Revised Comprehensive Sediment Investigation Report for Operable Unit 2

Volume II of II

Hudson (Water Street) Site
Hudson, New York

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ARCADIS

Appendix A

Characterization of the Bioavailability and Toxicity of PAHs in Aquatic Sediments at OU-2, Hudson (Water Street) Former MGP Site

GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Site Characterization of the Bioavailability and Toxicity of PAHs in Aquatic Sediments at OU2 of the Hudson (Water Street) MGP Site

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Abbreviations and Acronyms

ANOVA	Analysis of Variance
Aquatec	Aquatec Biological Sciences, Inc.
AquaTOX	AquaTOX Research, Inc.
ASTM	American Society for Testing and Materials
bss	Below the Sediment Surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
COC	Chain of Custody
CSIR	Comprehensive Sediment Investigation Report
EERC	Energy and Environment Research Center
EqP	Equilibrium Partitioning
ER-L	Effects Range-Low
ER-M	Effect Range-Median
F&W	Fish, Wildlife, and Marine Resources
Foth	Foth Infrastructure & Environment
GEI	GEI Consultants, Inc.
H. azteca	Hyallela azteca
HBI	Hilsenhoff Biotic Index
LD_{20}	Lethal Dose for 20% of Organisms
LOEs	Lines of Evidence
LOEL	Lowest Observed Effect Level
MGP	Manufactured Gas Plant
NAPL	Non-aqueous Phase Liquid
NOAA	National Oceanographic and Atmospheric Administration
NYSDEC	New York State Department of Environmental Conservation
OU	Operable Unit
PAHs	Polycyclic Aromatic Hydrocarbons
PAH_{16}	Sum of the 16 U.S. EPA priority pollutant PAHs, which are a subset of the PAH_{34}.
PAH_{34}	Sum of 34 NOAA PAHs, which include 18 parent and 16 groups of alkylated PAHs
RA	Remedial Action
RETEC	The RETEC Group, Inc.
RI	Remedial Investigation
SOW	Scope of Work
SOC	Soot Organic Carbon
SPME	Solid-Phase Microextraction
SQT	Sediment Quality Triad
TestAmerica	TestAmerica Laboratories, Inc.
3D	3-dimensional
TOC	Total Organic Carbon
TU	Toxic Unit

U.S. EPA	United States Environmental Protection Agency
WOE	Weight-of-Evidence

MEASUREMENTS

bss	below the sediment surface
cy	cubic yard
ft	feet
mg/kg	milligrams per kilogram
mm	millimeter
µg/L	microgram per liter
µm	micrometer
Wt.%	weight percent

Executive Summary

On behalf of National Grid, ARCADIS, Foth Infrastructure & Environment, LLC (Foth), and GEI Consultants, Inc. (GEI) implemented a demonstration project to assess the bioavailability and toxicity of polycyclic aromatic hydrocarbons (PAHs) in surface sediments at National Grid's manufactured gas plant (MGP) site located on the Hudson River in Hudson, New York (Site). This PAH bioavailability assessment was one of three inter-related studies that were conducted to better understand the nature and extent of MGP-related impacts in Operable Unit 2 (OU2) sediment and to provide information for use in updating the Comprehensive Sediment Investigation Report (CSIR).

This characterization of toxicity and bioavailability of PAHs in aquatic sediments from Hudson indicates five main conclusions:

1. PAHs present in sediment samples are not as toxic to benthic aquatic organisms as is currently assumed by the New York State Department of Environmental Conservation (NYSDEC) regulatory guidance for screening contaminated sediments. Sediment samples with total PAH_{16} concentrations as high as 566 mg/kg showed no significant reductions in *Hyallela azteca* (*H. azteca)* survival.
2. The concentrations of pore water PAHs measured using solid-phase microextraction (SPME) were a better predictor of *H. azteca* survival than total PAH_{16} concentrations. The site-specific threshold value for Hudson appears to be closer to 5 SPME pore water TU_{34} instead of the 20 SPME pore water TU_{34} value determined from the previous work conducted in 2003, 2005, and 2006.
3. The locations where toxicity to *H. azteca* is due to bioavailable PAHs are primarily adjacent to Embayment #1.
4. Evaluation of the benthic macroinvertebrate data showed that there were no significant correlations between higher concentrations of PAHs measured by total PAH_{16} or SPME pore water TU_{34} and lower diversity, richness, dominance, or Hilsenhoff Biotic Index (HBI) of the sediments analyzed.
5. The weight-of-evidence assessment of sediment chemistry, toxicity testing, and benthic macroinvertebrate survey shows that only the seven site sediments with both SPME pore water TU_{34} concentrations greater than 5.4 toxic unit (TU) and significant reduction in *H. azteca* survival pose a potential risk to benthic invertebrates at the Site. The locations of these seven sediment samples are primarily adjacent to Embayment #1.

1. Introduction

On behalf of National Grid, ARCADIS, Foth Infrastructure & Environment, LLC (Foth), and GEI Consultants, Inc. (GEI) implemented a demonstration project to assess the bioavailability and toxicity of polycyclic aromatic hydrocarbons (PAHs) in surface sediments at National Grid's manufactured gas plant (MGP) site located on the Hudson River in Hudson, New York (Site). This PAH bioavailability assessment was one of three inter-related studies that were conducted to better understand the nature and extent of MGP-related impacts in Operable Unit 2 (OU2) sediment and to provide information for use in updating the Comprehensive Sediment Investigation Report (CSIR).

The primary goal of this demonstration project was to characterize surface sediments at the Site and evaluate whether PAH impacts pose a risk to benthic invertebrates using a modified sediment quality triad (SQT) approach. The modified SQT approach included three lines of evidence (LOEs): 1) sediment chemical testing, 2) laboratory toxicity testing, and 3) counts of the benthic macroinvertebrates. In addition to measurements of bulk sediment total PAH concentrations, the sediment chemical testing included the application of a new ASTM method (Method D7363-07) for directly measuring dissolved-phase pore water PAH concentrations. The demonstration project was conducted at the request of the New York State Department of Environmental Conservation (NYSDEC), and builds upon the sediment PAH bioavailability research conducted on MGP sediments in New York State through funding and support provided by National Grid and the Northeast Gas Association.

This assessment of PAH bioavailability and toxicity was conducted following the September 2009 Supplemental Sediment Investigation Work Plan for OU2 (SSI Work Plan) with support by the following principle contractors:

- **Dr. Steven B. Hawthorne – Sediment PAH Bioavailability Chemistry**
  Energy and Environment Research Center (EERC)
  University of North Dakota
  Grand Forks, ND
- **Dr. Frank Doherty – Aquatic Toxicity Testing**
  AquaTOX Research, Inc. (AquaTOX)
  Syracuse, NY

- **Dr. Phil Downey – Benthic Macroinvertebrate Taxonomy**
  Aquatec Biological Sciences, Inc. (Aquatec)
  Williston, VT
- **Mr. Rayburn J. Lavigne – General Sediment Chemistry**
  TestAmerica Laboratories, Inc. (TestAmerica)
  South Burlington, VT

A description of the field activities performed at the site, the results of the analytical work that was performed, and interpretation of the data are presented in the remainder of this report.

