the shallow wells at the site perimeter. This indicates that elevated levels of these constituents in the groundwater on site (up to one order of magnitude higher than found in the upgradient wells) may be due to the landfill.

Chromium is found in MW-124 at 72.7 μg/l. Only seven well samples have measured chromium concentrations greater than this. They are MW-104, -105, -107, -115, -118B, -120, and -125. The presence of chromium in the samples of groundwater from the landfill therefore, cannot be conclusively determined.

Other constituents detected in the shallow groundwater monitoring wells above NYSDEC groundwater standards are likely to be the result of leaching processes in the landfill. The exception are compounds that are components of seawater (sodium, chloride, magnesium, manganese, boron).

A similar type of comparison cannot be done in the bedrock since groundwater flow is mostly through interconnected joints/fractures from the ridge in the center of the landfill (i.e., there are no upgradient wells by definition in the bedrock). Bedrock monitoring wells that contain constituents that in the shallow groundwater are linked to the site (i.e., all the VOCs, arsenic, ammonia, etc) include MW-113B, -116B, -118B, -119B, and -122B. These wells are in all directions from the site center and as such, reflect the radial flow-pattern possible in the bedrock.

Bedrock groundwater samples that do not show constituents or constituent levels indicative of the landfill (MW-114B, -117B, -124B) indicate that no hydraulic connection to the site via the bedrock structure exists.

4.3.8 Comparison of Monitoring Well, Seep, and Surface Water Ionic Chemistry

4.3.8.1 Chloride Concentrations and the Distinction Between Freshwater and Saltwater

Saltwater is present beneath portions of the Pelham Bay Landfill as described in Section 3.4. Saltwater in the fill and till is found in a narrow zone near the perimeter of the bay and its encroachment occurs in a mixing zone as shown in Figure 3-30. Saltwater encroachment is limited by the extent of mounding present in the landfill and the shallow nature of the fill/till flow system which limits the stratification of the more dense saltwater. To check the field and modeling conclusions on the extent of saltwater encroachment, chloride concentrations in the monitoring wells, seep samples, and surface water samples were compared. A listing of these concentrations is provided in Table 4-37.

The chloride concentrations in surface water ranged from 12,300 mg/L to 16,400 mg/L with an average concentration of 13,977 mg/L. This is less than the average seawater chloride concentration of 19,000 mg/L (Goldberg, 1969), which is reasonable given the freshwater flow into Eastchester Bay from the Hutchinson River.

Monitoring well chloride concentrations ranged from 11 mg/L to 14,700 mg/L. Only seven of the well samples, however, had chloride concentrations greater than 10,000 mg/L. These wells, MW-103, -118, -118B, -119, -119B, -120B, and -125B, had chloride concentrations ranging from 10,460 mg/L to 14,700 mg/L. The remaining 27 well samples had chloride concentrations ranging from 11 mg/L to 6,040 mg/L with most concentrations under 4,000 mg/L. The chloride concentration isopleths for the fill/till wells are plotted on Figure 3-29.

The pattern of chloride concentrations in the monitoring wells shows, to some extent, the degree of saltwater influence with those wells having the greater than 10,000 mg/L chloride concentrations being influenced by seawater. Chlorides are also commonly high in landfill leachate. This distinction as to the source of the chlorides can be made in some cases from the evaluation of the groundwater flow system which is discussed in Section 3.4. For example, in wells MW-106, -118, and -119, the hydraulic gradient from the landfill to the bay is lower than in other areas of the landfill sideslopes. This lower gradient along the southwest corner of the site allows for more seawater encroachment in the groundwater. This explains why wells MW-118, and MW-119 have chloride levels similar to seawater and show the greatest tidal responses.

The chloride concentrations that were relatively high in other wells (MW-105, -120, -121, and -126) could be due to chloride contributions from the landfill waste. For MW-126 where there was no surface water influence (based on the lack of tidal response in the well) the chloride level (5,140 mg/L) is indicative of water that has infiltrated through the waste. The MW-105, -120, and -121 chloride concentrations are possibly due to both their location near the bay and from consituents leached from the waste.

Several wells in the bedrock had chloride levels similar to seawater (MW-118B, -119B, -120B, and -125B). These chloride levels are likely indicative of the interconnection of fractures in the bedrock at these locations with those in bedrock beneath the bay.

Background chloride concentrations in groundwater are obtained from those wells that are hydraulically upgradient of the site; MW-123 (179 mg/L), MW-116 (30 mg/L), and MW-124 (590 mg/L). The bedrock wells MW-116B (105 mg/L) and MW-124B (11 mg/L) also had background chloride levels. With the exception of MW-124B, these chloride concentrations are high for groundwater. Snoeyink and Jenkins (1980) list chloride concentrations for fresh surface water and groundwater between 2 mg/L and 13 mg/L.

The seep samples show trends similar to those seen in the monitoring well samples. Samples LS-3, -5, and -7 have chloride concentrations approaching that of seawater. The other seep samples, LS-1, -2, -4, -9, and -10 have chloride levels similar to the majority of well samples collected near the bay.

The community basement water samples (presented in Section 4.10) have chloride concentrations (56 mg/L to 67 mg/L) that are indicative of background levels.

4.3.8.2 Comparison of Major Ion Chemistry in the Monitoring Well, Seep, and Surface Water Samples

Natural waters are commonly classified on the basis of chemical composition. Groundwater, surface water, and leachate often exhibit specific chemical compositions; however, in some instances, the chemistry may be quite similar where mixing has occurred between two or more types of these waters. Trilinear diagrams are used to graphically display the ionic composition of different types of water. Figures 4-26, 4-27, and 4-28 show trilinear diagrams for selected monitoring well, seep, and surface water samples, respectively, at the Pelham Bay Landfill. These diagrams are based on the analytical results and calculated ionic balances presented in Appendix HYD-5.

Methods

The major ionic species in water are Na^+, K^+, Ca^{++}, Mg^{++}, Cl^-, $CO_3^=$, HCO_3^-, and $SO_4^=$. The solubility of an ionic species is dependent upon the electrical charge of the ion, and therefore, the formula weight of each ion is divided by its electrical charge to provide the equivalent, or combining weight of that dissolved species in water. Ionic concentrations are often reported by the laboratory in mg/L or μg/L. The concentration is expressed in terms of milliequivalents per liter by dividing the concentration in mg/L by the equivalent weight.

Ionic compositions are plotted on a trilinear diagram by expressing each ionic species as a percentage of the total concentration of specific ions present. A typical trilinear diagram consists of two triangular-shaped plots separated by a diamond-shaped plot. (See Figures 4-26 through 4-28). Na^+ and K^+ are combined together and the percent composition of the major cations is displayed on the left triangular plot. Similarly, $CO_3^=$ and HCO_3^- are combined together and the percentage composition of the major anions is shown on the right triangular plot. By projecting the cation point parallel to the magnesium axis and the anion point parallel to the sulfate axis, the intersection of the two points in the diamond-shaped field represents the composition of the sample with respect to both anions and cations.

Discussion

The inorganic chemistry of the selected monitoring well, seep, and surface water samples is summarized in Figures 4-26, 4-27, and 4-28 respectively. The monitoring well data shows the most variable distribution of ions (Figure 4-26). Samples that contain high percentages of sodium and potassium, chloride, and sulfate are similar in composition to seawater according to definition (Freeze and Cherry, 1979). The samples plotted on Figure 4-26 that fall into this category are MW-104, -117, -117B, -118B, -120, -120B, -122, -122B, -125 and -125B, which are wells located near surface water. These samples are similar in ionic distribution to seep samples LS-5, -9, and -10 (see Figure 4-27) and all of the surface water samples (see Figure 4-28). Water in this group is classified as sodium and chloride types. This characterization is consistent with previous discussions on the extent of saltwater encroachment stated in Section 3.4.2 and 4.3.8.1

The monitoring well and seep samples plotted on Figures 4-26 and 4-27 that are more representative of non-saline water (i.e. samples that contain high percentages of calcium, carbonate/bicarbonate, and magnesium) include MW-114, -115, -115B, -116, -116B, and -124B. Water in this group is classified as calcium and bicarbonate types. Other samples that fall somewhere between this classification type and the saline water type are MW-126, LS-1 and LS-2. In these samples, the impact of the landfill leachate on water quality masks clear distinction of groundwater class.

4.4 SURFACE WATER

Analytical results of surface water samples collected from Eastchester Bay in the vicinity of the landfill are discussed in this section. Surface water samples were collected from six locations near the landfill seawall (SW-1 through SW-6), two locations just off the beach southwest of the landfill (SW-7 and SW-8) and one reference location (SW-9) located approximately two miles south of the landfill and approximately one-half mile off the west shore of Eastchester Bay at high and low tides. The surface water sample locations are shown on Figure 2-8. In total, eighteen surface water samples were analyzed for VOCs, SVOs, pesticides and PCBs, inorganics and a modified list of BMW parameters using the NYSDEC ASP 1989 methods.

4.4.1 Results

The analytical results for VOCs, SVOs, pesticides and PCBs and inorganics are presented in Table 4-38. Only analytes for which there was a detected value in at least one of the samples are listed in this table. Concentrations of analytes that were rejected ("R" qualifier) or negated ("R#" qualifier) as a result of the data validation process are listed on this table but were not used for any calculations nor discussed in the test. An "H" following the sample designation refers to samples collected at high tide and an "L" refers to samples collected at low tide. The NYSDEC Ambient Water Quality Standards and the EPA Water Quality Criteria for the protection of aquatic life and for protection of human health are also listed in Table 4-38. Also listed in this table are data for six metals (copper, lead, mercury, nickel, silver, and zinc) from three western Long Island Sound locations sampled by Battelle (1991, 1992a, and 1992b). The results of the analyses for organic chemicals (VOCs, SVOs and pesticides and PCBs) and for selected metals for surface water are also shown on Figures 4-29 and 4-30, respectively. The analytical results of the modified list of BMW parameters are presented in Table 4-39. The physical/chemical data collected in the field are presented in Table 4-40. A comparison of the chemical data for the eight sample locations in the vicinity of the landfill to the reference location is presented in Table 4-41.

4.4.1.1 Volatile Organic Compounds

As can be seen from Table 4-38, methylene chloride was the only volatile organic compound that was detected. All concentrations reported for this analyte were attributed to blank contamination and were negated as a result of the data validation process.

4.4.1.2 Semi-volatile Organic Compounds

From Table 4-38, it can be seen that one PAH and two phthalates were detected in at least one of the eighteen surface water samples. The PAH pyrene was only detected in one sample (SW-5L) at a concentration of 12 μg/L. Di-n-butyl phthalate was detected in three of the eighteen samples analyzed at concentrations ranging from 2 μg/L to 3 μg/L. Bis(2-ethylhexyl)phthalate was only detected in sample SW-4L at a concentration of 4 μg/L.

4.4.1.3 Pesticides and PCBs

The results of the pesticides and PCBs analyses for the surface water samples are summarized in Table 4-38. No PCBs were detected in any sample. Alpha-BHC and delta-BHC were detected at concentrations ranging from 0.0066 μg/L to 0.034 μg/L. Endosulfan sulfate was detected in six of the eighteen samples collected with the highest concentration being found in sample SW-2H (0.27 μg/L).

4.4.1.4 Inorganics

The results of the inorganics analyses for the surface water samples are presented in Table 4-38. The concentrations reported for all metals are for the total metal concentration. The results for the individual inorganics that were detected are discussed below.

Aluminum. Aluminum was only detected during low tide sampling at three locations with concentrations ranging from 290 μg/L (at SW-7L) to 580 μg/L (at SW-6L).

Barium. Barium was detected at all sample locations. Concentrations ranged from 9 μg/L (at SW-4H) to 17 μg/L (at SW-3L).

Calcium. The concentration range of calcium found in the surface water samples is from 193,000 μg/L (at SW-1L) to 305,000 μg/L (at SW-9L).

Copper. The metal copper was detected in two of the eighteen surface water samples collected. Concentrations of copper ranged from 4.9 μg/L to 10.0 μg/L (at SW-6H and SW-5H, respectively).

Iron. Iron concentrations ranged from 97 μg/L (at SW-9H) to 1,140 μg/L (at SW-6L).

Lead. The highest concentration of lead, for the six samples in which this analyte was detected, was 13.3 μg/L (at SW-5H). The lowest detected concentration for lead was 1.4 μg/L (at SW-3L).

Magnesium. Magnesium concentrations ranged from 808,000 μg/L (at SW-1L) to 1,070,000 μg/L (at SW-5L).

Manganese. The range of manganese concentrations was from 102 μg/L to 130 μg/L (at SW-8L and SW-6L, respectively).

Mercury. The metal mercury was detected in four of the eighteen surface water samples collected. Concentrations of the four detected values ranged from 0.2 μg/L (at SW-8H) to 9.5 μg/L (at SW-1L).

Nickel. Nickel was detected in three samples. The range of these three concentrations was from 10.5 μg/L (at SW-6H) to 15.7 μg/L (at SW-1L).

Potassium. Potassium concentrations ranged from 231,000 μg/L (at SW-1L) to 314,000 μg/L (at SW-4L).

Silver. All reported concentrations of silver were negated as a result of the data validation process.

Sodium. The range of sodium concentrations was from 7,449,000 μg/L to 9,273,000 μg/L (at SW-1L and SW-7L, respectively).

Thallium. The one reported concentration of thallium was rejeced as a result of the data validation process.

Vanadium. Vanadium was only detected in one sample (SW-4H) at a concentration of 5 μg/L.

Zinc. All reported concentrations of zinc were negated as a result of the data validation process.

4.4.1.5 Conventional Parameters

The surface water samples were analyzed for a modified BMW list of conventional parameters which included: alkalinity as bicarbonate, alkalinity as carbonate, ammonia-N, Chemical Oxygen Demand (COD), chloride, nitrate-N, sulfate, Total Dissolved Solids (TDS), and Total Kjeldahl-N (TKN). The results of these analyses are presented in Table 4-39.

Alkalinity was detected in sixteen of the eighteen surface water samples ranging from 94 mg/L to 164 mg/L. Alkalinity as carbonate was detected in two of the samples ranging from 4 mg/L to 5 mg/L. Ammonia nitrogen was detected in twelve of the eighteen surface water samples ranging from 0.06 mg/L to 0.29 mg/L. Nitrate-N was detected in three of the samples ranging from 0.14 mg/L to 0.15 mg/L and TKN was detected in all of the eighteen samples ranging from 0.63 mg/L to 1.83 mg/L. COD was detected in fourteen of the samples ranging from 133 mg/L to 419 mg/L. Chloride and sulfate were detected in all of the samples and ranged from 12,300 mg/L to 16,400 mg/L and 1,630 mg/L to 2,990 mg/L, respectively. TDS concentrations ranged from 21,200 mg/L to 29,000 mg/L.

4.4.1.6 Physical/Chemical Data Collected in the Field

Physical/chemical data collected in the field at the time of the surface water sampling included water depth, Secchi depth, temperature, dissolved oxygen concentration, salinity, conductivity, pH, and eH. This data is presented in Table 4-40. The water depths at the locations at which the samples were collected ranged from 1 ft to 9 ft for the low tide samples and from 8 ft to 16 ft for the high tide samples. Secchi depths ranged from 12 to 60 inches. Temperature ranged from 21.4° C to 24.5° C. The dissolved oxygen concentrations ranged from 4.2 mg/L to 16.0 mg/L. Salinity was found to range from 23.5 o/oo to 25.5 o/oo and conductivity ranged from 35,000 μmhos to 38,000 μmhos. The pH at the sample locations was found to range from 6.6 to 8.4 and eH was found to range from -084 to -018.

4.4.2 Surface Water TIC Data

The tentatively identified compounds (TICs) that were detected in surface water samples are discussed in this section. Following ASP protocols, a maximum of 10 VOC TICs and 20 SVO TICs were reported by the laboratory. The TIC data are summarized in Table 4-42.

TIC concentrations that were rejected ("R" qualifier) or negated ("R#" qualifier) in the data validation process are listed on Table 4-42 but will not be discussed. Two groups of VOC TICs and two groups of SVO TICs were detected in surface water samples. VOC TICs were detected in samples SW-1L and SW-2H with total concentrations of 24 μg/L and 8 μg/L, respectively. SVO TICs were detected in surface water samples SW-4L and SW-5L with total SVO TIC concentrations of 21 μg/L and 12 μg/L, respectively.

4.4.3 Comparison of Surface Water Sample Results to NYSDEC Standards and EPA Criteria

The concentrations of VOCs, SVOs, pesticides and inorganics detected in the surface water samples were compared to NYSDEC Ambient Water Quality Standards for saline surface waters (Class SB). The concentrations of the detected analytes were also compared to EPA Water Quality Criteria for the protection of aquatic life and for protection of human health. Both the NYSDEC standards and EPA criteria are listed on Table 4-38.

4.4.3.1 NYSDEC Ambient Water Quality Standards

Of the detected analytes, NYSDEC Ambient Water Quality Standards for saline surface waters (Class SB) are only listed for the metals copper, lead, nickel and zinc. The NYSDEC standard for copper is for the dissolved form, and therefore, cannot be compared to the total copper concentrations reported. No standard is given for mercury but a guidance value is provided.

The concentrations of lead reported in samples SW-5H and SW-6L exceeded the standard for this metal. The standard was exceeded by less than two times in these samples.

No NYSDEC Ambient Water Quality Standard is available for mercury although a guidance value of 0.1 μg/L is given. Reported mercury concentrations for the four locations where this analyte was detected all exceeded this guidance value with the concentrations in SW-1L and SW-5L exceeding the guidance value by more than an order of magnitude.

The NYSDEC Ambient Water Quality Standard for nickel was exceeded in the three samples where this analyte was detected with no reported concentration exceeding the standard by greater than three times. None of the detected concentrations for zinc exceeded the standard.

4.4.3.2 EPA Water Quality Criteria

The one detected concentration for the PAH pyrene does not exceed EPA Water Quality Criteria for this analyte. All reported concentrations for the pesticides alpha-BHC and delta-BHC exceeded the EPA Water Quality Criteria for the protection of human health by more than an order of magnitude.

One or more EPA Water Quality Criteria are listed for nine of the sixteen inorganic compounds detected. The criteria for the protection of aquatic life are compared to the reported concentrations first. The chronic criteria for the protection of aquatic life were exceeded in all samples where there was a detected concentration for the metals copper (detected in two samples), mercury (detected in four samples) and nickel (detected in two samples). The chronic criteria for copper is the same as the acute criteria. None of the concentrations of the samples where copper or nickel were detected exceeded the chronic (also acute for copper) criteria by more than an order of magnitude. One of the sample concentrations (SW-4H) for mercury exceeded the chronic criteria by more than an order of magnitude, while two sample concentrations (SW-1L and SW-5L) exceeded the chronic criteria by more than two orders of magnitude. The reported concentrations for lead in three of the surface water samples exceeded the chronic criteria with no concentration being greater than three times the chronic criteria. The acute criteria for lead and nickel were not exceeded in any surface water sample. The acute criteria for mercury was exceeded by less than an order of magnitude in two samples (SW-1L and SW-5L).

EPA Water Quality Criteria are also listed for the protection of human health for water and fish ingestion, and for fish consumption only. The criteria for water and fish ingestion for iron was exceeded at four of the eighteen locations with no concentration exceeding the criteria by greater than four times. No surface water samples exceeded the water and fish ingestion criteria for lead. The manganese concentrations for all samples exceeded the criteria for water and fish ingestion and for fish consumption only. All exceedances for water and fish ingestion were by approximately two times, and all exceedances for fish consumption only were by less than two times. Both human health water quality criteria for mercury were exceeded in the four samples where this analyte was detected. Both criteria for mercury were exceeded by more than an order of magnitude in samples SW-1L and SW-5L. Only one surface water sample (SW-1L) exceeded the water and fish ingestion criteria for nickel while no detected concentrations exceeded the criteria for fish consumption only.

4.4.4 Comparison of Surface Water Chemical Data from the Vicinity of the Landfill to the Reference Location

As a means of comparison, concentrations of the analytes that were detected in the surface water samples collected at the eight locations in the vicinity of the landfill were divided by the maximum concentration of the high and low tide samples collected at the reference location (SW-9H and SW-9L) to calculate a ratio to reference (RTR) location value. These RTR values are presented in Table 4-41.

Concentrations of analytes that were rejected ("R" qualifier) or negated ("R#" qualifier) in the data validation process were treated as a non-detected value in this analysis. A RTR value of greater than 1.0 means that the concentration of a particular analyte in a sample in the vicinity of the landfill is greater than the maximum concentration of the high and low tide samples from the reference location (SW-9H and -9L). The converse is true for a RTR value of less than 1.0. Although an RTR value greater than 1.0 may appear to suggest elevated levels of a contaminant, the location may not be different from the reference location because of natural variation of the concentration of the chemicals in surface water in this system. Therefore, RTR values greater than 1.0 should be interpreted as a qualitiative expression and not as a measure of elevated levels of a contaminant at a particular sample location. Although RTR values can be described as quantitative expressions, their interpretation is primarily qualitative. Excessively high values may be indicative of elevated levels of a contaminant relative to the reference location, but such values cannot be interpreted as definitive evidence that the landfill is the source of the contamination. this is particularly true when data representing one reference location is available (as is the case for the Pelham Bay Landfill). The RTR values calculated for organic (VOCs, SVOs and pesticides) and inorganic analytes are discussed below.

Organic Chemicals

No organic contaminants were detected in the surface water samples collected at the reference location. The organic chemicals pyrene, di-n-butyl phthalate, bis(2-ethylhexyl)phthalate, endosulfan sulfate, delta-BHC and alpha-BHC were detected in at least one sample from the vicinity of the landfill. Since these chemicals were not detected in the reference location samples, no RTR value was calculated. Samples in which these contaminants were detected are shown as ">SW-9" on Table 4-41.

Inorganic Chemicals

Of the sixteen inorganic analytes detected in at least one surface water sample six metals (aluminum, copper, lead, mercury, nickel, and vanadium) were not detected in the samples from the reference location but were detected in at least one sample from the vicinity of the landfill. Samples in which these metals were detected are shown as ">SW-9" on Table 4-41. Vanadium was only detected in one sample while aluminum, copper, mercury, and nickel were detected in four or less samples from the vicinity of the landfill. Lead was detected in six samples from the vicinity of the landfill. Of the other inorganic analytes detected all RTR values for barium, calcium, magnesium, manganese, potassium and sodium were between 0.6 and 1.3. All of the RTR values for iron in the sixteen samples collected from the vicinity of the landfill were greater than

1.0. The RTR values for iron in ten of the samples collected from the vicinity of the landfill were greater than two with the maximum being for SW-6L where the RTR value was 11.7.

None of the six metals (copper, lead, mercury, nickel, silver and zinc) analyzed for by Battelle (1991, 1992a and 1992b) for the three western Long Island Sound sample locations were detected in the reference location samples collected from Eastchester Bay. Long Island Sound sample locations where these metals were detected are shown as "> SW-9" on Table 4-41.

4.4.5 Comparison of Selected Metals Surface Water Data from the Vicinity of the Landfill to Battelle Western Long Island Sound Data

The western Long Island Sound (WLIS) surface water data for the six metals (copper, lead, mercury, nickel, silver and zinc) that were analyzed for by Battelle (1991 and 1992a) were compared to the concentrations of these metals found in the Eastchester Bay surface water collected in the vicinity of the landfill. Battelle metals data are for total recoverable metals whereas the surface water samples collected from Eastchester Bay were analyzed for total metals. The analytical method for total recoverable metals uses a less rigorous digestion process than that used in the total metals method and may yield lower reported concentrations than the total metals method. Even though different analytical methods were used in the metals determination, the two data sets were compared noting the limitations of this comparison. Battelle total recoverable metals data are included in Table 4-38. The three WLIS sample locations were at the Throg's Neck Bridge (E5), north of King's Point (E6) and north of Hempstead Harbor (E7). Battelle collected samples at these three locations during January 1991 and at the north of King's Point location during February 1992.

From Table 4-38, it can be seen that all copper, lead, mercury and nickel surface water concentrations reported by Battelle for the three WLIS sample locations were less than the lowest reported value for the landfill vicinity samples where these metals were detected. Copper was detected in two landfill vicinity samples and lead, mercury and nickel were detected in six, four and three landfill vicinity samples, respectively. The reported concentrations of copper in thirteen of the sixteen surface water samples collected from the vicinity of the landfill were negated ("R#" qualifier) in the data validation process while five of the sixteen reported concentrations of lead were rejected

("R" qualifier) or negated in the data validation process. The concentrations of copper and lead for the landfill vicinity samples that were rejected or negated in the data validation process may or may not have been similar to the concentrations reported by Battelle.

The maximum copper concentration detected in the landfill vicinity samples of 10.0 μg/L was greater than three times the mean copper concentration (3.16 μg/L) for the four WLIS samples while the lowest landfill vicinity sample copper concentration was less than two times this mean value. The mean lead concentration for the four WLIS samples of 0.76 μg/L is approximately one-half the lowest detected landfill vicinity sample concentration of 1.4 μg/L, while the maximum value is more than an order of magnitude greater than this mean value. The lowest mercury concentration detected in the landfill vicinity samples was more than an order of magnitude greater than the mean of the four WLIS samples (0.0041 μg/L) while the maximum landfill vicinity sample concentration of 9.5 μg/L was more than two orders of magnitude greater than this mean value. The three detected nickel concentrations for the landfill vicinity samples were all greater than six times the mean nickel concentration of 1.69 μg/L for the four WLIS samples.

The concentration of silver in all landfill vicinity surface water samples was either nondetected (13 of 16 samples) or negated in the data validation process (3 of 16 samples) and therefore could not be compared to the concentrations of silver reported by Battelle for the four WLIS samples. The required detection limit for silver (10.2 μg/L) for the Eastchester Bay surface water samples was more than two orders of magnitude greater than the reported silver concentrations by Battelle for the four WLIS samples they analyzed. The reported zinc concentrations for all sixteen surface water samples from the vicinity of the landfill were all negated in the data validation process and therefore also could not be compared to the concentrations reported by Battelle for the four WLIS samples they analyzed.

4.5 SEDIMENTS

Analytical chemistry results and the toxicity testing results of sediment samples collected from Eastchester Bay in the vicinity of the landfill are discussed in this section. Sediment was sampled at a total of eleven different locations. The eleven sediment sample locations are shown on Figure 2-9. Surficial (0 - 6 inches depth) sediment samples were collected from six locations near the seawall of the landfill (SD-1 through SD-6), two locations just off the beach southwest of the landfill (SD-7 and SD-8) and two locations on the beach southwest of the landfill (SD-10 and SD-11). In addition to the sediment samples collected in the vicinity of the landfill, sediment was also collected at a reference location (SD-9) located approximately two miles south of the landfill and approximately one-half mile off the west shore of Eastchester Bay. The locations of sediment samples SD-1 through SD-9 correspond to the surface water sample locations with the same number (SW-1 through SW-9). Chemical analyses were performed on the nine sediment samples from all eleven locations while toxicity tests were only performed on the nine samples collected from the bay (locations SD-1 through SD-9). The results of the chemical data are discussed in Section 4.5.1 and the results of the toxicity testing are discussed in Section 4.5.2.

4.5.1 Results

The results of the VOCs, SVOs, pesticides and PCBs, and inorganics analyses are presented in Appendix W, Tables W-1 through W-4, respectively. Only analytes for which there was a detected value for at least one of the replicates for one of the sample locations are listed in the tables. Blank cells in these tables represent analytes which were reported as nondetected from the laboratory. Mean concentrations were calculated using only detected values. Detected compounds that were rejected or negated in the data validation process were not used in calculating mean concentrations, totals or the number of detects and are not discussed in the text. These compounds, however, are included on the data tables and they are identified with a "R" qualifier for values that were rejected, and with a "R#" qualifier for values that were negated.

The mean values of the replicates for the SVOs, pesticides and inorganics analyses, are presented in Tables 4-43 through 4-45, respectively. The discussion about each of the analytical groups will center around these summary tables. No summary table is presented for VOCs because only three mean values for one of the analytes were calculated. If there are no mean values listed for SVOs, pesticides or inorganics on these tables either there were no detected values reported for any of the replicates or all detected values had a "R" or "R#"qualifier. The summarized results of the analyses for organic chemicals (VOCs, SVOs and pesticides) and for selected metals for sediments area also shown on Figures 4-32 and 4-33, respectively. The percent organic carbon and percent fines (the percent by weight of silt and clay fractions combined having a diameter of less than 63 μm) for each of the samples as well as the contract required detection limit (CRDL) range for each of the analytes are also presented on these tables.

The August 1992 Draft NYSDEC Sediment Cleanup Criteria, where applicable, are listed on the summary tables. EPA Sediment Quality Criteria, NOAA Overall Apparent Effects Thresholds (AETs) and Washington Marine Sediment Quality Standards are also presented on the summary tables for additional comparison to the concentrations of contaminants found.

In addition to the results for the eleven sediment sample locations, the results of three sample locations from NOAA (1991) for western Long Island Sound are also included on the summary tables. The NOAA concentrations for the three locations are the mean values of a number of replicates. These mean concentrations were calculated in the same way as the mean concentrations for the eleven WCCI sample locations in Eastchester Bay. The locations of these sites were selected according to NOAA (1991) so as not to be in close proximity to major point sources of contamination although they may reflect the combined influence of many point and non-point sources of contamination on an area. Thus, these three NOAA sample locations in western Long Island Sound provide additional reference data for use in evaluating the samples collected in the vicinity of the landfill. The results of each analytical group are discussed below separately. The human health and ecological implications of the levels of contaminants found in the sediment samples are discussed in detail in Section 6.0, Hazard Evaluation.

4.5.1.1 Volatile Organic Compounds

Three replicate sediment samples were collected at each of the eleven locations and analyzed for VOCs using the NYSDEC ASP 1989 methods. The data for these analyses for the individual replicates are presented in Appendix W, Table W-1. The mean values of the three replicates at each sample location are also presented in this table. 2-Propanone was the only VOC for which all detected values were not negated in the data validation process. This analyte was detected at locations SD-3, -4, and -5 with mean concentrations ranging from 26 μg/kg to 44 μg/kg at locations SD-5 and SD-3, respectively.

4.5.1.2 Semi-volatile Organic Compounds

Six replicate sediment samples were collected and analyzed for SVOs using the NYSDEC ASP 1989 methods at each of the eleven locations. The data for these analyses for the individual replicates are presented in Appendix W, Table W-2. The mean values of the six replicates at each sample location along with the four sediment quality criteria or standards are presented in Table 4-43. Also included on this table is the NOAA (1991) data for the three western Long Island Sound sample locations. A total of eighteen PAHs and four phthalates were detected in at least one replicate. It should be noted, as can be seen on Table 4-43, that the CRDL range for several of the PAHs analyzed for was higher than or included one or more of the sediment quality criteria or standards listed. This has implications in that what was reported as a nondetect value may in fact exceed one or more of the criteria or standards for these analytes.

PAHs. Mean total PAH concentrations generally fell out into three groupings. The lower group consisted of the two beach sample locations where the mean total PAH concentrations were 1,059 μg/kg and 1,283 μg/kg (at SD-10 and SD-11, respectively). The middle group consisted of locations SD-1 through SD-5, SD-7 through SD-8, and the reference location SD-9. Mean total PAH concentrations for this middle group ranged from 5,712 μg/kg to 11,745 μg/kg (at SD-7 and SD-4, respectively). The highest group consisted of only SD-6 where the mean total PAH concentration of 23,823 μg/kg was approximately twice the next highest concentration and greater than an order of magnitude higher than the two beach sample locations.

Phthalates. Total phthalates mean concentrations ranged from 38 μg/kg (at the beach sample SD-10) to 9,868 μg/kg (at SD-6). Total phthalates mean concentrations for the eleven sample locations generally fell out into four groups. The beach sample SD-10 is the only member of the lowest group with a mean total phthalate concentration of 38 μg/kg. This concentration is greater than an order of magnitude less than any other location. The second group consists of sample locations SD-2 through SD-5, SD-7 through SD-9 and the beach sample SD-11. Mean total concentrations in this group range from 1,211 μg/kg (at SD-4) to 2,861 μg/kg (at SD-2). The third group consists only of location SD-1 where the mean total phthalate concentration was 4,410 μg/kg. Sample location SD-6 is the only member of the highest group with a mean total phthalate concentration of 9,868 μg/kg.

SVOs. The sum of all the mean concentrations for all the SVOs detected are shown in the row called "Grand Total" on Table 4-43. The mean total SVOs for the eleven sample locations can be generally grouped into four groups. The lowest group consists of the two beach sample locations, SD-10 and SD-11, where the mean total SVOs are 1,097 μg/kg and 3609 μg/kg, respectively. The second group consists of sample locations SD-3, -5 and -7 through -9 where the mean total SVO concentrations ranged from 7,283 μg/kg (at SD-3) to 8,833 μg/kg (at SD-9). The third group is made up of sample locations SD-1, -2 and -4. Mean total SVO concentrations ranged from 11,093 μg/kg (at SD-2) to 12,955 μg/kg (at SD-4) in this group. The only member of the highest group is sample location SD-6 which has a mean total SVO concentration of 33,701 μg/kg. The mean total SVO concentration for SD-6 is greater than twice any other sample location.

4.5.1.3 Pesticides and PCBs

Three replicate samples were collected at each of the eleven locations and analyzed for pesticides and PCBs using the NYSDEC ASP 1989 methods. The data for the individual replicates for these analyses are presented in Appendix W, Table W-3. Six pesticides were detected in at least one replicate and no PCBs were detected in any of the replicates at any of the sample locations. The mean values of the three replicates at each sample location are presented in Table 4-44 along with the CRDL range, four sediment quality criteria or standards, and data for the detected pesticides from NOAA (1991) for three western Long Island Sound locations. Like SVOs, it should be noted that the CRDL range for several of the pesticides analyzed for was higher than or included one or more of the sediment quality criteria or standards listed. This has implications in that what was reported as a nondetect may in fact exceed one or more of the criteria or standards for these analytes.

4,4'-DDD was only detected at sample locations SD-1, -2, and -6 where the mean concentrations ranged from 40 μg/kg to 180 μg/kg (at SD-6 and SD-2, respectively). The range of the mean concentrations of 4,4'-DDE for the five locations at which this analyte was detected was from 50 μg/kg (at SD-3) to 130 μg/kg (at SD-1). 4,4'-DDT was only detected in one of the replicates at SD-2. The pesticide endosulfan sulfate was detected at five of the bay sample locations with concentrations ranging from 25 μg/kg to 117 μg/kg (at SD-8 and SD-6, respectively). Delta-BHC was detected at all of the bay sample locations (SD-1 through SD-9). Mean concentrations ranged from 16 μg/kg (at SD-4) to 290 μg/kg (at SD-1).

4.5.1.4 Inorganics

Three replicate samples were collected at the eleven sample locations and analyzed for inorganic compounds using the NYSDEC ASP 1989 methods. The results of the individual replicates are presented in Appendix W in Table W-4. The mean values of the three replicates at each sample location are presented in Table 4-45 along with the CRDL range, four sediment quality criteria and standards, and data for the detected inorganics from NOAA (1991) for three western Long Island Sound locations.

The mean concentrations for all inorganic analytes for the beach samples SD-10 and SD-11 were always much lower than any of the bay sample locations. The only criteria exceeded at the beach sample locations were the NYSDEC Sediment Cleanup Criteria lowest effect levels for cadmium, at SD-10 and SD-11, and for copper, at SD-10. The results of the beach sample locations for inorganics will not be discussed along with the results for the nine bay sample locations.

Arsenic. Arsenic was detected at all nine bay sample locations with mean concentrations ranging from 6.5 mg/kg (at SD-6) to 14.7 mg/kg (at SD-4).

Barium. Barium was detected at all bay sample locations with mean concentrations ranging from 94.1 mg/kg (at SD-3) to 117.8 mg/kg (at SD-6).

Beryllium. Beryllium was detected at seven of the nine bay sample locations. Mean concentrations ranged from 0.53 mg/kg (at SD-3) to 0.87 mg/kg (at SD-8).

Cadmium. The metal cadmium was detected at sample locations SD-3 and SD-5 through SD-9. Mean concentrations ranged from 1.9 mg/kg (at SD-6) to 4.6 mg/kg (at SD-7).

Calcium. The mean concentration of calcium ranged from 7517 mg/kg (at SD-1) to 45,967 mg/kg (at SD-4).

Chromium. Chromium was detected at all sample locations with mean concentrations ranging from 61 mg/kg (at SD-6) to 126 mg/kg (at SD-8 and at the reference location SD-9).

Cobalt. The range of the mean concentrations of cobalt was from 9.2 mg/kg to 13.4 mg/kg (at SD-2 and SD-5, respectively).

Copper. The mean concentrations for the metal copper range from 124 mg/kg (at SD-6) to 218 mg/kg (at SD-8).

Iron. Mean iron concentrations ranged from 24,167 mg/kg (approximately 2.4%) (at SD-6) to 39,633 mg/kg (approximately 4%) (at SD-8).

Lead. Lead mean concentrations ranged from 131 mg/kg to 226 mg/kg (at SD-3 and SD-8, respectively).

Magnesium. The range of the mean concentrations of magnesium was from 9,053 to 11,633 mg/kg (at SD-6 and SD-1, respectively).

Manganese. Manganese mean concentrations ranged from 251 mg/kg (at SD-6) to 586 mg/kg (at the reference location SD-9).

Mercury. The mean concentration range for the metal mercury was from 0.55 mg/kg (at SD-3) to 1.73 mg/kg (at SD-7).

Nickel. The only bay sample location where the reported concentrations of nickel were not negated during the data validation process was the reference locaitons (SD-9) where the mean concentration is 46.7 mg/kg.

Potassium. The range of mean concentrations of potassium was from 3,503 mg/kg for SD-6 to 5,807 mg/kg for SD-1.

Selenium. Selenium was only detected at SD-1, -5 and -8. Mean concentrations ranged from 1.0 mg/kg to 1.9 mg/kg (at SD-5 and SD-8, respectively).

Silver. The range of mean concentrations for the metal silver was from 1.9 mg/kg (at SD-4) to 5.7 mg/kg (at SD-9) for the five bay sample locations where this analyte was detected.

Sodium. Sodium mean concentrations ranged from 8,273 mg/kg (at SD-6) to 21,633 mg/kg (at SD-1).

Thallium. Thallium was detected at five of the nine bay sample locations with the lowest mean concentration of 1.02 mg/kg (at SD-6) and the highest mean concentration of 1.83 mg/kg (at SD-4).

Vanadium. The range of mean concentrations for vanadium was from 38.5 mg/kg (at SD-6) to 56.8 mg/kg (at SD-1).

Zinc. The mean concentrations for the metal zinc ranged only from 241 mg/kg (at SD-3) to 345 mg/kg (at SD-7).

4.5.2 Sediment TIC Data

The tentatively identified compounds (TICs) that were detected in sediment samples are discussed in this section. Following ASP protocols, a maximum of 10 VOC and 20 SVO TICs were reported by the laboratory. The TIC data are summarized in Table 4-46.

For data presentation, the TICs found in any given sample were grouped in Table 4-46 on the basis of similarity, and not by chemical composition. For example, if the laboratory identified several compounds as "unknown phthalates", with different retention times, the compounds were grouped together and their individual concentrations summed. The number of VOC and SVO TICs listed on Table 4-46 includes the number of individual TICs reported. The number of, and summed concentration of VOC and SVO TICs for each sample does not include concentrations that were rejected ("R" qualifier) or negated ("R#" qualifier) in the data validation process.

Two groups of VOC TICs and 45 groups of SVO TICs were detected in the 66 sediment samples collected. One VOC TIC was detected in sediment samples SD-1A, -3A and -8A. Total VOC TIC concentrations ranged from 22 μg/L to 23 μg/L. The total number of SVO TICs detected ranged from one (at SD-4F, -6A, -10A and -10C) to eighteen (at SD-3A). Total SVO TIC concentrations ranged from 190 (at SD-10A) to 231,300 μg/L (at SD-1C).

4.5.3 Comparison of Sediment Sample Results to NYSDEC Cleanup Criteria and Other Criteria and Standards

VOCs

There are no NYSDEC Sediment Cleanup Criteria, EPA Sediment Quality Criteria, NOAA Overall Apparent Effects Thresholds (AETs) or Washington Marine Sediment Quality Standards for the only VOC detected, 2-propanone.

SVOs

Mean concentrations of SVOs detected in the sediment samples were compared to the Draft NYSDEC Sediment Cleanup Criteria. NYSDEC Sediment Cleanup Criteria for human health residue basis are listed for the PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene and indeno(1,2,3-c,d)pyrene. The criteria value of 15 μg/kg for these six PAHs was exceeded at all sample locations. The bay locations (SD-1 through SD-9) all had a mean concentration more than an order of magnitude above the criteria for these analytes. Sample location SD-6 had a mean concentration more than two orders of magnitude greater than the criteria for these PAHs except indeno(1,2,3-c,d)pyrene. The only NYSDEC Sediment Cleanup Criteria for aquatic toxicity is for phenanthrene. The criteria value of 2,140 μg/kg for phenanthrene was only exceeded at SD-6 where the mean concentration was 2,183 μg/kg.

None of the mean concentrations exceeded the EPA Sediment Quality Criteria for the three PAHs for which a criteria value was listed.

Of the twelve NOAA Overall AETs listed for PAHs nine were exceeded at one or more sample locations. No Overall AET was exceeded by greater than an order of magnitude with most exceedences being less than twice the value. The NOAA Overall AETs for acenaphthalene and anthracene were only exceeded at location SD-6. The NOAA Overall AET for benzo(a)anthracene was exceeded at locations SD-1 through SD-6 and at the reference location SD-9. The NOAA Overall AETs for benzo(a)pyrene and chrysene were exceeded at SD-1, -2, -4 and -6. The mean concentrations for dibenzo(a,h)anthracene for the three locations where this analyte was detected (SD-3, -4 and -6) all exceeded the NOAA Overall AET for this analyte. The NOAA Overall AET for fluoranthene was exceeded at locations SD-4 and SD-6. The mean concentrations for phenanthrene at all bay sample locations exceeded the NOAA Overall AET for this analyte. The NOAA Overall AET for pyrene was exceeded at all bay sample locations except for SD-3.

Washington Marine Sediment Quality Standards are given for all SVOs detected except benzo(b)fluoranthene and benzo(k)fluoranthene. For PAHs only the mean concentrations for chrysene and phenanthrene at SD-6 exceeded these standards. The Washington Marine Sediment Quality Standard for butyl benzyl phthalate was exceeded at SD-1, -2, -5, -6 and at the reference location SD-9. No exceedences were greater than five times the criteria value. The standard for bis(2-ethylhexyl)phthalate was exceeded at all bay sample locations as well as the beach sample location SD-11. No exceedences were greater than an order of magnitude greater than the standard while all locations except SD-6 were less than four times the standard.

Pesticides

Mean concentrations of pesticides detected in the sediment samples were compared to the Draft NYSDEC Sediment Cleanup Criteria. The criteria for wildlife residue basis for 4,4'-DDD was exceeded at the three sample locations where this analyte was detected with the mean concentration at sample location SD-2 exceeding the criteria by more than an order of magnitude. The criteria for human health residue basis was for 4,4'-DDE was exceeded by more than two orders of magnitude at the five sample locations (SD-1 through SD-3, SD-7 and SD-8) where this analyte was detected. None of the detected mean concentrations exceeded the criteria for aquatic toxicity basis for 4,4'-DDE. The only detected concentration for 4,4'-DDT (SD-2) exceeded the criteria for wildlife residue basis. None of the concentrations of dieldrin at the three locations (SD-6 through SD-8) where this analyte was detected exceeded the criteria for aquatic toxicity basis but all exceeded the criteria for human health residue basis.

The only USEPA Sediment Quality Criteria for the pesticides that were detected is for dieldrin. This criteria was not exceeded at any of the three sample locations where this analyte was detected.

4,4'-DDT is the only detected pesticide for which there is a NOAA Overall AET. The NOAA Overall AET for this analyte was exceeded by more than an order of magnitude at SD-2, the only location where this analyte was detected.

There are no Washington Marine Sediment Quality Standards for the six pesticides that were detected.

Inorganics

Mean concentrations of metals were compared to Draft NYSDEC lowest effect level and severe effect level Sediment Cleanup Criteria. The lowest effect level is defined by NYSDEC as the concentration which will impair sediment use by some benthic organisms. All mean concentrations for the bay samples, including the reference location SD-9, where the metals arsenic, cadmium, chromium, copper, iron, mercury, nickel and zinc were detected exceeded the NYSDEC lowest effect level Sediment Cleanup Criteria. None of the mean concentrations exceeded this criteria by greater than an order of magnitude except for copper where the mean concentration for SD-1, -2, -5, and -7 through -9 was an order of magnitude greater than the criteria. The lowest effect level criteria for manganese was exceeded at SD-1 and SD-7 through SD-9.

The severe effect level is defined by NYSDEC as the concentration which will significantly impair use of sediment by benthic organisms. This criteria was exceeded for the metals chromium and copper. The severe effect level for chromium was exceeded at SD-7, SD-8 and at the reference location SD-9. The mean concentrations for these locations did not exceed this criteria by greater than two times. The mean concentrations of all bay locations for copper exceeded the severe effect level. No mean concentration exceeded the severe effect level by greater than two times.

There are no EPA Sediment Quality Criteria for the inorganics that were detected.

NOAA Overall AETs were exceeded at one or more of the sample locations for mercury, silver and zinc. Mean concentrations of mercury for SD-2, -4 and -7 through -

9 exceeded the NOAA Overall AET with no concentration exceeding this value by greater than two times. The mean silver concentration at the five bay sample locations exceeded the NOAA Overall AET for this analyte. No mean concentration exceeded this value by greater than four times. The NOAA Overall AET for zinc was exceeded at all bay sample locations, except SD-3, with no mean concentration exceeding this value by greater than two times.

The only Washington Marine Sediment Quality Standard for metals that was exceeded was for mercury. This standard was exceeded at all bay sample locations with no mean concentration exceeding this standard by greater than four times.

4.5.4 Comparison of Results from the Vicinity of the Landfill Samples to the Reference Location

4.5.4.1 Normalization of Sediment Inorganics Results

Normalization is a process of adjusting sediment metal levels to compensate for natural variability among samples caused by differences in grain-size, mineralogy and/or organic content. Both granulometric and geochemical (e.g. aluminum, iron, cesium, scandium and lithium) variables have been used to normalize sediment metal levels to aid detection of anthropogenic metal enrichment (Loring, 1991). Some methods show better results for sediments of specific origin and mineralogy, but at best the techniques provide qualitative results with only limited predictive value. The granulometric approach for normalization was used.

Sediment physical characteristics have a profound effect on the trace metal levels in sediments; this is especially true since trace metals have a strong affinity for co-deposition with the fine-grained silts and clays (the weight percent of sediment < 63 micrometers (μm)) and organic matter. To select between the grain-size (weight percent) and organic content (weight percent) options for granulometric normalization a correlation/regression analysis was conducted by comparing each of these variables with their respective concentration of aluminum and iron. Aluminum and iron were selected since they are the most abundant elements in the sediments collected from Eastchester Bay. The beach sample locations (SD-10 and SD-11) were not included in this analysis nor included in the normalization process because these samples are classified as sandy sediments (< 20% of sediment < 63 μm), not fine-grained sediments like the nine bay sample locations.

The correlation/regression analysis showed that the weight percent of fines (sediment < 63 μm) in the sediment samples was significantly correlated with the iron and aluminum concentrations ($r = 0.97$ and $r = 0.96$, respectively) while the percent of organic carbon was not significantly positively correlated with aluminum or iron concentrations ($r = -0.87$ and -0.81, respectively). The sediment metal concentrations were therefore normalized to weight of percent fines (bulk metal sediment concentration divided by % fines). It is interesting to note that the concentrations of the aluminum and iron were negatively correlated with the percent organic carbon in the nine bay sediment samples. The normalized metal concentrations for the bay samples (SD-1 through SD-9) are presented in Table 4-47. Also presented in this table are the NOAA (1991) normalized sediment metals data for the three western Long Island Sound locations.

4.5.4.2 Comparison of Normalized Inorganic Results to the Reference Location

The normalization process yields a set of metal values that can then be used to compare sediment metal levels from one location to another. A useful way of effecting this comparison is to calculate a ratio of the normalized metal level at the landfill vicinity sample locations (SD-1 to SD-8) to the reference location (SD-9). This quotient is termed a ratio to reference (RTR) value. As stated previously, although RTR values can be described as quantitative expressions, their interpretation is largely qualitative. RTR values may suggest that when a landfill vicinity sample location's RTR value is equal to 1.0, that particular location is similar to the reference location in terms of metals concentrations; or when an RTR value is greater than 1.0 that metal contamination is present. However, the sample location actually may not be different from the reference location because of natural variation of the RTR value caused by percent fines used to normalize the data. Therefore, RTR values should be interpreted as a qualitative expression and not as a measure of metal contamination at a sample location.

The RTR values for the eight bay sample locations in the vicinity of the landfill are presented in Table 4-48. The RTR values comparing the normalized metal concentrations of the three NOAA (1991) western Long Island Sound sample stations data to the reference location (SD-9) are also presented in this table. Although the RTR values for all the inorganics detected are listed on this table only the ten metals for which there is a NYSDEC Sediment Cleanup Criteria for (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel and zinc) will be discussed. All of these ten metals were also analyzed by NOAA for the three western Long Island Sound stations. These ten metals are shaded on Table 4-48.

Based on this evaluation of the sediment data none of the sample locations in the vicinity of the landfill were considerably different than the reference location with respect to these ten metals. All sample locations, except SD-6, had RTR values of less than two. Greater than half of the RTR values (49 out of 80) for the ten selected metals were less than, or equal to 1.0. SD-6 is the only sample location with an RTR value greater than two. RTR values of 3.1 and 3.0 were calculated for the metals lead and zinc, respectively, for this sample location. The slightly higher RTR values for these two metals at SD-6 can possibly be explained by the fact that the lowest value for percent fines (34.1% compared to the next highest value of 57.6%) was found at this sample location.

The RTR values calculated for the ten selected metals for the three NOAA Long Island Sound sample locations also showed that the metal concentrations normalized to percent fines for these locations are relatively similar to SD-9. All RTR values for the ten selected metals for these three locations were less than two except for manganese for the Mamaroneck station (RTR value = 2.2). Greater than one half (22 out of 30) of the RTR values for the ten selected metals for these three stations were less than, or equal to 1.0.

4.5.4.3 Normalization of Sediment SVOs Results

A normalization process similar to that used for the sediment metals data was used for the SVO data. Like inorganic chemicals, sediment physical characteristics have a profound effect on the semi-volatile contaminant levels in sediments. To select between the grain-size (weight percent) and organic content (weight percent) options for granulometric normalization a correlation/regression analysis was conducted by comparing each of these variables with their respective concentration of total PAHs, total phthalates and total SVOs ("Grand Total" on Table 4-43). The beach sample locations (SD-10 and SD-11) were not included in this analysis, or in the normalization process because these samples are classified as sandy sediments (< 20% of sediment < 63 μm), not fine-grained sediments like the nine bay sample locations.

The correlation/regression analysis showed that the percent organic carbon in the sediment samples was significantly correlated with the total PAHs, total phthalates and total SVOs concentrations ($r = 0.89$, $r = 0.85$ and $r = 0.90$, respectively) while the percent fines was not significantly positively correlated with concentrations of total PAHs, total phthalates and total SVOs ($r = -0.80$, $r = -0.66$ and $r = -0.77$, respectively). The sediment SVO concentrations were therefore normalized to weight of percent organic carbon (SVO concentration divided by percent organic carbon). The normalized SVO concentrations for the bay samples (SD-1 through SD-9) are presented in Table 4-49. Also presented in this table are the NOAA (1991) normalized sediment SVO data for the three western Long Island Sound locations.

4.5.4.4 Comparison of Normalized SVOs Results to the Reference Location

The normalized SVO concentrations for the eight sample locations from the vicinity of the landfill were compared to the reference location (SD-9) using the same RTR value technique used for metals. The RTR values for SVOs are presented in Table 4-50. The RTR values comparing the reference location (SD-9) to the three NOAA western Long Island Sound stations are also listed on this table.

From Table 4-50 it can be seen that none of the RTR values for any of the SVOs detected for the eight landfill vicinity sample locations were greater than three, with only three values greater than or equal to two. Greater than one half (74 out of 135) of the RTR values for analytes that were detected in either the landfill vicinity sample locations or the reference location were less than or equal to 1.0. RTR values listed as "< SD-9" on Table 4-50 were counted as being less than 1.0. Also, none of the RTR values for total PAHs, total phthalates and total SVOs ("Grand Total") were greater than three, with only the total phthalate RTR values for SD-1 and SD-6 greater than two (2.6 and 2.3, respectively). Greater than one half (13 out of 24) of the RTR values for total PAHs, total phthalates and total SVOs were also less than or equal to 1.0. Based on these results, it does not appear that any of the normalized concentrations of SVOs at any of the landfill vicinity locations were considerably different than the reference location (SD-9).

RTR values for the individual PAHs that were analyzed by NOAA (1991) for the three western Long Island Sound sample stations were generally less than the RTR values for the eight landfill vicinity locations. Greater than half (26 out of 40) of the RTR values for these three locations were less than or equal to 1.0.

4.5.4.5 Comparison of VOCs Results to the Reference Location

No RTR values were calculated for VOCs because, as can be seen from Table W-1, no VOCs were detected at the reference location (SD-9). Three of the eight landfill vicinity sample locations (SD-3, -4, and -5) had detected concentrations of 2-propanone in one or more of the three replicate samples. This analyte was not analyzed by NOAA (1991) for the three western Long Island Sound sample locations.

4.5.4.6 Comparison of Pesticides Results to the Reference Location

From Table 4-44 it can be seen that the only pesticide detected in the sediment samples collected from the reference location (SD-9) was delta-BHC. The mean concentration of delta-BHC detected at the reference location (73 μg/kg) is less than that reported at five of the eight landfill vicinity sample locations. Four of the landfill vicinity sample locations (SD-1, -2, -7 and -8) had mean concentrations greater than twice the mean concentration reported at the reference location. None of the other five pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, and endosulfan sulfate) that were detected in at least one replicate at one sample location were detected at greater than four of the landfill vicinity sample locations.

Five of the six pesticides detected in the landfill vicinity sediment samples were also detected at the three NOAA (1991) western Long Island Sound stations. Endosulfan sulfate was not analyzed by NOAA. The concentrations of the five pesticides that were analyzed by NOAA at the three western Long Island Sound stations were all less than the concentrations at the landfill vicinity sample locations where these pesticides were detected.

4.5.5 *Ampelisca abdita* Bulk Sediment Toxicity

4.5.5.1 Survival Analysis

Bulk sediment bioassessment of the field collected samples from Eastchester Bay began on August 20, 1992 and was terminated on August 31, 1992. The ultimate assessment for survival of the *A. abdita* exposed to the sediment samples was conducted at the termination of the exposure. A number of mortalities were observed during the exposure time-frame. Mortalities were removed from the test vessels upon their discovery.

No mortalities were observed until day 3 during the assessment. The progression of mortalities within each test sediment replicate and control is presented in Table 4-51. The air supply was observed to be off in both SD-9 replicates on day three. The air line had popped off from the connection to the compressor manifold. This caused the DO level within replicates SD-9 A & B to drop to 1.8 and 1.3 mg/L, respectively. The air line had again popped its connection the following day, and a total of 13 mortalities were discovered in SD-9. The DO content on this day had dropped below 1 mg/L in both replicates. This loss of aeration is suspected to be the cause of the mortality observed in SD-9.

One mortality in SD-2 replicate A was discovered stuck to the teflon cover over the jar. This is possibly due to the animal getting stuck to the water's surface by surface tension, and subsequently blown by air bubbles (2 to 5 bubbles per second) onto the cover. It is uncertain that this mortality is associated with any toxicity inherent in the sediment sample. The mortality was included as a mortality for the survival analysis.

Data collected and observations made during the survival analysis imply that the deaths of the organisms were all verifiable mortalities. A coloration change was observed with each mortality, an uncurling of the body, and respiratory or circulatory motions were not observable under the microscope. Those mortalities that occurred in the early stages of the bioassay were placed in uncontaminated water with control sediment, but none ever responded. Mortalities observed later in the survival analyses were unmistakably verified mortalities.

The collection process for living *A. abdita* was conducted on day 10. Not all *A. abdita* were recovered after sieving the sediments. In attempt to assure a complete recovery, WCCI exposed the collected remains of the sieved debris to a 10% formalin solution.

The addition of the formalin caused any remaining animals to evacuate the sediment. The reaction to the formalin was immediate and effective. This accounted for significant additional recovery for five out of the ten test and control sediment replicates. These animals recovered using the formalin exposure were alive and included in the survival analysis as such. None of the animals recovering via formalin treatment, however, were used in the reburial assessment. This reduced the degrees of freedom associated with the reburial assessment, as it was believed that the exposure to formalin would compromise their behavior.

The resultant counts of the survivors are graphically presented in Figure 4-33 and in Table 4-52. The number of animals recovered in SD-3 replicate A revealed that an extra five animals were inadvertently added at the start of the exposure. Mortality counts, based on the number of animals recovered alive, were subjected to statistical analysis and found not to satisfy a normal distribution or homogeneity of variances. After transformation the data set was still found not to satisfy the requirements for analysis of variance. Thus, a non-parametric method, Fisher's exact test, was used to determine which (if any) sediment samples produced significant mortality when compared to the control sediment (Table 4-52). Sediments collected from stations SD-2 and SD-5 through SD-9 produced statistically significant greater mortality than the laboratory control. However, the validity of mortality is a question for SD-9, as the animals were exposed to extremely low oxygen concentrations. For this reason, sediments from SD-9 were re-tested (see Section 4.5.5.4). Aside from SD-9, none of the sediment samples produced a mortality rate greater than 50%, as compared to controls. Therefore, the second stage of toxicity testing was not performed.

The original intent of the toxicity testing of sediments collected from station SD-9 was to provide a comparison of toxicity observed in near-field sediments (collected adjacent to the landfill) to the toxicity observed in a far-field sediment sample, which would presumably represent ambient conditions. Since no *Ampelisca* survived the exposure to sediments from SD-9, this comparison could not be made. Therefore, the WCCI *Ampelisca* toxicity testing data were compared to the solid phase toxicity testing data reported by Battelle (1992b). As part of a joint EPA/NYCDEP project, Battelle collected sediments from 20 locations throughout the New York/New Jersey Harbor and New York Bight and performed solid phase toxicity tests using *Ampelisca abdita* and the upper five centimeters of sediment from each location. The Battelle toxicity data should represent ambient conditions within the study area. Mean survival in the Battelle

Ampelisca toxicity tests ranged from 0 (Kill van Kull) to 100% (Jamaica Bay). The lowest regional toxicity was observed in samples collected in the Hudson River, where mean survival ranged from 59% to 75%. As a comparison, excluding the results of SD-9, the mean percent survival of Eastchester Bay sediment samples ranged from 50% (SD-7) to 80% (SD-1 and SD-3).

Sediments from a total 9 out of the 20 Battelle locations exhibited statistically greater mortality than their control sample, which had a mean survivorship of 90%. The 11 sediment samples which proved to be statistically similar to their control sample exhibited a range of mean survival of 54% (Raritan Bay, Harlem River, and East River at Throgs Neck) to 100% (Jamaica Bay). Three of the Eastchester sediment samples had mean survivals of less than 54%; SD-5 and SD-8 (52.5% survival), and SD-7 (50% survival). Although sediments collected from SD-2 and SD-6 showed a statistical difference from the WCCI laboratory control sediment, they are within the range of mean percent survival values which Battelle determined to be similar to their control sample.

4.5.5.2 Sublethal Toxicity Assessments

At no time during the tests was any animal observed swimming in the water column. The animals were either hidden in the sediment, stuck on the surface of the water by surface tension, or noted and removed as mortalities.

As an evaluation of sublethal effects due to exposure to the test bulk sediment samples, the time required for the surviving animals to rebury themselves in control sediment was measured on each of the replicates for the control and test sediment groups. All animals found as survivors on day 10 and not exposed to formalin were placed in a polystyrene cup containing control saltwater, gently poured into a plastic tray containing approximately 30 mm (depth) of control sediment, and covered with control saltwater. The number of animals placed in the tray were counted. The number of *A. abdita* that had not buried themselves was noted after 30 seconds, 5 minutes, 15 minutes, 30 minutes, 1 hour and 3 hours. These counts were evaluated as quantal (whole number) data using log time, probit transformed counts, and regression analysis (Table 4-53). This produced an effective time for the reburial of 50% of the animals present (ET_{50}). Due to the fact that there were less than two response times between 0 and 100% burial, no ET_{50} could be produced for the control replicate B, SD-2 replicate B or SD-8 replicate B. Confidence intervals were produced for those replicates that satisfied this requirement, except for the ET_{50} produced for SD-5 replicate A. The data for SD-5 replicate A produced a slope not significantly different from zero, thus no confidence could be placed on the ET_{50}.

Only one ET_{50} was found to produce a confidence interval that did not overlap the control confidence interval: SD-4 replicate A (Figure 4-34). The other SD-4 replicate produced a similar ET_{50} but with a fairly wide confidence interval, which overlaps that for the control. The most divergent ET_{50}'s are those produced for two of the sediment samples that did not show a significant mortality rate compared to the control: SD-3 and SD-4. The only other sediment sample that appears to have a slightly different ET_{50} as compared to the control is SD-7. None of the ET_{50}'s were greater than five minutes.

Observations regarding the number of burrows were probably affected by the occurrence of the floaters prevalent during the bioassay (Figure 4-35). There does appear to be a reduction in the observable number of burrows for sediment samples SD-6, -7, -8 and -9, as compared to sediment samples SD-1 through SD-5. The physical sediment characteristics may have an impact on the results of the number of burrows observed. The observer may not recognize a burrow due to the consistency or character of the sediment. Given this qualification and the fact that there were only two observers, there does still, however, appear to be an effect related to the number of burrows present and the sediment samples.

A significant problem occurred in the bulk sediment toxicity assessment regarding the occurrence of "floaters" during the test. As many as all 20 animals within a given test vessel were found trapped in the water's surface tension during the first few days of the test. Logic suggests that the animals were leaving their burrows after the lighting was turned off, swimming around within the water column and becoming trapped by surface tension. From test day 1 through test day 5, significant numbers of animals had to be pushed back into the water column (Figure 4-35). The control test vessels exhibited the same problem. On test day 5, the lights were set for a 24-hour photoperiod, as suggested in the ASTM standard to assure a maximum contact time with the sediment. It was hypothesized prior to the start of the test that a 24-hour photoperiod may be an added stressor and affect the mortality of the organisms. It has been shown that the photoperiod has a direct impact on lethality and can affect stress proteins (Sprague, 1985). As such, a consistent photoperiod was determined to be preferred. However, leaving the lights on for the full 24 hours did assure that the animals stayed in the sediment and would not get trapped by surface tension. After the lights remained on constantly, the number of floaters was reduced to zero. The effect of the stress related to being trapped by surface tension has an unknown impact on the results of this test.

4.5.5.3 Water Quality Measurements

The pore water analyzed prior to the start of the bulk sediment bioassessment (Table 4-54) reveals low salinity, high ammonia and low dissolved oxygen. The pH of the pore water was near neutral.

Over the course of the bulk sediment bioassessment there was a problem with maintaining a dissolved oxygen (DO) level (Table 4-55). This was apparently due to the high sulfides in the sediments and a subsequent high oxygen demand. Thus, when the sediments were not being aerated, the oxygen level would drop very rapidly. The overall average DO was adequate for the amphipods, the lower ranges ran as low as around 50% of saturation. The salinity, translated from the specific gravity within the overlying water did creep up slightly during the bioassay, but not to any significant degree (Table 4-56). Total ammonia also crept up during the assessment (Table 4-57). The high levels found in the pore water analysis would suggest that the ammonia levels would be higher, but the high aeration probably mitigated the ammonia concentrations. Only in SD-9 were the ammonia levels dramatically high. This coupled with the DO problems observed during the bioassay may have impacted on the survival results for SD-9. The measured pH in the replicates is presented in Table 4-58. The pH, as with ammonia and salinity, showed some increase over the course of the experiment. This increase in pH with the increase in ammonia concentration has the potential to impact on the survival results.

4.5.5.4 Retesting of SD-7 and SD-9

The results of the retesting of SD-7 and SD-9 are included in Appendix N. The retesting was initiated to address the mortality observed in SD-9 during the first test. SD-7 was selected for retesting to reassess the reburial results observed during the first test. The results are questionable, as the control mortality rate was 37.5%. A total of 13 mortalities occurred on day one during the test in the control replicates. As such, the reburial assessment was not analyzed. The DO was maintained through the test, with the lowest observed DO being 6.4 mg/L. Although total ammonia was not followed during this retest, it is not believed to have caused the test failure in the control test vessels. Only eleven animals were recovered alive from the retest of SD-7 and four live animals recovered from the retest of SD-9. The survival rates were corrected due to the high control mortality (Abbott's Correction; APHA, 1989) and were then 44% and 16% respectively. The corrected value for SD-7, 44%, is lower than the rate observed during the first test, 50%, but not overly dissimilar. The results for SD-9, 16% survival, given that the first test results were compromised by low DO's, reveal a distinct possibility that SD-9 can express significant mortality in *A. abdita*. The photoperiod during the test was 24 hours and there were no floaters observed.

4.5.6 *Menidia Beryllina* Elutriate Toxicity

4.5.6.1 Survival Analysis

There were a total of three series of tests. Each test series incorporated three locations for the collected sediment samples and a control. The first test series or test battery was of sediment samples SD-1 through SD-3 and began on August 18, 1992. The test animals were ten days of age when the test began. The second test battery, using sediment samples SD-4 through SD-6, began on August 21, 1992. The test animals were from seven to nine days of age when the test began. The third battery of tests, SD-7 through SD-9, began on August 25, 1992. The test larvae were those that were hatched on August 13, 1992 and eleven days of age at the start of the test.

Survival curves were produced for the interpretation of the mortality data collected during the bioassays of the sediment sample elutriates (Figure 4-36, 4-37, 4-38). Survival data is summarized in Table 4-59. At no time did the control mortality exceed the 20% criteria. During the assessment of the elutriate produced from sediment sample SD-8, one of the test chambers was accidently dropped and broken during the water exchange on test day 2. This replicate was censored (Brown and Hollander, 1977) from the data set, beginning at the time that it was broken to the end of the bioassay to produce the survival curve.

The first group of sediment elutriates tested included SD-1 through SD-3 and was performed over a seven day period (August 18, 1992 - August 25, 1992). There was some mortality (11.1%) that occurred in the control group. This mortality was observed within the first 24 hours during the test and is likely associated with the stress due to handling. Statistical analysis included transforming the data by taking the inverse of the square root of the number of mortalities plus 0.5. This transformation (inverse square root) is cited as the most appropriate for count data (Sokal & Rohlf, 1981) and the addition of 0.5 was used to code the data, allowing for the inclusion of zeros in the analysis. The transformed data was tested for normality using the Chi Square technique, and homogeneity of variances using Hartley's test (USEPA, 1988). The transformed data was found to satisfy the requirements for analysis of variance (ANOVA), which was performed. Using the variance components produced by the ANOVA, Dunnett's test compared the field collected sediment results to the control sediment results (USEPA, 1988). The mortalities observed in the three elutriate samples evaluated during this test series were not statistically greater than the control. The mortality counts, however, did show a progression. The SD-1 elutriate showed very little mortality at 24 hours (4%), indicating a minimal effect due to handling, but progressed to 20% mortality over the course of the exposure. The SD-2 elutriate sample showed a 9% mortality rate at 24 hours and progressed to 22.2% over the course of the exposure period. The progression of the elutriate sample for SD-3 followed the control mortality.

The second battery of elutriate bioassays included elutriates of SD-4 through SD-6 and ran from August 21, 1992 to August 28, 1992. Statistical analysis was performed as described for the first test series. The data set satisfied the requirements for ANOVA, and Dunnett's method was performed to assess if any mortality counts in the elutriate tests were greater than control. Mortality in those silversides exposed to elutriates of SD-4 and SD-5 was significantly greater than that observed in the control test groups. The mortality counts for SD-6 were not significantly different from the control. Although the mortality rate appears significant (Figure 4-37), the variability between replicates produced a non-significant effect. Resultant mortality percentages were 47.8%, 40.0% and 33.3% for SD-4, -5 and -6, respectively. Some control mortality occurred initially, and additional control mortality occurred from day 5 through day 7. The resultant control mortality for this test run was 13.3%, still well within the acceptable range for control mortality. Both SD-4 and SD-5 elutriates showed a steady progression of mortality, whereas the mortality associated with SD-6 appeared to taper off after day 3.

The final battery of tests was conducted from August 25, 1992 through September 1, 1992 on elutriates of sediment samples SD-7 through SD-9. Statistical analysis performed on this test series was different than for the other two batteries. The transformation was the same, inverse square root of the number of mortalities plus 0.5, as was the Chi Square test for normality. Bartlett's test for homogeneity of variances was used rather than Hartley's, as there were not equal sample sizes. The unequal sample sizes were due to the breakage of a test replicate vessel for SD-8 on day 2 of the test. The data set did pass the requirements for ANOVA, but the Bonferroni T-Test was used over Dunnett's, again due to the unequal sample sizes. There was no significant mortality as compared to control for sediment samples SD-7, -8, and -9. By the end of the exposure period, elutriates of SD-7, -8 and -9 produced mortality rates of 26.7%, 26.7%, and 15.6%, respectively. The progression of toxicity was different from the elutriates of SD-1 through SD-6, however, in that little mortality occurred until days 6 and 7 (Figure 4-38). Control mortality was 11.1% by the termination of the exposure period.

Since none of the elutriates produced from any of the sediment samples produced a mortality rate greater than 50%, the second stage of toxicity testing was not initiated.

4.5.6.2 Sublethal Toxicity Assessments

To assess any sublethal effects due to exposure to the elutriates of the sediment samples, the larvae remaining alive at the end of the test were dried and weighed to assess growth effects. These assessments were made, as in the mortality assessment, in test batteries of three sediment samples at a time. These data are summarized in Table 4-60 and Figure 4-39. Each replicate of the test elutriates and associated controls were pooled and dried at 100°C. This resulted in three samples, one per replicate, for the analysis of growth. There were only two replicates for the growth assessment of SD-8 as one replicate was accidently broken during the test. Transformation of the dry weights was not used in the statistical analysis of the data. All three of the data sets passed the requirements for ANOVA as tested by the Chi Square test for normality and Hartley's test for homogeneity of variance. Bartlett's test for homogeneity was used in the evaluation of the third data set (SD-7, -8, and -9) due to the unequal sample sizes caused by the loss of one replicate in SD-8 (see above). Dunnett's multiple comparison method for multiple treatments with a control was used to determine statistically different values as compared to control except in the data set that included SD-8. The third data set, which included SD-8 was assessed using the Bonferroni T-Test. Two mortalities found on day 7 during the assessment of SD-4 were inappropriately added to the group of larvae dried for the growth assessment.

The first battery, initiated on August 18, 1992, including elutriates of SD-1, -2 and -3, showed only SD-3 to produce a statistically lower dry weight per individual as compared to control. The average individual dry weights of the silverside larvae used in this battery were 0.526 mg, 0.422 mg, 0.395 mg, and 0.321 mg for control, SD-1, -2, and -3, respectively. These values translate into inhibitions of 19.8%, 24.9% and 39.0% for SD-1, -2 and -3, respectively, as compared to control.

The test battery for elutriates of SD-4, -5, and -6, performed from August 21, 1992 to August 28, 1992, did not produce a statistically significant difference in dry weight per individual, when compared to control. The mean dry weight per individual larvae was 0.652 mg, 0.702 mg, 0.747 mg and 1.026 mg for control, SD-4, -5, -6, respectively. The test values of SD-4 through SD-6 are higher than the control value, but not significantly higher. The amount of food added to each replicate was reduced in the test vessels due to the mortality observed. This, however, did not appear to totally control the increased growth in the treatment groups due to a greater amount of available food stuffs. It is noteworthy that, in all treatment groups, during all of the tests performed, there were always live brine shrimp in the test vessels before water exchanges were performed. Thus, it appears that the larvae were all being fed in excess. It is doubtful that the larvae showed greater growth due to greater food availability caused by the loss of test animals to morality, as the mortality percentages and apparent body weight are not related. The apparent increase in growth in the elutriate test groups is due to some unknown factor.

The last test battery (August 25, 1992 - September 1, 1992) used elutriates of SD-7, -8 and -9, and did not produce any statistically significant effect on the growth of the silverside larvae compared to control. The control dry weight, however, was only 0.3822 mg per individual. This is below the criteria of 0.500 mg (USEPA, 1988). The reason for this is uncertain, as these larvae were of the same batch used in the assessment of SD-4, -5 and -6 which overlapped in time with SD-7, -8 and -9. Thus, they were fed, for the most part, the same brine shrimp at the appropriate level. It is possible that the muffle furnace that was used to dry the larvae ran a higher temperature than the set temperature. A problem was discovered involving the muffle furnace regarding the set and actual temperature during its use in a separate project. It was found that the temperature may have been as high as 120°C to 130°C when set at 100°C. The resultant dry weights for the two sediment sample elutriates, SD-7 and SD-9, were also below 0.500 mg: 0.367 mg and 0.385 mg, respectively. Exposure to the elutriate of SD-8 produced an individual dry weight of 0.523 mg. None of the elutriates (SD-7, -8 and -9) were significantly different than the control value. Only SD-7 produced a dry weight less than the control: a 4% inhibition. Although the data may be questionable, there does not appear to have been a reduction of growth due to exposure to SD-7, -8 and -9 elutriates when compared to the growth of the control silversides.

4.5.6.3 Water Quality Measurements

The measured water quality parameters are presented in Tables 4-61 through 4-72. The freshly prepared elutriates showed a low dissolved oxygen (DO) level, but do not appear to have been outside the tolerance range of the fish. Salinity measurements, converted from the specific gravity, do vary slightly, but not extensively. The elutriate pH also varied and, given the total ammonia values, may have played a role in the overall toxic stress during these bioassays.

4.5.6.4 Reference Toxicity Assessment

A batch of the silversides obtained from ARO were assessed for their sensitivity to cadmium in order to evaluate their comparability to other silverside minnows. A total of 10 larvae (two replicates with 5 larvae each) were exposed to five cadmium concentrations and a control. The resultant 24 hour LC_{50} equals 367 μg/l, with a 95% confidence interval of 131 μg/l to 615 μg/l. The 48 hour LC_{50} was calculated to equal 200 μg/l, with a 95% confidence interval of 35 μg/l to 320 μg/l.

4.5.7 Acid Volatile Sulfide Analysis

4.5.7.1 Bulk Sediment Samples

Measurements of the cold acid volatile sulfides (AVS) within the sediments collected for bioassessment in *A. abdita* were made as described in Section 2.5.2.2.4. Triplicate samples for each sediment were measured. The data is summarized in Table 4-73 and graphically depicted in Figure 4-40. Sulfides were detected in all samples. There was variation between samples, and in some, variation between the sample replicates (e.g. SD-1).

4.5.7.2 Elutriate Sediment Samples

Measurements of the AVS within the sediment samples used to produce elutriate show a very similar profile to those collected for bulk sediment bioassessment (Table 4-74 and Figure 4-40). The concentrations in the sediment samples, in general, are higher. The sediments collected for the bulk sediment bioassessment were collected from the uppermost layer of sediment which most likely contains a higher oxygen concentration, thus greater sulfide oxidation rates. One distinct difference is notable: the concentration for AVS in sediment samples SD-2 and SD-8 are higher in the bulk sediment analysis than in the elutriate sediment sample analysis.

4.5.7.3 Sulfide Standards

Solutions of sodium nanosulfide were subjected to the same treatment as the sediment samples after all of the samples were analyzed. The results showed a range for the percent recovery from around 60 to 90%, depending on the amount of sulfide added to the systems. The system with the 1000-ml reaction flask showed a slightly higher recovery rate. This reduced recovery may be explained by the fact that, although DiToro *et al.* showed a high recovery, he reported average sulfide precipitate weights of 20 to 30 mg. Our sulfide precipitate weights were between 60 mg and 80 mg. To compensate for the apparent reduction in recovery as the amount of sulfide precipitate increased, the data was used to produce a standard regression curve to provide a percent correction based on the amount of sulfide precipitate recovered for the sample. Separate standard curves were produced for each system used, and both regressions were linear in nature.

4.5.8 Statistical Analysis of Sediment Chemistry and Toxicity Testing Data

4.5.8.1 Normalization of Data

Chemical data representing the means for bulk sediment replicate samples collected at nine locations in Eastchester Bay (SD-1 through SD-9) were collated and tabulated with toxicity responses observed in the bioassays performed using sediments from these locations. In calculating these means, compounds not detected in the sample replicates were treated as one half of the detection limit.

Normalization of the tabulated bulk sediment was then performed in order to account for the phenomena of "bio-availability" within sediment samples (Geisy & Hoke, 1990). Many toxic materials in the water column or associated with sediments are not readily available for uptake due to certain physical/chemical characteristics. Normalization of bulk sediment concentrations to percent organic carbon of the sample and/or the particle sizes of the sediments in question are methods that have been used to evaluate data on the basis of bioavailability. Recently, normalization to the AVS fraction of sediment samples procedure has been advocated (DiToro, *et al*; 1990). The role of AVS lies in the chemical reaction of sulfides, normally associated with ferrous ions, with certain metals and metal species. The reaction has been identified as affecting the toxicity/bio-accumulation process for a small suite of metals, but its effect on all metals has not been fully explored. Therefore, only certain metals (cadmium, chromium, copper, iron, lead, nickel, silver, and zinc) found within the Eastchester Bay sediments were normalized to their AVS concentrations. The bulk sediment concentrations for these metals and the remainder of the analytes determined to be potential contributors were also normalized using the traditional TOC and grain size measures.

The toxicity data collected during the screening bioassays performed on the *Ampelisca abdita* and *Mendia beryllina* were also normalized to account for mortality rates observed in the control replicates. This normalization used Abbott's correction as outlined in APHA (1989). This correction set the spontaneous control response at zero for all of the samples. Given that control mortality varied within the bioassays of the sediment elutriates, this normalization allowed for a matrix of comparable toxicity results for all of the samples tested (SD-1 through SD-9).

The results of the toxicity assessments made using *Ampelisca abdita* and *Medina beryllina* were subjected to "predictor analysis" following stepwise multiple regression techniques. Stepwise regression was selected because it employs correlations (full and partial) between the individual contaminant values and toxicity to evaluate potential causes of the observed toxicity results.

4.5.8.2 Statistical Analyses - *Ampelisca abdita*

Because of the large volume of sediment data to evaluate, data subsets for potential toxicity contributors and arithmetic means were used. The subsets initially analyzed were grouped as follows: semi-volatiles, metals, and pesticides/volatiles/furans. Within each subset, the values were evaluated as bulk sediment concentrations; and sediment concentrations normalized by percent organic carbon, fine sediment particles, and AVS (certain metals only). Most of the calculations were performed on a 386 PC using the stepwise regression module of the statistical program SYSTAT (Version 3; L. Wilkinson, 1989. SYSTAT: The System for Statistics. Evanston, IL: SYSTAT, Inc.). Some procedures were done on a hand calculator. Additional guidance and methods were taken from Sokal and Rolhf (1981) in developing the overall procedure for the assessment.

An analyte must contribute to the overall significance of a multiple regression to be considered as a potential contributor to the observed toxicity. To determine this, p levels ranging from 0.150 to 0.200 were used (most were at the 0.150 level). Once the potential contributors were identified on this basis, formal multiple regression (least squares) was performed to establish their predictive power. The regression also provided an indication of the overall contribution of each variable and established the relative amount of variation explained by the regression, as well as the amount left unexplained (error term). Once the regression analysis was completed, the model was run to determine how well it fit the observed data. The fit of the predicted to the observed was the basis by which variables were selected for further additions and omission of the overall predictor group.

Initially, a matrix of the Spearman product moment correlation coefficients was produced for all of the measured materials in the sediments, including *Ampelisca abdita* toxic response. Stepwise regression analysis was then used to develop a list of analytes detected in Eastchester Bay sediments that may have a cause/effect relationship with the *Ampelisca abdita* toxicity (see Table 4-75). The analytes in the left hand column of Table 4-75 are those that were selected as a result of this analysis. The second column lists the correlation between the average concentration of the analyte(s) in the bulk sediment and the toxicity observed for that sediment in *A. abdita*. The remaining columns list the correlation coefficients between the sediment concentrations that had been normalized to the percent fine particles in the sample, the percent organic carbon in the sample, and if an appropriate metal, after normalization by the AVS present in the sample. With a sample size of eight sample sites, a correlation coefficient in this tabulation greater than 0.707 is statistically significant at the 0.05 level. Only two analytes were determined to have statistically significant zero order correlation coefficients: anthracene and zinc. The observed toxicity of Eastchester Bay sediments to *A. abdita* is positively correlated with the bulk sediment concentrations of both zinc and anthracene (0.735 and 0.855, respectively).

To further evaluate the data, a multiple regression of the seven analytes thought to be most pertinent and showing the highest correlation coefficients was run. This analysis did not yield any significant multiple regressions (p=0.164). Regressions were then run for each analyte to evaluate the relative ability of individual analytes to account for the observed toxicity. No strong correlations were found to exist.

Colinearity was then assessed using a regression analysis. As zinc and anthracene had the only statistically significant zero order correlations with toxicity, they were assessed first. Zinc is significantly inter-correlated with anthracene (r=0.905), lead (r=0.922), barium (r=0.922), and butyl-benzyl phthalate (r=0.714). All of these materials appear to be contenders as possible contributors to the toxicity. Anthracene is similarly collinear with barium (r=0.802), lead (r=0.910), zinc (r=0.905), and butyl-benzyl phthalate (r=0.714).

Mercury does not appear to be correlated with any of the other predictors on the long list, nor does silver. The phthalates are collinear with each other , chromium (r=0.881), vanadium (r=0.833), BHC (r=0.810), and both zinc and anthracene, as previously mentioned. All of these inter-correlations are statistically significant.

4.5.8.3 Statistical Summary - *Ampelisca abdita*

From these analyses it can be stated that no one analyte is associated with the toxicity observed in all of the samples. Thus, a series of multiple regressions were performed to assess the potential that combinations of the variables might be associated with the toxicity. The statistical paramaters considered in selecting the analytes to be further assessed were colinearity, significant partial regression coefficients, a significant overall regression, and the predictive error when the variables are plugged into the regression. After the regressions were performed, the relative contribution made by the variables was evaluated. Those that were judged to have bearing and meaning pertinent to the question at hand are included.

As predicted by the stepwide procedure performed on the long list, anthracene and mercury comprised the two base variables required to produce a significant regression with a semblance of predictive ability. With these two base analytes, combinations with other analytes were able to accurately predict the observed toxicity within all but two of the samples; SD-1 and SD-5. For the overall observed *Ampelisca abdita* results, mercury along with a group of intercorrelated variables (anthracene, barium, zinc, lead) appear as the most probable analytes associated with the toxicity. Two other analytes, silver and AVS, while not correlated with the analytes on the long list, were also identified as possible predictors of toxicity.

4.5.8.4 *Menidia Beryllina* Results

The results of the bioassessment of elutriates produced from the sediment samples collected from Eastchester Bay along with the sediment chemical data were handled as described in the section for *A. abdita* (Section 4.5.8.2). Initially, a matrix of the Spearman product moment correlation coefficients was produced for all of the measured analytes in the sediments, including toxic response. Stepwise regression analysis identified a list of analytes that may have predictive value (see Table 4-76).

The analytes in the left hand column are those that showed up in the stepwise regression analysis of each of the subsets evaluated. The second column lists the correlation between the average concentration of the analyte(s) in the bulk sediment and the toxicity observed for that sediment in *M. beryllina*. The remaining columns list the correlation of the material after its concentration had been normalized to the percent fine particles in the sample, the percent organic carbon in the sample, and if an appropriate metal, after normalization by the AVS present in the sample. With a sample size of nine sample sites, a correlation coefficient greater than 0.632 is statistically significant at the 0.05 level. Only one material has a statistically significant zero order correlation coefficient; benzo(a)pyrene.

Subjecting the data matrix to stepwise regression resulted in the identification of four predictors: lead, iron, chrysene, and silver. Restricting the requirements for the significance level required to be chosen as a predictor resulted in the omission of silver. Conversely the liberalization of the requirements did not add any new predictors to the regression. The multiple regression of these four predictors was significant ($p=0.0004$) as were three of the four partial regression coefficients, all but that for silver. The omission of silver did not effect the significance of the regression (p=0.0003). All of the partial regression coefficients were significant.

Colinearity, the inter-correlation between predictor variables, was evident in the silverside data matrix as it was for the amphipod bioassessment. The correlation matrix was slightly different. Even though some of the same variables were selected for the assessment, they were not always from the same category for normalization. For example, lead was selected for the amphipod toxicity evaluation and here for the silversides. The variable, however, was raw lead concentrations for the amphipod assessment and acid volatile sulfide normalized for the silverside assessment. Thus, lead's inter-correlation with other variables is different.

Of the base predictors selected by the stepwise procedure, lead and iron are significantly colinear with an r value of 0.800. Both of these metals are colinear with the percent organic carbon (-0.717) and the AVS concentration (-0.967). Both metals were normalized by the AVS concentration which surely influenced the correlation. Chrysene is correlated with benzo(k)fluorene (r=0.717) and indenopyrene (r=0.850). Silver is inversely correlated with acenaphthalene (-0.688), benzo(k)fluorene (r=0.705), and benzo(a)pyrene (-0.722). The correlation between lead and iron is the probable root of the high colinearity of the initial multiple regressions.

Given the distribution of predictive ability and the base variables as provided by the stepwise regression analysis, combinations of variables, avoiding obvious colinearity problems, were assessed for their predictive ability. The overall significance of the multiple regression, the significance of the partial regression coefficients as well as colinearity were evaluated in addition to the predictive ability for each of the multiple regressions performed.

4.5.8.5 Statistical Summary - *Menidia beryllina* Results

None of the additional multiple regressions evaluated were better than the one selected by the stepwise procedure (lead, iron, chrysene, and silver). This regression was accurate (less than 10% error) only in sample sites SD-3, -4, -6, and -7. Samples sites SD-1 and SD-2 were best predicted by AVS alone (sample SD-1; 6.3% error) and AVS plus lead (sample SD-2; 3.3% error). Sample SD-5 was best predicted by the combination of lead, chrysene, silver, and butyl benzyl phthalate (5.0% error). The toxicity observed in sample SD-8 was best predicted by the combination of lead, chrysene, silver, and AVS (2.5% error). None of the combinations of variables were able to predict the observed toxicity in sample site SD-9.

Attempts to incorporate benzo(a)pyrene, the only significant zero order correlation coefficient, into the multiple regressions resulted in either non-significant partial regression coefficient, or poor predictive ability.

The most pertinent analytes appear to be lead, chrysene, silver, AVS, butyl benzyl phthalate, and perhaps iron.

4.6 FINFISH AND SHELLFISH TISSUE ANALYSES

4.6.1 Results

The analytical results of the finfish and shellfish tissues collected in Eastchester Bay during August, 1992 are presented in this section. The samples were collected from three general areas in the Bay: from the area adjacent to the southern seawall, adjacent to the eastern seawall, and adjacent to the rock jetty at Weir Creek (the "reference" station). Details on the method of capture and processing of the tissue samples are discussed in Section 2.6.3. Attempts were made to collect a sufficient amount of tissue to provide five replicate analyses for each target species at each location. Thirty-one finfish samples and 50 shellfish samples were analyzed for cadmium, lead, mercury, PCBs, pesticides, percent moisture, and percent lipids.

The mean concentrations of analytes detected in the finfish and shellfish tissues are presented in Tables 4-77 and 4-78. Metal concentrations are reported as mg/kg wet weight, and PCBs and pesticides are reported in μg/kg wet weight. Only analytes which were detected in at least one of the replicates from one of the sample locations are listed in these tables. Shaded cells in these tables represent analytes which were reported as not detected by the laboratory. Mean concentration values were calculated using only detected values. The number of detected values used to calculate the mean is presented in parentheses next to the mean value. These data are also presented graphically in Figures 4-41 through 4-45. The analytical data for the individual replicates are presented in Appendix X, Tables X-1 through X-6.

Means of the replicate tissue were statistically analyzed as follows: the data were tested for normality/log normality using the W-test (Gilbert, 1987), if the data from both the landfill locations and the reference location were either normally distributed or lognormally distributed, the data were examined using a two sample T-test. If the data were non-normally distributed, the non-parametric Wilcoxon test with adjustment for ties was used on the rankings of the data. In this analysis, non-detected parameters were used (as 1/2 the detection limit) in order to provide sufficient statistical power to draw meaningful conclusions. If the non-detected results were ignored, in many cases there would not be enough data to make statistically defensible conclusions.

4.6.1.1 Finfish

The total of 31 finfish samples were composed of the following target species: 15 samples of whole body Atlantic silverside, 2 samples of tautog (skinless fillet), 2 samples of American eel (beheaded and eviscerated), and 12 samples of flounder (skinless fillets).

Flounder

Of the 12 samples of flounder fillet tissue nine were of summer flounder and three were winter flounder. All five replicates collected from the eastern seawall were of summer flounder. The southern seawall samples were made up of two replicates of summer flounder and three replicates of winter flounder. Only two replicates of flounder were captured at the reference location, both were summer flounder. All replicate samples of flounder, except one replicate of winter flounder from the southern seawall (WF-S5), were made up of the fillet tissue from one fish. The flounder used for analysis were all adult fish, ranging in size from 20.3 cm to 47.5 cm total length (TL). Based on their size, the flounder used were approximately three to five years old. Since both species of flounder are known to migrate, the origin of the analytes detected in their muscle tissue is uncertain.

Cadmium was detected in only one replicate of winter flounder, at a concentration of 0.21 mg/kg. This fish was collected off the southern seawall.

Mean lead concentrations in flounder collected near the landfill ranged from 0.04 mg/kg to 0.09 mg/kg, from the eastern and southern seawalls, respectively. Each mean was calculated using two detected values, with both detected values from the southern seawall being from winter flounder. Lead was detected in one of the two summer flounder from the reference location, at a concentration of 0.5 mg/kg. There were not enough data to draw statistically meaningful conclusions in comparing the east and south seawall lead concentration data to that of the reference station.

Mercury was detected in each of the 12 flounder replicates analyzed. The highest mean value (0.08 mg/kg) was from the two summer flounder collected at the reference location. The summer flounder from the eastern seawall were quite similar, with an average of 0.07 mg/kg mercury. The mean mercury concentration in flounder from the southern seawall was 0.04 mg/kg, but this value combines both winter and summer flounder. Mercury concentrations in the three replicates of winter flounder from the southern seawall ranged from 0.02 to 0.04 mg/kg, with an average of 0.03 ± 0.01 mg/kg. The remaining two replicates of summer flounder contained 0.06 mg/kg and 0.07 mg/kg of mercury (average of 0.065 mg/kg). From this very limited data set it appears that the summer flounder contained slightly higher concentrations of mercury than winter flounder.

None of the seven PCB congeners for which the samples were analyzed (Aroclor-1016, -1221, -1232, -1242, -1248, -1254, or -1260) were detected in any flounder replicate.

Two pesticides were detected in flounder fillets. The compound 4,4'- DDE was detected in two of the five replicates collected from the southern seawall, with a mean of 21 μg/kg. This mean was calculated using the results from one winter and one summer flounder. The other pesticide, alpha - Chlordane, was detected in one of the three replicates of winter flounder from the southern seawall, at a concentration of 13 μg/kg. It should be noted that this value was "J" flagged (i.e., is an estimated value). No pesticides were detected in flounder collected at the reference station.

Tautog

Four tautog of sufficient size to be used in the analyses of their fillet tissue were captured, two from the eastern and two from the southern seawall. No tautog were captured at the reference location. Since the fish were not very large (size range of 15.5 cm - 18.0 cm TL), the fillets from the two fish from each location were composited to provide one fillet sample per location.

The tautog fillet tissue collected from the southern seawall contained 0.04 mg/kg cadmium and 0.02 mg/kg lead. These metals were not detected in the composite fillet sample collected from the eastern seawall.

Mercury was detected in both samples at concentrations of 0.04 mg/kg at the eastern seawall and 0.05 mg/kg at the southern seawall.

No PCBs or pesticides were detected in the tautog fillet tissues.

American Eel

Only two American eels were captured during the two week fish collection effort. Both of these were captured off of the southern seawall on August 21, 1992. Both eels were adults, and measured 59.1 cm and 70 cm TL. Each eel provided enough tissue for one replicate sample.

The concentration of lead detected in the eels ranged from 0.16 mg/kg to 0.24 mg/kg, with the mean being 0.20 (± 0.06) mg/kg.

The mean concentration of mercury was 0.07 (± 0.01) mg/kg.

PCB Aroclor-1254 was detected in both eel samples, and ranged from 330 μg/kg to 340 μg/kg. PCB Aroclor-1260 was detected in only one of the eels, at a concentration of 190 μg/kg.

The pesticides dieldrin and endrin were detected in both of the eel samples. Dieldrin ranged from 21 μg/kg to 44 μg/kg (mean of 33 ± 16.3 μg/kg), and endrin had a mean concentration of 31 ± 3.5 μg/kg.

Atlantic Silverside

Five replicate samples of Atlantic silverside were analyzed from each of the three locations. Since Atlantic silverside are relatively small fish (overall size range captured was 3.0 cm - 12.2 cm TL), the number of individuals used to comprise each replicate ranged from 41 to 100.

Cadmium was not detected in any of the 15 replicates analyzed, while both lead and mercury were detected in every replicate.

The mean concentration of lead in Atlantic silverside collected from the reference station was 0.11 (± 0.02) mg/kg. In contrast, the mean lead concentration in Atlantic silverside collected at the northern portion of the eastern seawall was 0.28 ± 0.08 mg/kg. This is statistically higher (p=0.05) than at the reference station. The mean lead concentration in silverside collected near the western portion of the southern seawall (near leachate seeps L-1 and L-3) was 0.21 (± 0.14) mg/kg. Athough this is almost twice the level found at the reference station, statistical significance could not be documented due to non-equal variances. The samples from the southern seawall ranged from 0.11 mg/kg to 0.40 mg/kg of lead.

The mean concentration of mercury in Atlantic silversides was similar at the eastern seawall and reference station (0.03 mg/kg). However, the mean mercury concentration at the southern seawall, 0.05 ug/kg, was statistically higher (p=0.05) than the mean mercury concentration at the reference station.

PCB Aroclor-1248 was detected in Atlantic silverside only in samples collected off of the eastern seawall, but in all five replicates. The mean concentration of this PCB was 154 (±11.4) μg/kg. Since the silversides from the reference station did not contain any PCB-1248, this mean concentration is significantly higher. PCB Aroclor-1254 was detected in four replicates from the reference location (mean concentration of 240 (± 28.3 μg/kg), and in only one replicate from the southern seawall (300 μg/kg). This does not represent a significant difference from the reference location.

The pesticide 4,4'-DDE was detected in all replicate samples. The mean concentrations were 27 (±4.6) μg/kg, 51 (± 3.5)μg/kg, and 45 (± 7.1) μg/kg for silversides collected from the reference station, eastern, and southern seawalls, respectively. The concentrations of 4,4'-DDE in silversides collected at both of the landfill locations are statistically (p=0.05) greater than that of the reference station. The pesticide beta-BHC was detected in only one replicate sample from the reference location, at a concentration of 12 μg/kg.

4.6.1.2 Shellfish

The fifty shellfish samples were made up by the following: fifteen samples of the hard clam *Mercenaria mercenaria (*five replicate samples at each location), twenty samples of the blue mussel *Mytilus edulis* (five replicate samples at each location, with two locations on the eastern seawall), and fifteen samples of the blue crab *Callinectes sapidus* (a crustacean) (five replicates from each location).

<u>Blue Crab</u>

Although the blue crab was not listed as a target species in the revised ecology work plan, muscle tissue from these organisms were submitted for analyses due to public concern. The crabs used for analyses ranged from 10.2 cm to 18.6 cm in size (measured across the widest part of the carapace, i.e. "point to point"). All replicate samples analyzed from the eastern and southern seawalls were made up of a composite of the muscle tissue from two male crabs, as were three of the five replicate samples collected from the reference location. Of the other two reference location samples, one (CS-RS3) was a composite of muscle tissue from four male crabs, and the other (CS-RS5) was a composite of the muscle tissue from three male and two female crabs.

Cadmium was detected in one of the five replicates at the reference location, at a concentration of 0.02 mg/kg. This concentration was flagged with a "B" qualifier, meaning that this value was between the Contract Required Detection Limit (CRDL) and the Instrument Detection Limit (IDL). This metal was also detected in each of the five replicate samples from the eastern and southern seawalls. Their mean cadmium concentrations were 0.06 (± 0.03) mg/kg and 0.04 (± 0.01) mg/kg respectively. These concentrations are statistically significantly higher than that of the reference station. The range of cadmium concentrations in southern seawall blue crab was narrow (0.03 mg/kg to 0.05 mg/kg), and each concentration was "B" qualified. The range of eastern seawall cadmium concentrations was wider (0.02 to 0.11 mg/kg), and only the 0.11 mg/kg concentration (from replicate CS-E5) was not flagged with a "B".

The mean lead concentration detected in four of the five replicates from both the reference station and the southern seawall was 0.03 mg/kg. Each of the lead concentrations in all replicates from these two locations were "B" qualified. The mean lead concentration in crabs collected from the area adjacent to the eastern seawall was 0.05 (± 0.03) mg/kg. Three of the five samples were "B" qualified. The data were not sufficient to determine any statistical signficiance in lead at the eastern seawall.

Mercury was detected in all replicates at each location. None of the individual replicate concentrations were qualified. The mean mercury concentrations for the reference station, eastern, and southern seawall blue crabs were 0.09 (± 0.02) mg/kg, 0.07 (± 0.03) mg/kg, and 0.10 (± 0.05) mg/kg, respectively. There was no statistically significant difference in mean mercury concentrations between the sampling locations.

No PCBs or pesticides were detected in any of the 15 blue crab samples.

Hardclam

Five replicate samples of hardclam tissue were analyzed from each of the three sample locations. The soft tissues of from three to seven clams were composited in each replicate to provide sufficient tissue for all analyses.

Cadmium was detected in all 15 replicate clam tissue samples. The mean cadmium concentration at the reference location was 0.48 mg/kg, (range of 0.32 mg/kg to 0.74 mg/kg). The mean concentration of cadmium in eastern seawall clams was 0.35 (± 0.05) mg/kg, and for southern seawall clams it was 0.41 (± 0.13) mg/kg. The mean cadmium concentrations in hard clams collected adjacent to the landfill seawall were statistically similar to those from the reference station.

Lead was detected in every hardclam replicate analyzed. The mean concentrations of lead at the eastern and southern seawalls were quite similar, being 1.3 mg/kg and 1.2 mg/kg, respectively. The standard deviation for both of these means was ± 0.33 mg/kg. The mean for the reference location was 2.2 mg/kg, with the individual replicate concentrations ranging from 1.4 mg/kg to 2.7 mg/kg. The mean lead concentration in hardclams collected at both locations at the landfill was significantly lower than the mean concentration from the reference location.

Mercury was also detected in every replicate analyzed. The mean concentration in hard clams collected adjacent to the eastern seawall was 0.02 (± 0.01) mg/kg, and at the southern seawall the mean was 0.03 (± 0.02) mg/kg. The mean concentration of mercury in clams from the reference location was 0.05 (± 0.01) mg/kg. The mean concentration of mercury at the eastern seawall location was significantly lower than at the reference location, while at the southern seawall location it was not significantly different from the reference location.

No PCBs were detected in any of the hard clam tissue samples, but two pesticides were detected in clams collected from the eastern seawall. Endosulfan I was detected in one replicate, at 19 μg/kg. Beta-BHC was detected in four of the five replicates from this location, with the mean concentration being 15 (± 1) μg/kg. Since neither Endosulfan I nor beta-BHC were detected in hardclams at the reference location, these concentrations represent a significantly higher level than that at the reference location.

Blue Mussel

A total of twenty replicate samples of blue mussel soft tissue were analyzed. These consisted of five replicates each from the reference location and the southern seawall, and ten replicates (five replicates from two locations) collected from the eastern seawall. Sample locations along the landfill seawall reflect areas of known or suspected leachate seeps. Eastern seawall Site-1 is the northern most of the two eastern seawall mussel sampling locations, and is adjacent to a bundle of about five metal pipes which open at the face of the seawall, and are only visible at low tide. Eastern seawall Site-2 is south of Site-1, and is adjacent to an approximately 5-ft diameter concrete pipe which is partially covered by the huge rocks which make up the seawall (Figure 4-45).

The soft tissues from between 12 and 28 blue mussels were composited to provide a sufficient quantity of tissue for each of the replicate analyses.

The metals cadmium, lead, and mercury were detected in every blue mussel replicate sample. The mean concentration of cadmium in mussels from the reference location was 0.40 (± 0.05) mg/kg. The mean concentration of cadmium from the southern seawall mussels was 0.43 (± 0.05) mg/kg. Mean cadmium at eastern seawall Site-1 was 0.47 (±0.10) mg/kg, while at Site-2 it was 0.67 (±0.05) mg/kg. Cadmium levels in blue mussels collected adjacent to the eastern seawall site-1 and southern seawall locations were not significantly different from those at the reference location, but eastern seawall Site-2 cadmium concentrations were significantly higher than that of the reference location.

Mean lead concentrations were highest in mussel tissue collected from the eastern seawall. Mean lead concentrations at Site-1 were 2.6 mg/kg, and were 4.1 mg/kg at Site-2. The mean lead concentrations in mussels from the southern seawall was 1.8 mg/kg, while that from the reference location was 1.4 mg/kg. The mean lead concentrations in all mussels collected from the landfill seawall were significantly higher than the mean lead concentration at the reference location.

Mercury was detected over a narrow range (0.03 mg/kg to 0.06 mg/kg) in all replicates. Therefore, the mean mercury concentrations were 0.03 mg/kg at the eastern seawall Site-1 and southern seawall, and 0.04 mg/kg at the reference location and at eastern seawall Site-2.

The only PCB detected in blue mussel tissue was Aroclor-1254. It was detected in all of the replicates from eastern seawall Site-1, and in four of the five replicates collected from eastern seawall Site-2. The mean concentration at Site-1 was 260 μg/kg, and at Site-2 the mean was 210 μg/kg. These levels are significantly different from the reference station, where PCBs were not detected.

A total of six pesticides were detected in blue mussel tissues. The compound 4,4'-DDT was only detected in one replicate from the reference location (18 μg/kg). This represents the only pesticide detected in reference station mussels. The samples collected from the eastern seawall Site-1 contained five pesticides; 4,4'-DDD had a mean concentration of 23 μg/kg, the mean concentration of 4,4'-DDE was 20 μg/kg, endosulfan I was detected in only one replicate, at 9.7 μg/kg, alpha-chlordane was found in all five replicates, with a mean of 12 μg/kg, and beta-BHC was found in four of the five replicates at a mean concentration of 13 μg/kg. The samples from eastern seawall Site-2 contained a mean of 25 μg/kg of 4,4'-DDD (mean of three detects), while alpha-chlordane and beta-BHC were each detected in only one replicate, at concentrations of 13 μg/kg and 11 μg/kg, respectively.

4.6.2 Comparison to Other Data

For comparing the biota tissue data collected from Eastchester Bay to other tissue data, several sources of information were used. The preferred comparison would be to the same species collected from Eastchester Bay. Unfortunately, few data exist which describe concentrations of contaminants from Eastchester Bay fauna. The NYSDEC has collected tissues from Eastchester Bay blue crabs (leg muscle collected in 1982, cadmium and mercury analyses, mean concentration of 12 samples), hard clams (collected in 1982, 1987, and 1988, cadmium, lead, mercury concentrations, mean of five, one, and three samples, respectively), and one analysis (composite of four fish) of winter flounder collected at City Island (mercury, chlordane). These data were obtained from a memo from Karen Chytalo (NYSDEC, Marine Resources) to Gordon Colvin (March 5, 1992). The NYSDC data are reported in Tables 4-77 and 4-78, and have been deemed acceptable and valid by NYSDEC (Chytalo, 1993). While other limited data on chemical residues in tautog, blue crab, and hard clam have been collected in Eastchester Bay by NYSDEC (memo to Cyril Moore, Norman Nosenchuck and Gordon Colvin, from Edward G. Horn and Lawrence C. Skinner, NYSDEC, dated March 8, 1984), these data have not been used for comparison due to questions raised about the validity of the data (memo from Edward G. Horn to Cyril Moore, Jr. dated March 27, 1984).

Given the scarcity of Eastchester Bay biota tissue data, other sources of data were consulted. These included Greig and Wenzloff (1977) (cadmium, lead, mercury in Long Island Sound winter flounder), Greig and Sennefelder (1985) (cadmium in blue mussels collected from the Connecticut shoreline of Long Island Sound), NOAA (1989) (total PCBs, total DDT, cadmium, lead, and mercury in blue mussel tissues from three Long Island Sound "mussel watch" stations), and Squibb, et al. (1991) (a compilation and review of data for toxic substances generated in many previous studies of the NY/NJ Harbor Estuary, which includes a review of contaminant residues in various species of fish and shellfish).

The NYSDEC data for biota collected from Eastchester Bay are given as wet weight values, but several of the other studies (NOAA, and many of the studies listed in Squibb, et.al., 1991) give their tissue residue concentrations on a dry weight basis. Therefore, in order to make a more direct comparison to these studies, some of the WCCI data were converted to a dry weight basis using the following formula:

$$\left(\frac{100}{(100 - \%\ \text{moisture})}\right) (\text{wet weight concentration}) = \text{dry weight concentration}$$

Since the analytical methodologies and sample preparation techniques employed on much of the data culled from the literature are not fully described, these data may not be directly comparable, but they can be used in a general way to examine if the biota collected near the landfill in 1992 are generally similar to (or different from) the same species collected from other nearby urban estuarine environments. As such the dry weight concentrations converted from the wet weights reported by Hazelton Laboratory are not shown in the tables, but are only mentioned in the text. The dry weight concentrations can be calculated using the above formula and the individual replicate biota data presented in Appendix X.

4.6.2.1 Finfish

Flounder

The only data found on tissue residue analysis of flounder were for winter flounder. PCB residue was reported only for the winter flounder collected by NYSDEC near the landfill at City Island (date of collection unknown). NYSDEC reported a value of 110 μg/kg (wet weight) for one analysis of a composite of fillets from four fish. No PCB's were detected in winter or summer flounder fillets collected near the landfill.

The pesticide DDT was also reported by NYSDEC in the City Island composite winter flounder sample, at 30 μg/kg (wet weight). The NYSDEC (1987, cited in Squibb et al., 1991) also collected samples of winter flounder from the NY Harbor area (Hudson River, Upper and Lower NY Bays, Arthur Kill, Jamaica Bay, East River) between 1980-1985. The total DDT (DDT plus DDD plus DDE) found in winter flounder fillets collected from this area ranged from 10 μg/kg to 80 μg/kg (wet weight). Mc Leod (1981, cited in Squibb et al., 1991) reported that winter flounder muscle collected from Raritan Bay, Hudson River and Lower NY Bay contained between < 46-80 μg/kg (dry weight) of total DDT. Of the three samples of winter flounder collected from Eastchester Bay in 1992, only one sample contained detectable levels of one of the pesticides, 4,4'-DDE, at a concentration of 24 μg/kg wet weight (93 μg/kg dry weight). This value is similar to that reported in the literature.

The pesticide chlordane was also reported in winter flounder in the three studies cited above. The NYSDEC City Island sample contained 30 μg/kg (wet weight), while the NY Harbor samples ranged from 10-80 μg/kg (alpha and gamma chlordane combined). The McLeod data cited in Squibb, et al. (1991) gave only one concentration for chlordane of 40 μg/kg (dry weight). Only one winter flounder sample (out of three) collected at the southern seawall contained any chlordane (as alpha-chlordane), at a concentration of 13 μg/kg wet weight (an estimated value, i.e, "J" flagged). This is lower than the City Island value, but when converted to dry weight (60 μg/kg), appears to be higher than the McLeod data.

Mercury was reported as < 0.10 mg/kg (wet weight) by NYSDEC in the sample of winter flounder collected at City Island, while winter flounder from the NY harbor area collected by NYSDEC ranged from <0.10 -0.22 mg/kg total mercury. Samples of winter flounder muscle collected from western Long Island Sound (mean of duplicate determinations on composite samples) contained 0.07 mg/kg mercury (wet weight) (Reid et.al. 1982, cited in Ebasco, 1986). Mercury was detected in all three replicates of winter flounder collected in Eastchester Bay, all of which were below 0.10 mg/kg (range of 0.02 to 0.04 mg/kg).

Greig and Wenzloff (1977) analyzed two samples of a composite of muscle tissue from 10 winter flounder for nine metals, including cadmium and lead, from eastern and central LIS. Cadmium was below detection in both of these samples (<0.1 mg/kg wet weight). Reid et.al. (1982, cited in Ebasco 1986) reported cadmium in winter flounder muscle tissue from western and eastern Long Island Sound as below detection (<0.7 and <0.09 mg/kg, respectively). O'Connor and Moese (1984) reported a range of <0.02 - 0.34 mg/kg (dry weight) cadmium in winter flounder muscle tissue collected throughout NY harbor (Hudson River, Upper and Lower NY Bays, Newark Bay, Arthur Kill, Raritan Bay) in 1982 (data from Squibb, et al. 1991). Cadmium was detected in only one winter flounder at the landfill, at 0.21 mg/kg. This equates to a concentration of 0.98 mg/kg on a dry weight basis, which seems high compared to the data of O'Connor and Moese.

Lead was not detected in the winter flounder muscle reported by Greig and Wenzloff (1977) for either western or central Long Island Sound (<0.8 mg/kg wet weight for each), nor was it detected in the Reid et.al. study, for western and eastern LIS (<0.6 and <0.15 mg/kg wet weight, respectively). Lead was detected in two of the three samples of winter flounder collected at the landfill, at 0.14 and 0.04 mg/kg (wet weight).

Tautog

Tissue residue analyses of tautog fillets were conducted by NYSDEC (1987) on tautog collected from the waters of NY Harbor during 1980-1985 (seen in Squibb, et al. 1991). Total mercury ranged from 0.13-0.16 mg/kg (wet weight). The tautog fillets analyzed from the eastern seawall contained 0.04 mg/kg of mercury, and the sample collected from the southern seawall contained 0.05 mg/kg of total mercury. These data are not directly comparable to the NYSDEC data since the fillets were skinned prior to analysis.

Brownawell et.al. (1991) cites a Connecticut DEP study done in 1985 which reported concentrations of total PCB's in tautog fillets (with skins on) ranging from 0.05 to 0.70 mg/kg (wet weight). No PCB's were detected in Eastchester Bay skinless tautog fillets.

American Eel

Cadmium levels ranged from 0.01 mg/kg to 0.5 mg/kg in American eels collected from the Hudson, Hackensack, Passaic, and Raritan Rivers and Raritan Bay (Ellis et.al. 1980, in Squibb et.al. 1991). Cadmium was not detected in either of the two eels collected adjacent to the southern seawall.

Four studies giving results for mercury in American eel tissues are described in Squibb et. al. (1991). Three of these studies present data from the Hackensack River and its tributaries, where there are several known sources of mercury contamination. The other study was done by NYSDEC (1987), and gives a range of 0.30 - 1.37 mg/kg mercury (wet weight) in eels collected around NY Harbor. The Hackensack River mercury data range from 0.01 mg/kg to 2.10 mg/kg wet weight (Ellis, *et al.*, 1980, in Squibb, et al. 1991). Mercury was detected in both replicates of Eastchester Bay eels, at 0.08 and 0.06 mg/kg wet weight. These values are well below the lowest value given for NY Harbor eels.

The NYSDEC (1987) study also given results for tissue levels of the pesticides dieldrin and endrin in American and collected between 1980-1985. Dieldrin ranged from 10 μg/kg to 80 μg/kg, and endrin from <10 μg/kg to 10 μg/kg (wet weight). The mean concentration (of two samples) of dieldrin in American eels collected adjacent to the south seawall was 33 μg/kg, and for endrin, 31 μg/kg. While the mean dieldrin concentration appears low, and the endrin value for the Eastchester Bay sample seems high, although these data are not directly comparable since the Eastchester Bay samples were not skinned.

Squibb et.al. (1991) provides the following data on total PCB concentrations in American eels: NYSDEC (1981) gives a range of 83-2569 μg/kg in eels collected during 1978-1981 from the Hudson and Harlem Rivers, and Jones Beach. NYSDEC (1987) gives a range of 95-2459 μg/kg total PCBs in eels collected from 15 locations throughout the NY Harbor, and Hauge et.al. (1990) reported a range of 65-4810 μg/kg total PCBs for eels collected throughout NY Harbor during 1986-1987. Two PCBs were found in one of the Eastchester Bay eel samples (PCB-1254 and -1260), for a total PCB concentration of 520 μg/kg. The other eel sample contained 340 μg/kg of PCB-1254. These values are well within the range for PCBs found in American eels with the NY Harbor region.

Atlantic Silverside

The only data found on Atlantic silverside tissue residue analysis was an analysis of total mercury in silverside muscle tissue collected from the tributaries of the Hackensack River, which are known to have high levels of mercury (Sabounjian and Galluzi, 1980, in Squibb et.al. 1991). A value of 0.572 mg/kg of total mercury was reported, but it is unclear from the Squibb report is this represents a mean value, one analysis of a composite of many fish, or the analysis of a single fish. The mean mercury concentrations for whole body Atlantic Silversides collected adjacent to the eastern and southern seawalls were 0.03 and 0.05 mg/kg, respectively.

4.6.2.2 Shellfish

Blue Crab

Limited historical data on blue crab muscle tissue exist for crabs collected from Eastchester Bay. The mean concentration of cadmium for 12 samples of blue crab leg muscle were reported by NYSDEC as 0.17 mg/kg (wet weight). NYSDEC (1987, cited in Squibb, et al. 1991) reported a range of 0.05 mg/kg to 1.06 mg/kg cadmium in blue crab muscle tissue collected during 1981 from the Hudson and East Rivers, and Jamaica and Lower NY Bays. O'Connor and Moese (1984, in Squibb, *et al.*, 1991) gave a range of <0.02-1.41 mg/kg (dry weight basis) for blue cravb muscle collected from the NY Harbor area. For comparison, the mean cadmium concentrations in blue muscle tissues collected adjacent to the landfill contained 0.06 mg/kg and 0.04 mg/kg cadmium, from the eastern and southern seawall, respectively. For comparison with the data of O'Connor and Moese, the individual replicate values were converted to dry weights, with the mean dry weight concentrations being 0.31 mg/kg for the eastern seawall and 0.20 mg/kg for the southern seawall. The mean values for cadmium in blue crab muscle tissues collected in 1992 are lower than those collected in Eastchester Bay by NYSDEC, and at the low end of the range given for NY Harbor blue crabs by NYSDEC.

The mean mercury concentration of blue crab leg muscle collected by NYSDEC in 1982 from Eastchester Bay was 0.07 mg/kg wet weight (mean of 12 samples). Other data on blue crab muscle tissue listed in Squibb et al. (1991) are mainly from New Jersey rivers and/or bays. Ellis et al. (1980, cited in Squibb et al. 1991) reported a range of 0.01-0.25 mg/kg wet weight in blue crab muscle tissue collected from the Hudson, Hackensack, Passaic and Raritan Rivers between 1978-1979. The widest range of mercury values (<0.02 mg/kg to 1.55 mg/kg) was reported in blue crab muscle tissue collected in Berry's Creek, which has several known sources of mercury, by the Hackensack Meadowlands Development Commission (HMDC, 1986). The mean mercury concentrations in blue crab muscle tissue collected adjacent to the eastern seawall was 0.07 (±0.03) mg/kg, and 0.10 (±0.05) mg/kg from the southern seawall. These values are similar to that reported by NYDEC for blue crabs from Eastchester Bay, and are close to the middle of the ranges reported in the literature.

Hardclam

The NYSDEC collected hardclams for tissue analyses from Eastchester Bay in 1982 (five samples), 1987 (one sample), and 1988 (three samples). Analytes in common between the NYSDEC and WCCI tissue analyses were cadmium, lead, mercury, and PCBs (which were not detected in either sampling program). Other tissue data on these three metals were extracted from Squibb et al. 1991. The NYSDEC reported mean cadmium concentrations of 0.13 mg/kg, 0.17 mg/kg, and 0.18 mg/kg in soft tissues of hardclam collected in 1982, 1987, and 1988, respectively. Unpublished data on cadmium in hardclams collected by the New Jersey Department of Environmental Protection (NJDEP) (in Squibb et al. 1991) from the waters of Raritan/Sandy Hook Bays and the Navesink and Shrewsbury Rivers ranged from 0.15 mg/kg to 0.82 mg/kg wet weight. Franz and Harris (1984, in Squibb et al. 1991) reported cadmium ranging from <0.1 mg/kg to 4.8 mg/kg (on a dry weight basis) in hardclams collected from 27 locations in Jamacia Bay during 1981-1982.

Mean cadmium concentrations in Eastchester Bay hardclam tissue samples collected by WCCI were 0.35 mg/kg, 0.41 mg/kg and 0.48 mg/kg (wet weight) for the eastern and southern seawall, and reference location, respectively. These concentrations are between 2.6 to 3.7 times higher than those reported by NYSDEC for Eastchester Bay hardclams. The WCCI cadmium results fall near the middle of the range of the NJDEP data, but these clams were collected from NJ waters. For comparison to the cadmium range reported by Franz and Harris, the WCCI data were converted into dry weights. The range in cadmium on a dry weight basis is 1.42 mg/kg to 3.19 mg/kg, with both values from samples collected at the reference station. The mean cadmium concentrations on a dry weight basis are 1.54, 1.85 and 2.22 mg/kg from the eastern seawall, southern seawall, and reference station, respectively.

The mean concentrations of lead determined by NYSDEC in Eastchester Bay clams were 0.34 mg/kg, 0.57 mg/kg, and 0.51 mg/kg for the 1982, 1987 and 1988 samples, respectively. The unpublished NJDEPE data range from 0.10 mg/kg to 2.8 mg/kg, and Franz and Harris give a range of 0.44 mg/kg to 23 mg/kg (dry weight) of lead in hardclam tissues. The mean concentrations of lead in the 1992 collections of Eastchester Bay hardclams were 1.3, 1.2, and 2.2 mg/kg (wet weights) for the eastern seawall, southern seawall and reference station, respectively. The range of concentrations was 0.8 mg/kg (southern and eastern seawall) - 2.7 mg/kg (reference location). All of the WCCI lead values are higher than those measured by NYSDEC. The WCCI lead concentrations fall approximately in the middle of the range reported by Franz and Harris, after conversion to a dry weight basis. The mean lead concentrations on a day weight basis are 5.8, 5.4, and 10 mg/kg in eastern seawall, southern seawall and reference location samples, respectively, and ranged from 3.4-12.9 mg/kg (dry weight).

Total mercury concentration in hardclams collected by NYSDEC in Eastchester Bay are only available for the 1987 and 1988 samples. The one sample from 1987 was <0.025 mg/kg and the mean of three samples collected in 1988 was 0.06 mg/kg. The NJDEP unpublished mercury data given in Squibb et al. range from 0.01-0.17 mg/kg, and unpublished NYSDEC data (also in Squibb et al. 1991) range from below detection to 0.15 mg/kg in hardclams collected from Raritan Bay, the East River, and Jamaica Bay during 1987-1988. The concentrations of mercury in WCCI collected hardclams ranged from 0.02-0.06 mg/kg, which are less than or equal to the NYSDEC Eastchester Bay sample, and are in the low to middle area of the other reported ranges.

Blue Mussel

The data on blue mussels collected in Long Island Sound which were examined for comparison with the data collected by WCCI included: Greig and Sennefelder (1985) for cadmium, and NOAA (1989) for total PCBs, total DDT, cadmium, lead and mercury. Since all of the NOAA data are given as dry weights, the WCCI data for these analytes were converted to dry weights to facilitate the comparison.

Greig and Sennefelder (1985) collected blue mussels from the mouths of rivers and inshore areas along the Connecticut coast of Long Island Sound. They reported a range of cadmium concentrations between 0.41 mg/kg to 5.1 mg/kg (wet weight). All concentrations, with the exception of the 5.1 mg/kg value from a sample collected at Bridgeport, CT, (i.e. 0.41 mg/kg to 1.3 mg/kg) were considered "low". The range of wet weight concentrations found in the Eastchester Bay blue mussels ranged from 0.32 mg/kg (reference station) to 0.73 mg/kg (eastern seawall Site-2). These values fit the Greig and Sennefelder definition of "low" concentrations of cadmium. As part of the National Status and Trends program, NOAA (1989) has collected three years of tissue data on PAHs, PCBs, chlorinated pesticides and 12 trace elements in blue mussels at 132 sites from estuarine and coastal United States locations (i.e. "Mussel Watch Project"). NOAA (1989) presents the mean concentrations determined in three composite samples collected at each site in 1986, 1987 and 1988. Each composite consisted of tissues from 30 blue mussels. NOAA data from the three Long Island Sound stations closest to the landfill were used in comparing the Eastchester Bay blue mussel data. These were the Long Island Sound stations LITN (Throgs Neck), LIHH (Hempstead Harbor), and LIMR (Mamaroneck). The Throgs Neck station is approximately four miles south of the landfill, and probably represents the most comparable blue mussel tissue data.

The mean cadmium concentrations detected in Eastchester Bay blue mussels ranged from 1.3 mg/kg at the reference station (dry weight) to 2.7 mg/kg (dry weight) at the eastern seawall site-2. These mean concentrations are within the range of cadmium concentrations determined over three years by NOAA at LITN (2.3 mg/kg to 4.6 mg/kg dry weight), LIHH (2.6 mg/kg to 3.7 mg/kg) and LIMR (2.1 mg/kg to 3.4 mg/kg), and therefore likely represent ambient conditions.

Mean lead concentrations in blue mussels ranged from 4.5 mg/kg (dry weight) at the reference location to 16.3 mg/kg (dry weight) at the eastern seawall site-2. A mean of 11.1 mg/kg lead was detected at eastern seawall Site-1. With the exception of the 16.3 mg/kg mean concentration, these values are within the range NOAA reported for LITN (5.5 mg/kg to 14.0 mg/kg) but are all outside the highest mean reported at LIHH (3.8 mg/kg, from 1987). The mean lead concentrations reported by NOAA for LIMR (3.0 mg/kg to 5.1 mg/kg) is also exceeded by that detected in blue mussels collected from the landfill seawalls.

Mean concentrations of mercury detected in blue mussels from Eastchester Bay ranged from 0.13 mg/kg (dry weight) at both the eastern seawall Site-1 and the southern seawall, to 0.15 mg/kg (dry weight) at the reference location. The Eastchester Bay samples are similar to those from LITN (range of 0.11 mg/kg to 0.16 mg/kg dry weight), but are higher than the other two LIS stations as the range for LIHH was 0.057 mg/kg to 0.11 mg/kg and for LIMR it was 0.063 mg/kg to 0.074 mg/kg (dry weights).

The only PCB detected in the Eastchester Bay mussels was PCB Aroclor-1254 which was only detected in the samples collected from the two eastern seawall locations. The mean concentrations of PCB Aroclor-1254 were 827 μg/kg at eastern seawall Site-2 and 1,099 μg/kg (dry weights) at site-1. These concentrations are just below the range for total PCBs at LITN (1,100 μg/kg to 1,400 μg/kg), within the range at LIHH (420 μg/kg to 1,200 μg/kg), and the 1,099 μg/kg value is slightly higher than the 300 μg/kg to 950 μg/kg concentrations determined for LIMR. It would appear that the PCBs detected in blue mussels in Eastchester Bay are similar to those detected in other nearby areas of Long Island Sound.

NOAA (1989) reports mean concentrations of total DDT, which is a combination of all six forms of DDT and its metabolites. Only three forms were detected in the Eastchester Bay blue mussel tissues, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT. Only at eastern seawall site-1 were more than one of the DDT forms detected in the same samples (4,4'-DDD and 4,4'-DDE). In this case, the concentrations of these two forms on a dry weight basis were added to obtain a single concentration for comparison to the NOAA data. At eastern seawall Site-1, the mean concentration of the sum of DDD and DDE is 179 μg/kg (dry weight basis). At eastern seawall Site-2 only 4,4'-DDD was detected, at a mean concentration of 98 μg/kg. None of the DDT or its forms were detected in mussels collected from the southern seawall. The pesticide 4,4'-DDT was detected in only one replicate from the reference location, at 62 μg/kg (dry weight). These concentrations of DDT's are similar to that reported by NOAA, which ranged from 140 μg/kg to 280 μg/kg at LITN, 73 μg/kg to 210 μg/kg at LIHH, and 120 μg/kg to 150 μg/kg at LIMR, and likely represent ambient levels of this pesticide group in blue mussel tissues collected from Eastchester Bay.

Similar to the DDT's, the mean concentrations of chlordane reported by NOAA (1989) are the sums of the concentrations of alpha-chlordane, trans-nonachlor, heptachlor, and heptachlor epoxide. The only type of chlordane detected in blue mussel tissues collected from the landfill was alpha-chlordane. This pesticide was detected in all five replicate samples from eastern seawall Site-1 (mean of 51.5 μg/kg dry weight), and in only one replicate (49 μg/kg dry weight) from eastern seawall Site-2. It was not detected at the southern seawall or the reference location. The mean concentrations of alpha-chlordane are at the lower end of the ranges determined at the three LIS stations sampled by NOAA (68 μg/kg to 100 μg/kg for LITN, 40 μg/kg to 170 μg/kg for LIHH, and 58 μg/kg to 91 μg/kg for LIMR). This suggests that the levels of alpha-chlordane in Eastchester Bay blue mussels represent ambient conditions, rather than landfill impacts.

4.6.3 Comparison to FDA Fish Tissue Standards

The biota tissue data were compared to the Food and Drug Administration (FDA) fish tissue standards. The FDA currently has fish tissue standards for 5 toxic substances: PCBs (2.0 mg/kg), mercury (1.0 mg/kg), chlordane (0.3 mg/kg), dieldrin (0.3 mg/kg), and total DDTs (5.0 mg/kg).

The highest concentration of total PCBs was detected in American eel captured off of the southern seawall, with a concentration of 0.52 mg/kg. This concentration is well below the FDA standard for PCBs. PCBs were detected in 22 out of 81 samples.

The highest concentration of mercury was detected in a blue crab sample collected off of the southern seawall, with a concentration of 0.19 mg/kg. This concentration is below the FDA standard for mercury. Mercury was detected in all 81 biota tissue samples.

The highest concentration of chlordane was detected in a blue mussel sample collected from the eastern seawall Site-1, with a concentration of 0.019 mg/kg of alpha-chlordane. This concentration is well below the FDA standard for chlordane. Alpha-chlordane was detected in 7 of the 81 biota tissue samples.

Dieldrin was only detected in 2 of the 81 biota tissue samples. Both detections were in the American eel collected at the southern seawall. The maximum concentration of dieldrin was 0.014 mg/kg, which is well below the FDA dieldrin standard.

The highest concentration of DDTs was detected in a blue mussel sample collected from the eastern seawall Site-1. The total of 4,4'-DDD and 4,4'-DDE in this sample was 0.051 mg/kg. This concentration is well below the FDA standard for total DDT. DDTs were dected in 30 out of the 81 biota tissue samples.

4.7 AIR QUALITY

4.7.1 Results

Perimeter Soil Gas Evaluation

The results of the perimeter soil gas survey are summarized in Table 4-79. Of the seven soil gas survey points, only three stations (SG92-3, SG92-4, and SG92-5) had methane emissions that exceeded background levels. The percent oxygen at these points dropped to below background levels in response to the increased levels of methane. Hydrogen sulfide readings did not exceed background levels at any survey point. Soil gas measurements made off site (stations SG92-6 and SG92-7) showed that only background levels of methane and hydrogen sulfide occurred in these areas.

The three stations with the high methane levels are located in the northeast area of the site (Figure 2-14), the same area that showed relatively high methane levels during the 1989-1991 site investigation.

Soil Gas Sampling

The soil gas sampling program identified the rate at which various compounds are released from the landfill surface. The soil gas samples represent maximum emission rates from the landfill surface during strong solar heating conditions. Samples were obtained over an 8-hour period to provide a daytime average emission rate. The results of the soil gas sampling program are summarized in Table 4-80, which identifies the soil gas emission rate by sampling location for each of the detected contaminants. For those contaminants that were not detected in the soil gas samples, the level of detection is provided in Appendix U, Table U-2.

The soil gas emissions were analyzed for a list of 50 VOCs and SVOs and three select inorganics: ammonia, hydrogen sulfide and hydrogen cyanide. Ammonia was only detected in the sample taken over the leachate seep along the northwest slope of the landfill. Hydrogen sulfide was only detected at one location in an outwash area along the southern slope of the landfill where the landfill cover had been eroded and fissures in the landfill surface were visible. Hydrogen cyanide was not detected at any of the soil gas sampling locations. Of the 50 VOC/SVOs analyzed, 28 compounds were detected in the soil gas samples. The majority of these compounds consist of standard solvent materials and refrigerants.

Ambient Air Quality Monitoring

In general, during the 10-day ambient air monitoring program metal compounds were only found in trace amounts and PAHs were never detected in both the on-site and off-site particulate ambient air samples. The level of detection of PAHs is provided in Appendix U, Table U-18. No inorganics were detected at any of the off-site ambient air monitoring locations. The NYSDEC PM_{10} data collected during the month of July, 1992 from their regional air monitoring network were not available for inclusion in this report at this time to compare to WCCI's monitoring results. In addition, the NYSDEC has performed previous monitoring studies prior to 1989 to establish background concentrations of metals in the ambient air; however, these data were based on total suspended particulate data, not particulates < 10 microns (PM_{10}) and could not be accurately compared to the PM_{10} data measured by WCCI.

Average PM_{10} and metals concentrations for eight on-site and eight off-site locations are presented in Table 4-81. The average concentrations are presented for each day of the 5-day sampling program for both on-site and off-site locations. The individual sample concentrations for each location by date are provided in Appendix U, Tables U-13 through U-17. A comparison of on-site and off-site concentrations indicates that off-site concentrations are about the same or slightly higher than on-site concentrations. A comparison of the individual metals shows the same result. This suggests that the source of particulates and metals are regional, and are not from the landfill.

Twenty-eight VOC/SVOs detected at least once in the landfill soil gas emissions were used as the initial target list of chemicals to be evaluated in the ambient air quality analyses. Ambient metals concentrations were excluded from the list because on-site and off-site concentrations were approximately equal, indicating no significant off-site contribution from the landfill. Also excluded were PAH and inorganic compounds because they were not detected.

The off-site monitoring data for the 28 target chemicals have been summarized in Tables 4-82 through 4-88. These tables list the maximum and average contaminant concentrations by date and location, including a summary over the entire 10-day monitoring period. The individual sample concentrations for each location by date are provided in Appendix U, Tables U-3 through U-12.

The maximum concentration for each contaminant measured in the off-site air samples over the 10-day monitoring program is listed in Table 4-82. For the sampling event where the maximum concentrations were recorded, the monitoring location, date, average wind speed and direction have been included in the summary table. The average wind speed and direction data have been broken out into two periods: 1) a 10-hour summary during the daytime period corresponding to peak solar heating hours, and 2) a 24-hour period to correspond with the period over which the VOC samples were collected. The 10-hour average may be more appropriate in the evaluation of off-site impacts associated with the landfill, since peak emissions would occur during periods of solar heating on high solar heating days.

A review of the average wind direction recorded during each sampling event showed that the location of the maximum off-site contaminant concentrations was downwind of the landfill in several cases, but not consistently. The majority of the maximum contaminant concentrations were recorded on July 14, 1992 (Table 4-82 and 4-85). During this sampling event, there were high winds with a predominant west-southwest component and unstable atmospheric conditions resulting in significant thermal mixing. For the majority of the target chemicals, the maximum concentrations on July 14, 1992 were found at locations upwind and crosswind from the landfill. If there was a strong correlation between the landfill soil gas emission rates and off-site impacts, we would expect to see the maximum concentration for the majority of the target chemicals at Site AM-3. A review of the locations of the highest maximum and the highest average concentrations over the entire 10-day monitoring period, as shown in Table 4-83 and 4-84, shows no general relationship between the predominant downwind location and the highest concentration for the contaminants emitted from the landfill surface.

The maximum and average contaminant concentrations summarized by location and date are presented in Tables 4-83 through 4-86. As shown in these summary tables, in many instances the maximum concentration of one target chemical was found at a different location than the maximum concentration of another target chemical, although each of the compounds were found in the landfill emissions. Maximum concentrations of various target chemicals were also recorded at both upwind and downwind locations during the same sampling event. In addition, many compounds emitted from the landfill were never detected off site.

A review of the frequency of detection of each of the target chemicals by date and location is provided in Tables 4-87 and 4-88. This information indicates that the majority of the compounds were detected across the entire monitoring network, not just at the downwind monitoring locations. This further suggests that there are regional air emission sources other than the landfill that have a significant contribution to the ambient air quality. In addition, the frequency of detection of each compound at each site was not consistent, and many of the target chemicals emitted from the landfill were never detected off site.

Based on the soil gas monitoring results, methane is emitted at levels 1,000 to 10,000 times higher than the next highest target chemical emitted from the landfill (Table 4-80). Because the landfill appears to be a significant source of methane, methane should be a good tracer of the landfill soil gas emissions. Based on the monitoring data results for Day 1 (July 14, 1992), when the majority of the maximum off-site target chemical concentrations were recorded, the maximum off-site methane concentration was the second <u>lowest</u> methane concentration recorded during the entire 10-day monitoring program (see Table 4-85 and 4-86).

Note that for all of the ambient air quality results described above 1,1,1 trichloroethane results are considered invalid. Concentrations of 1,1,1 trichloroethane from the ambient air monitoring program were several orders of magnitude higher than expected, based on data from another New York metropolitan site.

The laboratory which preformed the volatile organics analysis, Air Toxics Limited, suspected newly manufactured flow controllers used for the sampling may have been contaminated with 1,1,1 trichloroethane from the manufacturing process. Therefore, Air Toxics Limited performed an equipment blank analysis on a newly manufactured flow controller. The results for the equipment blank analysis indicated 1,1,1 trichloroethane contamination. The contamination occurred because the manufacturer of the flow controllers did not follow standard operating procedure for TO-14 applications, per agreement between the laboratory, its supplier, and the manufacturer.

A review of the laboratory's shipment records indicated that 15 flow controller units shipped for use in the off-site ambient air monitoring program at Pelham Bay were newly manufactured units from the manufacturer and had never been cleaned and certified by the laboratory.

Shipment records also indicate that four flow controllers used for the EIFC program were not newly manufactured units from the manufacturer but old, cleaned units, off the shelf of the laboratory, and therefore not contaminated.

4.7.2 Analysis of Results

The Decision Process Applied to the Analysis of Outdoor Air Data

This section describes the overall decision process applied to the analysis of the outdoor air data. A flow diagram of the decision process is shown in Figure 4-46. Basic to this process is the distinction between on-site measurements of landfill emissions and off-site measurements of ambient air. As can be seen from the diagram, the starting point of the decision process is a list of chemicals that could be detected using the EIFC (Emission Isolation Flux Chamber) in conjunction with the specific sampling methodology. (The sampling methodology is described in Section 2.7: Air Quality/Soil Gas Characterization) The list of chemicals analyzed based on the sampling methodology, consisted of 51 VOCs and SVOs and three select inorganics: ammonia, hydrogen sulfide and hydrogen cyanide. All chemicals that were analyzed are listed in the first column of Table 4-89. Although all of these chemicals had the potential of being emitted from the landfill (Section 2.7), not all were present in detectable quantities.

As is indicated by Figure 4-46, only chemicals that were detected both on-site and off-site were analyzed in further detail. The steps of this detailed analysis are represented by rectangles along the main vertical axis of the decision diagram in Figure 4-46. The branches that are to the right and left of the vertical axis represent situations for which no further analysis of data was conducted. These situations and the chemicals associated with them were identified, but no further analysis was conducted since the focus of this study is the landfill, not regional air quality. The cases and chemicals for which no further analysis was conducted are shown in the second, third and fourth columns of Table 4-89. Chemicals not detected on site (second and third columns of Table 4-89) were not analyzed further, even though they may have been detected off site, because they did not originate from the landfill. The chemicals identified in the fourth column were detected on site, but not off site, and, therefore, were not analyzed further. The compounds corresponding to those listed in columns two through four are presented in Tables 4-90, 4-91, and 4-92, respectively, along with their level of detection, if applicable, as shown in the decision diagram.

The chemicals that were detected both on site and off site are listed in the last two columns of Table 4-89. The chemicals in the next to last column had designated guideline concentrations, as published in NYSDEC Air Guide 1, 1991 Edition. [According to Air Guide 1, Short-term Guideline Concentrations (SGC) are developed to protect the health or environment from effects which may be associated with acute short-term exposures to the contaminant]. Chemicals in the last column did not have designated guideline concentrations. As can be seen by comparing the two columns, most chemicals had SGC values defined by NYSDEC. The four chemicals which did not have defined guideline concentrations were Freon 12, 1,4-dichlorobenzene, cumene, and methane. The remainder of this analysis of air data focuses on the chemicals listed in the last two columns of Table 4-89.

Soil Gas

Because the number of soil gas sampling locations were limited to seven on-site locations, the emissions data set was not equivalent to the EPA requirements for 95% confidence. However, the locations selected for conducting the soil gas sampling were based on a walk-over grid survey to identify locations where maximum soil gas emissions occur. Therefore, the average measured emission rate for each of the target chemicals (chemicals listed in the last two columns of Table 4-89) should provide a conservative estimate of the soil gas emission rate for the entire landfill surface.

At two locations on the landfill, methane emissions were below the limit of detection. These locations were excluded in calculating the average methane emissions from the landfill. A location over the leachate drainage channel was not used in the emission average and neither was a grass covered location at the top of the landfill

Ambient Air

From a preliminary review of the off-site ambient monitoring results, as presented in the tables above, no clear relationship between the on-site and off-site monitoring results can be established, indicating that there are other off-site sources contributing to the measured concentrations. Therefore, in order to determine whether there is any relationship between the on-site measured emission rates and the off-site ambient measurements for the target chemicals, a more detailed evaluation of the data was performed.

The initial step included an evaluation of interrelationships between the target chemicals measured at each site. This was performed by developing a concentration profile and comparing the profiles between sites. In addition to concentration profiles, an independent statistical analysis of the data was also conducted. A discussion of the Concentration Profiles is presented below, and the Statistical Analysis of Ambient Air Data is presented in Appendix XX.

Concentration Profiles - Preliminary Analysis of Data

The profiles are shown in Tables 4-93 and 4-94. From a review of the profiles for both the on-site flux data and the off-site monitoring locations (Day 1, July 14, 1992), only one clear relationship emerges: the methane concentrations, both on site and off site, dwarf the concentrations of all other chemicals. There are no clear relationships that can be established between landfill emissions and off-site air contaminants. The on-site data shows significant variability from location to location on the landfill; therefore, no relationship between on-site and off-site measurements can be determined using this approach. Comparing the concentrations among the off-site locations also shows no relationship, which indicates that there is no one local source contributing to the measured contaminant concentrations.

4.8 INDOOR AIR QUALITY

4.8.1 Results

An indoor air quality study was performed by WCCI on July 15, 1992 at the request of the SAC. This was a cursory study in which air samples were collected at three homes within a nearby residential community. The purpose of the study was designed to identify the presence or absence of certain air toxics selected by the SAC within local residential homes. Detectable concentrations of air toxics found within the homes that were tested were reported to the NYCDEP. The NYCDEP and NYSDEC in concert with the NYSDOH informed the homeowners of the indoor air sampling results. Their report concluded that the low levels of VOCs detected were typical of findings from other studies of indoor residential air quality. Note that the indoor and outdoor air results for 1,1,1-trichloroethane at Pelham Bay during the July 1992 monitoring program were inaccurate because of contaminated flow controllers (Section 4.7.1). Subsequent outdoor air sampling conducted on January 20, 1993 by WCCI, NYSDEC, and NYSDOH confirmed that the original results were inaccurate.

In part, the jurisdiction for indoor air sampling was based on postulated routes of migration of contaminants from the landfill into the homes. Two postulated routes of migration included the groundwater and surface water pathway. There routes were discounted for the following reasons:

- there is no hydraulic connection in the groundwater between the landfill and the homes based on the groundwater flow directions measured during the RI
- there is no hydraulic connection between the homes and the surface water based on low chloride concentrations in the basement water samples

In addition, methane measured in the homes is consistent with the fact that the homes are built on fill which is over an alluvial deposit that likely generates methane.

4.9 POTABLE WATER

In the fall of 1992 the Drinking Water Quality Control Unit, at the request of the Hazardous Materials Division of NYCDEP, collected potable water samples at 53 residences in the Pelham Bay area. All of the samples were tested for the 23 Target Analyte List metals, cyanide, temperature, turbidity, fluoride, chloride residual, nitrate, odor, color, specific conductivity, pH, sulphate, chloride, and coliform bacteria. In addition, 12 of these samples were analyzed for Target Compound List VOCs, SVOs, pesticides and PCBs. The results of these analyses are summarized below:

- all but two parameters were either not detected or detected at levels below the Maximum Contaminant Level established by the USEPA and NYSDOH (Principe, 1992)
- the Maximum Contaminant Level for lead was exceeded in eleven samples
- the Maximum Contaminant Level for copper was exceeded in one sample

Based on these results, it was concluded that the lead and copper exceedances were probably attributable to lead service lines, lead and copper piping, and lead-soldered copper piping (Principe, 1992).

4.10 COMMUNITY SAMPLES

4.10.1 Results

The results from the analysis of the water collected in the basements of the Hogan and Catalano homes are summarized on Tables 4-95 through 4-99. Tables 4-95 and 4-96 show no VOCs or SVOs detected in the validated data. Low detections of pesticides (Table 4-97) are in both the Catalano and Hogan samples. Only Endosulfan sulfate and Heptachlor epoxide (less than 1 μg/L) are detected in the three Hogan samples. The Catalano sample contained less than 1 μg/L levels of seven pesticide compounds.

The inorganic results (Table 4-98) show detections of arsenic, barium, calcium, copper, iron, lead, magnesium, manganese, potassium, and sodium in both the Hogan and Catalano samples. Aluminum, vanadium, and zinc were also detected in the Hogan samples.

Ammonia-N was only detected in the Catalano sample at 50 μg/L. Chloride levels in the four basement water samples ranged from 56 mg/L to 67 mg/L, sulfate from 31.4 mg/L to 40 mg/L, nitrate from 3.68 mg/L to 5.48 mg/L, and TDS from 424 mg/L to 510 mg/L.

The only metals detected in the basement water samples that exceeded NYSDEC groundwater standards are iron, lead, sodium, and manganese in the Hogan samples and sodium in the Catalano sample.

4.11 SUMMARY OF FINDINGS - NATURE AND EXTENT OF CONTAMINATION

4.11.1 Summary of Findings - Soil Contamination

Three sets of soil samples were collected from the site and from areas around the site. Samples were collected from on-site and off-site soil borings, from on-site and off-site air monitoring stations, and from the former community garden on site. A total of forty- four soil samples were collected and submitted for laboratory analyses. The analytical results of samples collected from boring SB-124 were used to provide a reference standard for the other samples.

Volatile Organic Compounds

Detectable levels of VOCs ranged from 1 μg/kg to about 3,700 μg/kg. The highest level occurred in a sample collected from the on-site boring SB-119S2. The compound 2-propanone (acetone) was the principle VOC in most samples. Sample SB-125S1 was the only off-site sample with detectable levels of VOCs (11 μg/kg).

Semi-volatile Organic Compounds

SVOs were detected in nearly all soil samples at concentrations ranging from 45 μg/kg (SB-120S2) to 227,300 μg/kg (SB-118S2). Sample SB-124S2, the deep reference sample, was the only sample that did not contain detectable levels of targeted SVOs. PAHs were the most common type of SVO compound detected in the samples.

Off-site SVO levels ranged from 1,518 μg/kg (SS-H4) to 74,860 μg/kg (SS-H1).

Pesticides and PCBs

Pesticides were detected in nearly all soil samples. Total pesticide concentrations ranged from about 1 μg/kg (SB-124S1) to nearly 2,700 μg/kg (SB-123S1).

Pesticides were detected in nearly all off-site samples, with concentrations ranging from about 1 μg/kg (SB-124S1) to 1,751 μg/kg (SS-H6).

PCBs were detected in eight soil borings, two on-site air monitoring locations, and in all the garden samples. PCB levels ranged from about 53 μg/kg (SB-GAR5) to 1,100 μg/kg (SS-GAR1).

PCBs were detected in one off-site sample (SB-123S1, 430 μg/kg).

Inorganics

Because inorganic analytes are ubiquitous in soil due to natural or anthropomorphic processes, this summary focuses on five analytes that potentially pose the greatest risk to human health and the environment. They are arsenic, chromium, cyanide, lead, and mercury.

Arsenic was detected in every soil sample. The concentrations ranged from 0.42 mg/kg (SB-122S2) to 29.1 mg/kg (SS-H8). Off-site arsenic concentrations ranged from 1.4 mg/kg to 29.1 mg/kg. The reference concentration for arsenic is 4.4 mg/kg.

Chromium was detected in every soil sample. The concentrations ranged from 8.7 mg/kg (SS-A) to 150 mg/kg (SS-H6). Off-site chromium concentrations ranged from 10.4 mg/kg (SS-H3) to 150 mg/kg (SS-H6). The reference concentration for chromium is 31.4 mg/kg.

Cyanide was not detected in any of the soil samples.

Lead was detected in every soil sample (excluding six rejected lead results). The concentrations ranged from 2.1 mg/kg (SB-122S2) to 1,350 mg/kg (SS-H8). Off-site lead concentrations ranged from 24.75 mg/kg (SB-124S2) to 1,350 mg/kg (SS-H8). The reference concentration for lead is 200 mg/kg.

Mercury was detected in most of the samples. The detected concentrations ranged from 0.11 mg/kg (SB-PZ3BS1) to 1.3 mg/kg (SS-GAR1 and SB-122S2). Off-site mercury concentrations ranged from non-detect to 0.58 mg/kg (SB-123S2). The reference concentration for mercury is 0.39 mg/kg.

4.11.2 Summary of Findings - Groundwater/Leachate Contamination

The monitoring well and seep samples collected during the RI have adequately characterized the nature and extent of contamination of the groundwater beneath the Pelham Bay Landfill. A summary of the important findings is as follows:

- VOCs are present in 32 out of 40 monitoring wells and 6 out of 8 seep samples. Acetone, benzene, chlorobenzene, ethylbenzene, toluene, and xylenes were the most frequently detected compounds

- The highest concentrations of aromatic hydrocarbons were detected in MW-116B and the highest concentrations of acetone were detected in MW-119B and -121B. Each of these wells are in the bedrock

- SVOs were infrequently detected in the well and seep samples. With the exception of samples from MW-105, MW-126, and LS-1, and LS-9 where PAHs, phenols, and phthalates were found at the highest concentrations, other samples contained very low SVO concentrations

- SVOs were only found in two bedrock well samples at total concentrations of 8 μg/L and 10 μg/L

- Pesticides were detected in many of the well and seep samples, however, their concentrations were mostly below 1.0 μg/L

- PCB compounds (Aroclor-1016 and -1260) were only found in MW-105 and LS-2 at 1.0 μg/l or less

- Metals were detected in all well and seep samples
- Constituent levels in many of the shallow monitoring wells are similar to what is found in the seep samples. VOCs are generally lower in concentration in the seep samples, and metals are higher in some seep samples
- The MW-126 sample contained the highest concentrations of mercury, arsenic, lead, cadmium, barium, chromium, vanadium, cobalt, and potassium. Sample MW-118B had the highest concentrations of aluminum, calcium, copper, magnesium, and manganese
- Cyanide was only detected in five monitoring well samples and one seep sample
- Chloride was found in all samples from 11 mg/L to 13,560 mg/L
- Sulfate, ammonia-N, and nitrate were detected in most of the well and all of the seep samples
- Shallow groundwater samples in the fill wells and seeps generally contain higher levels of constituents than the till wells
- Samples collected during the RI are very similar in the compounds detected and the concentrations of these compounds when compared to the same samples collected during the Phase I investigation
- The comparison of well and seep sample results to NYSDEC groundwater standards shows exceedances for VOCs, SVOs, and pesticides, however, the majority of the exceedances found are for metals and TDS, ammonia, chloride, and sulfate
- The comparison of well and seep sample results to draft effluent limits for surface water discharges showed exceedances for benzene, toluene, xylenes, naphthalenes, cyanide, aluminum, copper, chromium, iron, lead, manganese, barium, vanadium, zinc, ammonia, and hexavalent chromium

- Comparison of monitoring well sample results to background or upgradient wells shows that for other than iron, manganese, magnesium, sodium, chloride, and chromium; constituents detected in the shallow groundwater samples above NYSDEC standards are likely due to the landfill

- Constituents detected in the bedrock wells that are indicative of the landfill are found in all directions from the site center where a hydraulic connection exists

- Chloride concentrations in seven of the shallow and bedrock wells are indicative of saltwater intrusion

- Wells along the Eastchester Bay perimeter are generally similar in ionic distribution to seawater

- Upgradient wells and wells along the western site perimeter are indicative of non-saline (fresh) groundwater

- The community basement water sample chloride results are indicative of fresh groundwater

4.11.3 Summary of Findings - Surface Water Contamination

- NYSDEC Surface Water Criteria were exceeded for the three metals nickel (two samples locations), lead (two sample locations) and mercury (four sample locations) in the landfill vicinity samples

- One PAH (pyrene) was detected in one landfill vicinity sample and two phthalates were detected in three of the sixteen landfill vicinity samples. No SVOs were detected in the reference location samples (SW-9H and SW-9L)

- Three pesticides were detected in one or more of the landfill vicinity samples but not detected in the reference location samples

- The concentrations of metals found in the landfill vicinity samples were generally similar to the concentrations found in the reference location samples

- The detected total metal concentrations of copper (two detects), lead (six detects), mercury (four detects) and nickel (three detects) found in the landfill vicinity samples were all higher than the total recoverable metal concentrations of these four metals reported by Battelle (1991 and 1992a) for three western Long Island Sound sample locations. Battelle analyzed for total recoverable metals whereas the Eastchester Bay samples were analyzed for total metals. A less rigorous digestion process in the total recoverable metals analytical method may result in lower reported concentrations of metals than the total metals analytical method.

4.11.4 Summary of Findings - Sediment Contamination

Chemical Data

- The draft NYSDEC sediment cleanup criteria for human health residue basis for the six PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k) fluoranthene, chrysene, and indeno(1,2,3-c,d)pyrene were exceeded at all sample locations including the reference location (SD-9) and the beach sample locations (SD-10 and SD-11). The mean concentrations of these six PAHs for all landfill vicinity bay samples (SD-1 through SD-8) and the reference location (SD-9) exceeded the criteria values by more than an order of magnitude. The draft NYSDEC sediment cleanup criteria for aquatic toxicity basis for the PAH phenanthrene was exceeded at one landfill vicinity sample location (SD-6)

- The draft NYSDEC sediment cleanup criteria for wildlife residue basis for the pesticides 4,4'-DDD and 4,4'-DDT were exceeded at the landfill vicinity sample locations where these analytes were detected. The draft NYSDEC sediment cleanup criteria for human health residue basis for the pesticides 4,4'-DDE and dieldrin were exceeded at the landfill vicinity sample locations where these analytes were detected

- The lowest effect level draft criteria was exceeded for at least seven metals at all bay sample locations including the reference location. The severe effect level draft criteria was exceeded for copper at all bay sample locations including the reference location and for chromium at three bay sample locations including the reference location

- The bulk sediment concentrations of metals for the nine bay sample locations were found to be positively significantly correlated to percent fines (< 63 um diameter) and were normalized to percent fines. Based on the results of comparing the normalized metal concentrations from the eight landfill vicinity sample locations (SD-1 through SD-8) to the reference location (SD-9) none of the sample locations in the vicinity of the landfill were considerably different than the reference location with respect to the normalized concentrations of the selected metals

- The bulk sediment metal concentrations for data collected by NOAA (1991) for three western Long Island Sound sample locations were also normalized to percent fines and compared to the Eastchester Bay reference sample location (SD-9). These normalized concentrations were also generally similar to the Eastchester Bay normalized metal concentrations

- The bulk sediment concentrations of semi-volatile organic compounds (SVOs) for the nine bay sample locations were found to be positively significantly correlated to percent organic carbon and were normalized to percent organic carbon. Based on the results of comparing the normalized SVO concentrations from the eight landfill vicinity sample locations to the reference location none of the sample locations in the vicinity of the landfill were considerably different than the reference location with respect to the normalized concentrations of SVOs

- The bulk sediment PAH concentrations for data collected by NOAA (1991) for three western Long Island Sound sample locations were also normalized to percent organic carbon and compared to the Eastchester Bay reference sample location (SD-9). These normalized concentrations were generally less than the Eastchester Bay normalized PAH concentrations

- One pesticide was detected in sediment samples collected from the reference location (SD-9) while between one and four pesticides were detected in samples collected from the vicinity of the landfill

- The concentrations of the five pesticides that were analyzed for by NOAA (1991) for three western Long Island Sound sample locations were all lower than the concentrations of these pesticides detected in the landfill vicinity samples

- One volatile organic compound was detected in sediment samples collected at three landfill vicinity sample locations

Toxicity Testing

Certain analytes appear as potential causes of toxicity in both bioassessments, lead, silver, and AVS. Mercury, zinc and anthracene seem particular to the *A. abdita* bioassessment while chrysene, butyl benzyl phthalate appear in the *M. beryllina* assessment. These analytes are predictive of the bioassessment results and potential causes of the observed toxicity. Certain samples were not predicted accurately by the analytes measured. These include samples SD-1 and SD-5 for the *A. abdita* and SD-9 for the *M. beryllina*. The reasons behind this lack of prediction include a missing variable or variables or experimental error in the bioassessment so that the analyte values don't correlate with the chemical data.

4.1.1.5 Summary of Findings - Air/Soil Gas Contamination

The following represents a summary of the major findings of the air quality/soil gas characterization of the Pelham Bay Landfill:

- Methane is the predominant gas being emitted, as is the case with most landfills of this age.

- VOCs are emitted by the landfill. Some of these compounds are known air toxics and are regulated. Emissions of these compounds are small compared to methane.

- The landfill is a heterogeneous source of emissions.

- For 19 of the 20 non-methane compounds emitted from the landfill, short-term modeling indicates that the emissions of these compounds account for less than 25% of that compound's concentration measured in the community.

Most of these compounds from the landfill account for less than 5% of the concentrations measured in the community.

- Short-term modeling indicates that predicted methane concentrations from the landfill emissions could account for about 95% of the methane concentrations measured in the community.

- The results of short-term modeling for methane and other compounds within the surrounding community are summarized by the following table:

	% of Emissions from Landfill	% of Emissions from Other Sources
Methane	95%	5%
VOCs	0% - 25%	75% - 100%

- Long-term modeling predicts annual average concentrations within the surrounding community which are less than 1% of the New York State AGCs for most VOCs. The predicted concentration for benzene is about 25% of the AGC.

- Based on a statistical analysis of the ambient air quality data, it is likely that methane measured at off-site locations originates from the landfill. Landfill emissions cannot account for all other chemicals measured off site.

- Short-term and long-term modeling predicts on-site concentrations of air constituents which are well below the New York State SGCs and AGCs, respectively.

4.13 REFERENCES

American Public Health Association. 1989. American Water Works Association and the Water Pollution Control Federation. Standard Methods for the Examination of Water and Wastewater 17th Ed., American Public Health Association, Washington, DC.

Battelle Ocean Sciences. 1991. Evaluation of Trace-Metal Levels in Ambient Waters and Discharges to New York/New Jersey Harbor for Waste Load Allocation - Final Data Report. Report to USEPA Office of Wetlands, Oceans, and Watersheds, and Region II. Battelle Ocean Services, Duxbury, MA.

Battelle Ocean Sciences. 1992a. Evaluation of Trace-Metals New York/New Jersey Harbor Ambient Waters, Tributaries, and Discharges During Low-Flow Conditions for Waste Load Allocation - Data Report to NYCDEP. Battelle Ocean Services, Duxbury, MA.

Battelle Ocean Sciences. 1992b. Sediment Toxicity and Concentrations of Trace-Metals in Sediment and Porewater in New York/New Jersey Harbor. Report to NYCDEP. Battelle Ocean Services, Duxbury, MA.

Brownawell, B.J., N.S. Fisher and L. Naeher. 1991. Characterization of Data Base on Toxic Chemical Contamination in Long Island Sound. Marine Sciences Research Center, State University of New York, January 31, Stony Brook, NY.

Brown, W., and M. Hollander. 1977. Methods for censored data. Chapter 13 in Statistics: A Biomedical Introduction. J. Wiley & Sons, New York, NY pp 341-361.

Chytalo, K. 1993. Personal Communication with A. Brett Bragin, WWCI.

DiToro, D.M., J. Mahony, D. Hansen, K. Scott, M. Hicks, S. Mayr, and M. Redmound. 1990. Toxicity of Cadmium in Sediments: The Role of Acid Volatile Sulfide. Environ. Toxicol. Chem. 9:1487-1502.

Ebasco, 1986. Sound Cable Project, Estuarine Ecology Report, Final Report. Prepared for the New York Power Authority.

Ellis, R.H., S.J. Koepp, J. Weiss, E.D. Santoro, and S.L. Cheng. 1980. A Comprehensive Monitoring and Assessment Program for Selected Heavy Metals in New Jersey Aquatic Fauna. Final Report to the New Jersey Department of Environmental Protection, Trenton, N.J., pp. 166, in Squibb *et al.*, 1991.

Franz, D.R. and W.H. Harris. 1984. Benthos Study Jamaica Bay Wildlife Refuge Gateway National Recreation Area Brooklyn, N.Y. Final Report to Gateway Institute for Natural Resource Sciences, GATE-N-022-III, National Park Service, in Squibb *et al.*, 1991.

Freeze, A.R. and A.J. Cherry. 1979. Groundwater. Englewood Cliffs, NJ: Prentice-Hall.

Giesy, J.P. & R.A. Hoke. 1990. Freshwater Sediment Water Quality Criteria: Toxicity Bioassessment, in Sediments: Chemistry and Toxicity of In-Place Sediments. R. Baudo & J. Giesy Ed.s, Lewis Publishers, Chelsea, MI, pp 265-348.

Gilbert, R. O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold. New York, New York.

Goldberg, E.D. 1963. Chemistry - The Oceans as a Chemical System, in H.M. Hill, Composition of Sea Water, Comparative and Descriptive Oceanography, Vol. 2 of The Sea. Wiley Interscience, New York, pp. 3-25.

Greig, R.A., and G. Sennefelden. 1985. Metals and PCB Concentrations in Mussels from Long Island Sound. Bull. Environ. Contam. Toxicol. 35:331-334.

Greig, R.A. and D.R. Wenzloff. 1977. Trace Metals in Finfish from the New York Bight and Long Island Sound. Mar. Poll. Bull. Vol. 8, No. 9.

Hauge, P., J. Bukowsk, P. Morton, M. Boriek, J. McClain, and G. Casey. 1990. Polychlorinated Biphenyls (PCBs), Chlordane, and DDTs In Selected Fish and Shellfish From New Jersey Waters, 1986-1987: Results From New Jersey's Toxics In Biota Monitoring Program. New Jersey Department of Environmental Protection. May, in Squibb *et al.*, 1991.

Loring, D.H. 1991. Normalization of Heavy-Metal Data from Estuarine and Coastal Sediments. ICES J. Mar. Sci., 48:101-115.

MacLeod, W.D. Jr., L.S. Ramos, A.J. Friedman, D.G. Burrows, P.G. Prohaska, D.L. Fisher, and D.W. Brown. 1981. Analysis of Residual Chlorinated Hydrocarbons, Aromatic Hydrocarbons and Related Compounds in Selected Sources, Sinks, and

Biota; of the New York Bight. NOAA Technical Memorandum OMPA-6, in Squibb *et al.*, 1991.

National Oceanic and Atmospheric Administration (NOAA). 1989. National Status and Trench Program for Marine Environmental Quality, Progress Report, A Summary of Data on Tissue Contamination from the First Three Years (1986-1988) of the Mussel Watch Project Technical Memorandum NOS OMA 49.

National Oceanic and Atmospheric Administration (NOAA). 1991. Second Summary of Data on Chemical Contaminants in Sediments from the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 59. Rockville, Maryland.

New York State Department of Environmental Conservation. 1981. Toxic Substances in Fish and Wildlife: May 1 to November 1, 1981. Vol. 4, No. 2. DEC Publication Technical Report 82-1 (BEP), in Squibb *et al.*, 1991.

New York State Department of Environmental Conservation. 1987. Toxic Substances in Fish and Wildlife Analyses Since May 1, 1982, Vol. 6. DEC Publication Technical Report 87-4 (BEP), in Squibb *et al.*, 1991.

New York State Department of Environmental Conservation. 1992b. Technical and Administrative Guidance Memorandum: Determination of Soil Clean-up Objectives and Clean-up Levels - HWR-92-4046, November 16.

O'Connor, J.M. 1984. Polycyclic Aromatic Hydrocarbons and Metals in Organisms From New York Harbor and Adjacent Waters. Final Report to the American Petroleum Institute, Washington, DC. February, in Squibb *et al.*, 1991.

Principe, M. 1992. Letter from NYCDEP to the Honorable John C. Dearie, New York State Assembly, November, 2 pp.

Reid, R.N., J.E. O'Reilly, and V.S. Zdanowicz,(eds.). 1982. Contaminants in New York Bight and Long Island Sound Sediments and Demersal Species, and Contaminant Effects on Benthol, summer 1980. U.S. Natl. Mar. Fish Serv. Woods Hold, MA., in Ebasco, 1986.

Sabounjian, E.E. and P.F. Galluzzi. 1980. Mercury Concentrations in Fish and Aquatic Invertebrates from the Hackensack Meadowlands, New Jersey. Paper presented at the New Jersey Academy of Science, March, in Squibb *et al.*, 1991.

Sokal, R.R. and F.J. Rohlf. 1991. Biometry. 2nd Ed. W.H. Freeman & Company, San Francisco, CA. 859 p.

Snolyink, V.L. and Jenkins, D. 1980. Water Chemistry, John Wiley and Sons, Inc., New York.

Sprague, J.B. 1985. Factors that modify toxicity. Chapter 6 In Fundamentals of Aquatic Toxicology. G.M. Rand & S.R. Petrocelli ed. s. Hemisphere Publ., Washington, DC. pp 124-163.

Woodward-Clyde Consultants, Inc. 1991. Remedial Investigation/Feasibility Study. Volume 3 - Quality Assurance Project Plan. Prepared for City of New York Department of Environmental Protection, April.