1.1 Background

Several remedial investigations (RIs) and remedial actions (RAs) have been performed between 1995 and 2009 related to the Hudson River adjacent to the Site. The Site consists of two OUs: OU1 and OU2. OU1 is defined as the Upland Area and Embayment #1. OU2 is identified by the NYSDEC to include sediments in a portion of the Hudson River adjacent to the Site and Embayment #2 sediments (Figure 1-1).

Previous work conducted in 2003, 2005, and 2006 by National Grid (National Grid, 2007) demonstrated that the toxicity of the total PAHs in surface sediments at the Site to benthic aquatic organisms was not adequately predicted by the NYSDEC technical guidance sediment screening values of 4.0 and 44.8 milligrams per kilogram (mg/kg) (NYSDEC, 1999). For example, sediment samples with concentrations of the 16 U.S. Environmental Protection Agency (U.S. EPA) priority pollutant PAHs (total PAH_{16}) as high as 746 mg/kg showed no significant reductions in *Hyalella azteca* (*H. azteca*) survival, and the lowest observed effect level (LOEL) was 310 mg/kg total PAH_{16} (Figure 1-2, top).

As part of the sediment PAH bioavailability research program, it was also demonstrated that the concentration of 34 National Oceanographic and Atmospheric Administration (NOAA) PAHs measured in sediment pore water using solid-phase microextraction (SPME pore water PAH_{34}), correctly classified *H. azteca* survival in 100% (30/30) of samples tested (NOAA, 1998). When expressed in terms of toxic units (TU) [SPME pore water TU_{34}] using the U.S. EPA (2003) equilibrium partitioning (EqP)/narcosis methodology, no significant reductions in survival of *H. azteca* were observed in sediment samples with up to 20 SPME pore water TU_{34} (Figure 1-2, bottom).

The characterization of bioavailability and toxicity of PAHs in aquatic sediments from the three rounds of sampling at the Site indicated that PAHs in surface sediments were not as bioavailable as would have been assumed by regulatory screening levels, and that SPME pore water TU_{34}

measurement provided accurate and protective classification of "toxic" and "nontoxic" sediment samples at the Site. These determinations provided the basis for the demonstration project for OU2, and set the precedent for incorporating SPME pore water TU_{34} measurements into an assessment program to delineate the areal extent of surface sediments which may pose a risk to benthic invertebrates.

1.2 Additional Data Analysis

GMS-SED Model Input

The 3-dimensional (3D) nature and extent of existing RI data was evaluated using GMS-SED 6 (Aquaveo, LLC). GMS-SED is a commercially available finite-element mesh model. The GMS-SED package of stratigraphy modeling and geostatistics tools can be applied for modeling contaminated sediment deposits, and has a proven track record of accuracy, validation, compatibility, and visualization. The GMS-SED model domain (area within which the 3D nature and extent were evaluated) was fixed at an approximate 200-foot buffer beyond the existing RI data, and extended to the centerline of the Hudson River.

Three data types were used to enhance the current understanding of the Site. These included:

1. Sediment RI total PAH_{16} data;
2. SPME pore water TU_{34} data from PAH bioavailability case studies in 2003, 2005, and 2006; and
3. Sediment RI boring log visual observations of sheen and/or non-aqueous phase liquid (NAPL).

Each of these data types and input sources is explained in greater detail below.

Sediment Total PAH_{16} Data

The existing project RI sediment data consisting of 332 total PAH_{16} measurements collected from 108 different sediment borings and surface grab locations were provided to Foth in electronic format (Microsoft Excel®) by ARCADIS. These data were used to evaluate the 3D distribution (horizontal and vertical extent) of total PAH_{16} in sediment (Figure 1-3).

SPME Pore Water PAH_{34} Data

The complete SPME pore water TU_{34} data from the 2003, 2005, and 2006 PAH bioavailability case studies were evaluated. These SPME pore water TU_{34} measurements were made on the 30 samples that were also evaluated for toxicity to *H. azteca* (Figure 1-2), in addition to nine other sediment samples which were not subjected to toxicity testing with *H. azteca*. Therefore, SPME pore water

TU_{34} data are available for 39 sediment samples. These porewater data were used to evaluate the relationship between surface sediment SPME pore water TU_{34} concentrations and the 3D distribution of total PAH_{16} in sediment as defined by the existing project RI sediment data.

Sediment Sheen/NAPL Observations

Sediment boring logs from the RI were reviewed and the top and bottom depth of visible sheen/NAPL, if present in the boring, were recorded. These data were provided to Foth electronically (Microsoft Excel®), and formed the basis of the input for evaluating the presence or absence of sheen/NAPL in sediments at the Site. These qualitative data were semi-quantified according to the following numerical scale:

0 = No visible sheen in the boring
1 = Trace sheen visible in the boring
2 = NAPL visible in the boring

These data were evaluated to determine the presence/absence and depth of visible sheen/NAPL in the main Hudson River channel and Embayments #2 through #4. In addition, the data were evaluated spatially to determine whether deposits were concentrated within specific areas or randomly distributed across the Site.

Sediment Total PAH_{16} Distribution

The sediment total PAH data were interpolated throughout the model domain using a geostatistical kriging routine in GMS-SED. The current understanding of the horizontal and vertical extent of sediment total PAH distributions is shown in Figure 1-3.

Main Hudson River Channel

Based upon interpolation of the data, an areal region of sediment with total PAH_{16} concentrations greater than 100 mg/kg exists in the main Hudson River channel adjacent to Embayment #1, and extends approximately 150 feet from the shoreline and approximately 250 feet up-and-down river of this location (Figure 1-3).

The vertical extent of sediment samples in the main channel of the Hudson River with a total PAH_{16} concentration greater than 100 mg/kg was approximately 8 feet below the sediment surface (bss) [Table 1-1, Figure 1-3].

It was estimated using the GMS-SED model that:

- Approximately 50,000 cy[1] and 15,000 cy of sediment in the main Hudson River channel exceeded 4.0 and 44.8 mg/kg total PAH_{16}, respectively; and
- Approximately 8,000 cy of sediment in the main Hudson River channel exceeded 100 mg/kg total PAH_{16}.

Embayment #2

Thirteen of the RI sediment borings were located within Embayment #2 (MPE2-1, MPE2-2, MPE2-3, SD-30, SD-32, and SD-58 to SD-65). The maximum total PAH_{16} concentration in sediment samples collected less than 4 ft bss was 32 mg/kg. Sediment samples with total PAH_{16} concentrations greater than 100 mg/kg were greater than 4 ft bss and extended to approximately 12 ft bss (Table 1-1, Figure 1-3).

Embayments #3 and #4

Ten of the RI sediment borings were located within Embayment #3 (SD-76, SD-84, SD-85, SD-86, and XSD-1 to XSD-6). The maximum total PAH_{16} concentration in sediment samples collected less than 2 ft bss was 93 mg/kg. Sediment samples with total PAH_{16} concentrations greater than 100 mg/kg were greater than 2 ft bss and extended to approximately 12 ft bss (Table 1-1, Figure 1-3).

Four of the RI sediment borings were located within Embayment #4 (SD-83, XSD-7, XSD-8, and XSD-9). The total PAH_{16} concentrations from samples collected within these borings ranges from less than 1 to 20 mg/kg [Table 1-1, Figure 1-3], with no samples greater than 100 mg/kg.

SPME Pore Water PAH_{34} Concentrations

Five of the SPME pore water PAH_{34} samples, including two of the nine sediment samples with concentrations greater than 20 SPME pore water TU_{34}, were located in Embayment #1 and were collected in 2003 (Figure 1-4). However, since this area of the Site was dredged and backfilled in 2004, these data are no longer representative of impacts in this area of the Site.

Main Hudson River Channel

Six of the remaining seven sediment samples with concentrations greater than 20 SPME pore water TU_{34} in the main channel of the Hudson River were located within the interpolated 100 mg/kg total PAH isopleth. One sediment sample was located approximately 70 feet down river from the 100 mg/kg total PAH_{16} isopleth (yellow/red areas shown in Figure 1-4). All other SPME pore water

[1] Note: Cubic yard estimates are "in-place" cy, and do not account for overcut or other design specifications.

PAH_{34} sediment samples collected at the Site had less than 20 SPME pore water TU_{34} concentrations (blue colored circles in Figure 1-4).

However, within the 100 mg/kg total PAH_{16} isopleth, sediment samples were collected with SPME pore water TU_{34} concentrations ranging from 0.2 near the perimeter to 157 near Embayment #1. Once again, as observed at other MGP sites, these pore water TU_{34} data do not correlate well with the total sediment PAH_{34} concentration data. This observation reflects differences in the extent to which the sediment PAHs are bound within the sediment matrix, which can vary widely across a site.

Embayments #2 through #4

All surface sediment samples collected in Embayments #2 through #4 were less than 20 SPME pore water TU_{34}, and ranged from 0.1 to 4.3 SPME pore water TU_{34} (Figure 1-4).

Sheen and NAPL Distribution

The 31 RI sediment cores and grab samples within which sheen/NAPL was observed are presented in Figure 1-5.

Trace sheen was observed at all 31 locations, with depth intervals ranging from 0 to 14 ft bss in the main Hudson River channel and approximately 4 to 12 ft bss within Embayment #2.

Visible NAPL observations were limited to sediment cores and grab samples collected adjacent to Embayment #1, and were located within the 100 mg/kg isopleth. The depth range for visible NAPL at these locations was from 0 to 4 ft bss. However, one sediment core (SD-78) contained visible NAPL at 4 to 6 ft bss and 10 to 12 ft bss (Figure 1-5).

Additional Characterization Samples

Given the evaluation of sediment total PAH_{16}, SPME pore water TU_{34}, and sheen/NAPL distributions at the Site, the focus of sediment sample locations presented in the SSI Work Plan was to achieve general site-wide characterization of surface sediment PAH bioavailability along the main Hudson River channel, with an emphasis on the region adjacent to Embayment #1. Additional characterization samples were not planned for Embayments #2 through #4. Additional characterization samples were not planned for Embayments #2 through #4 because previous investigations have demonstrated that surface sediment SPME pore water PAH concentrations in these areas were less than 4 SPME pore water TU_{34}.

1.3 Objective and Scope of Work

The objective of the demonstration project was to collect information to assess the bioavailability and potential toxicity of PAHs in OU2 surface sediments. The scope of work (SOW) was developed to assess the chemical, biological, and physical characteristics of these sediments. The SOW included:

- Additional surface sediment sampling to further delineate the sediment total and pore water concentrations of PAH_{34}, with emphasis on the region adjacent to Embayment #1;
- Evaluation of a subset of the surface sediment samples for chronic toxicity (survival and growth endpoints) using the freshwater amphipod *H. azteca*; and
- Evaluation of a subset of the surface sediment samples for benthic macroinvertebrates to assess the in-situ benthic community.

2. Field Activities

Sixty-two sediment samples were collected from the Hudson River adjacent to the Site on October 12 to 22, 2009. This fieldwork was conducted during the mobilization for the third and final round of the sediment monitoring program. The sediment sampling field forms for all 62 samples are provided in Appendix A.

The sediment sampling activities conformed to U.S. EPA and ASTM standard methods where appropriate (ASTM 2000a, ASTM 2000b, U.S. EPA 2001).

2.1 Sediment Sample Locations

Figure 2-1 shows the locations of the 62 sediment samples that were collected. Table 2-1 provides the northing and easting coordinates of the sediment samples, the water depth at the time of sample collection, and a brief field description of each of the samples. Three groups of three reference sediment samples were collected, for a total of nine reference sediment samples. One group was to the north, one to the west, and one to the south of the Site (Figure 2-1).

GEI field personnel recorded observations of the physical characteristics of the sediment encountered at each sampling location and also important observations regarding the physical characteristics of the study area. Information recorded included the presence of fill (if any); aquatic vegetation; sediment color, texture and particle size; and odor and presence of sheens or NAPL. This information is also provided in Table 2-1.

2.2 Field Measurements

Water quality was measured in the field at each sample station location approximately 3 feet above the top of the sediment surface (Table 2-2). The water quality parameters measured in the field were temperature, dissolved oxygen, conductivity, and pH.

2.3 Sediment Sample Collection and Processing

Surface sediment was collected by ARCADIS from each sample station using a 3/8 cubic yard (cy) clamshell dredge deployed by a crane. Each deployment of the dredge was observed by a GEI geologist who observed the recovery and determined whether the recovered sediments should be used or whether additional deployments were needed. The grab was judged to be acceptable if the dredge recovered a sample at least 6 inches thick, and if a sufficiently intact (undisturbed) volume of sediment could be removed from the dredge for at least one sample.

Each sediment sample was divided into two portions, which were placed into clean, plastic buckets. Sediment designated for the benthic invertebrate survey was placed into a 2-gallon bucket; sediment designated for all other samples was placed into a 5-gallon bucket. The buckets were labeled with the sample station designation and transported to an on-shore sample preparation area, where custody of the samples was transferred to GEI.

Sediment samples used for the benthic invertebrate survey were processed by Aquatec personnel. These sediment samples were passed through a 500 µm sieve. The material that did not pass through the sieve was placed into a glass container with a 70% ethyl alcohol preservative and transported to Aquatec's laboratory.

At the on-shore preparation area, the sediment samples were push screened with a #5-mesh (4-mm openings) screen to remove large objects such as cobbles, sticks, or shells. Samples were then homogenized to ensure the consistency of the samples that were sent to each laboratory. Following homogenization, the sediment samples were placed into glass jars with Teflon™-lined lids. The jars were then shipped overnight to the laboratories via FedEx.

All oversized sediment and debris which was screened from the sediment samples, along with all other investigation-derived waste, were placed into drums at the site and disposed of as non-hazardous waste.

3. Sediment Analysis

3.1 Analyses and Testing Methods

Table 3-1 lists the parameters that were measured and the laboratories that performed the analysis on the sediment samples.

3.2 Sample Screening and Selection

All 62 sediment samples were analyzed by EERC for the concentration of total extractable and pore water concentrations of the 34 NOAA PAHs (PAH_{34}), which include 18 parent and 16 groups of alkylated PAHs, subsequently referred to as PAH_{34} (NOAA, 1998). The 16 U.S. EPA priority pollutant PAHs (PAH_{16}) are a subset of the PAH_{34}. Two replicate analyses were performed and reported for each sample.

Sediment pore water PAH_{34} concentrations were measured in two replicate analyses using SPME and expressed as TU (SPME pore water TU_{34}), per U.S. EPA (2003). The SPME pore water TU_{34} concentrations were then used to guide the selection of a subset of 41 sediment samples for measurement of PAH bioavailability using toxicity tests and also for benthic macroinvertebrate identification and counts.