Table 4-1
Soil - Borings - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1 RE	SB-117S1	SB-118S1	SB-118S2	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92
depth (ft):	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2
Halogenated Aliphatic Compounds												
Methylene chloride		2 JR#	4 BJR#	12 BJR#	11 BJR#	19 BJR#	63 BJR#	10 BJR#	72 BJR#		4 BJR#	9 BJR#
Total												
Ketones												
2-Propanone	4 BJR#	15 BR#					1400 BEJ	7 BJR#	3700 BEJ	13 BR#	1200 BJ	22 J
Total							1400		3700		1200	22
Monocyclic Aromatic Hydrocarbons												
Benzene									13 J			
Chlorobenzene							26 J					
Toluene											3 J	1 J
Total							26		13		3	1
Miscelaneous												
Carbon Disulfide											7 J	
Total											7	
Grand Total							1426		3713		1210	23

	SB-121S2	SB-122S1	SB-122S2	SB-123S1	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth (ft):	22-24	0-2	30-32	0-0.5	10-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
Halogenated Aliphatic Compounds												
Methylene chloride	10 BR#	4 BJR#	6 BJR#	29 BJR#	11 BJR#	28 BJR#	31 BJR#	22 BJR#	2 BJR#	2 BJR#	6 BJR#	
Total												
Ketones												
2-Propanone	160 J	11 BJR#	34 BJR#	11 BJR#	13 BJR#		8 BJR#	20 BJR#		16	110 BJR#	110 J
Total	160									16		110
Monocyclic Aromatic Hydrocarbons												
Benzene								9				
Chlorobenzene												6 J
Toluene								2 J				1 J
Total								11				7
Miscellaneous												
Carbon Disulfide	2 J											
Total	2											
Grand Total	162							11		16		117

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant

E = Estimated value (reported concentration exceeded calibration range)
J = Estimated value
RE = Reanalysis
R# = Negated result

Prepared by: SMM
Checked by: REC
92C4087

Table 4-2
Soil - Borings - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1	SB-117S1	SB-118S1 RE	SB-118S2 DL	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1	SB-121S2	SB-122S1	SB-122S2	SB-123S1 RE	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth (ft):	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2	22-24	0-2	30-32	0-0.5	10-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
PAHs																								
2-Methylnaphthalene							1800 DJ		19 J				62 J							39 J				
Acenaphthene					99 J	37 J	5100 DJ		59 J				190 J			75 J	69 J			120 J				
Acenaphthylene				150 J									78 J	51 J		570	1200	53 J		750 J				
Anthracene				180 J	270 J	46 J	8600 DJ	130 J	100 J			100 J	590	62 J		460 J	900	41 J		950 J	40 J		53 J	40 J
Benzo(a) anthracene	91 J		210 J	760 J	1000	670 J	20000 D	410	180 J	56		240 J	1300	300 J		1500	3100	150 J		2700	160 J		140 J	110 J
Benzo(a) pyrene			230 J	790	930		23000 D	520				300 J	1500	360 J		1600	4000	160 J		2000	250 J		210 J	110 J
Benzo(b) fluoranthene	140 J		260 J	740 J	790		19000 D	410	190 J			300 J	1300	420		2400	5200	169 J		3000			200 J	110 J
Benzo(g,h,i) perylene	80 J			460 J	350 J							180 J	530	240 J		660	1100	98 J		960 J			140 J	
Benzo(k) fluoranthene	100 J		200 J	790	820		18000 D	510	200 J	45 J		190 J	1200	290 J		1400	2700	178		2500	240 J		180 J	110 J
Chrysene	130 J		250 J	960	1000	850	21000 D	580	250 J	57 J		250 J	1100	340 J		1500	3700	220 J		3000	250 J		160 J	130 J
Dibenzo(a,h) anthracene				130 J	100 J							42 J	170 J			200 J	420			460 J				
Dibenzofuran						21 J	3900 DJ	18 J	43 J				110 J				54 J			110 J				
Fluoranthene	220 J		350 J	1500	1900	530 J	30000 DJ	1100	590	200 J	56 JR#	560	2600	500		2300 J	850 J	390		4100 J	450 J	55 J	180 J	230 J
Fluorene					110 J		5900 DJ					45 J	250 J			130 J	230 J			310 J				
Indeno(1,2,3-c,d) pyrene	89 J			510 J	490 J							170 J	610	290 J		730	1300	120 J		1400 J			180 J	
Naphthalene							3000 DJ						110 J				39 J			50 J				93 J
Phenanthrene	91 J			720 J	1200	480 J	34000 D	660	520	44 J		380	2000	230 J		1200 J	3000	190 J		2000 J	240 J		140 J	170 J
Pyrene	180 J		340 J	1200	1600	720 J	31000 DJ	880	430	160 J	45 J	440	2500	480		2600	5000	290 J		4200	370 J	71 J	170 J	250 J
Total	1121		1840	8890	10659	3354	224300	5218	2581	562	45	3197	16200	3563		17325	32862	2059		28649	2000	126	1753	1353
Phenols																								
4-Methylphenol																						140 J	150 J	
4-Nitrophenol																								61 J
Total																						140	150	61
Phthalates																								
Bis(2-Ethylhexyl) Phthalate	110 J	58 J		100 J	180 J	4900 BJ		610 BJR#	360 BJR#	130 J		73 J	82 J	1600	74 J	1400	650			96 J	670 J	2800 J	3000 JR#	950 JR#
Butyl benzyl phthalate								130 J						64 J		170 J				43 J				
Di-n-butyl phthalate	44 J	57 J		85 J	83 J	670 J	1400 DJ	1300	1400				290 J	43 BJR#	79 BJR#	79 BJR#	44 J	41 BJR#		53 BJR#	1000 J	820	100 JR#	48 BJ
Di-n-octyl phthalate																							370 J	110 J
Total	154	115		185	263	5570	1400	1430	1400	130		73	372	1664	74	1570	694			139	1670	3620	370	158
Chlorinated Hydrocarbons																								
1,4-Dichlorobenzene							1600 DJ																	
Total							1600																	
Grand Total	1275	115	1840	9075	10922	8924	227300	6648	3981	692	45	3270	16572	5227	74	18895	33556	2059		28788	3670	3886	2273	1572

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
D = Results reported from a diluted sample or sample extract
DL = Diluted sample
J = Estimated value
RE = Reanalysis
R# = Negated result

Prepared by: SMM
Checked by: REC
92C4087

Table 4-3
Soil - Borings - Pesticides and PCBs Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1	SB-117S1	SB-118S1	SB-118S2 DL	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92
depth (ft):	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2
4,4'-DDD			12 J				410					
4,4'-DDE	44 J		7.7 J				190 J		24 J			
4,4'-DDT	100		18 J	14 J								16 J
alpha-Chlordane			5.1 J					23 J				
delta-BHC					7.4 J							
Dieldrin												
Endosulfan sulfate			8.2 JR#	27 J	17 J							
Endrin ketone												
gamma-Chlordane												3.1 J
Heptachlor epoxide												
PCB-1242												
PCB-1254						200 J		310 J				
PCB-1260			130 J									

	SB-121S2	SB-122S1	SB-122S2	SB-123S1	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth (ft):	22-24	0-2	30-32	0-0.5	7-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
4,4'-DDD	9.4 J			420	18			66 J				
4,4'-DDE	7.4 J	10 J		750	307	1.1 J		40 J				
4,4'-DDT				1400	530			85 J				
alpha-Chlordane				11 J					17 J			
delta-BHC												
Dieldrin				45 J				55 J				
Endosulfan sulfate				30 J	2.2 J	0.82 JR#	0.81 JR#					
Endrin ketone					42			37 J				
gamma-Chlordane												
Heptachlor epoxide				20 J								
PCB-1242											150 J	
PCB-1254		140 J							270			130 J
PCB-1260				430 J							99 J	

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
DL = Diluted sample
J = Estimated value
R# = Negated result

Prepared by: SMM
Checked by: REC
92C4087

Table 4-4
Soil - Borings - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1	SB-117S1	SB-118S1	SB-118S2	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92
depth (ft):	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2
Aluminum	9690	11800	7600	12700	6040	11100	8830	8380	12000	3210	7990	5590
Antimony												
Arsenic	8.8	1.6 B	5.9	3.7	4.8	3.5 N	4.3 N	2.6 N	4.2 N	1.7 B	1.1 B	2 B
Barium	57.2	120	67.9	111	120	136 N*	236 N*	94.7 N*	140 N*	31.1 B	51.6	55
Beryllium				0.45 B	0.27 B			0.2 B				
Cadmium			1.2					0.88 B	2.6			
Calcium	2190	1620	34500 E	3460	4710	6910 *	40100 *	5320 *	10400 *	3160	1490	3200
Chromium	19.8	93.7	16.9	29.3	22.1	27.5	21.4	23.6	34.7	24.4	37.2	13.8
Cobalt	5.6 B	17.5	3.9 B	8.7 B	6.4 B	8.4 B	6.2 B	6 B	8.1 B	5.3 B	9.4 B	6.2 B
Copper	30.7	27.4	53	21.1	126	45.8 *	62.5 *	33.1 *	41.9 *	10.9	23.1	37.4
Iron	15200	26900	18100	16500	21100	23100	24400	22600	28700	16700	15600	15200
Lead	91.2	6.4	90.7	72	161	119 N*R	285 N*R	86.8 N*R	87.5 N*R	26.7	10.8	35.5
Magnesium	2620	8150	10700	3800	2780	6140 *	10100 *	4500 *	5620 *	2420	5800	2380
Manganese	261 NR	295 NR	224 E	549	218	316	302	294	345	159 NR	151 NR	199
Mercury	0.19 *J	0.19 *J	0.29	0.25	0.24	0.46 *J	0.34 *J	0.36 *J	0.2 *J			
Nickel	22.6	123	17.5	37.1	15.3	22.9	22.5	22	27.5	36.7	53.4	20.2
Potassium	1390	5760	1380	901 B	1010	2600	2060	1240	3110	514 B	3210	862 B
Selenium								0.48 BW				
Sodium	69.1 B	280 B	149 B	51.8 B	262 B	157 B	417 B	322 B	2050	194 B	2040	320 B
Thallium	0.49 B				0.63 BW	0.53 BW						0.47 B
Vanadium	27.6	33.8	40	27.2	20	38.7	46.3	28.9	61.5	15.5	26.3	21.7
Zinc	67.7 E	37.4 E	107	95.4	500	164 N*	205 N*	144 N*	158 N*	29.6 E	35 E	81.1

Notes:

All concentrations in milligrams per kilogram (ppm)

Blank indicates compound was not detected

B = Reported value is acceptable (reported value less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit))

E = Estimated value due to matrix interference

J = Estimated value

N = Estimated value (spiked sample recovery not within quality control limits)

R = Rejected result

R# = Negated result

W = Estimated value (post-digestion spike sample results reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)

* = Estimated value (duplicate analysis result not within quality control limits)

Prepared by: SMM
Checked by: REC
92C4087

Table 4-4
Soil - Borings - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-121S2	SB-122S1	SB-122S2	SB-123S1	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth (ft):	22-24	0-2	30-32	0-0.5	10-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
Aluminum	9590	12100	6490	12500	9360	16800	10100	13900	4880	9700	8590	7060
Antimony						9.1 BN						
Arsenic	3.1	5.6	0.42 B	11	10.9	4.4	2 B	4.9	2.9 N	1.8 BN	0.48 B	5
Barium	125	371	77.2	136	77.2	76.3	45	174	326 N*	53.7 N*	82.3	36.6 B
Beryllium		0.33 B			0.24 B	0.39 B			0.19 B	0.29 B		
Cadmium								1				
Calcium	13200	14100	1700	17000 E	2550	473 BE	1340 E	3640 E	20000 *	3530 *	2510	17100
Chromium	27.1	35.4	37	32.3	25.3	30.8	31.4	32	17.8	26.6	33.2	15.7
Cobalt	9.5 B	11.3	9.6 B	5.9 B	8.3 B	8.7 B	10.5	13	3.5 B	7.5 B	8.5 B	5 B
Copper	28.5	97.8	18	66.5	34.8 *	18.2	24.6	51.5	21 *	18.4 *	25.5	13.1
Iron	19300	30400	16100	18700	14200 E	19900	16300	30200	14200	19600	17200	14100
Lead	69.2	211	2.1	411 *	96.5	36.8 *J	24.75 *J	151 *	287 R	21.5 R	9.3	49.1
Magnesium	10300	7060	7380	10000	2930	3310	3810	6450	5810 *	4280 *	6570	8050
Manganese	230	450	149	392 E	224	479 E	272 E	374 E	199	206	158	252
Mercury	0.12 N	0.57	1.3	0.39	0.58 N*	0.22	0.39	0.51	0.96 *J			0.11 N
Nickel	23.2	30.6	84.1	24.5	39.4 *	33.3	49.5	54.9	10.3	18.7	40.4	18.1
Potassium	4540	2470	3090	1200	1490	574 B	1180	5120	786 B	2240	3560	761 B
Selenium												
Sodium	1540	281 B	617 B	134 B	163 B	27.1 B	121 B	544 B	164 B	8270	1200	162 B
Thallium			0.55 BJR#			0.5 BW				0.57 B		
Vanadium	31.8	83.2	22.2	49.1	28.9	34.4	26.4	58.2	21.1	36.3	31.2	45.5
Zinc	105	351	23.9	320	76 E	48.8	21.8	132	321 N*	40.4 N*	31.5	32.4

Notes: All concentrations in milligrams per kilogram (ppm)

Blank indicates compound was not detected

B = Reported value is acceptable (reported value less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit))

E = Estimated value due to matrix interference

J = Estimated value

N = Estimated value (spiked sample recovery not within quality control limits)

R = Rejected result

R# = Negated result

W = Estimated value (post-digestion spike sample results reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)

* = Estimated value (duplicate analysis result not within quality control limits)

Prepared by: SMM
Checked by: REC
92C4087

Table 4-5
Soil - On-Site and Off-Site Air Sampling Locations - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

OFF-SITE LOCATIONS	SS-H1	SS-H2	SS-H3	SS-H4	SS-H5	SS-H6 RE	SS-H7	SS-H8
date:	27-Aug-92	26-Aug-92	26-Aug-92	27-Aug-92	27-Aug-92	26-Aug-92	27-Aug-92	26-Aug-92
depth:	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
Halogenated Aliphatic Compounds								
Methylene chloride	6 BR#	5 JR#	6 R#	4 BJR#	5 JR#	6 BJR#	7 BJR#	26 BJR#
Total								
Ketones								
2-Propanone		11 BJR#	6 BJR#	4 BJR#	7 BJR#	8 BJR#		12 BR#
Total								
Grand Total								

ON-SITE LOCATIONS	SS-HA	SS-HB	SS-HC	SS-HD	SS-HD DUP	SS-HE	SS-HF	SS-HG
date:	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92
depth:	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
Halogenated Aliphatic Compounds								
Chloroform					0.8 J			1 J
Methylene chloride	6 BJR#	5 BJR#	3 BJR#	6 BJR#	6 BJR#	3 BJR#	7 BJR#	4 BJR#
Total					0.8			1
Ketones								
2-Butanone					6 J			
2-Propanone		11 BJR#	85 BJR#	110 BJR#	150 BJR#	9 BJR#		11 BJR#
Total					6			
Monocyclic Aromatic Compounds								
Benzene				2 J	0.9 J			
Chlorobenzene	1 J			220	170			
Ethylbenzene				20	120			
Styrene					3 J			
Toluene	2 J			2 J	2 J			2 J
Xylene (total)				78	55			
Total	3			322	350.9			2
Grand Total	3			322	357.7			3

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant

DUP = Duplicate sample
J = Estimated value
RE = Reanalysis
R# = Negated result

Prepared by: PGN
Checked by: REC
92C4087

Table 4-7
Soil - On-Site and Off-Site Air Sampling Locations - Pesticides and PCBs Data Summary
Pelham Bay Landfill
Bronx, New York

OFF-SITE LOCATIONS	SS-H1	SS-H2	SS-H3	SS-H4	SS-H5	SS-H6	SS-H7	SS-H8
date:	27-Aug-92	26-Aug-92	26-Aug-92	27-Aug-92	27-Aug-92	26-Aug-92	27-Aug-92	26-Aug-92
depth:	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
4,4'-DDD		19 JV	65 JV		46 JV	390	9.4 JV	15 J
4,4'-DDE	27 JV	34 J	41 JV	0.53 JV	70 JV	280	16 JV	42
4,4'-DDT	46 JV	48	130 JV	6.8 JV	210 V	270	22 JV	130
Dieldrin	230 V	7.7 JV	30 JV	1.2 JV		81 J		17 JV
Endrin ketone	29 JV			7.5 JV		45 J		
gamma-chlordane						170 J		
Heptachlor epoxide		1.9 JV	4.6 JV	1.3 JV		39 J		
alpha-Chlordane						460 J		
delta-BHC	6.2 JV					16 JV		

ON-SITE LOCATIONS	SS-HA	SS-HB	SS-HC	SS-HD	SS-HD DUP	SS-HE	SS-HF	SS-HG
date:	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92
depth:	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
4,4'-DDD	44	72 JV			6.2 JV			7.5 JV
4,4'-DDE	18 JV	11 JV		23 JV	15 JV		62 JV	5.4 JV
4,4'-DDT	94	42 JV					330 J	15 V
Dieldrin		7 JV		6.9 JV	7.9 JV	34 JV	130 V	3.6 JV
alpha-chlordane	9.6 JV	11 JV				18 JV	22 JV	
delta-BHC	3.3 JV	19 JV						
Methoxychlor	140 V							
PCB-1254						830 J	770 J	

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
J = Estimated value
DUP = Duplicate sample
V = Reported results for this compound could not be verified during data validation

Prepared by: PGN
Checked by: REC
92C4087

Table 4-6
Soil - On-Site and Off-Site Air Sampling Locations - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	Off-Site Locations								On-Site Locations								
	SS-H1	SS-H2	SS-H3	SS-H4	SS-H5	SS-H6	SS-H7	SS-H8	SS-HA	SS-HB	SS-HC	SS-HD	SS-HD DUP	SS-HE	SS-HF	SS-HG
date:	27-Aug-92	26-Aug-92	26-Aug-92	27-Aug-92	27-Aug-92	26-Aug-92	27-Aug-92	26-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92
depth:	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
PAHs																
Acenaphthene			85 J			86 J				140 J					130 J	
Acenaphthylene	3000		73 J	36 J	110 J	300 J	190 J	94 J	200 J	130 J			47 J	77 J	820	45 J
Anthracene	1100 J		220 J		110 J	510 J	130 J	110 J	130 J	190 J			76 J	66 J	700	43 J
Benzo(a) anthracene	5900	160 J	820	110 J	500	1900	590	530 J	420	550	55 J	62 J	280 J	250 J	2600	170 J
Benzo(a) pyrene	7600	130 J	730	140 J	550	1800	650	480 J	530 J	720 J	67 J	63 J	230 J	290 J	2800	180 J
Benzo(b) fluoranthene	9000		800	170 J	510	2400	960	640 J	890 J	1200 J	54 J	90 J	210 J	370 J	4500	220 J
Benzo(g,h,i) perylene	3500	130 J	510 J	110 J	190 J	610 J	330 J	320 J	79 J	100 J			65 J	56 J	260 J	51 J
Benzo(k) fluoranthene	8200		690 J	110 J	630	1300	460	330 J	530 J	840 J	85 J	63 J	250 J	250 J	1100	190 J
Chrysene	7700	180 J	1100	140 J	620	2400	830	620 J	540	860	73 J	84 J	330 J	290 J	3300	200 J
Dibenzo(a,h) anthracene	2000 J		170 J		70 J	260 J	160 J	93 J							140 J	
Dibenzofuran										46 J					79 J	
Fluoranthene	7400	330 J	1400	200 J	780	2700	1200	1000	610	970	120 J	130 J	540	420	3600	280 J
Fluorene			85 J			130 J	43 J			98 J					180 J	
Indeno(1,2,3-c,d) pyrene	5400	160 J	620 J	120 J	270 J	940	480	400 J	150 J	96 J			110 J	59 J	440	68 J
Naphthalene						98 J				54 J	45 J	120 J	160 J		56 J	
Phenanthrene	2600	150 J	810	67 J	290 J	1300	560	400 J	360 J	610		52 J	290 J	130 J	2300	98 J
Pyrene	11000	290 J	1600	200 J	990	3700	1200	970	980	1300	120 J	140 J	550	530	5000	360
Total	74400	1530	9713	1403	5620	20434	7783	5987	5419	7904	619	804	3138	2788	28005	1905
Phenols																
2,4,5-Trichlorophenol												130 J				
2,4,6-Trichlorophenol													220 J			
Total												130	220			
Phthalates																
Bis(2-Ethylhexyl) Phthalate	230 J	91 J	710 J	74 J	400	3300	89 J	120 J	640	34000 D	87 J	190 J	88 J	87 J	370 J	55 J
Butyl benzyl phthalate	230 J			41 J	39 J	780		140 JR#		5700 D						
Di-n-butyl phthalate		170 BJR#	89 BJ		39 J	220 BJ		79 BJ	51 J	310 J						
Di-n-octyl phthalate									41 J	160 J						
Total	460	91	799	115	478	4300	89	199	732	40170	87	190	88	87	370	55
Chlorinated Hydrocarbons																
1,2-Dichlorobenzene										42 J			52 J			
1,4-Dichlorobenzene										440		98 J	140 J		150 J	
1,2,4-Trichlorobenzene										48 J						
Total										530		98	192		150	
Miscellaneous																
Benzoic acid						170 J		130 J	80 J					60 J		
N-Nitrosodi-n-propylamine										420						
Total						170		130	80	420				60		
Grand Total	74860	1621	10512	1518	6098	24904	7872	6316	6231	49024	706	1222	3638	2935	28525	1960

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant

D = Results reported from a diluted sample or sample extract
DUP = Duplicate sample
J = Estimated value
R# = Negated result

Prepared by: PGN
Checked by: REC
92C4087

Table 4-8
Soil - On-Site and Off-Site Air Sampling Locations - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	Off-Site Locations								On-Site Locations							
	SS-H1	SS-H2	SS-H3	SS-H4	SS-H5	SS-H6	SS-H7	SS-H8	SS-HA	SS-HB	SS-HC	SS-HD	SS-HD DUP	SS-HE	SS-HF	SS-HG
date:	27-Aug-92	26-Aug-92	26-Aug-92	27-Aug-92	27-Aug-92	26-Aug-92	27-Aug-92	26-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92
depth:	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
Aluminum	8350	6280	3650	5580	9420	9700	11900	7380	4410	6660	5160	11500	10500	7800	5050	9130
Antimony		11.2 B						10.6 B		9.6 BNR						
Arsenic	3.7	4.7	9.2	1.4 B	4	5.7	4.1	29.1	2.3	3.3	2.5	9.2	7.9	2.1 B	2.6	6
Barium	79.6 *	64.7	77.5	39.5 *	84.8 *	204	78.7 *	119	121 *	160 *	52.6 *	36.8 B*	34.4 B*	58.1 *	845 *	76.7 *
Beryllium	0.19 B	0.2 B	0.14 B	0.15 B		0.26 B	0.15 B	0.25 B		0.17 B	0.35 B	0.2 B	0.19 B	0.14 B		0.14 B
Calcium	2750	2270	4070	3790	13900	6140	2930	20000	42800	5770	3120	1100	1050	103000	17900	13000
Chromium	20	16.6	10.4	14.5	27.4	150	29.8	20.6	10.8	22.9	117	14.5	13.8	18.9	12.4	18.9
Cobalt	7.5 B	5.9 B	3.1 B	6.6 B	10.2	6.3 B	9.1 B	6.7 B	5.6 B	13.7	26	4.8 B	5.8 B	8.6 B	6.7 B	7.1 B
Copper	30 N*	22.8	36.5	16.6 N*	33.7 N*	68.3	26.1 N*	178	24.7 N*	98.2 N*	16.9 N*	12 N*	12.2 N*	20 N*	26 N*	28.2 N*
Iron	14900 *	14100	8730	14100 *	18100 *	16000	17800 *	19600	12300 *	23500 *	21400 *	15600 *	15000 *	15300 *	12900 *	15600 *
Lead	125 *J	52.5	293	40.4 *	104 *J	613	70.2 *	1350	90.9 *J	1130 *	61.7 *	89.3 *J	88.5 *J	49.8 *	203 *J	112 *J
Magnesium	2460	2230	1920	2800	10400	3690	4160	10900	20700	3370	3200	1580	1570	6950	7060	8020
Manganese	257 N*	257	164	254 N*	258 N*	329	245 N*	316	192 N*	211 N*	542 N*	164 N*	173 N*	307 N*	244 N*	226 N*
Mercury	0.14 *		0.2			0.51		0.37	0.19 *	0.16 *		0.12 *	0.19 *		0.14 *	0.15 *
Nickel	25.2	11.2 J	3.2 BJ	16.5	32.4	16.5 J	40.5	21.6 J	17.6	19	477	13.2	13.6	21.9	17.3	22.8
Potassium	936 B	1510	560 B	860 B	3120	1120	1620	1050 B	1120	940 B	903 B	544 B	469 B	1740	1180	1300
Selenium	0.54 B							0.55 BW								0.5 BW
Silver		0.78 B				1.3 B		0.87 B								
Sodium	132 B	49.3 B	106 B	90.4 B	187 B	85.3 B	138 B	95.5 B	182 B	131 B	54.7 B	56.6 B	38.8 B	116 B	120 B	96.6 B
Vanadium	35.5	19.9	12.6	23.4	47.3	38.2	38.8	24.8	32	32.4	24.3	25.6	22.9	29.9	26	40.1
Zinc	93.6 N*	70	167	50.2 N*	105 N*	486	79.6 N*	192	134 N*	212 N*	80.5 N*	41.3 N*	39.7 N*	52.9 N*	530 N*	89.1 N*

Notes:
All concentrations in milligrams per kilogram (ppm)
Blank indicates compound was not detected
B = Reported value is acceptable (reported value less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit))
DUP = Duplicate sample
J = Estimated value
N = Estimated value (spiked sample recovery not within quality control limits)
R = Rejected result
W = Estimated value (post-digestion spike sample results reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)
* = Estimated value (duplicate analysis result not within quality control limits)

Prepared by: PGN
Checked by: REC
92C4087

Table 4-9
Soil - On-Site Air Sampling Locations - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	SS-A	SS-A DUP	SS-B	SS-C	SS-D	SS-E	SS-E-COLO	SS-F	SS-G
date:	11-May-92	11-May-92	11-May-92	11-May-92	11-May-92	11-May-92	11-May-92	11-May-92	11-May-92
depth:	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
Aluminum	3430 E*	4010 E*	7230 E*	7830 E*	11500 E*	5840 E*	6220 E*	9790 E*	5930 E*
Arsenic	2.8	2.8	3.5	5.8	9.4	1.5 B	1.1 B	3.1	1.5 B
Barium	83.3 EN	103 EN	111 EN	78.5 EN	44.9 EN	34.6 BEN	40.4 BEN	70 EN	35.9 BEN
Beryllium	0.23 B	0.3 B	0.39 B	0.52 B	0.33 B	0.39 B	0.33 B	0.46 B	0.35 B
Calcium	69900 *	57000 *	24500 *	3680 *	411 B*	2170 *	2500 *	1820 *	977 *
Chromium	8.7 *	14.7 *	14.6 *	84 *	18.5 *	15.8 *	14 *	18.5 *	10.7 *
Cobalt	1.5 B		5.8 B	16.9	3.4 B	3.7 B	5.4 B	6.5 B	3.9 B
Copper	10.3	14.6	39.9	19.3	14.5	49	22.3	31.4	14.8
Iron	9490 E	10200 E	14300 E	21900 E	13300 E	13000 E	15800 E	15300 E	10400 E
Lead	74.7 *	80.9 *	77.3 *	73.4 *	71.8 *	41.8 *	35.6 *	89.3 *	84.3 *J
Magnesium	33400 *	24300 *	13300 *	3840 *	1540 *	2310 *	2090 *	2330 *	1320 *
Manganese	313 EN*R	244 EN*R	183 EN*R	597 EN*R	73.4 EN*R	120 EN*R	176 EN*R	268 EN*R	200 EN*R
Mercury	0.21		0.18		0.26	0.13		0.21	0.16
Nickel	4.9 B	5.8 B	9.4	234	5.9 B	9.5	7.4 B	9.6	5.5 B
Potassium	695 B	942 B	1010 B	711 B	594 B	968 B	1020 B	1080	392 B
Sodium	374 B	453 B	168 B	77.2 B	25.6 B	72.6 B	81.5 B	43.1 B	39.7 B
Thallium		0.55 B							
Vanadium	38	30.7	36.1	31.5	25.8	24.1	22.7	27.1	17.9
Zinc	92.9 E*	117 E*	140 E*	72.7 E*	31.5 E*	46.8 E*	43.2 E*	70.4 E*	41.8 E*

Notes:

All concentrations in milligrams per kilogram (ppm)
Blank indicates compound was not detected
COLO = Colocated high volume sample
B = Reported value is acceptable (reported value less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit))
DUP = Duplicate sample
E = Estimated value due to matrix interference
J = Estimated value
N = Estimated value (spiked sample recovery not within quality control limits)
R = Rejected result
* = Estimated value (duplicate analysis result not within quality control limits)

Prepared by: SMM
Checked by: PGN
92C4087

Table 4-10
Soil - Former Community Garden - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	SS-GAR1	SS-GAR2	SS-GAR3	SS-GAR4	SB-GAR5
date:	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92
depth:	0-2"	0-2"	0-2"	0-2"	12"-24"
Halogenated Aliphatic Compounds					
Chloroform			1 J		
Methylene chloride	9 BJR#	11 BJR#	15 BJR#	31 BJR#	5 BJR#
Total			1		
Ketones					
2-Propanone					5 BJR#
Total					
Monocyclic Aromatic Hydrocarbons					
Toluene					1 J
Total					1
Grand Total			1		1

Notes:

All concentrations in micrograms per kilograms (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
J = Estimated value
R# = Negated result

Prepared by: PGN
Checked by: REC
92C4087

Table 4-11
Soil - Former Community Garden - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	SS-GAR1	SS-GAR2	SS-GAR3	SS-GAR4	SB-GAR5
date:	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92
depth:	0-2"	0-2"	0-2"	0-2"	12"-24"
PAHs					
2-Methylnaphthalene	73 J	74 J			
Acenaphthene	55 J	66 J		71 J	
Acenaphthylene	120 J	450	120 J	150 J	52 J
Anthracene	220 J	570	160 J	220 J	95 J
Benzo(a) anthracene	920	2000	420 J	940	370
Benzo(a) pyrene	680	1300	300 J	670	270 J
Benzo(b) fluoranthene	630	1800	480	680	300 J
Benzo(g,h,i) perylene	140 J	200 J	78 J	110 J	100 J
Benzo(k) fluoranthene	680	890	360 J	860	260 J
Chrysene	910	1900	490	960	380
Dibenzo(a,h) anthracene	50 J	130 J		47 J	
Dibenzofuran		62 J		51 J	
Fluoranthene	1400	3300	720	1900	900
Fluorene	86 J	85 J	54 J	98 J	44 J
Indeno(1,2,3-c,d) pyrene	230	410 J	130 J	210 J	160 J
Naphthalene	82 J	98 J			
Phenanthrene	730	1600	350 J	1000	520
Pyrene	1400	2900	660	1500	650
Total	8186	17835	4322	9467	4101
Phthalates					
Bis(2-Ethylhexyl) Phthalate	270 J	230 J	370 J	210 J	36 J
Di-n-butylphthalate	82 J		70 J		
Total	352	230	440	210	36
Miscellaneous					
Benzoic acid	670 J	450 J	350 J	270 J	89 J
Total	670	450	350	270	89
Grand Total	9208	18515	5112	9947	4226

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
J = Estimated value

Prepared by: PGN
Checked by: REC
92C4087

Table 4-12
Soil - Former Community Garden - Pesticides and PCBs Data Summary
Pelham Bay Landfill
Bronx, New York

	SS-GAR1	SS-GAR2	SS-GAR3	SS-GAR4	SB-GAR5
date:	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92
depth:	0-2"	0-2"	0-2"	0-2"	12"-24"
4,4'-DDD	180 V	72 V	21 JV	86 V	1.1 JV
4,4'-DDE	130 V	54 V	24 V	75 V	1.7 JV
4,4'-DDT	130 V	57 V		120 V	5.4 JV
alpha-chlordane	140 JV	39 JV	31 JV	72 JV	0.74 JV
delta-BHC	35 BJV	17 BV			
Dieldrin	25 JV		26 V	20 JV	7.8 JV
Endrin ketone			6.4 JV		1.6 JV
gamma-BHC			2.2 JV		1.3 JV
gamma-chlordane	93 JV	29 JV		42 JV	
Heptachlor epoxide	6.7 JV	3.5 JV	3 JV	9.4 JV	
Methoxychlor	36 JV				
PCB-1254	1100 J	230 J	460 J	180 J	53 J

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
B = Blank contaminant
J = Estimated value
V = Reported results for this compound could not be verified during data validation

Prepared by: PGN
Checked by : REC
92C4087

Table 4-13
Soil - Former Community Garden - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	SS-GAR1	SS-GAR2	SS-GAR3	SS-GAR4	SB-GAR5
date:	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92
depth:	0-2"	0-2"	0-2"	0-2"	12"-24"
Aluminum	7290	7970	8050	7010	7570
Arsenic	6.5	7.8	5.7	7.7	2 B
Barium	130	101	338	67.4	39.6
Beryllium	0.28 B	0.21 B	0.22 B	0.18 B	0.17 B
Calcium	23000	19100	10200	9260	2850
Chromium	26.4	38.1	22.2	18.6	18
Cobalt	7 B	6.5 B	6.2 B	4.7 B	5.4 B
Copper	72.2	50.9	43.5	32.3	15.6
Iron	17300	17500	17700	13100	11000
Lead	293 *	215 *	246 *	114 *	28.2 *J
Magnesium	7090	7200	4890	4440	2870
Manganese	346 N	296 N	299 N	254 N	128 N
Mercury	1.3 N	0.65 N	0.39 N	0.41 N	0.45 N
Nickel	11.8 J	11.2 J	12.6 J	10.4 J	7 J
Potassium	1090 B	980 B	1230	1140	809 B
Silver	1.1 B	0.72 B		0.81 B	
Sodium	175 B	194 B	120 B	65.4 B	87.1 B
Thallium					0.67 B
Vanadium	29	30.3	26.7	21.6	22.6
Zinc	263	217	319	111	37.2

Notes:

All concentrations in milligrams per kilogram (ppm)

Blank indicates compound was not detected

* = Estimated value (duplicate analysis result not within quality control limits)

B = Reported value is acceptable (reported value less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit))

J = Estimated value

N = Estimated value (spiked sample recovery not within quality control limits)

Prepared by: PGN
Checked by: REC
92C4087

Table 4-14
Soil - Borings - Volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-116S1 RE	SB-118S2	SB-119S2	SB-121S2	SB-122S2	SB-123S1
date:	10-Aug-92	25-Jun-92	25-Jun-92	28-May-92	2-Jun-92	7-Jul-92
depth:	0-0.5	8-12	8-12	22-24	30-32	0-0.5
2-Propanol			980 J			
2-Propanol, 1-Chloro					12 J	
Methane, Oxybis			110 J			
Unknown	12 BJR#					8 BJR#
Unknown		30 J				
Unknown Alcohol		79 J		34 J		
Total Number of TICs		2	2	1	1	
Total concentrations		109	1090	34	12	

	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2
date:	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92
depth:	10-12	0-1	8-10	0-1	0-0.5	16-18
2-Propanol						
2-Propanol, 1-Chloro						
Methane, Oxybis						
Unknown (Negated)	8 BJR#	9 BJR#	12 BJR#	20 BJR#		
Unknown				35 J	22 J	11 J
Unknown Alcohol						
Total number of TICs				3	2	1
Total concentrations				35	22	11

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Soil borings not shown in table showed no TICs hits
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
J = Estimated value
RE=Reanalysis
R# = Negated result

Prepared by: SMM
Checked by: REC
92C4087

Table 4-15
Soil - Borings - Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1	SB-117S1	SB-118S1 RE	SB-118S2 DL	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92
depth:	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2
(24R)-4-Stigmasten-3-One	300 J										220 J	
1-Octadecanol				360 JBR#								
13 (16), 14-Labdien-8-Ol					480 J							
1,2-Benzenedicarboxyl												
1,2-Benzenedicarboxylic Acid		240 J										
2-Pentanone, 4-Hydroxy-4-Met	1100 BJAR#	1500 BJAR#	5800 BJAR#	1700 BJAR#	1600 BJAR#					600 BJAR#	890 BJAR#	3300 BJR#
2-Propenamide, N,3-Diphenyl-											210 J	
4-Hydroxy-3,4-Dimethyl-Phena										210 J		
4H-Cyclopenta[Def]Phenanthre												
7H-Benz[De]Anthracen-7-One												
9,10-Anthracenedione												
Benzene, 1-Ethyl-2,3-Dimethy												
Benzeneacetic Acid												
Benzenebutanoic Acid, 2,5-Di												
Benzo [e] pyrene				700 J								
Benzo(H) Isoquinoline												
C15H12 Aromatic Hydrocarbon							4100 J					
C16H16 Aromatic Hydrocarbon								430 J				
C17H12 Aromatic Hydrocarbon						550 J	18300 J	270 J	420 J			
C20H12 Aromatic Hydrocarbon							40000 J	670 J				
C8H8 Hydrocarbon								450 J				
Cholest-5-En-3-Ol (3.Beta.)-				600 J							430 J	
Cholest-5-En-3-Ol(3,Beta)Isomer												
Fluoranthene												
Heptacosane	1000 J											
Hexadecane												
Hexadecane, 2,6,10,14-Tetram		170 J										
Hexadecanoic Acid					460 J							
Hexanedioic Acid, Dioctyl Es												
Hexanoic Acid, 2-Ethyl-												
Hexatriacontane												
P,P'-DDD												
Phenanthrene, 2,5-Dimethyl												

Table 4-15
Soil - Borings - Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1	SB-117S1	SB-118S1 RE	SB-118S2 DL	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92
depth:	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2
Pyrene, 1-Methyl												
Stigmast-5-En-3-Ol, (3.Beta.)												
Sulfur, Mol. (S8)												190 J
Thiocamphor					560 J							
Tricosane												
Unknown		120 J	7320 J	1140 J	3080 J	9340 J	11700 J	4960 J	660 J		3560 J	890 J
Unknown Acid								580 J				
Unknown Alcohol				3880 J								
Unknown Aldehyde	1450 J											
Unknown Alkane	4630 J		1400 J	2400 J	630 J		3400 J	4200 J			420 J	410 J
Unknown Aromatic							13300 J		150 J			
Unknown Hydrocarbon	1650 J				310 J					390 J	3950 J	190 J
Unknown Ketone												
Unknown M												
Unknown PAH	950 J											240 JR#
Unknown Phthalate				750 J	920 J							
Unknown Phthalate												
Unknown Pyrene												
Total number of TICs	17	3	7	9	10	10	11	17	5	3	12	7
Total concentrations	9980	530	8720	9470	6440	9890	90800	11560	1230	600	8570	1680

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
A = Aldol condensation product (Laboratory artifact, not a site contaminant)
B = Blank contaminant
DL = Diluted sample
J = Estimated value
RE=Reanalysis
R# = Negated result

Prepared by: SMM
Checked by: REC
92C4087

Table 4-15
Soil - Borings - Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-121S2	SB-122S1	SB-122S2	SB-123S1 RE	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth:	22-24	0-2	30-32	0-0.5	10-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
(24R)-4-Stigmasten-3-One												
1-Octadecanol												
13 (16), 14-Labdien-8-Ol												
1,2-Benzenedicarboxyl											890 J	
1,2-Benzenedicarboxylic Acid												
2-Pentanone, 4-Hydroxy-4-Met	1100 BJR#	1000 BJR#	1400 BJR#	6000 BJAR#	46800 BJAR#	4600 BJAR#	5500 BJAR#	4400 BJAR#			1400 BJR#	1200 BJR#
2-Propenamide, N,3-Diphenyl-												
4-Hydroxy-3,4-Dimethyl-Phena												
4H-Cyclopenta[Def]Phenanthre				380 J				570 J				
7H-Benz[De]Anthracen-7-One					320 J							
9,10-Anthracenedione					900 J							
Benzene, 1-Ethyl-2,3-Dimethy												420 J
Benzeneacetic Acid											940 J	
Benzenebutanoic Acid, 2,5-Di											250 J	
Benzo [e] pyrene												
Benzo(H) Isoquinoline	340 J											
C15H12 Aromatic Hydrocarbon												
C16H16 Aromatic Hydrocarbon												
C17H12 Aromatic Hydrocarbon												
C20H12 Aromatic Hydrocarbon												
C8H8 Hydrocarbon												
Cholest-5-En-3-Ol (3.Beta.)-												
Cholest-5-En-3-Ol(3,Beta)Isomer					4600 J							
Fluoranthene					850 J							
Heptacosane		410 J	410 J									
Hexadecane			360 J									
Hexadecane, 2,6,10,14-Tetram												
Hexadecanoic Acid									510 J			
Hexanedioic Acid, Dioctyl Es				3400 BJ		3600 BJ	3500 BJ	720 BJR#				
Hexanoic Acid, 2-Ethyl-											750 J	
Hexatriacontane		1300 J	230 J									
P,P'-DDD				250 J								
Phenanthrene, 2,5-Dimethyl					560 J							

Table 4-15
Soil - Borings - Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-121S2	SB-122S1	SB-122S2	SB-123S1 RE	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth:	22-24	0-2	30-32	0-0.5	10-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
Pyrene, 1-Methyl					620 J							
Stigmast-5-En-3-Ol, (3.Beta.)				700 J				500 J				
Sulfur, Mol. (S8)											280 J	
Thiocamphor												
Tricosane		210 J										
Unknown	1070 J	2740 J	460 J	1740 J	1250 J	640 J	930 J	270 J	3450 J	10750 J	10400 J	1460 J
Unknown Acid												
Unknown Alcohol				880 J		710 J		480 J				
Unknown Aldehyde						270 J						
Unknown Alkane	330 J	7300	1790 J	4600 J	2200 J	490 J	3380 J	3300 J		1630 J	4260 J	11990 J
Unknown Aromatic												
Unknown Hydrocarbon												
Unknown Ketone				320 J				200 J				
Unknown M								2600 J				
Unknown PAH	4950 J			3030 J	9700 J			3450 J			350 J	
Unknown Phthalate				260 J		240 J	490 J	340 J				
Unknown Phthalate							230 JR#					
Unknown Pyrene					230 J							
Total number of TICs	16	15	10	18	19	10	18	16	11	14	19	19
Total concentrations	6690	11960	3250	15560	21230	5950	8300	11710	3960	12380	18120	13870

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
A = Aldol condensation product (Laboratory artifact, not a site contaminant)
B = Blank contaminant
DL = Diluted sample
J = Estimated value
RE=Reanalysis
R# = Negated result

Prepared by: SMM
Checked by: REC
92C4087

Table 4-16
Soil - On-Site Air Sampling Locations - Volatile and Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SS-HA	SS-HB	SS-HC	SS-HD	SS-HE	SS-HF	SS-HG
date:	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92	27-Aug-92
depth:	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
VOLATILE ORGANICS							
Bicyclo[2.2.1]Heptane,2,2,3			30 JNV				
Camphene (Dot)(8C1)			15 JNV				
Unknown			47 J	95 JNV		27 JNV	
Unknown (Dichlorobenzene)			91 JNV				
Unknown (Sub. Benzene)			96 JNV				
Total number of TICs			5	5		2	
Total concentrations			279 J	95 J		27 J	
SEMI-VOLATILE ORGANICS							
1H-Idene,2,3,-Dihydro-1,1,3		500 J					
1H-Idene,2,3,-Dihydro-1-Met			230 J				
1H-Idene,Octahydro-2,2,4,4 13		270 J					
1H-Idene,Octahydro-2,2,4,4 14		290 J					
2-Methyldecalin(Probably Tra		300 J					
2-Pentanone, 4-Hydroxy-4-Met	1500 BJAR#	1300 BJAR#	1600 BJAR#	1600 BJAR#	2400 BJAR#	2200 BJAR#	1900 BJAR#
7H-Benz[De]Anthracen-7-One						640 J	
9,10-Anthracenedione						740 J	
Benzene, (2,-Methyl-1-Methyle			230 J				
Benzene, 1-Ethyl-3,5-Dimethyl			280 J				
Hexane,2,2,5-Trimethyl-			440 J				
Hexanoic Acid, Dioctyl Es					170 J		
Naphthalene,Decahydro-2-Met			290 J	260 J			
Pyrene, 4-Methyl-						270 J	
Unknown	410 J	4430 J	11200 J	12590 J	1800 J	12740 J	4830 J
Unknown					180 JR#		
Unknown Aldehyde							180 J
Unknown Alkane	5900 J	6230 J	2500 J	5270 J	1400 J	1200 J	4650 J
Unknown Alkyl Benzene			470 J	340 J			
Unknown Alkyl Heptane				380 J			
Unknown Hydrocarbon		1400 J					
Unknown PAH	160 J					6980 J	
Veridiflorol			270 J				
Total number of TICs	4	16	19	19	6	19	11
Total concentrations	6470 J	13420 J	15910 J	18840 J	3370 J	22570 J	9660 J

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
A = Aldol condensation product (Laboratory artifact, not a site contaminant)
B = Blank contaminant
J = Estimated value
NV = Reported results for this compound was not verified during data validation
R# = Negated result

Prepared by: DAJ
Checked by: PGN
92C4087

Table 4-17
Soil - Off-Site Air Sampling Locations - Volatile and Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SS-H1	SS-H2	SS-H3	SS-H4	SS-H5	SS-H6	SS-H7	SS-H8
date:	27-Aug-92	27-Aug-92	26-Aug-92	27-Aug-92	27-Aug-92	26-Aug-92	27-Aug-92	27-Aug-92
depth:	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"	0-2"
VOLATILE ORGANICS								
Unknown				6 J				
Total number of TICs				1				
Total concentrations				6 J				
SEMI-VOLATILE ORGANICS								
16-Octadecenal							270 J	
2-Pentanone, 4-Hydroxy-4-Met	3100 BJAR#	2600 BJAR#	1500 BJAR#	1400 BJAR#	1000 BJAR#	2100 BJAR#	1600 BJAR#	2200 BJAR#
4H-Cyclopenta[Def]Phenanthre	970 J				160 J			
7H-Benz[De]Anthracen-7-One	3000 J							
9,10-Anthracenedione	1100 J					720 J	270 J	
Benzaldehyde								660 J
D-Friedoolean-14-En-3-One		1900 J				1400 J		
Hexadecanoic Acid Methyl Es						620 J		770 J
Hexanedioic Acid, Dioctyl Es		7800 BJR#	14000 BJR#			1100 BJR#		13000 BJR#
Pyrene, 1-Methyl							180 J	
Unknown	5490 J	22020 J	840 J	970 J	310 J	4370 J	2120 J	4500 J
Unknown		390 BJR#	460 BJR#			430 BJR#		630 BJR#
Unknown Aldehyde		10000 J	920 J			5300 J		
Unknown Alkane	13100 J	8980 J	6870 J	3090 J	1870 J	15510 J	9900 J	7900 J
Unknown Cyclo-Alkane		500 J						
Unknown Hydrocarbon					1300 J			
Unknown PAH	15800 J				400 J	1970 J	640 J	
Total number of TICs	15	16	5	7	7	17	18	10
Total concentrations	39460 J	43400 J	8630 J	4060 J	4040 J	29890 J	13380 J	13830 J

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
A = Aldol condensation product (Laboratory artifact, not a site contaminant)
B = Blank contaminant
J = Estimated value
R# = Negated result

Prepared by: DAJ
Checked by: PGN
92C4087

Table 4-18
Soil - Former Community Garden - Volatile and Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SS-GAR 1	SS-GAR 2	SS-GAR 3	SS-GAR 4	SB-GAR 5
date:	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92	9-Sep-92
depth:	0-2"	0-2"	0-2"	0-2"	12"-24"
VOLATILE ORGANICS					
1,1,2-Trichloro-1,2,2 Triflu				8 J	
Unknown	8 J				
Total number of TICs	1			1	
Total concentrations	8 J			8 J	
SEMI-VOLATILE ORGANICS					
2-Pentanone, 4-Hydroxy-4-Met	11000 BJAR#	8000 BJAR#	10000 BJAR#	5800 BJAR#	2800 BJAR#
Cholest-5-En-3-Ol (3.Beta.)-		810 J	780 J	3300 J	
Hexadecanoic Acid					320 J
Stigmast-5-En-3-Ol, (3.Beta.)	1100 J	910 J	1100 J	1300 J	
Unknown	10150 J	7410 J	5890 J	7810 J	340 J
Unknown					330 BJR#
Unknown Aldehyde				3200 J	
Unknown Alkane	25592 J	7840 J	12830 J	22600 J	470 J
Unknown Carboxylic Acid	1300 J	7200 J	6750 J	8590 J	
Unknown Ester	2400 J	980 J	1510 J	860 J	
Unknown PAH	890 J	2270 J	570 J	960 J	250 J
Unknown Phthalate					210 J
Total number of TICs	18	18	18	18	6
Total concentrations	41432 J	27420 J	29430 J	48620 J	1590 J

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
A = Aldol condensation product (Laboratory artifact, not a site contaminant)
B = Blank contaminant
J = Estimated value
R# = Negated result

Prepared by: DAJ
Checked by: PGN
92C4087

Table 4-19
Monitoring Wells - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-114B	MW-115	MW-115B	MW-115BP	MW-115P	MW-116	MW-116B	MW-117	MW-117B
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	8-Aug-92	28-Jul-92	29-Jul-92	30-Jul-92	28-Jul-92	28-Jul-92	5-Aug-92	30-Jul-92	30-Jul-92	31-Jul-92	31-Jul-92	14-Aug-92	12-Aug-92	3-Aug-92	7-Aug-92	31-Jul-92	7-Aug-92
Halogenated Aliphatic Compounds																					
1,1-Dichloroethylene																					
1,2-Dichloroethylene			1 J																		
Chloroform						2 J															
Methylene chloride	2 BJR#	2 BJR#	2 BJR#		12 BJR#	2 BJR#		2 BJR#	3 BJR#	2 BJR#	1 BJ	3 BJR#	3 BJR#	2 BJR#	12 BR#		4 J	15 BJR#	9 BJR#	9 BR#	2 BJR#
Tetrachloroethylene																			6 J		
Trichloroethylene																			5 J		
Total			1			2											4		11		
Ketones																					
2-Butanone																					
2-Hexanone																				5 J	
2-Propanone															8 J				47		
4-Methyl-2-pentanone																					
Total															8				47	5	
Monocyclic Aromatic Hydrocarbons																					
enzene		2 J	4 J	3 J			3 JBR#	2 J		1 J	3 J								62		
hlorobenzene		7	1 J	2 J			5	18	11	16	28	14		3 J							
Ethylbenzene			8					3 J											36		
Toluene																			230		
Xylenes (total)																			200		
Total		9	13	5			5	23	11	17	31	14		3					528		
Miscellaneous																					
Carbon Disulfide		1 J																			
Total		1																			
Grand Total		10	14	5		2	5	23	11	17	31	14		3	8		4		586	5	

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
D= Result reported from a diluted sample or sample extract
E = Estimated value (Reported concentration exceeded the calibration range)
J ==Estimated value
R# = Negated

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-19
Monitoring Wells - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-118	MW-118B	MW-119	MW-119B	MW119BD	MW-120	MW-120B	MW-120H	MW-120L	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	29-Jul-92	6-Aug-92	5-Aug-92	7-Aug-92	7-Aug-92	4-Aug-92	4-Aug-92	20-Aug-92	20-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	3-Aug-92	3-Aug-92	30-Jul-92	30-Jul-92	6-Aug-92
Halogenated Aliphatic Compounds																			
1,1-Dichloroethylene																			
1,2-Dichloroethylene						1 J													
Chloroform		11 J									20 J								
Methylene chloride		120 BR#		2 BJR#	150 BDJR#	12 BJR#	12 BJR#	2 BJR#	1 BJR#	11 BJR#	99 BJR#	8 BJR#	3 BJR#		15 BJR#	15 BJR#	1 BJR#	3 BJR#	3 BJR#
Tetrachloroethylene				6															
Trichloroethylene				3 J															1 J
Total		11		9		1					20								1
Ketones																			
2-Butanone																			51
2-Hexanone																			
2-Propanone		1700 B		1800 EJ	1500 D	24 JR#		18	20 B	9 JR#	2100 BJ	120 J	26		62		8 J		87
4-Methyl-2-pentanone																			9 J
Total		1700		1800	1500			18	20		2100	120	26		62		8		147
Monocyclic Aromatic Hydrocarbons																			
Benzene						3 J		4 J	5	1 J		4 J	3 J						1 J
lorobenzene						12		14	17			25	46				3 J	2 J	
Ethylbenzene				8		5		6	7	3 J		5 J	5 J						2 J
Toluene				2		8		9	11			1	2						8
Xylenes (total)				40		9		5	14										6
Total				50		37		38	54	4		35	56				3	2	17
Miscellaneous																			
Carbon Disulfide																			
Total																			
Grand Total		1711		1859	1500	38		56	74	4	2120	155	82		62		11	2	165

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
D= Result reported from a diluted sample or sample extract
E = Estimated value (Reported concentration exceeded the calibration range)
J ==Estimated value
R# = Negated

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-20
Monitoring Wells - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-114B	MW-115	MW-115B RE	MW-116	MW-116B
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	3-Aug-92	28-Jul-92	29-Jul-92	31-Jul-92	28-Jul-92	28-Jul-92	5-Aug-92	10-Aug-92	30-Jul-92	31-Jul-92	31-Jul-92	3-Aug-92	7-Aug-92
PAHs																	
2-Methylnaphthalene			33 J														2 J
Acenaphthene		4 J	18	3 J										8 J			
Acenaphthylene																	
Anthracene			8 J														
Benzo(a) anthracene			2 J														
Chrysene																	
Dibenzofuran			12											3 J			
Fluoranthene		2 J	10														
Fluorene		2 J	15	3 J													
Naphthalene		6 J	140 J	8 J													8 J
Phenanthrene			35														
Pyrene		2 J	9 J														
Total		16	282	14										11			10
Phenols																	
2-Methylphenol																	
2,4-Dimethylphenol			73														
4-Methylphenol																	
Total			73														
Phthalates																	
Bis(2-Ethylhexyl) Phthalate		4 J	13								2 J						
Di-n-butyl phthalate	3 JR#		3 BJR#	3 J	3 BJR#	4 BJR#			3 BJR#					2 J			
Di-n-octyl phthalate																	
Total		4	13	3							2			2			
Ethers																	
bis(2-Chloroisopropyl) ether						4 J					3 J						
Total						4					3						
Chlorinated Hydrocarbons																	
1,4-Dichlorobenzene											6 J						
Total											6						
Amines/Nitroarenes																	
N-Nitrosodi-n-propylamine											24						
N-Nitrosodiphenylamine																	
Total											24						
Grand Total		20	368	17		4					35			13			10

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
J = Estimated value
RE = Reanalysis
R# = Negated result

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-20
Monitoring Wells - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-117	MW-117B	MW-118	MW-118B	MW-119	MW-119B	MW-120	MW-120B	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	31-Jul-92	7-Aug-92	29-Jul-92	29-Jul-92	5-Aug-92	7-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	3-Aug-92	3-Aug-92	30-Jul-92	30-Jul-92	6-Aug-92
PAHs																		
2-Methylnaphthalene						2 J	4 J											6 J
Acenaphthene							4 J		2 J									8 J
Acenaphthylene						2 J												
Anthracene							3 J		2 J									5 J
Benzo(a) anthracene																		3 J
Chrysene																		3 J
Dibenzofuran																		5 J
Fluoranthene							3 J											10 J
Fluorene							3 J											5 J
Naphthalene						4 J	35		2 J									45
Phenanthrene							4 J											19
Pyrene																		9 J
Total						8	56		6									118
Phenols																		
2-Methylphenol							51											49 J
2,4-Dimethylphenol							68		5 J									290
4-Methylphenol			4 J															
Total			4				119		5									339
Phthalates																		
Bis(2-Ethylhexyl) Phthalate				28 J		17 J	6 J	2 J										38
Di-n-butyl phthalate	2 J			4 J								2 J	2 J		2 BJR#			
Di-n-octyl phthalate																		10 J
Total	2			32		17	6	2				2	2					48
Ethers																		
bis(2-Chloroisopropyl) ether		5 J	3 J															
Total		5	3															
Chlorinated Hydrocarbons																		
1,4-Dichlorobenzene							4 J											
Total							4											
Amines/Nitroarenes																		
N-Nitrosodi-n-propylamine																		
N-Nitrosodiphenylamine				11 J		17 J				4 J								
Total				11		17				4								
Grand Total	2	5	7	43		42	185	2	11	4		2	2					505

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
J = Estimated value
RE = Reanalysis
R# = Negated result

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-21
Monitoring Wells - Pesticides and PCBs Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-106AR	MW-107	MW-109	MW-110AR	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-114B	MW-115	MW-115B	MW-116	MW-116B
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	29-Jul-92	3-Aug-92	28-Jul-92	29-Jul-92	31-Jul-92	28-Jul-92	28-Jul-92	5-Aug-92	10-Aug-92	30-Jul-92	31-Jul-92	31-Jul-92	3-Aug-92	7-Aug-92
4,4'-DDD	0.013 JV	0.012 J		0.024 JV				0.015 J										
4,4'-DDE	0.013 JV	0.015 J	0.067 JV	0.027 JV	0.01 JV			0.011 J										0.014 J
alpha-BHC			0.1 V									0.02 JV						0.032 J
alpha-Chlordane	0.056 JV																	
delta-BHC		0.017 J	0.068 V		0.058 VR#			0.018 JVR#					0.02 J					
Dieldrin	0.18 V	0.0063 J	0.47 V	0.04 JV					0.011 J	0.042 JV	0.033 JV							0.044 J
Endosulfan II			2.1 V								0.053 JV							
Endosulfan sulfate	0.04 BJVR#						0.051 BJVR#			0.047 BJVR#	0.031 BJVR#					0.011 JR#		
Endrin										0.023 JV								
Endrin ketone																		
gamma-BHC																		
Methoxychlor			0.27 JV	0.15 JV														
PCB-1016			0.84 J															
PCB-1260			1 J															

	MW-117	MW-117B	MW-118AR	MW-118B	MW-119	MW-119B	MW-120	MW-120B	MW-121	MW-121B	MW-122	MW-122B	MW-123AR	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	31-Jul-92	7-Aug-92	29-Jul-92	29-Jul-92	5-Aug-92	7-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92	30-Jul-92	6-Aug-92
4,4'-DDD					0.011 JV				0.037 JV									
4,4'-DDE							0.013 J	0.017 JV										0.052 J
alpha-BHC								0.011 JV		0.0082 J	0.0093 JV							
alpha-Chlordane																		
delta-BHC			0.011 BJVR#									0.02 J						
Dieldrin						0.014 J	0.03 J											0.091 J
Endosulfan II																		
Endosulfan sulfate	0.059 JR#	0.036 J				0.052 J							0.011 JVR#					
Endrin																		
Endrin ketone						0.057 J												
gamma-BHC																		0.037 J
Methoxychlor							0.41 J											
PCB-1016																		
PCB-1260																		

Notes:
All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
AR=Archived portion of sample reanalyzed
B=Blank contaminant
J = Estimated value
R# = Negated result
V = Reported results for this compound could not be verified during data validation

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-22
Monitoring Wells - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-114B
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	3-Aug-92	28-Jul-92	29-Jul-92	31-Jul-92	28-Jul-92	28-Jul-92	5-Aug-92	10-Aug-92	30-Jul-92
Aluminum	460	874			30300 N	305	1170	351	156 B	9510	3460 N	2040	1080
Antimony					51.2 B	56.3 BJR#	52.5 BJR#						
Arsenic		7.2 BJ	13.4	2.3 BW	10.1 B			6.2 B	2 B	3.7 B	6.2 B	15.8 J	1.8 BJ
Barium	57 B	983	1030	946	908 EN	167 B	539	129 B	891	393	1110 EN	164 B	210
Beryllium					0.6 B								
Cadmium			9.6	6.6									
Calcium	259000	122000	57700	147000	79900 E	100000	180000	150000	87400	99900	437000 E	53600	338000
Chromium		110	312	56	165		25.4	18.6	13.7	39.9	23.2	36.5	
Cobalt		16 BJR#	39.9 B	8.3 B	42.3 BJNR#	78.7		29.2 BJR#	24.4 B	23.2 B	59 N	19.3 BJR#	8 BJR#
Copper	590	50.6 S	471	182	173	13.3 BJR#	52.5	20.7 B	61.9	43.9	771	7.3 B	
Cyanide		10.8		24.6						22.6			
Iron	2160	6110	11200	15100	62600 E	657	9770	19200	11900	18800	10300 E	12100	1210
Lead	40.2	51.9	65.1 S	9.5 B+	36.3 J		68.3	2.8 BJR#	7.7	26.2 S	30.3	3.6 B	1.2 B
Magnesium	921000	252000	44300	296000	104000	43700	288000	201000	50800	45800	220000	54500	56500
Manganese	162	111	75.8	98.8	2030 E	5100	121	8920	630	3060	24500 E	691	147
Mercury	1.2			0.2 BJ									
Nickel		26 BJ	73.3	14.9 B	246	483	18.3 B	227	106	182	267	67.4 J	
Potassium	300000	331000	563000	309000	84300	5850	170000	97000	129000	94400	50200	243000	17100
Selenium		13.6 BN											
Silver		8.6 BNWJR#									4.8 B	4.1 BNJR#	
Sodium	8764000	3053000	3154000	3836000	566000	116000	3150000	2268000	316000	428000	790000	709000	1151000
Thallium													
Vanadium	5.7 B	244	869	102	109		46.3 B	9.6 B	5.2 B	23.7 B	14.5 BJR#	33.8 B	
Zinc	70.2	45	139	43.9	141 E	34.9	99	15.9 BJR#	24.4 JR#	39.9	88.9 E	17.3 B	28.2

Notes: All concentrations in microgram per liter (ppb)

Blank indicates compound was not detected

B = Reported value is acceptable. Reported value is less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit)

E = Estimated value due to matrix interference

J = Estimated value.

N= Estimated value (Spiked sample recovery was not within quality control limits)

R = Rejected result

R# = Negated result

S = Reported value is acceptable. Reported value was determined by the Method of Standard Additions (MSA)

W = Estimated value (Post-digestion spike sample results were reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)

+ = Estimated value (The correlation coefficient reported for the MSA is less than 0.995)

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-22
Monitoring Wells - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-120B	MW-120H	MW-120L	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	4-Aug-92	20-Aug-92	20-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	3-Aug-92	3-Aug-92	30-Jul-92	30-Jul-92	6-Aug-92
Aluminum		234	534 J	1430 N	2300 N	941 N		2450	11000 N	3670 N	3930	2010	3230
Antimony											55.5 BJ		
Arsenic	4.5 B			11 B	4.4 B	21.9	3.3 B	2.1 BW	4.5 B	2.1 B	7 BJ	1.8 BJ	63.4
Barium	70 BEN	782 J	973 J	437 EN	547 EN	807 EN	441	111 B	218 EN	73 BEN	112 B	163 B	3090
Beryllium		4.5 B	8.7										
Cadmium							6.8 R				5.2 WR#		7.5 R
Calcium	547000 E	94100 J	67100 J	60600 E	943000 E	158000 E	141000	35300	55400	54100	93100	1297000	19100
Chromium		297 J	409 J	42.1	23.6	33.8	21	15.4	72.7		26.6	15.7	1240
Cobalt	13.8 BNJR#	67.6	60.8	42.2 BNJR#	13.8 BNJR#	45.7 BNJR#	34.4 B	17 B	28.7 BNJR#	11.2 BNJR#	23.3 BJR#	22.3 BJR#	77.3
Copper	13.7 BJR#	32.5	45.8	34.1 JR#	50.7	47.7	20.5 B	14.6 BJR#	75.3 BJR#	12.1 BJR#	16.2 B	24.3 B	356
Cyanide													30.4
Iron	3760 E	3660 EJ	6350 EJ	8540 E	6450 E	63300 E	10800	4440	26600 E	4390 E	24200	10800	39400
Lead				2.9 B	34	14.2	11.3 JR#	7.2	23.1	3.4 B	6.1	16.1 +	423
Magnesium	901000	255000 J	142000 J	275000	98200	319000	328000	23500	63500	8940	250000	829000	13700
Manganese	2200 E	678	312 J	1640 E	117 E	6870 E	2220	2100	4310 E	93.6 E	1040	2240	265
Mercury		0.26	0.39	0.24 N									1.1
Nickel		216 J	158	328		414	322	65	168		304	126 J	213
Potassium	137000	558000 J	668000 J	246000	47500	100000	101000	5390	9790	17800	100000	93300	1431000
Selenium													
Silver				3.5 B		3.7 B				5.4 B	7.1 BNJR#	5.7 BNJR+	
Sodium	7449000	4440000 J	3567000 J	4242000	1224000	1786000	2505000	36300	404000	10700	2449000	6909000	6924000
Thallium													
Vanadium	5 B	955 J	1370 J	19.7 B	11.1 B	16.6 B	9.9 B	8.9 B	29.8 B	14.3 B	11.9 B	4.6 B	2860
Zinc	20.2 E	66.6 EJ	123 J	8.5 BE	37.5 E	30.7 E	37.9	15.1 BJR#	48.8 E	53.4 E	20.6	50	1390

Notes: All concentrations in microgram per liter (ppb)

Blank indicates compound was not detected

B = Reported value is acceptable. Reported value is less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit)

E = Estimated value due to matrix interference

J = Estimated value.

N= Estimated value (Spiked sample recovery was not within quality control limits)

R = Rejected result

R# = Negated result

S = Reported value is acceptable. Reported value was determined by the Method of Standard Additions (MSA)

W = Estimated value (Post-digestion spike sample results were reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)

+ = Estimated value (The correlation coefficient reported for the MSA is less than 0.995)

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-23
Monitoring Wells - Conventional Parameters (Modified BMW List) Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-113	MW-113B	MW-114	MW-114B	MW-115	MW-115D DUP	MW-115B	MW-115BP	MW-115P	MW-116	MW-116B	MW-117
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	3-Aug-92	29-Jul-92	29-Jul-92	31-Jul-92	28-Jul-92	5-Aug-92	10-Aug-92	30-Jul-92	31-Jul-92	31-Jul-92	31-Jul-92	14-Aug-92	12-Aug-92	3-Aug-92	7-Aug-92	31-Jul-92
Alkalinity as Bicarbonate	225	2760	5880	2040	780	34	1064	1640	1350	1470	2000	41	950	970	570			106	1480	1580
Alkalinity as Carbonate																			720	
Ammonia Nitrogen	4.86	320	234	159	64	3.00	113	82.9	77.8	26.7	240	0.37	59.6	60.8	2.95				0.17	221
Chemical Oxygen Demand	258 J	997	3250	724 J	177		394 J	421 J	181	517	509									428 J
Chloride	14700	3720	6040	4270 J	780	468	5120	3160	514	1130	638	2460	2110	1950	2440	2550	2170	30	105	1990
Nitrate Nitrogen	0.22		0.23	0.23	0.04		1.81	0.05		0.02		0.02	0.04	0.03	0.03			0.11	0.104	0.02
Sulfate	1490	356	277	542	224	125	435	315	102	69	55	177	120	110	158			80	42	128
Total Dissolved Solids	26000	9230	10500	9870 J	2250	1170	10540	6920	1620	4270	2680	5320	4700	4680	6370			304	1130	3710
Total Kjeldahl Nitrogen	9.37 J	451 J	1010 J	335 J	68.7	0.36 J	168 J	134	156 J	52	372 J	1.1 J	73.6 J		8.52			0.28	0.72	281 J

	MW-117B	MW-118	MW-118B	MW-119	MW-119B	MW-119D	MW-120	MW-120B	MW-120H	MW-120L	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	7-Aug-92	29-Jul-92	6-Aug-92	5-Aug-92	7-Aug-92	7-Aug-92	4-Aug-92	4-Aug-92	20-Aug-92	20-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	3-Aug-92	3-Aug-92	30-Jul-92	30-Jul-92	6-Aug-92
Alkalinity as Bicarbonate	332	924	35	574	190	594	5050	724			2780	60	1780	2370	1100	70	69	1560	1030	1346
Alkalinity as Carbonate			10														6			900
Ammonia Nitrogen		96.8	1.83	40.6	3	37.9	604	3.28			91.8		16.9	0.93				0.34	0.52	1260
Chemical Oxygen Demand		480 J	1380 J	620 J	635		2360	628 J			997	170 J	805					436 J	580 J	8170
Chloride	2150	10570	10460 J	11240	11740	11360	5320	13560	5500	3740	4980	3210	1840	3050 J	179	590	11	2940	11980	5140 J
Nitrate Nitrogen	0.084	23		0.23		0.24											0.01			
Sulfate	149	594	599	1680	520	1720	713	494			336	364	86	98	30	102	60	161	408 J	759
Total Dissolved Solids	3110	24500	24250	25200	27100	25300	15200	28300			13000	7380	5730	8640	334	1410	194	7360	26300	12200
Total Kjeldahl Nitrogen	0.29	151 J	4.27	52.6	3.83		1640	4.95			132	2.4	35.1	24.9	0.32 J		0.37	10.7 J	9.79 J	1200

Notes:

All concentrations in milligrams per liter (ppm)
Blank indicates compound was not detected
D = Laboratory QA/QC duplicate
DUP = Duplicate sample
J = Estimated value

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-24
Seeps - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
Halogenated Aliphatic Compounds									
Methylene chloride	2 JBR#	2 JBR#	2 JBR#	19 JBR#	12 JBR#	11 JBR#	2 JBR#	1 JBR#	2 JBR#
Total									
Ketones									
2-Butanone	62								
2-Propanone	13 JR#						12		
Total	62						12		
Monocyclic Aromatic Hydrocarbons									
Benzene	4 J						4 J	2 J	
Chlorobenzene	5 J	2 J		10	2 J		12	4 J	2 J
Ethylbenzene	15				1 J		5	2 J	
Toluene	81						7		
Xylenes (total)	65						8	4 J	
Total	170	2		10	3		36	12	2
Miscellaneous									
Carbon Disulfide	3 J						1 J		
Total	3						1		
Grand Total	235	2		10	3		49	12	2

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
J = Estimated value
R# = Negated

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-25
Seeps - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
PAHs									
2-Methylnaphthalene	5 J						4 J		
Acenaphthene	12						3 J		
Anthracene	8 J								
Dibenzofuran	9 J	10							
Fluorene	12								
Naphthalene							33	3 J	
Phenanthrene	24						3 J		
Pyrene	4 J								
Total	74	10					43	3	
Phenols									
2,4-Dimethylphenol	7 J						51		
4-Methylphenol	8 J								
4-Nitrophenol		4 J							
Total	15	4					51		
Phthalates									
Bis(2-Ethylhexyl) Phthalate	13	5 J					5 J	3 J	7 J
Di-n-butyl phthalate							3 J	2 J	
Di-n-octyl phthalate	2 J								
Total	15	5					8	5	7
Chlorinated Hydrocarbons									
1,2-Dichlorobenzene				5 J					
1,3-Dichlorobenzene				5 J					
1,4-Dichlorobenzene				9 J			4 J		
Total				19			4		
Miscellaneous									
Benzoic Acid		33 J							
Total		33							
Grand Total	104	52		19			106	8	7

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
J = Estimated value

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-26
Seeps - Pesticides and PCBs Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2AR	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
4,4'-DDD		0.042 JV			0.015 JV				0.078 JV
4,4'-DDE		0.049 JV			0.026 V			0.078 JV	
Aldrin									0.058 JV
alpha-Chlordane		0.025 JV							
beta-BHC		0.033 JV							
delta-BHC		0.047 JV		0.01 JV	0.028 JV	0.0099 J			0.03 JV
Dieldrin					0.24 V		0.23 V	0.64 V	0.024 JV
Endosulfan II							1.5 V		
Endosulfan sulfate		0.042 BJVR#			0.028 BJVR#				
Endrin	0.023 JV							0.062 JV	
Methoxychlor								0.65 V	
PCB-1016		0.88 J							

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
B = Blank contaminant
J = Estimated value
V = Reported results for this compound could not be verified during data validation
R# = Negated result

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-27
Seeps - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
Aluminum	2380	1300	839		65800	501	4480	3410	60300
Antimony					70.3				
Arsenic	40.3 +	7.5 B	2.7 BW	8.3 B	89.1		18.7 B+	14.5	1.6 B
Barium	1060	660	104 B	287	1490	123 B	590	844	8470
Beryllium					1 B				1.2 BJ
Boron	8900	4200	2520	1570	4680	2820	6910	6800	4330
Cadmium									29.1
Calcium	35600	76500	282000	65600	218000	228000	134000	116000	301000
Chromium	289	62.3		27.2	390	26	293	180	483
Cobalt	54.2	16.2 B		12.5 B	61.7		34.8 B	24.4 B	57.4
Copper	56.8	41.6	20.7 B	6.1 B	977	11.7 B	54.8	70.7	852
Cyanide		20.4							26.2
Iron	9760 E	44400 E	4070 E	2990 E	136000 E	2970 E	12500 E	24900 E	860000 E
Lead	104	146	17.4	3 B	707	7 B+	58.5	88.7	2780
Magnesium	80200	66400	899000	46300	481000	795000	333000	175000	120000
Manganese	130	259	140	546	2260	162	523	239	4290
Mercury		0.34			2	5			1.6
Nickel	127 J	25.4 BJ		46.8 J	137 J		54 J	48.7 J	161 J
Potassium	650000	269000	306000	101000	402000	282000	562000	456000	256000
Silver					12.1				
Sodium	4146000	743000	7912000	862000	5931000	7587000	5676000	2781000	672000
Thallium						16.77			
Vanadium	562	29.8 B	4.9 B	34.2 B	368	46 B	822	397	367
Zinc	226	201	48.8	48.4	1330	28.1	136	177	3710

Notes: All concentrations in micrograms per liter (ppb)

Blank indicates compound was not detected

B = Reported value is acceptable. Reported value is less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit)

J = Estimated value

E = Estimated value due to matrix interference

W = Estimated value (Post-digestion spike results were reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)

+ = Estimated value (The correlation coefficient reported for the MSA is less than 0.995)

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-28
Seeps - Conventional Parameters (Modified BMW List) Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-2D	LS-3	LS-4	LS-4 D	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
Alkalinity as Bicarbonate	5900	2300		200	1170	1190	1030	610	801	3320	6000
Alkalinity as Carbonate		80	84							98	
Ammonia Nitrogen	637	74.8		5.54	151	161	373	44.2	404	85.1	317
BOD	190	41		< 3	24		277	7	157	107	NA
Chemical Oxygen Demand		716 J			369 J		2040 J	295 J		1230 J	2370 J
Chloride	3740	1420		11400	1170	1140	12250 J	11680	6830	2860 J	1310
Color, Pt/Co	300	200		60	200		240	200	300	200	NA
Hardness	419	465		4410	354	332	2520	3840	1710	1010	1240
Hexavalent Chromium	0.4	0.08		< 0.01	0.03		0.02	0.02	0.56	0.21	NA
Nitrate Nitrogen	0.06	0.71		0.44	1.02	1.01	6.26 J	0.24	0.35	0.35	0.22
Odor, T.O.N	10	10		1	10		50	10	10	10	NA
Phenolics	0.12 J								0.1 J		
Sulfate	379	110		1770	157	155	1680	1690	599	335	320
Total Dissolved Solids	12900	2850 J		26100	3190	3180	24300	24400	17460	8420	3250
Total Kjeldahl Nitrogen	1110 J	366 J		6.27 J	175 J		506 J	75.6 J	718 J	542 J	408 J
Total Organic Carbon	1900	450		14	140	140	110	59		780	360
Total Volatile Solids	1480	641		3560	307	314	4500	3170	2120	1060	2510

Notes:

All concentrations in milligrams per liter (ppm) except for color and odor
Blank indicates compound was not detected
D = Laboratory QA/QC duplicate
J = Estimated value
NA = Not Analyzed

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-29
Seeps - Volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
Cineole (Van)	9 J								
Unknown	30 J						11 J	21 J	
Unknown Alcohol	6 J								
Unknown Cycloalkane	110 J						43 J	24 J	
Unknown Dichlorobenzeneisome				56 J					
Unknown Ketone	7 J								

Notes:

All units in micrograms per liter (ppb)
Blank indicates compound was not detected
J = Estimated value

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-30
Seeps - Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
1,3-Benzenediol				8 J					22 J
1-Propene, 2-Fluoro-	46 J								
3-Octyne, 7-Methyl-	110 J								
Benzoic Acid, 3,5-Dimethyl-								50 J	
Benzoic Acid, 3-Methyl-							110 J		
Benzoic Acid, 4-Methyl-, Met		85 J							
Butanoic Acid, Methyl Ester	75 J								
Camphor					13 J		170 J		
Cholest-5-En-3-Ol (3. Beta.)					12 J				
Fenchone					11 J		100 J	80 J	
Hexadecanoic Acid					16 J				
Hexadecanoic Acid, Tetradecy		13 J							
Hexanedioic Acid, Dioctyl Es	360 JBR#							660 JBR#	
Neophytadiene		14 J			9 J				49 J
Phenol, 2,6-Bis(1,1-Dimethyl		33 J							
Phenol, 4,4'-(1-Methylethyl)									29 J
Phenol, 4-(1,1-Dimethylethyl)		18 J							
Sulfur, Mol					46 J				
Tosyl Derivative Of Ethylami		18 J							31 J
Tosyl Dimethylamine								33 J	
Unknown	677 J	186 J		83 J	57 J		941 J	495 J	495 J
Unknown Alcohol		22 J					90 J	16 J	46 J
Unknown Alkane		61 J							526 J
Unknown Alkene								31 J	
Unknown Carboxylic Acid				17 J	39 J				
Unknown Cycloalkane							59 J	36 J	
Unknown Cycloketone	11 J								
Unknown Hydrocarbon				27 J					
Unknown Ketone	196 J						49 J		
Unknown Methyl Phenol					13 J				
Unknown PAH							42 J		
Unknown Phenol				11 J					
Unknown Phthalate		15 JBR#	11 JBR#	17 J	14 JBR#				17 JR#

Notes:

All units in micrograms per liter (ppb)
Blank indicates compound was not detected
B = Blank contaminant
J = Estimated value
R# = Negated result

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-31
Monitoring Wells - Volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-115	MW-115B	MW-116	MW-116B	MW-117
2-Pentanone, 4,4-Dimethyl											9 J						
Butane, 2-Methoxy-2-Methyl-																10 J	
Cineole (Van)																	
Propane, 2-Methoxy-2-Methyl-																40 J	
Silanol, Trimethyl- (8CI9CI)		5 J										6 J					
Unknown			59 J													6 J	
Unknown Alkane																	
Unknown Benzene Isomer																56 J	
Unknown Cycloalkane			82 J														
Unknown Cycloketone																	
Unknown Dichlorobenzene Iso								14 J									
Unknown Ketone																	

	MW-118	MW-118B	MW-119	MW-119B	MW-120	MW-120B	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126	MW-126 RE
2-Pentanone, 4,4-Dimethyl																	
Butane, 2-Methoxy-2-Methyl-																	
Cineole (Van)																17 J	
Propane, 2-Methoxy-2-Methyl-																	
Silanol, Trimethyl- (8CI9CI)									5 J								
Unknown		53 J		21 J	16 J							7 J				80 J	
Unknown Alkane				6 J													
Unknown Benzene Isomer				40 J													
Unknown Cycloalkane																	
Unknown Cycloketone					58 J											240 J	
Unknown Dichlorobenzene Iso																	
Unknown Ketone										5 J							

Notes:

All units in micrograms per liter (ppb)
Blank indicates compound was not detected
J = Estimated value
Re = Reanalysis

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-32
Monitoring Wells - Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-115	MW-115B	MW-116	MW-116B	MW-117
Alpha.-Terpineol																	
1-Decanol																	
1-Dodecanol																	
1-Hexanol, 2-Ethyl-																14 J	
1-Phenanthrenecarboxylic Acid																	
2(3H)-Benzothiazolone																	
2,3,5-Trimethylpyrazine																	
2,5-Cyclohexadiene-1,4-Dione																	
2-Butanol																	
3-Pentanol																	
5-Hepten-2-One, 6-Methyl-																	
Benzene, 1,2,3-Trimethyl-																9 J	
Benzene, 1,2,4-Trimethyl-																10 J	
Benzene, 1-Ethyl-2-Methyl-																25 J	
Benzeneacetic Acid, Ethyl Es																	
Benzeneacetic Acid, Methyl E																	
Benzenesulfonamide, N-Ethyl-																	
Benzoic Acid, 2-Mercapto-			300 J														
Benzoic Acid, 3,4-Dimethyl-		13 J															
Benzoic Acid, 4-(1,1-Dimethy				36 J			11 J	29 J									18 J
Benzoic Acid, 4-Methyl-, Met										67 J							
Butanoic Acid, Methyl Ester					10 J												
Camphor		63 J	310 J														
Decanoic Acid																	
Fenchone																	
Hexadecanoic Acid																	
Hexanedioic Acid, Dioctyl Es													8 J				
Hexanoic Acid, 3,5,5-Trimeth					54 J												
Isomer Pyrazine								10 J									
Morpholine, 4-Nitroso-										15 J							
Napthalene, 1-Methyl-			71 J														
Nonanoic Acid																10 J	
Phenol, 2,6-Bis(1,1-Dimethyl																12 J	
Phenol, 2-(1,1-Dimethylethyl)																	
Phenol, 4,4'-(1-Methylethyl)								110 J	12 J	11 J		76 J	20 J				
Phenol, 4-(1,1-Dimethylethyl)												20 J					18 J
Pyrazine, Tetramethyl-			19 J														
Sulfur, Mol. (S8)				13 J													
Thiocyanic Acid, 4-Hydroxyph									31 J								

Table 4-32
Monitoring Wells - Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-115	MW-115B	MW-116	MW-116B	MW-117
Tosyl Deriv. Of Ethylami 14.53								39 J									
Tosyl Deriv. Of Ethylami 15.26								25 J									
Tosyl Derivative Of Ethylami		17 J							13 J	11 J		27 J					
Tosyl Derivative Of Ethylamine				15 J													
Tosyl Dimethylamine		33 J					8 J										12 J
Unknown	185 J	160 J	1084 J	158 J	52 J	58 J	43 J	248 J	96 J	51 J	585 J	422 J	88 J	59 J		48 J	95 J
Unknown Alcohol		10	40									9					
Unknown Alkane			36 J								16 J						
Unknown Alkene				9 J								9 J					
Unknown Alkyne																	
Unknown Aromatic																	
Unknown Benzoic Acid																	
Unknown Carboxylic Acid		10 J						40 J				12 J	29 J				16 J
Unknown Cycloalkane																	
Unknown Diene			250 J														
Unknown Diol								26 J				18 J					
Unknown Ester					48 JBR#						1100 J						
Unknown Ketone			22 J														
Unknown Phenol																	
Unknown Phthalate	18 JBR#	10 JBR#		13 J	12 JBR#	28 JBR#	8 J	12 JBR#	18 JBR#	11 JBR#		11 JBR#	23 JBR#	21 JBR#	12 JBR#	10 J	19 JBR#
Unknown Quinoline																	
Unknown Siloxane					49												

Notes:

All units in micrograms per liter (ppb)
Blank indicates compound was not detected
B = Blank contaminant
J = Estimated value
R# = Negated result

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-32
Monitoring Wells - Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-118	MW-118B	MW-119	MW-119B	MW-120	MW-120B	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126	MW-126 RE
Alpha.-Terpineol																800 J	260 J
1-Decanol		220 J															
1-Dodecanol		78 J															
1-Hexanol, 2-Ethyl-				21 J													
1-Phenanthrenecarboxylic Acid					290 J												
2(3H)-Benzothiazolone										70 J							
2,3,5-Trimethylpyrazine										28 J							
2,5-Cyclohexadiene-1,4-Dione								22 J									
2-Butanol	22 J																
3-Pentanol	9 J																
5-Hepten-2-One, 6-Methyl-																210 J	
Benzene, 1,2,3-Trimethyl-																	
Benzene, 1,2,4-Trimethyl-																	
Benzene, 1-Ethyl-2-Methyl-																	
Benzeneacetic Acid, Ethyl Es																	120 J
Benzeneacetic Acid, Methyl E																280 J	
Benzenesulfonamide, N-Ethyl-										26 J							
Benzoic Acid, 2-Mercapto-																	
Benzoic Acid, 3,4-Dimethyl-																	
Benzoic Acid, 4-(1,1-Dimethy	9 J																
Benzoic Acid, 4-Methyl-, Met																	
Butanoic Acid, Methyl Ester																	
Camphor	38 J														10 J	570 J	180 J
Decanoic Acid										44 J							
Fenchone					120 J											480 J	540 J
Hexadecanoic Acid								8 J									
Hexanedioic Acid, Dioctyl Es																	
Hexanoic Acid, 3,5,5-Trimeth																	
Isomer Pyrazine																	
Morpholine, 4-Nitroso-																	
Napthalene, 1-Methyl-																	
Nonanoic Acid																	
Phenol, 2,6-Bis(1,1-Dimethyl																	
Phenol, 2-(1,1-Dimethylethyl)														9 J			
Phenol, 4,4'-(1-Methylethyl)																	
Phenol, 4-(1,1-Dimethylethyl)																	
Pyrazine, Tetramethyl-																	
Sulfur, Mol. (S8)																	
Thiocyanic Acid, 4-Hydroxyph																	

Table 4-32
Monitoring Wells - Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-118	MW-118B	MW-119	MW-119B	MW-120	MW-120B	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126	MW-126 RE
Tosyl Deriv. Of Ethylami 14.53																	
Tosyl Deriv. Of Ethylami 15.26																	
Tosyl Derivative Of Ethylami																	
Tosyl Derivative Of Ethylamine																	
Tosyl Dimethylamine																	
Unknown		1250 J		720 J	1028 J	455 J	409 J	678 J	668 J	372 J		21 J		36 J	69 J	1626 J	2059 J
Unknown Alcohol		103															
Unknown Alkane		464 J		531 J				31 J	23 J					10 J			
Unknown Alkene		44 J															
Unknown Alkyne																	120 J
Unknown Aromatic																	120 J
Unknown Benzoic Acid					57 J												
Unknown Carboxylic Acid	22 J													22 J	28 J	62 J	120 J
Unknown Cycloalkane																82 J	
Unknown Diene																	
Unknown Diol																	
Unknown Ester			740 J	163 J					34 J			370 JB	220 JB			720 J	770 J
Unknown Ketone										32 J				21 J		180 J	
Unknown Phenol										25 J							
Unknown Phthalate	9 J		13 J				11 J				11 J		11 JBR#	10 JBR#	12 JBR#		
Unknown Quinoline	8 J																
Unknown Siloxane												33					

Notes:

All units in micrograms per liter (ppb)
Blank indicates compound was not detected
B = Blank contaminant
J = Estimated value
R# = Negated result

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-33
Comparison of Monitoring Well and Seep Samples to NYSDEC Groundwater Standards
Pelham Bay Landfill
Bronx, New York

Compound	NYSDEC SCG[1] (ug/l)	Range of Concentrations (ug/l)	Samples that Exceed Standards
Benzene	0.7	1 to 62	104, 105, 106, 111, 113, 113B, 116B, 120, 121, 122, 122B, 125, 125B, LS-1, LS-9, LS-10
Chlorobenzene	5	1 to 46	104, 111, 112, 113, 113B, 114, 120, 122, 122B, LS-4, LS-9
Ethylbenzene	5	3 to 36	105, 116B, 119B, 120, LS-1
Methylene Chloride	5	1 to 150	(2)
Toluene	5	1 to 230	116B, 120, 126, LS-1, LS-9
Xylenes	5	4 to 200	116B, 119B, 120, 126, LS-1, LS-9
Acenaphthene	20*	2 to 18	
Anthracene	50*	2 to 8	
Fluoranthene	50	2 to 10	
Fluorene	50*	2 to 15	
Naphthalene	10*	2 to 140	105, 120, 126, LS-9
Phenanthrene	50*	3 to 35	
Pyrene	50*	2 to 9	
1,2-Dichlorobenzene	4.7	5	LS-4
1,3-Dichlorobenzene	5	5	
1,4-Dichlorobenzene	4.7	4 to 9	113B, LS-4
N-Nitrosodiphenylamine	50*	4 to 17	
bis(2-Ethylhexyl)phthalate	50	2 to 38	
Aldrin	Non-detect	0.058	LS-2
Dieldrin	Non-detect	0.0063 to 0.64	103, 104, 105, 106, 111, 112, 113, 116B, 119B, 120, 126, LS-2, LS-5, LS-9, LS-10
4,4' DDD	Non-detect	0.011 to 0.078	103, 104, 106, 110, 119, 121, LS-1, LS-2, LS-5
4,4' DDE	Non-detect	0.01 to 0.078	103, 104, 105, 106, 110, 116B, 120, 120B, 126, LS-2, LS-5, LS-10
Antimony	3*	51.2 to 56.3	107, 125, LS-5
Arsenic	25	2.3 to 89.1	118B, 126, LS-1, LS-5
Barium	1,000	60 to 8470	105, 113B, 118B, 126, LS-1, LS-2, LS-5
Boron	1,000	1570 to 8900	LS-1, LS-2, LS-3, LS-4, LS-5, LS-7, LS-9, LS-10 (3)
Cadmium	10	5.4 to 29.1	LS-2
Chromium	50	18.6 to 1240	104, 105, 106, 107, 115, 116B, 117, 118B, 119B, 120, 124, 126, LS-1, LS-2, LS-5, LS-9, LS-10
Hexavalent Chromium	50	20 to 560	LS-1, LS-2, LS-9, LS-10 (3)
Cobalt	34	8.1 to 77.3	105, 109, 113B, 115, 115B, 117, 118B, 126, LS-1, LS-2, LS-5
Copper	200	7.3 to 1130	103, 105, 113B, 118B, 126, LS-2, LS-5
Iron	300	165 to 860,000	All monitoring well and seep samples except 117B
Lead	25	7.7 to 2,780	103, 104, 105, 107, 110, 113, 113B, 118B, 119, 121B, 126, LS-1, LS-2, LS-9, LS-10
Magnesium	35,000*	5,290 to 1,936,000	All monitoring well and seep samples except 116, 116B, 124B
Manganese	300	75.8 to 29,600	107, 109, 111, 112, 113, 113B, 114, 115, 115B, 116, 117, 118B, 119, 119B, 120, 120B, 121, 122, 122B, 123, 124, 125, 125B, LS-2, LS-4, LS-5, LS-9
Mercury	2	0.2 to 5	LS-7
Selenium	10	13.6	104
Sodium	20,000	10,700 to 8,000,000	All monitoring well and seep samples except 124B
Thallium	4*	2.8 to 16.8	118, LS-7
Zinc	300	6.5 to 7,110	118B, 119B, 126, LS-2, LS-5
TDS	500,000	304,000 to 27,100,000	All monitoring well and seep samples except 116, 123, 124B
Ammonia	2,000	170 to 1,260,000	All monitoring well and seep samples except 114B, 116, 116B, 117B, 121B, 123, 124, 124B, 125, 125B
Chloride	250,000	11,000 to 12,250,000	All monitoring well and seep samples except 116, 116B, 124B
Cyanide	100	10.8 to 267	118
Nitrate	10,000	20 to 23,000	118
Sulfate	250,000	46,000 to 1,690,000	104, 105, 106, 110, 111, 118, 118B, 119, 119B, 120, 120B, 121, 121B, 126, LS-1, LS-2, LS-3, LS-4, LS-5, LS-7, LS-9, LS-10

Notes:

* Guidance value, regulated standard for this chemical is not available

1. New York State Department of Environmental Conservation, Water Quality Standards and Guidance Values, September 25, 1990, 6NYCRR Part 700-705
2. Compound was also detected in blank sample
3. Indicates compound was only analyzed in the leachate seep samples

Prepared by:SMM
Checked by: TRP
92C4087

Table 4-34
Compounds that Exceed NYSDEC Groundwater Standards by Sampling Location
Pelham Bay Landfill
Bronx, New York

Samples	Compounds that Exceed NYSDEC Groundwater Standards
MW-103	4,4' DDD, 4,4' DDE, dieldrin, copper, lead, iron, magnesium, sodium, TDS, chloride, ammonia
MW-104	4,4' DDD, 4,4' DDE, benzene, chlorobenzene, dieldrin, chromium, iron, lead, magnesium, selenium, sodium, TDS, ammonia, chloride, sulfate
MW-105	4,4' DDE, benzene, ethylbenzene, naphthalene, dieldrin, barium, chromium, cobalt, copper, iron, lead, magnesium, sodium, TDS, chloride, sulfate, ammonia
MW-106	4,4' DDD, 4,4' DDE, benzene, dieldrin, chromium, iron, magnesium, sodium, TDS, chloride, sulfate, ammonia
MW-107	antimony, chromium, cobalt, iron, lead, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-108	iron, magnesium, sodium, TDS, chloride
MW-109	cobalt, iron, lead, magnesium, manganese, sodium, TDS, chloride, ammonia
MW-110	4,4' DDD, 4,4' DDE, iron, lead, magnesium, sodium, TDS, chloride, sulfate, ammonia
MW-111	benzene, chlorobenzene, dieldrin, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-113	benzene, chlorobenzene, dieldrin, iron, lead, magnesium, manganese, sodium, TDS, chloride, ammonia
MW-113B	benzene, chlorobenzene, 1,4-dichlorobenzene, barium cobalt, copper, iron, lead, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-114	chlorobenzene, iron, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-114B	iron, magnesium, manganese, sodium, TDS, chloride
MW-115	chromium, cobalt, iron, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-115B	cobalt, iron, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-116	iron, manganese, sodium
MW-116B	4,4' DDE, benzene, ethylbenzene, toluene, xylenes, dieldrin, chromium, iron, sodium, TDS
MW-117	chromium, cobalt, iron, magnesium, manganese, sodium, ammonia, chloride
MW-117B	magnesium, sodium, TDS, chloride
MW-118	iron, magnesium, sodium, thallium, TDS, chloride, cyanide, nitrate, sulfate, ammonia
MW-118B	arsenic, barium, chromium, cobalt, copper, iron, lead, magnesium, manganese, sodium, TDS, chloride, sulfate
MW-119	4,4' DDD, iron, lead, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-119B	4,4' DDD, ethylbenzene, xylenes, dieldrin, chromium, iron, magnesium, manganese, sodium, zinc, TDS, ammonia, chloride, sulfate
MW-120	4,4' DDE, benzene, chlorobenzene, ethylbenzene, toluene, xylenes, naphthalene, dieldrin, chromium, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-120B	4,4' DDE, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-121	4,4' DDD, benzene, iron, magnesium, manganese, sodium, ammonia, chloride, sulfate
MW-121B	iron, lead, magnesium, sodium, TDS, chloride, sulfate
MW-122	benzene, chlorobenzene, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-122B	benzene, chlorobenzene, iron, magnesium, manganese, sodium, TDS, chloride, sulfate
MW-123	iron, magnesium, manganese, sodium, chloride
MW-124	chromium, iron, magnesium, manganese, sodium, TDS, chloride
MW-124B	iron
MW-125	benzene, antimony, iron, magnesium, manganese, sodium, TDS, chloride
MW-125B	benzene, iron, magnesium, manganese, sodium, TDS, chloride
MW-126	4,4' DDE, toluene, xylenes, naphthalene, dieldrin, arsenic, barium, chromium, cobalt, copper, iron, lead, magnesium, manganese, sodium, zinc, TDS, ammonia, chloride, sulfate
LS-1	4,4' DDD, benzene, toluene, xylenes, arsenic, boron, chromium, hexavalent chromium, iron, lead, magnesium, sodium, TDS, ammonia, chloride, sulfate
LS-2/LS-2DUP	4,4' DDD, 4,4' DDE, aldrin, dieldrin, barium, cadmium, chromium, hexavalent chromium, cobalt, copper, iron, lead, magnesium, manganese, sodium, zinc, TDS, ammonia, chloride, sulfate
LS-3	boron, iron, magnesium, sodium, TDS, ammonia, chloride, sulfate
LS-4	chlorobenzene, 1,4-dichlorobenzene, boron, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
LS-5	4,4' DDD, 4,4' DDE, dieldrin, antimony, barium, boron, chromium, cobalt, copper, iron, magnesium, manganese, sodium, zinc, TDS, ammonia, chloride, sulfate
LS-7	boron, iron, magnesium, sodium, thallium, TDS, ammonia, chloride, sulfate
LS-9	benzene, chlorobenzene, toluene, xylene, naphthalene, dieldrin, boron, chromium, hexavalent chromium, iron, lead, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
LS-10	4,4' DDE, benzene, dieldrin, boron, chromium, hexavalent chromium, iron, lead, magnesium, sodium, TDS, ammonia, chloride, sulfate

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-35
Comparison of Monitoring Well and Seep Analytical Results to NYSDEC's Pelham Bay Landfill Effluent Limitations*
Pelham Bay Landfill
Bronx, New York

	NYSDEC Effluent Limit	Range of Detected Groundwater Sample Results	Range of Detected Seep Sample Results
VOLATILE ORGANICS			
Benzene	10	1 to 62	2 to 4
Ethylbenzene	100	2 to 36	1 to 15
Toluene	100	1 to 230	7 to 81
Xylenes	100	5 to 200	4 to 65
SEMI-VOLATILE ORGANICS			
Bis (2-Ethylhexyl) Phthalate	800	2 to 38	3 to 13
Naphthalene	10	2 to 140	3 to 33
INORGANICS			
Aluminium	1800	156 to 46200	501 to 65800
Arsenic	70	1.6 to 63.40	1.6 to 89.10
Barium	4000	60 to 3090	104 to 8740
Chromium	1000	8.8 to 1240	26 to 483
Chromium (+6)	200	not analyzed	10 to 560
Cobalt	400	8 to 78.7	12.5 to 57.4
Copper	400	7.3 to 1130	6.1 to 977
Cyanide	10	10.8 to 267	20.4 to 26.2
Iron	4000	165 to 194000	2970 to 860000
Lead	200	1.2 to 423	3 to 2780
Manganese	750	93.6 to 29600	130 to 4290
Nickel	1400	14.9 to 414	25.4 to 161
Vanadium	900	4.6 to 2860	4.9 to 822
Zinc	400	6.5 to 7110	28.10 to 3710
CONVENTIONAL PARAMETERS			
(MODIFIED BMW LIST)			
Ammonia	26400	170 to 1260000	5.54 to 637

Notes: all values in micograms per liter (ppb)
*Based on the November 23,1992 letter from NYSDEC. Limitations are considered draft

Prepared by: DAD
Checked by: TRP
92C4087

Table 4-36
Samples That Exceed NYSDEC's Pelham Bay Landfill Effluent Limitations*
Pelham Bay Landfill
Bronx, New York

	NYSDEC Effluent Limit	Groundwater Samples that Exceed Effluent Limits	Seep Samples that Exceed Effluent Limits
VOLATILE ORGANICS			
Benzene	10	MW-116B	None
Ethylbenzene	100	None	None
Toluene	100	MW-116B	None
Xylenes	100	MW-116B	None
SEMI-VOLATILE ORGANICS			
Bis (2-Ethylhexyl) Phthalate	800	None	None
Naphthalene	10	MW-105,120,126	LS-9
INORGANICS			
Aluminium	1800	MW-107,113,113B,114,115,116,116B,117,118B,	LS-1, 2, 5, 9, 10
		119,119B,120,121B,123,124,124B,125,125B,126.	
Arsenic	70	None	LS-5
Barium	4000	None	LS-2
Chromium	1000	MW-126	LS-5
Chromium (+6)	200	not analyzed	
Cobalt	400	NONE	None
Copper	400	MW-105,113,118B	LS-5
Cyanide	10	MW-104,106,113,118,126	LS-2
Iron	4000	MW-104,105,106,107,110,111,112,113,113B,	LS-1, 2, 3, 5, 9, 10
		114,115,115B,116,116B,117,118B,119,119B,120,	
		121,121B,122,122B,123,124,124B,125,125B,126.	
Lead	200	MW-118B,126	LS-5
Manganese	750	MW-107,109,111,113,113B,115,115B,117,118B,	LS-5
		119,119B,120B,121,122,122B,123,124,125,125B.	
Nickel	1400	None	None
Vanadium	900	MW-120,126	None
Zinc	400	MW-118B,119B,126	LS-2, 5
CONVENTIONAL PARAMETERS			
(MODIFIED BMW LIST)			
Ammonia	26400	W-104,105, 106, 107,110, 111,113, 113B,114,115,115B	LS-1, 2, 4, 5, 7, 9, 10
		117, 118, 119, 120, 121, 126	

Notes: all values in micograms per liter (ppb)

*Based on the November 23,1992 letter from NYSDEC. Limitations are considered draft

Prepared by: DAD
Checked by: TRP
92C4087
10:19 AM 2/11/93

Table 4-37
Summary of Chloride Concentrations
Pelham Bay Landfill
Bronx, New York

GROUNDWATER SAMPLES

MW-103	14,700
MW-104	3,720
MW-105	6,040
MW-106	4,270
MW-107	780
MW-109	468
MW-110	5120
MW-111	3,160
MW-113	514
MW-113B	1,130
MW-114	638
MW-114B	2,460
MW-115	2,110
MW-115B	2,440
MW-116	30
MW-116B	105
MW-117	1,190
MW-117B	1,038
MW-118	10,570
MW-118B	10,460
MW-119	11,240
MW-119B	11,740
MW-120	5,320
MW-120B	13,560
MW-121	4,980
MW-121B	3,210
MW-122	1,840
MW-122B	3,050
MW-123	179
MW-124	590
MW-124B	11
MW-125	2,940
MW-125B	11,980
MW-126	5,140

SURFACE WATER SAMPLES

SW-1 H/L	12,300/14,000
SW-2 H/L	14,300/14,400
SW-3 H/L	13,800/14,100
SW-4 H/L	16,400/13,200
SW-5 H/L	14,400/14,100
SW-6 H/L	14,600/13,200
SW-7 H/L	14,000/14,800
SW-8 H/L	13,300/13,400
SW-9 H/L	13,600/13,700

SEEP SAMPLES

LS-1	3,740
LS-2	1,310 to 1,420
LS-3	11,400
LS-4	1,170
LS-5	12,250
LS-7	11,680
LS-9	6,830
LS-10	2,860

COMMUNITY WATER SAMPLES

CATALANO	56
HOGAN	60 to 67

Notes: all concentrations in milligrams per liter (ppm)
H = high tide sample
L = Low tide sample

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-38
Surface Water - Chemical Data Summary
Pelham Bay Landfill
Bronx, New York

	SW-1H	SW-1L	SW-2H	SW-2L	SW-3H	SW-3L	SW-4H	SW-4L	SW-5H	SW-5L	SW-6H	SW-6L	SW-7H
date:	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	29-Jul-92	31-Jul-92	29-Jul-92	31-Jul-92	29-Jul-92	31-Jul-92	30-Jul-92
VOCs													
Methylene chloride	3 BJR#	2 BJR#	3 BJR#	2 BJR#	2 BJR#	2 BJR#	2 BJR#	2 BJR#	2 BJR#	2 BJR#	2 BJR#	2 BJR#	2 BJR#
SVOs													
PAHs													
Pyrene										12 J			
Phthalates													
Di-n-butyl phthalate	2 JR#	3 JR#	2 JR#	3 JR#	3 JR#			3 J		2 J		2 J	
bis(2-Ethylhexyl)phthalate								4 J					
Pesticides													
Endosulfan sulfate	0.03 JV	0.09 JV	0.27 V	0.10 V	0.16 V	0.051 JV		0.026 BJR#	0.065 JR#				
alpha-BHC	0.02 JV	0.01 JV			0.034 JV			0.011 J		0.0071 J		0.0066 J	
delta-BHC						0.0071 JV							0.011 JR#
Inorganics													
Aluminum								577				580	
Barium	16 BN	16 BN	14 BN	15 BN	16 BN	17 BN	9 BNJ	16 B	14 BNJ	11 B	14 BNJ	14 B	13 B
Calcium	207,000 E	193,000 E	207,000 E	213,000 E	221,000 E	210,000 E	222,000 E	255,000	230,000 E	242,000	220,000 E	236,000	228,000
Copper	8.6 BJR#	6.7 BJR#	8.6 BJR#	6.5 BJR#	7.0 BJR#	4.9 BJR#		11.5 BJR#	10.0 B	16.6 BJR#	4.9 B	13.1 BJR#	12.0 BJR#
Iron	156 N	245 N	136 N	208 N	138 N	196 N	161 NJ	275	133 NJ	323	117 NJ	1140	231
Lead	1.8 BNW		6.9 +NR			1.4 BNW		4.0 B	13.3 BNJ	5.6	53.1 +NR	9.6	2.8 BWJR#
Magnesium	873,000 E*	808,000 E*	873,000 E*	958,000 E*	955,000 E*	939,000 E*	974,000 E*	978,000	1,012,000 E*	1,070,000	1,023,000 E*	1,038,000	924,000
Manganese	112 N	114 N	107 N	123 N	111 N	122 N	110 N	124	113 N	116	109 N	130	104
Mercury		9.5 *					0.28 *			5.9			
Nickel	12.5 BN	15.7 BN									10.5 BN		
Potassium	263,000	231,000	255,000	289,000	274,000	272,000	277,000	314,000	297,000	312,000	274,000	313,000	290,000
Silver							4.2 BNJR#						
Sodium	7,894,000	7,449,000	7,711,000	7,970,000	8,577,000	8,259,000	8,511,000	8,931,000	8,988,000	8,396,000	8,530,000	9,044,000	8,161,000
Thallium											13.8 BNR		
Vanadium							5.2 BN						
Zinc	8.2 BNJR#	9.7 BNJR#	10.8 BNJR#	10.5 BNJR#	10.0 BNJR#	12.0 BNJR#	9.3 BNJR#	5.5 BJR#	13.8 BJR#	7.1 BJR#	9.0 BNJR#	15.0 BJR#	6.1 BJR#

Notes:

All values reported in micrograms/liter (ppb)
All metal concentrations are for total metals
Blank indicates the compound was not detected in that sample
Surface water sample identification numbers followed by a "L" are low tide samples and sample identification numbers followed by a "H" are high tide samples
Qualifiers for organic and inorganic compounds listed on page 2 of this table
Reported values with a "R" or "R#" qualifier are listed on this table but are not discussed in the text

(1) New York State Department of Environmental Conservation, Water Quality Standards and Guidance Values, September 25, 1990. Best usages for class SB are primary and secondary contact recreation and fishing. The waters shall be suitable for fish propagation and survival.
(2) EPA, Water Quality Criteria, 1986.
(3) The NYSDEC surface water standard for copper applies to the dissolved form
(4) Guidance value, regulated standard for this chemical is not available
(5) Insufficient data to develop criteria. Value presented is the L.O.E.L. -- Lowest Observed Effect Level
(6) Human health criteria for carcinogen reported for 10 to the -6 risk level
(7) Station E5 - Western end of Long Island Sound, Throgs Neck Bridge; results from one sample collected January 1991, Battelle 1991. Total recoverable metals except acid soluble for silver
(8) Station E6 - Western end of Long Island Sound, north of King's Point; results from one sample collected January 1991, Battelle 1991. Total recoverable metals except acid soluble for silver
(9) Station E6 - Western end of Long Island Sound, north of King's Point; results from one sample collected October 1991, Battelle 1992. Total recoverable metals
(10) Station E7 - Western end of Long Island Sound, north of Hempstead Harbor; results from one sample collected January 1991, Battelle 1991. Total recoverable metals except acid soluble for silver

Table 4-38
Surface Water - Chemical Data Summary
Pelham Bay Landfill
Bronx, New York

							NYSDEC SCGs Saline Surface Waters (1)	CWA WQC (2) Protection of Marine Aquatic Life		CWA WQC (2) Protection of Human Health		Battelle Metals Data for Western Long Island Sound(see notes 7 to 10)			
	SW-7L	SW-8H	SW-8L	SW-9H	SW-9L	Range				Water & Fish	Fish Consump-				
date:	03-Aug-92	30-Jul-92	03-Aug-92	30-Jul-92	03-Aug-92	Min - Max	Class SB	Acute	Chronic	Ingestion	tion Only	E5 (7)	E6 (8)	E6 (9)	E7 (10)
VOCs															
Methylene chloride		2 BJR#		2 BJR#		all R#						---	---	---	---
SVOs															
PAHs															
Pyrene						12 - 12		300 (5)				---	---	---	---
Phthalates															
Di-n-butyl phthalate						2 - 3						---	---	---	---
bis(2-Ethylhexyl)phthalate						4 - 4						---	---	---	---
Pesticides															
Endosulfan sulfate						0.03 - 0.27						---	---	---	---
alpha-BHC						0.0066 - 0.034				0.00072 (6)	0.00074 (6)	---	---	---	---
delta-BHC		0.0062 JR#		0.0079 JR#		0.0071 - 0.0071				0.00072 (6)	0.00074 (6)	---	---	---	---
Inorganics															
Aluminum	290					290 - 580						---	---	---	---
Barium	13 B	12 B	14 B	11 B	13 B	9 - 17					1000	---	---	---	---
Calcium	291,000	238,000	270,000	244,000	305,000	193,000 - 305,000						---	---	---	---
Copper	6.2 BJR#	5.6 BJR#	6.7 BJR#	12.8 BJR#	7.6 BJR#	4.9 - 10.0	2.9 (3)	2.9	2.9			4.1	3.3	2.23	3
Iron	550 J	214	467 J	97 B	93 BJR#	97 - 1140				300		---	---	---	---
Lead		1.3 BWJR#	2.1 BJR#	1.9 BWJR#		1.4 - 13.3	8.6	140	5.6	50		1.2	0.82	0.43	0.58
Magnesium	976,000	977,000	846,000	981,000	945,000	808,000 - 1,070,000						---	---	---	---
Manganese	123	106	102	107	108	102 - 130				50	100	---	---	---	---
Mercury		0.2 B				0.2 - 9.5	0.1 (4)	2.1	0.025	0.144	0.146	0.0055	0.0037	0.00434	0.0029
Nickel						10.5 - 15.7	7.1	75	8.3	13.4	100	1.7	1.8	1.45	1.8
Potassium	306,000	310,000	248,000	311,000	293,000	231,000 - 314,000						---	---	---	---
Silver	4.2 BJR#		4.1 BJR#		4.2 BJR#	all R#		2.3		50		0.043 (AS)	0.022 (AS)	---	0.017 (AS)
Sodium	9,273,000	8,295,000	7,618,000	9,108,000	8,954,000	7,449,000 - 9,273,000						---	---	---	---
Thallium						all R			2130 (4)	13	48	---	---	---	---
Vanadium						5 - 5						---	---	---	---
Zinc	9.1 BJR#	4.9 BJR#	7.8 BJR#	8.3 BJR#	3.4 BJR#	all R#	58.0	96	86			7.2	7.3	3.62	5.5

Notes:

Organic Qualifiers

A = Aldol-condensation (laboratory artifact, not a site contaminant)
B = Blank contaminant
D = Result reported from a diluted sample or sample extract
E = Estimated value (reported concentration exceeded the calibration range)
J = Estimated value
R = Rejected
R# = Negated result
V = Reported result for this compound could not be verified during data validation

Inorganic Qualifiers

B = Reported value acceptable. Reported value less than the CRDL (Contract Required Detection Limit) but greater than the IDL(Instrument Detection Limit)
E = Estimated value due to matrix interference
J = Estimated value
N = Estimated value (Spiked sample recovery not within control limits)
R = Rejected
R# = Negated result
S = Reported value is acceptable. Reported value was determined by the Method of Standard Additions (MSA)
W = Estimated value (Post-digestion spike sample results were reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance
* = Duplicate analysis not within control limits (estimated value)
+ = Correlation coefficient for MSA is less than 0.995 (estimated values)
"---" = not analyzed for by Battelle

Prepared by: RTG
Checked by:ABB
92C4087

Table 4-39
Surface Water - Conventional Parameters (Modified BMW List) Data Summary
Pelham Bay Landfill
Bronx, New York

	SW-1H	SW-1L	SW-2H	SW-2L	SW-3H	SW-3L	SW-4H	SW-4L	SW-5H
date:	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	29-Jul-92	31-Jul-92	29-Jul-92
Alkalinity	100	102	105	112	104	120	97	98	98
Alkalinity as Carbonate									
Ammonia Nitrogen	0.24	0.08	0.14	0.17	0.06	0.16	0.06	0.29	
Chemical Oxygen Demand	133		148		148	281 J	222	358 J	268 J
Chloride	12,300	14,000	14,300	14,400	13,800 J	14,100	16,400	13,200	14,400
Nitrate Nitrogen								0.15	
Sulfate	2,160 J	1,630 J	2,150 J	2,370 J	2,080 J	2,100 J	2,990 J	1,980	2,060 J
Total Dissolved Solids	27,900	26,700	26,900	26,700	27,700	26,700	28,200	21,200	28,300
Total Kjeldahl Nitrogen	1.18	1.21	0.94	1.11	1.18	1.83	0.70	1.11	0.70

	SW-5L	SW-6H	SW-6L	SW-7H	SW-7L	SW-8H	SW-8L	SW-9H	SW-9L
date collected:	31-Jul-92	29-Jul-92	31-Jul-92	30-Jul-92	03-Aug-92	30-Jul-92	03-Aug-92	30-Jul-92	03-Aug-92
Alkalinity	94	164	94	96	98	100	96	97	95
Alkalinity as Carbonate					4		5		
Ammonia Nitrogen		0.06	0.07					0.12	0.05
Chemical Oxygen Demand	369 J	261 J	362 J	266 J	419	303 J		299 J	
Chloride	14,100	14,600 J	13,200	14,000	14,800	13,300	13,400	13,600	13,700
Nitrate Nitrogen	0.14		0.14						
Sulfate	2,020	2,110 J	1,880	2,220	2,370	2,080	2,820	2,018	2,260
Total Dissolved Solids	27,500	28,900	28,200	28,200	28,700	28,300	28,900	28,400	29,000
Total Kjeldahl Nitrogen	0.68	0.75	1.08	0.45	1.14	0.63	0.83	0.67	0.67

Notes:

All concentrations in milligrams per liter (ppm)
Blank indicates compound was not detected
Surface water sample identification numbers followed by an "L" are low tide samples
Surface water sample identification numbers followed by an "H" are high tide samples
J = Estimated value

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-40
Surface Water - Physical/Chemical Data Collected During Sampling
Pelham Bay Landfill
Bronx, New York

Sample ID	Date Sampled	Time of Low or High Tide	Time Sampled	Water Depth (ft)	Sample Depth (ft)	Secchi Depth (in)	Temperature (°C)	Dissolved Oxygen (mg/l)	Salinity (o/oo)	Conductivity (umhos)	pH	eH
SW-1L	27-Jul-92	1550	1430	7	3	48	24.5	7.9	23.5	37,000	6.6	-019
SW-1H	27-Jul-92	0935	0935	12	6 - 7	50	22.9	4.2	24.5	37,500	7.4	-018
SW-2L	27-Jul-92	1550	1535	4	2	48	24.0	9.8	24.0	36,500	6.7	-023
SW-2H	27-Jul-92	0935	0955	12	6 - 7	39	24.1	5.6	25.0	38,000	7.3	-018
SW-3L	27-Jul-92	1550	1600	4	3	48	24.0	11.3	24.0	36,500	6.8	-027
SW-3H	27-Jul-92	0935	1040	10	5 - 6	45	22.5	5.6	24.5	37,000	7.2	-018
SW-4L	31-Jul-92	0730	0730	5	3	24	22.5	9.6	24.0	36,000	7.9	-047
SW-4H	29-Jul-92	1135	1020	11	6 - 7	48	22.7	NA	25.0	36,500	7.6	-052
SW-5L	31-Jul-92	0730	0815	3	2	26	21.7	9.8	24.5	36,000	7.5	-058
SW-5H	29-Jul-92	1135	1150	10	5 - 6	42	22.1	NA	25.0	37,000	7.8	-061
SW-6L	31-Jul-92	0730	0850	1	0.5	12	21.8	10.0	24.5	36,000	7.7	-058
SW-6H	29-Jul-92	1135	1230	9	5	42	22.9	NA	25.5	38,000	7.8	-060
SW-7L	3-Aug-92	1004	0950	2	1	18	22.8	13.6	23.5	35,000	8.4	-084
SW-7H	30-Jul-92	1226	1130	8	4	33	22.5	11.6	24.5	37,000	7.9	-061
SW-8L	3-Aug-92	1004	1035	2.5	1	20	23.4	16.0	25.0	36,500	8.4	-084
SW-8H	30-Jul-92	1226	1225	9	4 - 5	30	22.3	11.2	25.5	36,500	7.8	-064
SW-9L	3-Aug-92	1004	1150	9	4 - 5	60	22.2	9.7	24.5	36,000	7.8	-056
SW-9H	30-Jul-92	1226	1330	16	8	51	21.4	8.4	24.5	36,000	7.4	-045

Notes: Surface water sample identification numbers followed by an "L" are low tide samples
Surface water sample identification numbers followed by an "H" are high tide samples
NA = not available, D.O. meter malfunction

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-41
Surface Water - Chemical Data - Ratio to Reference (RTR) Values
Pelham Bay Landfill
Bronx, New York

	SW-1H	SW-1L	SW-2H	SW-2L	SW-3H	SW-3L	SW-4H	SW-4L	SW-5H	SW-5L	SW-6H	SW-6L	SW-7H	SW-7L	SW-8H	SW-8L	Battelle Metals Data for Western Long Island Sound (see notes 1 to 4)			
date:	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	29-Jul-92	31-Jul-92	29-Jul-92	31-Jul-92	29-Jul-92	31-Jul-92	30-Jul-92	03-Aug-92	30-Jul-92	03-Aug-92	E5 (1)	E6 (2)	E6 (3)	E7 (4)
VOCs																				
Methylene chloride																				
SVOs																				
PAHs																				
Pyrene										> SW-9										
Phthalates																				
Di-n-butyl phthalate								> SW-9		> SW-9		> SW-9								
bis(2-Ethylhexyl)phthalate								> SW-9												
Pesticides																				
Endosulfan sulfate	> SW-9	> SW-9	> SW-9	> SW-9	> SW-9	> SW-9														
alpha-BHC	> SW-9	> SW-9			> SW-9			> SW-9		> SW-9		> SW-9								
delta-BHC						> SW-9														
Inorganics																				
Aluminum								> SW-9				> SW-9		> SW-9						
Barium	1.2	1.2	1.1	1.2	1.2	1.3	0.7	1.2	1.1	0.8	1.1	1.1	1.0	1.0	0.9	1.1				
Calcium	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.7	0.8	0.7	1.0	0.8	0.9				
Copper									> SW-9		> SW-9						> SW-9	> SW-9	> SW-9	> SW-9
Iron	1.6	2.5	1.4	2.1	1.4	2.0	1.7	2.8	1.4	3.3	1.2	11.8	2.4	5.7	2.2	4.8				
Lead	> SW-9					> SW-9		> SW-9	> SW-9	> SW-9		> SW-9					> SW-9	> SW-9	> SW-9	> SW-9
Magnesium	0.9	0.8	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.1	0.9	1.0	1.0	0.9				
Manganese	1.0	1.1	1.0	1.1	1.0	1.1	1.0	1.1	1.0	1.1	1.0	1.2	1.0	1.1	1.0	0.9				
Mercury		> SW-9					> SW-9			> SW-9					> SW-9		> SW-9	> SW-9	> SW-9	> SW-9
Nickel	> SW-9	> SW-9									> SW-9						> SW-9	> SW-9	> SW-9	> SW-9
Potassium	0.8	0.7	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	0.9	1.0	0.9	1.0	1.0	0.8				
Silver																	> SW-9	> SW-9		> SW-9
Sodium	0.9	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0	0.9	0.9	1.0	0.9	1.0	0.9	0.8				
Thallium																				
Vanadium							> SW-9													
Zinc																	> SW-9	> SW-9	> SW-9	> SW-9

Notes:

The RTR values are the concentration of the analyte at that sample location divided by the maximum concentration detected in the reference location samples (SW-9H and SW-9L)

Blank indicates the compound was not detected in either the reference location samples (SW-9H and SW-9L) or the sample location being compared to

Values that were negated (R# qualifier) or rejected (R qualifier) in data validation were treated as nondetects in calculating RTR values

> SW-9 indicates that the analyte was detected in the sample location but was not detected in the reference location samples (SW-9H and SW-9L)

< SW-9 indicates that the analyte was detected in at least one of the reference location location samples (SW-9H and SW-9L) but not detected at the sample location being compared to

(1) Station E5 - Western end of Long Island Sound, Throgs Neck Bridge; results from one sample collected January 1991, Battelle 1991. Total recoverable metals except acid soluble for silver

(2) Station E6 - Western end of Long Island Sound, north of King's Point; results from one sample collected January 1991, Battelle 1991. Total recoverable metals except acid soluble for silver

(3) Station E6 - Western end of Long Island Sound, north of King's Point; results from one sample collected October 1991, Battelle 1992. Total recoverable metals

(4) Station E7 - Western end of Long Island Sound, north of Hempstead Harbor; results from one sample collected January 1991, Battelle 1991. Total recoverable metals except acid soluble for silver

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-42

Surface Water - Volatile and Semi-volatile Organic Compounds TICs Data Summary

Pelham Bay Landfill

Bronx, New York

	SW-1H	SW-1L	SW-2H	SW-2L	SW-3H	SW-3L	SW-4H	SW-4L	SW-5H
date:	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	27-Jul-92	29-Jul-92	31-Jul-92	29-Jul-92
VOCs									
Unknown cycloalkane	12 JBR#								
Unknown alkane									
SVOs									
Unknown phthalate	14 JBR#	12 JBR#	10 JBR#	15 JBR#	17 JBR#			21 J	
Hexanedioic acid, Dioctyles							220 BJR#		61 JBR#

	SW-5L	SW-6H	SW-6L	SW-7H	SW-7L	SW-8H	SW-8L	SW-9H	SW-9L
date:	31-Jul-92	29-Jul-92	31-Jul-92	30-Jul-92	03-Aug-92	30-Jul-92	03-Aug-92	30-Jul-92	03-Aug-92
VOCs									
Unknown cycloalkane		15 J	8 J						
Unknown alkane		9 J							
SVOs									
Unknown phthalate	12 J	8 JBR#	10 JBR#	12 JBR#	15 JBR#	12 JBR#	16 JBR#		13 JBR#
Hexanedioic acid, Dioctyles		13 JBR#							

Notes:

All values reported in micrograms/liter (ppb)

Surface water sample identification numbers followed by an "L" are low tide samples

Surface water sample identification numbers followed by an "H" are high tide samples

Organic Qualifiers

A = Aldol-condensation (laboratory artifact, not a site contaminant)
B = Blank contaminant
D = Result reported from a diluted sample or sample extract
E = Estimated value (reported concentration exceeded the calibration range)
J = Estimated value
R = Rejected
R# = Negated result
V = Reported result for this compound could not be verified during data validation

Prepared by: RTG
Checked by: .
92C4087

Table 4-43
Surface Sediments - Semi-volatile Organic Compounds Data Summary Table, Mean Values
Pelham Bay Landfill
Bronx, New York

													Selected Sediment Quality Criteria and Stadards				NOAA L.I. Sound Reference Stations (6)		
location:	SD-1	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8	SD-9	SD-10	SD-11	CRDL Range (1)	NYSDEC Sediment Cleanup Criteria (2)	EPA Sediment Quality Criteria (3)	NOAA Overall AETs (4)	Washington Marine Sediment Quality Standards (5)	Throgs Neck	Hempstead Harbor	Mamaroneck
PAHs																			
2-Methylnaphthalene						140 (1)						340 - 2400	—	—	300	800	153	81	43
Acenaphthene			140 (1)			255 (4)						340 - 2400	—	5040	150	340	65	73	
Acenaphthylene			116 (4)	352 (6)		227 (6)			217 (6)			340 - 2400	—	—	—	1350	132	—	—
Anthracene	268 (4)	248 (5)	181 (4)	298 (6)	220 (2)	633 (6)	190 (1)		182 (5)		47 (1)	340 - 2200	—	—	300	4620	282	126	78
Benzo(a)anthracene	686 (5)	680 (6)	607 (6)	1267 (6)	553 (6)	2033 (6)	482 (6)	535 (6)	622 (6)	99 (5)	100 (6)	370 - 2200	15 (7)	—	550	2310	761	370	335
Benzo(a)pyrene	758 (6)	755 (6)	485 (6)	1343 (6)	648 (6)	1667 (6)	553 (6)	625 (6)	508 (6)	78 (4)	93 (5)	350 - 370	15 (7)	—	700	2080	890	442	418
Benzo(b)fluoranthene	670 (4)	768 (6)	552 (6)	1371 (6)	602 (6)	2483 (6)	582 (6)	568 (6)	682 (5)	91 (5)	119 (6)	350 - 2400	15 (7)	—	—	—	352	—	—
Benzo(g,h,i)perylene	356 (5)	422 (6)	293 (4)	594 (5)	388 (6)	605 (4)	298 (4)	325 (6)	353 (6)	62 (3)	47 (4)	340 - 2400	—	—	—	650	262	—	—
Benzo(k)fluoranthene	748 (4)	760 (6)	448 (6)	953 (6)	597 (6)	2217 (6)	543 (6)	568 (6)	564 (5)	90 (5)	104 (6)	350 - 2400	15 (7)	—	—	—	260	—	—
Chrysene	1007 (6)	972 (6)	688 (6)	1245 (6)	682 (6)	2417 (6)	673 (6)	717 (6)	830 (6)	112 (6)	141 (6)	N/A - N/A	15 (7)	—	900	2310	996	562	490
Dibenzo(a,h)anthracene			110 (1)	158 (5)					135 (2)			340 - 2400	—	—	100	250	132	75	97
Dibenzofuran						220 (2)						340 - 2400	—	—	—	320	—	—	—
Fluoranthene	852 (6)	892 (6)	682 (6)	1268 (6)	725 (6)	2600 (6)	573 (6)	573 (6)	735 (6)	196 (6)	190 (6)	N/A - N/A	—	28100	1000	3360	1273	835	847
Fluorene			140 (1)			282 (5)					36 (1)	340 - 2400	—	—	350	480	88	67	39
Indeno(1,2,3-c,d)pyrene	398 (5)	402 (5)	318 (4)	612 (6)	398 (6)	608 (5)	305 (4)	328 (6)	397 (6)	84 (3)	59 (5)	340 - 2100	15 (7)	—	—	710	256	—	—
Naphthalene						180 (2)						340 - 2400	—	—	500	2080	145	112	52
Phenanthrene	465 (6)	533 (6)	315 (6)	350 (6)	352 (6)	2183 (6)	333 (6)	340 (6)	500 (6)	111 (2)	120 (5)	340 - 370	2140 (8)	3400	260	2100	612	375	345
Pyrene	1800 (6)	1800 (6)	955 (6)	1933 (6)	1087 (6)	5083 (6)	1180 (6)	1217 (6)	1162 (6)	137 (6)	228 (6)	N/A - N/A	—	—	1000	21000	1448	842	782
Total	8007	8232	6029	11745	6252	23833	5712	5797	6886	1059	1283								
Phthalates																			
Butyl benzyl phthalate	250 (1)	230 (2)	88 (2)		260 (1)	440 (1)			130 (1)			340 - 2400	—	—	—	100	—	—	—
Di-n-butyl phthalate	360 (3)	248 (4)	127 (3)	134 (5)		356 (5)						340 - 2200	—	—	—	4620	—	—	—
Di-n-octyl phthalate						222 (5)						340 - 2400	—	—	—	1220	—	—	—
bis(2-Ethylhexyl)phthalate	3800 (6)	2383 (6)	1040 (6)	1077 (6)	1533 (6)	8850 (6)	2183 (6)	1817 (6)	1817 (6)	38 (2)	2326 (6)	350 - 370	—	—	—	990	—	—	—
Total	4410	2861	1254	1211	1793	9868	2183	1817	1947	38	2326								
Grand Total	12417	11093	7283	12955	8045	33701	7896	7613	8833	1097	3609								
% organic carbon	1.71%	2.34%	2.24%	2.09%	2.12%	4.31%	2.04%	2.39%	1.96%	1.57%	0.09%						2.9%	3.2%	2.1%
% fines	91.7%	91.2%	57.6%	73.6%	90.1%	34.1%	85.8%	88.7%	88.5%	0.8%	0.4%						71%	90%	74%

Notes: All values reported in micrograms per kilogram (ppb) dry weight

Blank indicates the compound was not detected in any of the six replicates or all detected values had a "R" or "R#" qualifier

The mean represents the average concentration of the detected values of the six replicates excluding samples with a "R" or "R#" qualifier

The number in parentheses following the mean concentrations are the number of detected values out of six replicates excluding samples with a "B" qualifier

% fines = % (by weight) of silt and clay fractions combined (< 63 um)

(1) CRDL - Contract Required Detection Limit

(2) New York State Department of Environmental Conservation, Clean-Up Criteria for Aquatic Sediments, December 1989. Revised draft 1992; sediment guidelines for metals from Persaud et. al., 1992. Criteria listed for bulk sediment with 2.1% organic carbon. The lowest effect level is the concentration which will impair sediment use by some benthic organisms, but that can be tolerated by the majority. Severe effect level is the concentration which will significantly impair use of sediment by benthic organisms.

(3) U.S. Environmental Protection Agency, Proposed Sediment Quality for Organics to Protect Benthic Invertebrates, November 1991. Criteria listed for bulk sediments with 2.1% organic carbon.

(4) National Oceanic and Atmospheric Administration, Overall Apparent Effects Thresholds (AETs). The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. March 1990. Sediment organic content not specified.

(5) Washington Marine Sediment Quality Standards, promulgated in 1991 under the State of Washington Administration Code, Chapter 173-204, Sediment Management Standards. These standards correspond to sediment quality that will result in no acute or chronic adverse effects on biota.

(6) The data for these three locations taken from: National Oceanic and Atmospheric Administration, Second Summary of Data on Chemical Contaminants in Sediments from the National Status and Trends Program. April 1991. Blanks indicate analyte not detected. "—" indicates analyte not analyzed for.

(7) Human health residue basis

(8) Aquatic toxicity basis

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-44
Surface Sediments - Pesticides Data Summary, Mean Values
Pelham Bay Landfill
Bronx, New York

													Selected Sediment Quality Criteria and Stadards				NOAA L.I. Sound Reference Stations (6)		
location:	SD-1	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8	SD-9	SD-10	SD-11	CRDL Range (1)	NYSDEC Sediment Cleanup Criteria(2)	EPA Sediment Quality Criteria(3)	NOAA Overall AETs(4)	Washington Marine Sediment Quality Standards (5)	Throgs Neck	Hempstead Harbor	Mamaroneck
4,4'-DDD	95 (1)	180 (2)				40 (1)						17 - 530	17 (7)	---	--- (10)	---	31.0	29.4	13.7
4,4'-DDE	130 (2)	80 (3)	50 (1)				85 (3)	110 (1)				17 - 530	1050(8) / 0.21(9)	---	--- (10)	---	13.1	11.2	5.3
4,4'-DDT		70 (1)										17 - 530	21 (7)	---	6	---	10	6	2
Dieldrin						25 (1)	44 (3)	66 (1)				17 - 530	121(8) / 2.73(9)	357	--- (10)	---	2.6	7.1	3.0
Endosulfan sulfate					33 (1)	117 (3)	35 (2)	25 (2)				17 - 530	---	---	---	---	---	---	---
delta-BHC	290 (3)	271 (3)	46 (2)	16 (2)	97 (2)	70 (3)	163 (3)	185 (2)	73 (3)			8.3 - 130	---	---	---	---	1.5	0.8	1.4
% organic carbon	1.71%	2.34%	2.24%	2.09%	2.12%	4.31%	2.04%	2.39%	1.96%	1.57%	0.09%						2.9%	3.2%	2.1%
% fines	91.7%	91.2%	57.6%	73.6%	90.1%	34.1%	85.8%	88.7%	88.5%	0.8%	0.4%						71%	90%	74%

Notes:

All values reported in micrograms per kilogram (ppb) dry weight

Blank indicates the compound was not detected in any of the three replicates

The mean represents the average concentration of the detected values of the three replicates

The numbers in parentheses following the mean concentrations are the number of detected values out of three replicates

% fines = % (by weight) of silt and clay fractions combined (< 63 um)

(1) CRDL - Contract Required Detection Limit

(2) New York State Department of Environmental Conservation, Clean-Up Criteria for Aquatic Sediments, December 1989. Revised draft 1992; sediment guidelines for metals from Persaud et. al., 1992. Criteria listed for bulk sediment with 2.1% organic carbon.

(3) U.S. Environmental Protection Agency, Proposed Sediment Quality for Organics to Protect Benthic Invertebrates, November 1991. Criteria listed for bulk sediments with 2.1% organic carbon.

(4) National Oceanic and Atmospheric Administration, Overall Apparent Effects Thresholds (AETs). The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. March 1990. Sediment organic content not specified.

(5) Washington Marine Sediment Quality Standards, promulgated in 1991 under the State of Washington Administration Code, Chapter 173-204, Sediment Management Standards. These standards correspond to sediment quality that will result in no acute or chronic adverse effects on biota.

(6) The data for these three locations taken from: National Oceanic and Atmospheric Administration, Second Summary of Data on Chemical Contaminants in Sediments from the National Status and Trends Program. April 1991. "---" indicates analyte not analyzed for.

(7) Wildlife residue basis

(8) Aquatic toxicity basis

(9) Human health residue basis

(10) Insufficient data available to determine NOAA Overall AET

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-45
Surface Sediments - Inorganics Data Summary, Mean Values
Pelham Bay Landfill
Bronx, New York

location:	SD-1	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8	SD-9	SD-10	SD-11	CRDL Range (1)	Selected Sediment Quality Criteria and Stadards					NOAA L.I. Sound Reference Stations (6)		
													NYSDEC Sediment Cleanup Criteria (2)		EPA Sediment Quality Criteria (3)	NOAA Overall AETs (4)	Washington Marine Sediment Quality Standards (5)	Throgs Neck	Hempstead Harbor	Mamaroneck
													Lowest	Severe						
Aluminum	19400 (3)	18200 (3)	15333 (3)	17500 (3)	18833 (3)	10997 (3)	18833 (3)	19867 (3)	18167 (3)	1663 (3)	2097 (3)	N/A - N/A	---	---	---	---	---	37884	56667	37500
Arsenic	11.3 (3)	10.9 (3)	8.6 (3)	14.7 (3)	11.3 (3)	6.5 (3)	11.5 (3)	12.3 (3)	12.2 (3)	1.2 (2)	0.8 (3)	0.51 - 0.51	6	33	---	50	57	7	13	8
Barium	106.3 (3)	102.2 (3)	94.1 (3)	99.0 (3)	102.7 (3)	117.8 (3)	114.0 (3)	113.7 (3)	94.7 (3)	11.7 (3)	15.5 (3)	N/A - N/A	---	---	---	---	---	---	---	---
Beryllium	0.77 (3)	0.73 (3)	0.52 (3)	0.72 (3)	0.55 (3)			0.87 (3)	0.68 (3)			0.11 - 0.18	---	---	---	---	---	---	---	---
Cadmium			4.0 (1)		2.70 (1)	1.9 (1)	4.6 (1)	2.2 (1)	3.6 (2)	1.5 (1)	1.2 (1)	0.82 - 2.9	0.6	10	---	5	5.1	1.5	2.1	1.5
Calcium	7517 (3)	8317 (3)	37700 (3)	45967 (3)	13733 (3)	20400 (3)	11700 (3)	12303 (3)	12667 (3)	1005 (3)	4030 (3)	N/A - N/A	---	---	---	---	---	---	---	---
Chromium	107 (3)	98 (3)	81 (3)	65 (3)	103 (3)	61 (3)	117 (3)	126 (3)	126 (3)	6 (3)	6 (3)	N/A - N/A	26	110	---	--- (7)	160	149	135	111
Cobalt	12.1 (3)	9.2 (3)	10.2 (3)	10.7 (3)	13.4 (3)	9.4 (3)	11.8 (3)	10.1 (3)	10.9 (3)	2.5 (2)	1.9 (2)	1.3 - 1.5	---	---	---	---	---	---	---	---
Copper	193 (3)	173 (3)	136 (3)	128 (3)	181 (3)	124 (3)	211 (3)	218 (3)	179 (3)	10 (3)	28 (3)	N/A - N/A	16	110	---	300	390	142	162	96
Iron	39467 (3)	36533 (3)	30300 (3)	33333 (3)	37100 (3)	24167 (3)	38833 (3)	39633 (3)	35700 (3)	6570 (3)	4683 (3)	N/A - N/A	20000	40000	---	---	---	23792	35333	34833
Lead	183 (3)	177 (3)	131 (3)	172 (3)	183 (3)	214 (3)	209 (3)	226 (3)	179 (3)	20 (3)	17 (3)	N/A - N/A	31	250	---	300	450	142	135	81
Magnesium	11633 (3)	10767 (3)	9630 (3)	9587 (3)	11067 (3)	9053 (3)	11467 (3)	11233 (3)	11567 (3)	1183 (3)	1657 (3)	N/A - N/A	---	---	---	---	---	---	---	---
Manganese	483 (3)	441 (3)	382 (3)	414 (3)	460 (3)	251 (3)	471 (3)	484 (3)	586 (3)	56 (3)	87 (3)	N/A - N/A	460	1110	---	---	---	837	775	1092
Mercury	0.89 (2)	1.57 (3)	0.55 (3)	1.07 (3)	0.93 (3)	0.48 (3)	1.73 (3)	1.03 (3)	1.47 (3)	0.13 (1)		0.09 - 0.34	0.2	2	---	1	0.41	0.85	0.59	0.38
Nickel									46.7 (3)	12.3 (3)	10.6 (3)	N/A - N/A	16	75	---	--- (7)	---	40	41	41
Potassium	5807 (3)	5397 (3)	4790 (3)	4863 (3)	5103 (3)	3503 (3)	5230 (3)	5243 (3)	5247 (3)	628 (3)	517 (3)	N/A - N/A	---	---	---	---	---	---	---	---
Selenium	1.5 (1)				1.0 (1)			1.9 (1)				0.42 - 1.4	---	---	---	---	---	0.54	0.68	0.50
Silver			2.6 (2)	1.9 (2)			3.4 (3)	3.3 (3)	5.7 (3)	0.9 (2)		0.53 - 1.9	---	---	---	1.7	6.1	3.7	4.8	1.3
Sodium	21633 (3)	19833 (3)	16733 (3)	16800 (3)	15733 (3)	8273 (3)	18367 (3)	16367 (3)	20033 (3)	951 (3)	506 (3)	N/A - N/A	---	---	---	---	---	---	---	---
Thallium			1.10 (1)	1.83 (3)		1.02 (2)	1.60 (1)		1.60 (1)			0.44 - 1.4	---	---	---	---	---	0.47	0.71	0.61
Vanadium	56.8 (3)	55.2 (3)	45.4 (3)	42.1 (3)	51.6 (3)	38.5 (3)	55.6 (3)	56.5 (3)	47.8 (3)	9.0 (3)	6.4 (3)	N/A - N/A	---	---	---	---	---	---	---	---
Zinc	317 (3)	288 (3)	241 (3)	273 (3)	299 (3)	319 (3)	345 (3)	329 (3)	279 (3)	21 (3)	30.1 (1)	N/A - N/A	120	820	---	260	410	227	279	222
% organic carbon	1.71%	2.34%	2.24%	2.09%	2.12%	4.31%	2.04%	2.39%	1.96%	1.57%	0.09%							2.9%	3.2%	2.1%
% fines	91.7%	91.2%	57.6%	73.6%	90.1%	34.1%	85.8%	88.7%	88.5%	0.8%	0.4%							71%	90%	74%

Notes: All values reported in milligrams / kilogram (ppm) dry weight

Blank indicates the compound was not detected in any of the three replicates or all detected values had a "R" or "R#" qualifier

The mean represents the average concentration of the detected values of the three replicates

The numbers in parentheses following the mean concentrations are the number of detected values out of three replicates

% fines = % (by weight) of silt and clay fractions combined (< 63 um)

(1) CRDL - Contract Required Detection Limit

(2) New York State Department of Environmental Conservation, Clean-Up Criteria for Aquatic Sediments, December 1989. Revised draft 1992; sediment guidelines for metals from Persaud et. al., 1992. Criteria listed for bulk sediment with 2.1% organic carbon. The lowest effect level is the concentration which will impair sediment use by some benthic organisms, but that can be tolerated by the majority. Severe effect level is the concentration which will significantly impair use of sediment by benthic organisms.

(3) U.S. Environmental Protection Agency, Proposed Sediment Quality for Organics to Protect Benthic Invertebrates, November 1991. Criteria listed for bulk sediments with 2.1% organic carbon.

(4) National Oceanic and Atmospheric Administration, Overall Apparent Effects Thresholds (AETs). The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. March 1990. Sediment organic content not specified.

(5) Washington Marine Sediment Quality Standards, promulgated in 1991 under the State of Washington Administration Code, Chapter 173-204, Sediment Management Standards. These standards correspond to sediment quality that will result in no acute or chronic adverse effects on biota.

(6) The data for these three locations taken from: National Oceanic and Atmospheric Administration, Second Summary of Data on Chemical Contaminants in Sediments from the National Status and Trends Program. April 1991. "---" indicates analyte not analyzed for.

(7) Insufficient data to determine NOAA Overall AET

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-46
Surface Sediments - Volatile and Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SD - 1						SD - 2					
date:	6-Aug-92						6-Aug-92					
replicates:	A	B	C	D	E	F	A	B	C	D	E	F
VOLATILE ORGANICS												
Unknown	23 J											
2-Heptanamine, 5-Methyl- (9C)												
Total number of TICs	1											
Total concentrations	23											
SEMI-VOLATILE ORGANICS												
(_)-Loliolide	1200 J											
1,2-Benzenedicarboxylic Acid							1600 J					
1-Hexadecanol, 3,7,11,15-Tet	2200 J	2400 J		3600 J	3600 J	3000 J				2200 J	2000 J	2200 J
1-Phenanthrenecarboxylic Aci												
13(16),14-Labdien-8-Ol			2700 J	3000 J	3000 J		3700 J	2900 J	4000 J			
13(16),14-Labdien-8L												
1H-Indene, Octahydro-2,2,4,4												
1H-Pyrrole-2,5-Dione, 3-Ethy												
2(4H)-Benzofuranone, 5,6,7,7												
2-Hexadecen-1-Ol, 3,7,11,15-												
2-Pentanone, 4-Hydroxy	22200 BJAR#			31000 BJAR#	31000 BJAR#	24900 JR#						
2-Pentanone, 4-Hydroxy-4-Met												
2-Pentanone, 4-Hydroxy-4-Met		22000 BJAR#	23000 BJAR#				19000 BJAR#	12000 BJAR#	26100 BJAR#	24000 BJAR#	25000 BJAR#	31000 BJR#
3-Pentanone,4-Hydroxy-4-Methyl												
3-Penten-2-One, (E)-												
9,10-Anthracenedione												
Benzo[E]Pyrene												
Cholest-5-En-3-Ol (3.Beta.)-												
Dihydrocholesterol												
Hexadecanoic Acid												
Hexanedioic Acid, Dioctyl Es	2900 J	78000 J	210000 J			2500 J		67000 J				
Hexanedioic Acid, Dioctyl Es												
Isomer												
Neophytadiene												
Pregna-5,16-Dien-20-One, 3-H												
Pyrrolidine	940 J											
Sulfur, Mol. (S8)				2000 J	2000 J				1000 J			
Tri-M-Cresyl Phosphate												
Tri-P-Cresyl Phosphate												
Unknown	7720 J	7400 J	6200 J	12700 J	12700 J	4400 J	29900 J	5600 J	10180 J	8580 J	5900 J	7170 J
Unknown												
Unknown Alcohol												
Unknown Alkane	10500 J		10000 J	11000 J	11000 J	2700 J	2000 J	2200 J	5500 J	2600 J	7300 J	2200 J
Unknown Alkene												
Unknown Amide												
Unknown Carboxylic Acid												
Unknown Cholestanone						2400 J						
Unknown Ester												
Unknown Hydrocarbon			2400 J									
Unknown Hydrocarbon												
Unknown Ketone												
Unknown Pah				1900 J	1900 J							
Unknown Pentenone Isomer												
Unknown Phthalate	1200 J	1500 J			3600 J			1500 J	2600 J	2600 J	1300 J	1800 J
Unknown Phthalate												
Total number of TICs	12	6	7	12	5	9	10	7	10	12	5	9
Total concentrations	26660	89300	231300	34200	37800	15000	37200	79200	23280	15980	16500	13370

Notes:

All values reported in micrograms per kilogram (ppb) dry weight
Sediment samples collected from a depth of 0-6 inches
Total number of TICs and Total concentratios do not include samples with a "R" or "R#" qualifier

Organic Qualifiers
J = Estimated value
R = Rejected
R# = Negated result
B = Blank contaminant

A = Aldol-condensation (laboratory artifact, not a site contaminant)
E = Estimated value (reported concentration exceeded the calibration range)
D = Result reported from a diluted sample or sample extract
V = Reported result for this compound could not be verified during data validation

Prepared by: RTG
Checked by: ABB

92C4087

Table 4-46
Surface Sediments - Volatile and Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SD - 3						SD - 4					
date:	6-Aug-92						6-Aug-92					
replicates:	A	B	C	D	E	F	A	B	C	D	E	F
VOLATILE ORGANICS												
Unknown	22 J											
2-Heptanamine, 5-Methyl- (9C)												
Total number of TICs	1											
Total concentrations	22											
SEMI-VOLATILE ORGANICS												
(_)-Loliolide			1000 J				400 J					
1,2-Benzenedicarboxylic Acid												
1-Hexadecanol, 3,7,11,15-Tet	360 J											
1-Phenanthrenecarboxylic Aci												
13(16),14-Labdien-8-Ol												
13(16),14-Labdien-8L												
1H-Indene, Octahydro-2,2,4,4												
1H-Pyrrole-2,5-Dione, 3-Ethy		490 J	1000 J									
2(4H)-Benzofuranone, 5,6,7,7		360 J	520 J									
2-Hexadecen-1-Ol, 3,7,11,15-												
2-Pentanone, 4-Hydroxy												
2-Pentanone, 4-Hydroxy-4-Met												
2-Pentanone, 4-Hydroxy-4-Met	1400 BJAR#	4000 BJAR#	3200 BJR#	2600 BJAR#	2300 BJAR#	2400 BJAR#	3200 BJAR#	3200 BJAR#	4000 BJAR#	4700 BJAR#	3900 BJAR#	5200 BJAR#
3-Pentanone,4-Hydroxy-4-Methyl												
3-Penten-2-One, (E)-												
9,10-Anthracenedione												
Benzo[E]Pyrene												
Cholest-5-En-3-Ol (3.Beta.)-	4100 J				5700 J	3500 J	1600 J	1300 J		1400 J		
Dihydrocholesterol						1100 J		740 J				
Hexadecanoic Acid					2400 J	1100 J						
Hexanedioic Acid, Dioctyl Es	440 J	20000 J			18000 J	490 J	330 J	900 J	25000 J	19000 J	3400 J	
Hexanedioic Acid, Dioctyl Es												
Isomer	1100 J											
Neophytadiene												
Pregna-5,16-Dien-20-One, 3-H	1200 J					990 J						
Pyrrolidine												
Sulfur, Mol. (S8)												
Tri-M-Cresyl Phosphate												
Tri-P-Cresyl Phosphate												
Unknown	3340 J	2780 J	8160 J	5420 J		2400 J	670 J	1200 J	1990 J	1200 J		430 J
Unknown												
Unknown Alcohol		1200 J										
Unknown Alkane			1300 J			700 J	650 J		830 J	1000 J		
Unknown Alkene	990 J					460 J						
Unknown Amide		1300 JR#										
Unknown Carboxylic Acid	1080 J			7090 J	5850 J	2480 J	13520 J	870 J		470 J		
Unknown Cholestanone												
Unknown Ester		1150 J	1320 J									
Unknown Hydrocarbon	2070 J				1000 J		950 J	1330 J	550 J	1430 J		
Unknown Hydrocarbon						510 JBR#						
Unknown Ketone												
Unknown Pah	710 J					2100 J	990 J	1980 J	1810 J	1620 J	491 J	
Unknown Pentenone Isomer												
Unknown Phthalate												
Unknown Phthalate	860 JBR#	1100 JR#	770 JBR#	1300 JBR#	1100 JBR#	1300 JBR#	1200 JBR#	1300 JBR#	930 JR#	630 JBR#	950 JBR#	960 JR#
Total number of TICs	18	10	17	7	7	16	10	12	8	10	2	1
Total concentrations	15390	25980	13300	12510	32950	15320	19110	8320	30180	26120	3891	430

Notes:
All values reported in micrograms per kilogram (ppb) dry weight
Sediment samples collected from a depth of 0-6 inches
Total number of TICs and Total concentratios do not include samples with a "R" or "R#" qualifier

Organic Qualifiers
J = Estimated value
R = Rejected
R# = Negated result
B = Blank contaminant

A = Aldol-condensation (laboratory artifact, not a site contaminant)
E = Estimated value (reported concentration exceeded the calibration range)
D = Result reported from a diluted sample or sample extract
V = Reported result for this compound could not be verified during data validation

Prepared by: RTG
Checked by: ABB

92C4087

Table 4-46
Surface Sediments - Volatile and Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SD - 5						SD - 6					
date:	6-Aug-92						6-Aug-92					
replicates:	A	B	C	D	E	F	A	B	C	D	E	F
VOLATILE ORGANICS												
Unknown												
2-Heptanamine, 5-Methyl- (9C)												
Total number of TICs												
Total concentrations												
SEMI-VOLATILE ORGANICS												
(_)-Loliolide	900 J											
1,2-Benzenedicarboxylic Acid												
1-Hexadecanol, 3,7,11,15-Tet												
1-Phenanthrenecarboxylic Aci												
13(16),14-Labdien-8-Ol												
13(16),14-Labdien-8L												
1H-Indene, Octahydro-2,2,4,4											510 J	
1H-Pyrrole-2,5-Dione, 3-Ethy												
2(4H)-Benzofuranone, 5,6,7,7												
2-Hexadecen-1-Ol, 3,7,11,15-												
2-Pentanone, 4-Hydroxy												
2-Pentanone, 4-Hydroxy-4-Met												
2-Pentanone, 4-Hydroxy-4-Met	4500 BJAR#	3000 BJAR#	3700 BJAR#	3000 BJAR#	4100 BJAR#	2600 BJAR#	3500 BJAR#	4800 BJAR#	3600 BJAR#	2500 BJAR#	4500 BJAR#	2500 BJAR#
3-Pentanone,4-Hydroxy-4-Methyl											450 JR#	
3-Penten-2-One, (E)-												
9,10-Anthracenedione								800 J				
Benzo[E]Pyrene												
Cholest-5-En-3-Ol (3.Beta.)-	6000 J		5000 J									
Dihydrocholesterol												
Hexadecanoic Acid	2900 J											
Hexanedioic Acid, Dioctyl Es												
Hexanedioic Acid, Dioctyl Es											15000 BJR#	
Isomer												
Neophytadiene												
Pregna-5,16-Dien-20-One, 3-H												
Pyrrolidine												
Sulfur, Mol. (S8)												
Tri-M-Cresyl Phosphate												
Tri-P-Cresyl Phosphate												
Unknown	6690 J		8083 J	2700 J	3100 J	1500 J					860 J	
Unknown												
Unknown Alcohol												
Unknown Alkane	930 J	700 J			850 J	560 J						
Unknown Alkene												
Unknown Amide												
Unknown Carboxylic Acid	7460 J											
Unknown Cholestanone												
Unknown Ester												
Unknown Hydrocarbon	900 J											
Unknown Hydrocarbon												
Unknown Ketone												
Unknown Pah				1700 J	1600 J	2700 J	2000 J		1400 J	1100 J		
Unknown Pentenone Isomer												
Unknown Phthalate		900 J		1000 J	1100 J	800 J		1200 J	1000 J	710 J		660 J
Unknown Phthalate												
Total number of TICs	12	2	4	3	4	4	1	2	2	2	2	4
Total concentrations	25780	1600	13083	5400	6650	5560	2000	2000	2400	1810	1370	660

Notes:
All values reported in micrograms per kilogram (ppb) dry weight
Sediment samples collected from a depth of 0-6 inches
Total number of TICs and Total concentratios do not include samples with a "R" or "R#" qualifier

Prepared by: RTG
Checked by: ABB
92C4087

Organic Qualifiers
J = Estimated value
R = Rejected
R# = Negated result
B = Blank contaminant

A = Aldol-condensation (laboratory artifact, not a site contaminant)
E = Estimated value (reported concentration exceeded the calibration range)
D = Result reported from a diluted sample or sample extract
V = Reported result for this compound could not be verified during data validation

Table 4-46
Surface Sediments - Volatile and Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SD - 7						SD - 8					
date:	6-Aug-92						6-Aug-92					
replicates:	A	B	C	D	E	F	A	B	C	D	E	F
VOLATILE ORGANICS												
Unknown												
2-Heptanamine, 5-Methyl- (9C)							22 J					
Total number of TICs							1					
Total concentrations							22					
SEMI-VOLATILE ORGANICS												
(_)-Loliolide												
1,2-Benzenedicarboxylic Acid												
1-Hexadecanol, 3,7,11,15-Tet							820 J		780 J			
1-Phenanthrenecarboxylic Aci												
13(16),14-Labdien-8-Ol		2500 J	2200 J	1700 J	2800 J		2000 J	2600 J	2800 J	1700 J	2600 J	2700 J
13(16),14-Labdien-8L						2500 J						
1H-Indene, Octahydro-2,2,4,4												
1H-Pyrrole-2,5-Dione, 3-Ethy												
2(4H)-Benzofuranone, 5,6,7,7												
2-Hexadecen-1-Ol, 3,7,11,15-												
2-Pentanone, 4-Hydroxy												
2-Pentanone, 4-Hydroxy-4-Met												
2-Pentanone, 4-Hydroxy-4-Met		2600 JABR#	3900 JABR#	3900 JABR#	3000 JABR#	2600 JAR#	3500 JABR#	2500 JABR#	3800 JABR#	4500 JABR#	4600 JABR#	3700 JABR#
3-Pentanone,4-Hydroxy-4-Methyl												
3-Penten-2-One, (E)-												
9,10-Anthracenedione												
Benzo[E]Pyrene												
Cholest-5-En-3-Ol (3.Beta.)-												
Dihydrocholesterol												
Hexadecanoic Acid												
Hexanedioic Acid, Dioctyl Es	1200 J		1100 J			1100 J			1300 J	17000 J		83000 J
Hexanedioic Acid, Dioctyl Es								990 JBR#				
Isomer												
Neophytadiene												
Pregna-5,16-Dien-20-One, 3-H												
Pyrrolidine												
Sulfur, Mol. (S8)												
Tri-M-Cresyl Phosphate												
Tri-P-Cresyl Phosphate												
Unknown	2549 J	1900 J	5700 J	2290 J	1600 J	1900 J	2180 J	1600 J	1700 J	1500 J	3500 J	2970 J
Unknown	2000 JBR#											
Unknown Alcohol												1100 J
Unknown Alkane										930 J		
Unknown Alkene				1000 J								
Unknown Amide												
Unknown Carboxylic Acid												
Unknown Cholestanone												
Unknown Ester				1530 J		700 J	890 J		820 J			
Unknown Hydrocarbon												
Unknown Hydrocarbon												
Unknown Ketone												
Unknown Pah												
Unknown Pentenone Isomer												
Unknown Phthalate								2300 J				830 J
Unknown Phthalate	1900 JBR#	1500 JBR#	1900 JBR#	1700 JBR#	1400 JBR#	1800 JBR#	1800 JBR#		2300 JBR#	1900 JBR#	1900 JBR#	1400 JBR#
Total number of TICs	3	2	3	6	2	4	6	3	5	4	4	6
Total concentrations	3749	4400	9000	6520	4400	6200	5890	6500	7405	21130	6100	90600

Notes:

All values reported in micrograms per kilogram (ppb) dry weight
Sediment samples collected from a depth of 0-6 inches
Total number of TICs and Total concentratios do not include samples with a "R" or "R#" qualifier

Prepared by: RTG
Checked by: ABB
92C4087

Organic Qualifiers
J = Estimated value
R = Rejected
R# = Negated result
B = Blank contaminant

A = Aldol-condensation (laboratory artifact, not a site contaminant)
E = Estimated value (reported concentration exceeded the calibration range)
D = Result reported from a diluted sample or sample extract
V = Reported result for this compound could not be verified during data validation

Table 4-46
Surface Sediments - Volatile and Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SD - 9						SD - 10					
date:	6-Aug-92						6-Aug-92					
replicates:	A	B	C	D	E	F	A	B	C	D	E	F
VOLATILE ORGANICS												
Unknown												
2-Heptanamine, 5-Methyl- (9C)												
Total number of TICs												
Total concentrations												
SEMI-VOLATILE ORGANICS												
(_)-Loliolide				760 J	1400 J							
1,2-Benzenedicarboxylic Acid												
1-Hexadecanol, 3,7,11,15-Tet												
1-Phenanthrenecarboxylic Aci												
13(16),14-Labdien-8-Ol												
13(16),14-Labdien-8L												
1H-Indene, Octahydro-2,2,4,4												
1H-Pyrrole-2,5-Dione, 3-Ethy	1300 J		940 J		2600 J							
2(4H)-Benzofuranone, 5,6,7,7												
2-Hexadecen-1-Ol, 3,7,11,15-		530 J		1000 J								
2-Pentanone, 4-Hydroxy												
2-Pentanone, 4-Hydroxy-4-Met									1100 BJA			
2-Pentanone, 4-Hydroxy-4-Met	3600 BJAR#	3700 BJAR#	3200 BJAR#	4600 BJAR#	5100 BJAR#	5000 BJAR#	920 BJAR#	1000 BJAR#		1500 BJAR#	1400 BJAR#	1600 BJAR#
3-Pentanone,4-Hydroxy-4-Methyl												
3-Penten-2-One, (E)-	610 J											
9,10-Anthracenedione												
Benzo[E]Pyrene										180 J		
Cholest-5-En-3-Ol (3.Beta.)-								740 J		420 J	170 J	180 J
Dihydrocholesterol												
Hexadecanoic Acid						840 J					200 J	180 J
Hexanedioic Acid, Dioctyl Es								180 J		340 J		
Hexanedioic Acid, Dioctyl Es												
Isomer												
Neophytadiene				1700 J	1500 J							
Pregna-5,16-Dien-20-One, 3-H												
Pyrrolidine												
Sulfur, Mol. (S8)	630 J											
Tri-M-Cresyl Phosphate												
Tri-P-Cresyl Phosphate												
Unknown	6700 J	19520 J	6730 J	5940 J	9550 J	1300 J	190 J	230 J				
Unknown												
Unknown Alcohol												
Unknown Alkane	480 J		460 J	790 J								
Unknown Alkene												
Unknown Amide												
Unknown Carboxylic Acid		540 J		4500 J	3600 J							
Unknown Cholestanone												
Unknown Ester				490 J	1540 J	2510 J		340 J			210 J	
Unknown Hydrocarbon												
Unknown Hydrocarbon												
Unknown Ketone					1000 J							
Unknown Pah		540 J										
Unknown Pentenone Isomer		810 J										
Unknown Phthalate												
Unknown Phthalate	1800 JBR#	1500 BJR#	1400 BJR#	1500 BJR#	2100 BJR#	1300 BJR#		400 BJR#		690 BJR#	480 BJR#	230 BJR#
Total number of TICs	12	12	8	14	17	5	1	5	1	3	3	2
Total concentrations	9720	21940	7190	15180	21390	4650	190	1490	1100	940	580	360

Notes:
All values reported in micrograms per kilogram (ppb) dry weight
Sediment samples collected from a depth of 0-6 inches
Total number of TICs and Total concentratios do not include samples with a "R" or "R#" qualifier

Organic Qualifiers
J = Estimated value
R = Rejected
R# = Negated result
B = Blank contaminant

A = Aldol-condensation (laboratory artifact, not a site contaminant)
E = Estimated value (reported concentration exceeded the calibration range)
D = Result reported from a diluted sample or sample extract
V = Reported result for this compound could not be verified during data validation

Prepared by: RTG
Checked by: ABB

92C4087

Table 4-46
Surface Sediments - Volatile and Semi-volatile Organic Compounds TICs Data Summary
Pelham Bay Landfill
Bronx, New York

	SD - 11					
date:	6-Aug-92					
replicates:	A	B	C	D	E	F
VOLATILE ORGANICS						
Unknown						
2-Heptanamine, 5-Methyl- (9C)						
Total number of TICs						
Total concentrations						
SEMI-VOLATILE ORGANICS						
(_)-Loliolide						
1,2-Benzenedicarboxylic Acid						
1-Hexadecanol, 3,7,11,15-Tet						
1-Phenanthrenecarboxylic Aci						140 J
13(16),14-Labdien-8-Ol			340 J			
13(16),14-Labdien-8L						
1H-Indene, Octahydro-2,2,4,4						
1H-Pyrrole-2,5-Dione, 3-Ethy						
2(4H)-Benzofuranone, 5,6,7,7						
2-Hexadecen-1-Ol, 3,7,11,15-						
2-Pentanone, 4-Hydroxy						
2-Pentanone, 4-Hydroxy-4-Met				940 BJA		
2-Pentanone, 4-Hydroxy-4-Met	1600 BJAR#	1400 BJAR#	1200 BJAR#		1375 BJAR#	1600 BJAR#
3-Pentanone,4-Hydroxy-4-Methyl						
3-Penten-2-One, (E)-						
9,10-Anthracenedione						
Benzo[E]Pyrene						
Cholest-5-En-3-Ol (3.Beta.)-						
Dihydrocholesterol						
Hexadecanoic Acid						
Hexanedioic Acid, Dioctyl Es	450 J	200 J			220 J	
Hexanedioic Acid, Dioctyl Es						
Isomer						
Neophytadiene						
Pregna-5,16-Dien-20-One, 3-H						
Pyrrolidine						
Sulfur, Mol. (S8)						
Tri-M-Cresyl Phosphate						680 J
Tri-P-Cresyl Phosphate						990 J
Unknown	1030 J	2320 J	1140 J		1122 J	2750 J
Unknown						
Unknown Alcohol						
Unknown Alkane					370 J	
Unknown Alkene						
Unknown Amide						
Unknown Carboxylic Acid						
Unknown Cholestanone						
Unknown Ester	200 J	240 J				140 J
Unknown Hydrocarbon						
Unknown Hydrocarbon						
Unknown Ketone						
Unknown Pah						
Unknown Pentenone Isomer						
Unknown Phthalate	610 J			410 J		
Unknown Phthalate	800 BJR#	900 BJR#	190 JBR#		620 JBR#	580 JBR#
Total number of TICs	9	9	6	2	8	14
Total concentrations	2290	2760	1480	1350	1712	4700

Notes:

All values reported in micrograms per kilogram (ppb) dry weight
Sediment samples collected from a depth of 0-6 inches
Total number of TICs and Total concentratios do not include samples with a "R" or "R#" qualifier

Prepared by: RTG
Checked by: ABB

92C4087

Organic Qualifiers
J = Estimated value
R = Rejected
R# = Negated result
B = Blank contaminant

A = Aldol-condensation (laboratory artifact, not a site contaminant)
E = Estimated value (reported concentration exceeded the calibration range)
D = Result reported from a diluted sample or sample extract
V = Reported result for this compound could not be verified during data validation

Table 4-47
Surface Sediments - Inorganics Data Normalized to Grain Size (% fines)
Pelham Bay Landfill
Bronx, New York

										NOAA L.I. Sound Reference Stations		
location	SD-1	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8	SD-9	Throgs Neck	Hempstead Harbor	Mamaroneck
Aluminum	21156	19956	26620	23777	20903	32248	21950	22398	20527	53358	62963	50676
Arsenic	12.4	12.0	14.9	20.0	12.5	19.0	13.4	13.9	13.7	9.8	14	11
Barium	115.9	112.1	163.4	134.5	113.9	345.4	132.9	128.1	107.0	---	---	---
Beryllium	0.84	0.80	0.90	0.98	0.61			0.98	0.77	---	---	---
Cadmium			6.9		3.00	5.6	5.4	2.5	4.0	2.1	2.3	2.0
Calcium	8197	9119	65451	62455	15242	59824	13636	13871	14313	---	---	---
Chromium	117	107	141	88	115	179	136	142	142	210	150	150
Cobalt	13.2	10.1	17.8	14.6	14.9	27.6	13.8	11.4	12.3	---	---	---
Copper	211	189	236	174	201	363	246	245	202	200	180	130
Iron	43039	40058	52604	45290	41176	70870	45260	44682	40339	33510	39259	47072
Lead	200	194	227	234	203	627	244	254	203	200	150	110
Magnesium	12686	11806	16719	13025	12283	26549	13364	12664	13070	---	---	---
Manganese	527	484	664	563	511	737	549	546	662	1179	861	1476
Mercury	0.97	1.72	0.95	1.45	1.04	1.42	2.02	1.16	1.66	1.20	0.66	0.51
Nickel									52.8	57	46	55
Potassium	6332	5917	8316	6608	5664	10274	6096	5911	5928	---	---	---
Selenium	1.6				1.1			2.1		0.76	0.76	0.67
Silver			4.4	2.5			4.0	3.7	6.5	5.2	5.3	1.8
Sodium	23591	21747	29051	22826	17462	24262	21406	18452	22637	---	---	---
Thallium			1.91	2.49		2.99	1.86		1.81	0.66	0.79	0.82
Vanadium	62.0	60.5	78.8	57.2	57.2	112.8	64.8	63.7	54.0	---	---	---
Zinc	345	316	418	371	332	936	402	371	315	320	310	300
% fines	91.7%	91.2%	57.6%	73.6%	90.1%	34.1%	85.8%	88.7%	88.5%	71%	90%	74%

Notes: All values reported in mg / kg fines

% fines = % (by weight) of silt and clay fractions combined (< 63 um)

Blank indicates the compound was not detected in any of the three replicates or all values had a "R" or "R#" qualifier

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-48
Surface Sediments - Inorganics Data Normalized to Grain Size (% fines) - Ratio to Reference (RTR) Values
Pelham Bay Landfill
Bronx, New York

location	SD-1	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8	NOAA L.I. Sound Reference Stations (1) Throgs Neck	Hempstead Harbor	Mamaroneck
Aluminum	1.0	1.0	1.3	1.2	1.0	1.6	1.1	1.1	2.6	3.1	2.5
Arsenic	**0.9**	**0.9**	**1.1**	**1.5**	**0.9**	**1.4**	**1.0**	**1.0**	**0.7**	**1.0**	**0.8**
Barium	1.1	1.0	1.5	1.3	1.1	3.2	1.2	1.2	---	---	---
Beryllium	1.1	1.0	1.2	1.3	0.8	< SD-9	< SD-9	1.3	---	---	---
Cadmium	**< SD-9**	**< SD-9**	**1.7**	**< SD-9**	**0.7**	**1.4**	**1.3**	**0.6**	**0.5**	**0.6**	**0.5**
Calcium	0.6	0.6	4.6	4.4	1.1	4.2	1.0	1.0	---	---	---
Chromium	**0.8**	**0.8**	**1.0**	**0.6**	**0.8**	**1.3**	**1.0**	**1.0**	**1.5**	**1.1**	**1.1**
Cobalt	1.1	0.8	1.4	1.2	1.2	2.2	1.1	0.9	---	---	---
Copper	**1.0**	**0.9**	**1.2**	**0.9**	**1.0**	**1.8**	**1.2**	**1.2**	**1.0**	**0.9**	**0.6**
Iron	**1.1**	**1.0**	**1.3**	**1.1**	**1.0**	**1.8**	**1.1**	**1.1**	**0.8**	**1.0**	**1.2**
Lead	**1.0**	**1.0**	**1.1**	**1.2**	**1.0**	**3.1**	**1.2**	**1.3**	**1.0**	**0.7**	**0.5**
Magnesium	1.0	0.9	1.3	1.0	0.9	2.0	1.0	1.0	---	---	---
Manganese	**0.8**	**0.7**	**1.0**	**0.9**	**0.8**	**1.1**	**0.8**	**0.8**	**1.8**	**1.3**	**2.2**
Mercury	**0.6**	**1.0**	**0.6**	**0.9**	**0.6**	**0.9**	**1.2**	**0.7**	**0.7**	**0.4**	**0.3**
Nickel	**< SD-9**	**< SD-9**	**< SD-9**	**< SD-9**	**< SD-9**	**< SD-9**	**< SD-9**	**< SD-9**	**1.1**	**0.9**	**1.0**
Potassium	1.1	1.0	1.4	1.1	1.0	1.7	1.0	1.0	---	---	---
Selenium	> SD-9				> SD-9			> SD-9	> SD-9	> SD-9	> SD-9
Silver	< SD-9	< SD-9	0.7	0.4	< SD-9	< SD-9	0.6	0.6	0.8	0.8	0.3
Sodium	1.0	1.0	1.3	1.0	0.8	1.1	0.9	0.8	---	---	---
Thallium	< SD-9	< SD-9	1.1	1.4	< SD-9	1.7	1.0	< SD-9	0.4	0.4	0.5
Vanadium	1.1	1.1	1.5	1.1	1.1	2.1	1.2	1.2	---	---	---
Zinc	**1.1**	**1.0**	**1.3**	**1.2**	**1.1**	**3.0**	**1.3**	**1.2**	**1.0**	**1.0**	**1.0**
% fines	91.7%	91.2%	57.6%	73.6%	90.1%	34.1%	85.8%	88.7%	71%	90%	74%

Notes:

RTR values are the mean concentration of the analyte at the sample location divided by the mean concentration detected at the reference location (SD-9)

A blank indicates that the compound was not detected in either ther reference location sample (SD-9) or the sample location being compared to it

> SD-9 indicates that the analyte was detected in the sample location but was not detected in the reference location sample (SD-9)

< SD-9 indicates that the analyte was detected in the reference location sample (SD-9) but was not detected at the sample location being compared to

Shaded metals are metals for which there is a NYSDEC Sediment Cleanup Criteria for

(1) For the NOAA L.I. Sound Reference Stations "---" indicates the analyte was not analyzed for

% fines = % (by weight) of silt and clay fractions combined (< 63 um)

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-49
Surface Sediments - Semi-volatile Organic Compounds Data Normalized to Percent Organic Carbon
Pelham Bay Landfill
Bronx, New York

										NOAA L.I. Sound Reference Stations (1)		
location:	SD-1	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8	SD-9	Throgs Neck	Hempstead Harbor	Mamaroneck
PAHs												
2-Methylnaphthalene						3,248				5,276	2,531	2,048
Acenaphthene			6,250			5,916				2,241	2,281	
Acenaphthylene			5,190	16,826		5,259			11,054	4,552	---	---
Anthracene	15,643	10,598	8,092	14,274	10,377	14,695	9,314		9,286	9,724	3,938	3,714
Benzo(a)anthracene	40,117	29,060	27,083	60,606	26,101	47,177	23,611	22,385	31,718	26,241	11,563	15,952
Benzo(a)pyrene	44,347	32,265	21,652	64,274	30,582	38,670	27,124	26,151	25,935	30,690	13,813	19,905
Benzo(b)fluoranthene	39,181	32,835	24,628	65,598	28,381	57,618	28,513	23,780	34,796	12,138	---	---
Benzo(ghi)perylene	20,819	18,020	13,058	28,421	18,318	14,037	14,583	13,598	18,027	9,034	---	---
Benzo(k)fluoranthene	43,713	32,479	20,015	45,614	28,145	51,431	26,634	23,780	28,776	8,966	---	---
Chrysene	58,869	41,524	30,729	59,569	32,154	56,071	32,990	29,986	42,347	34,345	17,563	23,333
Dibenzo(a,h)anthracene			4,911	7,560					6,888	4,552	2,344	4,619
Dibenzofuran						5,104				---	---	---
Fluoranthene	49,805	38,105	30,432	60,686	34,198	60,325	28,105	23,989	37,500	43,897	26,094	40,333
Fluorene			6,250			6,543				3,034	2,094	1,857
Indeno(1,2,3-c,d)pyrene	23,275	17,179	14,174	29,258	18,789	14,107	14,951	13,738	20,238	8,828	---	---
Naphthalene						4,176				5,000	3,500	2,476
Phenanthrene	27,193	22,792	14,063	16,746	16,588	50,657	16,340	14,226	25,510	21,103	11,719	16,429
Pyrene	105,263	76,923	42,634	92,504	51,258	117,943	57,843	50,907	59,269	49,931	26,313	37,238
Total	468,226	351,781	269,159	561,938	294,890	552,978	280,008	242,538	351,344			
Phthalates												
Butyl benzyl phthalate	14,620	9,829	3,906		12,264	10,209			6,633	---	---	---
Di-n-butyl phthalate	21,053	10,577	5,655	6,411		8,260				---	---	---
Di-n-octyl phthalate						5,151				---	---	---
bis(2-Ethylhexyl)phthalate	222,222	101,852	46,429	51,515	72,327	205,336	107,026	76,011	92,687	---	---	---
Total	257,895	122,258	55,990	57,927	84,591	228,956	107,026	76,011	99,320			
Grand Total	726,121	474,038	325,149	619,864	379,481	781,933	387,034	318,550	450,663			
% organic carbon	1.71%	2.34%	2.24%	2.09%	2.12%	4.31%	2.04%	2.39%	1.96%	2.9%	3.2%	2.1%

Notes:

All values reported in ug / kg sediment organic carbon

Blank indicates the compound was not detected in any of the six replicates or all detected values had a "R" or "R#" qualifier

(1) For the NOAA L.I. Sound Reference stations "---" indicates analyte not analyzed for

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-50
Surface Sediments - Semi-volatile Organic Compounds Data Normalized to Percent Carbon - Ratio to Reference (RTR) Values
Pelham Bay Landfill
Bronx, New York

									NOAA L.I. Sound Reference Stations (1)		
location:	SD-1	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8	Throgs Neck	Hempstead Harbor	Mamaroneck
PAHs											
2-Methylnaphthalene						> SD-9			> SD-9	> SD-9	> SD-9
Acenaphthene			> SD-9			> SD-9			> SD-9	> SD-9	
Acenaphthylene	< SD-9	< SD-9	0.5	1.5	< SD-9	0.5	< SD-9	< SD-9	0.4	---	---
Anthracene	1.7	1.1	0.9	1.5	1.1	1.6	1.0	< SD-9	1.0	0.4	0.4
Benzo(a)anthracene	1.3	0.9	0.9	1.9	0.8	1.5	0.7	0.7	0.8	0.4	0.5
Benzo(a)pyrene	1.7	1.2	0.8	2.5	1.2	1.5	1.0	1.0	1.2	0.5	0.8
Benzo(b)fluoranthene	1.1	0.9	0.7	1.9	0.8	1.7	0.8	0.7	0.3	---	---
Benzo(ghi)perylene	1.2	1.0	0.7	1.6	1.0	0.8	0.8	0.8	0.5	---	---
Benzo(k)fluoranthene	1.5	1.1	0.7	1.6	1.0	1.8	0.9	0.8	0.3	---	---
Chrysene	1.4	1.0	0.7	1.4	0.8	1.3	0.8	0.7	0.8	0.4	0.6
Dibenzo(a,h)anthracene	< SD-9	< SD-9	0.7	1.1	< SD-9	< SD-9	< SD-9	< SD-9	0.7	0.3	0.7
Dibenzofuran						> SD-9			---	---	---
Fluoranthene	1.3	1.0	0.8	1.6	0.9	1.6	0.7	0.6	1.2	0.7	1.1
Fluorene			> SD-9			> SD-9			> SD-9	> SD-9	> SD-9
Indeno(1,2,3-c,d)pyrene	1.2	0.8	0.7	1.4	0.9	0.7	0.7	0.7	0.4	---	---
Naphthalene						> SD-9			> SD-9	> SD-9	> SD-9
Phenanthrene	1.1	0.9	0.6	0.7	0.7	2.0	0.6	0.6	0.8	0.5	0.6
Pyrene	1.8	1.3	0.7	1.6	0.9	2.0	1.0	0.9	0.8	0.4	0.6
Total	1.3	1.0	0.8	1.6	0.8	1.6	0.8	0.7			
Phthalates											
Butyl benzyl phthalate	2.2	1.5	0.6	< SD-9	1.8	1.5	< SD-9	< SD-9	---	---	---
Di-n-butyl phthalate	> SD-9	> SD-9	> SD-9	> SD-9		> SD-9			---	---	---
Di-n-octyl phthalate						> SD-9			---	---	---
bis(2-Ethylhexyl)phthalate	2.4	1.1	0.5	0.6	0.8	2.2	1.2	0.8	---	---	---
Total	2.6	1.2	0.6	0.6	0.9	2.3	1.1	0.8			
Grand Total	1.6	1.1	0.7	1.4	0.8	1.7	0.9	0.7			
% organic carbon:	1.71%	2.34%	2.24%	2.09%	2.12%	4.31%	2.04%	2.39%	2.9%	3.2%	2.1%

Notes:

A blank indicates either there were no detected values for SD-9 or the comparison location
(1) For the NOAA L.I. Sound Reference stations "---" indicates analyte not analyzed for.
> SD-9 indicates that the analyte was detected in the sample location but was not detected in the reference location sample (SD-9)
< SD-9 indicates that the analyte was detected in the reference location sample (SD-9) but was not detected at the sample location being compared to

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-51
Observed Mortalities During the Ten Day Exposure of Ampelisca abdita to Sediment Samples from Eastchester Bay
Pelham Bay Landfill
Bronx, New York

Day	Control	Stations								
		SD-1	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8	SD-9
Number	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B
1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
3	0/1	0/0	0/0	0/1	0/0	0/0	0/0	0/0	1/0	1/5
4	0/0	0/0	0/1	2/0	0/1	1/0	1/1	0/0	0/1	9/6
5	0/0	0/0	0/0	0/0	0/0	0/0	1/0	0/0	1/1	0/0
6	0/0	1/1	1/0	2/0	0/0	0/0	1/0	0/1	1/1	0/0
7	0/0	0/0	0/0	0/0	0/0	0/0	0/1	0/0	0/0	0/0
8	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
9	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
10	0/0	1/0	2/1	0/0	0/1	5/1	0/0	1/0	0/0	0/0

Note: Definitive counts for mortality were based on the number of animals recovered from the sediments on day #10 (see Table 4-52)

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-52
Survivorship Count for Assessment of Ampelisca abdita Exposed to Bulk Sediment Samples
Pelham Bay Landfill
Bronx, New York

Test Group	Replicate A	Replicate B	Total Survival	% Survival
Control	20	18	38	95
Station SD-1	18	14	32	80
Station SD-2	12	14	26	65 *
Station SD-3	21	11	32	80
Station SD-4	20	10	30	75
Station SD-5	9	12	21	52.5 *
Station SD-6	12	13	25	62.5 *
Station SD-7	12	8	20	50 *
Station SD-8	11	10	21	52.5 *
Station SD-9	0	0	0	0 *

Note: * = Significant difference when compared to Control (p=0.95); replicates were pooled for statistical analysis using Fisher's Exact Test

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-53
Summary Ampelisca abdita Reburial Assessment
Pelham Bay Landfill
Bronx, New York

Sample	Slope	Standard Error of Slope	ET(50) (min)	95% Confidence for ET(50)
Control A	1.2611	0.3425	0.2756	0.02181 - 0.6838
Control B[1]	----	----	----	----
SD-1 A	0.9234	0.2001	0.9199	0.1633 - 2.2416
SD-1 B	1.4694	0.3008	1.5998	0.5814 - 3.0954
SD-2 A	1.7855	0.4996	1.3824	0.3607 - 3.1594
SD-2 B[1]	----	----	----	----
SD-3 A	1.0926	0.2215	0.7308	0.1746 - 1.6125
SD-3 B	0.7089	0.2238	4.3251	0.3641 - 13.2657
SD-4 A	1.2678	0.2071	4.4620	2.1933 - 7.5358
SD-4 B	0.7345	0.2259	4.4666	0.4520 - 13.2386
SD-5 A[2]	0.4568	0.2994	0.0836	---[2]
SD-5 B	1.3136	0.4802	0.2962	0.0034 - 0.8900
SD-6 A	1.7375	0.4572	1.1210	0.3279 - 2.4109
SD-6 B	1.3572	0.4938	0.3552	0.0062 - 1.0376
SD-7 A	1.1381	0.3180	1.8529	0.2400 - 4.8826
SD-7 B	0.7010	0.3169	3.1682	0.0000 - 16.4044
SD-8 A	1.6709	0.5170	0.6120	0.1097 - 1.3854
SD-8 B[1]	----	----	----	----

Notes:

1. Less than two response times between 0 and 100%
2. Slope not significantly different from zero, no CI possible

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-54
Pore Water Analysis of Bulk Sediments Used in Ampelisca abdita Bioassay
Pelham Bay Landfill
Bronx, New York

Test Group	pH	Dissolved Oxygen (ppm)	Salinity[1] (ppt)	Total Ammonia (ppm)
SD-1	7.18	6.2	23.3	3.70
SD-2	7.29	5.1	22.6	4.89
SD-3	7.36	5.0	23.3	4.48
SD-4	7.34	4.6	23.3	1.23
SD-5	7.29	3.7	23.3	2.40
SD-6	7.26	3.3	22.6	3.96
SD-7	7.30	3.7	23.3	2.44
SD-8	7.37	5.6	23.3	2.01
SD-9	7.11	4.9	23.3	2.19

Note: 1. Salinity as converted from specific gravity following the tables in Spotte, 1970

Prepared by: SMM
Checked by:ABB
92C4087

Table 4-55
Dissolved Oxygen Concentrations During the Bulk Sediment Bioassay
Pelham Bay Landfill
Bronx, New York

Test Group	Mean Value (ppm)	Standard Error	# of Measurements	Range of values
Control	7.24	0.078	20	6.7 - 7.7
SD-1	6.52	0.126	20	4.6 - 7.1
SD-2	6.58	0.223	20	4.1 - 7.7
SD-3	6.83	0.185	20	3.8 - 7.5
SD-4	6.58	0.191	20	4.4 - 7.5
SD-5	6.83	0.098	20	6.1 - 7.5
SD-6	5.99	0.177	20	4.4 - 7.3
SD-7	6.90	0.080	20	6.0 - 7.4
SD-8	6.76	0.121	20	5.4 - 7.4
SD-9	5.19	0.534	20	0.5 - 7.5

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-56
Salinity Measurements Made During the Bulk Sediment Bioassay
Pelham Bay Landfill
Bronx, New York

Test Group	Mean Value[1] (ppt)	Standard Error[2]	# of Measurements	Range of values
Control	25.2	1.68E-04	12	24.6 - 26.5
SD-1	24.6	1.60E-04	12	23.9 - 25.6
SD-2	24.6	1.68E-04	12	23.9 - 25.9
SD-3	24.6	1.68E-04	12	23.9 - 25.9
SD-4	24.7	1.83E-04	12	23.9 - 25.9
SD-5	24.7	1.64E-04	12	23.9 - 25.9
SD-6	24.6	1.51E-04	12	23.9 - 25.9
SD-7	24.7	1.61E-04	12	23.9 - 25.9
SD-8	24.7	1.61E-04	12	23.9 - 25.9
SD-9	24.6	1.51E-04	12	23.9 - 25.9

Notes:

1. Salinity as converted from specific gravity following the tables in Spotte, 1970
2. Based on the original units of specific gravity

Prepared by:SMM
Checked by: ABB
92C4087

Table 4-57
Total Ammonia (ppm) Measurements Made During the Bulk Sediment Bioassay
Pelham Bay Landfill
Bronx, New York

Test Group	Day 1 (ppt)	Day 5	Day 10
Control	ND	ND	ND
SD-1	0.35	1.04	1.67
SD-2	ND	1.25	0.83
SD-3	ND	0.66	ND
SD-4	ND	ND	0.98
SD-5	ND	0.20	0.31
SD-6	ND	0.17	0.50
SD-7	ND	ND	0.04
SD-8	ND	ND	0.72
SD-9	2.64	2.42	4.82

Notes: ND = Not Detected

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-58
pH Measurements Made During the Bulk Sediment Bioassay
Pelham Bay Landfill
Bronx, New York

Test Group	Day 1	Day 5	Day 10
Control	7.25, 7.20	7.94, 7.81	7.91, 7.88
SD-1	7.30, 7.50	7.98, 7.62	8.06, 7.95
SD-2	7.44, 7.51	7.98, 7.75	8.09, 7.92
SD-3	7.39, 7.33	8.26, 7.80	8.24, 7.84
SD-4	7.34, 7.47	7.88, 7.71	7.92, 7.73
SD-5	7.48, 7.45	8.23, 7.84	8.31, 7.95
SD-6	7.33, 7.35	7.92, 8.03	7.91, 8.11
SD-7	7.32, 7.44	8.04, 8.26	8.07, 8.15
SD-8	7.55, 7.58	8.43, 8.34	8.33, 8.26
SD-9	7.27, 7.23	7.97, 7.58	8.06, 7.84

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-59
Summary of Menidia beryllina Survival Exposed for Seven Days to Elutriates of Eastchester Bay Sediments
Pelham Bay Landfill
Bronx, New York

Test Group	Replicate A	Replicate B	Replicate C	Total Survival	% Survival
Control	13	14	13	40	88.9
SD-1	10	13	13	36	80.0
SD-2	10	11	14	35	77.8
SD-3	14	15	11	40	88.9
Control	12	13	14	39	86.7
SD-4	7	8	9	24 of 46[1]	52.2 *
SD-5	12	5	10	27	60 *
SD-6	9	13	8	30	66.7
Control	12	14	14	40	88.9
SD-7	11	13	9	33	73.3
SD-8	ND	12	10	22 of 30	73.3
SD-9	12	12	14	38	84.4

Note:
1. One extra larvae found on day seven and incorporated into assessment
ND = No data due to breakage of test vessel
* = Significant difference when compared to control (p=0.95); replicates were pooled for statistical analysis using Dunnetts test

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-60
Summary Growth of Menidia beryllina Exposed for Seven Days to Elutriates of Eastchester Bay Sediments
Pelham Bay Landfill
Bronx, New York

Test Group	Replicate A	Replicate B	Replicate C	Mean Dry Weight per Larvae (mg)
Control	0.3962	0.4943	0.6877	0.5261
SD-1	0.5300	0.3592	0.3754	0.4215
SD-2	0.3600	0.4303	0.3957	0.3953
SD-3	0.3700	0.3071	0.2847	0.3206 *
Control	0.6458	0.7023	0.6064	0.6515
SD-4	0.9443	0.6233[1]	0.5380	0.7019
SD-5	0.7820	0.8980	0.5600	0.7467
SD-6	1.3362	1.1111	0.6315	1.0263
Control	0.4875	0.3521	0.3064	0.3820
SD-7	0.3567	0.3877	0.3567	0.3660
SD-8	N/M	0.5360	0.5092	0.5226
SD-9	0.4067	0.4875	0.2621	0.3854

Notes:

1. Includes two mortalities collected on day seven

* = Significantly less than control value (p=0.95), based on Dunnett's Test

N/M = Not Measured (lost due to breakage of replicate during test)

Prepared by:SMM
Checked by:ABB
92C4087

Table 4-61
Dissolved Oxygen Measured During Testing Series #1
SD-1 Through SD-3 (Elutriate Test)
Pelham Bay Landfill
Bronx, New York

Sample	Mean Dissolved Oxygen (ppm)	Standard Error	Number of Measurements	Range of Values
Control A	7.11	0.150	14	6.1 - 8.1
SD-1	6.04	0.207	14	4.8 - 7.5
SD-2	6.03	0.261	14	4.2 - 7.3
SD-3	6.18	0.221	14	4.7 - 7.3

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-62
Salinity Measured During Testing Series #1
SD-1 Through SD-3 (Elutriate Test)
Pelham Bay Landfill
Bronx, New York

Sample	Mean Salinity[1] (ppt)	Standard Error[2]	Number of Measurements	Range of Values
Control A	27.7	1.4E-04	13	26.5 - 29.1
SD-1	27.1	4.2E-04	13	25.2 - 33.0
SD-2	26.8	1.9E-04	13	25.9 - 29.1
SD-3	26.8	1.6E-04	13	25.9 - 28.5

Notes:
1. Converted from specific gravity based on tables in Spotte, 1970
2. Based on original values of specific gravity

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-63
Test Chamber Temperature and Test water pH Ranges During Elutriate Testing Series #1; SD-1, SD-2, and SD-3
Pelham Bay Landfill
Bronx, New York

Temperature Mean = 25.2 C (SE 0.06; N=7) Range: 25.0 - 25.2		
Test Group	Range in pH	Number of Measurements
Control	7.27 - 8.78	14
SD-1	7.73 - 8.20	14
SD-2	7.78 - 8.22	14
SD-3	7.78 - 8.20	14

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-64
Dissolved Oxygen Measured During Testing Series #2
SD-4 Through SD-6 (Elutriate Test)
Pelham Bay Landfill
Bronx, New York

Sample	Mean Dissolved Oxygen (ppm)	Standard Error	Number of Measurements	Range of Values
Control A	7.25	0.181	13	5.8 - 8.1
SD-4	6.33	0.286	14	4.9 - 8.4
SD-5	6.21	0.296	14	5.1 - 8.4
SD-6	6.22	0.284	14	5.1 - 8.6

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-65
Salinity Measured During Testing Series #2
SD-4 Through SD-6 (Elutriate Test)
Pelham Bay Landfill
Bronx, New York

Sample	Mean Salinity[1] (ppt)	Standard Error[2]	Number of Measurements	Range of Values
Control A	27.6	2.8E-04	13	25.9 - 29.8
SD-4	26.7	3.0E-04	14	24.6 - 28.5
SD-5	27.3	2.4E-04	14	24.6 - 29.1
SD-6	26.9	1.9E-04	14	25.2 - 28.5

Notes:

1. Converted from specific gravity based on tables in Spotte, 1970
2. Based on original values of specific gravity

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-66
Test Chamber Temperature and Test Water pH Ranges During Elutriate Testing Series #2; SD-4, SD-5, and SD-6
Pelham Bay Landfill
Bronx, New York

Temperature Mean = 25.1 C (SE 0.08; N=7) Range: 24.8 - 25.5		
Test Group	Range in pH	Number of Measurements
Control	7.67 - 8.78	13
SD-4	7.79 - 8.12	14
SD-5	7.88 - 8.26	14
SD-6	7.76 - 8.13	14

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-67
Dissolved Oxygen Measured During Testing Series #3
SD-7 Through SD-9 (Elutriate Test)
Pelham Bay Landfill
Bronx, New York

Sample	Mean Dissolved Oxygen (ppm)	Standard Error	Number of Measurements	Range of Values
Control A	6.94	0.236	14	5.6 - 8.6
SD-7	5.77	0.303	14	4.0 - 8.2
SD-8	5.93	0.310	14	4.1 - 8.0
SD-9	5.86	0.291	14	4.1 - 8.2

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-68
Salinity Measured During Testing Series #3
SD-7 Through SD-9 (Elutriate Test)
Pelham Bay Landfill
Bronx, New York

Sample	Mean Salinity[1] (ppt)	Standard Error[2]	Number of Measurements	Range of Values
Control A	26.8	1.4E-04	14	25.9 - 28.5
SD-7	26.3	1.4E-04	14	25.9 - 28.5
SD-8	26.3	1.1E-04	14	25.9 - 27.8
SD-9	26.4	1.2E-04	14	25.9 - 27.8

Notes:

1. Converted from specific gravity based on tables in Spotte, 1970
2. Based on original values of specific gravity

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-69
Test Chamber Temperature and Test Water pH Ranges During Elutriate Testing Series #3; SD-7, SD-8, and SD-9
Pelham Bay Landfill
Bronx, New York

Temperature Mean = 25.3 C (SE 0.11; N=7) Range: 25.0 - 25.8		
Test Group	Range in pH	Number of Measurements
Control	7.63 - 8.39	14
SD-7	7.60 - 8.13	14
SD-8	7.72 - 8.11	14
SD-9	7.80 - 8.13	14

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-70
Total Ammonia (ppm) Measured During Elutriate Bioassay
Series #1; SD-1, SD-2, and SD-3
Pelham Bay Landfill
Bronx, New York

Test Group	Day 1 (old)	Day 4 (old)	Day 7 (old)	Day 1 (new)	Day 4 (new)
Control A	ND	ND	ND	ND	1.32[1]
Control B	ND	ND	ND	ND	ND
SD-1 A	1.46	1.27	1.60	1.66	2.17
SD-1 B	1.55	1.38	1.75	2.31	2.40
SD-2 A	1.38	0.76	0.62	3.72	0.76
SD-2 B	1.83	1.04	0.76	3.86	0.25
SD-3 A	1.04	0.98	0.48	1.04	0.76
SD-3 B	0.98	0.34	0.53	0.98	1.01

Notes: 1. Believe an anomalous measurement
ND = Not Detected

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-71
Total Ammonia (ppm) Measured During Elutriate Bioassay
Series #2; SD-4, SD-5, and SD-6
Pelham Bay Landfill
Bronx, New York

Test Group	Day 1 (old)	Day 4 (old)	Day 7 (old)	Day 1 (new)	Day 4 (new)
Control A	NM	ND	ND	1.32[1]	ND
Control B	NM	ND	ND	ND	ND
SD-4 A	0.90	ND	ND	0.76	ND
SD-4 B	0.70	ND	ND	ND	ND
SD-5 A	1.30	ND	0.25	0.20	0.05
SD-5 B	1.58	ND	ND	ND	ND
SD-6 A	ND	ND	0.76	ND	0.70
SD-6 B	0.25	0.17	0.84	ND	0.90

Notes:
1. Believe an anomalous measurement
ND = Not Detected
NM = Not Measured

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-72
Total Ammonia (ppm) Measured During Elutriate Bioassay
Series #3; SD-7, SD-8, and SD-9
Pelham Bay Landfill
Bronx, New York

Test Group	Day 1 (old)	Day 4 (old)	Day 7 (old)	Day 1 (new)	Day 4 (new)
Control A	ND	ND	ND	ND	ND
Control B	ND	ND	ND	ND	ND
SD-7 A	0.76	0.70	0.93	0.62	0.22
SD-7 B	0.53	0.70	1.15	0.62	0.62
SD-8 A	0.24	0.62	0.72	0.76	0.98
SD-8 B	0.48	0.48	0.72	0.48	0.76
SD-9 A	0.70	1.13	1.15	0.76	0.53
SD-9 B	0.53	0.34	0.93	0.53	0.48

Note: ND = Not Detected

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-73
Acid Volatile Sulfide Content in the Sediment Samples from Eastchester Bay Used in Solid Phase Toxicity Tests
Pelham Bay Landfill
Bronx, New York

Sediment Samples	Mean Sulfide Concentration (mg/kg)	Range	Standard Error
SD-1	511.0	245.22 to 817.82	165.3
SD-2	866.3	785.33 to 1026.09	65.2
SD-3	664.7	443.68 to 916.57	112.2
SD-4	345.1	248.93 to 401.16	39.4
SD-5	587.5	461.71 to 686.23	54.1
SD-6	990.9	790.90 to 1126.64	83.4
SD-7	779.7	660.67 to 978.92	81.8
SD-8	930.7	791.85 to 1153.49	91.9
SD-9	811.4	782.75 to 827.86	11.7

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-74
Acid Volatile Sulfide Content in the Sediment Samples from Eastchester Bay Used in Elutriate Toxicity Tests
Pelham Bay Landfill
Bronx, New York

Sediment Samples	Mean Sulfide Concentration (mg/kg)	Range	Standard Error
SD-1	701.2	250.26 to 955.17	184.6
SD-2	606.2	413.91 to 760.87	83.2
SD-3	869.1	816.96 to 933.89	28.0
SD-4	390.8	301.59 to 477.12	41.4
SD-5	604.5	438.17 to 815.93	90.9
SD-6	1321.8	1237.16 to 1469.33	60.4
SD-7	692.8	606.92 to 783.98	41.8
SD-8	779.1	616.68 to 912.67	70.8
SD-9	736.7	626.49 to 913.86	73.0

Prepared by: SMM
Checked by: ABB
92C4087

Table 4-75
Correlation Coefficients Between Concentrations of Selected Analytes in Eastchester Bay Sediments and the Observed Toxicity to Ampelisca abdita
Pelham Bay Landfill
Bronx, New York

Analyte	Correlation Coefficients			
	Bulk Sediment Concentration	Sediment Concentration Normalized to % Fines	Sediment Concentration Normalized to % Organic Carbon	Sediment Concentration Normalized to AVS
4,4'-DDD	-0.205	-0.627	-0.325	---
4,4'-DDT	-0.229	-0.627	-0.325	---
Anthracene	0.855	0.590	0.627	---
Barium	0.612	-0.145	0.229	---
Butyl-benzyl phthalate	0.349	0.349	0.337	---
Chromium	0.458	0.217	0.217	-0.157
Cobalt	0.072	-0.096	-0.072	-0.398
Delta BHC	0.133	-0.012	0.048	---
Di-n-octyl phthalate	-0.036	0.133	-0.000	---
Endosulfan	-0.795	-0.735	-0.687	---
Fluorene	0.048	0.012	-0.000	---
Lead	0.691	0.458	0.229	0.048
Mercury	0.458	0.554	0.458	---
Silver	0.359	0.359	0.359	0.308
Vanadium	0.120	0.072	0.217	---
Zinc	0.735	-0.024	0.229	-0.241

Prepared by: SMM
Checked by: RLH
92C4087

Table 4-76
Correlation Coefficients Between Concentrations of Selected Analytes in Eastchester Bay Sediments and the Observed Toxicity to Menidia beryllina
Pelham Bay Landfill
Bronx, New York

Analyte	Correlation Coefficients			
	Bulk Sediment Concentration	Sediment Concentration Normalized to % Fines	Sediment Concentration Normalized to % Organic Carbon	Sediment Concentration Normalized to AVS
Acenaphthene	-0.025	0.134	-0.092	---
Anthracene	0.477	0.410	0.293	---
Arsenic	0.294	0.301	0.167	---
Barium	0.445	0.259	-0.025	---
Benzo(a)pyrene	0.644	0.293	0.611	---
Benzo(k)fluoranthene	0.586	0.360	0.259	---
Butyl-benzyl phthalate	0.092	0.343	0.084	---
Chrysene	0.192	-0.025	0.243	---
Delta BHC	-0.243	-0.126	-0.343	---
Dibenzofuran	0.059	0.134	-0.092	---
Indeno pyrene	0.469	0.142	0.017	---
Iron	0.050	0.226	-0.126	0.226
Lead	0.311	0.460	-0.109	0.577
Phenanthrene	0.109	-0.310	0.092	---
Silver	-0.323	-0.323	-0.323	-0.122
Sodium	-0.544	-0.393	-0.477	---
Thallium	0.063	0.109	-0.184	---

Prepared by: SMM
Checked by: RLH
92C4087

Table 4-77
Mean Finfish Tissue Analytical Results
Pelham Bay Landfill
Bronx, New York

	Flounder				Atlantic Silverside			Tautog		American Eel
	Eastern Seawall	Southern Seawall	Reference Station	NYSDEC City Island	Eastern Seawall	Southern Seawall	Reference Station	Eastern Seawall	Southern Seawall	Southern Seawall
number of replicates analyzed	(n=5)	(n=5)	(n=2)	(n=1)	(n=5)	(n=5)	(n=5)	(n=1)	(n=1)	(n=2)
mean % moisture	77.4	76.7	74.7		76.7	73.4	75.4	78.3	78.5	62.8
mean % lipids	1.03	1.74	1.18		1.93	3.38	2.90	1.52	1.53	15.01
size range (cm)	34.2 - 47.5	20.3 - 38.2	36.0 - 39.1	125 - 220	3.0 - 8.9	3.3 - 12.2	3.0 - 10.0	15.5 - 17.0	17.5 - 18.0	59.1 - 70
weight range (g)	190 - 600	67 - 600	450 - 600	20 - 99	0.1 - 3.8	0.3 - 10.0	0.1 - 5.0	74 - 92	102 - 128	375 - 850
range of no. of indiv. used/rep.	1	1 - 2	1	4	75 - 100	41 - 80	42 - 90	2	2	1
avg. no. indiv. used/rep.	1		1	4	91	55	61	2	2	1
Analyte										
Metals (ppm)										
Cadmium		0.21 (1)							0.04	
Lead	0.04 (2)	0.09 (2)	0.5 (1)		0.28 (5)	0.21 (5)	0.11 (5)		0.02	0.20 (2)
Mercury	0.07 (5)	0.04 (5)	0.08 (2)	< 0.10	0.03 (5)	0.05 (5)	0.03 (5)	0.04	0.05	0.07 (2)
PCBs (ppb)				110						
PCB-1248					154 (5)					
PCB-1254						300 (1)	240 (4)			335 (2)
PCB-1260										190 (1)
Pesticides (ppb)										
4,4'-DDD										
4,4'-DDE		21 (2)			51 (5)	45 (5)	27 (5)			
4,4'-DDT				0.03						
Dieldrin				< 0.01						33 (2)
Endosulfan I										
Endrin				< 0.01						31 (2)
alpha-Chlordane		13 (1)								
beta-BHC							12 (1)			

Notes: Number in parentheses represents the number of detected values used to calculate the mean value

Metals are reported as milligrams per kilogram (ppm) wet weight

PCBs and Pesticides are reported as micrograms per kilogram (ppb) wet weight

Shaded areas mean compound was not detected in any replicate sample at that location

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-78
Mean Shellfish Tissue Analytical Results
Pelham Bay Landfill
Bronx, New York

	Blue Crab				Hard Clam							Blue Mussel			
	Eastern Seawall	Southern Seawall	Reference Station	NYSDEC Pelham Bay	Eastern Seawall	Southern Seawall	Reference Station	NYSDEC - Eastchester Bay			Eastern Seawall - 1	Eastern Seawall - 2	Southern Seawall	Reference Station
								1982	1987	1988				
number of replicates analyzed	(n=5)	(n=5)	(n=5)	(n=12)	(n=5)	(n=5)	(n=5)	(n=5)	(n=1)	(n=3)	(n=5)	(n=5)	(n=5)	(n=5)
mean % moisture	80.5	79.5	78.9		77.2	77.6	78.3				76.4	74.8	74.6	70.0
mean % lipids	0.69	0.80	0.89		1.36	1.24	1.20				3.22	2.25	2.34	2.82
size range (cm)	15.4 - 18.5	15.0 - 18.6	10.2 - 15.5		5.0 - 9.8	5.7 - 10.0	7.9 - 9.0				nd	nd	nd	nd
weight range (g)	nd	nd	nd		8 - 44	9 - 47	30.5 - 50.6				3 - 12	5 - 14.7	3.5 - 10.0	4.5 - 13.3
range of no. of indiv. used/rep.	2	2	2 - 5		5	4 - 7	3 - 6				16 - 28	12 - 23	18 - 22	14 - 16
avg. no. indiv. used/rep.	2	2	3		5	5	4				22	14	19	14
Analyte														
Metals (ppm)														
Cadmium	0.06 (5)	0.04 (5)	0.02 (1)	0.17	0.35 (5)	0.41 (5)	0.48 (5)	0.13	0.17	0.18	0.47 (5)	0.67 (5)	0.43 (5)	0.40 (5)
Lead	0.05 (5)	0.03 (4)	0.03 (4)		1.3 (5)	1.2 (5)	2.2 (5)	0.34	0.57	0.51	2.6 (5)	4.1 (5)	1.8 (5)	1.4 (5)
Mercury	0.07 (5)	0.10 (5)	0.09 (5)	0.07	0.02 (5)	0.03 (5)	0.05 (5)		< 0.025	0.06	0.03 (5)	0.04 (5)	0.03 (5)	0.04 (5)
PCBs (ppb)														
PCB-1248	▨	▨	▨		▨	▨	▨				▨	▨	▨	▨
PCB-1254	▨	▨	▨		▨	▨	▨				260 (5)	210 (4)	▨	▨
PCB-1260	▨	▨	▨		▨	▨	▨				▨	▨	▨	▨
Pesticides (ppb)														
4,4'-DDD	▨	▨	▨		▨	▨	▨				23 (4)	25 (3)	▨	▨
4,4'-DDE	▨	▨	▨		▨	▨	▨				20 (4)	▨	▨	▨
4,4'-DDT	▨	▨	▨		▨	▨	▨				▨	▨	▨	18 (1)
Dieldrin	▨	▨	▨		▨	▨	▨				▨	▨	▨	▨
Endosulfan I	▨	▨	▨		19 (1)	▨	▨				9.7 (1)	▨	▨	▨
Endrin	▨	▨	▨		▨	▨	▨				▨	▨	▨	▨
alpha-Chlordane	▨	▨	▨		▨	▨	▨				12 (5)	13 (1)	▨	▨
beta-BHC	▨	▨	▨		15 (4)	▨	▨				13 (4)	11 (1)	▨	▨

Notes: Number in parentheses represents the number of detected values used to calculate the mean value
Metals are reported as milligrams per kilogram (ppm) wet weight
PCBs and Pesticides are reported as micrograms per kilogram (ppb) wet weight
Shaded areas mean compound was not detected in any replicate sample at that location

Prepared by: RTG
Checked by: ABB
92C4087

Table 4-79
Results of Perimeter Soil Gas Survey
Pelham Bay Landfill
Bronx, New York

Sample Number	Depth (inches)	Date	Time	%LEL (background)	%LEL (measured)	%O_2 (background)	%O_2 (measured)	PPM H_2S (background)	PPM H_2S (measured)
SG92-1	19.75	9/2/92	1100	0	0	21.0	21.0	0.0	0.5
SG92-2	26.25	9/2/92	1106	0	0	21.0	20.8	0.3	0.5
SG92-3	37.00	9/2/92	1110	0	10	20.8	20.2	0.4	0.5
SG92-4	38.50	9/2/92	1120	1	>100	21.3	16.0	0.3	0.5
SG92-5	43.00	9/2/92	1130	0	>100	21.0	16.0	0.0	0.2
SG92-6	43.00	9/2/92	1140	0	0	21.0	20.5	0.0	0.5
SG92-7	30.50	9/2/92	1200	0	0	20.3	20.3	0.2	0.2
VENT-1	0.00	9/2/92	1330	0	15	21.0	20.6	0.0	0.0
VENT-1A	0.00	9/2/92	1335	0	>100	21.0	2.2	0.0	1.2
VENT-2	0.00	9/2/92	1350	1	1	20.6	20.6	0.1	0.1

Notes: LEL = Lower Explosive Limit
ppm = Parts per million.

Prepared by: DA
Checked by: PGN
92C4087

Table 4-80
EIFC Compound Emission Rates
Pelham Bay Landfill
Bronx, New York

Compound	AM-A	AM-B	AM-C	AM-D	AM-E	AM-F	AM-G	AM-1
1,1,1-Trichloroethane	0.0004	0.0045	0.0014	1.5485	0.0009	< 0.0005	1.4453	0.0006
1,2,4-Trichlorobenzene	< 0.0011	0.0035	< 0.0013	< 0.0016	< 0.0006	0.0007	< 0.0010	< 0.0004
1,2,4-Trimethylbenzene	0.0029	0.0439	0.0791	< 0.0011	0.0558	0.0016	0.0035	0.0015
1,2-Dichlorobenzene	< 0.0004	< 0.0014	0.0426	0.0152	0.0720	< 0.0005	< 0.0008	< 0.0003
1,2-Dichloroethylene	< 0.0003	0.0042	< 0.0031	< 0.0009	0.0046	< 0.0003	< 0.0005	< 0.0002
1,3,5-Trimethylbenzene	0.0009	0.0151	0.0348	0.0175	0.0260	0.0006	0.0038	0.0004
1,3-Dichlorobenzene	< 0.0008	0.0069	0.0309	0.0120	0.0261	< 0.0005	0.0019	< 0.0003
1,4-Dichlorobenzene	0.0025	0.1458	0.1973	0.0338	0.0833	0.0005	0.0248	0.0021
2-Propanone	0.0090	0.0379	0.0520	0.0316	0.1362	0.0197	0.0224	0.0076
Ammonia Nitrogen	10.2633	< 0.2349	< 0.2533	< 0.2454	< 0.2578	< 0.2648	< 0.2429	< 0.2836
Benzene	0.0006	0.0245	0.1007	0.0131	0.2013	0.0005	0.0086	0.0005
Bromoform	0.0007	0.0030	0.0019	< 0.0027	0.0009	0.0010	0.0015	0.0006
Carbon Disulfide	0.0020	0.0022	0.0017	0.0023	0.0029	0.0014	0.0011	0.0006
Chlorobenzene	0.0019	0.0353	0.7109	0.0500	1.1312	< 0.0004	0.0325	0.0007
Cumene	0.0011	0.0085	0.0981	< 0.0011	0.0310	0.0006	0.0021	< 0.0002
Ethylbenzene	0.0007	0.0277	0.3074	0.0029	0.0438	0.0004	0.0066	0.0006
Freon 11	0.0011	0.0024	0.0012	0.0014	0.0015	0.0013	< 0.0012	0.0010
Freon 113	0.0160	< 0.0018	< 0.0014	< 0.0017	< 0.0006	< 0.0006	< 0.0010	0.0006
Freon 114	< 0.0004	0.0085	< 0.0049	< 0.0015	0.0128	< 0.0006	< 0.0009	< 0.0003
Freon 12	< 0.0003	< 0.0012	< 0.0009	0.0221	< 0.0004	< 0.0004	< 0.0006	0.0009
Heptane	< 0.0003	0.0419	0.0040	0.0021	< 0.0003	< 0.0003	0.0013	< 0.0002
Hexachlorobutadiene	< 0.0020	< 0.0025	< 0.0019	< 0.0023	< 0.0009	0.0014	< 0.0014	< 0.0005
Hydrogen Sulfide	< 0.0013	< 0.0007	0.0213	< 0.0009	< 0.0009	< 0.0014	< 0.0009	< 0.0009
Methane	< 0.8284	4606.1000	6331.9000	1624.1000	9093.5000	< 1.0457	965.4000	< 0.6457
Methylene Chloride	0.0006	< 0.0008	< 0.0006	< 0.0008	< 0.0003	0.0007	< 0.0004	< 0.0002
Styrene	0.0180	0.0139	0.0060	0.0098	0.0062	0.0024	0.0075	0.0105
Tetrachloroethylene	< 0.0004	0.0031	< 0.0012	< 0.0015	< 0.0006	< 0.0006	0.0022	0.0006
Toluene	0.0809	0.0722	0.0242	0.0432	0.0332	< 0.0004	0.0184	0.0121
Trichloroethylene	< 0.0003	0.0015	< 0.0010	< 0.0012	< 0.0004	< 0.0004	< 0.0007	< 0.0003
Xylenes	0.0025	0.0665	0.0503	0.0147	0.0224	0.0019	0.0064	0.0016

Notes:

All values are ug/m²-sec
This table lists only those compounds detected at least once
The value following the "<" indicates the minimum level of detection for that compound
These numbers have not been reviewed

Prepared by: BW
Checked by: RJM
92C4087

Table 4-81
Average PM10 and Selected Metals Concentrations
Pelham Bay Landfill
Bronx, New York

Analyte	7/14/92		7/16/92		7/17/92		7/20/92		7/22/92	
	On-site	Off-site	On-site	Off-site	On-site	Off-site	On-site	Off-site	On-site	Off-site
Arsenic	0.0010	0.0006	0.0001	0.0002	0.0003	0.0005	0.0008	0.0006	0.0002	0.0002
Barium	0.0147	0.0172	0.0063	0.0075	0.0083	0.0132	0.0205	0.0241	0.0093	0.0072
Beryllium	0.00005	0.00004	0.00002	0.00002	0.00002	0.00002	0.00004	0.00004	0.00002	0.00002
Chromium	0.0030	0.0033	0.0017	0.0017	0.0013	0.0015	0.0023	0.0029	0.0027	0.0021
Hexavalent Chromium	0.0005	0.0007	0.0003	0.0002	0.0003	0.0005	0.0008	0.0008	0.0005	0.0004
Lead	0.0077	0.0118	0.0016	0.0043	0.0101	0.0100	0.0150	0.0190	0.0053	0.0147
Manganese	0.0153	0.0168	0.0009	0.0014	0.0014	0.0024	0.0071	0.0082	0.0044	0.0055
Nickel	0.0129	0.0127	0.0013	0.0013	0.0040	0.0034	0.0216	0.0205	0.0024	0.0024
Particulate (PM10)	62.98	63.28	9.63	11.16	18.91	21.77	50.58	54.63	21.53	22.03

Notes: All units in ug/m^3
Non-detected values are included in the average as one-half the detection limit

Prepared by: BW
Checked by: RJM
92C4087

Table 4-82
Maximum 24-Hour Measured Off-Site VOC/SVO Concentrations
Pelham Bay Landfill
Bronx, New York

Compound	Concentration	Date	Location	24-Hour Wind Direction	10-Hour Wind Direction	24-Hour Wind Speed	10-Hour Wind Speed	Downwind Wind Directions[1]
1,1,1-Trichloroethane*	*	14-Jul	AM-3	WSW, E thru ESE	WSW	9.7	13.0	SSW thru W
1,2,4-Trichlorobenzene	ND	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	17.00	15-Jul	AM-6	NE thru ENE	NE thru ENE	8.8	13.5	NNW thru NNE
1,2-Dichlorobenzene	ND	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethylene	ND	NA	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	3.50	15-Jul	AM-6	NE thru ENE	NE thru ENE	8.8	13.5	NNW thru NNE
1,3-Dichlorobenzene	ND	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	3.42	14-Jul	AM-6	WSW, E thru ESE	WSW	9.7	13.0	NNW thru NNE
2-Propanone	265.76	16-Jul	AM-1	ENE thru E	ENE thru SSE	8.7	9.2	NW thru ENE
Benzene	9.75	14-Jul	AM-2	WSW, E thru ESE	WSW	9.7	13.0	ESE thru S
Bromoform	6.31	15-Jul	AM-3	NE thru ENE	NE thru ENE	8.8	13.5	SSW thru W
Carbon Disulfide	5.70	14-Jul	AM-2	WSW, E thru ESE	WSW	9.7	13.0	ESE thru S
Chlorobenzene	1.12	22-Jul	AM-4	E	E	8.0	7.0	NE thru SW
Cumene	0.95	14-Jul	AM-2	WSW, E thru ESE	WSW	9.7	13.0	ESE thru S
Ethylbenzene	7.51	14-Jul	AM-6	WSW, E thru ESE	WSW	9.7	13.0	NNW thru NNE
Freon 11	52.57	14-Jul	AM-4	WSW, E thru ESE	WSW	9.7	13.0	NE thru SW
Freon 113	8.57	18-Jul	AM-2	WNW thru NW	WSW thru NW	5.8	5.9	ESE thru S
Freon 114	ND	NA	NA	NA	NA	NA	NA	NA
Freon 12	9.56	14-Jul	AM-2	WSW, E thru ESE	WSW	9.7	13.0	ESE thru S
Heptane	4.13	14-Jul	AM-7	WSW, E thru ESE	WSW	9.7	13.0	NNE thru E
Hexachlorobutadiene	ND	NA	NA	NA	NA	NA	NA	NA
Methane	21351	22-Jul	AM-4	E	E	8.0	7.0	NE thru SW
Methylene Chloride	70.67	14-Jul	AM-2	WSW, E thru ESE	WSW	9.7	13.0	ESE thru S
Styrene	12.13	14-Jul	AM-2	WSW, E thru ESE	WSW	9.7	13.0	ESE thru S
Tetrachloroethylene	406.99	16-Jul	AM-5	ENE thru E	ENE thru SSE	8.7	9.2	NE thru S
Toluene	241.47	14-Jul	AM-6	WSW, E thru ESE	WSW	9.7	13.0	NNW thru NNE
Trichloroethylene	5.14	16-Jul	AM-5	ENE thru E	ENE thru SSE	8.7	9.2	NE thru S
Xylenes	40.63	14-Jul	AM-6	WSW, E thru ESE	WSW	9.7	13.0	NNW thru NNE

Notes:

All results reported in ug/m^3

ND = compound was not detected

1. Represents the range of wind direction trajectories that place the monitoring locations downwind to the landfill.

* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 4-83
Averaged 24-Hour Measured Off-Site VOC/SVO Concentrations (over all days, by location)
Pelham Bay Landfill
Bronx, New York

Compound	AM-1	AM-2	AM-3	AM-4	AM-5	AM-6	AM-7	AM-8
1,1,1-Trichloroethane*	*	*	*	*	*	*	*	*
1,2,4-Trichlorobenzene	0.34	0.39	0.43	0.31	0.36	0.33	0.41	**0.45**
1,2,4-Trimethylbenzene	3.43	2.69	3.50	2.90	3.55	**4.60**	2.19	2.59
1,2-Dichlorobenzene	0.28	0.31	0.35	0.28	0.31	0.30	0.34	**0.36**
1,2-Dichloroethylene	0.18	0.21	0.23	0.19	0.20	0.19	0.22	**0.24**
1,3,5-Trimethylbenzene	0.95	0.69	0.89	0.77	0.91	**1.44**	0.80	0.89
1,3-Dichlorobenzene	0.28	0.32	0.35	0.28	0.25	0.29	0.35	**0.36**
1,4-Dichlorobenzene	0.93	0.67	0.92	**1.08**	0.83	1.46	0.95	0.63
2-Propanone	**66.55**	29.64	31.02	40.21	19.57	33.65	30.11	20.15
Benzene	2.65	2.91	2.96	2.36	**3.28**	2.92	2.45	2.30
Bromoform	1.04	1.22	**1.82**	1.04	0.96	1.01	1.27	1.40
Carbon Disulfide	1.23	**1.55**	1.47	1.11	1.47	1.26	0.92	1.09
Chlorobenzene	0.23	0.25	0.29	**0.33**	0.26	0.22	0.28	0.29
Cumene	0.27	0.31	0.31	0.23	0.25	0.26	**0.48**	0.30
Ethylbenzene	2.11	1.76	2.50	1.94	2.05	**2.71**	2.02	1.66
Freon 11	3.00	5.57	5.27	**10.08**	4.48	6.81	3.46	2.05
Freon 113	0.73	**2.16**	1.29	1.37	1.25	1.28	0.79	0.68
Freon 114	0.32	0.36	0.41	0.33	0.36	0.34	0.39	**0.42**
Freon 12	3.28	3.47	3.28	3.87	3.70	**4.36**	3.10	3.41
Heptane	0.19	0.21	0.24	0.19	0.21	0.20	**0.60**	0.25
Hexachlorobutadiene	0.49	0.55	0.62	0.50	0.54	0.52	0.60	**0.64**
Methane	1908.99	1227.69	1024.19	**7732.35**	4170.13	830.69	1324.46	770.64
Methylene Chloride	1.30	**7.74**	1.11	0.69	0.97	1.69	0.93	1.08
Styrene	1.51	**1.84**	0.82	1.15	0.90	1.06	1.32	0.71
Tetrachloroethylene	0.84	1.97	1.62	1.21	**51.34**	**0.47**	2.91	1.01
Toluene	16.67	15.18	18.93	23.29	11.55	**33.77**	23.49	16.79
Trichloroethylene	0.25	0.35	0.41	0.30	**0.90**	0.26	0.37	0.44
Xylenes (Total)	9.97	8.26	11.92	9.24	9.57	**13.15**	10.09	9.27

Notes:

Listed are the VOCs detected at least once during the EIFC monitoring
Non-detects are included in the average as one-half the detection limit
Shaded, Boldface values indicated the maximum value for that compound
* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

7 ppb measured
9×10^{-5} mg/m3 = modeled

Table 4-84
Maximum 24-Hour Measured Off-Site Concentrations (by location)
Pelham Bay Landfill
Bronx, New York

Compound	AM-1	AM-2	AM-3	AM-4	AM-5	AM-6	AM-7	AM-8
1,1,1-Trichloroethane*	*	*	*	*	*	*	*	*
1,2,4-Trichlorobenzene								
1,2,4-Trimethylbenzene	9.00	8.00	7.50	8.50	6.00	**17.00**	9.50	8.00
1,2-Dichlorobenzene								
1,2-Dichloroethylene								
1,3,5-Trimethylbenzene	2.45	1.90	1.65	2.30	1.60	**3.50**	2.25	2.75
1,3-Dichlorobenzene								
1,4-Dichlorobenzene	2.51	1.35	2.63	3.30	1.35	**3.42**	2.75	1.22
2-Propanone	**265.76**	86.98	135.29	198.11	53.15	149.79	215.02	45.90
Benzene	5.52	**9.75**	5.52	5.52	5.52	5.52	5.20	3.57
Bromoform	1.68	1.89	**6.31**	1.58	1.26	2.10	2.84	1.58
Carbon Disulfide	4.12	**5.70**	2.69	2.76	3.80	2.28	2.09	1.52
Chlorobenzene				**1.12**				
Cumene	0.75	**0.95**	0.50			0.50		
Ethylbenzene	5.30	5.74	4.86	5.74	3.22	**7.51**	6.62	3.75
Freon 11	5.49	23.43	20.00	**52.57**	14.86	39.43	8.00	4.74
Freon 113	1.17	**8.57**	6.63	7.41	4.99	4.29	1.95	1.71
Freon 114								
Freon 12	5.53	**9.56**	6.54	6.04	8.05	8.05	5.53	4.53
Heptane							**4.13**	
Hexachlorobutadiene								
Methane	3135.94	2268.55	2802.33	**21351.08**	9341.10	1601.33	2201.83	
Methylene Chloride	4.95	**70.67**	4.24	1.34	1.87	3.53	2.01	3.18
Styrene	6.50	**12.13**	2.21	5.20	2.95	7.37	5.63	1.95
Tetrachloroethylene	3.10	6.69	4.14	4.00	**406.99**	4.41	17.94	2.97
Toluene	53.66	53.66	49.83	114.98	16.10	**241.47**	99.65	61.32
Trichloroethylene		1.09	1.31	0.82	**5.14**		1.26	1.15
Xylenes	25.17	30.91	26.94	30.91	15.90	**40.63**	37.10	23.41

Notes:

All results reported in ug/m³
Blank indicates that compound was not detected
A boldface, shaded value indicates the maximum value for that compound
Ammonia Nitrogen and Hydrogen Sulfide were measured for 8 hours
* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 4-85
Maximum 24-hour Measured Off-Site VOC/SVO Concentrations (by day)
Pelham Bay Landfill
Bronx, New York

Compound	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul
1,1,1-Trichloroethane*	*	*	*	*	*	*	*	*	*	*
1,2,4-Trichlorobenzene										
1,2,4-Trimethylbenzene	11.50	**17.00**	3.20	3.75	6.00	7.00	5.00	2.90	3.10	1.75
1,2-Dichlorobenzene										
1,2-Dichloroethylene										
1,3,5-Trimethylbenzene	3.30	**3.50**	0.75	1.05	1.65	2.00	1.45	0.75	0.80	
1,3-Dichlorobenzene										
1,4-Dichlorobenzene	**3.42**	0.67	0.79	0.73	1.90	3.30	2.51	1.35	0.73	
2-Propanone	154.62	149.79	**265.76**	57.98	21.02	20.54	22.47	36.24	67.65	215.02
Benzene	**9.75**	3.02	2.96	3.57	5.52	5.52	3.90	3.25	2.40	1.56
Bromoform	2.84	**6.31**	1.58		1.37	1.47	1.26	1.26	1.37	1.37
Carbon Disulfide	**5.70**	4.12	2.82	1.14	2.06	1.20	1.84	3.80	2.25	1.17
Chlorobenzene									**1.12**	
Cumene	**0.95**	0.50								
Ethylbenzene	**7.51**	2.83	1.85	2.34	3.71	4.42	2.74	2.16	1.68	1.02
Freon 11	**52.57**	3.14	3.54	2.86	23.43	3.37	4.17	3.14	2.63	1.89
Freon 113	**7.79**	0.94	0.86	0.78	8.57	0.86	0.94	0.78	1.71	1.01
Freon 114										
Freon 12	**9.56**	3.12	3.37	3.67	6.04	6.04	5.53	3.37	8.05	3.62
Heptane	**4.13**									
Hexachlorobutadiene										
Methane	3002.50	2135.11	11342.76	9341.10	8006.66	14011.65	6672.21	3069.22	**21351.08**	4670.55
Methylene Chloride	**70.67**	4.95	3.14	2.76	0.85	0.71	1.87	4.24	1.52	1.10
Styrene	**12.13**	0.61	1.26	1.39	2.82	1.21	1.17	1.56	1.21	0.48
Tetrachloroethylene	4.41	0.69	**406.99**	17.94	2.55	1.45	2.55	1.17	2.07	0.69
Toluene	**241.47**	26.83	15.33	16.10	27.21	19.16	34.50	20.31	14.56	18.01
Trichloroethylene	1.26	0.77	**5.14**		0.44					
Xylenes	**40.63**	17.22	9.27	10.60	18.11	24.29	13.25	10.16	8.39	4.86

Notes:

All results reported in ug/m³
Blank indicates that compound was not detected
A boldface, shaded value indicates the maximum value for that compound
These numbers have not been reviewed
* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 4-86
Averaged 24-Hour Measured Off-Site VOC/SVO Concentrations (over all locations, by day)
Pelham Bay Landfill
Bronx, New York

Compound	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul
1,1,1-Trichloroethane*	*	*	*	*	*	*	*	*	*	*
1,2,4-Trichlorobenzene	**0.57**	0.37	0.41	0.39	0.35	0.39	0.35	0.34	0.36	0.37
1,2,4-Trimethylbenzene	**8.79**	4.67	1.86	2.71	4.96	4.48	3.98	2.06	1.79	1.19
1,2-Dichlorobenzene	**0.46**	0.29	0.34	0.32	0.28	0.32	0.28	0.28	0.29	0.30
1,2-Dichloroethylene	**0.30**	0.19	0.22	0.21	0.19	0.21	0.19	0.18	0.19	0.20
1,3,5-Trimethylbenzene	**2.23**	1.10	0.45	0.73	1.44	1.24	1.07	0.51	0.42	0.24
1,3-Dichlorobenzene	**0.46**	0.29	0.34	0.32	0.28	0.32	0.24	0.28	0.29	0.30
1,4-Dichlorobenzene	**2.39**	0.53	0.34	0.53	1.21	1.55	1.52	0.77	0.43	0.30
2-Propanone	**93.53**	38.10	75.38	20.17	16.79	17.88	19.69	17.67	29.96	37.15
Benzene	4.78	1.83	1.53	2.53	**5.12**	4.22	3.30	1.71	1.60	1.10
Bromoform	1.92	**2.06**	1.25	1.12	1.12	1.10	0.93	0.97	1.12	1.09
Carbon Disulfide	**2.62**	1.50	1.27	0.94	1.08	0.88	1.07	1.22	1.14	0.87
Chlorobenzene	0.35	0.23	0.26	0.24	0.22	0.24	0.22	0.21	0.34	**0.38**
Cumene	**0.53**	0.31	0.27	0.26	0.23	0.26	0.23	0.26	0.24	0.24
Ethylbenzene	**5.65**	1.63	1.21	1.72	3.02	2.80	2.34	1.25	1.16	0.77
Freon 11	**19.30**	2.47	2.39	2.26	13.01	2.76	3.04	2.49	2.16	1.69
Freon 113	2.42	0.70	0.53	0.46	**4.42**	0.70	0.78	0.66	0.71	0.58
Freon 114	**0.54**	0.32	0.39	0.37	0.33	0.37	0.33	0.33	0.34	0.35
Freon 12	4.70	2.22	2.34	2.67	**5.17**	4.97	4.72	2.79	4.77	1.54
Heptane	**0.84**	0.20	0.23	0.22	0.19	0.22	0.19	0.21	0.20	0.20
Hexachlorobutadiene	**0.82**	0.52	0.60	0.56	0.50	0.56	0.50	0.50	0.52	0.53
Methane	1496	1373	2844	2440	2569	2758	1568	1359	**4370**	1735
Methylene Chloride	**11.13**	2.25	0.90	0.77	0.62	0.59	1.15	1.71	1.02	0.61
Styrene	**5.59**	0.28	0.44	0.92	1.95	0.71	0.70	0.52	0.55	0.28
Tetrachloroethylene	3.50	0.38	**52.66**	3.24	1.53	1.01	1.33	0.82	0.81	0.47
Toluene	**96.37**	13.69	9.63	11.59	17.34	15.01	16.53	10.83	9.68	8.55
Trichloroethylene	**0.73**	0.27	1.13	0.28	0.28	0.28	0.51	0.25	0.26	0.27
Xylenes	**30.73**	9.41	5.67	7.78	14.30	13.69	10.99	5.63	5.12	3.56

Notes:

Listed are the volatile organic compounds detected at least once during the EIFC monitoring
Boldface, shaded values indicated the maximum value for that compound
Non-detects are included in the average as one-half the detection limit
* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92c4087

Table 4-87
Off-Site Ambient Monitoring Detection Frequency (by day)
Pelham Bay Landfill
Bronx, New York

Compound	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul
1,1,1-Trichloroethane*	*	*	*	*	*	*	*	*	*	*
1,2,4-Trichlorobenzene	0	0	0	0	0	0	0	0	0	0
1,2,4-Trimethylbenzene	100	100	100	100	100	100	100	100	100	100
1,2-Dichlorobenzene	0	0	0	0	0	0	0	0	0	0
1,2-Dichloroethylene	0	0	0	0	0	0	0	0	0	0
1,3,5-Trimethylbenzene	100	57	50	87	100	100	100	75	50	0
1,3-Dichlorobenzene	0	0	0	0	0	0	0	0	0	0
1,4-Dichlorobenzene	100	71	25	62	100	100	100	87	37	0
2-Propanone	100	100	100	100	100	100	100	100	100	100
Benzene	100	100	100	100	100	100	100	100	100	100
Bromoform	100	100	100	87	75	83	25	87	100	100
Carbon Disulfide	100	100	100	100	100	100	100	100	100	100
Chlorobenzene	0	0	0	0	0	0	0	0	13	0
Cumene	29	29	0	0	0	0	0	0	0	0
Ethylbenzene	100	100	100	100	100	100	100	100	100	100
Freon 11	100	100	100	100	100	100	100	100	100	100
Freon 113	71	71	25	13	100	67	100	75	37	37
Freon 114	0	0	0	0	0	0	0	0	13	0
Freon 12	86	71	75	75	100	100	100	87	75	50
Heptane	14	0	0	0	0	0	0	13	0	0
Hexachlorobutadiene	0	0	0	0	0	0	0	0	0	0
Methane	29	57	50	50	50	67	25	37	62	50
Methylene Chloride	100	100	75	62	100	100	100	100	100	100
Styrene	86	29	37	100	100	67	75	50	50	25
Tetrachloroethylene	100	14	87	25	62	67	50	75	62	37
Toluene	100	100	100	100	100	100	100	100	100	100
Trichloroethylene	57	0	37	0	13	0	0	0	0	0
Xylenes	100	100	100	100	100	100	100	87	100	100

Notes:

Listed are the volatile organic compounds detected at least once during the EIFC monitoring
All numbers are expressed as a percent
* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 4-88
Off-Site Ambient Monitoring Detection Frequency (by location)
Pelham Bay Landfill
Bronx, New York

Compound	AM-1	AM-2	AM-3	AM-4	AM-5	AM-6	AM-7	AM-8
1,1,1-Trichloroethane*	*	*	*	*	*	*	*	*
1,2,4-Trichlorobenzene	0	0	0	0	0	0	0	0
1,2,4-Trimethylbenzene	100	100	100	100	100	100	100	100
1,2-Dichlorobenzene	0	0	0	0	0	0	0	0
1,2-Dichloroethylene	0	0	0	0	0	0	0	0
1,3,5-Trimethylbenzene	89	50	80	56	88	90	60	50
1,3-Dichlorobenzene	0	0	0	0	0	0	0	0
1,4-Dichlorobenzene	78	50	70	89	75	80	60	40
2-Propanone	100	100	100	100	100	100	100	100
Benzene	100	100	100	100	100	100	100	100
Bromoform	89	100	100	100	75	60	100	100
Carbon Disulfide	100	100	100	100	100	100	100	100
Chlorobenzene	0	0	0	11	0	0	0	0
Cumene	11	10	10	0	0	11	0	0
Ethylbenzene	100	100	100	100	100	100	100	100
Freon 11	100	100	100	100	100	100	100	100
Freon 113	78	70	40	56	75	70	60	30
Freon 114	0	0	0	0	0	0	0	0
Freon 12	89	70	70	100	75	90	70	90
Heptane	0	0	0	0	0	0	10	0
Hexachlorobutadiene	0	0	0	0	0	0	0	0
Methane	89	40	20	100	88	20	50	0
Methylene Chloride	89	90	80	89	100	100	100	100
Styrene	89	70	60	56	63	30	60	60
Tetrachloroethylene	44	80	70	67	38	40	90	70
Toluene	100	100	100	100	100	100	100	100
Trichloroethylene	0	10	10	11	25	0	10	20
Xylenes	100	90	100	100	100	100	100	100

Notes:
Listed are the volatile organic compounds detected at least once during the EIFC monitoring
All numbers are expressed as a percent
* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 4-89
Decision Checklist
Pelham Bay Landfill
Bronx, New York

Compound	NOT DETECTED ON-SITE		DETECTED ON-SITE		
	Not Detected Off-Site	Detected Off-Site	Not Detected Off-Site	Detected Off-Site	
				NYSDEC GC defined*	NYSDEC GC not defined*
1,1,1-Trichloroethane				X	
1,1,2,2-Tetrachloroethane	X				
1,1,2-Trichloroethane		X			
1,1-Dichloroethane		X			
1,1-Dichloroethylene		X			
1,2,4-Trichlorobenzene			X		
1,2,4-Trimethylbenzene				X	
1,2-Dibromoethane	X				
1,2-Dichlorobenzene			X		
1,2-Dichloroethane	X				
1,2-Dichloroethylene			X		
1,2-Dichloropropane	X				
1,3,5-Trimethylbenzene				X	
1,3-Dichlorobenzene			X		
1,4-Dichlorobenzene					X
2-Butanone		X			
2-Hexanone	X				
2-Propanone				X	
4-Methyl-2-pentanone		X			
Ammonia			X		
Benzene				X	
Benzyl Chloride		X			
Bromoform				X	
Carbon Disulfide				X	
Carbon Tetrachloride		X			
Chlorobenzene				X	
Chlorodibromomethane	X				
Chloroethane		X			
Chloroform		X			
cis-1,3-Dichloropropylene	X				
Cumene					X
Dichlorobromomethane	X				
Ethylbenzene				X	
Freon 11				X	
Freon 113				X	
Freon 114			X		
Freon 12					X
Heptane				X	
Hexachlorobutadiene			X		
Hydrogen Cyanide	X				
Hydrogen Sulfide			X		
Methane					X
Methyl Bromide	X				
Methyl Chloride	X				
Methyl Mercaptan	X				
Methylene Chloride				X	
Styrene				X	
Tetrachloroethylene				X	
Toluene				X	
trans-1,3-Dichloropropylen	X				
Trichloroethylene				X	
Vinyl Acetate	X				
Vinyl Chloride		X			
Xylenes				X	

Notes:

*New York State Department of Environmental Conservation determined an SGC or AGC for that compound.

Prepared by: BW
Checked by: WJH
92C4087

Table 4-90
Compounds Not Detected On-Site or Off-Site
Pelham Bay Landfill
Bronx, New York

Compound	Average Detection Limit
1,1,2,2-Tetrachloroethane	0.73
1,2-Dibromoethane	0.88
1,2-Dichloroethane	0.43
1,2-Dichloropropane	0.49
1,3-cis-Dichloropropylene	0.48
1,3-trans-Dichloropropylene	0.48
2-Hexanone	8.39
Chlorodibromoethane	0.89
Dichlorobromomethane	0.71
Hydrogen Cyanide	107.54
Methyl Bromide	0.41
Methyl Chloride	0.22
Methyl Mercaptan	21.15
Vinyl Acetate	7.19

Note: Units are ug/m^3

Prepared by: BW
Checked by: JS
92C4087

Table 4-91
Compounds Not Detected On-Site But Detected Off-Site
Pelham Bay Landfill
Bronx, New York

Compound
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethylene
2-Butanone
4-Methyl-2-Pentanone
Benzyl Chloride
Carbon Tetrachloride
Chloroethane
Chloroform
Vinyl Chloride

Prepared by: BW
Checked by: RJM
92C4087

Table 4-92
Compounds Detected On-Site But Not Off-Site
Pelham Bay Landfill
Bronx, New York

Compound	Minimum Detection Limit	Maximum Detection Limit	Average Detection Limit
1,2,4-Trichlorobenzene	0.53	1.66	0.78
1,2-Dichlorobenzene	0.43	9.17	0.73
1,2-Dichloroethylene	0.28	0.89	0.42
1,3-Dichlorobenzene	0.43	1.35	0.63
Freon 114	0.50	1.56	0.74
Hexachlorobutadiene	0.76	24.95	1.50
Hydrogen Sulfide	1.35	1.84	1.46

Note: Units are ug/m^3

Prepared by: BW
Checked by: JS
92C4087

Table 4-93
On-Site EIFC Concentration Profiles
Pelham Bay Landfill
Bronx, New York

Compound	AM-A	AM-B	AM-C	AM-D	AM-E	AM-F	AM-G	AM-1
1,1,1-Trichloroethane	0.0004	0.0045	0.0014	1.5485	0.0009	< 0.0005	1.4453	0.0006
1,2,4-Trimethylbenzene	0.0029	0.0439	0.0791	< 0.0011	0.0558	0.0016	0.0035	0.0015
1,3,5-Trimethylbenzene	0.0009	0.0151	0.0348	0.0175	0.0260	0.0006	0.0038	0.0004
1,3-Dichlorobenzene	< 0.0008	0.0069	0.0309	0.0120	0.0261	< 0.0005	0.0019	< 0.0003
1,4-Dichlorobenzene	0.0025	0.1458	0.1973	0.0338	0.0833	0.0005	0.0248	0.0021
2-Propanone	0.0090	0.0379	0.0520	0.0316	0.1362	0.0197	0.0224	0.0076
Benzene	0.0006	0.0245	0.1007	0.0131	0.2013	0.0005	0.0086	0.0005
Bromoform	0.0007	0.0030	0.0019	< 0.0027	0.0009	0.0010	0.0015	0.0006
Carbon Disulfide	0.0020	0.0022	0.0017	0.0023	0.0029	0.0014	0.0011	0.0006
Cumene	0.0011	0.0085	0.0981	< 0.0011	0.0310	0.0006	0.0021	< 0.0002
Ethylbenzene	0.0007	0.0277	0.3074	0.0029	0.0438	0.0004	0.0066	0.0006
Freon 11	0.0011	0.0024	0.0012	0.0014	0.0015	0.0013	< 0.0012	0.0010
Freon 113	0.0160	< 0.0018	< 0.0014	< 0.0017	< 0.0006	< 0.0006	< 0.0010	0.0006
Freon 12	< 0.0003	< 0.0012	< 0.0009	0.0221	< 0.0004	< 0.0004	< 0.0006	0.0009
Heptane	< 0.0003	0.0419	0.0040	0.0021	< 0.0003	< 0.0003	0.0013	< 0.0002
Methane	< 0.8284	4606.1000	6331.9000	1624.1000	9093.5000	< 1.0457	965.4000	< 0.6457
Methylene Chloride	0.0006	< 0.0008	< 0.0006	< 0.0008	< 0.0003	0.0007	< 0.0004	< 0.0002
Styrene	0.0180	0.0139	0.0060	0.0098	0.0062	0.0024	0.0075	0.0105
Tetrachloroethylene	< 0.0004	0.0031	< 0.0012	< 0.0015	< 0.0006	< 0.0006	0.0022	0.0006
Toluene	0.0809	0.0722	0.0242	0.0432	0.0332	< 0.0004	0.0184	0.0121
Trichloroethylene	< 0.0003	0.0015	< 0.0010	< 0.0012	< 0.0004	< 0.0004	< 0.0007	< 0.0003
Xylenes	0.0025	0.0665	0.0503	0.0147	0.0224	0.0019	0.0064	0.0016

Notes: Listed are the volatile organic compounds detected at least once during the EIFC monitoring

Prepared by: BW
Checked by: RJM
92C4087

Table 4-94
Off-Site Ambient Concentration Profiles (July 14, 1992)
Pelham Bay Landfill
Bronx, New York

Compound	AM-1	AM-2	AM-3	AM-4	AM-5	AM-6	AM-7	AM-8
1,1,1-Trichloroethane*	*	*	*	*	*	*	*	*
1,2,4-Trimethylbenzene	9.00	8.00	7.50	8.50	(1)	11.50	9.50	7.50
1,3,5-Trimethylbenzene	2.45	1.90	1.65	2.30	(1)	3.30	2.25	1.75
1,3-Dichlorobenzene	< 0.73	< 0.92	< 1.04	< 0.79	(1)	< 0.92	< 1.35	< 0.73
1,4-Dichlorobenzene	2.51	1.04	2.63	3.30	(1)	3.42	2.75	1.10
2-Propanone	154.62	86.98	135.29	50.74	(1)	50.74	130.46	45.90
Benzene	3.90	9.75	3.90	3.90	(1)	4.55	4.22	3.25
Bromoform	B 1.68	B 1.89	B 2.00	B 1.58	(1)	B 2.00	B 2.84	B 1.47
Carbon Disulfide	B 1.30	B 5.70	B 2.69	B 2.76	(1)	B 2.28	B 2.09	B 1.52
Cumene	0.75	0.95	< 0.85	< 0.65	(1)	< 0.75	< 1.10	< 0.60
Ethylbenzene	5.30	5.74	4.86	5.74	(1)	7.51	6.62	3.75
Freon 11	5.49	17.71	9.71	52.57	(1)	39.43	8.00	2.17
Freon 113	1.01	7.79	< 1.33	1.33	(1)	4.29	< 1.71	1.01
Freon 12	4.02	9.56	< 0.86	4.38	(1)	5.53	4.43	4.53
Heptane	< 0.50	< 0.63	< 0.71	< 0.54	(1)	< 0.63	4.13	< 0.50
Methane	2068.39	< 2001.66	< 2201.83	3002.50	(1)	< 2001.66	< 2935.77	< 1668.05
Methylene Chloride	0.53	70.67	1.17	1.34	(1)	2.08	1.27	0.88
Styrene	6.50	12.13	< 0.74	5.20	(1)	7.37	5.63	1.95
Tetrachloroethylene	3.10	3.10	3.17	4.00	(1)	4.41	3.72	2.97
Toluene	53.66	53.66	49.83	114.98	(1)	241.47	99.65	61.32
Trichloroethylene	< 0.66	1.09	< 0.93	0.82	(1)	< 0.82	1.26	0.71
Xylenes	B 25.17	B 30.91	B 26.94	B 30.91	(1)	B 40.63	B 37.10	B 23.41

Notes:
Listed are the volatile organic compounds detected at least once during the EIFC monitoring
1. Sample invalidated due to insufficient cannister pressure
Blank indicates the compound was not detected so a ratio is not applicable
* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 4-95
Community Samples - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	CS-CATALANO	CS-HOGAN	HOG-HIGH	HOG-LOW
date:	16-Jul-92	16-Jul-92	29-Jul-92	29-Jul-92
Chlorinated Aliphatic Compounds				
Methylene chloride	5 BR#	5 BR#		
Total				

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include samples with "R#" in qualifier
B = Blank contaminant
R# = Negated result

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-96
Community Samples - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	CS-CATALANO	CS-HOGAN	HOG-HIGH	HOG-LOW
date:	16-Jul-92	16-Jul-92	29-Jul-92	29-Jul-92
Phthalates				
Di-n-butyl phthalate	4 BJR#	3 BJR#		
Total				

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include samples with "R#" in qualifier
B = Blank contaminant
J = Estimated value
R# = Negated result

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-97
Community Samples - Pesticides and PCBs Data Summary
Pelham Bay Landfill
Bronx, New York

	CS-CATALANO	CS-HOGAN	HOG-HIGH	HOG-LOW
date:	16-Jul-92	16-Jul-92	29-Jul-92	29-Jul-92
4,4'-DDD	0.023 J			
4,4'-DDT	0.025 J			
alpha-Chlordane	0.025 J			
delta-BHC	0.063			
Endosulfan sulfate		0.67		0.013 JR#
Endrin	0.15			
gamma-Chlordane	0.24 J			
Heptachlor	0.059			
Heptachlor epoxide			0.011 J	0.012 J

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
J = Estimated value
R# = Negated result

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-98
Community Samples - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	CS-CATALANO	CS-HOGAN	HOG-HIGH	HOG-LOW
date:	16-Jul-92	16-Jul-92	29-Jul-92	29-Jul-92
Aluminum		2120	855	165 B
Arsenic	2.2 B	1.7 B	1.3 B	
Barium	61 B	118 B	115 B	96 B
Calcium	62300	108000	115000	101000
Copper	8.9 B	26.4	20.6 B	8.3 B
Iron	54 B	2510	1240	173
Lead	3.4 BN	66.9 N	32.5	5.7
Magnesium	31800	19000	21300	19900
Manganese	244	1510	478	214
Mercury	N*	N*	0.38 N*	0.71 N*
Potassium	2190 B	4360 B	4250 B	4250 B
Sodium	31200	27500	33100	32900
Vanadium		6.9 B		
Zinc		144	87.7	48.1

Notes:
All concentrations in microgram per liter (ppb)
Blank indicates compound was not detected
B = Blank contaminant
N = Estimated value (spiked sample recovery was not within quality control limits)
* = Estimated value (duplicate analysis result was not within quality control limits)

Prepared by: CLH
Checked by: TRP
92C4087

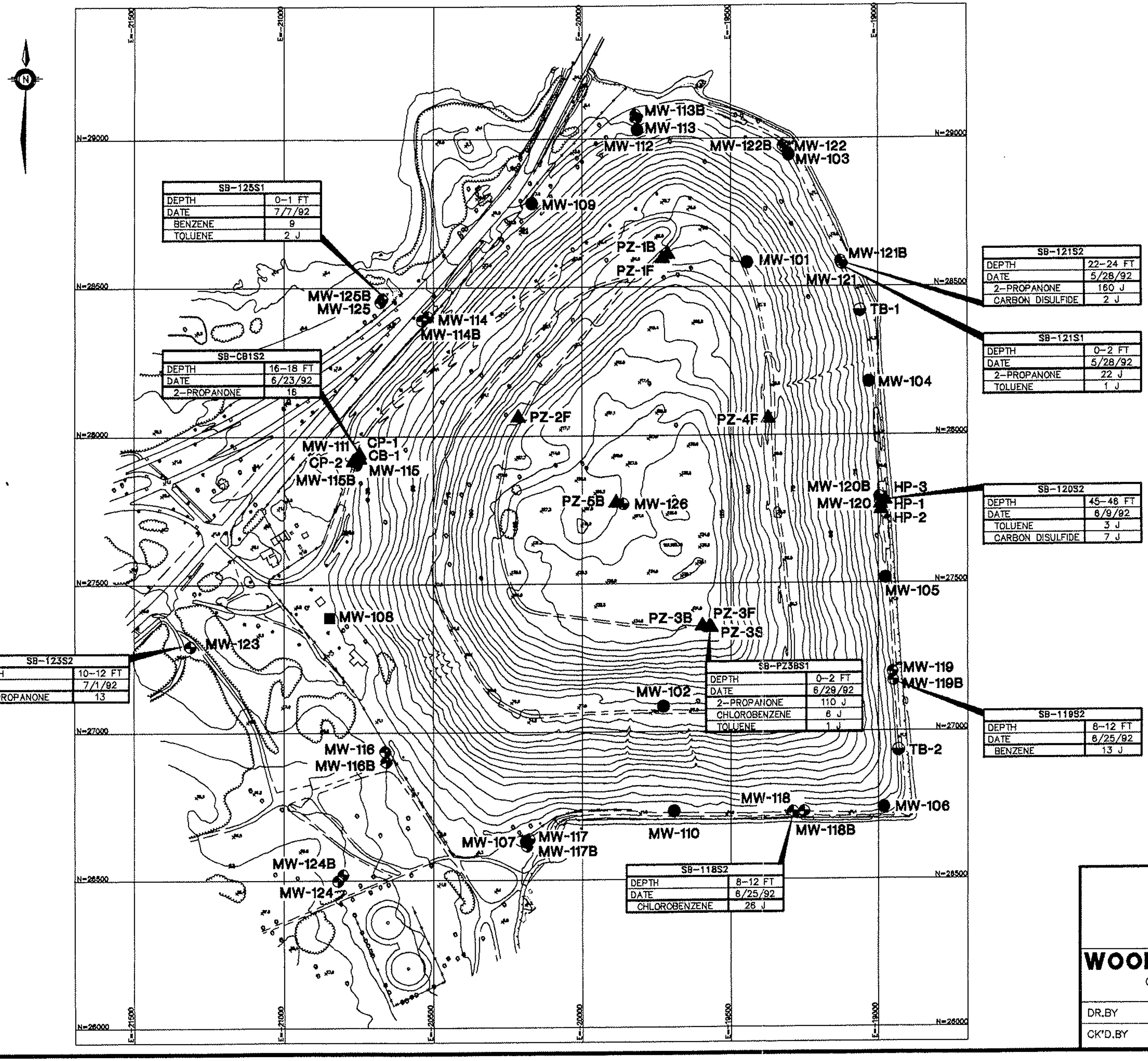
Table 4-99
Community Samples - Conventional Parameters (Modified BMW List) Data Summary
Pelham Bay Landfill
Bronx, New York

	CS-CATALANO	CS-HOGAN	CS-HOGAN DUP	HOG-HIGH	HOG-HIGH D	HOG-LOW
date:	16-Jul-92	16-Jul-92	16-Jul-92	29-Jul-92	29-Jul-92	29-Jul-92
Alkalinity as Bicarbonate	186	220	220	302	524	216
Ammonia Nitrogen	0.05					
Chloride	56	60	62	65	63	67
Nitrate Nitrogen	3.68	5.02	5.48			
Sulfate	48.6	31.4	32.3	32	37	40
Total Dissolved Solids	424	473		510	510	496
Total Kjeldahl Nitrogen				0.42 J		0.26 J

Notes:

All concentrations in milligrams per liter (ppm)
Blank indicates compound was not detected
D=Laboratory QA/QC duplicate
DUP = Duplicate Sample
J = Estimated value

Prepared by: CLH
Checked by: TRP
92C4087



SB-125S1	
DEPTH	0-1 FT
DATE	7/7/92
BENZENE	9
TOLUENE	2 J

SB-CB1S2	
DEPTH	16-18 FT
DATE	6/23/92
2-PROPANONE	16

SB-121S2	
DEPTH	22-24 FT
DATE	5/28/92
2-PROPANONE	160 J
CARBON DISULFIDE	2 J

SB-121S1	
DEPTH	0-2 FT
DATE	5/28/92
2-PROPANONE	22 J
TOLUENE	1 J

SB-120S2	
DEPTH	45-48 FT
DATE	6/9/92
TOLUENE	3 J
CARBON DISULFIDE	7 J

SB-123S2	
DEPTH	10-12 FT
DATE	7/1/92
2-PROPANONE	13

SB-PZ3BS1	
DEPTH	0-2 FT
DATE	6/29/92
2-PROPANONE	110 J
CHLOROBENZENE	6 J
TOLUENE	1 J

SB-119S2	
DEPTH	8-12 FT
DATE	6/25/92
BENZENE	13 J

SB-118S2	
DEPTH	8-12 FT
DATE	6/25/92
CHLOROBENZENE	26 J

File name: C:\92C4087\S-B-S-R.DWG Last edited: 93/02/09 @ 18:09

LEGEND:

MW-103	●	MONITORING WELLS INSTALLED 1989
MW-108	■	MONITORING WELL DESTROYED DURING IRM
PZ-3B	▲	PIEZOMETERS INSTALLED 1992
MW-113	◐	MONITORING WELLS INSTALLED 1992
MW-116B	◐	BEDROCK WELLS INSTALLED 1992
TB-1	◒	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED VALUE.
5. REFER TO TABLE 4-1 FOR ALL SOIL BORING SAMPLE VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:

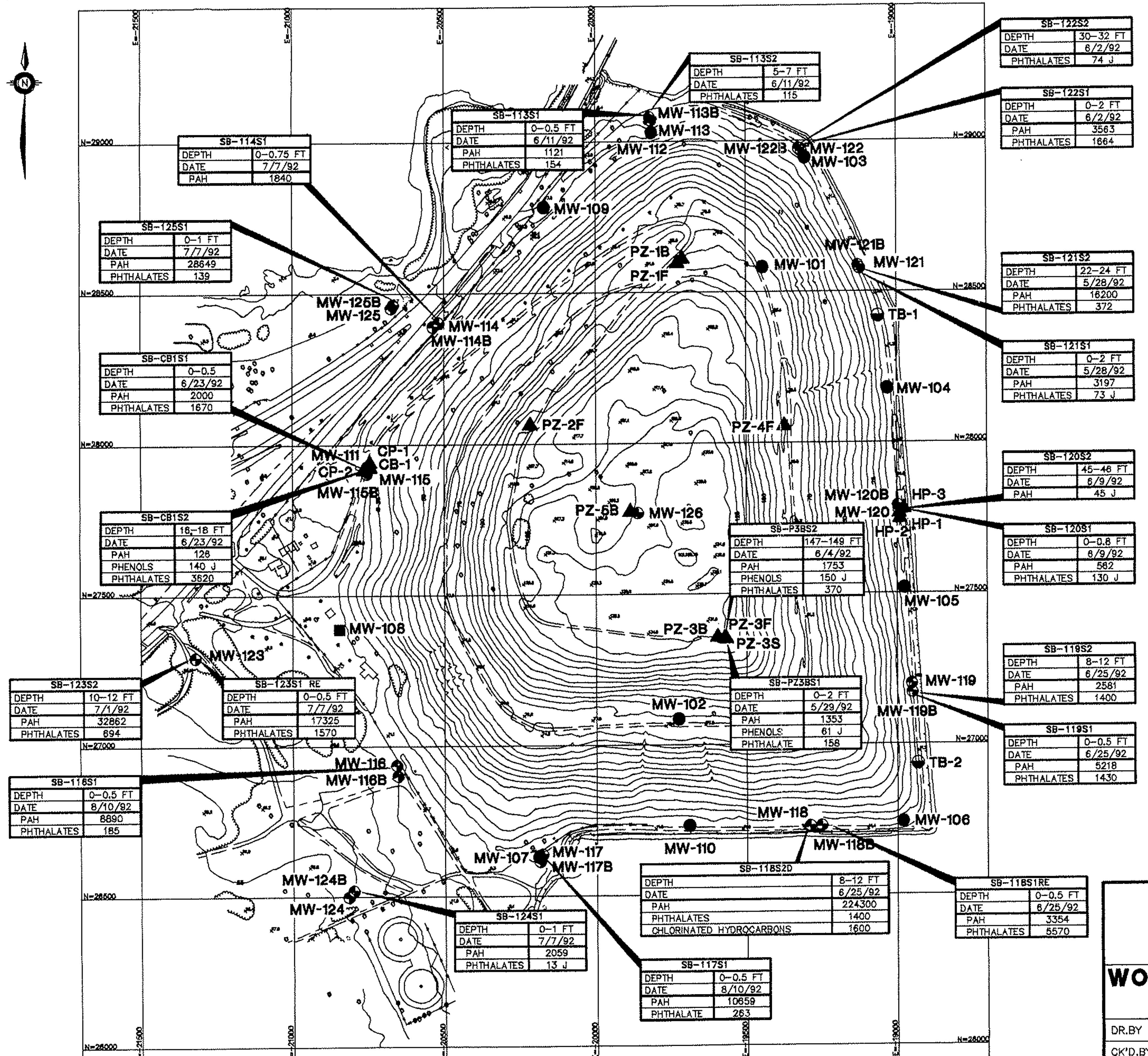
ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT
SCALE

SOIL BORING SAMPLE ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-1



SB-113S2	
DEPTH	5-7 FT
DATE	6/11/92
PHTHALATES	115

SB-122S2	
DEPTH	30-32 FT
DATE	6/2/92
PHTHALATES	74 J

SB-122S1	
DEPTH	0-2 FT
DATE	6/2/92
PAH	3563
PHTHALATES	1664

SB-113S1	
DEPTH	0-0.5 FT
DATE	6/11/92
PAH	1121
PHTHALATES	154

SB-114S1	
DEPTH	0-0.75 FT
DATE	7/7/92
PAH	1840

SB-125S1	
DEPTH	0-1 FT
DATE	7/7/92
PAH	28649
PHTHALATES	139

SB-121S2	
DEPTH	22-24 FT
DATE	5/28/92
PAH	16200
PHTHALATES	372

SB-121S1	
DEPTH	0-2 FT
DATE	5/28/92
PAH	3197
PHTHALATES	73 J

SB-CB1S1	
DEPTH	0-0.5
DATE	6/23/92
PAH	2000
PHTHALATES	1670

SB-120S2	
DEPTH	45-46 FT
DATE	6/9/92
PAH	45 J

SB-CB1S2	
DEPTH	16-18 FT
DATE	6/23/92
PAH	128
PHENOLS	140 J
PHTHALATES	3620

SB-P3BS2	
DEPTH	147-149 FT
DATE	6/4/92
PAH	1753
PHENOLS	150 J
PHTHALATES	370

SB-120S1	
DEPTH	0-0.8 FT
DATE	6/9/92
PAH	582
PHTHALATES	130 J

SB-119S2	
DEPTH	8-12 FT
DATE	6/25/92
PAH	2581
PHTHALATES	1400

SB-123S2	
DEPTH	10-12 FT
DATE	7/1/92
PAH	32862
PHTHALATES	694

SB-123S1 RE	
DEPTH	0-0.5 FT
DATE	7/7/92
PAH	17325
PHTHALATES	1570

SB-PZ3BS1	
DEPTH	0-2 FT
DATE	5/29/92
PAH	1353
PHENOLS	61 J
PHTHALATE	158

SB-119S1	
DEPTH	0-0.5 FT
DATE	6/25/92
PAH	5218
PHTHALATES	1430

SB-116S1	
DEPTH	0-0.5 FT
DATE	8/10/92
PAH	8890
PHTHALATES	185

SB-118S2D	
DEPTH	8-12 FT
DATE	6/25/92
PAH	224300
PHTHALATES	1400
CHLORINATED HYDROCARBONS	1600

SB-118S1RE	
DEPTH	0-0.5 FT
DATE	6/25/92
PAH	3354
PHTHALATES	5570

SB-124S1	
DEPTH	0-1 FT
DATE	7/7/92
PAH	2059
PHTHALATES	13 J

SB-117S1	
DEPTH	0-0.5 FT
DATE	8/10/92
PAH	10659
PHTHALATE	263

LEGEND:

MW-103	●	MONITORING WELLS INSTALLED 1989
MW-108	■	MONITORING WELL DESTROYED DURING IRM
PZ-3B	▲	PIEZOMETERS INSTALLED 1992
MW-113	◕	MONITORING WELLS INSTALLED 1992
MW-116B	◕	BEDROCK WELLS INSTALLED 1992
TB-1	◒	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED VALUE.
5. REFER TO TABLE 4-2 FOR ALL SOIL BORING SAMPLE SEMI-VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

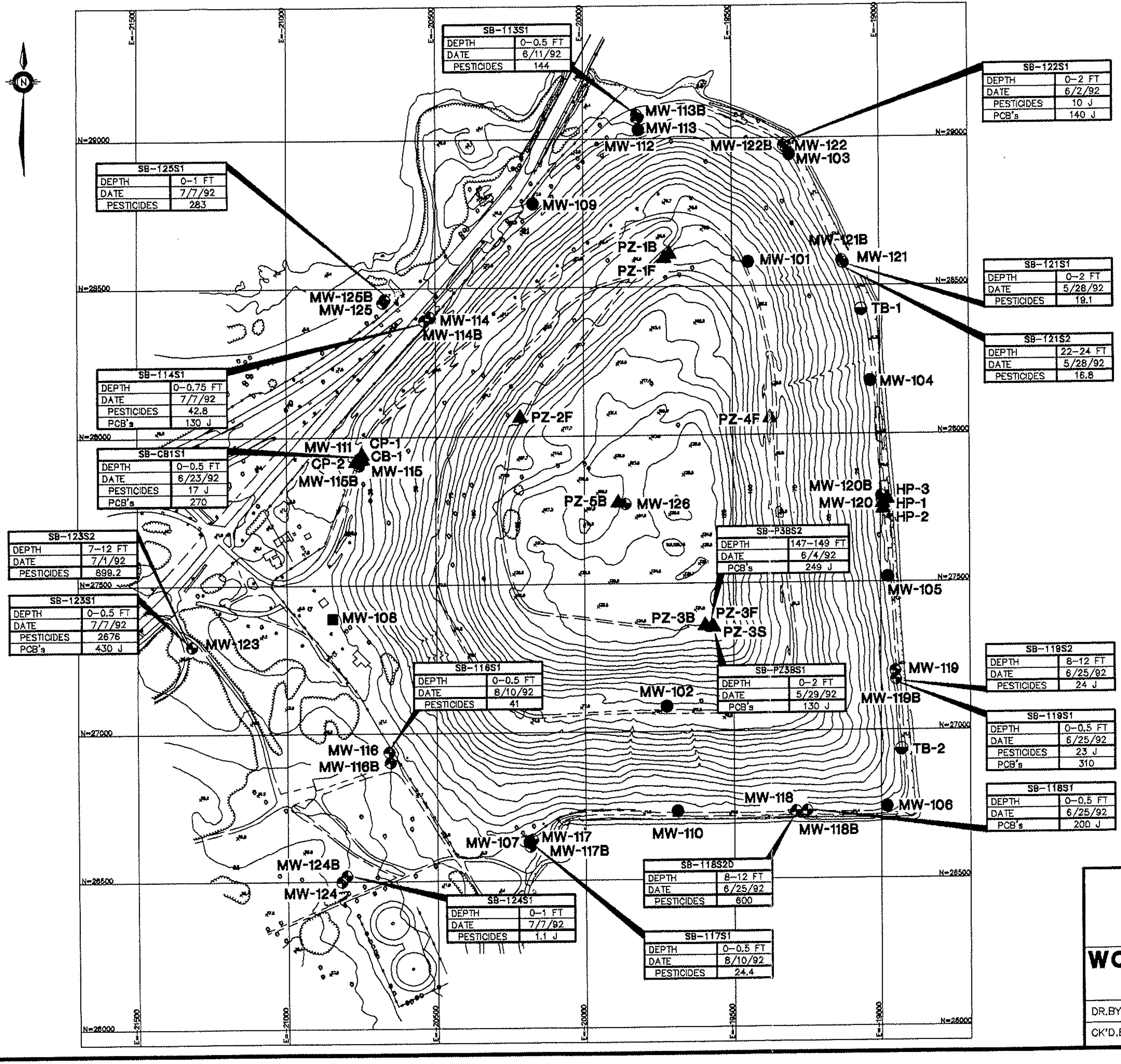
SCALE

SOIL BORING SAMPLE ANALYTICAL RESULTS
SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-2

File name: C:\92C4087\S-V-0.DWG Last edited: 93/02/09 @ 18:16



SB-113S1	
DEPTH	0-0.5 FT
DATE	6/11/92
PESTICIDES	144

SB-122S1	
DEPTH	0-2 FT
DATE	6/2/92
PESTICIDES	10 J
PCB's	140 J

SB-125S1	
DEPTH	0-1 FT
DATE	7/7/92
PESTICIDES	283

SB-121S1	
DEPTH	0-2 FT
DATE	5/28/92
PESTICIDES	19.1

SB-121S2	
DEPTH	22-24 FT
DATE	5/28/92
PESTICIDES	16.8

SB-114S1	
DEPTH	0-0.75 FT
DATE	7/7/92
PESTICIDES	42.8
PCB's	130 J

SB-CB1S1	
DEPTH	0-0.5 FT
DATE	6/23/92
PESTICIDES	17 J
PCB's	270

SB-123S2	
DEPTH	7-12 FT
DATE	7/1/92
PESTICIDES	899.2

SB-P3BS2	
DEPTH	147-149 FT
DATE	6/4/92
PCB's	249 J

SB-123S1	
DEPTH	0-0.5 FT
DATE	7/7/92
PESTICIDES	2676
PCB's	430 J

SB-116S1	
DEPTH	0-0.5 FT
DATE	8/10/92
PESTICIDES	41

SB-PZ3BS1	
DEPTH	0-2 FT
DATE	5/29/92
PCB's	130 J

SB-119S2	
DEPTH	8-12 FT
DATE	6/25/92
PESTICIDES	24 J

SB-119S1	
DEPTH	0-0.5 FT
DATE	6/25/92
PESTICIDES	23 J
PCB's	310

SB-118S1	
DEPTH	0-0.5 FT
DATE	6/25/92
PCB's	200 J

SB-118S2D	
DEPTH	8-12 FT
DATE	6/25/92
PESTICIDES	600

SB-124S1	
DEPTH	0-1 FT
DATE	7/7/92
PESTICIDES	1.1 J

SB-117S1	
DEPTH	0-0.5 FT
DATE	8/10/92
PESTICIDES	24.4

LEGEND:

MW-103	●	MONITORING WELLS INSTALLED 1989
MW-108	■	MONITORING WELL DESTROYED DURING IRM
PZ-3B	▲	PIEZOMETERS INSTALLED 1992
MW-113	⊕	MONITORING WELLS INSTALLED 1992
MW-116B	⊕	BEDROCK WELLS INSTALLED 1992
TB-1	◒	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED VALUE.
5. REFER TO TABLE 4-3 FOR ALL SOIL BORING SAMPLE PESTICIDE AND PCB ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

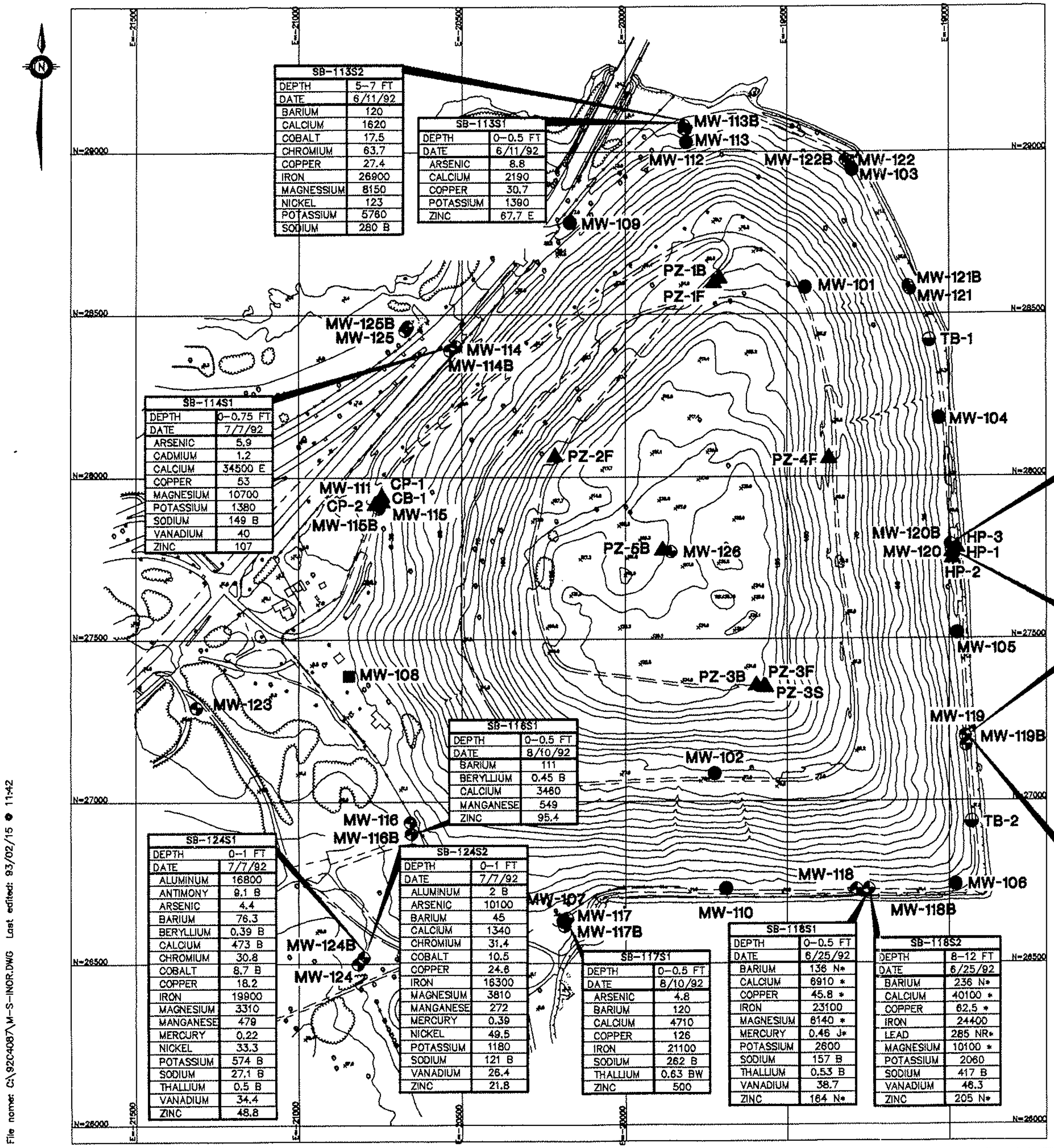
SCALE

SOIL BORING SAMPLE ANALYTICAL RESULTS
PESTICIDES AND PCBs
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-3

File name: C:\92C4087\P-PCB.DWG Last edited: 93/02/09 @ 18:25



SB-113S2	
DEPTH	5-7 FT
DATE	6/11/92
BARIUM	120
CALCIUM	1620
COBALT	17.5
CHROMIUM	63.7
COPPER	27.4
IRON	26900
MAGNESSIUM	8150
NICKEL	123
POTASSIUM	5760
SODIUM	280 B

SB-113S1	
DEPTH	0-0.5 FT
DATE	6/11/92
ARSENIC	8.8
CALCIUM	2190
COPPER	30.7
POTASSIUM	1390
ZINC	67.7 E

SB-114S1	
DEPTH	0-0.75 FT
DATE	7/7/92
ARSENIC	5.9
CADMIUM	1.2
CALCIUM	34500 E
COPPER	53
MAGNESIUM	10700
POTASSIUM	1380
SODIUM	149 B
VANADIUM	40
ZINC	107

SB-120S2	
DEPTH	45-46 FT
DATE	6/9/92
CALCIUM	1490
CHROMIUM	37.2
MAGNESIUM	5800
NICKEL	53.4
POTASSIUM	3210
SODIUM	2040

SB-120S1	
DEPTH	0-0.8 FT
DATE	6/9/92
CALCIUM	3160
SODIUM	194 B

SB-119S2	
DEPTH	0-0.5 FT
DATE	6/25/92
BARIUM	140 N*
CADMIUM	2.6
CALCIUM	10400 *
CHROMIUM	34.7
COPPER	41.9 *
IRON	28700
MAGNESSIUM	5620 *
POTASSIUM	3110
SODIUM	2050
VANADIUM	61.5
ZINC	158 N*

SB-119S1	
DEPTH	0-0.5 FT
DATE	6/25/92
BARIUM	94.7 N*
CADMIUM	0.88 B
CALCIUM	5320 *
COPPER	33.1 *
IRON	22600
MAGNESIUM	4500 *
POTASSIUM	1240
SELENIUM	0.48 BW
SODIUM	322 B
ZINC	144 N*

SB-116S1	
DEPTH	0-0.5 FT
DATE	8/10/92
BARIUM	111
BERYLLIUM	0.45 B
CALCIUM	3460
MANGANESE	549
ZINC	95.4

SB-124S1	
DEPTH	0-1 FT
DATE	7/7/92
ALUMINUM	16800
ANTIMONY	9.1 B
ARSENIC	4.4
BARIUM	76.3
BERYLLIUM	0.39 B
CALCIUM	473 B
CHROMIUM	30.8
COBALT	8.7 B
COPPER	18.2
IRON	19900
MAGNESIUM	3310
MANGANESE	479
MERCURY	0.22
NICKEL	33.3
POTASSIUM	574 B
SODIUM	27.1 B
THALLIUM	0.5 B
VANADIUM	34.4
ZINC	48.8

SB-124S2	
DEPTH	0-1 FT
DATE	7/7/92
ALUMINUM	2 B
ARSENIC	10100
BARIUM	45
CALCIUM	1340
CHROMIUM	31.4
COBALT	10.5
COPPER	24.8
IRON	16300
MAGNESIUM	3810
MANGANESE	272
MERCURY	0.39
NICKEL	49.5
POTASSIUM	1180
SODIUM	121 B
VANADIUM	26.4
ZINC	21.8

SB-117S1	
DEPTH	0-0.5 FT
DATE	8/10/92
ARSENIC	4.8
BARIUM	120
CALCIUM	4710
COPPER	126
IRON	21100
SODIUM	262 B
THALLIUM	0.63 BW
ZINC	500

SB-118S1	
DEPTH	0-0.5 FT
DATE	6/25/92
BARIUM	136 N*
CALCIUM	6910 *
COPPER	45.8 *
IRON	23100
MAGNESIUM	6140 *
MERCURY	0.46 J*
POTASSIUM	2600
SODIUM	157 B
THALLIUM	0.53 B
VANADIUM	38.7
ZINC	164 N*

SB-118S2	
DEPTH	8-12 FT
DATE	6/25/92
BARIUM	236 N*
CALCIUM	40100 *
COPPER	62.5 *
IRON	24400
LEAD	285 NR*
MAGNESIUM	10100 *
POTASSIUM	2060
SODIUM	417 B
VANADIUM	46.3
ZINC	205 N*

File name: C:\92C4087\M-S-INOR.DWG Last edited: 93/02/15 @ 11:42

LEGEND:

MW-103	●	MONITORING WELLS INSTALLED 1989
MW-108	■	MONITORING WELL DESTROYED DURING IRM
PZ-3B	▲	PIEZOMETERS INSTALLED 1992
MW-113	⊕	MONITORING WELLS INSTALLED 1992
MW-116B	⊕	BEDROCK WELLS INSTALLED 1992
TB-1	◒	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. ALL CONCENTRATIONS IN mg/kg (ppm).
   - * = ESTIMATED VALUE (DUPLICATE ANALYSIS RESULT NOT WITHIN QUALITY CONTROL LIMITS).
   - B = REPORTED VALUE IS ACCEPTABLE (REPORTED VALUE LESS THAN THE CRDL (CONTRACT REQUIRED DETECTION LIMIT) BUT GREATER THAN THE IDL (INSTRUMENT DETECTION LIMIT)).
   - N = ESTIMATED VALUE (SPIKED SAMPLE RECOVERY NOT WITHIN QUALITY CONTROL LIMITS).
   - R = REJECTED RESULT.
   - W = ESTIMATED VALUE (POST-DIGESTION SPIKE SAMPLE RESULTS REPORTED OUTSIDE QUALITY CONTROL LIMITS, WHILE SAMPLE ABSORBANCE IS LESS THAN 50% OF SPIKE ABSORBANCE).
5. SOIL BORING SAMPLES SB-124S1 AND SB-124S2 ARE REFERENCE CONCENTRATIONS.
6. ONLY SAMPLE CONCENTRATIONS WHICH EXCEED THE MAXIMUM REFERENCE CONCENTRATIONS FROM SOIL BORINGS SB-124S1 AND SB-124S2 (TABLE 4-4) ARE INCLUDED.
7. ONLY VALUES >200 ppm WERE REPORTED FOR LEAD.
8. REFER TO TABLE 4-4 FOR ALL SOIL BORING SAMPLE INORGANIC COMPOUND ANALYTICAL RESULTS.
9. SHEET 1 OF 2.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

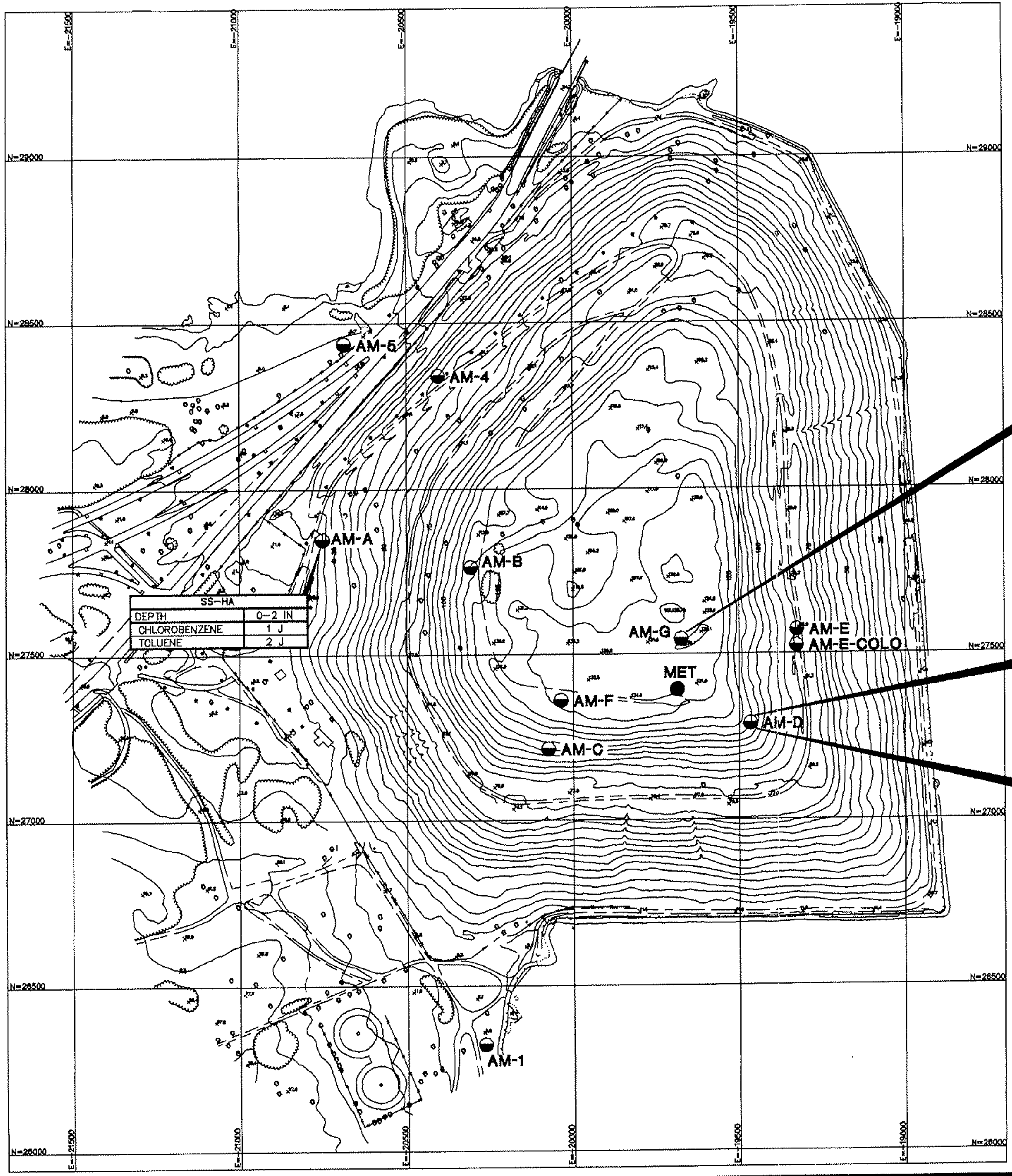
0 350 700 FT

SCALE

SOIL BORING SAMPLE ANALYTICAL RESULTS
INORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-4



SS-HA	
DEPTH	0-2 IN
CHLOROBENZENE	1 J
TOLUENE	2 J

SS-HG	
DEPTH	0-2 IN
CHLOROFORM	1 J
TOLUENE	2 J

SS-HD	
DEPTH	0-2 IN
BENZENE	2 J
CHLOROBENZENE	220
ETHYLBENZENE	20
TOLUENE	2 J
XYLENE (TOTAL)	78

SS-HD DUP	
DEPTH	0-2 IN
CHLOROFORM	0,8 J
2-BUTANONE	6 J
BENZENE	0,9 J
CHLOROBENZENE	170
ETHYLBENZENE	120
STYRENE	3 J
TOLUENE	2 J
XYLENE (TOTAL)	55

N

LEGEND

◒	AIR MONITORING STATION
MET ●	METEOROLOGICAL STATION

NOTES:

1. OFF-SITE LOCATIONS AM-5, AM-1, AM-4 ARE ALSO INCLUDED ON THIS FIGURE.
2. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED VALUE.
3. ALL SAMPLES TAKEN 8/27/92.
4. REFER TO TABLE 4-5 FOR ALL SOIL SAMPLE VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

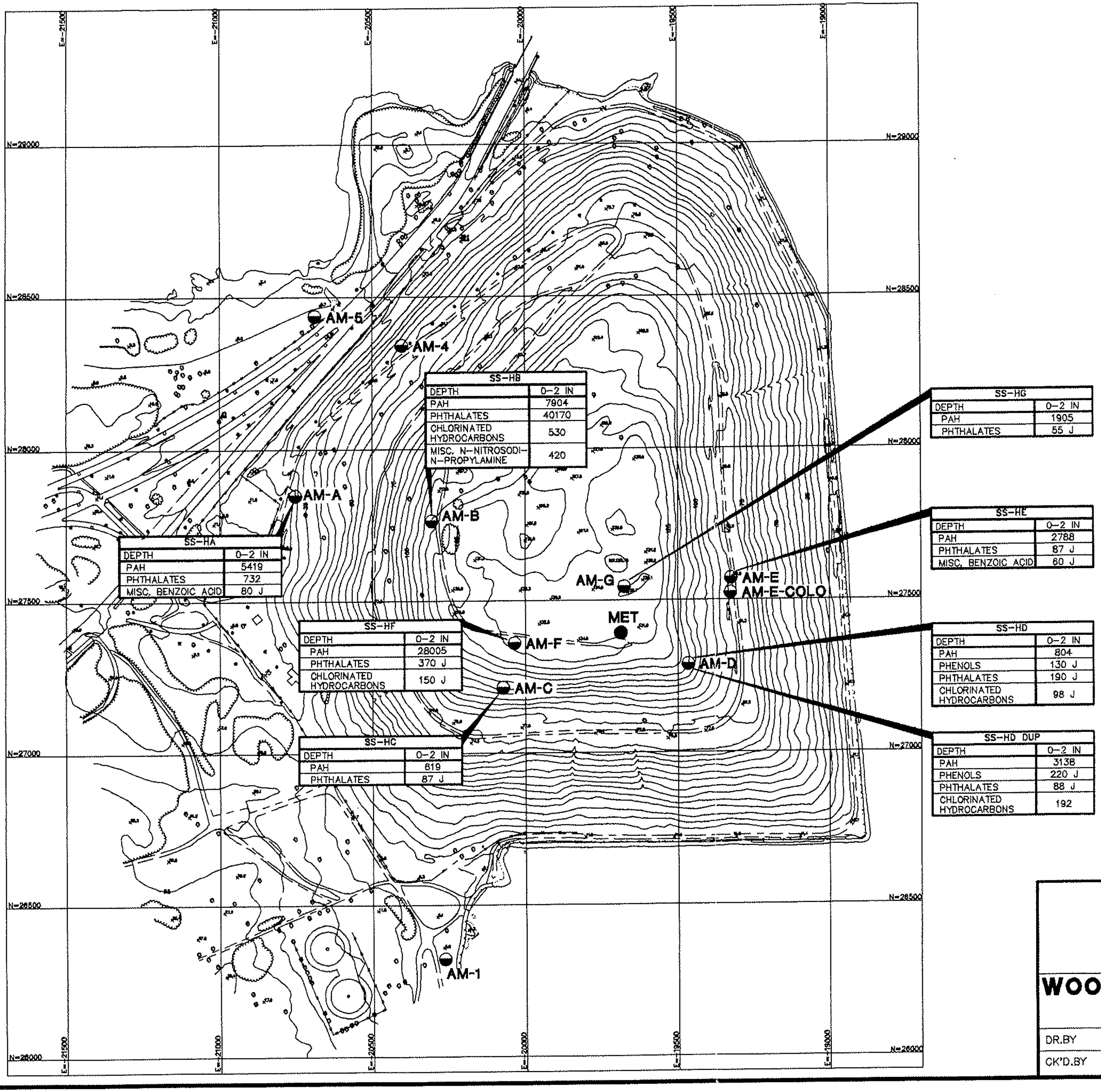
0 350 700 FT
SCALE

ON-SITE AIR MONITORING LOCATION SOIL SAMPLE
ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	BAS	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-5

File name: C:\92C4087\VOA.DWG Last edited: 93/02/10 @ 10:35



SS-HA	
DEPTH	0-2 IN
PAH	5419
PHTHALATES	732
MISC. BENZOIC ACID	80 J

SS-HB	
DEPTH	0-2 IN
PAH	7904
PHTHALATES	40170
CHLORINATED HYDROCARBONS	530
MISC. N-NITROSODI-N-PROPYLAMINE	420

SS-HF	
DEPTH	0-2 IN
PAH	28005
PHTHALATES	370 J
CHLORINATED HYDROCARBONS	150 J

SS-HC	
DEPTH	0-2 IN
PAH	619
PHTHALATES	87 J

SS-HG	
DEPTH	0-2 IN
PAH	1905
PHTHALATES	55 J

SS-HE	
DEPTH	0-2 IN
PAH	2788
PHTHALATES	87 J
MISC. BENZOIC ACID	60 J

SS-HD	
DEPTH	0-2 IN
PAH	804
PHENOLS	130 J
PHTHALATES	190 J
CHLORINATED HYDROCARBONS	98 J

SS-HD DUP	
DEPTH	0-2 IN
PAH	3138
PHENOLS	220 J
PHTHALATES	88 J
CHLORINATED HYDROCARBONS	192

N

LEGEND

◒	AIR MONITORING STATION
MET ●	METEOROLOGICAL STATION

NOTES:

1. OFF-SITE LOCATIONS AM-5, AM-1, AM-4 ARE ALSO INCLUDED ON THIS FIGURE.
2. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED VALUE.
3. ALL SAMPLES TAKEN 8/27/92.
4. REFER TO TABLE 4-6 FOR ALL SOIL SAMPLE SEMI-VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

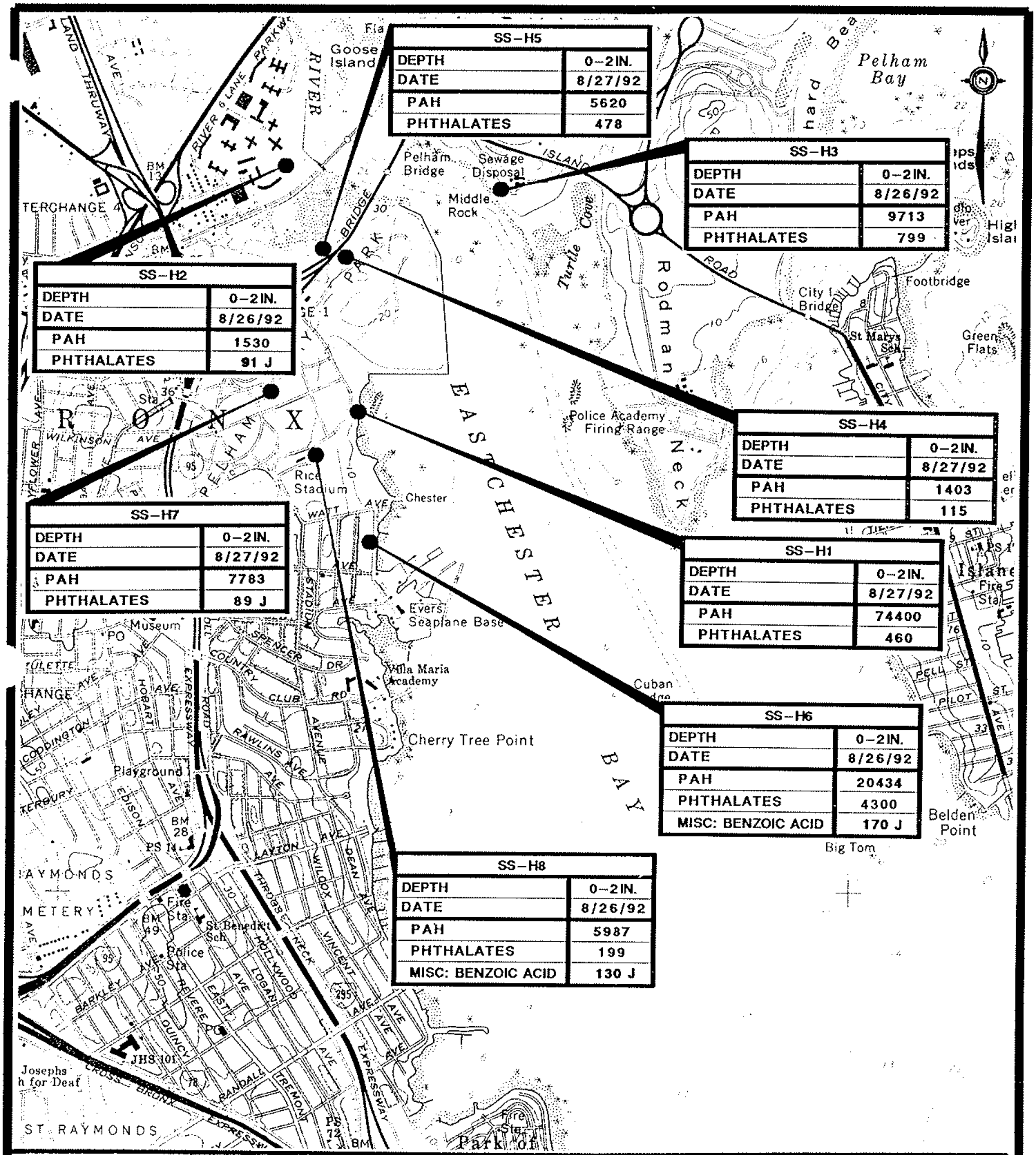
0 350 700 FT
SCALE

ON-SITE AIR MONITORING LOCATION SOIL SAMPLE
ANALYTICAL RESULTS
SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	BAS	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-6

File name: C:\92C4087\S-V-O-C.DWG Last edited: 93/02/10 @ 10:48



SS–H5

DEPTH	0–2 IN.
DATE	8/27/92
PAH	5620
PHTHALATES	478

SS–H3

DEPTH	0–2 IN.
DATE	8/26/92
PAH	9713
PHTHALATES	799

SS–H2

DEPTH	0–2 IN.
DATE	8/26/92
PAH	1530
PHTHALATES	91 J

SS–H4

DEPTH	0–2 IN.
DATE	8/27/92
PAH	1403
PHTHALATES	115

SS–H7

DEPTH	0–2 IN.
DATE	8/27/92
PAH	7783
PHTHALATES	89 J

SS–H1

DEPTH	0–2 IN.
DATE	8/27/92
PAH	74400
PHTHALATES	460

SS–H6

DEPTH	0–2 IN.
DATE	8/26/92
PAH	20434
PHTHALATES	4300
MISC: BENZOIC ACID	170 J

SS–H8

DEPTH	0–2 IN.
DATE	8/26/92
PAH	5987
PHTHALATES	199
MISC: BENZOIC ACID	130 J

0 1000 2000 FT
SCALE

NOTES:

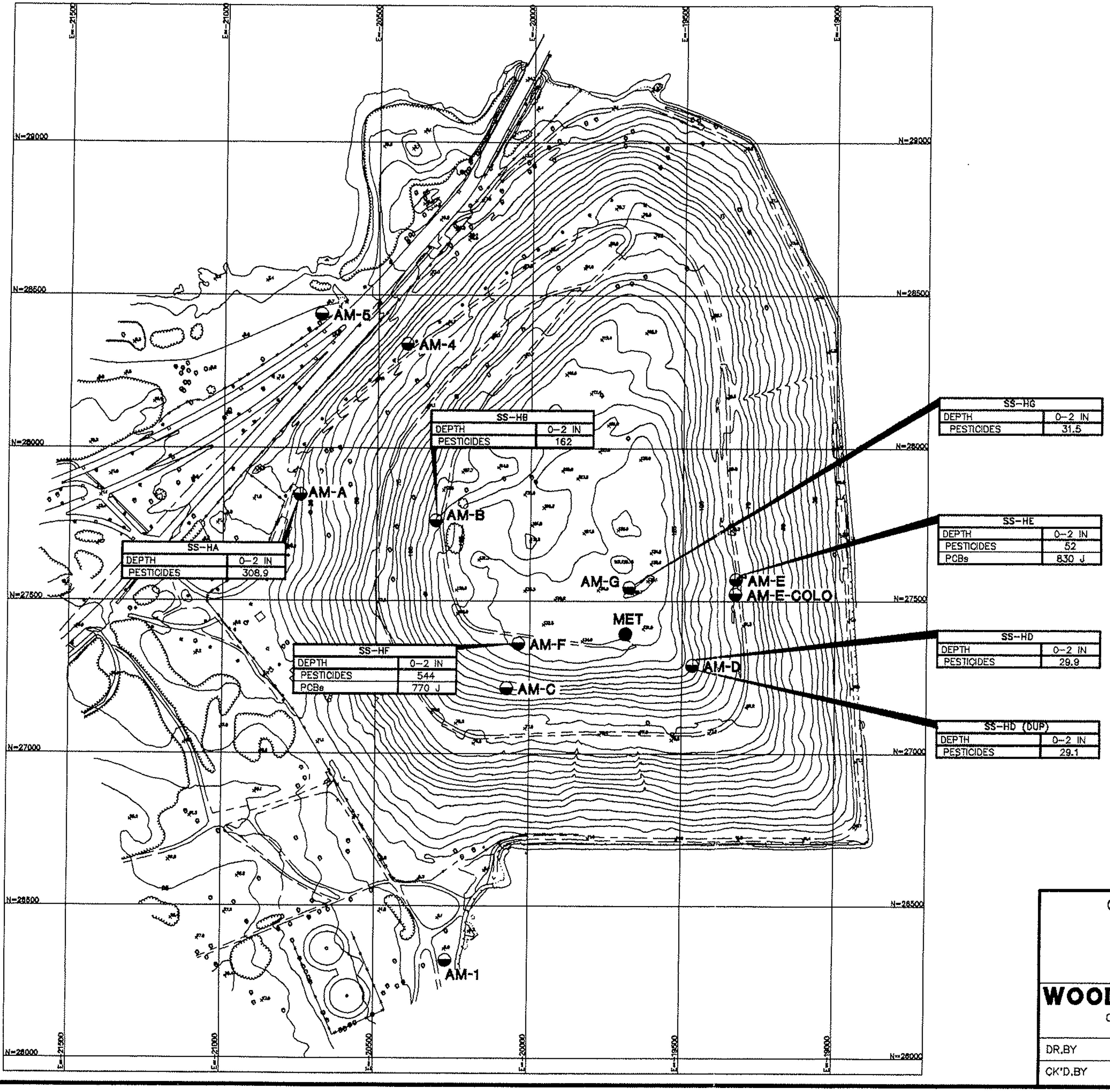
1. ALL CONCENTRATIONS IN ug/kg (ppb)
J = ESTIMATED CONCENTRATION.
2. REFER TO TABLE 4–6 FOR ALL SOIL SAMPLE SEMI–VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

OFF–SITE AIR MONITORING LOCATION SOIL SAMPLE ANALYTICAL RESULTS – SEMI–VOLATILE ORGANIC COMPOUNDS PELHAM BAY LANDFILL, BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: REC	SCALE: AS SHOWN	PROJ. NO.: 92C4087
CK'D BY: REC	DATE: DEC 11, 1992	FIG. NO: 4–7



LEGEND

◓ AIR MONITORING STATION

MET● METEOROLOGICAL STATION

NOTES:

1. OFF-SITE LOCATIONS AM-5, AM-1, AM-4 ARE ALSO INCLUDED ON THIS FIGURE.
2. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED CONCENTRATIONS.
3. ALL SAMPLES TAKEN 8/27/92.
4. REFER TO TABLE 4-7 FOR ALL SOIL SAMPLE PESTICIDE AND PCB ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

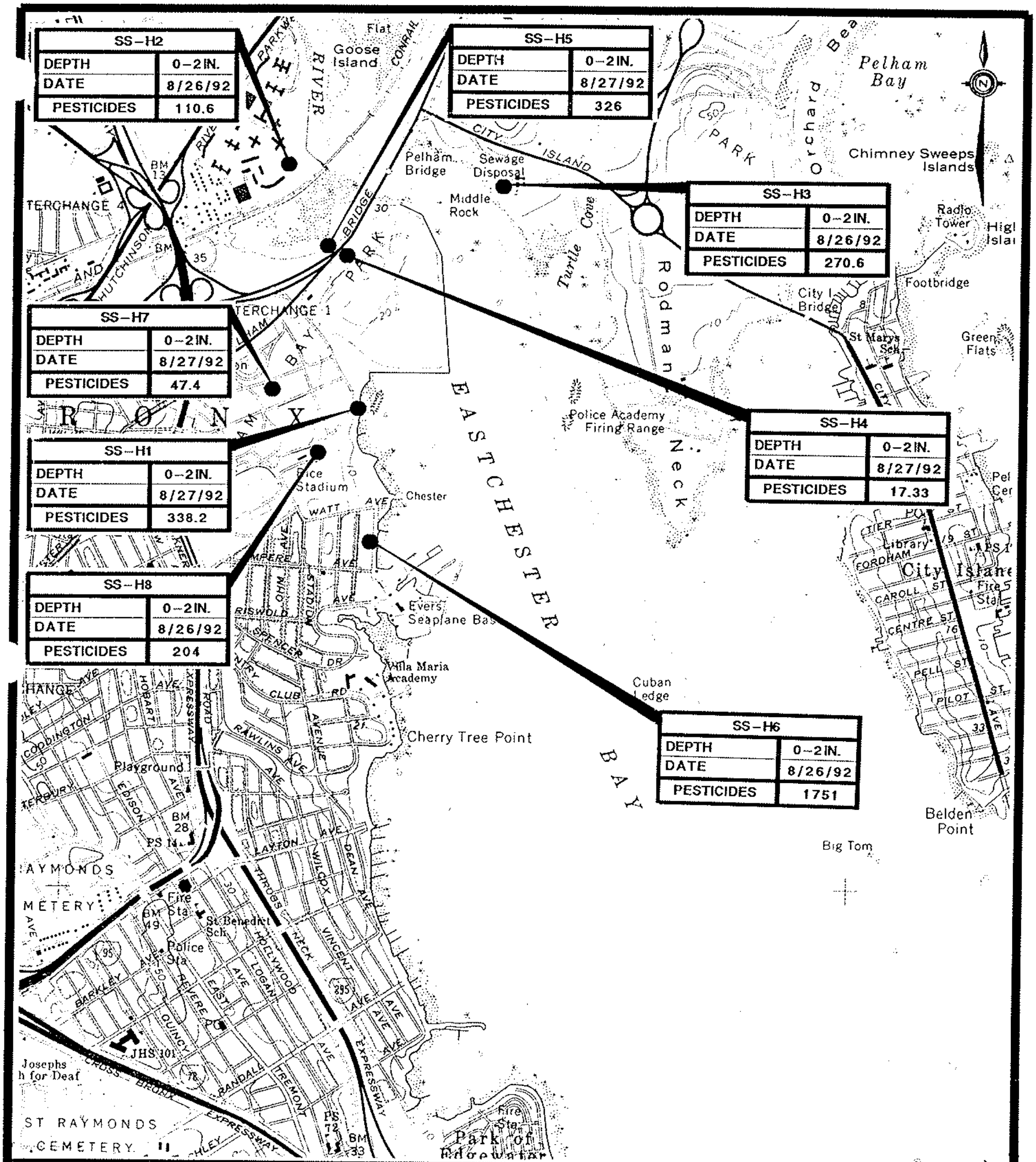
ON-SITE AIR MONITORING LOCATION SOIL SAMPLE
ANALYTICAL RESULTS
PESTICIDES AND PCBs
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	BAS	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-8

File name: C:\92C4087\O-S-P.DWG Last edited: 93/02/12 @ 15:27



SS-H2

DEPTH	0-2 IN.
DATE	8/26/92
PESTICIDES	110.6

SS-H5

DEPTH	0-2 IN.
DATE	8/27/92
PESTICIDES	326

SS-H3

DEPTH	0-2 IN.
DATE	8/26/92
PESTICIDES	270.6

SS-H7

DEPTH	0-2 IN.
DATE	8/27/92
PESTICIDES	47.4

SS-H1

DEPTH	0-2 IN.
DATE	8/27/92
PESTICIDES	338.2

SS-H4

DEPTH	0-2 IN.
DATE	8/27/92
PESTICIDES	17.33

SS-H8

DEPTH	0-2 IN.
DATE	8/26/92
PESTICIDES	204

SS-H6

DEPTH	0-2 IN.
DATE	8/26/92
PESTICIDES	1751

0 1000 2000 FT
SCALE

NOTES:

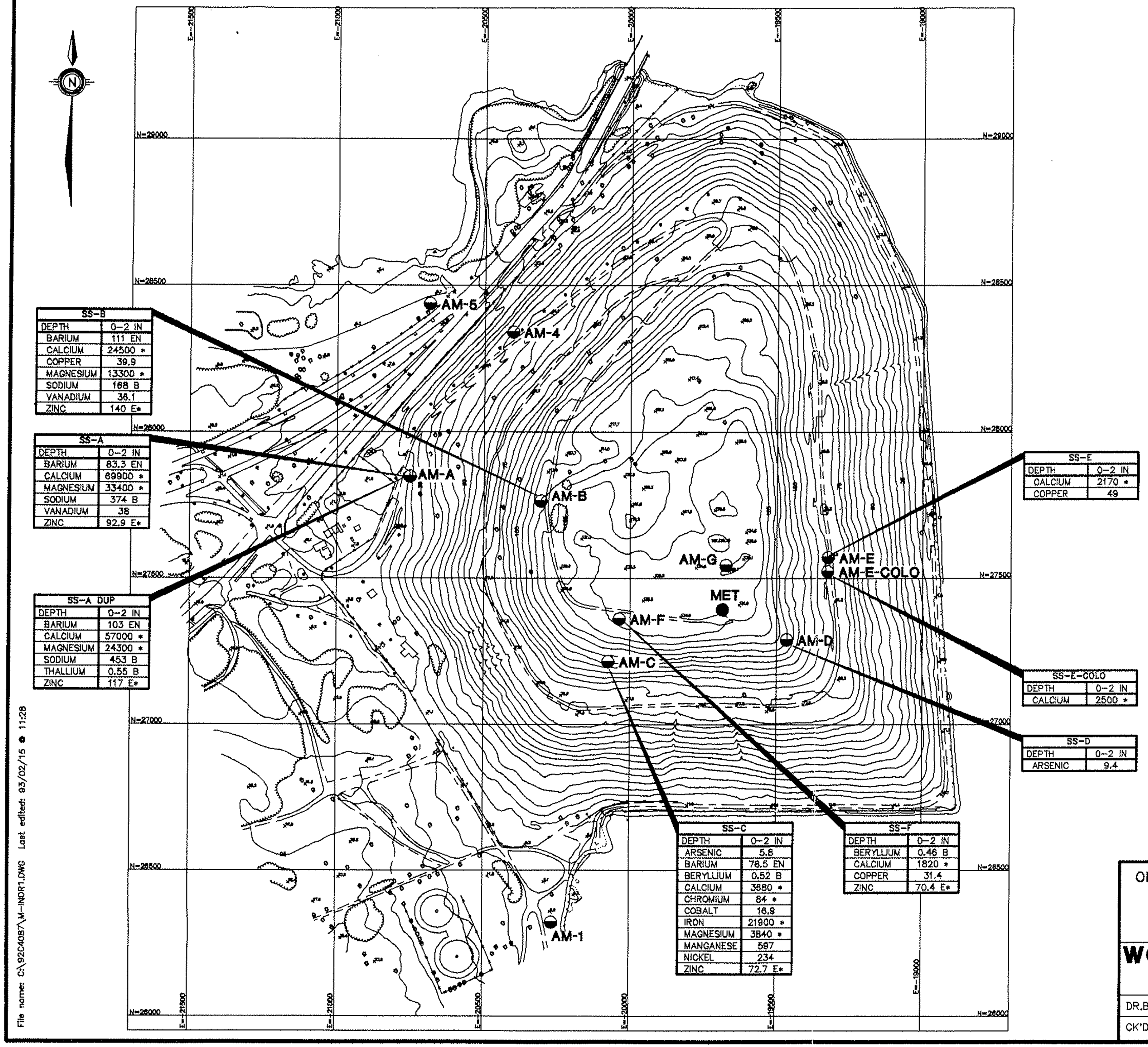
1. ALL CONCENTRATIONS IN ug/kg (ppb)
2. REFER TO TABLE 4-7 FOR ALL SOIL SAMPLE PESTICIDE AND PCB ANALYTICAL RESULTS.

MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

OFF-SITE AIR MONITORING LOCATION SOIL SAMPLE ANALYTICAL RESULTS-PESTICIDES AND PCBs PELHAM BAY LANDFILL, BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: REC	SCALE: AS SHOWN	PROJ. NO.: 92C4087
CK'D BY: REC	DATE: DEC 11, 1992	FIG. NO: 4-9



SS-B	
DEPTH	0-2 IN
BARIUM	111 EN
CALCIUM	24500 *
COPPER	39.9
MAGNESIUM	13300 *
SODIUM	168 B
VANADIUM	38.1
ZINC	140 E*

SS-A	
DEPTH	0-2 IN
BARIUM	83.3 EN
CALCIUM	69900 *
MAGNESIUM	33400 *
SODIUM	374 B
VANADIUM	38
ZINC	92.9 E*

SS-A DUP	
DEPTH	0-2 IN
BARIUM	103 EN
CALCIUM	57000 *
MAGNESIUM	24300 *
SODIUM	453 B
THALLIUM	0.55 B
ZINC	117 E*

SS-C	
DEPTH	0-2 IN
ARSENIC	5.8
BARIUM	78.5 EN
BERYLLIUM	0.52 B
CALCIUM	3880 *
CHROMIUM	84 *
COBALT	16.9
IRON	21900 *
MAGNESIUM	3840 *
MANGANESE	597
NICKEL	234
ZINC	72.7 E*

SS-F	
DEPTH	0-2 IN
BERYLLIUM	0.46 B
CALCIUM	1820 *
COPPER	31.4
ZINC	70.4 E*

SS-E	
DEPTH	0-2 IN
CALCIUM	2170 *
COPPER	49

SS-E-COLO	
DEPTH	0-2 IN
CALCIUM	2500 *

SS-D	
DEPTH	0-2 IN
ARSENIC	9.4

File name: C:\92C4087\M-INOR1.DWG Last edited: 93/02/15 @ 11:28

LEGEND

◒	AIR MONITORING STATION
MET ●	METEOROLOGICAL STATION

NOTES:

1. OFF-SITE LOCATIONS AM-5, AM-1, AM-4 ARE ALSO INCLUDED ON THIS FIGURE.
2. ALL SAMPLES TAKEN ON 5/11/92.
3. ALL CONCENTRATIONS ARE IN mg/kg (ppm).
   - * = ESTIMATED VALUE (DUPLICATE ANALYSIS RESULT NOT WITHIN QUALITY CONTROL LIMITS).
   - B = REPORTED VALUE IS ACCEPTABLE (REPORTED VALUE LESS THAN THE CRDL (CONTRACT REQUIRED DETECTION LIMIT) BUT GREATER THAN THE IDL (INSTRUMENT DETECTION LIMIT)).
   - E = ESTIMATED VALUE DUE TO MATRIX INTERFERENCE.
   - N = ESTIMATED VALUE (SPIKED SAMPLE RECOVERY NOT WITHIN QUALITY CONTROL LIMITS).
4. SOIL BORING SAMPLES SB-124S1 AND SB-124S2 ARE REFERENCE CONCENTRATIONS.
5. ONLY SAMPLE CONCENTRATIONS WHICH EXCEED THE MAXIMUM REFERENCE CONCENTRATIONS FROM SOIL BORING SAMPLES SB-124S1 AND SB-124S2 (TABLE 4-4) ARE INCLUDED IN FIGURE.
6. REFER TO TABLE 4-9 FOR ALL SOIL SAMPLE INORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.

ETTLINGER & ETTLINGER SITE SURVEY 1992.

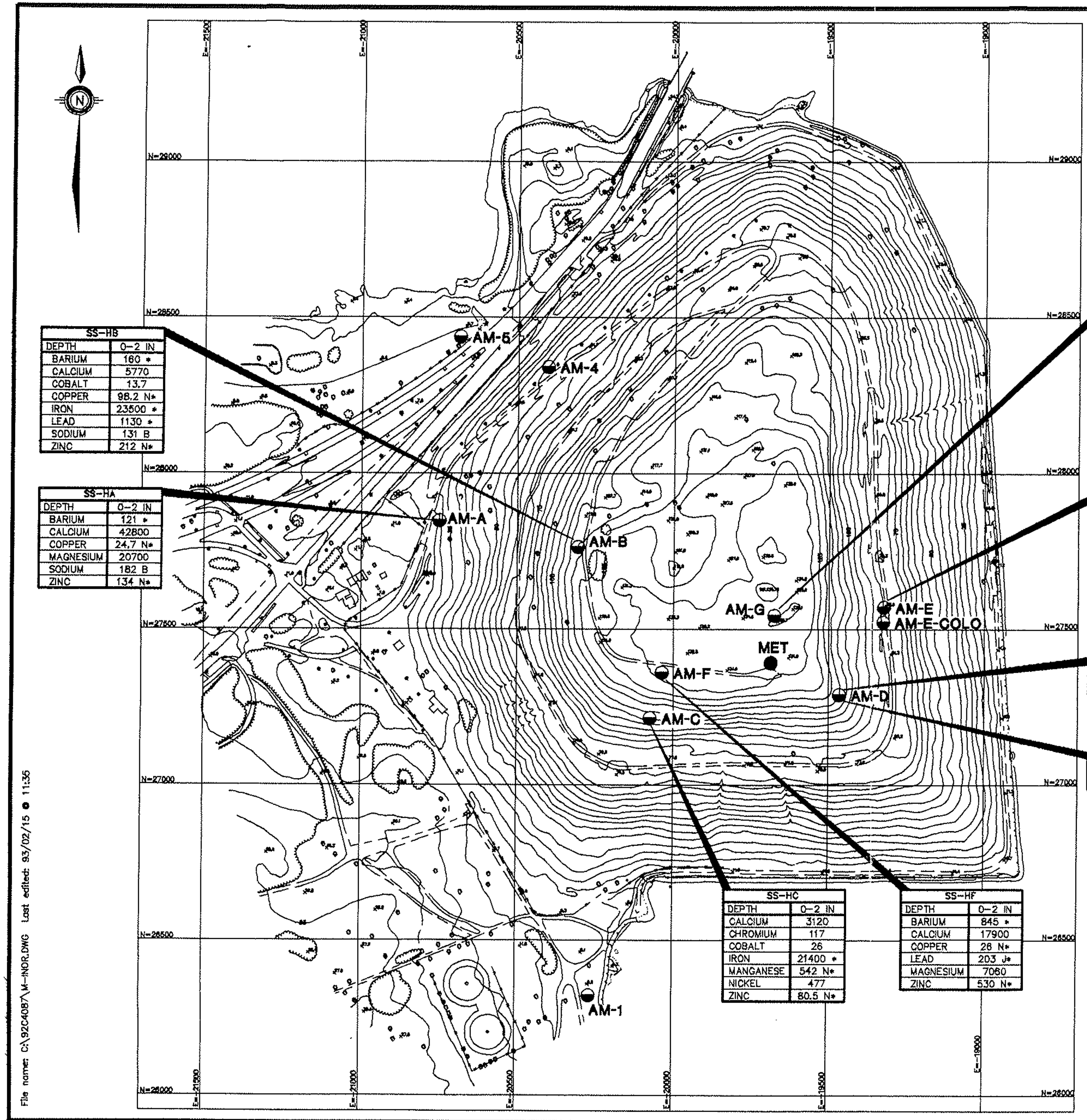
0 350 700 FT

SCALE

ON-SITE AIR MONITORING LOCATION SOIL SAMPLE ANALYTICAL
RESULTS - INORGANIC COMPOUNDS - 5/11/92
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	BAS	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-10



SS-HB	
DEPTH	0-2 IN
BARIUM	160 *
CALCIUM	5770
COBALT	13.7
COPPER	98.2 N*
IRON	23500 *
LEAD	1130 *
SODIUM	131 B
ZINC	212 N*

SS-HA	
DEPTH	0-2 IN
BARIUM	121 *
CALCIUM	42800
COPPER	24.7 N*
MAGNESIUM	20700
SODIUM	182 B
ZINC	134 N*

SS-HG	
DEPTH	0-2 IN
ARSENIC	6
BARIUM	76.7 *
CALCIUM	13000
COPPER	28.2 N*
MAGNESIUM	8020
POTASSIUM	1300
SELENIUM	0.5 BW
VANADIUM	40.1
ZINC	89.1 N*

SS-HE	
DEPTH	0-2 IN
CALCIUM	103000
MAGNESIUM	6950
POTASSIUM	1740
ZINC	52.9 N*

SS-HD	
DEPTH	0-2 IN
ARSENIC	9.2

SS-HD DUP	
DEPTH	0-2 IN
ARSENIC	7.9

SS-HC	
DEPTH	0-2 IN
CALCIUM	3120
CHROMIUM	117
COBALT	26
IRON	21400 *
MANGANESE	542 N*
NICKEL	477
ZINC	80.5 N*

SS-HF	
DEPTH	0-2 IN
BARIUM	845 *
CALCIUM	17900
COPPER	26 N*
LEAD	203 J*
MAGNESIUM	7060
ZINC	530 N*

File name: C:\92C4087\M-INOR.DWG Last edited: 93/02/15 @ 11:35

LEGEND

◒ AIR MONITORING STATION

MET● METEOROLOGICAL STATION

NOTES:

1. OFF-SITE LOCATIONS AM-5, AM-1, AM-4 ARE ALSO INCLUDED ON THIS FIGURE.
2. ALL SAMPLES TAKEN ON 5/11/92.
3. ALL CONCENTRATIONS ARE IN mg/kg (ppm).
   - * = ESTIMATED VALUE (DUPPLICATE ANALYSIS RESULT NOT WITHIN QUALITY CONTROL LIMITS).
   - B = REPORTED VALUE IS ACCEPTABLE (REPORTED VALUE LESS THAN THE CRDL (CONTRACT REQUIRED DETECTION LIMIT) BUT GREATER THAN THE IDL (INSTRUMENT DETECTION LIMIT)).
   - J = ESTIMATED VALUE.
   - N = ESTIMATED VALUE (SPIKED SAMPLE RECOVERY NOT WITHIN QUALITY CONTROL LIMITS).
   - W = ESTIMATED VALUE (POST-DIGESTION SPIKE SAMPLE RESULTS REPORTED OUTSIDE QUALITY CONTROL LIMITS, WHILE SAMPLE ABSORBANCE IS LESS THAN 50% OF SPIKE ABSORBANCE).
4. SOIL BORING SAMPLES SB-124S1 AND SB-124S2 ARE REFERENCE CONCENTRATIONS.
5. ONLY SAMPLE CONCENTRATIONS WHICH EXCEED THE MAXIMUM REFERENCE CONCENTRATIONS FROM SOIL BORING SAMPLES SB-124S1 AND SB-124S2 (TABLE 4-4) ARE INCLUDED IN FIGURE.
6. ONLY VALUES >200 ppm WERE REPORTED FOR LEAD.
7. REFER TO TABLE 4-8 FOR ALL SOIL SAMPLE INORGANIC ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.

ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

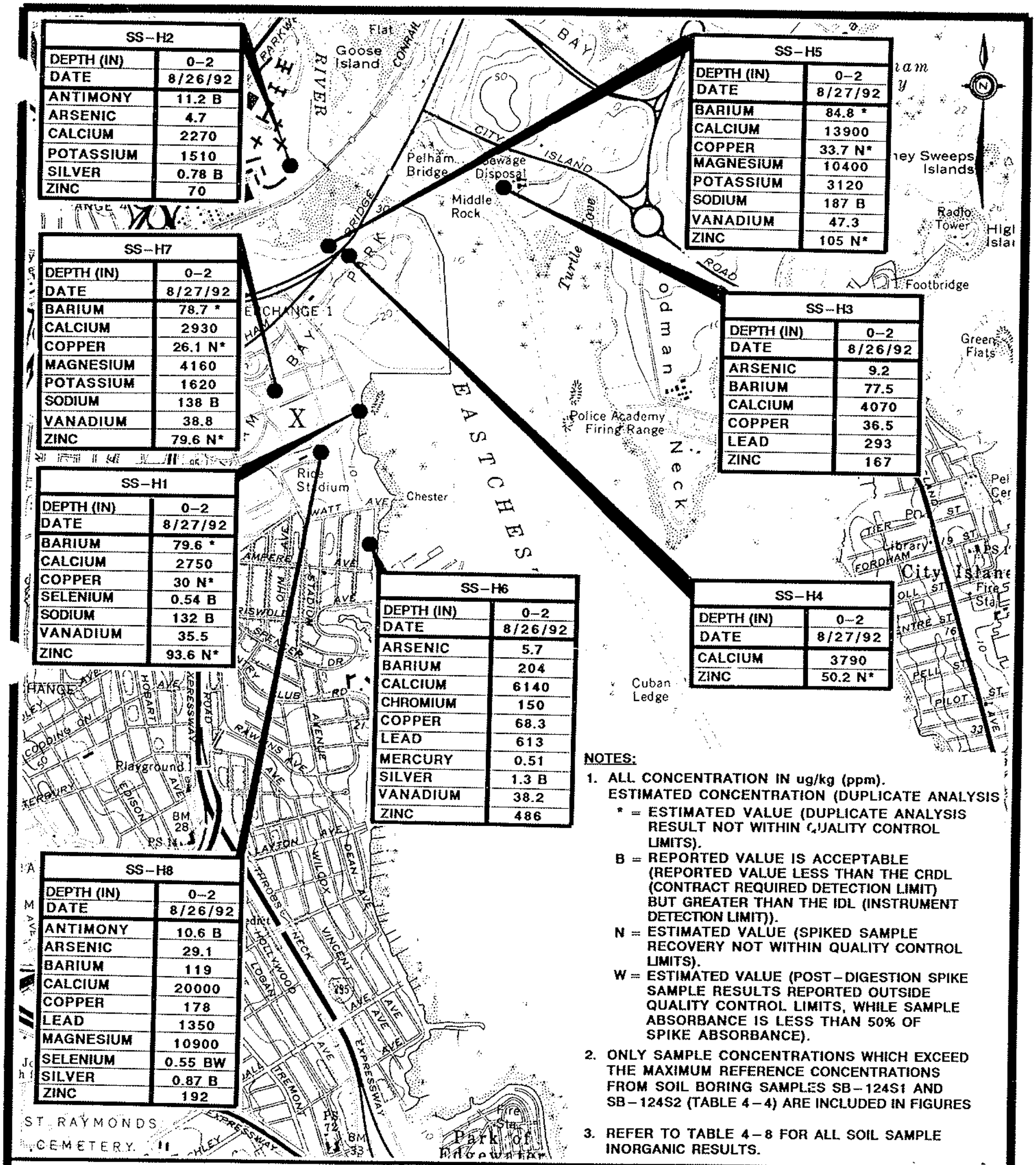
SCALE

ON-SITE AIR MONITORING LOCATION SOIL SAMPLE ANALYTICAL RESULTS - INORGANIC COMPOUNDS - 8/27/92
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-11



SS-H2

DEPTH (IN)	0-2
DATE	8/26/92
ANTIMONY	11.2 B
ARSENIC	4.7
CALCIUM	2270
POTASSIUM	1510
SILVER	0.78 B
ZINC	70

SS-H5

DEPTH (IN)	0-2
DATE	8/27/92
BARIUM	84.8 *
CALCIUM	13900
COPPER	33.7 N*
MAGNESIUM	10400
POTASSIUM	3120
SODIUM	187 B
VANADIUM	47.3
ZINC	105 N*

SS-H7

DEPTH (IN)	0-2
DATE	8/27/92
BARIUM	78.7 *
CALCIUM	2930
COPPER	26.1 N*
MAGNESIUM	4160
POTASSIUM	1620
SODIUM	138 B
VANADIUM	38.8
ZINC	79.6 N*

SS-H3

DEPTH (IN)	0-2
DATE	8/26/92
ARSENIC	9.2
BARIUM	77.5
CALCIUM	4070
COPPER	36.5
LEAD	293
ZINC	167

SS-H1

DEPTH (IN)	0-2
DATE	8/27/92
BARIUM	79.6 *
CALCIUM	2750
COPPER	30 N*
SELENIUM	0.54 B
SODIUM	132 B
VANADIUM	35.5
ZINC	93.6 N*

SS-H6

DEPTH (IN)	0-2
DATE	8/26/92
ARSENIC	5.7
BARIUM	204
CALCIUM	6140
CHROMIUM	150
COPPER	68.3
LEAD	613
MERCURY	0.51
SILVER	1.3 B
VANADIUM	38.2
ZINC	486

SS-H4

DEPTH (IN)	0-2
DATE	8/27/92
CALCIUM	3790
ZINC	50.2 N*

SS-H8

DEPTH (IN)	0-2
DATE	8/26/92
ANTIMONY	10.6 B
ARSENIC	29.1
BARIUM	119
CALCIUM	20000
COPPER	178
LEAD	1350
MAGNESIUM	10900
SELENIUM	0.55 BW
SILVER	0.87 B
ZINC	192

NOTES:

1. ALL CONCENTRATION IN ug/kg (ppm).
   ESTIMATED CONCENTRATION (DUPLICATE ANALYSIS
   - * = ESTIMATED VALUE (DUPLICATE ANALYSIS RESULT NOT WITHIN QUALITY CONTROL LIMITS).
   - B = REPORTED VALUE IS ACCEPTABLE (REPORTED VALUE LESS THAN THE CRDL (CONTRACT REQUIRED DETECTION LIMIT) BUT GREATER THAN THE IDL (INSTRUMENT DETECTION LIMIT)).
   - N = ESTIMATED VALUE (SPIKED SAMPLE RECOVERY NOT WITHIN QUALITY CONTROL LIMITS).
   - W = ESTIMATED VALUE (POST-DIGESTION SPIKE SAMPLE RESULTS REPORTED OUTSIDE QUALITY CONTROL LIMITS, WHILE SAMPLE ABSORBANCE IS LESS THAN 50% OF SPIKE ABSORBANCE).
2. ONLY SAMPLE CONCENTRATIONS WHICH EXCEED THE MAXIMUM REFERENCE CONCENTRATIONS FROM SOIL BORING SAMPLES SB-124S1 AND SB-124S2 (TABLE 4-4) ARE INCLUDED IN FIGURES
3. REFER TO TABLE 4-8 FOR ALL SOIL SAMPLE INORGANIC RESULTS.

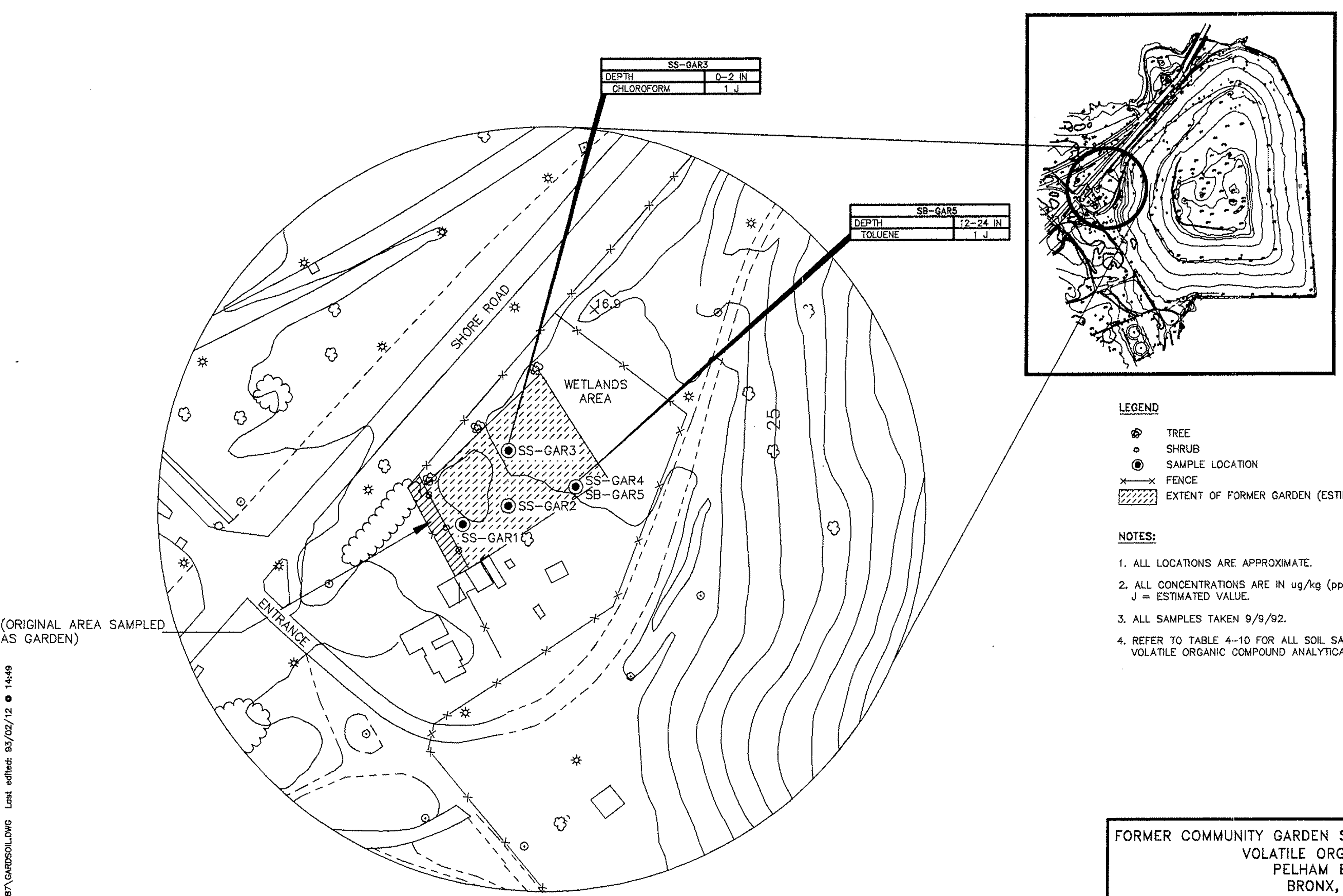
0 1000 2000 FT
SCALE

OFF-SITE AIR MONITORING LOCATION SOIL SAMPLE ANALYTICAL RESULTS - INORGANIC COMPOUNDS PELHAM BAY, BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: REC	SCALE: AS SHOWN	PROJ. NO.: 92C4087
CK'D BY: REC	DATE: DEC 15, 1992	FIG. NO: 4-12

MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.



SS-GAR3	
DEPTH	0-2 IN
CHLOROFORM	1 J

SB-GAR5	
DEPTH	12-24 IN
TOLUENE	1 J

LEGEND

✿	TREE
○	SHRUB
◉	SAMPLE LOCATION
×—×	FENCE
▨	EXTENT OF FORMER GARDEN (ESTIMATED)

NOTES:

1. ALL LOCATIONS ARE APPROXIMATE.
2. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED VALUE.
3. ALL SAMPLES TAKEN 9/9/92.
4. REFER TO TABLE 4-10 FOR ALL SOIL SAMPLE VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 100 200 FT

SCALE

FORMER COMMUNITY GARDEN SOIL SAMPLE ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

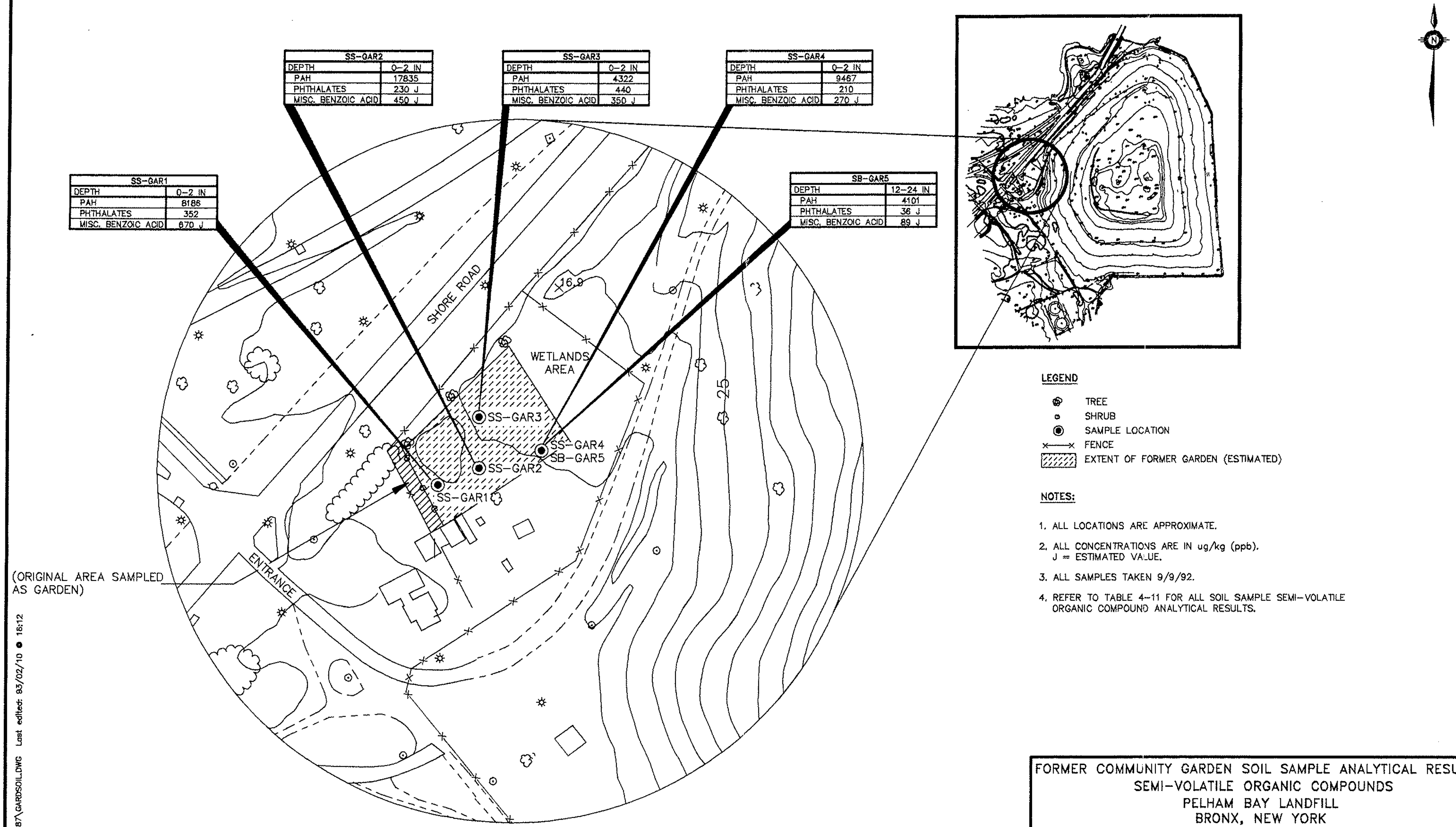
WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	BAS	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-13

File name: D:\92C4087\GARDSOIL.DWG Last edited: 93/02/12 @ 14:49

V-0-C



SS-GAR1	
DEPTH	0-2 IN
PAH	8186
PHTHALATES	352
MISC. BENZOIC ACID	670 J

SS-GAR2	
DEPTH	0-2 IN
PAH	17835
PHTHALATES	230 J
MISC. BENZOIC ACID	450 J

SS-GAR3	
DEPTH	0-2 IN
PAH	4322
PHTHALATES	440
MISC. BENZOIC ACID	350 J

SS-GAR4	
DEPTH	0-2 IN
PAH	9467
PHTHALATES	210
MISC. BENZOIC ACID	270 J

SB-GAR5	
DEPTH	12-24 IN
PAH	4101
PHTHALATES	36 J
MISC. BENZOIC ACID	89 J

LEGEND

❀	TREE
○	SHRUB
◉	SAMPLE LOCATION
x—x	FENCE
▨	EXTENT OF FORMER GARDEN (ESTIMATED)

NOTES:

1. ALL LOCATIONS ARE APPROXIMATE.
2. ALL CONCENTRATIONS ARE IN ug/kg (ppb).
   J = ESTIMATED VALUE.
3. ALL SAMPLES TAKEN 9/9/92.
4. REFER TO TABLE 4-11 FOR ALL SOIL SAMPLE SEMI-VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS.

0 100 200 FT
SCALE

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

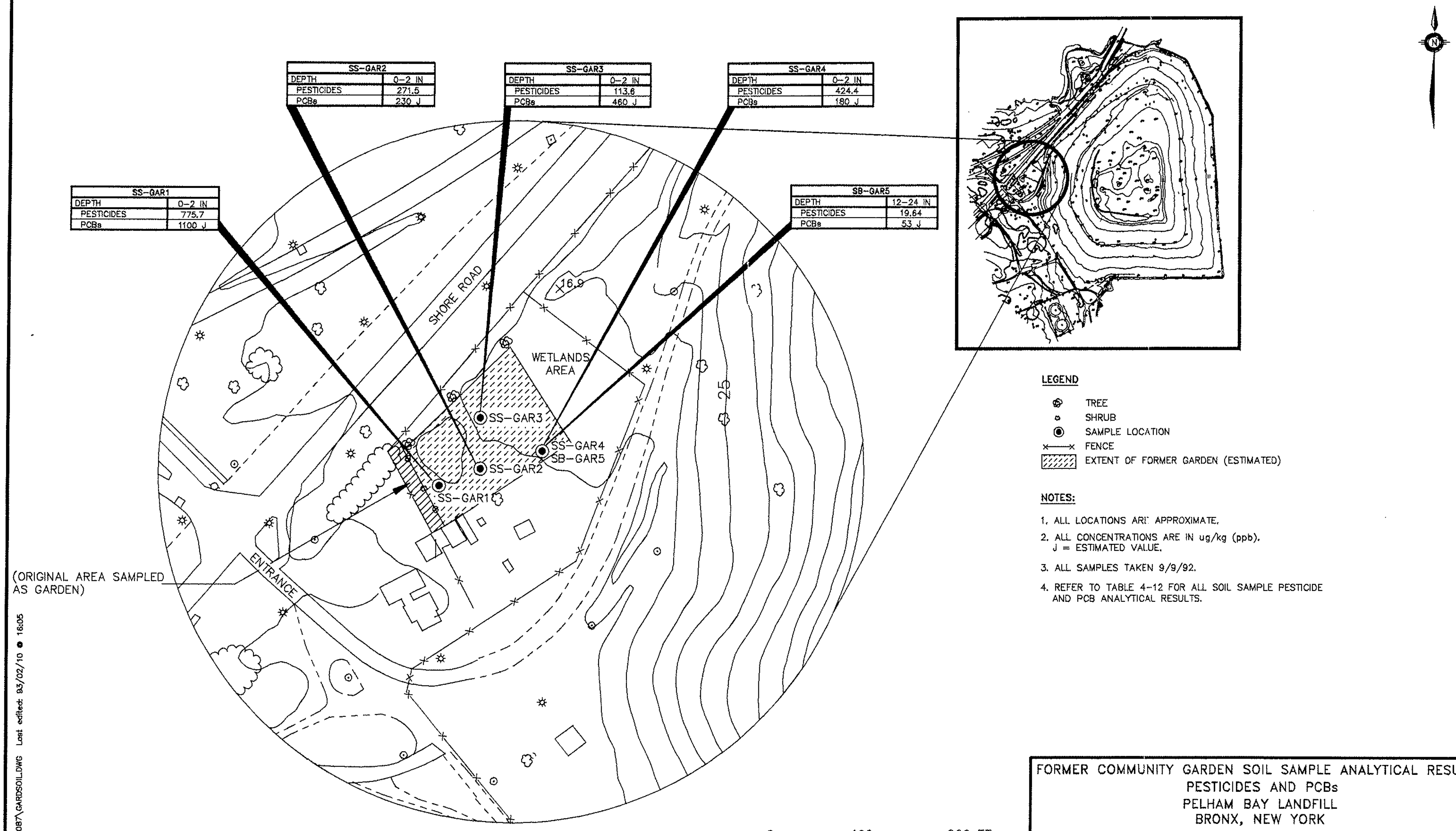
File name: D:\92C4087\GARDSOIL.DWG Last edited: 93/02/10 @ 18:12

S-V-0

FORMER COMMUNITY GARDEN SOIL SAMPLE ANALYTICAL RESULTS
SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	BAS	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-14



SS-GAR1	
DEPTH	0-2 IN
PESTICIDES	775.7
PCBs	1100 J

SS-GAR2	
DEPTH	0-2 IN
PESTICIDES	271.5
PCBs	230 J

SS-GAR3	
DEPTH	0-2 IN
PESTICIDES	113.6
PCBs	460 J

SS-GAR4	
DEPTH	0-2 IN
PESTICIDES	424.4
PCBs	180 J

SB-GAR5	
DEPTH	12-24 IN
PESTICIDES	19.64
PCBs	53 J

LEGEND

✲	TREE
○	SHRUB
●	SAMPLE LOCATION
×——×	FENCE
▨	EXTENT OF FORMER GARDEN (ESTIMATED)

NOTES:

1. ALL LOCATIONS ARE APPROXIMATE.
2. ALL CONCENTRATIONS ARE IN ug/kg (ppb).
   J = ESTIMATED VALUE.
3. ALL SAMPLES TAKEN 9/9/92.
4. REFER TO TABLE 4-12 FOR ALL SOIL SAMPLE PESTICIDE AND PCB ANALYTICAL RESULTS.

0 100 200 FT

SCALE

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

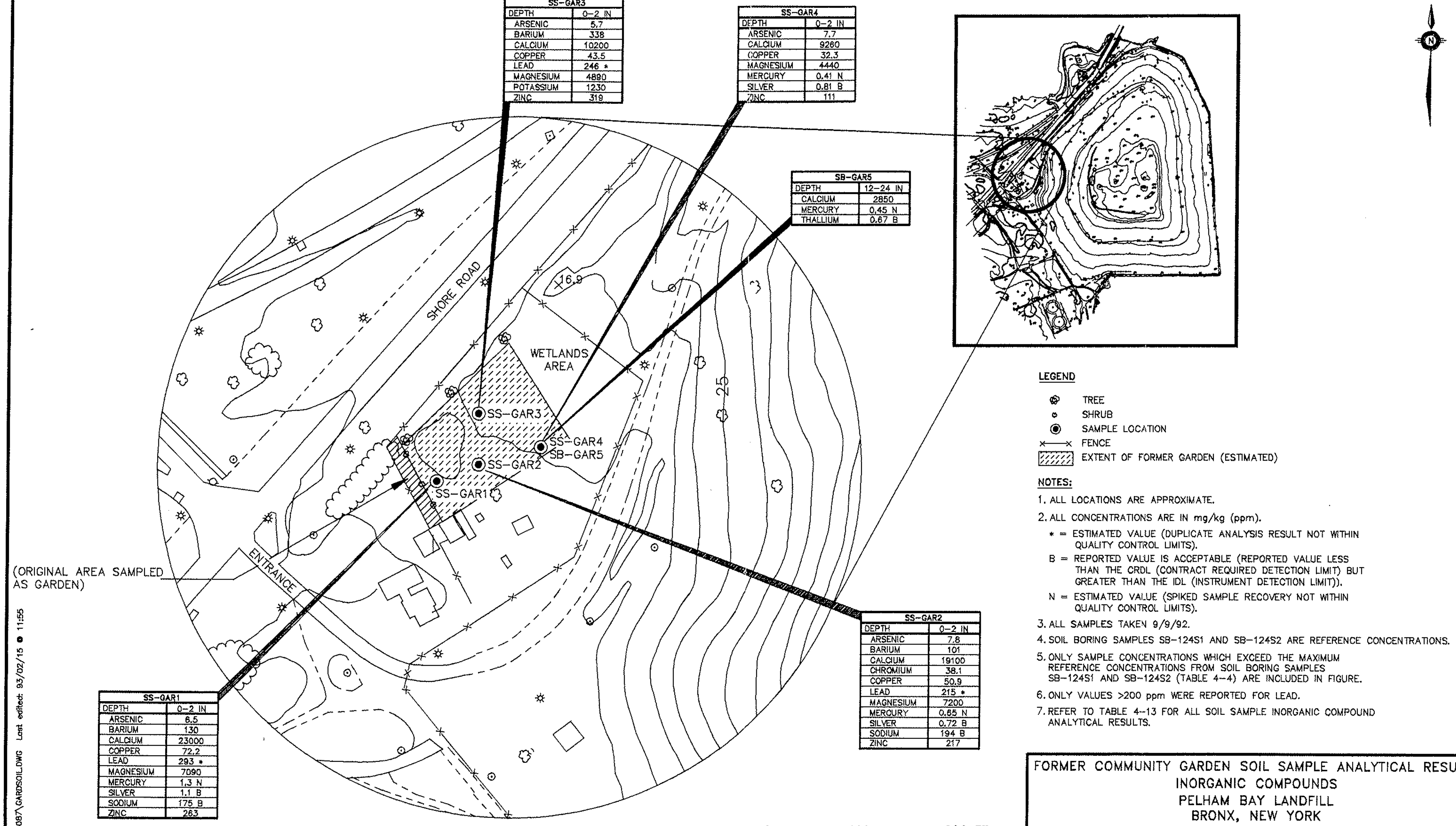
FORMER COMMUNITY GARDEN SOIL SAMPLE ANALYTICAL RESULTS
PESTICIDES AND PCBs
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	BAS	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-15

File name: D:\92C4087\GARDSOIL.DWG Last edited: 03/02/10 @ 16:05

P-PCB



SS-GAR3	
DEPTH	0–2 IN
ARSENIC	5.7
BARIUM	338
CALCIUM	10200
COPPER	43.5
LEAD	246 *
MAGNESIUM	4890
POTASSIUM	1230
ZINC	319

SS-GAR4	
DEPTH	0–2 IN
ARSENIC	7.7
CALCIUM	9260
COPPER	32.3
MAGNESIUM	4440
MERCURY	0.41 N
SILVER	0.81 B
ZINC	111

SB-GAR5	
DEPTH	12–24 IN
CALCIUM	2850
MERCURY	0.45 N
THALLIUM	0.67 B

SS-GAR1	
DEPTH	0–2 IN
ARSENIC	6.5
BARIUM	130
CALCIUM	23000
COPPER	72.2
LEAD	293 *
MAGNESIUM	7090
MERCURY	1.3 N
SILVER	1.1 B
SODIUM	175 B
ZINC	263

SS-GAR2	
DEPTH	0–2 IN
ARSENIC	7.8
BARIUM	101
CALCIUM	19100
CHROMIUM	38.1
COPPER	50.9
LEAD	215 *
MAGNESIUM	7200
MERCURY	0.65 N
SILVER	0.72 B
SODIUM	194 B
ZINC	217

LEGEND

✿	TREE
○	SHRUB
◉	SAMPLE LOCATION
×—×	FENCE
▨	EXTENT OF FORMER GARDEN (ESTIMATED)

NOTES:

1. ALL LOCATIONS ARE APPROXIMATE.
2. ALL CONCENTRATIONS ARE IN mg/kg (ppm).
   - * = ESTIMATED VALUE (DUPLICATE ANALYSIS RESULT NOT WITHIN QUALITY CONTROL LIMITS).
   - B = REPORTED VALUE IS ACCEPTABLE (REPORTED VALUE LESS THAN THE CRDL (CONTRACT REQUIRED DETECTION LIMIT) BUT GREATER THAN THE IDL (INSTRUMENT DETECTION LIMIT)).
   - N = ESTIMATED VALUE (SPIKED SAMPLE RECOVERY NOT WITHIN QUALITY CONTROL LIMITS).
3. ALL SAMPLES TAKEN 9/9/92.
4. SOIL BORING SAMPLES SB-124S1 AND SB-124S2 ARE REFERENCE CONCENTRATIONS.
5. ONLY SAMPLE CONCENTRATIONS WHICH EXCEED THE MAXIMUM REFERENCE CONCENTRATIONS FROM SOIL BORING SAMPLES SB-124S1 AND SB-124S2 (TABLE 4-4) ARE INCLUDED IN FIGURE.
6. ONLY VALUES >200 ppm WERE REPORTED FOR LEAD.
7. REFER TO TABLE 4-13 FOR ALL SOIL SAMPLE INORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 100 200 FT
SCALE

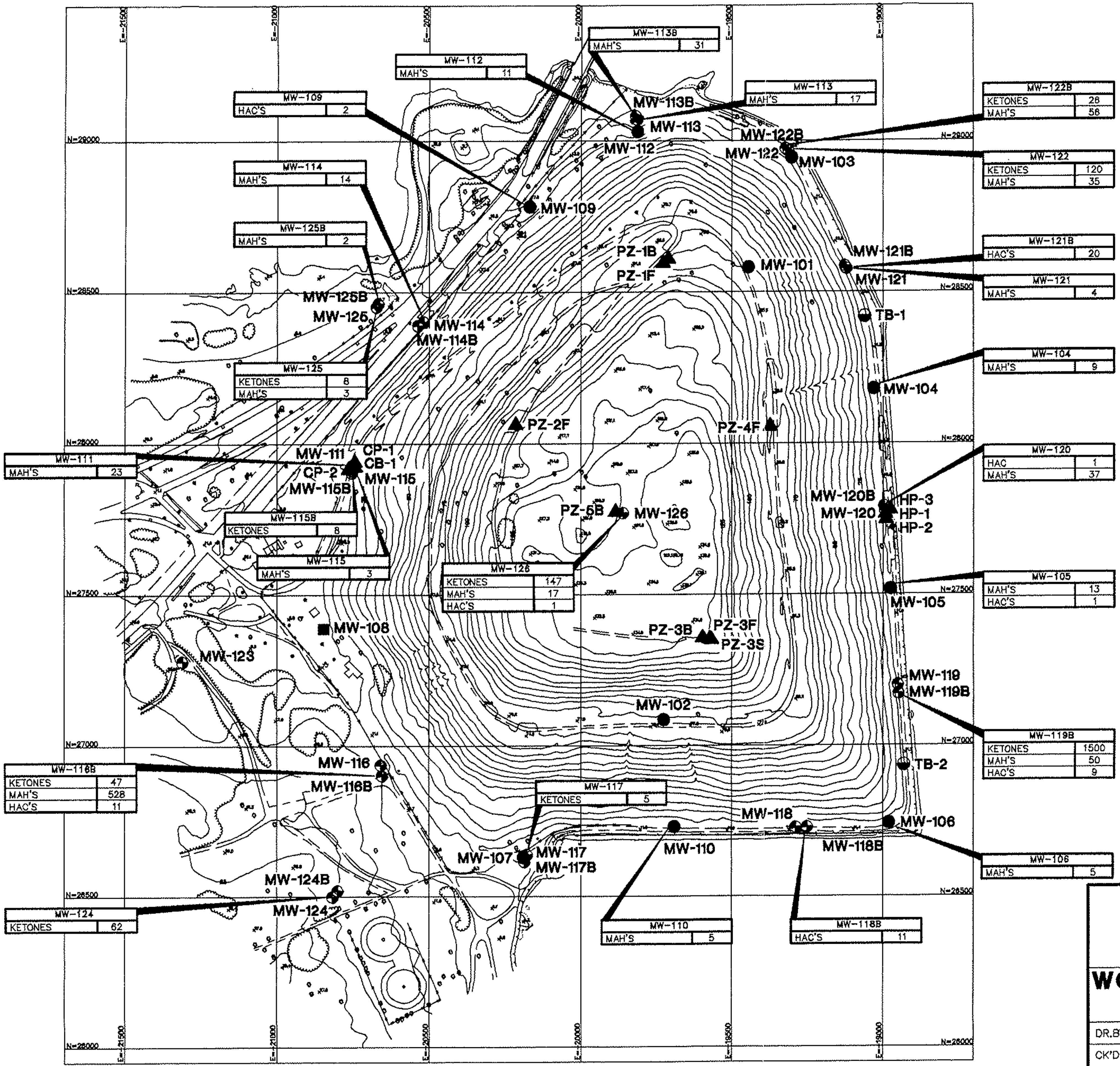
File name: D:\92C4087\GARDSOIL.DWG Last edited: 93/02/15 @ 11:55

VOC

FORMER COMMUNITY GARDEN SOIL SAMPLE ANALYTICAL RESULTS
INORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	BAS	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-16



N

LEGEND:

MW-103 ●	MONITORING WELLS INSTALLED 1989
MW-108 ■	MONITORING WELL DESTROYED DURING IRM
PZ-3B ▲	PIEZOMETERS INSTALLED 1992
MW-113 ◑	MONITORING WELLS INSTALLED 1992
MW-116B ◑	BEDROCK WELLS INSTALLED 1992
TB-1 ◒	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. ALL CONCENTRATIONS ARE IN ug/l

MAH'S – MONOCYCLIC AROMATIC HYDROCARBONS

HAC'S – HALOGENATED ALIPHATIC COMPOUNDS

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541

ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

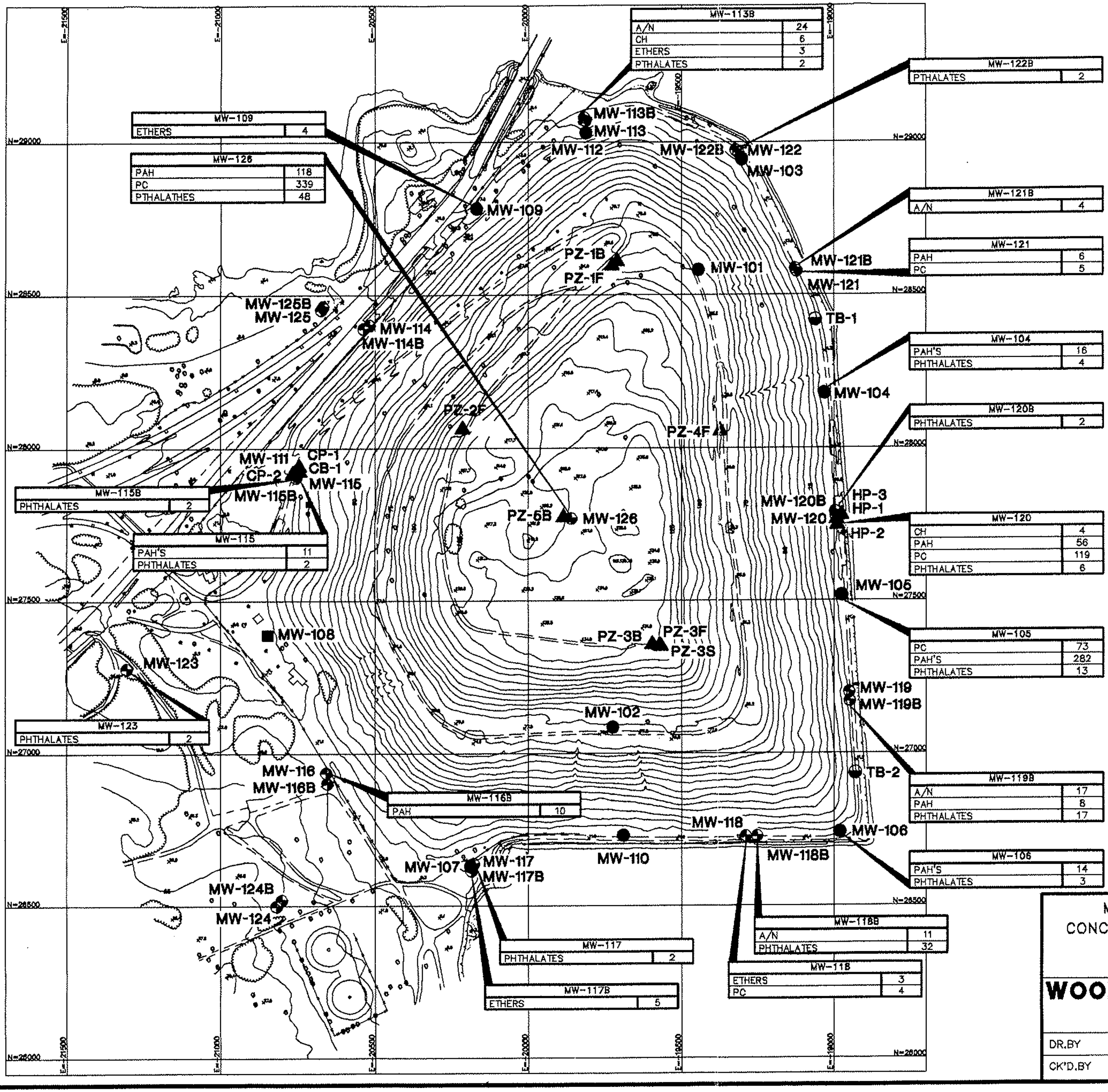
MONITORING WELL SAMPLING LOCATIONS SHOWING
CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4–17

File name: C:\92C4087\ALL.DWG Last edited: 93/02/12 @ 14:15



MW-113B	
A/N	24
CH	6
ETHERS	3
PTHALATES	2

MW-109	
ETHERS	4

MW-126	
PAH	118
PC	339
PTHALATHES	48

MW-122B	
PTHALATES	2

MW-121B	
A/N	4

MW-121	
PAH	6
PC	5

MW-104	
PAH'S	16
PHTHALATES	4

MW-120B	
PHTHALATES	2

MW-115B	
PHTHALATES	2

MW-115	
PAH'S	11
PHTHALATES	2

MW-120	
CH	4
PAH	56
PC	119
PHTHALATES	6

MW-105	
PC	73
PAH'S	282
PHTHALATES	13

MW-123	
PHTHALATES	2

MW-116B	
PAH	10

MW-119B	
A/N	17
PAH	8
PHTHALATES	17

MW-106	
PAH'S	14
PHTHALATES	3

MW-118B	
A/N	11
PHTHALATES	32

MW-117	
PHTHALATES	2

MW-118	
ETHERS	3
PC	4

MW-117B	
ETHERS	5

N

LEGEND:

MW-103	●	MONITORING WELLS INSTALLED 1989
MW-108	■	MONITORING WELL DESTROYED DURING IRM
PZ-3B	▲	PIEZOMETERS INSTALLED 1992
MW-113	◐	MONITORING WELLS INSTALLED 1992
MW-116B	◐	BEDROCK WELLS INSTALLED 1992
TB-1	◒	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. ALL CONCENTRATIONS ARE IN ug/l

CH – CHLORINATED HYDROCARBONS
PC – PHENOLIC COMPOUNDS
PAH'S – POLYNUCLEAR AROMATIC HYDROCARBONS
A/N – AMINES/NITROARENES

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

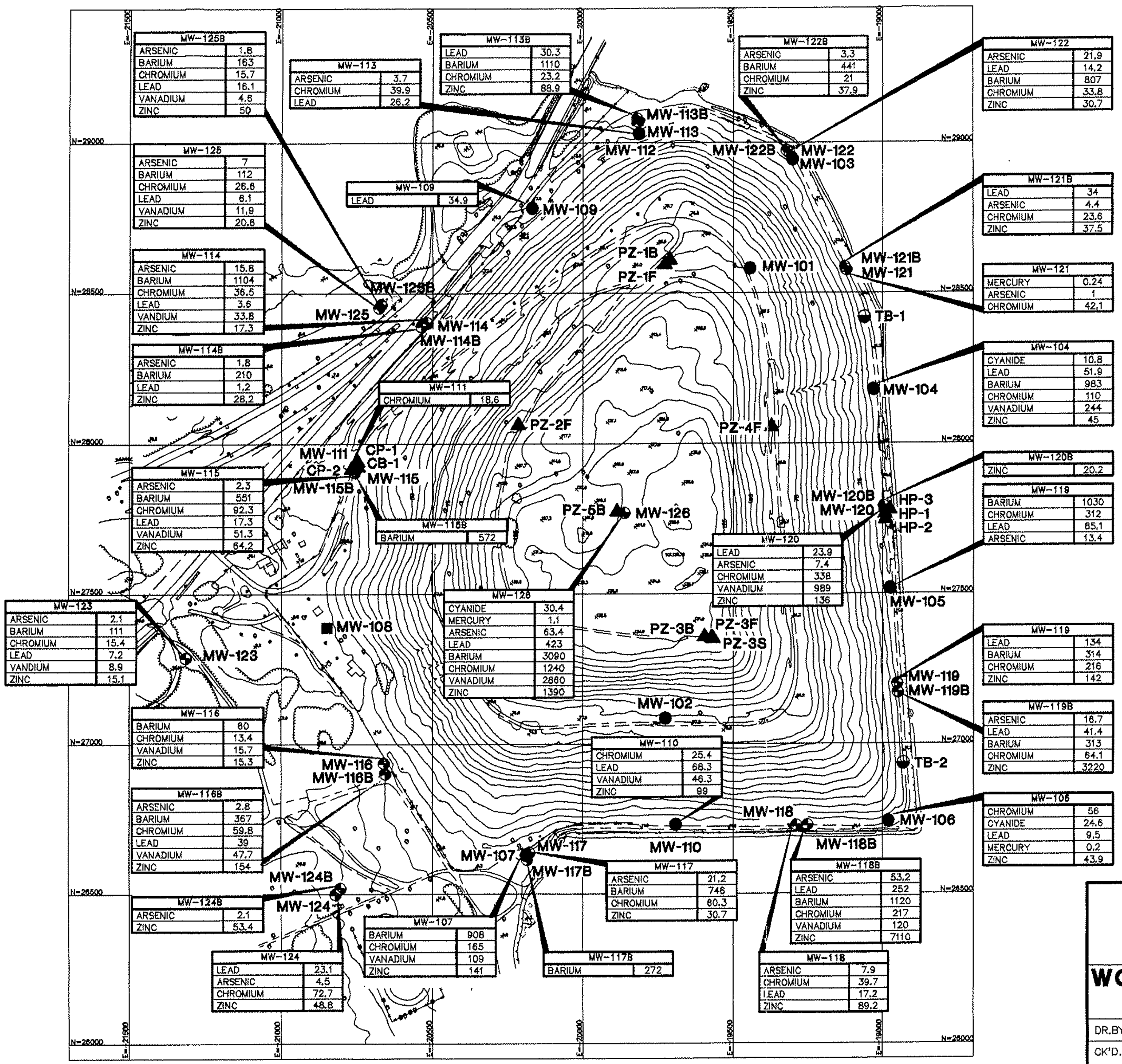
0 350 700 FT
SCALE

MONITORING WELL SAMPLING LOCATIONS SHOWING
CONCENTRATIONS OF SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-18

File name: C:\92C4087\G-W-SEMI.DWG Last edited: 93/02/09 @ 15:39



MW-125B	
ARSENIC	1.8
BARIUM	163
CHROMIUM	15.7
LEAD	16.1
VANADIUM	4.6
ZINC	50

MW-113	
ARSENIC	3.7
CHROMIUM	39.9
LEAD	26.2

MW-113B	
LEAD	30.3
BARIUM	1110
CHROMIUM	23.2
ZINC	88.9

MW-122B	
ARSENIC	3.3
BARIUM	441
CHROMIUM	21
ZINC	37.9

MW-122	
ARSENIC	21.9
LEAD	14.2
BARIUM	807
CHROMIUM	33.8
ZINC	30.7

MW-125	
ARSENIC	7
BARIUM	112
CHROMIUM	26.8
LEAD	6.1
VANADIUM	11.9
ZINC	20.6

MW-109	
LEAD	34.9

MW-121B	
LEAD	34
ARSENIC	4.4
CHROMIUM	23.6
ZINC	37.5

MW-114	
ARSENIC	15.8
BARIUM	1104
CHROMIUM	36.5
LEAD	3.6
VANDIUM	33.8
ZINC	17.3

MW-121	
MERCURY	0.24
ARSENIC	1
CHROMIUM	42.1

MW-114B	
ARSENIC	1.8
BARIUM	210
LEAD	1.2
ZINC	28.2

MW-111	
CHROMIUM	18.6

MW-104	
CYANIDE	10.8
LEAD	51.9
BARIUM	983
CHROMIUM	110
VANADIUM	244
ZINC	45

MW-120B	
ZINC	20.2

MW-115	
ARSENIC	2.3
BARIUM	551
CHROMIUM	92.3
LEAD	17.3
VANADIUM	51.3
ZINC	64.2

MW-115B	
BARIUM	572

MW-119	
BARIUM	1030
CHROMIUM	312
LEAD	65.1
ARSENIC	13.4

MW-120	
LEAD	23.9
ARSENIC	7.4
CHROMIUM	338
VANADIUM	989
ZINC	136

MW-123	
ARSENIC	2.1
BARIUM	111
CHROMIUM	15.4
LEAD	7.2
VANDIUM	8.9
ZINC	15.1

MW-126	
CYANIDE	30.4
MERCURY	1.1
ARSENIC	63.4
LEAD	423
BARIUM	3090
CHROMIUM	1240
VANADIUM	2860
ZINC	1390

MW-119	
LEAD	134
BARIUM	314
CHROMIUM	216
ZINC	142

MW-119B	
ARSENIC	16.7
LEAD	41.4
BARIUM	313
CHROMIUM	64.1
ZINC	3220

MW-116	
BARIUM	80
CHROMIUM	13.4
VANADIUM	15.7
ZINC	15.3

MW-110	
CHROMIUM	25.4
LEAD	68.3
VANADIUM	46.3
ZINC	99

MW-116B	
ARSENIC	2.8
BARIUM	367
CHROMIUM	59.8
LEAD	39
VANADIUM	47.7
ZINC	154

MW-106	
CHROMIUM	56
CYANIDE	24.6
LEAD	9.5
MERCURY	0.2
ZINC	43.9

MW-117	
ARSENIC	21.2
BARIUM	746
CHROMIUM	60.3
ZINC	30.7

MW-118B	
ARSENIC	53.2
LEAD	252
BARIUM	1120
CHROMIUM	217
VANADIUM	120
ZINC	7110

MW-124B	
ARSENIC	2.1
ZINC	53.4

MW-107	
BARIUM	908
CHROMIUM	165
VANADIUM	109
ZINC	141

MW-117B	
BARIUM	272

MW-124	
LEAD	23.1
ARSENIC	4.5
CHROMIUM	72.7
ZINC	48.8

MW-118	
ARSENIC	7.9
CHROMIUM	39.7
LEAD	17.2
ZINC	89.2

LEGEND:

MW-103 ●	MONITORING WELLS INSTALLED 1989
MW-108 ■	MONITORING WELL DESTROYED DURING IRM
PZ-3B ▲	PIEZOMETERS INSTALLED 1992
MW-113 ◕	MONITORING WELLS INSTALLED 1992
MW-116B ◕	BEDROCK WELLS INSTALLED 1992
TB-1 ◒	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. ALL CONCENTRATIONS ARE IN ug/l

MAP SOURCE:

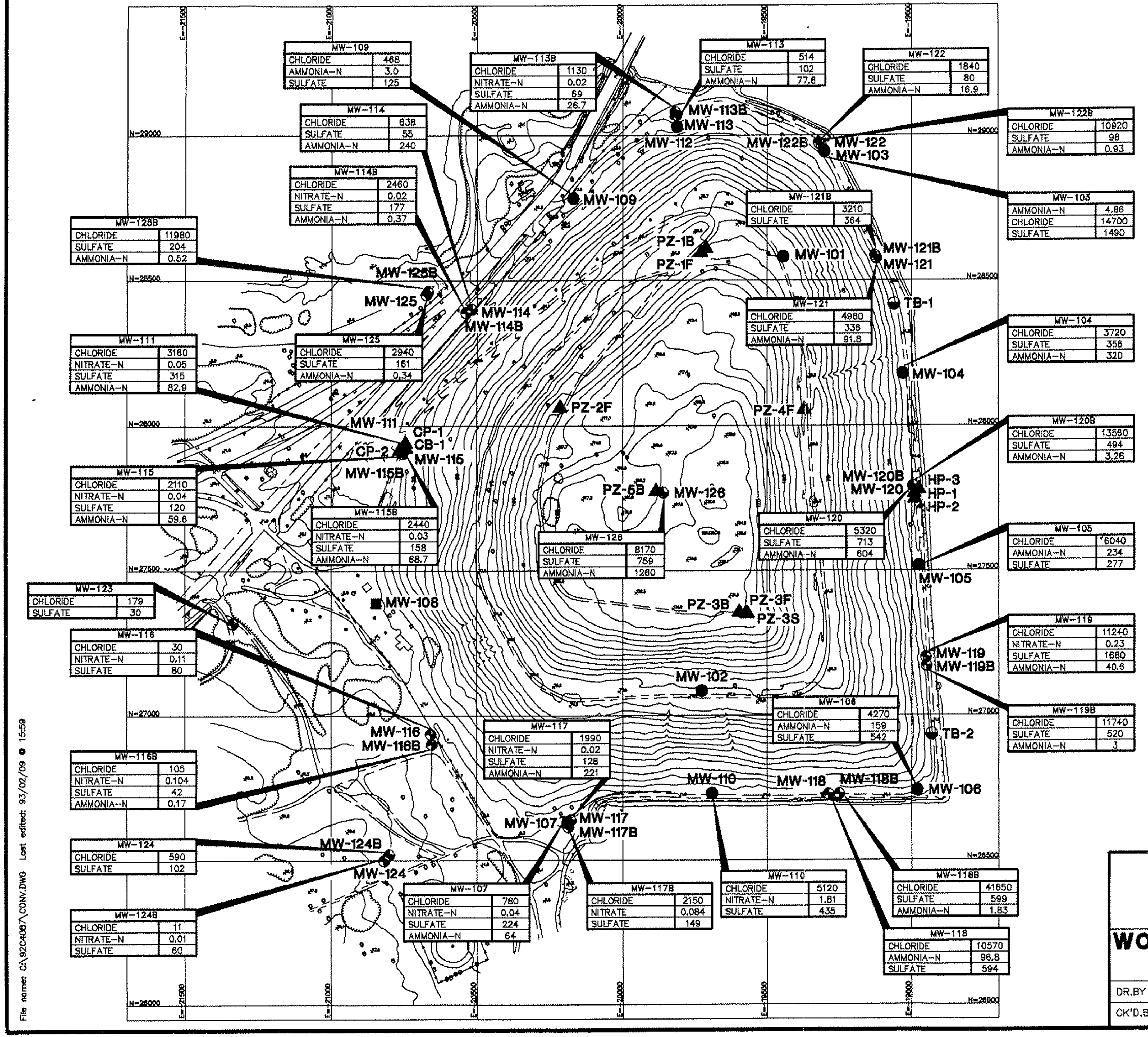
ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

MONITORING WELL SAMPLING LOCATIONS
SHOWING CONCENTRATIONS OF INORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-19

File name: C:\92C4087\G-W-INOR.DWG Last edited: 93/02/12 @ 15:37



MW-109	
CHLORIDE	468
AMMONIA-N	3.0
SULFATE	125

MW-113B	
CHLORIDE	1130
NITRATE-N	0.02
SULFATE	69
AMMONIA-N	26.7

MW-113	
CHLORIDE	514
SULFATE	102
AMMONIA-N	77.8

MW-122	
CHLORIDE	1840
SULFATE	80
AMMONIA-N	16.9

MW-122B	
CHLORIDE	10920
SULFATE	98
AMMONIA-N	0.93

MW-114	
CHLORIDE	638
SULFATE	55
AMMONIA-N	240

MW-114B	
CHLORIDE	2460
NITRATE-N	0.02
SULFATE	177
AMMONIA-N	0.37

MW-103	
AMMONIA-N	4.86
CHLORIDE	14700
SULFATE	1490

MW-121B	
CHLORIDE	3210
SULFATE	364

MW-125B	
CHLORIDE	11980
SULFATE	204
AMMONIA-N	0.52

MW-121	
CHLORIDE	4980
SULFATE	336
AMMONIA-N	91.8

MW-104	
CHLORIDE	3720
SULFATE	356
AMMONIA-N	320

MW-111	
CHLORIDE	3180
NITRATE-N	0.05
SULFATE	315
AMMONIA-N	82.9

MW-125	
CHLORIDE	2940
SULFATE	161
AMMONIA-N	0.34

MW-120B	
CHLORIDE	13560
SULFATE	494
AMMONIA-N	3.28

MW-115	
CHLORIDE	2110
NITRATE-N	0.04
SULFATE	120
AMMONIA-N	59.6

MW-115B	
CHLORIDE	2440
NITRATE-N	0.03
SULFATE	158
AMMONIA-N	68.7

MW-126	
CHLORIDE	8170
SULFATE	759
AMMONIA-N	1260

MW-120	
CHLORIDE	5320
SULFATE	713
AMMONIA-N	604

MW-105	
CHLORIDE	6040
AMMONIA-N	234
SULFATE	277

MW-123	
CHLORIDE	179
SULFATE	30

MW-116	
CHLORIDE	30
NITRATE-N	0.11
SULFATE	80

MW-119	
CHLORIDE	11240
NITRATE-N	0.23
SULFATE	1680
AMMONIA-N	40.6

MW-106	
CHLORIDE	4270
AMMONIA-N	159
SULFATE	542

MW-119B	
CHLORIDE	11740
SULFATE	520
AMMONIA-N	3

MW-117	
CHLORIDE	1990
NITRATE-N	0.02
SULFATE	128
AMMONIA-N	221

MW-116B	
CHLORIDE	105
NITRATE-N	0.104
SULFATE	42
AMMONIA-N	0.17

MW-124	
CHLORIDE	590
SULFATE	102

MW-124B	
CHLORIDE	11
NITRATE-N	0.01
SULFATE	60

MW-107	
CHLORIDE	780
NITRATE-N	0.04
SULFATE	224
AMMONIA-N	64

MW-117B	
CHLORIDE	2150
NITRATE	0.084
SULFATE	149

MW-110	
CHLORIDE	5120
NITRATE-N	1.81
SULFATE	435

MW-118B	
CHLORIDE	41650
SULFATE	599
AMMONIA-N	1.83

MW-118	
CHLORIDE	10570
AMMONIA-N	96.8
SULFATE	594

N

LEGEND:

MW-103	●	MONITORING WELLS INSTALLED 1989
MW-108	■	MONITORING WELL DESTROYED DURING IRM
PZ-3B	▲	PIEZOMETERS INSTALLED 1992
MW-113	⊕	MONITORING WELLS INSTALLED 1992
MW-116B	⊕	BEDROCK WELLS INSTALLED 1992
TB-1	◓	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. ALL CONCENTRATIONS ARE IN mg/l

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

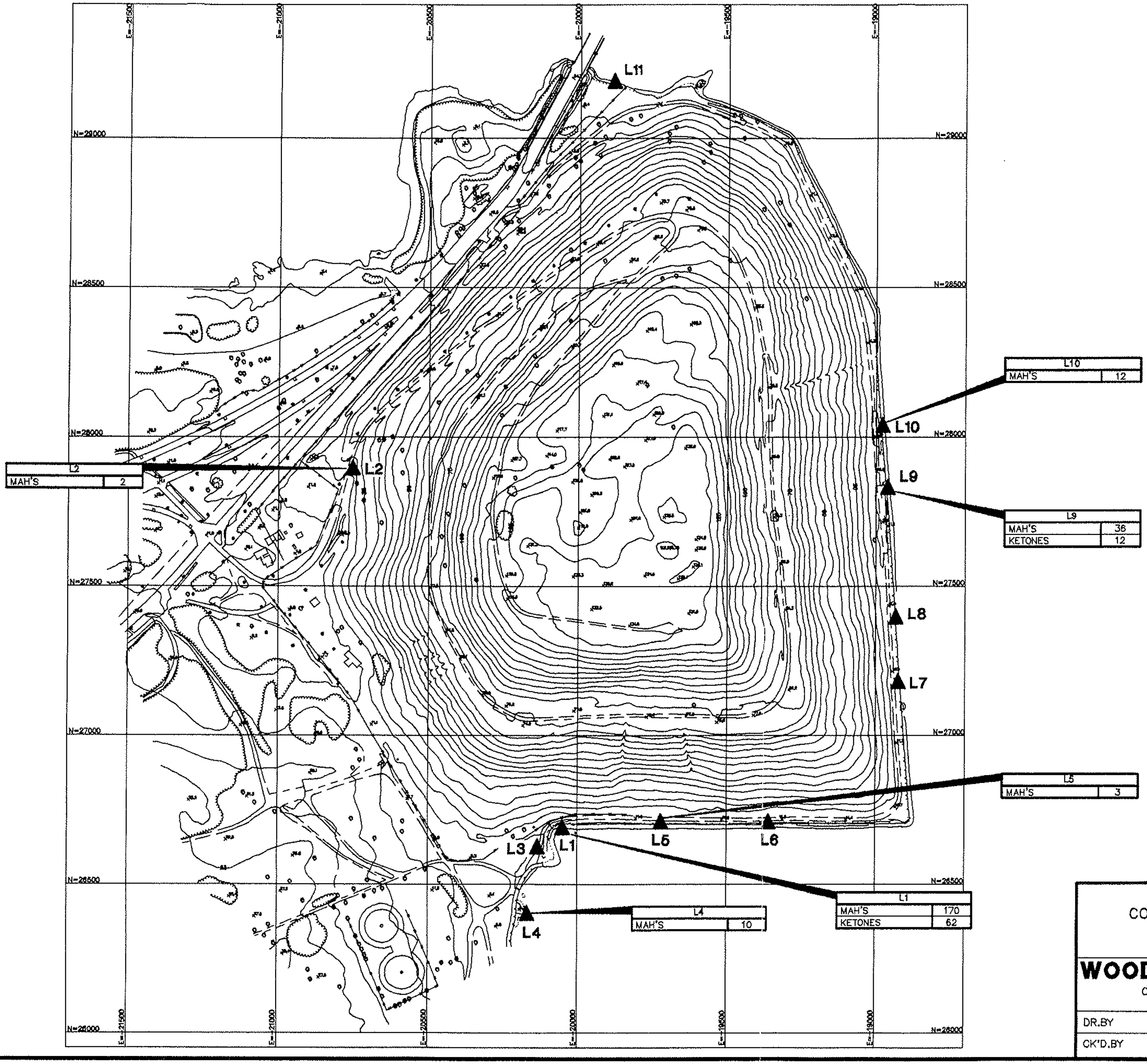
SCALE

MONITORING WELL SAMPLING LOCATIONS
SHOWING CONVENTIONAL PARAMETER CONCENTRATIONS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-20

File name: C:\92C4087\CONV.DWG Last edited: 93/02/09 @ 15:59



LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. CONCENTRATION IN ug/l

MAH'S – MONOCYCLIC AROMATIC HYDROCARBONS

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

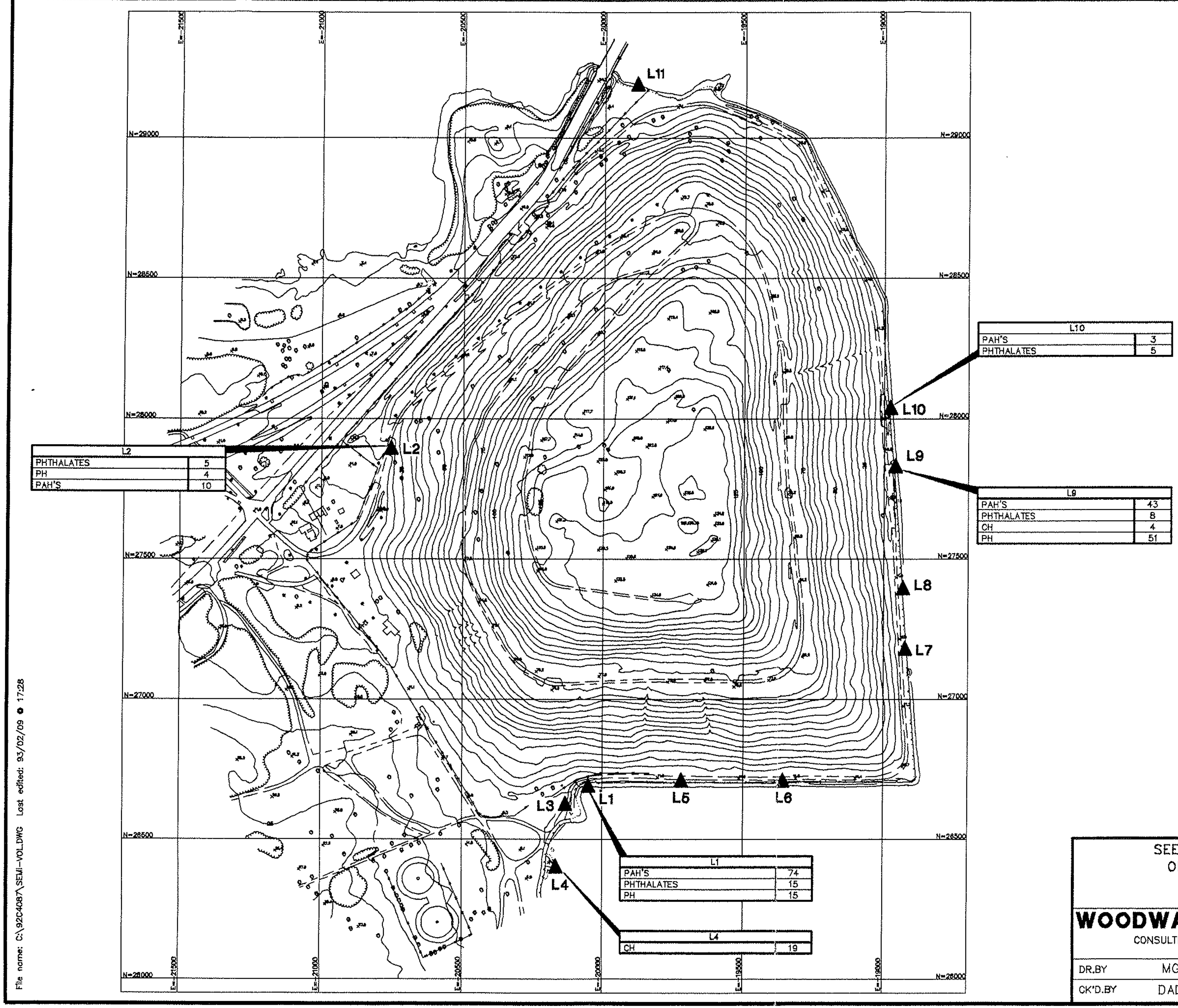
SEEP LOCATIONS SHOWING
CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-21

File name: C:\92C4087\VOLA-ORG.DWG Last edited: 93/02/09 @ 17:34



L10	
PAH'S	3
PHTHALATES	5

L2	
PHTHALATES	5
PH	4
PAH'S	10

L9	
PAH'S	43
PHTHALATES	8
CH	4
PH	51

L1	
PAH'S	74
PHTHALATES	15
PH	15

L4	
CH	19

LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. CONCENTRATIONS IN ug/l

PAH'S – POLYNUCLEAR AROMATIC HYDROCARBONS
CH – CHLORINATED HYDROCARBONS
PH – PHENOLIC COMPOUNDS

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

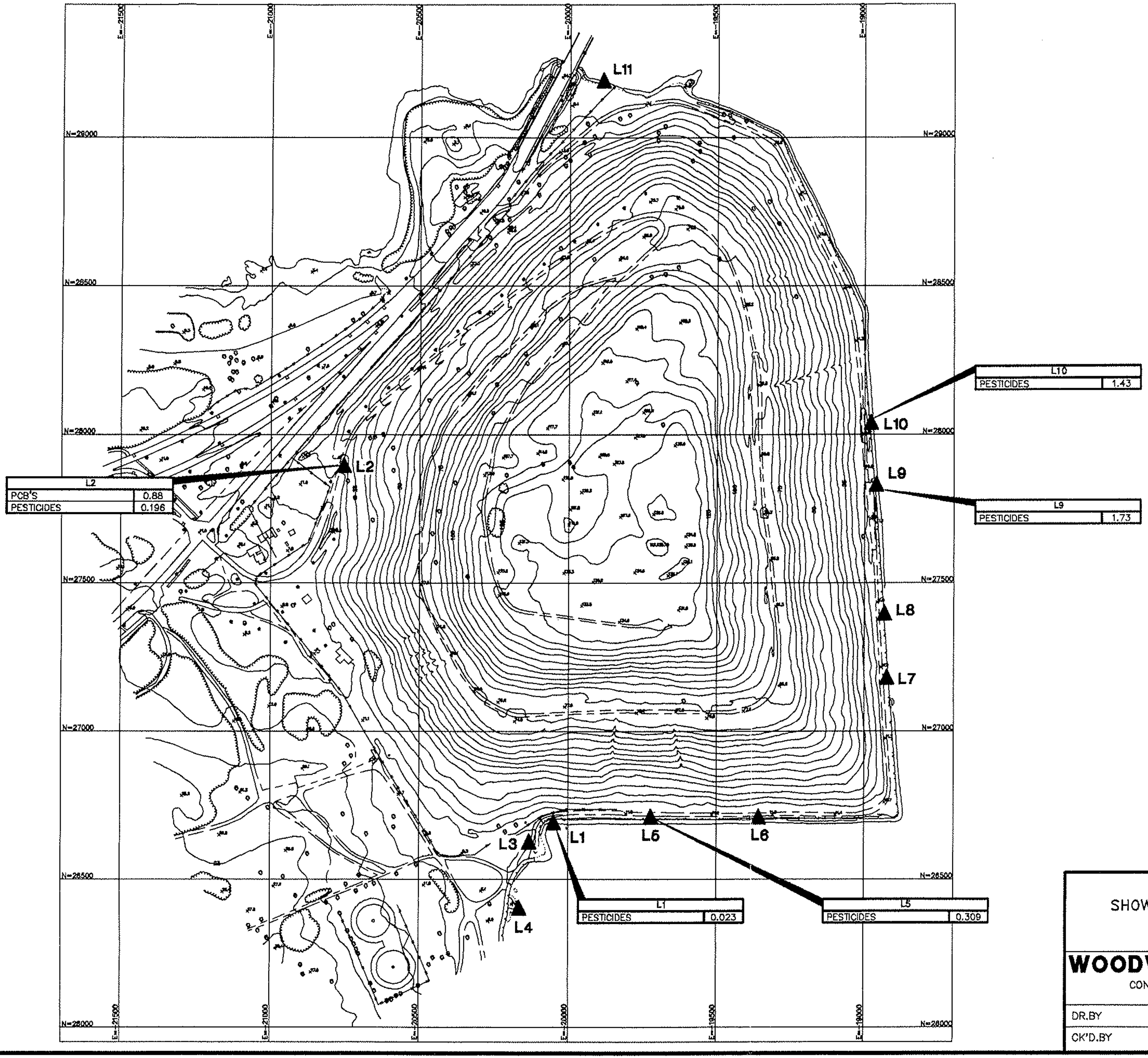
0 350 700 FT
SCALE

SEEP LOCATIONS SHOWING CONCENTRATIONS
OF SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-22

File name: C:\92C4087\SEMI-VOL.DWG Last edited: 93/02/09 @ 17:28



L2	
PCB'S	0.88
PESTICIDES	0.196

L10	
PESTICIDES	1.43

L9	
PESTICIDES	1.73

L1	
PESTICIDES	0.023

L5	
PESTICIDES	0.309

LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. CONCENTRATIONS IN ug/l

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

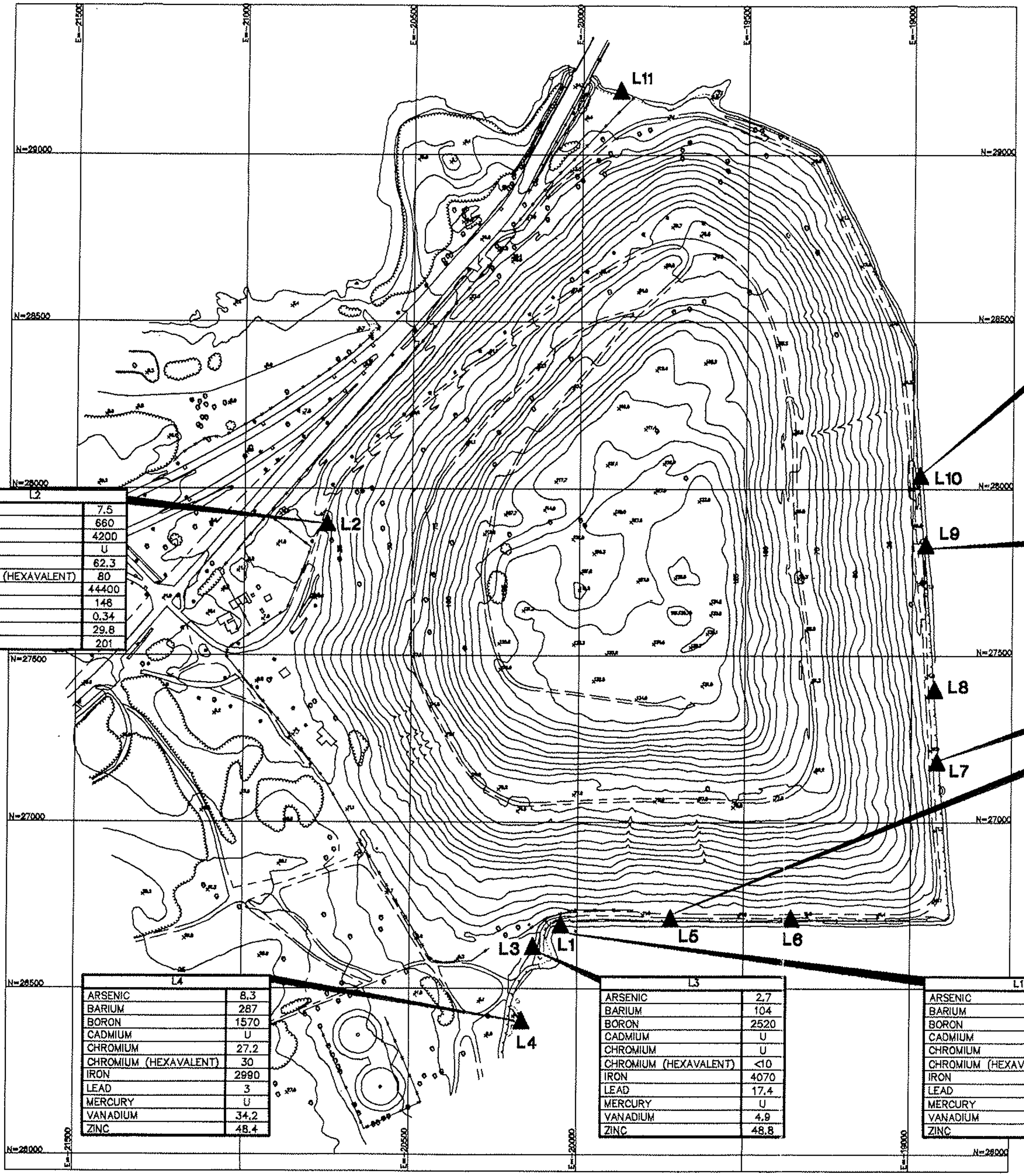
SCALE

SEEP LOCATIONS
SHOWING CONCENTRATIONS OF PESTICIDES AND PCBs
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV 23 1992	FIG.NO.	4-23

File name: C:\92C4087\PESTICID.DWG Last edited: 93/02/16 @ 09:17



L2	
ARSENIC	7.5
BARIUM	660
BORON	4200
CADMIUM	U
CHROMIUM	62.3
CHROMIUM (HEXAVALENT)	80
IRON	44400
LEAD	146
MERCURY	0.34
VANADIUM	29.8
ZINC	201

L10	
ARSENIC	14.5
BARIUM	844
BORON	6800
CADMIUM	U
CHROMIUM	180
CHROMIUM (HEXAVALENT)	210
IRON	24900
LEAD	88.7
MERCURY	U
VANADIUM	397
ZINC	177

L9	
ARSENIC	18.7
BARIUM	590
BORON	6910
CADMIUM	U
CHROMIUM	293
CHROMIUM (HEXAVALENT)	560
IRON	12500
LEAD	58.5
MERCURY	U
VANADIUM	822
ZINC	136

L7	
ARSENIC	U
BARIUM	123
BORON	2820
CADMIUM	U
CHROMIUM	26
CHROMIUM (HEXAVALENT)	20
IRON	2970
LEAD	7
MERCURY	5
VANADIUM	46
ZINC	28.1

L5	
ARSENIC	89.1
BARIUM	1490
BORON	4680
CADMIUM	U
CHROMIUM	390
CHROMIUM (HEXAVALENT)	20
IRON	136000
LEAD	707
MERCURY	2
VANADIUM	368
ZINC	1330

L4	
ARSENIC	8.3
BARIUM	287
BORON	1570
CADMIUM	U
CHROMIUM	27.2
CHROMIUM (HEXAVALENT)	30
IRON	2990
LEAD	3
MERCURY	U
VANADIUM	34.2
ZINC	48.4

L3	
ARSENIC	2.7
BARIUM	104
BORON	2520
CADMIUM	U
CHROMIUM	U
CHROMIUM (HEXAVALENT)	<10
IRON	4070
LEAD	17.4
MERCURY	U
VANADIUM	4.9
ZINC	48.8

L1	
ARSENIC	40.3
BARIUM	1060
BORON	8900
CADMIUM	U
CHROMIUM	289
CHROMIUM (HEXAVALENT)	400
IRON	9760
LEAD	104
MERCURY	U
VANADIUM	562
ZINC	226

N

LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. CONCENTRATIONS IN ug/l
5. U=NOT DETECTED

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

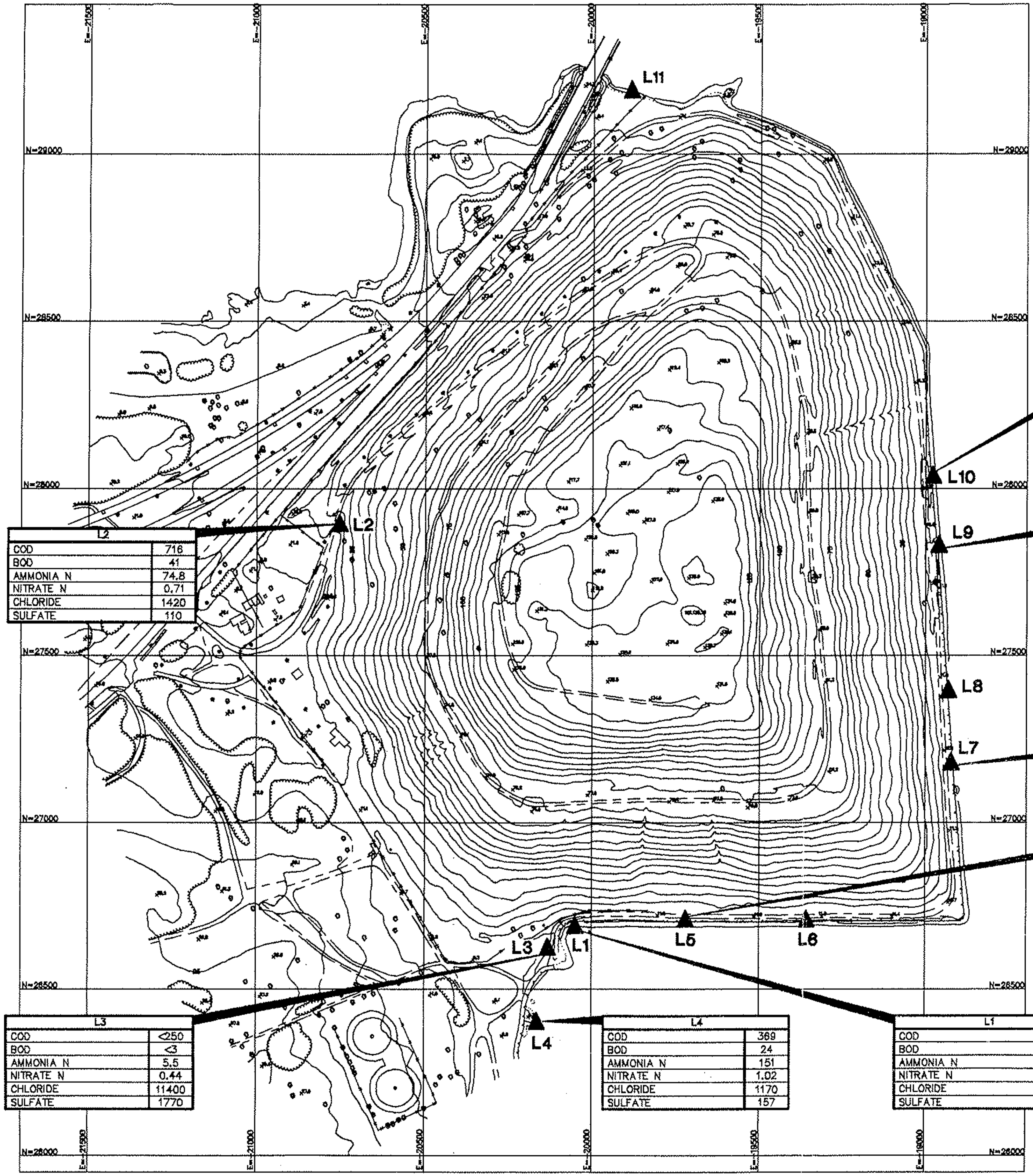
SCALE

SEEP LOCATIONS
SHOWING CONCENTRATIONS OF INORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-24

File name: C:\92C4087\INORGAN.DWG Last edited: 93/02/18 @ 09:29



L10	
COD	1230
BOD	107
AMMONIA N	85.1
NITRATE N	0.35
CHLORIDE	11340
SULFATE	355

L2	
COD	716
BOD	41
AMMONIA N	74.8
NITRATE N	0.71
CHLORIDE	1420
SULFATE	110

L9	
COD	<500
BOD	157
AMMONIA N	404
NITRATE N	0.35
CHLORIDE	6830
SULFATE	599

L7	
COD	295
BOD	7
AMMONIA N	44.2
NITRATE N	0.24
CHLORIDE	11680
SULFATE	1690

L5	
COD	2040
BOD	277
AMMONIA N	373
NITRATE N	0.42
CHLORIDE	3380
SULFATE	1680

L3	
COD	<250
BOD	<3
AMMONIA N	5.5
NITRATE N	0.44
CHLORIDE	11400
SULFATE	1770

L4	
COD	369
BOD	24
AMMONIA N	151
NITRATE N	1.02
CHLORIDE	1170
SULFATE	157

L1	
COD	<500
BOD	190
AMMONIA N	637
NITRATE N	0.06
CHLORIDE	3740
SULFATE	379

LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. CONCENTRATIONS IN mg/l.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

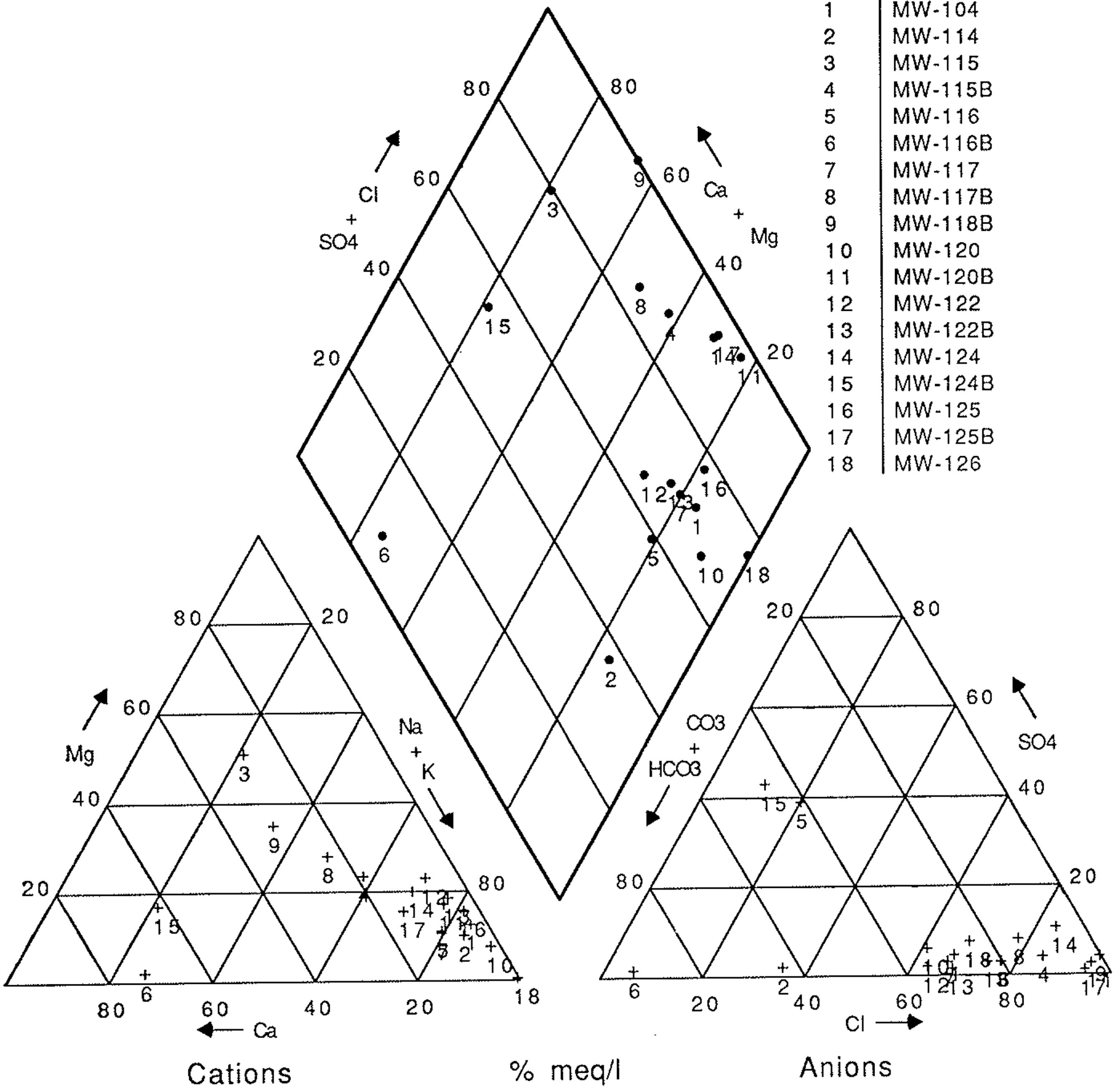
SCALE

SEEP LOCATIONS SHOWING
CONVENTIONAL PARAMETER CONCENTRATIONS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-25

File name: C:\92C4087\CONVENT.DWG Last edited: 93/02/18 @ 09:23



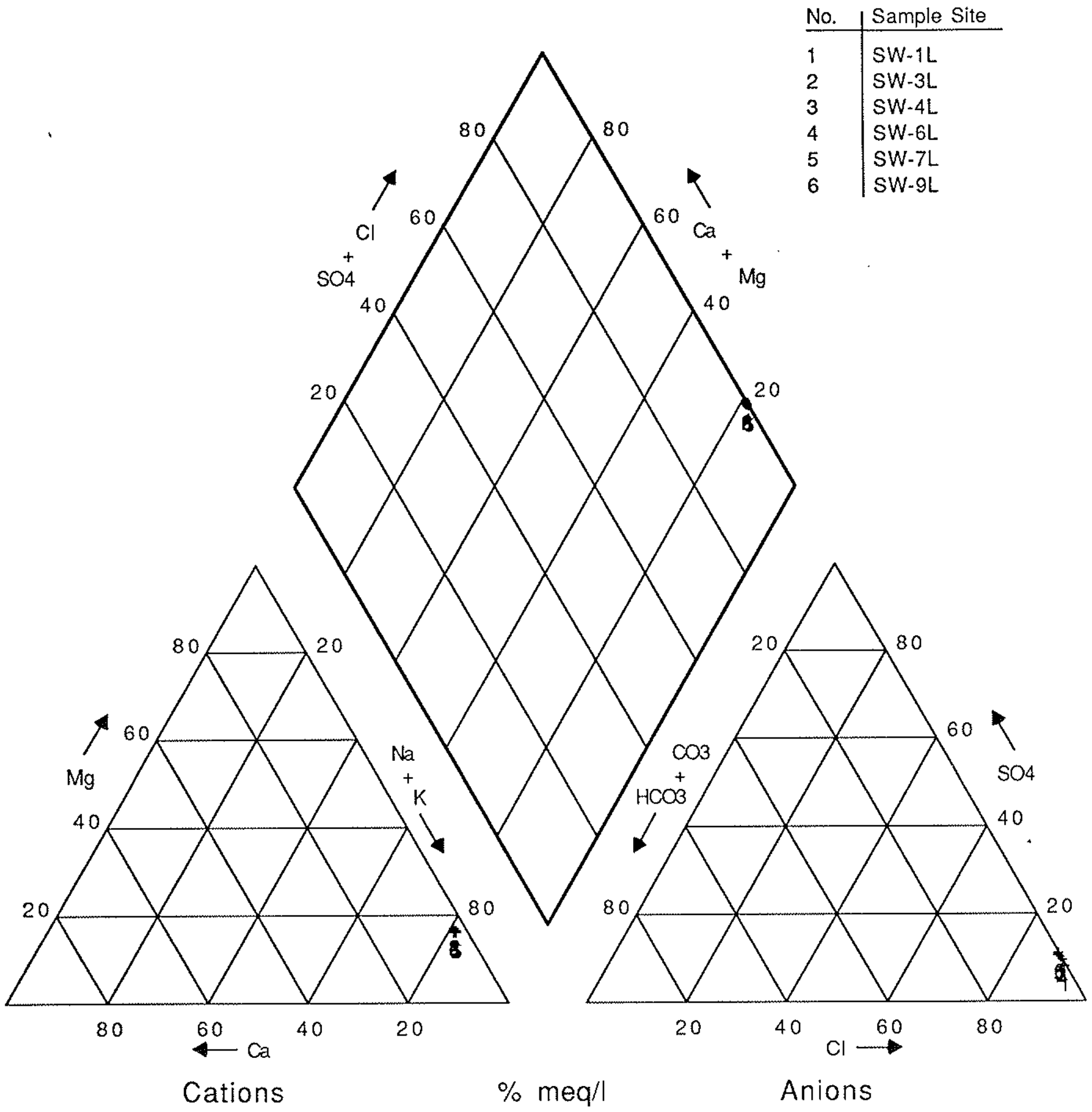
No.	Sample Site
1	MW-104
2	MW-114
3	MW-115
4	MW-115B
5	MW-116
6	MW-116B
7	MW-117
8	MW-117B
9	MW-118B
10	MW-120
11	MW-120B
12	MW-122
13	MW-122B
14	MW-124
15	MW-124B
16	MW-125
17	MW-125B
18	MW-126