The toxicity and benthic macroinvertebrate community structure of all nine reference samples were determined. The remaining 32 sediment samples were evaluated as "site" sediment samples. These site samples were selected to provide adequate spatial coverage of the Site, in particular the region adjacent to Embayment #1. The 41 samples were selected in consultation with the NYSDEC Fish, Wildlife, and Marine Resources (F&W) through a series of phone calls and e-mails from November 12 to 16, 2009.

4. Results

Chain of custody (COC) documents and reported laboratory results are included as part of this report in Appendices B through E, which are provided as electronic portable data files (pdf) on compact disc.

4.1 PAH Chemistry

The complete digital laboratory report of these data from EERC is provided in Appendix B.

Sediment Total PAH_{16}

The mean concentrations of total PAH_{16} in the 53 site sediment samples (62 sediment samples less the nine reference samples) ranged from 0.03 (HD126) to 11,200 (HD148) mg/kg[2]. The mean concentrations of total PAH_{16} in the nine field reference sediment samples ranged from <0.01 to 5.6 mg/kg. Mean concentrations of total PAH_{34} in the 53 site sediment samples ranged from 0.10 (HD126) to 22,100 (HD148) mg/kg (Table 4-1).

The highest sediment total PAH_{16} concentrations were located adjacent to, and immediately down-river of, Embayment #1 (Figure 4-1). The majority of the sediment samples were less than the NYSDEC F&W Effect Range-Median (ER-M) concentration of 44.8 mg/kg (NYSDEC, 1999).

SPME Pore Water PAH_{34}

The mean concentration of pore water PAH_{34} in the 53 site sediment samples ranged from non-detect (HD107, HD118, HD121, HD125, HD126, HD136, HD154-HD159, HD161, and HD162) to 6,237 (HD148) µg/L. When expressed in terms of TU_{34}, the pore water concentrations for these samples ranged from <0.1 to 163 SPME pore water TU_{34} (Table 4-2).

The mean concentration of pore water PAH_{34} in the nine field reference sediment samples ranged from <0.001 (eight of nine samples) to 0.418 (HD160) µg/L. When expressed in terms of TUs, the

[2] It should be noted that historically the EERC lab results for total PAH_{16} and total PAH_{34} have been approximately 2 to 3 times greater than those measured by a standard commercial laboratory. The reason for this result is primarily due to the fact that EERC is a research laboratory and therefore performs a much more aggressive extraction procedure than a commercial lab. For example, EERC uses centrifugation to dry samples, whereas commercial labs typically decant. In addition, EERC uses an 18-hour soxhlet extraction procedure, whereas commercial labs typically use 1-hour soxhlet or sonication extraction. Therefore, the total PAH_{16} and PAH_{34} concentrations reported in this report should not be compared to the data in the broader CSIR, which focuses on the nature and extent of total PAHs at the Site.

pore water concentrations for these samples ranged from <0.01 to 0.03 SPME pore water TU_{34} (Table 4-2).

Similar to the spatial distribution of total PAH_{16} sediment concentrations, the highest SPME pore water TU_{34} concentrations were located adjacent to and immediately down-river of Embayment #1 (Figure 4-2). As shown in Figure 4-2, the majority of the sediment porewater samples were less than 1.0 SPME pore water TU_{34}.

4.2 Total and Soot Organic Carbon

Total organic carbon (TOC) and soot organic carbon (SOC) were measured using a CHN elemental analyzer on all of the sediment samples that also had the PAH concentrations measured in their porewaters. SOC is defined as the TOC remaining following sediment pretreatment at 375 ºC in a muffle furnace under oxidizing conditions (Gustafsson, et al., 1997).

TOC in the 53 site sediment samples ranged from 0.2 to 11.7 wt. %, and the SOC ranged from 0.1 to 10.5 wt. %. The ratio of SOC to TOC (SOC/TOC) ranged from 0.11 to 0.90 (Table 4-1).

TOC in the nine field reference sediment samples ranged from 0.2 to 1.0 wt. %, and the SOC ranged from 0.1 to 0.5 wt.%. The ratio of SOC to TOC (SOC/TOC) ranged from 0.10 to 0.76 (Table 4-1).

4.3 General Sediment Characteristics

Analyses of sediment ammonia, grain size, percent solids, and pH were performed on all of the 41 samples that were selected for *H. azteca* toxicity testing (Table 4-3). The complete digital laboratory reports from TestAmerica that contain these results are provided in Appendix C.

A review of these general sediment characteristics reveals the following information about the 53 site sediment samples and the nine reference samples:

- Concentrations of ammonia in the site sediment samples ranged from 18.6 to 277 mg/kg, while ammonia in the reference sediment samples ranged from 25.2 to 87.7 mg/kg (Table 4-3);

- The site sediment samples ranged from fine-grained silts and clays (up to 85% fines) to predominantly medium- to fine-grained sands (up to 96% sand fraction). By contrast, the reference sediment samples were mostly medium- to fine-grained sands, with between 64 and 97% sand fraction (Table 4-3) [3].
- Percent solids in the site sediment samples ranged from 55 to 83%, and percent solids in the reference sediment samples ranged from 69 to 80% (Table 4-3).

The pH of the 53 site sediment samples was circum-neutral, ranging between 7.0 and 8.1. The pH of the nine reference sediment samples was similar, ranging between 6.8 and 7.9 (Table 4-3).

4.4 Characterization of Sediment Toxicity

The bioavailability and toxicity of PAHs was also determined by measuring the survival and growth of the aquatic amphipod *H. azteca* following exposure to sediments for 28 days (Table 4-4). The complete reporting of the data from AquaTOX is provided in Appendix D.

Reference Sediment Samples

Three reference sediment samples were collected from each of three different reference areas: one up-river from the site to the north; one across the river to the west; and one down-river to the south (Figure 2-1). The survival and growth of *H. azteca* among these three groups were compared to determine whether or not all nine reference sediment samples could be pooled together, or whether each of the three reference areas would need to treated independently.

Survival of *H. azteca* in all nine reference sediment samples was 100%. Therefore, for the survival endpoint, all reference samples were pooled into a single population.

The mean growth of *H. azteca* was 0.383 ± 0.089, 0.378 ± 0.051, and 0.384 ± 0.077, mg dry wt./organism in the northern, western, and southern reference areas, respectively. A Kruskal-Wallis test (nonparametric equivalent of analysis of variance, or ANOVA) for multiple comparisons (Dunn's Test) showed that the medians of the three reference groups were not significantly different from one another ($p > 0.427$ for all comparisons). Therefore, the growth endpoint for all of the reference samples was also pooled into a single population.

[3] All of the sediment samples were field-screened through a #5-mesh (4-mm openings) screen; therefore, samples described as "gravel" in the field (Table 2-1) do not have companion laboratory measurements of "gravel" in Table 4-3. However, the distributions of coarse- and medium-grained sand in these samples were captured in the laboratory grain size analysis.

The survival and growth of *H. azteca* exposed to the 32 site sediment samples was compared to the survival and growth of the nine pooled reference sediment samples using the nonparametric Wilcoxon Rank Sum test with Bonferroni's adjustment (U.S. EPA, 2000).

Amphipod Survival

Survival of *H. azteca* in the laboratory controls and all nine field reference sediments was 100%. Significant ($p < 0.05$) reduction in *H. azteca* survival compared to the field reference sample was observed for amphipods exposed to the sediment samples HD131, HD138, HD142, HD143, HD146, HD147, HD148 (Table 4-4).