**TRILINEAR DIAGRAM FOR MONITORING WELL SAMPLES
PELHAM BAY LANDFILL
BRONX, NEW YORK**

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	TMR	DATE:	JAN. 4, 1993	FIG. NO.:	4–26



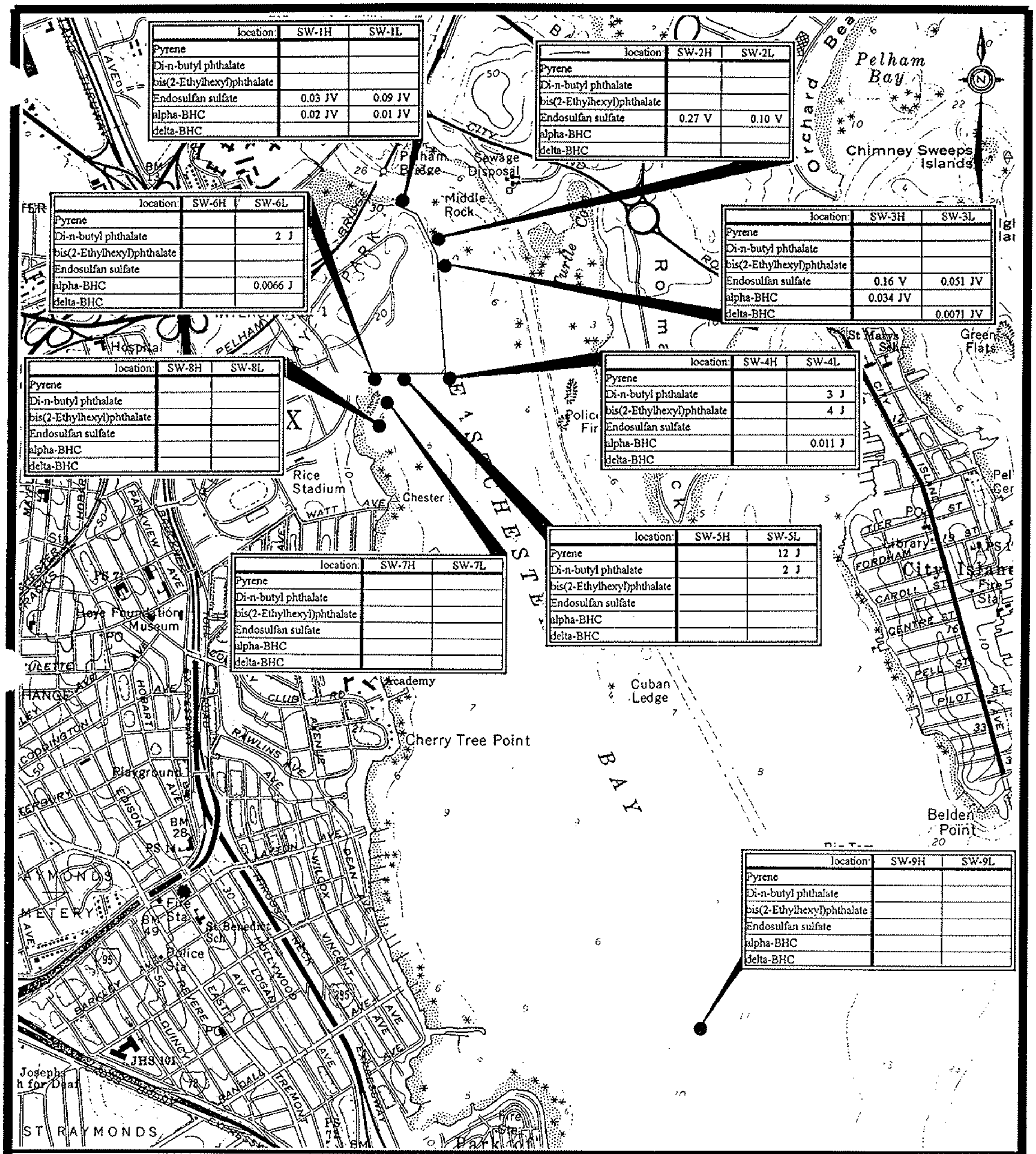
No.	Sample Site
1	SW-1L
2	SW-3L
3	SW-4L
4	SW-6L
5	SW-7L
6	SW-9L

TRILINEAR DIAGRAM FOR SURFACE WATER SAMPLES
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	TMR	DATE:	JAN. 4, 1993	FIG. NO.:	4 – 28



location:	SW-1H	SW-1L
Pyrene		
Di-n-butyl phthalate		
bis(2-Ethylhexyl)phthalate		
Endosulfan sulfate	0.03 JV	0.09 JV
alpha-BHC	0.02 JV	0.01 JV
delta-BHC		

location:	SW-2H	SW-2L
Pyrene		
Di-n-butyl phthalate		
bis(2-Ethylhexyl)phthalate		
Endosulfan sulfate	0.27 V	0.10 V
alpha-BHC		
delta-BHC		

location:	SW-6H	SW-6L
Pyrene		
Di-n-butyl phthalate		2 J
bis(2-Ethylhexyl)phthalate		
Endosulfan sulfate		
alpha-BHC		0.0066 J
delta-BHC		

location:	SW-3H	SW-3L
Pyrene		
Di-n-butyl phthalate		
bis(2-Ethylhexyl)phthalate		
Endosulfan sulfate	0.16 V	0.051 JV
alpha-BHC	0.034 JV	
delta-BHC		0.0071 JV

location:	SW-8H	SW-8L
Pyrene		
Di-n-butyl phthalate		
bis(2-Ethylhexyl)phthalate		
Endosulfan sulfate		
alpha-BHC		
delta-BHC		

location:	SW-4H	SW-4L
Pyrene		
Di-n-butyl phthalate		3 J
bis(2-Ethylhexyl)phthalate		4 J
Endosulfan sulfate		
alpha-BHC		0.011 J
delta-BHC		

location:	SW-5H	SW-5L
Pyrene		12 J
Di-n-butyl phthalate		2 J
bis(2-Ethylhexyl)phthalate		
Endosulfan sulfate		
alpha-BHC		
delta-BHC		

location:	SW-7H	SW-7L
Pyrene		
Di-n-butyl phthalate		
bis(2-Ethylhexyl)phthalate		
Endosulfan sulfate		
alpha-BHC		
delta-BHC		

location:	SW-9H	SW-9L
Pyrene		
Di-n-butyl phthalate		
bis(2-Ethylhexyl)phthalate		
Endosulfan sulfate		
alpha-BHC		
delta-BHC		

0 1000 2000 FT
SCALE

LEGEND:

● SURFACE WATER SAMPLING LOCATION
ALL CONCENTRATIONS IN ug/L

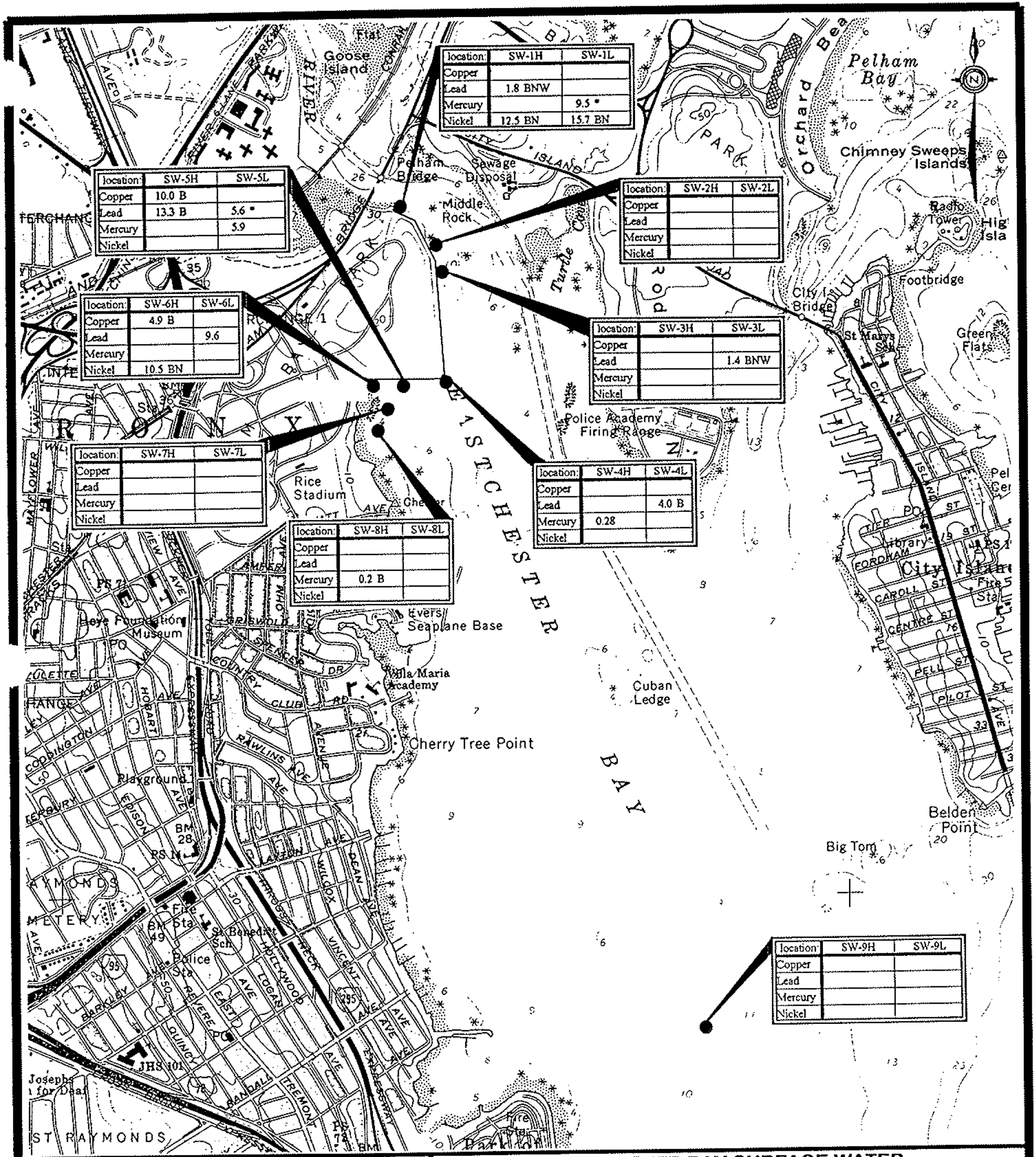
MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

EASTCHESTER BAY SURFACE WATER ORGANIC CHEMICALS DATA SUMMARY
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	RTG	DATE:	JAN. 28, 1993	FIG. NO.:	4–29



location:	SW-1H	SW-1L
Copper		
Lead	1.8 BNW	
Mercury		9.5 *
Nickel	12.5 BN	15.7 BN

location:	SW-2H	SW-2L
Copper		
Lead		
Mercury		
Nickel		

location:	SW-3H	SW-3L
Copper		
Lead		1.4 BNW
Mercury		
Nickel		

location:	SW-4H	SW-4L
Copper		
Lead		4.0 B
Mercury	0.28	
Nickel		

location:	SW-5H	SW-5L
Copper	10.0 B	
Lead	13.3 B	5.6 *
Mercury		5.9
Nickel		

location:	SW-6H	SW-6L
Copper	4.9 B	
Lead		9.6
Mercury		
Nickel	10.5 BN	

location:	SW-7H	SW-7L
Copper		
Lead		
Mercury		
Nickel		

location:	SW-8H	SW-8L
Copper		
Lead		
Mercury	0.2 B	
Nickel		

location:	SW-9H	SW-9L
Copper		
Lead		
Mercury		
Nickel		

0 1000 2000 FT
SCALE

LEGEND:

● SURFACE WATER SAMPLING LOCATION
ALL CONCENTRATIONS IN mg/L

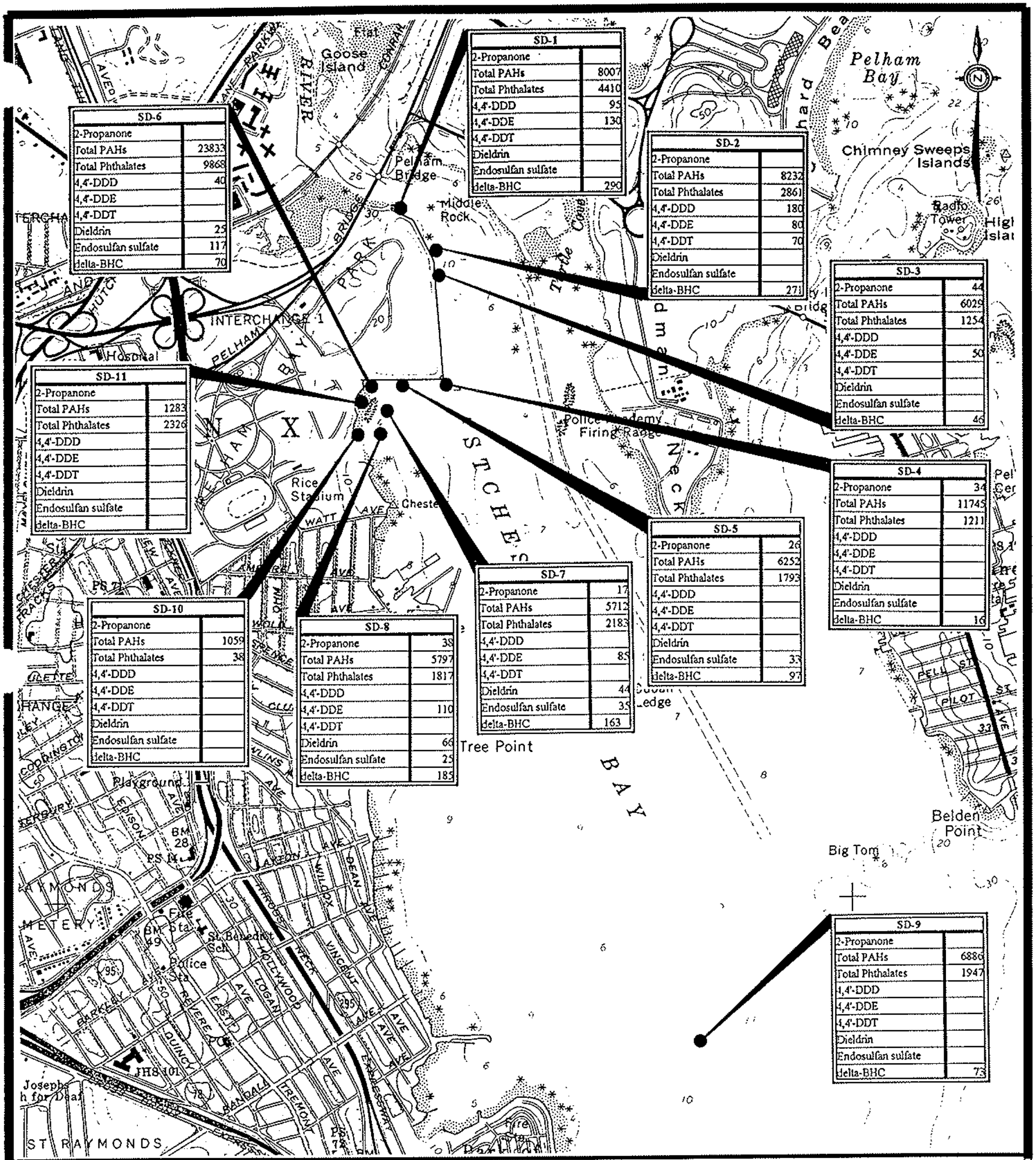
MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

EASTCHESTER BAY SURFACE WATER SELECTED METALS DATA SUMMARY PELHAM BAY LANDFILL BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: KJF	SCALE: AS SHOWN	PROJ. NO.: 92C4087	
CK'D BY: RTG	DATE: JAN. 28, 1993	FIG. NO.: 4–30	



SD-1	
2-Propanone	
Total PAHs	8007
Total Phthalates	4410
4,4'-DDD	95
4,4'-DDE	130
4,4'-DDT	
Dieldrin	
Endosulfan sulfate	
delta-BHC	290

SD-2	
2-Propanone	
Total PAHs	8232
Total Phthalates	2861
4,4'-DDD	180
4,4'-DDE	80
4,4'-DDT	70
Dieldrin	
Endosulfan sulfate	
delta-BHC	271

SD-3	
2-Propanone	44
Total PAHs	6029
Total Phthalates	1254
4,4'-DDD	
4,4'-DDE	50
4,4'-DDT	
Dieldrin	
Endosulfan sulfate	
delta-BHC	46

SD-4	
2-Propanone	34
Total PAHs	11745
Total Phthalates	1211
4,4'-DDD	
4,4'-DDE	
4,4'-DDT	
Dieldrin	
Endosulfan sulfate	
delta-BHC	16

SD-5	
2-Propanone	26
Total PAHs	6252
Total Phthalates	1793
4,4'-DDD	
4,4'-DDE	
4,4'-DDT	
Dieldrin	
Endosulfan sulfate	33
delta-BHC	97

SD-6	
2-Propanone	
Total PAHs	23833
Total Phthalates	9868
4,4'-DDD	40
4,4'-DDE	
4,4'-DDT	
Dieldrin	25
Endosulfan sulfate	117
delta-BHC	70

SD-7	
2-Propanone	17
Total PAHs	5712
Total Phthalates	2183
4,4'-DDD	
4,4'-DDE	85
4,4'-DDT	
Dieldrin	44
Endosulfan sulfate	35
delta-BHC	163

SD-8	
2-Propanone	38
Total PAHs	5797
Total Phthalates	1817
4,4'-DDD	
4,4'-DDE	110
4,4'-DDT	
Dieldrin	66
Endosulfan sulfate	25
delta-BHC	185

SD-9	
2-Propanone	
Total PAHs	6886
Total Phthalates	1947
4,4'-DDD	
4,4'-DDE	
4,4'-DDT	
Dieldrin	
Endosulfan sulfate	
delta-BHC	73

SD-10	
2-Propanone	
Total PAHs	1059
Total Phthalates	38
4,4'-DDD	
4,4'-DDE	
4,4'-DDT	
Dieldrin	
Endosulfan sulfate	
delta-BHC	

SD-11	
2-Propanone	
Total PAHs	1283
Total Phthalates	2326
4,4'-DDD	
4,4'-DDE	
4,4'-DDT	
Dieldrin	
Endosulfan sulfate	
delta-BHC	

0 1000 2000 FT
SCALE

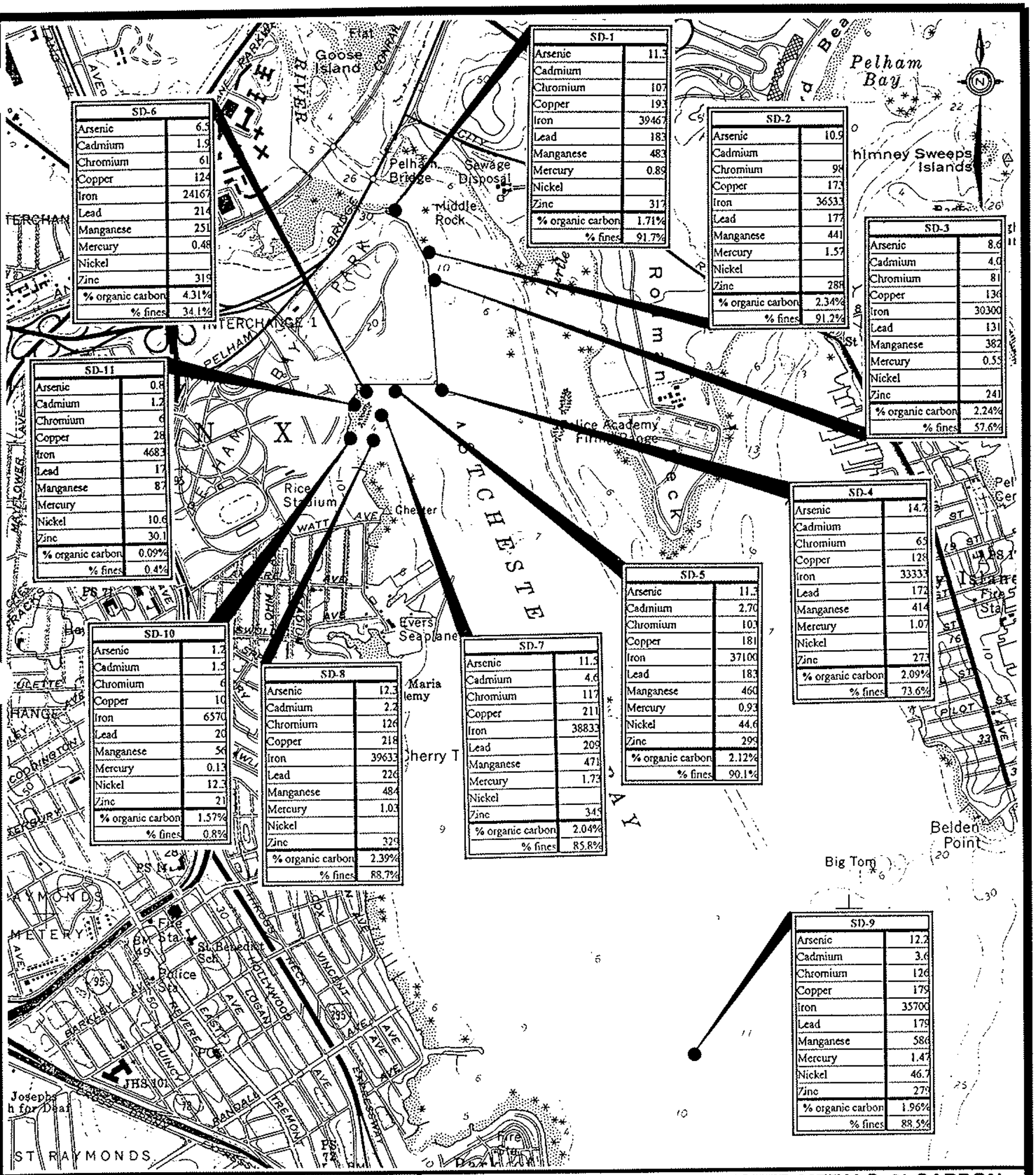
EGEND:
● SEDIMENT SAMPLING LOCATION
ALL CONCENTRATIONS IN ug/kg
DRY WEIGHT

MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

SURFACE SEDIMENTS
ORGANIC CHEMICALS DATA SUMMARY
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	RTG	DATE:	JAN. 28, 1993	FIG. NO.:	4–31



SD-1	
Arsenic	11.3
Cadmium	
Chromium	107
Copper	193
Iron	39467
Lead	183
Manganese	483
Mercury	0.89
Nickel	
Zinc	317
% organic carbon	1.71%
% fines	91.7%

SD-2	
Arsenic	10.9
Cadmium	
Chromium	98
Copper	173
Iron	36533
Lead	177
Manganese	441
Mercury	1.57
Nickel	
Zinc	288
% organic carbon	2.34%
% fines	91.2%

SD-3	
Arsenic	8.6
Cadmium	4.0
Chromium	81
Copper	136
Iron	30300
Lead	131
Manganese	382
Mercury	0.55
Nickel	
Zinc	241
% organic carbon	2.24%
% fines	57.6%

SD-4	
Arsenic	14.7
Cadmium	
Chromium	65
Copper	128
Iron	33333
Lead	172
Manganese	414
Mercury	1.07
Nickel	
Zinc	273
% organic carbon	2.09%
% fines	73.6%

SD-5	
Arsenic	11.3
Cadmium	2.70
Chromium	103
Copper	181
Iron	37100
Lead	183
Manganese	460
Mercury	0.93
Nickel	44.6
Zinc	299
% organic carbon	2.12%
% fines	90.1%

SD-6	
Arsenic	6.5
Cadmium	1.9
Chromium	61
Copper	124
Iron	24167
Lead	214
Manganese	251
Mercury	0.48
Nickel	
Zinc	319
% organic carbon	4.31%
% fines	34.1%

SD-7	
Arsenic	11.5
Cadmium	4.6
Chromium	117
Copper	211
Iron	38833
Lead	209
Manganese	471
Mercury	1.73
Nickel	
Zinc	345
% organic carbon	2.04%
% fines	85.8%

SD-8	
Arsenic	12.3
Cadmium	2.2
Chromium	126
Copper	218
Iron	39633
Lead	226
Manganese	484
Mercury	1.03
Nickel	
Zinc	329
% organic carbon	2.39%
% fines	88.7%

SD-9	
Arsenic	12.2
Cadmium	3.6
Chromium	126
Copper	179
Iron	35700
Lead	179
Manganese	586
Mercury	1.47
Nickel	46.7
Zinc	279
% organic carbon	1.96%
% fines	88.5%

SD-10	
Arsenic	1.2
Cadmium	1.5
Chromium	6
Copper	10
Iron	6570
Lead	20
Manganese	56
Mercury	0.13
Nickel	12.3
Zinc	21
% organic carbon	1.57%
% fines	0.8%

SD-11	
Arsenic	0.8
Cadmium	1.2
Chromium	6
Copper	28
Iron	4683
Lead	17
Manganese	87
Mercury	
Nickel	10.6
Zinc	30.1
% organic carbon	0.09%
% fines	0.4%

0 1000 2000 FT
SCALE

LEGEND:

● SEDIMENT SAMPLING LOCATION
ALL CONCENTRATIONS IN mg/kg
DRY WEIGHT

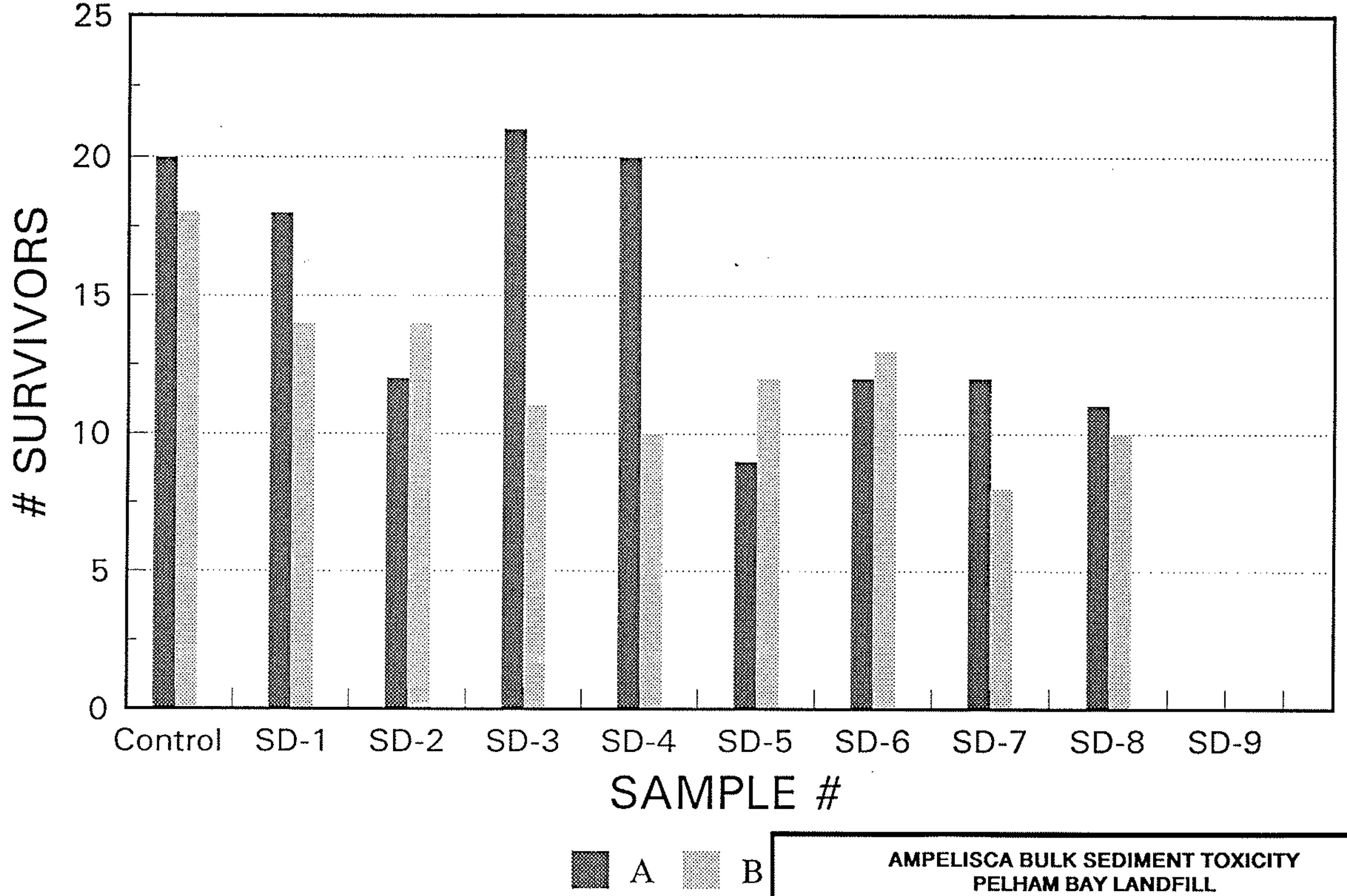
MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

SURFACE SEDIMENTS – SELECTED METALS, % CARBON, AND % FINES DATA SUMMARY
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	RTG	DATE:	JAN. 28, 1993	FIG. NO.:	4–32

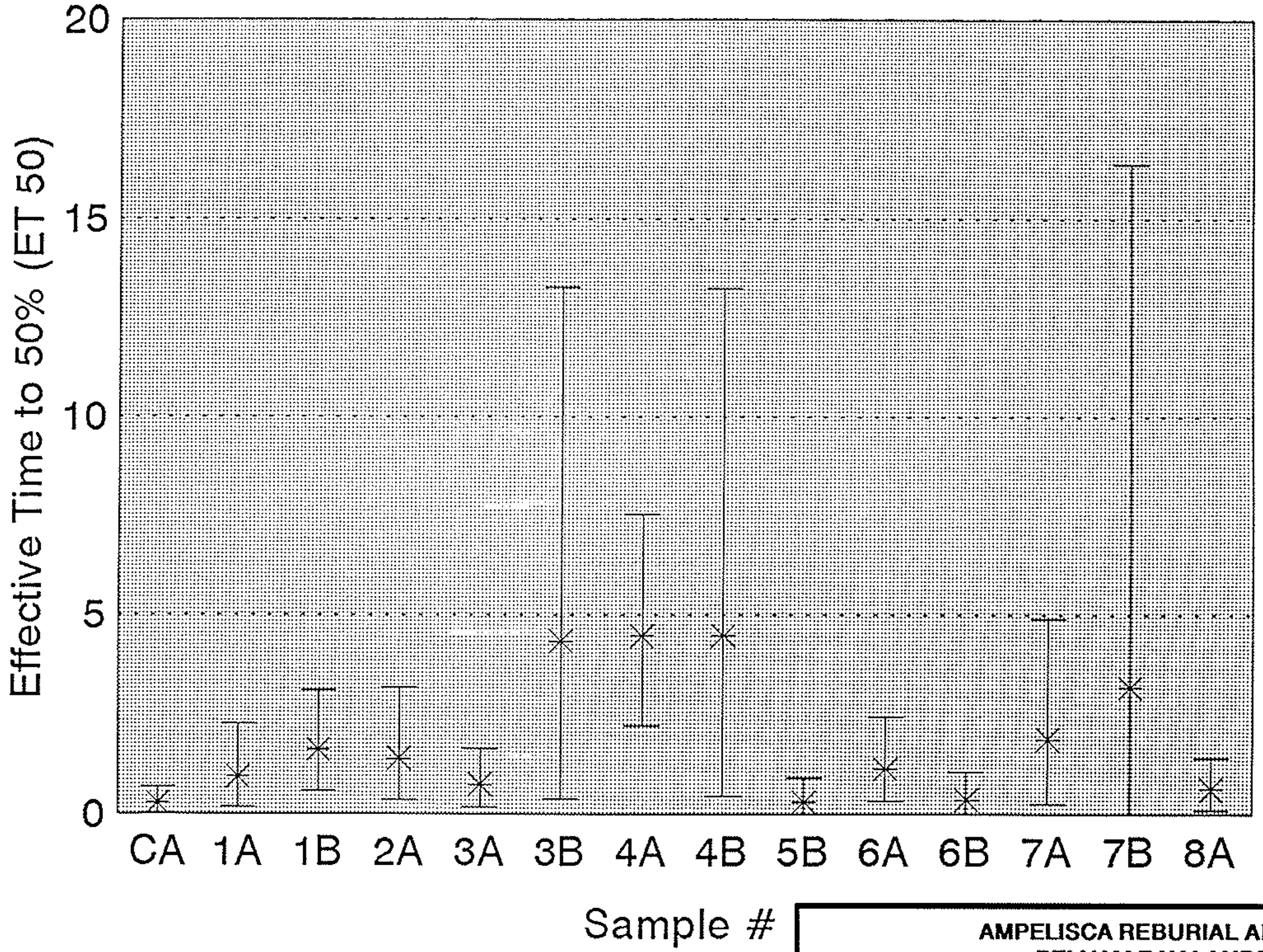


AMPELISCA BULK SEDIMENT TOXICITY
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

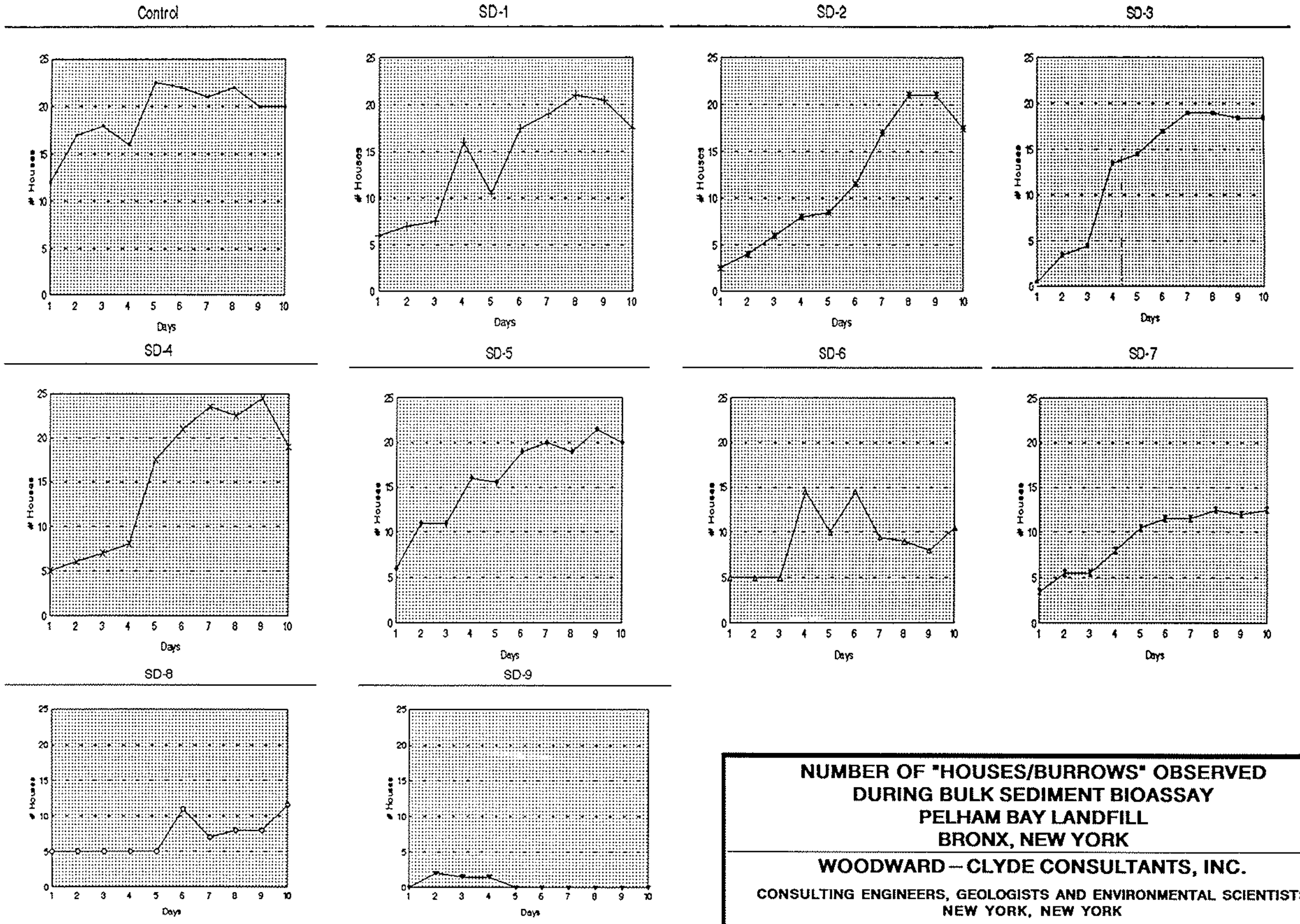
DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	SMM	DATE:	FEB. 16, 1993	2FIG. NO.:	4–33



AMPELISCA REBURIAL ANALYSIS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	SMM	DATE:	FEB. 16, 1993	2FIG. NO.:	4–34

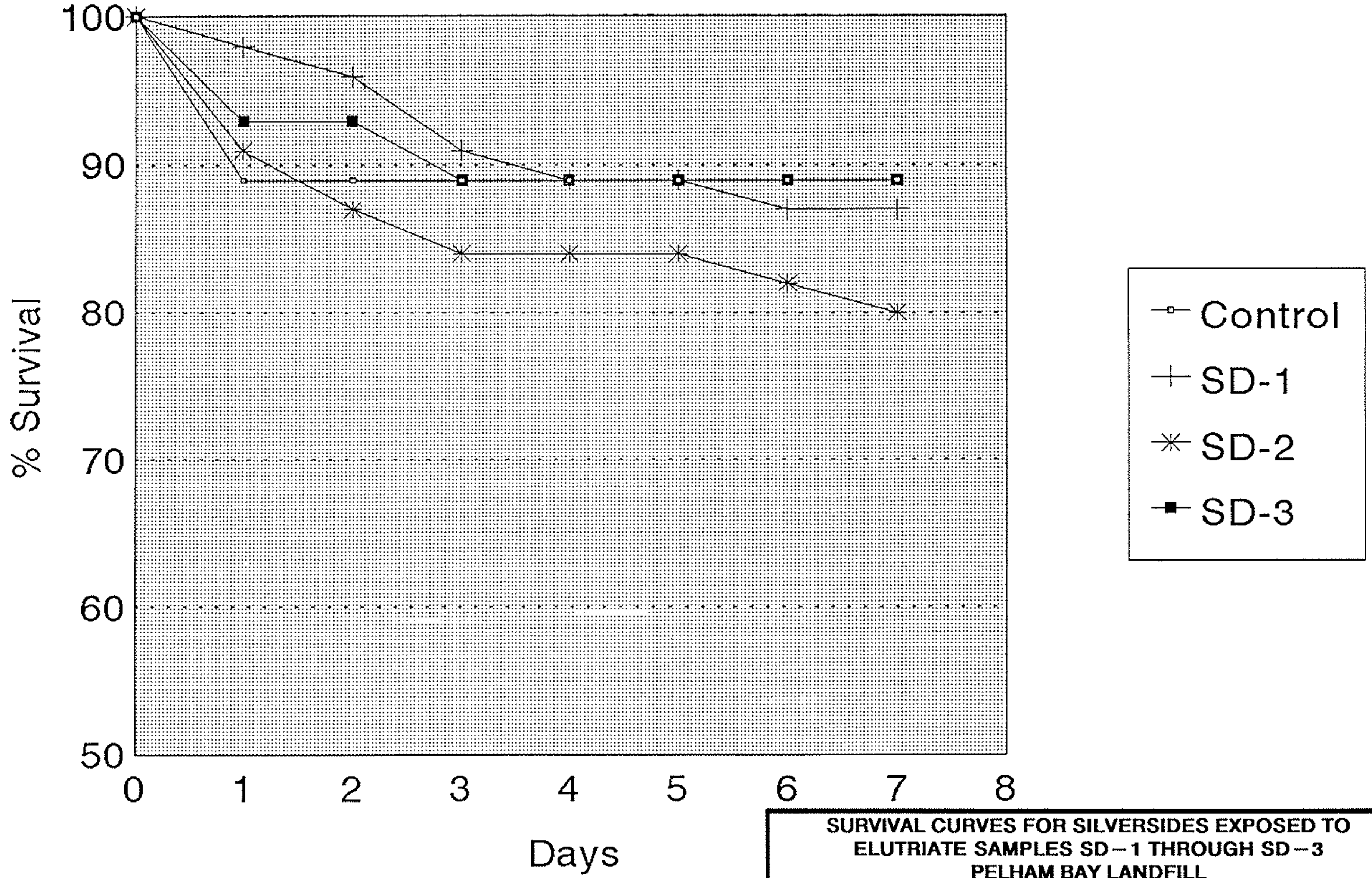


NUMBER OF "HOUSES/BURROWS" OBSERVED DURING BULK SEDIMENT BIOASSAY PELHAM BAY LANDFILL BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

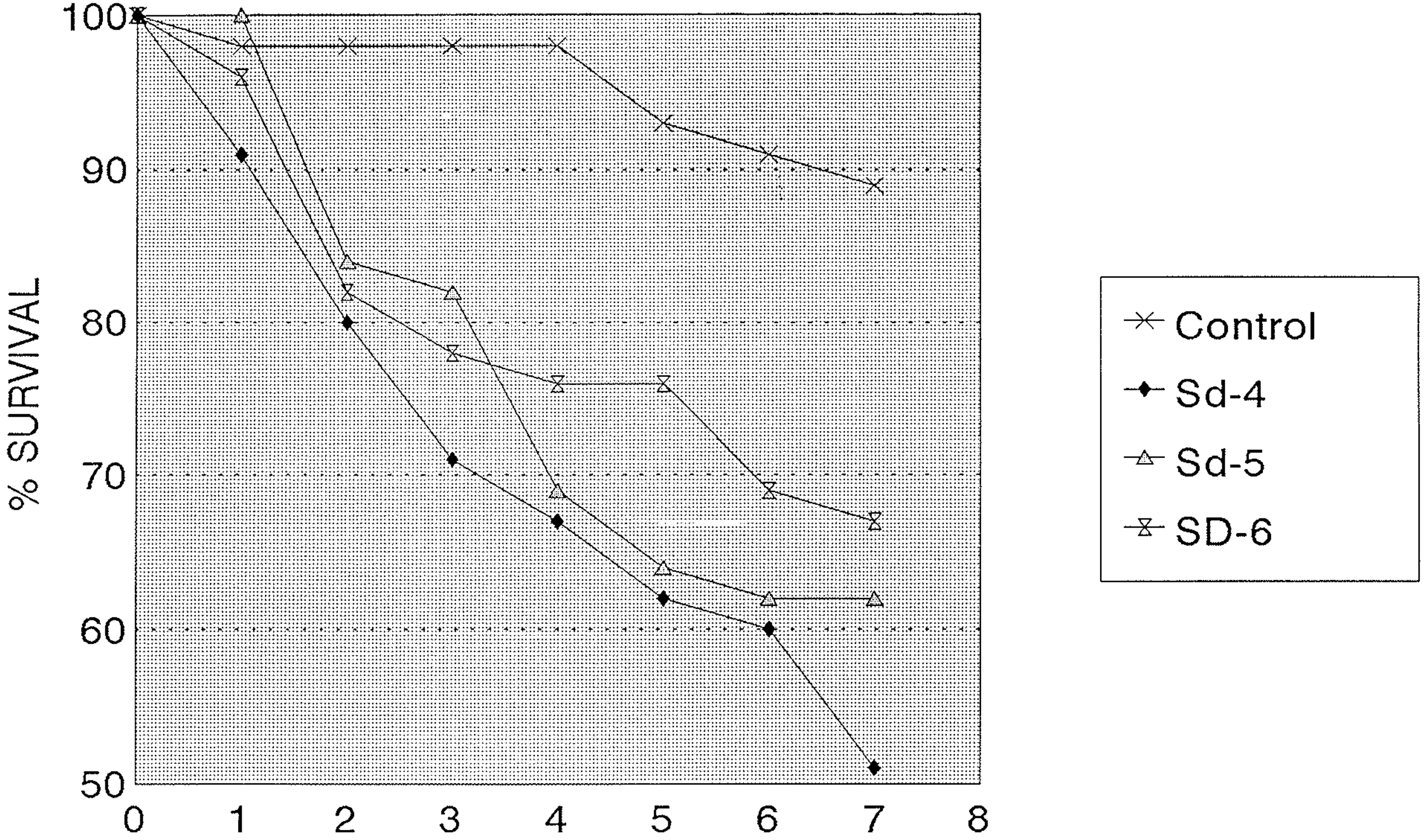
DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	SMM	DATE:	FEB. 16, 1993	2FIG. NO.:	4–35



SURVIVAL CURVES FOR SILVERSIDES EXPOSED TO ELUTRIATE SAMPLES SD – 1 THROUGH SD – 3
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	SMM	DATE:	FEB. 16, 1993	2FIG. NO.:	4 – 36

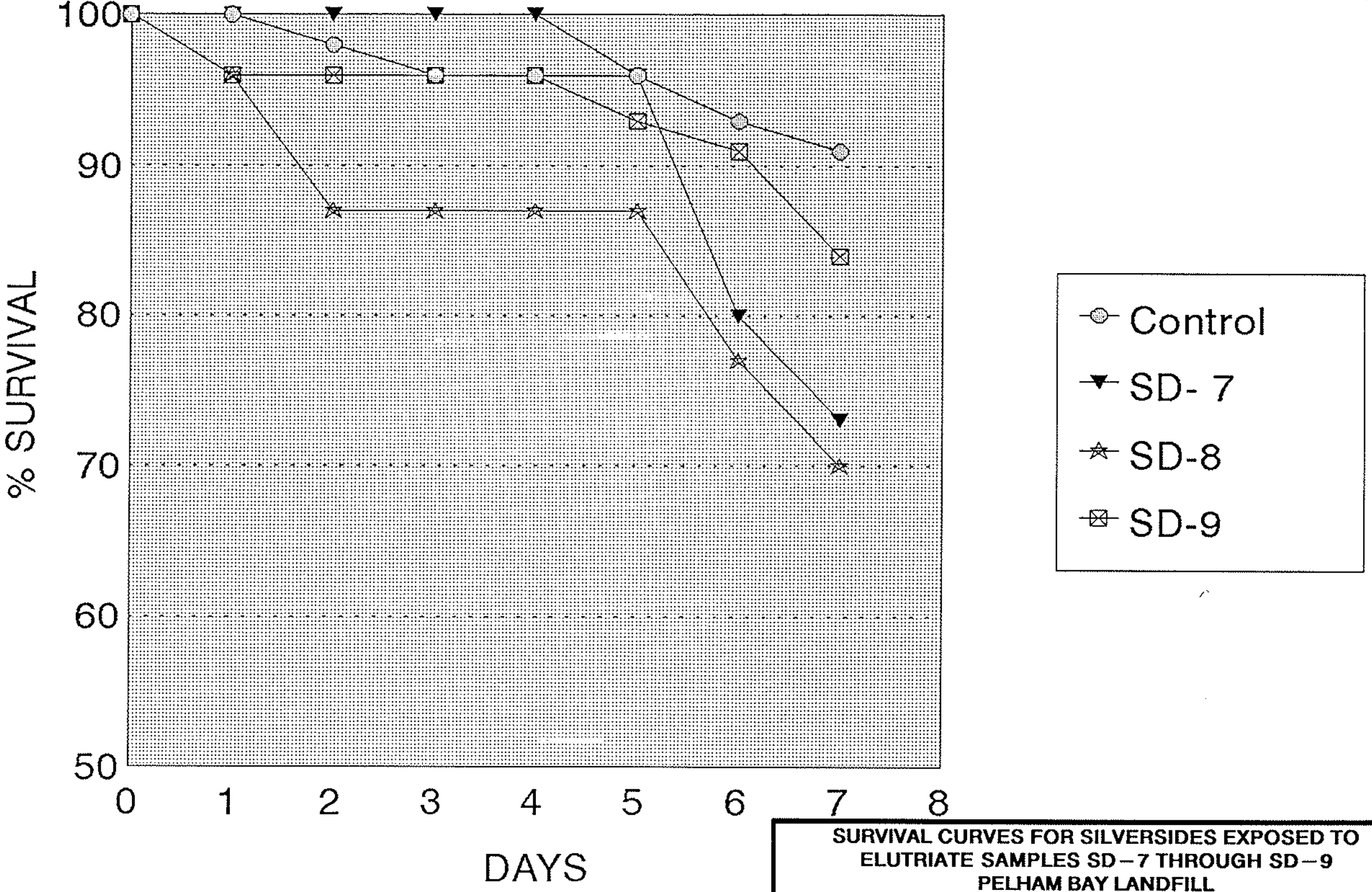


SURVIVAL CURVES FOR SILVERSIDES EXPOSED TO ELUTRIATE SAMPLES SD−4 THROUGH SD−6
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD − CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

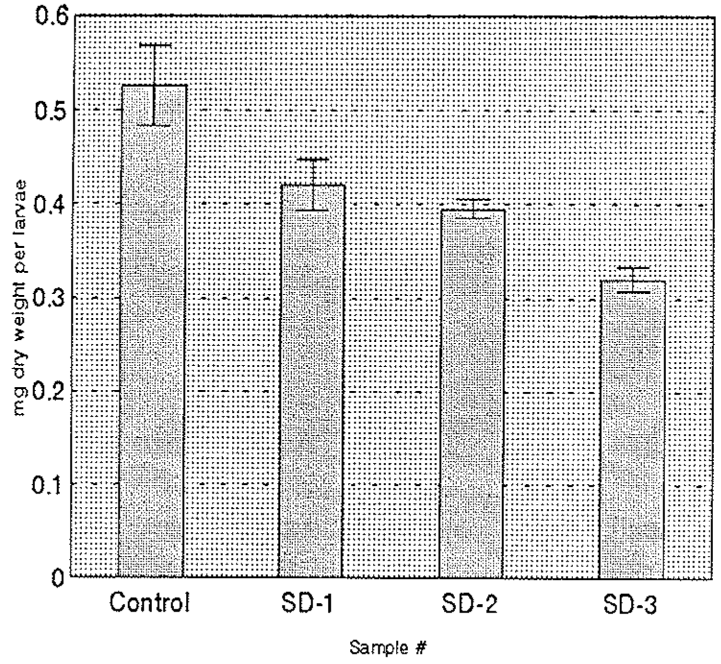
DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	SMM	DATE:	FEB. 16, 1993	2FIG. NO.:	4−37

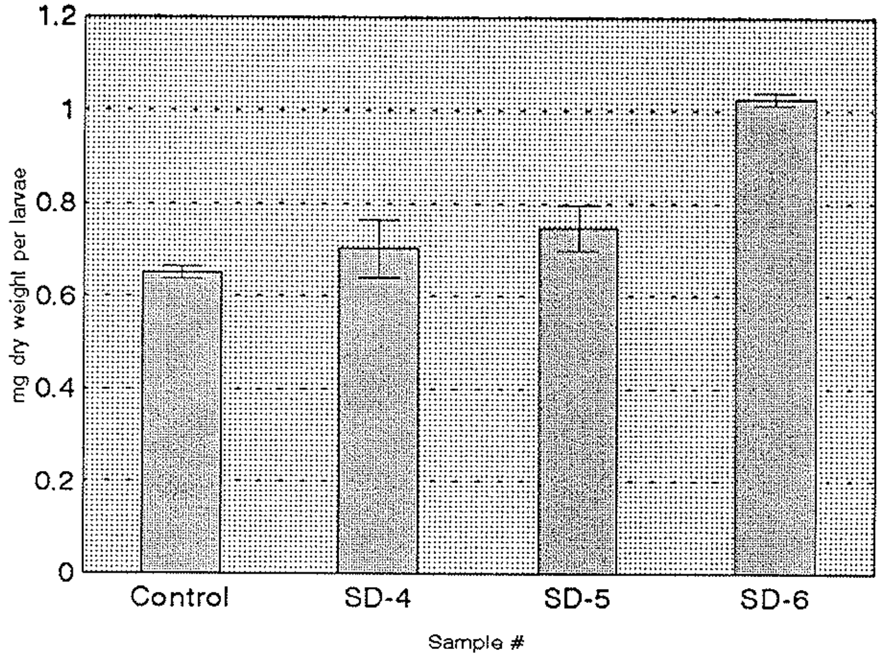


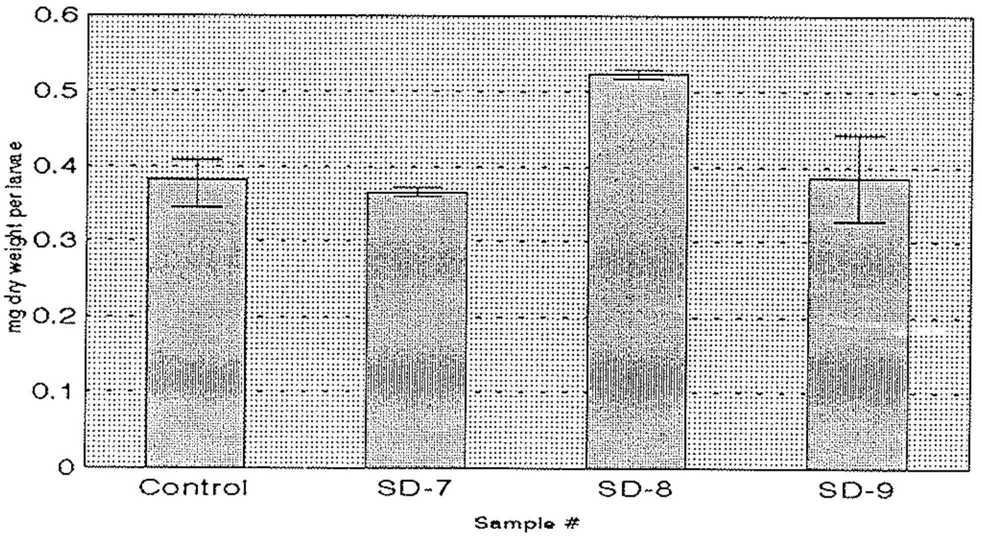
SURVIVAL CURVES FOR SILVERSIDES EXPOSED TO ELUTRIATE SAMPLES SD-7 THROUGH SD-9
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	SMM	DATE:	FEB. 16, 1993	2FIG. NO.:	4-38







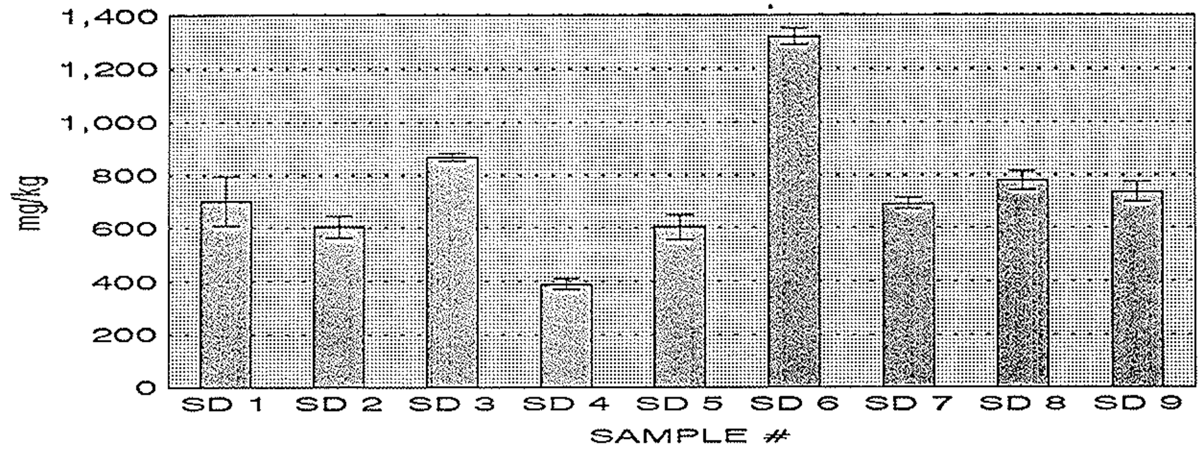
GROWTH ASSESSMENT
INLAND SILVERSIDES
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

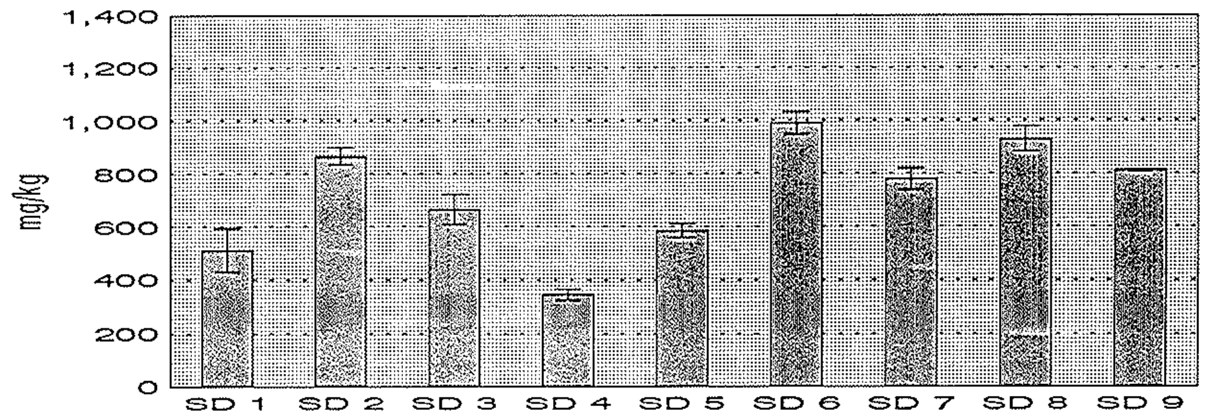
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	SMM	DATE:	FEB. 16, 1993	2FIG. NO.:	4–39

ACID VOLATILE SULFIDE ANALYSIS FOR SAMPLES USED IN ELUTRIATE SEDIMENT TOXICITY ASSESSMENT



ACID VOLATILE SULFIDE ANALYSIS FOR SAMPLES USED IN BULK SEDIMENT TOXICITY ASSESSMENT

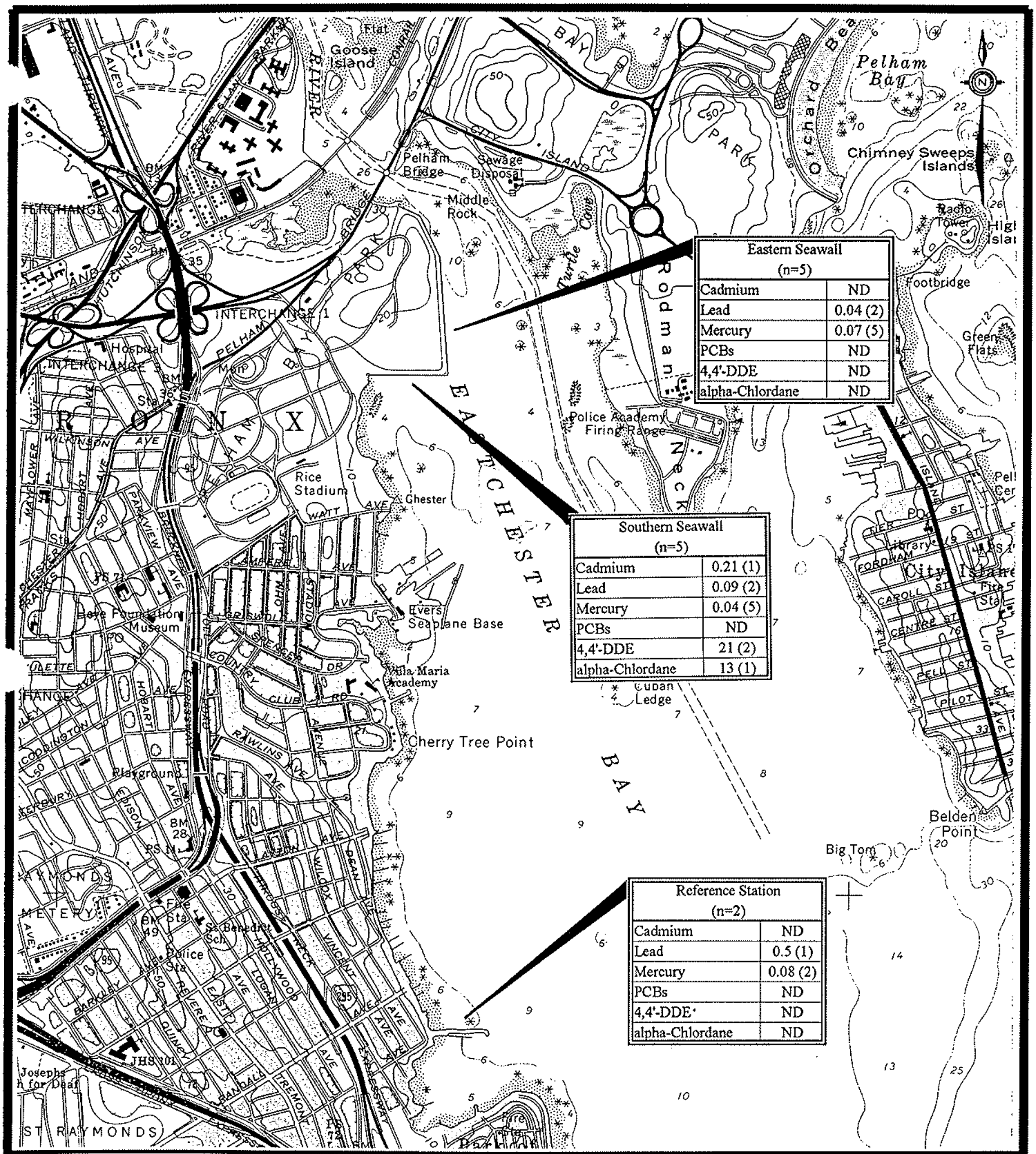


ACID VOLATILE SULFIDE ANALYSIS FOR SAMPLES USED IN ELUTRIATE/BULK SEDIMENT TOXICITY ASSESSMENT
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	SMM	DATE:	FEB. 16, 1993	2FIG. NO.:	4 – 40



Eastern Seawall (n=5)	
Cadmium	ND
Lead	0.04 (2)
Mercury	0.07 (5)
PCBs	ND
4,4'-DDE	ND
alpha-Chlordane	ND

Southern Seawall (n=5)	
Cadmium	0.21 (1)
Lead	0.09 (2)
Mercury	0.04 (5)
PCBs	ND
4,4'-DDE	21 (2)
alpha-Chlordane	13 (1)

Reference Station (n=2)	
Cadmium	ND
Lead	0.5 (1)
Mercury	0.08 (2)
PCBs	ND
4,4'-DDE	ND
alpha-Chlordane	ND

0 1000 2000 FT
SCALE

NOTE:
Metals fish concentrations are mg/kg.
PCBs and pesticides fish tissue concentrations are ug/kg.
Number in parentheses represents the number of detected values used to calculate the mean.

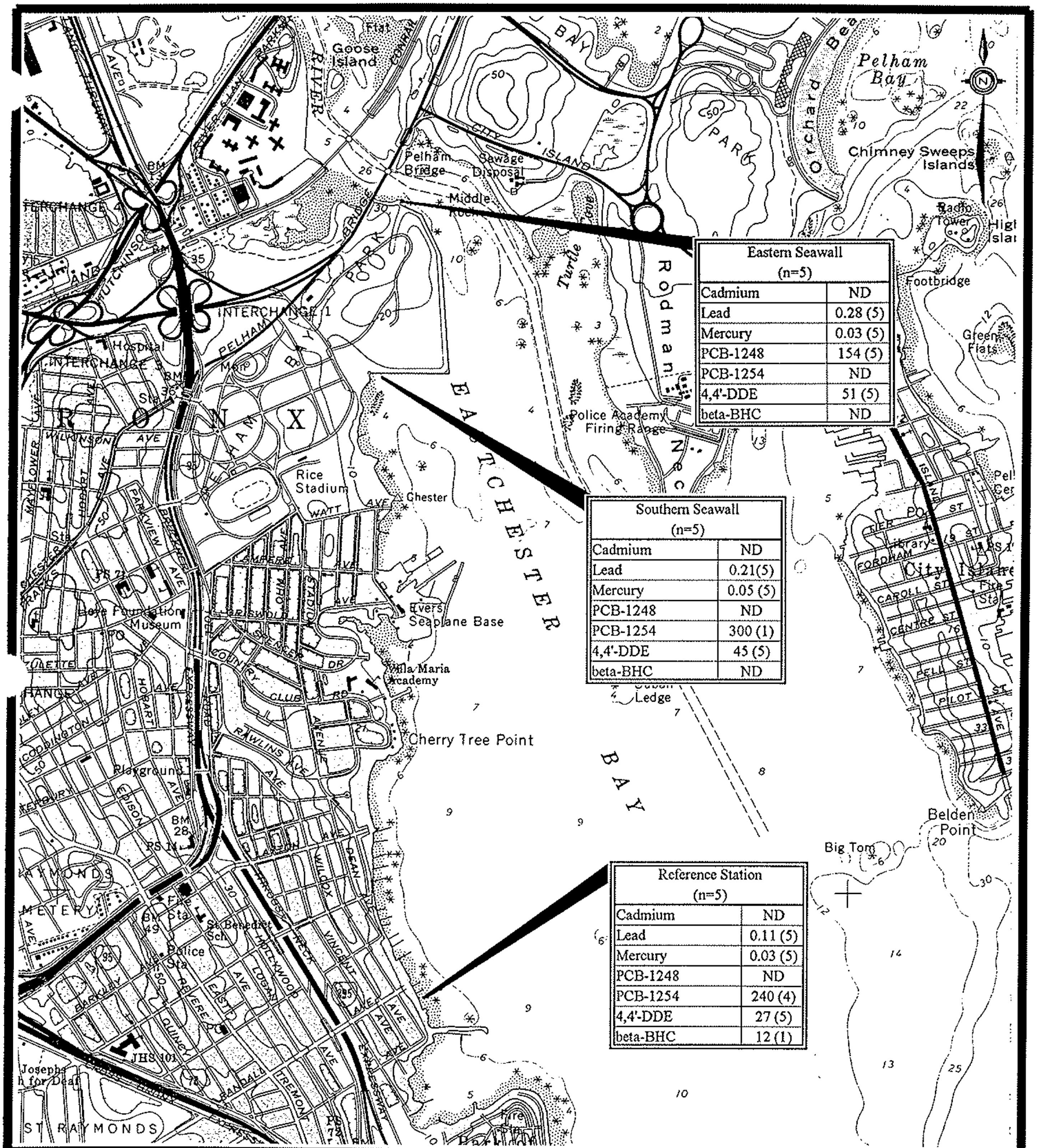
MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

UNVALIDATED FISH TISSUE LEVELS IN FLOUNDER PELHAM BAY LANDFILL BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	ABB	DATE:	JAN. 27, 1993	FIG. NO.:	4–41



Eastern Seawall
(n=5)

Cadmium	ND
Lead	0.28 (5)
Mercury	0.03 (5)
PCB-1248	154 (5)
PCB-1254	ND
4,4'-DDE	51 (5)
beta-BHC	ND

Southern Seawall
(n=5)

Cadmium	ND
Lead	0.21(5)
Mercury	0.05 (5)
PCB-1248	ND
PCB-1254	300 (1)
4,4'-DDE	45 (5)
beta-BHC	ND

Reference Station
(n=5)

Cadmium	ND
Lead	0.11 (5)
Mercury	0.03 (5)
PCB-1248	ND
PCB-1254	240 (4)
4,4'-DDE	27 (5)
beta-BHC	12 (1)

0 1000 2000 FT
SCALE

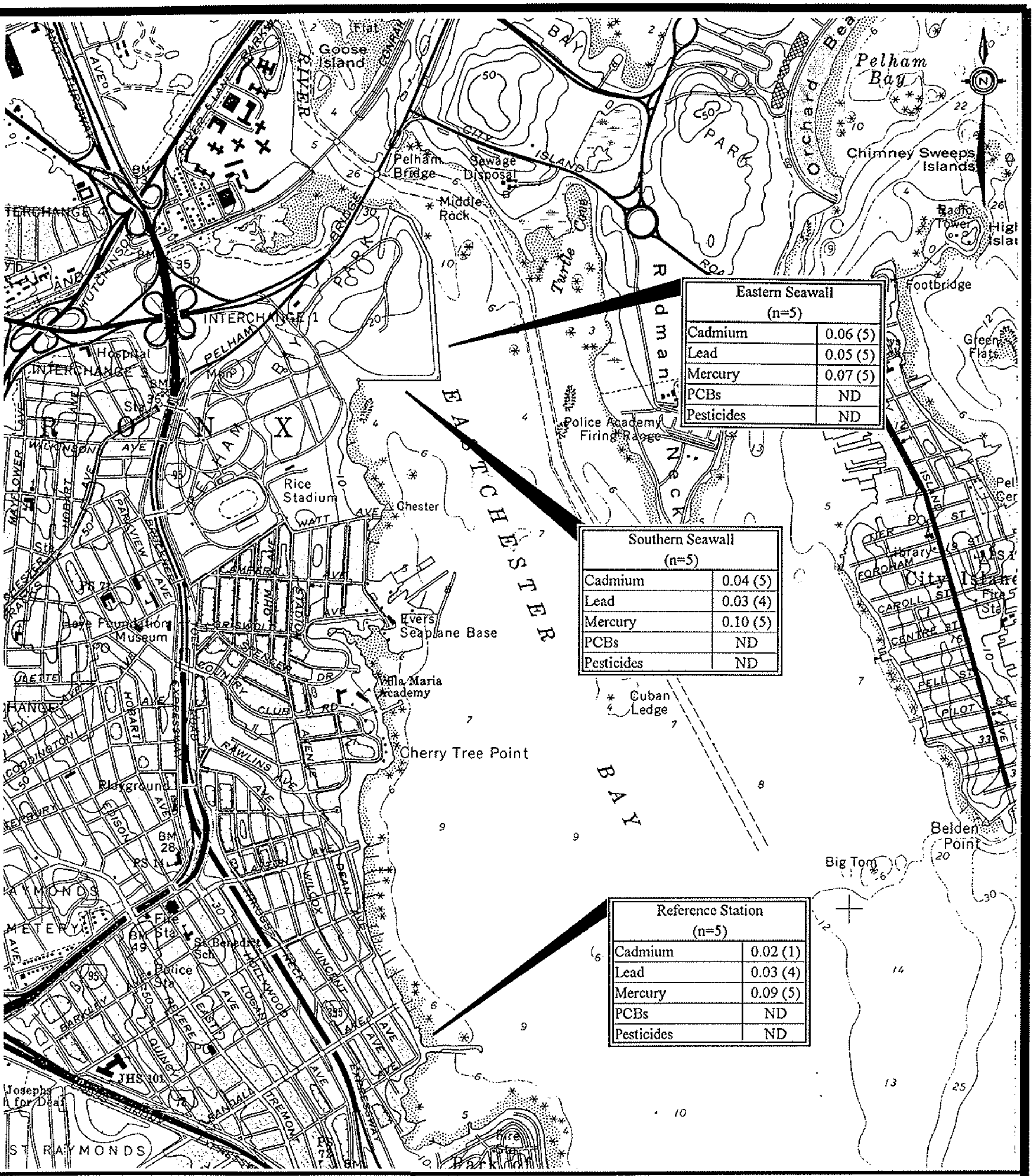
NOTE:
Metals fish concentrations are mg/kg.
PCBs and pesticides fish tissue concentrations are ug/kg.
Number in parentheses represents the number of detected values used to calculate the mean.

MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

UNVALIDATED FISH TISSUE LEVELS IN ATLANTIC SILVERSIDE PELHAM BAY LANDFILL BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	ABB	DATE:	JAN. 27, 1993	FIG. NO.:	4 – 42



Eastern Seawall
(n=5)

Cadmium	0.06 (5)
Lead	0.05 (5)
Mercury	0.07 (5)
PCBs	ND
Pesticides	ND

Southern Seawall
(n=5)

Cadmium	0.04 (5)
Lead	0.03 (4)
Mercury	0.10 (5)
PCBs	ND
Pesticides	ND

Reference Station
(n=5)

Cadmium	0.02 (1)
Lead	0.03 (4)
Mercury	0.09 (5)
PCBs	ND
Pesticides	ND

0 1000 2000 FT
SCALE

NOTE:
Metals fish concentrations are mg/kg.
PCBs and pesticides fish tissue concentrations are ug/kg.
Number in parentheses represents the number of detected values used to calculate the mean.

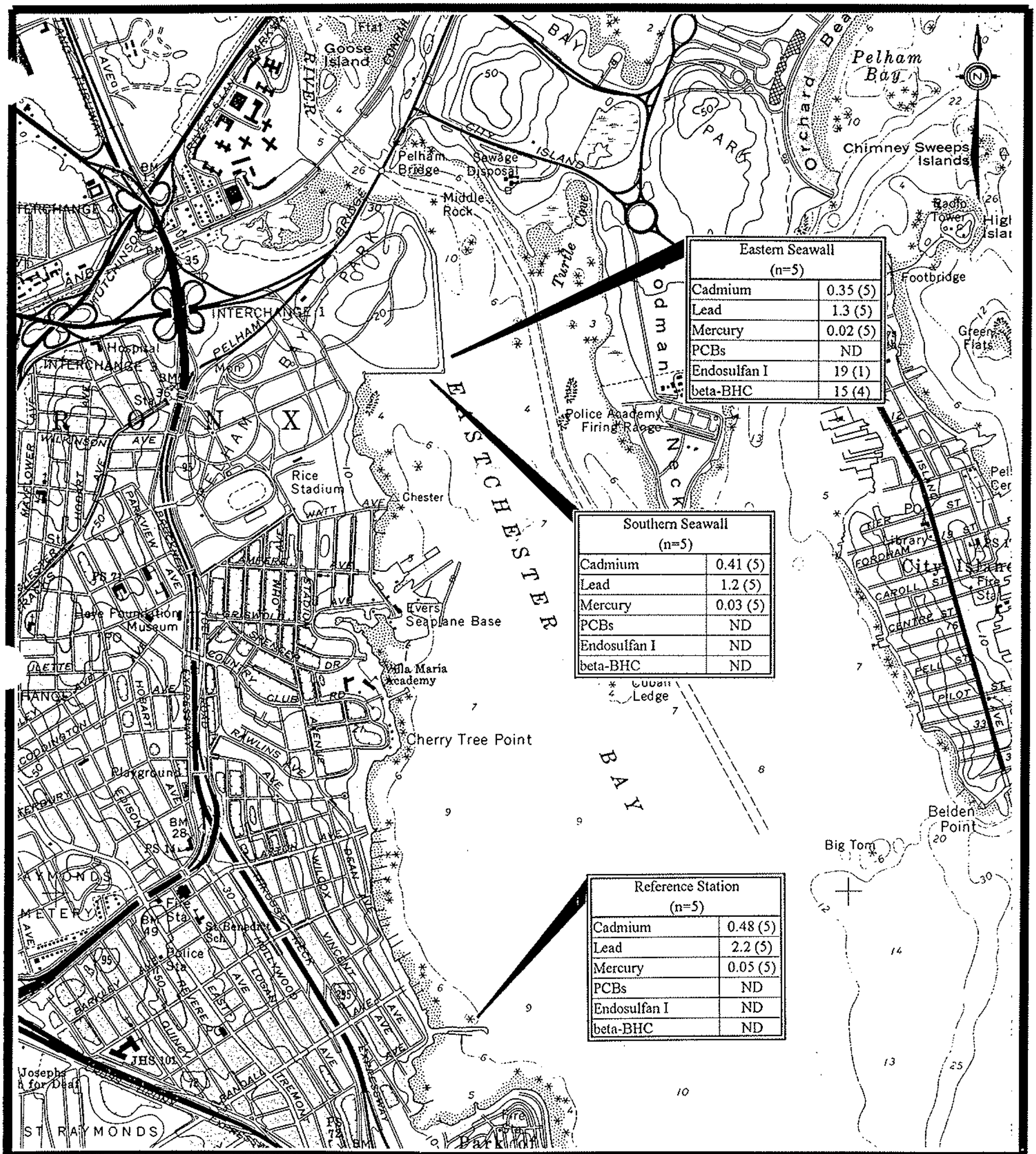
MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

UNVALIDATED FISH TISSUE LEVELS IN BLUE CRAB
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	ABB	DATE:	JAN. 27, 1993	FIG. NO.:	4-43



Eastern Seawall (n=5)	
Cadmium	0.35 (5)
Lead	1.3 (5)
Mercury	0.02 (5)
PCBs	ND
Endosulfan I	19 (1)
beta-BHC	15 (4)

Southern Seawall (n=5)	
Cadmium	0.41 (5)
Lead	1.2 (5)
Mercury	0.03 (5)
PCBs	ND
Endosulfan I	ND
beta-BHC	ND

Reference Station (n=5)	
Cadmium	0.48 (5)
Lead	2.2 (5)
Mercury	0.05 (5)
PCBs	ND
Endosulfan I	ND
beta-BHC	ND

NOTE:
Metals fish concentrations are mg/kg.
PCBs and pesticides fish tissue concentrations are ug/kg.
Number in parentheses represents the number of detected values used to calculate the mean.

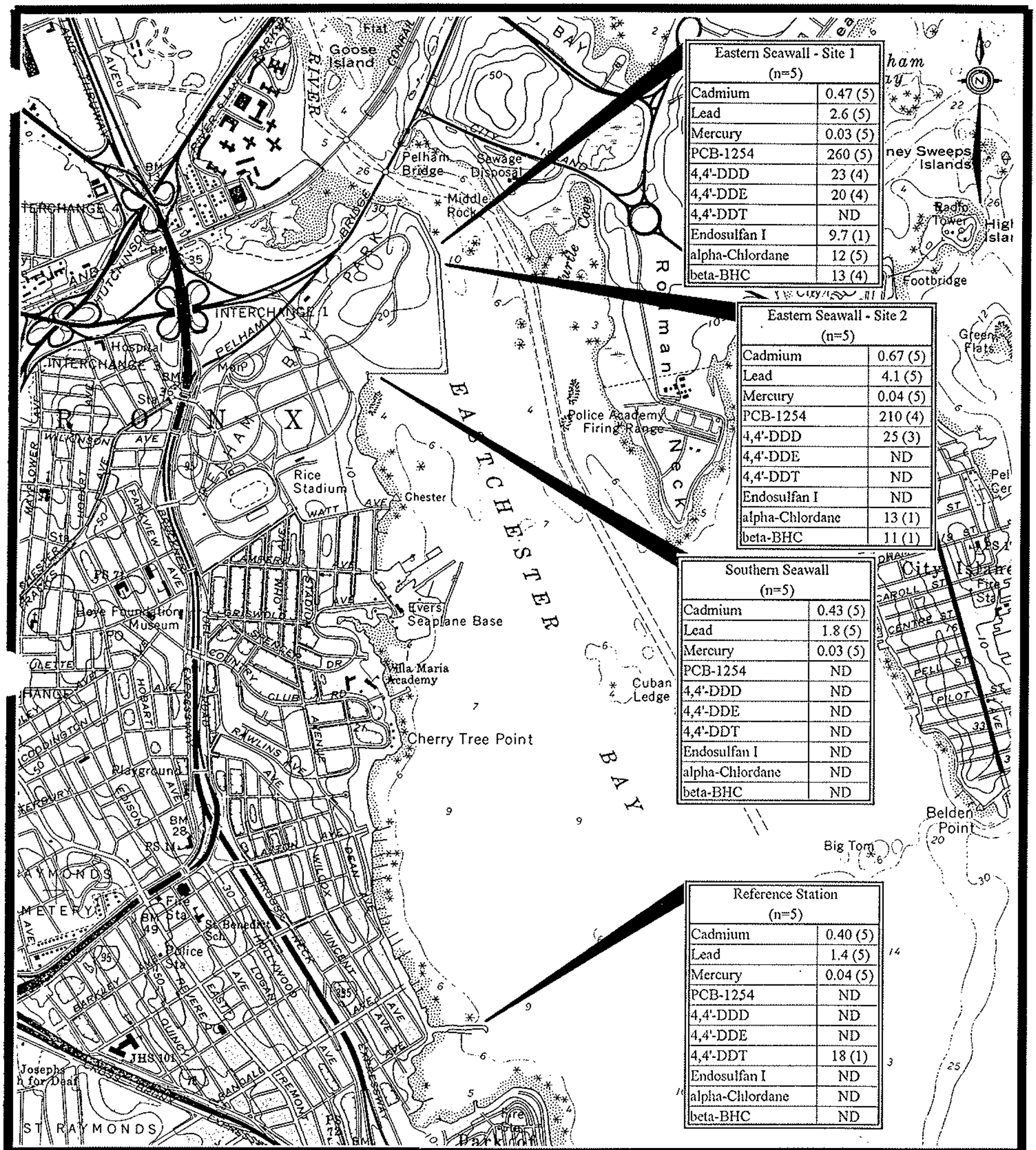
MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

UNVALIDATED FISH TISSUE LEVELS IN HARD CLAM PELHAM BAY LANDFILL BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	ABB	DATE:	JAN. 27, 1993	FIG. NO.:	4 – 44



Eastern Seawall - Site 1 (n=5)	
Cadmium	0.47 (5)
Lead	2.6 (5)
Mercury	0.03 (5)
PCB-1254	260 (5)
4,4'-DDD	23 (4)
4,4'-DDE	20 (4)
4,4'-DDT	ND
Endosulfan I	9.7 (1)
alpha-Chlordane	12 (5)
beta-BHC	13 (4)

Eastern Seawall - Site 2 (n=5)	
Cadmium	0.67 (5)
Lead	4.1 (5)
Mercury	0.04 (5)
PCB-1254	210 (4)
4,4'-DDD	25 (3)
4,4'-DDE	ND
4,4'-DDT	ND
Endosulfan I	ND
alpha-Chlordane	13 (1)
beta-BHC	11 (1)

Southern Seawall (n=5)	
Cadmium	0.43 (5)
Lead	1.8 (5)
Mercury	0.03 (5)
PCB-1254	ND
4,4'-DDD	ND
4,4'-DDE	ND
4,4'-DDT	ND
Endosulfan I	ND
alpha-Chlordane	ND
beta-BHC	ND

Reference Station (n=5)	
Cadmium	0.40 (5)
Lead	1.4 (5)
Mercury	0.04 (5)
PCB-1254	ND
4,4'-DDD	ND
4,4'-DDE	ND
4,4'-DDT	18 (1)
Endosulfan I	ND
alpha-Chlordane	ND
beta-BHC	ND

0 1000 2000 FT
SCALE

NOTE:
Metals fish concentrations are mg/kg.
PCBs and pesticides fish tissue concentrations are ug/kg.
Number in parentheses represents the number of detected values used to calculate the mean.

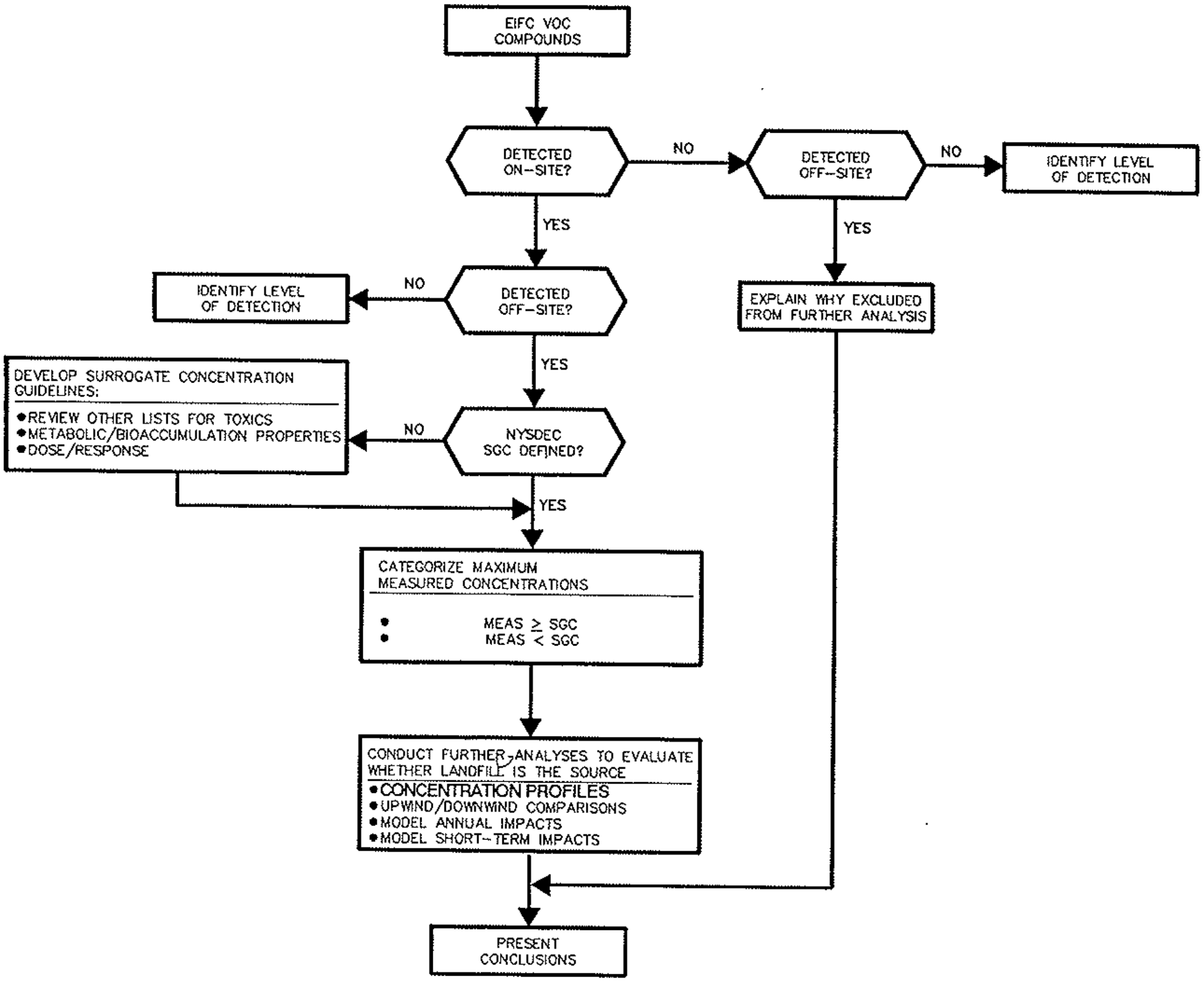
MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

UNVALIDATED FISH TISSUE LEVELS
IN BLUE MUSSEL
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	ABB	DATE:	JAN. 27, 1993	FIG. NO.:	4-45



LOGIC DIAGRAM FOR ANALYSIS OF AMBIENT AIR DATA
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	FWD	SCALE:	NONE	PROJ. NO.:	92C4087
CK'D BY:	RJW	DATE:	DEC. 9, 1992	2FIG. NO.:	4-46

5.0
CONTAMINANT FATE AND TRANSPORT

5.1 INTRODUCTION

This section provides a discussion of the results of the RI in terms of the fate and transport of landfill-derived constituents identified in the sampled media. Based on the results of sampling of the soil, monitoring wells, seeps, surface water, sediment, and air, potential migration routes of constituents from the landfill to the nearby environment are identified, and the fate of these constituents along these routes is discussed. Fate and transport modeling has been conducted to characterize the transport of landfill-derived constituents in the surface water and air, as discussed in Sections 5.3.2.1.2 and 5.3.3.2, respectively.

5.2 POTENTIAL ROUTES OF MIGRATION

Constituents in the landfill may move to the surrounding environment by a number of potential migration pathways. A summary of the significant transport pathways is illustrated in the three-dimensional conceptual model in Figure 5-1. The conceptual site model illustrates the different transport mechanisms by which landfill-derived constituents may enter the surrounding environment. The three major pathways for transport from the landfill are:

- Groundwater pathway
- Surface water pathway
- Air pathway

Each of the potential migration routes and their effect on other media are discussed in this section. Details are provided in the following sections for relevant site-specific fate processes.

5.2.1 Groundwater Pathway

Groundwater at the Pelham Bay Landfill is found in the fill, till, and bedrock. Precipitation that infiltrates into the landfill moves through the waste, potentially leaching contaminants that may be transported into the groundwater system. This section presents a description of the following potential routes of contaminant transport:

- shallow groundwater flow in the fill and till units
- shallow groundwater flow which ultimately discharges in seeps
- groundwater flow in the bedrock

5.2.1.1 Shallow Groundwater Flow

The unconsolidated material present at the Pelham Bay Landfill consists of fill associated with the landfilling operations, glacial till which is predominantly composed of variable percentages of sand and silt, and the riprap wall which contains interlocked angular boulders with interstitial cobbles, gravel, and sands. Groundwater in these units comprises the shallow groundwater flow system which is described in detail in Section 3.4.2.

The shallow flow system at the Pelham Bay Landfill is dominated by the bedrock high in the center of the site. The direction of groundwater flow is from the bedrock high in the center of the site radially to Eastchester Bay to the east, and to the tidal wetlands to the west. Groundwater that is offsite in the Pelham Bay Park area (southwest of the landfill) flows onto a portion of the southwestern corner of the landfill. Based on groundwater elevation contours, this water would mix with flow originating from the landfill before discharging to either the bay or the tidal wetlands. The extent to which on-site groundwater is influenced by the off-site groundwater system will vary depending on the amount of mounding present. When mounding is limited, for example during the August 1992 rounds, up to 20% of the groundwater water on site may be influenced by the off-site flow system. When mounding was more pronounced (e.g., November 1992) less than 10% of the on-site groundwater maybe influenced by off-site flow.

Saltwater intrusion was shown in Sections 3.4.2.2 and 3.4.2.6 to affect shallow groundwater only in a limited area adjacent to the bay riprap perimeter wall. Modeling results (Section 3.4.2.6) predict that a large mixing zone is present near the Eastchester Bay shoreline. The model results were confirmed by the chloride analytical data which show decreases in concentration with distance from the bay. Saltwater intrusion based on the RI investigation and modeling is believed to have little effect on groundwater flow and contaminant transport at the landfill.

The amount of leachate produced and discharged with groundwater from the Pelham Bay Landfill is affected primarily by the amount of precipitation that infiltrates into the fill. A water balance was developed for the landfill using the groundwater flow model. The water balance results, which are presented in Sections 3.4.2.6 and 3.4.2.7, show that with 41 in of precipitation per year and up to 24% infiltrating, up to 75,000 gal/day of groundwater/leachate will discharge from the fill/till. This result represents a maximum average or steady-state condition. After significant rainfall events, the discharge and recharge is expected to be higher. The opposite is expected during dry periods.

Approximately 70% (up to 52,500 gal/day) of the total volume of water discharged from the shallow groundwater system discharges to Eastchester Bay. The remaining 30% (up to 22,500 gal/day) discharges to the tidal wetlands. These estimates are based on the groundwater flow lines and the percentage of the total area around the site where groundwater discharges occur. There could be significant variations to these estimates based on aquifer properties which are not known in many areas around the site. The volume of water in storage is estimated to be approximately 400 million gallons based on the volume of saturated unconsolidated materials and a porosity of 0.35 which was used in the flow model.

Contaminant Transport in the Shallow Groundwater Flow System

The source of the contamination present in the shallow groundwater system is the waste disposed of at the Pelham Bay Landfill. This includes the refuse (household waste, construction and demolition waste, and other wastes) and cover material from unknown sources. (For a more detailed description of the landfall history, refer to Section 1.3.2).

In areas where glacial till soils are present (generally landward of the natural shoreline), wastes were disposed of directly onto these soils. When construction of the fill extended into the bay, dikes were built and water was drained from cells. Waste was placed in this portion of the landfill either directly onto the bedrock or over a very thin layer of till. The thickness of the waste is generally greater on the eastern side of the landfill than in the western portion due to the absence or thinness of the till unit in many areas in the eastern portion of the landfill. Also, most of the saturated unconsolidated material in the eastern part of the landfill is waste material whereas in the western portion (i.e., west of the bedrock ridge) much of the saturated material is till. This factor has an impact on contaminant transport and is discussed later in this section.

The analytical data from the shallow groundwater samples shows a wide variety of compounds present. VOCs, SVOs, inorganics, pesticides, and PCBs were all detected, but generally at very low concentrations. Inorganics represent the bulk of the constituents detected. A complete description of the constituents detected in the shallow groundwater samples is presented in Section 4.3.

Contaminant transport in the shallow groundwater system represents the most significant groundwater pathway of concern. It is through this pathway that the bulk of groundwater that is in contact with wastes will discharge from the site into the surface water bodies. This pathway can be broken down as follows:

- Precipitation falls on the landfill surface with infiltration of up to 10 in per year (24%) on the top of the landfill and 4 in per year (10%) on the landfill sideslopes.

- Much of the infiltrated precipitation moves vertically through up to 125 ft of unsaturated material at rates that are predicted to be 10 times less than horizontal movement through the till unit.

- When the infiltrated precipitation moves through the fill/waste material, constituents that are present either in the pore water of the unsaturated material or as a soluble portion of the solid waste or soil can be dissolved by the downward moving water, and be eventually transported to the saturated zone.

- Some of the infiltrated water temporarily becomes pore water in the unsaturated zone by capillary attraction, and is later leached downward by infiltrated precipitation.

The flow of groundwater and contaminants is dominated by preferential flow pathways, which for the Pelham Bay Landfill is horizontally in the unit with the highest conductivity, which in most areas is the till unit. Groundwater contaminant transport in the till unit is largely by advection/dispersion with the contamination originating primarily in dissolved form from the fill unit and secondarily from dissolution of contaminants adsorbed to soil particles. As predicted by the groundwater flow model, (see Section 3.4.2.6) flow in the till unit is believed to be largely horizontal due to the lower permeability fill and bedrock units above and below it.

Groundwater contaminant transport in the fill unit also occurs by advection/dispersion. However, this pathway differs from the till in that the constant contact of groundwater with waste materials increases the potential for leaching of contaminants to occur. This conclusion is supported by the analytical data which generally shows higher organic and metal contaminant concentrations in the wells in the eastern and southern portion of the landfill where the saturated fill thickness is greatest than along the western perimeter of the landfill.

The shallow groundwater pathway in the eastern portion of the landfill is completed when groundwater flows through the riprap wall and enters Eastchester Bay. Flow through the riprap is believed to be relatively rapid (based on the modeling) in comparison to flow in the fill or till. The fate of contaminants that are entering the surface water is presented in Section 5.3.2.1.

The shallow groundwater pathway along the western portion of the landfill continues from the landfill boundary through off-site groundwater (between the landfill and the tidal wetlands) before ending in the tidal wetlands to the north and west of the site. The area between the site and the wetlands varies in width from approximately 225 to 825 ft in width. In this area, contamination travelling from the landfill mixes with groundwater that is unaffected by the direct vertical leaching of contaminants from units above it. In addition, some retardation/attenuation of contaminants in groundwater will occur between the landfill and the wetlands. This is discussed further in Section 5.3.1.2.

5.2.1.2 Groundwater/Leachate Seepage

Surface seeps have been classified from this RI as being representative of shallow groundwater flow (see Section 3.4.2.4), not as a separate perched flow system. As such, seeps are only a surface expression of subsurface flow. Seeps will, however, be discussed separately in this section due to the separate sampling and other work associated with evaluating this pathway.

Seeps occur as part of the shallow groundwater flow system where lateral groundwater flow in the fill discharges onto the land surface as described in Section 3.4.2.4. Seeps occur mainly in the riprap wall where high permeability channels are created due to the open structure of the rock. The seeps along the riprap wall are generally visible only at low tide.

The volume of water flowing from the Pelham Bay Landfill as seeps is not quantifiable since the flow in each seep or seep zone could not be measured, nor could seep flow be estimated from the water balance since the seeps represent a portion of the total shallow groundwater flow system (i.e., they are not a separate flow system). From the field investigation, knowledge of the shallow groundwater flow system and the groundwater model, seeps are estimated to represent 5 to 10% of the total shallow groundwater flow into Eastchester Bay. This is between 3,750 gal/day and 7,500 gal/day based on the maximum estimated average daily discharge to Eastchester Bay from the shallow groundwater system (75,000 gal/day).

The discharge rate of seep L2 on the western side of the landfill was estimated visually to be about 0.4 gpm which is similar to the flow rate measured at L9. Using this flow rate, the discharge from the trench at L2 is estimated to be 600 gal/day.

The volume of water flowing as seeps depends on the factors controlling the shallow groundwater pathway as described in Section 5.2.1.1. The seepage volume is especially sensitive to rainfall since the seeps are the uppermost reflection of groundwater flow, and infiltrated precipitation will locally discharge at the groundwater table. As such, seep volumes and seep chemistry are expected to have significant fluctuations which are dependent on rainfall events.

Contaminant Transport in the Seeps

The source of contamination in the seeps is the waste disposed of at the Pelham Bay Landfill as described in Sections 5.2.1.1 and 1.3.2.

Constituents detected and their concentrations in the seeps are similar to the shallow groundwater samples (see Section 4.3.2), particularly for samples from wells screened entirely in the fill (MW-104, -105, -106, -118, and -126). Metal concentrations reported in the seeps are generally higher than those reported in the monitoring wells.

5.2.1.3 Groundwater Flow in the Bedrock

Groundwater flow in the bedrock is distinct from the shallow flow system for two reasons. The first reason is based on the mechanics of groundwater flow (fracture flow in the bedrock versus porous media flow in the overburden), and the second is based on the directions of groundwater flow (groundwater in the bedrock has the potential to flow to the southwest which is not the case in the shallow flow system). The bedrock flow pathway is described in Sections 3.4 and 4.3.

For groundwater to enter the bedrock beneath the site, it has to flow vertically through the unconsolidated material and enter through the upper weathered bedrock zone where present or through fractures in the competent portion of the rock. The upper weathered zone of the bedrock, as described in Section 3.3.2.2, varies in thickness from 0 to 15.5 ft and is believed to have a very low permeability and hydraulic conductivity based on the high silt and clay content of the samples examined. As such, the downward migration of groundwater is limited by this zone where present. Groundwater entering the bedrock beneath the site is also limited to locations where a downward vertical gradient is present between the overburden and the rock. It is in the center area of the site where migration of contaminants into the bedrock is most likely to occur because the vertical head downward is at times the greatest, the bedrock elevation is highest, and the more permeable till is thin to absent.

Groundwater/leachate that does reach the competent portion of the bedrock can only migrate through joints, fractures, or other discontinuities in the rock. Groundwater flow through joints in the bedrock is believed to be a minor pathway based on the RI. While the joint system is pervasive in some areas, the joints are generally tight and not interconnected based on the outcrops examined (see Section 3.3.2.3).

Groundwater flow through fractures is dependent on the extent of their occurrence and their interconnection. Flow through fractures is the predominant pathway in the bedrock. Based on the RI core samples and the response of the wells to pumping, major fracture zones were only present in three locations (MW-114B, -115B, and -125B). Sustainable yields greater than 1 gpm could be maintained only at these locations.

The extent of fracturing with depth has been evaluated in the RI. Based on the rock cores examined, the extent of fracturing decreases with depth. Thus, the likelihood of deep (greater than 100 ft) contamination from the vertical migration of constituents through interconnected fractures is believed to be minimal.

The flow of groundwater in the bedrock on-site to areas off-site has not been characterized. The elevations of groundwater in the rock from the RI field work suggest that flow is possible in almost all directions from the ridge in the center of the landfill. Flow, however, is only possible where interconnected fractures or other pathways exist.

Groundwater flow in the bedrock may result in discharges to the surface water. Based on the RI work, this is most likely to occur in the areas of MW-118B, -119B, -120B, and -125B based on their chloride concentrations (similar to that of seawater), their contaminant levels, and tidal responses. Flow in the direction of Pelham Bay Park has not been characterized. The possibility exists for flow to occur in that direction, however, it would likely be limited by another bedrock ridge present less than 4,000 feet southwest of the site (see Section 3.4.2.6).

Contaminant Transport in Bedrock

Contaminant transport in the bedrock is believed to be a minor pathway of concern. This is based on the nature of the flow system as described above. Contamination of the bedrock groundwater system can potentially occur through the vertical migration of leachate/groundwater from the overlying fill and till. VOCs, SVOs, pesticides, and inorganics were detected in the bedrock groundwater. A complete description of the detected constituents is provided in Section 4.3. The sample for MW-116B showed the highest concentrations of monocyclic aromatic hydrocarbons. Some of the inorganic parameters were the highest in wells MW-118B, -119B, and -120B. The bedrock monitoring well samples exhibited lower concentrations and less frequent detections of SVOs and pesticides relative to the shallow groundwater samples.

Quantification of the mass of contaminants in the bedrock flow system cannot be made since the volume of water entering the bedrock is unknown. The need for further evaluation of the bedrock to better determine its flow patterns and contaminant loading is largely unwarranted since it is a minor transport pathway and as such will have a much smaller effect on the surface water bodies around the site than the more permeable overburden.

5.2.2 Surface Water Pathway

The potential migration routes for surface water include:

- Surface water runoff
- Surface water transport in the surrounding surface water bodies

Most of the surface water runoff which leaves the site is likely to flow into the surrounding surface water of Eastchester Bay. Contaminants which may enter Eastchester Bay can be subsequently transported further from the landfill by the following mechanisms:

- Tidal currents and physical transport processes (e.g., dispersion)
- Sediment adsorption and transport
- Food chain transfer

The following subsections discuss the migration routes, their respective source areas, and the significance of the migration routes for site-specific contaminant transport.

5.2.2.1 Surface Runoff

The topography of the landfill promotes surface water runoff. The landfill slopes average around 20% and a maximum elevation of approximately 135 ft. The surrounding topography is generally of low relief, with elevations ranging from 10 ft to 20 ft. During rainfalls, the precipitation which does not penetrate into the landfill runs down the slopes of the landfill.

The surficial soil of the existing landfill cap and limited areas of exposed waste are potential sources of contamination for surface water runoff. Contamination of surface runoff can occur either through dissolution or leaching of soluble contaminants from surficial materials, or by entrainment of contaminated soil/waste particles. Since most of the site is covered with soil and is highly vegetated, particulate transport is unlikely to be significant for most of the landfill. Particulate entrainment with subsequent transport in runoff is likely to be limited primarily to erosion channels. Waste materials may also be exposed in erosion channels. Erosion gully formation has been noted near the summit of the landfill, and is evidence of the occurrence of surface water runoff. The majority of surface water runoff probably flows into Eastchester Bay as it surrounds the landfill on three sides. Surface runoff flowing to the west will be channeled along the parkway (Shore Road) and will not reach or impact tidal wetlands across the road. Surface runoff flowing to the southwest has the potential to impact Pelham Bay Park. These and other nearby off-site land areas may be contaminated due to surface water runoff from the landfill.

No information is available regarding the permeability of the surficial soil. However, WCCI geologists have observed puddles forming on the landfill after rainfalls. Sometimes, the puddles have remained for several days. In addition, the top of the landfill gets very muddy after rainfalls and ponding has been noted from aerial photographs of the site. From these observations, the soil cover is likely to be made up of clays and silt-size particles and therefore, infiltration is probably limited (i.e., most precipitation is lost to surface water runoff and evapotranspiration). Literature references (Geraghty, *et al.*, 1973) and the HELP model (see Section 3.4.2.7) estimate that approximately 24% of the precipitation infiltrates the landfill on the top and 10% on the sideslopes. Overall, approximately 80% of the total precipitation may leave the site as surface water runoff and evapotranspiration.

The quality of surface water runoff is unknown since no samples were collected for its evaluation. However, using the analytical data from surficial soil, an estimate of the quality of surface water runoff can be made. The on-site surficial soil was sampled at a depth of 0 to 0.5 or 1 ft. The detected organic contaminants are summarized in Table 5-1 with their corresponding values for water solubility. PAHs, phthalates, PCBs, and pesticides were detected in surface soils. All of these constituents have extremely low solubilities in water. These compounds are, therefore, unlikely to be found dissolved in surface water runoff, and are relatively immobile in water pathways. These compounds could be transported in surface runoff with suspended particulate matter. Several moderately soluble compounds were detected infrequently in surface soils, including phenolic compounds, benzoic acid, N-nitroso-n-propylamine. These compounds and other highly soluble compounds in the surface soils could potentially be transported as dissolved constitutents in surface water.

Some of the surface runoff that does not infiltrate back into the soils will be trapped in pools. As water from pooled surface runoff evaporates, most of the volatile compounds will vaporize into the atmosphere. Other less volatile constituents and metals are expected to be readsorbed onto the soil. Contaminated soil particles transported via surface water runoff will settle and be deposited in the pooled areas.

The impact of surface water runoff from the landfill on off-site land areas is unknown because no studies or sampling were performed for historical surface water runoff pathways and erosion channels during this RI investigation. However, the impact on off-site land areas from surface water runoff is considered of minor significance since the majority of surface water runoff from the landfill is expected to enter Eastchester Bay, and contaminant loading via runoff is likely to be limited relative to that from shallow groundwater/leachate. The fate of contaminants which enter Eastchester Bay from runoff is discussed in Section 5.3.2. The potential presence of off-site contaminated soils resulting from deposition or adsorption of contaminants will be addressed in the supplemental RI study.

5.2.2.2 Surface Water

The surface water surrounding the landfill, Eastchester Bay, is itself a medium and a migration route for contaminant transport. The primary physical mechanisms controlling contaminant transport throughout Eastchester Bay and beyond include:

- Tidal currents
- Physical transport processes, such as dilution and dispersion

The sources of Eastchester Bay contamination that may be derived from the landfill, are surface water runoff and groundwater/leachate, as previously discussed in Section 5.2.2.1 and 5.2.1, respectively. However, it is important to note that Eastchester Bay also receives pollutants from many other sources (e.g., Combined Sewer Overflows), and the extent to which the sampled surface water data reflects inputs of landfill-derived constituents is uncertain. A comparison of surface water monitoring data with groundwater/leachate chemistry is provided in Section 5.3.2.1.3.

This section describes our current understanding of flow and transport in Eastchester Bay. Some of this discussion is detailed in Section 3.5. The movement and concentrations of landfill-derived constituents in the surface water has also been modeled assuming the landfill as the only source. This analysis is discussed in Section 5.3.2.1.2.

5.2.2.2.1 Currents and Circulation Patterns

As discussed in Section 3.5, a study of circulation patterns was conducted to assess the speed and direction of local currents and patterns in the Hutchinson River and Eastchester Bay and to identify areas of potential contaminant deposition. The information collected in the study was also used to aid in the selection of sampling locations for water, sediment and biota. The study concluded that the high tidal variations and shallow depth in the bay promote fairly vigorous mixing by tidal currents. Field data, including current measurements, drogue tracking, and dye studies, also indicated that the tidal currents in the bay are dynamic and would promote rapid dispersion of soluble constituents from landfill-related inputs.

The study showed a relatively uniform vertical distribution of currents, temperature, and salinity (no evidence of a saltwater wedge). Currents in the open water area of the bay ranged between 0.1 to 0.2 ft/sec. Currents along the southern disposal site boundary (about 100 ft south of the seawall) were lower and ranged from 0.01 to 0.06 ft/sec. Flow velocities in excess of 1.0 ft/sec were measured just upstream of the Conrail Bridge in the Hutchinson River.

During ebb tide, drogue studies showed that the surface water from the Hutchinson River flows south-southeast nearly parallel to the east-facing seawall at the landfill. Currents tend to move south-southwest toward the west shore of Eastchester Bay at the southeast corner of the landfill. During flood tide, the currents moved slowly to the northeast. At maximum flood tide, drogues moved parallel to the east facing seawall and north-northwest up the Hutchinson River. Figures showing drogue tracks were presented previously in Section 3.5.

The dye study showed rapid mixing and transport in the bay. Dye was transported almost throughout the bay within two complete tidal cycles (about 1 day). In support of the drogue studies, it was also noted that dye transport was toward the western side of the bay during ebb tide.

5.2.2.2.2 Flow Ratio and Flushing Time

The flow ratio and flushing time of the estuary were calculated to assess how well Eastchester Bay is mixed. Calculations of the nominal flow ratio and flushing time using mean river flow and tidal data for Eastchester Bay are included in Appendix Y. Based on these calculations, the Eastchester Bay system has a flow ratio much less than 0.1 and is considered well mixed. This is supported by the field studies discussed in Section 3.5.

Total estuarine flushing time for Eastchester Bay was estimated to be 6.93 tidal cycles. Using a value of 12.4 hours for each tidal cycle, total flushing time is approximately 85 hours or about 3.5 days.

5.2.2.3 Adsorption to Sediments

Sediments are commonly viewed as the ultimate "sinks" for many chemicals in the environment. Sediments exposed to contaminated water can adsorb organic chemicals and metals. The total chemical concentration sorbed to the sediment is highly dependent on numerous factors, such as the sediment type and percentage of organic carbon. These factors are further discussed using site-specific data in Section 5.3.2.2.

The groundwater/leachate from the landfill represents one potential source of contamination for Eastchester Bay sediments. Eastchester Bay sediments that are subjected to groundwater/leachate which enters the bay via shallow groundwater discharge and seeps along the landfill seawall, can adsorb chemicals. However, the extent to which the sampled sediments reflect landfill-derived constituents is uncertain because the sediments are exposed to Eastchester Bay waters which contain pollutants from a variety of sources. A comparison of sediment monitoring data with groundwater/leachate chemistry with regard to the potential impact of the landfill on sediments, is described in Section 5.3.2.2.2.

Once chemicals are adsorbed to the sediments, the potential means by which sediments can be transported include:

- Tidal currents
- Periodic dredging of the shipping channel

- Passing of ships and boats
- Storm-generated waves
- Bioturbation - the stirring or movement of sediments by the activity of benthic organisms

These five types of bottom disturbance may suspend and transport sediments in Eastchester Bay and beyond.

The south seawall eddy cove represents an area of potential sediment accumulation which is potentially affected by the landfill. This area is shallow and has exhibited relatively slow current speed during the current and tides study (see Section 3.5). The sediment in this area is dominated by silt and clay, indicating that this is a depositional area. In contrast, areas of high current velocity (e.g., the shipping channel) are expected to have little fine-grained sediments, as the tidal currents would scour these areas.

The sediment in the depositional areas south of and directly adjacent to the east side of the landfill can occasionally be resuspended and transported by storm-generated waves. McCall (1978) stated that most fine-grained natural sediments are entrained from the bottom at stresses from 0.5 to 1 dynes/cm. The combined effect of storms and tidal streams have little influence on the bottom sediments of Long Island Sound below approximately 20 m. Since all of Eastchester Bay is much shallower than 20 m (approximately 4 to 8 m deep on a spring high tide), it is assumed that severe winter storms as well as tropical cyclones would disturb and redistribute sediments within Eastchester Bay.

For instance, on December 11, 1992, an extremely strong Northeaster raked the Atlantic seaboard. Meteorologists at the National Weather Service generally classify this storm as a 100-year occurrence based on winds and tides. Average wind speeds were 40 mph and the gusts were measured as high as 70 mph. This storm likely led to substantial resuspension of sediments in depositional areas. The sediments distribution after this storm is likely to be substantially different from the conditions sampled during the summer of 1992.

5.2.2.4 Food-Chain Transfer

Direct transfer of chemicals from the surface water and sediments to organisms is a transport pathway for chemicals to the environment. As discussed in the previous two sections, landfill-derived constituents may be present in the surface water and sediments. In turn, these media become potential sources of chemicals to biota. The concern associated with contaminated media is that many commercial species and food chain organisms spend a major portion of their life-cycle in and/or on the waters and sediments.

The biota in the estuary play an important role in the absorption and distribution of contaminants. Active uptake of essential trace elements (e.g., Cu, Co, Cr, Fe, Mo, Ni, V, Zn) can be significant, especially during algal blooms. Phytoplankton use these elements in metal-requiring and metal-activated enzyme systems which catalyze major steps in glycolysis, the tricarboxylic acid cycle, photosynthesis, and protein metabolism. Zooplankton facilitate the removal of heavy metals by consolidating them in fecal material which sinks to the estuarine seafloor. Heavy metals bound to fecal pellets, crustacean molts, and dead plants and animals generally are responsible for more than 90 percent of their vertical transport in the water column (Kennish, 1992). After being deposited on the seafloor, the heavy metal-bound materials are redistributed due to the bioturbating activities of the benthos. Uptake of organic chemicals and metals from sediments by benthic organisms can occur by adsorption to the body wall or exoskeleton; absorption through the integument or respiratory surfaces; and ingestion of food, sediment, or water followed by uptake through the gut wall (Reynoldson, 1987).

After uptake of contaminants by individual organisms from sediments and surface water, movement of the contaminants up the food chain can occur. Many benthic invertebrates and fish are food sources for other fish. In addition, the contamination of these species may have deleterious effects on humans that consume them. Thus, biomagnification and atrophic transfer of contaminants is a transport pathway of concern.

Filter-feeding bivalves tend to accumulate heavy metals, because the bivalves filter particulate matter from the water, have considerable water-tissue contact for the uptake of dissolved heavy metals, and cannot regulate the concentrations of the adsorbed metals as wells as other organisms, such as fish. The metals accumulated by bivalves include silver, arsenic, cadmium, chromium, copper, iron, mercury, manganese, nickel, lead, selenium, and zinc (Lawler, 1981). Because estuarine and marine invertebrates, especially mollusks, concentrate heavy metals, they are generally regarded as indicators of heavy metal contamination in their environment (Kennish, 1992). Some species, such as the blue mussel, *Mytilus edulis*, are unusually adept at accumulating the metals in certain tissues. Furthermore, their ability to integrate variations in heavy metal concentrations through time makes them ideally suited as biomonitors of potentially contaminated habitats.

Many commercially and recreationally important finfish and shellfish species, either inhabiting the seafloor or feeding on bottom-dwelling organisms, tend to absorb and accumulate contaminants present on the estuarine bottom. Uptake of organic chemicals by fish occurs from the water by transfer via the gills and from food via ingestion and uptake by the gut (Clark, *et al.*, 1990; Lee, *et al.*, 1972). The uptake of metals by fish also occurs from the water through the gills and the alimentary tract (Dallinger, *et al.*, 1987). The gills are the main organs of gas exchange. Since the gills are highly specialized and are an exposed part of the fish's body surface, they represent an important site of uptake of essential and non-essential metal ions from the water. Uptake of particulate metal fractions by fish may also occur from contaminated suspended matter, sediments, and contaminated prey organisms.

The blue mussel is found in abundance along the landfill seawalls and was selected as a target shellfish species for whole body analysis. Blue mussels were collected from one location on the southern seawall and two locations on the eastern seawall. These areas are at or adjacent to seeps. The hardclam, *Mercenaria mercenaria*, was also present in several subtidal mud areas just offshore of the landfill seawalls, and was therefore also collected for analysis. The finfish selected for analysis include flounder (winter and summer), tautog, American eel, and Atlantic silversides. Finfish were collected from two general locations adjacent to the landfill, off the eastern and southern seawalls. Blue crab was also collected for analysis. The biota samples were analyzed for cadmium, lead, mercury, PCBs, and pesticides. These chemical parameters were selected based on their propensity to bioaccumulate. (These parameters were agreed to by NYCDEP and NYSDEC by their approval of the Revised Work Plan for ecological studies.) The chemical results of biota sampling was previously discussed in Section 4.6. A comparison of selected biota data with groundwater/leachate chemistry in order to evaluate the potential impact of the landfill, is described in Section 5.3.2.3.2.

5.2.3 Air Pathway

The potential migration routes for constituents in air include:

- Volatilization of gaseous and organic compounds to the atmosphere
- Wind erosion of particulates and fugitive dust

The following subsections discuss the migration routes, their respective source areas, and the significance of the migration routes for site-specific contaminant transport.

5.2.3.1 Volatilization to the Atmosphere

Landfills have long been recognized as sources of volatile compounds because of the generation of methane and other byproduct gases from the decomposition of organic matter deposited in the landfill and vaporization of volatile compounds in the municipal waste. The gaseous compounds can migrate both horizontally and vertically through the fill. Gases that migrate horizontally may move into the surrounding soil and ultimately discharge into the atmosphere. Gases that migrate upward will directly discharge to the atmosphere and then move and disperse in the air.

5.2.3.1.1 Vertical Migration

As described in Section 2.7.2, the concentration of volatile compounds was measured using emission isolation flux chambers (EIFCs) which provide a direct measurement of landfill gas emissions. This investigation showed that volatile compounds were migrating vertically through the soil cover and being released to the atmosphere. The gases and VOCs that were detected are listed below:

Halogenated Aliphatic Hydrocarbons	Monocyclic Aromatic Hydrocarbons	Miscellaneous
bromoform	benzene	acetone
methylene chloride	toluene	ammonia
1,1,1-trichloroethane	xylenes	carbon disulfide
tetrachloroethylene	ethyl benzene	heptane
1,2-dichloroethylene	styrene	hydrogen sulfide
trichloroethylene	cumeme	methane
hexachlorobutadiene	1,2,4-trimethylbenzene	
Freons 11, 12, 113, 114	1,3,5-trimethylbenzene	
	chlorobenzene	
	1,2-dichlorobenzene	
	1,3-dichlorobenzene	
	1,4-dichlorobenzene	
	1,2,4-trichlorobenzene	

The emission rates of these gaseous and volatile compounds are presented in Table 4-80 in Section 4.7. The maximum measured emission rate for each detected compound is listed in Table 5-2.

The measured emission rates for methane were used to calculate an estimate of the total gas flow rate out of the landfill. At two locations on the landfill (AM-A and AM-F), methane emissions were below the limit of detection. These two locations were excluded in calculating the average methane emissions from the landfill. One of the excluded locations was over a leachate drainage channel and the other was a vegetated area.

The average methane emission rate from the five hotspot locations was 4,524 ug/m^2-s and the average total methane emission rate was estimated to be 4,890 ft^3/min (cfm). This value is calculated by multiplying the average measured emission rate times the surface area of the landfill and the vapor density of methane using appropriate unit conversions. The maximum measured emission rate was 9,094 ug/m^2-s for location AM-E. Using this emission rate, the total estimated methane emission rate for the landfill is 9,874 cfm. These total methane flow rates represent upper-bound limits and probably overestimate the actual rates. The calculations are based on the entire surface area of the landfill and do not account for the vegetated areas which are unlikely to emit methane (location AM-F was a grass covered area and no methane emissions were detected). The total values would be considered high production rates for methane considering the age of the Pelham Bay Landfill and assuming a steady-state rate of emission.

The migration of gaseous contaminants released to the air is affected by the following physical processes:

- Diffusion
- Wind advection
- Turbulence

The movement of volatile compounds in the air to potential off-site receptors has been modeled taking into consideration these physical transport processes. The results are presented in Section 5.3.3.2.

There are three potential sources of gaseous and volatile contaminants to air:

- Subsurface municipal waste and organic matter
- Surficial soils
- Groundwater/leachate

The first item is the major source of gases and VOCs emitted from the landfill. The majority of organic compounds in the landfill result from the decomposition of organic matter in soils (humus) and industrial wastes disposed of onsite. Methane formation is the result of anaerobic decomposition of organic wastes by methanogenic bacteria. Methanogenic bacteria are strictly anaerobic, and even small quantities of oxygen are toxic to them. The high production rate of methane at Pelham Bay Landfill is characteristic of anaerobic decomposition, and is expected since the landfill has been closed for 15 years. The composition of landfill gas produced under anaerobic conditions is typically observed to be 50 to 70% methane and 30 to 50% carbon dioxide. Traces of ammonia, hydrogen sulfide, and other gases may also be present usually at levels of less than 1% (Emcon

Associates, 1980). During this RI investigation, methane was detected at a maximum emission rate 1,000 times greater than ammonia and 6,000 times greater than the highest emitted volatile organic compound (1,1,1-trichloroethane). These results correlate well with expectations for landfill gas composition.

The other two sources, surficial soils and groundwater/leachate, are considered minor contributors to overall gaseous and volatile compounds in the air from the landfill. The EIFCs used to monitor emissions from the landfill would also capture volatile compound from each of these sources. The analytical data indicate that the volatile compounds detected in the surficial soils and the groundwater/leachate were also detected in landfill gas emissions from the EIFCs.

In on-site surficial soils (25 samples: SS-HA through -HG and SB-#S1, excluding off-site locations SB-123, -124, and -125), nine VOCs were detected (which were not due to blank contamination): acetone, benzene, 2-butanone, chlorobenzene, chloroform, ethyl benzene, styrene, toluene, and xylenes. Acetone was detected two times at concentrations of 22J, and 110 J μg/kg. Benzene was detected three times at concentrations of 9, 2J, 0.9 μg/kg. Chlorobenzene was detected four times at concentrations of 220, 170, 6J, and 1J μg/kg. Chloroform, 2-butanone, and styrene were only detected once at a concentration 1J, 6J, and 3J, respectively. Ethyl benzene was detected two times at concentrations of 120 and 20 μg/kg. Xylenes was detected two times at concentrations of 78 and 55 μg/kg. Toluene was detected six times at concentrations of 1J or 2J μg/kg. These data indicate that there are few volatile compounds present in the surficial soils, and where present, they are at relatively low concentrations. Therefore, the surficial soil is an insignificant source for volatilization to the atmosphere.

In the groundwater/leachate, five VOCs were detected most frequently: benzene, chlorobenzene, ethyl benzene, toluene, and xylenes. These monocyclic aromatic compounds all have partial solubility in water with benzene having the highest solubility of 1,791 mg/L and 1,3-xylene having the lowest solubility of 146 mg/L. Most of the samples in which one or more of these compounds were detected, had concentrations less than 25 μg/L, well below their saturation limits in water. Most of the volatilization that can occur from the groundwater/leachate, occurs within the landfill because of the favorable conditions (i.e., high temperatures). The temperatures within the landfill refuse are elevated (see Table 3-4 in Section 3.3.3.2), thus increasing the vapor pressure of the chemicals and enhancing volatilization. The organic compounds can also volatilize from the groundwater/leachate once they are exposed to the ambient air. The presence of wind and air currents at the water/air interface promotes volatilization.

The volatilization of landfill-derived contaminants via shallow groundwater/leachate that enters Eastchester Bay is considered a surface water pathway at that point, and is discussed in Section 5.3.2.1.1. Volatilization of contaminants via seeps is expected to be a minor contributor to air contamination from the landfill due to the small volume of groundwater that flows as seeps (less than 5,000 gallons/day) and the small mass of VOCs present in the seeps (less than 0.0007 lbs/day of which a small percentage will volatilize to the atmosphere).

5.2.3.1.2 Horizontal Migration

The presence of landfill gas in the soil adjacent to the landfill was evaluated during this RI. Two independent studies were conducted to evaluate the horizontal transport of gases from the landfill to offsite: the perimeter soil gas study described in Section 2.7.7 and the soil gas sampling study using EIFCs described in Section 2.7.2. The analytical data is discussed in Section 4.7.

The purpose of perimeter soil gas sampling was to evaluate off-site horizontal migration by estimating subsurface gaseous emissions potential using concentrations of methane and hydrogen sulfide as indicators. Methane is a simple asphyxiant, which in very high concentrations, can also be explosive. Measuring methane in relation to the LEL (Lower Explosive Limit) is a screening method for evaluating horizontal migration. Methane concentrations well below the LEL would indicate no horizontal migration at levels that would warrant concern based on explosivity or asphyxiation.

The perimeter soil gas study focused on sampling methane and hydrogen sulfide. Four on-site stations and two off-site stations to the south and west (approximatley 200 ft from the landfill boundary) showed only background levels of methane and hydrogen sulfide, indicating no horizontal migration of soil gas. At the northeast area of the landfill, three stations exceeded background levels for methane, but these readings may reflect vertical migration of methane due to decomposition of the refuse below rather than horizontal migration from other portions of the landfill.

The observation that landfill gases are not migrating horizontally offsite to the south and west is supported by the soil gas sampling study using flux chambers. The sample from the one off-site location to the south (AM-1) was found to contain methane at a concentration below the detection limit (usually < 1 $\mu g/m^2$-sec). Station AM-1's methane profile was similar to the methane generation at a leachate drainage canal (AM-A) and at a vegetated area (AM-F, a non-hotspot). These two sampling locations are expected to have low readings of methane. The remaining five on-site hotspot locations contained methane well above the detection limit (965 to 9,094 $\mu g/m^2$-sec). Figure 5-2 illustrates this trend for methane. This same pattern between AM-1 and the on-site locations was also observed for the other gases and volatile organic compounds. The emission rate for gases and volatile organic compounds is consistently lower at AM-1 than at the on-site locations.

The flux chamber data also showed that methane on the landfill is emitted at levels 1,000 to 10,000 times higher than the air toxics. Since the methane measured off-site is already below the level of detection (Table 4-80, Section 4.7.1), it suggests that horizontal migration of gaseous toxics in the soil is not substantial because it is one-thousandth to ten-thousandth of the methane concentration. Furthermore, there is no visual evidence off-site in Pelham Bay Park of vegetation that is stressed due to methane emissions or toxic emissions from the soil.

Therefore, off-site horizontal migration of soil gas is probably not occurring. This is consistent with and supported by visual observations of healthy vegetation, the limited perimeter and flux chamber sampling results and previous sampling.

5.2.3.2 Wind Erosion

Chemicals present in the soil which do not undergo vaporization, dissolution, or degradation remain in the soil pore space. The chemical molecules may be bound to the surface of the soil particles or complexed within the soil matrix. In the case of surficial soil, the contaminated particles and dust can become airborne due to wind transport and erosion.

The Pelham Bay Landfill is expected to have a low emission potential for fugitive dust and particulates because the surface is highly vegetated. At the top of the landfill, the surface is typically heavily vegetated with ground cover, stands of phragmites, reeds, and occasional trees. At lower elevations, the vegetation cover is much denser and higher than at the upper level. High dense stands of phragmites inhabit much of the fringe areas of the landfill toe.

The expected low emission potential of the landfill for dust and particulates is supported by the ambient air study. Average PM_{10} and metals concentrations were determined for eight on-site and off-site locations, and the results are presented in Table 4-81 in Section 4.7. A comparison of on-site and off-site concentrations indicates that off-site concentrations are about the same or slightly higher than on-site concentrations. A comparison of the individual metals shows the same result. This suggests that the observed concentrations of particulates and metals are related to regional sources, rather than the landfill.

Although some limited erosion and resuspension by wind of materials deposited on the landfill surface may occur, contaminant transport via fugitive dust does not represent a significant pathway based upon the monitoring data collected at the landfill.

5.3 FATE AND PERSISTENCE OF LANDFILL-DERIVED COMPOUNDS

Physical, chemical, and biological processes may affect the fate and persistence of contaminants in environmental media. For example, oxidation/reduction processes often play an important role in the migration of redox-sensitive compounds (e.g., iron and manganese), and microbial degradation can influence contaminant concentration of chlorinated organic compounds. In this section, the fate and persistence of contaminants in the groundwater, surface water, and air pathways, identified in Section 5.2, are discussed.

From the evaluation of the nature and extent of contamination (Section 4.0), a list of landfill-derived constituents was developed from on-site groundwater/leachate, soils, and air data, and is presented in Table 5-3. This list comprises those chemicals which were detected in groundwater/leachate in concentrations above drinking water standards, in on-site soils in concentrations above background, and in landfill gas emissions. This list provides an overview of the composition of the constituents potentially originating from the landfill.

5.3.1 Compound Fate and Persistence in the Groundwater Pathway

5.3.1.1 Fate Processes

This section reviews the fate processes which affect the constituents present in the groundwater pathway. Because most of the groundwater/leachate monitoring data was collected from wells at the perimeter of the landfill -- downgradient of the source areas

-- the observed leachate quality reflects the combined effects of the various physical, chemical, and biological processes controlling chemical fate. Section 5.3.1.2 summarizes the results and conclusions for the groundwater pathway.

Leaching

Dissolution of organic chemicals and metals in the landfill by infiltrating water is the principal means by which contaminants can enter the groundwater/leachate.

The presence of organic compounds in the groundwater/leachate is generally governed by the solubility of the chemical in water. Knowing the water solubility of a chemical compound can provide considerable insight into the fate and transport of the chemical in the environment. Water solubility values for the landfill-derived organic compounds are summarized in Table 5-4.

Highly water soluble chemicals have a tendency to remain dissolved in the water column, and not to partition to soil or sediments or bioconcentrate in aquatic organisms. They are also less likely to volatilize from water (depending on the vapor pressure, see 5.3.2.1.1 - Fate Processes for Surface Water) and are generally more likely to biodegrade. The classes of compounds which may be classified as highly water soluble chemicals are the volatile halogenated hydrocarbons, the phenols, and N-nitrosodi-n-propylamine (Table 5-4). The volatile non-halogenated hydrocarbons and the semi-volatile chlorinated hydrocarbons are of moderate solubility.

Chemicals with low water solubilities exhibit the opposite behavior. They tend to partition to soil or sediments, and frequently bioconcentrate in aquatic organisms. They also are more likely to volatilize from the water, and are less likely to be biodegradable. The classes of compounds which exhibit these properties are PAHs, phthalates, pesticides, and PCBs (Table 5-4).

The organic compounds in groundwater/leachate may be retarded in their transport through the landfill by interactions with the soil. The primary mechanism for these interactions is the formation of a hydrophobic bond between the organic chemical and the organic matter associated with the landfill. As indicated earlier, the organic contaminants that are likely to partition to the soil are chemicals with low water solubilities. Transport of heavy metals in groundwater may be retarded by precipitation or by surface phenomena, such as adsorption.

Because most of the groundwater/leachate monitoring data was collected at the perimeter of the landfill and the primary groundwater pathway ends at Eastchester Bay, retardation during groundwater transport is not likely to have a substantial effect on estimates of constituent loading for the groundwater pathway. Retardation will have some effect on reducing constituent concentrations in the shallow groundwater traveling from the western site perimeter to the tidal wetlands. This effect is not expected to be significant due to the limited area that groundwater travels before exiting into the wetlands. Adsorption of contaminants to soils/sediments as a method of removing chemicals from the aqueous phase is a significant fate process for the sediments of Eastchester Bay. This process is discussed in further detail and correlated to site-specific data in Section 5.3.2.2.

The characteristics of metals in aqueous solution are key to understanding their fate and transport in the environment. Factors which control the fate and transport of metals include flocculation and precipitation, adsorption, complexation, ion exchange, and oxidation/reduction behavior. Most metals analyzed, excluding those considered to be natural seawater constituents, were detected in the groundwater/leachate. The following is a brief review of the chemical and geochemical properties of the metals in the groundwater/leachate which provides a basis for understanding their nature in aqueous solutions and subsequent fate in the environment.

> **Antimony** (Sb) exists in the valence states of -3, 0, +3, and +5, with Sb(III) and Sb(V) the important oxidation states in aqueous solution. Antimony tends to form anions which are mobile in pH and redox conditions that exist in most natural waters. Sorption or co-precipitation of antimony onto hydrous iron and aluminum oxides appears to be important in removing antimony from solution (USEPA, 1979).
>
> **Arsenic** (As) occurs in nature in oxidation states of -3, 0, +3, and +5, with As(III) and As(V) oxyanions (oxygen-containing anions) the important valence states in aqueous solution. In oxidizing environments, the As(V) oxyanions are dominant, while in reducing environments the As(III) oxyanions dominate. Arsenic is mobile in aqueous solutions under alkaline conditions. Co-precipitation of arsenic with hydrous oxides of iron or aluminum, or sorption onto clays or organic matter, is important in removing arsenic from solution (USEPA, 1979).
>
> **Barium** (Ba) occurs primarily in the +2 valence state in aqueous solutions (Battelle, 1984). Barium concentrations in aqueous solutions are generally expected to be

controlled by sorption onto clay minerals, oxides, and hydrous oxides (Matthess, 1982).

Boron (B) occurs primarily in the +3 valence state, but commonly exists as the hydroxide form in aqueous solution. Boron in aqueous solutions exists as H_3BO_3 at pH values of approximately <9.2 and as $B(OH)_4^-$ at pH values >9.2. Most of the solid phases of boron are fairly soluble. Boron adsorption displays marked pH dependency with maximum adsorption occurring between pH 7.5 and 10 on clay minerals, aluminum and iron oxides, soil organic matter, and soils (USEPA, 1979).

Cadmium (Cd) occurs in aqueous solution as the +2 ion at pHs <8, whereas at higher pHs, cadmium carbonate or hydroxy complexes predominate. Cadmium is sorbed to hydrous oxides of iron, aluminum, and silicon; to organic matter; to clays; and to calcite. Along with sorption, the precipitation of $CdCO_3$ may control cadmium concentrations in natural waters.

Chromium (Cr) may exist in either the +3 or +6 oxidation state in natural waters. Chromium occurs as a cation in the +3 state under more reducing conditions, and as an oxyanion under more oxidizing conditions. Cr(III) readily sorbs to or is coprecipitated with hydrous iron oxides and manganese oxides; Cr(III) concentrations in water also may be controlled by precipitation of Cr_2O_3 at pHs >5. Cr(VI) is quite soluble and mobile in the aquatic environment, and is slightly sorbed by iron and aluminum oxides and clay minerals (Battelle, 1984). If aquatic conditions are highly oxidizing and favor Cr(VI), chromium will be more soluble; whereas if conditions favor Cr(III), then chromium will accumulate in sediments (USEPA, 1979).

Cobalt (Co) occurs in the divalent form and has a relatively low solubility. Cobalt is adsorbed by hydrous iron and manganese oxides, which together with the low solubility explains why cobalt usually occurs only in trace amounts, often below the level of analytical detection (Matthess, 1982).

Copper (Cu) exists in the +1 or +2 valence state. In oxidizing conditions at pHs up to about 7, Cu^{2+} is the dominant species, with copper hydroxide and carbonate species becoming important at higher pHs. Copper is relatively mobile in aqueous environments, partly because it readily forms complexes with soluble organic fractions which reduce its sorption. Under acidic, oxidizing conditions, Cu^{2+} is stable and relatively mobile (USEPA, 1979). Concentrations of copper in aqueous solutions of neutral and alkaline pH are controlled by sorption to and coprecipitation with hydrous oxides of iron and manganese, and by sorption to clays and particulate organic matter (Battelle, 1984).

Iron (Fe) exists in the +2 and +3 valence states. Fe(III) species are dominant under oxidizing conditions and Fe(II) species under reducing conditions. Iron concentrations in aqueous environments are expected to be controlled by precipitation/dissolution reactions. Metastable ferric hydroxide $Fe(OH)_3$ is the predominant complex existing in changing redox conditions, although other less soluble iron oxides and hydroxides may be present. Adsorption can be an important retention mechanism of iron at low pH or at low aqueous concentrations (USEPA, 1979).

Lead (Pb) exists primarily in the +2 oxidation state in natural aqueous environments. Under acidic conditions, the dominant species are lead salts, while lead carbonate species predominate at neutral and alkaline pHs. Lead exhibits very low mobility in most natural waters, due to its strong sorption to organic matter, clays, and oxides of manganese, iron, and aluminum; and due to the low solubility of lead sulfates, sulfides, carbonates, and phosphates (Battelle, 1984).

Manganese (Mn) exhibits +2, +3, +4, and +7 oxidation states, with the +3 and +4 manganese solids more stable in oxidizing conditions and +2 solids more stable in reducing conditions. Mn(II) predominates in aqueous solutions, although Mn(III) and Mn(VII) also occur in more oxidizing conditions. Under acidic, oxidizing conditions with sulfate present, manganese is relatively mobile and the Mn^{2+} and $MnSO_4$ ions are important, while at neutral and alkaline pHs, manganese carbonates and oxides precipitate and limit solubility (Battelle, 1984). Manganese also complexes with organic matter, and sorbs to clay minerals and hydrous iron oxides. In comparison with aqueous species of iron, Mn^{2+} is stable over a wider range of pH and redox conditions (Hem, 1985), and thus detectable concentrations of manganese may persist after much of the iron oxidizes and precipitates out of solution.

Mercury's (Hg) valence state depends on the pH and redox conditions of the environment. Mercury can be relatively mobile under oxidizing conditions in the aqueous environment, because it forms soluble complexes with soluble organic fractions and with halides (iodide, chloride, bromide). Under reducing conditions, mercury concentrations in aqueous solution may be controlled by the formation of native mercury or Hg(I) sulfides (Battelle, 1984). Mercury sorbs strongly to organic material as well as to oxides of manganese and therefore is expected to concentrate in sediments (USEPA, 1979).

Selenium (Se) exists in natural aqueous environments in -2, +4, and +6 valence states. Most of the selenium species in the environmental Eh and pH range (4 to 10) exist as anions. Although some of the studies indicate precipitation may occur, no definitive information on solubility-controlling solids is available. Maximum adsorption of selenate and selinite occurs primarily through specific adsorption in the acidic pH range on geologic materials enriched in hydrous oxides of Al and Fe or amorphous aluminosilicates (USEPA, 1979).

Thallium (Tl) exists in the +1 and +3 oxidation states, with the +1 state more stable in water. Thallium is expected to behave similarly to lead in the aquatic environment, based on similar metallic and covalent radii. Thallium forms soluble salts with many ligands in aerobic waters but can be removed from solution by sorption onto clay minerals or organic material, or by precipitation as the sulfide under reducing conditions (USEPA, 1979).

Zinc (Zn) is present in the +2 oxidation state in aqueous solutions. At pHs up to about 8, zinc occurs in aqueous solution as Zn^{2+} (and zinc sulfate species if sulfate is present), whereas at higher pHs, zinc carbonate and zinc hydroxide species predominate (Battelle, 1984). Zinc is relatively mobile in oxidizing conditions but is precipitated as the sulfide in reducing environments. Zinc is sorbed onto hydrous oxides of manganese and iron, organic material, and clay minerals. At high concentrations, precipitation of zinc hydroxides, carbonates, or sulfates may limit aqueous zinc concentrations (USEPA, 1979).

As most of the data suggests, many of the metals are soluble and mobile in aqueous solutions in a variety of ionized or complexed forms. They may exist as hydrates, salts, oxides, or complexed with organic ligands. The salinity of the seawater will also greatly affect the state of the metal (e.g., precipitation). Many of the metals are expected to be adsorbed onto clay minerals, aluminum and iron oxides, and organic matter.

For the conditions at the Pelham Bay Landfill, all of the metals described above with the exception of boron, would be expected to adsorb to some extent to the surrounding sediments. Some of the metals which are known to have a high tendency for adsorption and precipitation are arsenic, barium, cadmium, chromium (+3), cobalt, copper, iron, lead, manganese, mercury, and zinc. The process by which adsorption occurs for metals and its effect on the sediments are further discussed in Section 5.3.2.2. Metals may also be present adsorbed onto particulates, or may flocculate and precipitate. These processes are further discussed in Section 5.3.2.2.

Biodegradation

Organic compounds represent potential energy sources for microbes, and biodegradation represents an important fate process for many chemicals in the environment. Indigenous microbial communities have the capacity to degrade many compounds *in situ*. Organic compounds may be completely degraded, converted to non-toxic forms, or in some cases, converted to more toxic or mobile species.

In the early active life of a landfill, decomposition of the waste occurs via an aerobic process. Aerobic biodegradation will continue until the air is displaced by waste and the oxygen is used up. Once the oxygen is depleted, anaerobic conditions prevail. Anaerobic biodegradation is characterized by the production of methane (Emcon Associates, 1980). At the Pelham Bay Landfill, biodegradation is most likely occurring via anaerobic processes due to the age of the landfill as confirmed by methane monitored in the air investigation (see Section 4.7).

Conventional aerobic biodegradation involves the oxidation of organic chemicals to give carbon dioxide and water. The aerobic degradability of some of the organic compounds found in the groundwater/leachate is defined below (Zitomer, *et al.*, 1993):

- Readily biodegradable - benzene, toluene, xylenes, naphthalene
- Moderately biodegradable - 2-propanone, ethyl benzene
- Slightly biodegradable - phenanthrene

- Non-biodegradable - chloroform; 1,2-dichloroethylene; chlorobenzene; 1,3-dichlorobenzene; 1,4-dichlorobenzene

Conventional anaerobic biodegradation involves the conversion of organic compounds to methane, carbon dioxide, and other inorganic products. Most of the organic compounds found in the groundwater/leachate are relatively resistant to conventional anaerobic biodegradation (i.e., aromatic hydrocarbons, phthalates, and phenols). The chlorinated hydrocarbons, pesticides, and PCBs may be more conducive to anaerobic reductive dehalogenation.

The rate of biodegradation of any time is a function of numerous factors which include:

- Moisture content of the refuse
- Temperature conditions in the landfill
- Quantity and quality of nutrients
- pH of groundwater/leachate within the landfill

Although no specific study was conducted to determine biodegradation in the landfill, anaerobic degradation is believed to be a currently active process. The data which support this conclusion are high methane production, favorable landfill temperature of 32 to 51 °C (see Table 3-4), favorable pH range (see following discussion), and moisture in the subsurface, especially in the saturated zone.

pH

In an aqueous system, the optimum pH for aerobic and anaerobic biodegradation is about 7.0 to 7.2. Biodegradation will proceed in a pH range of 6.5 to 8.0, but when the pH drops below 6.0 to 6.5, the bacteria may be adversely affected. The lower the pH, the greater the decrease in microbial activity. If pH control is not in place, then the process may not be operating under optimum conditions (Emcon Associates, 1980).

Most landfills have an acidic environment initially, but within the first several years, the pH rises toward neutrality (Emcon Associates, 1980). This is a result of the decrease in oxygen, increase of carbon dioxide due to anaerobic biodegradation, and formation of bicarbonate ion in the groundwater/leachate. This trend is illustrated in the graph shown in Figure 5-3. The presence of significant alkalinity will tend to buffer the system, minimizing sudden changes in pH, and stabilizing the biodegradation process.

Samples from 28 of the monitoring wells out of 32 had pHs in the range of 6.65 to 7.99. Three of the off-site wells (MW-116B, -124B, and -125B) had pHs outside of this range at values of 9.86, 8.86, and 6.3, respectively. The well at the center of the landfill (MW-126) had a pH of 8.38. This information is summarized in Table 5-5. Most of the on-site monitoring well samples had pH values which would favor biodegradation.

The monitoring wells showed a wide range of alkalinity as bicarbonate (Table 5-5). When the bicarbonate alkalinity drops below about 500 mg/L and carbon dioxide levels in the gases are normal (e.g., about 50%), the pH will drop close to 6.0 (Emcon Associates, 1980). This effect may be counteracted by the presence of ammonia from nitrogenous organic waste in the landfill. The neutralization of the organic acids by ammonia will stabilize the pH and produce ammonium ion. As shown in Table 5-5, nitrogen as ammonium ion was detected at a high frequency (28 out of 34 samples) and was above the NYSDEC standard of 2 mg/L in 22 samples.

5.3.2 Compound Fate and Persistence in the Surface Water Pathway

In parallel with Section 5.2.2, this section will discuss the fate and persistence of contaminants in the surface water pathway which address the following media of concern:

- Surface water
- Sediments
- Biota

5.3.2.1 Surface Water

5.3.2.1.1 Fate Processes

At this site, the landfill-derived constituents that may be present in the groundwater/leachate will be substantially attenuated when they enter the surface water due to dilution and dispersion. It is difficult to distinguish the extent to which sampled surface water reflects contaminants from Pelham Bay Landfill because there are numerous other contributors of contaminants to Eastchester Bay. An evaluation of the surface water monitoring data, surface water modeling results, and the groundwater/leachate chemistry is presented in Section 5.3.2.1.3.

Some of the processes affecting the fate and persistence of surface water contaminants are volatilization, biodegradation, hydrolysis, adsorption to sediments, and uptake into organisms. These processes are common to those constituents that are landfill-derived as well as those from other sources. Adsorption of contaminants in the surface water to sediments and food chain transfer to biota are described in Sections 5.3.2.2 and 5.3.2.3, respectively, in order to examine these processes in more detail using site-specific data. Volatilization, biodegradation, and abiotic degradation of contaminants in the surface water are discussed in this section.

Volatilization

For many chemicals, volatilization can be the major route of removal from surface waters. The volatilization process is dependent on the physical properties of the chemical (e.g., Henry's Law constant), the presence of modifying materials (e.g., adsorbents, electrolytes), and the physical and chemical properties of the environment (e.g., water depth, flow rate).

The Henry's Law constant (H) is a value which represents the tendency of a chemical to volatilize from solution, and therefore, can give qualitative indications of the importance of volatilization. Table 5-6 lists the H values for the organic chemicals that may be landfill-derived. For chemicals with values less than 10^{-7} atm-m^3/mole, the chemical is less volatile than water and will typically remain in solution. For chemicals, with values around 10^{-3} or greater, volatilization will be rapid. For the chemicals on Table 5-6, this includes most of the volatile halogenated and non-halogenated hydrocarbons. Organic chemicals in the middle range of 10^{-3} to 10^{-7}, include some of the PAHs, phthalates, semi-volatile chlorinated hydrocarbons, pesticides, and PCBs. These classes of compounds are not likely to substantially volatilize. However, they may be subject to the other fate processes, such as adsorption or biodegradation, which are discussed in other sections.

For the Pelham Bay Landfill, this data indicates that the majority of VOCs entering the surface water from the landfill (i.e., groundwater/leachate) will be removed by volatilization to the atmosphere. This conclusion is supported by the surface water monitoring data which showed no VOCs in any of the samples.

Biodegradation

Biodegradation of organic chemicals within Pelham Bay Landfill was previously discussed in Section 5.3.1.1. Biodegradation of contaminants is also a dominant degradation process in the surface water of Eastchester Bay which reduces the concentration of landfill-derived constituents.

Many organic chemicals are susceptible to aerobic and anaerobic biodegradation by microorganisms. The degree of transformation varies from compound to compound, with some undergoing complete mineralization. The rate of mineralization is directly proportional to the chemical concentration over a wide range (Alexander, 1985). When the concentration is quite high, diffusion will provide molecules to the cell surface at a rate that is rapid enough to meet the organism's needs for maintenance and growth. At lower concentrations, the needs for maintenance, but not for growth, are satisfied by diffusion of the molecules. At still lower levels, if a species is unable to use the contaminant or is unable to use the organic matter present in the natural environment, neither needs are met. Some organic chemicals may be completely resistant to microbial attack or only mineralizable at high concentrations.

Listed below are some of the microorganisms that are found in common marine estuaries (Atlas, 1981; Day, 1989; Stanier, 1984). The habitat and accumulation of organic materials usually observed in estuaries tend to favor complex microbial interactions and high rates of microbial metabolism. These microorganisms may be found in Eastchester Bay. The consortium of microorganisms have the ability to degrade and mineralize a wide variety of organic chemicals, including many of those detected in the groundwater/leachate as listed in Section 5.3.1.1.

Bacteria: *Alteromonas haloplanktis*
Pseudomonas marina
Nitrosomonas, Nitrosococcus, Nitrospina, Nitrococcus, Nitrobacter (nitrogen recycling)
Desulfovibrio (sulfur recycling)
Trichodesmium (cyanides)

Fungi: *Candida, Torulopsis, Cryptococcus, Trichosporon, Saccharomyces, Rhodotorula, Rhodosporidium*

Algae: Members of Chlorophycophyta, Euglenophycophyta, Phaeophycophyta, Chrysophycophyta, Cryptophycophyta, Pyrrophycophyta and Rhodophycophyta

Protozoa: *Coccolithophoridae, Radiolaria, Acantharia, Tintinnidium*

For the Pelham Bay Landfill, biodegradation is an ongoing process and a mechanism of natural attenuation for contaminants in Eastchester Bay. The rate of biodegradation in the bay cannot be quantified, but typically aerobic biodegradation in surface water occurs over a period of days to months. The more readily biodegraded compounds (e.g., volatile aromatic hydrocarbons) may be biodegraded before they are ultimately flushed from the bay.

Abiotic Degradation

Non-biological degradation processes also contribute to the attenuation of contaminants in the surface water. Two major abiotic processes are hydrolysis and photolysis. These and other chemical transformations are usually specific for certain classes of compounds.
Hydrolysis is the reaction of an organic compound with a water molecule. Hydrolysis at pHs that are normally found in the environment (pHs 5 to 9) is important for chemicals that have hydrolyzable functional groups, such as a carboxylic acid ester or an alkyl halide. The organic compounds detected in the groundwater/leachate that are likely to be affected by hydrolysis are listed in Table 5-7 with their corresponding hydrolysis half-lives. For some of the chlorinated hydrocarbons, the half-lives are in the range of 7 to 12 months; others are in the range of tens to thousands of years. Therefore, hydrolysis is expected to have little effect on most of the compounds within the residence time of water in the bay.

If a chemical absorbs light at wavelengths provided by sunlight (>290 nm), the chemical can directly photolyze. Once an electronically excited state is formed, the molecule may photodegrade through a unimolecular process. For some chemicals in water, indirect photolysis processes may be important. For example, some chemicals can undergo sensitized photolysis by absorbing triplet state energy from other light absorbing organic substances found in natural water, such as humic acids. Also, transient oxidants (e.g., peroxy radicals, singlet oxygen) may contribute to photolytic degradation for some chemicals.

The half-lives for photolysis are presented in Table 5-8. These half-lives are usually based on measured or estimated rates of photolysis of compounds in solution (aqueous or solvent) and if necessary, adjusted to reflect environmental conditions. The photolytic half-life is often used to represent both aqueous and atmospheric rates. Most of the compounds listed in Table 5-8 have half-lives on the order of days to years. Therefore, photolysis will attenuate the concentrations of some landfill-derived contaminants and may reduce long-term accumulation.

5.3.2.1.2 Surface Water Modeling

A one-dimensional analysis following the approach described by Fischer *et al.* (1979) was used to predict the concentration of leachate constituents in surface water at points upstream and downstream from the landfill. The one-dimensional analysis uses the distribution of ambient salinity as an indicator of dilution and dispersion, assuming that salinity at any point along the estuary results from the mixing of freshwater tributary flow and ocean water. In the case of Eastchester Bay, water from Long Island Sound, as opposed to ocean water, was used as the downstream source of water for the bay.

The use of a one-dimensional model is usually acceptable if:

- The time scale across the estuary is significantly less than the time required for the effluent to pass out of the estuary (or into a section of greatly changed cross-section)
- The estuary is not significantly stratified
- Allowance is made in the analysis for higher concentrations expected near the source before cross-sectional mixing takes place

The dye study (see Section 3.5) showed that dye entering Eastchester Bay from the landfill is transported throughout the bay within about 2 tidal cycles (about 1 day). Based on these results, it appears that lateral transport is relatively rapid. The time required for the effluent to pass out of the estuary (flushing time) is about 3.5 days, as discussed in Section 5.2.2.2.2. The time scale across the estuary, therefore, is significantly less than the flushing time.

Field measurements presented in Section 3.5 showed that the estuary was not stratified. Little variation in salinity, temperature, or current was observed vertically in the water column in the estuary.

Higher concentrations are expected near the source, as the model assumes a completely mixed scenario. Water samples collected in the field were used to address potentially elevated constituent concentrations in Eastchester Bay near the Pelham Bay Landfill. These were discussed in Section 4.4.

The following simplifications are made in the one-dimensional analysis:

- Salinity is representative of steady-state conditions. This is usually not a valid assumption; however, a conservative approach was taken in the selection of salinity values and model leachate flow inputs, as discussed below

- The model does not include constituent contributions from other discharges in the system, or background concentrations

- The results are valid only for conservative constituents. Therefore, for non-conservative constituents, i.e., constituents that can decay or partition, the model will overestimate the average concentration of constituents in the water column

- As noted above, the results provide cross-sectional averages as opposed to peak concentrations

The salt balance in the estuary may be shown as:

$$Q_o S_o = (Q_o + Q_l + Q_f)S$$

Q_o = the circulating flow of ocean water
S_o = Long Island Sound salinity = 26.5 o/oo
Q_l = leachate flow = 75,000 gal/day = 0.116 cfs
Q_f = tributary discharges upstream from the site discharge = 7.17 cfs
S = salinity in the combined flows = 23 o/oo

Salinities in Long Island Sound (Hardy, 1972) and off the south coast of Long Island (Hydroscience, 1974) vary between 26.5 and 28.5 o/oo (EPA, 1982). The salinity of the estuary (S), ranged from 23 o/oo to 24.5 o/oo in the field studies described in Section 3.5. As a conservative approach, S and S_o values of 23 o/oo and 26.5 o/oo, respectively, were used in the model. These values resulted in a higher average modeled constituent concentration in the estuary. The shallow groundwater/leachate flow discussed in Section 5.2.1.1 was estimated at 50,000 to 75,000 gal/day. Additional conservatism was incorporated into the model by using the maximum estimated groundwater/leachate flow (resulting in a conservatively high constituent loading to the bay).

Solving for Q_o results in the following relationship:

$$Q_o = (Q_l + Q_f)S/(S_o - S)$$

The total flow (Q_d) available for diluting the effluent is:

$$Q_d = Q_o + Q_l + Q_f = (Q_l + Q_f)S_o/(S_o - S) = 37.8 \text{ cfs}$$

The mean concentration of leachate near the point of discharge can be estimated from:

$$C_d = M/Q_d$$

$$\text{where } M = C_l Q_l$$

M = the discharge rate of a constituent in units of mass per unit time
C_d = mean concentration of the constituent in the estuary
C_l = concentration of the constituent in the leachate

Assuming a 75,000 gal/day discharge of leachate from the site (0.116 cfs), the above equation simplifies to:

$$C_d = 0.0031\ C_l$$

Model parameters for constituent contribution from the landfill were developed from a compilation of all on-site shallow monitoring well and seep sample analyses. The 95% upper confidence limit of the mean was used for the leachate constituent concentration, C_l. This provided a conservative approach for selecting model parameters. The model parameters and results are presented in Table 5-9. A primary limitation of the model is that the output represents steady-state constituent concentrations assuming complete mixing across the bay. Near the discharge locations, the peak ambient concentrations can greatly exceed the model-generated average values. The peak constituent concentration in the near-field area (as one progresses away from the landfill in an upstream or downstream direction) theoretically will be less than the leachate concentration and greater than or equal to the mean concentration in the estuary. Surface water samples collected adjacent to the landfill provide a better indication of constituent concentrations in the near-field area than the model results.

In addition to the physical hydraulic and dispersive transport processes described above, other processes will also play a role in the fate of constituents that enter the estuary in the landfill groundwater/leachate. These include those fate processes discussed in Section 5.3.2.1.1. The modeling produces the steady-state concentrations of a conservative constituent. Other fate processes that might further reduce the concentration of a constituent in the water column have not been taken into account.

5.3.2.1.3 Evaluation of Surface Water Monitoring Data

The results of the surface water model (Table 5-9) were compared to surface water monitoring data collected adjacent to the landfill (Table 4-38). The average constituent concentrations predicted by the model are generally equal to or less than the near-field surface water monitoring results, consistent with expectations for the model. The higher monitored concentrations in the near-field may be caused by limited dilution relative to that predicted by the model, or by other sources in the Eastchester Bay system that may contribute to *in situ* constituent concentrations.

The model-generated surface water concentrations were also compared to the NYSDEC surface water quality standards for Class SB saline waters (see Table 5-10). The predicted average values do not exceed NYSDEC surface water quality standards. Peak concentrations of constituents adjacent to the landfill can exceed model-generated values. Surface water samples collected adjacent to the landfill provide an indication of constituent concentrations in this area (see Section 4.4).

In order to evaluate further the potential impact of landfill groundwater/leachate on near-field Eastchester Bay water quality, constituent concentrations in groundwater/ leachate were compared to surface water concentrations adjacent to the landfill. To ease comparison of the monitoring well and seep sample data with surface water sample data, the landfill was divided into two sections: the east seawall and the south seawall. The monitoring well and seep sample locations comprising the east seawall were MW-103, -104, -105, -112, -113, -119, -120, -121, -122, LS-7, -9, and -10. Data from these locations were compared to surface water samples SW-1, -2, and -3. The monitoring well and seep sample locations comprising the south seawall were MW-106, -107, -110AR, -118AR, LS-1, and LS-5. Data from these locations were compared to surface water samples SW-4, -5, and -6.

The means of constituent concentrations in the monitoring wells and seeps along the south and east seawalls were compared with the mean of the adjacent surface water samples collected during both low and high tide. Data for the south and east seawalls are presented in Tables 5-11 and 5-12, respectively. The following processes were used in evaluating these data:

- If the constituents were detected in the groundwater/leachate and not in the surface water, this suggests that the constituents were rapidly attenuated through dilution in Eastchester Bay. Other fate processes, such as volatilization for the VOCs may also play a role. The landfill does not appear to be producing a measurable effect on surface water quality for these constituents.

- Where constituents were detected in the surface water at lower concentrations than in the groundwater/leachate, surface water concentrations were compared to reference samples SW-9L and SW-9H. If the concentrations were approximately equal to the reference values, this suggests that the constituent is ubiquitous throughout the Eastchester Bay system, and are not considered elevated as a result of landfill inputs.

- If the constituents in the surface water samples were less than the groundwater/leachate concentrations but greater than the reference samples, then the landfill may be contributing to the elevated concentrations.

- Where constituents were detected in higher concentrations in the surface water than in the groundwater/leachate, then the landfill may be contributing to loadings to the bay, but other sources are primarily responsible for the elevated concentrations of these constituents in the surface water samples.

In monitoring well, seep, and surface water samples for both the east and south seawalls, calcium, magnesium, potassium, and sodium were relatively high as compared to the other constituents, probably due to the saltwater influence on these samples. These constituents are not included in the following discussion.

A comparison of landfill groundwater/leachate and surface water concentrations is shown in Table 5-11 for the south seawall. The landfill potentially contributes to elevated concentrations of bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, aluminum, copper, iron, lead, nickel, and vanadium. Mercury was higher in the surface water than in the leachate samples, suggesting that other sources in addition to the landfill are contributing to elevated mercury concentrations. The average pyrene concentration in the surface water was greater than the groundwater/leachate by a factor of three. However, pyrene was not measured in the other surface water samples adjacent to the landfill or in reference samples. This suggests that the landfill may be providing a localized contribution to the pyrene measured along the seawall, though other sources could potentially play a role. The pesticide alpha-BHC was detected in the surface water samples, but not in the groundwater/leachate, suggesting that other sources are the primary contributors to its presence. Barium and manganese were detected in the surface water samples, but concentrations were similar to those at the reference locations. Concentrations of other constituents were below detectable levels in the surface water samples.

A comparison of landfill groundwater/leachate and surface water concentrations is shown in Table 5-12 for the east seawall. The landfill groundwater/leachate potentially contributed to elevated levels of alpha-BHC, delta-BHC, iron, lead, and nickel. As was observed for the south seawall, mercury was higher in the surface water than in the leachate samples, suggesting that other sources are contributing to observed surface water concentrations. Endosulfan sulfate was detected in the surface water samples, but not in the groundwater/leachate, suggesting that other sources are the primary contributors to its presence. Concentrations of other constituents were below detectable levels in the surface water samples.

5.3.2.2 Sediments

5.3.2.2.1 Fate Processes

Adsorption of organic compounds and metals is a major process of removal for contaminants in the aqueous phase. Sediments surrounding the Pelham Bay Landfill have the potential for adsorbing landfill-derived contaminants. It should be noted however, that these same sediments also have a potential for adsorbing contaminants that may be present in the surface water from other sources.

This section reviews the soil properties and physicochemical properties that affect adsorption. The site-specific properties are based on geotechnical data from the sediment sampling locations surrounding the landfill (SD-1 to SD-6).

Soil Particle Size

Particle size can be used to distinguish between the sediment types present near the landfill and to obtain a rough estimate on the potential for adsorption. A summary of the percentage of fines and sands found at the sediment sampling locations is presented in Table 5-13. A detailed grain size profile is provided in Table 3-19 in Section 3.6.1. Sediments with a large percentage of fines have a greater surface area for adsorption, and are usually composed of more organic matter than sands. As a result, the percentage of fines is sometimes used as an indicator of the amount of organic carbon in the sediment.

Organic Carbon Content

Organic carbon content (%OC) is an important site-specific parameter for the prediction of adsorption of organic compounds to sediments and soils. Organic sorption occurs by formation of a hydrophobic bond between the chemical and the naturally occurring organic matter associated with the sediments. Inorganic compounds tend to be less affected by the organic carbon content than by other surface phenomena. For metals, surface complexation, such as ion exchange reactions, control metal partitioning.

The %OC was measured during the field investigations and is presented in Table 5-13. The %OC of the sediment surrounding the landfill (SD-1 to SD-6) has a median value of 2.1%, a moderate value. The partitioning of a contaminant between the sediment and water can be estimated by using the %OC and the organic carbon/water partitioning coefficient to generate the overall sediment/water distribution coefficient.

Organic Carbon/Water Partitioning Coefficient

This parameter indicates the tendency of a hydrophobic organic chemical to partition between particles containing organic carbon and water. The partition coefficient (Koc) is defined as the ratio of adsorbed chemical per unit weight of organic carbon to the aqueous solute concentration. Chemicals with high Koc values tend to be adsorbed onto organic rich soil/sediments and characteristically have low solubilities. Chemicals with low Koc values have low tendencies to adsorb to soil/sediments and usually have high solubilities in water.

Table 5-14 lists the organic chemicals detected in sediments and their corresponding Koc values. Table 5-15 lists the organic chemicals detected in the groundwater/leachate and their corresponding Koc values. These Koc values are used to estimate the distribution coefficient.

Distribution Coefficient

The distribution coefficient (Kd) is used to estimate the partitioning of a chemical between the soil or sediment and the pore water. Kd is defined as the mass of the chemical on the solid phase per unit mass of solid phase, by the concentration of the chemical in solution (mL/g). Kd is both a site-specific and compound-specific parameter in that it is calculated by the following equation:

$$\text{Kd} = \text{Koc} \times \%\text{OC}$$

The Kd values indicate whether an organic chemical will tend to adsorb to the sediments of Eastchester Bay or remain dissolved in the water column. The Kd values for the Pelham

Bay Landfill were calculated using the median value of 2.1% organic carbon content for the sediments nearest to the landfill.

For Kd values between zero and 1.0 mL/g, chemicals will partition to the liquid phase and have little tendency to adsorb to sediments. For Kd values between 1 and 10 mL/g, chemicals have limited tendency to adsorb to sediments. For Kd above 10 mL/g, chemicals tend to partition to the solid phase. For Kd values that are orders of magnitude larger than 1 (> 100 mL/g), chemicals have a strong tendency to bind to sediments, and are tightly bound in the solid phase.

Table 5-14 lists the organic chemicals detected in sediment samples and their corresponding Kd values. As expected, all of the organic chemicals detected in the sediments except 2-propanone, have Kd values >25. (2-Propanone or acetone is a common laboratory contaminant and is believed to be an artifact of the laboratory analysis.)

Table 5-15 lists the organic chemicals detected in the shallow monitoring well and seep samples and their corresponding Kd values. Based on the Kd values, PAHs, phthalates, pesticides, and PCBs detected in the groundwater/leachate are expected to partition from the water to the sediments, while the VOCs, phenols, ethers, semi-volatile chlorinated hydrocarbons, amines, and benzoic acid are expected to remain in the water column. This expectation is supported by the sediment analytical results which show no detections of the above classes of compounds. The fate of compounds expected to remain in the water is described for constituents in surface water in Section 5.3.2.1.1.

The evaluation of whether the PAHs, phthalates, pesticides, and PCBs found in the sediment are derived from the groundwater/leachate originating from the landfill, is described in Section 5.3.2.2.2.

Precipitation/Flocculation

The transition from freshwater to saltwater causes both physical and chemical changes in the dissolved and suspended content of waters. The most important physical effect is flocculation, the process by which materials aggregate or coalesce into small lumps or loose clusters. Clay minerals, organic matter, and colloidal hydroxides of several metals all tend to form stable suspensions in freshwater, but tend to flocculate and sink in seawater (Drever, 1982). Dissolved trace elements undergo varying degrees of recycling, although most of them are ultimately removed to seafloor sediments (Kennish, 1992). This recycling involves removal of metals from solution by co-precipitation with particulate matter or adsorption onto particle surfaces and their subsequent deposition.

Chemical interactions between sediments and water in estuaries are not well understood. Some species, such as organic matter and metal hydroxides, which are operationally defined as dissolved in water from sources entering the estuary (passing through a 0.45 μm membrane filter), are in fact present as fine colloids. These colloids can flocculate and precipitate. The colloidal material that is flocculated in an estuary contains mostly heavy metals, both natural and anthropogenic. Estuarine sediments often contain high concentrations of heavy metals, notably cadmium, chromium, copper, lead, and zinc (Drever, 1982). This behavior is expected based on the chemical and geochemical properties of the metals as previously described in Section 5.3.1.1. As that section concluded, many of the metals found in the groundwater/leachate are expected to adsorb to some extent to Eastchester Bay sediments. An evaluation of the chemistry of Eastchester Bay sediments versus the chemical profile for groundwater/leachate is discussed in the next section.

5.3.2.2.2 Evaluation of Sediment Monitoring Data

Constituent concentrations in groundwater/leachate were compared with sediment concentrations adjacent to the landfill. Using a similar approach as the surface water analysis, the landfill was divided into two sections: the east seawall and the south seawall. The groundwater monitoring wells and leachate sample locations comprising the east seawall were MW-103, -104, -112, -113, -121, -122, and LS-10. These locations are the closest to the east seawall sediment stations, SD-1, -2, and -3, and are likely to have the greatest impact on the sampled sediments. The groundwater monitoring wells and leachate sample locations comprising the south seawall were MW-106, -107, -110AR, -117, -118AR, LS-1, and LS-5. Data from these locations were compared to sediment samples SD-4, -5, and -6.

The means of constituent concentrations in the monitoring wells and seeps along the east and south seawalls were compared with the mean of the replicates from the adjacent sediment samples. Data for the east and south seawalls are presented in Tables 5-16 and 5-17, respectively. The following processes were used in evaluating these data:

- If the constituents were detected in groundwater/leachate and not in the sediments, this suggests that the constituents are not adsorbing to the sediments of Eastchester Bay. The constituents, instead, remain dissolved in the water. This conclusion should be supported by the water solubility and Kd value of the constituent given in Tables 5-4 and 5-15, respectively.

- Where constituents were detected in the sediments adjacent to the landfill and in the groundwater/leachate, these values were compared to the reference station SD-9. If the concentrations were approximately equal to the reference value, this suggests that the level of the constituent in the sediments is ubiquitous throughout the Eastchester Bay system. Therefore, these constituents were not identified as being elevated as a result of landfill inputs.

- If the constituents in the sediment samples adjacent to the landfill were greater than the reference sample, then this indicates that the landfill may be contributing to the elevated concentrations.

- Where constituents were detected in the sediment samples and not in the groundwater/leachate samples, then this suggests that there are other sources that are contributing to the observed concentration of these constituents in the sediments. It may be that these constituents are ubiquitous to the Eastchester Bay system, if the sediment sample concentration is comparable to the reference station concentration.

In monitoring well, seep, and sediment samples for both the east and south seawalls, calcium, magnesium, potassium, and sodium were relatively high as compared to the other constituents. This is likely due to the saltwater influence on these samples. Therefore, these constituents are not included in the following discussion.

The comparison of groundwater/leachate and sediment concentrations is shown in Table 5-16 for the east seawall. The landfill groundwater/leachate potentially contributed to elevated concentrations of 2-propanone, acenaphthene, fluorene, di-n-butyphthalate, 4,4'-DDD, 4,4'-DDE, delta-BHC, and selenium. The pesticide, 4,4'-DDT, was detected in the sediment samples, but not in the groundwater/leachate samples, suggesting that the presence of 4,4'-DDD and 4,4'-DDE could be from the breakdown of 4,4'-DDT in the sediments rather than from adsorption from the groundwater/leachate. For the remaining constituents which were detected in sediment samples, their concentrations were comparable to the reference station concentration, and in the majority of cases, the concentration of the constituent in the sediments adjacent to the landfill was lower than that at the reference station. Concentrations of other constituents were below detectable levels in the sediment samples.

A comparison of groundwater/leachate and sediment concentrations is shown in Table 5-17 for the south seawall. The landfill groundwater/leachate potentially contributed to elevated concentrations of 2-methyl naphthalene, acenaphthene, anthracene, dibenzofuran, fluorene, naphthalene, phenanthrene, pyrene, di-n-butyl phthalate, di-n-octyl phthalate, bis(2-ethylhexyl)phthalate, 4,4'-DDD, and Dieldrin. The constituents, 2-propanone, endosulfan sulfate, and selenium, were detected in sediment samples, but not in the groundwater/leachate samples. For these three constituents, other sources of contamination are the primary contributors to their presence in sediments. In contrast to the east seawall, a number of constituents were detected in elevated concentrations in the sediments adjacent to the landfill when compared to the reference station, but were not detected in the landfill groundwater/leachate. These constituents are benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, and butyl benzyl phthalate. Because these constituents were not detected in the groundwater/leachate samples, other sources are likely contributing to the observed sediment concentrations. The south seawall eddy cove is a depositional area for sediment accumulation. It is likely that sediments impacted by other sources could be transported and deposited in the south seawall eddy cove. For the remaining constituents which were detected in sediment samples, their concentrations were comparable to the reference station concentration. Again, in the majority of cases, the concentration of the constituent in the sediments adjacent to the landfill was lower than that at the reference station. Concentrations of other constituents were below detectable levels in the sediment samples.

5.3.2.3 Biota

5.3.2.3.1 Fate Processes

The uptake of contaminants from the surface water and sediments by biota depends on many factors. In aquatic systems, the availability of a contaminant to organisms (e.g., fish) depends upon the physicochemical properties of the contaminant and biological factors.

The uptake of water-borne organic chemicals is by absorption of the contaminant through the organism's lipid-water system. Physicochemical properties of an organic chemical that are important in determining biological activity and fate include electronic, hydrophobic, and steric factors. Steric parameters of molecular size and shape of some hydrophobic chemicals can impede or inhibit uptake and accumulation (Barron, 1990). Physiological controls of uptake for organic chemicals include the permeability of the plasma membrane in the gills and skin, movement of the chemical from water through diffusion barriers (mucus, membranes) and transport by the blood to lipid rich tissues (Barron, 1990).

Physicochemical factors which affect metal availability are the speciation of the ionic metal forms, and the relative distribution of metals between soluble and particulate fractions. Biological factors which affect metal availability include species-specific differences like feeding behavior, feeding habits, and habitat preferences. These are modified by physiological factors such as accumulation rates and the binding capacity of the metals in an animal, as well as by influences like temperature (Dallinger, *et al.*, 1987).

Elevated concentrations of contaminants in organisms compared to environmental concentrations may not always signal food-chain transfer. Elevated levels of a chemical in aquatic fish can occur by direct concentration of the contaminant from the water, soil, or sediments rather than through the food chain (USEPA, 1989b).

Bioconcentration factors (BCFs) have been developed to help evaluate the potential impacts of contaminated media on biota. The BCF is the ratio of the concentration of a contaminant in the organism to the concentration in the medium in the immediate environment. For aquatic species, BCFs greater than 300 are generally considered significant (USEPA, 1989b).

The BCFs for selected compounds of ecological concern and species specific for the Eastchester Bay estuary are presented in Table 5-18. These factors are measured values from laboratory studies or estimated values based on available literature information and only provide a general indication of the tendency of chemicals to bioaccumulate. The constituents in Table 5-18 have a tendency to bioaccumulate as evidenced by the high BCFs.

5.3.2.3.2 <u>Evaluation of Biota Monitoring Data</u>

Evaluation of the biota monitoring data with respect to constituents found in the seeps or shallow monitoring well samples associated with the biota sampling locations was conducted on the species most likely to have substantial contact with the groundwater/leachate. Since the blue mussels attach themselves to the rocks that comprise the seawall and are relatively sessile once they have attached themselves to the substrate, they are likely to have the greatest exposure to the groundwater/leachate which leaves the landfill at the bay/seawall interface. Thus they are better than mobile species (e.g., fishes, crabs) as integrators of chemical pollution for a given area. Therefore, mobile species will not be examined here. Blue mussels were collected from one location along the southern seawall and two locations from the eastern seawall in areas of known or suspected seeps.

The concentrations of cadmium, mercury, lead, pesticides, and PCBs detected in blue mussel tissues were compared to monitoring well and seep sample concentrations from sampling locations near to the mussel sampling locations. Seeps/monitoring wells near to the southern seawall blue mussel sampling, location include LS-1, LS-5, MW-107, -110, and -117. Mussels collected at eastern seawall sites 1 and 2 were close to location LS-10, MW-104, and MW-121. The concentrations of constituents in mussels collected at the landfill were also compared to the results from the mussels collected at the reference location, and to blue mussels collected by NOAA (1989) as part of their "Mussel Watch Program". Since the NOAA data are given as dry weights, the RI data have been converted to dry weights (as described in Section 4.6.2) for these comparisons. Unless otherwise noted, all concentrations are given as wet weights. NOAA's sites have been selected with the intention of collecting samples that are "representative" of their surroundings, and are not near major point sources of contamination.

In evaluating these data the following processes were used:

- Constituents detected in groundwater/leachate and not in blue mussel tissues suggest that these constituents are not being taken up by the mussels.

- Where constituents were detected in the blue mussels and in the groundwater/leachate, these concentrations were compared to the concentrations in mussels collected at the reference station. If the concentrations were approximately equal to those found in the reference location mussels, the constituent is likely to be ubiquitous in Eastchester Bay. These constituents were not identified as being elevated due to groundwater/leachate inputs.

- If the constituents in the blue mussels adjacent to the landfill were greater than the reference station, then the landfill may be contributing to an elevated body burden.

- Where constituents were detected in the mussels and not in the groundwater/leachate, this suggests that sources other than the landfill are contributing to the observed concentrations of these contaminants in the blue mussels.

South Seawall

The mussels collected from the south seawall were collected from the area between seeps LS-1 and LS-5. Although cadmium was not detected in these samples, it was detected in the blue mussel tissue samples, at a mean concentration of 0.43 mg/kg (range of 0.36 to 0.49 mg/kg, see Appendix X, Table X-6). Cadmium was not detected in the shallow groundwater at the nearby monitoring wells MW-107, -110, or -117. The mean cadmium concentration in southern seawall mussels was not statistically different than that at the reference location (0.40 mg/kg). Mean cadmium in mussels from the south seawall (1.7 mg/kg, dry weight) are lower than the cadmium data reported by NOAA (see Section 4.6.2). The origin of the cadmium in the mussel tissue is not known, but appears to be ubiquitous to Eastchester Bay.

Lead concentrations from the two seep samples were 0.104 mg/L and 0.707 mg/L for LS-1 and -5, respectively. (The groundwater/leachate value for metals have been converted to mg/L or ppm from μg/L or ppb, as shown on Tables 4-21, 4-22, 4-26, and 4-27, for ease of comparison with mussel tissue levels, which are reported in mg/kg or ppm wet weight.) Concentrations of lead in monitoring wells MW-107 and MW-110 were 0.0363 and 0.0683 mg/L, respectively. Mean lead concentrations in mussels from the south seawall were 1.8 mg/kg (range of 1.5 to 2.1 mg/kg). This represents a statistically significant increase compared to the mean lead concentration in blue mussels at the reference location. The mean concentration for lead in mussel tissue from the southern seawall (7.3 mg/kg, dry weight) is within the range reported for mussels collected from Throgs Neck, the closest NOAA monitoring station (5.5-14.0 mg/kg, dry weight).

Mercury was detected in the mussel tissue collected at the southern seawall at a mean concentration of 0.03 mg/kg and was detected in the sample from LS-5 at 0.002 mg/L. Mercury was not detected in the sample from LS-1, nor was it detected in any of the three nearby monitoring wells. The mean concentration of mercury at the south seawall was similar to that measured at the reference location (0.04 mg/kg). Converted to a dry weight, the mean mercury concentration of 0.13 mg/kg is within the range of means reported by NOAA for Throgs Neck (LITN) (0.11-0.16 mg/kg, dry weight), is slightly higher than the highest mean value given for Hempstead Harbor (LIHH) (0.057-0.11 mg/kg, dry weight), and is high compared to the mean range reported for Mamaroneck (LIMR) (0.063-0.074 mg/kg, dry weight). Although mercury was detected in one of the seep samples, it appears from the NOAA data that there are other sources of mercury in the extreme western portion of Long Island Sound (LIS).

No PCBs were detected in the seep samples from LS-1 or -5, monitoring wells MW-110, -107, and -117, or in the mussel tissue from the south seawall. The pesticides 4,4'-DDD, 4,4'-DDE, delta-BHC, dieldrin, endosulfan sulfate, and endrin were detected at low levels in the LS-1 and -5 samples. The pesticides, 4,4'-DDD and 4,4'-DDE, were detected at low concentrations in the sample from MW-110AR, but were not detected in MW-107 and MW-117. These pesticides were not detected in any of the five replicate mussel tissue samples collected from the southern seawall. Therefore, accumulation of these pesticides is apparently not occurring in mussels from the south seawall.

East Seawall

The mussels collected from the eastern seawall were collected from areas adjacent to two outfall pipes. Samples were not collected from these pipes, but sample LS-10 was south of the eastern seawall Site 2 mussel location; monitoring wells MW-121 and MW-104 bracket the two eastern seawall mussel sampling locations. Therefore, concentrations of contaminants in mussel tissues will be compared to the leachate/groundwater from these sampling locations.

The mean concentrations of cadmium in mussels from the eastern seawall, site-1 and site-2 were 0.47 mg/kg and 0.67 mg/kg, respectively (2.0 mg/kg and 2.7 mg/kg dry weight, respectively). Cadmium was not detected in the sample from LS-10, nor in monitoring well samples from MW-104 or MW-121. The mean concentration at eastern seawall site-2 was statistically greater than that of the reference location. Means converted to dry weights are at the low end of NOAAs reported cadmium means for LITN (2.3 mg/kg, dry weight), LIHH (2.6 mg/kg, dry weight), and LIMR (2.1 mg/kg, dry weight). The source for the cadmium in the mussel tissues from the two locations on the eastern seawall is unknown, but the NOAA data suggest that cadmium does accumulate in mussel tissue and may be ubiquitous in western Long Island Sound.

The concentration of lead was 0.0887 mg/L in the sample from LS-10 , and 0.0519 mg/L and 0.0029 mg/L in the samples from MW-104 and MW-121, respectively. Lead was detected in each replicate sample of eastern seawall mussels (total n=10), and had a mean concentration of 2.6 mg/kg and 4.1 mg/kg from sites 1 and 2, respectively. These mean lead concentrations were statistically higher than the mean lead concentration in mussels collected at the reference location (1.4 mg/kg). Mean lead concentrations are 11.1 mg/kg (dry weight) at eastern seawall site-1, and 16.3 mg/kg (dry weight) at site-2. The mean for Site 1 is within the range given by NOAA for LITN (5.5-14.0 mg/kg, dry weight), and was higher than the ranges given for the two stations further east in Long Island Sound. Lead from the landfill may be contributing to the levels seen in the eastern seawall blue mussels, but there are obviously many sources of lead to the system.

Mercury was detected only in the sample from MW-121, at a concentration of 0.00024 mg/L. The mean concentration of mercury in blue mussels at site-1 was 0.03 mg/kg, and at site-2, 0.04 mg/kg. These means are not significantly different from that of the reference location (0.04 mg/kg) which suggests that mercury is found throughout this area. Mean concentrations of mercury were 0.13 and 0.14 mg/kg (dry weight) for site-1 and site-2, respectively. These means are similar to those determined by NOAA for LITN (0.11-0.16 mg/kg, dry weight), but are slightly higher than the highest mean mercury concentration at LIHH (0.11 mg/kg, dry weight). The eastern seawall mean mercury concentrations are higher than those at the LIMR location (0.063-0.074 mg/kg, dry weight). Mercury from the landfill may contribute to the levels detected in eastern seawall mussels, but the NOAA data for LITN and LIHH indicate that other sources of mercury may also affect mussel body burdens in extreme western Long Island Sound.

The PCB, Aroclor-1254, was detected in all mussel replicate samples collected from eastern seawall Site 1, and from four out of five replicates at Site 2. No PCBs of any type were detected in the samples from LS-10, MW-104, or MW-121. Furthermore, Aroclor-1254 was not detected in any seep or monitoring well sample from any location. This PCB mixture was not detected in blue mussles at the reference location. The origin of the Aroclor-1254 detected in the eastern seawall blue mussel tissues is unknown. However, total PCBs were detected at all NOAA western Long Island Sound locations in all three years sampled. PCBs have been found in sediments and tissue samples throughout the New York and New Jersey Harbor Estuary system (Squibb, *et al.*, 1991).

The pesticide 4,4'-DDD was found at low concentrations in the shallow groundwater at MW-104 (0.012 μg/L) and MW-121 (0.037 μg/L). The mean concentration of this pesticide in blue mussels was 23 μg/kg (4 of 5 replicates) at eastern seawall site-1, and 25 mg/kg (3 out of 5 replicates) at site-2. 4,4'-DDD was not detected in blue mussels collected at the reference location. The pesticide 4,4-DDE was detected in seep LS-10 (0.078 μg/L) and in groundwater from MW-104 (0.015 μg/L). (These values are "J" flagged (estimated), and the LS-10 concentration could not be verified during data validation.) This compound was also detected in mussels from eastern seawall site-1 (4 out of 5 replicates), at a mean concentration of 20 μg/kg, but was not detected in any other blue mussel sample. The pesticide 4,4'-DDT was only detected at a concentration of 18 μg/kg in one out of five replicates of blue mussel collected at the reference location. This was the only pesticide detected in blue mussels at the reference station. As discussed in Section 4.6.2, the mean concentrations of total DDTs in blue mussel tissues collected from the eastern seawall (179 μg/kg, dry weight for 4,4'-DDD and 4,4'-DDE combined at site-1; and 98 μg/kg, dry weight for 4,4'-DDD at site-2) are within the ranges given by NOAA for total DDT's at LITN (140-280 μg/kg, dry weight), LIHH (73-210 μg/kg, dry weight) and LIMR (120-150 μg/kg).

Although the pesticide endosulfan I was detected in only one mussel sample (a replicate from eastern seawall site-1), none of the endosulfan derivatives (endosulfan I, II, or endosulfan sulfate) were detected in the groundwater/leachate in the vicinity of the mussel collection location. The origin of the endosulfan I is not certain.

The pesticide, alpha-chlordane, was detected in all five replicate samples of blue mussel from the eastern seawall site-1 (mean concentration 12 μg/kg), and in only one replicate (13 μg/kg) from site-2. alpha-Chlordane was not detected in any seep sample collected from the eastern seawall, and was detected in only one monitoring well sample, from MW-103 (0.056 μg/L). This well was further north than MW-121, which was adjacent to site-1 for eastern seawall mussel collections. alpha-Chlordane was not detected in blue mussels at the reference station. The mean concentration for alpha-Chlordane (51.5 μg/kg, dry weight at Site 1; and 49 μg/kg, dry weight in one replicate at Site 2) is at the lower end of the ranges determined by NOAA for total chlordanes [dry weights: LITN (68-100 μg/kg), LIHH (40-170 μg/kg) and LIMR (58-91 μg/kg)].

The pesticide, beta-BHC, was detected in four of the five mussel samples from eastern seawall site-1, and in only one replicate at site-2. This compound was not detected in samples from eastern seawall seeps, in any monitoring well samples, or at the reference location. NOAA did not report on beta-BHC. The origin of beta-BHC in the mussel tissues in not known.

5.3.3 Compound Fate and Persistence in the Air Pathway

5.3.3.1 Fate Processes

This section reviews how a chemical will behave if released to the atmosphere. The soil gas sampling investigation using EIFCs confirmed that volatile compounds were present in landfill gas emissions. The off-site ambient air study also detected a variety of volatile compounds. The compounds of interest considered for the air pathway were those that were detected both on site and off site. Evaluation of these detected compounds showed that their chemical concentrations were below the NYSDEC Short-term and Annual Guideline Concentrations, with the exception of methane. This was discussed in detail in Section 4.7.

Methane, unlike most of the other air constituents, is a gas under ambient conditions. The other volatile organic compounds are liquids at ambient temperatures and partition between their vapor and liquid phases. The physicochemical property which describes this behavior is vapor pressure. These compounds are emitted from the landfill in their vapor phase, and will remain as vapors as long as their concentrations are below their vapor pressure. This is generally the observed case. The resulting vapors may then be transported vertically through the fill and till, and eventually diffuse into the atmosphere. Atmospheric processes reduce the concentration levels of airborne landfill-derived constituents through dispersion and degradation.

Vapor Pressure

The vapor pressure of a chemical is an indicator of the rate at which it volatilizes. Compounds that have high vapor pressures will volatilize rapidly when in an open system, such as soils exposed to the atmosphere. A high vapor pressure is taken to be greater than 10 mm Hg at room temperature and a low vapor pressure would be less than 1 mm Hg at room temperature.

The vapor pressures of the landfill-derived constituents are summarized in Table 5-19. As indicated by the data on the table, the volatile halogenated and non-halogenated hydrocarbons have high vapor pressures. The SVOs, pesticides, and PCBs have very low vapor pressures which indicates that these compounds would be expected to be at low concentrations as vapor in air.

Photodegradation

Exposure of landfill-derived gases to atmospheric air and sunlight will lead to photolytic degradation. Photooxidation and photolysis are the major degradation processes for gas contaminants in air. Photooxidation is the vapor phase reaction of a chemical molecule with photochemically produced hydroxyl radicals. Photolysis occurs when a chemical molecule absorbs light at wavelengths provided by sunlight (> 290 nm), to produce an electronically excited state. The excited molecule can photodegrade through a unimolecular process or through reactions involving other photoexcited molecules.

These decomposition processes affect the persistence of gaseous compounds in air. Estimated half-lives (the amount of time for the concentration to be reduced by 50%) for several of the landfill gases are presented in Table 5-8. For most compounds, the photodegradation half-lives are on the order of days to years. Photodegradation half-lives are on the order of hours for some compounds. On this timescale, photodegradation processes will not significantly affect concentrations of landfill-derived constituents in the immediate vicinity of the landfill. Based on a local annual average for windspeed (LaGuardia Airport) of 4.6 m/s or 10.4 mph, air contaminants from the landfill will reach the nearest receptors at Cops Beach in 10 to 15 seconds. For the residential community approximately 700 meters distant, gaseous compounds from the landfill will reach receptors in a few minutes. This simple evaluation is performed assuming a persistent wind of approximately 5 m/s. The windspeeds during daytime hours at which time air sampling occurred, tend to be higher and therefore, the use of the annual average wind speed of 5 m/s is reasonable. The conclusion, therefore, is that photodegradation processes will have almost no effect on concentration of air concentrations in the short-term, but they will tend to decrease constituent concentrations during long-range transport.

5.3.3.2 Air Quality Modeling

Samples of landfill gas were collected from the Pelham Bay Landfill using emission isolation flux chambers (EIFCs) as described in Sections 2.7.2. These samples were analyzed for VOCs and selected inorganic compounds as described in Section 2.7.4. The results of the laboratory analyses were presented in Section 4.7. Selection of the chemicals to be modeled are based on the decision analysis process described in Section 4.7.2 The measured chemical concentrations were used in two separate air dispersion models (short-term and long-term) to estimate ambient air concentrations of the detected compounds at receptors on the landfill and at off-site locations surrounding the landfill. The methodology used to predict off-site air quality impacts from gaseous landfill emissions is described below.

5.3.3.2.1 Model Selection

To evaluate potential impacts of gaseous landfill emissions, an analysis was performed using the Industrial Source Complex model Version 2 (ISC2). This model allows the landfill to be broken into multiple area sources to model emissions from the landfill surface. The ISC2 model is recommended by the USEPA for area and volume sources for gaseous pollutants less dense than air (USEPA, 1986). Modeling with the ISC2 model is also a recommended technique identified in the Air/Superfund National Technical Guidance Study Series (NTGS) (USEPA, 1989).

For the long-term modeling analysis, ISCLT2 (ISC2 Version 2 Long Term) model was used. For the short-term modeling analysis, the ISCST2 (ISC2 Version 2 Short Term) model was used. WCCI's intention to use these models was submitted in writing to the NYSDEC on June 26, 1992.

All model input assumptions were selected from the USEPA regulatory guidelines identified in the USEPA's Guidelines on Air Quality Models (USEPA, 1986).

5.3.3.2.2 Model Application

The landfill was modeled as a group of individual area sources with the use of the ISCST2 and ISCLT2 models. The landfill was represented as 65 area sources; each area source was a square no more than 100 m wide. The height of each individual area source above ground was the average height of the landfill in the general area corresponding to a location on the modeling grid. The area source elevations ranged from near sea level to 175 ft above ground.

The width of the individual area sources was intentionally limited to 100 meters so that receptors could be placed close to the landfill. A limitation of the ISC2 model is that receptors should be no closer than the width of one area source from the landfill. If the source-receptor separation is less than this width, the finite line segment algorithm does not adequately represent the source-receptor geometry (USEPA, 1992).

Each of the individual area sources was modeled with a unit emission rate of 1.0×10^{-4} gm/sec-m^2. The off-site concentrations were calculated by using an adjustment factor to account for the actual measured emission rates for each compound. The emission rate for each of the selected compounds was based on the results of the air sampling with EIFCs at designated locations on the landfill. The locations likely contain high emission rates from the landfill, as described in Section 2.7.2. Emission estimates for the entire landfill based on these values are likely to overestimate off-site pollutant concentrations.

Urban dispersion coefficients were used, since the majority of the surrounding land use is high density urban residential. Annual concentrations were predicted using the ISCLT2 model with the 5-year joint wind direction, wind speed, and stability class data for the period 1985-1989 from LaGuardia Airport, New York. This is the procedure recommended by USEPA in its Guidelines on Air Quality Models. When off-site meteorological data is used, a 5-year data period is preferred to ensure that variabilities in the meteorological data base are reflected in predicted pollutant concentrations.

The meteorological conditions for ISCST2 modeling were selected to be consistent with emissions from a landfill, which are strongly driven by solar heating of the ground surface. The meteorological conditions were also selected to maximize the predicted concentration and yet be consistent with the meteorology that occurred on the day with the highest measured off-site concentrations. These meteorological conditions corresponded to a wind speed of 5 m/sec and neutral to unstable atmospheric stability.

On-site ISCST2 modeling was conducted in the following manner. The landfill center receptor was modeled with 36 wind directions blowing through the landfill center (i.e., the wind was always blowing towards the receptor). The wind speed for this modeling scenario was set to 1 m/s, since it is reasonable to assume that a low wind speed such as this could persist for a significant amount of time and blow over any section of the landfill towards the center. Area sources in the vicinity of the landfill center receptor had to be sub-divided into smaller area sources to conform with source-receptor restrictions of the ISC2 model.

ISCLT2 modeling of the landfill center receptor was conducted utilizing the 1985-1989 composite STAR data for the LaGuardia Airport, New York, National Weather Service station. Again, area sources in the vicinity of the landfill center receptor had to be subdivided into smaller area sources.

5.3.3.2.3 Receptor Locations

The ISCLT2 model used individual discrete receptor locations. Discrete receptors were selected based on a survey of the area and included residences to the south, west, and northwest (e.g., Watt Avenue, Co-op City), sensitive receptors (e.g., hospitals, schools), and the landfill guard house. All discrete receptors were located within a distance of 3 km from the landfill. Because gaseous landfill emissions are assumed to occur throughout the surface of the landfill, the maximum off-site air quality impacts will occur close to the landfill and decrease in magnitude with distance.

On-site ISCST2 and ISCLT2 modeling was conducted at a receptor located at the landfill center. The on-site receptor terrain elevation was determined from site maps of the Pelham Bay Landfill.

5.3.3.2.4 Results from Short-Term Modeling

Off-site Modeling

Short-term average concentrations (24 hours or less) were estimated from modeled 1-hour values using extremely conservative assumptions that were designed to maximize predicted concentrations. These assumptions are that:

- All compounds are emitted at the maximum rate measured during the soil gas monitoring program
- The entire landfill emits the compounds at that maximum rate
- The wind direction remains constant throughout the averaging period of interest

For the Pelham Bay Landfill, the meteorological data used for the off-site ISCST2 modeling consists of combinations of hourly wind speeds, wind directions, stability classes, mixing depths, and air temperatures likely to occur in the region. The data set, however, was limited further to maximize the predicted concentrations and yet be consistent with meteorological conditions which occurred on the days with the highest measured off-site constituent concentrations during the ambient monitoring program. These meteorological conditions corresponded to a wind speed of 5 m/s with neutral to slightly unstable atmospheric stability. Although a wind speed of 1 m/s would result in higher predicted concentrations, a wind speed of 5 m/s is the reasonably lowest wind speed that can be used for a wind that is expected to persist for periods of 8 to 24 hours.
A persistent 1 m/s wind speed is not physically reasonable for modeling off-site receptors. Atmospheric stability under stable conditions was not considered since it is not consistent with maximum gaseous emissions from the landfill, which are expected to occur on summer days when solar heating of the ground is strongest. The atmospheric stabilities used in ISCST2 modeling runs were restricted to stability class C and D. Stability class D will give the highest ground level concentrations for neutral to slightly unstable atmospheric conditions when both the source and receptor is at ground level, as is the case with Pelham Bay landfill modeling. Neutral/unstable atmospheric conditions were characteristic of the day with the highest measured concentrations of VOCs in the ambient air.

The results are summarized in Table 5-20. The first column in the table lists the compounds; the second column lists the maximum emission rate from the soil gas monitoring program. The 1-hour predicted concentration from the model for each compound is listed in the third column. The modeled 1-hour concentrations in the table are the highest concentrations of the seven off-site monitoring locations. The highest modeled 1-hour concentrations occurred at Cops Beach (Monitoring Location #1).

To place the model predictions in perspective, the highest off-site concentration for each compound is listed in the fourth column. Models are notorious for overpredicting ambient air concentrations, especially in this case with very conservative input assumptions. Therefore, if the 1-hour value predicted by a model is lower than the measured 24-hour concentration, it is doubtful that the only source of the compound is the landfill. The ratio of the predicted concentration to the measured concentration is shown in the fifth column. As can be seen, the ratio for most of the compounds is much less than one (on the order of 0.01 or less), indicating that the measured off-site concentrations cannot be accounted for by emissions from the landfill alone. The only compounds with ratios close to one are methane and chlorobenzene, suggesting that the landfill alone could account for the majority of the measured methane concentrations, based on the above assumptions, which maximize the contribution of the landfill. Chlorobenzene, however, was only measured in the air at one location and only on one day (see Tables 4-87 and 4-88). This location was on the northwest corner of the landfill. The concentration was one-five thousandth of the NYSDEC Short-term Guideline Concentration (SGC).

For an additional perspective on the modeling and measurement results, the toxicity rating, the SGC, and the AGC (Annual Guideline Concentration) for each compound are listed in the last three columns of Table 5-20. All measured concentrations are well below the New York State SGCs. The highest off-site measured concentrations are typically between 1% to 0.01% of the SGC value. Predicted concentrations from the model are even smaller than these percentages.

The sources of contaminants in ambient air can be identified through the use of modeling. For 19 of the 20 non-methane compounds emitted from the landfill, short-term modeling indicates that the emissions of these compounds account for less than 25% of that compound's concentration measured in the community. Most of these compounds from the landfill account for less than 5% of the concentrations measured in the community. One compound (chlorobenzene), based on modeled results, accounts for more than 100% of the actual measured value. But since chlorobenzene was measured at only one location on only one day of the air monitoring program, the modeling results for chlorobenzene are considered an anomaly.

The results of short-term modeling for methane and other compounds within the surrounding community are summarized by the following table:

	% of Emissions from Landfill	% of Emissions from Other Sources
Methane	95%	5%
VOCs	0% - 25%	75% - 100%

The predicted 1-hour concentrations from the ISCST2 model were checked against the results of a simple box model. There are several forms of the box model equation. The form of the box model cited by WCCI is applicable to an area source. The area-source form of the Box-Model equation can be found in two references: (1) Equation 9.2; Hanna, Briggs, and Hosker, 1982: Handbook on Atmospheric Dispersion, Technical Information Center, U.S. Department of Energy, and (2) Equation 6.32; Pasquill and Smith, 1983: Atmospheric Diffusion, John Wiley & Sons. WCCI chose the area-source form of the equation because the Pelham Bay landfill is considered an area source of emissions. The following is the area-source form of the box model equation:

$$\text{Air concentration} = \frac{\text{Width of area source X Area source emissions}}{\text{Mixing height X Wind speed}}$$

Box model concentrations were calculated using the following values for the input parameters:

width of area source = 600 meters
area source emissions = values listed in Table 5-20
mixing height = 1,000 meters
wind speed = 5 meters per second

A mixing height of 1000 meters was selected because this corresponds to the average daily mixing depth in New York during the summer (Holzworth, 1972: Mixing Height, Wind and Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, USEPA). With these input values, the concentrations predicted by the box model are about 6% of the concentrations predicted by the ISCST2 model, which are listed in column 3 of Table 5-20.

The modeled 1-hour concentrations in Table 5-20 occurred at Cops Beach and were the highest concentrations of the seven off-site locations. Modeled 1-hour concentrations for other locations for this meteorological scenario are shown in Table 5-21. Each column in Table 5-21 corresponds to a different location. The locations are ordered according to distance from the landfill: locations closest to the landfill are on the left portion of the table and the farthest locations are toward the right portion of the table. As can be seen from Table 5-21, higher concentrations occur closer to the landfill. The lowest modeled concentration occurred at 1621 Bayshore Avenue (Location #6). This concentration is about 30% of the highest concentration; the location is also the farthest from the landfill.

Tables 5-22 through 5-29 represent the modeling results for different meteorological scenarios. Neutral or stable conditions with low wind speeds (Tables 5-24 and 5-28) show the highest modeled concentrations. Neutral conditions with high wind speeds give the lowest concentrations (Tables 5-26 and 5-27). Other meteorological conditions result in modeled concentrations in between these two extremes. Based on the reasons discussed in the beginning of this section, the modeled concentrations for meteorological conditions in Table 5-21 (Stability Class D, 5 m/s wind speed) were considered the most plausible yet conservative.

On-site Modeling

The results of the short-term on-site modeling is presented in . All predicted concentrations are well below both the OSHA 8-hour Permissible Exposure Limits (PELs) and the NYSDEC SGCs. In contrast to the off-site modeling, the on-site concentrations were predicted using a 1 m/s wind speed, which is reasonable since a low wind speed could conceivably blow towards the landfill center for extended periods.

5.3.3.2.5 Results from Long-Term Modeling

Off-site Modeling

Annual concentrations were predicted using the ISCLT2 model with the 5-year joint wind direction, wind speed, and stability class data for the period 1985-1989 from LaGuardia Airport, New York. The annual concentrations were predicted using conservative assumptions that were designed to maximize the concentrations:

- All compounds are emitted at the average rate of emission measured during the soil gas monitoring program. Although these were average values, not maximum values, the averages are summertime averages, and did not take into account the much lower emission rates which are expected during the other three seasons of the year

- The entire landfill emits the compounds at the average rate

The results of the long-term modeling are summarized in Table 5-31, which has a format similar to Table 5-20. The modeled annual concentrations are presented in the third column. The location corresponding to these concentrations is Cops Beach, which is at the southern edge of the landfill. Since measured annual concentrations of the listed compounds are not available, the modeled concentration is compared to the NYSDEC AGC in the fifth column. (The 24-hour concentration is shown for reference purposes only, in the fourth column.) Comparison of the modeled annual concentration with the AGC shows that, with one exception, concentrations of all modeled compounds are less than 1% of the AGC. The one exception is benzene, which is 26% of the AGC. Since this result is based on modeling which assumes that the entire landfill is emitting benzene at a rate typical of only isolated locations on the landfill and typical of summertime conditions, the result should be viewed as a theoretical upper bound and is not based on measurements.

The highest modeled annual concentrations for the seven off-site monitoring locations are shown in Table 5-32. The locations are ordered according to distance from the landfill: the closest locations are on the left portion of the table and the farthest locations are toward the right portion of the table. As can be seen from Table 5-32, higher concentrations generally occur closer to the landfill. The lowest modeled annual concentration, however, did not occur at the location farthest away from the landfill. It occurred at Co-op City, where the concentration was about 13% of the highest concentration. It is lowest there because Co-op City is infrequently downwind of the landfill compared to other receptor locations.

On-site Modeling

The results of the long-term on-site modeling is presented in Table 5-33. All predicted concentrations are well below the NYSDEC AGCs.

5.4 SUMMARY OF FATES OF CONSTITUENTS

5.4.1 Summary of the Fate of Constituents in the Groundwater Pathway

The groundwater pathway, as described in detail in Section 5.2.1, consists of the shallow flow system, seeps, and the bedrock flow system. Factors which may affect constituents traveling in these pathways are described in Section 5.3.1.1. These fate processes in groundwater largely affect constituents as they migrate from the landfill to the site perimeter.

Because the bulk of the groundwater discharge points are at the site boundary, there is no need to evaluate off-site groundwater transport. Once contaminants leave the on-site groundwater transport pathways, they predominantly enter the surface water/sediment pathways which are described in Section 5.3.2. The perimeter monitoring well and seep samples represent the quality of the discharges from the groundwater to the surface water pathway.

The following is a summary of the fate of constituents in the groundwater pathway:

- The shallow groundwater flow system (fill and till) represents the major discharge pathway from the landfill.
- Most of the constituents in the shallow groundwater flow system discharge into Eastchester Bay (70%) or to the tidal wetlands (30%).
- Perimeter wells reflect complex biogeochemical processes which control the fate and transport of landfill-derived constituents. These processes are expected to have a limited effect on groundwater quality between the perimeter wells and the groundwater discharge points.
- Some attenuation of constituents can be expected in the shallow groundwater pathway from the western site boundary to the tidal wetlands. Attenuation would be limited by the short travel time expected for groundwater traveling through this area.
- VOCs in the shallow groundwater and seeps are expected to volatilize to a large extent within the landfill or when they come in contact with the atmosphere (e.g., at the seeps). VOCs in bedrock are largely unaffected by volatilization.
- The attenuation of VOCs during groundwater transport is expected to be limited based on their generally high solubility.
- SVOs are predominantly present in the shallow groundwater. Retardation of SVOs in soils within the landfill limits their migration. Bedrock monitoring data showed almost no detections of SVOs.

- Because monitoring was conducted at the perimeter of the landfill, groundwater quality with respect to metals is expected to be representative of groundwater discharge.

- Other inorganics, especially ammonia, are generated from processes in the landfill and are transported from the site with minimal to no degradation.

- Contaminants in the bedrock flow system are largely unaffected during transport. Contaminants in the bedrock are expected to migrate predominantly along fractures that are interconnected. Pathways in the bedrock are believed to be limited in extent both horizontally and vertically.

5.4.2 Summary of the Fate of Constituents in the Surface Water Pathway

The surface water pathway, as described in detail in Section 5.2.2, consists of the Eastchester Bay surface water system, sediment adsorption and transport, and food chain transfer. Factors which may affect constituents traveling in these pathways are described in Sections 5.3.2.1.1, 5.3.2.2.1, and 5.3.2.3.1.

Fate processes in the surface water pathway will largely affect constituents when the groundwater/leachate enters Eastchester Bay. The following is a summary of the fate of constituents in the surface water pathway:

- The shallow groundwater flow system is the primary source of landfill-derived constituents entering Eastchester Bay

- VOCs in the surface water will to a large extent volatilize into the atmosphere due to increased water movement and an increase in the air/water surface area

- VOCs which have high water solubility will remain dissolved in the water to some extent, but will be subject to biotic and abiotic degradation processes. These VOCs will be rapidly diluted and dispersed in the surface water

- Phenols, ethers, multi-chlorinated aromatic hydrocarbons, amines, and benzoic acid present in the surface water originating from the landfill groundwater/leachate will remain dissolved in the water and be subject to biotic and abiotic degradation processes. These soluble SVOs will be rapidly diluted and dispersed in the surface water

- PAHs and phthalates in surface water will adsorb to sediments in Eastchester Bay and be subject to biotic and abiotic degradation

- Pesticides and PCBs in surface water will adsorb to sediments in Eastchester Bay and may bioaccumulate in biota tissue

- Metals originating from the landfill may be present in all three of the media: surface water, sediments, and biota tissue. The presence of a particular metal in a particular medium will be dependent on a variety of biogeochemical processes controlling its valence state and form

- Surface water modeling indicates that adjacent to the landfill average concentrations of constituents potentially related to landfill sources are below NYSDEC surface water quality standards

- The landfill groundwater/leachate potentially contributed to elevated concentrations of the following compounds in the surface water adjacent to the landfill: bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, alpha-BHC, delta-BHC, aluminum, copper, iron, lead, nickel, and vanadium

- The landfill groundwater/leachate potentially contributed to elevated concentrations of the following constituents in the sediments along the east seawall: 2-propanone, acenaphthene, fluorene, di-n-butyl phthalate, 4,4'-DDD, 4,4'-DDE, delta-BHC, and selenium

- The landfill groundwater/leachate potentially contributed to elevated concentrations of the following compounds in the sediments along the south seawall: 2-methyl naphthalene, acenaphthene, anthracene, dibenzofuran, fluorene, naphthalene, phenanthrene, pyrene, di-n-butyl phthalate, di-n-octyl phthalate, bis(2-ethylhexyl) phthalate, 4,4'-DDD, and Dieldrin

- The landfill groundwater/leachate potentially contributed to the bioaccumulation of lead, 4,4'-DDD, 4,4'-DDE, and alpha-Chlordane in blue mussels found along the east seawall

- The landfill groundwater/leachate potentially contributed to the bioaccumulation of lead in blue mussels found along the south seawall

- Other sources contribute to observed concentrations of potentially landfill-derived constituents in surface water, sediments, and biota

5.4.3 Summary of the Fate of Constituents in the Air Pathway

The air pathway, as described in detail in Section 5.2.3, consists of the release of gases, VOCs, dust, and particulates into the air. Factors which may affect constituents traveling in the air are described in Section 5.3.3.1.

The following is a summary of the atmospheric fate of landfill-derived constituents in the air pathway:

- Vertical migration of gases and VOCs in the landfill with subsequent release to and transport in the atmosphere is the primary pathway for air constituents

- There appears to be no horizontal migration of landfill gases in shallow soils inland to the south and east

- The landfill has a low emission potential for particulates and dust; the particulates measured in the community appear to be related to regional sources

- Atmospheric dispersion is the main mechanism affecting contaminant concentrations in the vicinity of the landfill. Atmospheric fate processes, such as photodegradation, will not significantly affect airborne constituent concentrations in the immediate vicinity of the landfill

- Short-term modeling indicates that landfill emissions typically can account for no more than 25% of the VOC concentrations measured in the community, but could account for the majority of the methane concentrations measured in the community

- Long-term modeling predicts annual average concentrations within the surrounding community which are less than 1% of the New York State AGCs for most VOCs.

- Short-term and long-term modeling predicts on-site concentrations of air constituents which are well below the New York State SGCs and AGCs, respectively.

5.4 REFERENCES

Alexander, M. 1985. Biodegradation of Organic Chemicals. Environ. Sci. Technol., Vol. 18, No. 2.

Atlas, R.M., R. Bartha. 1981. Microbial Ecology: Fundamentals and Applications, Benjamin/Cummings Publishing.

Battelle. 1984. Chemical Attenuation Rates, Coefficients, and Constants in Leachate Migration. Vol. 1: A Critical Review. Battelle, Pacific Northwest Laboratories, for Electric Power Research Institute (EPRI), EA-3356, Final Report. February

Barron, M.G. 1990. Bioconcentration. Environ. Sci. Technol., Vol. 24 (11).

Clark, K.E., F. Gobas, and D. Mackey. 1990. Model of Organic Chemical Uptake and Clearance by Fish from Food and Water. Environ. Science and Technology, Vol. 24, No. 8.

Dallinger, R., F. Prosi, H. Segner, and H. Back. 1987. Contaminated Food and Uptake of Heavy Metals by Fish: a Review and a Proposal for Further Research. Oecologia, Vol. 73, 91-92.

Day, J.W., A.A.S. Hall, W.M. Kemp., A. Yanez-Arancibia. 1989. Estuarine Ecology, Wiley Interscience.

Drever, J.I. 1982. The Geochemistry of Natural Waters, Prentice-Hall, Inc., Englewood Cliff, New Jersey.

Emcon Associates. 1980. Methane Generation and Recovery Farm Landfills, Ann Arbor Science, Ann Arbor.

Fischer, H.B., E.J. List, R.C.Y. Koh, J. Imberger, and N.H. Brooks. 1979. "Mixing in Inland and Coastal Waters." Academic Press, Inc., San Diego, California.

Geraghty, J.J., Miller, D.W., Van der Leeden, F., and Troise, F.L. 1973. Water Atlas of the United States. 3rd edition. Water Information Center Inc. Port Washington, N.Y.

Hem, John D. 1985. Study and Interpretation of the Chemical Characteristics of Natural Water. Third Edition, U.S. Geological Survey Water-Supply Paper 2254.

Kennish, Michael J. 1992. Ecology of Estuaries: Anthropogenic Effects, CRC Press, Boca Raton, Florida.

Lawler, J.P., Hogarth, W.T., Copeland, B.J., Weinstein, M.P., Hoston, R.G., and Chen, H.Y. 1981. Techniques for Assessing the Impact of Entrainment and Impingement as Applied to the Brunswick Stream Electric Plant, in Issues Associated with Impact Assessment, Proceedings, 5th National Workshop on Entrainment and Impingement, Jensen, L.D., Ed., EA Communications, Sparks, Maryland, 1981.

Lee, R.F., R. Sauerheber, and G.H Dobss. 1972. Uptake, Metabolism, and Discharge of Polycyclic Aromatic Hydrocarbons by Marine Fish. Marine Biology, Vol. 17, pp. 201-208.

Matthess, G. 1982. The Properties of Groundwater. John Wiley & Sons, New York.

McCall, P.L. 1978. "Spatial Temporal Distributions in Long Island Sound Infauna: The Role of Bottom Disturbance in a Nearshore Marine Habitat" in Estuarine Interactions, Martin L. Wiley, Ed., Academic Press, New York.

Reynoldson, T.B. 1987. Interactions Between Sediment Contaminants and Benthic Organisms. Hydrobiology, Vol. 149, pp. 53-66.

Squibb, K.S., J.M. O'Connor, and T.J. Kneip. 1991. New York/New Jersey Harbor Estuary Program. Module 3.1: Toxics Characterization Report, Submitted to USEPA.

Stanier, R.Y., E.A. Adelberg, J.L. Ingraham. 1984. General Microbiology, Prentice Hall, Inc.

U.S. Environmental Protection Agency. 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Part I, Metals and Inorganics, Pesticides and PCBs, EPA-440/4-79-029a, November.

U.S. Environmental Protection Agency. 1986. Guideline on Air Quality Models (Revised). Office of Air Quality Planning and Standards. EPA-450/2-78-027R). July. (Supplement B to the Guidelines, Draft, September 1990).

U.S. Environmental Protection Agency. 1989. Air/Superfund National Technical Guidance Study Series, Vol. IV. Office of Air Quality Planning and Standards. Procedures for Dispersion Modeling and Air Monitoring for Superfund Air Pathway Analysis (EPA 450/1-89-004). July.

U.S. Environmental Protection Agency. 1992. User's Guide for the Industrial Source Complex (ISC2) Dispersion Models, Vol. II. Office of Air Quality Planning and Standards. (EPA-450/4-92-008b). March.

Zitomer, D.H., and R.E. Speece. 1993. Sequential Environments for Enhanced Biotransformation of Aqueos Contaminants. Environ. Sci. Technol., Vol. 27, No. 2.

Table 5-1
Constituents in Surface Soils - Water Solubilities
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Water Solubility (mg/L at 25°C except where indicated)
VOLATILE ORGANIC COMPOUNDS	
Halogenated Hydrocarbons	
Chlorobenzene	471.7
Chloroform	7950
Non-Halogenated Hydrocarbons	
Benzene	1791
Ethyl benzene	161
Styrene	160 to 300
Toluene	534.8
2-Butanone	Miscible
2-Propanone	Miscible
Xylenes	146-175
SEMI-VOLATILE ORGANIC COMPOUNDS	
PAHs	
2-Methylnaphthalene	25
Acenaphthene	3.6
Acenaphthylene	3.93
Anthracene	0.045
Benzo(a)anthracene	0.014
Benzo(a)pyrene	0.0038
Benzo(b)fluoranthene	0.0012
Benzo(g,h,i)perylene	0.00026
Benzo(k)fluoranthene	0.00055
Chrysene	0.006
Dibenzo(a,h)anthracene	0.0005
Dibenzofuran	10
Fluoranthene	0.265
Fluorene	1.69
Indeno(1,2,3-c,d)pyrene	5.3 x 10-4
Naphthalene	31.7
Phenanthrene	1
Pyrene	0.132
Phenols	
4-Nitrophenol	25,000
2,4,5-Trichlorophenol	982
2,4,6-Trichlorophenol	900

Table 5-1
Constituents in Surface Soils - Water Solubilities
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Water Solubility (mg/L at 25°C except where indicated)
Phthalates	
bis(2-Ethylhexyl) phthalate	0.3
Butyl benzyl phthalate	2.69
Di-n-butyl phthalate	11.2
Di-n-octyl phthalate	Insoluble
Chlorinated Hydrocarbons	
1,2-Dichlorobenzene	156
1,4-Dichlorobenzene	80
1,2,4-Trichlorobenzene	48.8 (20°C)
Miscellaneous	
Benzoic acid	2700 (18°C)
N-Nitrosodi-N-propylamine	9900
PESTICIDES AND PCBs	
4,4'-DDD	0.160 (24°C)
4,4'-DDE	0.04 (20°C)
4,4'-DDT	0.00310 to 0.00340
Chlordane	0.056
delta-BHC	31.4
Dieldrin	0.17 (20°C)
Endosulfan sulfate	0.117
Endrin ketone	
Methoxychlor	0.045
PCB-1254	0.0120 to 0.0700 (20°C)
PCB-1260	0.00270 (20°C)

Prepared by: JSS
Checked by: VKC
92C4087

References: Howard, P. H. 1989, Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Lewis Publishers, Volumes I, II, III.

The Installation Restoration Program Toxicology Guide, July 1989, U.S. Department of Commerce, Volumes I - V.

Gordon, Arnold J. and Ford, Richard A., 1972, The Chemist's Companion, John Wiley & Sons.

The Merck Index, 1989, Merck & Company, Inc., Eleventh Edition.

Montgomery, J. H.; Welkom, L. M. 1990. Groundwater Chemicals Desk Reference, Lewis Publishers.

USEPA, 1986. Superfund Public Health Evaluation Manual, Office of Emergency and Remedial Response, EPA/540/1-86/060, October 1986.

Table 5-2
Maximum Measured Emission Rates for Detected Compounds
Pelham Bay Landfill
Bronx, New York

EIFC Detected Compounds	Maximum Measured Emission Rate (ug/m²-s)
1,1,1-Trichloroethane	1.5485
1,2,4-Trichlorobenzene	0.0035
1,2,4-Trimethylbenzene	0.0791
1,2-Dichlorobenzene	0.072
1,2-Dichloroethylene	0.0046
1,3,5-Trimethylbenzene	0.0348
1,3-Dichlorobenzene	0.0309
1,4-Dichlorobenzene	0.1973
Acetone	0.1362
Ammonia	10.2633
Benzene	0.2013
Bromoform	0.003
Carbon disulfide	0.0029
Chlorobenzene	1.1312
Cumene	0.0981
Ethyl benzene	0.3074
Freon 11	0.0024
Freon 113	0.016
Freon 114	0.0128
Freon 12	0.0221
Heptane	0.0419
Hexachlorobutadiene	0.0014
Hydrogen sulfide	0.0213
Methane	9093.5
Methylene chloride	0.0007
Styrene	0.018
Tetrachloroethene	0.0031
Toluene	0.0809
Trichloroethylene	0.0015
Xylenes	0.0665

Prepared by: RJM

Checked by: BW

92C4087

Table 5-3
Landfill-Derived Constituents
Pelham Bay Landfill
Bronx, New York

VOLATILE ORGANIC COMPOUNDS	**Halogenated Hydrocarbons**
	Bromoform
	Chlorobenzene
	1,2-Dichloroethylene
	Hexachlorobutadiene
	Methylene chloride
	Tetrachloroethylene
	1,1,1-Trichloroethane
	Trichloroethylene
	Freon 11 (fluorotrichloromethane)
	Freon 12 (dichlorodifluoromethane)
	Freon 113 (1,1,2-trichlorotrifluoroethane)
	Freon 114 (1,2-dichlorotetrafluoroethane)
	Non-Halogenated Hydrocarbons
	Acetone
	Carbon disulfide
	Methane
	Heptane
	Benzene
	Cumene
	Ethyl benzene
	Styrene
	Toluene
	Xylenes
	1,2,4-Trimethylbenzene
	1,3,5-Trimethylbenzene
SEMI-VOLATILE ORGANIC COMPOUNDS	**PAHs**
	2-Methylnaphthalene
	Acenaphthene
	Acenaphthylene
	Anthracene
	Benzo(a)anthracene
	Benzo(a)pyrene
	Benzo(b)fluoranthene
	Benzo(g,h,i)perylene
	Benzo(k)fluoranthene
	Chrysene
	Dibenzo(a,h)anthracene
	Dibenzofuran
	Fluoranthene
	Fluorene
	Indeno(1,2,3-c,d)pyrene

Table 5-3
Landfill-Derived Constituents
Pelham Bay Landfill
Bronx, New York

SEMI-VOLATILE ORGANIC COMPOUNDS	**PAHs**
	Naphthalene
	Phenanthrene
	Pyrene
	Phenols
	4-Methylphenol
	4-Nitrophenol
	Phthalates
	bis(2-Ethylhexyl) phthalate
	Butyl benzyl phthalate
	Di-n-butyl phthalate
	Di-n-octyl phthalate
	Chlorinated Hydrocarbons
	1,2-Dichlorobenzene
	1,3-Dichlorobenzene
	1,4-Dichlorobenzene
	1,2,4-Trichlorobenzene
	Miscellaneous
	N-Nitrosodi-n-propylamine
PESTICIDES AND PCBs	4,4'-DDD
	4,4'-DDE
	4,4'-DDT
	Aldrin
	alpha-Chlordane
	delta-BHC
	Dieldrin
	Endosulfan sulfate
	Endrin ketone
	gamma-Chlordane
	Heptachlor epoxide
	PCB-1242
	PCB-1254
	PCB-1260

Table 5-3
Landfill-Derived Constituents
Pelham Bay Landfill
Bronx, New York

INORGANICS	Ammonia Antimony Arsenic Barium Boron Cadmium Calcium Chloride Chromium, total Chromium (VI) Cobalt Copper Cyanide Hydrogen Sulfide Iron Lead Magnesium Manganese Mercury Nickel Nitrate Potassium Selenium Sodium Sulfate Thallium Vanadium Zinc

Prepared by: JSS
Checked by: VKC
92C4087

Table 5-4
Water Solubilities For Organic Compounds
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Water Solubility (mg/L at 25°C except where indicated)
VOLATILE ORGANIC COMPOUNDS	
Halogenated Hydrocarbons	
Bromoform	3100
Chlorobenzene	471.7
cis-1,2-Dichloroethylene	3500
trans-1,2-Dichloroethylene	6300
Hexachlorobutadiene	2.55 (20°C)
Methylene chloride	13,000
Tetrachloroethylene	1503
1,1,1-Trichloroethane	347
Trichloroethylene	1100
Freon 11	1100
Freon 12	280
Freon 113	
Freon 114	
Non-Halogenated Hydrocarbons	
2-Propanone	Miscible
Carbon disulfide	2100 (20°C)
Methane	25.1 (17°C)
Heptane	
Benzene	1791
Cumene	
Ethyl benzene	161
Styrene	310
Toluene	534.8
1,2-Xylenes	175
1,3-Xylenes	146
1,4-Xylenes	156
1,2,4-Trimethylbenzene	
1,3,5-Trimethylbenzene	
SEMI-VOLATILE ORGANIC COMPOUNDS	
PAHs	
2-Methylnaphthalene	25
Acenaphthene	3.6
Acenaphthylene	3.93
Anthracene	0.045
Benzo(a)anthracene	0.014
Benzo(a)pyrene	0.0038
Benzo(b)fluoranthene	0.0012
Benzo(g,h,i)perylene	0.00026

Table 5-4
Water Solubilities For Organic Compounds
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Water Solubility (mg/L at 25°C except where indicated)
PAHs	
Benzo(k)fluoranthene	0.00055
Chrysene	0.006
Dibenzo(a,h)anthracene	0.0005
Dibenzofuran	10
Fluoranthene	0.265
Fluorene	1.69
Indeno(1,2,3-c,d)pyrene	5.3 x 10-4
Naphthalene	31.7
Phenanthrene	1
Pyrene	0.132
Phenols	
4-Methylphenol	23,000
4-Nitrophenol	25,000
Phthalates	
bis(2-Ethylhexyl) phthalate	0.3
Butyl benzyl phthalate	2.69
Di-n-butyl phthalate	11.2
Di-n-octyl phthalate	Insoluble
Chlorinated Hydrocarbons	
1,2-Dichlorobenzene	156
1,3-Dichlorobenzene	111 (20°C)
1,4-Dichlorobenzene	87
1,2,4-Trichlorobenzene	48.8 (20°C)
Miscellaneous	
N-Nitrosodi-n-propylamine	9900
PESTICIDES	
4,4'-DDD	0.160 (24°C)
4,4'-DDE	0.04 (20°C)
4,4'-DDT	0.00310 to 0.00340
Aldrin	0.02 (20°C)
Chlordane	0.056
delta-BHC	31.4
Dieldrin	0.17 (20°C)
Endosulfan sulfate	0.117
Endrin ketone	
Heptachlor epoxide	0.2

Table 5-4
Water Solubilities For Organic Compounds
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Water Solubility (mg/L at 25°C except where indicated)
PCBs	
PCB-1242	0.200 to 0.700
PCB-1254	0.0120 to 0.0700 (20°C)
PCB-1260	0.00270 (20°C)

Prepared by: JSS
Checked by: VKC
92C4087

References: Howard, P. H. 1989, Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Lewis Publishers, Volumes I, II, III.

The Installation Restoration Program Toxicology Guide, July 1989, U.S. Department of Commerce, Volumes I - V.

Gordon, Arnold J. and Ford, Richard A., 1972, The Chemist's Companion, John Wiley & Sons.

The Merck Index, 1989, Merck & Company, Inc., Eleventh Edition.

Montgomery, J. H.; Welkom, L. M. 1990. Groundwater Chemicals Desk Reference, Lewis Publishers.

USEPA, 1986. Superfund Public Health Evaluation Manual, Office of Emergency and Remedial Response, EPA/540/1-86/060, October 1986.

Table 5-5
pH Parameters for Groundwater
Pelham Bay Landfill
Bronx, New York

Sample Location	pH	Alkalinity as Bicarbonate (mg/L)	Alkalinity as Carbonate* (mg/L)	Ammonium Ion (mg/L)
MW-103	7.99	225		4.86
MW-104	6.68	2760		320
MW-105	6.79	5880		234
MW-106	7.15	2040		159
MW-107	7.27	780		64
MW-109	6.83	34		3
MW-110	6.84	1064		716
MW-111	6.82	1640		82.9
MW-112	--	--		--
MW-113	6.64	1350		77.8
MW-113B	7.37	1470		26.7
MW-114	7.08	2000		240
MW-114B	7.24	41		0.37
MW-115	7.1	950		59.6
MW-115B	6.98	570		2.95
MW-116	7.87	106		ND
MW-116B	9.86	1480	720	0.17
MW-117	7.04	1580		221
MW-117B	7.85	332		ND
MW-118	6.87	924		96.8
MW-118B	--	35	10	1.83
MW-119	7.18	574		40.6
MW-119B	7.64	190		3
MW-120	7.84	5050		604
MW-120B	7.55	724		3.28
MW-121	7.66	2780		91.8
MW-121B	--	60		ND
MW-122	7.31	1780		16.9
MW-122B	7.76	2370		0.93
MW-123	6.65	1100		ND
MW-124	7.35	70		ND
MW-124B	8.86	69	6	ND
MW-125	6.81	1560		0.34
MW-125B	6.3	1030		0.52
MW-126	8.38	13460	900	1260
	Min - Max	Min - Max	Min - Max	Min - Max
Ranges:	6.3 - 9.86	35 - 505	6 - 900	0.17 - 1260

Notes:
ND = not detected
-- = parameter not analyzed for
* If the pH of the sample is below 8.3,
then there is no carbonate alkalinity in the sample.

Prepared by: SMA
Checked by: VKC
92C4087

Table 5-6
Henry's Law Constants
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Henry's Law Constant atm-m^3/mole (x 10-3 except where indicated)
VOLATILE ORGANIC COMPOUNDS	
Halogenated Hydrocarbons	
Bromoform	0.56
Chlorobenzene	3.45
cis-1,2-Dichloroethylene	3.37
trans-1,2-Dichloroethylene	6.72
Hexachlorobutadiene	10.3
Methylene chloride	2.68
Tetrachloroethylene	14.9
1,1,1-Trichloroethane	8
Trichloroethylene	10.3
Freon 11	1730
Freon 12	425
Freon 113	
Freon 114	
Non-Halogenated Hydrocarbons	
2-Propanone	0.0367
Carbon disulfide	1.4
Heptane	
Benzene	5.43
Cumene	0.15
Ethyl benzene	8.44
Styrene	2.81
Toluene	5.94
1,2-Xylenes	5.1
1,3-Xylenes	7.68
1,4-Xylenes	7.68
1,2,4-Trimethylbenzene	
1,3,5-Trimethylbenzene	
SEMI-VOLATILE ORGANIC COMPOUNDS	
PAHs	
2-Methylnaphthalene	
Acenaphthene	0.15
Acenaphthylene	0.28
Anthracene	0.065
Benzo(a)anthracene	0.00066
Benzo(a)pyrene	<0.0024
Benzo(b)fluoranthene	0.012
Benzo(g,h,i)perylene	5.34 x 10-5
Benzo(k)fluoranthene	0.0394

Table 5-6
Henry's Law Constants
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Henry's Law Constant atm-m^3/mole (x 10-3 except where indicated)
PAHs	
Chrysene	0.00105
Dibenzo(a,h)anthracene	7.33 x 10-5
Dibenzofuran	
Fluoranthene	0.0065
Fluorene	0.0642
Indeno(1,2,3-c,d)pyrene	6.86 x 10-5
Naphthalene	0.483
Phenanthrene	0.039
Pyrene	0.00504
Phenols	
4-Methylphenol	0.000792
4-Nitrophenol	0.0000331
Phthalates	
bis(2-Ethylhexyl) phthalate	0.00025 (20°C)
Butyl benzyl phthalate	0.0013
Di-n-butyl phthalate	0.0045 (25°C)
Di-n-octyl phthalate	
Chlorinated Hydrocarbons	
1,2-Dichlorobenzene	0.0012 (20°C)
1,3-Dichlorobenzene	1.8 (20°C)
1,4-Dichlorobenzene	0.0015 (20°C)
1,2,4-Trichlorobenzene	1.42
Miscellaneous	
N-Nitrosodi-n-propylamine	
PESTICIDES	
4,4'-DDD	0.031 (25°C)
4,4'-DDE	0.190 (25°C)
4,4'-DDT	0.280 (25°C)
Aldrin	0.496
Chlordane	0.220 (25°C)
delta-BHC	
Dieldrin	0.058 (25°C)
Endosulfan sulfate	
Endrin ketone	
Heptachlor epoxide	0.032

Table 5-6
Henry's Law Constants
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Henry's Law Constant atm-m^3/mole (x 10-3 except where indicated)
PCBs	
PCB-1242	0.340 (25°C)
PCB-1254	0.280 (20°C)
PCB-1260	0.340 (20°C)

Prepared by: JSS
Checked by: VKC
92C4087

References: Howard, P. H. 1989. Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Lewis Publishers, Volumes I, II, III.

The Installation Restoration Program Toxicology Guide, July 1989, U.S. Department of Commerce, Volumes I - V.

Montgomery, J. H.; Welkom, L. M. 1990. Groundwater Chemicals Desk Reference, Lewis Publishers.

USEPA, 1986. Superfund Public Health Evaluation Manual, Office of Emergency and Remedial Response, EPA/540/1-86/060, October 1986.

Table 5-7
Hydrolysis Half-Lives for Selected Groundwater/Leachate Constituents
Pelham Bay Landfill
Bronx, New York

Compound	Hydrolysis Half-Life (pH 7 at 25°C)
1,2-Dichlorobenzene	>879 yr
1,2-Dichloroethylene	--
1,3-Dichlorobenzene	>879 yr
1,4-Dichlorobenzene	>879 yr
Benzoic acid	--
bis(2-Chloroethoxy)methane	--
bis(2-Chloroisopropyl)ether	--
bis(2-Ethylhexyl)phthalate	2000 yr
Chlorobenzene	>879 yr
Chloroform	3,500 yr
Di-n-butyl phthalate	10 yr
Di-n-octyl phthalate	107 yr
Tetrachloroethylene	9 mo
Trichloroethylene	10.7 mo
4,4'-DDD	28 yr
4,4'-DDE	--
Aldrin	2 yr
alpha-BHC	7 mo
alpha-Chlordane	>197,000 yr
beta-BHC	7 mo
delta-BHC	7 mo
Dieldrin	10.5 yr
Endosulfan II	--
Endosulfan sulfate	--
Endrin	--
Endrin ketone	--
gamma-BHC	7 mo
Methoxychlor	1 yr
PCBs	--

-- = No data available.

References: Howard,P.H.,et.al.,1991. Handbook of Environmental Degradation Rates, Lewis Publishers.

Prepared by: JDV
Checked by: VKC
92C4087

Table 5-8
Photodegradation Half-Lives
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Photooxidation Half-Life	Photolysis Half-Life	Comments
VOLATILE ORGANIC COMPOUNDS			
Halogenated Hydrocarbons			
Bromoform	54 - 541 d		
Chlorobenzene	17 d	1 mo	Degradation faster in polluted atmospheres
cis-1,2-Dichloroethylene	8 d		
trans-1,2-Dichloroethylene	3.6 d	not significant	
Hexachlorobutadiene	2 mo - 1.6 yr		
Methylene chloride	7 mo	not significant	
Tetrachloroethylene	1 hr - 2 mo		Values are for complete degradation
1,1,1-Trichloroethane	6 mo - 25 yr	5 yr	Degradation accelerated in presence of ozone
Trichloroethylene	5 d	not significant	Rapid photooxidation under smog conditions
Freon 11	52 - 207 yr		Photolysis occurs in stratosphere
Freon 12			
Freon 113	20 yr		
Freon 114	20 yr		
Non-Halogenated Hydrocarbons			
2-Propanone	13 d	79 d	Combination of both photodegradation processes
Carbon disulfide	9 d	not significant	
Methane			
Heptane			
Benzene	13.4 d	16.9 d	4 to 6 hours in polluted atmospheres
Cumene			
Ethyl benzene	0.5 hr - 2 d	not significant	
Styrene	2.5 hr	not significant	
Toluene	3 hr - 1 d	not significant	
1,2-Xylenes	1.5 - 15 hr		Half-life larger in winter
1,3-Xylenes	1.0 - 10 hr		Half-life larger in winter
1,4-Xylenes	1.7 - 18 hr		Half-life larger in winter
1,2,4-Trimethylbenzene			

Table 5-8
Photodegradation Half-Lives
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Photooxidation Half-Life	Photolysis Half-Life	Comments
Non-Halogenated Hydrocarbons			
1,3,5-Trimethylbenzene	6.17 mo		
SEMI-VOLATILE ORGANIC COMPOUNDS			
PAHs			
2-Methylnaphthalene			
Acenaphthene		3 - 60 hr	
Acenaphthylene			
Anthracene		0.6 - 1.7 hr	
Benzo(a)anthracene			
Benzo(a)pyrene		0.4 - 1.1 hr	
Benzo(b)fluoranthene		9 - 720 hr	
Benzo(g,h,i)perylene			
Benzo(k)fluoranthene		4 - 499 hr	
Chrysene		4.4 - 13 hr	
Dibenzo(a,h)anthracene		0.25 - 32.6 d	
Dibenzofuran			
Fluoranthene		21 - 63 hr	
Fluorene			
Indeno(1,2,3-c,d)pyrene		125 - 250 d	
Naphthalene	<1 d	71 - 550 d	Photooxidation accelerated in presence of NO3
Phenanthrene		3 - 25 hr	
Pyrene		0.68 - 2.04 hr	
Phenols			
4-Methylphenol			
4-Nitrophenol	14 hr	3 hr - 14 d	Subject mainly to settling and photolysis
Phthalates			
bis(2-Ethylhexyl) phthalate			
Butyl benzyl phthalate	1 - 5 d	not significant	
Di-n-butyl phthalate		not significant	Not expected to be degraded by direct photolysis
Di-n-octyl phthalate			

Table 5-8
Photodegradation Half-Lives
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Photooxidation Half-Life	Photolysis Half-Life	Comments
Chlorinated Hydrocarbons			
1,2-Dichlorobenzene	24 d	not significant	
1,3-Dichlorobenzene	14 d	not significant	
1,4-Dichlorobenzene	31 d	not significant	
1,2,4-Trichlorobenzene	18.5 d	not significant	Direct photolysis not appreciable
Miscellaneous			
N-Nitrosodi-n-propylamine		0.17 - 1 hr	
PESTICIDES			
4,4'-DDD		5 d	Estimated data in natural water (mid-June sunlt.)
4,4'-DDE		1 - 6 d	For aquatic systems, half-life longer in winter
4,4'-DDT		5 d	Natural water in summer sunlight
Aldrin	35.46 min	1.1 d	Direct photolysis not a significant degrad. factor
Chlordane		not significant	No data available in presence of natural substances
delta-BHC			
Dieldrin	No data	No data	Long residence time suspected
Endosulfan sulfate			
Endrin ketone			
Heptachlor epoxide	1.5 d		Half-life longer in winter
PCBs (data grouped for listed compounds)			
PCB-1242	Resistant to oxidation	Slow process but significant	Photolytic dechlorination greatest for highly chlorinated species.
PCB-1254			
PCB-1260			

Prepared by: JSS
Checked by: VKC
92C4087

References: Howard, P. H. 1989, Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Lewis Publishers, Volumes I, II, III.
Howard, P. H., et al. 1991. Handbook of Environmental Degradation Rates, Lewis Publishers.
The Installation Restoration Program Toxicology Guide, July 1989, U.S. Department of Commerce, Volumes I - V.

Table 5-9
Surface Water Modeling Parameters and Results
Pelham Bay Landfill
Bronx, New York

Constituent	Qe (cfs)	Qf (cfs)	So (o/oo)	S (o/oo)	Qd (cfs)	Cl (ug/L)	Cd (ug/L)
1,2-Dichloroethylene	0.116	7.17	28.5	23.0	37.8	2.50	0.008
1,4-Dichlorobenzene	0.116	7.17	28.5	23.0	37.8	5.28	0.016
2,4-Dimethylphenol	0.116	7.17	28.5	23.0	37.8	22.27	0.068
2-Butanone	0.116	7.17	28.5	23.0	37.8	9.17	0.028
2-Methylnaphthalene	0.116	7.17	28.5	23.0	37.8	6.43	0.020
2-Methylphenol	0.116	7.17	28.5	23.0	37.8	8.82	0.027
2-Propanone	0.116	7.17	28.5	23.0	37.8	14.00	0.043
2-Hexanone	0.116	7.17	28.5	23.0	37.8	5.00	0.015
4,4'-DDD	0.116	7.17	28.5	23.0	37.8	0.17	0.0005
4,4'-DDE	0.116	7.17	28.5	23.0	37.8	0.16	0.0005
2-Methyl-2-pentanone	0.116	7.17	28.5	23.0	37.8	5.14	0.016
4-Methylphenol	0.116	7.17	28.5	23.0	37.8	6.26	0.019
Acenaphthene	0.116	7.17	28.5	23.0	37.8	6.43	0.020
alpha-BHC	0.116	7.17	28.5	23.0	37.8	0.035	0.00011
Aluminum	0.116	7.17	28.5	23.0	37.8	25,381	78.0
Anthracene	0.116	7.17	28.5	23.0	37.8	5.49	0.017
Antimony	0.116	7.17	28.5	23.0	37.8	29.09	0.09
Arsenic	0.116	7.17	28.5	23.0	37.8	35.55	0.11
Barium	0.116	7.17	28.5	23.0	37.8	1,078	3.31
Benzene	0.116	7.17	28.5	23.0	37.8	2.94	0.009
Benzo(a)anthracene	0.116	7.17	28.5	23.0	37.8	5.00	0.015
Beryllium	0.116	7.17	28.5	23.0	37.8	0.33	0.001
bis(2-Chloroisopropyl)ether	0.116	7.17	28.5	23.0	37.8	5.00	0.015
bis(2-Ethylhexyl)phthalate	0.116	7.17	28.5	23.0	37.8	7.40	0.023
Boron	0.116	7.17	28.5	23.0	37.8	8,900	27.3
Cadmium	0.116	7.17	28.5	23.0	37.8	3.25	0.010
Calcium	0.116	7.17	28.5	23.0	37.8	175,441	539
Carbon Disulfide	0.116	7.17	28.5	23.0	37.8	2.65	0.008
Chlorobenzene	0.116	7.17	28.5	23.0	37.8	9.06	0.03
Chromium	0.116	7.17	28.5	23.0	37.8	354	1.1
Chromium (VI)	0.116	7.17	28.5	23.0	37.8	0.56	0.002
Chrysene	0.116	7.17	28.5	23.0	37.8	5.00	0.015
Cobalt	0.116	7.17	28.5	23.0	37.8	61	0.186
Copper	0.116	7.17	28.5	23.0	37.8	323	0.99
Cyanide	0.116	7.17	28.5	23.0	37.8	17.91	0.055
delta-BHC	0.116	7.17	28.5	23.0	37.8	0.035	0.00011
Di-n-butyl phthalate	0.116	7.17	28.5	23.0	37.8	5.00	0.015
Di-n-octyl phthalate	0.116	7.17	28.5	23.0	37.8	5.46	0.017

Table 5-9
Surface Water Modeling Parameters and Results
Pelham Bay Landfill
Bronx, New York

Constituent	Qe (cfs)	Qf (cfs)	So (o/oo)	S (o/oo)	Qd (cfs)	Cl (ug/L)	Cd (ug/L)
Dibenzofuran	0.116	7.17	28.5	23.0	37.8	5.97	0.018
Dieldrin	0.116	7.17	28.5	23.0	37.8	0.15	0.0005
Endosulfan II	0.116	7.17	28.5	23.0	37.8	0.18	0.001
Endosulfan sulfate	0.116	7.17	28.5	23.0	37.8	0.25	0.00077
Endrin	0.116	7.17	28.5	23.0	37.8	0.06	0.0002
Ethylbenzene	0.116	7.17	28.5	23.0	37.8	3.93	0.012
Fluoranthene	0.116	7.17	28.5	23.0	37.8	5.69	0.017
Fluorene	0.116	7.17	28.5	23.0	37.8	6.06	0.019
gamma-BHC	0.116	7.17	28.5	23.0	37.8	26.01	0.08
Iron	0.116	7.17	28.5	23.0	37.8	52,671	162
Lead	0.116	7.17	28.5	23.0	37.8	278	0.85
Magnesium	0.116	7.17	28.5	23.0	37.8	558,919	1,717
Manganese	0.116	7.17	28.5	23.0	37.8	5,440	16.7
Mercury	0.116	7.17	28.5	23.0	37.8	0.52	0.002
Methoxychlor	0.116	7.17	28.5	23.0	37.8	0.34	0.001
Methylene chloride	0.116	7.17	28.5	23.0	37.8	2.50	0.008
Naphthalene	0.116	7.17	28.5	23.0	37.8	15.49	0.048
Nickel	0.116	7.17	28.5	23.0	37.8	404	1.24
PCB-1016	0.116	7.17	28.5	23.0	37.8	0.37	0.001
Phenanthrene	0.116	7.17	28.5	23.0	37.8	8.21	0.026
Potassium	0.116	7.17	28.5	23.0	37.8	605,490	1,860
Pyrene	0.116	7.17	28.5	23.0	37.8	5.58	0.017
Silver	0.116	7.17	28.5	23.0	37.8	2.41	0.007
Sodium	0.116	7.17	28.5	23.0	37.8	7,525,253	23,121
Thallium	0.116	7.17	28.5	23.0	37.8	3.08	0.009
Toluene	0.116	7.17	28.5	23.0	37.8	6.14	0.019
Trichloroethylene	0.116	7.17	28.5	23.0	37.8	2.50	0.008
Vanadium	0.116	7.17	28.5	23.0	37.8	1,222	3.76
Xylenes (total)	0.116	7.17	28.5	23.0	37.8	5.46	0.017
Zinc	0.116	7.17	28.5	23.0	37.8	337	1.04

Prepared by: CC
Checked by: VKC
92C4087

Table 5-10
Comparison of Surface Water Model Results and NYSDEC Surface Water Quality Criteria
Pelham Bay Landfill
Bronx, New York

Constituent	Surface Water Model Results	Surface Water Analytical Data		NYSDEC SCG Saline Water Class SB
		Min	Max	
	(ug/L)	(ug/L)	(ug/L)	(ug/L)
1,2-Dichloroethylene	0.008			NA
1,4-Dichlorobenzene	0.016			5
2,4-Dimethylphenol	0.068			NA
2-Butanone	0.028			NA
2-Methylnaphthalene	0.020			NA
2-Methylphenol	0.027			NA
2-Proponane	0.043			NA
2-Hexanone	0.015			NA
4,4'-DDD	0.0005			0.001
4,4'-DDE	0.0005			0.001
2-Methyl-2-pentanone	0.016			NA
4-Methylphenol	0.019			NA
Acenaphthene	0.020			NA
alpha-BHC	0.00011	0.0066 J	0.034 JV	NA
Aluminum	78.0	290	580	NA
Anthracene	0.017			NA
Antimony	0.09			NA
Arsenic	0.11			63
Barium	3.31	9 BNJ	17 BN	NA
Benzene	0.009			6
Benzo(a)anthracene	0.015			NA
Beryllium	0.001			NA
bis(2-Chloroisopropyl)ether	0.015			NA
bis(2-Ethylhexyl)phthalate	0.023		4 J	NA
Boron	27.3			1000
Cadmium	0.010			7.7
Calcium	539	193,000 E	305,000	NA
Carbon disulfide	0.008			NA
Chlorobenzene	0.03			5
Chromium	1.1			NA
Chromium, hexavalent	0.002			54
Chrysene	0.015			NA
Cobalt	0.186			NA
Copper	0.99	4.9 B	10 B	2.9 (diss)
Cyanide	0.055			1.0 (free)
delta-BHC	0.00011		0.0071 JV	NA
Di-n-butyl phthalate	0.015	2 J	3 J	NA
Di-n-octyl phthalate	0.017			NA
Dibenzofuran	0.018			NA
Dieldrin	0.0005			0.001
Endosulfan II	0.001			NA

Table 5-10
Comparison of Surface Water Model Results and NYSDEC Surface Water Quality Criteria
Pelham Bay Landfill
Bronx, New York

Constituent	Surface Water Model Results (ug/L)	Surface Water Analytical Data Min (ug/L)	Surface Water Analytical Data Max (ug/L)	NYSDEC SCG Saline Water Class SB (ug/L)
Endosulfan sulfate	0.00077	0.03 JV	0.27 V	NA
Endrin	0.0002			0.002
Ethylbenzene	0.012			NA
Fluoranthene	0.017			NA
Fluorene	0.019			NA
gamma-BHC	0.08			NA
Iron	162	97 B	1,140	NA
Lead	0.85	1.4 BNW	13.3 BNJ	8.6 (a)
Magnesium	1,717	808,000 E*	1,070,000	NA
Manganese	16.7	102	130	NA
Mercury	0.002	0.2 B	9.5 *	0.1 (a)
Methoxychlor	0.001			0.03
Methylene chloride	0.008			NA
Naphthalene	0.048			NA
Nickel	1.24	10.5 BN	15.7 BN	7.1
PCB-1016	0.001			0.001
Phenanthrene	0.026			NA
Potassium	1,860	231,000	314,000	NA
Pyrene	0.017		12 J	NA
Silver	0.007			NA
Sodium	23,121	7,449,000	9,273,000	NA
Thallium	0.009			NA
Toluene	0.019			NA
Trichloroethylene	0.008			NA
Vanadium	3.76		5 BN	NA
Xylenes(TOTAL)	0.017			NA
Zinc	1.04			58.0

Blanks indicate the compound was not detected in the sample

NA - there is not a NYSDEC criterion for this compound

(a) Guidance Value, regulated standard for this chemical is not available

B = for organics indicates blank contaminant

B = for inorganics indicates acceptable reported value (less than the Contract Required Detection Limit but greater than the Instrument Detection Limit)

E = for organics indicates an estimated value (reported concentration exceeded the calibration range)

E = for inorganics indicates an estimated value due to matrix interference

J = Estimated value

N = Estimated value (Spiked sample recovery was not within quality control limits)

V = Reported results could not be verified during data validation

W = Estimated value (Post digestion spike sample results reported outside quality control limits, sample absorbance is less than 50% of spike absorbance)

* = Estimated result (Duplicate analysis result was not within quality control limit)

Prepared by: CC
Checked by: VKC
92C4087

Table 5-11
Comparison of Groundwater/Leachate with Surface Water Samples - South Seawall
Pelham Bay Landfill
Bronx, New York

Constituent	South Seawall Leachate Mean Concentration (ug/L)	Surface Water High Tide Mean Concentration (ug/L)	Surface Water Low Tide Mean Concentration (ug/L)	Surface Water Reference Station SW-9	
				High Tide (ug/L)	Low Tide (ug/L)
Volatile Organic Compounds					
Ketones					
2-Butanone	62				
2-Hexanone	5				
Monocyclic Aromatic Hydrocarbons					
Benzene	3.5				
Chlorobenzene	3.5				
Ethyl benzene	8				
Toluene	81				
Xylenes (total)	65				
Miscellaneous					
Carbon disulfide	3				
Semi-volatile Organic Compounds					
PAHs					
2-Methylnaphthalene	5				
Acenapthene	7.5				
Anthracene	8				
Dibenzofuran	9				
Fluorene	7.5				
Naphthalene	8				
Phenanthrene	24				
Pyrene	4		12		
Phenols					
2,4-Dimethylphenol	7				
4-Methylphenol	6				
Phthalates					
bis(2-Ethylhexyl) phthalate	13		4		
Di-n-butyl phthalate	2.5		2.3		
Di-n-octyl phthalate	2				
Ethers					
bis(2-Chloroisopropyl) ether	3				

Table 5-11
Comparison of Groundwater/Leachate with Surface Water Samples - South Seawall
Pelham Bay Landfill
Bronx, New York

Constituent	South Seawall Leachate Mean Concentration (ug/L)	Surface Water High Tide Mean Concentration (ug/L)	Surface Water Low Tide Mean Concentration (ug/L)	Surface Water Reference Station SW-9	
				High Tide (ug/L)	Low Tide (ug/L)
Pesticides and PCBs					
4,4'-DDD	0.018				
4,4'-DDE	0.021				
alpha-BHC			0.0082		
delta-BHC	0.028				
Dieldrin	0.14				
Endrin	0.023				
Methoxychlor	0.15				
Inorganics					
Aluminum	17791		578.5		
Antimony	60.8				
Arsenic	28.5				
Barium	841	12.3	13.7	11	13
Beryllium	0.8				
Boron	6790				
Cadmium	6.6				
Calcium	145214	224000	244333	244000	305000
Chromium	146.5				
Cobalt	34.3				
Copper	252.7	7.5			
Cyanide	145.8				
Iron	36629.7	137	579	97	
Lead	157.1	13.3	6.4		
Magnesium	295014	1003000	1028667	981000	945000
Manganese	973	110.7	123.3	107	108
Mercury	1.1	0.3	5.9		
Nickel	105.3	10.5			
Potassium	303471	282667	313000	311000	293000
Silver	12.1				
Sodium	3745857	8676333	8790333	9108000	8954000
Thallium	13.5				
Vanadium	186.6	5			
Zinc	321.5				

Note: Blanks indicate constituents below detection limit

Prepared by: CC
Checked by: VKC
92C4087

Table 5-12
Comparison of Groundwater/Leachate with Surface Water Samples - East Seawall
Pelham Bay Landfill
Bronx, New York

Constituent	East Seawall Leachate Mean Concentration (ug/L)	Surface Water High Tide Mean Concentration (ug/L)	Surface Water Low Tide Mean Concentration (ug/L)	Surface Water Reference Station SW-9	
				High Tide (ug/L)	Low Tide (ug/L)
Volatile Organic Compounds					
Halogenated Aliphatic Compounds					
1,2-Dichloroethylene	1				
Ketones					
2-Propanone	66				
Monocyclic Aromatic Hydrocarbons					
Benzene	2.6				
Chlorobenzene	11				
Ethyl benzene	4.7				
Toluene	7				
Xylenes (total)	5.3				
Miscellaneous					
Carbon disulfide	1				
Semi-volatile Organic Compounds					
PAHs					
2-Methylnaphthalene	13.7				
Acenapthene	6.2				
Anthracene	4.3				
Benzo(a)anthracene	2				
Dibenzofuran	12				
Fluoranthene	5				
Fluorene	6.7				
Naphthalene	36.5				
Phenanthrene	14				
Pyrene	5.5				
Phenols					
2-Methylphenol	51				
2,4-Dimethylphenol	49.3				
Phthalates					
bis(2-Ethylhexyl) phthalate	6.2				
Di-n-butyl phthalate	2.5				
Chlorinated Hydrocarbons					
1,4-Dichlorobenzene	4				

Table 5-12
Comparison of Groundwater/Leachate with Surface Water Samples - East Seawall
Pelham Bay Landfill
Bronx, New York

Constituent	East Seawall Leachate Mean Concentration (ug/L)	Surface Water High Tide Mean Concentration (ug/L)	Surface Water Low Tide Mean Concentration (ug/L)	Surface Water Reference Station SW-9	
				High Tide (ug/L)	Low Tide (ug/L)
Pesticides and PCBs					
4,4'-DDD	0.018				
4,4'-DDE	0.037				
alpha-BHC	0.055	0.026	0.01		
alpha-Chlordane	0.056				
delta-BHC	0.032		0.007		
Dieldrin	0.204				
Endosulfan II	1.218				
Endosulfan sulfate		0.153	0.079		
Endrin	0.043				
Methoxychlor	0.443				
PCB-1016	0.84				
PCB-1260	1				
Inorganics					
Aluminum	2911.1				
Arsenic	11.1				
Barium	600	15.3	16	11	13
Boron	5510				
Cadmium	7.7				
Calcium	138417	211667	205333	244000	305000
Chromium	128.2				
Cobalt	27.5				
Copper	155.8				
Cyanide	16.7				
Iron	16047.9	143.3	216.3	97	
Lead	43.4	1.8	1.4		
Magnesium	355992	900333	901667	981000	945000
Manganese	1251.5	110	119.7	107	108
Mercury	2.1		9.5		
Nickel	145	12.5	15.7		
Potassium	338268	264000	264000	311000	293000
Selenium	13.6				
Silver	3.6				
Sodium	4220433	8060667	7892667	9108000	8954000
Thallium	16.8				
Vanadium	289				
Zinc	87				

Note: Blanks indicate constituents below detection limit

Prepared by: CC
Checked by: VKC

Table 5-13
Site-Specific Sediment Properties
Pelham Bay Landfill
Bronx, New York

Sediment Location	% Fines*	% Organic Carbon**
SD - 1	91.7	1.71
SD - 2	91.2	2.34
SD - 3	57.6	2.24
SD - 4	73.6	2.09
SD - 5	90.1	2.12
SD - 6	34.1	4.31

Notes: * Particles <63 micrometers

** Analytical method EPA 9060A

Prepared by: VKC
Checked by: ABB
92C4087

Table 5-14
Koc and Kd Values For Organic Compounds in Sediments
Pelham Bay Landfill
Bronx, New York

Organic Compound	Koc (1) (mL/g)	Kd* (mL/g)
2- Propanone	0.37	00.008
PAHs		
2-Methylnapthalene	7,943	167
Acenaphthene	6,026 (2)	127
Acenaphthylene	4,786	101
Anthracene	19,724	414
Benz(a)anthracene	1,380,384	28,988
Benzo(a)pyrene	398,107 to 1,949,845	8,360 to 40,947
Benzo(b)fluoranthene	549,541	11,540
Benzo(g,h,i)perylene	4,365,158	91,668
Benzo(k)fluoranthene	7,762,471	163,012
Chrysene	245,471	5,155
Dibenzo(a,h)anthracene	1,659,587	34,851
Dibenzofuran	10,000	210
Fluoranthene	125,893 (3)	2,644
Fluorene	5,012	105
Indeno(1,2,3-cd)pyrene	30,902,954	648,962
Napthalene	1,369	29
Phenanthrene	19,498 (4)	409
Pyrene	68,956	1,448
Phthalates		
Butyl benzyl phthalate	67.6 to 347	1.42 to 7.29
Di-n-butyl phthalate	1,380	29
Di-n-octyl phthalate	977,237,221	20,521,982
bis(2-Ethylhexyl)phthalate	100,000	2,100
Pesticides and PCBs		
4,4'-DDD	43,652	917
4,4'-DDE	493,174	10,357
4,4'-DDT	260,615	5,473
Dieldrin	144,544 (5)	3,035
Endosulfan sulfate	2,344	49
delta-BHC	1,901	40

Note: * Based on 2.1% organic carbon.

References: (1) Montgomery, J.H.;Welkom,L.M.,1989. Groundwater Chemicals Desk Reference. Lewis Publishers.
(2) USEPA,1991. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Acenaphthene. Office of Science and Technology, Health and Ecological Criteria Division, November 1991.
(3) USEPA,1991. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Fluoranthene. Office of Science and Technology, Health and Ecological Criteria Division, November 1991.
(4) USEPA,1991. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene. Office of Science and Technology, Health and Ecological Criteria Division, November 1991.
(5) USEPA,1991. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Dieldrin. Office of Science and Technology, Health and Ecological Criteria Division, November 1991.

Prepared by: JDV
Checked by: VKC
92C4087

Table 5-15
Koc and Kd Values for Organic Compounds in Groundwater/Leachate
Pelham Bay Landfill
Bronx, New York

Organic Compound	Koc (1) (mL/g)	Kd (mL/g)
VOLATILES		
Halogenated Aliphatic Compounds		
1,1-Dichloroethylene	64.6	1
1,2-Dichloroethylene	58.9	1
Chloroform	43.6	0.92
Methylene chloride	8.7	0.18
Tetrachloroethylene	271.6	6
Trichloroethylene	95.1	2
Ketones		
2-Butanone	1.23	0.03
2-Hexanone	134.9	3
2-Propanone	0.37	0.01
4-Methyl-2-pentanone	6.17	0.13
Monocyclic Aromatic Hydrocarbons		
Benzene	78.1	2
Chlorobenzene	125.9	3
Ethyl benzene	156.7	3
Toluene	131.8	3
1,2-Xylene	128.8	3
1,3-Xylene	1,584.9	33
1,4-Xylene	204.2	4
SEMI-VOLATILES		
PAHs		
2-Methylnaphthalene	7,943	167
Acenaphthene	6,026 (2)	127
Acenaphthylene	4,786	101
Anthracene	19,724	414
Benz(a)anthracene	1,380,384	28,988
Chrysene	245,471	5,155
Dibenzofuran	10,000	210
Fluoranthene	125,893 (3)	2,644
Fluorene	5,012	105
Naphthalene	1,369	29
Phenanthrene	19,498 (4)	409
Pyrene	68,956	1,448
Phenols		
2-Methylphenol	21.9	0.46
2,4-Dimethylphenol	117.5	2
4-Methylphenol	49	1
4-Nitrophenol	108.4	2
Phthalates		
bis(2-Ethylhexyl)phthalate	100,000	2,100
Di-n-butyl phthalate	1,380	29
Di-n-octyl phthalate	977,237,221	20,521,982

Table 5-15
Koc and Kd Values for Organic Compounds in Groundwater/Leachate
Pelham Bay Landfill
Bronx, New York

Organic Compound	Koc (1) (mL/g)	Kd (mL/g)
Ethers		
bis(2-Chloroisopropyl)ether	61.7	1
bis(2-Chloroethoxy)methane	114.8	2
Chlorinated Hydrocarbons		
1,2-Dichlorobenzene	384.6	8
1,3-Dichlorobenzene	537	11
1,4-Dichlorobenzene	158.5	3
Amines/Nitroarenes		
3-Nitroaniline	18.2	0.38
N-Nitrosodi-n-propylamine	10.2	0.21
N-Nitrosodiphenylamine	575.4	12
Miscellaneous		
Benzoic acid	182	4
PESTICIDES AND PCBs		
4,4'-DDD	43,652	917
4,4'-DDE	493,174	10,357
Aldrin	407.4	9
alpha-BHC	1,901	40
alpha-Chlordane	453,593	9,525
beta-BHC	2,790	59
delta-BHC	1,901	40
Dieldrin	144,544 (5)	3,035
Endosulfan II	2,344	49
Endosulfan sulfate	2,344	49
Endrin	8,318	175
Endrin ketone	--	
gamma-BHC	1,244	26
Methoxychlor	84,140	1,767
PCB-1016	50,119	1,052
PCB-1260	2,630,268	55,236

Notes:
-- = No data available
* Based on 2.1% organic carbon.

References: (1) Montgomery, J.H.;Welkom,L.M.,1989. Groundwater Chemicals Desk Reference. Lewis Publishers.
(2) USEPA,1991. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Acenaphthene. Office of Science and Technology, Health and Ecological Criteria Division, November 1991.
(3) USEPA,1991. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Fluoranthene. Office of Science and Technology, Health and Ecological Criteria Division, November 1991.
(4) USEPA,1991. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene. Office of Science and Technology, Health and Ecological Criteria Division, November 1991.
(5) USEPA,1991. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Dieldrin. Office of Science and Technology, Health and Ecological Criteria Division, November 1991.

Prepared by: JDV
Checked by: VKC

Table 5-16
Comparison of Constituents in Groundwater/Leachate with Sediments - East Seawall
Pelham Bay Landfill
Bronx, New York

Constituents	Groundwater/Leachate Mean Concentration* (ppb)	Sediments Mean Concentration** (ppb)	Sediment Reference Station, SD-9 (ppb)
VOLATILE ORGANIC			
2-Propanone	120	44	
Benzene	2.0		
Chlorobenzene	12.6		
Ethyl benzene	3.3		
Toluene	1.0		
Xylenes (total)	4.0		
Carbon disulfide	1.0		
SEMI-VOLATILE ORGANIC			
PAHs			
Acenaphthene	3.0	140	
Acenaphthylene		116	217
Anthracene	2.0	232	182
Benzo(a)anthracene		658	622
Benzo(a)pyrene		666	508
Benzo(b)fluoranthene		663	682
Benzo(g,h,i)perylene		357	353
Benzo(k)fluoranthene		652	564
Chrysene		889	830
Dibenzo(a,h)anthracene		110	135
Fluoranthene	2.0	808	735
Fluorene	2.0	140	
Indeno(1,2,3-c,d)pyrene		373	397
Naphthalene	3.7		
Phenanthrene		438	500
Pyrene	2.0	1518	1162
Phenols			
2,4-Dimethylphenol	5.0		
Phthalates			
Butyl benzyl phthalate		189	130
Di-n-butyl phthalate	2.0	245	
bis(2-Ethylhexyl)phthalate	3.5	2408	1817
PESTICIDES			
4,4'-DDD	0.021	138	
4,4'-DDE	0.035	87	
4,4'-DDT		70	
alpha-BHC	0.009		
alpha-Chlordane	0.056		

Table 5-16
Comparison of Constituents in Groundwater/Leachate with Sediments - East Seawall
Pelham Bay Landfill
Bronx, New York

Constituents	Groundwater/Leachate Mean Concentration* (ppb)	Sediments Mean Concentration** (ppb)	Sediment Reference Station, SD-9 (ppb)
delta-BHC	0.017	202	73
Dieldrin	0.180		
Endosulfan II	0.053		
Endrin	0.0425		
Methoxychlor	0.65		
INORGANICS	**(ppm)**	**(ppm)**	**(ppm)**
Aluminum	2397	17644	18167
Arsenic	10	10	12
Barium	630	101	95
Beryllium		0.7	0.7
Boron	6800		
Cadmium		4.0	3.6
Calcium	129021	17844	12667
Chromium	70	95	126
Cobalt	24	11	11
Copper	144	167	179
Iron	19386	35433	35700
Lead	33	164	179
Magnesium	291256	10677	11567
Manganese	1816	435	586
Mercury	0.7	1.0	1.5
Nickel	184		47
Potassium	236603	5331	5247
Selenium	13.6	1.5	
Silver	3.6	2.6	5.7
Sodium	3052886	19400	20033
Thallium		1.1	1.6
Vanadium	102	52	48
Zinc	62	282	279

*Groundwater/leachate mean concentrations were determined from monitoring wells MW-103, 104, 112, 113, 121, and 122, and leachate seep LS-10.

**Sediment mean concentrations were determined from sampling locations SD-1, 2, and 3.

Prepared by: VKC
Checked by: VKC
92C4087

Table 5-17
Comparison of Constituents in Groundwater/Leachate with Sediments - South Seawall
Pelham Bay Landfill
Bronx, New York

Constituent	Groundwater/Leachate Mean Concentration* (ppb)	Sediments Mean Concentration** (ppb)	Sediment Reference Station, SD-9 (ppb)
VOLATILE ORGANIC			
2-Butanone	62		
2-Hexanone	5.0		
2-Propanone		30	
Benzene	3.5		
Carbon disulfide	3.0		
Chlorobenzene	3.5		
Ethyl benzene	8.0		
Toluene	81		
Xylenes (total)	65		
SEMI-VOLATILE ORGANIC			
PAHs			
2-Methylnaphthalene	5.0	140	
Acenaphthene	7.5	255	
Acenaphthylene		289	217
Anthracene	8.0	384	182
Benzo(a)anthracene		1284	622
Benzo(a)pyrene		1219	508
Benzo(b)fluoranthene		1474	682
Benzo(g,h,i)perylene		529	353
Benzo(k)fluoranthene		1256	564
Chrysene		1448	830
Dibenzo(a,h)anthracene		158	135
Dibenzofuran	9.0	220	
Fluoranthene		1531	735
Fluorene	7.5	282	
Indeno(1,2,3-c,d)pyrene		539	397
Naphthalene	8.0	180	
Phenanthrene	24	962	500
Pyrene	4.0	2701	1162
Phenols			
2,4-Dimethylphenol	7.0		
4-Methylphenol	6.0		
Phthalates			
bis(2-Ethylhexyl)phthalate	13	3820	1817
Butyl benzyl phthalate		350	130
Di-n-butyl phthalate	2.5	245	
Di-n-octyl phthalate	2.0	222	

Table 5-17
Comparison of Constituents in Groundwater/Leachate with Sediments - South Seawall
Pelham Bay Landfill
Bronx, New York

Constituent	Groundwater/Leachate Mean Concentration* (ppb)	Sediments Mean Concentration** (ppb)	Sediment Reference Station, SD-9 (ppb)
Ethers			
bis(2-Chloroisopropyl)ether	3.0		
PESTICIDES			
4,4'-DDD	0.018	40	
4,4'-DDE	0.021		
delta-BHC	0.028	61	73
Dieldrin	0.140	25	
Endosulfan sulfate		75	
Endrin	0.023		
Methoxychlor	0.15		
INORGANICS	**(ppm)**	**(ppm)**	**(ppm)**
Aluminum	17791	15777	18167
Antimony	61		
Arsenic	28	11	12
Barium	841	106	95
Beryllium	0.8	0.6	0.7
Boron	6790		
Cadmium	6.6	2.3	3.6
Calcium	145214	26700	12667
Chromium	146	76	126
Cobalt	34	11	11
Copper	253	144	179
Iron	36630	31533	35700
Lead	157	190	179
Magnesium	295014	9902	11567
Manganese	973	375	586
Mercury	1.1	0.8	1.5
Nickel	105		47
Potassium	303471	4490	5247
Selenium		1.0	
Silver	12.1	1.9	5.7
Sodium	3745857	13602	20033
Thallium	13.5	1.4	1.6
Vanadium	187	44	48
Zinc	322	297	279

*Groundwater/leachate mean concentrations were determined from monitoring wells MW-106, 107, 110AR, 117, and 118AR, and leachate seep LS-1 and 5.

**Sediment mean concentrations were determined from sampling locations SD-4, 5, and 6.

Prepared by: VKC
Checked by: VKC
92C4087

Table 5-18
Bioconcentration Factors for Selected Compounds and Aquatic Species
Pelham Bay Landfill
Bronx, New York

Compounds	BCF	Species
INORGANIC COMPOUNDS		
Metals		
Copper	1,670	Marine Invertebrates
	667	Marine Fish
	90	Hard Clam and Blue Mussel (bivalves)
	670	Atlantic Silverside
Lead	17.5	Hard Clam
	2,570	Blue Mussel
	200 est	Marine Invertebrates
	60	Fish
	3,454	Eastern Oyster
Mercury (methyl mercury)	100,000	Invertebrates
	1,670	Fish
	2,500 (10°)	Mosquitofish
	4,300 (26°)	Mosquitofish
	3,000 est	Atlantic Silverside
Mercury (total)	10,000	Invertebrates
	300	Fish
Nickel	259, 329-473	Hard Clam and Blue Mussel (bivalves)
	259	Marine Invertebrates
	100	Fish
Zinc	225-500	Blue Mussel
	500 est	Hard Clam
	2,000	Marine Fish
VOLATILE ORGANIC COMPOUNDS		
Halogenated Hydrocarbons		
Chlorobenzene	645	Mosquitofish
SEMI-VOLATILE ORGANIC COMPOUNDS		
PAHs		
Phenanthrene	1,230	Fish
	32	Clam (Rangia cuneata)
	650 est	Atlantic Silverside
	6,500 est	Hard Clam and Mussel (bivalves)

Table 5-18
Bioconcentration Factors for Selected Compounds and Aquatic Species
Pelham Bay Landfill
Bronx, New York

Compounds	BCF	Species
PESTICIDES		
4,4-DDD	1,000-100,000	Aquatic Systems
4,4-DDE	10,000-100,000	Aquatic Systems
	108-217	Mosquitofish
alpha-Chlordane (Chlordane)	5,522	Eastern Oyster
	8,500-12,300	Juvenile Sheepshead Minnow
	13,000-22,000	Adult Sheepshead Minnow
	12,300 est	Atlantic Silverside
Dieldrin	500 at 0.5 ug/l	Eastern Oyster
	8,900 at 0.1 ug/l	Spot
	5,000 at 0.015 ug/l	Spot
	6,900 at 0.075 ug/l	Spot
	500 est	Hard Clam and Blue Mussel (bivalves)
	8,900 est	Atlantic Silverside
Endosulfan II	9.8	Blue Mussel
	9.8 est	Hard Clam
	779	Spot
	1,173	Pinfish
	1,376	Striped Mullet
	1100 est	Atlantic Silverside
Endrin	2,640 at 0.1 ug/l	Eastern Oyster
	6,400 at 0.025 to 0.72 ug/l	Sheapshead Minnow
Methoxychlor	1,500 at 0.11 ug/l	Mosquitofish
	0.18 at 9,360 ug/l to 110 at 108 ug/l	Striped Mullet
	1,500 est	Atlantic Silverside
	1,500 est	Bivalves
PCBs		
PCBs (total)	100,000	Fish
	85,000	Hard Clam and Blue Mussel (bivalves)

Prepared by: JSS
Checked by: VKC
92C4087

References: see references in Section 6.3

Table 5-19
Vapor Pressures
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Vapor Pressure (mm Hg at 25°C except where indicated)
VOLATILE ORGANIC COMPOUNDS	
Halogenated Hydrocarbons	
1,1,1-Trichloroethane	123.7
Bromoform	5.6
Chlorobenzene	11.9
cis-1,2-Dichloroethylene	200 (35°C)
Freon 11	802.8
Freon 113	362.5
Freon 114	2014
Freon 12	4870
Hexachlorobutadiene	0.15
Methylene chloride	434.9
Tetrachloroethylene	18.49
trans-1,2-Dichloroethylene	340
Trichloroethylene	69
Non-Halogenated Hydrocarbons	
1,2,4-Trimethylbenzene	
1,2-Xylenes	6.6
1,3,5-Trimethylbenzene	
1,3-Xylenes	8.3
1,4-Xylenes	8.7
2-Propanone	231
Benzene	95.19
Carbon disulfide	297 (20°C)
Cumene	
Ethyl benzene	9.53
Heptane	
Methane	
Styrene	6.6
Toluene	28.4
SEMI-VOLATILE ORGANIC COMPOUNDS	
PAHs	
2-Methylnaphthalene	
Acenaphthene	0.00155
Acenaphthylene	0.029 (20°C)
Anthracene	0.000195
Benzo(a)anthracene	1.1 x 10-7
Benzo(a)pyrene	5.5 x 10-9
Benzo(b)fluoranthene	5 x 10-7 (20°C)
Benzo(g,h,i)perylene	1 x 10-10

Table 5-19
Vapor Pressures
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Vapor Pressure (mm Hg at 25°C except where indicated)
PAHs	
Benzo(k)fluoranthene	9.6 x 10-11
Chrysene	6.3 x 10-9
Dibenzo(a,h)anthracene	1 x 10-10 (20°C)
Dibenzofuran	
Fluoranthene	5 x 10-6
Fluorene	7.1 x 10-4
Indeno(1,2,3-c,d)pyrene	1 x 10-10
Naphthalene	0.082
Phenanthrene	6.8 x 10-4
Pyrene	2.5 x 10-6
Phenols	
4-Methylphenol	0.08
4-Nitrophenol	0.001
Phthalates	
bis(2-Ethylhexyl) phthalate	6.2 x 10-8
Butyl benzyl phthalate	8.6 x 10-6 (20°C)
Di-n-butyl phthalate	1.60 x 10-4
Di-n-octyl phthalate	
Chlorinated Hydrocarbons	
1,2-Dichlorobenzene	1.47
1,3-Dichlorobenzene	2.3
1,4-Dichlorobenzene	1.76
1,2,4-Trichlorobenzene	0.29
Miscellaneous	
N-Nitrosodi-n-propylamine	
PESTICIDES	
4,4'-DDD	1.30 x 10-9 to 2.50 x 10-9 (30°C)
4,4'-DDE	6.20 x 10-6 to 6.60 x 10-6 (20°C)
4,4'-DDT	1.50 x 10-7 (20°C)
Aldrin	3.75 x 10-5 (20°C)
Chlordane	1.00 x 10-5 (20°C)
delta-BHC	1.7 x 10-5 (20°C)
Dieldrin	3.75 x 10-6 (20°C)
Endosulfan sulfate	
Endrin ketone	
Heptachlor epoxide	1.95 x 10-5

Table 5-19
Vapor Pressures
Pelham Bay Landfill
Bronx, New York

Organic Compounds	Vapor Pressure (mm Hg at 25°C except where indicated)
PCBs	
PCB-1242	4.00 x 10-4
PCB-1254	6.00 x 10-5 (20 °C)
PCB-1260	4.00 x 10-5

Prepared by: JSS
Checked by: VKC
92C4087

References: Howard, P. H. 1989. Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Lewis Publishers, Volumes I, II, III.

The Installation Restoration Program Toxicology Guide, July 1989, U.S. Department of Commerce, Volumes I - V.

Montgomery, J. H.; Welkom, L. M. 1990. Groundwater Chemicals Desk Reference, Lewis Publishers.

USEPA, 1986. Superfund Public Health Evaluation Manual, Office of Emergency and Remedial Response, EPA/540/1-86/060, October 1986.

Table 5-20
Comparison of Short-Term Air Modeling Results with Field Measurements and NYSDEC Concentration Guidelines
Pelham Bay Landfill
Bronx, New York

EIFC Detected Compounds	Maximum Measured Emission Rate (ug/m^2-s)	Highest Modeled 1 - hour * (ug/m^3)	Highest Offsite Conc. (24 hours) (ug/m^3)	Ratio of Modeled/ Measured Concentrations	NYSDEC Toxicity Rating	SGC Conc (ug/m^3)	AGC Conc (ug/m^3)
1,1,1-Trichloroethane ***	***	***	***	0.0001	Low	***	***
1,2,4-Trimethylbenzene	0.0791	0.177184	17	0.0104	Moderate	29,000	290
1,3,5-Trimethylbenzene	0.0348	0.077952	3.5	0.0223	Moderate	29,000	290
1,4-Dichlorobenzene	0.1973	0.441952	3.42	0.1292	-	-	-
Acetone	0.1362	0.305088	265.76	0.0011	Low	140,000	14,000
Benzene	0.2013	0.450912	9.75	0.0462	High	30	0.12
Bromoform	0.003	0.00672	6.31	0.0011	Moderate	1,200	12
Carbon disulfide	0.0029	0.006496	5.7	0.0011	Moderate	710	7
Chlorobenzene	1.1312	2.533888	1.12	2.2624	Moderate	11,000	20
Cumene	0.0981	0.219744	0.95	0.2313	-	58,000 **	583 **
Ethyl benzene	0.3074	0.688576	7.51	0.0917	Moderate	100,000	1,000
Freon 11	0.0024	0.005376	52.57	0.0001	Low	560,000	700
Freon 113	0.016	0.03584	8.57	0.0042	Low	1,800,000	90,000
Freon 12	0.0221	0.049504	9.56	0.0052	-	-	-
Heptane	0.0419	0.093856	4.13	0.0227	Moderate	83,000	830
Methane	9093.5	20369.44	21351	0.9540	-	-	-
Methylene chloride	0.0007	0.001568	70.67	0.0000	Moderate	41,000	27
Styrene	0.018	0.04032	12.13	0.0033	Moderate	51,000	510
Tetrachloroethylene	0.0031	0.006944	406.99	0.0000	Moderate	81,000	0.075
Toluene	0.0809	0.181216	241.47	0.0008	Low	89,000	2,000
Trichloroethylene	0.0015	0.00336	5.14	0.0007	Moderate	33,000	0.45
Xylenes	0.0665	0.14896	40.63	0.0037	Moderate	100,000	300

Notes:
* Highest modeled concentration occurred at Cops Beach
** A calculated interim value based on a moderate toxicity classification.
*** = Data not usable, see Data Usability Report, Appendix B

Prepared by: RJM
Checked by: BW
92C4087

Table 5-21
Modeled 1-Hour Concentrations for Seven Off-Site Locations
Stability Class D, Wind Speed 5 m/s
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane *	*	*	*	*	*	*	*
1,2,4-Trimethylbenzene	0.177184	0.147917	0.07119	0.083846	0.070399	0.065653	0.052206
1,3,5-Trimethylbenzene	0.077952	0.065076	0.03132	0.036888	0.030972	0.028884	0.022968
1,4-Dichlorobenzene	0.441952	0.368951	0.17757	0.209138	0.175597	0.163759	0.130218
Acetone	0.305088	0.254694	0.12258	0.144372	0.121218	0.113046	0.089892
Benzene	0.450912	0.376431	0.18117	0.213378	0.179157	0.167079	0.132858
Bromoform	0.00672	0.00561	0.0027	0.00318	0.00267	0.00249	0.00198
Carbon disulfide	0.006496	0.005423	0.00261	0.003074	0.002581	0.002407	0.001914
Chlorobenzene	2.533888	2.115344	1.01808	1.199072	1.006768	0.938896	0.746592
Cumene	0.219744	0.183447	0.08829	0.103986	0.087309	0.081423	0.064746
Ethyl benzene	0.688576	0.574838	0.27666	0.325844	0.273586	0.255142	0.202884
Freon 11	0.005376	0.004488	0.00216	0.002544	0.002136	0.001992	0.001584
Freon 113	0.03584	0.02992	0.0144	0.01696	0.01424	0.01328	0.01056
Freon 12	0.049504	0.041327	0.01989	0.023426	0.019669	0.018343	0.014586
Heptane	0.093856	0.078353	0.03771	0.044414	0.037291	0.034777	0.027654
Methane	20369.44	17004.845	8184.15	9639.11	8093.215	7547.605	6001.71
Methylene chloride	0.001568	0.001309	0.00063	0.000742	0.000623	0.000581	0.000462
Styrene	0.04032	0.03366	0.0162	0.01908	0.01602	0.01494	0.01188
Tetrachloroethylene	0.006944	0.005797	0.00279	0.003286	0.002759	0.002573	0.002046
Toluene	0.181216	0.151283	0.07281	0.085754	0.072001	0.067147	0.053394
Trichloroethylene	0.00336	0.002805	0.00135	0.00159	0.001335	0.001245	0.00099
Xylenes	0.14896	0.124355	0.05985	0.07049	0.059185	0.055195	0.04389

* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 5-22
Modeled 1-Hour Concentrations for Seven Off-Site Locations
Stability Class A, Wind Speed 1 m/s
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane *	*	*	*	*	*	*	*
1,2,4-Trimethylbenzene	0.430304	0.414484	0.147126	0.143171	0.132097	0.117068	0.074354
1,3,5-Trimethylbenzene	0.189312	0.182352	0.064728	0.062988	0.058116	0.051504	0.032712
1,4-Dichlorobenzene	1.073312	1.033852	0.366978	0.357113	0.329491	0.292004	0.185462
Acetone	0.740928	0.713688	0.253332	0.246522	0.227454	0.201576	0.128028
Benzene	1.095072	1.054812	0.374418	0.364353	0.336171	0.297924	0.189222
Bromoform	0.01632	0.01572	0.00558	0.00543	0.00501	0.00444	0.00282
Carbon disulfide	0.015776	0.015196	0.005394	0.005249	0.004843	0.004292	0.002726
Chlorobenzene	6.153728	5.927488	2.104032	2.047472	1.889104	1.674176	1.063328
Cumene	0.533664	0.514044	0.182466	0.177561	0.163827	0.145188	0.092214
Ethyl benzene	1.672256	1.610776	0.571764	0.556394	0.513358	0.454952	0.288956
Freon 11	0.013056	0.012576	0.004464	0.004344	0.004008	0.003552	0.002256
Freon 113	0.08704	0.08384	0.02976	0.02896	0.02672	0.02368	0.01504
Freon 12	0.120224	0.115804	0.041106	0.040001	0.036907	0.032708	0.020774
Heptane	0.227936	0.219556	0.077934	0.075839	0.069973	0.062012	0.039386
Methane	49468.64	47649.94	16913.91	16459.235	15186.145	13458.38	8547.89
Methylene chloride	0.003808	0.003668	0.001302	0.001267	0.001169	0.001036	0.000658
Styrene	0.09792	0.09432	0.03348	0.03258	0.03006	0.02664	0.01692
Tetrachloroethylene	0.016864	0.016244	0.005766	0.005611	0.005177	0.004588	0.002914
Toluene	0.440096	0.423916	0.150474	0.146429	0.135103	0.119732	0.076046
Trichloroethylene	0.00816	0.00786	0.00279	0.002715	0.002505	0.00222	0.00141
Xylenes	0.36176	0.34846	0.12369	0.120365	0.111055	0.09842	0.06251

* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 5-23
Modeled 1-Hour Concentrations for Seven Off-Site Locations
Stability Class A, Wind Speed 3 m/s
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane *	*	*	*	*	*	*	*
1,2,4-Trimethylbenzene	0.143171	0.138425	0.049042	0.04746	0.044296	0.038759	0.024521
1,3,5-Trimethylbenzene	0.062988	0.0609	0.021576	0.02088	0.019488	0.017052	0.010788
1,4-Dichlorobenzene	0.357113	0.345275	0.122326	0.11838	0.110488	0.096677	0.061163
Acetone	0.246522	0.23835	0.084444	0.08172	0.076272	0.066738	0.042222
Benzene	0.364353	0.352275	0.124806	0.12078	0.112728	0.098637	0.062403
Bromoform	0.00543	0.00525	0.00186	0.0018	0.00168	0.00147	0.00093
Carbon disulfide	0.005249	0.005075	0.001798	0.00174	0.001624	0.001421	0.000899
Chlorobenzene	2.047472	1.9796	0.701344	0.67872	0.633472	0.554288	0.350672
Cumene	0.177561	0.171675	0.060822	0.05886	0.054936	0.048069	0.030411
Ethyl benzene	0.556394	0.53795	0.190588	0.18444	0.172144	0.150626	0.095294
Freon 11	0.004344	0.0042	0.001488	0.00144	0.001344	0.001176	0.000744
Freon 113	0.02896	0.028	0.00992	0.0096	0.00896	0.00784	0.00496
Freon 12	0.040001	0.038675	0.013702	0.01326	0.012376	0.010829	0.006851
Heptane	0.075839	0.073325	0.025978	0.02514	0.023464	0.020531	0.012989
Methane	16459.235	15913.625	5637.97	5456.1	5092.36	4455.815	2818.985
Methylene chloride	0.001267	0.001225	0.000434	0.00042	0.000392	0.000343	0.000217
Styrene	0.03258	0.0315	0.01116	0.0108	0.01008	0.00882	0.00558
Tetrachloroethylene	0.005611	0.005425	0.001922	0.00186	0.001736	0.001519	0.000961
Toluene	0.146429	0.141575	0.050158	0.04854	0.045304	0.039641	0.025079
Trichloroethylene	0.002715	0.002625	0.00093	0.0009	0.00084	0.000735	0.000465
Xylenes	0.120365	0.116375	0.04123	0.0399	0.03724	0.032585	0.020615

* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 5-24
Modeled 1-Hour Concentrations for Seven Off-Site Locations
Stability Class D, Wind Speed 1 m/s
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane *	*	*	*	*	*	*	*
1,2,4-Trimethylbenzene	0.88592	0.738794	0.354368	0.416857	0.351995	0.326683	0.262612
1,3,5-Trimethylbenzene	0.38976	0.325032	0.155904	0.183396	0.15486	0.143724	0.115536
1,4-Dichlorobenzene	2.20976	1.842782	0.883904	1.039771	0.877985	0.814849	0.655036
Acetone	1.52544	1.272108	0.610176	0.717774	0.60609	0.562506	0.452184
Benzene	2.25456	1.880142	0.901824	1.060851	0.895785	0.831369	0.668316
Bromoform	0.0336	0.02802	0.01344	0.01581	0.01335	0.01239	0.00996
Carbon disulfide	0.03248	0.027086	0.012992	0.015283	0.012905	0.011977	0.009628
Chlorobenzene	12.66944	10.565408	5.067776	5.961424	5.03384	4.671856	3.755584
Cumene	1.09872	0.916254	0.439488	0.516987	0.436545	0.405153	0.325692
Ethyl benzene	3.44288	2.871116	1.377152	1.619998	1.36793	1.269562	1.020568
Freon 11	0.02688	0.022416	0.010752	0.012648	0.01068	0.009912	0.007968
Freon 113	0.1792	0.14944	0.07168	0.08432	0.0712	0.06608	0.05312
Freon 12	0.24752	0.206414	0.099008	0.116467	0.098345	0.091273	0.073372
Heptane	0.46928	0.391346	0.187712	0.220813	0.186455	0.173047	0.139108
Methane	101847.2	84933.29	40738.88	47922.745	40466.075	37556.155	30190.42
Methylene chloride	0.00784	0.006538	0.003136	0.003689	0.003115	0.002891	0.002324
Styrene	0.2016	0.16812	0.08064	0.09486	0.0801	0.07434	0.05976
Tetrachloroethylene	0.03472	0.028954	0.013888	0.016337	0.013795	0.012803	0.010292
Toluene	0.90608	0.755606	0.362432	0.426343	0.360005	0.334117	0.268588
Trichloroethylene	0.0168	0.01401	0.00672	0.007905	0.006675	0.006195	0.00498
Xylenes	0.7448	0.62111	0.29792	0.350455	0.295925	0.274645	0.22078

* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 5-25
Modeled 1-Hour Concentrations for Seven Off-Site Locations
Stability Class D, Wind Speed 3 m/s
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane	5.775905	4.815835	2.307265	2.72536	2.29178	2.13693	1.718835
1,2,4-Trimethylbenzene	0.295043	0.246001	0.117859	0.139216	0.117068	0.109158	0.087801
1,3,5-Trimethylbenzene	0.129804	0.108228	0.051852	0.061248	0.051504	0.048024	0.038628
1,4-Dichlorobenzene	0.735929	0.613603	0.293977	0.347248	0.292004	0.272274	0.219003
Acetone	0.508026	0.423582	0.202938	0.239712	0.201576	0.187956	0.151182
Benzene	0.750849	0.626043	0.299937	0.354288	0.297924	0.277794	0.223443
Bromoform	0.01119	0.00933	0.00447	0.00528	0.00444	0.00414	0.00333
Carbon disulfide	0.010817	0.009019	0.004321	0.005104	0.004292	0.004002	0.003219
Chlorobenzene	4.219376	3.518032	1.685488	1.990912	1.674176	1.561056	1.255632
Cumene	0.365913	0.305091	0.146169	0.172656	0.145188	0.135378	0.108891
Ethyl benzene	1.146602	0.956014	0.458026	0.541024	0.454952	0.424212	0.341214
Freon 11	0.008952	0.007464	0.003576	0.004224	0.003552	0.003312	0.002664
Freon 113	0.05968	0.04976	0.02384	0.02816	0.02368	0.02208	0.01776
Freon 12	0.082433	0.068731	0.032929	0.038896	0.032708	0.030498	0.024531
Heptane	0.156287	0.130309	0.062431	0.073744	0.062012	0.057822	0.046509
Methane	33918.755	28280.785	13549.315	16004.56	13458.38	12549.03	10093.785
Methylene chloride	0.002611	0.002177	0.001043	0.001232	0.001036	0.000966	0.000777
Styrene	0.06714	0.05598	0.02682	0.03168	0.02664	0.02484	0.01998
Tetrachloroethylene	0.011563	0.009641	0.004619	0.005456	0.004588	0.004278	0.003441
Toluene	0.301757	0.251599	0.120541	0.142384	0.119732	0.111642	0.089799
Trichloroethylene	0.005595	0.004665	0.002235	0.00264	0.00222	0.00207	0.001665
Xylenes	0.248045	0.206815	0.099085	0.11704	0.09842	0.09177	0.073815

Prepared by: BW
Checked by: RJM
92C4087

Table 5-26
Modeled 1-Hour Concentrations for Seven Off-Site Locations
Stability Class D, Wind Speed 10 m/s
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane	1.73432	1.440105	0.696825	0.820705	0.68134	0.634885	0.511005
1,2,4-Trimethylbenzene	0.088592	0.073563	0.035595	0.041923	0.034804	0.032431	0.026103
1,3,5-Trimethylbenzene	0.038976	0.032364	0.01566	0.018444	0.015312	0.014268	0.011484
1,4-Dichlorobenzene	0.220976	0.183489	0.088785	0.104569	0.086812	0.080893	0.065109
Acetone	0.152544	0.126666	0.06129	0.072186	0.059928	0.055842	0.044946
Benzene	0.225456	0.187209	0.090585	0.106689	0.088572	0.082533	0.066429
Bromoform	0.00336	0.00279	0.00135	0.00159	0.00132	0.00123	0.00099
Carbon disulfide	0.003248	0.002697	0.001305	0.001537	0.001276	0.001189	0.000957
Chlorobenzene	1.266944	1.052016	0.50904	0.599536	0.497728	0.463792	0.373296
Cumene	0.109872	0.091233	0.044145	0.051993	0.043164	0.040221	0.032373
Ethyl benzene	0.344288	0.285882	0.13833	0.162922	0.135256	0.126034	0.101442
Freon 11	0.002688	0.002232	0.00108	0.001272	0.001056	0.000984	0.000792
Freon 113	0.01792	0.01488	0.0072	0.00848	0.00704	0.00656	0.00528
Freon 12	0.024752	0.020553	0.009945	0.011713	0.009724	0.009061	0.007293
Heptane	0.046928	0.038967	0.018855	0.022207	0.018436	0.017179	0.013827
Methane	10184.72	8456.955	4092.075	4819.555	4001.14	3728.335	3000.855
Methylene chloride	0.000784	0.000651	0.000315	0.000371	0.000308	0.000287	0.000231
Styrene	0.02016	0.01674	0.0081	0.00954	0.00792	0.00738	0.00594
Tetrachloroethylene	0.003472	0.002883	0.001395	0.001643	0.001364	0.001271	0.001023
Toluene	0.090608	0.075237	0.036405	0.042877	0.035596	0.033169	0.026697
Trichloroethylene	0.00168	0.001395	0.000675	0.000795	0.00066	0.000615	0.000495
Xylenes	0.07448	0.061845	0.029925	0.035245	0.02926	0.027265	0.021945

Prepared by: BW
Checked by: RJM
92C4087

Table 5-27
Modeled 1-Hour Concentrations for Seven Off-Site Locations
Stability Class D, Wind Speed 20 m/s
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane	0.86716	0.727795	0.34067	0.40261	0.34067	0.325185	0.263245
1,2,4-Trimethylbenzene	0.044296	0.037177	0.017402	0.020566	0.017402	0.016611	0.013447
1,3,5-Trimethylbenzene	0.019488	0.016356	0.007656	0.009048	0.007656	0.007308	0.005916
1,4-Dichlorobenzene	0.110488	0.092731	0.043406	0.051298	0.043406	0.041433	0.033541
Acetone	0.076272	0.064014	0.029964	0.035412	0.029964	0.028602	0.023154
Benzene	0.112728	0.094611	0.044286	0.052338	0.044286	0.042273	0.034221
Bromoform	0.00168	0.00141	0.00066	0.00078	0.00066	0.00063	0.00051
Carbon disulfide	0.001624	0.001363	0.000638	0.000754	0.000638	0.000609	0.000493
Chlorobenzene	0.633472	0.531664	0.248864	0.294112	0.248864	0.237552	0.192304
Cumene	0.054936	0.046107	0.021582	0.025506	0.021582	0.020601	0.016677
Ethyl benzene	0.172144	0.144478	0.067628	0.079924	0.067628	0.064554	0.052258
Freon 11	0.001344	0.001128	0.000528	0.000624	0.000528	0.000504	0.000408
Freon 113	0.00896	0.00752	0.00352	0.00416	0.00352	0.00336	0.00272
Freon 12	0.012376	0.010387	0.004862	0.005746	0.004862	0.004641	0.003757
Heptane	0.023464	0.019693	0.009218	0.010894	0.009218	0.008799	0.007123
Methane	5092.36	4273.945	2000.57	2364.31	2000.57	1909.635	1545.895
Methylene chloride	0.000392	0.000329	0.000154	0.000182	0.000154	0.000147	0.000119
Styrene	0.01008	0.00846	0.00396	0.00468	0.00396	0.00378	0.00306
Tetrachloroethylene	0.001736	0.001457	0.000682	0.000806	0.000682	0.000651	0.000527
Toluene	0.045304	0.038023	0.017798	0.021034	0.017798	0.016989	0.013753
Trichloroethylene	0.00084	0.000705	0.00033	0.00039	0.00033	0.000315	0.000255
Xylenes	0.03724	0.031255	0.01463	0.01729	0.01463	0.013965	0.011305

Prepared by: BW
Checked by: RJM
92C4087

Table 5-28
Modeled 1-Hour Concentrations for Seven Off-Site Locations
Stability Class F, Wind Speed 1 m/s
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane *	*	*	*	*	*	*	*
1,2,4-Trimethylbenzene	1.551942	1.121638	0.734048	0.973721	0.795746	0.750659	0.661276
1,3,5-Trimethylbenzene	0.682776	0.493464	0.322944	0.428388	0.350088	0.330252	0.290928
1,4-Dichlorobenzene	3.871026	2.797714	1.830944	2.428763	1.984838	1.872377	1.649428
Acetone	2.672244	1.931316	1.263936	1.676622	1.370172	1.292538	1.138632
Benzene	3.949506	2.854434	1.868064	2.478003	2.025078	1.910337	1.682868
Bromoform	0.05886	0.04254	0.02784	0.03693	0.03018	0.02847	0.02508
Carbon disulfide	0.056898	0.041122	0.026912	0.035699	0.029174	0.027521	0.024244
Chlorobenzene	22.194144	16.040416	10.497536	13.925072	11.379872	10.735088	9.456832
Cumene	1.924722	1.391058	0.910368	1.207611	0.986886	0.930969	0.820116
Ethyl benzene	6.031188	4.358932	2.852672	3.784094	3.092444	2.917226	2.569864
Freon 11	0.047088	0.034032	0.022272	0.029544	0.024144	0.022776	0.020064
Freon 113	0.31392	0.22688	0.14848	0.19696	0.16096	0.15184	0.13376
Freon 12	0.433602	0.313378	0.205088	0.272051	0.222326	0.209729	0.184756
Heptane	0.822078	0.594142	0.388832	0.515789	0.421514	0.397631	0.350284
Methane	178414.47	128945.83	84387.68	111940.985	91480.61	86297.315	76021.66
Methylene chloride	0.013734	0.009926	0.006496	0.008617	0.007042	0.006643	0.005852
Styrene	0.35316	0.25524	0.16704	0.22158	0.18108	0.17082	0.15048
Tetrachloroethylene	0.060822	0.043958	0.028768	0.038161	0.031186	0.029419	0.025916
Toluene	1.587258	1.147162	0.750752	0.995879	0.813854	0.767741	0.676324
Trichloroethylene	0.02943	0.02127	0.01392	0.018465	0.01509	0.014235	0.01254
Xylenes	1.30473	0.94297	0.61712	0.818615	0.66899	0.631085	0.55594

* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 5-29
Modeled 1-Hour Concentrations for Seven Off-Site Locations
Stability Class F, Wind Speed 3 m/s
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane	10.12719	7.324405	4.784865	6.34885	5.187475	4.89326	4.320315
1,2,4-Trimethylbenzene	0.517314	0.374143	0.244419	0.32431	0.264985	0.249956	0.220689
1,3,5-Trimethylbenzene	0.227592	0.164604	0.107532	0.14268	0.11658	0.109968	0.097092
1,4-Dichlorobenzene	1.290342	0.933229	0.609657	0.80893	0.660955	0.623468	0.550467
Acetone	0.890748	0.644226	0.420858	0.55842	0.45627	0.430392	0.379998
Benzene	1.316502	0.952149	0.622017	0.82533	0.674355	0.636108	0.561627
Bromoform	0.01962	0.01419	0.00927	0.0123	0.01005	0.00948	0.00837
Carbon disulfide	0.018966	0.013717	0.008961	0.01189	0.009715	0.009164	0.008091
Chlorobenzene	7.398048	5.350576	3.495408	4.63792	3.78952	3.574592	3.156048
Cumene	0.641574	0.464013	0.303129	0.40221	0.328635	0.309996	0.273699
Ethyl benzene	2.010396	1.454002	0.949866	1.26034	1.02979	0.971384	0.857646
Freon 11	0.015696	0.011352	0.007416	0.00984	0.00804	0.007584	0.006696
Freon 113	0.10464	0.07568	0.04944	0.0656	0.0536	0.05056	0.04464
Freon 12	0.144534	0.104533	0.068289	0.09061	0.074035	0.069836	0.061659
Heptane	0.274026	0.198187	0.129471	0.17179	0.140365	0.132404	0.116901
Methane	59471.49	43012.255	28098.915	37283.35	30463.225	28735.46	25370.865
Methylene chloride	0.004578	0.003311	0.002163	0.00287	0.002345	0.002212	0.001953
Styrene	0.11772	0.08514	0.05562	0.0738	0.0603	0.05688	0.05022
Tetrachloroethylene	0.020274	0.014663	0.009579	0.01271	0.010385	0.009796	0.008649
Toluene	0.529086	0.382657	0.249981	0.33169	0.271015	0.255644	0.225711
Trichloroethylene	0.00981	0.007095	0.004635	0.00615	0.005025	0.00474	0.004185
Xylenes	0.43491	0.314545	0.205485	0.27265	0.222775	0.21014	0.185535

Prepared by: BW
Checked by: RJM
92C4087

Table 5-30
Modeled 1-Hour On-Site Air Concentrations
Pelham Bay Landfill
Bronx, New York

EIFC Detected Compounds	Maximum Measured Emission Rate (ug/m^2-s)	Modeled 1-Hour Center of Landfill (ug/m^3)	OSHA 8-hour PEL (ug/m^3)	Footnotes	NYSDEC Toxicity Rating	SGC Conc (ug/m^3)
1,1,1-Trichloroethane*	*	*	1,900,000		Low	450,000
1,2,4-Trichlorobenzene	0.0035	0.04382	37,000	C (2)	High	3,700
1,2,4-Trimethylbenzene	0.0791	0.990332	123,000	(6)	Moderate	29,000
1,2-Dichlorobenzene	0.072	0.90144	300,000	C (3)	Moderate	30,000
1,2-Dichloroethylene	0.0046	0.057592	790,000		Moderate	190,000 **
1,3,5-Trimethylbenzene	0.0348	0.435696	123,000	(6)	Moderate	29,000
1,3-Dichlorobenzene	0.0309	0.386868	-	(5)	Moderate	30,000
1,4-Dichlorobenzene	0.1973	2.470196	450,000		-	-
Acetone	0.1362	1.705224	1,800,000		Low	140,000
Ammonia	10.2633	128.496516	27,000	STEL (1)	Low	4,000
Benzene	0.2013	2.520276	3,250		High	30
Bromoform	0.003	0.03756	5,000	(skin)	Moderate	1,200
Carbon Disulfide	0.0029	0.036308	12,000		Moderate	710
Chlorobenzene	1.1312	14.162624	350,000		Moderate	11,000
Cumene	0.0981	1.228212	245,000		-	58,000 ***
Ethyl benzene	0.3074	3.848648	435,000		Moderate	100,000
Freon 11	0.0024	0.030048	5,600,000	C (3)	Low	560,000
Freon 113	0.016	0.20032	7,600,000		Low	1,800,000
Freon 114	0.0128	0.160256	7,000,000		-	-
Freon 12	0.0221	0.276692	4,950,000		-	-
Heptane	0.0419	0.524588	1,600,000		Moderate	83,000
Hexachlorobutadiene	0.0014	0.017528	210	(skin) (7)	Moderate	50
Hydrogen Sulfide	0.0213	0.266676	14,000		-	-
Methane	9093.5	113850.62	-	(4)	-	-
Methylene Chloride	0.0007	0.008764	1,765,000		Moderate	41,000
Styrene	0.018	0.22536	215,000		Moderate	51,000
Tetrachloroethene	0.0031	0.038812	170,000		Moderate	81,000
Toluene	0.0809	1.012868	375,000		Low	89,000
Trichloroethene	0.0015	0.01878	270,000		Moderate	33,000
Xylenes	0.0665	0.83258	435,000		Moderate	100,000

* = Data not usable, see Data Usability Report, Appendix B

** Values are for cis-1,2-Dichlorethylene

*** A calculated interim value based on a moderate toxicity classification.

Prepared by: RJM
Checked by: BW

OSHA PEL (Permissable Exposure Limit) is an 8-hour TWA (Time Weighted Average) unless otherwise noted by footnotes.

STEL- Short-term Exposure Limit- 15 minute TWA.

C- Ceiling concentration not to be exceeded during any part of the workday.

skin- indicates the potential for dermal absorption, including through mucous membranes and the eyes, either by contact with vapors or direct skin contact.

(1) - OSHA standard for ammonia is a STEL (Short-term Exposure Limit). The NIOSH 8-Hour TWA REL (Recommended Exposure Limit) is 18 mg/m3.

(2) - No OSHA or NIOSH standards exist. Value is an ACGIH (American Conferencee of Governmental Industrial Hygienists) ceiling value.

(3)- OSHA ceiling value. No 8-hour or STEL standard.

(4)- No OSHA, NIOSH or ACGIH standards. The compound is referred to as a "simple asphyxiant".

(5)- No OSHA, NIOSH or ACGIH standards.

(6)- No OSHA or NIOSH standards. The value is the ACGIH 8-hour REL for "Trimethyl benzene".

(7)- No OSHA or NIOSH standards. The value is the ACGIH 8-hour REL.

Table 5-31
Comparison of Long -Term Modeling Results with Field Measurements and NYSDEC Concentration Guidelines
Pelham Bay Landfill
Bronx, New York

EIFC Detected Compounds	Average Measured Emission Rate (ug/m²-s)	Highest Modeled Annual* (ug/m³)	Highest Offsite Conc. (24 hours) (ug/m³)	Ratio of Modeled/AGC Concentrations	NYSDEC Toxicity Rating	SGC Conc (ug/m³)	AGC Conc (ug/m³)
1,1,1-Trichloroethane***	***	***	39401		Low	450,000	1,000
1,2,4-Trimethylbenzene	0.0235	0.0170	17	0.0001	Moderate	29,000	290
1,3,5-Trimethylbenzene	0.0124	0.0089	3.5	0.0000	Moderate	29,000	290
1,4-Dichlorobenzene	0.0613	0.0441	3.42	NA	-	-	-
Acetone	0.0396	0.0285	265.76	0.0000	Low	140,000	14,000
Benzene	0.0437	0.0315	9.75	0.2624	High	30	0.12
Bromoform	0.0012	0.0009	6.31	0.0001	Moderate	1,200	12
Carbon disulfide	0.0018	0.0013	5.7	0.0002	Moderate	710	7
Chlorobenzene	0.2453	0.1766	1.12	0.0088	Moderate	11,000	20
Cumene	0.0178	0.0128	0.95	0.0000	-	58,000 **	583 **
Ethylbenzene	0.0488	0.0351	7.51	0.0000	Moderate	100,000	1,000
Freon 11	0.0013	0.0009	52.57	0.0000	Low	560,000	700
Freon 113	0.0025	0.0018	8.57	0.0000	Low	1,800,000	90,000
Freon 12	0.0031	0.0022	9.56	NA	-	-	-
Heptane	0.0062	0.0045	4.13	0.0000	Moderate	83,000	830
Methane	2827.7825	2036.0034	21351	NA	-	-	-
Methylene chloride	0.0004	0.0003	70.67	0.0000	Moderate	41,000	27
Styrene	0.0093	0.0067	12.13	0.0000	Moderate	51,000	510
Tetrachloroethylene	0.0010	0.0007	406.99	0.0097	Moderate	81,000	0.075
Toluene	0.0356	0.0256	241.47	0.0000	Low	89,000	2,000
Trichloroethylene	0.0005	0.0003	5.14	0.0007	Moderate	33,000	0.45
Xylenes	0.0208	0.0150	40.63	0.0000	Moderate	100,000	300

Notes:

* Highest modeled concentration occurred at Cops Beach

** A calculated interim value based on a moderate toxicity classification.

*** = Data not usable, see Data Usability Report, Appendix B

Prepared by: RJM
Checked by: BW
92C4087

Table 5-32
Modeled Annual Concentrations for Seven Off-Site Locations
Pelham Bay Landfill
Bronx, New York

Location Number	1	5	7	8	2	3	6
Location Identification	Cops Beach	Bridge Rd	Park Statue	Mounted	Coop City	Sewage	Bayshore
Distance from Landfill (m)	51	55	375	378	448	460	725
COMPOUND	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
1,1,1-Trichloroethane*	*	*	*	*	*	*	*
1,2,4-Trimethylbenzene	1.70E-02	1.44E-02	4.94E-03	4.47E-03	2.35E-03	4.00E-03	2.35E-03
1,3,5-Trimethylbenzene	8.92E-03	7.56E-03	2.60E-03	2.35E-03	1.24E-03	2.11E-03	1.24E-03
1,4-Dichlorobenzene	4.41E-02	3.74E-02	1.29E-02	1.16E-02	6.13E-03	1.04E-02	6.13E-03
Acetone	2.85E-02	2.41E-02	8.31E-03	7.51E-03	3.96E-03	6.72E-03	3.96E-03
Benzene	3.15E-02	2.67E-02	9.18E-03	8.31E-03	4.37E-03	7.43E-03	4.37E-03
Bromoform	8.76E-04	7.42E-04	2.55E-04	2.31E-04	1.22E-04	2.07E-04	1.22E-04
Carbon disulfide	1.28E-03	1.08E-03	3.73E-04	3.37E-04	1.78E-04	3.02E-04	1.78E-04
Chlorobenzene	1.77E-01	1.50E-01	5.15E-02	4.66E-02	2.45E-02	4.17E-02	2.45E-02
Cumene	1.28E-02	1.09E-02	3.74E-03	3.39E-03	1.78E-03	3.03E-03	1.78E-03
Ethyl benzene	3.51E-02	2.97E-02	1.02E-02	9.26E-03	4.88E-03	8.29E-03	4.88E-03
Freon 11	9.45E-04	8.01E-04	2.76E-04	2.49E-04	1.31E-04	2.23E-04	1.31E-04
Freon 113	1.81E-03	1.54E-03	5.29E-04	4.79E-04	2.52E-04	4.28E-04	2.52E-04
Freon 12	2.24E-03	1.90E-03	6.54E-04	5.91E-04	3.11E-04	5.29E-04	3.11E-04
Heptane	4.49E-03	3.80E-03	1.31E-03	1.18E-03	6.23E-04	1.06E-03	6.23E-04
Methane	2.04E+03	1.72E+03	5.94E+02	5.37E+02	2.83E+02	4.81E+02	2.83E+02
Methylene chloride	2.57E-04	2.17E-04	7.48E-05	6.77E-05	3.56E-05	6.06E-05	3.56E-05
Styrene	6.69E-03	5.67E-03	1.95E-03	1.76E-03	9.29E-04	1.58E-03	9.29E-04
Tetrachloroethylene	7.25E-04	6.14E-04	2.11E-04	1.91E-04	1.01E-04	1.71E-04	1.01E-04
Toluene	2.56E-02	2.17E-02	7.47E-03	6.75E-03	3.56E-03	6.04E-03	3.56E-03
Trichloroethylene	3.29E-04	2.78E-04	9.58E-05	8.67E-05	4.56E-05	7.76E-05	4.56E-05
Xylenes	1.50E-02	1.27E-02	4.37E-03	3.95E-03	2.08E-03	3.53E-03	2.08E-03

* = Data not usable, see Data Usability Report, Appendix B

Prepared by: BW
Checked by: RJM
92C4087

Table 5-33
Modeled Annual On-Site Air Concentrations
Pelham Bay Landfill
Bronx, New York

EIFC Detected Compounds	Average Measured Emission Rate (ug/m^2-s)	Modeled Annual Center of Landfill (ug/m^3)	NYSDEC Toxicity Rating	AGC Conc (ug/m^3)
1,1,1-Trichloroethane*	*	*	Low	1,000
1,2,4-Trichlorobenzene	0.001	0.00209	High	9
1,2,4-Trimethylbenzene	0.0235	0.049115	Moderate	290
1,2-Dichlorobenzene	0.0188	0.039292	Moderate	200
1,2-Dichloroethylene	0.0016	0.003344	Moderate	1,900 **
1,3,5-Trimethylbenzene	0.0124	0.025916	Moderate	290
1,3-Dichlorobenzene	0.0112	0.023408	Moderate	200
1,4-Dichlorobenzene	0.0613	0.128117	-	-
Acetone	0.0396	0.082764	Low	14,000
Ammonia	1.5733	3.288197	Low	360
Benzene	0.0437	0.091333	High	0.12
Bromoform	0.0012	0.002508	Moderate	12
Carbon Disulfide	0.0018	0.003762	Moderate	7
Chlorobenzene	0.2453	0.512677	Moderate	20
Cumene	0.0178	0.037202	-	583 ***
Ethyl benzene	0.0488	0.101992	Moderate	1,000
Freon 11	0.0013	0.002717	Low	700
Freon 113	0.0025	0.005225	Low	90,000
Freon 114	0.0036	0.007524	-	-
Freon 12	0.0031	0.006479	-	-
Heptane	0.0062	0.012958	Moderate	830
Hexachlorobutadiene	0.001	0.00209	Moderate	0.05
Hydrogen Sulfide	0.002	0.00418	-	-
Methane	2827.8	5910.102	-	-
Methylene Chloride	0.0004	0.000836	Moderate	27
Styrene	0.0093	0.019437	Moderate	510
Tetrachloroethene	0.001	0.00209	Moderate	0.075
Toluene	0.0356	0.074404	Low	2,000
Trichloroethene	0.0005	0.001045	Moderate	0.45
Xylenes	0.0208	0.043472	Moderate	300

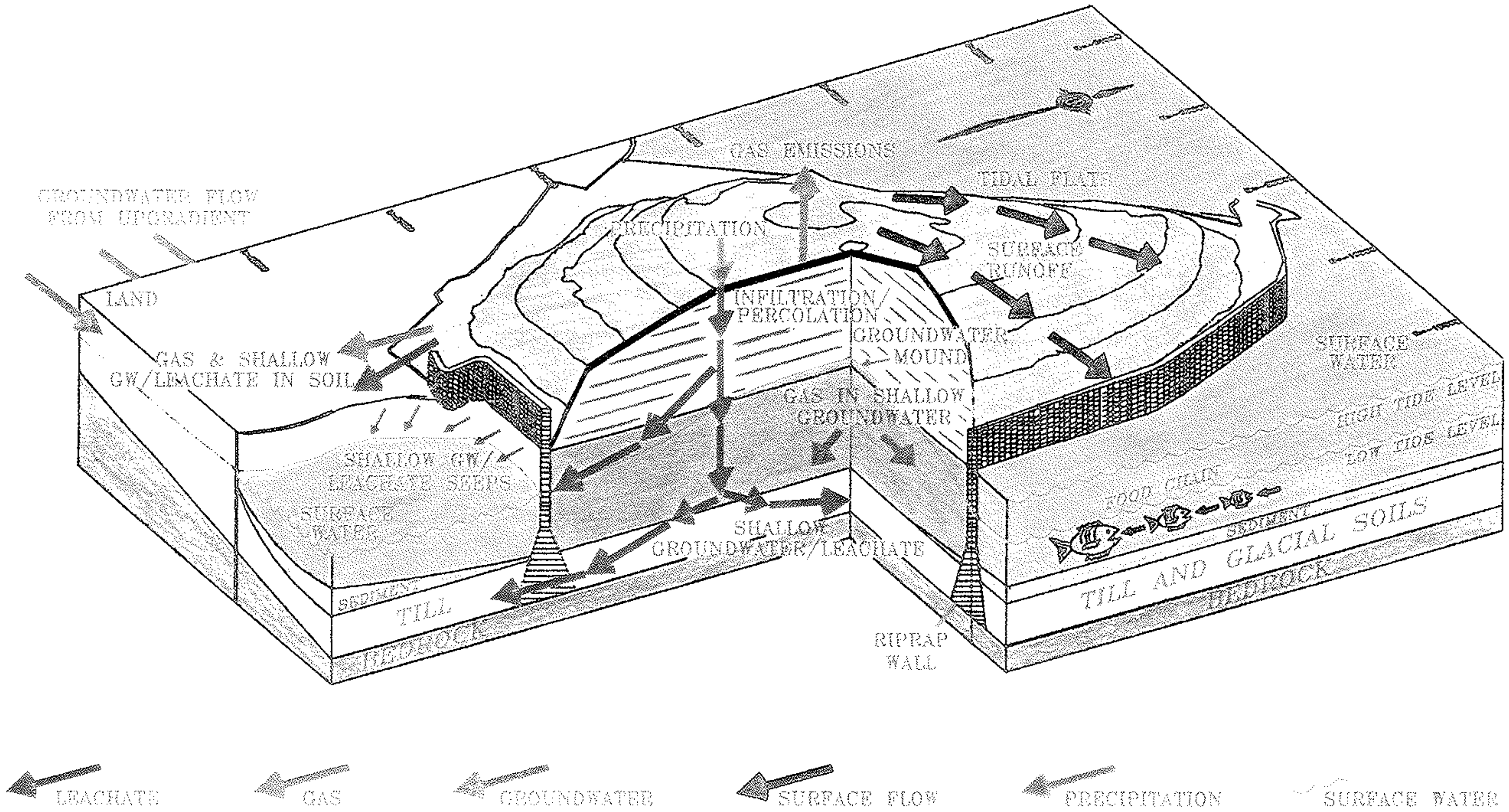
Note:

* = Data not usable, see Data Usability Report, Appendix B

** A calculated interim value based on a moderate toxicity classification.

*** A calculated interim value based on a moderate toxicity classification.

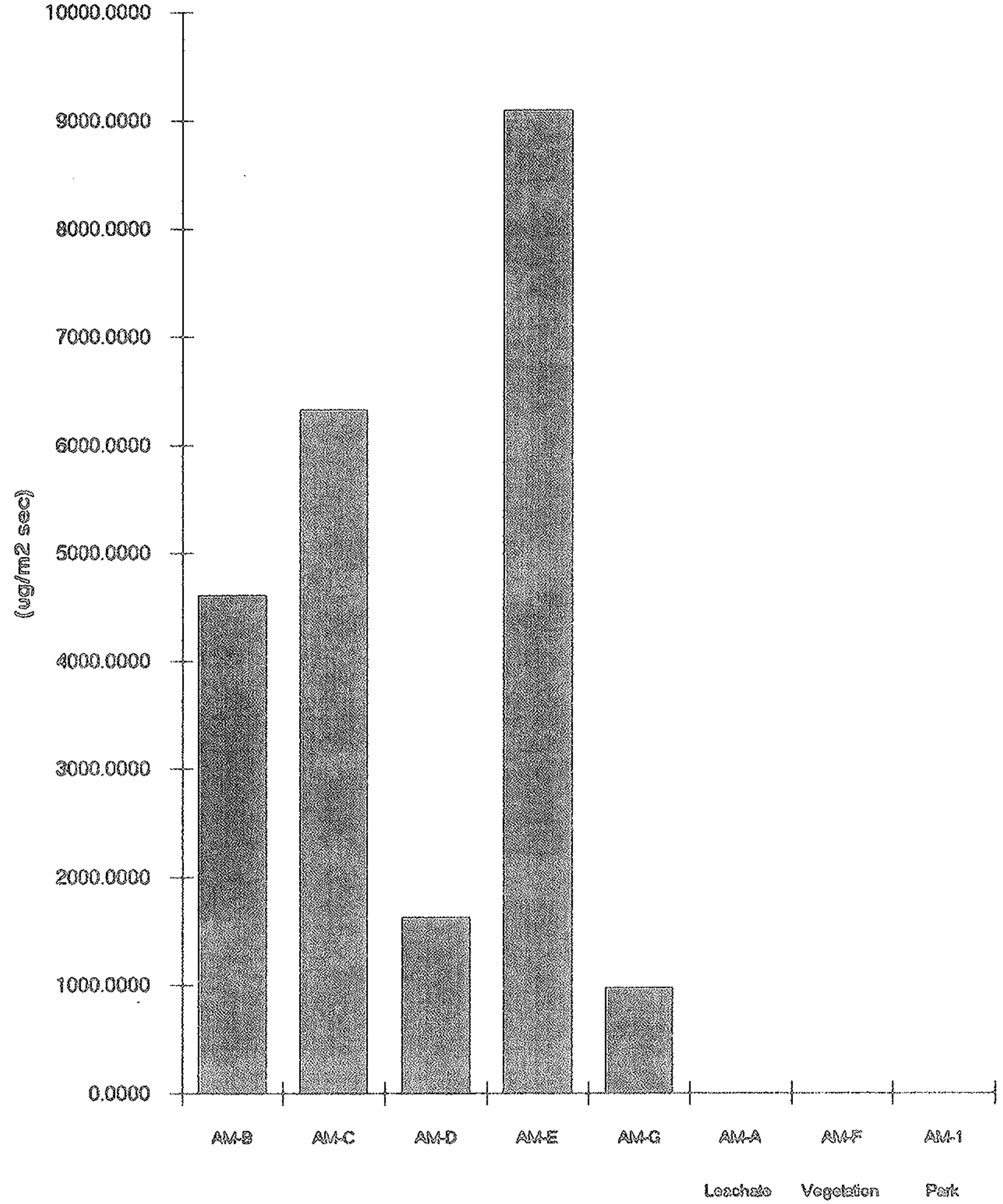
Prepared by: RJM
Checked by: BW
92C4087



TRANSPORT PATHWAYS MODEL
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	BTM	SCALE:	NONE	PROJ. NO.:	92C4087
CK'D BY:	REC	DATE:	JAN. 25, 1992	FIG. NO.:	5 – 1

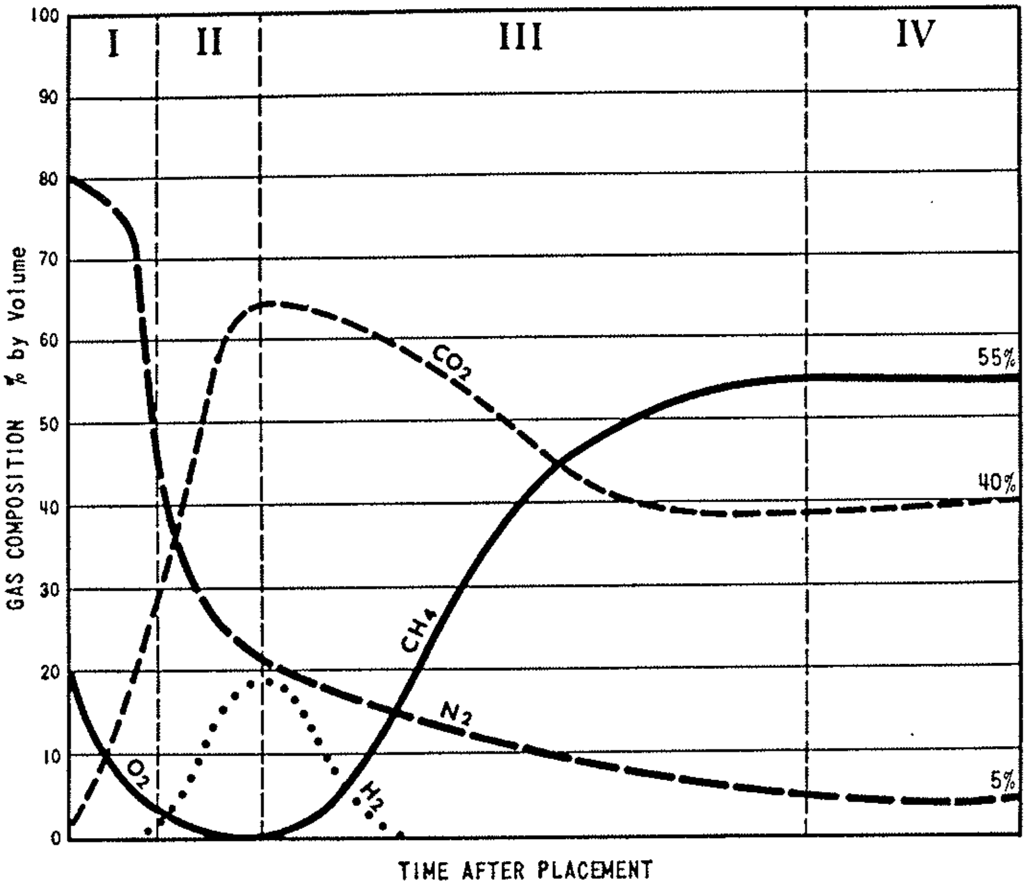


METHANE EIFC PROFILE
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	RJW	DATE:	JAN. 28, 1993	FIG. NO.:	5–2



I. AEROBIC
II. ANAEROBIC, NON-METHANOGENIC
III. ANAEROBIC, METHANOGENIC, UNSTEADY
IV. ANAEROBIC, METHANOGENIC, STEADY

Reference: Emcon Associates, 1980. Methane Generation and Recovery from Landfills, Ann Arbor Science, Ann Arbor, Michigan.

TYPICAL LANDFILL COMPOSITION
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	NONE	PROJ. NO.:	92C4087
CK'D BY:	VKC	DATE:	JAN. 27, 1993	FIG. NO.:	5–3

6.0
HAZARD EVALUATION (RISK ASSESSMENT)

6.1 INTRODUCTION

The purpose of this Hazard Evaluation (HE) is to provide a preliminary evaluation of the potential hazards to human health and the environment associated with exposure to Chemicals of Concern (COCs) on the Pelham Bay Landfill site. The focus of the evaluation is onsite in order to provide timely input to the development of the FS relative to remediation of the landfill itself. The evaluation is considered preliminary because the data utilized were not validated at the time that this section was prepared. A complete Baseline Risk Assessment (BRA) for the Pelham Bay Landfill will be completed by June 1993. This document will utilize the validated database that is now available (as presented in Section 4 of the RI) and will evaluate both on site and off site risks associated with COCs in the various media sampled.

The HE integrates the information developed in the RI, and is intended to represent an analysis of the nature and severity of those hazards attributable to the landfill as it now exists, prior to any remediation. It is composed of a Health Hazard Evaluation (HHE) and a Ecological Hazard Evaluation (EHE), in Sections 6.2 and 6.3, respectively. The HHE characterizes the potential for adverse human health hazards (carcinogenic and noncarcinogenic) to occur as a result of possible on-site exposure to site COCs (in air, groundwater/leachate and surface soils), while the EHE characterizes the potential for adverse ecological hazards to occur as a result of possible on-site exposure to COCs (in surface soils and groundwater/leachate). Information is also presented in the EHE relating to the selection of offsite COCs (in sediments and surface water), but the ecological hazards associated with offsite exposures are not presented herein. As stated above, the BRA will present the results of these evaluations.

The specific federal guidance used to develop the HE can be found in a series of documents and official memoranda published and/or released by the United States Environmental Protection Agency (USEPA), New York State Department of Conservation (NYSDEC) and New York State Department of Health (NYSDOH) namely:

- Risk Assessment Guidance for Superfund (RAGS), Volume I. Human Health Evaluation Manual (Parts A, B & C), (USEPA, 1989a, 1991b and 1991d)
- Risk Assessment Guidance for Superfund, Volume II. Ecological Evaluation Manual (Part A), (USEPA, 1989b)
- Superfund Exposure Assessment Manual, (USEPA, 1988)
- Exposure Factors Handbook, (USEPA, 1989c)
- Guidelines for Exposure Assessment, (USEPA, 1992b)
- Dermal Exposure Assessment: Principles and Applications, (USEPA, Draft 1992e)
- Draft Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites, (NYSDEC, 1991)
- Standard Default Exposure Factors, (USEPA, 1991d) as modified by the NYSDOH
- Draft NYSDOH Guidance for Exposure Assessment of Municipal Solid Waste and Hospital Waste Incinerator Emissions, (NYSDOH, 1991)

6.1.1 Scope and Objectives

It is not the intent of this HE to draw conclusions from or attribute any associations to any other health-related studies concerning the Pelham Bay area. Again, in keeping with federal guidelines, this HE only considers the current conditions at the landfill and is not concerned with future public health considerations. It does not address the incidence or prevalence of disease in the nearby community or any historical regional diminution of environmental quality perceived to be attributed to the impact of the landfill, i.e., the health and ecological evaluations in this HE are not to be confused with public health epidemiology studies, nor are they studies of the regional environmental quality. Neither this nor the future BRA will address the potential future use of the landfill property since future use of the property remains undefined.

6.1.2 Organization of the Human Health and Ecological Hazard Evaluations

This HE is based on unvalidated analytical data which in some cases may differ from that presented in the earlier sections of this RI report), information gathered from relevant state and federal agencies, and the biomedical/bioenvironmental scientific literature. This information is integrated and used to characterize exposure routes, chemical intakes and potential health and ecological hazards that may be reasonably attributed to the environmental conditions as they exist at the landfill.

Using this information, the HE involves estimating the potential human health hazards posed by known or suspected cancer-causing and non cancer-causing agents plus potential impacts on terrestrial and aquatic biota that may be occuring due to exposure to landfill soils and discharges of groundwater/leachate. These hazards were evaluated under a range of exposure scenarios developed by consensus using Federal/State guidance, the unvalidated analytical database and field observations. Relevant and applicable information from the respective city, state and federal agencies as well as information from the biomedical/bioenvironmental research programs published in peer-reviewed scientific literature were used in this HE. The scope of the HE included the following:

- Potential health and ecological hazards were examined by evaluating landfill history, and chemical, hydrologic, and other available information

- Potential pollutant transport and exposure pathways were identified and evaluated through a review of RI data, current and past landfill activities, on-site human and ecological populations-at-risk and other related data

- Conceptual site models (CSMs), Figures 6-1 and 6-5 were developed to identify complete pathways indicating that exposures to compounds are likely to occur. These CSMs present an analysis of chemical release mechanisms and sources, chemical fate and transport, human and ecological exposure (contact) points and potential chemical contact/intake routes

- Estimated human intake from each of the potential chemical contact/intake routes was quantified. For this HE, neither human toxicology profiles nor summary statements for each compound are included. They will be developed upon completion of the BRA. A summary table of the toxic properties and toxicity values can be found in the Toxicity Assessment section of the HE. Ecological toxicology summary statements ae provided in Section 6.3 of the HE.

- Individual Hazard Quotients (HQs) and aggregated Hazard Indices (HIs) risks from noncarcinogenic compounds and carcinogenic hazards were characterized and uncertainties in risk characterization were determined.

- Qualitative assessments of the risks that selected COCs pose to terrestrial and aquatic biota that are resident on or frequent the landfill site were made.

The HHE focuses on potential exposure of workers and trespassers who may reasonably come into contact with COCs in groundwater/leachate, soil and air. The EHE focuses on potential exposure of terrestrial mammals and birds that may come into contact with COCs in surficial soil and groundwater/leachate and aquatic biota (shellfish and forage fish) that may come into contact with COCs in groundwater/leachate at seeps located along the toe of the landfill.

6.1.3 Landfill Background

Landfill background and sampling information can be found in Section 1.4 of this RI report. This HE is based on data collected during field investigations that occurred from approximately May through November 1992.

The results of the analysis of groundwater/leachate, soil and air samples collected during these investigations are presented in Tables 4-1 through 4-9 (soil samples), Tables 4-19 through 4-22 (monitoring well samples), Tables 4-24 through 4-27 (leachate seep samples) and Table 4-80 (air) in Section 4.0 of this report.

6.2 HEALTH HAZARD EVALUATION (HHE)

The HHE is composed of four units:

- Exposure Assessment
- Selection of Chemicals of Concern (COCs)
- Toxicity Assessment
- Hazard Characterization

An uncertainty analysis is also included to qualify assumptions incorporated into the HHE. The following sections present a discussion of each of these components as they relate to the Pelham Bay Landfill.

6.2.1 Exposure Assessment

The purpose of an exposure assessment is to estimate the magnitude of potential chemical exposure that may be reasonably expected to occur among various receptor populations. The steps required to perform an exposure assessment include:

- Identification of potential receptor populations
- Evaluation of potential exposure pathways for completeness (sources, release mechanisms, transport media, and exposure routes)
- Evaluation of potential exposure parameters for complete exposure pathways
- Estimation of exposure point concentrations
- Estimation of daily intake factors

The approach used in this HHE was to incorporate conservative exposure assumptions, presented in a site conceptual site model (CSM), to ensure that the potential hazards posed by exposure to the landfill compounds were not underestimated for the maximally exposed individual (USEPA, 1992b) when evaluating the magnitude of potential human exposures. Although it is important to considerate the maximally exposed individual, in the BRA the average hazard faced by exposed individuals will also be evaluated. At the same time, those exposure scenarios which are considered unlikely were excluded, since they do not reflect complete exposure pathways or were regarded as unrealistic exposure conditions.

The exposure assessment used data on current site conditions to determine exposure scenarios and exposure point concentrations. It relied on site-specific analytical data generated from RI field investigation activities and compiled in the RI analytical database. The HHE assumed that the concentrations of constituents in each medium at the landfill has virtually stabilized since it was closed in 1978. It also assumed that the chemical characteristics of the landfill constituents will not change over time for the exposure pathways.

6.2.1.1 Potential Receptor Populations

Since there is a potential for on-site workers to be exposed to landfill compounds, an exposure scenario for workers was developed for this HHE.

The landfill is located near a residential area. It is known that some unauthorized person(s) or trespassers gain entry to the landfill, despite physical restrictions (a fence) and on-site security forces. Therefore, an exposure scenario for trespassers was also included.

The landfill is no longer used for waste disposal and the future use of the property is unknown, however, it is highly unlikely that its end use would be residential since it is a known solid waste landfill. Therefore, a future residential use scenario was excluded from this HHE.

6.2.1.2 Potential Exposure Pathways

The purpose of an exposure assessment is to identify those pathways whereby exposure to compounds released from the landfill can occur. An exposure pathway consists of:

- A mechanism whereby compounds can be released from a source (landfill) to the environment
- A medium (soil, water or air) that facilities movement of the landfill compounds
- A point of contact whereby a receptor can come into direct contact with the compounds in the medium
- An exposure route whereby compounds can gain entry into the body

All four conditions must be present for a pathway to be complete, i.e., one where people are potentially exposed.

The selection of complete and incomplete pathways represents an important step in focusing the HE only on those site conditions that are important. In this HE (as in a BRA), all potential transport pathways are carefully evaluated, taking site-specific conditions into account. All incomplete or unrealistic pathways were eliminated since no exposure was expected to occur.

Exposure pathways have been integrated into a CSM presented in Figure 6-1. This CSM presents the sources of releases to the contaminant transport pathways, transport media, potential human receptors, and exposure routes of concern. A solid dot under the receptor category signifies a complete pathway. All pathways presented in the CSM are complete pathways insofar as health is concerned.

The various environmental media thought to be involved in the release of compounds from the landfill that were thought to result in human exposures include:

- Air
- Groundwater
- Leachate
- Surface water

- Soil and Sediment

A discussion of each of these pollutant transport media is presented in the following sections.

6.2.1.2.1 Air

Potential exposure pathways involving air transport include release from the surface of the landfill either as volatile organic compounds (VOCs) or as constituents adsorbed to or contained in dust particles (airborne particulate matter). These constituents released to the air from the landfill were monitored at various air monitoring stations on the landfill chosen because of their lack of vegetation (flux chamber locations A through G; i.e., AM-A through AM-G, Figure 2-2). Site surface soils were found to contain metals and some persistent chlorinated compounds that are likely to be adsorbed to or contained within particulate matter. Therefore, the potential exists for dust generation from wind blowing on unvegetated contaminated surface soils, especially on the southern portion of the landfill. Release of dust particles into the air is facilitated where ground vegetation and cover is relatively sparse, leaving surface soils partially exposed to wind erosion. The remainder of the landfill possesses little or no potential for chemical release through fugitive dust generation based on the following:

- Vegetative cover (Common reed and Mugwort) exists over the remainder of the site surface, including other areas that may contain potentially contaminated soils

- Small trees (Eastern Cottonwood) are scattered across the landfill and serve to minimize wind erosion of the surface soil

- The Pelham Bay area has an annual average rainfall of 41 inches. Rainfall occurs, on average, once every three days, which would preclude substantial dust generation

Workers working on the landfill and trespassers were considered to be potentially exposed to VOCs and dust particles released from the exposed soils. Airborne hazards to workers and trespassers due to exposure to dusts and VOCs are expected to be greatest during remedial activities at the landfill.

6.2.1.2.2 Groundwater

The RI has revealed the presence of compounds in groundwater. However, since the turn of the century, potable drinking water in New York City has been provided by a public water supply using surface water from reservoirs upstate. There are no known private residential wells located on or near the landfill. Furthermore, according to a letter from the NYSDOH to WCCI, dated October 11, 1990, there are no public water system production wells located in the Bronx.

Since there are no known public or private wells which are used for consumptive or household purposes within 0.5 miles of the site, it is unlikely that any area drinking water supply is affected under current conditions. Therefore, the groundwater exposure pathway is regarded as an incomplete pathway for workers and trespassers on the landfill property (and for nearby residents) and is therefore excluded from the HHE.

Although groundwater beneath the landfill is not used for consumption or other purposes, there is a remote possibility that workers on the landfill may incidentally ingest groundwater contaminated with leachate since it seeps onto the surface of the site creating a complete pathway.

6.2.1.2.3 Groundwater/Leachate

As discussed in Section 2.0 of this report, leachate is considered to be that portion of below-grade water that has percolated through the buried waste. Once leachate reaches the water table, it mixes rapidly with the groundwater and is therefore referred to as groundwater/leachate in this RI report. However, in this section of the RI the term leachate is not used to distinguish between seepage fluids that may leach onto the landfill surface and groundwater/leachate that may be released beneath the landfill and flow radially into bay. Both seepage fluids and groundwater leachate can appear on the surface of the landfill and can find their way to the bay. From an HHE perspective, both contain chemicals. Therefore, no distinction is made between the two in the HHE. The term groundwater/leachate is used for both fluids.

Potential release of compounds may occur under circumstances where leachate from the landfill reaches the surface and is discharged or seeps into the bay or appears on surface soils. Since inhalation, incidental ingestion, and direct dermal contact with compounds in leachate is possible for both workers and trespassers, these routes of exposure are regarded as complete pathways and included in this HHE.

6.2.1.2.4 Surface Water

The landfill is next to the marine waters of Pelham Bay, which are considered off site for the purposes of this HHE. Since no surface water bodies are located on site, surface water has been excluded from this HHE. However, potential exposure to surface water will be addressed in the BRA.

6.2.1.2.5 Soil and Sediment

Surface soil samples collected from grassy and unvegetated areas on the landfill surface indicate the presence of compounds in surface soils. A conservative approach was applied since it was assumed that all soils were available to exposed individuals regardless of the sample location. Current soil exposure scenarios were used to evaluate hazards of landfill surface soils to the trespasser and on-site workers.

In addition to concern for inhalation of airborne particulates and volatiles released from the landfill soils (see Section 6.2.1.2.1), potential exposures to compounds in soils included direct contact and incidental ingestion. Incidental ingestion of surface soil may occur as a result of dropping food in soil or through mouth to hand contact with these soils, a reasonable occurrence for both adults and trespassing children. Therefore, incidental ingestion and dermal contact with soil compounds are regarded as complete exposure pathways and will be included in this HHE.

Dust particles could deposit on the skin of those exposed and on vegetation covering the landfill. However, at the present time, there is no known edible vegetation grown on the landfill for human consumption. At one time there was a community garden located on the site (see Figure 2-3). This garden was tended by senior citizens living in the Pelham Bay area. In 1988, analysis of a soil sample collected from the garden revealed levels of lead over 300 mg/kg. The garden was then closed. Therefore, growing and consuming edible vegetation on the landfill by workers and/or trespassers has been designated an incomplete pathway and will be excluded from the HHE.

Sediment samples have been collected near the landfill and at a reference location in Eastchester Bay. Despite the restricted (underwater) access of human receptors to sediment areas, it is reasonable to assume that workers and/or trespassers may come into contact with these sediments, especially at low tide. Although sediments are considered an exposure pathway of concern, they are off site and, therefore, are excluded from this evaluation. Off-site sediments will be considered in the BRA.

6.2.1.3 Exposure Pathway Summary

Based on the above, the following exposure pathways are considered to be complete exposure pathways for workers and trespassers:

- Inhalation of VOCs, metals and total particulates
- Incidental ingestion and direct contact with compounds in groundwater/leachate
- Incidental ingestion and dermal contact with compounds in surface soils

6.2.2 Selection of Chemicals of Concern (COCs)

After selecting those exposure pathways that are thought to lead to exposure, the HHE is further focused by selecting those compounds that are of greatest concern, i.e., chemicals of concern (COCs) that may pose the greatest health hazards at the site. COC selection was performed for the following transport media:

- Air
- Groundwater/leachate
- On-site surface soil

A general description of the COC selection process, media-specific selections of COCs, and the final selection of COCs for each medium is presented in the following section.

Pre-Screening

Initially, all analytical data for each medium were reviewed. These data included CLP organic and inorganic analyses, PCBs and pesticides analysis. Groundwater/leachate analyses for the modified Bureau of Municipal Waste (BMW) list of conventional parameters were excluded from the data set prior to the COC selection process. These parameters included alkalinity as carbonate, alkalinity as bicarbonate, total dissolved solids, chloride, nitrate-N, sulfate, chemical oxygen demand (COD), total Kjeldahl nitrogen and ammonia. These parameters are either general indicators unrelated to toxicity to humans or are parameters of such low toxicity that they are unlikely to contribute to human hazard potential.

Tentatively identified compounds (TICs) were also excluded from the data set used for COC selection since they can not be quantitatively or qualitatively verified with any degree of certainty and no historical information indicates that a particular TIC was/is present at the landfill. Duplicate field samples were also excluded from the data set.

The data from samples that were reanalyzed were included in the data set for each media. For example, if the original sample was re-analyzed or diluted due to laboratory protocols, the data for these "RE" or "DL" samples were compared to the concentration in the original sample. To be conservative, the highest concentration of these multiple analyses were used in this HHE.

Quantitation Limits

Compounds that were not detected above detection limits in a particular medium were excluded from further consideration. Table 6-1 (on site soil) and Table 6-2 (leachate) list compounds that were not detected and their range of detection limits.

In keeping with federal guidance used by the NYSDOH, average and 95% upper confidence limit concentrations were calculated using one half the laboratory reporting limit when a compound was not detected in a given sample (USEPA, 1989a). When a laboratory reporting limit was elevated due to matrix interference or sample dilution, the normal, and not the elevated reporting limit was used in this calculation. The 95% upper confidence limit (UCL) for COCs media specific concentrations was calculated assuming a lognormal distribution (USEPA, 1992a) The UCL was calculated as:

$$UCL=e^{(x^2+0.5s^2+sH/\sqrt{n-1})}$$

Where:

UCL = upper confidence limit
e = constant (base of the natural log, equal to 2.718...)
x = mean of the transformed data
s = standard deviation of the transformed data
H = H-statistic (e.g., from table published in Gilbert, 1987)
n = number of samples

This concentration is considered a conservative estimate of the average concentration an individual could be exposed to and is the concentration used in calculating exposure.

Background

In selecting COCs, it is customary to evaluate background concentrations. For this HE background was defined as the concentration in a sample that was collected away from the landfill and that was not expected to be influenced by release of any constituents from the landfill. For soil, this was a location in the park far from the landfill. This does not mean background is "pristine" or "natural" or uninfluenced by human activity. If concentrations measured on the landfill or in areas assumed to be influenced by the landfill are greater than those in the background sample(s), then those compounds are excluded as COCs in that media because it is likely the contamination is either natural in origin or caused by human activity unrelated to the landfill. This will be discussed in more detail in Section 6.2.3.1.

Essential Nutrients

Several inorganic compounds are also biologically essential trace elements required for maintenance of good health and normal metabolism. Some of these have been assigned recommended daily allowances (RDAs) for children and adults by the National Academy of Sciences (NAS, 1989). In keeping with RAGs, those essential nutrients that have been excluded from the HHE are calcium, copper, iron, magnesium, potassium, selenium, sodium and zinc.

Frequency of Detection

The frequency with which a chemical is detected in a media was examined to select COCs. Compounds which had a low frequency of detection (i.e., 5% or less) do not indicate a clear pattern of contamination were excluded from consideration as COCs (USEPA, 1989a).

Toxicity Screening

A toxicity screening of the remaining compounds was used to further narrow the list COCs. Toxicity values used in the screening process can be found in Appendix Z. This screening can only be performed for compounds that have quantitative toxicity values, such as References Doses (RfDs) for noncarcinogens and Slope Factors (SFs) for carcinogens. For compounds with no defined RfDs or SFs, WCCI did not develop these factors. These compounds were simply excluded as COCs.

A concentration/toxicity screening procedure was used to identify those compounds in each medium that are likely to account for the majority of the hazard. Application of this screening procedure serves to focus the HHE on the most significant compounds present in each medium at the landfill.

Only those compounds with published RfDs and/or SFs were evaluated for inclusion as COCs using the concentration/toxicity screening procedure (USEPA, 1989a). Basically, this procedure incorporates both the concentration and toxicity of the compounds into a single factor. The procedure is explained below and is shown for the media in Tables 6-3, 6-5 and 6-6. In accordance with the guidelines, the compounds which had RfDs were evaluated by multiplying the medium specific maximum detected concentration by the inverse of the RfD to obtain a noncarcinogenic risk factor for an exposure route. All of these risk factors were summed to provide a total noncarcinogenic risk factor. Each individual risk factor was then divided by the total risk factor to produce a relative noncarcinogenic risk ratio. Any chemical with a small noncarcinogenic risk ratio (i.e., less than 1% of the total risk from that medium, with respect to the other chemicals detected on the landfill), was eliminated from the list of COCs. A similar process was performed on carcinogenic chemicals having SFs. The maximum detected concentration was multiplied directly by the SF (rather than by its inverse) and the compounds with small (i.e., less than 1% of the total) carcinogenic risk ratios for an exposure route were accordingly eliminated from the list of COCs, as described above.

Blank Contamination

Compounds believed to be detected as a result of laboratory contamination were not included in the HHE since they do not represent site contamination but are artifacts (i.e., false positives). Compounds that are typically detected in the laboratory blanks, field blanks, or trip blanks that were not considered as COCs included acetone (2-propanone), 2-butanone, toluene, methylene chloride and phthalate esters (USEPA, 1989a).

6.2.3 Media-Specific COCs

6.2.3.1 Surface Soils

Seventeen representative on-site surface soil samples were selected for this HHE to characterize surface soil. Seven surface soil samples (SS-HA, -HB, -HC, -HD, -HE, -HF and -HG) were collected from surface soil at the air monitoring stations located on the landfill and six surface soil samples (SB-113S1, -116S1, -117S1, -118S1, -119S1, and -CB1S1) were collected from on-site soil boring locations. In addition, four shallow soil samples were collected from the former community garden area (SS-GAR1, -GAR2, -GAR3 and -GAR4).

The sample designations indicate the sample location and the relative depth of the sample. Samples were collected at the air monitoring stations at a depth of not greater than two inches whereas soil boring samples were collected from soil cores up to one foot deep. Tables 4-1 through 4-9 in Section 4.0 present the actual depths for each of these samples.

One sample, SB-124S1, was identified as a reference sample to be used as background in consultation with NYSDEC AND NYSDOH as it is unlikely to have been influenced by the landfill (see Section 4.2).

For all compounds with at least one detection on site, the 95% UCL was calculated assuming a lognormal distribution and that non-detects are best estimated by half the reported detection limit. If the UCL was equal to or below the reference value, the compound was excluded as a COC (aluminum, antimony, beryllium and thallium). However, if the UCL was above the reference location but the average was below or slightly above (within 20%) of the reference location, a more critical examination of the data set was made.

When there was only one detection in the seventeen on-site samples and this value was an estimated value (J qualified) well below any of the detection limits, the compound was excluded as a COC since this presents very limited evidence of a pattern of contamination. This was true for 1,2,4-trichlorobenzene, 2,4,5-trichlorophenol, and 1,2-dichlorobenzene.

Average arsenic levels were also comparable to the reference location (4.8 vs. 4.4 mg/kg). Compared to an estimated average arsenic concentration of 4.8 mg/kg (in the eastern U.S., east of the 96th meridian, Shacklette and Boerngen, 1984), it appears unlikely to be due to landfill contamination. Arsenic, therefore, was excluded as a COC.

Average chromium levels were below those at the reference station and only two of seventeen samples exceeded the levels at the reference station location. The same was true for cobalt. Therefore, these compounds were excluded as COCs.

Average dibenzo(a,h)anthracene levels were also below the reference station location level and the detects were very low estimated values, well below the reported detection limit of most samples. Therefore dibenzo(a,h)anthracene was excluded as a COC.

For 1,4-dichlorobenzene, the average concentration was slightly above the mean but this was due to the higher detection limit for the on-site samples. Therefore, 1,4-dichlorobenzene was excluded as a COC.

For both silver and thallium, the UCL was slightly higher than the reference location but the average was almost 30% lower and only two out of the seventeen samples exceeded the reference location. Therefore, these compounds were also excluded as COCs.

Table 6-3 presents detailed results of the concentration/toxicity screen for on-site soil samples. Compounds contributing less than 1% of the ingestion screening factors were eliminated from further consideration. These compounds were: 2-methylnaphthalene, 4,4'-DDD, 4,4'-DDE, acenaphthene, anthracene, benzo(g,h,i)perylene, benzoic acid, chlorobenzene, chloroform, chrysene, ethylbenzene, fluoranthene, fluorene, gamma-BHC, methoxychlor, naphthalene, pyrene and xylenes.

The following fifteen compounds were selected as soil COCs:

4,4'-DDT
Alpha-Chlordane
Barium
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Cadmium
Dieldrin
Gamma-Chlordane
Heptachlor epoxide
Indeno(1,2,3-cd)pyrene
N-Nitrosodi-n-propylamine
Nickel
PCBs

Benzene could have been eliminated as a COC since it contributed to less than 1% of the relative hazard ratio for soil, based on its concentration and toxicity. However, due to the fact that benzene is a recognized Class A human carcinogen capable of inducing leukemia in people, benzene has been retained as a COC for this medium as a matter of professional judgement.

Lead has been detected in soils on the landfill. NYSDEC and NYSDOH have recommended a 200 mg/kg soil lead cleanup level for this site based on recent discussions at a meeting on January 13, 1992. Only six out of seventeen non-aqueous lead samples from the landfill exhibited lead concentrations that exceeded 200 mg/kg. They were samples SB-CB1S1 (287 mg/kg), SS-HF (203 mg/kg), SS-HB (1130 mg/kg), SS-GAR1 (293 mg/kg), SS-GAR2 (215 mg/kg) and SS-GAR3 (246 mg/kg). The average and median UCL soil concentrations are 201 mg/kg and 114 mg/kg, respectively. Based on the average value for on-site soil concentrations being almost identical to the cleanup guideline, lead was excluded as a soil specific COC at the landfill.

6.2.3.2 Groundwater/Leachate

Selection of groundwater/leachate COCs was performed according to the previously described process. Samples LS-1, -2, -3, -4, -5, -7, -9, and -10 were collected from historic or current areas where seepage of leachate was visible. Groundwater samples designated MW-104, -105, -106, -109, -110, -111, -113, -114, -115, -118, -119, -120, -121, -122, -123 were actually samples collected from monitoring wells. These were selected as those directly influenced only by precipitation infiltration through the landfill, taking the RI hydrogeologic evaluation (Section 3.4) into account. Due to the similarity between these two matrices, they were grouped together as one data set and defined as groundwater/leachate.

Table 6-4 presents a list of compounds which were excluded based on low frequency of detection, (less than 5% of samples), in the groundwater/leachate data set. Table 6-5 presents detailed results of the concentration/toxicity screen for groundwater/leachate COC selection. As in on-site soil samples, several compounds did not have USEPA approved toxicity values and were therefore excluded as COCs. Twenty one compounds contributing to less than 1% of the total screening factor were also excluded. The excluded compounds were: 1,2-dichloroethylene, 1,4-dichlorobenzene, 2,4-dimethylphenol, 2-methylnaphthalene, 4-methylphenol, 4,4'-DDD, 4,4'-DDE, acenaphthene, alpha-BHC, aluminum, anthracene, bis(2-chloroisopropyl)ether, carbon disulfide, chlorobenzene, chromium (total, VI), endrin, ethylbenzene, fluoranthene, fluorene, mercury, methoxychlor, naphthalene, pyrene, silver, vanadium and xylenes.

Based on the concentration/toxicity screening, the following compounds, most contributing greater than 1% of the hazard for this media and retained as COCs are:

Antimony
Arsenic
Barium

Benzene (< 1% but retained because of its designation as a Class A carcinogen)
Boron
Cadmium
Cyanide
Dieldrin
Endosulfan I,II
Manganese
Nickel
PCBs
Thallium

6.2.3.3 Air

The selection of COCs for on-site air was similar to the process previously described with the exception that a simplified air model (Section 5.3.3.2) was used to estimate the concentration of volatile compounds (in mg/m^3) expected to be encountered by workers and trespassers on the landfill in their breathing zone from emissions measured from eight on-site emission isolation flux chambers (EIFC).

Concentrations of volatile organic compounds (VOCs), eight metals and total airborne particulate matter were measured at both on site and off-site locations. Since for metals and total particulate matter, there is no evidence that on-site concentrations exceed those levels measured off site (Table 4-81), those compounds were excluded from the COC list.

Table 6-6 presents results of the concentration/toxicity screen for air. VOCs which did not have toxicity values were excluded prior to the concentration/toxicity screen. Thirteen compounds contributing to less than 1% of the total hazard ratio were excluded as COCs. They were 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,2-dichloroethylene, 1,4-dichlorobenzene, bromoform, carbon disulfide, freons 11, 12 and 113, styrene, tetrachloroethane, trichloroethene and xylenes.

Those seven volatile compounds expected to contribute to greater than 1% of the screening factor for this media:

Benzene
Chlorobenzene
Cumene
Ethyl benzene
Hexachlorobutadiene
Hydrogen sulfide

6.2.3.4 COC Selection Summary

The collective list of COCs for the landfill was:

Volatile Compounds

- Benzene
- Chlorobenzene
- Cumene
- Ethylbenzene
- Hexachlorobutadiene
- Hydrogen sulfide

Inorganics and Metals

- Antimony
- Arsenic
- Barium

Inorganics and Metals (Continued)

- Boron
- Cadmium
- Cyanide
- Manganese
- Nickel
- Thallium

Base Neutrals - Semi-volatiles

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Indeno(1,2,3-cd)pyrene
N-Nitroso-di-n-propylamine

Pesticides and PCBs

4,4'-DDT
Alpha-Chlordane
Dieldrin
Endosulfan I, II
Gamma-Chlordane
Heptachlor epoxide
PCBs

The average as well as the range in concentration for each of these COCs (minimum value and maximum value reported) along with the 95% UCL in each specific medium are found in Tables 6-7, 6-8 and 6-9.

6.2.4 Toxicity Assessment

The purpose of the toxicity assessment was to review and evaluate available information regarding each COC's potential to cause an adverse effect to potentially exposed people. The assessment considers molecular structure and dose (exposure level, time and frequency of exposure, absorption, etc.). As the level of exposure increases, the likelihood or probability of an adverse effect (response) occurring also increases. This dose-response relationship is used in this HHE to identify, if appropriate, a threshold dose or no-observed-adverse-effect-level (NOAEL), at which no observable adverse effects are known to occur.

Toxic reactions to exposures can be short-term and acute in character. These reactions usually involve exposures to high levels of a substance over brief periods of time.

Reactions can also be chronic, generally involving repeated exposure to lower levels over prolonged periods of time. This latter exposure is more relevant at Pelham Bay Landfill. Using chemical-specific dose-response parameters and estimated exposure parameters (Section 6.2.5), the goal is to establish quantitative exposure levels which can be correlated with the likelihood of an adverse outcome or effect.

The two principal quantitative indices of toxicity are the Reference Dose (RfD) used to estimate noncarcinogenic effects and Slope Factor (SF) for carcinogenic substances. An RfD is the intake or dose per unit of body weight per day (mg/kg-day) that is unlikely to result in noncarcinogenic adverse effects to people even if exposure occurs for an entire lifetime, including sensitive subgroups, such as those predisposed by age, illness or by genetics. Only values derived by the USEPA were used in this HHE.

The SF, a measure of a chemical's cancer induction potency (slope of the dose-response curve), is used to estimate an upper-bound probability of an exposed individual developing cancer as a result of contact/absorption. RfDs and SFs for selected COCs are presented in Table 6-10.

Chemical carcinogens are classified by the World Health Organization (WHO) and USEPA using a weight-of-evidence classification system. This system takes into account all of the biomedical literature including epidemiology studies, experimental toxicology and any available clinical studies. Table 6-11 presents the USEPA weight-of-evidence classification system.

For the purposes of this toxicity assessment, toxicological profiles have been developed for each COC using computerized data searches. Data evaluations and data incorporation into this report followed the review hierarchy referenced in applicable USEPA guidance documents (USEPA, 1989a). Unless otherwise indicated, RfDs and SFs for each COC were selected from the following hierarchy of reference sources:

- Integrated Risk Information System (USEPA, 1992c)
- Health Effects Assessment Summary Tables (USEPA, 1992d)
- USEPA Criteria Documents

- Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles

- National Library of Medicine Hazardous Substances Data Base (HSDB, 1992)

- Relevant New York State Criteria and Guidelines (SCG)

Ordinarily, a toxicology profile of the toxic properties of the COC would be developed from information collected from these sources. This information would then be summarized for each COC and presented in the toxicity assessment. Toxicology profiles and summary statements prepared by the Agency for Toxic Substances and Disease Registry (ATSDR) will be included in the BRA in keeping with the recommendations of the SAC. The information is summarized in Table 6-12 and 6-13.

Basically, from the biomedical information system two categories of toxicity are discussed: carcinogenicity and noncarcinogenicity. Noncarcinogenic effects can include either acute or chronic effects. Such toxic endpoints might include impairment of organ(s), system dysfunction, (e.g., respiratory, neurological and immune), reproductive interference (including sterility and birth defects), metabolic changes, etc. These effects can be either reversible or irreversible. Noncarcinogenic effects generally occur only after a threshold dose has been exceeded.

A RfD is derived from the lowest-observed-adverse-effect-level (LOAEL) of the experimental toxicology data. In order to be health-protective, RfD values are derived based on the adverse effect that occurs at the lowest dose, irrespective of its clinical significance or severity. Effects in sensitive populations are taken into account by the use of uncertainty factors which are multiplicative adjustments that reduce the allowable dose level tenfold to account for sensitive or more susceptible members of an exposed population. If necessary, additional uncertainty factors of 10 may also be used to:
(1) provide a margin of safety in comparing animal studies to human responses, and (2) in adjusting data obtained in subchronic or acute studies to be relevant in assessing risk associated with chronic exposures. Thus, the RfD values used in the assessment are often 100 to 1,000 times lower than the lowest dose found to be associated with the least

severe adverse effect for a given chemical. The RfD for each chemical is used as a benchmark for comparison of the estimated exposure dose for each chemical.

Carcinogenic effects refer to the demonstrated or suspected capacity of a chemical to induce cancer. SFs are calculated based upon available scientific evidence of the dose-response relationship between the cancer induced and the level(s) of a chemical administered that caused the carcinogenic response. Specifically, the upper 95% confidence limit of the dose-response curve is used to calculate SFs. The SFs are then used to estimate the probability that exposure to the chemical will result in a carcinogenic response. Because the exact nature of the link between cancer and chemical agents is unknown, regulatory agencies at the federal level (USEPA, Occupational Safety and Health Administration (OSHA) and the Consumer Product Safety Commission) and state level have adopted a scientific policy which assumes that no threshold dose exists for carcinogens. Under this approach, the agencies assume that the levels of exposure below which cancer will not appear cannot be defined. These assumptions lead to conservative estimates of carcinogenic risks for some chemicals. In general, federal guidance indicates that risks below one new cancer case in one million people exposed (1×10^{-6} or 1.0E-06) is a negligible risk that does not usually require regulatory action.

6.2.4.1 General Toxicity Information

Table 6-10 summarizes the SFs and RfDs used in this HHE for the selected COCs. Table 6-12 presents carcinogenicity information for inorganic COCs including USEPA weight-of-evidence and limited scientific data to support carcinogenicity for specific tumors and cancers. Table 6-13 presents similar information for organic COCs. Both tables present target organ toxicities. It should be noted that some chemicals have multiple target organs. Symptoms and toxicity in a specific organ by a chemical is different from other organ effects. Therefore, noncarcinogenic effects of organ toxicity cannot be simply summed together or expressed in terms of hazard index (HI).

Toxicological Profiles for each COC are being developed in accordance with USEPA guidance (USEPA, 1989a) and SARA Section 110, using a format approved by the NYSDOH. They will be included in the BRA.

6.2.5 Quantification of Exposure to COCs by Media

Specific exposure values for each pathway were developed for each receptor and are presented in the sections that follow, as well as in Tables 6-14 through 6-18. Table 6-19 lists several exposure assumptions that have previously been approved by NYSDOH for this site. These assumptions have been used in the calculations, where appropriate. General assumptions that remain consistent with RAGS, regardless of pathway and media, are stated below.

The matrix effect (ME) describes the observation that chemicals bound to a matrix (i.e., particulate matter) are less easily absorbed than are chemicals administered in laboratory vehicles such as water or acetone. A value of 1 was used for this assessment to be conservative. Therefore, health hazards calculated may in fact be greater than the actual health hazards from exposure to site media.

Body weights (BW) for the worker and youth trespasser were derived from the Exposure Factors Handbook (USEPA, 1989a and USEPA, 1989c). The average body weight for adults is given as 70 kg. The average body weights for the youth trespasser (youth 7 - 16 years of age) is 30 kg.

The exposure duration (ED) refers to the number of years a receptor is estimated to spend on the landfill. The worker was assumed to be employed (ED) 25 year at the same location (USEPA, 1991d). This represents the 95th percentile as indicated by Department of Labor Statistics, 1990. The youth is assumed to be raised at the same house and to move away before becoming an adult, making the exposure duration 9 years. The exposure time (ET) at the landfill was estimated at a reasonable maximum time for the worker of 12 hours/day, 250 day/year, while a youth may spend up to 4 hours/day, 240 days/year (NYSDOH Communication, Table 6-19).

6.2.5.1 Potential Inhalation of VOCs, Metals, and Total Particles

As indicated in Section 6.2.1.2.1, workers and trespassers are expected to inhale COCs in VOCs or dust particles generated from the wind erosion of on-site surface soils. However, since airborne metals and total particulates were at or below background, they are excluded from this HHE. Only VOCs are considered for this exposure route.

Inhalation intake dose estimates were obtained using the following equation:

$$\text{Inhaled Dose (mg/kg-dy)} = \frac{CA \times IR \times ET \times EF \times ED \times ME \times DF \times CC \times FI}{BW \times AT}$$

Where:

CA = Modeled Chemical Concentration in air (mg/m^3)
IR = Inhalation Rate (m^3/hr)
ET = Exposure Time (hr/dy)
EF = Exposure Frequency (dy/yr)
ED = Exposure Duration (yr)
ME = Matrix Effect (unitless)
DF = Deposition Factor (unitless)
CC = Ciliary Clearance (unitless)
FI = Fraction Contaminated (unitless)
BW = Body Weight (kg)
AT = Averaging Time (dy): Pathways specific period of exposure for noncarcinogenic effects (i.e., ED x 365 dy/yr) and 70 yr lifetime for carcinogenic effects (i.e., 70 yr x 365 dy/yr).

On-site Worker

The IR was assumed to be 1.04 m^3/hour for an average adult weighing 70 kg (BW) engaged in light physical activity (USEPA, 1989c). It was assumed that the worker was at the landfill 12 hrs/dy (ET), 250 days/yr (EF). The ED was assumed to be 25 years (USEPA, 1991d). These exposure parameters are all presented in Table 6-14.

Trespasser

It was assumed that the most likely trespasser would be an adventurous child/teenager (7 - 16 yr old). The inhalation rate (IR) was assumed to be 1.21 m^3/hour for a 30 kg BW child engaged in light physical activity (USEPA, 1989c). It was assumed that the individual was exposed for 4 hours each day (ET), 240 days/year (NYSDOH

Communication, Table 6-19). The ED used was 9 years. These exposure parameters are presented in Table 6-14.

6.2.5.2 Groundwater/Leachate

6.2.5.2.1 Potential Groundwater/Leachate Ingestion

Presently, groundwater at the landfill is not used for consumption or other purposes since a public water supply has been available since the turn of the century. There are no known public or private wells within a 0.5 mile radius of the site. As such, no regular exposure to COCs in drinking water is occurring presently nor is likely to occur in the future. However, there is a remote possibility that workers on the landfill may incidentally ingest groundwater contaminated with leachate since it seeps onto the surface of the site creating a complete exposure pathway.

The following relationship was used to estimate potential intake exposures from incidentally ingesting groundwater/leachate:

$$\text{Intake Dose (mg/kg-dy)} = \frac{CW \times IR \times EF \times ED \times FI}{BW \times AT}$$

Where:

CW = Chemical Concentration in leachate (mg/L)
IR = Ingestion Rate (l/dy)
EF = Exposure Frequency (dy/yr)
ED = Exposure Duration (yr)
FI = Fraction Contaminated (unitless)
BW = Body Weight (kg)
AT = Averaging Time (dy): Pathways specific period of exposure for noncarcinogenic effects (i.e.,ED x 365 dy/yr), and 70 yr lifetime for carcinogenic effects (i.e., 70 yr x 365 dy/yr).

On-site Worker

Ingestion rates were calculated for an adult worker. A water ingestion rate (IR) of 0.0008 l/dy, assuming ingestion of dermally adhered leachate (1 mg/cm^2) on the hands. (Although the factor of 1 mg/cm^2 was developed based on soil adherence, it was used for leachate in the absence of alternative guidance). An exposure frequency of 250 dy/yr (EF) (NYSDOH Communication, Table 6-19) was assumed for a 70 kg (BW) adult (USEPA, 1991d; USEPA, 1989a and 1989c). These exposure parameters are presented in Table 6-15.

Trespasser

An ingestion rate (IR) of 0.0007 l/dy was used for the young trespasser; less than that for a worker due to the smaller hand surface area. Although the landfill is fenced, it was assumed that a trespasser would be present 240 days per year (EF) (NYSDOH Communication, Table 6-19). In calculating exposures for youth, the exposure duration was set at 9 years and a body weight of 30 kg was used (USEPA, 1989c). These exposure parameters are presented in Table 6-15.

6.2.5.2.2 Potential Groundwater/Leachate Dermal Contact

Since groundwater/leachate is discharged from the surface of the landfill, there is a potential for dermal contact with the COCs in this fluid. Although it is extremely difficult to estimate how often this contact would occur for workers and/or trespassers and how much of each COC would be absorbed once contact with the skin was made, the following relationship was used to provide a conservative estimate of the potential intake of the COCs from dermal contact with groundwater/leachate:

$$\text{Intake Dose (mg/kg-dy)} = \frac{CW \times SA \times ET \times EF \times ED \times PC \times CF}{BW \times AT}$$

Where:

CW = Chemical Concentration in groundwater/leachate ()
SA = Surface Area (cm^2)
ET = Exposure Time (hr/dy)
EF = Exposure Frequency (dy/yr)
ED = Exposure Duration (yr)
PC = Permeability Constant (cm/hr)
CF = Conversion Factor (l/cm^3)
BW = Body Weight (kg)

AT = Averaging Time (dy): Pathways specific period of exposure for noncarcinogenic effects (i.e., ED x 365 dy/yr), and 70 yr lifetime for carcinogenic effects (i.e., 70 yr x 365 dy/yr).

On-site Worker

The surface area (SA) of the adult worker weighing 70 kg was assumed to be 2,090 cm^2 (NYSDOH Communication, Table 6-19). An ET of 1 hr/day was used for this scenario. Table 6-16 presents the rest of the exposure parameters for the on-site worker.

Trespasser

The surface area of the young trespasser who weighs 30 kg was assumed to be 2,975 cm^2 (NYSDOH Communication, Table 6-19). It was also assumed that a trespasser spends 1 hour each day at the landfill over a 240 day year (EF) (NYSDOH Communication: Table 6-19). In calculating exposures for the trespasser, the exposure duration (ED) was set at 9 years. These exposure parameters can be found in Table 6-16.

6.2.5.3 Soils

Conservative human exposure estimates have been made for potential exposure routes associated with direct contact with surface soils on the landfill. Incidental soil ingestion and dermal absorption and inhalation of VOCs were the potential exposure routes evaluated. In keeping with USEPA policy (USEPA, 1989a) the chemical concentrations used for these dose calculations were the 95% UCL on the arithmetic average chemical concentrations for all landfill surface soil samples. In conducting these calculations, it was assumed all non-detected results were equal to one-half the MDL (USEPA, 1989a).

6.2.5.3.1 Potential Soil Ingestion

The following equation was used to estimate potential ingestion of COCs present in surface soils:

$$\text{Ingested Dose (mg/kg-dy)} = \frac{CS \times IR \times EF \times ED \times ME \times FI \times CF}{BW \times AT}$$

Where:

CS = Chemical Concentration in surface soil (mg/kg)
IR = Ingestion Rate (mg/dy)
EF = Exposure Frequency (dy/yr)
ED = Exposure Duration (yr)
ME = Matrix Effect (unitless)
FI = Fraction Ingested from Contaminated Source (unitless)
CF = Conversion Factor (kg/mg)
BW = Body Weight (kg)
AT = Averaging Time (dy): Pathways specific period of exposure for noncarcinogenic effects (i.e., ED x 365 dy/yr) and 70 yr lifetime for carcinogenic effects (i.e., 70 yr x 365 dy/yr).

On-site Worker

The worker was assumed to be at the landfill 250 days/yr. This exposure frequency would be relevant to groundkeepers and construction workers. An ingestion rate (IR) of 200 mg/day was used (NYSDOH Communication, Table 6-19). The fraction ingestion (FI) from the site is estimated to be 0.5. It was assumed that a worker is employed (ED) 25 years at the same location (USEPA, 1991d). This represents the 95th percentile as indicated by Department of Labor Statistics, 1990. A body weight (BW) of 70 kg was used in the calculations (USEPA, 1989a and 1989c).

Trespasser

Again, it was assumed that the most likely trespasser would be an adventurous child/teenager (7 - 16 years old). An ingestion rate (IR) of 200 mg/day was used (NYSDOH Communication, Table 6-19). Although the landfill is fenced, it was assumed that a child/teenager is outdoors 8 hrs/day (Hawley, 1985) and that one-half of this time (or 4 hrs/day) is spent at the landfill. Therefore, it was assumed that 50% (0.5) of the total daily soil ingested (FI) was contaminated landfill soils. It was assumed that the trespasser would be on the landfill 240 days/yr. In calculating exposure to children, the exposure duration (ED) was 9 yrs and the body weight was 30 kg (NYSDOH Communication, Table 6-19).

6.2.5.3.2 Potential Soil Dermal Contact

Dermal contact with compounds present in soils was estimated using the following equation:

$$\text{Dermal Dose (mg/kg-dy)} = \frac{CS \times SA \times EF \times ED \times ME \times AF \times ABS \times CF \times FI}{BW \times AT}$$

Where:

CS = Chemical Concentration in soil (mg/kg)
SA = Surface Area (cm^2/event)
EF = Exposure Frequency (dy/yr)IR
ED = Exposure Duration (yr)
ME = Matrix Effect (unitless)
AF = Adherence Factor (mg/cm^2)
ABS = Absorption Factor (Percentage of chemical desorbed from soil matrix and absorbed through skin) (unitless)
CF = Conversion Factor (1×10^{-6} kg/mg)
FI = Fraction Contaminated (unitless)
BW = Body Weight (kg)
AT = Averaging Time (dy): Pathways specific period of exposure for noncarcinogenic effects (i.e., ED x 365 day/yr) and 70 yr lifetime for carcinogenic effects (i.e., 70 year x 365 day/yr).

On-site Worker and Trespasser

All assumptions of exposure frequency and duration were identical to those for soil ingestion. For both workers and trespassers, an adherence factor of 1 mg/cm^2 and absorption factor of 0.1 (USEPA, 1989c) were used. Table 6-18 presents the exposure parameters for both these receptors.

6.2.6 Hazard Characterization

Hazard characterization is the final step in the hazard evaluation process. The purpose of this section is to estimate and characterize the potential for noncarcinogenic adverse toxic effects and potential cancer hazards.

Hazards are characterized for each specific exposure pathway and for those individuals who are assumed to experience reasonable maximum exposures and to exhibit maximum sensitivities to the chemicals to which they are exposed. Reasonable maximum exposures were defined for all exposure pathways; exposure scenarios were constructed so that the estimated exposure by a given route is almost certain to be higher than the exposure actually experienced.

The noncarcinogenic and carcinogenic hazards which were characterized are dependent upon numerous assumptions made throughout each stage of the process. The presentation of these hazards considers the attendant scientific uncertainties and limitations of the available data.

Caution should be exercised in attempting to draw conclusions regarding any actual or perceived hazards to any individual who may or may not exist within a potentially exposed population. The quantitative hazard estimates which may be attributable to chemical exposures are often based on limited experimental toxicology or epidemiological data. Therefore, while these estimates rely on numerous scientific and professional judgments of toxicologists, epidemiologists, clinicians and other health professionals, emphasis was placed on using consensus-based peer-reviewed information in making these judgements.

Nonetheless, the HE process provides a systematic and consistent basis for evaluating the potential hazards thought to exist and identifies those exposure pathways of possible concern. This information is factored into the selection of the most cost-effective and feasible remedial hazard management alternative that is expected to be protective of the public health and the environment.

6.2.6.1 Noncarcinogenic Hazards

The potential for noncancer health adversities associated with chronic exposure to noncarcinogens is characterized using the ratio of Chronic Daily Intake (CDI) to the RfD. The CDI is estimated from the pollutant pathway analysis and estimates of exposure route concentrations involving those pathways.

Toxic hazards are assessed on an individual COC basis using Hazard Quotients (HQ), as well as on a cumulative basis through the use of Hazard Indices (HI). This ratio of

CDI to RfD provides some indication of the relationship between the estimated daily exposure and the lowest exposure known to be associated with the potential for adverse effects in the most sensitive among the exposed population.

The HI does not represent a numerical estimate of either the probability or severity of chronic noncancer effects. The numerical value for the CDI/RfD ratios is often referred to as a HQ and may be thought of more accurately as a margin of safety at values below 1. The sum of the individual HQs for a particular pathway is referred to as the Hazard Index (HI). If the HQ (or HI) were to exceed 1, this was interpreted as an indication that adverse effects could be of concern, especially for sensitive populations. It does not, however, unequivocally indicate that adverse effects will occur. An HI of less than one, particularly if it represents the aggregated (sum) HQs of many of the COCs, in general, provides a degree of assurance that adverse impacts will not occur. This is due to the conservativeness inherent in the way that RfD values are derived and in the way that such hazards are characterized.

In order to assess the potential for adverse noncarcinogenic effects associated with multiple chemical exposures, an additive approach is used in keeping with RAGS. The sum of all the HQs for the selected chemical exposures is considered to be the HI. The HI was calculated as follows:

$$Hazard\ Index\ (HI) = \Sigma\ HQ = \Sigma\ (CDI_i\ /\ RfD_i)$$

where subscript (i) is the CDI and RfD for each COC in the exposure pathway. The potential for adverse noncarcinogenic effects associated with workers or trespassers being exposed to the COCs by more than one pathway is calculated by summing the exposure levels across all exposure pathways and then calculating HQs and HIs as described. This approach is consistent with USEPA RAGS (USEPA, 1989a). The toxicological parameters used in the noncarcinogenic hazard evaluation were derived mainly from peer-reviewed government sources (USEPA, 1989a).

A noncarcinogenic HQ is calculated for each COC in each exposure pathway. Environmental exposure levels used to calculate chemical-specific intake rates are the 95% UCL on the arithmetic average concentrations. If the 95% UCL was greater than the maximum detected concentration (due to small sample size and highly variable levels in a given media), the maximum detected concentration is used in these calculations. Only chronic references doses are used in these calculations. These assumptions provide a very conservative estimate of hazard.

6.2.6.2 Carcinogenic Hazards

Cancer hazards were quantified as additional per capita hazard expressed as the odds per million over a lifetime that a hypothetical maximally exposed person will contract cancer as a result of his or her exposure at the landfill. The incremental cancer hazard due to exposure to a particular COC was calculated from the lifetime average daily dose (LADD) estimated from the pollutant pathway analysis, estimates of exposure route concentrations involving those pathways and the slope factor (SF) for that COC, as follows:

$$\text{Lifetime Cancer Hazard} = \text{LADD (mg/kg/dy)} \times \text{SF (mg/kg/dy)}^{-1}$$

The LADD used to assess hazards refers to the daily lifetime average dose received through a given exposure pathway (for pathway specific hazards) or to the estimated total dose of a given COC received by a worker or trespasser from a number of exposure pathways.

As mentioned earlier, the values used for the SFs for the COCs come entirely from USEPA sources (IRIS, HEAST, Health Assessment documents). These SFs are considered to be conservative, since they represent the 95% upper-bound confidence interval of the cancer slope parameter derived from animal or human dose-response curves.

The result of the cancer hazard evaluation is a numerical estimate of the incremental possibility (over and above the background cancer rate) that an individual experiencing a given exposure will contract cancer in his or her lifetime. These probabilities are generally expressed in chances per million (1×10^{-6}, etc.) of contracting cancer from lifetime exposure to a COC.

In calculating cancer hazards from multiple chemical exposures, the hazards associated with each individual exposure are summed to give an estimate of total pathway cancer hazards:

$$Excess\ Lifetime\ Cancer\ Hazard = \Sigma\ (LADD_i \times SF_i)$$

where subscript (i) refers to the LADDs and the SFs for each of the COCs. This approach does not explicitly take into account the potential for either positive (synergistic) or negative (antagonistic) chemical interactions. It is assumed that the conservatism inherent in the estimation of the SF values, combined with the conservatism employed in exposure and dose assessment modeling, exceed the greatest synergistic effect expected in any population. Finally, antagonistic or interfering interactions between chemicals are at least as likely, on biochemical grounds, as synergistic ones. Taking all of the above into account, it is highly probable that the hazard evaluation methods used here will result in conservative estimates of cancer hazards due to multiple chemical exposures.

Carcinogenic hazards were calculated following USEPA guidelines (USEPA, 1989a; USEPA, 1991d). SFs were multiplied by the oral and dermal intake rates calculated previously. The SFs represent the upper 95% confidence limit or upper bound estimate of the dose-response curves for a specific substance.

6.2.7 Exposure Pathway Specific Potential Hazards

6.2.7.1 Air

Worker Scenario

The potential carcinogenic risks posed by the inhalation of VOCs by workers on the landfill are presented in Table 6-20 (calculations can be found in Appendix AA). The excess cancer risk for inhalation of VOCs as estimated to one significant figure to be 5×10^{-8}. The potential excess cancer risk for this scenario was well below the risk range often used by USEPA (10^{-4} to 10^{-6}) in setting cleanup goals under Superfund (USEPA, 1990a).

The potential noncarcinogenic hazards posed by the inhalation of VOCs by workers on the landfill are presented in Table 6-20. The HI for inhalation exposures to COCs in air was 5×10^{-4}. This value is much less than unity indicating that noncarcinogenic adverse effects are extremely unlikely to occur.

Trespasser Scenario

The potential carcinogenic hazards posed by the inhalation of VOCs by a landfill child/teenage trespasser are presented in Table 6-20. The excess cancer hazard for inhalation of VOCs was estimated to be 1 x 10^{-8}. The potential excess cancer hazard for this scenario is well below the hazard range often used by USEPA (10^{-4} to 10^{-6}) in setting cleanup goals under Superfund (USEPA, 1990a).

The potential noncarcinogenic hazards posed by the inhalation of VOCs by trespassers on the landfill are presented in Table 6-20. The HI for inhalation exposures to COCs in air was 4 x 10^{-4}. This value does not exceed unity indicating that noncarcinogenic adverse effects are unlikely to occur.

6.2.7.2 Groundwater/Leachate

Worker Scenario

Groundwater beneath the landfill has been shown to contain COCs and is referred to herein as groundwater/leachate. Since the turn of the century, drinking water within the City of New York has been provided by a public water supply using surface water from reservoirs. There are no known public or private wells which are used for consumptive or household purposes within a 0.5 mile radius of the landfill. Therefore, it is unlikely that the area drinking water supply is or had been affected (see discussion in Section 6.2.1.2.2).

It is unlikely, but possible, that an individual working on the landfill may come into contact with groundwater/leachate. For this reason, incidental ingestion of groundwater /leachate was evaluated in this HE in terms of ingesting it as a sole source of drinking water as a worst case exposure scenario. In addition, dermal contact was also considered as a complete pathway.

The potential carcinogenic hazards posed by the incidental ingestion of and dermal contact with on-site groundwater/leachate by workers on the landfill are presented in Table 6-20. The excess cancer hazard summed for incidental ingestion and dermal contact was estimated to be 1 x 10^{-7}, which was well below the hazard range often used by USEPA (10^{-4} to 10^{-6}) in setting cleanup goals under Superfund (USEPA, 1990a).

The potential noncarcinogenic hazards posed by incidental ingestion of and dermal contact with on-site groundwater/leachate by workers on the landfill are presented in Table 6-20. The additive HI for both routes was 4 x 10^{-3}. This value does not exceed unity, indicating that adverse noncarcinogenic effects will probably not occur.

Trespasser Scenario

The potential carcinogenic hazards posed by incidental ingestion of and dermal contact with groundwater/leachate by trespassers on the landfill are presented in Table 6-20. The excess cancer hazard summed for incidental ingestion of and dermal contact was estimated to be 1 x 10^{-7}. The potential excess cancer hazard for this scenario was well below the hazard range often used by USEPA (10^{-4} to 10^{-6}) in setting cleanup goals under Superfund (USEPA, 1990a).

The potential noncarcinogenic hazards posed by the incidental ingestion and dermal contact of groundwater/leachate by juvenile trespassers on the landfill are presented in Table 6-20. The additive HI for both routes combined was 8 x 10^{-3}. This value is well below unity indicating that adverse noncarcinogenic effects will probably not occur.

6.2.7.3 Soils

Worker Scenario

A reasonable worst-case scenario was developed to evaluate potential hazards to workers on the landfill. The potential carcinogenic hazards posed by the incidental ingestion and dermal absorption from landfill soils by a landfill worker are presented in Table 6-20. The excess cancer hazard for ingestion of and dermal contact with contaminated soils was estimated to be 2 x 10^{-5}. The potential excess cancer hazard for this scenario is within the hazard range often used by USEPA (10^{-4} to 10^{-6}) in setting cleanup goals under Superfund (USEPA, 1990a).