The geographic distribution of samples determined to result in a significant reduction in survival was concentrated adjacent to Embayment #1, with two sample locations extending down-river (HD131 and HD138) [Figure 4-3].

Amphipod Growth

Growth of *H. azteca* for the nine field reference samples ranged from 0.303 ± 0.096 to 0.442 ± 0.061 mg dry wt./organism. Significantly reduced growth ($p < 0.05$) of *H. azteca* compared to the field reference sediments was observed in amphipods exposed to samples HD118 and HD139 (Table 4-4).

4.5 Benthic Macroinvertebrate Data

The 41 sediment samples were evaluated in the laboratory to determine their effects on the benthic macroinvertebrate community structure. Macroinvertebrates recovered from each sample were sorted, counted, and identified down to the lowest feasible taxonomic level (Genus) by Aquatec. The complete digital reporting of the laboratory results from Aquatec is provided in Appendix E.

Up to 679 total organisms (N) and 25 individual taxons (S) were identified in the sediment samples (Table 4-5). To simplify the data reporting and subsequent interpretation, several common indices were calculated from these raw count data. The four main indices included:

1. Diversity,
2. Richness,
3. Hilsenhoff Biotic Index (HBI), and
4. Dominance.

Detailed descriptions of how each index was calculated, including method references, are provided below.

Calculation of Indices

Shannon's diversity index (diversity) was computed according to Shannon (1948):

$$Diversity = -\sum_{i=1}^{s} p_i \log_2 p_i$$

where s is the number of taxons per sample and p_i is the proportion of total individuals in the *i*th species.

Margalef's species richness index (richness) was computed according to Margalef (1958):

$$Richness = \frac{s-1}{\ln(N)}$$

where s is the number of taxons and N the total number of individuals in a sample.

The HBI was adapted from Hilsenhoff (1987) to include tolerance values listed by NYSDEC (NYSDEC, 2002):

$$HBI = \frac{\Sigma TV_i N_i}{\Sigma N_i}$$

where TV_i is the pollution tolerance value of the *i*th species (1 = very intolerant and 10 = highly tolerant) and N_i is the abundance of the *i*th taxa. HBI was expressed as (10-HBI) for order of scales (i.e., a low 10-HBI correlates with degraded conditions).

Lastly, dominance was the percent contribution of the most numerous species (NYSDEC, 2002). Dominance was also expressed as (10-dominance) for order of scales (i.e., a low 10-dominance correlates with degraded conditions, which represent conditions that are dominated by only a limited number of species).

Benthic Index Summary

Table 4-5 lists the results of the benthic macroinvertebrate survey. The ranges for N in the reference and site sediment samples were from 10 to 414 and 4 to 679 organisms, respectively. The ranges for S were from 5 to 20 and 1 to 25, respectively.

The ranges for each of the indices were similar between the reference and site sediment samples as shown below:

- Diversity ranged from 0.9 to 3.1 in the reference sediments and 0.0 to 3.8 in the site sediments;
- Richness ranged from 1.3 to 4.3 in the reference sediments and 0.0 to 4.2 in the site sediments;
- The 10-HBI ranged from 0.1 to 2.8 in the reference sediments and 0.5 to 3.6 in the site sediments; and
- 10-dominance ranged from 1.7 to 7.6 in the reference sediments and 0.0 to 8.4 in the site sediments.

The benthic macroinvertebrate indices were variable across the site. For example, diversity varied by a factor of two within an individual reference area and, unlike the PAH chemistry and toxicity testing, showed no relationship with Embayment #1 (Figure 4-4). These indices are discussed along with all of the other measurement endpoints in Section 5 (Interpretation).

5. Interpretation

The three measurement endpoints – sediment chemistry, laboratory toxicity testing, and benthic macroinvertebrate survey – were evaluated in a weight-of-evidence (WOE) assessment to characterize surface sediments at the Site. This WOE assessment was organized into four main components:

1. Correlation between sediment total (PAH_{16}) and pore water PAH_{34} measurements and the survival and growth of *H. azteca*.
2. Correlation between sediment total and pore water PAH measurements and the benthic macroinvertebrate survey indices.
3. Comparison of benthic macroinvertebrate survey indices between reference and site sediment samples.
4. SQT assessment combining the three measurement endpoints into a matrix.

5.1 Sediment Chemistry and Toxicity Testing

Survival Endpoint

NYSDEC technical guidance sediment screening values of 4.0 mg/kg (Effects Range-Low or ER-L) and 44.8 mg/kg (Effect Range-Median or ER-M) total PAH_{16} (NYSDEC, 1999) did not provide sufficient discrimination between "toxic" and "nontoxic" sediments at the Site. For example, 33 of the 41 (81%) sediment samples analyzed from the Site exceeded the ER-L value, despite the fact that only seven of the 33 sediment samples (21%) were toxic to *H. azteca*. Twenty-four samples exceeded the ER-M value, but only seven of the 24 samples (29%) were toxic to *H. azteca* (Figure 5-1).

The LOEL total PAH_{16} concentration associated with a significant reduction in amphipod survival was 112 mg/kg (HD142 at 18% survival). However, sediment samples with total PAH_{16} concentrations as high as 566 mg/kg (HD151) showed no significant reductions in *H. azteca* survival (Table 4-4). Therefore, a LOEL approach using the total PAH_{16} measurement endpoint yields an approximate factor of four uncertainty.

The LOEL SPME pore water TU_{34} concentration associated with a significant reduction in amphipod survival was 5.6 TU (HD142 at 18% survival). However, sediment samples with SPME pore water TU_{34} concentrations as high as 8.6 TU (HD123) showed no significant reductions in *H. azteca* survival (Table 4-4).

To better quantify the correlation between sediment PAH chemistry and the survival endpoint, comparisons of sediment total and pore water PAH measurements to *H. azteca* survival were also made using a logistic regression (Field, et al., 2002; Helsel, 2005). The classification of "toxic" and "nontoxic" for each sediment samples was based on sediment toxicity test data. Sediment samples determined to have significantly ($p < 0.05$) reduced survival in comparison to the field reference sediments were classified as "toxic", and those sediment samples determined to have no significantly reduced survival were classified as "nontoxic" (Table 4-4). For each regression, the intercept (β_0) and slope (β_1) were determined. Models were evaluated and compared using the likelihood r-squared (a measure of the overall "strength" of the relationship) and Goodman-Kruskal gamma [a rank-order correlation statistic used as a measure of association for the ability of the predictor variable (PAH measurement) to explain the response variable ("toxic" or "nontoxic")]. The 95% confidence intervals were determined for each of the predicted probabilities using the procedures outlined by Helsel (2005). All logistic regression analyses were performed using MINITAB® Release 14 (Minitab, Inc.).

Logistic regression showed that total PAH_{16}, total PAH_{34}, and SPME pore water TU_{34} concentrations were all significant ($p < 0.05$) predictors of *H. azteca* survival. However, the SPME pore water PAH_{34} concentrations explained about 10% more of the variance in *H. azteca* survival (likelihood r-square value of 0.53 as opposed to 0.44 and 0.46, respectively). In addition, the SPME pore water TU_{34} concentrations provided greater precision to predictions of *H. azteca* survival. For example, the 95% confidence intervals for the LD_{20} (Lethal Dose, 20% - the concentration required to kill 20% of the test organism population after 28 days) using total PAH_{16} and total PAH_{34} were 200 to 650 mg/kg and 300 mg/kg to 3,000 mg/kg, respectively. By contrast, the 95% confidence interval for the LD_{20} using SPME pore water TU_{34} concentrations was 5.4 to 10 TU (Table 5-1, Figure 5-1).

The results of the logistic regression show that the SPME pore water TU_{34} concentrations were a more accurate predictor of *H. azteca* survival. These results are similar to those observed at other sites (Hawthorne, et al., 2007). Therefore, this measurement endpoint was weighted more heavily than ER-L or ER-M screening criteria based on total PAH_{16} concentrations for the WOE assessment.

Growth Endpoint

Comparisons of sediment total and pore water PAH measurements to *H. azteca* growth were made using Spearman's rho, a rank correlation between two variables (Helsel and Hirsch, 2002; Helsel, 2005). Rho is the linear correlation coefficient (Pearson's r) computed on the ranks of the data. Thus rho can be computed as a rank transform method.

The growth of *H. azteca* showed no significant correlation with respect to the concentration of total PAH_{16}, total PAH_{34}, or SPME pore water PAH_{34} (Figure 5-2). The p-values for the Spearman's rho for total PAH_{16}, total PAH_{34}, and SPME pore water TU_{34} concentrations versus *H. azteca* growth were 0.437, 0.405, and 0.139, respectively. Therefore, none of the measurements of PAH concentration could explain a significant ($p < 0.05$) fraction of the variability in the growth of *H. azteca*.

Due to the lack of correlation between sediment PAH chemistry and the growth endpoint, this measurement endpoint was not considered further in the WOE assessment of sediments at the Site.

5.2 Sediment Chemistry and Benthic Indices

Comparisons of sediment total and pore water PAH measurements to benthic macroinvertebrate indices were also made using Spearman's rho. The benthic macroinvertebrate indices showed no significant correlation ($p > 0.322$ for all comparisons) with respect to the concentration of total PAH_{16}, total PAH_{34}, or SPME pore water TU_{34} (Figure 5-3).

The benthic macroinvertebrate survey data are potentially the most ecologically relevant of the three measurement endpoints, as these data represent a snapshot of the in-situ benthic community. Therefore, rather than exclude this measurement from further evaluation, the benthic macroinvertebrate indices for site sediment samples were compared against the nine reference sediment samples (Section 5.3).

5.3 Site and Reference Benthic Indices

Four benthic macroinvertebrate indices (diversity, richness, 10-HBI, and 10-dominance) were compared simultaneously between site and reference sediment samples. Prior to this comparison, the metrics were scaled on a 0 to 99-scale for inter-metric scale consistency per NOAA (2004):

$$\text{Scaled Value} = \frac{(\text{Initial Value} - \text{Minimum Value})}{(\text{Maximum Value} - \text{Minimum Value})} \times 99$$

This methodology for scaling introduces no mathematical aberrations (i.e., noise) into the data, and was therefore chosen for the multi-metric comparison as opposed to the NYSDEC Appendix V formulas for calculating biological assessment profile values for ponar samples (NYSDEC, 2002).

The range in the four benthic macroinvertebrate indices for the reference sediment samples, normalized on a 99-scale for comparison, was similar to the range observed in the site sediment samples. Two site sediment samples were consistently lower than the reference range for diversity, richness and 10-dominance, and were in the bottom 25th percentile (i.e., less than 25) for these indices (HD143 and HD148). One reference sediment sample was consistently lower than the

others (HD157). The 10-HBI metric did not provide discrimination between reference and site sediment samples, as the reference range was lower than the range for site sediment samples (Figure 5-4).

Based on this multi-metric comparison, the in-situ benthic macroinvertabrate community in the site sediment samples, with the exclusion of HD143 and HD148, is commensurate with (i.e., within the expected range) the three reference locations. Therefore, in the WOE assessment, only samples HD143 and HD148 are classified as "significant".

5.4 Sediment Quality Triad Assessment

The three measurements endpoints were combined into a matrix (table) for a WOE evaluation of impacts (Table 5-2). Sediment samples were denoted with an asterisk for the following metrics:

- If they exceeded 44.8 mg/kg total PAH_{16} PEC value (Section 4.1, MacDonald et al., 2000);
- If they exceeded 5.4 SPME pore water TU_{34}, the lower 95% confidence level (LCL_{95}) for the LD_{20} (Section 5.1);
- If they had significantly reduced *H. azteca* survival as compared to the field reference sediment samples (Section 4.4); and
- If they were consistently lower than the reference range for the benthic macroinvertabrate multi-metric comparison between site and reference sediment samples (Section 5.3).

Only two of the site sediment samples failed all four criteria, HD143 and HD148. Of the 12 site sediment samples exceeding 5.4 SPME pore water TU_{34}, seven of these samples had significantly reduced *H. azteca* survival as compared to the field reference sediment samples.

The relatively high fraction of SOC/TOC in the sediment samples (up to 90% in some site sediment samples, Table 4-1) provides an explanation for why the ER-L/ER-M screening values for total PAH_{16} concentrations do not predict biological effects. The PAHs are much more strongly bound to sediment organic carbon than is assumed by the standard equilibrium partitioning assumptions. PAHs sorb to anthropogenic sources of "hard" organic carbon (e.g. charcoal, soot, coal or coke fines, or coal tar pitch) more strongly than to natural sources of "soft" organic carbon (e.g., natural organic matter). As a consequence, the total PAH_{16} concentration is not bioavailable. By contrast, the direct measurement of sediment pore water (SPME pore water TU_{34}) only measures the concentration of PAHs that partition from the solid phase (i.e., sediment) to the dissolved phase (i.e., pore water). It is this bioavailable fraction which drives exposure, and is therefore a better predictor of biological effects (e.g., *H. azteca* survival).

The reduction in *H. azteca* survival in the seven site sediments can positively be attributed to PAHs in sediment. Logistic regression shows a high degree of certainty between these two measurement

endpoints (Section 5.1). However, the remaining five site sediments with SPME pore water TU_{34} concentrations greater than 5.4 TU did not cause significant reductions in *H. azteca* survival, and all had 100% survival. In addition, no observable effects on the benthic macroinvertebrate community survey were associated with these five sediment samples.

Therefore, the WOE assessment of sediment chemistry, toxicity testing, and benthic macroinvertebrate survey shows that only the seven site sediments with both SPME pore water TU_{34} concentrations greater than 5.4 TU and significant reduction in *H. azteca* survival pose a potential risk to benthic invertebrates at the Site (Table 5-2, Figure 5-5).

6. Conclusions

This characterization of toxicity and bioavailability of PAHs in aquatic sediments from Hudson indicates that the PAHs present in sediment samples are not as toxic to benthic aquatic organisms as is currently assumed by the NYSDEC regulatory guidance for screening contaminated sediments. Sediment samples with total PAH_{16} concentrations as high as 566 mg/kg showed no significant reductions in *H. azteca* survival.

The concentrations of pore water PAHs measured using SPME were a better predictor of *H. azteca* survival than total PAH_{16} concentrations. The site-specific threshold value for Hudson appears to be closer to 5 SPME pore water TU_{34} instead of the 20 SPME pore water TU_{34} value determined from the previous work conducted in 2003, 2005, and 2006.

The locations where toxicity to *H. azteca* is due to bioavailable PAHs are primarily adjacent to Embayment #1.