The potential noncarcinogenic hazards posed by the incidental ingestion of and dermal contact with landfill soils by workers are presented in Table 6-20. The HI for oral and dermal exposures to COCs in landfill soil was 6 x 10^{-2}. This value does not exceed unity indicating that adverse noncarcinogenic effects are not likely to occur.

Trespasser Scenario

The potential carcinogenic hazards posed by the incidental ingestion of and dermal contact with landfill soils by a child/teenage trespasser are presented in Table 6-20. The excess cancer hazard for ingestion of and dermal contact with contaminated soils was estimated to be 2 x 10^{-5}. The potential excess cancer hazard for this scenario is within the hazard range often used by USEPA (10^{-4} to 10^{-6}) in setting cleanup goals under Superfund (USEPA, 1990a).

The potential noncarcinogenic hazards posed by the ingestion of and dermal contact with landfill soils by trespassers on the landfill are presented in Table 6-20. The HI for oral and dermal exposures to COCs in site soils was 2 x 10^{-1}. This value does not exceed unity indicating that adverse noncarcinogenic effects are unlikely to occur.

6.2.8 Uncertainty Analysis

The hazard estimates presented above are not intended to be calculations of absolute hazard to individuals. A multitude of uncertainties prevent exact determination of hazard to potentially exposed populations. The goal of this hazard evaluation is to provide conservative, but reasonable, estimates of the hazard for the maximally exposed individual in order to guide decision making. The sources described above, particularly the various "Risk Assessment Guidance for Superfund" documents, provide a framework for estimating these hazards which in turn guide decisions on whether remediation is likely to be required.

In the NCP (USEPA, 1990a), USEPA establishes an acceptable cancer-hazard range of one-in-one-million to one-in-ten-thousand (i.e., a range of estimates). It is widely acknowledged, that uncertainty in hazard assessment can cause estimates to differ by more than one order of magnitude.

It is important to distinguish between variability and uncertainty. Variability is the true variation in the parameter (i.e., body weight varies across the population). Uncertainty, is the inaccuracy in estimating a parameter (i.e., the estimate of a COC concentration in a soil sample is, in theory, knowable but is uncertain due to field sampling or laboratory errors). Since hazard is a combination of exposure and toxicity, uncertainties and variability may be divided into these two groups.

Toxicity Uncertainties

Toxicity data used in hazard assessments are generally derived from animal studies. Uncertainties result from the following:

- Effects (e.g., impact on a target organ) and doses are extrapolated from animals to humans
- Short term exposure studies are used to predict the effect of long-term exposures
- High dose studies are used to predict the effect of low-dose exposures
- Studies of homogenous populations of animals are used to predict the effects on heterogeneous human populations (e.g., the young, old and the sick)

For example, in a recent paper (Cox & Ricci, 1992) it was shown that recalibration of animal bioassay data to internal rather than total dose, and use of a physiologically-based pharmacokinetic (PBPK) model rather than a simple nonlinear regression model, changed the estimate of inhalation hazard for a given low exposure to benzene from 7×10^{-4} to 6×10^{-9}, a factor of approximately 100,000 times lower than the "standard" USEPA approach. The paper also showed that this lower estimate was more consistent with epidemiological data than the "standard" approach.

In addition, toxicity values for many chemicals were estimated by groups or by structure activity relationship to similar chemicals (i.e., PAHs, PCBs). In an attempt to characterize the uncertainty in the toxicity parameters, USEPA includes uncertainty factors in RfDs and weight-of-evidence for carcinogenic effects.

Exposure Uncertainties

At the time of the writing of this HHE, only unvalidated data were available. Although it is not expected that this would appreciably affect the conclusions, it is possible that validation could either increase or decrease estimates of hazard. Since hazard assessment may be driven by a few chemicals in one medium, (i.e., PCBs and benzo(a)pyrene in the soil), and validation could eliminate individual samples or chemicals or even classes of chemicals, it is possible that the hazards may have been substantially overestimated. It is less likely, but possible, that validation could substantially increase the estimate of hazard if, for example, an incorrect dilution was assumed.

Statistically, it is impossible to characterize exactly a heterogeneous environment with a limited number of samples. For example, soil contaminant concentrations may vary by orders of magnitude over a few inches. To address these issues, USEPA guidance to use the 95% upper confidence limit of the arithmetic mean (i.e., a conservative estimate of the average) was followed, provided this did not exceed the maximum value. However, for the air pathway, where the selected samples were known to be hotspots, the average concentration was used as a conservative estimate of average emission rates. In reality this may have overestimated the average site emission rate by more than an order of magnitude, and since summer values were used to represent an annual average, further overconservatism was introduced. Finally, air exposure point concentrations were estimated using a box model which included several conservative assumptions.

The intake assumptions were selected to be consistent with the USEPA Guidance:

> *"For Superfund exposure assessments, intake variables for a given pathway should be selected so that the combination of all intake variables results in an estimate of the reasonable maximum exposure (RME) for that pathway"* (USEPA, 1989a).

However, in many cases, there are few empirical data for any real hazardous waste sites, let alone this particular landfill, to enable accurate estimates of intake assumptions. For example, an ingestion rate for soil of 200 mg/day for site security workers is likely an overestimate based on the activities required by the job and the good vegetative cover over most of the landfill. In general, some parameter estimates appear to be "high-end" such as soil ingestion rate and exposure times, frequency and duration factors and some are "mid-range" such as body weight and surface area. This makes the overall uncertainty and conservatism of the hazard estimates difficult (in fact, impossible) to estimate. If many assumptions are chosen to be "conservative", then the combination may no longer be reasonable. That is it may give an estimate of RME hazard that is beyond the level that might reasonably be expected to occur for any individual in the exposed population. There is a method to estimate the degree of uncertainty and conservatism associated with quantitative hazard estimates Monte Carlo Analysis described below. There is a regulatory basis for using Monte Carlo Analysis rather than the "second approach" used as the basis for this HHE:

> *"..., the assessor has at least two choices. First, statistical tools, such as Monte Carlo analysis, can be used to enter the values as frequency distributions which results in a frequency distribution for the lifetime average daily dose ... a second approach is to select or estimate discrete values ... This approach usually results in a less certain estimate ..."* (USEPA, 1992b).

This HHE used the "second approach" i.e., discrete values. A discussion of the use of the Monte Carlo approach is presented in the next section.

6.2.8.1 Monte Carlo Analysis

The concept of Monte Carlo Analysis is simple. Each of the intake assumptions and toxicity values that goes into estimating hazard is not estimated by a single number but by a distribution of values. For example, body weight for adult males may be estimated to be normally distributed with a geometric mean of 76.7 kg and a geometric standard deviation of 1.185 based on Brainard and Burmaster (1992) rather than the value of 70 kg usually used. A similar distribution is estimated for each intake assumption. It now remains to calculate hazard from the combination of these distributions. This is done by estimating the hazard for many (perhaps 500) different "trials". In the first trial the value for every variable is chosen randomly from each appropriate distribution and a hazard estimate is calculated. This is repeated so that 500 estimates of hazard are generated. From these estimates the 25th highest (95th percentile) would be the RME estimate. This could be done for every pathway and chemical, but for illustrative purposes only the pathway and the chemical with the highest hazard are presented here - ingestion of benzo(a)pyrene in soil.

As shown in Table 6-21, ten assumptions go into calculating the hazard for workers from ingestion of soil containing benzo(a)pyrene. The assumptions used in the estimate of default RME hazard are shown as well as the distributions used for the Monte Carlo analyses. Based on 500 trials, the 25th highest (i.e., the 95th percentile) is 2.7×10^{-7} additional lifetime hazard of cancer compared with the value of 3.4×10^{-6} calculated earlier using standard hazard assessment methods. This value (3.4×10^{-6}) is equal to the

3rd highest of the 500 trials (i.e., approximately the 99.5 percentile). The median or middle value of the 500 trials was 1.7×10^{-9} and the average 7×10^{-8}. The HHE focused only on RME hazard, not average hazard. Both will be presented in the BRA. As demonstrated in the Monte Carlo analysis, the average hazard (which is more representative of the hazard faced by the majority of the exposed population) is likely to be substantially lower than the estimate of RME hazard.

In conclusion, the Monte Carlo estimate of the 95th percentile hazard is approximately 12 times lower than that calculated using the standard RME assumptions. This factor is likely to be similar for other chemicals in soil. The Monte Carlo estimate is likely to be more representative of the true hazard than the standard RME hazard. It should be noted that the median and average hazards were estimated by the Monte Carlo Analysis to be 2,000 and (approximately) 50 times below the RME hazard estimate, respectively. In summary, the estimates of hazards presented in Section 6.2.7 are probably overestimated.

6.2.9 Summary and Conclusions

This HE evaluated potential exposure on site for landfill workers and youth trespassers to compounds found in groundwater/leachate, soil and air. This hazard evaluation does not evaluate potential future on-site or off-site exposures to residents who may later use the landfill for recreational purposes.

Twenty nine site-specific COCs were identified as potential public health concerns. Environmental data collected during the RI found landfill groundwater/leachate, soil and air to be contaminated by these COCs.

The toxicity assessment of the twenty-nine COCs included a review of the most up-to-date regulatory and toxicology computerized databases and information. This information was carefully reviewed and summarized. This information was then used to characterize the potential hazards on both a chemical-by-chemical basis, as well as the aggregated mixture of the COCs. The City of New York, including the Pelham Bay Area, is supplied drinking water via a public water supply. There are no known residential or commercial wells within a 0.5 mile radius of the landfill or on the landfill itself suitable for consumptive or domestic use. As such, no regular exposure to COCs in drinking water presently occurs.

The following potential exposure pathways associated with the landfill were identified:

- Incidental ingestion, dermal contact and inhalation of groundwater/leachate
- Incidental ingestion and dermal contact with landfill soils and inhalation of fugitive dust
- Breathing volatile emissions on the landfill

Exposures to the twenty-nine COCs were estimated using actual (but unvalidated) environmental analytical data. These data were used to estimate potential carcinogenic (cancer causing) and noncarcinogenic hazards following USEPA hazard assessment guidelines. Two current use scenarios were developed to evaluate ingestion and dermal exposures to landfill leachate and soils and the inhalation of VOCs at the landfill; exposures to individuals trespassing at the landfill and exposures to landfill workers. Conservative assumptions were used to develop these scenarios. Although access to the landfill is restricted by a fence, evidence indicates that trespassing occurs. Based on the analysis of the current exposure pathways, exposure of landfill workers to contaminated soils occurs.

In general, the noncarcinogenic hazards associated with the exposure of workers to soils on the landfill under present conditions is not expected to be a problem. The carcinogenic hazards ranged from 10^{-8} to 10^{-5} for the exposure pathways evaluated (Table 6-20). The soil exposure pathway posed the greatest potential carcinogenic hazards, with an excess cancer hazard for both workers and youth trespassers of approximately 2×10^{-5}. This hazard level is in the 10^{-4} to 10^{-6} range referenced in the National Contingency Plan (USEPA, 1990a). However, the comments in Section 6.2.8 (Uncertainty Analysis) indicate that these estimates may substantially overestimate the true risks, likely by more than a factor of 10. Calculations found in Appendix AA indicate that benzo(a)pyrene and PCBs account for the majority of the cancer hazard associated with the soil exposure pathway.

The excess cancer hazards for all other exposure pathways are in the acceptable hazard range (i.e., below 10^{-6}) established by the USEPA. The potential cumulative multiple exposure pathway carcinogenic hazards are presented in Table 6-20.

In conclusion, based on the exposure pathways presented in this HHE, the only current use exposure pathway which may pose a potential long-term health concern is the exposure of landfill workers and youth trespassers to contaminated soils. Noncarcinogenic health hazards are not expected to occur.

6.3 ECOLOGICAL HAZARD EVALUATION

The following Ecological Hazard Evaluation (EHE) is analogous to a preliminary ecological risk assessment (ERA). It is considered a preliminary assessment for the following reasons: 1) the chemical analytical data for abiotic and biological media used in the evaluation were not validated at the time that the EHE was performed, and 2) the evaluation focuses on the on-site ecological risks only. A complete ERA will be incorporated into the Pelham Bay BRA report. Like the Human Health Risk Assessment to be included in that report, the ERA will utilize validated data and consider both on-site and off-site ecological risks.

Like risk assessment, the EHE is a process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more chemical stressors. The process of evaluating ecological hazards generally involves four steps: 1) problem formulation, 2) exposure assessment, 3) ecological effects assessment, and 4) hazard characterization (USEPA, 1992a). The presentation of data compiled in completing these steps generally follows an outline developed by USEPA and discussed in its ecological risk assessment guidance manual (USEPA, 1989a). The outline consists of the following:

- Site characterization
- Selection of ecological endpoints of concern and key receptor species
- Selection of the chemicals of concern (COCs)
- Exposure assessment
- Ecological hazard evaluation

As stated above, this EHE is focused on the hazards directly associated with on-site chemicals. Therefore, chemicals are selected as COCs only if they have been detected in either the on-site groundwater/leachate or soils. However, chemical data from Eastchester Bay surface water, sediment, and fish/shellfish tissues also are presented because of the interdependence and complexity of the estuarine ecosystem.

Two ecosystems are evaluated in this EHE, the terrestrial ecosystem supported by on-site soils and the estuarine ecosystem. The estuarine ecosystem is considered onsite because of the fact that estuarine tidal waters cover the rip-rap toe of the landfill at high tide. The intertidal zone that exists between the high tide elevation and the landfill's toe is a habitat for various aquatic species as well as their predators. A third ecosystem, tidal wetlands (which occur adjacent to the landfill's northwest border, and on the north side of Pelham Bay Parkway) will be evaluated as part of the ERA. However, the initial selection of key receptors and ecological COCs for the tidal wetlands are included in Sections 6.3.3.2 of this on-site EHE, as this information was available at the time that this section was being prepared.

The following sections present information pertinent to each of the above elements concerning the Pelham Bay Landfill.

6.3.1 Site Characterization

Detailed physical and biological descriptions of the Pelham Bay Landfill and surrounding areas are discussed in Section 3.0 of this RI report. In summary, the landfill is located adjacent to Eastchester Bay at the western end of the Long Island Sound estuary. Upland areas associated with Pelham Bay Park adjoin the site to the west. The landfill itself is covered by upland vegetation typical of a disturbed site. The species growing on the landfill are early successional species. Herbaceous vegetation dominates the area, with common reed and mugwort being the most common and, in some areas, forming monotypic stands. Small trees are scattered over the site, with the most common species being the eastern cottonwood.

Several small areas adjacent to the seawall contain plant species which are usually associated with estuarine wetlands: Saltmarsh cordgrass, glasswort, sea lavender, and seaside goldenrod. These and other estuarine wetland species occur over large intertidal areas (several hundred acres).

Adjacent to the Hutchinson River along its east shore are wetlands known as the Pelham Bay Park Wetlands which NYSDEC considers a "significant coastal fish and wildlife habitat."

6.3.1.1 Potentially Exposed Habitats and Species

Due to the diversity of vegetation cover types present and the site's proximity to Eastchester Bay, a wide variety of fish and wildlife species have the potential to occur in the site vicinity. Following guidance provided by NYSDEC (1991), a habitat map for the 0.5 mile radius area around the site is presented as Figure 3-46. Wetlands within 2 miles of the site are shown in Figure 3-47. Species lists based on data complied by the NYCDPR (1987) and the observation by WCCI biologists are also presented in Section 3.0.

The ecological data presented in Section 3.0 were evaluated to determine the potential for the exposure of habitats and species to chemicals detected in the various media sampled as presented in Section 4.0 via the transport mechanisms discussed in Section 5.0. As a first priority, the potential for exposure of special concern species was evaluated.

An ecological conceptual site model (ECSM) was then developed and key receptors and food webs were identified. Summary information relating to special concern species is presented in the following section. Detailed discussions relating to the CSM, key receptors, food webs, and other elements of the EHE are also presented in following sections.

6.3.1.2 Special Concern Habitats and Species

6.3.1.2.1 Special Concern Habitats

Information related to significant habitats was obtained from NYSDEC Natural Heritage Program and Significant Habitat Unit. Significant Habitat Unit maps show the Pelham Bay Park wetlands (area SW03-001), which are across the bay from Pelham Bay Landfill and extend up into the Hutchinson River north to I-95, as a significant coastal fish and wildlife habitat. The fish and wildlife habitat encompasses two major coastal wetland areas within the park - an approximately 475-acre high-salt marsh, intertidal marsh, and salt flats associated with the eastern shore of the Upper Eastchester Bay and Hutchinson River; and the Lagoon, an approximately 275-acre narrow bay and wetland complex located around Hunter Island. The area around City Island (area SW-03-002) is also listed as a significant habitat as it provides a waterfowl wintering area of approximately 2,188 acres.

Approximately four miles southeast of the landfill, the Throgs Neck Bridge (area SW 41-017) has been listed as a significant habitat due to the presence of a pair of nesting peregrine falcons (endangered) which has nested at the site since 1983 (Nadareski and Loucks, 1992). Also, approximately 4 miles southeast of the landfill, Little Neck Bay, Queens (area SW 41-500) is listed as one of the five most important waterfowl wintering areas on the north shore of Long Island. It is also a productive area for marine finfish and shellfish. SW 41-500 also includes an area known as Udalls Cove, located at the southeastern end of Little Neck Bay at North Hempstead. The habitat includes tidal shallows and salt marsh, and adjoining undeveloped upland areas including Udalls Cove Ravine. Approximately 3.5 miles west of Little Neck Bay, in the East River, Powell Cove (area SW 41-012) is a shallow sheltered area of subtidal aquatic beds used by wintering waterfowl.

6.3.1.2.2 Special Concern Species

Information on New York State threatened and endangered species was also obtained from the NYSDEC Natural Heritage Program. The Natural Heritage Program Database lists the following threatened, endangered, or rare plant species as occurring within 2 miles of the site. All are located across the Eastchester Bay at various locations within the Pelham Bay Park: endangered, globose flatsedge; threatened, purple milkweed; rare, persimmon winfed monkey flower, and the sedge *Carex bushii.*

No threatened or endangered animals have been listed by the NYSDEC Nature Heritage Program as occurring within a 2 mile radius of the site, however the common barn owl is listed as a "Protected-Special Concern" species occurring within the two mile radius.

Although not listed in the Natural Heritage Program Database, other bird species listed by either New York State and/or the U.S. Department of Interior as endangered (E), threatened (T), or of special concern (SC) status are identified as occurring in the vicinity of the site. (NYCDPR, 1987). These species are listed in Section 3.7.5.2. Many of the listed species are birds that are either migrants or infrequently occur. The exceptions are the New York State listed diamondback terrapin (SC), a reptile that occurs in the Pelham Bay Park wetlands; and the red-shouldered hawk (T), northern harrier (T), common loon (SC), Cooper's hawk (SC), short-eared owl (SC), common nighthawk (SC), and vesper sparrow (SC)—all bird species that are considered part-year residents (winter or summer). Additional New York State listed species observed by WCCI biologists in the site vicinity are the osprey (T) and common tern (T).

6.3.2 Ecological Conceptual Site Model (ECSM)

Information concerning potential chemical sources and releases (Section 1), the ecology of the site (Section 3), the results of WCCI sampling and analyses (Section 4) and transport mechanisms (Section 5) was used to develop an ECSM for the Pelham Bay Landfill. The ECSM is a schematic representation of exposure pathways from the chemical source media through potential intake routes to potential receptors. An exposure pathway requires five basic elements:

- A source of chemicals (e.g., groundwater/leachate)
- A mechanism of chemical release (e.g., percolation, contact)
- An environmental transport medium (e.g., surface water, sediment)
- An exposure point where receptors are present
- An intake route (e.g., ingestion, direct contact)

All five of these elements must be present for an exposure pathway to be complete. If one of them is missing, the pathway is not complete and ecological exposure cannot occur. Only pathways considered complete based on the data reviewed and the assumptions described in this section and the exposure evaluation (Section 6.3.6.1) are addressed in this hazard evaluation.

Prior to development of the ECSM for the Pelham Landfill, a preliminary exposure matrix (Table 6-22) was developed to identify potentially complete pathways from the source to general receptor categories in the estuarine and wetland ecosystems at the Pelham Bay Landfill site. An "X" placed at the intersection of each pathway and receptor category indicates a potentially complete chemical pathway. It is important to note that there are potentially complete pathways extending from groundwater/leachate to estuarine and terrestrial receptors. This is due to the food habits of both groups of receptors and the periodic exposure of prey organisms residing within the intertidal zone that exists between the toe of the landfill and the mean high water elevation.

The trophic relationships represented by the general receptor categories in Table 6-22 are shown in the terrestrial, tidal wetland, and estuarine food web diagrams (Figures 6-2 through 6-3). Because actual food webs are very complex, these three food webs have been simplified to clarify the movement of food and chemicals from the primary producers up through the various consumer levels. For example, in the estuarine food web (Figure 6-4) the trophic level of many estuarine organisms such as crabs and fish changes as the organisms mature, increase in size, and change their food habits. Many estuarine organisms are scavengers and opportunistic eaters — they will eat virtually anything that fits into their mouths. Because of this food habit and the existence of multiple potential food pathways in the web, the higher consumers occupy a range of trophic levels. In addition to the typical movement of food up through the web, detritus (i.e., partially decomposed plant and animal tissue) is an important food item for crabs, some fish, and other scavengers. Detrital material that is not eaten by these animals is decomposed by bacteria, thus returning basic nutrients to the environmental media.

Based on the estuarine, terrestrial, and tidal wetland food web diagrams and the preliminary exposure matrix, a detailed ECSM (Figure 6-5) was developed to identify principal exposure pathways from chemical sources to ecological receptors within the estuarine and terrestrial ecosystems. While most of the basic components of the estuarine and terrestrial ecosystems are similar (i.e., primary producers, primary consumers, and higher consumers), the specific receptor organisms that comprise the various trophic levels are different. In both the estuarine and terrestrial ecosystem scenarios, the volatilization/inhalation pathway (which could include landfill vapors, spray from waterfowl landing, or mist created during windy conditions) was not included in this ECSM as it was considered relatively insignificant compared to the direct contact or ingestion pathways.

6.3.2.1 Estuarine Ecosystem

As illustrated in the ECSM, the principal environmental transport media where exposure occurs in the estuarine ecosystem are the groundwater/leachate, surface water, and sediments. The principal receptor groups in the estuarine ecosystem are the benthic invertebrates (mussels, clams, polychaetes, and other infauna), pelagic invertebrates (shrimp, copepods, and other crustaceans), forage fish (Atlantic silverside, mummichog), crabs (blue crab, lady crab, green crab), and predatory fish (flounder, bluefish, tautog). All of these estuarine receptors are potentially exposed to chemicals through direct contact and/or ingestion of bay sediments and surface water. Because the groundwater/leachate directly affects only a limited area adjacent to the landfill, only limited numbers of estuarine organisms are potentially exposed to undiluted groundwater/leachate.

A number of avian species and predatory terrestrial mammals also are principal receptors in the estuarine ecosystem. Winter ducks such as scaup, merganser, and bufflehead and wading birds, such as great blue herons and great and snowy egrets, potentially contact source chemicals through both direct and indirect food web pathways. Predatory birds, such as the osprey, which largely feed on fish, and the peregrine falcon, which largely feeds on waterfowl, are included in the estuarine ecosystem CSM based on their food habits and potential presence at the site.

6.3.2.2 Terrestrial Ecosystem

The terrestrial ecosystem includes wetland and upland habitats. The principal environmental media in the terrestrial ecosystem are soils and groundwater/leachate, which may be affecting wetland surface water and sediments. These environmental transport media are termed secondary and tertiary sources in Figure 6-5. The terrestrial ecosystem exposure pathway, which is shown in the lower half of Figure 6-5, is based on the release of chemicals from the landfill to two environmental media: surface soils and groundwater/leachate. Receptors principally contact chemicals from the soils through either direct uptake (vegetation), direct contact (soil invertebrates), direct ingestion (small mammals and small birds), and through indirect ingestion (predatory birds and mammals). A potential exposure pathway also is shown in the ECSM for chemicals in groundwater to be discharged to wetland (i.e., marshland) surface water and sediments such as that found near the northwest landfill boundary. Small birds, waterfowl, wading birds, and predatory birds and mammals are the likely primary receptor categories in the wetland ecosystem.

6.3.3 Identification of Ecological Endpoints and Key Receptor Species

Key receptors, the specific species within ecosystems that may be adversely affected by a pollutant, are selected and described in Section 6.3.3.2. Ecological endpoints, which include both assessment endpoints and measurement endpoints, are described in Section 6.3.3.1.

6.3.3.1 Ecological Endpoints

To put this discussion into perspective, some definitions of the biological world as seen by ecologists are needed. Ecologists view the world on several interrelated levels of organization. Populations are composed of individual organisms of related species. Communities are groups of populations. Ecosystems are communities and the physical and chemical habitat in which they live and interact (Suter, 1993).

An ecological endpoint is a characteristic of an ecological component (e.g., population, community) that may be affected by exposure to a contaminant or stressor (Suter, 1990). Two types of endpoints are used in hazard evaluations (i.e., risk assessments): assessment endpoints and measurement endpoints. Assessment endpoints are formal expressions of the environmental values to be protected (Suter, 1989) and generally refer to characteristics of populations and ecosystems defined over rather large scales (Suter, 1993). Measurement endpoints are measurable responses to a contaminant that are related to the valued characteristics (i.e., assessment endpoints) chosen to be evaluated in a risk assessment. If an assessment endpoint can be directly measured, then the assessment and measurement endpoints are the same (USEPA, 1992a). However, because assessment endpoints typically cannot be directly measured, measurement endpoints are selected that can be related to the assessment endpoint.

Assessment and measurement endpoints may include components from any level of the biological organization. However, because the complexity of interactions among ecological components and the physical habitat increases with each higher level, the effects of contaminants can be more clearly measured at the population or species level than at the community or ecosystem levels.

A number of assessment and measurement endpoints were considered for use in this EHE. The two primary assessment endpoints considered were 1) potential toxic impacts to biotic populations, and individuals if endangered or threatened, on or adjacent to the landfill (e.g., forage fish, invertebrates, game fish, birds, small mammals) and 2) toxic effects on the Eastchester Bay benthic invertebrate community. The corresponding measurement endpoints for the first assessment endpoint are 1) lethal or toxic responses for species of interest or their surrogates, 2) bioassays of sediments (especially elutriate tests), and 3) field observations of potentially affected populations on and adjacent to the landfill. The measurement endpoints related to the second assessment endpoint are

1) bioassays of sediments, and 2) sampling and analysis of the benthic invertebrate community.

For the purpose of this EHE, which is limited to on-site effects, only the first assessment endpoint (adverse effects to on-site populations or individuals of special concern) is used in the hazard evaluation. Actual measurement endpoints were not selected for the EHE due to the large number of COCs and diverse types of chemical-specific responses that may be expected. Instead, the lowest reasonable toxic or lethal doses, or dietary chemical concentrations as reported in the literature were used as estimated toxic thresholds to assess potential adverse effects to populations or individuals of concern.

6.3.3.2 Key Receptors

The selection of key receptors is based on several criteria, some which require professional judgements (e.g., identifying key components within a food web) and some which are objective (e.g., listing as a special concern species). For this EHE, selection of key receptor species or taxa included consideration of the following criteria:

- Known occurrence in the vicinity of the Pelham Bay Landfill
- Potential or documented exposure to site-related chemicals
- Availability of toxicological information for the species or a surrogate species (e.g., mallard as a surrogate species for ducks)
- Documented sensitivity to preliminary COCs
- Listing as a threatened, endangered or special concern species by the federal or state government
- Game species or commercially important species
- A key component within one of the food webs (e.g., an abundant prey organism for other important species)
- Limited mobility or home range that limits exposure to other sources of chemicals

Additional characteristics that may be used in the selection of key receptors include habitat preferences, food preferences, and other behavioral characteristics that can significantly affect the potential for exposure or determine population size and distribution in the area of the landfill.

Based on the information provided in the initial sections of the EHE, in Section 3.10 (site habitats and species, special concern species) and species or taxa illustrated in the food webs and the ECSM, a species selection matrix was developed matrix (Table 6-23). This matrix presents the selection criteria listed above for each of the three ecosystems (i.e., estuarine, terrestrial, and tidal wetland) and the receptor species categories from the ECSM (Figure 6-5). In the table, three of the selection criteria (known occurrence, potential exposure, and key component in the food web) are unique for each ecosystem, while the remaining five criteria are independent of the ecosystem. Applicability of the criteria to receptors is shown by a filled-in circle. An open circle indicates that the criteria are either not met or their applicability is unknown. The last row under each ecosystem indicates whether or not a species within the receptor category was selected as a key receptor.

6.3.3.2.1 Terrestrial Ecosystem

In the terrestrial ecosystem, three receptor categories and four key receptor species were selected:

Receptor Category	Species
Small mammals	White-footed mouse (*Peromyscus leucopus*)
Small birds	American robin (*Turdus migratorius*)
Game birds	Ring-necked pheasant (*Phasianus colchicus*)
Predatory birds	Red-tailed hawk (*Buteo jamaicensis*)

The principal reasons for selecting these species as receptors are shown in Table 6-23 and in the terrestrial food web (Figure 6-2). The white-footed mouse fulfills a key role in the terrestrial ecosystem. The mouse is omnivorous and eats large insects, caterpillars, cocoons, snails, centipedes, and earthworms, as well as seeds, fruits, and roots (Martin *et al.*, 1951). Small mammals such as the white-footed mouse or shrew (*Sorex* spp.), whose diets contain ground-dwelling invertebrates or detritivores, are more likely to accumulate higher levels of contaminants, such as metals, than herbivorous species (Hunter *et al.*, 1989). Because of its ground-dwelling habit, the mouse is likely to directly ingest soil on a frequent basis. The mouse very likely occurs on the landfill, although the existence and identity of small mammals on the landfill has not been confirmed. The American robin and ring-necked pheasant are frequently seen on the landfill. The robin feeds primarily on the ground, searching for and eating almost anything edible (e.g., insects, spiders, earthworms, fruits, berries) (Pearson, 1936; USFS, 1991). The ring-necked pheasant feeds primarily on plant foods, including grasses, seeds, and soft parts of herbaceous vegetation; it also eats insects, snakes, and mice (USFS, 1991).

Raptors, which feed upon small mammals and birds, waterfowl, and shorebirds that may be exposed to chemicals, also were determined to be a critical group of key receptors. The peregrine falcon, a state and federal endangered species that nests 4 miles southeast of the site on the Throgs Neck Bridge, was not chosen as a key receptor because it is not expected to be found at the landfill site. Over the past 10 years, the pair that nests on the bridge was never seen taking waterfowl as prey, and they were seldom seen more than 1 mile from the bridge (Frank S., Personal communication 1992; Loucks B., NYSDEC, Personal communication, 1992). The red-tailed hawk was chosen as a key receptor species because it has been observed nesting within 1 mile of the landfill and carrying a rat that it captured on the landfill (Frank S., Personal communication, 1992). The red-tailed hawk prefers small mammals but will eat small birds, insects, and carrion (Pearson, 1936; USFS, 1991).

6.3.3.2.2 Tidal Wetland Ecosystem

In the tidal wetland ecosystem (Figure 6-3), four receptor categories and key receptor species were selected:

Receptor Category	Species
Forage fish	Mummichog (*Fundulus heteroclitus*)
Waterfowl	Mallard (*Anas platyrhynchos*)
Wading birds	Great blue heron (*Ardea herodias*)
Predatory birds	Northern harrier (*Circus cyaneus*)

Selection of these four species was based on satisfaction of the selection criteria as shown in Table 6-23. The mummichog, a species that has a limited home range, is a likely key component in the tidal wetland ecosystem. It is omnivorous, feeding on invertebrates, vegetation, and decaying organisms (Bigelow and Schroeder, 1953). The mummichog is, in turn, a prey species for wading birds, predatory mammals, and larger fish. The mallard feeds by dabbling in shallow waters of ponds and wetlands and by grazing in meadows and fields. It eats snails, algae, mollusks, fish, and fish eggs in addition to seeds, acorns, and waste grains (Pearson, 1936; USFS, 1991). The great blue heron is frequently seen in the vicinity of the landfill. It feeds by wading in shallow water, often near the shoreline, where it stands motionless waiting for prey to come within striking distance. The heron eats small fish, crabs, and also small terrestrial prey organisms such as mice, voles, and rats (Terres, 1991). The northern harrier is thought to be the top predator in the tidal wetland ecosystem. Based on information provided in Pearson (1936) and USFS (1991), the northern harrier diet consists almost exclusively of small birds that are prey organisms found in the wetland (e.g., red-winged blackbirds, mallard ducklings) and small mammals.

6.3.3.2.3 Estuarine Ecosystem

Within the estuarine ecosystem, six receptor categories were selected. They are: bivalve mollusks, forage fish, crabs, carnivorous fish, waterfowl, and predatory birds. The following key receptor species were chosen to represent each of the six categories:

Receptor Category	Species
Bivalve mollusks	Blue mussel (*Mytilus edulis*)
Forage fish	Atlantic silverside (*Menidia menidia*)
Crabs	Blue crab (*Callinectes sapidus*)
Carnivorous fish	Summer flounder (*Paralichthys dentatus*)
Omnivorous fish	American eel (*Anguilla rostrota*)
Waterfowl/Wading Birds	Common merganser (*Mergus merganser*)
Predatory birds	Osprey (*Pandion haliaetus*)

As shown in Table 6-23, all of the selected key receptor species are known to occur in the vicinity of the landfill and have the potential to be in contact with COCs. Some of the selected species are game or commercially important species.

Tissues for four of the selected species (blue mussel, Atlantic silverside, blue crab, and summer flounder) were analyzed for selected potential COCs during 1992 (see Section 4); results of the analyses will be used to confirm exposure to site-related chemicals. The blue mussel was selected as a key receptor species for two reasons: 1) it is attached to the intertidal substrate along the toe of the landfill and thus may be in regular contact with COCs, and 2) it is considered to be a key component in the estuarine food web (Figure 6-4).

The Atlantic silverside was selected because as a forage species, it is a key component in the food web. It has omnivorous feeding habits and is, in turn, a prey species for most of the predatory fish species that come close to shore (Bigelow and Schroeder, 1953). It is not attached (i.e., sessile) like the blue mussel, but it does remain close to the shoreline in the littoral habitat and at high tide would potentially be in contact with site-related chemicals.

The blue crab and summer flounder were selected because they are recreationally important species in the area and also are considered key components of the estuarine food web. However, summer flounder make offshore migrations, where they reside during the winter and early spring months (Bigelow and Schroeder, 1953). Therefore they would not be exposed to landfill derived COCs during those months. Blue crabs also make seasonal migrations, but most males remain in estuarine areas and probably overwinter there. Females, on the other hand, migrate to deeper and higher salinity estuarine and coastal spawning areas. Therefore, males would potentially be exposed to landfill derived COCs for a longer period of time (WCCI sampling of blue crabs for tissue analysis targeted male blue crabs).

The American eel was selected because it is carnivorous and not as migratory as summer flounder, usually residing within a home range that encompasses a harbor or embayment (Chytalo, 1993).

The common merganser, a diving duck commonly found in the waters of Eastchester Bay during winter, was selected as a key receptor representing waterfowl and wading birds in the estuarine ecosystem because it is the ultimate consumer of fish and benthic invertebrates (Bent, 1987), occurs at the site in large numbers and is a key part of the food web. Young waterfowl and wading birds may also serve as prey organisms for higher trophic level receptors, such as raptors or large predatory mammals.

The osprey was selected as a key receptor because it is one of the top predators in the estuarine ecosystem and was observed feeding at the site in late summer on fish captured from Eastchester Bay. As reported in Terres (1991) and USFS (1991), the osprey eats fish almost exclusively.

6.3.4 Selection of Ecological Chemicals of Concern

Ecological COCs are compounds that are likely to be released from the Pelham Bay Landfill and may pose risk to ecological receptors. The process of identifying ecological COCs for evaluation in this EHE is discussed in the following sections. The process involved evaluating the concentration of each analyte against screening criteria appropriate for each environmental matrix to separate chemicals (and their concentrations) considered normal or background to the area from chemicals that might have been released from the landfill. While only the surface soil and groundwater/leachate hazards were evaluated in this onsite EHE, the selection process was also completed (and is presented herein) for surface water and sediment in preparation for the offsite evaluation to be presented in the BRA.

6.3.4.1 Approach

Unvalidated data from four environmental media (groundwater/leachate, soil, surface water, and sediment) were considered in the selection of ecological COCs. Samples of the media used to determine the COCs were collected during WCCI's 1992 investigation. To be considered as a COC, a chemical must be detected in the on-site matrices of groundwater/leachate or soil. Additional screening was then applied to determine if a chemical found in one of these on-site media or in off-site sediments or surface water would be retained as a COC. As stated previously, the selections of ecological COCs for these off-site media is incorporated into this EHE even though no hazard evaluation is presented. This off-site evaluation well be incorporated into the Supplemental RI Report.

Groundwater/leachate and soil are considered to be on-site matrices for the purpose of the EHE because they originate from within the landfill. Biota potentially could directly contact groundwater/leachate at the surface water interface or above the water among the riprap.

Selected groundwater/leachate data were compiled from unvalidated data representing 15 wells (MW-103, -104, -105, -106, -109, -111, -112, -113, -114, -115, -118, -119, -120, -121, and -122) and seven seeps (LS-1, -3, -4, -5, -7, -9, and -10). The data from seep LS-2 were not evaluated for the estuarine ecosystem because this leachate location is on the upland portion of the landfill and is unlikely to affect the estuarine ecosystem.

To facilitate screening of the analytes, the environmental data were reviewed and compiled into medium-specific data bases. As in the HHHE, results of duplicate samples from these locations were not included in the data bases because they were not from additional discrete samples. Also, tentatively identified compounds (TICs) were not included in the data set used in this initial COC selection process.

Data from surface water and sediment station SW-9/SED-9 were compiled and analyzed separately from other surface water and sediment data. Results of dye and current studies conducted by WCCI in 1992 indicated that this location is not significantly influenced by groundwater/leachate from the landfill. Therefore, this station was considered a reference station for the purpose of this assessment.

The following sections describe the ecological COC selection process used in each of the three site ecosystems that were evaluated: the upland habitat of the site itself, tidal wetlands along Eastchester Bay, and the estuarine habitat that adjoins the landfill site.

6.3.4.2 Ecological Chemical of Concern Selection Process - Terrestrial and Wetland Ecosystems

The selection of ecological COCs is described below for two terrestrial habitats - uplands and tidal wetlands.

6.3.4.2.1 Uplands

The soils of the upland areas of the site represent a pathway leading to the various terrestrial wildlife that frequent the area. The following criteria were used for the preliminary selection of ecological COCs in surficial soils at the Pelham Bay landfill:

- Presence of chemicals in blanks
- Exceedance of background concentrations as represented by one soil boring (0 to 1-ft) from reference station MW-124 S1
- Exceedance of NYSDEC recommended soil cleanup objectives and cleanup levels (NYSDEC, 1992a)
- Exceedance of Eastern USA soil background concentrations (NYSDEC, 1992b

- Exceedance of USEPA human health risk based criteria (NYSDEC, 1992b)
- Potential for chemical to transfer through food chains and bioaccumulate

Landfill soil concentrations were initially compared to soil concentrations from one soil boring (0 to 1-ft interval) at reference station MW-124 S1 (Table 6-24). Landfill soil concentrations were based on combined data from seven surficial scrapes (Table 6-25); six samples from the 0- to 0.5-ft interval, two samples from a 0- to 1-ft interval, and two samples from a 0- to 2-ft interval (Table 6-26). Organic chemicals were retained as potential ecological COCs if the mean and reasonable maximum exposure (RME) values were both greater than the reference station concentration. The RME concentration is the lesser of either the maximum detected concentration and the 95th percentile upper confidence limit (UCL) of the mean. The term RME as used in the ecological COC selection process only refers to the chemical concentration and does not include other exposure factors such as exposure duration. Metals were retained as potential ecological COCs if the mean and RME values were both 1.5 times greater than the reference station concentration. The 1.5 factor was used to account for the limited number of background samples available and the natural variability of metals concentrations in soils.

All of the organic chemical concentrations exceed reference station values; however, most are below NYSDEC soil cleanup objectives. NYSDEC soil cleanup objectives are primarily based on the protection of groundwater quality rather than protection of human health. Criteria that are based on protection of human health rather than groundwater quality are indicated with an asterisk in Table 6-24. Chemicals that exceed the soil cleanup objective but are below the human health based criteria are not considered to pose a risk to wildlife if they are also unlikely to bioaccumulate. The following organic chemicals were retained as ecological COCs because the mean and RME concentrations exceeded both the NYSDEC cleanup objectives and USEPA health-based criteria:

benzo(a)anthracene
benzo(a)pyrene
chrysene
n-nitrosodi-n-propylamine (retained for initial consideration as no standard is available)

Although none of the pesticide, PCB, or dibenzofuran concentrations exceed NYSDEC soil cleanup objectives, these chemicals were retained as potential ecological COCs for the terrestrial ecosystem due to their potential to transfer through food chains and bioaccumulate in upper trophic level organisms.

Although the 2,4,5-trichlorophenol arithmetic mean (1,260 μg/kg) and RME (130 μg/kg) concentrations exceed the NYSDEC cleanup criteria (100 μg/kg), this chemical was not retained as a potential ecological COC because the mean and RME concentrations are more than three orders of magnitude below the conservative human health criterion of 8,000 mg/kg. This chemical also is not likely to bioaccumulate (low Log P value) and therefore is not considered likely to pose a risk to wildlife through either direct ingestion or bioaccumulation.

Most metals were eliminated from further consideration as an ecological COC because their means and RME values are below reference station concentrations. The following five metals have mean and RME values that are 1.5 times greater than the reference station concentration: barium, copper, lead, magnesium and zinc.

Barium and copper were eliminated as ecological COCs based on a comparison with NYSDEC recommended cleanup levels and eastern USA background concentrations. Barium was eliminated because its concentration is below the soil cleanup criterion. Although mean and RME copper values exceed reference station and NYSDEC values, copper was eliminated as an ecological COC because its mean value fell within the background range for copper in eastern USA soils (NYSDEC, 1992b). RME and mean values for magnesium also exceed the reference station value and the background range for eastern soils. However, magnesium was eliminated from further consideration, because it is an essential nutrient and unlikely to be toxic at the reported concentrations. Lead and zinc were retained as ecological COCs in soil, based on their exceedance of all three screening criteria.

Two metals, mercury and nickel, were retained as ecological COCs, even though their mean concentrations were less than 1.5 times the reference station concentrations. Mercury was retained because 1) the mean and RME values exceed both the NYSDEC soil cleanup criterion and the background range for eastern soils and 2) mercury may potentially bioaccumulate in terrestrial ecosystems. Nickel also was retained because the mean and RME values exceed the NYSDEC soil cleanup objective criterion and eastern USA background concentration range for metals in soil.

As a result of the preceding screen, the following chemicals were retained as ecological COCs in soil for the terrestrial ecosystem:

Organics

benzo(a)anthracene
benzo(a)pyrene
chrysene
n-nitrosodi-n-propylamine

Pesticides/PCBs/Furans

4,4'-DDD
4,4'-DDE
4,4'-DDT
alpha-chlordane
delta-BHC
dibenzofuran
dieldrin
endosulfan sulfate
gamma-chlordane
methoxychlor
PCB-1254
PCB-1260

Metals

lead
mercury
nickel
zinc

6.3.4.2.2 Tidal Wetlands

As shown in the ECSM and described in Section 6.3.2, tidal wetland habitats along Eastchester Bay also may be affected by the movement of groundwater/leachate from the landfill. Well MW-125 is located between the landfill and the tidal wetland nearest to the site. The analysis of groundwater/leachate from this well (Table 6-27) provides an indication of the potential concentrations of chemicals moving toward this wetland. If the data representing MW-125 are compared to blank results, seven chemicals (two organics and five metals) detected at MW-125 can be deleted from further consideration (as shown by a "D" on Table 6-28). Of the remaining chemicals detected at MW-125, only nickel exceeds marine surface water standards and is retained as a COC. Six chemicals (aluminum, barium, iron, magnesium, manganese, and vanadium) have no standards and also are retained.

The following chemicals do not exceed standards and are deleted from consideration as groundwater/leachate COCs potentially affecting the wetland west of the landfill:

Chlorobenzene
Antimony
Arsenic
Cadmium
Chromium

6.3.4.3 Chemical of Concern Selection Process - Estuarine Ecosystem

The following seven criteria were used to screen the Pelham Bay Landfill data to select ecological COCs for each matrix in the estuarine habitat:

- Detection in at least one sample above the method or instrument detection limit
- Absence of chemicals in blanks
- Exceedance of environmental benchmarks
- Frequency of detection and estimated value
- Exceedance of reference station concentrations
- Exceedance of Western Long Island Sound (WLIS) concentrations
- Exceedance of typical seawater/estuarine constituent concentrations

These criteria are described below, and their application in the screening process is illustrated in a flow diagram (Figure 6-6) and in Sections 6.3.4.3 through 6.3.4.10.

- Detection in at Least One Sample

  To be selected from the full list of analytes for inclusion in the ecological COC screening process, a chemical has to be detected at least once at a level greater than its method detection limit (MDL) or instrument detection limit (IDL) in at least one of the matrices. Chemicals are included that have concentrations between their IDL and contract-required detection limit (CRDL) and were therefore estimated (i.e., "J" qualified) in addition to those that are above the CRDL and are not qualified. See Section 6.2.1.2.1 for an explanation of data qualifiers.

- Chemicals not Detected in Blanks

  Based on EPA guidance (USEPA, 1989b), if a sample contains a chemical also present in a sampling (trip or field) or laboratory blank, the sample is considered positive only if it contains ten times more than the amount in the blank for common laboratory contaminants (i.e., acetone, 2-butanone, methylene chloride, toluene, and phthalate esters) or five times more than the amount in the blank for other chemicals. To determine if a chemical can be eliminated from further consideration, results of trip, field, and laboratory blank analyses are reviewed for detected levels of chemicals. A site sample organic analysis that is qualified with a "B" indicates that the chemical was found in the associated laboratory blank as well as in the sample. In these instances, the concentration in the blank is defined as the reporting limit for the sample and the sample is considered a "non-detect" at that reporting limit.

- Regulatory Standards or Environmental Benchmarks

  Chemicals are retained as ecological COCs if their reasonable maximum exposure (RME) concentrations exceed appropriate state or federal regulatory standards or environmental benchmarks for a specific matrix.

As shown in Figure 6-6, chemicals that exceed standards, as well as those for which there are no available regulatory standards or other environmental benchmarks, are retained as ecological COCs for further screening. Although it is assumed that chemicals not having standards typically do not represent a significant risk to the receptor species, they are retained at this step in the screening to permit a pathway's evaluation among the various environmental media. Also, toxicity, bioconcentration, and tissue residue data for those chemicals without standards generally are much less available for use in assessing risk than for chemicals having environmental standards or criteria.

- Frequency of Detection and Estimated Value

When a chemical is retained as an ecological COC because there is no available standard, the analyte is then examined to determine its frequency of detection in the matrix (Figure 6-6). To be retained, the analyte must be detected in more than five percent of each of the matrix samples (and at least once at a concentration above its MDL or IDL). Chemicals are eliminated that are detected in five percent or fewer of the samples and are detected only at estimated levels below the CRDL (i.e., "J"-qualified). Such chemicals are not thought to represent significant ecological risk to the ecological receptors.

This ecological COC selection criteria can be applied only to the groundwater/leachate and sediment sample data sets because the other matrices sampled in 1992 (surface water and soils) do not have more than 20 samples, the number required to eliminate chemicals based on frequency of detection.

- Reference Station Concentrations

When a chemical is retained because it exceeds an environmental benchmark or no benchmark is available and the chemical is detected in more than five percent of the matrix samples, it is then compared to concentrations detected in the reference stations (SW-9 for water samples and SD-9 for sediments). If the chemical's RME concentration exceeds the mean reference station concentration, it is retained for further screening.

- <u>Western Long Island Sound (WLIS) Concentrations</u>

  If a chemical in surface water or sediment is retained because it exceeds the reference station concentration, it is then compared to the results from other environmental studies in WLIS. For the purpose of this screening, when the Pelham Bay RME exceeds the mean WLIS concentration, the chemical is retained for the next ecological COC screening step.

- <u>Identification of the Chemical as a Natural Seawater/Estuarine Element</u>

  Many inorganic elements such as aluminum, barium, boron, sodium, and potassium are found in seawater unaffected by human activities. Because they are naturally occurring, they typically are not included in environmental studies. When data from WLIS for these elements are not available for comparison, the data are compared to naturally occurring seawater concentrations that are adjusted to account for the reduced salinity in estuarine waters of WLIS (11 to 26 parts per thousand). If the RME concentration exceeds the naturally occurring range of concentrations, the element is retained as an ecological COC. Several of these elements are generally considered to be essential trace elements for biota.

6.3.4.3.1 Detection Above MDL or IDL in at Least One Sample

Summaries of all organic compounds and metals that were detected at least once during the 1992 sampling above their respective MDLs or IDLs in surface water, sediments, and groundwater/leachate are shown in Tables 6-28 through 6-30, respectively. Also presented are the environmental standards and benchmarks, which are explained in Section 6.3.4.3.3. Chemicals that were not detected above their MDLs or IDLs are not shown in these summary tables; however, the results of all analyses are listed in Appendix V.

6.3.4.3.2 Presence of Chemicals in Blanks

To determine which chemicals, if any, can be deleted as ecological COCs because they were detected in the field or laboratory blanks, the blank analysis results were sorted according to matrix, concentrations multiplied by 10 (for common laboratory contaminants) by 5 (for other chemicals), and then compared to the concentrations reported in the environmental samples. Based on these matrix-specific comparisons and the USEPA guidance (USEPA, 1989b) on the "rule of 10 and 5", the following chemicals (as indicated with an "X") are deleted from further consideration:

Analyte	Surface Water	Sediment	GW/Leachate
2-Propanone	-	X	-
alpha-BHC	X	-	-
Chloroform	-	-	X
delta-BHC	X	-	-
Di-n-butylphthalate	X	-	-
Endosulfan sulfate	X	-	X
Methylene chloride	X	X	X
Beryllium	-	-	X
Copper	X	-	-
Silver	-	-	X
Zinc	X	-	-

The data summary tables (6-28 through 6-30) also show which analytes have been found in blanks and are deleted from further screening.

6.3.4.3.3 Comparison to Environmental Benchmarks and Regulatory Standards

To determine which candidate ecological COCs would be analyzed through an exposure assessment, the RME concentration for each chemical detected above its IDL or MDL and not found in the field or laboratory blanks is compared to the appropriate environmental benchmark or regulatory standards. The chemicals that exceeded available benchmarks or do not have environmental benchmarks are retained for further assessment. Standards used for each of the four media and results of the screening for each media are described in the following sections.

<u>Surface Water</u>. Regulatory standards for surface water were compiled from the following two sources:

- <u>State Ambient Water Quality Standards and Guidelines for Saline Surface Water</u>, Class SB, New York State Department of Environmental Conservation (NYSDEC), Division of Water, Technical and Operational Series (TOGS) (1.1.1.) dated September 25, 1990, as updated on August 2, 1991 in the New York Water Classifications and Quality Standards, Part 703. For the purpose of selecting COCs, the standards for metals are to-be-considered (TBC) values for the surface water and groundwater/leachate sample results as explained below.

- <u>Federal Water Quality Criteria</u> for the protection of marine organisms (acute and chronic) were promulgated by the U.S. Environmental Protection Agency (USEPA, 1986a) under the Clean Water Act. The acute and chronic federal criteria are nonenforceable guidelines and are therefore viewed as TBC values.

The state and federal surface water standards, criteria, and guidelines for the detected candidate ecological COCs are shown in Tables 6-28 and 6-30. The USEPA (1992b) recognizes four methods of sample preparation for metals analysis: total metals, total recoverable metals, acid-soluble metals, and dissolved metals. All four sample preparation methods allow measurement of the dissolved metals fraction in a water sample but differ in the amount of particulate metals measured. In general, for a given sample, the reported concentrations of particulate metals increase in the following order: dissolved, acid-soluble, total recoverable, and total metals. Results of the Pelham Bay metals analyses of surface waters and leachate are in terms of total metals. However, the NYSDEC standards are for the dissolved or acid-soluble metal fraction and therefore are not directly comparable. The EPA water quality criteria are for total recoverable metals and also are not directly comparable to the metal analyses results. Comparison of total metals analyses results to dissolved, acid soluble, or total recoverable metals standards is a conservative approach likely to overestimate the potential exposure to metals.

Thirteen metals were detected above their IDLs or MDLs in the 1992 surface water samples; of these, copper and zinc were found at high concentrations in blanks and were deleted from further screening. The RME concentrations of four metals (lead, mercury, nickel, and silver) exceeded the available NYSDEC water quality standards or the federal water quality criteria as shown by the shaded standards in Table 6-28. All four metals are retained as ecological COCs. Six other metals (aluminum, barium, iron, magnesium, manganese, and vanadium) have no standards available and are therefore also retained. Thallium concentrations did not exceed standards, and the metal is not retained.

Of the six organic compounds detected, none exceeded water quality standards and only one (bis[2-ethylhexyl]phthalate) was retained following comparison to blank concentrations. Because bis(2-ethylhexyl)phthalate has no water quality standards or criteria, it is retained as an ecological COC.

Based on a comparison of surface water results with NYSDEC standards and federal water quality criteria, the metal thallium is deleted as an ecological COC in surface water.

<u>Sediments</u>. The following four criteria were used to evaluate ecological COCs in sediments:

- <u>Draft NYSDEC Cleanup Criteria for Aquatic Sediments</u> (NYSDEC, 1989) with draft revised metals criteria (NYSDEC, 1992b). These sediment criteria, which are available for a number of non-polar organic chemicals and metals, are toxicity-based criteria and are predictive of sediment concentrations likely to cause toxicity to benthic or epibenthic life. Exceedance of these criteria for organic chemicals would potentially cause accumulation of the chemical in aquatic animals to levels that would be harmful to wildlife consumers of these animals. The metals criteria (i.e., Lowest and Highest) refer to Lowest Effect Level (LEL) and Severe Effect Level (SEL), respectively. LEL is the concentration that will impair sediment use by some benthic organisms but will be tolerated by most organisms. SEL is the concentration that will significantly impair use of sediment by benthic organisms.

- <u>Proposed Sediment Quality Criteria for Organics to Protect Benthic Invertebrates</u> (USEPA, 1991a, b, c, and d) are listed under EPA -

Sediment Quality Criteria in Table 6-29. The EPA currently has released five proposed criteria - acenaphthene, dieldrin, endrin, fluoranthene, and phenanthrene. Of these, all except endrin were detected in site sediments.

- Overall Apparent Effects Thresholds (AETs) for Organics and Metals were compiled by NOAA (1990) as part of their status and trends program. In contrast to NOAA's low and median effects ranges (ER-L and ER-M, respectively), overall AETs were established following review and evaluation of available sediment and biological effects data for each chemical. The AETs were then used to establish degrees of confidence in each of the statistically-determined ER-L and ER-M values.

- Washington Marine Sediment Quality Standards were promulgated in 1991 under the State of Washington Administration Code, Chapter 173-204, Sediment Management Standards (Environmental Reporter, 1991). These standards correspond to sediment quality that will result in no acute or chronic adverse effects on biota. They apply to marine sediments in Puget Sound but are used in this EHE as TBC values.

In order to have a common basis of comparison between the results of the sediment analyses and the various criteria and standards for many of the anthropogenic organic analytes, a level of total organic compounds (TOCs) in the sediment samples had to be determined. For this ecological COC screening, an average TOC value of 2.1 percent was used based on the median concentration of 2.105 percent and mean of 2.095 percent from the ten 1992 sediment sampling stations located near the landfill. The 1992 sediment TOC values ranged from 0.09 to 4.31 percent at these stations.

As shown in Table 6-29, all metal analytes in sediments except manganese are retained for further screening because they either exceed environmental benchmarks or no benchmark is available. The RME concentration of manganese (403 mg/kg) did not exceed any criteria. The RME concentrations of 10 metals exceeded at least one of the criteria and standards presented and are retained as ecological COCs for further assessment. The 10 metals exceeding criteria are arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, and zinc. The eight metals for which there were no evaluation criteria also are retained for further consideration as ecological COCs.

Thirty-one organic compounds were detected in sediment samples above their respective IDLs or MDLs; however, two compounds (2-propanone and methylene chloride) also were found at elevated concentrations in sediment blank samples. Of the remaining 29 organic analytes, five chemicals are retained because no criteria or standards were available for evaluation. Fourteen organics are retained for further assessment because their concentrations exceed criteria. Ten organic compounds do not exceed available criteria or standards and are therefore deleted from further ecological COC screening.

The following 11 chemicals are deleted because their concentrations do not exceed sediment criteria:

Organics
2-methylnaphthalene
4,4'-DDE
acenaphthylene
benzo(ghi)perylene
di-n-butyl phthalate
di-n-octyl phthalate
dibenzofuran
dieldrin
indeno(1,2,3-c,d)pyrene
naphthalene

Metals
manganese

Groundwater/leachate. As discussed earlier in Section 6.3.4.3, chemicals in the groundwater/leachate database were screened for this EHE because of the chemical pathway between the landfill and exposure points adjacent to the landfill and the potential for some receptors in the immediate vicinity of the landfill riprap to be directly exposed to chemicals in the groundwater/leachate. Since there are no regulatory standards or environmental benchmarks for leachate, chemical results for leachate were compared to the same regulatory standards used for the evaluation of surface water.

There are no New York Sate Saline Surface Water Class SB standards for ammonia. There are, however, federal water quality criteria for aquatic life based on total ammonia, where total ammonia equals the sum of the un-ionized form (NH_3) plus the ammonium ion (NH_4^+) (USEPA, 1989). Total ammonia often is reported as ammonia-nitrogen (NH_3-N). Un-ionized ammonia is more toxic to aquatic organisms than the

NH_4^+ ion (Russo, 1985), and the percentage of NH_2 increases with increased water temperature and pH and with decreased salinity (USEPA, 1989). Because the concentration of NH_3 changes with temperature, pH, and salinity, federal water quality criteria for total ammonia varies according to conditions in the area of interest. In Eastchester Bay, conservative estimates of these water quality parapeters are 20°C, 8.5, and 10 parts per thousand, respectively. Based on these estimates, the federal acute criterium for total ammonia is 1.6 mg/L, and the chronic criterium is 0.24mg/L (USEPA, 1989).

As shown in Table 6-30, 48 organic compounds and 22 metals were detected in groundwater/leachate. Of these, chloroform, endosulfan sulfate, methylene chloride, beryllium, and silver were deleted because they were found in blanks. Of the remaining analytes, 13 organic compounds and 6 metals had chemical concentrations exceeding evaluation criteria. Because there were no available criteria to exclude them at this time, an additional 20 organic compounds and 8 metals also are retained for further evaluation.

Based on their nonexceedance of surface water criteria, the following organics and metals are eliminated from further consideration as ecological COCs in groundwater/ leachate that may affect Eastchester Bay:

<u>Organics</u>
1,2-dichlorobenzene
1,2-dichloroethylene
1,3-dichlorobenzene
acenaphthene
alpha-BHC
benzene
delta-BHC
ethylbenzene
fluoranthene
naphthalene
toluene

<u>Metals</u>
antimony
arsenic
cadmium
chromium
chromium, hexavalent
thallium

6.3.4.3.4 Frequency of Detection and Estimated Value

The frequency with which a chemical was detected in a medium was examined and used as a criterion for selecting ecological COCs. The frequency of detection and data qualifiers for each chemical detected at least once in a medium are presented in Tables 6-28 through 6-30. As shown in Figure 6-6, chemicals eliminated in this evaluation: 1) have no criteria or standards, 2) were detected in fewer than 5 percent of the samples, and 3) were detected only at estimated levels below their CRDL (i.e., "J"-qualified). Chemicals eliminated by this method are not expected to contribute significantly to the total ecological hazard for this site.

No chemicals are eliminated from surface water based on the frequency of detection because fewer than 20 samples were reported for each of the matrices, and one detection would therefore be greater than 5 percent. For sediments, no organics or metals can be eliminated because these chemicals did not satisfy the three criteria presented above. The following three organic chemicals are removed from consideration as ecological COCs in groundwater/leachate because they satisfy the three criteria:

3-nitroanaline
benzo(a)anthracene
di-n-octyl phthalate

6.3.4.3.5 Comparison to Reference Station Concentrations

This step of the ecological COC screening process compares the 1992 chemical concentrations in surface water and sediments to concentrations detected in the 1992 reference station (SW-9 and SD-9) samples. During the 1992 sampling, two surface water samples (high tide and low tide) were collected and analyzed. A total of six sediment grab samples also were collected from the same location (station SD-9) with six replicates being analyzed for VOCs and three replicates analyzed for other various analytes. The basis for the selection of SD-9 as a valid reference station is based on the comparison of the concentrations of the various analytes detected normalized to the percent fines present in each sample as determined by physical testing (see Table 4-47 and 4-48).

Surface Water. Results of the reference station (SW-9) surface water sampling are summarized in Table 6-31. Chemicals are retained when the arithmetic mean concentrations in site samples exceed the mean reference station levels. In addition, those chemicals that do not have comparable reference station data are retained. Arithmetic mean concentrations are used as the basis for comparison because of the very different number of data points in the site and reference station data (i.e., 16 and 2, respectively). Based on these comparisons, magnesium and silver are deleted from the screening process and are eliminated as surface water ecological COCs.

Sediment. Results of the reference station (SD-9) sediment sampling are summarized in Table 6-32. Chemicals are retained when the RME concentrations in site samples exceed the mean reference station levels. In addition, those chemicals that do not have comparable reference station data are retained. Based on these comparisons the following 15 chemicals are deleted from the screening process and are eliminated as sediment COCs:

Metals
aluminum
arsenic
beryllium
cadmium
chromium
cobalt
copper
iron
lead
magnesium
nickel
silver
thallium
vanadium

Organics
butyl benzyl phthalate

Even though cadmium and lead would be eliminated as COCs based on this comparison they were retained as COCs as requested by NYSDOH.

6.3.4.3.6 Comparison to Western Long Island Sound Concentrations

This step of the ecological COC screening process compares site RME concentrations of chemicals in surface water and sediment still retained to mean concentrations reported in various studies of WLIS.

Surface Water. Surface water quality data for WLIS were not found to be readily available and this step in the COC screening process was not performed for this media. Even though this step was not performed, site surface water mean concentrations in terms of total metals were compared to total recoverable metals concentrations for WLIS presented by Battelle (1991). Site mean total metal concentrations were all higher than total recoverable WLIS surface water concentrations.

Sediment. A summary of available WLIS sediment data is presented in Table 6-33 for only those analytes that were detected in site sediment samples and were not deleted in previous screening steps. If the RME concentration of an analyte in site sediments is less than WLIS mean sediment concentration the analyte is eliminated as an ecological COC. On this basis no additional analytes are deleted as ecological COCs in sediment.

6.3.4.3.7 Comparison to Seawater/Estuarine Concentrations

As discussed above, seawater contains many dissolved inorganic elements. The sum of these dissolved solids is termed salinity and is expressed in parts per thousand (o/oo).

The salinity of the open ocean is approximately 35 o/oo, while the monthly mean salinity of WLIS ranges between 24 and 26 o/oo (Jay and Bowman, 1975). Salinity measured in Eastchester Bay as part of the 1992 sampling ranged between 15 and 24.5 o/oo (Section 3.5.3). As the salinity of the water is decreased by the addition of fresh water, the concentrations of the various constituents of seawater also decrease proportionately. For example, sodium, the most abundant dissolved ion in seawater (Svedrup *et al.*, 1954), is found at an average seawater concentration of 10,600 mg/L, but is only 3,340 mg/L in estuarine waters of 11 o/oo total salinity.

All of the metals remaining as ecological COCs in surface water (aluminum, barium, iron, manganese, mercury, and vanadium) are found naturally in seawater. Of these metals, only mercury exceeded surface water quality standards. According to Sverdrup *et al.* (1954), aluminum is found at a concentration of 500 μg/L in seawater. At 23 o/oo salinity, the average salinity (based on sodium content) found during the surface water sampling, aluminum would be present naturally at a concentration of 329 μg/L. This is more than the RME for aluminum and within the range of surface water concentrations measured in 1992. Therefore, aluminum is deleted as an ecological COC. Following the same comparison of RME concentrations to expected average naturally occurring concentrations in estuarine waters, barium also is eliminated.

Iron, manganese, and vanadium are retained following this comparison to estuarine metals concentrations. Mercury is retained as an ecological COC because it was detected at a RME concentration of 0.49 μg/L, which exceeds both the state and federal standards. The RME concentration of mercury also exceeded the concentration expected to be present naturally in estuarine waters (0.02 μg/L).

6.3.4.3.8 Prioritization and Selection of Chemicals of Concern

A list of all the ecological COCs for the estuarine EHE is presented in Table 6-34. Fifty-eight organic compounds and 22 metals were detected in at least one of the three matrices (i.e., surface water, groundwater/leachate, and sediment) at concentrations exceeding IDLs and MDLs. Of the 58 organic compounds, 42 are retained for further assessment; of the 22 metals, 14 are retained. Of these, 24 organic compounds and six metals are retained because their RME concentrations exceeded environmental benchmarks.

A priority listing of the ecological COCs for the estuarine system that exceeded environmental benchmarks was developed and is presented in Table 6-35. Those without standards are not included because they are not thought to represent significant hazards to receptor species. Analytes were prioritized using three criteria:

- Number of matrices in which environmental benchmarks are exceeded
- Ratio of the RME concentration to the benchmarks for the analyte and the matrix
- Presence of the analyte in other matrices, albeit not at concentrations exceeding environmental benchmarks

Table 6-35 shows that overall, 19 analytes exceeded standards in groundwater/leachate and that the 14 highest-ranked analytes exceeded standards in groundwater/leachate. The EHE for the estuarine habitat directly affected by on-site groundwater/leachate focuses on the 17 highest-ranked analytes that were detected at high concentrations in groundwater/leachate. These include (in decreasing order):

- mercury
- 4,4'-DDD
- nickel
- lead
- zinc
- ammonia nitrogen
- phenanthrene
- PCB 1260
- Endosulfan II
- PCB 1016
- dieldrin
- copper
- 4,4'-DDE
- cyanide
- endrin
- alpha-chlordane
- methoxychlor, and
- chlorobenzene

The remaining analytes either were not detected at elevated concentrations in GW/L or are not expected to represent a significant risk to aquatic receptors.

Figures 6-7 and 6-8 depict RME concentrations of the ten analytes that were detected in more than one abiotic matrix. Metals (mercury, copper, nickel, lead, and zinc) concentrations are shown in Figure 6-7; organic compounds (4,4'-DDD, 4,4,DDE, phenanthrene, ammonia nitrogen and dieldrin) are shown in Figure 6-8.

6.3.5 Terrestrial Exposure Assessment/Ecological Hazard Evaluation

The following sections address the potential for terrestrial ecosystem receptors to be exposed to chemicals released from the landfill. Soil was the only abiotic medium sampled or considered for the terrestrial ecosystem exposure assessment. Small birds, small mammals, and raptors were used as surrogate groups to represent key receptor species (white-footed mouse, pheasant, robin, red-tailed hawk) in the following terrestrial exposure assessment and ecological hazard evaluation (Sections 6.3.6.1 and 6.3.6.2, respectively).

The following terrestrial exposure assessment and ecological hazard evaluation are based on available data. While potential risk to receptor populations may be assessed as a result of the following analysis, these results do not necessarily represent risk to higher levels of organization (e.g., community, ecosystem). The landfill site is not considered an especially valuable terrestrial habitat, nor does it have the ability to attract and support special interest species (aside from raptors). Adverse impacts to a few individuals at the site are not likely to impact populations in the greater surrounding area. Chemical intake (dietary or dose) and tissue residue levels were calculated to evaluate potential hazards to the surrogate groups listed above. The calculated levels are compared to "no-effect" (NOELs and NOAELs) or "toxic" intake levels (TDLOs, LDLOs, LD_{50}s) as derived from the toxicological literature for birds and rodents.

Secondary ingestion exposure pathways, and the potential for bioconcentration and biomagnification, can be significant exposure routes, particularly for organochlorine pesticides and PCBs. A semi-quantitative evaluation of exposure and potential hazards from pesticide and PCB toxicity due to direct and indirect secondary ingestion is presented.

The following terrestrial exposure assessment and ecological hazard evaluation are intended to provide a predictive screening of potential hazards to terrestrial receptors of concern. The analysis is not intended to provide a determination of actual hazards or risk to terrestrial life at the site. Actual risk to biota at this site cannot be determined without field validation, which was not an element of the ecological work plan because of the assumption that the terrestrial environment of the site will likely be disrupted in any remedial design that is implemented.

6.3.5.1 Terrestrial Exposure Evaluation

The terrestrial exposure assessment includes preliminary identification of the source-receptor exposure pathways taking into account environmental fate and transport through both physical and biological means (see Section 5). Pathways are described in terms of the ecological COCs and media involved and the potential ecological receptors. The exposure assessment included the following steps:

- Evaluation of the actual or potential source-receptor pathways for completeness and significance
- Determination of exposure points and concentrations
- Estimation of chemical intake by key receptors
- Estimation of exposure duration, frequency, and area use

6.3.5.1.1 Potential Terrestrial Exposure Routes

Exposure pathways define the migration routes that chemicals may take from a source to the various exposure points. The transport media, chemicals involved, potential ecological receptors, and potential uptake of chemicals by receptors (exposure route) are described for the principal (i.e., significant) exposure pathways for the terrestrial ecosystem in Section 6.3.2.

There are three potential exposure routes for the key terrestrial receptors at the landfill: inhalation, dermal absorption, and ingestion. The following section briefly addresses each of these exposure routes. Potential exposure of biota to chemicals in small surface water puddles is not evaluated because data are not available for this pathway and the exposure would likely be insignificant compared to exposure from direct or secondary ingestion of soils.

Inhalation

Based on the concentrations of volatile ecological COCs detected in soils, the inhalation pathway is not considered significant for small birds or mammals onsite. Chemicals detected in soils on site included several volatile organic chemicals (VOCs) that have a high potential for volatization (e.g., benzene, chlorobenzene, ethylbenzene, pyrene, toluene, xylene, 2-propanone). Except for pyrene (RME = 1.3 mg/kg), RME concentrations for detected VOCs are less than 1 mg/kg. At these low concentrations, potential toxicity to small ground-dwelling birds and mammals is not considered a hazard. The ecological COCs detected in soil (organochlorine pesticides and PCBs, metals, PAHS, and one semivolatile organic chemical) are generally non-volatile, and therefore, are expected to produce a minimal inhalation exposure.

Dermal Absorption

Dermal absorption is not considered to be a significant exposure route for small mammals and birds at this site, because these animals are assumed to be largely protected by their fur or feathers. Dermal absorption or bioconcentration in earthworms is considered a significant exposure route since earthworms can be principal dietary sources for small birds and mammals. Potential adverse effects to plants from chemical uptake is briefly addressed for some COCs in the terrestrial ecological hazard evaluation. Plant uptake is not considered to be a significant exposure pathway for the more toxic COCs (i.e. those that are likely to bioaccumulate) detected at this site.

Ingestion

For the terrestrial ecosystem, the exposure pathway was limited to the consideration of direct and indirect oral ingestion of soil by animals. Small birds and mammals at the landfill may ingest COCs either directly or indirectly. Direct ingestion usually occurs along with food/prey ingestion from soil adhered to the surface of food or from preening/cleaning or burrowing activities. Indirect ingestion includes ingestion of chemicals that have been transferred via food webs or from parents to the fetus or embryo. Organic compounds with high Log P (logarithm of the octanol-water coefficient: K_{ow}) or high molecular weights (i.e., pesticides and PCBs) are more likely to be transferred through the food web than those with lower molecular weights. Plants may take up chemicals with low Log P values by way of their roots, but cannot transport significant amounts of chemicals with high molecular weights and high Log P values in the same manner (USEPA, 1989a). Predator species at the top of the food web are the most vulnerable to chemicals that bioaccumulate. In general, long-lived and larger species (that accumulate fat) have a greater opportunity to accumulate these compounds as well. Also, higher trophic levels species, particularly bird species, may be more sensitive to the COCs than the animals on which they prey. For terrestrial species, bioconcentration factors (BCFs) as little as 0.03 can be significant if the residue is toxic (USEPA, 1989a).

Organochlorine compounds are of particular concern in terrestrial biota, due to uptake by offspring of food or yolk storage from parental organisms, the long-term uptake and bioaccumulation process of these persistent chemicals, and the inability of these non-degradable compounds to leave the body by a diffusion process as in aquatic animals (Winter and Streit, 1992). Early life stages of bird and especially raptor populations are sensitive indicators of organochlorine contamination due to high net ingestion rate and transfer of organochlorine compounds from the mother bird.

6.3.5.1.2 Exposure Point Concentrations

Reasonable maximum exposure (RME) concentrations, rather than average concentrations, of ecological COCs in surficial scrapings and soil boring (0 to 2-ft) samples were used for the hazard evaluation. COCs in the terrestrial ecosystem include metals, organochlorine pesticides, PCBs (Aroclor-1254, -1260), PAHs and one semi-volatile organic chemical (SVOC) (N-nitrosodi-n-propylamine). Using RME concentrations for the combined surficial and soil boring data provides a conservative estimation of exposure.

Chemical concentrations were examined for their occurrence in either surficial scrapings or soil borings (Tables 6-25 and 6-26). Locations of the surficial scrapings and soils borings are described in Section 2.1.4.1 and shown in Figure 2-2. Ecological COCs which were detected only in surficial scrapings or at higher concentrations in surficial scrapings than at depth may not necessarily be related to the landfill. Two COCs, the pesticide methoxychlor and the SVOC n-nitrosodi-n-propylamine, were detected only once in surficial scrapings and not in any of the 2-ft soil borings. Three COCs (lead, nickel, and PCB-1254) were found at RME concentrations that were two or more times higher in surficial soils than in the soil borings. RME concentrations for nickel were approximately eight times greater in the surficial soil samples than in the soil borings. The presence of nickel and lead at higher concentrations in surficial soils may be due largely to releases from sources other than the landfill (e.g., industrial emissions, automotive exhaust and atmospheric deposition).

6.3.5.1.3 Estimating Chemical Intake

Chemical intake in small birds and mammals can be estimated based on intake of food/prey items or incidental ingestion of soil (as a percentage of food intake). Chemical intake from food or soil is estimated by using the following equation (for food):

chemical $\text{dose}_{(\text{food})}$ [milligram per kilogram-body weight per day (mg/kg-bw/day)] =

$$\frac{\text{chemical concentration (mg-chemical/kg-food)} \times \text{food intake (kg/day)}}{\text{body weight (kg-bw)}}$$

This equation may also be used to derive threshold dietary levels based on a NOEL dose: i.e.,

"no observable effects" diet (mg-chem/kg-food) =

$$\frac{\text{NOEL dose (mg/kg-bw/day)} \times \text{body weight (kg-bw)}}{\text{food intake (kg-day)}}$$

The above equations are used throughout the EHE to interpret dose, diet or residue information presented in the literature for laboratory or wildlife organisms. Laboratory animal live weight and food consumption values used in the preceding equations are from NIOSH (1987). Live weight for a gamebird/waterfowl (mallard) and small bird (killdeer/robin) are from Teres (1991). Food intake for waterfowl may be estimated to range from 5 to 20 percent of the duck's weight (Nagy, 1987; Newell, 1987). For this evaluation, food intake for the mallard (also gamebirds and other waterfowl) was estimated at 15 percent of weight; food intake for a small bird (i.e., killdeer/robin) or raptor was estimated at 20 percent of weight. Weight and food intake parameters used in this hazard evaluation are as follows:

Species	Weight (Kg)	Food intake (Kg/day)
mouse	0.025	0.003
rat	0.2	0.015
domestic duck	2.5	0.25
chicken	0.8	0.14
small bird (killdeer/robin)	0.088	0.0176
waterfowl/gamebird (mallard)	1.2	0.18

Small mammals may be directly exposed to soil concentrations at depth due to their burrowing activities. Incidental ingestion of sediments by small mammals may be estimated at 2 percent of their food intake (Garten, 1980). Small birds may also be exposed to soils at depth by consuming prey items such as earthworms that are directly exposed to deeper soils. Seed-eating birds are likely to have a greater exposure potential to surficial soils as they require grit for food digestion. Sediment intake for waterfowl and shorebirds has been estimated to be as high as 50 percent of food intake (Goodman and Fisher, 1962).

6.3.5.1.4 Exposure Duration, Frequency, and Area Use

Exposure duration, frequency and area use are factors that influence the potential for hazardous effects from exposure to ecological COCs. Most terrestrial bird species at Pelham are migratory and are therefore assumed to be directly in contact or indirectly exposed to chemicals in the landfill soils for a maximum of 8 months per year. Some raptors, however, may occur in the vicinity of the site year round. Their hunting territory is unlikely to be limited solely to the landfill. Exposure duration for small mammals, such as the white-footed mouse, would be greater than that of birds as they generally do not migrate, hibernate, or estivate.

Higher trophic level species which frequent the site are most at risk from bioaccumulation. Raptors, such as the northern harrier, that feed primarily on small rodents or small birds and are the key high trophic level receptors in the terrestrial ecosystem for those ecological COCs that bioaccumulate. Because raptors are species of special concern, the following hazard evaluation largely focuses on potential hazard to such species.

6.3.5.2 Terrestrial Ecological Hazard Evaluation

The following EHE for terrestrial soils is presented for the twenty COCs selected in Section 6.3.4.2.1. Unlike aquatic ecosystems, regulatory criteria and toxicological literature are not generally available for the determination of soil concentrations that are toxic to biota. The following EHE is largely based on toxicological information presented in the USFWS Contaminant Hazard Review Reports (Eisler, 1986, 1987, 1988, 1989) and the Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife (Newell, 1987). Additional information on toxic dose, dietary, and residue levels was obtained from the available literature. In some cases, the only data available relate to species that are not known to occur at the site (e.g., mink), but provide a basis for making evaluations of the potential hazards for species at the same trophic level (e.g., predators).

For a number of chemicals, no definite data are available on "hazardous effects" levels in wildlife. Eisler (1987b) suggests that, for such chemicals, proposed human criteria derived from laboratory experiments on rats or mice may be used as interim guidelines for protection of nonhuman mammalian resources. Due to the lack of data for some chemicals, laboratory experimental data on rats and mice were also used for the protection of avian receptors.

For most chemicals in this EHE, a semi-quantitative evaluation is presented based on a comparison of "no-effects" or "toxic" dose, dietary or residue levels for wildlife or related organisms as obtained from the literature with concentrations estimated to occur onsite. In cases where no NOELs were available, "safe" threshold levels were estimated by applying a conservative safety factor of 100 to available LD_{50} data. This was considered a conservative safety factor to use in that USEPA (1986d) guidance recommends safety factors of 1/5 the LD_{50} value for non-endangered terrestrial species, and 1/10 the LD_{50} or 1/5 the LD_{10} for endangered terrestrial species. Laboratory toxicity data for small mammals (rats and mice) were used for a few chemicals where no avian benchmarks were available. A conservative safety factor of 100 was also used in these cases to convert available LD_{50} data to "safe" threshold benchmark levels.

The potential for a number of COCs to bioconcentrate, bioaccumulate, or biomagnify is considered in this EHE. Information on food web pathways and bioaccumulation factors (BAFs, ratio of the biotic chemical concentration in an organism to the abiotic concentration) are included for similar ecological COCs and receptors of concern where such data are available from the published literature. Diet and residue values obtained from the literature are generally reported in this EHE as either fresh weight (FW), wet weight (WW) or dry weight (DW).

The following ESE focuses on the oral ingestion exposure route and is organized by chemical group. Evaluation of wildlife exposure and potential hazards from the dermal and inhalation are rarely done in ecological risk assessments due to the general lack of ecotoxicological information. Potential hazards are assessed by individual chemicals for birds and mammals. Additive and interactive effects between chemicals or chemical groups are not considered in the following analysis (see Section 6.3.8, Limitations and Uncertainties).

6.3.5.2.1 Organic Chemicals

The organic chemical N-Nitrosodi-n-propylamine was only detected in 1 (surficial soil) of 18 samples. Exposure to this chemical is therefore limited. Bioaccumulation potential and bioavailability are not important considerations for this chemical based on its low log P (logarithm of the octanol/water partition coefficient, 1.31). Photolysis in aqueous solution, and perhaps to a limited extent, in the atmosphere appear to be the major degradative process.

An oral LD_{50} of 480 mg/kg in rats is reported for this chemical (Sax, 1992). The lowest toxic effects (tumorigenic) oral doses reported are 120 mg/kg for mice and 660 mg/kg for rats (NIOSH, 1989; Sax, 1992).

Because the chemical is not likely to bioaccumulate the receptors of concern are limited to small mammals and birds which directly (incidentally) ingest soil. Based on the lowest toxic effects dose reported for mice (120 mg/kg-bw), dietary concentrations for a mouse would have to exceed 1000 mg/kg for the animal to be adversely affected (i.e., diet = dose x body weight/food intake). Given the mean (284 μg/kg) and RME (366 μg/kg) soil concentrations, it is unlikely that dietary concentrations for small mammals would exceed 1000 mg/kg or that small mammals, and likewise birds, would be impacted by this chemical.

6.3.5.2.2 Polycyclic Aromatic Hydrocarbons (PAHS)

Three PAHs were selected as COCs for the terrestrial ecosystem: benzo(a)anthracene, benzo(a)pyrene, and chrysene. Maximum detected values for these three PAHs range from 2.6 to 3.3 mg/kg. Maximum values for these three PAHS and several other PAHs were from the SS-HF surface soil location. Although these and other PAHS were detected at depth in the soil boring samples, RME soil concentrations for these three PAHs are approximately twice as high in the surficial samples.

Numerous PAH compounds are distinct in their ability to produce tumors in skin through dermal contact and in most epithelial tissues of practically all animal species tested; malignancies are often induced by acute exposure to microgram quantities (Eisler, 1987b). Target organs for PAH toxic action are diverse, due partly to extensive distribution in the body and also to selective attack by these chemicals on proliferating cells (USEPA, 1980a). Most 4- ,5-, and 6-ring PAH compounds (as are these PAH COCs) are considered to be carcinogenic (Eisler, 1987b). Laboratory studies with mice have shown that many carcinogenic PAHs adversely affect the immune system, thus directly impacting an organisms's general health; and, the more carcinogenic the PAH the greater the immuno-suppression (Ward *et al.*, 1985). PAHs can be taken into the mammalian body by inhalation, skin contact, or ingestion, although they are poorly absorbed from the gastrointestinal tract (Eisler, 1987b). Upon ingestion, some PAHs are transformed to intermediates, which can be highly toxic, mutagenic, or carcinogenic.

Eisler (1987) notes that information on PAH toxicity and avian wildlife is generally lacking (only two studies available). Available information suggests avian embryos are especially susceptible to PAHs and they may have a greater capacity to metabolize PAHs than do mammalian embryos and fetuses (Hoffman and Gay, 1981). Studies with mallard embryos and PAHs applied to the egg surface have shown toxic and adverse sublethal effects at concentrations as low as 0.002 μg/kg (benzo(a)pyrene-embryo), and 0.015 μg/kg (chrysene-embryo) and 0.18 μg PAH/kg (whole egg) (Eisler, 1987).

PAHs are not expected to accumulate in terrestrial ecosystems or in soil organisms such as earthworms. Marquerie *et al.* (1987) reported BCFs (based on dry wt for both soils and earthworms) to be less than 0.5 for 21 PAHs tested whose concentrations in soils ranged from 1 to 5 mg/kg (DW).

Benzo(a)pyrene (BaP). Mean and RME soils concentrations for benzo(a)pyrene (BaP) are 0.45 and 0.79 mg/kg, respectively. An acute oral LD_{50} value of 50 mg/kg-bw is reported for rodents (*Rattus* spp. or *Mus* spp.) (Sims and Overcash). Reproductive effects are found in mice fed 10 mg/kg-bw (83 mg/kg diet) during pregnancy (MacKenzie and Angevine, 1981).

Chronic oral doses in rodents as low as 0.002 mg/kg-bw (16 μg/kg diet, mouse) have been shown to result in cancer (Sims and Overcash, 1983). Assuming a BCF of 0.5 for the earthworm, results in dietary (earthworm) concentrations for a mouse would be 0.39 mg/kg (based on the RME soil concentration). Such dietary concentrations are not likely hazardous to small mammals.

The concentration of BaP detected in soils may present some concern to avian species. A dietary (earthworm concentration) can be estimated at 50 percent of the soil concentration, i.e., 0.39 mg/kg. Based on an embryo effects level of 0.002 μg/kg (applied externally to the egg and equivalent to about 0.036 μg/kg FW, based on an average egg weight of 55 grams), only a small percentage of an avian species diet need be passed onto the embryo in order for effects to occur. At 0.002 μg Bap/egg, embryonic growth reduction and an increased incidence of abnormal survivors are reported (Hoffman and Gay, 1981). At 0.01 μg BaP/egg, 60 percent died in 18 days; at 0.05 ug/egg, 75 percent died within 3 days (Hoffman and Gay, 1981). If PAHs are passed from an adult bird to the embryo, it is plausible that a 0.39 mg/kg dietary concentration for an adult small bird may pose a hazard to offspring.

Benzo(a)anthracene (BaA). Mean and RME soils concentrations for benzo(a)anthracene (BaA) of 0.49 and 0.75 mg/kg, respectively, are similar to those reported for BaP. Chronic doses of 40 mg/kg-bw BaA result in cancer in rodents (Sims and Overcash, 1983). Based on this chronic dose level, dietary concentrations would have to exceed 333 mg/kg (mouse), in order for a mouse to be chronically exposed to a hazardous level. It appears unlikely, based on soil concentrations detected, that dietary levels would exceed this level.

Based on the preceding information for BaP, the BaA RME soil concentration may pose a potential hazard to some avian species, if embryos are as sensitive to BaA as they are to BaP.

Chrysene. Mean and RME soils concentrations for chrysene of 0.58 mg/kg and 0.91 mg/kg, are similar to those for BaP and BaA. Chronic doses of 99 mg/kg-bw chrysene result in cancer in rodents (Sims and Overcash, 1983). At this dose level, chronic dietary concentrations of 825 mg/kg would be needed for cancerous effects to occur. Such dietary levels are unlikely based on the soil concentrations detected.

A toxic avian embryo effects level of 0.015 μg/kg is reported for chrysene (Eisler, 1987). Considering a dietary (earthworm concentration) of 0.45 mg/kg (0.5 x the RME), it is again plausible that the toxic effects levels in embryos for those species that largely feed on earthworms may be exceeded.

6.3.5.2.3 Pesticides and PCBs

RME concentrations for pesticides and PCBs in Pelham Bay Landfill soils range from 19 μg/kg for delta-BHC and 27 μg/kg for endosulfan sulfate to 140 μg/kg for methoxychlor and 451 μg/kg for PCB-1254. The following assessment focuses on the individual chemicals; potential effects from the combined concentrations of these chemicals are not considered in the following assessment but are addressed in Section 6.3.8, Limitations and Uncertainties.

DDT/DDE/DDD. The RME soil concentrations for DDT and its metabolites are 38.1 μg/kg (DDE), 42.1 μg/kg (DDD) and 82.5 μg/kg (DDT). These three values each exceed the estimated (J) reference station concentration of 1.1 μg/kg. All three values are below the NYSDEC recommended soil cleanup objective which is based on the protection of groundwater. RME concentrations for these three chemicals are slightly higher in surficial soil samples than in the soil boring samples. The highest value actually detected (i.e., no qualifiers) for these three chemicals is 330 μg/kg, from a surficial soil sample at the SS-HF sample location.

Birds. Eggshell thinning and reproductive impairment in birds, particularly raptors, are the principal endpoints of concern for DDT as well as the other pesticides and PCBs. The most protective dietary NOEL criterion (0.2 ppm) is for the brown pelican and is based on a eggshell thinning (Newell *et al.*, 1987). USEPA (1976) has reasoned that a 10-fold increase from food to egg residues can be used to estimate a NOEL diet in the case of the black duck and pelican. Dietary NOELs developed for the mallard/black duck and bald eagle are slightly higher at 2.0 ppm and 1.5 to 5 ppm, respectively. Heath *et al.* (1969) report eggshell thinning in mallards exposed to DDE at dose levels of 2 mg/kg-bw (approximately 13 ppm diet). For bald eagles, reproductive failure approaches 100 percent when DDE egg residues are greater than 15 mg/kg (WW) but is nearly normal when egg residues are less than 3 mg/kg (Wiemeyer *et al.*, 1984).

LD_{50} values commonly reported for birds range from 595 mg/kg-bw for California quail (Hudson *et al.*, 1984) to 4000 mg/kg-bw for the rock dove (Hudson *et al.*, 1984). The minimum lethal dose (death within 31 days) reported for mallards is 50 mg/kg-bw (approximately 333 mg/kg diet) (Hudson *et al.*, 1984). Toxic effects have been reported at lower dietary levels in Japanese quail (*Coturnix coturnix japonica*) of 40 mg/kg (approximately 7 mg/kg-bw) (Stickel and Rhodes, 1970). Bald eagles fed a 5 mg/kg diet (0.3 mg/kg-bw) were not visibly affected (Stickel *et al.*, 1966). Mortality and gross intoxication were found at higher feeding levels (>83 mg/kg) (Stickel *et al.*, 1966). For osprey, lower lethal levels reported in brain are 250 mg/kg (WW) for DDE and 86 mg/kg (WW) for DDT (Wiemeyer and Cromartie, 1981). Hazardous levels in carcass are estimated at 9,200 mg/kg (DDE) and 2,800 mg/kg (DDT) (Wiemeyer and Cromartie, 1981).

A BCF (DW-earthworm: DW-soil) of 5 is reported for DDT in earthworms (Beyer and Gish, 1980). DDT concentrations in earthworms of 32 mg/kg are reported as hazardous to sensitive bird species (Beyer and Gish, 1980). Poisoning of blackbirds (*Turdus merula*) and thrushes (*Turdus philomelus*) is associated with total DDT residues of 13 to 29 ppm (WW) in earthworms (Collett and Harrison, 1968). BAFs of 12 to 24 are reported for the American kestrel (*Falco sparverius*), which largely feeds on small mammals (Szaro, 1978). Average dietary concentrations of 10 mg/kg DDE may be considered hazardous to raptors (Beyer and Gish, 1980).

Based on an RME soil concentration of 82.5 μg/kg and a BAF of 5, a concentration of 0.41 mg/kg could potentially occur in earthworms. This concentration is unlikely to present a dietary hazard to small birds feeding on earthworms, although it slightly exceeds the protective NOEL dietary criterion (0.2 ppm) for the brown pelican. If one assumes a BAF of 10 from the earthworm to small birds or small mammals, the dietary concentration for a higher trophic level species such as raptors could be 4.1 mg/kg. Such a concentration is unlikely to pose a lethal or toxic effect in adult birds or present a potential risk to most species from eggshell thinning. Should any bird species at the site be as sensitive as the brown pelican, a slight potential for eggshell thinning exists based on exceedance of the protective NOEL dietary concentration of 0.2 ppm.

Mammals. The lowest LD_{50} values reported for a mouse and rat for DDT or its metabolites are 46 mg/kg-bw (rat) and 200 mg/kg-bw (mouse) (Wayland and Laws 1991; Pimental 1971; Gaines 1960). Toxic effects (decreased size of reproductive organs) are reported to occur in mice at 200 mg/kg-bw (Cannon and Holcomb, 1968). Newell *et al.* (1987) report a LOEL for a rat equal to or lower than 14.5 mg/kg-bw/day (193 mg/kg diet) and possibly close to 0.375 mg/kg-bw/day (5.0 mg/kg diet) depending on the interpretation of the severity of the non-lethal effects (increase liver weight or increased enzyme induction).

Based on the rat LD_{50} of 46 mg/kg-bw and a mouse LD_{50} of 200 mg/kg, dietary concentrations for these two species would have to exceed 613 mg/kg and 1666 mg/kg, respectively, for deaths to occur in 50 percent of the population. Toxic effects, however, may potential occur at much lower dose levels. If one assumes a safety factor of 100 to convert the LD_{50} values to safe threshold dose values for the rat and mouse, then dietary concentrations for these two species would need to exceed 6 mg/kg and 17 mg/kg, respectively, before toxic effects would possibly occur. These values are slightly above the estimated 0.5 mg/kg safe dietary concentration for a mink (a more sensitive species than rats) (Newell *et al.*, 1987).

In a field study, shrews (*Blarena* sp. and *Sorex* sp.) accumulated whole body DDT residues up to 6.4 times greater than in diet (Forsyth *et al.*, 1983). Based on a BCF of 5 (assumed for this EHE) for the earthworm, dietary concentrations for a carnivorous small mammal could be 0.41 mg/kg. Small mammals are unlikely to be at risk based on such dietary concentrations. If one assumes an additional BAF of 10 for larger mammals that eat small mammals (e.g., a fox), dietary concentrations for larger mammals could be 4.1 mg/kg. Unless the larger mammal is especially sensitive, these dietary concentrations are not likely to pose a hazard.

PCB-1254/PCB-1260. PCB toxicity varies with isomers with toxicity but is generally positively related to chlorine percentage (last two digits of number) (Heath *et al.*, 1970). RME soil concentrations at the landfill are 451 μg/kg for PCB-1254 and 130 μg/kg for PCB-1260. PCB-1260 was detected in only 1 of 11 soil boring samples and was not detected in surficial soils. The RME PCB-1254 concentration in surficial soils

(680.2 μg/kg) is approximately twice the RME soil boring concentration (310 μg/kg). Because of its higher concentration and detection frequency (7 of 18 samples), the following text focuses on PCB-1254.

Birds. LD_{50}s for PCBs in birds vary from 604 to more than 6,000 mg/kg-bw (Eisler, 1986). Toxic effects (reproduction) have been documented in ringed turtledoves given 10 ppm (diet) Aroclor 1254 for 3 months (Heinz *et al.*, 1984). Resulting residues in ringed turtle doves fed a 10 ppm diet were 136 ppm (BAF = 73) were 16 ppm in eggs (BAF = 1.6) (FW) and 2.8 mg/kg in brain (FW) (BAF = 0.28)(Heinz *et al.*, 1984 in Eisler 1986). Brain residue concentrations of greater than 310 mg/kg are considered indicative of PCB poisoning (Stickel *et al.*, 1984). Brain residues levels of 10 ppm (WW) have been reported in a number of hawks and owls for which the principal cause of death was intoxication with PCBs and numerous organochlorine pesticides (Cade *et al.*, 1988).

Among comparatively resistant species of birds no significant reproductive effects were observed during long-term exposures at high Aroclor-1254 feeding levels in Japanese quail (50 mg/kg diet), northern bobwhites (*Colinus virginianus*) (50 mg/kg diet) and mallard (25 mg/kg diet) (Eisler, 1986). Adverse reproductive effects, however, have been reported in white leghorn chickens at doses of 2.24 mg/kg-bw (12.8 mg/kg diet) (Britton and Huston, 1973). Toxic effects (reduced hatchability of eggs) have also been reported for Japanese quail at doses of 0.175 mg/kg-bw (1 mg/kg diet) (Sax, 1984; Scott, 1977). Dietary exposures of 5 mg/kg and 10 mg/kg in chickens and mourning doves, respectively, resulted in reproductive impairment, including altered courtship behavior (Tori and Peterle, 1983). Kestrels fed PCB levels equivalent to 9 to 10 mg/kg-bw exhibited a significant decline in sperm concentration, which may result in reproductive failure (Bird *et al.*, 1983).

McLane and Hughes (1980) recommend dietary PCB limits of <3.0 mg/kg (FW) for protection of birds based on their studies of screech owl. The International Joint Commission (IJC, 1981), a United State-Canada Treaty Organization, has set a PCB objective in fish of 0.1 mg/kg to protect piscivorous wildlife. A NOEL dietary criterion of 0.11 mg/kg was set for birds by Newell *et al.* (1987) based on the TDLO in white leghorn chickens of 2.24 mg/kg-bw (Britton and Huston, 1973).

Concentrations of PCB congeners in earthworms (WW) from a vineyard treated with compost were, on average, five or six times as great as the concentrations in the upper 20 cm of soil (DW) (Diercxsens *et al.*, 1985). Marquenie *et al.* (1987) found the median concentration factor (concentration in earthworms, ash-free DW, divided by the concentration in soil, DW) was approximately 6 for nine PCB components.

If one assumes a BAF of 6 for an earthworm, dietary concentrations for small mammals and birds could be 2.7 mg/kg for PCB-1254, which exceeds the NOEL dietary criterion of 0.11 mg/kg developed by Newell *et al.* (1967); the toxic effect (reduced hatchability) level for Japanese quail of 1 mg/kg (Sax, 1984; Scott, 1977); the IJC criterion of 0.1 mg/kg for protection of piscivorous birds; and is only slightly below the UFSWS bird protection criterion of 3.0 mg/kg (McLane and Hughes, 1980).

Assuming a BAF of 6 for a small bird that largely feeds on earthworms, a total BAF of 36 is obtained using a soil-earthworm (6x)-small bird (6x) pathway. Dietary concentrations for higher trophic level species could thus be as high as 16 mg/kg for PCB-1254. At such dietary levels, sensitive bird species and raptors could possibly experience adverse reproductive impacts.

Mammals. Mink are considered the most sensitive terrestrial wildlife species to PCBs (Eisler, 1986). Chronic dietary concentrations of 6.7 to 8.6 mg/kg are lethal to mink (Eisler, 1986). Death may also occur at dietary concentrations as low as 1.0 mg/kg (Fleming *et al.*, 1983). Reproductive failure reportedly occurs in minks fed 2 mg/kg Aroclor-1254 for 9 months (Aulerich and Ringer, 1977). The reported tolerable daily dietary limit for mink ranges from 0.01 mg/kg (Eisler, 1986) to 0.67 mg/kg (Ringer *et al.*, 1983). Newell *et al.* (1987) developed a NOEL dietary criterion for mink of 0.13 mg/kg.

Eisler (1986) concluded that the lethal dietary level of Aroclor 1254 to rats is from 500 to 2,000 mg/kg for 1 to 7 week exposures. Oral LD_{50}s reported for a rat range from 1,010 mg/kg-bw (NIOSH, 1982 in Newell, 1987) to 2000 mg/kg-bw (acute dose) (IRP, 1989). An LD10 of 188 mg/kg is also reported for a rat (Niosh, 1982). Newell *et al.* (1987) developed a NOEL dietary criterion of 4.2 mg/kg for rats.

A chronic 28-day LOEL (reproductive effects) for a mouse is reported at 2.0 mg/kg-bw (16.7 mg/kg dietary) (Newell *et al.*, 1987). Hepatomas have also been observed in mice fed 300 ppm Aroclor 1254 for 11 months (IRP, 1989). Gross hepatic changes, however, have been observed in mice fed 50 ppm Aroclor 1260 for 16 months (IRP, 1989). Newell *et al.* (1987) developed a NOEL dietary criterion of 2.7 mg/kg for mice.

Assuming a BAF of 6 for an earthworm, dietary concentrations for small carnivorous mammals could be 2.7 mg/kg for PCB-1254, which equals the NOEL criterion set for mice, but exceeds the dietary criterion set for mink by Newell *et al.* (1987). A potential hazard may thus exist for sensitive species at the site. A potential hazard may also exist for sensitive mammals at higher trophic levels should their food/prey accumulate PCBs to any extent.

a- and g-Chlordane. The RME a- and g-chlordane soil concentrations are estimated at 23 μg/kg and 3.1 μg/kg, respectively. G-chlordane was only detected in 1 (soil boring) out of 11 samples and not in any surficial soil sample. A-chlordane was detected in both the surficial and soil boring samples at approximately the same RME concentration.

Birds. Chlordane is metabolized in birds to heptachlor epoxide, oxychlordane, trans-nonachlor, cis-chlordane, and other compounds (Stickel *et al.*, 1979b). Heptachlor epoxide and oxychlordane appear to be the metabolites correlated with mortality. Brain concentrations near 5.0 ppm oxychlordane (WW) and 8 ppm heptachlor epoxide are considered diagnostic of poisoning in birds (Stickel *et al.*, 1979b, 1983).

Tissue levels (FW) of 6.5 mg/kg (a-chlordane) and 3.2 mg/kg (g-chlordane) were measured in barn owls (*Tyto alba*) that died after 40 days from diets containing 75 mg/kg chlordane (Eisler, 1990). Tissue levels of 5.1 mg/kg (a-chlordane) and 3.6 mg/kg (g-chlordane) were measured in a barn owl that died after 17 days from diets containing 150 mg/kg chlordane (Eisler, 1990). Sensitive bird species, however, may be adversely affected after consuming diets with average concentrations of 1.5 mg/kg chlordane (Eisler, 1990). A NOEL dietary criterion of 0.5 mg/kg was selected by Newell *et al.* (1987) for piscivorous birds based on dietary studies performed with rats and dogs.

In order for a bird's dietary concentration to exceed the NOEL dietary criterion of 0.5 mg/kg, the BCF (earthworm) or total BAF from soil to food/prey organism would have to exceed 21 for a-chlordane and 166 for g-chlordane. A BCF of 21 (for the earthworm) seems unlikely, but a total BAF, from soil to earthworm to small bird, may be possible. A potential hazard for raptors may exist, if the total BAF for a-chlordane exceeds 21. A total BAF of 166 for g-chlordane from soil to small birds seems unlikely. A potential hazard to sensitive species from g-chlordane exposure therefore seems unlikely based on this high BAF value and the low frequency of detection (one sample).

Mammals. An LD_{50} of 200 mg/kg-bw is reported for a rat (BEIA, 1989). NOAEL values for a rat and mouse are reported at 5 mg/kg-bw (66 mg/kg diet) and 25 mg/kg-bw (208 mg/kg diet), respectively (BEIA, 1989). A much lower NOEL dietary criteria of 0.5 mg/kg was developed by Newell *et al.* (1987) for piscivorous mammals based on dietary studies performed with rats and dogs.

As in the case of small birds, the BCF (earthworm) or total BAF from soil to a food/prey organism would have to exceed 21 for sensitive higher trophic level organisms to be affected. Should the total BAF from soil to small mammals exceed 21, sensitive higher trophic level organisms may be affected. Based on a NOAEL dietary value of 208 mg/kg for a mouse, however, the BCF or total BAF (for food/prey organisms) would have to exceed 9,000 for a mouse, or 3,000 for a rat, in order for such organisms to be affected. Based on these latter values, chloridane does not appear to present a potential hazard to small mammals.

Dieldrin. The RME soil concentration for dieldrin is 38.7 μg/kg with a mean of 25.5 μg/kg and a maximum value detected in surface soils (SS-HF location) of 130 μg/kg. Dieldrin was not detected in the soil boring samples, but was detected in five of seven surficial soil samples.

Dieldrin is the primary metabolite stored in fat tissue. Aldrin is readily converted to dieldrin via epoxidation in a number of animals (NIOSH, 1978) and is readily converted to dieldrin in all ecosystem components according to microcosm studies (Metcalf *et al.*, 1973).

Birds. For 12 animal species, the acute lethal dose (LD_{50}s) for dieldrin/aldrin ranges between 20 and 70 mg/kg (Hodge *et al.*, 1967). Hungarian partridge and mallard exhibit reproductive dietary LOELs of 1 and 3 mg/kg, respectively (Neill *et al.*, 1969). At dietary levels of 5 ppm, dieldrin suppressed quail (*Coturnix coturnix*) chick behavior (Kreitzer and Heinz, 1974). Behavioral changes have been noted in loggerhead shrikes (*Lanius ludoricianus*) at dieldrin levels as low as 2 ppm (Busbee, 1977). Enzyme depression and other dose related effects were observed in mallards at dietary levels of 4 ppm (0.4 mg/kg-bw) (Sharnma *et al.*, 1976).

The residue level in brains, principally birds, that is considered diagnostic of dieldrin poisoning is 6.8 mg/kg (Heinz and Johnson, 1981). Heinz and Johnson (1981) thought brain levels as low as 1 mg/kg in highly sensitive individuals may prove hazardous.

Dieldrin residues for herring gull eggs sampled from four Lake Ontario colonies averaged 0.232 mg/kg FW), i.e., 10 times higher than the alewife and smelt forage and 4 times higher than the piscivorous coho salmon residue levels (Norstrom *et al.*, 1978). Dieldrin accumulates in egg yolks, and while not affecting hatchability, may poison chicks (St. Omer, 1970). The estimated threshold level for toxic effects in eggs is greater than 1 ppm (Blus, 1982).

Dieldrin tends to accumulate in food chains with residue levels increasing with each trophic level transfer (Chadwick and Brocksen, 1969). Residue accumulation is lower in terrestrial ecosystems than in aquatic ecosystems where dosage is continual.

Beyer and Gish (1980) found the average ratios of earthworm residue (DW) to residues in soil (DW) were 8 for dieldrin. Korschgen (1971) reports earthworm concentrates of aldrin-dieldrin residues from 4 to 15 times the level found in field soil. Gile and Gillett (1979) report various insect species had concentration factors 11.9 to 58.4 times the soils level; adult snails had concentration factors 61.4 times the soil level; and voles (*Microtus canicaudis*) from the same microcosm had average concentration factors of 59.5. Earthworms (predominantly *Lumbricus terrestris*) kept in laboratory compost containing 25 ppm dieldrin accumulated from 18.4 to 24.4 mg/kg (FW) dieldrin after 20 days (Jeffries and Davis, 1968). A song thrush (*Turdus philomelos*) fed a diet of earthworms containing 12.38 ppm dieldrin died after 8 days (Jeffries and Davis, 1968). Song thrushes fed diets of earthworms containing from 0.32 ppm to 5.69 ppm dieldrin for 6 weeks accumulated from 0.09 ppm to 4.03 ppm dieldrin. A thrush containing 5.69 mg/kg dieldrin survived but accumulated what would be a lethal concentration if it had metabolized its fat reserves (Jeffries and Davis, 1968).

Newell *et al.* (1987) developed a dietary (fish flesh) NOEL criteria of 0.6 mg/kg for a mallard and 0.2 mg/kg for a hungarian partridge. A final value of 0.12 mg/kg was selected by Newell *et al.* (1987) as the final non-carcinogenic based dietary criterion for piscivorous wildlife based on studies with mink.

Based on a dietary LOEL of 1 ppm, a BCF or total BAF exceeding 25 may result in adverse impacts to sensitive terrestrial bird species. Based on a BCF of 15 for an earthworm and a soil concentration of 38.7 μg/kg, dietary concentrations for small birds would be 0.58 mg/kg, which is slightly below the reproductive dietary LOEL of 1 mg/kg. Based on the maximum song thrush BAF of 1.4, earthworm concentrations of 0.58 mg/kg could result in bird residue levels of 0.812 mg/kg. Should these levels be further magnified in higher trophic level organisms, such as raptors, resulting residue levels could prove hazardous in highly sensitive individuals.

In order for bird residue levels to exceed the 6.8 mg/kg level considered diagnostic of dieldrin poisoning, total BAF would have to exceed 175; or if the earthworm concentration was 0.58 mg/kg (i.e., BCF = 15), the BAF (earthworm to bird) would have to exceed 11.7. Based on an earthworm concentration of 0.58 mg/kg, it appears possible that the BAF for small birds and higher trophic level species may exceed 12 and a potential hazard to higher trophic level species may exist.

Mammals. Adverse effects reportedly occur in rats at dose levels as low as 3.75 mg/kg-bw (50 mg/kg diet). A dietary NOEL (enzyme effects) of 2 mg/kg is reported for a rat, although adverse liver effects have been found at a 1 mg/kg diet in rats (FAO/WHO, 1978). Lethal effects have also been reported in nursing rat pups at dietary concentrations of 2.5 to 10 mg/kg (Harr *et al.*, 1970). The reported LD_{50} value for various laboratory animals ranges from 43 to 64 mg/kg-bw for rats (573 to 853 mg/kg diet), 38 to 75 mg/kg-bw (316 to 625 mg/kg diet) for mice, and 45 to 50 for rabbits (St. Omer, 1970). For voles, the 30-day LC50 ranges from 43 to 129 mg/kg-bw (Cholakis *et al.*, 1981). Newell *et al.* (1987) selected a dietary (fish flesh) NOEL criterion of 0.12 mg/kg for mink.

Based on a BCF of 15 for an earthworm and a soils concentration of 38.7 μg/kg, dietary concentrations for small carnivorous mammals would be 0.58 mg/kg. This value exceeds the Newell *et al.* (1987) criterion for mink but is slightly below the 1 mg/kg dietary effects levels for nursing rat pups. An additional BAF of 5 for small mammals would result in residue level of 2.9 mg/kg. As a dietary concentration, this exceeds the lethal effects level for nursing rat pups. On this basis, successful survival of offspring may be impacted in higher trophic level mammals that consistently feed on small carnivores at the site.

Endosulfan. Endosulfan was detected in 3 of 11 soil boring samples and not in any surficial soil sample. The mean and RME concentrations reported for endosulfan are approximately the same (27 μg/kg).

Birds. LD_{50}s of 35 mg/kg-bw are reported for a wild bird and 33 mg/kg-bw (220 mg/kg diet) for a duck, although no toxic effects were noted in these studies (NIOSH, 1987). Assuming a safety factor of 100 to convert an LD_{50} value to a "no-effects" threshold value, the no-effects threshold value for the wild bird would be 0.35 mg/kg-bw. This is approximately equivalent to a "no-effects" threshold dietary concentration of 1.75 mg/kg, based on the weight and food intake values for a small bird (killdeer). In order for dietary concentrations to exceed the potential effects level for the wild bird, BAFs from soil to dietary organism would have to exceed 65. While it is unlikely that the BAF from soil to earthworm exceeds 65, it is possible that the total BAF from soil to diet for higher trophic level receptors could exceed 65.

Mammals. Oral doses (TD_{LO}) of 45 mg/kg-bw cause adverse reproductive effects in rats; doses of 330 mg/kg-bw are associated with tumorigenic effects in mice (NIOSH, 1987). The human noncarcinogenic reference dose is based on a LOAEL (kidney lesions) of 0.15 mg/kg-bw for a rat (USEPA, 1992c). Oral LD_{50}s are reported for a rat (18 mg/kg-bw), mouse (7.4 mg/kg-bw), cat (2 mg/kg-bw) and rabbit (28 mg/kg-bw) (NIOSH, 1987). Assuming an uncertainty factor of 100 to convert an LD_{50} value to a no-effects level, the no-effects threshold values would be 0.18 mg/kg-bw (2.4 mg/kg diet) and 0.074 mg/kg-bw (0.61 diet), respectively, for the rat and mouse.

In order for dietary concentrations to exceed the potential no-effects level for a rat or mouse, BAFs from soil to diet would have to exceed 88 for the rat and 22 for the mouse. While is unlikely that the BCF for an earthworm would exceed these values (22 or 88), it is possible that the total BAF from soil to diet of higher trophic level receptors could exceed 22 or 88.

Methoxychlor. Methoxychlor was only detected in one of seven surficial soil samples at an RME concentration of 140 μg/kg.

Methoxychlor is a suspected carcinogen with experimental carcinogenic, tumorigenic, and teratogenic data (Lewis, 1992). No toxicological information was found on methoxychlor effects in birds. An oral dose (TD_{10}) of 4,250 mg/kg-bw is associated with reproductive effects in rats (Lewis, 1992). Teratogenic effects in mice are reported at oral doses of 56.7 g/kg-bw (Lewis, 1992). The oral LD_{50} values for a rat and mouse are 5,000 mg/kg-bw and 1,000 mg/kg-bw, respectively. Assuming a safety factor of 100 to convert an LD_{50} to a "no-effects" threshold value would result in dose and dietary values of 50 mg/kg-bw (666 mg/kg diet) for a rat and 10 mg/kg-bw (83 mg/kg diet) for a mouse. In order for the threshold dietary effects level to be exceeded, the BAF from soil to the diet would have to exceed 592. Based on this BAF value, it appears unlikely that exposure to methoxychlor would pose a hazard to small mammals or birds.

Benzenehexachloride (delta-BHC). Delta-benzenehexachloride (BHC), also known as hexachlorocyclohexane (HCH), was detected in 2 of 7 surficial soil samples and 1 of 11 soil boring samples. The RME and maximum concentration for delta-BHC is 19 μg/kg for the three values detected.

Birds. BHC, a persistent organochlorine insecticide, has eight stereo isomers, of which gamma is the most acutely toxic and beta is the least toxic. Toxic effects (reduced hatchability) have been found in chickens at dietary levels of 0.1 to 10 mg/kg g-BHC (Sauter and Steele, 1972). Dietary NOELS for chickens range from 10 to 64 mg/kg (Whitehead *et al.*, 1972; Sauter and Steele, 1972). A dietary NOEL of 0.1 mg/kg was developed by Newell *et al.* (1987) for a bird.

To exceed the dietary NOEL of 0.1 mg/kg, the BCF or total BAF would have to exceed 5.5. Based on this low value, it is considered possible that dietary NOELs for small birds and their predators may be exceeded and that a potential hazard exists.

Mammals. The acute LD_{50} for gamma-BHC in a rat is 76 mg/kg-bw (Newell *et al.*, 1987). Newell *et al.* (1987) developed a dietary NOEL criterion of 2 mg/kg for a mink.

To exceed the dietary NOEL of 2 mg/kg, the total BAF for prey organisms would have to exceed 111. Based on the persistent lipophilic nature of this organochlorine pesticide, it is possible that the total BAF may exceed 111 and a hazard may exist for sensitive higher trophic level receptors.

Dibenzofuran. The RME concentration for dibenzofuran is 79 μg/kg. Dibenzofuran was detected at a lower concentration in one (of 10) soil boring sample (18.0 [J] μg/kg) than in the two (of 7) surficial soil samples (79.0 μg/kg). Little information is available with respect to the toxicity of dibenzofuran. No information for potential adverse effects from dibenzofuran on wildlife was found. EPA's Environmental Criteria Assessment Office (ECAO) currently recommends use of an interim human oral RfD of 4E-03 mg/kg-bw/d for dibenzofuran. Human reference dose values can be considered overprotective of small mammals (and possibly birds) due to the conservative safety factors which are applied in the derivation of the human dose value from laboratory animal data. Oral dose levels protective of mice may be conservatively assumed to be 100 times less than levels protective of humans; i.e., 4E-01 mg/kg-bw (3.3 mg/kg diet). To surpass this no-effects threshold level, the total BAF from soil to diet would have to exceed 41.

Information on the bioaccumulation potential of this chemical in terrestrial ecosystems was not found. If total bioaccumulation (biomagnification) values for this chemical exceed 41, a potential hazard may exist.

6.3.5.2.4 Metals

Four metals, mercury, lead, zinc, and nickel, were selected as COCs for terrestrial biota. Of these four metals, mercury is of the greatest concern because of its strong potential to bioaccumulate and biomagnify in food webs.

Mercury. The RME, mean, and maximum values in soil for mercury are 0.339, 0.245, and 0.96 mg/kg, respectively. RME concentrations are slightly higher in soil boring samples (RME = 0.5 mg/kg) than in surficial soil samples (RME = 0.2 mg/kg). Chemical speciation is one of the most important variables influencing the toxicity of mercury to biota. Methylmercury (MeHg) is the most hazardous mercury species due to its high stability, its lipid solubility, and its possession of ionic properties that lead to a high ability to penetrate membranes in living organisms (Beije and Jernelov, 1979). To evaluate the hazard of a particular mercury concentration, one may assume that 50 percent of the mercury detected is MeHg.

Birds. Average dietary levels of 7 to 10 ppm mercury can result in lethal effects in raptors (Fimreite and Karstad, 1971). For total mercury (inorganic and organic), Nicholson and Osborn (1984) reported a toxic (kidney lesions) dietary level of 1.1 mg/kg (dose of 0.19 mg/kg-bw) for juvenile starlings, which also resulted in elevated residues in the liver (6.5 mg/kg DW, BAF = 5.9) and kidney (36.3 mg/kg, BAF = 33), after exposure for 8 weeks. A dietary NOEL of 32 ppm inorganic mercury is reported for birds (*Coturnix* spp.) (Eisler, 1987c).

An LD_{50} value of 42 mg/kg-bw is reported for inorganic mercury in *Coturnix* (ESE, 1989). LD_{50}s for oral ingestion of organic mercury by birds range from 0.012 to 0.08 mg/kg-bw (McEwen *et al.*, 1973).

Female mallards fed diets of approximately 0.5 μg/kg mercury were found after three generations to have smaller clutches and raise fewer young (Gochfeld and Burger, 1987). Other authors report dietary levels of 0.5 ppm methyl mercury (DW) (approximately equivalent to 0.1 mg/kg FW) are associated with toxic effects in mallards (Wiemeyer *et al.*, 1984; Heinz, 1979). In American black ducks (*Anas rubripes*) fed diets containing 3.0 mg/kg as MeHg for 28 weeks, reproduction was significantly inhibited; tissue residues were elevated in kidney (16.0 mg/kg FW, BAF = 5.3) and liver (23.0 mg/kg, BAF = 7.6) (Finley and Stendell, 1978).

Domestic chickens fed diets containing 50 μg/kg MeHg, contained elevated total mercury (approximately 2.0 mg/kg FW, BAF = 40) residues in liver and kidney after 28 weeks; at 150 μg/kg, residues ranged from 1.3 to 3.7 mg/kg (BAF = 8.6 to 24) in heart, muscle, brain, kidney and liver; at 450 μg/kg in diets, residues in edible chicken tissues (3.3 to 82 mg/kg, BAF = 7.3 to 182) were considered hazardous to human consumers, although no overt signs of mercury toxicosis were observed in the chickens (March *et al.*, 1983).

Toxic tissue levels reported for mercury in birds range from 10 mg/kg (Braune, 1987) to 200 mg/kg (Borg *et al.*, 1969). Raptors may be especially sensitive; liver residues in red-tailed hawks experimentally killed by MeHg were 17 mg/kg (DW) (Solonen and Lodenues, 1984). Grossly elevated tissue residues of 400 mg/kg in feathers and 17 to 130 mg/kg (BAF = 16 to 20) in other tissues were measured in gray partridge (*Perdix perdic*) after dietary exposure of 20 to 25 mg total Hg/kg for 4 weeks (McEwen *et al.*, 1973). Mercury residues of 790 to 2,000 μg/kg in eggs are linked to impaired reproduction in bird species (NAS, 1978). Brain-Hg concentrations as low as 3 to 7 ppm can be lethal to newly hatched ducklings (Eisler, 1987c). Among sensitive avian species, adverse effects, predominantly on reproduction, have been reported at mercury concentrations (in μg/kg FW) of 5,000 in feather, 900 in egg, 50 to 100 in diet and daily administered doses of 640 μg/kg-bw (Eisler, 1987c).

To protect sensitive species of birds, total mercury concentration in prey should probably not exceed 100 μg/kg (Eisler, 1987c). For sensitive birds, harmful levels are 640 μg/kg-bw (daily dose) or 50-100 μg/kg (FW) (diet) (Eisler, 1987c).

If one assumes a BCF of 10 for an earthworm from soil, the dietary concentration for small earthworm-consuming birds would be 3.39 mg/kg based on the RME soil concentration. This is 30 times the USFWS (Eisler, 1987c) recommended dietary level for sensitive birds. This also exceeds the reported dietary toxic effects level for starlings. Based on the preceding literature cited, BAF values (residue/diet) for higher bird species may exceed 100. At total BAF (soil to earthworm to small bird) levels above 20, dietary levels for small bird-eating raptors exceed the recommended dietary limits and the average dietary levels that can result in lethal effects in raptors.

A BAF value of 11 was estimated in one study for transfer of mercury from small mammals to eagles (ESE, 1989). By assuming a BCF of 10 for earthworms and a BAF of 11 for small mammals, final residue levels in a small birds could be as much as 37 mg/kg. This value is within the range of toxic tissue levels reported in birds. A potential hazard is therefore considered to exist for small birds and their predators.

Mammals. A dietary level of 1.0 mg/kg (dose approximately 0.05 mg/kg-bw) is reported for toxic effects in mink. Tissue residues in kidney, blood, brain and hair in excess of 1,100 μg/kg in other nonhuman mammals are usually considered presumptive evidence of significant mercury contamination (Eisler, 1987c). A NOEL oral dose level of 0.01 mg/kg-bw MeHg is reported for rats (ESE, 1989). A toxic oral dose of 2.0 mg/kg-bw organic mercury is reported for rats (USDHHS, 1987). The lowest dietary concentration known to produce obvious signs of MeHg intoxication and mortality in adult animals is approximately 5 mg/kg DW (1-1.6 WW) (Eisler, 1987c).

To protect sensitive species of mammals that regularly consume fish and other aquatic organisms, total Hg concentration in these food items should probably not exceed 1,100 μg/kg (Eisler, 1987c). Dose levels of 250 μg/kg-bw (daily dose) are also considered harmful to sensitive mammals (Eisler, 1987c).

If one assumes a BCF of 10 for an earthworm from soil, the dietary concentration for small, earthworm-consuming mammals would be 3.39 mg/kg, based on the RME soil concentration. Such dietary concentrations exceed the level considered harmful to sensitive species such as a mink (Eisler, 1987c). Dietary levels of 3.39 mg/kg are equivalent to a dose level of 0.40 mg/kg-bw for mice and 0.25 mg/kg-bw for rats. The total Hg oral dose level for a rat is below the toxic oral dose for MeHg, but 25 times the NOEL oral dose level for MeHg. Based on these values, it appears possible that a potential hazard exists for mammals that are continuously exposed to such soil and dietary concentrations.

Lead. Lead was detected in all 18 samples at an RME concentration of 267 mg/kg. The RME lead concentration in surficial soil is approximately two times higher than the RME concentration for soil boring samples.

Lead is neither essential nor beneficial to living organisms and is potentially toxic in most of its chemical forms (Eisler and Gardner, 1988). In nature, lead occurs primarily as Pb^{2+}. Total concentrations of several hundred ppm lead in soils are usually required before plants exhibit adverse effects such as growth inhibition or reduced photosynthesis (Eisler and Gardner, 1988). Only a small portion of lead in soil becomes incorporated into plant foliage, and much of the lead contamination detected in biota is often due to aerial deposition. Food chain bioaccumulation of lead is uncommon in terrestrial species (Eisler and Gardner, 1988). The highest body burdens of lead are reported in mammals near urban areas of dense vehicular traffic. Diet provides the major pathway for lead exposure.

As with mercury, chemical speciation is one of the most important variables influencing the toxicity of lead to biota. Trialkyllead salts in particular are 10 to 100 times more toxic to birds than are inorganic lead salts; they tend to accumulate in lipophilic soft tissues in the yolk and developing embryo and have a high potential as neurotoxicants (Forsyth *et al.*, 1985).

Birds. NOAELs in birds range from 6.6 mg/kg-bw for the red-tailed hawk to 50 mg/kg-bw for kestrel and 1,850 mg/kg-bw for a chicken (Lawler *et al.*, 1991; Franson *et al.*, 1983; Eisler and Gardner, 1988). No effects on growth were found at dietary levels of 500 mg/kg for mallards and pheasants (Hoffman *et al.*, 1985a,b). At dose levels producing no overt signs of toxicity, neurobehavioral deficits have been documented in warm-blooded organisms (USEPA, 1980b, 1985a).

Nestlings of altricial species (those confined to nest after hatch) may be considerably more sensitive to lead exposure than adults or hatchlings of many precocial species (mallards and pheasants) (Hoffman *et al.*, 1985a). Dietary levels of 125 mg/kg have been shown to result in reduced growth rates or increased mortality in nestling kestrels (Scheuhammer, 1991).

Postmortem examination of lead-poisoned birds found elevated levels in liver (> 2 mg/kg FW; 10 mg/kg DW) and kidney (>6 mg/kg DW) (Eisler and Gardner, 1988). Liver residues in lead-poisoned birds range from 3.1 to 15 mg/kg FW (Kendall and Scanlon, 1985). Although no measurable adverse effects were noted in kestrels fed dietary levels of 10 mg/kg (metallic powder), tissue levels in bone and kidney were elevated (Franson *et al.*, 1983; Pattee, 1984).

On the basis of total heavy metal content of earthworms relative to soil, the concentration factor for lead is generally in the range of 0.1 to 1.0 (Ireland, 1975). Assuming concentrations in diet are similar to those in soil, dietary levels for small birds could be 267 mg/kg (dose = 53.4 mg/kg-bw). These dietary and dose levels suggest that adverse impacts to adult small birds are unlikely, but nestling small birds may be impacted. Small bird or dietary concentrations for higher trophic level species are likely to be considerably less than soil concentrations, as lead is not expected to bioaccumulate through food chains. A potential hazard for predatory nestling species is therefore considered to be unlikely.

Mammals. A NOAEL of 20 mg/kg-bw is reported for a shrew (Ma *et al.*, 1991). TDLOs for mice range from 0.05 mg/kg-bw (ALAD depression) to 6300 mg/kg-bw (NIOSH, 1987, Eisler and Gardner, 1988).

No criteria have been proposed by USEPA for lead in wildlife tissues connoting elevated or hazardous levels to wildlife. The National Research Council (1980) considers 25 ppm in the kidney cortex (DW) to be diagnostic of lead poisoning in domestic animals. At the IOWA Veterinary Diagnostic Laboratory, liver or kidney levels of 10 mg/kg (WW) are considered significant (Osweiler and Van Gelder, 1978).

Body burdens for lead are highest in insectivores such as shrews, and intermediate in herbivores and lowest in granivores (Boggess, 1977). Accumulations are highest in hard tissues, such as bone and teeth and lowest in soft tissues, such as fat and muscle (Braham, 1973).

Assuming a dietary (earthworm) concentration for lead equal to the soil RME concentrations (267 mg/kg), results in a dose level of 32 mg/kg-bw for a mouse, which is only slightly above the NOAEL level reported for shrews. Enzyme (ALAD) levels, however, may be affected at this dose level. While residue levels may become slightly elevated at such a dose level, the potential effects that may occur in small mammals are not considered to pose a significant hazard.

Zinc. Zinc was detected in all 18 soil samples at an RME concentration of 232 mg/kg. The RME surficial soil concentration (289 mg/kg) is approximately the same as the RME boring concentration (255 mg/kg). The highest maximum value detected (550 mg/kg) was in a surficial soil sample.

Zinc is relatively non-toxic to animals due to efficient homeostatic mechanisms. Zinc is principally phytotoxic, so most concerns about this metal are directed at effects on soil fertility. In most countries, the maximum permissible total zinc concentrations in sludge are in the range of 1,000 to 5,000 ppm zinc, with an average of 2,500 to 3,000 ppm zinc (Alloway, 1990). Levels for domestic animals from 300 to 1,000 ppm in diet appear to be safe depending on species (NAS, 1980).

For zinc, concentrations tend to increase with increasing pollution, but not proportionally, so that the concentration factor in earthworms tends to fall as soil concentrations rise. Gish and Christensen (1973) recorded concentration factors of 1.83 where the soil level was 13.4 mg/kg and the earthworm level was 24.6 μg/kg; and 1.37 where the soil level as 25.1 mg/kg and the earthworm level was 34.5 ug/g.

Based on this information, soil concentrations at this site are probably not phytotoxic and are not considered to pose a risk to small birds or mammals present on the site.

Nickel. Nickel was detected in all 19 soil samples at an RME concentration of 90.0 mg/kg. RME concentrations for nickel in surficial soil (211.4 mg/kg) are approximately 10 times higher than concentrations in the soil borings (27.7 mg/kg). The maximum nickel concentration (477 mg/kg) was detected in a surficial soil sample.

Nickel is an essential element required for growth and iron absorption (NAS, 1980). Data on the toxicity of nickel show a wide variation in the amounts required to produce adverse effects (NAS, 1980). The toxicity of nickel depends on chemical form, and the animal species, reproductive status, duration of administration, and nutrient content of diet (NAS, 1980).

Biomagnification through food chains has not been demonstrated in aquatic organisms (Kay, 1984) and also is not expected in terrestrial receptors (Alberici *et al.*, 1989; Dressler *et al.*, 1986; NAS, 1975). Although nickel may accumulate to elevated levels in certain "hyperaccumulator" plant species, nickel is not a lipophilic compound like the organochlorine COCs, and therefore not expected to biomagnify.

Nickel can be toxic to plants even at relatively low concentrations. Concentrations as low as 2 mg/kg in nutrient solution can be toxic to beans, maize, and oats (Vergnano and Hunter, 1952). Dietary concentrations of 500 ppm nickel sulfate can result in adverse effects (decreased growth) in avian species (Webber and Reid, 1968). Adverse effects are reported for Mallard ducklings at dietary levels of 800 μg/kg nickel sulfate after 28 days (Cain and Pafford, 1981).

The lowest dose levels associated with adverse effects (neurological and reproductive effects, tissue abnormalities) in mammals are 44 mg/kg-bw (366 mg/kg diet) for a mouse and 25 mg/kg-bw (333 mg/kg diet) for a rat (Gray *et al.*, 1986; Sobti and Gill, 1989; Dieter *et al.*, 1988; Waltschewa, 1972). A dietary level of 100 ppm has been designated as a NOEL for rats (Ambrose *et al.*, 1976; Whanger, 1973) Reduced body weight was reported in a lifetime rat study at a dietary concentration of 5 ppm (Schroeder *et al.*, 1974). The National Research Council (1975) reports the following from the literature: 1 to 3 g/kg-bw nickel metal is nontoxic to dogs; 1,000 ppm of nickel carbonate in young rat diet is nontoxic; 5 ppm of nickel acetate in drinking water of mice over a lifetime is nontoxic.

Because nickel is not thought to bioaccumulate in most plant species or biomagnify in animals, dietary concentrations for nickel are not likely to be greater than soil concentrations. RME concentrations in soils at the site are slightly above the designated dietary NOEL for rats, but below dietary levels associated with adverse effects in birds, mice and rats. RME soils concentrations are well above the 5 ppm dietary concentration associated with weight loss in rats.

Based on the preceding information, nickel concentrations at the site are not considered to pose a significant hazard to terrestrial species present at the site but may prove toxic to some sensitive plant species.

6.3.6 Tidal Wetlands Exposure Assessment/Ecological Hazard Evaluation

An exposure assessment and hazard evaluation were not conducted for tidal wetlands because any effects to the wetlands are considered off-site and are to be an element of the Supplemental RI.

6.3.7 Estuarine Exposure Assessment/Ecological Hazard Evaluation

Following is the exposure assessment and hazard evaluation of the estuarine ecosystem directly adjacent to the Pelham Bay Landfill. In the first section (6.3.7.1), exposure of the estuarine receptors to the selected ecological COCs is described. In the second section (6.3.7.2), the tissue concentrations and hazards associated with exposure to the chemicals are assessed. Section 6.3.7.2 is organized according to the relative ranking of potential COC hazards as discussed in Section 6.3.4.3 and shown in Table 6-35.

6.3.7.1 Estuarine Exposure Assessment

As discussed previously, this EHE focuses on potential on-site effects of the Pelham Bay landfill on the environment. The exposure assessment of the on-site estuarine habitat focuses on groundwater/leachate analytical data but also includes, where appropriate, information related to the other abiotic matrices of sediment and surface water.

By focusing the EHE on the groundwater/leachate matrix in the estuarine habitat, the physical area that can be described as the exposure point is limited to the riprap and the bottom sediments extending from the toe of the landfill to the mean high tide elevation. This is the area that is potentially directly affected by groundwater/leachate seeps discharging through the riprap. Small localized areas of groundwater/leachate seepage were seen and sampled at several locations along the edge of the landfill during the 1992 sampling.

It is assumed that small volumes of groundwater/leachate move slowly into the surface waters and that the groundwater/leachate becomes diluted by the large volume of water that flows past the landfill during tidal cycles. This has been demonstrated by tidal prism calculations presented in Section 5. However, for purposes of the on-site EHE for the estuarine ecosystem, the following effects are not estimated or considered: sorption of contaminants onto soils and sediments as the groundwater/leachate passes through these matrices, dilution of contaminants by interstitial waters, and other processes that tend to reduce concentrations of contaminants before the water reaches the exposure point. These and other applicable fate and transport processes will be considered in the offsite risk assessment to be completed as part of the Supplemental RI Report.

The key receptors used in the estuarine EHE are blue mussel, hard clam, Atlantic silverside, waterfowl, and raptors. Small populations of the three aquatic receptors, blue mussel, hard clam, and Atlantic silverside, could be directly exposed to groundwater/ leachate. A limited portion of the blue mussel population near the landfill could be directly exposed to leachate that leaks out through the riprap. Similarly, a small proportion of the hard clams buried in the soft sediments at the toe of the riprap could be directly exposed to groundwater/leachate that moves up through the sediments. Atlantic silversides, like most forage fish species, are expected to have a small home range. A limited number of Atlantic silversides that inhabit the shallow waters along the landfill could occasionally be directly exposed to groundwater/leachate if they forage for food between the riprap or in sediments along the toe of the riprap. Most of the three aquatic receptor species populations are expected, however, to be in contact with Eastchester Bay water (i.e, surface water) containing dilute concentrations of ecological COCs most of the time. Because most of the three populations are not expected to be exposed to the groundwater/leachate, the exposures and potential hazards described in this EHE are not thought to have an effect at the population or community levels.

Waterfowl/wading birds and raptors may be exposed to on-site COCs through the aquatic food web or through direct ingestion of sediments. Waterfowl and wading birds in the area may directly ingest sediments or may eat small forage fish and invertebrates that may have bioconcentrated chemicals in their tissues. Some waterfowl at Pelham

Bay, such as the common merganser, are obligatory piscivores (fish eaters), with fish providing over 95 percent of their diet (Newell *et al.*, 1987). Other waterfowl species, such as the Buffelhead, consume approximately 20 percent fish and 80 percent animal matter (Newell *et al.*, 1987). Wading birds, such as the great blue heron, have diets that are up to 85 percent fish (Newell *et al.*, 1987). Raptors are included in the estuarine ecosystem as they include species such as osprey, which are obligatory piscivores, and northern harrier, whose diet may include waterfowl or wading birds.

Tissue samples of several potential aquatic receptors were collected in 1992 and analyzed for pesticides, PCBs, and selected metals (cadmium, lead, and mercury). Results of the tissue analyses for Atlantic silverside, blue mussel, and hard clam are presented in Tables 6-36, 37, and 38, respectively. The Atlantic silverside analyses were of whole bodies, and the bivalve analyses were of the soft tissues. Tissue concentrations of the analytes are presented in terms of both wet weight and dry weight for purposes of comparison to various literature values that may be available.

A pathways diagram was prepared for each ecological COC retained for assessment. The diagram shows the source and potential exposure point for the COCs (the groundwater/leachate), pathways through which COCs can move, bioconcentration factors (BCFs), bioaccumulation factors (BAFs), and subsequent exposure points and receptors. The pathways and receptors (blue mussel, hard clam, Atlantic silverside, waterfowl/wading birds, and raptors) evaluated in this EHE are shown in the diagram with solid lines. Measured and estimated concentrations of the ecological COCs at the exposure point and receptors also are indicated. Broken lines represent contaminant pathways that have not been evaluated to date. The other two receptors illustrated (blue crab and flounder) are not evaluated because they are mobile species that are not expected to have direct exposure to the groundwater/leachate. Although waterfowl/wading birds and raptors are addressed in this EHE, direct sediment ingestion pathways for avian receptors are not considered. These other receptors and pathways will be evaluated in the ERA be incorporated into the Supplemental RI Report.

The following exposure assessment presents information used to construct pathway diagrams for each ecological COC and to estimate residue concentrations in each key receptor. Information on BCFs for aquatic species was obtained largely from EPA AWQC documents and from the AQUIRE database. Information on BAFs for avian species was obtained from available published literature. Much of the information on avian BAF values was presented in Section 6.3.6.2, the EHE for terrestrial soils. Additional parameters (weight/food intake) used for estuarine-only avian receptors, such as the osprey, are presented in the following section. Species-specific data are used in the following exposure assessment and hazard evaluation where available.

6.3.7.2 Estuarine Ecological Hazard Evaluation

Following are EHEs for the selected estuarine ecosystem receptor species and ecological COCs to which they are potentially exposed in groundwater/leachate from the Pelham Bay Landfill.

6.3.7.2.1 Mercury

Mercury was detected in groundwater/leachate at a RME concentration of 0.885 μg/L and a maximum concentration of 5.0 μg/L (total mercury) (Table 6-30). The RME (i.e., 95th UCL) concentration exceeded the New York State water quality standard of 0.1 μg/L and the federal ambient water quality chronic criteria of 0.025 μg/L. Pathways, BCFs, and groundwater/leachate and mercury tissue concentrations are shown in Figure 6-9.

It is important to note that the 1992 mercury concentrations in surface water were higher than those in the groundwater/leachate. The surface water RME and maximum concentrations of total mercury were 2.25 and 9.5 μg/L (Table 6-28) in contrast to 0.885 and 5.0 μg/L in groundwater/leachate. Because of these elevated surface water concentrations, aquatic receptors are exposed to higher mercury concentrations in surface water than they are in groundwater/leachate. Sediments near the landfill, which are affected by surface water, were found to contain a RME total mercury concentration of 0.998 mg/kg (Table 6-29). Methyl mercury (MeHg) concentrations were not determined for water, sediment, or tissue samples.

Bivalves and Fish. Mercury tissue concentrations are for total mercury on a fresh-weight (i.e., wet-weight) basis. MeHg BCFs in invertebrates and fish are reported as 100,000 and 1,670, respectively (Chapman *et al.*, 1968). The range of MeHg BCFs reported for the mosquitofish (*Gambusia affinis*) in AQUIRE (USEPA, 1993) is 2,500 at 10°C and 4,300 at 26°C. The estimated MeHg BCF used in this exposure assessment for the Atlantic silverside is 3,000, based on the assumption that the ambient temperature is close to 15°C. Because MeHg is preferentially assimilated from water, these BCFs can be reduced by a factor of 2 to 20 to reflect the BCFs for inorganic mercury (Pentreath, 1976 a,b,c; Fowler and LaRosa, 1978).

Following the method for estimating trophic transfer of inorganic mercury used by Evans and Engle (1992), BCFs for total mercury are reduced by a factor of ten (10) from those for methyl mercury. Based on the BCF of 10,000 for inorganic mercury in invertebrates, the estimated tissue concentration of total mercury in the blue mussel or hard clam is 8.8 mg/kg. The estimated total mercury level in the Atlantic silverside is 0.27 mg/kg based on the estimated inorganic mercury BCF of 300 for fish. The estimated total mercury levels in the two bivalve species are greater than the measured levels in the blue mussel (0.035 mg/kg) and hard clam (0.037 mg/kg). The estimated concentration of total mercury in the Atlantic silverside (0.27 mg/kg) also is more than the measured concentration (0.049 mg/kg) (Figure 6-9).

Differences in the relative concentrations could be due to several factors. These factors include differences in total mercury in the water directly affecting the various aquatic receptors, different percentages of MeHg in the groundwater/leachate and surface water, different exposure concentrations of mercury to the bivalves and Atlantic silverside, and the application of BCFs for total mercury that are not appropriate for the actual percentage of MeHg present. Because of the large differences between estimated and measured concentrations in bivalve and Atlantic silverside tissues, the measured total mercury concentrations are used to estimate tissue concentration in avian receptors.

Because of the two bivalves' sedentary nature, the exposure concentration is compared to available information concerning sublethal (chronic) effects. Although the RME total mercury concentration of 0.885 μg/L exceeds the state and federal chronic water quality benchmarks, it is at least an order of magnitude lower than any reported chronic effect levels for bivalves or other invertebrates seen in the toxicological literature reviewed. For example, at 32 μg/L mercuric chloride, abnormal development was noted in blue mussel larvae (Okubo and Okubo, 1962); and at 400 μg/L MeHg, a significant reduction in feeding rate by mussels was recorded (Dorn, 1976). Because MeHg was not measured and the percentage of MeHg in groundwater/leachate cannot be otherwise estimated, direct comparisons of total mercury to available toxicity data are not possible. However, the MeHg concentration in groundwater/leachate cannot be greater than the total mercury concentration of 0.885 μg/L.

Because the Atlantic silverside is mobile and would be exposed to groundwater/leachate for limited periods of time while foraging among the riprap, the RME concentration of 0.885 μg/L is compared primarily to acute effects concentrations. For example, Cardin (1982) reports that the ambient concentration of mercuric chloride that is lethal to 50% of the test organisms (LC_{50}) is 125 μg/L for Atlantic silverside larvae and 86 μg/L for juveniles. These acutely lethal concentrations are at least two orders of magnitude greater than the groundwater/leachate RME concentration of total mercury.

At 10 to 40 μg/l mercuric chloride, sublethal effects such as developmental abnormalities were noted in mummichog (Fundulus heteroclitus) embryos (Weis and Weis, 1977), and at 125 μg/l mercuric chloride, osmoregulation of adult mummichogs was noted (Rentro, et al, 1974).

Based on these comparisons of RME total mercury concentration to chronic and acute concentrations, it is unlikely that there is any measurable risk to the blue mussel, hard clam, or Atlantic silverside from mercury in the groundwater/leachate. However, the aquatic receptors may also be exposed to a surface water concentration of 2.25 μg/L total mercury that is significantly higher than the total mercury concentration in the groundwater/leachate.

<u>Birds</u>. BAF values for mercury for several bird species were estimated based on diet to tissue residue ratios as reported in the literature. BCFs values estimated in Section 6.3.6.2.4 range from 5.9 to 33 for total mercury in juvenile starlings and up to 182 for Me Hg in domestic chickens. BCFs of 16 to 20 are estimated for gray partridge, ESE (1989) estimated a BCF of up to 4.8 for transfer of total mercury from pike to the bald eagle. BCFs of 5 to 7 were also estimated for MeHg in black ducks.

A BAF of 10 was selected for use in this exposure assessment to estimate resulting residue (whole body or tissue) levels in both the mallard and raptor. For an obligatory piscivore (waterfowl, wading bird, or raptor), resulting tissue concentrations could range up to 0.49 mg/kg. Resulting tissue concentrations for a raptor whose diet contains a high percentage of obligatory piscivores could thus be 4.9 mg/kg (total mercury in total body, FW).

The estimated tissue residue concentrations of 0.49 mg/kg and 4.9 mg/kg in obligatory piscivores are below the toxic tissue threshold value (10 mg/kg) reported for mercury in birds (Braune, 1987). Measured mercury concentrations in estuarine prey (mussels, clams, silversides), however, are near the lower level of the recommended dietary threshold range of 50 to 100 μg/kg for sensitive birds (Eisler, 1987).

Among sensitive avian species such as raptors, adverse effects on reproduction have been reported at dietary concentrations of 0.05 mg/kg (Eisler, 1987), which is approximately equal to the measured silverside concentration of 0.049 mg/kg. Based on the USFWS (Eisler, 1987) recommended threshold dietary value for sensitive species, a potential hazard (reproductive effects) may exist for piscivores feeding largely on silversides (e.g., waterfowl/wading birds). A potential hazard may also exist for higher tropic level avian piscivores or raptors that largely feed on waterfowl/wading birds.

6.3.7.2.2 Copper

Copper was detected in the groundwater/leachate at a RME concentration of 221 μg/L and maximum concentration of 977 μg/L. The RME concentration for total copper, which is used as the basis for comparison, is approximately two orders of magnitude greater than the New York State surface water standard of 2.9 μg/L (dissolved) and the federal acute criteria of 2.9 μg/L (total recoverable). These is no chronic benchmark for copper. Pathways, BCFs, and groundwater/leachate and biotic concentrations of copper are shown in Figure 6-10.

Bivalves and Fish. Animal tissue samples collected during the 1992 sampling were not analyzed for copper. Copper has been shown to bioconcentrate in aquatic organisms, especially in the liver and gills (Phillips and Russo, 1978; Jenkins, 1980). However, biomagnification of copper has not been established (Windom *et al.*, 1973; Ellis *et al.*, 1980). Chapman *et al.* (1968) reports a BCF of 1,670 for marine invertebrates and 667 for marine fish. BCFs for the bivalves (hard clam and blue mussel) are reported to be 88 to 90 (Schuster and Pringle, 1968; Phillips, 1976). Ellis *et al.* (1980) reported tissue levels of copper from New Jersey waters as follows: hard clam - 46 mg/kg, blue mussel - 8 mg/kg, and mummichog - 145 mg/kg.

Based on these reported BCFs and tissue concentrations for copper, the BCFs used in the exposure assessment are 90 for the bivalves (based on data in Schuster and Pringle, 1968 and Phillips, 1976) and 670 for the Atlantic silverside (based on data in Chapman *et al.*, 1968). These BCFs applied to the RME copper concentration in groundwater/

leachate results in estimated tissue levels in the bivalves and silverside of 20 and 148 mg/kg, respectively (Figure 6-10).

According to data reported in USEPA (nd), the species mean acute values (SMAVs) for the blue mussel, eastern oyster (*Crassostria virginica*), and soft-shell clam (*Mya arenaria*) are 5.8, 28, and 39 μg/L, respectively. The SMAV for the Atlantic silverside is 136 μg/L and for the congeneric species tidewater silverside (*Menidia peninsulae*) is 140 μg/L (USEPA nd). The SMAV is an interim value used by the USEPA in calculating the ambient water quality criteria; it often is the same concentration as the reported LC_{50} concentration if there are no other acceptable data available for the species of interest.

Based on these available data, the estimated toxic thresholds (acute) for the receptor species are as follows: blue mussel - 5.8 μg/L, hard clam - 39 μg/L, and Atlantic silverside - 136 μg/L. Chronic acute toxicity screening concentrations for the blue mussel and hard clam are estimated to be 2.9 and 2.0 μg/l, respectively, using methods in USEPA (nd). The hazard evaluation is based on a comparison of the RME concentration of copper in the groundwater/leachate (221 μg/L) to the toxicity thresholds for the receptor species and the exposure scenario described in Section 6.3.6. According to the exposure scenario, some small segments of the blue mussel and hard clam populations are expected to be directly exposed to the on-site groundwater/leachate. These bivalves are likely to be at risk from the elevated levels of copper. The remaining majority of the two bivalve populations are not likely to be at risk because they are not in direct contact with the groundwater/leachate.

Because the RME concentration of copper exceeds the SMAV for the Atlantic silverside, it appears likely that the silverside in direct contact with groundwater/leachate while foraging among the riprap or along the toe of the riprap are at risk from copper. However, the majority of the silversides are not expected to be in direct contact with the groundwater/leachate and are not likely to be at risk because of the copper.

Birds. Copper is not expected to persist and bioaccumulate like mercury or pesticides through an avian food web. The evaluation of potential hazards was therefore limited to birds ingesting blue mussels and Atlantic silverside, and did not include consideration of raptors ingesting waterfowl/wading birds.

The maximum recommended threshold dietary level for chickens and turkeys is 300 mg/kg (NAS, 1980). Estimated concentrations for the silverside and blue mussel are well below this level. A dietary NOAEL of 250 mg/kg is also reported for mallards (NAS, 1977). Based on these available values, estimated copper concentrations in Atlantic silverside, blue mussels, and hard clams at the site are not considered to pose a hazard to avian receptors.

6.3.7.2.3 4,4'-DDD and 4,4'-DDE

DDD and DDE are degradation products of DDT and also are found at low concentrations within manufactured DDT. DDD and DDE were detected in groundwater/leachate at RME concentrations of 0.037 and 0.051 μg/L, respectively (Table 6-30). Both RME values exceeded the New York State water quality standard of 0.001 μg/L, but the federal acute criteria of 14 μg/L for DDE, which is the lowest observed effect level (LOEL) was not exceeded. DDD and DDE were not detected in surface waters but were detected in sediments near the landfill (Tables 6-29 and 37). DDD, which was detected at a RME concentration of 133 μg/kg, exceeded the New York State sediment cleanup criteria of 17 μg/kg. Figures 6-11 and 6-12 present the estuarine pathways, exposure and tissue concentrations of DDD and DDE.

Bivalves and Fish. DDD and DDE (in addition to DDT) are known to bioconcentrate, but data supporting biomagnification in the marine/estuarine food web are equivocal (Courtney and Langston, 1980; Bjerk and Brevik, 1980). Because DDT and its metabolites are lipid-soluble, their concentrations in fatty tissues are approximately 100 times greater than those in whole body analyses. BCFs for DDD in aquatic systems are reported by Callahan *et al.* (1979) to be in the range of 10^3 to 10^5. BCFs for DDE are in the range of 10^4 to 10^5. There are no BCF values available for DDD or DDE in USEPA (1980c). A search of the AQUIRE data base (USEPA, 1993) revealed no BCFs for DDD and only a limited number of BCFs for DDE in the mosquitofish. BCFs for DDE in the mosquitofish were reported as 108 to 217 over 24 to 72 hours (USEPA, 1993). For this assessment, a whole-body BCF of 10^4 was used for both DDD and DDE.

As shown in Figure 6-11, DDD was not detected in hard clam or Atlantic silverside tissues sampled in 1992. DDD was found in the blue mussel at 0.0193 mg/kg (wet weight). Estimated tissue levels of DDD based on a BCF of 10^4 in all three aquatic receptors is 0.37 mg/kg. These estimated tissue concentrations may be found in the few receptors that are in direct contact with the groundwater/leachate. The measured DDD tissue concentration in the blue mussel is likely more representative of the DDD level in most of mussels not in contact with the groundwater/leachate.

DDE was not detected in hard clam tissue, but was detected in the blue mussel and Atlantic silverside tissue at RME levels of 0.014 and 0.052 mg/kg (WW). Estimated tissue concentrations of DDE in the three aquatic receptors are 0.51 mg/kg (WW), which is an order of magnitude higher than the measured concentrations. As in the DDD tissue concentrations, receptors in direct contact with the groundwater/leachate may have the estimated tissue levels of DDE; those not in direct contact are likely to have lower levels as seen in the measured tissue concentrations.

Based on data presented in USEPA (1980c), neither of these groundwater/leachate concentrations appears to be acutely toxic to the receptors. However, relative to the data available for DDT, there are only limited toxicity data available for DDD and DDE and their effects on aquatic receptors or surrogate species. This lack of data is especially pronounced for chronic toxicity data.

Comparisons of listed values for acute toxicity of DDT, DDD, and DDE to three aquatic species indicate that DDT is approximately one order of magnitude more toxic than DDD or DDE. Following is a table of toxicity values compiled from the ambient water quality document for DDT (USEPA, 1980c) and the AQUIRE data base (USEPA, 1993):

Species	DDT (μg/L)	DDD (μg/L)	DDE (μg/L)
Eastern Oyster	7.9	25	14
Korean Shrimp	0.38	3.6	N/A
Striped Bass	0.53	2.5	N/A
Atlantic Silverside	0.4	N/A	N/A

N/A Data not available

For the eastern oyster, the toxic concentrations for DDT, DDD, and DDE are SMAVs (USEPA, 1980c). The 14 μg/L level for DDE in the oyster also is an EC_{50} value (the concentration that affects growth in 50 percent of the oysters) (USEPA, 1993). For the

Korean shrimp (*Palaemon macrodactylus*), the SMAVs for DDT and DDD are 0.38 and 3.6 μg/L (USEPA, 1980c). Striped bass (*Morone saxatilis*) LC_{50}s (and SMAVs) for DDT and DDD are 0.53 and 2.5 μg/L (USEPA, 1980c).

Using this order-of-magnitude relationship and the reported SMAV for DDT in Atlantic silverside (0.4 μg/L) (USEPA, 1980c), it is estimated that the LC_{50}s for DDD and DDE in the Atlantic silverside are both 4.0 μg/L. It appears that bivalves (e.g., oysters) are less sensitive to DDT and its metabolites than fish (e.g., striped bass). Using this relationship and the reported EC_{50} value of 14 μg/L for DDE in the eastern oyster, it is conservatively estimated that the chronic toxicity concentrations of DDD and DDE for the blue mussel and hard clam are both 14 μg/L.

For DDD, the RME concentration in groundwater/leachate is 0.037 μg/L, and the estimated acutely toxic threshold levels are 14 and 4.0 μg/L for the two bivalves and Atlantic silverside, respectively. Based on the two orders of magnitude difference between the RME concentration and the estimated toxic thresholds, it is unlikely that any of the aquatic receptors (blue mussel, hard clam, or Atlantic silverside) are at risk from direct exposure to DDD in the groundwater/leachate.

For DDE, the RME concentration in groundwater/leachate is 0.051 μg/L, and the estimated acutely toxic levels are 14 and 4.0 μg/L for the blue mussel/hard clam and the Atlantic silverside. Based on these measured concentrations of DDE and the estimated toxic levels, it appears unlikely that the aquatic receptors are at risk from exposure to DDE in the groundwater/leachate.

Although the aquatic receptors are unlikely to be at risk from DDD or DDE in the groundwater/leachate, as prey organisms, their tissue concentrations of the DDT metabolites may represent a potential hazard to higher trophic level receptors.

Birds. BAFs of 12 to 24 for DDE are reported for the American kestrel, which largely feeds on mammals, while black ducks can accumulate DDE from diet by factors of approximately 80 (Szaro, 1978). DDE concentrations in kestrel and black duck eggs may be 12 and 25 times higher than in diet (Szaro, 1978).

For this exposure assessment, a BAF of 10 was assumed for DDD and DDE in waterfowl from either the blue mussel or Atlantic silverside pathways. For DDD, this results in waterfowl residue concentrations of 0.19 mg/kg, based on a measured blue mussel concentration, or 3.7 mg/kg, based on estimated silverside or hard clam concentrations. Egg concentrations for waterfowl could be up to 25 times higher, however, resulting in egg residue levels of 4.75 mg/kg based on the measured blue mussel concentration and up to 9.25 mg/kg based on the estimated Atlantic silverside concentration.

Potential DDD residue levels in piscivorous raptors and their eggs could also be as high as 3.7 mg/kg and 9.25 mg/kg, respectively, based on silverside concentrations. Potential residue levels in raptors whose diet is largely waterfowl/wading birds could be as high as 37 mg/kg based on the Atlantic silverside pathway, with egg residue levels for such raptors as high as 92.5 mg/kg. Based on the more reasonable measured blue mussel concentrations, estimated residue concentrations for a waterfowl-ingesting raptor would be 1.9 mg/kg with egg residue levels of 4.75 mg/kg.

Residue concentrations of DDE in waterfowl and raptors are expected to be slightly lower than DDD levels due to lower estimated and measured concentrations in silversides and bivalves. For DDE, estimated waterfowl residue concentrations are 0.14 mg/kg, based on a measured blue mussel concentration, or 0.52 mg/kg based on a measured Atlantic silverside concentration. DDE residue concentrations in eggs could range from 0.35 mg/kg (based on measured blue mussel concentrations) to 1.3 mg/kg (based on measured Atlantic silverside concentrations).

Potential DDE residue levels in piscivorous raptors could also be as high as 0.52 mg/kg with egg residue concentrations up to 1.3 mg/kg. Potential residue levels in raptors whose diet is largely waterfowl/wading birds could be as high as 5.2 mg/kg with egg residue levels up to 13 mg/kg.

As discussed in the terrestrial soils EHE, eggshell thinning and reproductive impairment are the principal endpoints of concern in birds for DDT and the other organochlorine pesticides. To prevent eggshell thinning, NYSDEC dietary NOELs for piscivorous birds are set at 0.2 mg/kg (brown pelican), 2.0 mg/kg (mallard/black duck), and 1.5 to 5.0 mg/kg (bald eagle) (Newell *et al.*, 1987).

None of the measured blue mussel, hard clam, or silverside DDD or DDE concentrations exceed these NOEL values. Only the estimated DDD silverside concentration (0.37 mg/kg) slightly exceeds any of these NOELs. Based on these estimated (not measured) values, actual dietary levels for piscivorous avian receptors are uncertain, and actual hazards to these receptors may be unlikely.

Based on a BAF of 25, reasonable egg residue concentrations for waterfowl may be as high as 0.47 mg/kg for DDD (based on measured blue mussel concentrations) and 1.3 mg/kg for DDE (based on measured Atlantic silverside concentrations). Egg residue levels greater than 15 mg/kg (WW) result in 100 percent lethality for bald eagles (Wiemeyer *et al.*, 1984). Potential hazards to waterfowl/wading birds or raptors cannot be ruled out based on the estimated egg residue levels compared to this lethal value of 15 mg/kg.

Raptors whose diet largely consists of piscivorous waterfowl/wading birds may accumulate higher levels of DDE/DDD. Estimated DDD residue levels in waterfowl/wading birds equal or exceed the USEPA dietary NOELs for the brown pelican, duck, and eagle. Estimated DDE residue levels are below the USEPA dietary NOELs for ducks and eagles, but above the dietary NOEL for the brown pelican. Based on the measured DDD concentration in blue mussels, waterfowl/wading birds could accumulate DDD to a level near the USEPA dietary NOEL of 0.2 mg/kg for the brown pelican (most sensitive species). A potential hazard may therefore exist if raptors feeding on waterfowl or wading birds are as sensitive as brown pelicans.

DDD appears to pose a potential hazard to higher trophic level raptors only if Atlantic silverside concentrations are as high as the estimated value. Because DDD was not detected in silversides, it is unlikely that DDD will bioaccumulate to levels as high as those estimated based on the estimated silverside concentration. Also, waterfowl/wading birds may be expected to make up a considerable (up to 50 percent), but not total percentage of a raptor's diet. Any potential hazards posed by DDD and DDE, as released from the landfill, are therefore considered to be unlikely.

6.3.7.2.4 Nickel

Nickel was detected in 18 of 22 samples of groundwater/leachate at a RME concentration of 179 μg/L (total). This nickel concentration exceeds the New York State water quality standard of 7.1 μg/L (acid soluble) and the federal marine water quality criteria (total recoverable) for acute (75 μg/L) and chronic (8.3 μg/L) effects

(Table 6-30). As shown in Tables 6-29 and 6-35, nickel also was found in sediments at concentrations that exceeded environmental benchmarks. Total nickel concentrations in the surface water exceeded the New York State standard, but nickel was not retained as an ecological COC because Eastchester Bay concentrations did not exceed those in WLIS. The exposure pathways and matrix concentrations are illustrated in Figure 6-13.

Bivalves and Fish. Tissue concentrations of nickel shown are for estimated concentrations only because tissue samples collected in 1992 were not analyzed for nickel. Nickel is bioconcentrated in aquatic organisms, but biomagnification has not been demonstrated (Kay, 1984). BCFs increase from 329 to 473 for the blue mussel as water concentrations of nickel decrease from 10 to 5 μg/L (Zaroogian and Johnson, 1984), and Chapman *et al.* (1968) report BCFs of 259 and 100 for marine invertebrates and fish, respectively.

Estimated BCF for both bivalves is 300. This estimate is based on the groundwater/leachate nickel concentration (179 μg/L), which is significantly higher than BCF test concentrations reported in Zaroogian and Johnson (1984) and the BCF of 259 reported for bivalves by Chapman *et al.* (1968). The estimated BCF for Atlantic silverside is 100 based on data in Chapman *et al.* (1968). Estimated tissue levels of nickel in the bivalve receptors in direct contact with groundwater/leachate are 54 mg/kg. The estimated Atlantic silverside tissue concentration of nickel is 18 mg/kg for those fish in direct contact with groundwater/leachate. Tissue levels of nickel for organisms not in contact with groundwater/leachate are expected to be lower because the surface water RME nickel concentration is 8.0 μg/L (Table 6-24).

Nickel is reported as acutely toxic to hard clams at 1,180 to 310 μg/L (embryos) and 5,700 μg/L (larvae) (Calabrese *et al.*, 1973, 1977; Calabrese and Nelson, 1974). The USEPA (1986c) lists the SMAV for the hard clam as 310 μg/L. Cardin (1985) reported the LC_{50} for nickel in Atlantic silverside as 7,958 μg/L, which also is listed as the SMAV by the USEPA (1986c). The limited chronic effects data show that 10 μg/L nickel effects blue mussel metabolism (Zaroogian *et al.*, 1982), and the acute/chronic effects ratio is determined to be 18 by the USEPA (1986c).

Based on these data, the acute effects concentration of nickel for the blue mussel and hard clam is estimated to be 310 μg/L, and the chronic effects concentration is estimated to be 10 μg/L. The estimated acute concentration for Atlantic silverside is 7,958 μg/L.

According to the exposure scenario described above for the bivalve receptors, chronic effects due to 179 μg/L nickel in the groundwater/leachate are likely for the limited number of mussels and clams that are in direct contact with the groundwater/leachate. Some acutely toxic effects also are possible, depending on the maximum nickel levels experienced (i.e., a maximum nickel concentration of 483 μg/L was reported). It appears unlikely that there is a risk to the Atlantic silversides exposed to groundwater/leachate because of its occasional foraging behavior among the riprap described in Section 6.3.6 and because the reported SMAV for the Atlantic silverside is 7,958 μg/L nickel.

Birds. Nickel is not expected to persist or bioaccumulate in waterfowl/wading birds or in raptors. Potential hazards from nickel in these species were therefore based on estimated dietary concentrations in the bivalves and the Atlantic silverside.

In general, several hundred ppm nickel are needed in an animal's diet before toxic effects are evident. The toxicity of nickel, however, also largely depends on the chemical form. Up to 500 mg/kg nickel sulfate is needed before the toxic effects occur in avian species (Weber and Reid, 1968). Adverse effects, however, have been reported in mallard ducklings at dietary concentrations of 800 μg/kg nickel sulfate after 28 days and 1,200 μg/kg nickel sulfate after 14 days (Cain and Pafford, 1981).

Dietary concentrations for waterfowl/wading birds and raptors could range up to 54 mg/kg nickel which is the estimated bivalve concentration. Nickel sulfate, however, which is highly soluble, is not likely to be the form in which nickel occurs in blue mussels of silverside. More likely, the nickel measured in these animals is bound in the form of an organic complex. Although dietary concentrations for the avian estuarine species could be as high as 54 mg/kg, the toxic reactions noted in mallard ducklings fed 0.8 mg/kg sulfate crystal diets are not expected.

Nickel at these dietary concentrations is not considered to pose a hazard to avian waterfowl, wading birds, or raptors.

6.3.7.2.5 Lead

Lead was detected in 21 of 22 groundwater/leachate samples at RME and maximum concentrations of 118 and 707 μg/L (Table 6-30). The RME concentration exceeds the

New York State water quality standard of 8.6 μg/L (acid soluble) and the federal chronic water quality criteria of 8.5 μg/L (total recoverable). As shown in Table 6-35, lead levels in sediment (172 mg/kg RME) also exceeded New York State benchmarks. Lead concentrations in surface water (12.4 μg/L RME) were lower than in the groundwater/leachate but also exceeded standards. Lead was not retained as a COC in surface water following comparison to WLIS concentrations. The exposure pathways and matrix concentrations for lead are shown in Figure 6-14.

Bivalves and Fish. As described in the exposure scenario (Section 6.3.8), small populations of the hard clam, blue mussel, and Atlantic silverside populations near the landfill may be directly exposed to groundwater/leachate. Reported BCFs for lead include a wide range of values for the receptor and surrogate species. BCFs for bivalves ranged from 17.5 for the hard clam (Pringle *et al.*, 1968) to 2,570 for the blue mussel (Schultz-Blades, 1972). Chapman *et al.* (1968) estimate BCFs of 200 for marine invertebrates and 60 for fish. The BCF for soft body parts of the eastern oyster is reported as 3,454 (Zaroogian, 1979). The BCFs for use in this exposure assessment are conservatively estimated to be 2,570 for the blue mussel from data in Schultz-Blades (1972), 200 for the hard clam from data in Chapman *et al.* (1968), and 60 for the Atlantic silverside (Chapman *et al.*, 1968).

Estimated tissue levels of lead are one to two orders of magnitude higher than measured residue levels for all three receptors as shown in Figure 6-14. The hard clam has an estimated tissue lead concentration of 23.6 mg/kg in contrast to a measured RME level of 1.44 mg/kg. The estimated blue mussel tissue concentration of 303 mg/kg is 100 times the measured level of 3.31 mg/kg. The estimated and measured tissue levels in the Atlantic silverside are 7.08 and 0.31 mg/kg. These differences between the estimated and measured tissue levels may be due to the application of inappropriate BCFs but more likely are the result of the sampled aquatic receptors not being in direct contact with groundwater/leachate.

The LC_{50}s (and SMAVs) for blue mussel and hard clam are 476 and 780 μg/L, respectively. The LC_{50} for the Atlantic silverside, and the SMAV is greater than 10,000 μg/L. The final acute/chronic ratio for lead is reported as 51.3 (USEPA nd). Based on this ratio, chronic effects to the blue mussel and hard clam may occur at lead concentrations of 9.3 and 15.2 μg/L, respectively.

As described in the exposure scenario (Section 6.3.6), small populations of blue mussels and hard clams may be in direct contact with groundwater/leachate. In view of the RME lead concentration of 118 mg/L in groundwater/leachate, bivalves in direct contact with this water are likely to experience chronic effects because of the elevated lead concentrations. It also is possible that some of the groundwater/leachate is acutely toxic to the bivalves based on a reported maximum lead concentration of 707 μg/L. In view of the Atlantic silverside foraging behavior described above and an LC_{50} of greater 10,000 μg/L, it is unlikely that the silverside is at risk from the lead in the groundwater/leachate.

Birds. Like copper, zinc, and nickel, food chain biomagnification of lead in avian estuarine species is not expected. Although lead may accumulate to some extent in the bones and feathers of birds, potential hazards for waterfowl/wading birds and raptors in this EHE, were evaluated based on dietary concentrations in bivalves and Atlantic silversides and not on indirect exposure through the avian food chain (i.e., raptors ingesting waterfowl).

Dietary concentrations for waterfowl/wading birds are likely to be near 3.3 mg/kg, the measured concentration in blue mussels, and not the estimated concentration of 303 mg/kg. Dietary concentrations for piscivorous waterfowl/wading birds or raptors are also likely to be nearer the measured Atlantic silverside concentration of 0.31 mg/kg, rather than the estimated concentration of 7.08 mg/kg.

Adverse effects (reduced growth rate, increased mortality) have been found in nestling kestrels at dietary levels of 125 mg/kg. Although no measurable adverse effects were noted in kestrels fed dietary levels of 10 mg/kg (metallic powder), tissue levels in bone and kidney were elevated (Franson *et al.*, 1983; Patee, 1984). At dose levels producing no overt signs of toxicity, neurobehavioral deficits have been documented in warm-blooded organisms (USEPA, 1980b).

Unless dietary levels for avian estuarine species are greater than 25 ppm, it is unlikely that levels in kidney cortex of 25 ppm or levels in liver or kidney of 10 mg/kg (WW), which are diagnostic of lead poisoning, would be obtained. Levels of 3.3 mg/kg in blue mussels and 0.31 mg/kg in Atlantic silversides are therefore not considered likely to pose a hazard to avian estuarine species.

6.3.7.2.6 Zinc

Zinc was detected in the groundwater/leachate at a RME concentration of 232 μg/L and a maximum concentration of 1,330 μg/L. The RME concentration for zinc exceeds the New York State water quality standard of 58 μg/L (acid soluble) and the federal acute and chronic criteria of 95 and 86 μg/L (total recoverable) (Table 6-30). Zinc also was detected in sediment at a RME level of 283 mg/kg that exceeded the New York State sediment cleanup criteria (lowest effect) and the NOAA Overall AET (Table 6-29). Zinc was detected in surface water but was not retained as a COC because it did not exceed any surface water standards. The exposure pathways and matrix concentrations for zinc are shown in Figure 6-15.

Bivalves and Fish. Aquatic tissue samples collected in 1992 were not analyzed for zinc. The estimated tissue residue levels of zinc are based on literature-derived BCFs. The BCF for the blue mussel reportedly ranges from 225 (Phillips, 1977) to 500 (Pentreath, 1973). Chapman *et al.* (1968) report a BCF for marine fish of 2,000; USEPA (1993) does not list any BCFs for the Atlantic silverside or any surrogate forage fish species. Based on the available bioconcentration data, the BCF used in the exposure assessment for the blue mussel and hard clam is conservatively estimated to be 500 based on data in Pentreath (1973). The BCF of 2,000 reported by Chapman *et al.* (1968) for fish is used for the Atlantic silverside. Applying these BCFs to the groundwater/leachate concentration of zinc results in estimated tissue levels of 116 mg/kg in the blue mussel and the hard clam and 464 mg/kg in the Atlantic silverside. A majority of the bivalves and silversides are expected to have lower tissue concentrations than these estimates in view of a surface water RME zinc concentration of 10.5 μg/L that is significantly lower than the groundwater/leachate RME concentration.

The SMAVs for the blue mussel and hard clam are listed by the USEPA (1980d) as 3,380 and 166 μg/L. The LC_{50} and SMAV for the Atlantic silverside is 3,640 μg/L zinc. Using the overall acute/chronic ratio of 3.0 (USEPA 1980d), the estimated zinc concentrations causing chronic effects in the blue mussel and hard clam are 1,127 and 55 μg/L, respectively.

Because of their sessile habits, some of the blue mussels and hard clams immediately adjacent to the landfill may be exposed to groundwater/leachate for extended periods of time. Based on the acute and chronic toxicity values for the blue mussel (3,380 and

1,127 μg/L, respectively), it appears unlikely that the mussel is at risk from the zinc RME concentration of 232 μg/L in the groundwater/leachate. However, limited numbers of the hard clam that are in direct contact with the groundwater/leachate are likely to be at risk from the zinc because the RME zinc concentration is 232 μg/L and the SMAV for the hard clam is 166 μg/L. Also, the estimated chronic zinc level for the hard clam is 55 μg/L - one-fourth the RME concentration. The Atlantic silverside does not appear to be at risk due to the zinc because of its limited exposure during foraging and the fact that the acute zinc concentration for the silverside (3,640 μg/L) is an order of magnitude higher than the RME concentration (232 μg/L).

Birds. Like copper, nickel, and lead, food chain bioaccumulation or biomagnification of zinc in avian estuarine species is not expected. Potential hazards to waterfowl/wading birds and raptors are therefore based on estimated dietary concentrations in bivalves and silversides.

Estimated zinc dietary concentrations for avian estuarine receptors are 484 mg/kg, based on the estimated silverside concentration, and 116 mg/kg, based on the estimated blue mussel concentration. As was the case for lead, the estimated concentrations are especially conservative and actual concentrations may be expected to be much less. Concentrations likely to be found in the blue mussel, clam, or Atlantic silverside are therefore not considered likely to pose a hazard to waterfowl/wading birds or raptors.

6.3.7.2.7 Phenanthrene

Phenanthrene was detected in groundwater/leachate at a RME concentration of 9.83 μg/L and a maximum concentration of 35 μg/L (Table 6-30). Phenanthrene also was detected in sediments at a RME concentration of 661 μg/kg which exceeds the NOAA overall AET of 260 μg/kg (Table 6-29); it was not detected in surface water. The phenanthrene exposure pathways and matrix concentrations are shown in Figure 6-16.

Bivalves and Fish. Data and supporting information concerning BCFs for phenanthrene are generally sparse and inconsistent in trends among receptor species. Generally, fish have lower BCFs than shellfish, consequently, fish typically have lower tissue levels of phenanthrene (O'Conner *et al.*, 1982; Lawrence and Weber, 1984). A BCF for fish with 7.6 percent lipid content is estimated by USEPA (1980a) to be 1,230. Yet, Neff (1979) reports a BCF of 32 for the clam (*Rangia cuneata*). O'Conner *et al.* (1982) reported dry-weight tissue concentrations of phenanthrene in tissues samples from the New York Harbor area to be nondetected to 1 μg/kg for fish and 6 to 10 μg/kg for blue mussel.

Assuming that the fish and mussels were exposed to similar ambient water concentrations of phenanthrene in New York Harbor, and the water and water-borne food were the primary sources of PAHs, then the mussel would have a BCF that is an order of magnitude greater than that for the fish. Therefore, if the estimated BCF for the Atlantic silverside were 650 (based on a measured lipid content of 3.6 percent), then the estimated BCF for the mussel is 6,500. The same BCF also is estimated for the hard clam. Because tissues collected in 1992 were not analyzed for any PAHs, there are no tissue concentration data available for phenanthrene.

Some proportion of the blue mussel, hard clam, and Atlantic silverside populations near the landfill may be directly exposed to a RME concentration of 9.83 μg/L phenanthrene in the groundwater/leachate. The LC_{50} for the blue mussel and several other bivalves are reported as greater than 245 μg/L, and the LC_{50} for the Atlantic silverside is reported as 108 μg/L (Battelle Ocean Sciences, 1987). The AQUIRE data base (USEPA, 1993) lists a chronic effects threshold of 100 μg/L phenanthrene for the blue mussel. It is assumed, in view of the acute data presented above for bivalves, that the acute and chronic thresholds for the hard clam are the same as reported for the blue mussel.

A limited number of blue mussels and hard clams may be directly exposed to the groundwater/leachate. However, in view of the exposure concentrations of 9.83 μg/L (RME) and 35 μg/L (maximum) and the chronic toxicity threshold available for bivalves (100 μg/L), it appears that blue mussels and hard clams are unlikely to be at risk due to exposure to phenanthrene in the groundwater/leachate.

Atlantic silversides also are unlikely to be at risk due to phenanthrene in the groundwater/leachate. This conclusion is based on the expected exposure concentrations of phenanthrene and the reported acute toxicity value of 108 μg/L for the Atlantic silverside.

<u>Birds</u>. Phenanthrene, a 3-ring PAH, may exhibit significant acute toxicity and adverse effects to some organisms but is probably noncarcinogenic (Eisler, 1987a). In general,

PAHs are rapidly metabolized and unlikely to biomagnify despite their high lipid solubility (Eisler, 1987a). The intermediate metabolites, however, have been identified as mutagenic, carcinogenic, and teratogenic agents (Sims and Overcash, 1983).

Although phenanthrene is not expected to biomagnify through avian receptor pathways, a BAF of 1 was used to estimate dietary concentrations for the upper trophic level avian receptor. For this EHE, dietary concentrations for the avian receptors range from 6.4 to 64 mg/kg based on estimated concentrations in the Atlantic silverside and blue mussel, respectively.

No toxicity information on phenanthrene and avian receptors was available, therefore toxicity data for laboratory mammals was used. Phenanthrene is considered to be moderately toxic by ingestion (Sax, 1990). Dose values of 71 mg/kg-bw when applied to the skin of a mouse result in tumors at the site of application (USDHHS, 1986). An oral LD_{50} of 700 mg/kg-bw for a mouse is reported (USDHHS, 1986).

Applying a safety factor of 100 results in a "safe" threshold dose value of 7 mg/kg-bw for the oral ingestion pathway. At this dose level, dietary concentrations exceeding 46 mg/kg may pose a hazard to waterfowl. Safe dietary concentrations for smaller waterfowl/wading birds may be expected to be slightly less (e.g., 35 mg/kg for a smaller bird) and slightly higher for larger birds, assuming food intake is inversely proportional to body weight.

Because potential dietary concentrations are based on estimated rather than measured concentrations in the blue mussel and silverside, actual dietary concentrations are expected to be less than the estimated 46 mg/kg. The potential for a hazard from phenanthrene to exist, however, cannot be ruled out as estimated dietary concentrations from the blue mussel/hard clam pathway exceeded estimated "safe" dietary concentrations.

6.3.7.2.8 Ammonia Nitrogen

Ammonia nitrogen (total ammonia) was detected in groundwater/leachate at a RME concentration of 249 mg/l; it also was detected in surface water at a RME concentration of 0.13 mg/L. The RME concentration in groundwater/leachate exceeded both of a federal water quality criteria for total ammonia - 1.6 mg/l (acute) and 0.24 mg/L (chronic) (USEPA, 1989c). As discussed in Section 6.3.4.3, there are no New York State Saline Surface Water Class SB standards for total ammonia, where total ammonia equals the sum of the un-ionized form (NH_3) plus the ammonium ion (NH_4^+). Because ammonia does not bioaccumulate, there is no ammonia exposure pathways diagram.

Un-ionized ammonia (NH_3) is more toxic to aquatic organisms than the NH_4^+ ion (Russo, 1985), and the percentage of NH_3 increases with increased water temperature and pH and with decreased salinity (USEPA, 1989c). Because the concentration of NH_3 changes with temperature, pH, and salinity, federal water quality criteria for total ammonia varies according to conditions in the area of interest. In Eastchester Bay, conservative estimates of these water quality parameters are 25°C, 8.5, and 10 parts per thousand, respectively. Based on these estimates, the federal acute criterium for total ammonia is 1.6 mg/L, and the chronic criterium is 0.24 mg/L (USEPA, 1989c).

Ammonia reportedly does not bioconcentrate in animal tissues (USEPA, 1989c) and was not an analyte in the tissue analyses conducted. Ammonia is relatively toxic to aquatic organisms, but it is readily oxidized to nitrite (NO_2^-) by *Nitrosomonas* spp, bacteria in surface waters under aerobic conditions. Nitrite is, in turn, oxidized to relatively nontoxic nitrate (NO_3^-) by *Nitrobacter* spp, bacteria (Russo, 1985).

Bivalves and Fish. Based on data presented in USEPA (1989c) for 21 marine and estuarine animals, acutely toxic concentrations (LC_{50}) of total ammonia (i.e., ammonia nitrogen) ranged from 0.23 mg/L for mysid shrimp (*Mysidopsis bahia*) to 43 mg/L for the eastern oyster. Total ammonia was acutely toxic to the hard clam at concentrations of 3.3 to 8.8 mg/L, at a temperatuer of 20°C, salinity of 27 ppt, and a pH range of 7.7 to 8.2 (Epifanio and Sma, 1975). Ammonia was acutely toxic to Atlantic silverside juveniles at concentrations ranging from 0.14 to 1.24 mg/L, depending on test conditions. The salinity ranged from 8.5 to 10.6 ppt, temperature ranged from 10.8 to 24.8°C, and pH ranged from 7.0 to 9.0 (EA Engineering, 1986). The SMAV for Atlantic silversides was 1.1 mg/L (USEPA, 1989c).

Chronic effects data for total ammonia in salt water are more limited than those from acute toxicity tests. In early life stage tests of inland silverside (*Menidia beryllina*), chronic effects were noted at an average total ammonia concentration of 0.061 mg/L (Poucher, 1986). Mysid shrimp exhibited chronic effects at total ammonia concentrations of 0.16 to 0.33 mg/L (Cardin, 1986). Both chronic tests were conducted at temperatures of 24-27°C, salinities of 30-31.5 ppt, and pH values of 7.7-8.0.

Based on the available acute toxicity data summarized above for the hard clam, bivalves may experience acutely toxic effects at a total ammonia concentration of 3.3 mg/L. Chronic effects may occur at a concentration of 0.33 mg/L, based on data presented for the mysid shrimp. Because the Atlantic silverside is not expected to be continuously exposed to leachate, the SMAV of 1.1 mg/L total ammonia is used for comparison to the groundwater/leachate RME concentration of 249 mg/L. Comparisons of these toxic thresholds to the RME concentration indicates that bivalves and forage fish directly exposed to ammonia nitrogen (total ammonia) in groundwater/leachate are likely to be at risk. However, because of oxidation of ammonia to nitrite and nitrate under aerobic conditions, toxic concentrations are expected to be limited to those areas directly affected by the leachate seeps.

Birds. Based on lethal dose data presented in Osweiler et al. (1985), the estimated acutely toxic dietary level of total ammonia for waterfowl is 650 mg/L. However, because the primary exposure pathway for waterfowl/wading birds and raptors is ingestion of small prey organisms such as Atlantic silversides, and ammonia is not expected to be bioaccumulated, it is unlikely that the birds are at risk from ingestion of these forage fish. Also, because the RME concentration of ammonia in groundwater/leachate (249 mg/L) is approximately one-third the estimated toxic concentration, birds are unlikely to be at risk from direct ingestion of leachate.

The evaluations presented above are based on ammonia data developed as part of the RI investigation. Additional ammonia data relating to the landfill is also being developed as part of the monitoring of groundwater/leachate for the interim remediation program at the site. A review of a tabulation of these data indicates that concentrations equal to or greater than those found during the RI investigation are being reported as part of monitoring for the interim program.

6.3.7.2.9 Total PCBs

Two Aroclors, 1260 and 1016, were detected above New York State water quality criteria of 0.001 μg/L in the groundwater/leachate. Aroclor 1260 was detected at a RME concentration of 0.56 μg/L, and Aroclor 1016 was detected at 0.323 μg/L. No Aroclors were detected in surface water or sediment samples collected near the landfill.

Bivalves and Fish. A total PCB concentration of 0.88 μg/L was used to assess exposure and risk because BCF and toxicity data are not consistently available for the two Aroclors found in the groundwater/leachate. Tissue samples of blue mussels, hard clams, and Atlantic silverside collected in 1992 from Eastchester Bay did not have any detectable levels of Aroclor 1016 or 1260. However, Aroclor 1254 was detected in tissues of the Atlantic silverside and blue mussel, and Aroclor 1248 was detected in the silverside.

Pathways and tissue concentrations of total PCBs are shown in Figure 6-17. BCFs used in the exposure assessment for total PCBs were 100,000 in fish (USEPA, 1986d) and 85,000 for blue mussels and hard clams based on the BCF presented in Ernst (1984) for Aroclor 1254 in the American oyster. The estimated total PCB concentrations in clams and mussels is 75 mg/kg and in the Atlantic silverside is 88 mg/kg. Estimated tissue concentrations of total PCBs in the bivalves and silverside are more than 100 times higher than measured levels, which were 0.21 mg/kg in blue mussels, ND in hard clams, and 0.27 mg/kg in Atlantic silversides.

LC_{50} values for marine invertebrates and fish exposed to various PCBs ranged from 0.1 to over 100 μg/L (Eisler, 1986b). Sheepshead minnows exposed to Aroclor 1254 had 21-day LC_{50} values of 0.1 to 0.32 μg/L for fry and 0.9 μg/L for adults (Ernst, 1984; USEPA 1980c). USEPA (1993) reported a 7-day LC_{50} of 100 μg/L for Aroclor 1016 in sheepshead minnow fry and adults. LC_{50} values for Aroclor 1254 in the spot and pinfish were reported as 0.5 μg/L (Ernst, 1984). No acute or chronic toxicity data are currently available in the AQUIRE data base (USEPA, 1993) or data summaries by Eisler (1986b) and USEPA (1980c) for marine fish exposed to Aroclor 1260. EC_{50} (concentrations affecting 50 percent of organisms) for growth effects were reported for Aroclors 1016 and 1260 in the eastern oyster. The EC_{50}s were 10.2 μg/L (1016) and 60 μg/L (1260) (Hansen *et al.*, 1974; Lowe, nd).

Because of the lack of toxicity data for Aroclor 1260 and the wide range of toxic concentrations for species other than the receptor species, estimating toxicity thresholds for the receptors is difficult. It is therefore estimated that, depending on which Aroclors comprise the total PCBs, acutely toxic effects to the Atlantic silverside could occur at total PCB concentrations of 0.9 μg/L (Aroclor 1254 in sheepshead minnows) to 100 μg/L (Aroclor 1016 in sheepshead minnows). Toxic effects in the blue mussel and hard clam could occur at a total PCB level of 10.2 μg/L (Aroclor 1016 in eastern oyster).

In view of the groundwater/leachate RME concentration of 0.88 μg/L total PCBs and these toxicity estimates, it is unlikely that the blue mussels and hard clams exposed to the groundwater/leachate are at risk from PCBs. However, it is possible that the Atlantic silversides directly exposed to groundwater/leachate are at risk from PCBs.

Birds. BAFs for avian estuarine receptors are expected to be similar to those for mercury or the pesticides. BAFs of 73 from diet to adult fat residue and 1.6 for diet to egg were estimated for ringed turtle doves (see Section 6.3.6.2.3). An assumed BAF of 6 was used in the terrestrial soils EHE for small bird and raptor food chain transfer.

Based on a BAF of 6, waterfowl/wading bird residue concentrations could range from 1.26 mg/kg to 1.62 mg/kg, using the measured concentrations for the blue mussel and Atlantic silverside, respectively. Assuming another BAF of 6, residue concentration in raptors could range up to 9.72 mg/kg.

The dietary and residue concentrations estimated for piscivorous avian estuarine receptors are 0.27 mg/kg and 1.62 mg/kg, respectively. The 0.27 mg/kg dietary concentration exceeds the IJC (1981) PCB objective in fish of 0.1 mg/kg (set to protect piscivorous wildlife) and the NYSDEC NOEL dietary concentration of 0.11 mg/kg set for birds (Newell *et al.*, 1987). Estimated residue concentrations for these receptors are below toxic effects levels reported in Section 6.3.6.2.3.

Estimated tissue concentrations for bivalves and Atlantic silverside are more than two orders of magnitude greater than the measured concentrations. Unless dietary concentrations equal estimated values, no potential hazard would exist for waterfowl/wading birds feeding on these organisms.

Dietary concentrations for raptors feeding largely on waterfowl/wading birds would be an order of magnitude above the "safe objective" concentrations. A potential hazard is therefore considered to exist for such receptors.

6.3.7.2.10 Endosulfan II

Endosulfan II was detected in the groundwater/leachate at a RME concentration of 0.401 μg/L and a maximum concentration of 2.1 μg/L. The RME concentration exceeded the New York State and federal surface water quality criteria for acute and chronic effects (Table 6-30). As shown in Tables 6-34 and 35, endosulfan II was not detected in surface water or sediment samples. The estuarine pathways and matrix concentrations of endosulfan II are illustrated in Figure 6-18.

Bivalves and Fish. Endosulfan II was not detected the tissue samples; however, the closely related stereo isomer, endosulfan I, was found in one tissue sample from the blue mussel and hard clam sample sets (Tables 6-37 and 38). Endosulfan does not appear to biomagnify in marine ecosystems (Goerke *et al.*, 1979), although BCFs have been reported for a few marine organisms. The AQUIRE data base (USEPA, 1993) lists the following BCFs for endosulfan: blue mussel - 9.8, spot (*Leiostomus xanthurus*) - 779, pinfish (*Lagodon rhomboides*) - 1,173, and striped mullet (*Mugil cephalus*) - 1,376.

Based on these limited data, the BCF used in the exposure assessment for blue mussel and hard clam is 9.8; the BCF used for the Atlantic silverside is 1,100, an average of the fish BCF data in USEPA (1993). The estimated tissue concentration of endosulfan II in the blue mussel and hard clam is 0.004 mg/kg; estimated tissue concentration in the Atlantic silverside is 0.44 mg/kg. These estimated tissue concentrations of endosulfan II compare to undetected levels in the receptor species. Detected endosulfan I tissue concentrations were 0.005 mg/kg in the blue mussel and 0.008 mg/kg in the hard clam; endosulfan was not detected in the Atlantic silverside.

Toxicity data for endosulfan II or endosulfan I and the three receptor species are not currently available; however, data are available describing the effects of endosulfan on surrogate species. Chronic growth effects were noted in the eastern oyster at endosulfan II concentrations of 65 to 380 μg/L (USEPA, 1993). LC_{50}s of 0.09 to 3.0 are reported for the spot, striped mullet, and pinfish; the range of LC_{50}s for the mosquitofish is reported as 3.8 to 12 μg/L endosulfan II (USEPA, 1993). Using these surrogate species, it is estimated that chronic effects in the blue mussel and hard clam may be seen at an exposure concentration of 65 μg/L endosulfan II, and acutely toxic effects in the Atlantic silverside may be seen at an exposure concentration of 3.8 μg/L endosulfan II.

Some portions of the blue mussel, hard clam, and Atlantic silverside populations adjacent to the landfill may be exposed to an endosulfan II concentration (RME) of 0.401 μg/L. The hazard evaluation is based on this exposure concentration, the exposure scenarios described above, and the estimated acute and chronic toxicity values for the receptor species. It appears unlikely that the blue mussels and hard clams in contact with the groundwater/leachate are at risk of experiencing chronic or acute effects from the endosulfan II. Also, because the maximum measured concentration (2.1 μg/L) was in a groundwater sample, it is unlikely that Atlantic silversides in contact with groundwater/leachate are at risk from the endosulfan II.

Birds. No information on potential BAFs for endosulfan were obtained from the available literature. Endosulfan, like the other pesticides and PCBs, is likely to bioaccumulate through food webs (Eisler, 1986b). In this EHE, a BAF of 5 was assumed for trophic transfer of endosulfan between avian estuarine receptors.

Based on estimated residue concentrations for blue mussel and silversides, tissue concentrations in waterfowl/wading birds could range from 0.02 to 0.88 mg/kg. An additional BAF of 5 for transfer to the next trophic level would result in potential tissue concentrations in a raptor of up to 4.4 mg/kg.

Little information was available on potentially toxic doses, dietary concentrations, or residue levels in avian species. A "no-effects" threshold dietary concentration of 1.75 mg/kg was estimated for small terrestrial bird receptors. An LD_{50} of 33 mg/kg-bw (220 mg/kg diet) is reported for ducks (NIOSH, 1987).

Estimated residue concentrations for the blue mussel and Atlantic silverside are well below the estimated "no-effects" threshold dietary concentration for small birds and the lethal dietary level reported for ducks. The potential hazard to waterfowl/wading birds or piscivorous raptors is therefore considered to be negligible. Dietary concentrations for higher level receptors are also expected to be non-hazardous based on an estimated tissue concentration of up to 0.88 mg/kg in waterfowl/wading birds.

6.3.7.2.11 Dieldrin and Endrin

Dieldrin and endrin were detected in groundwater/leachate at concentrations exceeding New York State and federal marine water quality standards. Dieldrin was found at a

RME concentration of 0.171 $\mu g/L$. This concentration exceeded the state guidance value of 0.001 $\mu g/L$ (for aldrin and dieldrin) and the federal chronic criteria of 0.0019 $\mu g/L$. Dieldrin also was detected in Eastchester Bay sediments but was not found in surface water samples. The structurally-similar endrin was detected at a RME concentration of 0.051 $\mu g/L$ in groundwater/leachate, which exceeded the state standard (0.002 $\mu g/L$) and the federal acute and chronic criteria (0.037 and 0.0023 $\mu g/L$) (Table 6-26). Endrin was not found in surface water or sediment samples (Tables 6-34 and 35). Neither dieldrin nor endrin was detected in tissue samples of blue mussel, hard clam, and Atlantic silverside collected in 1992. The estuarine pathways and matrix concentrations of dieldrin and endrin are shown in Figures 6-19 and 6-20.

Bivalves and Fish. Although bioconcentration data are limited, dieldrin and endrin generally bioconcentrate more in fish than in bivalves. As reported in the AQUIRE database, dieldrin BCFs are 500 at 0.5 $\mu g/L$ dieldrin in the eastern oyster and 8,900 at 0.1 $\mu g/L$ in the spot (USEPA, 1993). BCFs of 5,000 and 6,900 were reported for the spot at dieldrin concentrations of 0.015 and 0.075 $\mu g/L$. For the exposure assessments being conducted on the groundwater/leachate, estimated dieldrin BCFs of 500 for the blue mussel and hard clam and 8,900 for the Atlantic silverside are being used. Applying these BCFs to the dieldrin RME concentration of 0.171 $\mu g/L$ results in estimated tissue levels of 0.086 mg/kg in the blue mussel and hard clam and 1.52 mg/kg in the Atlantic silverside (Figure 6-17).

Dieldrin appears to be more acutely toxic to fish than to bivalves. Lethal effects in the hard clam were noted after 96 hours at a dieldrin concentration of 10,000, and the sublethal effect on growth was noted in the eastern oyster after exposure to 34 $\mu g/L$ over 96 hours (USEPA, 1993). The 24- and 96-hour LC_{50}s for the Atlantic silverside were reported to be 10 and 5 $\mu g/L$ dieldrin, respectively (USEPA, 1993).

Based on the toxicity available and the exposure scenarios for the receptor species, the estimated dieldrin toxicity threshold for the blue mussel and hard clam is 34 $\mu g/L$, and the threshold for the Atlantic silverside is 5 $\mu g/L$. Relative to the RME concentration of dieldrin (0.171 $\mu g/L$), it appears unlikely that the blue mussels and hard clams directly exposed to the groundwater/leachate are at risk. However, it is possible that Atlantic silversides in contact with the groundwater/leachate are at risk from the dieldrin.

The available BCFs for endrin are 2,640 at an exposure concentration of 0.1 μg/L in the eastern oyster and 6,400 at 0.025 to 0.72 μg/L in the sheepshead minnow (USEPA, 1993). Using the BCF available for the eastern oyster, the estimated BCFs for the blue mussel and hard clam are both 2,640; the estimated BCF for the Atlantic silverside is 6,400 based on the sheepshead minnow BCF. Using these estimated BCFs and the RME concentration of 0.051 μg/L endrin, the estimated tissue concentrations are 0.14 mg/kg in the blue mussel and hard clam and 0.33 mg/kg in the Atlantic silverside (Figure 6-18).

Endrin also appears to be more toxic to fish than to bivalves. An endrin concentration of 33 μg/L was not acutely toxic but did affect growth in the eastern oyster after 96 hours, and the Atlantic silverside reportedly has 24- and 96-hour LC_{50}s of 0.5 and 0.05 μg/L endrin. Two other forage species, mummichog and sheepshead minnow, have 96-hour LC_{50}s of 0.6 and 0.34 μg/L, respectively (USEPA, 1993).

For the purpose of the hazard evaluation, it is estimated that the endrin toxicity threshold for the blue mussel and hard clam is 33 μg/L and the toxicity threshold for the silverside is 0.5 μg/L based on a 24-hour exposure. Similar to the dieldrin assessment, it is unlikely that the bivalve receptor species are at risk from exposure to 0.051 μg/L endrin. It appears possible that the Atlantic silversides in contact with the groundwater/leachate for any extended period of time are at risk from the endrin.

Birds. Bioaccumulation of dieldrin/endrin in waterfowl/wading birds and raptors depends on frequency and duration of exposure. Unlike aquatic ecosystems, exposure is not continuous for avian receptors, therefore bioaccumulation factors are much lower than those for aquatic receptors (fish, invertebrates). BAFs for dieldrin/endrin are likely to be similar to those of other lipophilic, organochlorine pesticides such as DDT.

For the purposes of the following assessment, BAFs and toxic effects levels for endrin were assumed to be the same as those for dieldrin. A value of 5 was selected for trophic level transfer for both dieldrin and endrin.

Dietary concentration for waterfowl/wading birds for the dieldrin pathway are based on estimated concentrations in the blue mussel/hard clam (0.086 mg/kg) and silverside (1.52 mg/kg). Dietary concentrations for these receptors for the endrin pathway are 0.14 mg/kg for the blue mussel/hard clam and 0.33 mg/kg for the Atlantic silverside.

The estimated dieldrin concentration in silversides is more than twice the dietary (fish flesh) NOEL criteria of 0.6 mg/kg for a mallard (Newell *et al.*, 1987). Reproductive impacts are reported in mallards at dietary concentrations of 3 mg/kg (Hodge *et al.*, 1967). A potential hazard may therefore exist for piscivorous waterfowl/wading birds on raptors based on the estimated silverside concentration.

For this hazard evaluation, a BAF was assumed for trophic transfer from the mussel/hard clam or silverside to waterfowl/wading birds and from waterfowl/wading birds to raptors. Resulting residue concentrations in waterfowl/wading birds for dieldrin could be as high as 7.6 mg/kg (from silversides) and 0.43 mg/kg (from blue mussel/hard clam). Resulting residue concentrations for endrin could be 1.65 mg/kg (from silversides) and 0.7 mg/kg (from mussel/hard clam).

Residue levels in brains considered diagnostic of dieldrin poisoning is 6.8 mg/kg (Heinz and Johnson, 1981). Heinz and Johnson (1981) thought brain levels as low as 1 mg/kg in highly sensitive individuals may be hazardous. Again, a potential hazard appears to exist for waterfowl/wading birds whose diet is largely silversides (where dieldrin/endrin tissue concentrations in silversides are close to the estimated value).

Dieldrin residues for herring gull eggs from Lake Ontario averaged 10 times higher than the alewife and smelt concentrations (Norstrom *et al.*, 1978). Assuming a BAF of 10 results in egg concentrations up to 15.2 mg/kg for dieldrin and 3.3 mg/kg for endrin. Based on an estimated toxic threshold level for eggs of 1 ppm (Blus, 1992), a potential hazard may exist for hatchling success in waterfowl/wading birds.

Dietary concentrations for higher trophic level receptors of 0.43-7.6 mg/kg for dieldrin and 0.7-1.65 mg/kg for endrin also exceed the recommended NOEL criteria of 0.6 mg/kg for piscivorous birds and are therefore considered to pose a potential hazard.

An additional BAF of 5 for raptors feeding on piscivorous waterfowl/wading birds could result in residue concentrations of 38 mg/kg for dieldrin and 8.25 mg/kg for endrin. Such residue concentrations in raptors may be considered a potential hazard.

6.3.7.2.12 Cyanide

Cyanide (i.e., total cyanide) was detected in the groundwater/leachate at a RME concentration of 39.3 μg/L and a maximum concentration of 267 μg/L. The RME concentration exceeded the New York State marine water standard and federal acute criteria of 1 μg/L. However, these benchmarks for cyanide are for free cyanide, which is HCN plus CN^-, and the water analysis results are in terms of total cyanide. Total cyanide consists primarily of cyanide compounds that are complexed with organics and metals in the water in addition to free cyanide. The half life of free cyanide in water is expected to be short because of evaporation and complexing with other chemicals (Callahan *et al.*, 1979; USDHHS, 1991). According to LeDuc (1981), in waters receiving industrial discharges, most of the total cyanide exists in the less toxic metallo complexes.

Bivalves and Fish. No studies have demonstrated biomagnification of cyanide in food webs because it is either rapidly metabolized or is lethal (Towill *et al.*, 1978; Callahan *et al.*, 1979). No bioconcentration is expected in the aquatic ecosystem, and no BCF data are available. Because no bioconcentration or biomagnification is expected, no estuarine pathways/matrix concentrations diagram is presented for cyanide.

Although the state and federal water quality benchmark of 1 μg/L for free cyanide is exceeded by the RME total cyanide concentration of 39.3 μg/l, the exceedance may not be significant because of the comparison of total cyanide to a free cyanide standard. The USEPA (nd) states that its criteria for cyanide may be overly protective when based on total cyanide.

Several studies report sublethal and lethal effects based on concentrations of free cyanide as CN; no studies reported results in terms of total cyanide. Normal physiological activities in the eastern oyster were suppressed at a free cyanide level of 150 μg/L (Usuki, 1956). LC_{50} concentrations of free cyanide for forage fish were 59 μg/L for the Atlantic silverside (Gardner and Berry, 1981) and 300 μg/L for the sheepshead minnow (Schimmel *et al.*, 1981).

In view of the detected RME concentration of total cyanide (39.3 μg/L), the expected low proportion of toxic free cyanide, and the reported chronic toxicity for free cyanide in the eastern oyster (150 μg/L), it is unlikely that the portions of the blue mussel and hard clam populations exposed to the groundwater/leachate are at risk from cyanide.

Based on the reported acute toxicity concentration of free cyanide (59 μg/L) to the Atlantic silverside, it appears unlikely that the silverside is at risk from exposure to the RME concentration of total cyanide. However, it is possible that the Atlantic silverside is at risk if exposed to the maximum detected concentration of 267 μg/L total cyanide is more than 20 percent of the total is free cyanide.

Birds. The only potential pathway for cyanide to pose a hazard to waterfowl/wading birds and raptors would be from direct ingestion of groundwater/leachate. No literature specific to birds was identified that addressed the toxic effects of total cyanide. Lethal dose/dietary values in birds for some of the more toxic cyanide compounds are as follows:

- Lethal dose HCN in rock doves (*Columba livia*) is 1.5 mg/kg-bw (Approximate dietary concentration of 7.5 mg/kg) (Hunt-Boston, 1923)
- LD_{50}s of NaCN to black vulture (*Coragyps atratus*), American kestrel (*Falco sparverius*), and the eastern screech owl (*Otis asio*) ranged from 4.0-8.6 mg/kg (Wiemeyer *et al.*, 1984). For the American kestrel, the 4.0 mg/kg-bw LD_{50} concentration is approximately equivalent to a dietary concentration of 13.2 mg/kg

Applying a safety factor of 100 to the lowest LD_{50} value for a bird, results in a "threshold concentration" of 0.015 mg/kg-bw. Assuming daily water intake for a mallard of 0.059 L/day (Calder and Braun, 1983) provides an estimate of the "safe threshold" concentration of HCN in water of 0.3 mg/L. The RME total cyanide concentration of 0.039 mg/L is therefore not considered to pose a potential hazard to waterfowl/wading birds or raptors from direct ingestion.

6.3.7.2.13 alpha-Chlordane

Alpha-chlordane was detected in groundwater/leachate at a RME concentration of 0.056 μg/L. This also is the maximum concentration that was found in MW-103, one of 22 samples analyzed. However, the detection level of alpha-chlordane was 0.5 to 0.51 μg/L, which prevented detection of similar alpha-chlordane concentrations in the other groundwater/leachate samples. Alpha-chlordane is also known as the cis isomer of chlordane, and gamma-chlordane is the trans isomer. Technical grade chlordane is a mixture of the two isomers (19% cis [alpha]- and 24% trans [gamma]-chlordane) plus other chlorinated hydrocarbon compounds (Brooks, 1974). According to data presented by Grimes and Morrison (1975), BCFs for the two isomers differ by approximately 10 percent.

New York State does not have a criterion for chlordane or its isomers. The federal acute and chronic criteria for chlordane are 0.09 and 0.004 μg/L, respectively. The alpha-chlordane detected in the groundwater/leachate exceeded the federal chronic benchmark (Table 6-30). Neither of the chlordane isomers was detected in surface water or sediment samples. However, alpha-chlordane was detected in one-third of the blue mussel tissue samples at a RME concentration of 0.013 mg/kg (WW) (Table 6-38). It was not detected in any other receptor species tissue samples. Gamma-chlordane was not detected in any abiotic or biotic matrices.

Bivalves and Fish. The estuarine pathways and matrix concentrations are shown in Figure 6-21. The BCFs shown in the figure are based on data presented in the USEPA water quality criteria document for chlordane (USEPA, 1980e); no additional, recent data are available in the AQUIRE data base (USEPA, 1993). Data listed in USEPA (1980e) indicated a BCF of 5,522 for chlordane in the eastern oyster. Because this was the only bivalve or invertebrate BCF available, it is used as the estimated BCF for blue mussel and hard clam.

Data for saltwater fish were limited to studies of the sheepshead minnow. Juvenile sheepshead minnows exposed to chlordane for 28 days had BCFs ranging from 8,500 to 12,300 with a median of 10,300, and adults exposed to chlordane for 189 days had BCFs of 13,000 to 22,000. Progeny (i.e., larvae) from the 28-day exposure experiment had BCFs of 6,500 to 22,000 (Parrish *et al.*, 1976; 1978). In view of the limited exposure expected during foraging among the riprap bordering the landfill, it was judged appropriate to use a BCF of 12,300 from the 28-day juvenile sheepshead minnow exposure for the estimated Atlantic silverside BCF.

Applying these estimated BCFs to the RME concentration of alpha-chlordane results in estimated tissue concentrations of 0.31 mg/kg in the blue mussel and hard clam and 0.69 mg/kg in the Atlantic silverside. The blue mussel had a measured RME concentration of 0.013 mg/kg alpha-chlordane.

Chlordane toxicity data are available for eastern oyster but not for the blue mussel or hard clam. Acute toxicity (LC_{50}) data for the oyster range from 6.2 to 10 μg/L (Parrish *et al.* 1976; Butler *et al.*, 1963), and the SMAV for chlordane is shown to be 6.2 μg/L (USEPA, 1980e). Sublethal effects on growth of the eastern oyster were seen by Butler (1963) at a concentration of 10 μg/L. LC_{50} data available for the sheepshead minnow, a forage fish species, ranged from 12.5 to 24.5 μg/L (Parrish *et al.*, 1976; 1978). The USEPA lists the SMAV for sheepshead minnow as 17.5 μg/L (USEPA, 1980e). Chronic effects to the sheepshead minnow were noted by Parrish *et al.* (1976; 1978) at concentrations of 0.5 to 17 μg/L, depending on the life stage being examined.

Toxicity threshold values of 6.2 μg/L (based on growth effects in the eastern oyster) and 12.5 μg/L (based on the lowest LC_{50} for the sheepshead minnow) were selected for the bivalves (blue mussel and hard clam) and the Atlantic silverside, respectively. A comparison of the RME concentration (0.056 μg/L) to these threshold levels indicates that the three aquatic receptor species are unlikely to be at risk from alpha-chlordane in the groundwater/leachate.

Birds. Chlordane, like the other lipophilic organochlorine pesticides, can be expected to accumulate in higher trophic level organisms. For this EHE, a BAF of 5 was selected for trophic transfer to waterfowl/wading birds and to raptors.

Dietary concentrations for waterfowl/wading birds for this EHE are based on measured concentrations of a-chlordane in the blue mussel of 0.013 mg/kg and estimated concentrations in the Atlantic silverside of 0.69 mg/kg. By applying a BAF of 5, resulting residue concentrations in waterfowl/wading birds could range from 0.065 mg/kg (blue mussel diet) to 3.45 mg/kg (Atlantic silverside diet).

Residue concentrations in the waterfowl/wading bird receptors are assumed to be equivalent to dietary levels for higher trophic level avian receptors. Assuming another BAF of 5, results in an estimated residue concentration range in raptors of 0.32 mg/kg (blue mussel pathway) to 17.25 mg/kg (silverside pathway).

Adverse effects are reported in sensitive bird species at dietary concentrations of 1.5 mg/kg chlordane (Eisler, 1990). A NOEL dietary criterion of 0.5 mg/kg was selected by Newell *et al.* (1987) for piscivorous birds. Dietary concentrations for waterfowl/ wading birds may exceed this criterion and present a potential hazard, if actual concentrations in silversides are as high as the estimated concentration of 0.69 mg/kg. Chlordane is not considered to pose a potential hazard based on the measured concentrations in blue mussels.

Tissue levels associated with poisoning in barn owls were as low as 5.1 mg/kg (a-chlordane) and 3.2 mg/kg (g-chlordane) (Eisler, 1990). Residue levels in waterfowl/wading birds may be as high as 3.45 mg/kg based on a BAF of 5 and an estimated silverside concentration of 3.45 mg/kg. The potential for hazardous residue concentrations to occur in waterfowl/wading birds appears slight.

Dietary concentrations for waterfowl/wading bird-consuming receptors are below the NOEL criterion based on the blue mussel pathway, but above the criterion based on the silverside pathway. Residue concentrations in the raptor receptors are considered to be non-hazardous for the blue mussel pathway but potentially hazardous for the Atlantic silverside pathway.

6.3.7.2.14 Methoxychlor

Methoxychlor was detected in the groundwater/leachate at a RME concentration of 0.307 μg/L (Table 6-30). This concentration exceeds the New York State surface water standard of 0.03 μg/L, which is also is the federal ambient water quality chronic criterion. There is no federal acute criterion. As shown in Tables 6-28 and 31, methoxychlor was not detected in surface water or sediment samples collected near the landfill in 1992.

Bivalves and Fish. Some portions of the blue mussel, hard clam, and Atlantic silverside populations found near the landfill may be exposed to RME methoxychlor concentrations of 0.307 μg/L in the groundwater/leachate. Although data on bioconcentration of methoxychlor are limited to those found in the AQUIRE data base, the available data indicate a wide range of BCFs for fish. The BCF for methoxychlor in mosquitofish is reported as 1,500 at an exposure concentration of 0.11 μg/L (USEPA, 1993). The methoxychlor BCFs for striped mullet were similar for juvenile and adult life stages and ranged from 0.18 at 9,360 μg/L to 110 at 108 μg/L, generally decreasing with increasing concentrations of methoxychlor. The BCFs for lowest test concentrations tested were 6.7 at 9 μg/L for juveniles and 20 at 10 μg/L for adults (USEPA, 1993). Considering the generally inverse relationship between BCF and concentration and the reported test concentration of 0.11 μg/L for the mosquitofish, the most appropriate estimated BCF for the Atlantic silverside is 1,500.

No BCF data for invertebrates, including bivalves, are currently available. BCFs for other pesticides and PCBs in bivalves are, however, generally lower than BCFs in fish. In view of this trend, it is assumed that blue mussel/hard clam BCF is less than the fish BCF. It is, therefore, conservatively estimated that the BCF for the receptor bivalve species is 1,500, the same as that for fish.

The estuarine pathways and matrix concentrations for methoxychlor are shown in Figure 6-22. Based on the estimated BCF of 1,500 for bivalves and Atlantic silverside, the estimated tissue concentrations for the individuals directly exposed to groundwater/leachate is 0.46 mg/kg. In contrast to these estimated tissue residue concentrations, tissue samples of blue mussel, hard clam, and Atlantic silverside that were collected in 1992 did not have any detectable levels of methoxychlor. It appears, based on the difference between the estimated and actual tissue concentrations, that the blue mussels, hard clams, and Atlantic silversides collected for tissue analysis had not been exposed to concentrations of methoxychlor approximating those seen in the groundwater/leachate.

Toxicity data for three bivalve species are listed in AQUIRE (USEPA, 1993). Methoxychlor concentrations of 8 to 15 μg/L caused limited lethal effects (less than 4% mortality) in larval blue mussels during a 40-day exposure. Survival of the adult hard clam was unaffected (NOEL) at a concentration of 10,000 μg/L over 96 hours. An EC_{50} of 97 μg/L (sublethal growth effects) is reported for the eastern oyster (USEPA, 1993). In view of these data, the blue mussel and hard clam toxicity thresholds for the hazard evaluation are estimated to be 8 μg/L and 10,000 μg/L, respectively. Based on these toxicity thresholds and the expected exposures to groundwater/leachate, it is possible that the blue mussel, especially the larvae, in direct contact with the groundwater/leachate are at risk from the methoxychlor. It is unlikely that the hard clam is at risk from the methoxychlor.

Toxicity data for several forage fish species, including the Atlantic silverside, are listed in AQUIRE. LC_{50}s of 44 μg/L (24-hour) and 33 μg/L (96-hour) are listed for Atlantic silverside. For the mummichog, the 24-hour LC_{50} is 37 μg/L, and the 96-hour LC_{50} is 35 μg/L. The 24-hour LC_{50} for striped killifish is 38 μg/L (USEPA, 1993). Based on these acute toxicity data, the conservative threshold chosen for the Atlantic silverside is 33 μg/L, even though exposure to groundwater/leachate by the silverside is expected to be of limited duration and not four continuous days (96 hours). Considering the exposure scenario for Atlantic silverside and the RME concentration of 0.307 μg/L, it is unlikely that the Atlantic silverside is at risk from the methoxychlor.

Birds. No information on the toxicity of methoxychlor to avian receptors was located. For this EHE, toxicity data for rats and mice were used. BAFs for methoxychlor for aquatic receptors (fish and bivalves) were considerably lower than those for the other pesticides and PCBs. A BAF of 2 was therefore selected for the trophic level transfer among avian receptors in the estuarine ecosystem.

Dietary concentrations for avian receptors in this ecosystem are based on estimated concentrations in the silverside/blue mussel of 0.46 mg/kg. Dietary (prey residue) concentrations for higher tropic level receptors are estimated at 1.84 mg/kg.

The only available toxicity information for methoxychlor was for rats and mice. In Section 6.3.6.2.3, oral LD_{50} values for these animals were converted to "no effects" threshold dose values of 50 mg/kg-bw (rat) and 10 mg/kg-bw (mouse) by applying a safety factor of 100. Based on the body weight and food intake parameters for a mallard, the rat and mouse dose values equate to a mallard dietary range of 66 to 333 mg/kg. Dietary "no-effects" values for smaller birds would be less. Based on a comparison of these criteria with the estimated dietary concentrations for the waterfowl/wading bird or raptor, no potential hazard is indicated.

6.3.7.2.15 Chlorobenzene

Chlorobenzene was detected in groundwater/leachate at a RME concentration of 9.66 μg/L and maximum concentration of 25 μg/L (Table 6-30). This RME concentration exceeds the New York State surface water guidance value of 5.0 μg/L; there are no federal marine surface water quality criteria for chlorobenzene. Chlorobenzene was not found in surface water or sediment samples, and tissue samples were not analyzed for this compound.

Bivalves and Fish. Bioconcentration factors for chlorinated benzenes have been shown to increase with increased chlorine substitution. The mean of dichlorobenzene BCFs was reported by the USEPA (1980f) as 72, while the hexachlorobenzene BCF in the pinfish was 23,000 (Parrish *et al.*, 1974) Chlorobenzene would be expected to have the lowest BCF of the six chlorinated benzenes and their isomers. However, there are very limited data available describing the potential for bioconcentration of chlorobenzene. No BCFs for chlorobenzene were reported in USEPA (1980f), and a search of the AQUIRE data base revealed one study in which the BCF was 645 for a mosquitofish in 1.0 μg/L chlorobenzene over a 24-hour period (USEPA, 1993). No other BCF data for (mono) chlorobenzene were found.

In view of the general lack of available data describing BCFs for the receptor species, it is assumed that the BCF for all receptors is 645, the value reported for the mosquitofish in AQUIRE (USEPA, 1993). Based on this BCF, the estimated tissue concentration of chlorobenzene in the blue mussel, hard clam, and Atlantic silverside is 6.23 mg/kg (Figure 6-23). Tissue samples collected in 1992 were not analyzed for chlorobenzene.

Toxicity data for chlorobenzene in saltwater species are relatively sparse in contrast to data for other, more chlorinated benzene compounds such as hexachlorobenzene. The only available toxicity data for chlorobenzene are reported in the water quality criteria document for chlorinated benzenes and in AQUIRE. The reported LC_{50} for chlorobenzene in mysid shrimp (*Mysidopsis bahia*) is 10,500 μg/L (USEPA, 1980f; 1993). The reported LC_{50} in sheepshead minnow is 16,400 μg/L. There are no chronic toxicity data or acute/chronic toxicity ratio available for chlorobenzene. However, applying the highest (i.e., most conservative) ratio for a chlorinated benzene (96 for trichlorobenzene [USEPA, 1980f]) to the LC_{50} of 10,500 (mysid shrimp) results in an estimated chronic chlorobenzene concentration of 109 μg/L.

Using these toxicity data, the estimated chronic toxic threshold for blue mussel and hard clam is 109 μg/L, and the estimated acutely toxic threshold for Atlantic silverside is 16,400 μg/L. Based on these estimates, it appears unlikely that the portions of the blue mussel and hard clam populations exposed to groundwater/leachate are at risk from the chlorobenzene. The Atlantic silverside also is unlikely to be at risk from exposure to chlorobenzene while foraging among the riprap along the landfill.

<u>Birds</u>. Chlorobenzene is both lipophilic and hydrophobic and may therefore potentially bioaccumulate in avian body fat. Chlorobenzene, however, is readily metabolized or

eliminated via the lungs in rats (USEPA, 1980f). Therefore its bioaccumulation potential in avian receptors may be somewhat limited.

USEPA (1980f) reports that chlorobenzene uptake equilibrium is expected to be reached in a relatively short time and that prolonged exposure to constant levels in the environment is not expected to result in continuous accumulation. Based on available bioaccumulation data for the rat (Varshavskaya, 1968), a maximum body burden level of 1.25 times the dietary concentration is reached in about two days. The same BAF of 1.25 was applied to waterfowl/wading birds and raptors for this exposure assessment in the absence of any information on differences in chlorobenzene uptake/elimination by rats and birds.

Dietary chlorobenzene concentration for estuarine avian receptors could be as much as 6.23 mg/kg based on estimated concentrations in the blue mussel/hard clam and silverside. Such dietary concentrations could result in residue concentrations of 7.8 mg/kg in waterfowl/wading birds and 9.7 mg/kg in raptors, based on a BAF of 1.25.

No data on the toxicity of chlorobenzene to avian species were located. Oral LD_{50} values of 2,290 mg/kg-bw and 2,300 mg/kg-bw are reported for a rat and mouse, respectively (Lewis, 1992). Behavioral and respiration effects have also been reported in mice at concentrations of 250 mg/kg-bw. By applying a safety factor of 100 to the LD_{50} dose values, safe "threshold" levels of 22.9 mg/kg-bw (rat) and 23 mg/kg-bw (mouse) may be obtained. Using a dose value of 22.9 mg/kg-bw results in a "safe" dietary concentration for a mallard/waterfowl of 152 mg/kg. Dietary concentrations for the avian estuarine receptors are estimated to be well below this value, therefore, a potential hazard from chlorobenzene to these receptors from food/prey ingestion is considered unlikely.

6.3.8 Limitations and Uncertainties

In the absence of complete information, the approach used in this EHE was to make conservative assumptions to ensure that the potential ecological hazards associated with exposure of fish and wildlife to ecological COCs at the Pelham Bay landfill were not underestimated. Assumptions for this EHE were made in the compilation of environmental media data, the selection of key receptors, the exposure evaluation and development of toxicity screening values (i.e., thresholds), and the hazard characterization. When many conservative assumptions are used to develop an overall hazard characterization, the result may be overly conservative, and the actual risks are likely to be lower. Other assumptions such as the percentage of total mercury and cyanide that are bioavailable as methyl mercury and free cyanide, respectively, may also tend to underestimate the potential hazards. The assumptions or other factors that tend to overestimate, underestimate, or have an unknown effect on the EHE are presented below with a discussion of their uncertainty.

6.3.8.1 Factors That May Overstate Potential Hazards

Several assumptions were made that may result in overstating the potential hazards. The major assumptions contributing to a conservative assessment are discussed below.

Exposure Point Concentrations of Contaminants. The expected chemical concentrations used for comparison to reference toxicity thresholds were primarily the RME concentrations from the combined groundwater/leachate data base that consisted of 22 samples from 15 wells and 7 leachate sampling locations. The RME concentration is the lower of the maximum detected concentration or the 95th percentile upper confidence level. By definition, the RME is higher than at least half of the concentrations detected. It was conservatively assumed that the exposure concentration was the RME concentration.

In addition, no ameliorating influences between the well or leachate sampling location and the exposure point were considered. It is likely that some degree of chemical adsorption onto fine-grain particles, dilution by interstitial seawater, complexing with naturally-occurring chemicals, and/or settling of suspended contaminants occurs between the wells and the exposure point. Such actions would reduce the concentrations of bioavailable chemicals and subsequent hazard potential.

Receptors also were assumed to be exposed to RME contaminant concentrations at all exposure points. This is a conservative assumption because several of the COC6.3.9.1s, especially organics, were found in limited numbers of samples, and the highest concentration often was detected in a well sample and not in a leachate sample. For example, alpha-chlordane was found in only one of 22 samples, monitoring well sample MW-103. The PCBs 1016 and 1260 were detected in only one well sample from MW-105. Both alpha-chlordane and the PCBs may have been present in other groundwater/

leachate samples, but they were not detected above the detection limits of 0.5 to 1.0 μg/L.

Further evidence that the assumptions made in assessing potential ecological hazards were conservative is provided by the fact that the measured concentrations of most chemicals were far lower than the estimated levels.

Toxicity Screening Thresholds and BCFs. No satisfactory system is available in the literature for identifying toxicity-based "safe" threshold values for waterfowl, shorebirds, and terrestrial wildlife. Toxic dose values for laboratory organisms are likely to be substantially lower than those for wildlife due to the sensitive strains of laboratory animals used and the direct means by which they are dosed. LD_{50} studies are usually designed to promote maximum exposure (absorption) and lessen any chemical complexing with dietary material. The LDLO dietary studies probably give a better indication of the toxicity of the chemical tested, while NOELs from longer studies are the best, but still imperfect, laboratory studies to use as predictors of field effects.

For this EHE, the lowest available LD_{50} or LDLO values or the highest NOELs were generally used to assess potential hazards to birds and wildlife. This is an overconservative approach given the wide range in toxicity values that are sometimes available. In other cases, toxicity information on chemicals that are likely to be of concern to biota (e.g., endosulfan) are noticeably lacking. Also, toxicity values were used without peer review of the original publications, as is required for establishment of toxicity reference doses in human health risk assessments.

In cases where "no-effects" levels (NOELs) were unavailable, "safe" threshold levels were estimated by applying a conservative safety factor of 100 to available LD_{50} data. This was considered a conservative safety factor to use in the EPA (1986d) guidance recommends safety factors of 1/5 to LD_{50} value for non-endangered terrestrial species, and 1/10 the LD_{50} or 1/5 to LD_{10} for endangered terrestrial species. Laboratory toxicity data for small mammals (rats and mice) were used for a few chemicals where no avian benchmarks were available. A conservative safety factor of 100 was also used in these cases to convert available LD_{50} data to "safe" threshold benchmark levels.

The available toxicity data doesn't always account for the formation of toxic intermediates as may be the case for PAHs and chlorobenzene. Evidence has been accumulating, for example, which implies that the metabolism of halogenated benzene compounds results in the formation of toxic intermediates (USEPA, 1980z).

Information on bioaccumulation factors is generally lacking in the available literature. Measured concentrations in aquatic receptors indicate that estimated concentrations based on literature BCF values are likely overconservative. The BAFs for terrestrial and avian estuarine receptors were selected based on the general tendency of a chemical to bioaccumulate. These values are likely to be overconservative, and any conclusions based on this approach are uncertain.

Almost without exception, laboratory studies of the aquatic receptor species or their surrogates were the sources of data on BCFs and chemical concentrations used for toxicity screening in this EHE. Results of these studies are typically more conservative (i.e., BCFs are higher, LC_{50}s are lower) because the testing solutions used contain the chemicals in a more bioavailable form. They do not contain naturally-occurring suspended solids and organics that tend to form chemical complexes, thereby making them less bioavailable. According to EPA (1992), a much more accurate measure of chemical toxicity is *in situ* testing of receptor organisms.

When a range of toxicity values was available for a receptor species or its surrogate, the lowest reasonable value was used as the screening value. LC_{50} concentrations from tests of short duration (e.g., 24 or 48 hours) were used if available. The SMAV, which is a conservative EPA-derived value, also was used whenever available.

BCFs applied to Atlantic silversides were conservative because the fish most likely are not directly exposed to the groundwater/leachate RME concentration for a period of time as long as typical laboratory test periods. BCF tests often last 30 days or longer so that the bioconcentration, metabolism, depuration rates, and tissue concentrations can reach equilibrium.

The tendency of fish to avoid elevated chemical concentrations when given the freedom to move to other areas was not routinely included in the evaluation of individual chemical hazards. Consequently, the fish are even less likely to be directly exposed to groundwater/leachate than estimated based on the area directly affected by the chemical seeps. It also is possible that bivalve larvae may find the areas on the riprap and the bottom sediments immediately adjacent to the riprap unsuitable for settlement based on larval chemical-sensing capabilities. These chemical avoidance behaviors would lead to reduced exposure and resulting potential hazard to the aquatic receptors.

Exposure Duration and Area Use. For this EHE, avian and mammalian receptors are conservatively assumed to be exposed to the estimated (maximum expected) concentrations in dietary organisms long enough for equilibrium to occur. Birds in both the terrestrial and estuarine ecosystems are likely to visit and feed at other habitats in the area. In both ecosystems, they are unlikely to consistently feed at exposure areas where tissue concentrations in prey organisms are at the estimated concentration levels used in this EHE, nor are always expected to be in such areas long enough for equilibrium to occur in prey species for those COCs that bioaccumulate.

The toxicity benchmarks used in the EHE are derived from available toxicity studies with varying, but generally chronic (several weeks to several months) exposure durations. Comparison of tissue, dietary or dose concentrations to such chronic toxicity benchmarks provides for an overestimation of potential hazard.

Weight and Food/Sediment Intake Parameters. Actual food and sediment intake parameters for most wildlife are unknown and may have been either overestimated or underestimated in this EHE. Animal live weight and food intake parameters for laboratory organisms were obtained from NIOSH (1986). Live weight and food intake parameters for wildlife (mallards, small birds, small mammals) were estimated based on available literature values (Teres, 1991; Nagy, 1987; Newell *et al.*, 1987).

Background Soils Concentrations. Ecological COCs for the terrestrial ecosystem were selected based on a comparison with limited criteria, including values obtained at one reference station location (MW-124 S1). Detected chemical concentrations for several PAHs at another nearby offsite location northwest of the highway (SB-125S1) were considerably elevated above both the reference station concentrations and onsite RME soils concentrations [e.g., benzo(a)anthracene (2,700 μg/kg); benzo(a)pyrene (2,000 μg/kg); and chrysene (3,000 μg/kg)]. Elevated PAH concentrations at the SB-125S1 location are likely attributable to the nearby highway. Elevated PAH concentrations detected in onsite soils, however, are also not necessarily related to the landfill, and may be the result of automotive emissions from the urbanized environment that occurs in the vicinity of the Pelham Bay landfill.

6.3.8.2 Factors That May Understate Potential Hazards

Various aspects of the EHE may also result in an understatement of potential hazards. Some of the major assumptions or data characteristics that could contribute to an understatement are discussed below.

Receptor Species. It is possible that receptors considered in this EHE are not those receptors that have the greatest likelihood of being impacted. Reptiles and amphibians were not addressed in this EHE as toxicity information for these species is generally lacking. Potential hazards were generally considered only for adult/mature individuals. Younger animals may be more sensitive to the COCs. Larger mammal species in the terrestrial ecosystem, such as the raccoon and skunk, were not addressed as potential exposure and subsequent hazards to these species were judged to be not significant that compared to those receptors that were evaluated. Potential impacts at higher levels of ecological organization such as ecosystem functioning also were not specifically considered in this EHE.

Evaluation of Individual Ecological COCs. The evaluation of hazards for individual ecological COCs may understate the cumulative hazard to the receptors by not considering additive or synergistic effects, particularly for the organochlorine pesticides. It is frequently assumed that toxic effects are additive when data describing the toxic levels of chemical combinations are lacking. In this EHE the hazard evaluation is qualitative, and "adding" qualitative evaluations for individual COCs can only be done by applying professional judgement to the exposure scenario as it has been developed for the onsite EHE. It also is possible that certain combinations of chemicals counteract each others toxicity, resulting in an antagonistic effect.

Unknown Concentrations of Bioavailable Forms. Total mercury and cyanide environmental concentrations were measured rather than the more bioavailable and toxic forms of methyl mercury and free cyanide. The availability of only total concentrations required using assumed proportions of the bioavailable forms because reported toxic levels and BCFs are expressed almost exclusively for methyl mercury and free cyanide. In this EHE, total mercury and cyanide concentrations in groundwater/leachate were relatively low, however; and the potential hazards are unlikely to have been substantially understated.

Exposure Pathways. Site-specific feeding observations for species of special concern, such as raptors, were not conducted as part of this preliminary investigation. In the estuarine ecosystem, the hazard potential was considered negligible as raptors are not expected to feed largely on avian species that may be in close contact with potentially contaminated dietary organisms such as the blue mussels or Atlantic silversides. The potential for some raptors to largely feed on such prey organisms cannot be ruled out without site-specific feeding studies.

This EHE was limited to an evaluation of the oral ingestion pathway for terrestrial and avian estuarine receptors. Information on other exposure pathways (inhalation, dermal absorption) that may be applied to wildlife are generally lacking. Pesticides, such as dieldrin can be readily absorbed after ingestion, inhalation or dermal exposure. By not considering these additional exposure pathways, exposure concentrations may be underestimated.

Extrapolation of Potential Hazards to the Estuarine Community and Ecosystem. This EHE was limited to onsite effects, including the possible hazard presented by groundwater/leachate to selected estuarine receptor species. Only a limited number of individuals are assumed to be directly exposed and potentially affected by the groundwater/leachate, but potential hazards to populations exposed to dilute groundwater/leachate were not considered. Similarly, the potential hazard of the landfill to the estuarine community of Eastchester Bay and Western Long Island Sound was not assessed in the EHE. This approach assumes that population level effects are valid surrogates for ecosystem health; that is, injury to the basic biotic components of an ecosystem decreases the ecosystem's stability, functional integrity, quality, and/or likelihood of survival. Other ecosystem effects, such as predator-prey relationships, community metabolism, or structural shifts are not considered. While these off-site effects cannot be evaluated without additional information, it cannot be assumed that the hazards are negligible.

6.3.9 Summary

A summary of conclusions regarding potential hazards to biota in the terrestrial and estuarine ecosystems based on unvalidated data is provided in the following sections.

6.3.9.1 Terrestrial Ecosystem

A terrestrial ecosystem EHE was conducted based on surface soil chemical analyses to determine whether existing concentrations of ecological COCs pose a potential hazard to wildlife. Potential hazards to terrestrial wildlife were evaluated for exposure to soils following EPA environmental evaluation guidance for Superfund sites (USEPA, 1989a). Considerable uncertainty was involved in the evaluation of potential hazards to wildlife at this site. Adequate information was often absent; therefore, conservative assumptions were used to ensure that potential hazards were not underestimated. The terrestrial ESE is intended to provide a predictive screening of potential hazards to terrestrial receptors of concern. The EHE is not intended to provide a determination of actual hazards to terrestrial biota at the site, nor is it intended to provide for the development of remediation criteria.

The robin, pheasant, red-tailed hawk, and white-footed mouse were selected as key receptors species for this ecosystem. Direct and indirect exposure pathways were evaluated for surrogate receptor groups (small birds, small mammals, and raptors) in order to evaluate potential hazards. Direct and indirect (bioaccumulation) chemical intake (dietary or dose) and tissue residue levels for surrogate receptor groups were compared to "no-effects"(NOELs and NOAELs) or "toxic" dose levels (TDLOs, LDLOs, and LD_{50}s) as derived from available toxicological literature for birds and rodents. BAFs (largely assumed values) were applied to COCs that bioaccumulate (i.e., organochlorine pesticides) in order to derive dietary and residue concentrations for different trophic levels in the food web. A summary of the results of the terrestrial evaluation is presented in Table 6-39.

Twenty chemicals (4 metals, 3 PAHs, 1 volatile organic compound, and 12 pesticides/PCBs/furans) were retained as ecological COCs in soils for the terrestrial ecosystem. The volatile (N-nitrosodi-n-propylamine) and three metals (zinc, lead, and nickel) were not considered to pose a hazard to terrestrial receptors. Dibenzofuran, methoxychlor, g-chlordane were also not considered to pose a hazard to terrestrial receptors, based on their low concentrations as compared to available toxicity benchmark values, and their infrequent detection onsite.

Although PAHs were considered to pose a potential hazard to small birds, concentrations detected may not necessarily be site-related. RME surficial soils concentrations for the 3 PAHs (benzo(a)anthracene, benzo(a)pyrene, and chrysene) were approximately twice as high as the soil boring concentrations. Onsite RME concentrations for these three PAHs, although greater than reference soil concentrations, were considerably less than concentrations detected at another nearby offsite sampling location (SB-125S1), which is adjacent to Pelham Bay Parkway. PAHs concentrations in onsite soils are therefore considered to be more likely related to offsite automotive or industrial emissions than releases from the landfill.

Eggshell thinning and reduced hatchability in birds and reproductive effects in mammals are the principal toxic effects of concern from pesticides and PCBs in terrestrial environments. Nine pesticides and PCBs were considered to pose a potential hazard to terrestrial receptors based on their potential to bioaccumulate in food chains and the resultant estimated residue values. These ecological COCs are DDT/DDE/DDD, Aroclor 1254/1260, a-chlordane, dieldrin, endosulfan, and delta-BHC.

Each of these ecological COCs is considered to pose a potential hazard to sensitive bird species, particularly the higher trophic level raptors that feed on smaller birds or mammals. Some of these, particularly the PCBs, were also considered to pose a potential hazard to sensitive small mammals and their predators. The evaluation of potential hazard for these chemicals, however, was largely based on assumed BAF values. Information on actual bioaccumulation factors is generally lacking in the available literature. Information on population parameters for onsite receptors, particularly the raptors and their actual feeding habits was also unavailable. The BAFs used in this EHE were selected based on the general tendency of a pesticide or PCB to bioaccumulate. These values are likely to be overconservative and any conclusions with respect to actual hazards to onsite species based on this approach are uncertain.

6.3.9.2 Estuarine Ecosystem

The estuarine ecosystem exposure assessment and hazard evaluation focused on the potential hazards associated with groundwater/leachate to which estuarine receptors could be directly or indirectly exposed. As more fully discussed in Section 6.3.8.1, this EHE is geographically limited to the small area of riprap and soft bottom extending from the toe of the Pelham Bay Landfill to the mean high water elevation. As a consequence, a limited number of receptor individuals/populations are potentially affected by direct exposure to groundwater/leachate.

The key estuarine receptors included blue mussel, hard clam, Atlantic silverside, waterfowl, wading birds, and raptors. Numeric estimates of contaminant amelioration (e.g., dilution, adsorption) and areas directly affected are not used in the exposure and hazard evaluations. Other estuarine receptor species (blue crab and flounder) are not expected to be directly exposed to groundwater/leachate and are therefore not considered in this onsite EHE. A summary of the results of the estuarine evaluation is presented in Table 6-40.

Bivalves and Fish. Eighteen groundwater/leachate ecological COCs were evaluated to determine their potential hazard to estuarine receptors. All were detected at concentrations exceeding surface water quality benchmarks, and most were detected in other media (e.g., sediment, surface water, tissues) that could act as secondary exposure points. Two PCBs (1016 and 1260) that were found in groundwater/leachate were evaluated as total PCBs because adequate toxicological data on the individual Aroclors were not available.

Of the 18 ecological COCs evaluated, three metals (copper, nickel, and lead) and one organic analyte (ammonia nitrogen) were judged to be present in groundwater/leachate at sufficient concentrations to constitute likely hazards to aquatic receptors directly exposed to groundwater/leachate. Copper and ammonia nitrogen likely present hazards to all aquatic receptors - blue mussel, hard clam and those Atlantic silverside directly exposed. Nickel and lead also are likely hazards to the bivalves, but they are unlikely hazards to the Atlantic silverside.

Seven of the ecological COCs evaluated were judged unlikely to present a potential hazard to any of the three aquatic receptors (blue mussel, hard clam, and Atlantic silverside) that could be directly exposed to groundwater/leachate. The seven COCs are: mercury, 4,4'-DDD, 4,4'-DDE, phenanthrene, cyanide, a-chlordane, and chlorobenzene.

Despite the fact that these COCs were not thought to present hazards to the estuarine receptors, four of them have BCFs of 10,000 or greater and may biomagnify to levels that are potentially toxic to higher trophic level predators (e.g., waterfowl, wading birds and raptors). Mercury is reported as having BCFs of 10,000 in bivalves; 4,4,-DDD and 4,4'-DDE have BCFs estimated to be 10,000 in bivalves and fish; and alpha-chlordane has BCFs of 5,500 in bivalves and 12,300 in fish. In addition to these four COCs, total PCBs have estimated BCFs of 85,000 in bivalves and 100,000 in fish. Use of these high

BCFs resulted in estimated tissue residue levels that were substantially greater than the measured tissue residue concentrations for all COCs and receptors except 4,4'-DDE in Atlantic silverside, where estimated and measured levels are equivalent.

As noted previously, the 1992 surface water mercury concentrations were approximately twice the groundwater/leachate concentrations. These higher concentrations in Eastchester Bay surface water are indicative of significant sources of mercury outside of the landfill (e.g., combined sewer overflows in the Hutchinson River).

Six COCs were thought to be unlikely hazards to two of the three directly-exposed receptors. Because of different toxicity thresholds, four COCs (total PCBs, endosulfan II, dieldrin, and endrin) present possible hazards to Atlantic silversides but are unlikely to present hazards to blue mussels and hard clams. Methoxychlor presents a possible hazard to blue mussels, especially the larvae, but is an unlikely hazard to hard clams and Atlantic silversides. Zinc is unlikely to present a hazard to the blue mussel and Atlantic silverside but is a likely hazard to the more sensitive hard clam.

Reiterating the estuarine exposure scenario, only limited numbers of receptor individuals/populations near the landfill are expected to be directly exposed to, and potentially affected by, COCs in the groundwater/leachate. The segments of the bivalve populations exposed to groundwater/leachate are determined by their position relative to locations of leachate seeps.

During the collection of tissue samples from near the landfill in August 1992, investigators noted reduced numbers of mussels in areas of the riprap and no hard clams directly adjacent to the riprap. Limited numbers of blue mussels and practically no algae encrusting the riprap were seen in the vicinity of leachate sampling location LS-5. This paucity of encrusting organisms may be due to stress from chemicals in the leachate seeping from LS-5. Based on water quality samples collected in August 1992, leachate sample LS-5 had the maximum concentrations of copper (977 μg/L) and lead (707 μg/L) of all the sampling locations included in the groundwater/leachate database. Also, no clams were found in the soft sediments directly adjacent to the riprap. Pieces of clam shells were found in the immediate area, but investigators had to move 30 to 50 feet offshore of the riprap to find whole, live clams for tissue analysis. The apparent absence of hard clams in the area directly adjacent to the riprap may be caused by physical constraints (e.g., wave action, sediment characteristics) or by the groundwater/leachate that is seeping out of the landfill.

Because the Atlantic silverside is a mobile species, some individuals may be directly exposed to groundwater/leachate when foraging among the riprap. It seems reasonable to assume, however, that areas directly exposed to leachate would not be frequented by Atlantic silversides in view of the expected lack of prey organisms and the tendency of fish to avoid high concentrations of contamination when given the freedom to move to other areas. In other words, the groundwater/leachate presents a likely hazard to prey organisms but is an unlikely hazard to the Atlantic silverside or other forage species.

Estuarine Birds. In the preceding hazard evaluation, potential hazards to waterfowl, wading birds, and raptors were indicated for several COCs, based on RME groundwater/leachate chemical concentrations and the potential for COCs to bioaccumulate through the food web. Actual site-related hazards or impacts to individual receptors or populations are considered unlikely, however, due to the limited exposure area and area use by avian receptors. Unless avian receptors are consistently feeding on prey organisms in direct contact with groundwater/leachate, concentrations of COCs in prey organisms are unlikely to be as high as the estimated values used in this EHE.

The preceding hazard characterization was largely based on estimated tissue concentrations in avian dietary organisms and bioaccumulation potential in avian receptors. As demonstrated by the measured tissue concentrations, the estimated concentrations (except in the case of DDE) are likely to result in an overestimation of residue concentrations, particularly in marine organisms. BAF values for avian receptors are largely unknown and were conservatively estimated in this EHE based on extremely limited information.

To judge potential hazards, residue and dietary concentrations for avian receptors were compared to the few available avian toxicity benchmarks. Laboratory toxicity data for small mammals (rats and mice) were used for a few chemicals where no avian benchmarks were available. A conservative safety factor of 100 was applied in several cases to convert available LD_{50} data to "safe" threshold benchmark levels. This was considered a conservative safety factor to use in that USEPA (1986d) guidance recommends safety factors of 1/5 the LD_{50} value for non-endangered terrestrial species, and 1/10 the LD_{50} or 1/5 the LD_{10} for endangered terrestrial species.

For the hazard characterization, prey organisms were assumed to be in direct contact with groundwater/leachate so as to achieve the estimated tissue concentrations. Based on this assumption, a number of COCs were considered to pose a potential hazard.

Mercury was the only metal considered to pose a potential hazard (adverse reproductive effects) to avian estuarine receptors. The measured concentration in Atlantic silversides exceeds the USFWS recommended dietary threshold level for sensitive birds (Eisler, 1987), thereby posing a potential hazard to piscivorous avian receptors. Because mercury may be expected to accumulate in waterfowl/wading birds that feed on silversides, a potential hazard may also exist for higher trophic level avian predators that principally feed on waterfowl or wading birds.

Three organochlorine pesticides (DDD, dieldrin, and chlordane) and total PCBs were considered to pose a potential hazard (eggshell thinning) to avian receptors. Only the estimated DDD concentration in Atlantic silversides exceeds any of the dietary NOELs set for DDT or its metabolites in piscivorous birds. The DDD concentration in Atlantic silversides, however, is an estimated concentration based on bioconcentration potential, actual concentrations in silversides are likely to be less and not pose a hazard to avian predators. Based on the measured DDD concentration in blue mussels and an assumed BAF of 10, waterfowl or wadingbirds or other species such as gulls which feed on these organisms, could accumulate DDD to a level near the EPA dietary NOEL of 0.2 mg/kg for sensitive birds (e.g., brown pelicans). DDD in blue mussels is unlikely to be a hazard for raptors, unless raptors consistently feed on prey which consume mussels that are in direct contact with the groundwater/leachate.

Estimated concentrations of dieldrin and chlordane in Atlantic silversides also were considered to pose a potential hazard to avian predators. The estimated dieldrin concentration in Atlantic silversides is more than twice the dietary NOEL criteria set for mallards (Newell *et al.*, 1987). A potential hazard (reproductive success) was therefore considered to exist for waterfowl/wading birds feeding on Atlantic silversides. Estimated residue concentrations in these waterfowl/wading birds also were considered to pose a potential dietary hazard for raptors. Estimated chlordane concentrations in Atlantic silversides were considered potentially hazardous as they exceed the NYSDEC NOEL criterion (Newell *et al.*, 1987) for sensitive avian piscivores. Estimated chlordane residue concentrations in raptors based on blue mussel to waterfowl/wading bird pathway, also were considered potentially hazardous. Again, each of these potential hazards was based on estimated concentrations in dietary organisms. Actual concentrations are likely to be much less and not pose a hazard to these receptors.

The greatest potential toxic effect from organochlorine pesticides and PCBs is reduced reproductive success. Three species of potentially breeding wading birds (great blue heron, great egret, snowy egret) were observed feeding on Atlantic silversides in the vicinity of leachate exposure points south of the landfill. Mallards, which also may breed in the area, were observed dabbling in sediments in the shallow water area near the south side of the landfill. The greatest hazard potential would be to individuals feeding in these areas. Because the potentially hazardous exposure area is limited to the groundwater/leachate areas, it is unlikely that enough individuals would be impacted for population impacts to occur. Unless the species is threatened or endangered, population rather than individual impacts are the assessment endpoint. Impacts to populations of these receptors are considered unlikely, largely due to the small exposure area.

Only a small portion of the blue mussel, hard clam, and Atlantic silverside populations are expected to be in direct contact with elevated COC concentrations found in groundwater/leachate. Birds that feed on these organisms could potentially accumulate pesticides and PCBs. The few birds that may feed largely at these areas, however, are not expected to make up a significant portion of diet for individual breeding raptors which may occur in the area. A potential hazard to estuarine raptors, is therefore likely to be negligible.

No potential hazard is considered to exist for the federally protected raptors, the bald eagle and peregrine falcon, based on this EHE. The bald eagle is not considered likely to feed on potentially hazardous prey organisms in the vicinity of the landfill. The peregrine falcon, which nests at Throg's Neck Bridge, also is considered very unlikely to feed in the immediate vicinity of the landfill.

The preceding EHE did not directly address receptors other than birds or small mammals (e.g., reptiles or amphibians). The assumption can be made that when key receptors are "protected" via risk criteria (i.e., toxicity benchmarks), some protection is afforded reptiles and amphibians by these same criteria. This follows USEPA guidance (1986d). One state-protected reptile, the diamondback terrapin, a largely carnivorous species, occurs in the Pelham Bay Park Wetlands, but was not observed at the landfill.

Should this species occur at the landfill, the potential for a hazard to such individuals to exist cannot be ruled out.

6.4 REFERENCES

6.4.1 Health Hazard Evaluation

Brainard, J. and D.E. Burnmaster. 1992. Bivariate Distribution for Height and Weight of Men and Woman in the United States. Risk Analyses, Vol. 12, No. 2, June, p.267-275.

Burnmaster, D.E., C.A. Menzie, A.C. Crouch, and T.E. McKone. 1992. Monte Carlo Techniques for Quantitative Uncertainty Analysis in Public Health Risk Assessments: Submitted to Risk Analysis.

Cox, L.A., Jr. and P.A. Ricci. 1992. Reassessing Benzene Cancer Risks Using Internal Doses. Risk Analysis, Vol. 12, No. 3. September.

Hawley, J.K. 1985. Assessment of health risk from exposure to contaminated soil. Risk Analysis, Vol. 5, No. ~~4~~: pp. ~~289-302~~
6 284-302

National Academy of Sciences - National Research Council. 1989. Recommended Daily Allowances.

New York State Department of Health. 1991. Guidance for Exposure Assessment of Municipal Solid Waste and Hospital Waste Incinerator Emissions, June 27.

New York State Department of Health. 1992. Personal communication by P.E. Brubaker (WCCI) with T. Gray, New York State Department of Health, Bureau of Toxic Substances Assessment, December.

Shacklette, H. and J. Boerngen. 1984. Elemental Concentrations in Soils and Other Surficial Materials of the Conterminous United States. U.S. Geological Survey Professional Paper 1270. U.S. Government Printing Office, Washington, D.C. 105 p.

U.S. Department of Labor Employee Tenure and Occupational Mobility in the Early 1990s. 1992. Bureau of Labor Statistics, USDOL.

U.S. Environmental Protection Agency. 1988. Superfund Exposure Assessment Manual. EPA/540/1-88/001, OSWER Directive 9285.5-1, April.

U.S. Environmental Protection Agency. 1989a. Risk Assessment Guidance for Superfund, Vol. 1: Human Health Evaluation Manual (Part A). EPA/540/1-89/002, December.

U.S. Environmental Protection Agency. 1989b. Risk Assessment Guidance for Superfund Vol. II: Environmental Evaluation Manual. Interim Final EPA/540/1-89-001, March.

U.S. Environmental Protection Agency. 1989c. Exposure Factors Handbook. Exposure Assessment Group Office of Health and Environmental Assessment. EPA/600/8-89/043, May.

U.S. Environmental Protection Agency. 1990a. National Oil and Hazardous Substances Pollution Contingency Plan. 40 CFR Part 300, March 8.

U.S. Environmental Protection Agency. 1990b. Basics of Pump and Treat Ground-Water Remediation Technology, EPA-600/8-90/003.

U.S. Environmental Protection Agency. 1991a. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene. Office of Science and Technology, Health and Ecological Criteria Division, November.

U.S. Environmental Protection Agency. 1991b. Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals). Interim. Publication 9285.7-01B, December.

U.S. Environmental Protection Agency. 1991c. Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual (Part C, Risk Evaluation of Remedial Alternatives). Interim. EPA/540/R-92/004, December.

U.S. Environmental Protection Agency. 1991d. Standard Default Exposure Factors. EPA/503/8-89/002.

U.S. Environmental Protection Agency. 1992a. Supplemental Guidance to RAGS: Calculating the Concentration Term. Office of Solid Waste and Emergency Response, May.

U.S. Environmental Protection Agency. 1992b. Guidelines for Exposure Assessment. Federal Register Vol. 57, No. 104, May 29, pp 22888-22938.

U.S. Environmental Protection Agency. 1992c. Integrated Risk Information System (IRIS). On-line computer database.

U.S. Environmental Protection Agency. 1992d. Health Effects Assessment Summary Tables (HEAST). FY-1992 and Supplement A, March and July.

U.S. Environmental Protection Agency. 1992e. Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/001B, January.

6.4.2 Ecological Hazard Evaluation

Alberici, T.M., W.E. Sopper, G.L. Storm, *et al.*, 1989. "Trace Metals in Soil Vegetation and Voles from Mine Land Treated with Sewage Sludge." J. Environ. Qual. 18:115-119. In USDHHS 1992.

Alloway, B.J. (ed.). 1990. *Heavy Metals in Soils*. Halsted Press. John Wiley & Sons, Inc. New York.

Ambrose, A.M. *et al.*, 1976. "Long Term Toxicologic Assessment of Nickel in Rats and Dogs." J. Food Sci. Technol: 13:181-187. In USEPA 1984.

Aulerich, R.J., and R.K. Ringer. 1977. "Current Status of PCB Toxicity to Mink, and Effect on Their Reproduction." *Arch. Environ. Contam. Toxicol.* 6:279-292.

Battelle Ocean Sciences (BOS). 1987. Acute Toxicity of Phenanthrene to Saltwater Animals. Report to USEPA Criteria and Standards Division. Battelle Ocean Sciences, Duxbury, MA. In USEPA 1991b.

Bayer, U. 1978. "In Vivo Induction of Sister Chromatic Exchanges by Three Polyaromatic Hydrocarbons." In *Carcinogenesis - A Comprehensive Survey* edited by P.W. Jones and R.I. Freudentahl. Vol. 3.

Beije, K., and A. Jernelov. 1979. "Methylation of Mercury in Natural Waters." In *The Biogeochemistry of Mercury in the Environment*, edited by J.O. Nriagu, 201-210. Elsevier/North-Holland Biomedical Press, New York. In Eisler 1987b.

Bent, A. C. 1987. *Life Histories of North American Wild Fowl*. Dover Publications, Inc. New York.

Beyer, W.N. and C.D. Gish. 1980. "Persistence in Earthworms and Potential Hazards to Birds of Soil Applied DDT, Dieldrin, and Heptachlor." *Journal of Applied Ecology*. 17:295-307.

Bigelow, H.B. and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. Fishery Bulletin of the Fish and Wildlife Service. Bulletin 74, Vol. 53.

Biomedical and Environmental Information Analysis (BEIA), for Harry G. Armstrong Aerospace Medical Research Laboratory, under DOE. 1989. *The Installation Restoration Program Toxicology Guide*. Volume 3. Oak Ridge, Tennessee.

Bird, D.M, P.H. Tucker, G.A. Fox, and P.C. Lague. 1983. "Synergistic Effects of Aroclor® 1254 and Mirex on the Semen Characteristics of American Kestrels." *Arch. Environ. Contam. Toxicol.* 12:633-650. In Eisler 1986b.

Bjerk, J.E. and E.M. Brevik. 1980. "Organochlorine Compounds in Aquatic Environments." *Arch. Environ. Contam. Toxicol.* 7:743-750. In Kay 1984.

Blus, L.L. 1982. Further Interpretation of the Relation of Organochlorine Residues in Brown Pelican Eggs to Reproductive Success. Environmental Pollution (Series A) 28:15-33.

Boggess, W.R. (ed.). 1977. "Lead in the Environment." Rep. NSF/RA-770214. U.S. Gov. Printing Office, Washington, DC. In Eisler 1988.

Borg, K., H. Wantorp, K. Erne, and E. Hanko. 1969. "Alkylmercury Poisoning in Terrestrial Swedish Wildlife." *Viltrevy* 6:301-379.

Braham, H.W. 1973. "Lead in the California Sea Lion (*Zalophus californianus*)." *Environ. Pollut.* 5:253-258. In Eisler 1988.

Braune, B.M. 1987. "Comparison of Total Mercury Levels in Relation to Diet and Molt for Nine Species of Marine Bird." *Archives of Environmental Contamination and Toxicology*. 16:217-224.

Britton, W. and J. Huston. 1973. "Influence of Polychlorinated Biphenyls in the Laying Hen." *Poult. Sci.* 52(4):1620. In Newell *et al.*, 1987.

Brooks, G.T. 1974. Chlorinated Insecticides: Volume I: Technology and Applications. CRC Press. Cleveland, Ohio. In Callahan *et al.* 1979.

Brownawell, B. J., N. S. Fisher, and L. Naeher. 1991. Characterization of Data Base on Toxic Chemical Contamination in Long Island Sound, Submitted to the Environmental Protection Agency Long Island Sound Study. Marine Science Research Center, State University of New York, Stony Brook, NY.

Burgess, Robert, and Elise Petrocelli nd DRAFT. Data Report on the Results of Toxicity Tests and Supporting Chemical Analysis of Environmental Samples from Black Rock Harbor, Connecticut.

Burt, W.H. and R.P. Grossenheider. 1976. Peterson Field Guide Series, A Field Guide to the Mammals, North America North of Mexico. Third Edition. Houghton Mifflin Company, Boston.

Busbee, E.L. 1977. "The Effects of Dieldrin on the Behavior of Young Loggerhead Shrikes." *The Auk* 94:28-35. In ESE 1989.

Butler, P.A., *et al.*, 1963. Commercial Fisheries Investigations. In USEPA 1980.

Cade, Tom J., J.H. Enderson, et al (eds.). 1988. "Peregrine Falcon Populations: Their Management and Recovery." The Peregrine Fund, Inc. Boise, Idaho.

Cain, B.W. and E.A. Pafford. 1981. "Effects of Dietary Nickel on Survival and Growth of Mallard Ducklings." *Environ. Contam. Toxicol.* 10:737-45. In Gochfeld and Burger 1987.

Calabrese, A. and D.A. Nelson. 1974. "Inhibition of Embryonic Development of the Hard Clam, *Mercenaria mercenaria*, by Heavy Metals." *Bull. Environ. Contam. Toxicol.* 11:92. In USEPA 1985.

Calabrese, A., *et al.*, 1973. "The Toxicity of Heavy Metals to Embryos of the American Oyster (Crassostrea virginica)." *Mar. Biol.* 18:162. In USEPA 1985.

Calabrese, A. *et al.*, 1977. "Survival and Growth of Bivalve Larvae Under Heavy-Metal Stress." Mar. Biol. 41:179. In USEPA 1985.

Calder, W. and E. Braun. 1983. "Scaling of Osmotic Regulation in Mammals and Birds." *Amer. J. of Physiol.* 244:R601-R606.

Callahan, M.A, M.W. Slimak, N.W. Gabel, I.P. May, C.F. Fowler, J.R. Freed, P. Jennings, R.L. Durfee, F.C. Whitmore, B. Maestri, W.R. Mabey, B.R. Holt, and C. Gould. 1979. *Water-related Environmental Fate of 129 Priority Pollutants.* U.S. Environmental Protection Agency Office of Water Planning and Standards Office of Water and Waste Management. Washington, D.C. USEPA 440/4-79-029a.

Cannon, M., and L. Holcomb. 1968. "The Effect of DDT on Reproduction in Mice." *Ohio J. Sci.* 68:19-24.

Cardin, J.A. 1982. Memorandum to John H. Gentile. U.S. EPA, Narragansett, Rhode Island. In USEPA 1985.

Cardin, J.A. 1985. USEPA Narragansett, Rhode Island. Memorandum to D.J. Hansen. In USEPA 1986b.

Cardin, J.A. 1986. Memorandum to D.J. Hansen. USEPA Narragansett, Rhode Island. In USEPA 1989c.

Chadwick, G.G. and R.W. Brocksen. 1969. "Accumulation of Dieldrin by Fish and Selected Fish Food Organisms." *Journal of Wildlife Management.* 33:693-700. In ESE 1989.

Chapman, W.H., H.L. Fisher, and M.W. Pratt. 1968. "Concentration Factors of Chemical Elements in Edible Organisms." Lawrence Radiation Laboratory, Livermore, Calif. UCRL-50564. In Callahan *et al.*, 1979.

Cholakis, J.M., M.J. McKee, L.C.K. Wong, and J.D. Gile. 1981. Acute and Subacute Toxicity of Pesticides in Microtime Rodents. In Avian and Mammalian Wildlife Toxicology: Second Conference, ASTM STP 757. D.W. Lamb and E.E. Kenaga, eds. American Society for Testing and Materials. pp. 143-154. In ESE 1989.

Chytalo, K. 1993. Letter of February 9, 1993 from Karen Chytalo, NYSDEC Marine Habitat Monitoring and Assessment Section to R.L. Hinble, Woodward-Clyde Consultants.

City of New York Department of Environmental Protection. 1987. New York Harbor Water Quality Survey. Bureau of Wastewater Treatment, Water Quality Section, Wards Island, New York.

City of New York Department of Environmental Protection. 1991. New York Harbor Water Quality Survey. Bureau of Clean Water, Marine Sciences Section, Wards Island, New York.

Collett, N. and D.L. Harrison. 1968. "Some Observations on the Effects of Using Organochlorine Sprays in an Orchard." New Zealand Journal of Science. 11:371-379. In Beyer and Gish 1980.

Courtney, W.A.M., and W.J. Langston. 1980. "Accumulation of Polychlorinated Biphenyls in Turbot (*Scophthalmus maximus*) from Seawater and Food." *Helgoländer Meeresunters.* 33:333-339. In Kay 1984.

Crawford, N.N. 1993. Letter data January 15, 1993 from Nigel N. Crawford, NYSDEC to Cyprian CDX, NYCDEP.

Diercxsens, P.D. de Weck, N. Borsinger, B. Rosset, and J. Tarradellas. 1985. "Earthworm Contamination by PCBs and Heavy Metals." *Chemosphere 14:511-522.*

Dieter, M.P. *et al.,* 1988. "Evaluation of Tissue Disposition, Myelopoitic, and Immunologic Responses in Mice after Long Term Exposure to Nickel Sulfate in the Drinking Water." J. Toxicol. Environ. Health. 24:356-372. In U.S. Department of Health and Human Services 1991.

Dipple, A. 1985. "Polycyclic Aromatic Hydrocarbon Carcinogenesis: An Introduction." In *Polycyclic Hydrocarbons and Carcinogenesis*, 1-17, edited by R.D. Harvey. ACS Symp. Ser. 283. Amer. Chem. Soc., Washington, D.C.

Dorn, P. 1976. "The Feeding Behavior of *Mytilus edulis* in the Presence of Methylmercury Acetate." *Bull. Environ. Contam. Toxicol.* 15:174. In USEPA 1985.

Dressler, R.L., G.L. Storm, W.M. Tzilkowski, *et al.*, 1986. "Heavy Metals in Cottontail Rabbits on Mined Lands Treated with Sewage Sludge." J. Environ. Qual. 15:278-281. In USDHHS 1992.

EA Engineering. 1986. Proposed modified effluent limitations for ammonia. EA Report BET54E. Prepared for Bethlehem Steel Corporation, Sparrows Point, MD. In USEPA 1989c.

Eisler, R. and G.R. Gardner. 1973. "Acute Toxicology to an Estuarine Teleost of Mixtures of Cadmium, Copper and Zinc Salts." *Jour. Fish Bio.* 5:131.

Eisler, R. and G.R. Gardner. 1988. Lead Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service. Contaminant Hazard Review Report No. 14. Biological Report 85(1.14).

Eisler, R. and R.J. Hennekey. 1977. "Acute Toxicities of Cd^{2+}, Cr^{+6}, Hg^{2+}, Ni^{2+}, and Zn^{2+} to Estuarine Macrofauna." *Arch. Environ. Contam. Toxicol.* 6:315. In Eisler 1987b.

Eisler, R. 1969. "Acute Toxicities of Insecticides to Marine Decapod Crustaceans." *Crustacean.* 16:320.

Eisler, R. 1970a. Acute Toxicities of Organochlorine and Organophosphorus Insecticides to Estuarine Fishes. Tech. Paper Bur. Sport Fish. Wildl. U.S. Dept. Inter. No. 46.

Eisler, R. 1970b. Factors Affecting Pesticide-induced Toxicity in an Estuarine Fish. Tech. Paper Bur. Sport Fish. Wildl. U.S. Dept. Inter. No. 45.

Eisler, R. 1986a. Dioxin Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report. 86(8).

Eisler, R. 1986b. Polychlorinated Biphenyl Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report. 85(1.7).

Eisler, R. 1987a. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85(1.11). May.

Eisler, R. 1987b. Mercury Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85(1.10). April.

Eisler, R. 1987c. Mercury Contamination Standards for Marine Environments Trace Metal Concentrations in Marine Organisms.

Eisler, Ronald. 1990. Chlordane Hazards to Fish, Wildlife and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report. 85(1.21).

Ellis, R.H., S.J. Koepp, J. Weis, E.D. Santoro, and S.L. Cheng. 1980. A Comprehensive Monitoring and Assessment Program for Selected Heavy Metals in New Jersey Aquatic Fauna. New Jersey Marine Sciences Consortium.

Environmental Reporter. 1991. U.S. Bureau of National Affairs, Inc. Washington, D.C. August 8. 941:1101. pp 85-110.

Environmental Science and Engineering (ESE). 1989. Prepared for the Office of the Program Manager, Rocky Mountain Arsenal Contamination Cleanup. 1989. Biota Remedial Investigation. 4 Volumes.

Environmental Science and Engineering (ESE). April 1987. Introduction to the Contamination Assessment Reports. Version 2.3. Prepared for Office of the Program Manager, Rocky Mountain Arsenal. In ESE 1989.

Epifanio, E.C. and R.F. Srna. 1975. Toxicity of ammonia, nitrite ion, nitrate ion, and orthophosphate to *Mercenaria mercenaria* and *Crassostrea virginica*. Mar. biol. 33(3): 241-246. In USEPA 1989c.

Ernst, W. 1984. Pesticides and Technical Organic Chemicals. In Eisler 1986.

Evans, D.W. and D.W. Engel. 1992. Report to the Technical Management Team of the Lavaca Bay Study Phase: I, Mercury Bioaccumulation Study: Stage I, Descriptive Model and Literature Search. National Marine Fisheries Service, Beaufort Laboratory, Beaufort, NC.

Fimreite, N. and L. Karstad. 1971. "Effects of Dietary Methyl Mercury on Red-tailed Hawks." *Journal of Wildlife Management*. 35:293-300. In ESE 1989.

Finley, M.T., and R.C. Stendell. 1978. "Survival and Reproductive Success of Black Ducks Fed Methylmercury." Environ. Pollut. 16:51-64. In Eisler 1987b.

Fleming, W.J., D.R. Clark, Jr., and C.J. Hanry. 1983. "Organochlorine Pesticides and PCBs: A Continuing Problem for the 1980s" *Trans. N. Am. Wildl. Natur. Resourc. Conf.* 48:186-199. In Eisler 1986b.

Food Agriculture Organization/World Health Organization (FAO/WHO). 1978. Evaluations of Some Pesticides in Food. Food and Agric. Organ. Plant Production and Protection Paper. Suppl. 10. Rome. In Newell *et al.*, 1987.

Forsyth, D.S., W.D. Marshall, and M.C. Collette. 1983. "Interaction of Alkyllead Salts with Avian Eggs." In ESE 1989.

Forsyth, D.S., W.D. Marshall, and M.C. Collette. 1985. "Interaction of Alkyllead Salts with Avian Eggs." J. Environ. Sci. Health. 20A:177-191. In Eisler 1988.

Fowler, S.W. and J. La Rosa. 1978. "Factors Affecting Methyl and Inorganic Mercury Dynamics in Mussels and Shrimp." *Marine Biology* 46:267-276. In Evans and Engel 1992.

Frank, S. 1992. Personal communication with R. Hinkle, Woodward-Clyde, regarding the peregrine falcon and red-tailed hawk. November 1992.

Franson, J.C., L. Sileo, O.H. Pattee, and J.F. Moore. 1983. "Effects of Chronic Dietary Lead in American Kestrels *(Falco sparverius)*." *J. Wildlife Dig.* 19:100-113. In Eisler 1988.

Gaines, T.B. 1960. "The Acute Toxicity of Pesticides to Rats." *Toxicology and Applied Pharmacology*. 14:515-534. In Newell *et al.*, 1987.

Gardner, G. and W. Berry. 1981. Memorandum to John H. Gentile. USEPA, Narragansett, Rhode Island. In USEPA 1985.

Garten, C.T. 1980. "Ingestion of Soil by Hispid Cotton Rats, White-Footed Mice, and Eastern Chipmunks." J. of Mammal. 16(1):136-7.

Gile, J.D. and J.W. Gillett. 1979. "Fate of 14C Dieldrin in a Simulated Terrestrial Ecosystem." *Archives of Environ. Contam. and Toxicology*. 8:107-124. In ESE 1989.

Gish and Christensen. 1973. In Lee 1985.

Gish, C.D. and R.E. Christensen. 1973. "Cadmium, Nickel, Lead, and Zinc in Earthworms from Roadside Soil." *Environ. Sci. and Technol.* 7:1060-1062.

Gochfeld, M., and J. Burger. 1987. "Heavy Metal Concentrations in the Liver of Three Duck Species: Influence of Species and Sex." *Environmental Pollution*. 45:1-15.

Goerke, H., G. Eder, K Weber, and W. Ernst. 1979. "Patterns of Organochlorine Residues in Animals of Different Trophic Levels from the Weser Estuary." *Marine Pollution Bulletin.* 10:127-132. In Kay 1984.

Goodman, D.C and H.I. Fisher. 1962. *Functional Anatomy of the Feeding Apparatus in Waterfowl.* Carbondale, Il. Southern Il. Univ. Press.

Gough, L.P., H.T. Shacklette, and A.A. Case. 1980. Element concentrations toxic to plants, animals, and man. U.S. Geologic Survey Bulletin 14. U.S. Government Printing Office, Washington, D.C.

Gray, L.E. *et al.*, 1986. "An Evaluation of Figure 8 Maze Activity and General Behavioral Development Following Prenatal Exposure to 40 Chemicals." Neurotoxicology 7:449-462. In U.S. Department of Health and Human Services 1991.

Greig, R.A., R.N. Reid, and D.R. Wenzloff. 1977. Trace Metal Concentrations in Sediments from Long Island Sound. Marine Pollution Bulletin. 8:183-188. In Brownawell *et al.*, 1991.

Grimes, D.J. and S.M. Morrison. 1975. "Bacterial Bioconcentration of Chlorinated Hydrocarbon Insecticides from Aqueous Systems." Microb. Ecol. 2(1): 43-59. In Callahan *et al.*, 1979.

Hansen, D.J. *et al.* 1974. "Aroclor® 1016: Toxicity to and Uptake by Estuarine Animals." Environ. Res. 7:363.

Harr, J., R. Claeys, J. Bone, and T. McCorcle. 1970. "Dieldrin Toxicosis: Rat Production." *Am. J. Vet. Research.* 31:181-187. In Newell *et al.*, 1987.

Heath, R., J. Spann, and J. Kreitzer. 1969. "Marked DDE Impairment of Mallard Reproduction in Controlled Studies." Nature. 224:47-48. In Newell *et al.*, 1987.

Heinz, G., and R. Johnson. 1981. "Diagnostic Brain Residues of Dieldrin: Some New Insights." Avian and Mammalian Wildlife Toxicology: Second Conference. ASTM STP 757, D. Lamb and G. Kenaga (eds.) American Society of Testing Materials. In Newell *et al.*, 1987.

Heinz, G.H. 1979. "Methylmercury: Reproductive and Behavioral Effects on Three Generations of Mallard Ducks." J. Wildl. Management. 43:394-401. In Eisler 1987x.

Heinz, G.H. D.M. Swineford, and D.E. Katsma. 1984. High PCB Residues in Birds from the Sheboygan River, Wisconsin. *Environ. Monitor. Assess.* 4:155-161. In Eisler 1986b.

Hill, E.F., R.G. Heath, J.W. Spann, and J.D. Williams. 1975. Lethal Dietary Toxicities of Environmental Pollutants to Birds. Fish and Wildlife Service Special Scientific Report-Wildlife 191. Washington, D.C.

Hodge, H., A. Boyce, W. Deichmann, and H. Kraybill. 1967. "Toxicology and No-effects Levels of Aldrin and Dieldrin." *Toxicol. Appl. Pharmacol.* 10:613-675. In Newell *et al.*, 1987.

Hoffman, D.J., and M.L. Gay. 1981. "Embryotoxic Effects of Benzo(a)pyrene, Chrysene, and 7, 12-dimethylbenzo(a)anthracene in Petroleum Hydrocarbon Mixtures in Mallard Ducks." J. Toxocol. Environ. Health. 7:775-787. In Eisler 1987a.

Hoffman, D.J., J.C. Franson, O.H. Pattee, C.M. Bunck, and H.C. Murray. 1985b. "Biochemical and Hematological Effects of Lead Ingestion in Nestling American Kestrels (*Falco sparveruis*)." *Comp. Biochem. Physiol.* 80C:431-439. In Eisler 1988.

Hoffman, D.J., J.C. Franson, O.H. Pattee, C.M. Bunck, and A. Anderson. 1985a. "Survival, Growth, and Accumulation of Ingested Lead in Nestling American Kestrels (*Falco Sparveruis*)." *Arch. Environ. Contam. Toxicol.* 14:89-94. In Eisler 1988.

Hudson, R.H., R.K. Tucker and M.A. Haegele. 1984. Handbook of Toxicity of Pesticides to Wildlife. 2nd ed. U.S. Department of the Interior Fish and Wildlife Service, Res. Pub. 153, Washington, D.C. In ESE 1989.

Hunt-Boston. 1923.

Hunter, B.A., M.S. Johnson, and D.J. Thompson. 1989. "Ecotoxicology of Copper and Cadmium in a Contaminated Grassland Ecosystem IV. Tissue Distribution and Age Accumulation in Small Mammals." Journal of Applied Ecology 26:89-99.

ICF Clement. 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites.

International Joint Commission (IJC). 1981. Report of the Aquatic Ecosystems Objective Committee. Windsor, Ontario. In Newell 1987.

Ireland. 1975. In Lee 1985.

Jay, David A. and Malcolm J. Bowman. 1975. The Physical Oceanography and Water Quality of New York Harbor and Western Long Island Sound. Technical Report #23. Ref. #75-7. December.

Jeffries, D.J. and B.N.K. Davis. 1968. "Dynamics of Dieldrin in Soil, Earthworms, and Song Thrushes." *J. Wildlife Management* 32:441-456.

Jenkins, D.W. 1980. Biological Monitoring of Toxic Trace Metals, Volume I: Biological Monitoring and Surveillance. EPA-600/3-80-089.

Kay, S.H. 1984. Potential for Biomagnification of Contaminants within Marine and Freshwater Food Webs. Department of the Army, Waterways Experiment Station, Corps of Engineers. Long-Term Effect of Dredging Operations Program. Technical Report D-84-7.

Kendall, R.J., and P.F. Scanlon. 1983. "Histologic and Ultrastructural Lesions of Mourning Doves (*Zenaida macroura*) Poisoned by Lead Shot." *Poult. Sci.* 62:952-956. In Eisler 1988.

Kendall, R.J., and P.F. Scanlon. 1985. "Histology and Ultrastructure of Kidney Tissue from Ringed Turtle Doves that Ingested Lead." *J. Environ. Pathol. Toxicol. oncal.* 6:85-96 In Eisler 1988.

Kennish, M.J. 1992. *Ecology of Estuaries: Anthropogenic Effects.* Marine Science Series, CRC Press, Boca Raton, FL.

Korschgen, L.J. 1971. "Disappearance and Persistence of Aldrin after Five Annual Applications." *Journal of Wildlife Management.* 35:494-500. In ESE 1989.

Kreitzer, J.F. and G.H. Heinz. 1974. "The Effect of Sublethal Dosages of Five Pesticides and a Polychlorinated Biphenyl on the Avoidance Response of Coturnix Quail Chicks." *Environmental Pollution.* 6:21-29.In ESE 1989.

Lawler, E.M., G.E. Duke, and P.T. Redig. 1991. "Effects of Sublethal Lead Exposure on Gastric Mortality of Red-tailed Hawks." *Arch. Environ. Contam. Toxicol.* 21:78-83.

Lawrence, J.F. and D.F. Weber. 1984. "Determination of Polycyclic Aromatic Hydrocarbons in Some Canadian Commercial Fish, Shellfish, and Meat Products by Liquid Chromatography with Confirmation by Capillary Gas Chromatography-Mass Spectrometry." *J. Agric. Food Chem.* 32:789. In Kennish 1992.

LeDuc, G. 1981. Ecotoxicology of Cyanides in Freshwater. In EPA 1989.

Lee, K.E. 1985. *Earthworms: Their Ecology and Relationships with Soils and Land Use.* Academic Press. New York.

Lewis, Richard J. 1992. *Sax's Dangerous Properties of Industrial Materials.* Eighth edition. Von Nostrand Reinhold. New York.

Louckes, B. 1992. NYSDEC. Personal communication with R. Hinkle, Woodward-Clyde, regarding peregrine falcon nesting on the Throgs Neck Bridge. November 1992.

Lowe, J.I. Results of Toxicity Tests with Fishes and Macroinvertebrates. Data sheets available from USEPA, Environmental Res. Lab., Gulf Breeze, Florida. In EPA 1980c.

Ma, W. 1982. "The Influence of Soil Properties and Worm-Related Factors on the Concentration of Heavy Metals in Earthworms." *Pedobiologia.* 24:109-119. In ESE 1989.

Ma, Wei-chun, W. Denneman, and J.Faber. 1991. "Hazardous Exposure of Ground-Living Small Mammals to Cadmium and Lead in Contaminated Terrestrial Ecosystems." *Arch. Environ. Contam. Toxicol.* 20, 266-270.

Mackenzie and Angevine. 1981.

March, B.E., R. Poon, and S. Chu. 1983. "The Dynamics of Ingested Methyl Mercury in Growing and Laying Chickens." *Poult. Sci.* 62:1000-1009. In Eisler 1987b.

Marquerie, J.J., J.W. Simmers and S.H. Kay. 1987. "Preliminary Assessment of Bioaccumulation of Metals and Organic Contaminants at the Times Beach Confined Disposal Site, Buffalo, N.Y." Miscellaneous paper EL-87-6, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi. In USFWS 1990.

Martin, M. *et al.*, 1981. "Toxicity of Ten Metals to Crassotrea gigas and *Mytilus edules* Embryos and Cancer Magister Larvae." *Mar. Pollut. Bull.* 12:305. In EPA 1985b.

McEwen, L.C., R.K. Tucker, J.O. Ells, and M.A. Haegele. 1973. Mercury Wildlife Studies by the Denver Wildlife Research Center. Pages 146-156 in D.R. Buhler (ed.). *Mercury in the Western Environment.* Oregon State University. Corvallis.

McLane, M.A.R. and D.L. Hughes. 1980. "Reproductive Success of Screech Owls Fed Arochlor 1248." *Arch. Environ. Contam. Toxicol.* 9:661-665.

Metcalf, R.L., G.M. Booth, C.K. Schuth, D.J. Hansen, and P.Y. Lu. 1973. "Uptake and Fate of Di-2-ethylhexyl Phthalate in Aquatic Organisms and in a Model Ecosystem." *Environ. Hlth. Persp.* 4:35-44.ICF Clement. In Newell *et al.*, 1987.

Mullins, W.H., E.G. Bizeau, and W.W. Benson. 1977. "Effects of Phenyl Mercury on Captive Game Farm Pheasants." J. Wildl. Manage. 41:302-308.

Nagy, K. 1987. "Field Metabolic Rate and Food Regulation Scaling in Mammals and Animals." *Ecol. Monographs.* 57:111-128.

National Academy of Science (NAS). 1975. Medical and Biological Effects of Environmental Contaminants. Nickel.

National Academy of Science (NAS). 1977. Medical and Biological Effects of Environmental Contaminants. Copper.

National Academy of Science (NAS). 1978. An Assessment of Mercury in the Environment. Washington, D.C. In Eisler 1987b.

National Academy of Science (NAS). 1980. Mineral Tolerance of Domestic Animals. National Academy Press. Washington, D.C.

National Institute for Occupational Safety and Health (NIOSH). 1978. Registry of Toxic Effects of Chemical Substances (RTECS). U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control edited by R.J. Lewis and R.L. Talkin. Publ. No. 79-100. In Newell *et al.*, 1987.

National Institute for Occupational Safety and Health (NIOSH). 1982. Registry of Toxic Effects of Chemical Substances (RTECS). In U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control edited by R.J. Lewis and R.L. Tatken. Publ. No. 83-107. In Newell *et al.*, 1987.

National Institute for Occupational Safety and Health (NIOSH). 1984. Registry of Toxic Effects of Chemical Substances (RTECS) . U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control. Cincinnati, Ohio.

National Institute for Occupational Safety and Health (NIOSH). 1986. Registry of Toxic Effects of Chemical Substances (RTECS). Available through the National Library of Medicine's MEDLARS system.

National Institute for Occupational Safety and Health (NIOSH). 1987. Registry of Toxic Effects of Chemical Substances (RTECS). U.S. Department of Health, Public Health Service, Center for Disease Control. Cincinnati, Ohio.

National Institute for Occupational Safety and Health (NIOSH). 1988. Registry of Toxic Effects of Chemical Substances (RTECS) Database. Available through the National Library of Medicine's MEDLARS system.

National Institute for Occupational Safety and Health (NIOSH). 1989. Registry of Toxic Effects of Chemical Substances (RTECS) Database. Available through the National Library of Medicine's MEDLARS system.

National Oceanic and Atmospheric Administration (NOAA). 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52.

National Oceanic and Atmospheric Administration (NOAA). 1991. Second Summary of Data on Chemical Contaminants in Sediments from the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 59 In Brownawell *et al.*, 1991.

National Research Council (NRC), Committee on Biological Effects of Atmospheric Pollutants. 1975. Nickel. Washington. National Acad. Sci. In Gough *et al.*, 1980.

National Research Council (NRC). 1980. Drinking Water and Health. Vol. 2. Safe Drinking Water Committee, National Academy Press, Washington, D.C.

Neff, J.M. 1979. "Polycyclic Aromatic Hydrocarbons in the Aquatic Environment." Applied Science Publ. Ltd. London.

Neff, J.M. 1985. "Polycyclic Aromatic Hydrocarbons." In *Fundamentals of Aquatic Toxicology*, pages 416-454 edited by G.M. Rand and S.R. Petrocelli.. Hemisphere Publ. Corp., New York.

Neill, D.D. *et al.* 1969. Fifty-eighth Annual Meeting of the Poultry Association. In Newell *et al.* 1987.

New York City Department of Parks and Recreation. 1987. The Pelham Bay Faunal Assemblage.

New York State Department of Environmental Conservation (NYSDEC). 1989. Clean-Up Criteria for Sediments. Draft criteria from A. Newell, NYSDEC Marine Resources, Stony Brook, NY. December 1989.

New York State Department of Environmental Conservation (NYSDEC). 1990. Division of Water, Technical and Operational Series (TOGS) (1.1.1). September 25. As updated on August 2, 1991 in the New York Water Classification and Quality Standards. Part 703.

New York State Department of Environmental Conservation (NYSDEC). 1991. Draft. Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites. Division of Fish & Wildlife.

New York State Department of Environmental Conservation (NYSDEC). 1992a. Memorandum HWR-92-4046. November 16.

New York State Department of Environmental Conservation (NYSDEC). 1992b. Sediment Guidelines for Metals. Revision to NYSDEC (1989) from A. Newell, NYSDEC Marine Resources, Stony Brook, NY. September.

Newell, A.J., D.W. Johnson, and L.K. Allen. 1987. Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife. New York State Department of Environmental Conservation, Division of Fish and Wildlife. Tech Report 87-3.

Nicholson, J.K., and D. Osborn. 1984. "Kidney Lesions in Juvenile Starlings (*Sturnus vulgaris*) Fed on a Mercury-contaminated Synthetic Diet." *Environ. Pollut.* 33A:195-206. In Newell *et al.* 1987.

Norstrom, R.J., D.J. Hallett, and R.A. Stonstegard. 1978. "Coho Salmon (*Oncorhynchus kisutch*) and Herring Gulls (*Larus argentatus*) as Indicators of Organochlorine Contamination in Lake Ontario." *J. Fish. Res. Bd. Can.* 35: 1401-1409. In Newell *et al.* 1987.

Oak Ridge National Laboratory (ORNL). 1989. The Installation Restoration Program Toxicology Guide. Vol. 3. Prepared for Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, OH. Under DOE Interagency Agreement No. 1891-AO76-A1. Oak Ridge, TN. July.

O'Conner, J.M., J.B. Klotz and T.J. Kneip. 1982. Ecological Stress and the New York Bight: Science and Management. G.F. Mayer, Ed. Estuarine Research Federation, Columbia, SC. In Kennish 1992.

Okubo, K. and T. Okubo. 1962. Study on the Bioassay Method for the Evaluation of Water Pollution - II. Use of the Fertilized Eggs of Sea Urchins and Bivalves." *Bull. Tokai Reg. Fish. Res. Lab.* 32: 131. In USEPA 1985.

Osweiler, G.D. and G.A. Van Gelder. 1978. "Epidemiology of Lead Poisoning in Animals." Pages 143-177 in F. W. Oehme (ed.). *Toxicity of Heavy Metals in the Environment.* 1978. Part 1. Marcel Dekker, New York.

Osweiler, G.D., T.L. Carson, W.B. Buck, and G.A. Van Gelder. 1985. *Clinical and Diagnostic Veterinary Toxicology.* 3rd Edition. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Parrish, P.R., *et al.* 1974. Hexachlorobenzene: Effects on Several Estuarine Animals. In USEPA 1980.

Parrish, P.R., *et al.* 1976. "Chlordane, Effects on Several Estuarine Organisms." *Jour. Toxicol. Environ. Health.* 1:485. In USEPA 1980.

Parrish, P.R., *et al.* 1978. "Chronic toxicity of Chlordane, Trifluralin, and Pentachlorophenol to Sheepshead Minnows *Cyprinodon variegatus.*" USEPA 600/3-78-010: 1. U.S. Environmental Protection Agency, Cincinnati, Ohio. In USEPA 1980.

Pattee, O.H. 1984. "Eggshell Thickness and Reproduction in American Kestrels Exposed to Chronic Dietary Lead." *Arch. Environ. Contam. Toxicol.* 13:29-34. In Eisler 1988.

Pearson, T. Gilbert (ed). 1936. *Birds of America.* Garden City Publishing Co., NY.

Pentreath, R.J. 1973. "The accumulation from water of ^{65}Zn and ^{54}Mn, ^{58}Co and ^{59}Fe by the mussel, *Mytilus edulis.*" *Jour. Mar. Biol. Assn.* U.K. 53:127. In USEPA 1980d.

Pentreath, R.J. 1976a. "The Accumulation of Mercury from Food by the Plaice, *Pleuronectes platessa.*" *L.J. Exp. Mar. Biol. Ecol.* 25:51-65. In Evans and Engel 1992.

Pentreath, R.J. 1976b. "The Accumulation of Inorganic Mercury from Sea Water by the Plaice, *Pleuronectes platessa.*" *L.J. Exp. Mar. Biol. Ecol.* 24:103-119. In Evans and Engel 1992.

Pentreath, R.J. 1976c. "The Accumulation of Organic Mercury from Sea Water by the Plaice, *Pleuronectes platessa.*" *L. J. Exp. Mar. Biol. Ecol.* 24:121-132. In Evans and Engel 1992.

Phillips, D.J.H. 1976. "The Common Mussel (*Mytilus edulis*) as an Indicator of Pollution by Zinc, Cadmium, Lead and Copper."

Phillips, D.J.H. 1977. "Effects of Salinity on the Net Uptake of Zinc by the Common Mussel *Mytilus edulis*." *Mar. Biol.* 41:79. In USEPA 1980.

Phillips, G.R. and R.C. Russo. 1978. Metal Bioaccumulation in Fishes and Aquatic Invertebrates. U.S. Environmental Protection Agency, Environmental Research Laboratory, Duluth, Minn. USEPA 600/3-78-103. In Callahan *et al.* 1979.

Pimental, D. 1971. *(DDT) Ecological Effects of Pesticides on Nontarget Species.* U.S. Government Printing Office, Washington, D.C. In: USEPA 1980. Ambient Water Quality Criteria for DDT. USEPA 440/5-80-038.

Poucher, S. 1986. Memorandum to D.R. Hansen. USEPA, Narragansett, Rhode Island. In USEPA 1989c.

Pringle, B.H., *et al.* 1968. "Trace Metal Accumulation by Estuarine Mollusks." *Am. Soc. Civil Eng., Jour. Sanit. Eng. Div.* 94:455. In USEPA undated.

Renfro, J.L. 1974. Methylmercury and inorganic mercury: uptake, distribution, and effect on osmoregulatory mechanisms in fishes. In: USEPA Undated.

Ringer, R. *et al.* 1983. *Toxicology of PCBs in Mink and Ferrets.* In PCBs: Human and Environmental Hazards, pp 227-240 edited by F. D'Itri and M. Kamrin. Butterworth Pub., Woburn, Massachusetts. In Newell *et al.* 1987.

Russo, R.C. 1985. Chapter 15 - Ammonia, Nitrite, and Nitrate In G.M. Rand and S.R. Petrocelli. 1985. *Fundamentals of Aquatic Toxicology.* Hemisphere Publishing Corp., Washington, D.C.

Sauter, E.A. and E.E. Steele. 1972. Poultry Science. 52:71. In S. Tullet, G. Ravie, and P.E. Lake. "Possible Effects of Gamma Benzene Hexachloride on Developing Turkey and Chicken Embryos." *Veterinary Record.* 110:499-500. In Newell *et al.*, 1987.

Sax, Irving. 1984. *Dangerous Properties of Industrial Materials.* 6th edition. Van Nostrand Reinhold Company, New York.

Scheuhammer, A.M. 1987. "The Chronic Toxicity of Aluminum, Cadmium, Mercury, and Lead in Birds: A Review." *Envir. Pollut.* 46:263-295.

Scheuhammer, A.M. 1991. "Effects of Acidification on the Availability of Toxic Metals and Calcium to Wild Birds and Mammals." *Enviro. Pollut.* 71:329-375.

Schimmel, S., *et al.* 1981. Memorandum to John H. Gentile. USEPA, Narragansett, Rhode Island. In USEPA 1985.

Schroeder, H.A., *et al.* 1974. "Life-term Effects of Nickel in Rats: Survival, Tumors, Interactions with Trace Elements and Tissue Levels." *J. Nutr.* 104:239-243. In USEPA 1984.

Schulz-Blades, M. 1972. "Toxicity and Accumulation of Lead in the Common Mussel (*Mytilus edulis*)." *Mar. Biol.* 25:177-193.

Schuster, C.N., Jr. and B.H. Pringle. 1968. "Effects of Trace Metals on Estuarine Mollusk." Proc. First Mid-Atlantic Ind. Waste Conf. Nov. 13-15, 1967. In USEPA 1985b.

Science Applications International Corp (SAIC). 1992. "Monitoring Cruise at the Western Long Island Sound Disposal Site, June 1991". Report to New England Division U.S. Army Corps of Engineers. Waltham, MA.

Scott, M.L. 1977. "Effects of PCBs, DDT, and Mercury Compounds in Chickens and Japanese Quail." Federation Proceedings 36:1888-1893. In ESE 1989.

Sharnma, R.P., D.S. Winn, and J.B. Low. 1976. "Toxic, Neurochemical and Behavioral Effects of Dieldrin Exposure in Mallard Ducks." *Archives of Environmental Contamination and Toxicology* 5:43-53. In ESE 1989.

Sims, R.C., and R. Overcash. 1983. "Fate of Polynuclear Aromatic Compounds (PNAs) in Soil-Plant Systems." *Residue Rev.* 88:1-68. In Eisler 1987a.

Slaga, T.J., W.M. Bracken, A. Viaji, D.L. Berry, S.M. Fischer, D.R. Miller, W. Levin, A.H. Conney, H. Yagi, and D.M. Jerina. 1978. Tumor Initiating and Promoting Activities of Various Benzo(a)pyrene Metabolites in Mouse Skin.

Sobti R.C. and R.K. Gill. 1989. "Incidence of Micronuclei and Abnormalities in the Head of Spermatozoa Caused by the Salts of a Heavy Metal Nickel." *Cytologia* 54:249-254. In U.S. Department of Health and Human Services 1991.

Solonen, T. and M. Lodenius. 1984. "Mercury in Finnish Sparrowhawks, *Accipiter Nisus*." *Ornis Fennica*. 61:58-63. In Eisler 1987b.

St. Omer, V.V. 1970. "Chronic and Acute Toxicity of the Chlorinated Hydrocarbon Insecticide in Mammals and Birds." *The Canadian Veterinary Journal*. 11:215-226. In ESE 1989.

Stickel, L.F., and L.I. Rhodes. 1970. *In The Biological Impact of Pesticides in the Environment* edited by J.W. Gillet. pp. 31-35. Environmental Health Science Series No. 1. Oregon State University, Corvallis.

Stickel, L.F., N. Chura, D. Steward, C. Menzie, R. Prouty, and W. Reichel. 1966. "Bald Eagle-Pesticide Relations." *N. Am. Wildlife Conf. Wildlife Management Institute.* Washington, D.C. 31:190-200. In Newell *et al.* 1987.

Stickel, L.F., W.H. Stickel, R.A. Dyrland, and D.L. Hughes. 1983. "Oxychlordane, HCS-3260, and Nonachlor in Birds: Lethal Residues and Loss Rates." *Journal of Toxicology and Environmental Health* 12:611-622. In ESE 1989.

Stickel, L.F., W.H. Stickel, R.D. McArthur, and D.L. Hughes. 1979a. "Chlordane in Birds: A Study of Lethal Residues and Loss Rates." *Toxicology and Occupational Medicine.* W.B. Deichmann (ed.) Elsevier/North Holland, N.Y. pp 387-396. In ESE 1989.

Stickel, W., L. Stickel, R. Dryland, and D. Hughes. 1984. "Aroclor 1254 Residues on Birds: Lethal Levels and Loss Rates." *Arch. Environ. Contam. Toxicol.* 13:7-13.

Stickel, W., W. Reichel, and D. Hughes. 1979b. "Endrin in Birds: Lethal Residues and Secondary Poisoning." In W.B. Deichman. *Organic Toxicology and Occupational Medicine*. Elseview, New York. pp 397-406.

Suter, G.W., II. 1989. Ecological Endpoints. In USEPA 1989.

Suter, G.W., II. 1990. "Endpoints for Regional Ecological Risk Assessments." *Environm. Mngt.* 14:9-23. In Suter 1993.

Suter, G.W., II. 1993. *Ecological Risk Assessment.* Lewis Publishers. Chelsea, Michigan.

Sverdrup, H.U., M. W. Johnson and R. H. Fleming. 1954. *The Oceans-Their Physics, Chemistry, and General Biology.* Modern Asia Edition, Prentice-Hall, Inc., New York.

Szaro, R.C. 1978. Review of USEPA Criterion Documentation on DDT and its Derivatives. February 15 memorandum. In ESE 1989.

Terres, J. K. 1991. *The Audubon Society Encyclopedia of North American Birds.* Wings Books, New York.

Tori, G.M., and T.J. Peterle. 1983. "Effects of PCBs on Mourning Dove Courtship Behavior." *Bull. Environ. Contam. Toxicol.* 30:44-49. In Eisler 1986b.

Towill L.E. *et al.* 1978. Reviews of the Environmental Effects of Pollutants: V. Cyanide. EPA-600/1-78-027. NTIS, Springfield, Virginia. In USEPA, 1985.

U.S. Army, Office of the Program Manager, Rocky Mountain Arsenal. 1991. RMA Ecological Risk Characterization Food Web Model Parameters. Commerce City, Colorado.

U.S. Department of Health and Human Services (USDHHS). 1992. Toxicological Profile for Nickel (Draft). February 18, 1992.

U.S. Environmental Protection Agency (USEPA). 1976. Quality Criteria for Water. USEPA 440/9-76-023. In Newell *et al.* 1987.

U.S. Environmental Protection Agency (USEPA). 1980a. Ambient Water Quality Criteria for Polynuclear Aromatic Hydrocarbons. USEPA 440/5-80-069. In Eisler 1987a.

U.S. Environmental Protection Agency (USEPA). 1980b. Ambient Water Quality Criteria for Lead. USEPA 440/5-80-057.

U.S. Environmental Protection Agency (USEPA). 1980c. Ambient Water Quality Criteria for DDE, DDT, PCBs. USEPA 440/5-80-068.

U.S. Environmental Protection Agency (USEPA). 1980d. Ambient Water Quality Criteria for Zinc. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division, Washington D.C. USEPA 440/5-80-079.

U.S. Environmental Protection Agency (USEPA). 1980e. Ambient Water Quality Criteria for Chlordane. 440/5-80-027.

U.S. Environmental Protection Agency (USEPA). 1980f. Ambient Water Quality Criteria for Chlorinated Benzenes. USEPA 440/5-80-028.

U.S. Environmental Protection Agency (USEPA). 1983. Ambient Water Quality Criteria for Zinc. USEPA 440/5-83.

U.S. Environmental Protection Agency (USEPA). 1985a. Ambient Water Quality Criteria for Lead - 1984. USEPA 440/5-84-026. In Eisler 1988.

U.S. Environmental Protection Agency (USEPA). 1985b. Ambient Water Quality Criteria for Copper - 1984. Office of Water Regulations and Standards. Criteria and Standards Division. EPA-440/5-84/031.

U.S. Environmental Protection Agency (USEPA). 1986a. Guidelines for the Health Risk Assessment of Chemical Mixtures. 51 FR 34014. September 24, 1986.

U.S. Environmental Protection Agency (USEPA). 1986b. Quality Criteria for Water 1986. As updated and presented in Water Quality Criteria Summary May 1, 1991.

U.S. Environmental Protection Agency (USEPA). 1986c. Water Quality Criteria for Nickel. Office of Water, Regulations and Standards. USEPA 440/5-86-001.

U.S. Environmental Protection Agency (USEPA). 1986d. Hazard Evaluation Division, Standard Evaluation Procedure - Ecological Risk Assessment. Office of Pesticide Programs. USEPA 540/9-85-001. June 1986.

U.S. Environmental Protection Agency (USEPA). 1989a. Risk Assessment Guidance for Superfund. Volume II: Environmental Evaluation Manual. EPA/540/1-89/001.

U.S. Environmental Protection Agency (USEPA). 1989b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. EPA/540/1-89/002.

U.S. Environmental Protection Agency (USEPA). 1989c. Ambient Water Quality Criteria for Ammonia (Saltwater) - 1989. Office of Water, Regulations and Standards. USEPA 440/5-88-004.

U.S. Environmental Protection Agency (USEPA). 1991a. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Acenaphthene. November.

U.S. Environmental Protection Agency (USEPA). 1991b. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene. November.

U.S. Environmental Protection Agency (USEPA). 1991c. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Fluoranthene. Offices of Water, Research and Development, Science and Technology-Health and Ecological Criteria Division.

U.S. Environmental Protection Agency (USEPA). 1991d. Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Dieldrin. Offices of Water, Research and Development, Science and Technology-Health and Ecological Criteria Division.

U.S. Environmental Protection Agency (USEPA). 1992a. Framework for Ecological Risk Assessment. EOA 630/R-92/001. February.

U.S. Environmental Protection Agency (USEPA). 1992b. Interim Guidance on Interpretation and Implementation of Aquatic Life Criteria for Metals. Office of Science and Technology-Health and Ecological Criteria Division. May 1992.

U.S. Environmental Protection Agency (USEPA). 1992c. Health Effects Assessment Summary Table (HEAST). FY-1992 Annual. OERR 9200.6-303 (91-1). January.

U.S. Environmental Protection Agency (USEPA). 1993. On-line data search of AQUIRE (Aquatic Information Retrieval) database. U.S. Environmental Protection Agency, Duluth, MN. Search conducted January 1993.

U.S. Environmental Protection Agency (USEPA). nd. Ambient Aquatic Life Water Quality for Cyanide. USEPA 440/5-84-028.

U.S. Environmental Protection Agency (USEPA). nd. Ambient Aquatic Life Water Quality Criteria for Mercury. Office of Research and Development, Duluth, Minnesota. PB85-22745. EPA-440/5-84-026.

U.S. Environmental Protection Agency (USEPA). nd. Ambient Aquatic Life Water Quality Criteria for Copper. USEPA 440/5-84-031.

U.S. Fish and Wildlife Service (USFWS). 1990. Evaluating Soil Contamination. Biological Report 90(2).

U.S. Forest Service (USFS). 1991. *Forest and Rangeland Birds of the U.S., Natural History and Habitat Use*. January.

Usuki, I. 1956. "A Comparison of the Effects of Cyanide and Azide on the Ciliary Activity of the Oyster Gill." *Sci. Rpt. Tohoku University, Fourth Sci.* 22:137. In USEPA 1985.

Varshavskaya, S.P. 1968. Comparative toxicological characteristics of chorobenzene and dichlorobenzene (ortho- and para-isomers) in relation to the sanitary protection of water bodies. (Russian Trans.) Hyg. San. 33:10.

Vergnano, Ornella and J.G. Hunter. 1952. "Nickel and Cobalt Toxicities in Oat Plants. *Ann. Botany*, V. 17, no. 66, pp. 317-328. In Gough, L.P. H. Shacklette, and A. Case. 1980. Element Concentrations Toxic to Plants, Animals, and Man. U.S. Govt. Printing Office. Washington, D.C. 20402.

Waltschewa, V.W. *et al.* 1972. "Testicular Changes Due to Long-Term Administration of Nickel Sulfate in Rats." *Exp. Pathol.* 6:116. (Ger. with Eng. abstr.) In: USEPA 1984.

Ward, E.C., M.J. Murray, and J.H. Dean. 1985. Immunotoxicity of Nonhalogenated Polycyclic Aromatic Hydrocarbons. In Eisler 1987a.

Wayland, J.H. and E.R. Laws (eds.). 1991. *Handbook of Pesticide Toxicology (HPT).* Volume 2.

Webber, C.W. and B.L. Reid. 1968. "Nickel Toxicity in Growing Chicks." *J. Nutr.* 95:612. In NAS 1980.

Weis, P. and J.S. Weis. 1977. Effects of heavy metals on development of the killifish, *Fundulus heteroclitus*. Jour. Fish. Biol. 11:49. In: USEPA 1985.

Whanger, P.D. 1973. Effects of Dietary Nickel on Enzyme Activities and Mineral Content in Rats. *Toxicol. Appl. Pharmacol.* 25:323-331. In USEPA 1984.

Whitehead, C., A. Downing, and R. Pettigrew. 1972. "The Effect of Lindane on Laying Hens." *Br. Poultry Sci.* 13:291-299. In Newell 1987.

Wiemeyer, S.N., and E. Cromartie. 1981. "Relationships Between Brain and Carcass Organochlorine Residues in Osprey." *Bulletin of Environmental Contamination and Toxicology*. 27:499-505. In ESE 1989.

Wiemeyer, S.N., T.G. Lamont, C.M. Bunk, C.R. Sindelar, F.J. Gramlich, J.D. Fraser, and M.A. Byrd. 1984. "Organochlorine Pesticide, Polychlorobiphenyl, and Mercury Residues in Bald Eagle Eggs - 1969-79 - and Their Relationships to Shell Thinning and Reproduction." *Archives of Environmental Contamination and Toxicology*. 13:529-549 (DDT). In ESE 1989.

Windom, H., R. Stickney, R. Smith, D. White, and F. Taylor. 1973. "Arsenic, Cadmium, Copper, Mercury, and Zinc in Some Species of North Atlantic Finfish." *J. Fish. Res. Board Can.* 30(2):275-279. In Phillips and Russo 1978.

Winter and Streit. 1992. "Organochlorine Compounds in a Three-Step Terrestrial Foodchain." *Chemsphere,* Vol.24, No. 12, pp 1765-1774.

Zaroogian, G.E., and M. Johnson. 1984. "Nickel Uptake and Loss in the Bivalves *Crassostrea virginica* and *Mytilus edulis*." *Arch. Environ. Contam. Toxicol.* 13:411-418.

Zaroogian, G.E. *et al.* 1982. "Application of Adenine Nucleotide Measurements for the Evaluation of Stress in *Mytilus edulis* and *Crassostrea virginica*." *Comp. Biochem. Physiol.* 71B:643-649. In USEPA, 1986.

Zaroogian, G.E., G. Morrison and J.F. Heltske. 1979. "*Crassostrea virginica* as an Indicator of Lead Pollution." *Marine Biolog.* 52:189-196.

Table 6-1
Compounds Not Detected in On-site Soil
Pelham Bay Landfill
Bronx, New York

Parameter Semi-Volatile Organics	Detection Limit
1,3-Dichlorobenzene	350 - 7400 ug/kg
2,4,6-Trichlorophenol	350 - 7400 ug/kg
2,4-Dichlorophenol	350 - 7400 ug/kg
2,4-Dimethylphenol	350 - 7400 ug/kg
2,4-Dinitrophenol	1700 - 36000 ug/kg
2,4-Dinitrotoluene	350 - 7400 ug/kg
2,6-Dinitrotoluene	350 - 7400 ug/kg
2-Chloronaphthalene	350 - 7400 ug/kg
2-Chlorophenol	350 - 7400 ug/kg
2-Methyl-4,6-Dinitrophenol	1700 - 36000 ug/kg
2-Methylphenol	350 - 7400 ug/kg
2-Nitroaniline	1700 - 36000 ug/kg
2-Nitrophenol	350 - 7400 ug/kg
3,3'-Dichlorobenzidine	690 - 15000 ug/kg
3-Nitroaniline	1700 - 36000 ug/kg
4-Bromophenyl phenyl ether	370 - 7400 ug/kg
4-Chloro-3-methyl phenol	350 - 7400 ug/kg
4-Chloroaniline	350 - 7400 ug/kg
4-Chlorophenyl phenyl ether	350 - 7400 ug/kg
4-Methylphenol	350 - 7400 ug/kg
4-Nitroaniline	1700 - 36000 ug/kg
4-Nitrophenol	1700 - 36000 ug/kg
Benzyl Alcohol	350 - 7400 ug/kg
bis(2-Chloroethoxy)methane	350 - 7400 ug/kg
bis(2-Chloroethyl) ether	350 - 7400 ug/kg
bis(2-Chloroisopropyl)ether	350 - 7400 ug/kg
Diethyl phthalate	350 - 7400 ug/kg
Dimethyl phthalate	350 - 7400 ug/kg
Hexachlorobenzene	350 - 7400 ug/kg
Hexachlorobutadiene	350 - 7400 ug/kg
Hexachlorocyclopentadiene	350 - 7400 ug/kg
Hexachloroethane	350 - 7400 ug/kg
Isophorone	350 - 7400 ug/kg
N-Nitrosodiphenylamine	350 - 7400 ug/kg
Nitrobenzene	350 - 7400 ug/kg
Pentachlorophenol	1700 - 36000 ug/kg
Phenol	350 - 7400 ug/kg

Parameter Metals	Detection Limit
Cyanide	2.3 - 2.9 mg/kg

Parameter Volatile Organics	Detection Limit
1,1,1-Trichloroethane	5 - 7 ug/kg
1,1,2,2-Tetrachloroethane	5 - 7 ug/kg
1,1,2-Trichloroethane	5 - 7 ug/kg
1,1-Dichloroethane	5 - 7 ug/kg
1,1-Dichloroethylene	5 - 7 ug/kg
1,2-Dichloroethane	5 - 7 ug/kg
1,2-Dichloroethylene	5 - 7 ug/kg
1,2-Dichloropropane	5 - 7 ug/kg
1,3-cis-Dichloropropylene	5 - 7 ug/kg
1,3-trans-Dichloropropylene	5 - 7 ug/kg
2-Butanone	11 - 14 ug/kg
2-Hexanone	11 - 14 ug/kg
4-Methyl-2-pentanone	11 - 14 ug/kg
Bromoform	5 - 7 ug/kg
Carbon Disulfide	5 - 7 ug/kg
Carbon tetrachloride	5 - 7 ug/kg
Dibromochloromethane	5 - 7 ug/kg
Chloroethane	11 - 14 ug/kg
Bromodichloromethane	5 - 7 ug/kg
Methyl bromide	11 - 14 ug/kg
Methyl chloride	11 - 14 ug/kg
Styrene	5 - 7 ug/kg
Tetrachloroethylene	5 - 7 ug/kg
Trichloroethylene	5 - 7 ug/kg
Vinyl Acetate	11 - 14 ug/kg
Vinyl chloride	11 - 14 ug/kg

Parameter PCB/Pesticides	Detection Limit
Aldrin	9 - 94 ug/kg
alpha-BHC	9 - 94 ug/kg
beta-BHC	9 - 94 ug/kg
Endosulfan I	9 - 47 ug/kg
Endosulfan II	18 - 190 ug/kg
Endrin	18 - 190 ug/kg
Heptachlor	9 - 94 ug/kg
PCB-1016	90 - 940 ug/kg
PCB-1221	90 - 940 ug/kg
PCB-1232	90 - 940 ug/kg
PCB-1242	90 - 940 ug/kg
PCB-1248	90 - 940 ug/kg
PCB-1260	180 - 1900 ug/kg
Toxaphene	180 - 1900 ug/kg

Prepared by: BB
Checked by: MS
92C4087

Table 6-2
Compounds not Detected in Leachate
Pelham Bay Landfill
Bronx, New York

Parameter Semi-volatile Organics	Detection Limit
1,3-Dichlorobenzene	350 - 7400 ug/kg
2,4,6-Trichlorophenol	350 - 7400 ug/kg
2,4-Dichlorophenol	350 - 7400 ug/kg
2,4-Dimethylphenol	350 - 7400 ug/kg
2,4-Dinitrophenol	1700 - 36000 ug/kg
2,4-Dinitrotoluene	350 - 7400 ug/kg
2,6-Dinitrotoluene	350 - 7400 ug/kg
2-Chloronaphthalene	350 - 7400 ug/kg
2-Chlorophenol	350 - 7400 ug/kg
2-Methyl-4,6-Dinitrophenol	1700 - 36000 ug/kg
2-Methylnaphthalene	350 - 7400 ug/kg
2-Methylphenol	350 - 7400 ug/kg
2-Nitroaniline	1700 - 36000 ug/kg
2-Nitrophenol	350 - 7400 ug/kg
3,3'-Dichlorobenzidine	690 - 15000 ug/kg
3-Nitroaniline	1700 - 36000 ug/kg
4-Bromophenyl phenyl ether	350 - 7400 ug/kg
4-Chloro-3-methyl phenol	350 - 7400 ug/kg
4-Chloroaniline	350 - 7400 ug/kg
4-Chlorophenyl phenyl ether	350 - 7400 ug/kg
4-Methylphenol	350 - 7400 ug/kg
4-Nitroaniline	1700 - 36000 ug/kg
4-Nitrophenol	1700 - 36000 ug/kg
Benzyl Alcohol	350 - 7400 ug/kg
bis(2-Chloroethoxy)methane	350 - 7400 ug/kg
bis(2-Chloroethyl) ether	350 - 7400 ug/kg
bis(2-Chloroisopropyl)ether	350 - 7400 ug/kg
Diethyl phthalate	350 - 7400 ug/kg
Dimethyl phthalate	350 - 7400 ug/kg
Hexachlorobenzene	350 - 7400 ug/kg
Hexachlorobutadiene	350 - 7400 ug/kg
Hexachlorocyclopentadiene	350 - 7400 ug/kg
Hexachloroethane	350 - 7400 ug/kg
Isophorone	350 - 7400 ug/kg
N-Nitrosodiphenylamine	350 - 7400 ug/kg
Nitrobenzene	350 - 7400 ug/kg
Pentachlorophenol	1700 - 36000 ug/kg
Phenol	350 - 7400 ug/kg

Parameter Volatile Organics	Detection Limit
1,1,1-Trichloroethane	5 - 6 ug/kg
1,1,2,2-Tetrachloroethane	5 - 6 ug/kg
1,1,2-Trichloroethane	5 - 6 ug/kg
1,1-Dichloroethane	5 - 6 ug/kg
1,1-Dichloroethylene	5 - 6 ug/kg
1,2-Dichloroethane	5 - 6 ug/kg
1,2-Dichloroethylene	5 - 6 ug/kg
1,2-Dichloropropane	5 - 6 ug/kg
1,3-cis-Dichloropropylene	5 - 6 ug/kg
1,3-trans-Dichloropropylene	5 - 6 ug/kg
Bromoform	5 - 6 ug/kg
Carbon Disulfide	5 - 6 ug/kg
Carbon tetrachloride	5 - 6 ug/kg
Chlorodibromomethane	5 - 6 ug/kg
Dichlorobromomethane	5 - 6 ug/kg
Styrene	5 - 6 ug/kg
Tetrachloroethylene	5 - 6 ug/kg
Trichloroethylene	5 - 6 ug/kg
2-Butanone	11 - 12 ug/kg
2-Hexanone	11 - 12 ug/kg
4-Methyl-2-pentanone	11 - 12 ug/kg
Chloroethane	11 - 12 ug/kg
Methyl bromide	11 - 12 ug/kg
Methyl chloride	11 - 12 ug/kg
Vinyl Acetate	11 - 12 ug/kg
Vinyl chloride	11 - 12 ug/kg

Table 6-2
Compounds not Detected in Leachate
Pelham Bay Landfill
Bronx, New York

Parameter Metals	Detection Limit
Cyanide	2.3 - 2.9 mg/kg
Thallium	0.46 - 0.54 mg/kg
Cadmium	0.89 - 1 mg/kg
Silver	0.56 - 0.64 mg/kg

Parameter Pesticides/PCB	Detection Limit
Aldrin	9.2 - 94 ug/kg
alpha-BHC	9.2 - 94 ug/kg
beta-BHC	9.2 - 94 ug/kg
Endosulfan I	9.2 - 94 ug/kg
Endosulfan II	18 - 190 ug/kg
Endosulfan sulfate	18 - 190 ug/kg
Endrin	18 - 190 ug/kg
Endrin ketone	18 - 190 ug/kg
gamma-BHC	9.2 - 94 ug/kg
gamma-Chlordane	92 - 940 ug/kg
Heptachlor	9.2 - 94 ug/kg
Heptachlor epoxide	9.2 - 94 ug/kg
PCB-1016	92 - 940 ug/kg
PCB-1221	92 - 940 ug/kg
PCB-1232	92 - 940 ug/kg
PCB-1242	92 - 940 ug/kg
PCB-1248	92 - 940 ug/kg
PCB-1260	180 - 1900 ug/kg
Toxaphene	180 - 1900 ug/kg

Prepared by: BB
Checked by: MS
92C4087

Table 6-3
Concentration/Toxicity Screening for On-site Soil
Pelham Bay Landfill
Bronx, New York

Parameter	Maximum (ppm)	Carcinogenic Slope Factor		Reference Dose (RfD)		Carcinogenic Screening Factor		Non-Carcinogenic Screening Factor		Percentages of Total Screening Factor			
		Inhalation $(mg/kg\text{-}d)^{-1}$	Ingestion $(mg/kg\text{-}d)^{-1}$	Inhalation mg/m^3	Ingestion mg/kg-d	Inhalation	Ingestion	Inhalation	Ingestion	Carcinogenic		Non-Carcinogenic	
										Inhalation	Ingestion	Inhalation	Ingestion
2-Methylnaphthalene	0.42				2.0E-01				2E+00				0.0037%
4,4' - DDD	0.45	----	2.4E-01	----	----		1E-01				0.24%		
4,4' - DDE	0.13	----	3.4E-01	----	----		4E-02				0.10%		
4,4' - DDT	0.33	----	3.4E-01	----	5.0E-04		1E-01		7E+02		0.25%		1.16%
Acenaphthene	0.39	----	----	----	6.0E-02				7E+00				0.01%
Alpha - Chlordane	0.24	1.3E+00	1.3E+00	*	6.0E-05	3E-01	3E-01		4E+03	0.94%	0.70%		7.04%
Anthracene	0.70	X	X	----	3.0E-01				2E+00				0.0041%
Barium	845	----	----	*	7.0E-02				1E+04				21.26%
Benzene	0.00	2.9E-02	2.9E-02	*	*	1E-04	1E-04			0.0003%	0.0002%		
Benzo (a) pyrene	2.80	6.1E+00	7.3E+00	----	----	2E+01	2E+01			51.23%	46.13%		
Benzo (a) anthracene	2.60	8.9E-01	1.0E+00	----	----	2E+00	3E+00			6.90%	6.04%		
Benzo (b) fluoranthene	4.50	8.5E-01	1.0E+00	----	----	4E+00	5E+00			11.53%	10.36%		
Benzo (k) fluoranthene	1.10	4.0E-01	4.8E-01	----	----	4E-01	5E-01			1.33%	1.20%		
Benzoic acid	18	X	X	----	4.0E+00				5E+00				0.01%
Cadmium	0.88	6.1E+00	----	*	5.0E-04	5E+00			2E+03	16.10%			3.10%
Chlorobenzene	0.22	X	X	*	2.0E-02				1E+01				0.02%
Chloroform	0.01		8.1E-02		1.0E-02		5E-04		6E-01		0.0011%		0.001%
Chrysene	3.30	2.7E-02	3.2E-02	----	----	9E-02	1E-01			0.27%	0.24%		
Dieldrin	0.13	1.6E+01	1.6E+01	----	5.0E-05	2E+00	2E+00		3E+03	6.24%	4.69%		4.58%
Ethylbenzene	0.02	X	X	1.0E+00	1.0E-01			2E-02	2E-01			0.0005%	0.0004%
Fluoranthene	3.60	X	X	----	4.0E-02				9E+01				0.16%
Fluorene	0.42	----	----	----	4.0E-02				1E+01				0.02%
Gamma-BHC	0.05	1.3E+00	----	----	----	6E-02				0.18%			
gamma-Chlordane	0.47	1.3E+00	1.3E+00	*	6.0E-05	6E-01	6E-01		8E+03	1.83%	1.38%		13.79%
Heptachlor epoxide	0.05	9.1E+00	9.1E+00	----	1.3E-05	4E-01	4E-01		4E+03	1.28%	0.97%		6.37%
Indeno (1,2,3-c,d) pyrene	0.51	1.4E+00	1.7E+00	----	----	7E-01	9E-01			2.17%	1.95%		
Mercury	1.30	X	X	3.0E-04	*			4E+03				100.00%	
Methoxychlor	0.47	X	X	----	5.0E-03				9E+01				0.17%
N-Nitrosodi-n-propylamine	0.42	----	7.0E+00	----	----		3E+00				6.63%		
Naphthalene	0.42	X	X	----	4.0E-02				1E+01				0.02%
Nickel, soluble salts	477	----	----	*	2.0E-02				2E+04				42.00%
PCBs	1.10	----	7.7E+00	----	----		8E+00				19.12%		
Pyrene	5.00	X	X	----	3.0E-02				2E+02				0.29%
Xylenes	0.08	X	X	*	2.0E+00				4E-02				0.0001%
					TOTALS	3E+01	4E+01	4E+03	6E+04	100%	100%	100%	100%

Notes:

X Not applicable
---- Not available
* Under review by EPA

Prepared by MS
Checked by PP
92C4087

Table 6-4
Compounds in Leachate with a Low Frequency of Detection
Pelham Bay Landfill
Bronx, New York

Chemical
1,2-Dichlorobenzene
1,3-Dichlorobenzene
2-Butanone
2-Methylphenol
3-Nitroaniline
4-Nitrophenol
Alpha-Chlordane
Benzo(a)anthracene
Benzoic Acid
Beryllium
beta-BHC
Bis(2-Chloroethoxy)methane
Chloroform
Di-n-octyl phthalate
PCB-1260
Selenium

Prepared by: PP
Checked by: MS
92C4087

Table 6-5
Concentration/Toxicity Screening for Leachate
Pelham Bay Landfill
Bronx, New York

Parameter	Maximum (ppm)	Carcinogenic Slope Factor		Reference Dose (RfD)		Carcinogenic Screening Factor		Non-Carcinogenic Screening Factor		Percentages of Total Screening Factor			
										Carcinogenic		Non-Carcinogenic	
		Inhalation $(mg/kg\text{-}d)^{-1}$	Ingestion $(mg/kg\text{-}d)^{-1}$	Inhalation mg/m^3	Ingestion mg/kg-d	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion
1,2 - Dichloroethylene	0.0025	X	X	----	1E-02				2.50E-01				0.02%
1,4 - Dichlorobenzene	0.009	----	----	7E-01	----			1.29E-02				0.00001%	
2,4 - Dimethylphenol	0.073	----	----	----	2E-02				3.65E+00				0.28%
2 - Methylnapthalene	0.033	----	----	----	2E-01				1.65E-01				0.01%
4,4' - DDD	0.00005	----	2.4E-01	----	----		1.20E-05				0.01%		
4,4' - DDE	7.8E-05	----	3.4E-01	----	----		2.65E-05				0.02%		
4-methylphenol	0.008	----	----	----	5E-02				1.60E-01				0.01%
Acenaphthene	0.018	----	----	----	6E-02				3.00E-01				0.02%
Alpha - BHC	0.0001	----	6.3E+00	----	----		6.30E-04				0.44%		
Aluminum	65.8	----	----	----	6.0E-03				3.00E-01				0.02%
Anthracene	0.008	X	X	----	3E-01				2.67E-02				0.002%
Antimony	0.0703	----	----	----	4E-04				1.76E+02				13.25%
Arsenic	0.0891	5.00E+01	1.40E+00	----	3.00E-04	4.46E+00	1.25E-01		2.97E+02	97.98%	87.30%		22.39%
Barium	1.49	----	----	*	7.00E-02				2.13E+01				1.60%
Benzene	0.004	2.90E-02	2.90E-02	*	*	1.16E-04	1.16E-04			0.003%	0.08%		
Bis(2-chloroisopropyl)ether	0.005	3.50E-02	7.00E-02	----	4.00E-02	1.75E-04	3.50E-04		1.25E-01	0.004%	0.24%		0.01%
Boron	8.9	----	----	9.00E-02	9.00E-02			9.89E+01	9.89E+01			0.09%	7.46%
Cadmium	0.0096	6.10E+00	----	*	5.00E-04	5.86E-02			1.92E+01	1.29%			1.45%
Carbon disulfide	0.003	----	----	*	1.00E-01				3.00E-02				0.00%
Chlorobenzene	0.025	X	X	*	2.00E-02				1.25E+00				0.09%
Chromium, III	0.39	----	----	*	1.00E+00				3.90E-01				0.03%
Chromium, VI	0.00056	4.10E+01	----	*	5.00E-03	2.30E-02			1.12E-01	0.50%			0.01%
Cyanide, free	0.267	X	X	----	2.00E-02				1.34E+01				1.01%
Dieldrin	0.00064	1.60E+01	1.60E+01	----	5.00E-05	1.02E-02	1.02E-02		1.28E+01	0.23%	7.17%		0.97%
Endosulfan I, II	0.0021	----	----	----	5.00E-05				4.20E+01				3.17%
Endrin	6.2E-05	X	X	----	3.00E-04				2.07E-01				0.02%
Ethylbenzene	0.015	X	X	1.00E+00	1.00E-01			1.50E-02	1.50E-01			0.00001%	0.01%
Fluoranthene	0.01	X	X	----	4.00E-02				2.50E-01				0.02%
Fluorene	0.015	----	----	----	4.00E-02				3.75E-01				0.03%
Manganese	45.8	X	X	4.00E-04	1.00E-01			1.15E+05	4.58E+02			99.78%	34.53%
Mercury	0.005	X	X	3.00E-04	*			1.67E+01				0.01%	
Methoxychlor	0.00065	X	X	----	5.00E-03				1.30E-01				0.01%
Naphthalene	0.14	X	X	----	4.00E-02				3.50E+00				0.26%
Nickel (soluble salts)	0.483	----	----	*	2.00E-02				2.42E+01				1.82%
PCBs	0.00088	----	7.70E+00	----	----		6.78E-03				4.74%		
Pyrene	0.009	X	X	----	3.00E-02				3.00E-01				0.02%
Silver	0.0121	----	----	----	5.00E-03				2.42E+00				0.18%

Table 6-5
Concentration/Toxicity Screening for Leachate
Pelham Bay Landfill
Bronx, New York

Parameter	Maximum (ppm)	Carcinogenic Slope Factor		Reference Dose (RfD)		Carcinogenic Screening Factor		Non-Carcinogenic Screening Factor		Percentages of Total Screening Factor			
										Carcinogenic		Non-Carcinogenic	
		Inhalation (mg/kg-d)$^{-1}$	Ingestion (mg/kg-d)$^{-1}$	Inhalation mg/m^3	Ingestion mg/kg-d	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion
Thallium (acetate)	0.0135	----	----	----	9.00E-05				1.50E+02				11.31%
Vanadium	0.989	----	----	7.00E-03	*			1.41E+02				0.12%	
Xylenes	0.065	X	X	*	2.00E+00				3.25E-02				0.00%
					TOTALS	4.55E+00	1.43E-01	1.15E+05	1.33E+03	100%	100%	100%	100%

Notes:

X Not applicable

---- Not available

* Under review by EPA

Prepared by: PP
Checked by: MS
92C4087

Table 6-6
Concentration/Toxicity Screening for Air
Pelham Bay Landfill
Bronx, New York

Parameter	Maximum (ppm)	Carcinogenic Slope Factor		Reference Dose (RfD)		Carcinogenic Screening Factor		Non-Carcinogenic Screening Factor		Percentages of Total Screening Factor			
										Carcinogenic		Non-Carcinogenic	
		Inhalation $(mg/kg\text{-}d)^{-1}$	Ingestion $(mg/kg\text{-}d)^{-1}$	Inhalation mg/m^3	Ingestion mg/kg-d	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion	Inhalation	Ingestion
1,1,1-Trichloroethane	19.39	X	X	----	9E-02				2.15E+02				19.23%
1,2,4-Trichlorobenzene	0.04	X	X	----	1E-02				4.38E+00				0.391%
1,2-Dichlorobenzene	0.90	X	X	----	9E-02				1.00E+01				0.894%
1,2-Dichloroethylene	0.06	X	X	----	1E-02				5.76E+00				0.514%
1,4-Dichlorobenzene	2.47	----	----	7E-01	----			3.53E+00				0.801%	
Benzene	2.52	2.9E-02	2.9E-02	*	*	7.31E-02	7.31E-02			97.82%	97.75%		
Bromoform	0.04	3.9E-03	7.9E-03	----	2E-02	1.46E-04	2.97E-04		1.88E+00	0.196%	0.397%		0.168%
Carbon Disulfide	0.04	----	----	*	1E-01				3.63E-01				0.032%
Chlorobenzene	14.16	X	X	*	2E-02				7.08E+02				63.21%
Cumene	1.23	----	----	9E-03	4E-02			1.36E+02	3.07E+01			30.99%	2.74%
Ethyl benzene	3.85	X	X	1E+00	1E-01			3.85E+00	3.85E+01			0.87%	3.44%
Freon 11	0.03	----	----	----	3E-01				1.00E-01				0.009%
Freon 113	0.20	----	----	*	3E-01				6.68E-01				0.060%
Freon 12	0.28	----	----	----	2E-01				1.38E+00				0.123%
Hexachlorobutadiene	0.02	7.8E-02	7.8E-02		2E-03	1.37E-03	1.37E-03		8.76E+00	1.83%	1.83%		0.782%
Hydrogen Sulfide	0.27	----	----	9E-04	3E-03			2.96E+02	8.89E+01			67.28%	7.93%
Styrene	0.23	----	----	1E+00	2E-01			2.25E-01	1.13E+00			0.051%	0.101%
Tetrachloroethene	0.04	----	----	----	1E-02				3.88E+00				0.346%
Trichloroethene	0.02	6E-03	1.1E-03	*	*	1.13E-04	2.07E-05			0.151%	0.028%		
Xylenes	0.83	X	X	*	2E+00				4.16E-01				0.037%
					TOTALS	7.47E-02	7.48E-02	4.40E+02	1.12E+03	100%	100%	100%	100%

Notes:

X Not applicable
---- Not available
* Under review by EPA

Prepared by: BB
Checked by: MS
92C4087

Table 6-7
Exposure Point Concentrations for On-site Soil
Pelham Bay Landfill
Bronx, New York

	Samples	Detects	Minimum	Maximum	Average	95% UCL
4,4'-DDT	17	9	9.00E-03	3.30E-01	6.92E-02	1.53E-01
Alpha-Chlordane	17	10	9.60E-03	2.40E-01	1.03E-01	2.40E-01
Barium	17	17	3.68E+01	8.45E+02	1.67E+02	8.45E+02
Benzene	17	1	2.00E-03	3.50E-03	3.00E-03	3.50E-03
Benzo(a)anthracene	17	17	5.50E-02	2.60E+00	7.05E-01	1.71E+00
Benzo(a)pyrene	17	16	6.30E-02	2.80E+00	6.35E-01	1.33E+00
Benzo(b)fluoranthene	17	15	5.40E-02	4.50E+00	8.01E-01	1.75E+00
Benzo(k)fluoranthene	17	16	6.30E-02	1.10E+00	5.13E-01	9.81E-01
Cadmium	17	1	3.90E-01	8.80E-01	5.01E-01	5.43E-01
Dieldrin	17	5	3.60E-03	1.30E-01	2.81E-02	5.15E-02
Gamma-Chlordane	17	3	2.90E-02	4.70E-01	1.56E-01	2.86E-01
Heptachlor epoxide	17	4	3.00E-03	4.70E-02	1.57E-02	2.88E-02
Indeno(1,2,3-c,d)pyrene	17	8	5.90E-02	5.10E-01	2.40E-01	3.59E-01
N-Nitrosodi-n-propylamine	17	7	1.75E-01	4.20E-01	2.49E-01	2.87E-01
Nickel	17	13	1.03E+01	4.77E+02	4.50E+01	5.27E+01
PCB-1254	17	5	9.00E-02	1.10E+00	4.43E-01	6.26E-01

Prepared by: PP
Checked by: MS
92C4087

Table 6-8
Exposure Point Concentrations for Leachate
Pelham Bay Landfill
Bronx, New York

Analyte	Samples	Detects	Minimum	Maximum	Average	95% UCL
Antimony	23	4	2.18E-02	7.03E-02	2.82E-02	3.25E-02
Arsenic	23	19	5.50E-04	8.91E-02	1.28E-02	3.24E-02
Barium	23	23	1.04E-01	1.49E+00	5.50E-01	8.82E-01
Benzene	23	12	1.00E-03	4.00E-03	2.63E-03	3.07E-03
Boron	8	8	1.57E+00	8.90E+00	4.80E+00	8.88E+00
Cadmium	23	4	2.30E-03	9.60E-03	3.08E-03	3.58E-03
Cyanide	23	5	5.00E-03	2.67E-01	1.90E-02	1.91E-02
Dieldrin	23	9	6.30E-06	6.40E-04	1.04E-04	1.66E-04
Endosulfan II	23	3	5.00E-05	2.10E-03	2.02E-04	2.03E-04
Manganese	23	23	7.58E-02	4.58E+01	3.77E+00	1.42E+01
Nickel	23	20	5.10E-03	4.83E-01	1.31E-01	4.08E-01
PCB-1016	23	2	2.50E-04	8.80E-04	3.03E-04	3.41E-04
Thallium	23	3	1.10E-03	1.35E-02	2.00E-03	2.35E-03

Prepared by: PP
Checked by: MS
92C4087

Table 6-9
Modeled Exposure Point Concentrations for On-Site Air
Pelham Bay Landfill
Bronx, New York

EIFC Detected Compounds	Average Measured Emission Rate (ug/m2-s)	Modeled Annual Concentration (ug/m3) Center of Landfill	NYSDEC Toxicity Rating	AGC Conc (ug/m3)
1,1,1-Trichloroethane	0.3752	0.784168	Low	1,000
Benzene	0.0437	0.091333	High	0.12
Chlorobenzene	0.2453	0.512677	Moderate	20
Cumene	0.0178	0.037202	-	583 ***
Ethyl benzene	0.0488	0.101992	Moderate	1,000
Hexachlorobutadiene	0.001	0.00209	Moderate	0.05
Hydrogen Sulfide	0.002	0.00418	-	-

Notes: *** A calculated interim value based on a moderate toxicity classification

Prepared by: RJM
Checked by: BW
92c4087

Table 6-10
Reference Doses and Slope Factors for Chemicals of Concern
Health Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Chemical Name	CAS Number	USEPA Weight of Evidence	Slope Factor		Oral RfD	Inhalation RfC
			Oral (mg/kg-d)$^{-1}$	Inhalation (mg/kg-d)$^{-1}$	Chronic mg/kg-d	Chronic mg/m^3
1,1,1-Trichloroethane	(71-55-6)	D	X	X	9E-02 H	----
4,4' - DDT	(50-29-3)	B2	3.4E-01 I	----	5E-04 I	----
Alpha - Chlordane	(57-74-9)	B2	1.3E+00 I	1.3E+00 H	6E-05 I	*
Antimony	(7440-36-0)	---	----	----	4E-04 I	----
Arsenic	(7440-38-2)	A	1.4E+00 I	5E+01 H	3E-04 I	----
Barium	(7440-39-3)	---	----	----	7E-02 I	*
Benzene	(71-43-2)	A	2.9E-02 I	2.9E-02 H	*	*
Benzo(a)anthracene	(56-55-3)	B2	1.03E+00 IC	8.85E-01 IC	----	----
Benzo(a)pyrene	(50-32-8)	B2	7.3E+00 I	6.1E+00 H	----	----
Benzo(b)fluoranthene	(205-99-2)	B2	1.02E+00 IC	8.54E-01 IC	----	----
Benzo(k)fluoranthene	(207-08-9)	B2	4.82E-01 IC	4.03E-01 IC	----	----
Boron	(7440-42-8)	---	----	----	9E-02 I	2E-02 H
Cadmium	(7440-43-9)	B1	----	6.1E+00 H	5E-04 I	*
Chlorobenzene	(108-90-7)	D	X	X	2E-02 I	*
Cumene	(98-82-8)	---	----	----	4E-02 I	9E-03 H
Cyanide (free)	(57-12-5)	D	X	X	2E-02 I	----
Dieldrin	(60-57-1)	B2	1.6E+01 I	1.6E+01 H	5E-05 I	----
Endosulfan I, II	(115-29-7)	---	----	----	5E-05 I	----
Ethylbenzene	(100-41-4)	D	X	X	1E-01 I	1E+00 I
Gamma - Chlordane	(57-74-9)	B2	1.3E+00 I	1.3E+00 H	6E-05 I	*
Heptachlor epoxide	(1024-57-3)	B2	9.1E+00 I	9.1E+00 H	1E-05 I	----
Hexachlorobutadiene	(87-68-3)	C	7.8E-02 I	7.8E-02 H	2E-03 I	----
Hydrogen Sulfide	(7783-66-4)	---	----	----	3E-03 I	9E-04 I
Indeno(1,2,3-c,d)pyrene	(193-39-5)	B2	1.69E+00 IC	1.42E+00 IC	----	----
Manganese	(7439-96-5)	D	X	X	1E-01 I	4E-04 I
N-Nitrosodi-n-propylamine	(621-64-7)	B2	7E+00 I	----	----	----
Nickel (soluble salts)	(7440-02-0)	---	----	----	2E-02 I	*
PCBs	(1336-36-3)	B2	7.7E+00 I	----	----	----
Thallium (acetate)	(563-68-8)				9E-05 I	

Notes:

I = Source is Integrated Risk Information System (IRIS)
H = Source is Health Effects Assessment Summary (HEAST)
IC = Source is ICF-Clement, 1988
RfD = Reference Dose
RfC = Reference Concentration
" -- " = Not Available
X = Not Applicable
* = Under review by EPA

Prepared by: PP
Checked by: MS
92C4087

Table 6-11
EPA Weight-of-Evidence Carcinogenic Classification of Chemicals
Pelham Bay Landfill
Bronx, New York

Group	Description	Description of Evidence
A	Human carcinogen	Sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer
B1 or B2	Probable human carcinogen	B1 indicates that limited human data are available from epidemiologic studies. B2 indicates sufficient evidence in animals and inadequate or no evidence in humans of carcinogenicity.
C	Possible human carcinogen	Limited evidence of carcinogenicity in animals
D	Not classifiable as to human carcinogenicity	Inadequate evidence of carcinogenicity in animals
E	No evidence of carcinogenicity in humans	No evidence of carcinogenicity in at least two adequate animal tests or in both epidemiologic and animal studies.

Notes: Substances in groups B and C are considered potential carcinogens.

Table 6-12
An Evaluation of Carcinogenicity Based On USEPA and Scientific Sources Inorganic Chemicals of Concern
Pelham Bay Landfill
Bronx, New York

Metals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Arsenic	lung by inhalation skin by ingestion	A Human Carcinogen	lung cancer skin cancer	● Human chronic oral studies through inhalation of arsenic and through consumption of drinking water at high concentrations. (USEPA, 1984; IARC, 1980 & 1987)	● Specific forms of arsenic found to be carcinogenic include arsenic trioxide, sodium arsenite, and arsenic trichloride. (Tam et al., 1979; IARC, 1980 & 1987) ● Sodium arsenate was the form evaluated in drinking water studies. (Tseng, 1977)

Table 6-12 (continued)

Metals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Cadmium	lung by inhalation	B1 Probable Human Carcinogen	lung cancer	● Limited evidence from occupational epidemiological studies of cadmium is consistent for different investigators and study populations. (Kipling & Waterhouse, 1967; Kjellstrom et al., 1979) ● Two fold excess risk of lung cancer in cadmium smelter workers was noted, but the results were not conclusive. (Thun et al., 1985; Kjellstrom et al., 1979; Lemen et al., 1976) ● There is sufficient evidence of carcinogenicity in rats and mice by inhalation and intramuscular and subcutaneous injection. (USEPA, 1985) ● Seven studies in rats and mice wherein cadmium salts (acetate, sulfate, chloride) were administered orally have shown no evidence of carcinogenic response. (IRIS Database, 1/93)	● Meat, fish, and fruit contain 1 to 50 ug/kg, grains contain 10 to 150 ug/kg of cadmium. (Friberg et al., 1986) ● Respiratory absorption of cadmium is about 15 to 30 percent. Gastrointestinal absorption is less than respiratory absorption and is about 5 to 8 percent. (Elinder et al., 1983) ● IARC (1987) reviewed several epidemiological studies and concluded that longterm occupational exposure to cadmium may contribute to lung cancer, but confounding exposures to arsenic, nickel, and possibly other respiratory carcinogens including cigarette smoke prevent a definitive conclusion. ● Specific forms of cadmium which have produced tumors in animal studies are: cadmium chloride, cadmium oxide, cadmium sulfate, and cadmium sulfide. The positive carcinogenic responses were obtained only by intramuscular and subcutaneous injection. (IARC, 1987)

Table 6-12 (continued)

Metals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Nickel	lung	A Human Carcinogen	lung cancer	● Nickel has been identified as a respiratory tract carcinogen in the workplace in the nickel-refining industry. (Peto et al., 1984; Enterline & Marsh, 1982) ● Other serious consequences of long-term exposure to nickel are not apparent. (Enterline & Marsh 1982) ● Only nickel (refinery dust) is carcinogenic; soluble nickel salts are not thought to be carcinogenic. (Chovil et al., 1981) ● Nickel is carcinogenic in humans via inhalation only. (Doll et al., 1977; Magnus et al., 1982)	● Deficiency of nickel alters glucose metabolism and decreases tolerance to glucose. There is growing evidence that nickel may be an essential trace element for mammals (Anke et al., 1983). ● Nickel subsulfide (Ni_3S_2) is more carcinogenic than amorphous nickel monosulfide (NiS). Differences in potency are due to differences in cell uptake rates or solubility. (Costa, 1980) ● Although nickel subsulfide is the most studied nickel compund, only one study has used inhalation as the route of exposure. Human carcinogen Class A was based on increased risks of lung and nasal cancer in humans exposed to nickel refinery dust, most of which was believed to have been nickel subsulfide. (Dunick et al., 1989) ● Nickel carbonyl is classified as a Class B2 carcinogen based on pulmonary carcinomas by inhaltion and intravenous injection in rats. (USEPA, 1986)

Table 6-12 (continued)

References for Table 6-12

Arsenic

International Agency for Research on Cancer. (IARC). 1980. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man, Vol. 23. Some Metals and Metallic Compounds. World Health Organization, Lyon, France.

International Agency for Research on Cancer. (IARC). 1987. Monograph on the evaluation of carcinogenicity: An update of IARC monographs. Vols. 1-42, suppl. 7. World Health Organization, Lyon, France.

Tam, G.K.H. et. al. 1979. Metabolism of inorganic arsenic in humans following oral ingestion. Toxicol. Appl. Pharmacol. 50:319-322.

Tseng, W.P. 1977. Effects and dose response relationships of skin cancer and blackfoot disease with arsenic. Environ. Health Perspect. 19: 109-119.

U.S. Environment Protection Agency. 1984. Health Assessment Document for Inorganic Arsenic. Environmental Criteria and Assessment Office, Research Triangle Park, NC. EPA 600/8-83-021F.

Cadmium

Elinder, C., T. Kjellstrom, B. Lind, L. Linnman, M. Piscator and Sundstedt, K. Cadmium exposure from smoking cigarettes. Variations with time and country where purchased. Environ. Res., 32:220-227,1983.

Friberg, L. Elinder, C.G. Kjellstrom, T. and G. Nordberg (eds). 1986. Cadmium and Health. A toxicological and epidemiological appraisal. Vol. I, General Aspects. Vol. II. Effects and Response. CRC Press, Inc., Boca Raton, Fla.

International Agency for Research Agency on Cancer. (IARC.) 1987. Monograph on the evaluation of carcinogenicity: An update of IARC monographs. Vols. 1-42, suppl. 7. World Health Organization, Lyon, France.

Kipling, M.D. and J.A.H. Waterhouse. 1967. Cadmium and prostatic carcinoma. Lancet. 1: 730.

Kjellstrom, T. Friberg, L. and B. Rahnster. 1979. Mortality and cancer mobility among cadmium-exposed workers. Environ. Health Perspect. 28:199-204.

Lemen, R.A., J.S. Lee, J.K. Wagoner and H.P. Blejer. 1976. Cancer mortality among cadmium production workers. Ann. N.Y. Acad. Sci. 271:273.

Thun, M.J., T.M. Schnorr, A.B. Smith and W.E. Halperin. 1985. Mortality among a cohort of U.S. cadmium production workers: An update. J. Natl. Cancer Inst. 74(2): 325-333.

U.S. Environmental Protection Agency. 1985. Updated Mutagenicity and Carcinogenicity Assessment of Cadmium. Addendum to the Health Assessment Document for Cadmium (EPA 600/B-B1-023). EPA 600/B-83-025F.

Table 6-12 (continued)

Nickel

Anke, M. Grun, M. Gropperd, B. and H. Kronemann. Nutritional requirement of nickel. In Sarkar, B. (ed). 1983. Biologic Aspect of Metals and Metal-Related Diseases. Raven Press, New York, pp. 88-105.

Chovil, A., R.B. Sutherland and M. Halliday. 1981. Respiratory cancer in a cohort of sinter plant workers. Br. J. Ind. Med. 38: 327-333.

Costa, M. 1980. Metal Carcinogenesis Testing, Principles and In Vitro Methods. Humana Press, Clifton, N. J., 1980.

Doll, R. Mathews, J.D. and L.G. Morgan. 1977. Cancers of the lung and nasal sinuses in nickel workers: reassessment of the period of risk. Br. J. Ind. Med.,34: 102-106.

Dunick, J.K. et. al. 1989. Lung toxicity after 13-week inhalation exposure to nickel oxide, nickel subsulfide or nickel sulfate hexahydrate in F344/N rats and B6C3F mice. Fund. Apl. Toxicol. 12:584-594.

Enterline, P.E. and G.M. Marsh. 1982. Mortality among workers in a nickel refinery and alloy manufacturing plant in West Virginia. J. Natl. Cancer Inst. 68: 925-933.

Magnus, K., A. Andersen and A. Hogetveit. 1982. Cancer of respiratory organs among workers at a nickel refinery in Norway. Int. J. Cancer. 30: 681-685.

Peto, J., H. Cuckle, R. Doll, C. Hermon and L.G. Morgan. 1984. Respiratory cancer mortality of Welsh nickel refinery workers. In: Nickel in the Human Environment: Proceedings of a Joint Symposium, March, 1983. IARC Scientific Publ. No. 53. International Agency for Research on Cancer, Lyon, France, p. 36-46.

U.S. Environmental Protection Agency. 1986. Health Assessment Document for Nickel and Nickel Compounds. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Research Triangle Park, NC. EPA/600/8-83/012FF.

Table 6-13
An Evaluation of Carcinogenicity Based on USEPA and Scientific Sources
Organic Chemicals of Concern
Pelham Bay Landfill
Bronx, New York

Organic Chemicals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Benzene	Bone Marrow and Hematopoetic cells	A	nonlymphocytic leukemia	● Several studies of increased incidence of nonlymphocytic leukemia from occupational exposure (Aksoy et al., 1974; Infante et al., 1977; IARC, 1982), increased incidence of neoplasia in rats (Maltoni & Scarnato, 1979; NTP, 1986; Snyder, 1981) and mice (NCI, 1986; Meyne & Legator, 1980; USEPA, 1980; Snyder, 1981) exposed by inhalation and gavage.	● Ott et al. (1978) observed three deaths from leukemia among 594 workers followed at least 23 years in a retrospective cohort mortality study, but the increase was not statistically significant. ● The increases in leukemia were statistically significant and dose-related in one of the human studies. (Rinsky et al., 1981)

Table 6-13 (continued)

Organic Chemicals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Benzo(a)anthracene	Stomach Skin	B2	forestomach papilloma hemangioendotheliomas fibrosarcomas pulmonary adenoma and hepatoma	● Benzo[a]anthracene produced tumors in mice exposed by gavage; intraperitoneal, subcutaneous or intramuscular injection; and topical application. (Wood et al., 1977a & 1977b; IARC, 1984) ● Benzo[a]anthracene produced mutations in bacteria and mammalian cells in culture. (Martin et al., 1978; Slaga et al., 1978)	• Human Carcinogenicity Data: None. There are no human data that specifically link exposure to benzo[a]anthracene to human cancers (Coombs et al., 1976; IARC, 1973 & 1984; USEPA, 1990). Although benzo[a]anthracene is a component of mixtures (i.e. coal tar, coke oven etc.) there is no human carcinogenic data directly related to benzo(a)anthracene exposures. (Lee et al., 1976; Fahmy & Fahmy, 1973; USEPA, 1984)

Table 6-13 (continued)

Organic Chemicals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Benzo(a)pyrene	Stomach Skin Upper respiratory	B2	stomach tumors by ingestion; tumors in the nasal cavity, larynx, trachea and pharynx by inhalation exposure	● There are multiple animal studies in rodent (Brune et al., 1981) and nonrodent species demonstrating B(a)P to be carcinogenic following administration by oral, intratracheal, inhalation and dermal routes. ● B(a)P has produced positive results in severe in vitro bacterial and mammalian genetic toxicology assays. (Conney, 1982; Guengerich, 1988).	● Human data specifically linking benzo[a]pyrene (BAP) to carcinogenic effects are lacking. (Cooke & Dennis, 1988; IARC, 1983) ● Human Carcinogenicity Data: Inadequate. Lung cancer has been shown to be induced in humans by various mixtures of polycyclic aromatic hydrocarbons known to contain BAP including cigarette smoke, roofing tar and coke oven emissions. It is not possible, however, to conclude from this information that BAP is the responsible agent (Sontag, 1981; T'so & DiPaolo, 1974; USEPA, 1991; US Dept of Health and Human Service, 1989).

Table 6-13 (continued)

Organic Chemicals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Benzo(b)fluoranthene	Lung Liver Skin	B2	liver adenomas and hepatomas epidermoid carcinomas pleomorphic sarcoma papillomas	● Human data are insufficient. (IARC, 1984; Amin et al., 1982; Jerina et al., 1978) ● Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal or subcutaneous injection, and skin painting. (LaVoie et al., 1979 & 1982; USEPA, 1984 & 1990)	● No positive data exist linking ingestion of B(b)F to potential carcinogenicity. ● Positive carcinogenic data in animals are limited to implantation, injection and skin painting. (LaVoie et al., 1982) ● Skin paining studies indicated that only the high dose (0.5% or 5000 ppm) produced papillomas in mice. (LaVoie et al., 1982)
Benzo(k)fluoranthene	Lung Skin Liver	B2	epidermoid carcinomas hepatic adenomas	● Insufficient human data (USEPA, 1984 & 1990; IARC, 1984). ● In a lifetime implant study, female Osborne-Mendel rats received lung implant of 0.16, 0.83 and 4.15 mg B(k)F. The incidence of epidermoid carcinomas in the lung and thorax showed a statistically significant dose-related increase (Deutsch-Wenzel et al., 1983). ● Test for mutagenicity in prokaryotic cells have produced positive results. (LaVoie et al., 1980; Hermann et al., 1980)	● A single dermal application of a high dose of 11 mg B(k)F to 20 Swiss mice in a 63-week study did not induce tumors. (Van Duuren et al., 1966) Production of tumors required the addition of a promoter at the same time. The combination of the promoter (croton resin) and B(k)F produced papillomas and carcinomas. ● Equivocal results have been found in a lung adenoma assay in mice. (LaVoie et al., 1987)

Table 6-13 (continued)

Organic Chemicals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
alpha-BHC (Chlordane)	Liver	B2	benign and malignant liver tumors	● Sufficient evidence in studies in which benign and malignant liver tumors were induced in four strains of mice of both sexes and in F344 male rats; chlordane is structurally related to other liver carcinogens (Nagasaki et al., 1972; Nagasaki et al., 1975). ● Insufficient human carcinogenicity data. Most of epidemiologic studies of workers exposed to chlordane were considered inadequate in sample size and duration of follow-up. (Ito et al., 1976; Hanada et al., 1973). ● A dose-dependent increase in the incidence of hepatocellular carcinomas was observed in both sexes of B6C3F1 mice. (Ito et al., 1976; Hanada et al., 1973) ● Positive mutation assay results using Chinese hamster lung V79 cells and mouse lymphoma L5178Y cells.	● A significant increase in ademonas of the liver was observed in male rats receiving 25 ppm of chlordane. No tumors were observed in female rats in the same study (Velsicol, 1983). ● Several other studies shown no increased tumor incidence after exposure to chlordane. In those studies, loss of body weight and a dose-related increase in mortality was observed, but no treatment-related incidence of tumors was reported (USEPA, 1986). ● Gene mutation assays indicate that chlordane is not mutagenic in bacteria (Schulte-Herman and Panzefall, 1981).

Table 6-13 (continued)

Organic Chemicals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Indeno(1,2,3-cd) pyrene	Lung Skin	B2	epidermal carcinoma in lungs skin tumors	● Sufficient data indicating that indeno (1,2,3-cd)pyrne produced tumors in mice following lung implants, subcutaneous injection and dermal exposure. ● Positive results in bacterial gene mutation assays. (LaVoie et al., 1979; Rice et al., 1985) ● Human carcinogenicity data are inadequate. (IARC, 1984; USEPA, 1984 & 1990)	● An intraperitoneal injection of indeno(1,2,3-cd)pyrene in dimethyl sulfoxide produced lung adenoma in one male mouse; no tumors occurred in female mice. Tumor incidence was not significantly different from vehicle controls. (LaVoie et al., 1987) ● There are some indications that vehicles used in carcinogenic studies may play a significant role in tumor induction. For example, dioxane preparation of indeno(1,2,3-cd)pyrene did not induce skin tumors, but acetone based preparation induced skin tumors in a dose-related fashion. (Rice et al., 1986)

Table 6-13 (continued)

Organic Chemicals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Dieldrin	Liver	B2	hepatocellular carcinomas	● Dieldrin has been shown to be carcinogenic in various strains of mice of both sexes by oral administration. At different dose levels the effects range from benign liver tumors to hepatocarcinomas. (Davis and Fitzhugh, 1962; Meierhenry et al., 1983; NCI, 1978; Tennekes et al., 1981)	● There is a large data gap in the carcinogenic studies of dieldrin. In the 1962 FDA study, dieldrin was administered orally to 218 male and female mice for 2 years. However, the study was compromised by poor survival rate, lack of detailed pathology, loss of a large percentage of the animals from the study, and failure to treat the data for males and females separately. (Epstein, 1976) ● Mutagenicity data for dieldrin are negative in S. cerevisiae assays, back-mutation in S. marcesans, forward mutation, and forward mutation to streptomycin resistance in E. coli. (Ahmed et al., 1977; Shirasu et al., 1976) ● Negative responses were produced in reverse mutation assays with six strains of S. typhimurium with or without metabolic activation. (Fahrig, 1974)

Table 6-13 (continued)

Organic Chemicals	Target Organs	EPA Weight of Evidence	Tumors or Cancers	Evidence	Comments
Aroclor-1260 (PCB)	Liver	B2	hepatocellular carcinomas	● Human carcinogenicity data are inadequate. (Bertazzi et al., 1987; Brown, 1987; USEPA, 1988) ● A long-term bioassay of Aroclor 1260 reported by Kimbrough et al. (1987) produced hepatocellular carcinomas in female Sherman rats when 100 ppm was administered for 630 days to 200 animals.	● There were two occurrences of ingestion of PCB-contaminated rice oil which have been reported: the Yusho incident of 1968 in Japan and the Yu-Cheng incident of 1979 in Taiwan. Although there were increased incidences of liver cancers in both studies, both studies lacked significant information regarding job histories or the influence of alcholism or smoking. ● The 1978 NCI carcinogenic study using Fischer 344 rats fed 100 ppm of PCBs indicated an increased incidence of liver carcinomas, but the incidence was not statistically significant. ● Most genotoxicity assays of PCBs have been negative. At least ten negative genotoxicity studies have been reported. (Schoeny, 1982; Schoeny et al., 1979).

Table 6-13 (continued)

References for Table 6-13

Benzene

Aksoy, M., S. Erdem and G. Dincol. 1974. Leukemia in shoeworkers exposed chronically to benzene. Blood. 44(6): 837-841.

Infante, P.F., R.A. Rinsky, J.K. Wagoner and R.J. Young. 1977. Benzene and Leukemia. The Lancet. 2(8043): 867-869.

International Agency for Research on Cancer. (IARC). 1982. Benzene. In: Some industrial chemicals and dyestuffs. IARC Monographs on the evaluation of carcinogenic risk of chemicals to humans. IARC,

WHO, Lyon, France. 29: 93-148.

Maltoni, C. and C. Scarnato. 1979. First experimental demonstration of the carcinogenic effects of benzene. Long-term bioassays on Sprague-Dawley Rats by oral administration. Med.Lav. 70: 352-357.

Meyne, J. and M.S. Legator. 1980. Sex-related differences in cytogenetic effects of benzene in the bone marrow of Swiss mice. Environ. Mutat. 2:43-50.

National Toxicology Program. (NTP). 1986. Toxicology and carcinogenesis studies of benzene (CAS No. 71-43-2) in F344/N rats and B6C3F mice (gavage studies). NTP Technical Report Series No. 289. NIH Publication No. 86-2545.

NCI, 1986 Ott, M.G., J.C. Townsend, W.A. Fishbeck and R.A. Langner. 1978. Mortality among individuals occupationally exposed to benzene. Arch. Environ. Health. 33: 3-10.

Rinsky. R.A., R.J. Young and A.B. Smith. 1981. Leukemia in benzene workers. Am. J. Ind. Med. 2: 217-245.

Snyder, C.A., M.N. Erlichman, S. Laskin, B.D. Goldstein, and R.E. Albert. 1981. The pharmacokinetics of repetitive benzene exposure at 300 and 100 ppm in AKR mice and Sprague-Dawley rats. Toxicol. Appl. Pharmacol. 57 : 164-171.

U.S. Environmental Protection Agency. 1980. Ambient Water Quality Criteria Document for Benzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office (Cincinnati, OH) and Carcinogen Assessment Group (Washington, DC), and the Environmental Research Labs (Corvalis, OR; Duluth, MN; Gulf Breeze, FL) for the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-018.

Benzo(a)anthracene

Coombs, M.M., C. Dixon and A.M. Kissonerghis. 1976. Evaluation of the mutagenicity of compounds of known carcinogenicity, belonging to the benzo[a]anthracene, chrysene, and cyclopenta[a]phenanthrene series, using Ame's test. Cancer Res. 36: 4525-4529.

Fahmy, O.G. and M.J. Fahmy. 1973. Oxidative activation of benzo(a)anthracene and methylated derivatives in mutagenesis and carcinogenesis. Cancer Res. 33: 2354-2361.

Lee, M.L., M. Novotny and K.D. Bartle. 1976. Gas chromatography/mass spectrometric and nuclear magnetic resonance studies of carcinogenic polynuclear aromatic hydrocarbons in tobacco and marijuana smoke condensates. Anal. Chem. 48(2): 405-416.

Table 6-13 (continued)

Benzo(a)anthracene (Continued)

International Agency for Research on Cancer. (IARC). 1973. Certain Polycyclic Aromatic Hydrocarbons and Heterocyclic Compounds. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Polynuclear Aromatic Compounds. Vol. 3. Lyon, France.

International Agency for Research on Cancer. (IARC). 1984. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Polynuclear Aromatic Compounds. Part 3. Industrial Exposures Aluminum Production, Coal Gasification, Coke Production, and Iron and Steel Founding. Vol. 34. World Health Organization.

Martin, C.N., A.C. McDermid and R.C. Garner. 1978. Testing of known carcinogens and noncarcinogens for their ability to induce unscheduled DNA synthesis in HeLa cells. Cancer Res. 38: 2621-2627.

Slaga, T.J., E. Huberman, J.K. Selkirk, R.G. Harvey and W.M. Braken. 1978. Carcinogenicity and mutagenicity of benzo[a]anthracene diols and diol-epoxides. Cancer Res. 38: 1699-1704.

U.S. Environmental Protection Agency. 1984. Carcinogen Assessment of Coke Oven Emissions. Office of Health and Environmental Assessment, Washington, DC. EPA 600/6-82-003F. NTIS PB 84-170181.

U.S. Environment Protection Agency. 1990. Drinking Water Criteria Document for Polycyclic Aromatic Hydrocarbons (PAHs). Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. Final Draft. ECAO-CIN-D010, September, 1990.

Wislocki, P.G., O.S. Bagan, A.Y.H. Lu, et al. 1986. Tumorigenicity of nitrated derivatives of pyrene, benz[a]anthracene, chrysene and benzo[a]pyrene in the newborn mouse assay. Carcinogenesis. 7(8): 1317-1322.

Wood, A.W., R.L. Chang, W. Levin, et al. 1977a. Mutagenicity and cytotoxicity of benzo[a]anthracene diol epoxides and tetrahydro-epoxides: Exceptional activity of the bay region 1,2-epoxides. Proc. Natl. Acad. Sci. USA. 74(7): 2746-2750.

Wood, A.W., W. Leven. R.L. Chang, et al. 1977b. Tumorigenicity of five dihydrodiols of benzo[a]anthracene on mouse skin: Exceptional activity of benz[a]anthracene 3,4-dihydrodiol. Proc. Natl. Acad. Sci. USA. 74(8): 3137-3179.

Benzo(a)pyrene

Brune, H., R.P. Deutsch-Wenzel, M. Habs, S. Ivankovic and D. Schm hl. 1981. Investigation of the tumorigenic response to benzo[a]pyrene in aqueous caffeine solution applied orally to Sprague-Dawley rats. J. Cancer Res. Clin. Oncol. 102(2): 153-157.

Conney, A.H. 1982. Induction of microsomal enzymes by foreign chemicals and carcinogenesis by polycyclic aromatic hydrocarbons. Cancer Res. 42: 4875-4917.

Cooke, M and A.J. Dennis. (eds). 1988. Polynuclear aromatic hydrocarbons: A Decade of Progress. Battelle, Columbus, Ohio.

Guengerich, F.P. 1988. Roles of cytochrome P-450 enzymes in chemical carcinogenesis and cancer chemotherapy. Cancer Res. 48:2946-2954.

International Agency for Research on Cancer. (IARC). 1983. Certain Polycyclic Aromatic Hydrocarbons and Heterocyclic Compounds. Monographs on the Evaluation of Carcinogenic Risk of the Chemical to Man, Vol. 3. Lyon, France.

Sontag, J. M. (ed): 1981. Carcinogens in Industry and the Environment. Marcel Dekker, New York.

Table 6-13 (continued)

Benzo(a)pyrene (Continued)

T'so, P. O. P. and J.A. DiPaolo. (eds): 1974. Chemical Carcinogenesis. Marcel Dekker, New York.

U.S. Department of Health and Human Services. 1989. Reducing the health consequences of smoking: 25 years of progress: a report of the Surgeon General. Public Health Service, DHHS Publication No. (CDC) 89-8411, Washington, D.C.

U.S. Environmental Protection Agency. 1991. Quantitative Risk Assessment of Ingested Benzo[a]pyrene. Human Health Assessment Group, Office of Health and Environmental Assessment, Washington, DC. (Final Draft)

Benzo(b)fluoranthene

Amin, S., E.J. LaVoie and S.S. Hecht. 1982. Identification of metabolites of benzo[b]fluoranthene. Carcinogenesis. 3(2): 171-174.

International Agency for Research on Cancer. (IARC). 1984. Monographs on the Evaluation of the Carcinogenic Risk of the Chemical to Man. Polynuclear Aromatic Hydrocarbons. Part 3. Industrial Exposures in Aluminum Production, Coal Gasification, Coke Production, and Iron and Steel Founding. Vol. 34. World Health Organization.

Jerina, D.M., H. Yagi, R.E. Lehr, et al. 1978. The Bay-region theory of carcinogenisis by polycyclic aromatic hydrocarbons. In: Polycyclic Hydrocarbons and Cancer, Vol. 1. Environment, Chemistry and Metabolism, H.V. Gelboin and P.O.P. Ts'o, Ed. Academic Press, NY.

LaVoie, E.J., E.V. Bedenko, N. Hirota, S.S. Hecht and D. Hoffmann. 1979. A comparison of the mutagenicity, tumor-initiating activity and complete carcinogenicity of polynuclear aromatic hydrocarbons. In: Polynuclear Aromatic Hydrocarbons, P.W. Jones and P. Leber, Ed. Ann Arbor Science Publishers, Ann Arbor, MI. p. 705-721.

LaVoie, E.J., S. Amin., S.S. Hecht, K. Furuya and D. Hoffmann. 1982. Tumor initiating activity of dihydrodiols of benzo[b]fluoranthene, benzo[j]fluoranthene and benzo[k]fluoranthene.
Carcinogenesis. 3(1): 49-52.

U.S. Environmental Protection Agency. 1984. Carcinogen Assessment of Coke Oven Emissions. Office of Health and Environmental Assessment, Washington, DC. EPA 600/6-82-003F. NTIS PB 84-170181.

U.S. Environmental Protection Agency. 1990. Drinking Water Criteria Document for Polycyclic Aromatic Hydrocarbons (PAHs). Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. Final Draft. ECAO-CIN-D010, September, 1990.

Benzo(k)fluoranthene

Deutsch-Wenzel, R., H. Brune, G. Grimmer, G. Dettbarn and J. Misfeld. 1983. Experimental studies in rat lungs on the the carcinogenicity and dose-response relationships of eight frequently occurring environmental polycyclic aromatic hydrocarbons. J. Natl. Cancer Inst. 71(3):539-543.

Hermann, M., J.P. Durand, J.M. Charpentier, et al. 1980. Correlations of mutagenic activity with polynuclear aromatic hydrocarbon content of various minerals oils. In: Polynuclear Aromatic Hydrocarbons: Chemistry and Biological Effects, 4th Int. Symp., A. Bjorseth and A.J. Dennis, Ed. Battelle Press, Columbus, OH. p. 899-916.

Table 6-13 (continued)

Benzo(k)fluoranthene (Continued)

IARC (International Agency for Research on Cancer). 1984. Monographs on the Evaluation of the Carcinogenic Risk of the Chemical to Man. Polynuclear Aromatic Hydrocarbons. Part 3. Industrial Exposures in Aluminum Production, Coal Gasification, Coke Production, and Iron and Steel Founding. Vol. 34. World Health Organization.

LaVoie, E.J., S.S. Hecht, S. Amin, V. Bedenko and D. Hoffmann. 1980. Identification of mutagenic dihydrodiols as metabolites of benzo(j)fluoranthene and benzo(k)fluoranthene. Cancel Res. 40: 4528-4532.

LaVoie, E.J., J. Braley, J.E. Rice and A. Rivenson. 1987. Tumorigenic activity for non-alternant polynuclear aromatic hydrocarbons in newborn mice. Cancer Lett. 34: 15-20.

U.S. EPA. 1984. Carcinogen Assessment of Coke Oven Emissions. Office of Health and Environmental Assessment, Washington, DC. EPA 600/6-82-003F. NTIS PB84-170181.

U.S. EPA. 1990. Drinking Water Criteria Document for Polycyclic Aromatic Hydrocarbons (PAHs). Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. Final Draft, ECAO-CIN-D010, September, 1990.
Van Duuren, B.L., A. Sivak, A. Segal, L. Orris and L. Langseth. 1966. The tumor-promoting agents of tobacco leaf and tobacco smoke condensate. J. Natl. Cancer Inst. 37(4): 519-526.

alpha-BHC (Chlordane)

Hanada, M., C. Yutani and T. Miyaji. 1973. Induction of hepatoma in mice by benzene hexachloride. Gann. 64: 511-513.

Ito, N., M. Hananouchi, S. Sugihara, et al. 1976. Reversibility and irreversibility of liver tumors in mice induced by the alpha isomer of 1,2,3,4,5,6-hexachlorocyclohexaneCancer Res. 36: 2227-2234.

Nagasaki, H., S. Tomii, T. Mega, M. Marugami and N. Ito. 1972. Hepatocarcinogenic effect of alpha-, beta-, gamma-, and delta-isomers of benzene hexachloride in mice. Gann. 63(3): 393.

Nagasaki, H., H. Kawabata, Y. Miyata, et al. 1975. Effect of various factors on induction of liver tumors in animals by the alpha-isomer of benzene hexachloride. Gann. 66(2): 185-191.

Schulte-Hermann, R. and W. Parzefall. 1981. Failure to determine initiation from promotion of liver tumors in a long-term study with the phenobarbital-type inducer alpha-hexachlorocyclohexane and the role of sustained stimulation of hepatic growth and monooxygenases. Cancer Res. 41: 4140-4146.

U.S. Environmental Protection Agency. 1986. Health and Environmental Effects Profile for Hexachloro- cyclohexanes. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC.

Velsicol Chemical Corporation, 1983. MRID No. 00138591. Available from EPA. Washington, DC 20460, cited or IRIS database, 1/93.

Indeno(1,2,3-cd)pyrene

International Agency for Research on Cancer. (IARC). 1984. Monographs on the Evaluation of the Carcinogenic Risk of the Chemical to Man. Polynuclear Aromatic Hydrocarbons. Part 3. Industrial Exposures in Aluminum Production, Coal Gasification, Coke Production, and Iron and Steel Founding. Vol. 34. World Health Organization.

LaVoie, E.J., E.V. Bedenko, N. Hirota, S.S. Hecht and D. Hoffmann. 1979. A comparison of the mutagenicity, tumor-initiating activity and complete carcinogenicity of polynuclear aromatic hydrocarbons. In: Polynuclear Aromatic Hydrocarbons, P.W. Jones and P. Leber, Ed. Ann Arbor Science Publishers, Ann Arbor, MI. p. 705-721.

Table 6-13 (continued)

Indeno(1,2,3-cd)pyrene (Continued)

LaVoie, E.J., J. Braley, J.E. Rice, and A. Rivensen, 1987. Tumorigenic activity for non-alternant polynuclear aromatic hydrocarbons in newborn mice. Cancer Lett. 34:15-20.

Rice, J.E., D.T. Coleman, T.J. Hosted, Jr., E.J. LaVoie, D.J. McClausland and J.C. Wiley, Jr. 1985. Identification of mutagenic metabolites in indeno[1,2,3-cd]pyrene formed in vitro with rat liver enzymes. Cancer Res. 45: 5421-5425.

Rice, J.E., T.J. Hosted, Jr., M.C. DeFloria, E.J. LaVoie, D.L. Fischer and J.C. Wiley, Jr. 1986. Tumor-initiating activity of major in vivo metabolites of indeno[1,2,3-cd]pyrene on mouse skin. Carcinogenesis. 7(10): 1761-1764.

U.S. Environmental Protection Agency. 1984. Carcinogen Assessment of Coke Oven Emissions. Office of Health and Environmental Assessment, Washington, DC. EPA 600/6-82-003F. NTIS PB 84-170181.

U.S. Environmental Protection Agency. 1990. Drinking Water Criteria Document for PolycyclicAromatic Hydrocarbons (PAHs). Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. Final Draft. ECAO-CIN-D010, September, 1990.

Dieldrin

Ahmed, F.E., R.W. Hart and N.J. Lewis. 1977. Pesticide induced DNA damage and its repair in cultured human cells. Mutat. Res. 42: 161-174.

Davis, K.J. and O.G. Fitzhugh. 1962. Tumorigenic potential of aldrin and dieldrin for mice. Toxicol. Appl. Pharmacol. 4: 187-189.

Epstein, S.S. 1976. Case study 5: Aldrin and dieldrin suspension based on experimental evidence and evaluation and societal needs. Ann. NY. Acad.Sci. 271: 187-195.

Fahrig, R. 1974. Comparative mutagenicity studies with pesticides. () Scientific Press No. 10. Fitzhugh, O.G., A.A. Nelson and M.L. Quaife. 1964. Chronic oral toxicity of aldrin and dieldrin in rats and dogs. Food Cosmet. Toxicol. 2: 551-562.

Meierhenry, E.F., B.H. Reuber, M.E. Gershwin, L.S. Hsieh and S.W. French. 1983. Deildrin-induced mallory bodies in hepatic tumors of mice of different strains. *Hepatology*. 3: 90-95.

National Cancer Institute. (NCI). 1978. Bioassays of aldrin and dieldrin for possible carcinogenicity. DHEW Publication No. (NIH) 78-821. National Cancer Institute Carcinogenesis Technical Report Series, No. 21. NCI-CG-TR-21.

Shirasu, Y., M. Moriya, K. Kato, A. Furuhashi and T. Kada. 1976. Mutagenicity screening of pesticides in the microbial system. Mutat. Res. 40(1): 19-30.

Tennekes, H.A., A.S. Wright, K.M. Dix and J.H. Koeman. 1981. Effects of dieldrin, diet, and bedding on enzyme function and tumor incidence in livers of male CF-1 mice. Cancer Res. 41:3615-3620.

Aroclor - 1260 (PCB)

Bertazzi, P.A., L. Riboldi, A. Pesatori, L. Radice and C. Zacchetti. 1987. Cancer mortality of capacitor manufacturing workers. Am. J. Ind. Med. 11(2): 165-176.

Brown, D.P. 1987. Mortality of workers exposed to polychlorinated biphenyls -- An update. Arch. Environ. Health. 42(6): 333-339.

Table 6-13 (continued)

Aroclor - 1260 (PCB) (Continued)

Kimbrough, R.D. 1987. Human health effects of polychlorinated biphenyls (PCBs) and polybrominated biphenyls (PBBs). Ann. Rev. Pharmacol. Toxicol. 27: 87-111.

National Cancer Institute (NCI). 1978. Bioassay of Aroclor (trademark) 1254 for possible carcinogenicity. CAS No. 27323-18-8.NCI Carcinogenesis Tech. Rep. Ser. No. 38.

Schoeny, R. 1982. Mutagenicity testing of chlorinated biphenyls and chlorinated dibenzofurans. Mutat. Res. 101: 45-56.

Schoeny, R.S., C.C. Smith and J.C. Loper. 1979. Non-mutagenicity for Salmonella of the chlorinated hydrocarbons Aroclor 1254, 1,2,4-trichlorobenzene, mirex and kepone. Mutat. Res. 68: 125-132.

U.S. Environmental Protection Agency. 1988. Drinking Water Criteria Document for Polychlorinated Biphenyls (PCBs). Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC.

Rossi, L., O. Barbieri, M. Sanguineti, J.R.P. Cabral, P. Bruzzi and L. Santi. 1983. Carcinogenicity study with technical-grade DTT and DDE in hamsters. Cancer Res. 43:776-781.

Tomatis, L., V. Turusov, R.L. Charles and M. Boicchi. 1974. Effect of long-term exposure to 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene, to 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane, and the two chemicals combined on CF-1 mice. J. Natl. Cancer Inst. 52:883-891.

U.S. EPA. 1985. The Carcinogen Assessment Group's Calculation of the Carcinogenicity of Dicofol (Kelthane), DDT, DDE and DDD (TDE). Office of Health and Environmental Assessment, Carcinogen Assessment Group, Washington, DC.

Table 6-14
Inhalation of Volatile Compounds
Intake Assumptions
Pelham Bay Landfill
Bronx, New York

$$\text{Intake Factor} = \frac{IR \times ET \times EF \times ED \times ME \times DF \times CC \times FI}{BW \times AT}$$

Parameter	Trespasser (Youth) RME	Worker (Adult) RME
IR: Inhalation Rate (m^3/hr) (1)	1.21	1.04
ET: Exposure Time (hrs/day) (2)	4	12
EF: Exposure Frequency (days/yr) (3)	240	250
ED: Exposure Duration (years) (4)	9	25
ME: Matrix Effect (unitless)	1	1
DF: Deposition Factor (unitless)	1	1
CC: Ciliary Clearance (unitless)	0.38	0.38
FI: Fraction Contaminated (unitless)	1	1
BW: Body Weight (kg) (5)	30	70
AT: Averaging Time (days) (6)		
Noncarcinogenic	3,285	9,125
Carcinogenic	25,550	25,550

Notes:
(1) Inhalation RME correspond with light and moderate activity, (USEPA, 1989c) and NYSDOH Communicaton - Table 6-19
(2) Assumes 8-hr average shift, extended to 12 hrs for RME
(3) USEPA, 1991d and NYSDOH Communications Table 6-19
(4) Trespassers, USEPA 1989a. Workers USEPA, 1991a and NYSDOH communicatons - Table 6-19
(5) NYSDOH Communications - Table 6-19
(6) Averaging time ED x 365 days/yr for noncarcinogenic effects, 70 year lifetime x 365 days/yr for carcinogenic effects, (USEPA, 1989a)

Table 6-15
Incidental Ingestion of Leachate
Intake Assumptions
Pelham Bay Landfill
Bronx, New York

$$\text{Intake Factor} = \frac{IR \times EF \times ED \times FI}{BW \times AT}$$

Parameter	Trespasser (Youth) RME	Worker (Adult) RME
IR: Ingestion Rate (L/day) (1)	0.0007	0.0008
EF: Exposure Frequency (days/yr) (2)	240	250
ED: Exposure Duration (years) (3)	9	25
FI: Fraction Contaminated (unitless)	1	1
BW: Body Weight (kg) (4)	30	70
AT: Averaging Time (days) (5)		
Noncarcinogenic	3,285	9,125
Carcinogenic	25,550	25,550

Notes:
(1) Based on ingestion of dermally absorbed leachate assuming adherence factor of 1 mg/cm^2 and mean surface area of 800cm^2 for adult males and mean surface area of 700 cm^2 for women, used for youth trespassers (USEPA, 1992e)
(2) USEPA, 1989a and NYSDOH Communications - Table 6-19
(3) USEPA, 1989a and NYSDOH Communications - Table 6-19
(4) NYSDOH Communication - Table 6-19
(5) Averaging time for noncarcinogenic effects, ED x 365 days/yr; carcinogenic effects 365 days x 70 year lifetime, (USEPA 1989a)

Table 6-16
Dermal Contact with Leachate
Intake Assumptions
Pelham Bay Landfill
Bronx, New York

$$\text{Intake Factor} = \frac{SA \times ET \times EF \times ED \times PC \times CF}{BW \times AT}$$

Parameter	Trespasser (Youth) RME	Worker (Adult) RME
SA: Surface Area (cm^2) (1)	2,975	2,090
ET: Exposure Time (hrs/day)	1	1
EF: Exposure Frequency (days/yr) (2)	240	250
ED: Exposure Duration (years) (3)	9	25
PC: Permeability Constant (cm/hr) (4)	10^{-6}	10^{-6}
CF: Conversion Factor ($1/cm^3$)	10^{-3}	10^{-3}
BW: Body Weight (kg) (5)	30	70
AT: Averaging Time (days) (6)		
Noncarcinogenic	3,285	9,125
Carcinogenic	25,550	25,550

Notes:
(1) NYSDOH Communication - Table 6-19
(2) NYSDOH Communication - Table 6-19
(3) NYSDOH Communication - Table 6-19
(4) USEPA, 1992e
(5) NYSDOH Communication - Table 6-19
(6) Averaging time for noncarcinogenic effects, ED x 365 days/yr; carcinogenic effects 365 days x 70 year lifetime, USEPA 1989a

Table 6-17
Incidental Ingestion of Soil
Intake Assumptions
Pelham Bay Landfill
Bronx, New York

$$\text{Intake Factor} = \frac{IR \times EF \times ED \times ME \times FI \times CF}{BW \times AT}$$

Parameter	Trespasser (Youth) RME	Worker (Adult) RME
IR: Ingestion Rate (mg/day) (1)	200	200
EF: Exposure Frequency (days/yr) (2)	240	250
ED: Exposure Duration (years) (3)	9	25
ME: Matrix Effect (unitless) (4)	1	1
FI: Fraction Contaminated (unitless) (5)	0.5	0.5
CF: Conversion Factor (kg/mg)	10^{-6}	10^{-6}
BW: Body Weight (kg) (6)	30	70
AT: Averaging Time (days) (7)		
Noncarcinogenic	3,285	9,125
Carcinogenic	25,550	25,550

Notes:
(1) (Hawley, 1985) and NYSDOH Communication - Table 6-19
(2) NYSDOH Communication - Table 6-19
(3) NYSDOH Communication - Table 6-19
(4) Matrix effect, i.e.,compounds adhering or bound to soil matrix available for absorption. RME absorption of 100% assumed here
(5) Assumes one-half RME of total daily soil intake stems from contaminated source.
(6) NYSDOH Communication - Table 6-19
(7) Averaging time for noncarcinogenic effects, ED x 365 days/yr; carcinogenic effects 365 days x 70 year lifetime, USEPA 1989a

Table 6-18
Dermal Contact with Soil
Intake Assumptions
Pelham Bay Landfill
Bronx, New York

$$\text{Intake Factor} = \frac{SA \times EF \times ED \times ME \times AF \times ABS \times FI \times CF}{BW \times AT}$$

Parameter	Trespasser (Youth) RME	Worker (Adult) RME
SA: Surface Area (cm^2) (1)	2,975	2,090
EF: Exposure Frequency (days/yr) (2)	240	250
ED: Exposure Duration (years) (3)	9	25
ME: Matrix Effect (unitless)	1	1
AF: Adherence Factor (mg/cm^2) (4)	1	1
ABS: Absorption Factor	0.1	0.1
FI: Fraction Contaminated (unitless) (5)	0.5	0.5
CF: Conversion Factor (kg/mg)	10^{-6}	10^{-6}
BW: Body Weight (kg) (6)	30	70
AT: Averaging Time (days) (7)		
Noncarcinogenic	3,285	9,125
Carcinogenic	25,550	25,550

Notes:
(1) NYSDOH Communication - Table 6-19
(2) NYSDOH Communication - Table 6-19
(3) NYSDOH Communication - Table 6-19
(4) USEPA 1989c
(5) Assuming one-half RME of soil/dust intake comes from the contaminated area
(6) NYSDOH Communication - Table 6-19
(7) Averaging time, ED x 365 days/yr for noncarcinogenic effects, 70 yrs x 365 days/yr for carcinogenic effects, USEPA 1989a

Table 6-19
NYSDOH Approved Parameter Values for Estimating Exposures
Pelham Bay Landfill
Bronx, New York

Scenarios and Parameters	Parameter Values - RME
Scenario 1: Occupational Exposure	
<u>Inhalation</u>	
Inhalation Rate (m^3/day)	25
Exposure Frequency (days/yr)	250
Exposure Duration (yrs)	25
Body Weight (kg)	70
<u>Dermal Contact</u>	
Surface Area (cm^2)	2090
Exposure Frequency (days/yr)	250
Exposure Duration (yrs)	25
Body Weight (kg)	70
Scenario 2: Youth Trespasser Exposure	
<u>Dermal Contact</u>	
Surface Area (cm^2)	2975
Exposure Frequency (days/yr)	180*
Exposure Duration (yrs)	9
Body Weight (kg)	30
<u>Inhalation</u>	
Inhalation Rate (m^3/day)	29
Exposure Frequency (days/yr)	240
Exposure Duration (yrs)	9
Body Weight (kg)	30

Notes: * 240 days used for consistency with other scenarios

Table 6-20
Receptor and Pathway Summary
Health Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Receptor	Pathway	Reasonbable Maximum Exposure	
		Cancer Risk	Chronic Hazard Index
Worker	VOC Inhalation	$4.7x10^{-08}$	$4.6x10^{-04}$
Worker	Leachate Ingestion	$1.4x10^{-07}$	$3.9x10^{-03}$
Worker	Soil Ingestion	$8.0x10^{-06}$	$2.8x10^{-02}$
Worker	Dermal Contact - Leachate	$3.7x10^{-10}$	$1.0x10^{-05}$
Worker	Dermal Contact - Soil	$8.4x10^{-06}$	$2.9x10^{-02}$
Total Worker		$1.7x10^{-05}$	$6.2x10^{-02}$
Youth Tresspasser	VOC Inhalation	$1.5x10^{-08}$	$4.0x10^{-04}$
Youth Tresspasser	Leachate Ingestion	$1.0x10^{-07}$	$7.7x10^{-03}$
Youth Tresspasser	Soil Ingestion	$6.5x10^{-06}$	$6.3x10^{-02}$
Youth Tresspasser	Dermal Contact - Leachate	$4.3x10^{-10}$	$3.3x10^{-05}$
Youth Tresspasser	Dermal Contact - Soil	$9.6x10^{-06}$	$9.4x10^{-02}$
Total Youth Tresspasser		$1.6x10^{-05}$	$1.7x10^{-01}$

Table 6-21
Incidental Ingestion of Soil Containing Benzo(a)pyrene
Comparison of Standard RME and Monte Carlo Exposure Assumptions
Pelham Bay Landfill
Bronx, New York

$$\text{Hazard} = \frac{IR \times EF \times ED \times ME \times FI \times CF \times SC \times SF}{BW \times AT}$$

Parameter	Worker (Adult) Standard RME	Worker (Adult) Monte Carlo
IR: Ingestion Rate (mg/day)	200 (1)	Lognormal (3.44, 0.8)* (10)
EF: Exposure Frequency (days/yr)	250 (2)	Lognormal (4.605, 0.715) (11)
ED: Exposure Duration (years)	25 (3)	Lognormal (1.609, 0.978) (12)
ME: Matrix Effect	1 (4)	1 (4)
FI: Fraction Contaminated	0.5 (5)	0.5 (5)
CF: Conversion Factor (kg/mg)	10^{-6}	10^{-6}
BW: Body Weight (kg)	70 (6)	Lognormal (4.34, 0.17) (13)
AT: Averaging Time (days)	25,550 (7)	25,550 (7)
SC: Soil Concentration (mg/kg)	1.33 (8)	Lognormal (0.087, 1.012) (14)
SF: Slope Factor $(mg/kg\text{-}d)^{-1}$	7.3 (9)	Lognormal (-0.79, 2.39) (10)

Notes:
(1) (Hawley, 1985) and NYSDOH Communication - Table 6-19
(2) NYSDOH Communication - Table 6-19
(3) NYSDOH Communication - Table 6-19
(4) Matrix effect, i.e., compounds adhering or bound to soil matrix available for absorption. RME absorption of 100% assumed here
(5) Assumes one-half RME of total daily soil intake stems from contaminated source
(6) NYSDOH Communication - Table 6-19
(7) Averaging time for noncarcinogenic effects, ED x 365 days/yr; carcinogenic effects 3365 days x 70 year lifetime, USEPA 1989a
(8) 95% UCL on-site soil concentration
(9) Table 6-10
(10) (Burnmaster, 1992)
(11) Assumed to be lognormal with geometric mean of 100 days per year with 90th percentile of 250 days
(12) (US Department of Labor, 1992)
(13) (Brainard, 1992)
(14) Calculated from 17 on-site soil samples assuming lognormal distribution

* Lognormal (a,b) means lognormally distributed with geometric mean e^a, geometric standard deviation e^b, where e = 2.71828...