Evaluation of the benthic macroinvertebrate data showed that there were no significant correlations between higher concentrations of PAHs measured by total PAH_{16} or SPME pore water TU_{34} and lower diversity, richness, dominance, or HBI of the sediments analyzed.

The WOE assessment of sediment chemistry, toxicity testing, and benthic macroinvertebrate survey shows that only the seven site sediments with both SPME pore water TU_{34} concentrations greater than 5.4 TU and significant reduction in *H. azteca* survival pose a potential risk to benthic invertebrates at the Site. The locations of these seven sediment samples are primarily adjacent to Embayment #1.

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Tables

Table 1-1
Summary of Sediment RI Total PAH_{16} Data

Depth Below Sediment Surface (ft)	Main Hudson River Channel		Embayment #2		Embayment #3		Embayment #4	
	Maximum Total PAH_{16} (mg/kg)	Sediment Boring ID(s)	Maximum Total PAH_{16} (mg/kg)	Sediment Boring ID(s)	Maximum Total PAH_{16} (mg/kg)	Sediment Boring ID(s)	Maximum Total PAH_{16} (mg/kg)	Sediment Boring ID(s)
0.0 to 0.5 ft	8,810	MPA-4	32	SD-58	84	SD-85	0.9	SD-83
0.5 to 2.0 ft	15,681	SD-09	20	SD-58	93	SD-87	20	XSD-7
2.0 to 4.0 ft	63,220	SD-05	-	-	123	SD-86	5.0	SD-83
4.0 to 6.0 ft	2,333	SD-78	571	SD-58	71	SD-84	4.6	SD-83
6.0 to 8.0 ft	4,066	SD-13	263	SD-59	282	SD-76	4.2	SD-83
8.0 to 10.0 ft	78	SD-09	294	SD-63	153	SD-85	0.1	SD-83
10.0 to 12.0 ft	23	SD-78	740	SD-65	142	SD-85	ND	ND
> 12.0 ft	1.4	SD-13	22	SD-62	ND	ND	ND	ND

ND = not detected

Table 2-1
Sediment Sample Locations and Field Descriptions

Sample ID	Northing[1]	Easting[1]	Sample Type	Water Depth (ft)	Sheen	Odor	Field Description
HD101	1246309.79	680774.58	Site	30	none	none	gravel (brick, shells), some silt, little sand
HD102	1246322.50	680751.88	Site	39	trace sheen	none	gravel and shells, some silt, trace sand
HD103	1246352.82	680690.10	Site	49	none	organic, sulphur	sand, some silt
HD104	1246386.14	680900.46	Site	21	trace sheen	organic	gravel, little silt
HD105	1246423.25	680847.88	Site	35	none	none	fine sand and silt with shells
HD106	1246453.06	680804.47	Site	38	none	none	sand, some gravel and shells, trace silt
HD107	1246498.95	680731.58	Site	52	none	none	fine sand, trace silt and gravel
HD108	1246467.69	681024.78	Site	24	trace sheen	petroleum-like odor	dense silt
HD109	1246515.29	680969.80	Site	36	none	organic	silt and sand
HD110	1246568.47	680919.92	Site	45	none	none	sand, little silt, trace gravel
HD111	1246578.24	681128.67	Site	27	none	none	silt, trace gravel
HD112	1246610.46	681082.78	Site	39	none	trace petroleum	sand, little gravel and slit
HD113	1246652.36	681052.35	Site	34	trace sheen	slight petroleum-like	sand, little silt, trace gravel
HD114	1246693.99	680992.16	Site	50	none	none	gravel, some sand
HD115	1246679.45	681261.44	Site	27	trace sheen	slight naphthalene	gravel and shells, some silt
HD116	1246701.41	681218.42	Site	31	trace sheen	slight naphthalene-like	gravel
HD117	1246749.71	681153.54	Site	42	trace sheen	none	sand and silt
HD118	1246735.93	681308.69	Site	17	none	slight organic	silt, trace gravel and sand
HD119	1246747.17	681285.71	Site	22	trace sheen	none	fine sand, some silt
HD120	1246772.86	681236.71	Site	22	trace sheen	slight petroleum-like	gravel and silt
HD121	1246868.44	681127.95	Site	56	none	none	sand, some gravel and silt
HD122	1246769.04	681362.55	Site	15	none	none	gravel, some sand
HD123	1246822.13	681319.92	Site	30	none	organic	gravel, some sand and shells
HD124	1246832.42	681288.16	Site	33	sheen	slight naphthalene-like	sand, some silt
HD125	1246920.41	681199.01	Site	55	none	none	fine sand, some silt and gravel
HD126	1246969.36	681159.99	Site	57	none	none	sand, little gravel
HD127	1246849.75	681402.36	Site	15	none	none	gravel, little sand
HD128	1246871.52	681387.25	Site	23	none	none	gravel
HD129	1246901.62	681334.63	Site	27	none	none	sand, some silt and gravel
HD130	1246894.86	681331.65	Site	31	none	organic	sand and silt, trace gravel
HD131	1246906.84	681450.78	Site	20	sheen and NAPL	strong naphthalene	gravel and silt
HD132	1246927.54	681450.82	Site	24	none	none	gravel, little sand
HD133	1246950.66	681381.49	Site	40	none	slight naphthalene-like	sand and silt, some gravel, trace silt
HD134	1246970.12	681370.94	Site	44	none	none	sand and silt, trace gravel
HD135	1247019.80	681338.88	Site	54	none	none	fine sand, trace silt and gravel
HD136	1247052.89	681265.32	Site	52	none	none	sand, trace silt and gravel
HD137	1246943.77	681520.98	Site	18	none	none	gravel, some sand, trace silt
HD138	1246943.77	681492.70	Site	NA	trace sheen	slight naphthalene-like	sand and silt, some gravel
HD139	1247029.81	681421.40	Site	53	none	none	fine sand, trace gravel and silt
HD140	1247041.43	681394.40	Site	53	none	organic	sand, trace gravel and silt
HD141	1247012.33	681561.75	Site	NA	trace sheen	slight naphthalene-like	gravel, shells, and debris, some sand, trace silt
HD142	1247023.76	681538.50	Site	NA	trace sheen	slight naphthalene-like	sand, some silt and gravel
HD143	1247076.18	681484.09	Site	46	sheen and NAPL	strong naphthalene-like	sand, trace silt and gravel
HD144	1247087.69	681463.28	Site	50	none	none	fine sand, trace silt and gravel
HD145	1247123.53	681409.50	Site	53	none	organic	sand, some gravel, little silt, gravel and shells
HD146	1247062.53	681610.37	Site	30	sheen and NAPL blebs	strong naphthalene-like	silt and sand, trace gravel
HD147	1247081.01	681592.29	Site	30	sheen and NAPL blebs	moderate naphthalene-like	sand and silt, little gravel
HD148	1247102.95	681512.22	Site	50	sheen and NAPL blebs	naphthalene-like	sand and silt, little gravel and organic material (grass)
HD149	1247128.16	681486.96	Site	53	none	organic	sand, little silt, trace shells
HD150	1247140.83	681636.44	Site	NA	none	none	gravel, little sand and silt
HD151	1247144.09	681601.34	Site	38	none	none	sand, little silt, trace gravel and shell fragments
HD152	1247168.00	681554.74	Site	47	none	none	sand, trace gravel, silt, and shells
HD153	1247186.38	681680.02	Site	30	none	none	sand, some shells, trace gravel and silt
HD154	1247616.21	681759.62	Reference	50	none	none	sand, little gravel and shells, trace silt
HD155	1247641.59	681825.83	Reference	57	none	none	sand, trace gravel and silt
HD156	1247705.29	681721.96	Reference	55	none	none	sand, some gravel and shells, trace silt
HD157	1247486.67	681177.16	Reference	60	none	none	sand, trace silt and gravel
HD158	1247630.20	681183.06	Reference	25	none	none	sand, sticks at the surface
HD159	1247525.24	681097.90	Reference	35	none	none	sand
HD160	1246178.47	680502.87	Reference	40	none	none	silt with shells
HD161	1246187.11	680384.94	Reference	49	none	none	silt, trace sand and gravel
HD162	1246303.45	680430.80	Reference	51	none	none	sand, trace silt and gravel