Table 6-22
Potential Exposure Pathways for Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

	RECEPTORS							
	ESTUARINE ORGANISMS				TERRESTRIAL ORGANISMS			
HABITAT **SOURCE** Pathway	**Primary Producers**	**Primary Consumers**	**Secondary Consumers**	**Tertiary^{1} Consumers**	**Primary Producers**	**Primary Consumers**	**Secondary Consumers**	**Tertiary^{1} Consumers**
ESTUARINE ECOSYSTEM								
GROUNDWATER/LEACHATE								
Direct Contact	X	X	X					
Ingestion^{2}	X	X	X					
SURFACE WATER								
Direct Contact	X	X	X	X				
Ingestion^{2}		X	X	X		X	X	X
SEDIMENT								
Direct Contact	X	X	X	X				
Ingestion		X	X	X		X	X	
PRIMARY PRODUCERS								
Ingestion		X						
PRIMARY CONSUMERS								
Ingestion			X				X	
SECONDARY CONSUMERS								
Ingestion				X				X
TERTIARY CONSUMERS								
Ingestion				X				X

Table 6-22
Potential Exposure Pathways for Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

	RECEPTORS							
	ESTUARINE ORGANISMS				TERRESTRIAL ORGANISMS			
HABITAT SOURCE Pathway	Primary Producers	Primary Consumers	Secondary Consumers	Tertiary[1] Consumers	Primary Producers	Primary Consumers	Secondary Consumers	Tertiary[1] Consumers
TERRESTRIAL ECOSYSTEM								
GROUNDWATER								
Direct Contact					X			
SURFACE WATER - WETLANDS								
Direct Contact	X	X	X		X			
Ingestion		X	X			X	X	X
SEDIMENTS - WETLANDS								
Direct Contact	X	X	X		X			
Ingestion		X	X			X	X	
SOIL								
Direct Contact					X			
Ingestion						X	X	
PRIMARY PRODUCERS								
Ingestion						X		
PRIMARY CONSUMERS								
Ingestion							X	
SECONDARY CONSUMERS								
Ingestion								X

Notes: [1] Tertiary or higher consumers
[2] Ingestion/bioconcentration

Prepared by: BL
Checked by: TGC
92C4087

Table 6-23
Key Receptor Species Selection Process for Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

SELECTION CRITERIA / RECEPTORS:	ALGAE/PHYTOPLANKTON	TERRESTRIAL PLANTS (GRASSES, REEDS)	ZOOPLANKTON	BIVALVE MOLLUSCS/INFAUNA (BLUE MUSSEL)	PELAGIC INVERTEBRATES (SHRIMP)	FORAGE FISH (ATLANTIC SILVERSIDE, MUMMICHOG)	CRABS (BLUE CRAB)	CARNIVOROUS FISH (SUMMER FLOUNDER)	TERRESTRIAL INVERTEBRATES (EARTHWORM)	AMPHIBIANS/REPTILES (BOX TURTLE)	SMALL MAMMALS (VOLE, MOUSE)	SMALL/GAME BIRDS (ROBIN/PHEASANT)	WATERFOWL (MERGANSER, MALLARD)	WADING BIRDS (HERON)	PREDATORY BIRDS (N. HARRIER, OSPRY, HAWK)	PREDATORY MAMMALS (RACCOON)
ESTUARINE ECOSYSTEM																
Known/expected occurence	●	○	●	●	●	●	●	●	○	○	○	○	●	●	●	●
Potential or documented exposure	●	○	●	●	●	●	●	●	○	○	○	○	●	●	●	●
Toxicological information available	●	●	○	●	●	●	●	●	○	○	●	●	●	○	○	○
Sensitive to preliminary COCs	●	●	○	●	●	●	●	●	○	○	●	●	●	○	○	○
Listed as special concern species	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	○
Game or commercial species	○	○	○	●	○	○	●	●	○	○	○	●	●	○	○	○
Key component in the food web	●	●	●	●	○	●	●	●	○	○	○	○	●	●	●	○
Limited mobility or home range	●	●	○	●	○	●	○	○	●	○	●	○	○	○	○	○
SELECTED AS KEY RECEPTOR	○	○	○	●	○	●	●	●	○	○	○	○	●	○	●	○
TERRESTRIAL ECOSYSTEM																
Known/expected occurence	○	●	○	○	○	○	○	○	●	●	●	●	○	○	●	●
Potential or documented exposure	○	●	○	○	○	○	○	○	●	●	●	●	○	○	●	●
Toxicological information available	●	●	○	●	●	●	●	●	○	○	●	●	●	○	○	○
Sensitive to preliminary COCs	●	●	○	●	●	●	●	●	○	○	●	●	●	○	○	○
Listed as special concern species	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	○
Game or commercial species	○	○	○	○	○	○	●	●	○	○	○	●	●	○	○	○
Key component in the food web	○	○	○	○	○	○	○	○	○	○	●	●	○	○	●	○
Limited mobility or home range	●	●	○	●	○	●	○	○	●	○	●	○	○	○	○	○
SELECTED AS KEY RECEPTOR	○	○	○	○	○	○	○	○	○	○	●	●	○	○	●	○
TIDAL WETLAND ECOSYSTEM																
Known/expected occurence	●	●	○	●	●	●	●	○	○	●	○	●	●	●	●	●
Potential or documented exposure	●	●	○	●	●	●	●	○	○	●	○	●	●	●	●	●
Toxicological information available	●	●	○	●	●	●	●	●	○	○	●	●	●	○	○	○
Sensitive to preliminary COCs	●	●	○	●	●	●	●	●	○	○	●	●	●	○	○	○
Listed as special concern species	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	○
Game or commercial species	○	○	○	○	○	○	●	●	○	○	○	●	●	○	○	○
Key component in the food web	○	○	○	○	○	●	○	○	○	○	○	○	●	●	●	○
Limited mobility or home range	●	●	○	●	○	●	○	○	●	○	●	○	○	○	○	○
SELECTED AS KEY RECEPTOR	○	○	○	○	○	●	○	○	○	○	○	○	●	●	●	○

KEY

● Criteria probably are met by receptor

○ Criteria not met by receptor or unknown

Table 6-24
Unvalidated Surface Soil Data Summary And Comparisons For Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Present in Blanks (2	Number of Detections	Number of Samples	CRDL Range (3)	Mimimum Value (4)	Mean	Maximum Detected Value (5)	95% UCL (6)	Reference Station MW-124 S1	NYSDEC Recommended Soil Cleanup Objective (7)	Eastern USA Background
Organics (ug/kg)											
1,2,4-Trichlorobenzene	---	1	18	350 - 2,000	48 J	263	48 J	347	---	3,400	---
1,2-Dichlorobenzene	---	1	18	350 - 2,000	42 J	263	42 J	347	---	7,900	---
1,4-Dichlorobenzene	---	3	18	350 - 2,000	98 J	277	440	361	---	8,500	---
2,4,5-Trichlorophenol	---	1	18	1,700 - 9,500	130 J	1260	130 J	1,660	---	100	---
2-Propanone	D	10	14	11 - 13	4 BJ	23.3	110	40.8	---	---	---
4,4'-DDD	---	4	18	18 - 190	7.5 J	31.5	72 J	42.1	---	2,900	---
4,4'-DDE	---	7	17	18 - 190	5.4 J	27.3	62 J	38.1	1.1 J	2,100	---
4,4'-DDT	---	8	18	18 - 190	9 U	51.1	330	82.5	---	2,100	---
4-Nitrophenol	---	1	18	1,700 - 9,500	61 J	1,260	61 J	1,660	---	100	---
Acenaphthene	---	3	17	350 - 2,000	99 J	240	140 J	326	---	50,000	---
Acenaphthylene	---	7	18	370 - 2,000	45 J	268	820	372	53 J	41,000	---
alpha-Chlordane	---	6	17	90 - 480	9.6 J	97.7	23 J	138	---	540	---
Anthracene	---	12	17	380 - 2,000	40 J	216	700	324	41 J	50,000	---
Benzene	---	1	18	5 - 6	2 J	2.92	2 J	3.02	---	60	---
Benzo(a)anthracene	---	17	17	N/A - N/A (8)	55 J	487	2,600	749	150 J	200 *	---
Benzo(a)pyrene	---	15	17	430 - 830	63 J	516	2,800	787	160 J	60 *	---
Benzo(b)fluoranthene	---	14	17	370 - 830	54 J	657	4,500	1,100	310 J	1,100	---
Benzo(ghi)perylene	---	9	17	370 - 2,000	51 J	257	460 J	352	98 J	50,000	---
Benzo(k)fluoranthene	---	17	18	830 - 830	45 J	376	1,100	507	400	1,100	---
Benzoic Acid	---	1	17	1,700 - 9,500	60 J	1,270	60 J	1,700	---	2,700	---
bis(2-Ethylhexyl)phthalate	---	17	18	2,000 - 2,000	55 J	3,040	41,000 E	6,970	13 J	50,000	---
Butyl benzyl phthalate	---	3	18	350 - 2,000	64 J	600	6,300 E	1.19	---	50,000	---
Chlorobenzene	---	3	18	5 - 6	1 J	15.1	220	36.1	---	1,700	---
Chloroform	D	1	18	6 - 6	1 J	2.89	1 J	3.08	---	---	---
Chrysene	---	17	17	N/A - N/A	57 J	580	3,300	912	220 J	400	---
delta-BHC	---	3	18	9 - 94	3.3 J	14.9	19 J	19.7	---	300	---
Di-n-butyl phthalate	---	10	18	350 - 2,000	43 BJ	339	1,300	499	41 BJ	8,100	---
Di-n-octyl phthalate	D	3	18	350 - 2,000	41 J	257	160 J	342	---	---	---
Dibenzo(a,h)anthracene	---	4	17	350 - 2,000	42 J	232	140 J	322	---	200 *	---
Dibenzofuran	---	3	17	350 - 2,000	18 J	237	79 J	329	---	6,200	---
Dieldrin	---	5	17	18 - 96	3.6 J	25.5	130	38.7	---	40 *	---
Endosulfan sulfate	---	3	18	18 - 190	8.2 J	27.1	27 J	36.7	0.82 J	1,000	---
Ethylbenzene	---	1	18	5 - 6	2.5 U	3.92	20	5.56	---	5,500	---
Fluoranthene	---	17	17	N/A - N/A	120 J	794	3,600	1,160	390	50,000	---
Fluorene	---	4	18	350 - 2,000	45 J	243	180 J	328	---	50,000	---
gamma-Chlordane	---	1	18	90 - 940	3.1 J	157	3.1 J	207	---	540	---
Indeno(1,2,3-c,d)pyrene	---	10	18	370 - 2,000	59 J	276	510 J	370	120 J	3,200	---
Methoxychlor	---	1	18	90 - 940	45 U	164	140	212	---	10,000	---
Methylene chloride	D	13	16	6 - 6	3 U	6.94	19 B	9.03	---	---	---
N-Nitrosodi-n-propylamine	---	1	18	350 - 2,000	175 U	284	420	366	---	---	---
Naphthalene	---	5	18	350 - 2,000	45 J	238	120 J	327	---	13,000	---
PCB-1254	---	7	18	180 - 960	90 U	361	830 J	451	---	1,000	---
PCB-1260	---	1	18	180 - 1,900	90 U	300	130 J	398	---	1,000	---
Phenanthrene	---	15	17	400 - 2,000	44 J	524	2,300	764	190 J	50,000	---
Pyrene	---	18	18	N/A - N/A	120 J	850	5,000	1,310	290 J	50,000	---
Toluene	---	5	18	6 - 6	1 J	2.61	2 J	2.90	---	1,500	---
Xylenes	---	1	18	5 - 6	2.5 U	7.14	78	14.4	---	1,200	---
Metals (mg/kg) (total)											
Aluminum	---	18	18	N/A - N/A	3,210	7,670	12,700	8,840	16,800	---	33,000
Antimony	---	1	18	8.1 - 9.6	4.05 U	4.68	9.60 B	5.19	9.1 B	30	---
Arsenic	---	18	18	N/A - N/A	1.7 B	4.14	9.2	5.06	4.4	7.5	3-12
Barium	---	18	18	N/A - N/A	31.1 B	153	845	234	76.3	300	15-600
Beryllium	---	10	18	0.12 - 0.23	0.06 U	0.178	0.45 B	0.222	0.39 B	0.14	0-1.75
Cadmium	---	2	18	0.78 - 1	0.39 U	0.510	1.2	0.593	---	1	0.1-1.0
Chromium	---	18	18	N/A - N/A	10.8	25.7	117	35.3	30.8	1	1.5-40
Cobalt	---	18	18	N/A - N/A	3.5 B	7.93	26	10.1	8.7 B	30	2.5-60
Copper	---	18	18	N/A - N/A	10.9	39.8	126	53.5	18.2	25	1-50
Iron	---	18	18	N/A - N/A	12,300	18,000	30,400	19,900	19,900	2,000	2,000-550,000
Lead	---	18	18	N/A - N/A	26.7	165	1,130	267	36.8	30	4-61
Magnesium	---	18	18	N/A - N/A	1,580	5,950	20,700	7,780	3,310	---	100-5,000
Manganese	---	18	18	N/A - N/A	159	278	549	327	479	---	50-5,000
Mercury	---	14	18	0.1 - 0.12	0.05 U	0.245	0.96	0.339	0.22	0.1	0.001-0.2
Nickel	---	18	18	N/A - N/A	10.3	46.8	477	90.9	33.3	13	0.5-25
Selenium	---	2	18	0.43 - 0.52	0.215 U	0.265	0.5 B	0.299	27.1 B	2	0.1-3.9
Thallium	---	4	18	0.43 - 0.54	0.215 U	0.306	0.63 B	0.359	0.5 B	20 (9)	---
Vanadium	---	18	18	N/A - N/A	15.5	32.2	83.2	38.3	34.4	150	1-300
Zinc	---	18	18	N/A - N/A	29.6	169	530	232	48.8	20 (10)	9-50

Notes:

Analytical Data Qualifiers as follows:

B For organics, the analyte is found in the associated blank as well as the sample. For inorganics, the reported value is less than the CRDL but greater that the Instrument Detection Limit (IDL).

J Estimated value (i.e., detected at less than the CRDL).

U Compound was analyzed but not detected; value shown is one-half the CRDL.

E For organics, the reported value exceeds calibration range. For inorganics, the reported value is estimated because of interference.

Prepared by: BL
Checked by: TGC
92C4087

Dash (---) indicates no standard or criteria available.

Shading indicates which standards, criteria, reference, or background concentrations are exceeded by the maximum detected concentration. Significance of the exceedance is discussed in text.

(1) Listed analytes are those detected in at least one soil sample collected from stations SB-113S1, SB-114S1, SB-116S1 through SB-122S1, SB-CB1S1, SB-PZ3BS1, and SB-HA through SB-HG during May through August 1992.

(2) "D" indicates chemical was deleted from further consideration because the maximum concentration in the sampl was less than ten times the maximum amount detected in the blank for common laboratory contaminants and less than five times the maximum amount detected in the blank for all other chemicals.

(3) CRDL - Contract-Required Detection Limit.

(4) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.

(5) Maximum detected concentration.

(6) UCL = Upper Confidence Level. 95% UCL = (mean + (Student t(.95,n-1) * (Standard Deviation / SQRT (N))))

(7) Soil Cleanup Objectives developed for soil organic carbon of 1%; criteria based on protection of groundwater quality except where indicated by * in which case cleanup objective based on USEPA health based criteria.

(8) N/A - CRDL not applicable.

(9) Thallium as thallium sulfate.

(10) Zinc as zinc phosphide.

Table 6-25
Unvalidated Surface Scrape Soil Data Summary For Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Number of Detections	Number of Samples	CRDL Range (2)	Minimum Value (3)	Mean	Maximum Detected Value (4)	95% UCL (5)
Organics (ug/kg)							
1,2,4-Trichlorobenzene	1	7	350 - 410	48 J	173	48 J	214
1,2-Dichlorobenzene	1	7	350 - 410	42 J	172	42 J	214
1,4-Dichlorobenzene	3	7	350 - 410	98 J	208	440	288
2,4,5-Trichlorophenol	1	7	1,700 - 2,000	130 J	811	130 J	1,035
2-Propanone	3	3	N/A - N/A(6)	9 BJ	43.3	110 B	141
4,4'-DDD	3	7	94 - 190	7.5 J	51.5	72 J	71.3
4,4'-DDE	5	7	96 - 190	5.4 J	37.5	62 J	61.4
4,4'-DDT	4	7	94 - 190	15 J	95.9	330	175
Acenaphthene	2	7	350 - 410	130 J	176	140 J	198
Acenaphthylene	5	7	390 - 400	45 J	238	820	432
alpha-Chlordane	4	7	420 - 480	9.6 J	107	22 J	191
Anthracene	4	6	390 - 400	43 J	232	700	429
Benzene	1	7	5 - 6	2 J	2.79	2 J	3.07
Benzo(a)anthracene	7	7	N/A - N/A	55 J	587	2,600	1,252
Benzo(a)pyrene	7	7	N/A - N/A	63 J	664	2,800	1,379
Benzo(b)fluoranthene	7	7	N/A - N/A	54 J	1,046	4,500	2,208
Benzo(ghi)perylene	4	6	390 - 400	51 J	144	260 J	215
Benzo(k)fluoranthene	7	7	N/A - N/A	63 J	437	1,100	732
Benzoic Acid	1	6	1,700 - 1,900	60 J	777	60 J	1,067
bis(2-Ethylhexyl)phthalate	7	7	N/A - N/A	55 J	6,061	41,000 E	17,377
Butyl benzyl phthalate	1	7	350 - 410	175 U	1,066	6,300 E	2,761
Chlorobenzene	2	7	5 - 6	1 J	33.6	220	94.0
Chloroform	1	7	6 - 6	1 J	2.71	1 J	3.27
Chromium	7	7	N/A - N/A	10.8	30.8	117	58.9
Chrysene	6	6	N/A - N/A	73 J	801	3,300	1,836
delta-BHC	2	7	42 - 94	3.3 J	23.0	19 J	32.5
Di-n-butyl phthalate	2	7	350 - 410	51 J	190	310 J	246
Di-n-octyl phthalate	2	7	350 - 410	41 J	167	160 J	210
Dibenzo(a,h)anthracene	1	7	350 - 410	140 J	184	140 J	200
Dibenzofuran	2	7	350 - 410	46 J	156	79 J	203
Dieldrin	5	7	18 - 96	3.6 J	34.1	130	67.5
Ethylbenzene	1	7	5 - 6	2.5 U	5.36	20	10.1
Fluoranthene	7	7	N/A - N/A	120 J	876	3,600	1,785
Fluorene	2	7	350 - 410	98 J	178	180 J	204
Indeno(1,2,3-c,d)pyrene	5	7	390 - 400	59 J	173	440	269
Methoxychlor	1	7	420 - 940	140	250	140	326
Methylene chloride	6	6	N/A - N/A	3 BJ	5	7 B	6.38
N-Nitrosodi-n-propylamine	1	7	350 - 410	175 U	226	420	289
Naphthalene	4	7	350 - 410	45 J	121	120 J	172
PCB-1254	2	7	180 - 960	90 U	500	830 J	680
Phenanthrene	6	7	400 - 400	52 J	536	2,300	1,124
Pyrene	7	7	N/A - N/A	120 J	1,204	5,000	2,474
Toluene	3	7	6 - 6	2 J	2.57	2 J	2.96
Xylenes (TOTAL)	1	7	5 - 6	2.5 U	13.6	78	34.5
Metals (mg/kg) (total)							
Aluminum	7	7	N/A - N/A	4,410	7,101	11,500	8,983
Antimony	1	7	8.4 - 9.6	4.2 U	5.18	9.6 B	6.6
Arsenic	7	7	N/A - N/A	2.1 B	4.00	9.2	5.95
Barium	7	7	N/A - N/A	36.8 B	193	845	406
Beryllium	5	7	0.12 - 0.12	0.06 U	0.16	0.35 B	0.233
Cobalt	7	7	N/A - N/A	4.8 B	10.4	26	15.9
Copper	7	7	N/A - N/A	12	32.3	98.2	54.0
Iron	7	7	N/A - N/A	12,300	16,700	23,500	19,751
Lead	7	7	N/A - N/A	49.8	248	1130	536
Manganese	7	7	N/A - N/A	164	269	542	364
Magnesium	7	7	N/A - N/A	1,580	7,269	20,700	11,964
Mercury	5	7	0.1 - 0.12	0.05 U	0.124	0.19	0.162
Nickel	7	7	N/A - N/A	13.2	84.1	477	211
Selenium	1	7	0.47 - 0.52	0.235 U	0.286	0.5 B	0.356
Vanadium	7	7	N/A - N/A	24.3	30.0	40.1	34.1
Zinc	7	7	N/A - N/A	41.3	163	530	289

Notes:

Analytical Data Qualifiers as follows:
B For organics, the analyte is found in the associated blank as well as the sample.
For inorganics, the reported value is less than the CRDL. but greater than the Instrument Detection Limit (IDL).
J Estimated value (i.e., detected at less than the CRDL).
U Compound was analyzed but not detected; value shown is one-half the CRDL.

(1) Listed analytes are those detected in at least one surficial soil sample.
(2) CRDL - Contract-Required Detection Limit.
(3) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.
(4) Maximum detected concentration.
(5) UCL - Upper Confidence Level. 95% UCL = (mean + (Student t(.95,n-1) * (Standard Deviation/SQRT (N))))
(6) N/A - CRDL not applicable.

Prepared by: BL
Checked by: TGC
92C4087

Table 6-26
Unvalidated Surficial Soil Boring Data Summary For Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Number of Detections	Number of Samples	CRDL Range(2)	Minimum Value (3)	Mean	Maximum Detected Value (4)	95% UCL (5)
Organics (ug/kg)							
2-Propanone	7	11	11 - 13	4 BJ	17.9	110	34.8
4,4'-DDD	1	11	18 - 94	9 U	18.8	12 J	27.3
4,4'-DDE	2	10	18 - 94	9 U	20.3	44 J	30.2
4,4'-DDT	4	11	18 - 89	9 U	22.7	100	37.8
4-Nitrophenol	1	11	1,800 - 9,500	61 J	1,469	61 J	2,139
Acenaphthene	1	10	370 - 2,000	99 J	283.9	99 J	436
Acenaphthylene	2	11	370 - 2,000	51 J	287	150 J	427
alpha-Chlordane	2	10	90 - 470	17 J	91.6	23 J	141
Anthracene	8	11	380 - 2,000	40 J	207	270 J	357
Benzo(a)anthracene	10	10	N/A - N/A(6)	56 J	417	1,000	618
Benzo(a)pyrene	8	10	430 - 830	110 J	412	930	565
Benzo(b)fluoranthene	7	10	370 - 830	110 J	384.5	790	516
Benzo(ghi)perylene	5	11	370 - 2,000	80 J	320	460 J	457
Benzo(k)fluoranthene	10	11	830 - 830	45 J	337	820	484
bis(2-Ethylhexyl)phthalate	10	11	2,000 - 2,000	73 J	1,111	6,800 B	2,176
Butyl benzyl phthalate	2	11	370 - 2,000	64 J	304	130 J	444
Chlorobenzene	1	11	6 - 6	3 U	3.27	6 J	3.77
Chrysene	11	11	N/A - N/A	57 J	459	1,100	670
delta-BHC	1	11	9 - 48	4.5 U	9.65	7.4 J	14.1
Di-n-butyl phthalate	8	11	370 - 2,000	43 BJ	433	1,300	695
Di-n-octyl phthalate	1	11	370 - 2,000	110 J	314	110 J	450
Dibenzo(a,h)anthracene	3	10	370 - 2,000	42 J	266.2	130 J	426
Dibenzofuran	1	10	370 - 2,000	18 J	293.3	18 J	450
Endosulfan sulfate	3	11	18 - 74	8.2 J	14.1	27 J	19.3
Fluoranthene	10	10	N/A - N/A	200 J	737	1,900	1,069
Fluorene	2	11	370 - 2,000	45 J	284	110 J	426
gamma-Chlordane	1	11	90 - 480	3.1 J	106	3.1 J	156
Indeno(1,2,3-c,d)pyrene	5	11	370 - 2,000	89 J	341	510 J	483
Methylene chloride	7	10	6 - 6	3 U	8.1	19 B	11.4
Naphthalene	1	11	370 - 2,000	93 J	312	93 J	449
PCB-1254	5	11	180 - 950	90 U	273	310	355
PCB-1260	1	11	180 - 940	90 U	189	130 J	274
Phenanthrene	9	10	2,000 - 2,000	44 J	516	1,200	735
Pyrene	11	11	N/A - N/A	160 J	625	1,600	882
Toluene	2	11	6 - 6	1 J	2.64	1 J	3.08
Metals (mg/kg) (total)							
Aluminum	11	11	N/A - N/A	3,210	8,032	12,700	9,715
Arsenic	11	11	N/A - N/A	1.7 B	4.23	8.8	5.36
Barium	11	11	N/A - N/A	31.1 B	128	371	191
Beryllium	5	11	0.2 - 0.23	0.1 U	0.189	0.45 B	0.252
Cadmium	2	11	0.78 - 0.93	0.39 U	0.536	1.2	0.678
Chromium	11	11	N/A - N/A	13.8	22.4	35.4	26.0
Cobalt	11	11	N/A - N/A	3.5 B	6.39	11.3	7.64
Copper	11	11	N/A - N/A	10.9	44.5	126	64.3
Iron	11	11	N/A - N/A	14,100	18,836	30,400	21,580
Lead	11	11	N/A - N/A	26.7	112	287	155
Magnesium	11	11	N/A - N/A	2,380	5,115	10,700	6,597
Manganese	11	11	N/A - N/A	159	284	549	348
Mercury	9	11	0.1 - 0.11	0.05 U	0.321	0.96	0.467
Nickel	11	11	N/A - N/A	10.3	23.0	37.1	27.7
Selenium	1	11	0.43 - 0.49	0.215 U	0.252	0.48 B	0.294
Thallium	4	11	0.43 - 0.49	0.215 U	0.337	0.63 B	0.424
Vanadium	11	11	N/A - N/A	15.5	33.6	83.2	43.9
Zinc	11	11	N/A - N/A	29.6	172	500	255

Notes:

B for organics, the analyte is found in the associated blank as well as the sample. For inorganics, the reported value is less than the CRDL but greater that the Instrument Detection Limit (IDL).
J Estimated values (i.e., detected at less than the CRDL).
U Compound was analyzed but not detected; value shown is one-half the CRDL.

(1) Listed analytes are those detected in at least one soil boring sample.
(2) CRDL - Contract-Required Detection Limit.
(3) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.
(4) Maximum detected concentration.
(5) UCL = Upper Confidence Level. 95% UCL = (mean + (Student t(.95,n-1) * (Standard Deviation / SQRT (N))))
(6) N/A - CRDL not applicable.

Prepared by: BL
Checked by: TGC
92C4087

Table 6-27
Unvalidated Groundwater Data And Comparisons for Monitoring Well 125 (MW-125)
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Present in Blanks (2)	Results	NYDEC WQ&G Saline Surface Water Class SB (3)	Fed WQC Marine Aquatic Life (4) (total recoverable)	
				Acute	Chronic
Organics (ug/l)					
2-Propanone	D	8 J	---	---	---
Chlorobenzene	---	3 J	5 (5)	---	---
Methylene chloride	D	1 BJ	---	---	---
Metals (ug/l) (total)					
Aluminum	---	3,930	---	---	---
Antimony	---	55.5 B	---	1500 (6)	500
Arsenic	---	7 B	63 (DS)	---	---
Barium	---	112 B	---	---	---
Cadmium	---	5.2	7.7 (AS)	43	9.3
Chromium	---	26.6	---	11,400 (7)	---
Cobalt	D	23.3 B	---	---	---
Copper	D	16.2 B	2.9 (DS)	2.9	---
Iron	---	24,200	---	---	---
Lead	D	6.1	8.6 (AS)	220	8.5
Magnesium	---	250,000	---	---	---
Manganese	---	1,040	---	---	---
Nickel	---	304	7.1 (AS)	75	8.3
Silver	D	7.1 B	---	2.3	0.92 (6)
Vanadium	---	11.9 B	---	---	---
Zinc	D	20.6	58 (AS)	95	86

Prepared by: BL
Checked by: TGC
92C4087

Notes:

B For organics, the analyte is found in the associated blank as well as the sample. For inorganics, the reported value is less than the CRDL but greater than the Instrument Detection Limit (IDL).
J Estimated value (i.e. detected at less than the CRDL).

Dash (---) indicates no standard or criteria available.
Shading indicates which standards and criteria are exceeded by the maximum detected concentration. Significance of the exceedance is discussed in text
DS = Dissolved
AS = Acid Soluble

(1) Listed analytes are those detected in groundwater sample MW-125 on July 30, 1992.
(2) "D" indicates chemical was deleted from further consideration because the maximum concentration in the sample was less than ten times the maximum amount detected in the blank for common laboratory contaminants and less than five times the maximum amount detected in the blank for all other chemicals.
(3) NYSDEC WQS&G - New York State Department of Environmental Conservation Water Quality Standards and Guidance values (NYSDEC September 1990; Standards updated as of August 1991).
(4) EPA Water Quality Criteria (1986); non-enforceable guidance numbers.
(5) Guidance value, standard not available.
(6) Proposed value.
(7) Criteria for chromium III and VI.

Table 6-28
Unvalidated Surface Water Data Summary and Comparisons for Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Present in Blanks (2)	Number of Detections	Number of Samples	CRDL Range (3)	Minimum Value (4)	Mean	Maximum Detected Value (5)	95% UCL (6)	NYSDEC WQ&G Saline Surface Water Class SB (7)	Federal WQC Marine Aquatic Life (8) (total recoverable)	
										Acute	Chronic
Organics (ug/l)											
alpha-BHC	D	6	16	0.05 - 0.05	0.0066 J	0.021	0.034 J	0.024	---	0.34 (9)	---
Ammonia Nitrogen	---	10	16	0.03 - 0.03	0.015	0.089	0.29	0.127	---	1.6 (10)	0.24 (10)
bis(2-ethylhexyl)phthalate	---	1	16	10 - 10	4 J	4.94	4 J	5.05	---	---	---
delta-BHC	D	3	16	0.05 - 0.05	0.0062 J	0.022	0.011 J	0.025	---	0.34 (9)	---
Di-n-butyl phthalate	D	8	16	10 - 10	2 J	3.75	3 J	4.34	---	2,944 (11)	3.4 (11)
Endosulfan sulfate	D	8	16	0.1 - 0.1	0.026 BJ	0.074	0.27	0.101	---	---	---
Methylene chloride	D	14	16	5 - 5	2 BJ	2.19	3 BJ	2.35	---	---	---
Metals (ug/l) (total)											
Aluminum	---	3	16	148 - 148	74 U	151	580	227	---	---	---
Barium	---	16	16	N/A - N/A (12)	9 B	14	17 B	14.9	---	---	---
Copper	D	15	16	4.8 - 4.8	2.4 U	8.21	16.6 B	9.80	2.9 (DS)	2.9	---
Iron	---	16	16	N/A - N/A	117	293	1,140	405	---	---	---
Lead	---	11	16	1.1 - 5.5	0.55 U	6.82	53.1	12.4	8.6 (AS)	220	8.5
Magnesium	---	16	16	N/A - N/A	808,000	952,000	1,070,000	983,100	---	---	---
Manganese	---	16	16	N/A - N/A	102	114	130	118	---	---	---
Mercury	---	4	16	0.2 - 0.4	0.1 U	1.08	9.5	2.25	0.1 (13)	2.1	0.025
Nickel	---	3	16	10.2 - 10.2	5.1 U	6.56	15.7 B	8.00	7.1 (AS)	75	8.3
Silver	---	3	16	2.9 - 2.9	1.45 U	1.96	4.2 B	2.44	---	2.3	0.92 (14)
Thallium	---	1	16	2.2 - 11	1.1 U	5.19	13.8 B	6.46	---	2,130 (15)	---
Vanadium	---	1	16	4 - 4	2 U	2.20	5.2 B	2.55	---	---	---
Zinc	D	16	16	N/A - N/A	4.9 B	9.30	15 B	10.5	58 (AS)	95	86

Notes:

B For organics, the analyte is found in the associated blank as well as the sample. For inorganics, the reported value is less than the CRDL but greater than the Instrument Detection Limit (IDL).
J Estimated value (i.e. detected at less than the CRDL).
U Compound was analyzed but not detected; value shown is one-half the CRDL.

Dash (---) indicates no standard or criteria available.
Shading indicates which standards and criteria are exceeded by the reasonable maximum exposure (RME) concentration. Significance of the exceedance is discussed in text.
DS = Dissolved
AS = Acid Soluble

Prepared by: BL
Checked by: TGC
92C4087

(1) Listed analytes are those detected in at least one surface water sample collected from stations SW-1 through SW-8 on July 27 - 30, 1992.
(2) "D" indicates chemical was deleted from further consideration because the maximum concentration in the sample was less than ten times the maximum amount detected in the blank for common laboratory contaminants and less than five time the maximum amount detected inthe blank for all other chemicals.
(3) CRDL - Contract-Required Detection Limit.
(4) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.
(5) Maximum detected concentration.
(6) UCL = Upper Confidence Level. 95% UCL = (mean + (Student t(.95, n-1) * (Standard Deviation/SQRT (N))))
(7) NYSDEC WQS&G - New York State Department of Environmental Conservation Water Quality Standards and Guidance values (NYSDEC September 1990; Standards updated as of August 1991).
(8) EPA Water Quality Criteria (1986); non-enforceable guidance numbers.
(9) LOEL - Lowest Observed Effect Level - for BHC.
(10) Criteria for ammonia nitrogen are based on 25 C, 8.5pH and 10 ppt salinity.
(11) LOEL - Lowest Observed Effect Level - for phthalate esters.
(12) N/A - CRDL not applicable.
(13) Guidance value, standard not available.
(14) Proposed value.
(15) LOEL - Lowest Observed Effect Level.

Table 6-29
Unvalidated Sediment Data Summary and Comparisons for Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Present in Blanks (2)	Number of Detections	Number of Samples	CRDL Range (3)	Minimum Value (4)	Mean	Maximum Detected Value (5)	95% UCL (6)	NYSDEC Sediment Cleanup Criteria (7)	EPA Sediment Quality Criteria (8)	NOAA Overall AETs (9)	Washington Marine Sediment Quality Standards (10)
Organics (ug/kg)												
2-Methylnaphthalene	---	1	60	340 2,400	140 J	678	140 J	752	---	---	300	800
2-Propanone	D	24	30	10 33	5 U	38.4	120 B	46.6	---	---	---(12)	---
4,4'-DDD	---	4	30	17 530	8.5 U	112	250 J	133	17 (11)	---	--- (12)	---
4,4'-DDE	---	10	30	17 530	8.5 U	93.8	150 J	110	1,050	---	--- (12)	---
4,4'-DDT	---	1	30	17 530	8.5 U	119	70 J	142	21	---	6	---
Acenaphthene	---	5	60	340 2,400	130 J	652	490 J	729	---	5,040	150	340
Acenaphthylene	---	16	60	340 2,400	85 J	597	430 J	679	---	---	---	1,390
Anthracene	---	29	60	340 2,200	47 J	473	1,300 J	545	---	---	300	4,620
Benzo(a)anthracene	---	58	60	370 2,200	37 J	713	4,000	848	---	---	550	2,310
Benzo(a)pyrene	---	57	60	350 370	36 J	705	2,900	815	---	---	700	2,080
Benzo(b)fluoranthene	---	57	60	350 2,400	35 J	787	4,300	941	---	---	---	---
Benzo(ghi)perylene	---	47	60	340 2,400	37 J	389	980 J	441	---	---	---	650
Benzo(k)fluoranthene	---	57	60	350 2,400	42 J	718	4,000	854	---	---	---	---
bis(2-ethylhexyl)phthalate	---	56	60	350 370	38 J	2,510	12,000	3,120	---	---	---	990
Butyl benzyl phthalate	---	7	60	340 2,400	79 J	620	440 J	696	---	---	---	100
Chrysene	---	60	60	N/A N/A (13	50 J	865	4,400	1,020	---	---	900	2,310
delta-BHC	---	20	30	8.3 130	4.15 U	112	410	147	---	---	---	---
Di-n-butyl phthalate	---	41	60	340 2,200	39 JB	401	850 J	480	---	---	---	4,620
Di-n-octyl phthalate	---	5	60	340 2,400	130 J	635	280 J	711	---	---	---	1,220
Dibenzo(a,h)anthracene	---	6	60	340 2,400	110 J	653	200 J	732	---	---	100	250
Dibenzofuran	---	2	60	340 2,400	140 J	666	300 J	740	---	---	---	320
Dieldrin	---	5	30	17 530	8.5 U	110	66 J	134	121	357	--- (12)	---
Endosulfan sulfate	---	8	30	17 530	8.5 U	107	180 J	133	---	---	---	---
Fluoranthene	---	60	60	N/A N/A	69 J	855	4,900	1,020	---	28,100	1,000	3,360
Fluorene	---	7	60	340 2,400	36 J	641	580 J	718	---	---	350	480
Indeno(1,2,3-c,d)pyrene	---	49	60	340 2,100	36 J	407	920 J	463	---	---	---	710
Methylene chloride	D	30	30	N/A N/A	3 J	35.6	180 B	47.2	---	---	---	---
Naphthalene	---	2	60	340 2,400	160 J	672	200 J	746	---	---	500	2,080
Phenanthrene	---	55	60	340 370	53 J	516	4,700	661	2,140	3,400	260	2,100
Pyrene	---	60	60	N/A N/A	63 J	1,540	9,300	1,860	---	---	1,000	21,000
Toluene	---	5	30	5 17	2 BJ	6.45	9 BJ	7.16	---	---	---	---

Table 6-29
Unvalidated Sediment Data Summary and Comparisons for Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Present in Blanks (2)	Number of Detections	Number of Samples	CRDL Range (3)	Minimum Value (4)	Mean	Maximum Detected Value (5)	95% UCL (6)	NYSDEC Sediment Cleanup Criteria (7)		EPA Sediment Quality Criteria (8)	NOAA Overall AETs (9)	Washington Marine Sediment Quality Standards (10)
									Lowest (14)	Severe (15)			
Metals (mg/kg)													
Aluminum	---	30	30	N/A N/A	1,500	14,300	20,700	16,400	---	---	---	---	---
Arsenic	---	29	30	0.51 0.51	0.255 U	8.88	16.4	10.3	6	33	---	50	57
Barium	---	30	30	N/A N/A	8.3 B	87.7	149	99.9	---	---	---	---	---
Beryllium	---	22	30	0.11 0.18	0.055 U	0.531	0.96 B	0.630	---	---	---	---	---
Cadmium	---	7	30	0.82 2.9	0.41 U	1.42	4.6	1.71	0.6	10	---	5	5.1
Chromium	---	30	30	N/A N/A	3	77.0	129	90.0	26	110	---	--- (12)	260
Cobalt	---	28	30	1.3 1.5	0.65 U	9.04	14.2 B	10.3	---	---	---	---	---
Copper	---	30	30	N/A N/A	7.6	140	220	162	16	110	---	300	390
Iron (%)	---	30	30	N/A N/A	0.348	2.91	4.1	3.31	2	4	---	---	---
Lead	---	30	30	N/A N/A	12.1	148	263	172	31	250	---	300	450
Magnesium	---	30	30	N/A N/A	1,010	8,730	12,100	9,940	---	---	---	---	---
Manganese	---	30	30	N/A N/A	37.9	353	513	403	460	1,100	---	---	---
Mercury	---	24	30	0.09 0.34	0.045 U	0.814	2.2	0.998	0.2	2	---	1	0.41
Nickel	---	30	30	N/A N/A	9.1	32.2	47.1	35.9	16	75	---	--- (12)	---
Selenium	---	3	30	0.42 1.4	0.21 U	0.591	1.9 B	0.702	---	---	---	---	---
Silver	---	22	30	0.53 1.9	0.265 U	2.30	5.9	2.80	---	---	---	1.7	6.1
Thallium	---	7	30	0.44 1.4	0.22 U	0.731	2.1 B	0.882	---	---	---	---	---
Vanadium	---	30	30	N/A N/A	6 B	41.7	59.4	47.6	---	---	---	---	---
Zinc	---	30	30	N/A N/A	19.1	246	438	283	120	820	---	260	410

Notes:

B For organics, the analyte is found in the associated blank as well as the sample. For inorganics, the reported value is less than the CRDL but greater than the Instrument Detection Limit (IDL).
J Estimated value (i.e., detected at less than the CRDL).
U Compound was analyzed but not detected; value shown is one-half the CRDL.

Prepared by: BL
Checked by: TGC
92C4087

Dash (---) indicates no standard or criteria available.
Shading indicates which standards and criteria are exceeded by the maximum detected concentration. Significance of the exceedance is discussed in text.

(1) Listed analytes are those detected in at least one sediment sample collected from stations SD-1 through SD-8 and SD-10 through SD-12 on August 6 through 12, 1992.
(2) "D" indicates chemical was deleted from further consideration because the maximum concentration in the sample was less than ten times the maximum amount detected in the blank for common laboratory contaminants and less than five times the maximum amount detected in the blank for all other chemicals.
(3) CRDL - Contract-Required Detection Limit.
(4) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.
(5) Maximum detected concentration.
(6) UCL - Upper Confidence Level. 95% UCL = (mean + (Student t(.95,n-1) * (Standard Deviation/SQRT (N))))
(7) New York State Department of Environmental Conservation, Clean-Up Criteria for Aquatic Sediments, December 1989. Revised draft 1992; sediment guidelines for metals from Persaud et al., 1992. Criteria listed are for bulk sediment with 2.1% total organic carbon (TOC) based on median Pelham Bay site TOC.
(8) U.S. Environmental Protection Agency, Proposed Sediment Quality Criteria for Organics to Protect Benthic Invertebrates, November, 1991. Criteria listed are for bulk sediments with 2.1% total organic carbon (TOC) based on median Pelham Bay site TOC.
(9) National Oceanic and Atmospheric Administration, Overall Apparent Effects Thresholds (AETs). The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the national Status and Trends Program. March 1990. Sediment organic carbon content not specified.
(10) Washington Marine Sediment Quality Standards, promulgated in 1991 under the State of Washington Administration Code, Chapter 173-204, Sediment Management Standards. These standards correspond to sediment quality that will result in no acute or chronic adverse effects on biota. Sediment organic carbon content not specified.
(11) Wildlife residue basis.
(12) Insufficient data available to determine overall AET.
(13) N/A - CRDL not applicable.
(14) Lowest refers to the lowest effect level, i.e. the concentration that will impair sediment use by some benthic organisms but will be tolerated by most organisms.
(15) Severe refers to the severe effect level, i.e. the concentration that will significantly impair sediment use by benthic organisms.

Table 6-30
Unvalidated Groundwater/Leachate Data Summary and Comparisons for Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Present in Blanks (2)	Number of Detections	Number of Samples	CRDL Range (3)	Minimum Value (4)	Mean	Maximum Detected Value (5)	95% UCL (6)	NYDEC WQ&G Saline Surface Water Class SB (7)	Fed WQC Marine Aquatic Life (8) (total recoverable) Acute	Fed WQC Marine Aquatic Life (8) (total recoverable) Chronic
Organics (ug/l)											
1,2-Dichlorobenzene	---	1	22	10 - 10	5 U	5	5 J	5	5 (9)	1,970 (10)	---
1,2-Dichloroethylene	---	2	22	5 - 5	1 J	2.36	1 J	2.53	---	24,000 (11	---
1,3-Dichlorobenzene	---	1	22	10 - 10	5 U	5	5 J	5	5 (9)	1,970 (10)	---
1,4-Dichlorobenzene	---	3	22	10 - 10	4 J	5.09	9 J	5.43	5 (9)	1,970 (10)	---
2,4-Dimethylphenol	---	5	22	10 - 10	5 U	13.1	73	20.8	---	---	---
2-Butanone	---	1	22	10 - 10	5 U	7.59	62	12.0	---	---	---
2-Methylnaphthalene	---	4	22	10 - 10	4 J	6.18	33	8.38	---	---	---
2-Methylphenol	---	1	22	10 - 10	5 U	7.09	51	10.7	---	---	---
2-Propanone	---	5	22	10 - 10	5 U	12.0	120	21.0	---	---	---
3-Nitroaniline	---	1	22	50 - 50	4 J	24.0	4 J	25.7	---	---	---
4,4'-DDD	---	6	22	0.1 - 0.1	0.011 J	0.041	0.037 J	0.047	0.001		---
4,4'-DDE	---	7	22	0.1 - 0.1	0.013 J	0.045	0.078 J	0.051	0.001	14 (12)	---
4-Methylphenol	---	2	22	10 - 10	4 J	5.09	8 J	5.34	---	---	---
Acenaphthene	---	8	22	10 - 10	2 J	5.64	18	6.87	---	970	710
alpha-BHC	---	2	22	0.05 - 0.051	0.0093 J	0.0277	0.1	0.0338	---	0.34 (13)	---
alpha-Chlordane	---	1	22	0.5 - 0.51	0.056 J	0.241	0.056 J	0.257	---	0.09 (14)	0.004 (14)
Ammonia Nitrogen	---	21	21	N/A - N/A (15)	3	178	637	249	---	1.6 (16)	0.24 (16)
Anthracene	---	4	22	10 - 10	2 J	5.05	8 J	5.49	---	---	---
Benzene	---	11	22	5 - 5	1 J	2.61	4 J	2.92	6	5100 (12)	700 (12)
Benzo(a)anthracene	---	1	22	10 - 10	2 J	4.86	2 J	5.10	---	---	---
bis(2-chloroethoxy)methane	---	1	22	10 - 10	5 U	5.32	12	5.87	---	---	---
bis(2-chloroisopropyl)ether	---	2	22	10 - 10	3 J	4.86	4 J	5.04	---	---	---
bis(2-ethylhexyl)phthalate	---	6	22	10 - 10	3 J	5.64	13	6.53	---	---	---
Carbon Disulfide	---	3	22	5 - 5	1 J	2.39	3 J	2.56	---	---	---
Chlorobenzene	---	15	22	5 - 5	1 J	7.25	25	9.66	5 (9)	---	---
Chloroform	D	1	22	5 - 5	2 J	2.48	2 J	2.52	---	---	---
Cyanide	---	4	22	10 - 12	5.0 U	18.9	267.0	39.3	1 (17)	1	---
delta-BHC	---	6	22	0.05 - 0.05	0.0099 J	0.0251	0.068	0.0291	---	0.34 (13)	---
Di-n-butyl phthalate	---	9	22	10 - 10	2 J	4.09	4 BJ	4.53	---	---	---
Di-n-octyl phthalate	---	1	22	10 - 10	2 J	4.86	2 J	5.10	---	---	---
Dibenzofuran	---	3	22	10 - 10	3 J	5.41	12	6.06	---	---	---
Dieldrin	---	11	22	0.1 - 0.1	0.0063 J	0.1124	0.64	0.1706	0.001(9,18)	0.71	0.0019
Endosulfan II	---	3	22	0.1 - 0.1	0.05 U	0.209	2.1	0.401	0.001 (19)	0.034 (19)	0.0087 (19)
Endosulfan sulfate	D	5	22	0.1 - 0.1	0.028 BJ	0.048	0.051 BJ	0.050	---	---	---
Endrin	---	3	22	0.1 - 0.1	0.023 J	0.048	0.062 J	0.051	0.002	0.037	0.0023
Ethylbenzene	---	9	22	5 - 5	1 J	3.61	15	4.69	---	430 (12)	---
Fluoranthene	---	3	22	10 - 10	2 J	5	10	5.49	---	40 (12)	16 (12)
Fluorene	---	5	22	10 - 10	2 J	5.45	15	6.47	---	---	---
Methoxychlor	---	4	22	0.5 - 0.51	0.15 J	0.272	0.65	0.307	0.03	---	0.03
Methylene chloride	D	19	22	5 - 5	1 BJ	4.89	19 B	6.69	---	---	---
Naphthalene	---	7	22	10 - 10	2 J	13.7	140	24.5	---	2,350 (12)	---
PCB-1016	---	1	22	0.5 - 0.51	0.25 U	0.277	0.84	0.323	0.001	10 (20)	0.03 (20)
PCB-1260	---	1	22	1 - 1	0.5 U	0.52	1	0.56	0.001	10 (20)	0.03 (20)
Phenanthrene	---	4	22	10 - 10	3 J	7.09	35	9.83	---	7.7 (21)	4.6 (21)
Phenolics, Total	---	2	7	0.1 - 0.1	0.05 U	0.067	0.12	0.089	---	---	---
Pyrene	---	3	22	10 - 10	2 J	5	9 J	5.41	---	---	---
Toluene	---	5	22	5 - 5	1 J	6.70	81	12.8	---	6,300 (12)	5,000 (12)
Xylenes	---	4	22	5 - 5	2.5 U	5.95	65	10.8	---	---	---
Metals (ug/l) (total)	---								---	---	---
Aluminum	---	19	22	148 - 148	74 U	5,640	65,800	10,845	---	---	---
Antimony	---	2	22	43.5 - 43.5	21.75 U	25.5	70.3	30.1	---	1,500 (21)	500 (21)
Arsenic	---	18	22	1.1 - 11	0.55 U	12.8	89.1	19.9	63 (DS)	---	---
Barium	---	22	22	N/A - N/A	58 B	559	1,490	707	---	---	---
Beryllium	D	1	22	0.6 - 0.6	0.3 U	0.33	1 B	0.39	---	---	---
Boron	---	7	7	N/A - N/A	1,570	4,886	8,900	6,892	1000 (AS)	---	---
Cadmium	---	3	22	4.6 - 4.6	2.3 U	2.99	9.6	3.67	7.7 (AS)	43	9.3
Chromium	---	19	22	7.3 - 7.3	3.65 U	108	390	155	---	11,400 (22)	---
Chromium, Hexavalent	---	6	7	0.01 - 0.01	0.005 U	0.178	0.56	0.342	54 (AS)	1,100	50

Table 6-30
Unvalidated Groundwater/Leachate Data Summary and Comparisons for Ecological Hazard Evaluation
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Present in Blanks (2)	Number of Detections	Number of Samples	CRDL Range (3)	Minimum Value (4)	Mean	Maximum Detected Value (5)	95% UCL (6)	NYDEC WQ&G Saline Surface Water Class SB (7)	Fed WQC Marine Aquatic Life (8) (total recoverable) Acute	Fed WQC Marine Aquatic Life (8) (total recoverable) Chronic
Cobalt	---	19	22	7.4 - 7.4	3.7 U	29.6	78.7	37.4	---	---	---
Copper	---	22	22	N/A - N/A	6.1 B	133	977	221	2.9 (DS)	2.9	---
Iron %	---	22	22	N/A - N/A	0.1	2.0	13.6	3.1	---	---	---
Lead	---	21	22	1.1 - 1.1	0.55 U	63.8	707	118	8.6 (AS)	220	8.5
Magnesium	---	22	22	N/A - N/A	43,700	333,000	921,000	444,000	---	---	---
Manganese	---	22	22	N/A - N/A	75.8	1,970	10,100	3,071	---	---	---
Mercury	---	5	22	0.2 - 0.4	0.1 U	0.479	5	0.885	0.1 (9)	2.1	0.025
Nickel	---	18	22	10.2 - 10.2	5.1 U	127	483	179	7.1 (AS)	75	8.3
Selenium	---	1	22	2.2 - 22	1.1 U	8.45	13.6 B	9.78	---	300	71
Silver	D	6	22	2.9 - 2.9	1.45 U	2.84	12.1	3.89	---	2.3	0.92 (21)
Thallium	---	3	22	2.2 - 11	1.1 U	2.25	13.5 B	3.29	---	2,130 (12)	---
Vanadium	---	21	22	4 - 4	2 U	215	989	330	---	---	---
Zinc	---	22	22	N/A - N/A	8.5 B	132	1,330	232	58 (AS)	95	86

Notes:

B For organics, the analyte is found in the associated blank as well as the sample. For inorganics, the reported value is less than the CRDL but greater than the Instrument Detection Limit (IDL).
J Estimated value (e.g. detected at less than the CRDL).
U Compound was analyzed but not detected; value shown is one-half the CRDL.

Prepared by: BL
Checked by: TGC
92C4087

Dash (---) indicates no standard or criteria available.
Shading indicates which standards and criteria are exceeded by the reasonable maximum exposure (RME) concentration. Significance of the exceedance is discussed in text.
DS = Dissolved
AS = Acid Soluble

(1) Listed analytes are those detected in at least one leachate or groundwater sample collected from stations LS-1 through LS-5, LS-7, LS-9, and LS-10 for leachate and MW-103 through MW106, MW-109, MW-111 through MW-115, and MW-118 through MW-122 for groundwater on July 28 through August 5, 1992.
(2) "D" indicates chemcial was deleted from further consideration because the maximum concentration in the sample was less than ten times the maximum amount detected in the blank for common laboratory contaminants and less than five times the maximum amount detected in the blank for all other chemicals.
(3) CRDL - Contract-Required Detection Limit.
(4) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.
(5) Maximum detected concentration.
(6) UCL = Upper Confidence Level. 95% UCL = (mean ÷ (Student t(.95,n-1) * (Standard Deviation / SQRT (N))))
(7) NYSDEC WQS&G - New York State Department of Environmental Conservation Water Quality Standards and Guidance values (NYSDEC September 1990; Standards updated as of August 1991).
(8) EPA Water Quality Criteria (1986); non-enforceable guidance numbers; also EPA Water Quality Criteria for Ammonia (Saltwater) - 1989.
(9) Guidance value, standard not available.
(10) LOEL - Lowest Observed Effect Level - for dichlorobenzenes.
(11) LOEL - Lowest Observed Effect Level - for dichloroethylenes. Proposed criteria.
(12) LOEL - Lowest Observed Effect Level.
(13) LOEL - Lowest Observed Effect Level - for BHC.
(14) Criteria for chlordane.
(15) N/A - CRDL not applicable.
(16) Criteria for amoonia nitrogen (total) are 25 C, 8.5 pH and 10 ppt salinity.
(17) Free cyanide (HCN = CH) expressed as CN.
(18) Standard for aldrin and dieldrin; human health (bioaccumulation) based.
(19) Criteria for endosulfan.
(20) Standard for total polychlorinated biphenyls (PCBs).
(21) Proposed criteria.
(22) Criteria for chromium III and VI.

Table 6-31
Unvalidated Surface Water Data Summary
For Refrerence Station (SW-9)
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Number of Detections	Number of Samples	CRDL Range (2)	Minimum Value (3)	Mean	Maximum Detected Value (4)
Organics (ug/l)						
Ammonia Nitrogen	2	2	N/A - N/A	0.05	0.08	0.12
delta-BHC	1	2	0.05 - 0.05	0.0079 J	N/A (5)	0.0079 J
Methylene chloride	1	2	5 - 5	2 BJ	N/A	2 BJ
Metals (ug/l) (total)						
Barium	2	2	N/A - N/A	11 B	12	13 B
Copper	2	2	N/A - N/A	7.6 B	10.2	12.8 B
Iron	2	2	N/A - N/A	93 B	95	97 B
Lead	1	2	1.1 - 1.1	0.55 U	N/A	1.9 B
Magnesium	2	2	N/A - N/A	945,000	963,000	981,000
Manganese	2	2	N/A - N/A	107	107.5	108
Silver	1	2	2.9 - 2.9	1.45 U	N/A	4.2 B
Zinc	2	2	N/A - N/A	3.4 B	5.85	8.3 B

Notes:

(1) Listed analytes are those detected at least once (high and/or low tide) from from the surface water reference station SW-9 collected on July 30,1992.

(2) CRDL - Contract Required Detection Limit.

(3) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.

(4) Maximum detected concentration.

(5) N/A - Mean or CRDL not applicable.

Prepared by: BL
Checked by: TGC
92C4087

Table 6-32
Unvalidated Sediment Data Summary
For Refreference Station (SD-9)
Pelham Bay Landfill
Bronx, New York

Analyte (1)	No. Detects	No. Samples	CRDL Range (2)	Minimum Value (3)	Mean	Maximum Detected Value (4)
Organic Analytes (ug/kg)						
2-Propanone	2	3	33 - 33	16.5 U	76.8	120 B
Acenaphthylene	6	6	N/A - N/A	130 J	217	280 J
Anthracene	5	6	1200 - 1200	130 J	252	260 J
Benzo(a)anthracene	6	6	N/A - N/A	340 J	622	870
Benzo(a)pyrene	6	6	N/A - N/A	170 J	508	930
Benzo(b)fluoranthene	5	6	1000 - 1000	310 J	652	1,000 J
Benzo(ghi)perylene	6	6	N/A - N/A	170 J	353	570
Benzo(k)fluoranthene	5	6	1000 - 1000	410 J	553	770
bis(2-Ethylhexyl)phthalate	6	6	N/A - N/A	1,300	1,817	2,500
Butyl benzyl phthalate	1	6	1000 - 1200	130 J	488	130 J
Chrysene	6	6	N/A - N/A	650 J	830	1,000 J
Fluoranthene	6	6	N/A - N/A	370 J	735	1,100
Indeno(1,2,3-c,d)pyrene	6	6	N/A - N/A	240 J	397	650
Phenanthrene	6	6	N/A - N/A	260 J	500	1,200
Pyrene	6	6	N/A - N/A	830 J	1,162	1,500
Metals (ug/l) Total						
Aluminum	3	3	N/A - N/A	16,300	18,167	20,500
Arsenic	3	3	N/A - N/A	11.3	12.2	13
Barium	3	3	N/A - N/A	87.6 B	94.7	106 B
Beryllium	3	3	N/A - N/A	0.59 B	0.68	0.8 B
Cadmium	2	3	2.5 - 2.5	1.25 U	2.78	4.3
Chromium	3	3	N/A - N/A	118	126	141
Cobalt	3	3	N/A - N/A	7.3 B	10.9	13.8 B
Copper	3	3	N/A - N/A	168	179	197
Iron	3	3	N/A - N/A	34,600	35,700	37,000
Lead	3	3	N/A - N/A	157	179.333	191
Magnesium	3	3	N/A - N/A	11,500	11,570	11,600
Manganese	3	3	N/A - N/A	568	586	610
Nickel	3	3	N/A - N/A	43.7	46.7	50
Silver	3	3	N/A - N/A	5.5 B	5.73	5.9
Thallium	1	3	1.4 - 1.6	0.7 U	1.03	1.6 B
Vanadium	3	3	N/A - N/A	45.1	47.8	52.8
Zinc	3	3	N/A - N/A	262	279	304

Notes:

(1) Listed analytes are those detected at least once in sediment samples collected from the sediment reference station SD-9

(2) CRDL - Contract Required Detection Limit.

(3) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.

(4) Maximum detected concentration.

(5) N/A - Mean or CRDL not applicable.

Prepared by: BL
Checked by: TGC
92C4087

Table 6-33
Background Concentrations In Western Long Island Sound Sediments
Pelham Bay Landfill
Bronx, New York

Station : Source: Analyte	E5 (1) Battelle (1992b)	E7 (2) Battelle (1992b)	WLIS (3) NOAA (1991) Mean/Max	E8 (4) City of New York DEP (1987 & 1991) Mean/Max	E9 (5) City of New York DEP (1987 & 1991) Mean/Max	E12 (6) City of New York DEP (1987 & 1991) Mean/Max	2000W (7) SAIC (1991) Mean/Max	WLIS-REF (8) SAIC (1991) Mean/Max	Weighted Average
Organic Analytes (ug/kg)									
Acenaphthene	—	—	53/100	—	—	—	11/15	24/37	37
Anthracene	—	—	340/600	—	—	—	49/60	124/170	223
Benzo(a)anthracene	—	—	933/1300	—	—	—	147/150	307/430	607
Benzo(a)pyrene	—	—	1101/1600	—	—	—	150/150	313/470	700
Benzo(b)fluoranthene	—	—	790	—	—	—	150/180	246/370	283
Benzo(k)fluoranthene	—	—	590	—	—	—	150/180	243/360	253
bis(2-ethylhexyl)phthalate	—	—	—	—	—	—	—	—	—
Butyl benzyl phthalate	—	—	—	—	—	—	—	—	—
Chrysene	—	—	1237/1900	—	—	—	193/200	343/480	790
DDD	—	—	39/62	—	—	—	—	—	39
DDT	—	—	5.8/22	—	—	—	—	—	5.8
delta-BHC	—	—	1.1/4	—	—	—	—	—	1.1
Dibenzo(a,h)anthracene	—	—	128/240	—	—	—	7/15	6/13	72
Endosulfan Sulfate	—	—	—	—	—	—	—	—	—
Fluoranthene	—	—	1547/2700	—	—	—	213/270	427/650	981
Fluorene	—	—	102/150	—	—	—	23/30	43/62	70
Phenanthrene	—	—	727/1200	—	—	—	160/180	283/390	494
Pyrene	—	—	1779/3100	—	—	—	477/520	747/1,050	1240
Toluene	—	—	—	—	—	—	—	—	—
Inorganic Analytes (mg/kg)									
Barium	—	—	—	—	—	—	—	—	—
Mercury	0.46	0.43	0.91/1.30	0.95/1.60	0.49/0.79	0.89/1.10	—	—	0.79
Selenium	—	—	0.60/0.80	—	—	—	—	—	0.60
Zinc	1.99	14.6	220/300	184.6/250	324.5/617	239.5/265	150/179	123/140	193

Notes:

— Indicates the analyte was not included for analysis.

(1) Station E5 - Western end of Long Island Sound, near Throgs Neck Bridge; results from one sample collected February 1992. Battelle 1992b.

(2) Station E7 - West-central Long Island Sound, north of Hempsted Harbor; results from one sample collected February 1992. Battelle 1992b.

(3) WLIS - Western Long Island Sound, from Throgs Neck to near Stamford, CT; 7 samples collected in 1986 - 1989 except for benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(g,h,i)pyrene which were only one sample collected in 1989. NOAA 1991.

(4) Station E8 - Throgs Neck Bridge midway between the two forts at the narrowest point; result from one sample collected in 1987, 1988 and 1989. City of New York DEP 1987 & 1991.

(5) Station E9 - Western Long Island Sound, one-half mile north of Stepping Stones Lighthouse; one sample collected in 1987, 1988 and 1989. City of New York DEP 1987 & 1991.

(6) Station E12 - Western Long Island Sound, in Eastchester Bay Channel; one sample collected in 1987, 1988 and 1989. City of New York DEP 1987 & 1991.

(7) Station 2000W - Western Long Island Sound, Western reference station for the Western Long Island Sound Disposal Site, 3 samples collected June 1991, Science Applications International Corp. 1992.

(8) Station WLIS-REF - Western Long Island Sound, Eastern reference station for the Western Long Island Sound Disposal Site, 3 samples collected June 1991, Science Applications International Corp. 1992.

Prepared by: BL
Checked by: TGC
92C4087

Table 6-34
Preliminary Ecological Chemicals Of Concern Retained For Further Assessment Of The Estuarine Habitat
Pelham Bay Landfill
Bronx, New York

	Rationale for Retaining/Eliminating Preliminary COCs (1)			Analyte Retained?	Analyte Exceeded Standards?
Analytes	Surface Water	Sediment	Groundwater/Leachate	No. Media Affected	No. Media Affected
Organic Analytes					
1,2-Dichlorobenzene	Not Detected	Not Detected	Not Retained-SNE(2)	No	No
1,2-Dichloroethylene	Not Detected	Not Detected	Not Retained-SNE	No	No
1,3-Dichlorobenzene	Not Detected	Not Detected	Not Retained-SNE	No	No
1,4-Dichlorobenzene	Not Detected	Not Detected	Retained - SE(3)	YES/1	YES/1
2,4-Dimethylphenol	Not Detected	Not Detected	Retained - NS(4)	YES/1	No
2-Butanone	Not Detected	Not Detected	Retained - NS	YES/1	No
Ethylbenzene	Not Detected	Not Detected	Not Retained - SNE	No	No
Fluoranthene	Not Detected	Retained - SE	Not Retained - SNE	YES/1	YES/1
Fluorene	Not Detected	Retained - SE	Retained - NS	YES/2	YES/1
Indeno(1,2,3-c,d)pyrene	Not Detected	Not Retained-SNE	Not Detected	No	No
Methoxychlor	Not Detected	Not Detected	Retained - SE	YES/1	YES/1
Methylene Chloride	Not Retained - BLNK	Not Retained - BLNK	Not Retained - BLNK	No	No
Nathphalene	Not Detected	Not Retained-SNE	Not Retained-SNE	No	No
PCB-1016	Not Detected	Not Detected	Retained - SE	YES/1	YES/1
PCB-1260	Not Detected	Not Detected	Retained - SE	YES/1	YES/1
Phenanthrene	Not Detected	Retained - SE	Retained - SE	YES/2	YES/2
Phenolics, Total	Not Detected	Not Detected	Retained - NS	YES/1	No
Pyrene	Not Detected	Retained - SE	Retained - NS	YES/2	YES/1
Toluene	Not Detected	Retained - NS	Not Retained-SNE	YES/1	No
Xylenes	Not Detected	Not Detected	Retained - NS	YES/1	No

Table 6-34
Preliminary Ecological Chemicals Of Concern Retained For Further Assessment Of The Estuarine Habitat
Pelham Bay Landfill
Bronx, New York

Analytes	Rationale for Retaining/Eliminating Preliminary COCs (1)			Analyte Retained?	Analyte Exceeded Standards?
	Surface Water	Sediment	Groundwater/Leachate	No. Media Affected	No. Media Affected
Metals					
Aluminum	Not Retained - SW (7)	Not Retained - REF	Retained - NS	YES/1	No
Antimony	Not Detected	Not Detected	Not Retained-SNE	No	No
Arsenic	Not Detected	Not Retained - REF	Not Retained - SNE	No	No
Barium	Not Retained - SW	Retained - NS	Retained - NS	YES/2	No
Beryllium	Not Detected	Not Retained - REF	Not Retained - BLNK	No	No
Boron	Not Detected	Not Detected	Retained - SE	YES/1	YES/1

Table 6-35
Priority Listing of Ecological Chemicals of Concern for Estuarine Habitat
Pelham Bay Landfill
Bronx, New York

Analyte	Matrix	Standard Exceeded (Acute or Chronic)	Ratio of RME Concentration/ Standard	Detected in Other Estuarine Matrices ?
Analytes Exceeding Standards in Three Matrices:				
Mercury	GW/L; SW; Sed	C; A, C; C	35; 1.1, 90; 5.0	N/A
Analytes Exceeding Standards in Two Matrices:				
4,4-DDD	GW/L; Sed	C; C	37; 7.8	No
Nickel	GW/L; SW	A, C; C	2.4, 25; 1.1	Yes - Sed
Lead	GW/L; SW	C; C	14; 1.5	Yes - Sed
Zinc	GW/L; Sed	A, C; C	2.4, 4.0; 2.4	No
Phenanthrene	GW/L; Sed	A, C; C	1.3, 2.1; 2.5	No
Analytes Exceeding Standards in One Matrix:				
Ammonia Nitrogen	GW/L	A, C	155/1040	Yes - SW
PCB 1260	GW/L	C	560	No
Endosulfan II	GW/L	A, C	12, 400	No
PCB 1016	GW/L	C	320	No
Dieldrin	GW/L	C	170	Yes - Sed
Copper	GW/L	A	76	Yes - Sed
4,4-DDE	GW/L	C	51	Yes - Sed
Cyanide	GW/L	A	41	No
Endrin	GW/L	A, C	1.4, 26	No
4,4-DDT	Sed	C	12	No
alpha-Chlordane	GW/L	C	14	No
bis(2-ethylhexyl)phthalate	Sed	C	3.2	Yes - SW; GW/L
Methoxychlor	GW/L	C	10	No
Chororbenzene	GW/L	C	1.9	No
Acenaphthene	Sed	C	3.3	Yes - GW/L
Fluorene	Sed	C	2.0	Yes - GW/L
Pyrene	Sed	C	1.9	Yes - GW/L
Anthracene	Sed	C	1.8	Yes - GW/L

Table 6-35
Priority Listing of Ecological Chemicals of Concern for Estuarine Habitat
Pelham Bay Landfill
Bronx, New York

Analyte	Matrix	Standard Exceeded (Acute or Chronic)	Ratio of RME Concentration/ Standard	Detected in Other Estuarine Matrices ?
Analytes Exceeding Standards in One Matrix (continued):				
Benzo(a)anthracene	Sed	C	1.5	Yes - GW/L
Fluoranthene	Sed	C	1.1	Yes - GW/L
Dibenzo(a,h) anthracene	Sed	C	2.0	No
Benzo(a)pyrene	Sed	C	1.2	No
Chrysene	Sed	C	1.1	No
1,4-Dichlorobenzene	GW/L	C	1.1	No
Boron	GW/L	C	6.9	No

Notes:
RME - Reasonable Maximum Exposure
SW - Surface Water
Sed - Sediment
GW/L - Groundwater/Leachate
A - Acute standard or criteria
C - Chronic standard or criteria

Prepared by: BL
Checked by: TGC
92C4087

Table 6-36
Results* Of Atlantic Silverside Tissue Analysis
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Number of Detections	Number of Samples	CRDL Range (2)	Minimum Value (3)	Mean	Maximum Detected Value (4)	95% UCL (5)
Wet Weight (mg/kg)							
4,4'-DDE	10	10	N/A - N/A (6)	0.036	0.048	0.055	0.052
Lead	10	10	N/A - N/A	0.110	0.246	0.400	0.311
Mercury	10	10	N/A - N/A	0.030	0.042	0.070	0.049
PCB-1248	5	10	0.08 - 0.08	0.040 U	0.097	0.170	0.132
PCB-1254	1	10	0.16 - 0.16	0.080 U	0.102	0.300 P	0.142
Moisture (%)	10	10	N/A - N/A	72.8	75.0	77.3	76.1
Lipid (%)	10	10	N/A - N/A	1.84	2.66	3.59	3.11
Dry Weight (mg/kg)							
4,4'-DDE	10	10	N/A - N/A	0.136	0.194	0.228	0.213
Lead	10	10	N/A - N/A	0.415	0.994	1.57	1.25
Mercury	10	10	N/A - N/A	0.131	0.166	0.257	0.189
PCB-1248	5	10	0.294 - 0.308	0.147	0.405	0.705	0.562
PCB-1254	1	10	0.599 - 0.705	0.300	0.403	1.10	0.546

Prepared by BL
Checked by: TGC
92C4087

Notes:

* - Whole body.

U - Compound was analyzed but not detected; value shown is one-half the CRDL.

P - Used for a pesticide/Aroclor analyte when there is greater than 25% difference for detected concentrations between the two GC columns. The lower of the two values is reported.

(1) Listed analytes are those detected in at least one tissue sample collected from the east and south seawalls on August 21 - 26, 1992.

(2) CRDL - Contract-Required Detection Limit.

(3) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.

(4) Maximum detected concentration.

(5) UCL = Upper Confidence Level. 95% UCL = (mean + (Student t(.95,n-1) * (Standard Deviation / SQRT (N))).

(6) N/A - CRDL not applicable.

Table 6-37
Results* Of Hard Clam Tissue Analysis
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Number of Detections	Number of Samples	CRDL Range (2)	Minimum Value (3)	Mean	Maximum Detected Value (4)	95% UCL (5)
Wet Weight (mg/kg)							
beta-BHC	4	10	0.008 - 0.008	0.004 U	0.008	0.016 P	0.011
Cadmium	10	10	N/A - N/A (6)	0.280	0.381	0.640	0.439
Endosulfan I	1	10	0.008 - 0.008	0.004 U	0.006	0.019	0.008
Lead	10	10	N/A - N/A	0.76	1.26	1.60	1.44
Mercury	10	10	N/A - N/A	0.02	0.029	0.060	0.037
Moisture (%)	10	10	N/A - N/A	76.3	77.4	78.9	77.9
Lipid (%)	10	10	N/A - N/A	1.18	1.30	1.49	1.36
Dry Weight (mg/kg)							
beta-BHC	4	10	0.034 - 0.038	0.017	0.036	0.071	0.050
Cadmium	10	10	N/A - N/A	1.24	1.70	3.03	1.99
Endosulfan I	1	10	0.034 - 0.038	0.017	0.024	0.084	0.037
Lead	10	10	N/A - N/A	3.41	5.60	7.11	6.43
Mercury	10	10	N/A - N/A	0.084	0.129	0.284	0.169

Notes:

* - Soft tissue only.

U - Compound was analyzed but not detected; value shown is one-half the CRDL.

P - Used for a pesticide/Aroclor analyte when there is greater than 25% difference for detected detected concentrations between the two GC columns. The lower of the two values is reported.

Prepared by: BL
Checked by: TGC
92C4087

(1) Listed analytes are those detected in at least one tissue sample collected from the east and south seawalls on August 20 - 21, 1992.

(2) CRDL - Contract-Required Detection Limit.

(3) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.

(4) Maximum detected concentration.

(5) UCL = Upper Confidence Level. 95% UCL = (mean + (Student t(.95,n-1) * (Standard Deviation / SQRT (N))).

(6) N/A - CRDL not applicable.

Table 6-38
Results* Of Blue Mussel Tissue Analysis
Pelham Bay Landfill
Bronx, New York

Analyte (1)	Number of Detections	Number of Samples	CRDL Range (2)	Minimum Value (3)	Mean	Maximum Detected Value (4)	95% UCL (5)
Wet Weight (mg/kg)							
4,4'-DDD	7	15	N/A - 0.016	0.008 U	0.015	0.030 P	0.019
4,4'-DDE	4	15	N/A - 0.016	0.008 U	0.011	0.024	0.014
alpha-Chlordane	5	15	N/A - 0.080	0.008 JP	0.030	0.013 JP	0.037
beta-BHC	5	15	N/A - 0.008	0.004 U	0.007	0.016	0.009
Cadmium	15	15	N/A - N/A (6)	0.320	0.520	0.730	0.577
Endosulfan I	1	15	N/A - 0.008	0.004 U	0.004	0.010 P	0.005
Lead	15	15	N/A - N/A	1.50	2.85	4.50	3.31
Mercury	15	15	N/A - N/A	0.030	0.033	0.040	0.035
PCB-1254	9	15	N/A - 0.160	0.080 U	0.175	0.290	0.214
Moisture (%)	15	15	N/A - N/A	73.4	75.2	77.1	75.8
Lipid (%)	15	15	N/A - N/A	2.07	2.61	4.15	2.86
Dry Weight (mg/kg)							
4,4'-DDD	7	15	0.062 - 0.068	0.031	0.062	0.113	0.078
4,4'-DDE	4	15	0.060 - 0.068	0.030	0.046	0.097	0.056
alpha-Chlordane	5	15	0.301 - 0.338	0.035	0.121	0.055	0.147
beta-BHC	5	15	0.030 - 0.034	0.015	0.028	0.068	0.037
Cadmium	15	15	N/A - N/A	1.37	2.10	2.99	2.32
Endosulfan I	1	15	0.030 - 0.035	0.015	0.018	0.041	0.021
Lead	15	15	N/A - N/A	5.84	11.525	18	13
Mercury	15	15	N/A - N/A	0.113	0.132	0.164	0.140
PCB-1254	9	15	0.618 - 0.656	0.309	0.714	1.23	0.881

Notes:

* - Soft tissue only.

U - Compound was analyzed but not detected; value shown is one-half the CRDL.

P - Used for a pesticide/Aroclor analyte when there is greater than 25% difference for detected concentrations between the two GC columns. The lower of the two values is reported.

J - estimated value (i.e. detected at less than the CRDL).

Prepared by: BL
Checked by: TGC
92C4087

(1) Listed analytes are those detected in at least one tissue sample collects from 2 sites on the east seawall and 1 site on the south seawall on August 24 - 25, 1992.

(2) CRDL - Contract-Required Detection Limit.

(3) Minimum detected concentration, except where qualified by a "U", in which case the value is one-half the CRDL.

(4) Maximum detected concentration.

(5) UCL = Upper Confidence Level. 95% UCL = (mean + (Student t(.95,n-1) * (Standard Deviation / SQRT (N))).

(6) N/A - CRDL not applicable.

Table 6-39
Onsite Terrestrial Ecological Hazard Evaluation Summary
Pelham Bay Landfill
Bronx, New York

Analyte	Hazard Evaluation							
	Likely		Slight Potential		Unlikely		Uncertain	
	Mammal	Bird	Mammal	Bird	Mammal	Bird	Mammal	Bird
N-Nitrosodi-n-propylamine					X	X		
Benzo(a)pyrene				X	X			
Benzo(a)anthracene				X	X			
Chrysene				X	X			
DDT / DDE / DDD				X	X			
PCB-1254 / PCB-1260			X	X				
a-chlordane				X	X			
g-chlordane					X	X		
Dieldrin			X	X				
Endosulfan							X	X
Methoxychlor					X	X		
Benzenehexachloride (delta-BHC)			X	X				
Dibenzofuran					X	X		
Mercury	X	X						
Lead					X	X		
Zinc					X	X		
Nickel					X	X		

Notes:

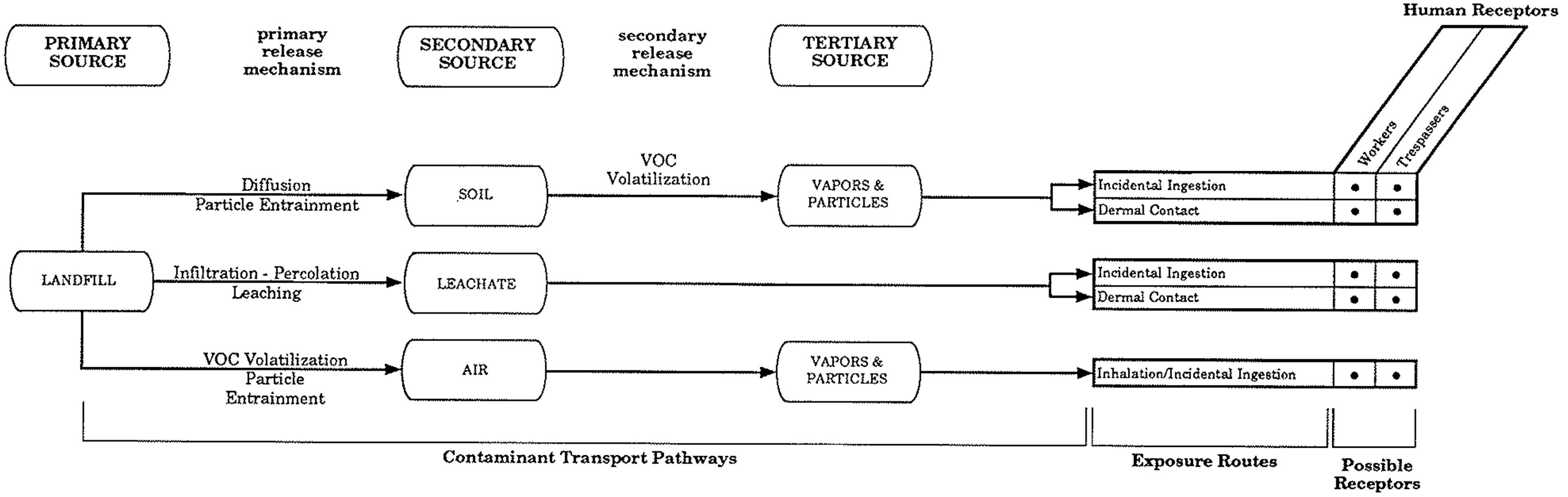
Prepared by: RTG
Checked by: RLH
92C4087

Table 6-40
Onsite Estuarine Ecological Hazard Evaluation Summary
Pelham Bay Landfill
Bronx, New York

Analyte	Hazard Evaluation								
	Likely			Possible			Unlikely		
	Bivalves	Fish	Birds	Bivalves	Fish	Birds	Bivalves	Fish	Birds
Mercury			X				X	X	X
Copper	X	X							X
DDD / DDE							X	X	X
Nickel	X							X	X
Lead	X							X	X
Zinc	X (a)						X (b)	X	X
Phenanthrene						X	X	X	
Ammonia Nitrogen	X	X							X
Total PCBs					X	X (c)	X		X (d)
Endosulfan II					X		X		X
Dieldrin / Endrin					X	X	X		
Cyanide							X	X	X
a-chlordane							X	X	X
Methoxychlor				X (b)			X (a)	X	X
Chlorobenzene							X	X	X

Notes:
(a) Hard clam only
(b) Blue mussel only
(c) Raptors only
(d) Waterfowl only

Prepared by: RTG
Checked by: RLH
92C4087



Key:

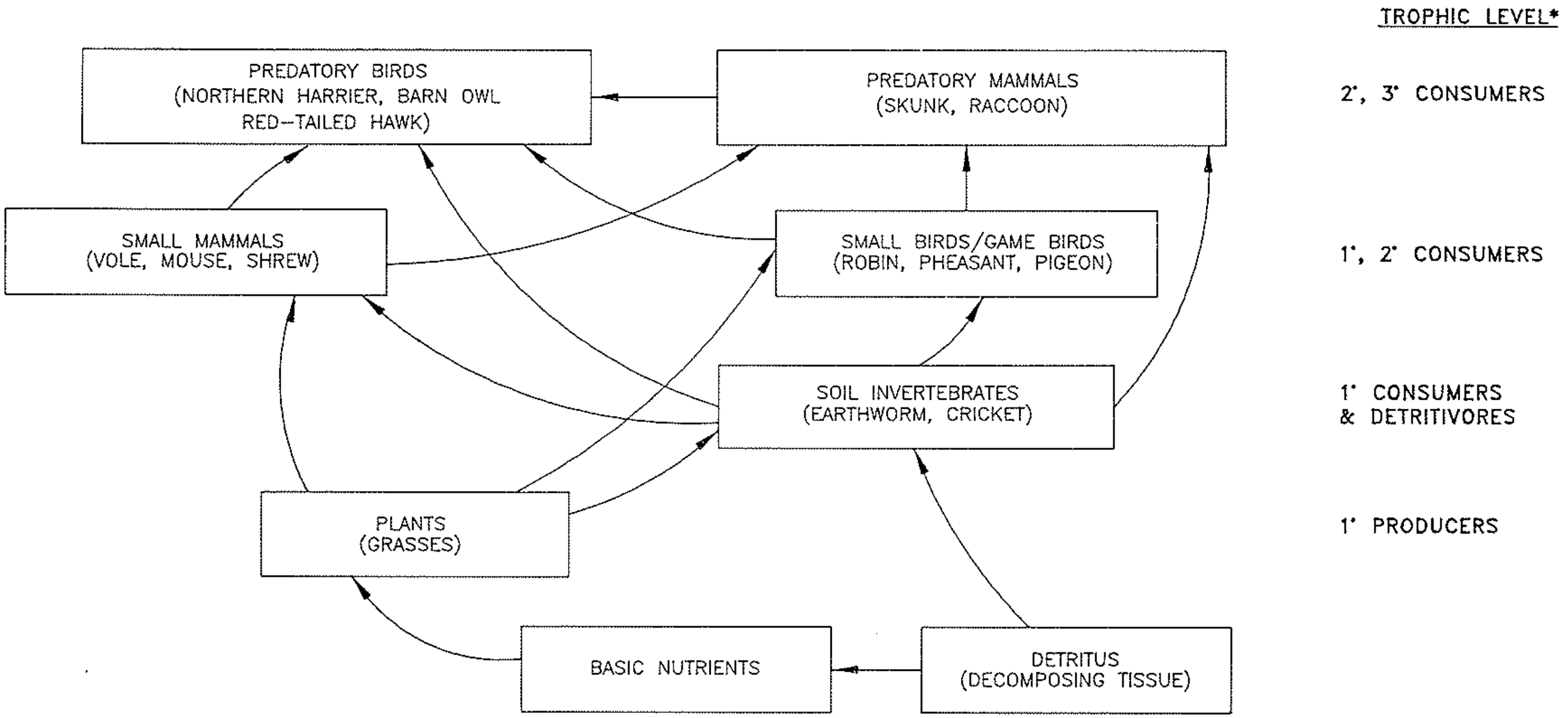
- ● Complete pathway – exposure

CONCEPTUAL SITE MODEL FOR THE ANALYSIS OF ON-SITE RISKS TO HUMAN HEALTH PELHAM BAY LANDFILL, BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	BAS	SCALE:	NONE	PROJ. NO.:	92C4087
CK'D. BY:	PP	DATE:	15 FEB 1993	FIG. NO:	6–1

92c4087/exposure model f



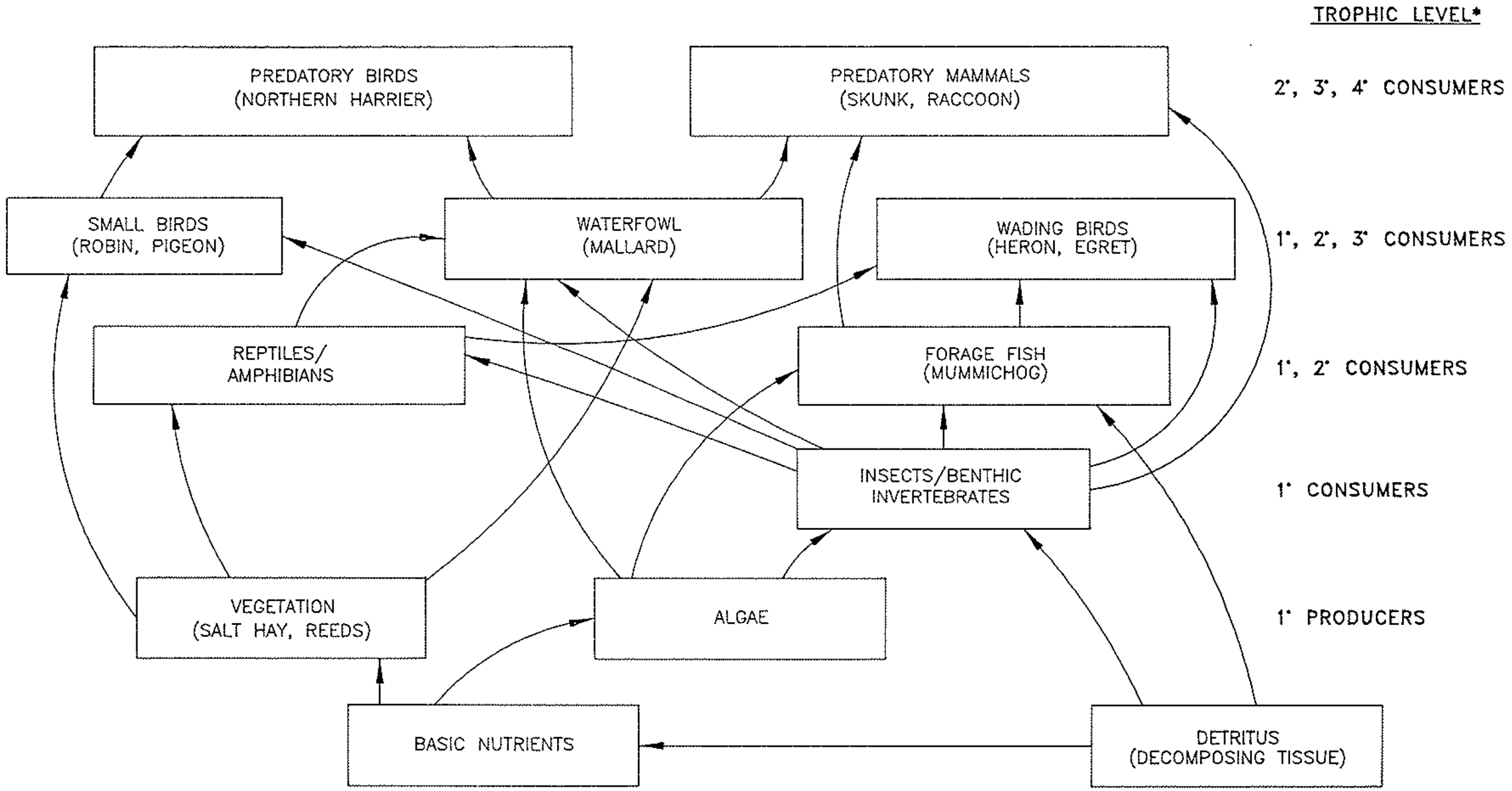
* 1°, 2°, 3°, ETC. – PRIMARY, SECONDARY, TERTIARY, ETC.

TERRESTRIAL (SOILS) FOOD WEB
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: SJK	SCALE: NONE	PROJ. NO.: 92C4087
CK'D. BY: TGC	DATE: 26 JAN 93	FIG. NO: 6-2

ARC8



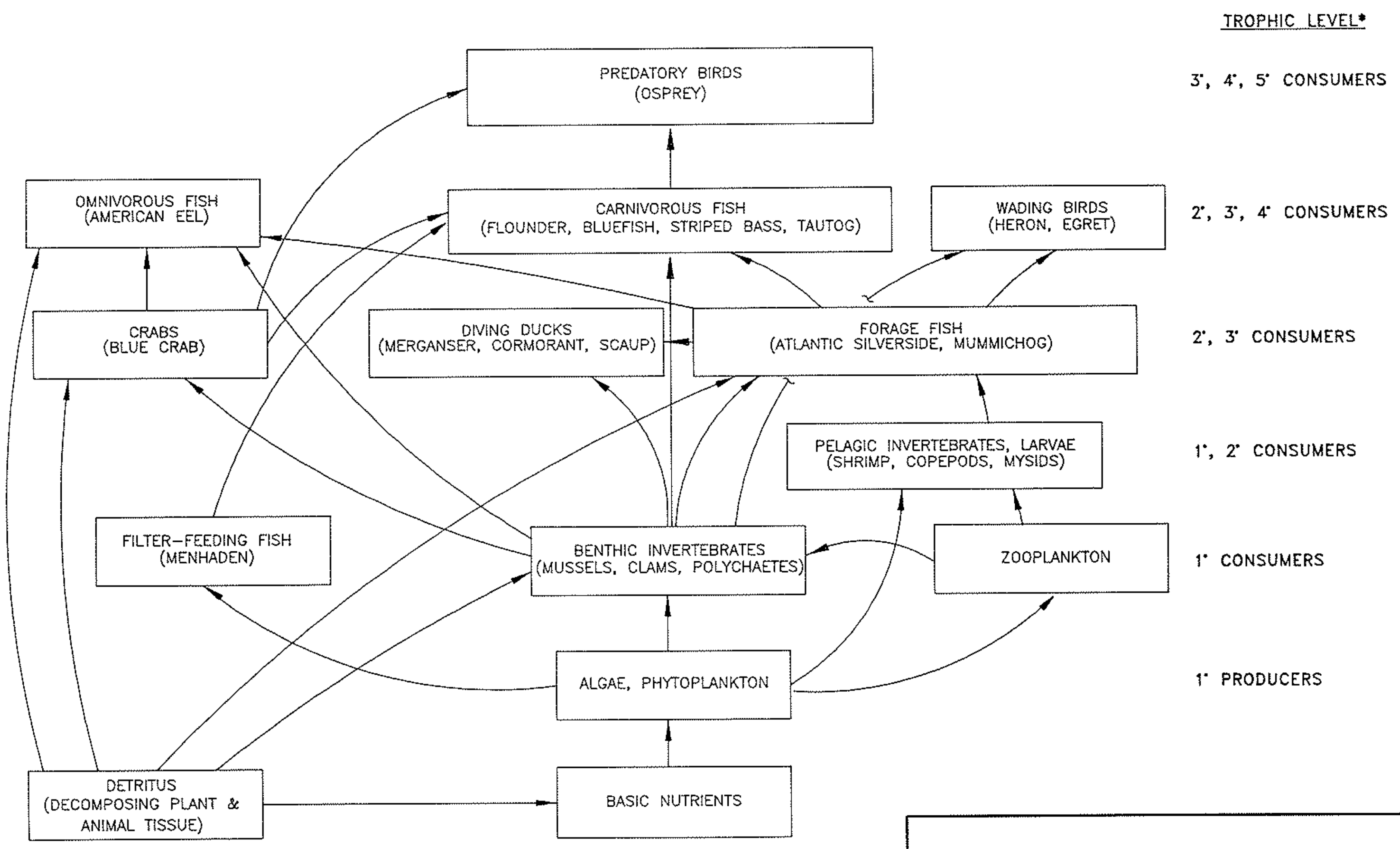
* 1', 2', 3', ETC. — PRIMARY, SECONDARY, TERTIARY, ETC.

TIDAL WETLAND
(MARSH LAND) FOOD WEB
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: SJK	SCALE: NONE	PROJ. NO.: 92C4087
CK'D. BY: TGC	DATE: 26 JAN 93	FIG. NO: 6-3

ARC7



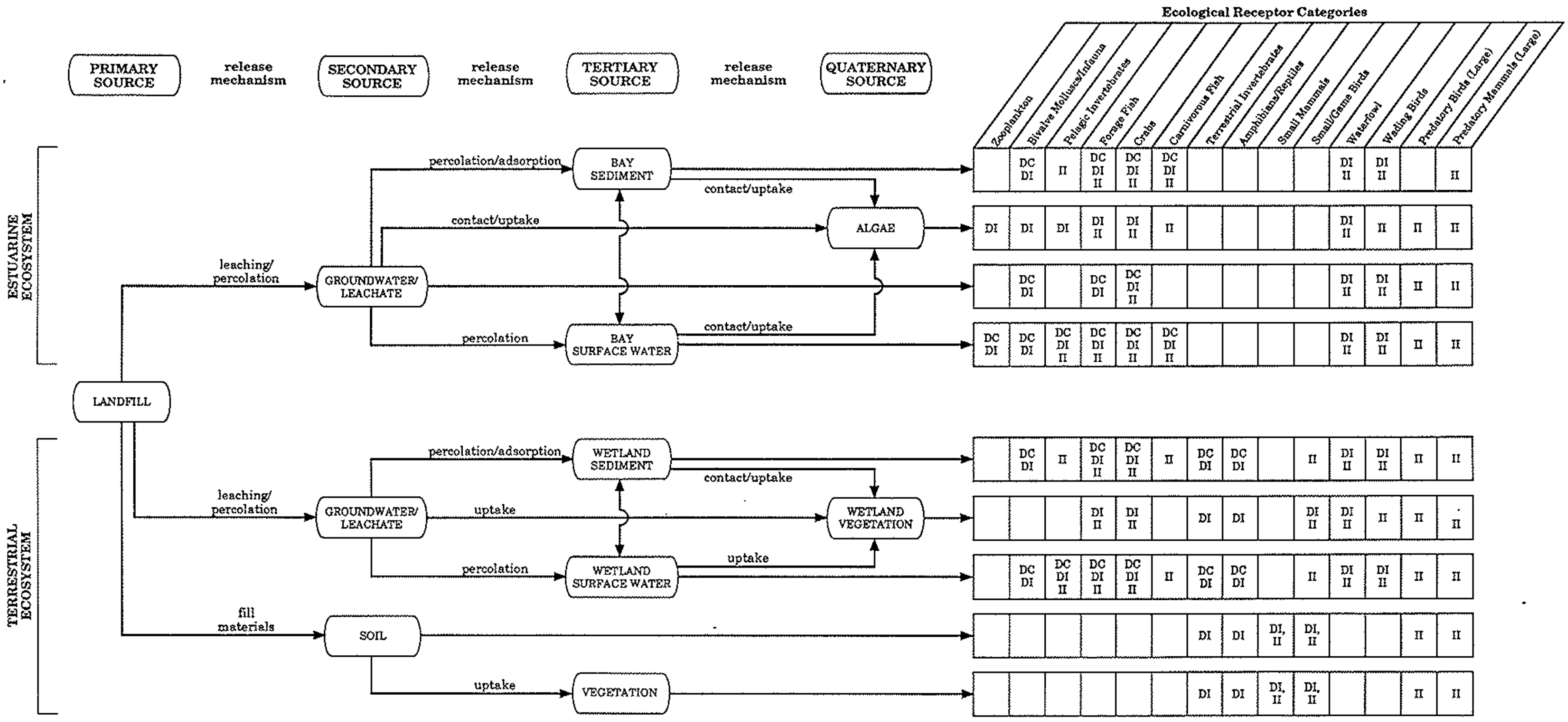
* 1°, 2°, 3°, ETC. – PRIMARY, SECONDARY, TERTIARY, ETC.

ESTUARINE FOOD WEB
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: SJK	SCALE: NONE	PROJ. NO.: 92C4087
CK'D. BY: TGC	DATE: 26 JAN 93	FIG. NO: 6–4

ARC1



	Zooplankton	Bivalve Molluscs/Infauna	Pelagic Invertebrates	Forage Fish	Crabs	Carnivorous Fish	Terrestrial Invertebrates	Amphibians/Reptiles	Small Mammals	Small/Game Birds	Waterfowl	Wading Birds	Predatory Birds (Large)	Predatory Mammals (Large)
BAY SEDIMENT		DC DI	II	DC DI II	DC DI II	DC DI II					DI II	DI II		II
ALGAE	DI	DI	DI	DI II	DI II	II					DI II	II	II	II
GROUNDWATER/ LEACHATE		DC DI		DC DI	DC DI II						DI II	DI II	II	II
BAY SURFACE WATER	DC DI	DC DI	DC DI II	DC DI II	DC DI II	DC DI II					DI II	DI II	II	II
WETLAND SEDIMENT		DC DI	II	DC DI II	DC DI II	II	DC DI	DC DI		II	DI II	DI II	II	II
WETLAND VEGETATION				DI II	DI II		DI	DI		DI II	DI II	II	II	II
WETLAND SURFACE WATER		DC DI	DC DI II	DC DI II	DC DI II	II	DC DI	DC DI		II	DI II	DI II	II	II
SOIL							DI	DI	DI, II	DI, II			II	II
VEGETATION							DI	DI	DI, II	DI, II			II	II

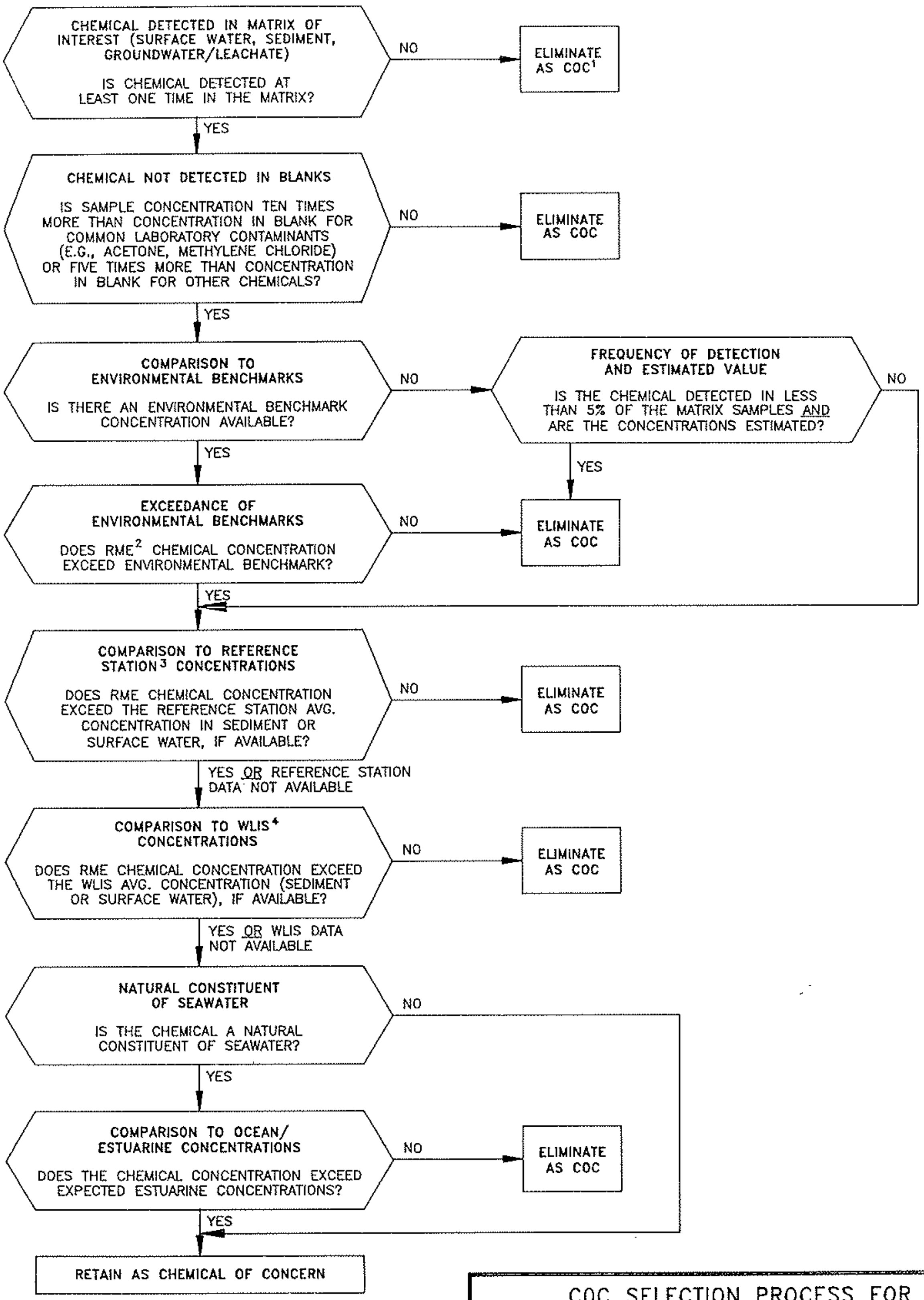
Key:
DC – Direct Contact
DI – Direct Ingestion
II – Indirect Ingestion
(i.e. secondary, tertiary consumption)

CONCEPTUAL SITE MODEL
ECOLOGICAL RISK ASSESSMENT
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	BAS	SCALE:	NONE	PROJ. NO.:	92C4087
CK'D. BY:	TGC	DATE:	NOV. 20, 1992	FIG. NO:	6-5

92c4087/exposure model c



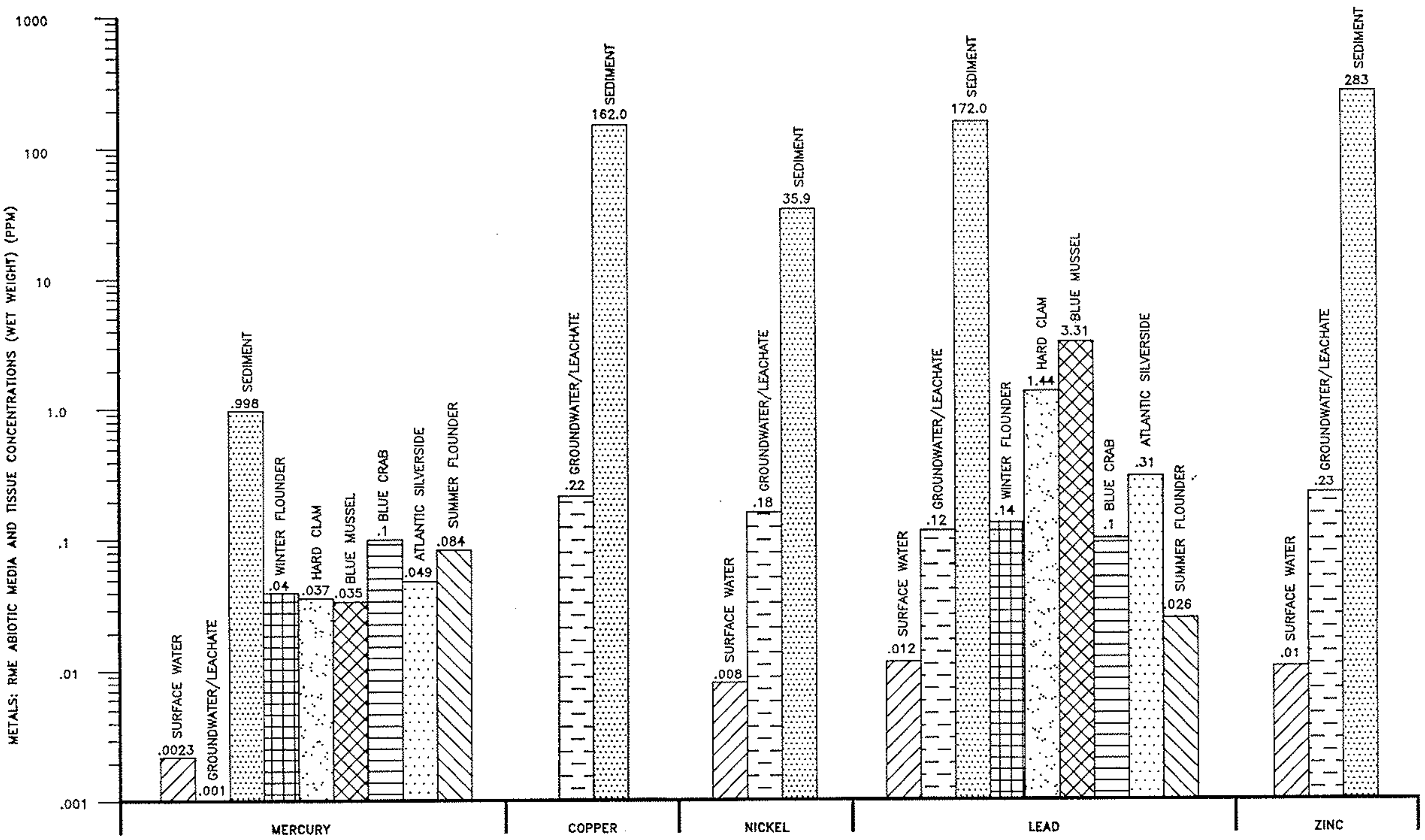
[1] COC	CHEMICAL OF CONCERN
[2] RME	REASONABLE MAXIMUM EXPOSURE
[3] REFERENCE STATIONS	SD-9 AND SW-9
[4] WLIS	WESTERN LONG ISLAND SOUND

COC SELECTION PROCESS FOR ESTUARINE ECOLOGICAL RISK ASSESSMENT

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: SJK	SCALE: NONE	PROJ. NO.: 92C4087
CK'D. BY: TGC	DATE: 5 APR 1993	FIG. NO: 6-6



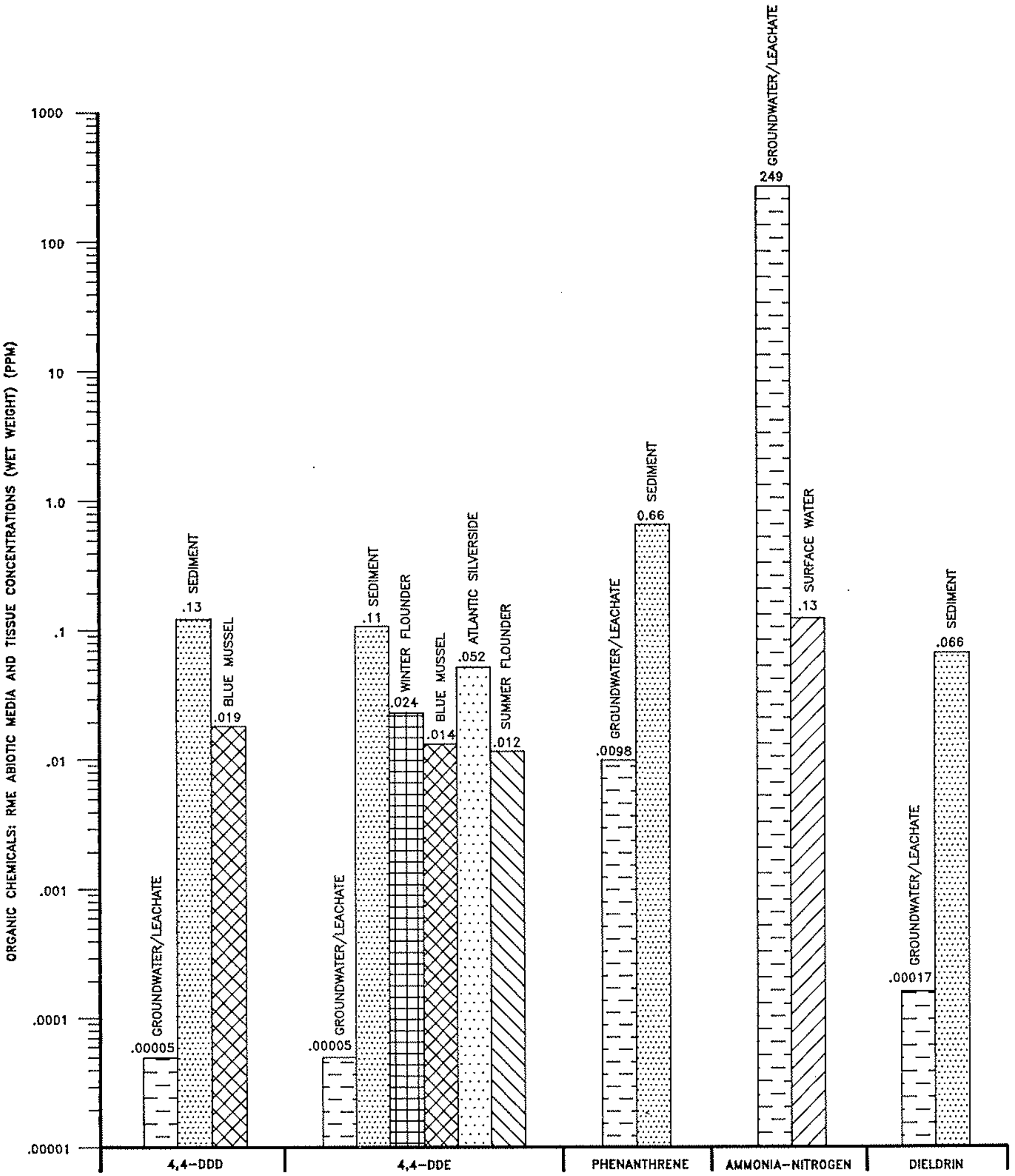
CONCENTRATIONS OF ESTUARINE METALS

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: SSK	SCALE: AS SHOWN	PROJ. NO.: 92C4087
CK'D. BY: TGC	DATE: 04/07/93	FIG. NO: 6-7

METALS



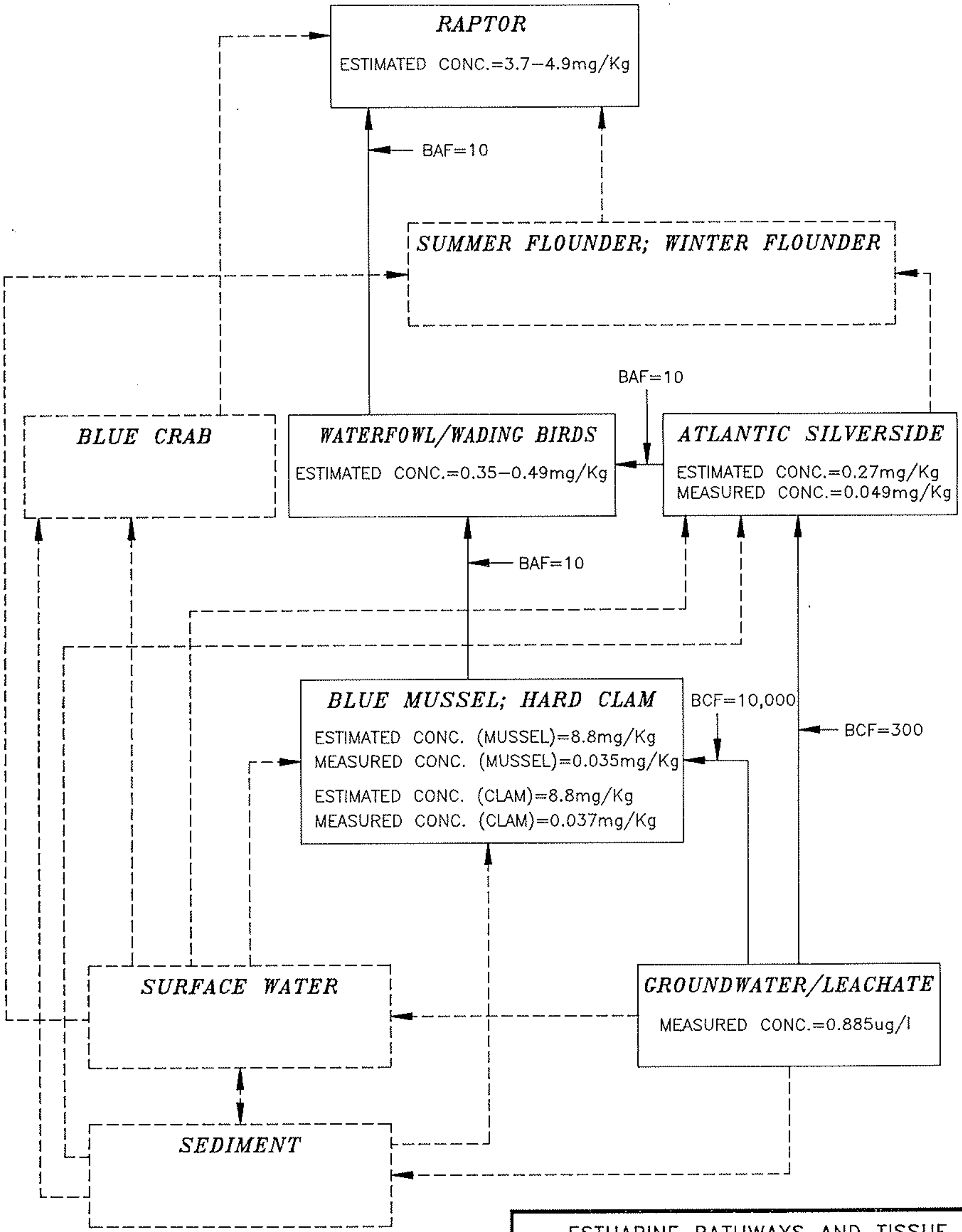
CONCENTRATIONS OF ESTUARINE ORGANICS

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: SSK	SCALE: AS SHOWN	PROJ. NO.: 92C4087
CK'D. BY: TGC	DATE: 04/07/93	FIG. NO: 6-8

METALS6



KEY

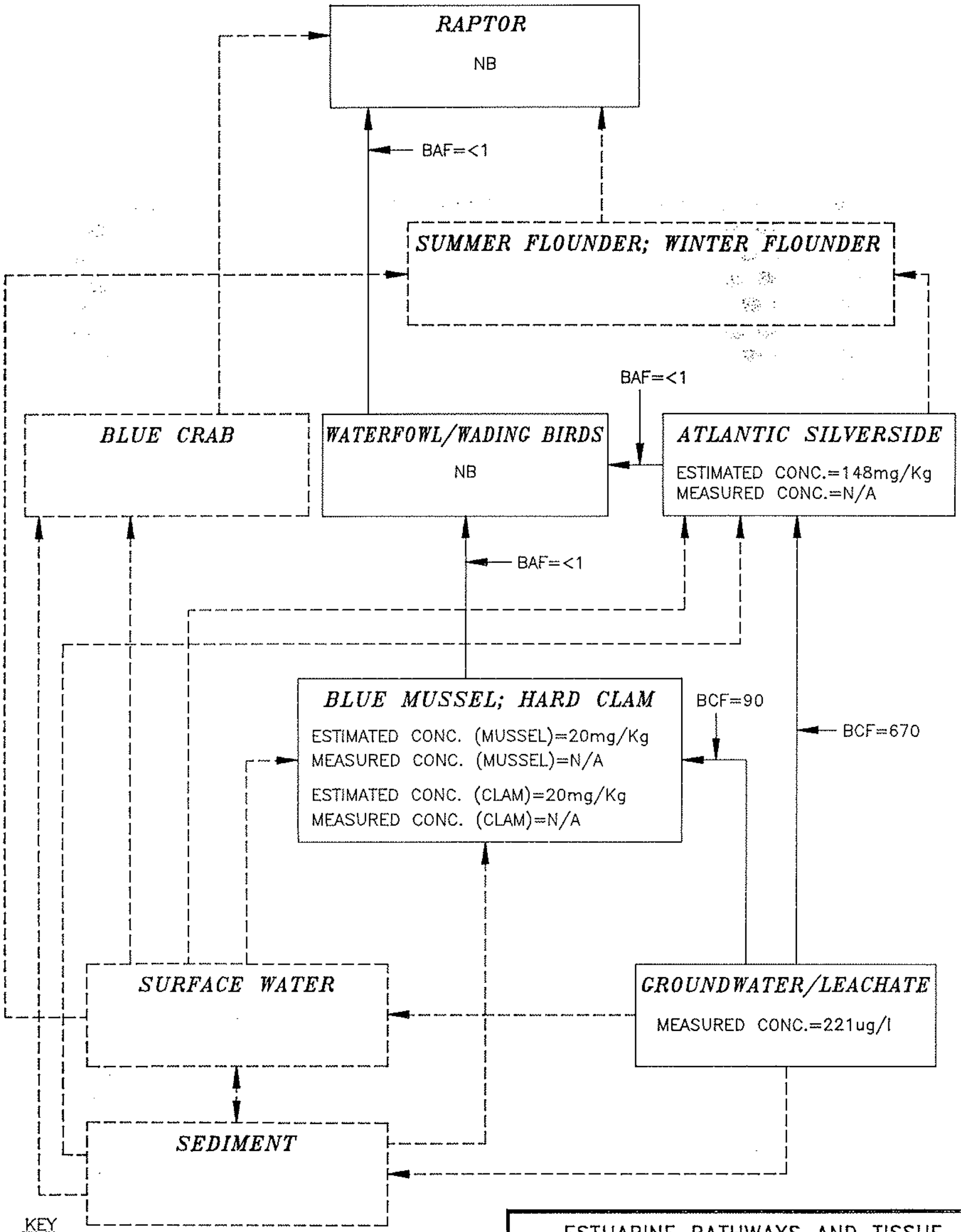
———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR MERCURY
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6-9

PEL6–8



KEY

———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED
NB	NO BIOACCUMULATION

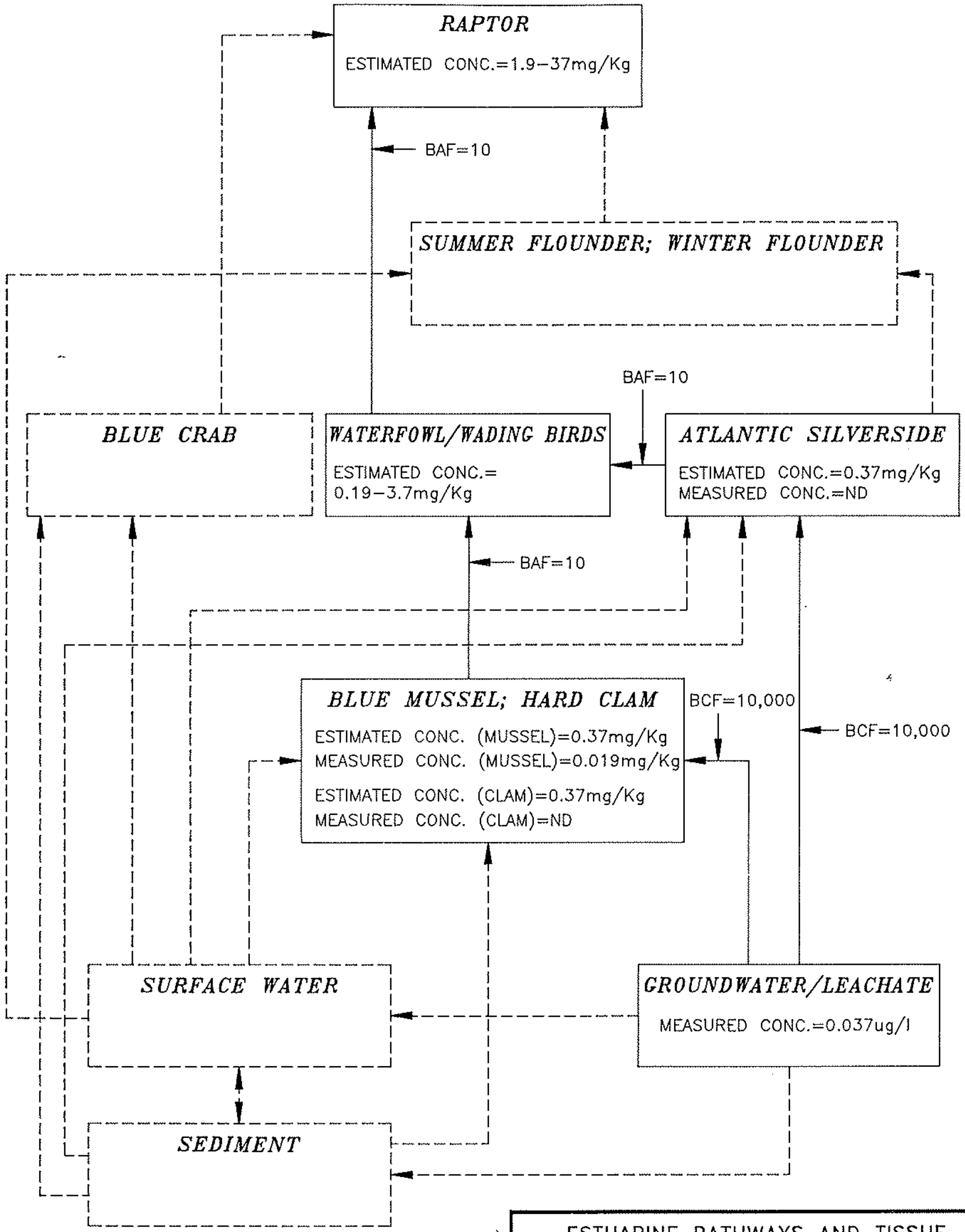
ESTUARINE PATHWAYS AND TISSUE
CONCENTRATIONS FOR COPPER

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6–10

PEL6–9



KEY

———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

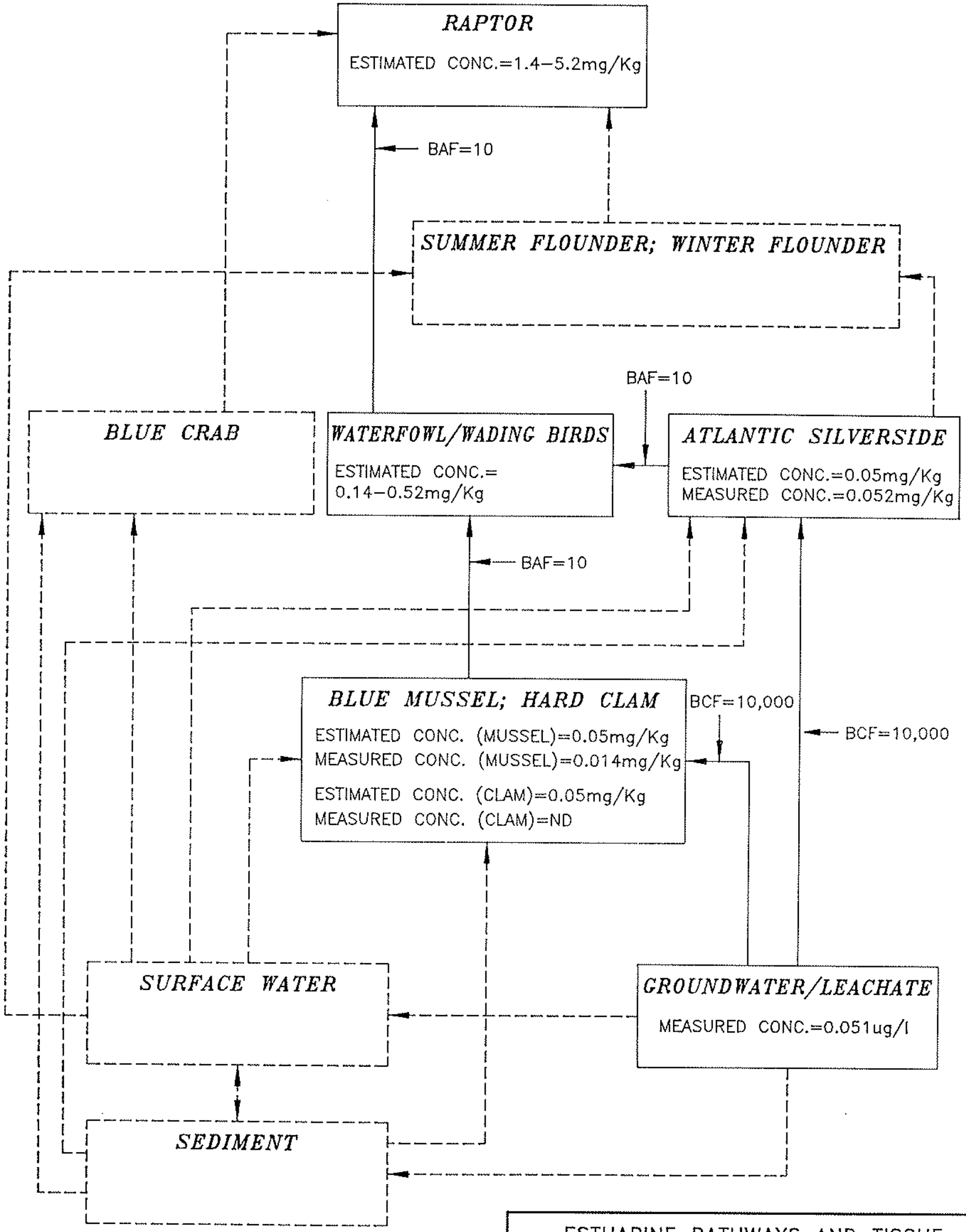
ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR 4,4–DDD

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6-11

PEL6–10



KEY

———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

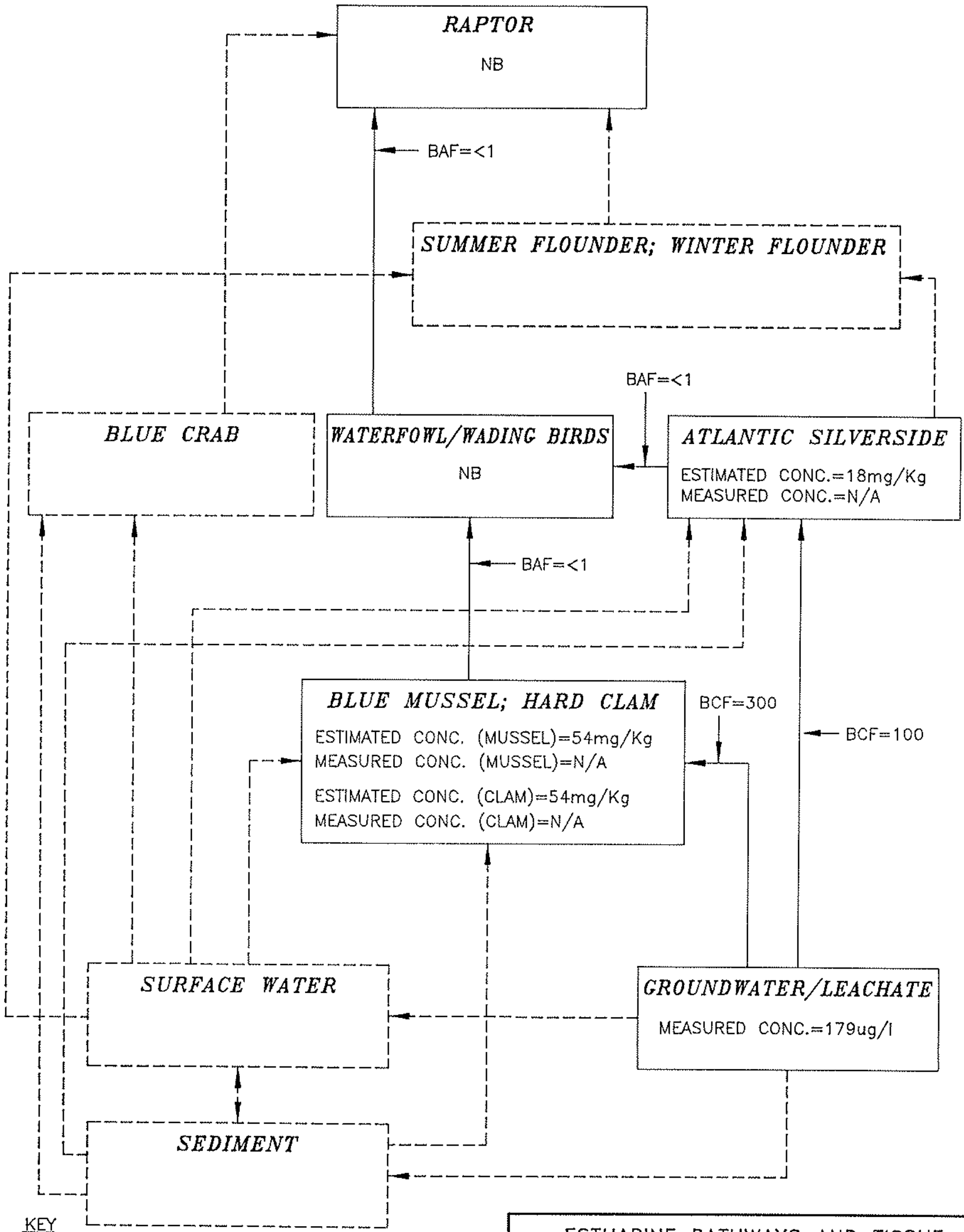
ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR 4,4–DDE

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6–12

PEL6–11



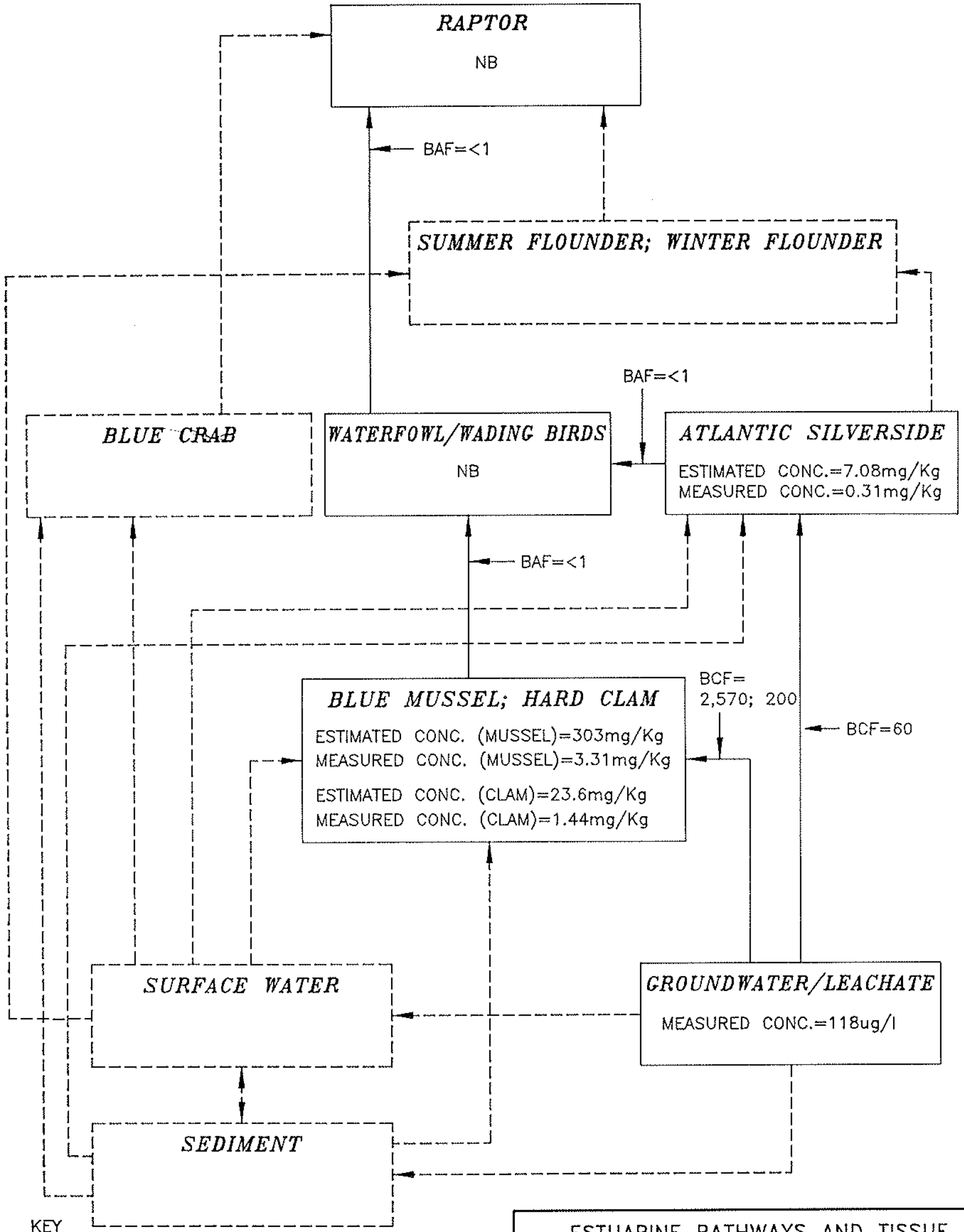
KEY

———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED
NB	NO BIOACCUMULATION

ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR NICKEL
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20-JAN-1993	FIG. NO: 6-13



KEY

———	QUANTIFIABLE PATHWAY
- - - -	NON-QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED
NB	NO BIOACCUMULATION

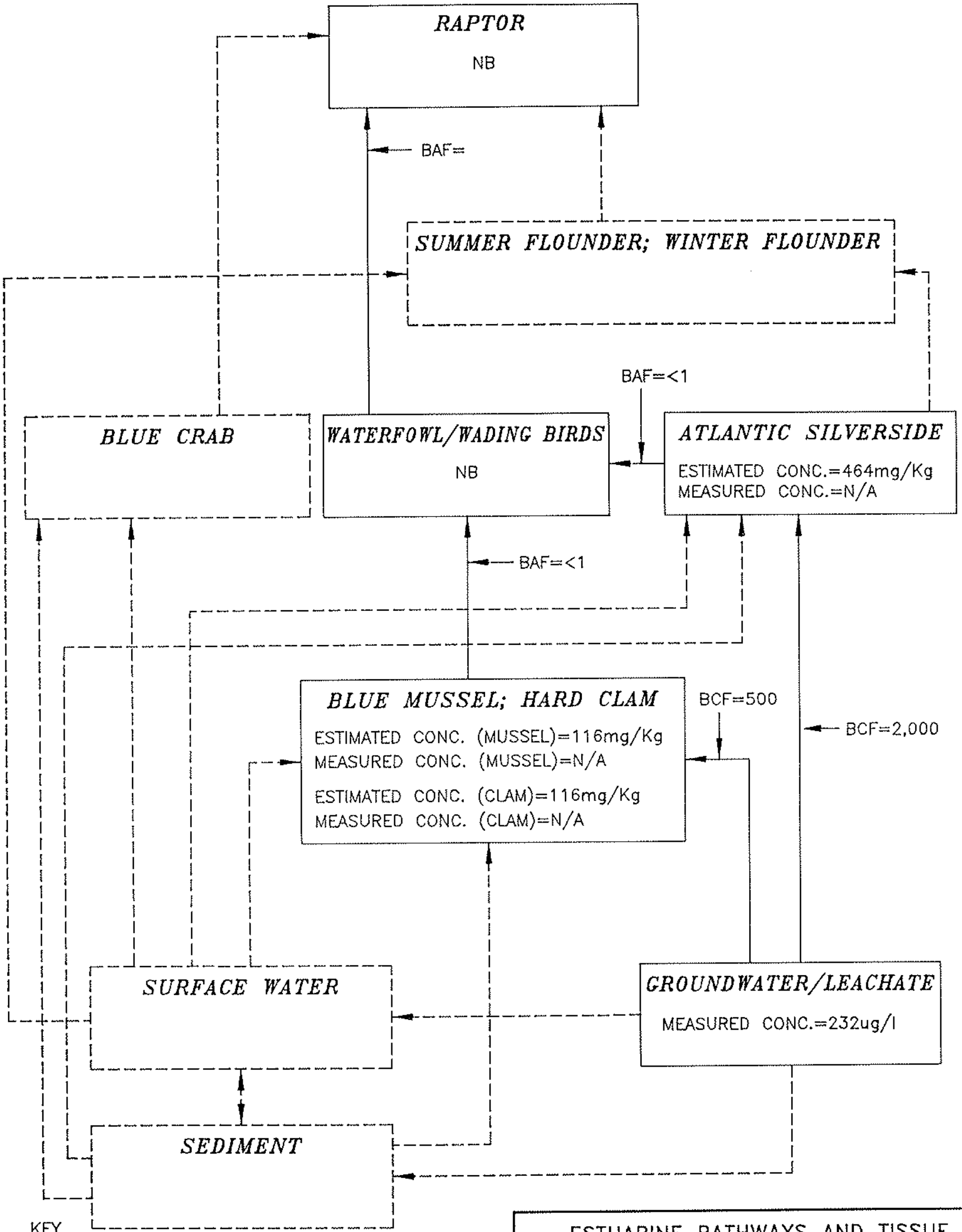
ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR LEAD

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6-14

PEL6-13



KEY

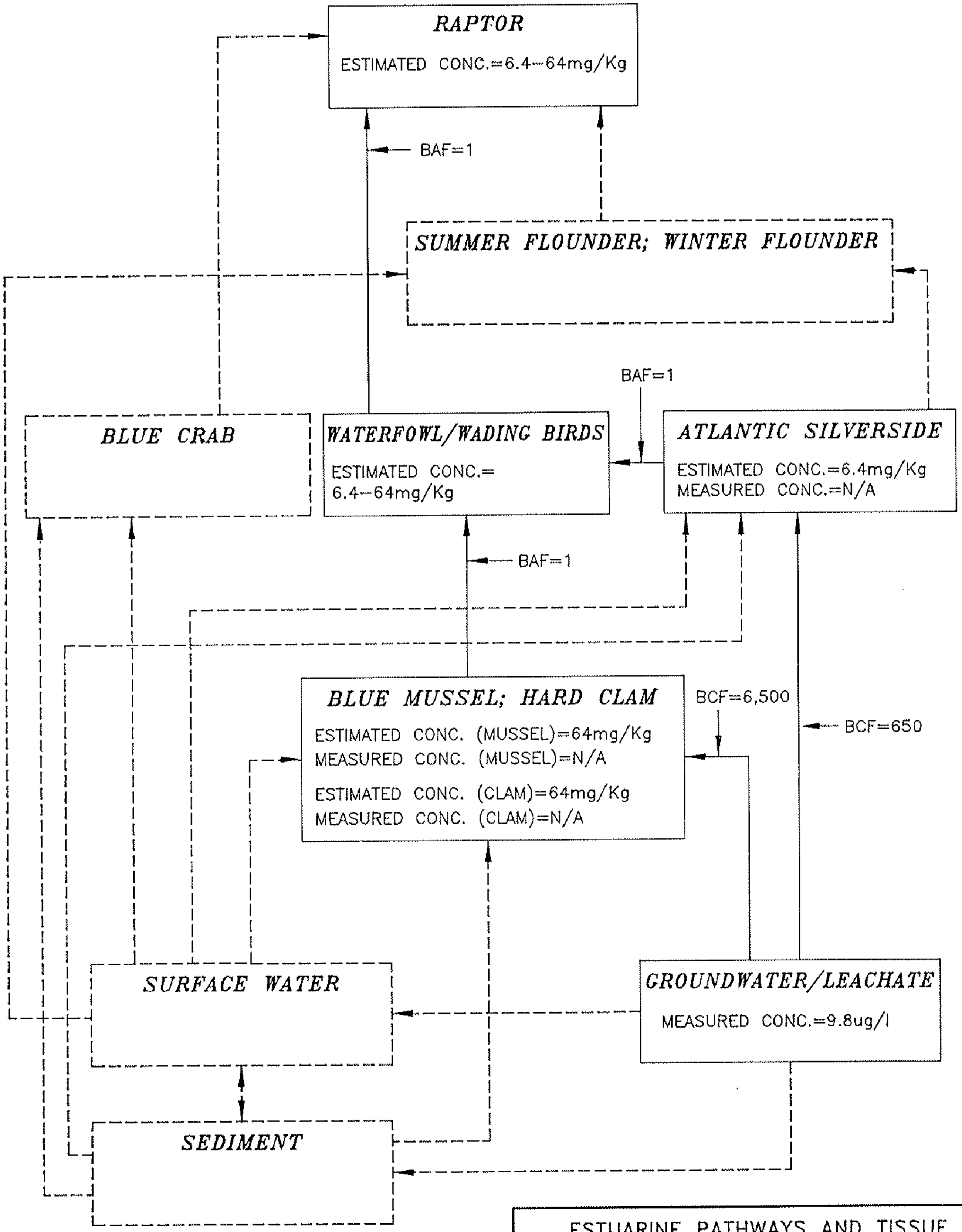
———	QUANTIFIABLE PATHWAY
- - - -	NON-QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED
NB	NO BIOACCUMULATION

ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR ZINC
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6-15

PEL6-14



KEY

———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

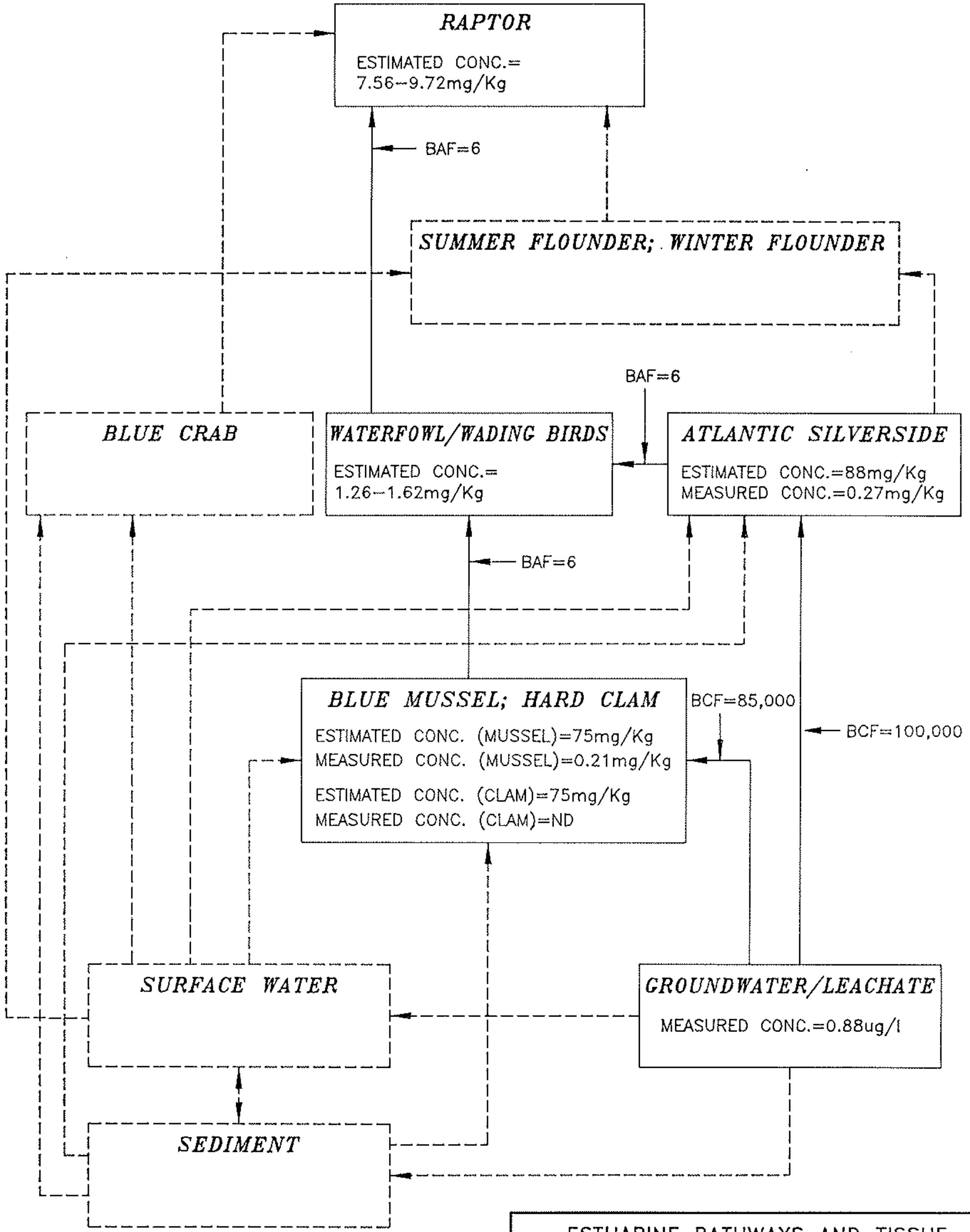
ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR PHENANTHRENE

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6–16

PEL6–15



KEY

———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

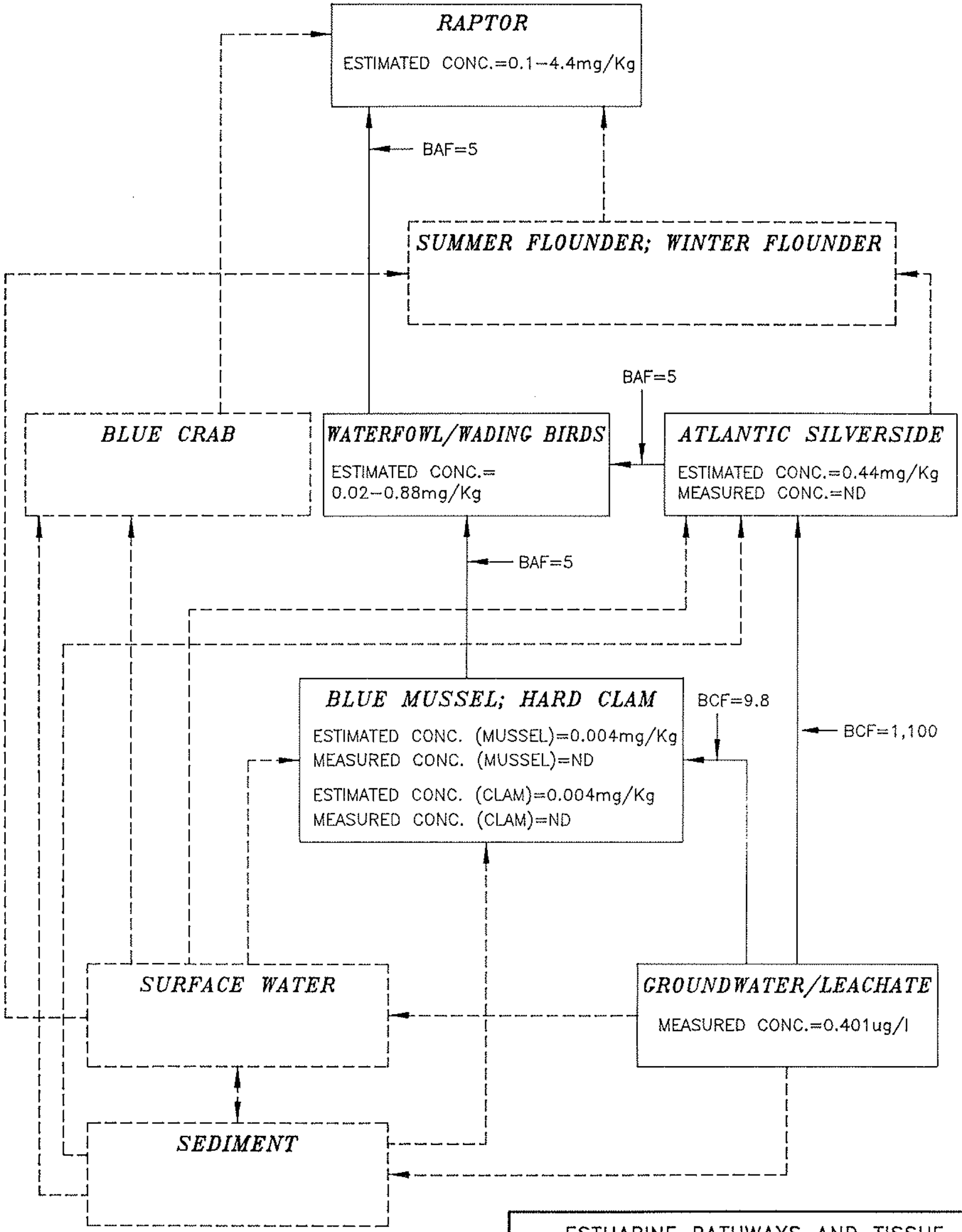
ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR TOTAL PCBs

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6–17

PEL6-16



KEY

———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

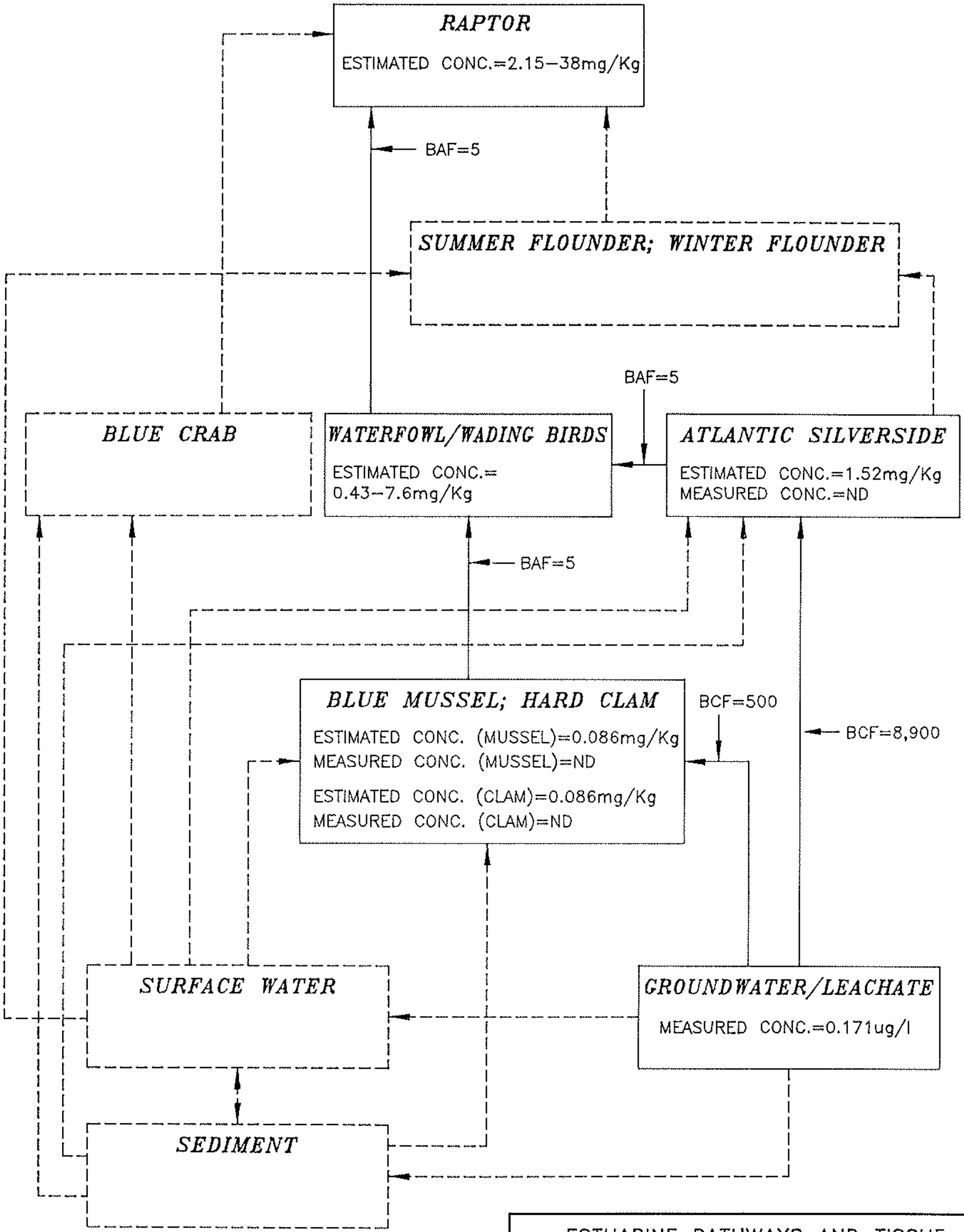
ESTUARINE PATHWAYS AND TISSUE
CONCENTRATIONS FOR ENDOSULFAN II

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6–18

PEL6–17



KEY

———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

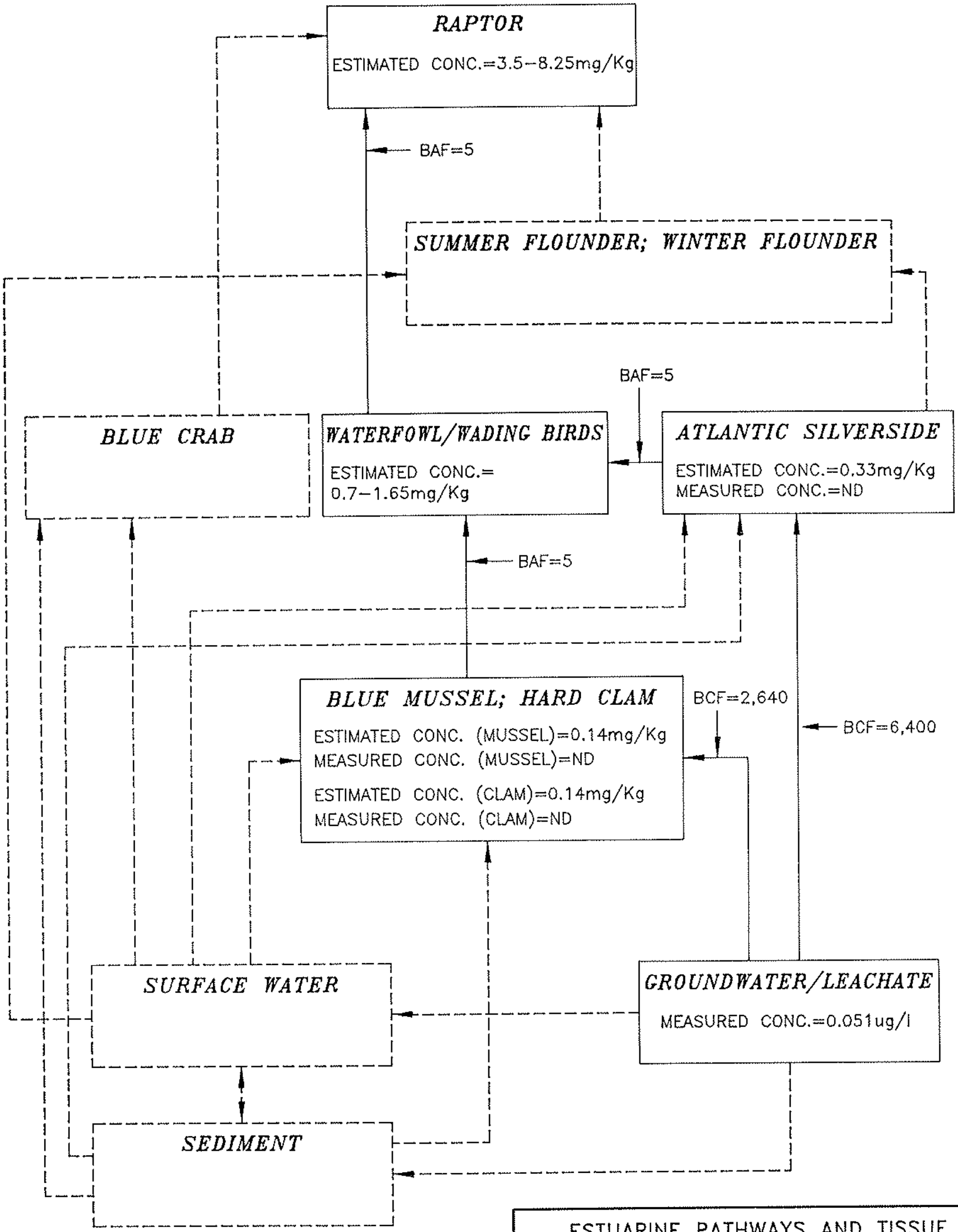
ESTUARINE PATHWAYS AND TISSUE
CONCENTRATIONS FOR DIELDRIN

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6–19

PE16–18



KEY

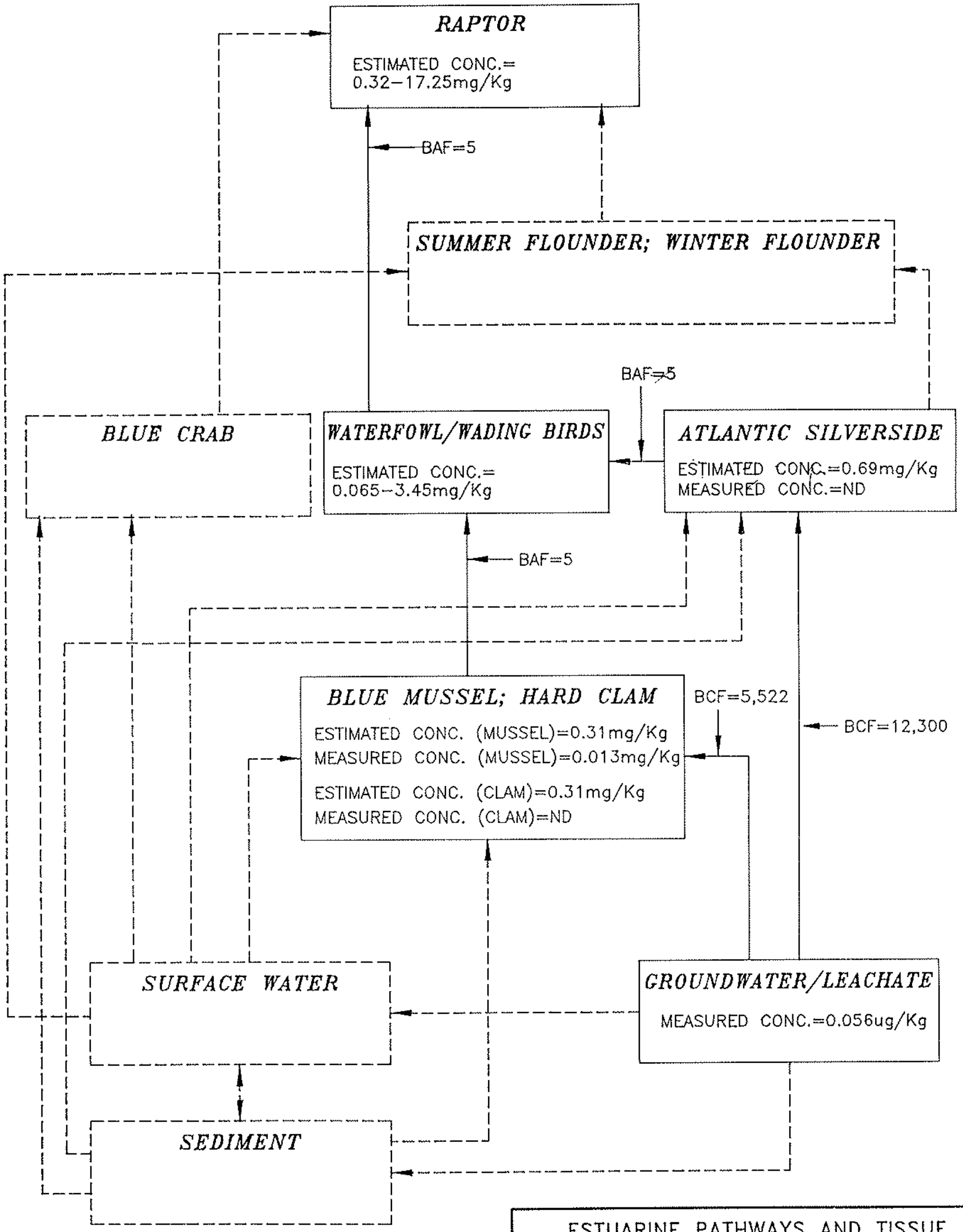
———	QUANTIFIABLE PATHWAY
– – – –	NON–QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR ENDRIN

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD–CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6–20



KEY

———	QUANTIFIABLE PATHWAY
– – – –	NON-QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

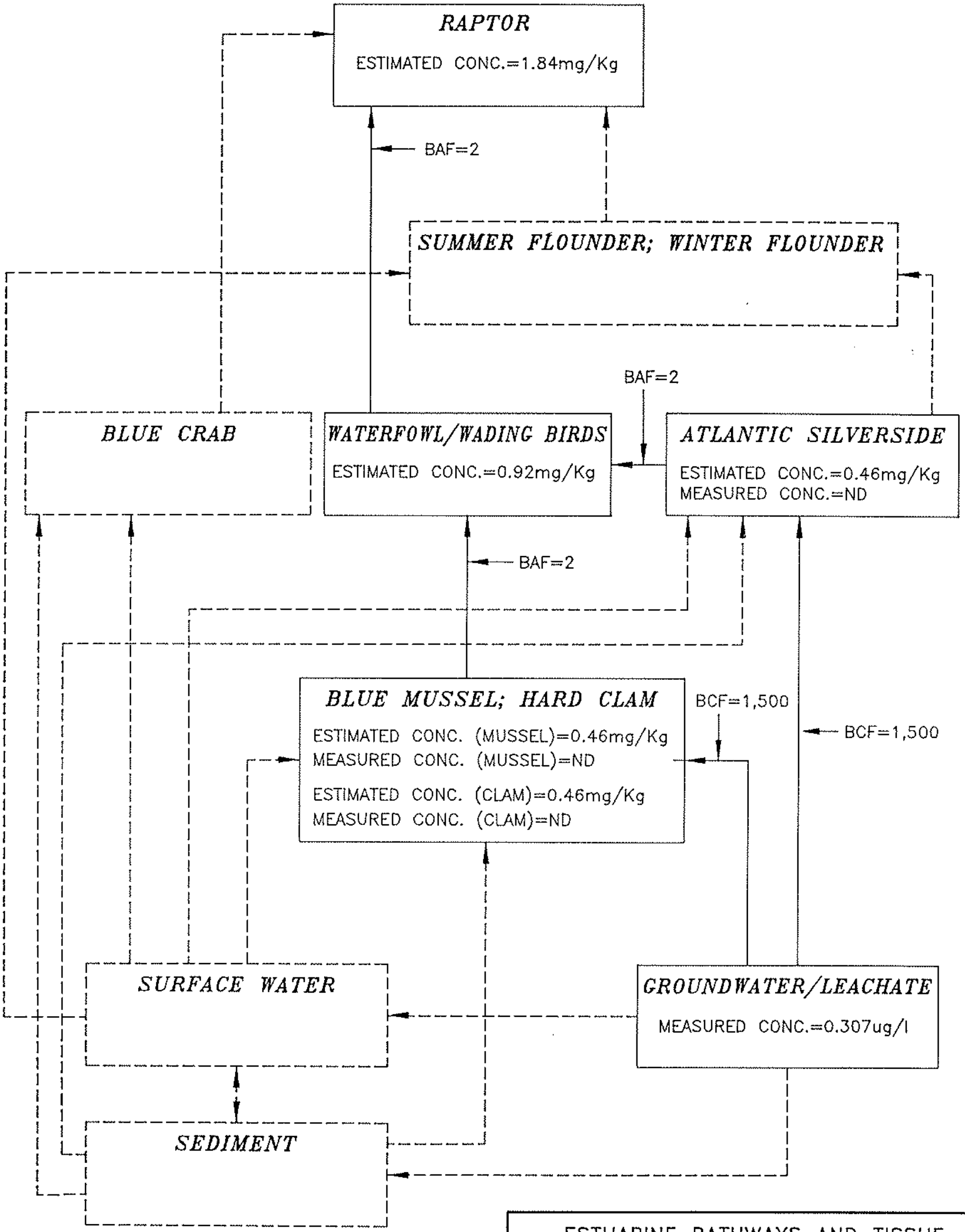
ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR ALPHA-CHLORDANE

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6-21

PEL6-20



KEY

————	QUANTIFIABLE PATHWAY
– – – –	NON-QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

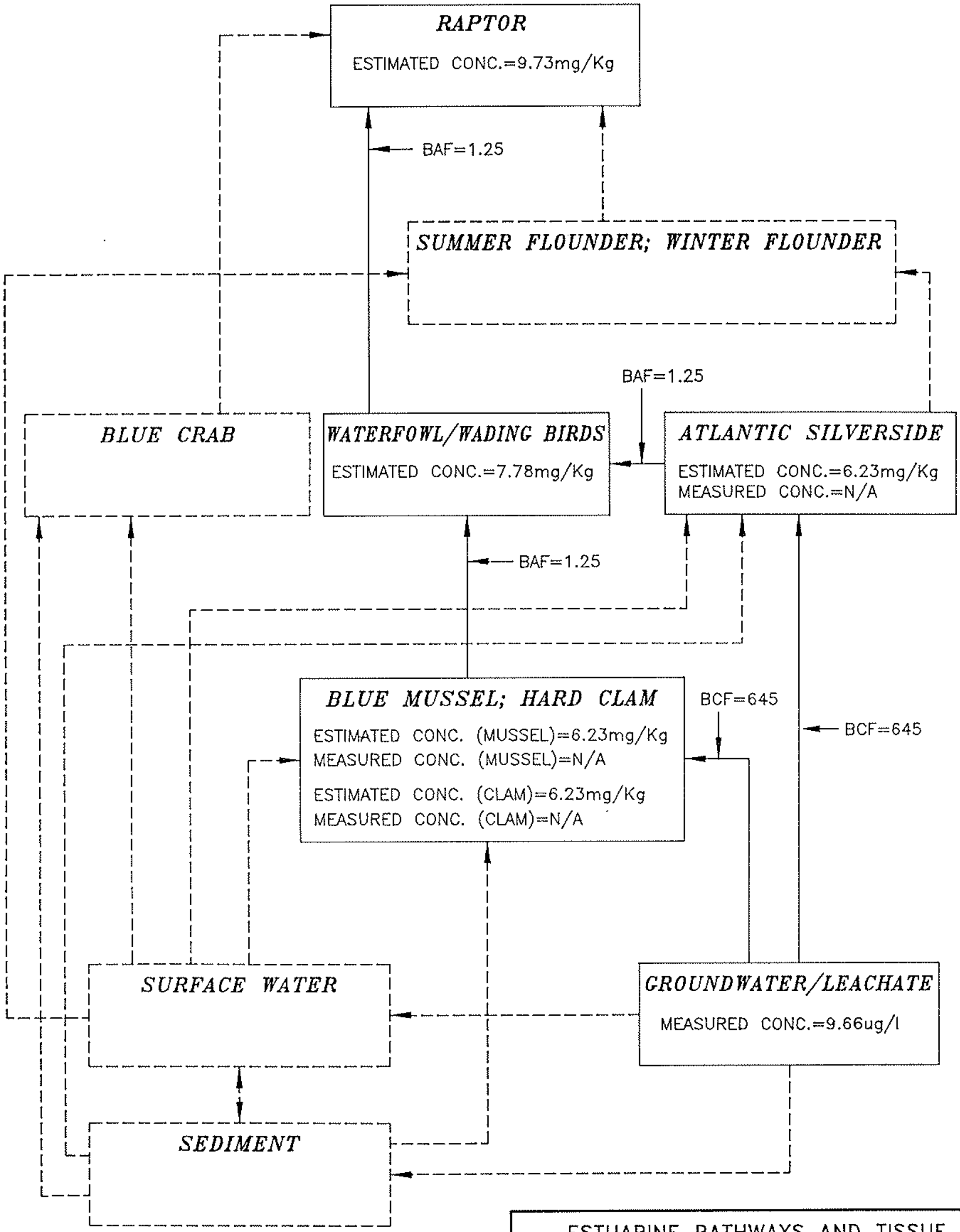
ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR METHOXYCHLOR

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6-22

PEL6-21



KEY

———	QUANTIFIABLE PATHWAY
- - - -	NON-QUANTIFIED PATHWAY OR MATRIX
BAF	BIOACCUMULATION FACTOR
BCF	BIOCONCENTRATION FACTOR
N/A	DATA NOT AVAILABLE
ND	NOT DETECTED

ESTUARINE PATHWAYS AND TISSUE CONCENTRATIONS FOR CHLOROBENZENE

PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DRAWN BY:	SCALE: NONE	PROJ. NO.: 92C4087
CHECKED BY: TGC	DATE: 20 JAN 1993	FIG. NO: 6-23

PEL6-22

7.0
CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

Summaries of the conclusions pertaining to each of the major tasks comprising the Pelham Bay Landfill RI are presented in the following sections.

7.1.1 Land Surface Characterization Conclusions

- The existing landfill cover is being eroded by surface water runoff in several places.
- The existence of underground structures may create local areas of high permeability beneath the landfill.

7.1.2 Geologic and Solid Materials Characterization Conclusions

- Hot spots, or areas of grossly contaminated soils, were not found on site or off site during this investigation.
- The SVO levels of the on-site and off-site surface soils exceed the reference levels at many locations.
- The source of the constituent exceedances in the shallow off-site soils is not known. This issue will be addressed in the SRI.
- The soils adjacent to the site are not adequately characterized in terms of potential impact from landfill surface water runoff.

7.1.3 Groundwater/Leachate Characterization Conclusions

- The landfill is the source of constituents in the groundwater/leachate that exceed NYSDEC Groundwater Standards and surface water discharge limitations.

- The shallow groundwater contaminated above standards extends to Eastchester Bay to the northeast, east, and south. Shallow groundwater also flows to the tidal wetlands to the northwest and west, and the potential exists for groundwater and soil contamination to exist between the site and the wetlands. Shallow groundwater contamination associated with the site is not present to the southwest, nor does a potential for it to occur exist based on flow.

- Contaminant migration in the bedrock is likely limited to locations where interconnected open fractures are present. The extent of contamination in the bedrock is not fully defined, but can reach the surface water bodies off site to the southwest, and to a limited depth vertically. The bedrock flow pathway is believed to be minor when compared to the shallow groundwater horizontal flow pathway. Further evaluation of the site's bedrock is not believed to be warranted.

- The major discharge pathway to surface water is the shallow groundwater system. Seep flow is believed to be less than 10% of shallow groundwater flow.

- Fate processes that affect the degradation and attenuation of constituents in the landfill play a role in limiting the migration of VOCs, SVOs, and pesticides in the shallow groundwater. The fate of contaminants in the bedrock flow system is largely unaffected during transport.

7.1.4 Surface Water Conclusions

- The large volume of water that flows past the landfill during tidal cycles rapidly dilutes and disperses landfill-derived groundwater/leachate that discharges to Eastchester Bay via seeps along the perimeter of the seawall that encloses the landfill.

- The landfill groundwater/leachate potentially contributes to concentrations of the following compounds in the surface water adjacent to the landfill: bis(2-ethylhexyl)phthalate, di-n-butylphthalate, alpha-BHC, delta-BHC, aluminum, copper, iron, lead, nickel and vanadium. Of these, lead and nickel were measured at concentrations above NYSDEC Surface Water Criteria and were not detected at a reference station outside the influence of the landfill. Whether or not these chemicals pose a risk to human health and the environment will be determined in the BRA.

7.1.5 Sediments Characterization Conclusions

- Sediment inorganic data (e.g., metals) normalized to percent fines suggest that the landfill is not a primary contributor to the observed concentrations.

- The landfill groundwater/leachate potentially contributed to concentrations of the following constituents in the sediments along the eastern seawall of the site: 2-propanone, acenaphthene, fluorene, di-n-butylphthalate, 4,4'-DDD, 4,4'-DDE, delta-BHC, and selenium. The pesticides 4,4'-DDD and 4,4'-DDE exceeded NYSDEC draft sediment cleanup criteria. Whether or not they pose a risk to human health and the environment will be determined in the BRA.

- The landfill groundwater/leachate potentially contributed to concentrations of the following compounds in the sediments along the southern seawall of the site: 2-methylnaphthalene, acenaphthene, anthracene, dibenzofuran, fluorene, naphthalene, phenanthrene, pyrene, di-n-butyl phthalate, di-n-octylphthalate, bis(2-ethylhexyl)phthalate, 4,4'-DDD and dieldrin. Phenanthrene, 4,4'-DDD, and dieldrin exceeded NYSDEC draft sediment criteria. Whether or not they pose a risk to human health and the environment will be determined in the BRA.

- Results of laboratory toxicity tests in which invertebrates and fish were exposed to sediments from locations adjacent to the landfill suggest that chemicals present in these sediments may have contributed to mortalities and growth effects observed during these tests.

- The best predictors for the observed toxicity in the tested invertebrate *Ampelisca abdita* appear to be mercury along with a group of intercorrelated analytes (anthracene, barium, zinc and lead). Of these, only anthracene is believed to be contributed by the landfill groundwater/leachate.

- The best predictors for the observed toxicity in the tested fish *Menidia beryllina* appear to be lead chrysene, silver, acid volatile sulfide (AVS) and butyl benzyl phthalate which are not believed to be landfill-derived.

7.1.6 Ecological Characterization Conclusions

Ecological Communities

- The presence of the landfill does not appear to have affected species diversity on and around the landfill.

- Benthic invertebrate populations resident in sediments appear to be depressed at some stations where groundwater/leachate seeps occur, or potentially occur.

- Groundwater/leachate seeps may be responsible for the observed low densities of rockweeds, other algae and mussels along the south seawall.

Biota Tissue Analyses

- Fillets of edible fish collected from the vicinity of the landfill were found to contain concentrations of chemicals below FDA standards.

- The landfill groundwater/leachate potentially contributed to the bioaccumulation of lead, 4,4'-DDD' 4,4'-DDE, and alpha-chlordane in blue mussels found along the seawall of the landfill. The risks associated with the consumption of these mussels will be determined in the BRA.

- Compounds which bioaccumulate in blue mussels may also be bioaccumulating in Atlantic silversides and/or hard clams; but since their exposure is less direct and infrequent, the concentrations detected are lower than found in mussels.

7.1.7 Air Quality/Soil Gas Characterization Conclusions

- Modeling indicates that current landfill emissions do not exceed regulatory guidelines for the compounds analyzed.

- Data collected indicate that off-site horizontal migration of soil gas is not occurring. This is consistent with and supported by visual observations of healthy vegetation off site, the limited perimeter and flux chamber sampling results, and the results of previous studies.

- The landfill has a low emission potential for particulates and dust; the particulates measured in the community appear to be related to regional sources.

- Some of the methane measured at off-site monitoring locations likely originates from the landfill.

- With the exception of methane, there is no clear relationship between landfill emissions and contaminants measured in the community.

7.1.8 Community Sampling Conclusions

- The results on the indoor air quality study were reported to homeowners by NYCDEP and NYSDEC in concert with the NYSDOH. Their report concluded that the low levels of VOCs detected were typical of findings from other studies of indoor residential air quality.

- There is no apparent hydraulic connection between the surface water and the water present in the basements of the three homes sampled.

- The three homes sampled are hydraulically upgradient from the landfill. Therefore, groundwater from beneath the landfill is unlikely to reach the homes.

7.1.9 Land Use and Demographics Characterization Conclusions

- It appears that the study area will remain predominantly residential in nature. Recently, the Department of City Planning proposed a new lower density residential zoning configuration for the Spencer Estates/Country Club Area to preserve the lower density residential character in the stable community.

7.2 RECOMMENDATIONS

7.2.1 Data Limitations and Recommended Additional Site Investigations

Data gaps exist with respect to off-site areas of concern. The draft RI has not generated sufficient data to determine if the landfill has negatively impacted off-site soils. Therefore, additional soil sampling is recommended to make this determination. Historical surface water/leachate runoff pathways would be located and sampled. Soil samples would be collected within identified pathways starting from the landfill and continuing until soil contamination, if any, is delineated. Samples would be collected from surficial soils and analyzed for TCL organics and metals. The results of these analyses would determine whether or not a second round of sampling is necessary, based on the level of contamination detected in the samples. The purpose of this second round of sampling would be to determine the extent (area and volume) of off-site soils adversely impacted by the landfill. A supplemental RI (SRI) report would be issued to present the findings of the additional sampling program.

7.2.2 Recommended Remedial Action Objectives

7.2.2.1 Recommended Objectives Based on Exceedances of Criteria

7.2.2.1.1 Soil

The soil analytical data were compared to the reference station (MW-124) data which may reflect natural or background conditions. Exceedances of the reference station results were noted both on site and off site. The results of shallow on-site soil sample analysis indicates that, although there are exceedances of reference concentrations, there are no areas of gross surface soil contamination. Off-site surface soil sample results indicate exceedances of reference station levels in areas where the source of these constituents is not known.

Corrective action measures for the on-site shallow soils should be based on limiting potential exposure of the soils to the environment. Corrective action measures for soils adjacent to the site will be evaluated once the soils are characterized in the supplemental RI.

7.2.2.1.2 Groundwater/Leachate

Groundwater/leachate is predominantly discharging into surface water and seeps along the riprap wall and beach area to the south of the site from the shallow groundwater flow pathway. Since most of these discharges, where measured, contain constituent levels above NYSDEC Groundwater Standards and surface water discharge limitations, there is a need for corrective action measures. These corrective action measures should be based on limiting the migration of groundwater in the shallow flow system from the site boundaries. Corrective action off site (between the western site boundary and the wetlands) is not believed to be warranted because the discharges to the wetlands will be minimized with containment at the site boundary. Corrective action in the bedrock is also not warranted since there are no sources of drinking water in the area and discharges to surface water from the bedrock are believed to be relatively minor.

7.2.2.1.3 Surface Water

Three metals (nickel, lead, and mercury), although not detected at the surface water field reference station, were detected in several samples in the vicinity of the landfill at concentrations above NYSDEC Surface Water Quality Standards for SB waters. While this might imply that the discharge of groundwater/leachate from the landfill is responsible for these exceedances, mercury was actually detected at higher levels in surface water than in groundwater/leachate. However, given the fact that exceedances of nickel and lead also occur near the site, the recommended objective for surface water is to reduce the potential for input of these metals to the surface waters of Eastchester Bay.

7.2.2.1.4 Sediment

Exceedances of the draft NYSDEC sediment cleanup criteria occur for both PAHs and metals at both the landfill vicinity and reference locations. In addition, the draft NYSDEC sediment criteria (on a wildlife residue basis) for the pesticides 4,4'-DDD and 4,4'-DDT and (on a human health residue basis) for the pesticides 4,4'-DDE and dieldrin, were exceeded at locations near the landfill, and were not found in sediments from the reference station. Since some of these pesticides also occur in the groundwater/leachate, the recommended objective for sediment is to reduce the potential for input of these pesticides to the surface waters of Eastchester Bay. In this way, the potential for the sediments to act as a sink for these pesticides would be reduced.

Both the human health and ecological risks associated with these off-site sediments will be addressed in the BRA. Specific remedial objectives will be re-evaluated based on these risk analyses and any additional NYSDEC guidance relating to the draft Sediment Cleanup Criteria. Since these criteria are draft guidelines, no objectives addressing the remediation of contaminated sediments are presented herein.

7.2.2.1.5 Biota

The biota tissue data were compared to the Food and Drug Administration (FDA) fish tissue standards. Since there were no FDA standard exceedances, no remedial actions objectives have been identified relating to this aspect of the uptake of these analytes by

Limitations

This hazard evaluation was based on unvalidated data and a large number of assumptions concerning the manner and frequency with which people could be exposed to COCs and the effects these exposures might have on human health. Based on Federal and New York State guidance, the approach taken was to estimate a reasonable maximum exposure for an individual using conservative assumptions. Therefore, there is a high likelihood that these estimates overestimate the risk to human health.

7.2.2.2.2 Objectives Based on Ecological Hazard Evaluation

The ecological hazard evaluation presents qualitative analyses of the potential risks to biota that inhabit the terrestrial ecosystem that occurs on the landfill, as well as that portion of the estuarine ecosystem that occurs within the intertidal zone adjacent to the seawall. The risks evaluated are those that occur through the following exposure pathways:

Estuarine Ecosystem

- Direct contact of aquatic biota with groundwater/leachate
- Indirect ingestion of aquatic biota by predatory estuarine birds

Terrestrial Ecosystem

- Direct uptake by vegetation from soil
- Direct contact of soil by terrestrial invertebrates
- Direct ingestion of soil by small mammals and birds
- Indirect ingestion of small mammals and birds by predatory birds and mammals

Estuarine Hazard Evaluation

The discharge of groundwater/leachate in the intertidal zone adjacent to the riprap wall poses potential risks to shellfish, forage fish, and predatory birds that feed in this area. The ecological COCs that pose the greatest potential hazard to these species are the metals copper, nickel, lead, mercury, and zinc; PCBs; and five pesticides (see Table 6-42). Landfill discharges also appear to have adversely affected the growth of rockweeds and mussels attached to the landfill riprap and may be responsible for reduced numbers of benthic invertebrates inhabiting the soft sediments around the perimeter of the landfill, particularly along the south seawall. Reduction of groundwater/leachate discharges is the recommended objective for the remedial action.

Terrestrial Hazard Evaluation

The surficial soils that comprise the existing landfill cap contain concentrations of ecological COCs that pose a risk to terrestrial biota. Primary among these COCs are mercury, PCBs, and six pesticides (see Table 6-41). Placement of a clean fill soil cover capable of supporting a permanent vegetative cover is a recommended objective for the remedial action.

biota. However, specific remedial objectives relating to impacts or uptake by biota are discussed in Section 7.2.2.2.

7.2.2.1.6 Air

The soil gas emission monitoring program identified 30 organic and inorganic compounds in the landfill soil gas emissions. The soil gas emissions data were then used to model air quality concentrations for the detected air constituents. The results of the air quality modeling identified that worse case on-site and off-site predicted air concentrations were well below the New York State AGC and SGC guidelines. In addition, for those constituents that are not identified by the New York State Guide-1 as air toxics, the predicted worse case on-site and off-site concentrations were compared and were well below the Occupational Safety and Health Administration (OSHA) 8-hour Permissible Exposure Limits (PEL). Methane concentrations are also well below the Lower Explosive Limits (LEL).

Comparing the modeling and off-site monitoring results indicated that no more than 25% of the measured ambient air concentrations was attributable to the soil gas emissions from the landfill. However, the landfill's contribution to ambient methane concentrations within the community was found to be significant. In order to reduce methane concentrations within the surrounding community, landfill soil gas emissions may need to be controlled during the site remediation.

7.2.2.2 Recommended Objectives Based on Hazard Evaluation

7.2.2.2.1 Objectives Based on Health Hazard Evaluation

The human health hazard evaluation presents estimates of carcinogenic and noncarcinogenic risks to workers and youth trespassers on site through the following exposure pathways:

- Incidental ingestion and dermal contact of leachate
- Incidental ingestion and dermal contact with landfill soils
- Breathing volatile emissions near the landfill

Noncarcinogenic Risks

In the three exposure pathways, chemical exposures are estimated to be below a level that would cause adverse health effects, even for sensitive subgroups (e.g., the very young and the very old).

Carcinogenic Risks

Carcinogenic risks may be expressed in terms of the number of additional cancer cases per million people exposed at that level for a lifetime. Generally, a risk of less than one additional cancer case per million is considered negligible while risks in excess of about 100 per million are considered to require risk reduction via site remediation or some other type of control. For excess risks between 1 and 100 per million, the need for remediation is generally a function of the number of people exposed, the cost and effectiveness of remediation, and the future use of the site.

Based on the hazard evaluation presented in Section 6.2, noting the discussion in Section 6.2.8 of the considerable uncertainty associated with all risk assessments, the calculated upper-bound number of new cancer cases per million people exposed at that level for a lifetime based on assumptions approved by New York State Department of Health (NYSDOH), are:

Workers	17 cases/million exposures
Youth Trespassers	16 cases/million exposures

The majority of these cases are estimated to result from ingestion of, and dermal contact with, soil. As such, remediation or institutional controls which would reduce the potential for access to soils would substantially reduce or eliminate these risks.

At the 17 per million total cancer risk level calculated for the landfill, it would require more than 58,000 people to be exposed to have an expected number of new cancers greater than one. In reality, far fewer people are expected to be exposed. Therefore, the expected number of new cancer cases would be substantially less than one.

Table 7-1
Surface Water and Sediment Data Summary
Pelham Bay Landfill
Bronx, New York

location:	SD-1	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8	Reference Location SD-9
Surface Water									
Number of PAHs detected					1				
Number of phthalates detected				2	2	1			
Number of pesticides detected	2	1	3	1	1	1			
NYSDEC Criteria Exceedences (H = high tide and L = low tide)	Ni (H&L), Hg (L)			Hg (H)	Pb (H), Hg (L)	Ni (H), Pb (L)		Hg (H)	
Sediment									
Total PAHs (ug / kg dry weight)	8,007	8,232	6,029	11,745	6,252	23,833	5,712	5,797	6,886
Number of PAHs exceeding the Draft NYSDEC Cleanup Criteria	5	5	5	5	5	6	5	5	5
Number of Pesticides exceeding the Draft NYSDEC Cleanup Criteria	2	3	3			2	2	2	
Metals Exceeding Draft NYSDEC Lowest Effect Level	As,Cr,Cu,Fe, Pb,Mn,Hg,Zn	As,Cr,Cu,Fe, Pb,Hg,Zn	As,Cd,Cr,Cu, Fe,Pb,Hg,Zn	As,Cr,Cu,Fe, Pb,Hg,Zn	As,Cd,Cr,Cu,Fe, Pb,Mn,Hg,Zn	As,Cd,Cr,Cu, Fe,Pb,Hg,Zn	As,Cd,Cr,Cu,Fe, Pb,Mn,Hg,Zn	As,Cd,Cr,Cu,Fe, Pb,Mn,Hg,Zn	As,Cd,Cr,Cu,Fe, Pb,Mn,Hg,Ni,Zn
Metals Exceeding Draft NYSDEC Severe Effect Level	Cu	Cu	Cu	Cu	Cu	Cu	Cu, Cr	Cu, Cr	Cu, Cr
Percent Fines	91.7%	91.2%	57.6%	73.6%	90.1%	34.1%	85.8%	88.7%	88.5%
Percent Organic Carbon	1.71%	2.34%	2.24%	2.09%	2.12%	4.31%	2.04%	2.39%	1.96%
Sediment Toxicity Testing									
Ampelisca percent survival (solid phase)	80.0%	65.0% (a)	80.0%	75.0%	52.5% (a)	62.5% (a)	50.0% (a)	52.5% (a)	0.0% (a)
Menidia percent survival (elutriate toxicity test)	80.0%	77.8%	88.9%	[illegible]2.2% (a)	60.0% (a)	66.7%	73.3%	73.3%	84.4%
Menidia growth (b)	0.4215	0.3953	0.3206(a)	0.7019	0.7467	1.0263	0.3660	0.5226	0.3854
Benthic Invertebrates									
Number of Taxa	29	31	23	20	13	17	12	6	6
Mean Density (No. of Organisms / Sq. Meter)	40,963	2,482	17,363	3,408	9,696	22,208	2,243	1,751	277

Notes:

% fines = % (by weight) of silt and clay fraction combined (< 63 um)
(a) Significantly different than the laboratory control
(b) Mean dry weight per larvae (mg)

prepared by: RTG
checked by: ABB
92c4087