[1]GPS coordinates are in New York State Plane East, North American Datum (NAD) 1983, Feet

Table 2-2
Water Quality Measurements

Sample ID	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (µmhos)	pH
HD101	14.4	9.7	0.16	7.9
HD102	14.4	9.7	0.16	7.9
HD103	13.2	21.4	0.18	8.1
HD104	14.4	9.6	0.16	8.0
HD105	14.3	9.6	0.16	8.0
HD106	13.3	19.0	0.18	8.3
HD107	12.7	10.4	0.17	7.9
HD108	14.3	9.3	0.17	8.1
HD109	13.8	9.9	0.19	8.0
HD110	13.9	9.9	0.19	8.1
HD111	14.0	9.9	0.19	8.1
HD112	13.9	9.9	0.19	8.1
HD113	13.8	9.9	0.19	8.1
HD114	12.6	10.3	0.16	7.6
HD115	14.0	10.3	0.19	8.2
HD116	14.0	10.4	0.19	8.2
HD117	13.4	10.2	0.18	8.1
HD118	14.0	10.5	0.18	8.2
HD119	14.0	10.5	0.19	8.3
HD120	13.3	10.3	0.18	8.1
HD121	12.8	10.3	0.16	7.9
HD122	13.5	10.4	0.18	8.2
HD123	13.5	10.1	0.18	8.1
HD124	13.5	10.1	0.18	8.1
HD125	12.9	10.9	0.18	8.0
HD126	12.8	10.6	0.17	7.9
HD127	12.2	10.7	0.15	7.9
HD128	11.9	10.6	0.15	7.8
HD129	10.6	10.6	0.11	8.1
HD130	10.5	10.5	0.15	8.0
HD131	11.8	10.4	0.15	7.7
HD132	11.8	10.5	0.15	7.7
HD133	10.8	10.2	0.14	8.0
HD134	10.7	10.3	0.14	8.0
HD135	11.0	10.4	0.14	7.9
HD136	11.0	10.5	0.14	7.8
HD137	10.8	11.0	0.14	8.0
HD138	NA	NA	NA	NA
HD139	10.7	11.2	0.14	8.0
HD140	10.7	10.9	0.14	7.9
HD141	NA	NA	NA	NA
HD142	NA	NA	NA	NA
HD143	10.4	10.2	0.14	7.8
HD144	10.4	10.3	0.14	7.9
HD145	11.1	10.5	0.14	7.9
HD146	10.6	10.7	0.14	8.0
HD147	10.7	10.9	0.14	8.0
HD148	10.6	10.1	0.14	7.8
HD149	10.7	10.6	0.14	7.7
HD150	NA	NA	NA	NA
HD151	NA	NA	NA	NA
HD152	10.4	10.7	0.14	8.0
HD153	NA	NA	NA	NA
HD154	10.6	10.4	0.14	7.8
HD155	10.6	10.5	0.14	7.8
HD156	10.7	10.7	0.14	7.9
HD157	10.9	10.2	0.14	7.8
HD158	12.2	11.0	0.16	7.8
HD159	12.3	10.7	0.16	7.9
HD160	14.1	9.6	0.16	7.8
HD161	13.2	9.9	0.17	7.8
HD162	10.6	10.2	0.14	7.8

Samples marked as "NA" were due to field instrumentation malfunctioning.

Table 3-1
Analytical Testing Program

Sample Type	Matrix	Parameter	Purpose	Quantity	Laboratory[1]
Field Measurement	Surface Water	Temperature	General environmental quality parameters	62	YSI 6820 Field Meter
		pH		62	
		Dissolved oxygen		62	
		Conductivity		62	
Chemical/Physical Characterization	Sediment	Total PAH_{34} [parent & alkylated 34 compounds]	Chemical test for estimating bioavailability	62	EERC
		Total and Soot Organic Carbon (TOC & SOC)	Characterization of sediment organic matter	62	EERC
				62	
		Total Solids	Potential confounding factors affecting interpretation of toxicity data	41	TA
		Grain size		41	TA
		pH		41	TA
		Ammonia		41	TA
	Porewater	Pore water PAH_{34} [parent & alkylated 34 compounds]	Chemical test for estimating bioavailability	62	EERC
Toxicity Testing	Sediment	Amphipod toxicity (*Hyalella azteca*) 28-day chronic test	Measurement of PAH bioavailability	41: 32 site samples and 9 reference samples	AquaTOX
Benthic Macroinvertebrates Survey	Sediment	Sort, count and identify benthic macroinvertebrates down to the lowest feasible taxonomic level (e.g. Genus)	Evaluate the sediment quality triad (SQT)	41	Aquatec

[1] EERC - Energy & Environment Research Center, Grand Forks, ND
AquaTOX - AquaTOX Research, Inc., Syracuse, NY
TA - TestAmerica Laboratories, Inc., South Burlington, VT
Aquatec - Aquatec Biological Sciences, Inc., Williston, VT

Table 4-1
Sediment Total PAH Concentrations and Organic Carbon

Sediment PAHs (µg/L)	HD101				HD102				HD103				HD104				HD105				HD106				GL07			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	0.24		0.18		0.74		0.31		0.04	J	0.03	J	0.19		0.15		0.20		0.31		0.17		0.13		0.02	J	0.03	
2-methylnaphthalene	0.19		0.10		0.42		0.19		0.02	J	0.02	J	0.14		0.25		0.10		0.14		0.08		0.09		0.01	J	0.01	
1-methylnaphthalene	0.11		0.05	J	0.27		0.11		0.01	J	0.02	J	0.09		0.74		0.04	J	0.06	J	0.03	J	0.04	J	0.01	J	0.01	
C2 naphthalenes	0.76		0.52		1.36		0.68		0.20		0.26		0.59		3.71		0.49		0.47		0.43		0.46		0.19		0.20	
C3 naphthalenes	0.59		0.30		1.23		0.40		0.15		0.12		0.40		2.38		0.43		0.36		0.49		0.33		0.08		0.12	
C4 naphthalenes	0.66		0.41	J	1.34		0.39	J	0.19	J	0.14	J	0.33	J	1.84		0.45		0.39	J	0.66		0.42	J		ND	ND	ND
acenaphthylene	0.17		0.07	J	0.28		0.10		0.05	J	0.03	J	0.07	J	0.04		0.12		0.14		0.08	J	0.06	J	0.01	J	0.02	
acenaphthene	0.16		0.08	J	0.43		0.13		0.04	J	0.05	J	0.06	J	0.07		0.12		0.12		0.13		0.07	J	0.02	J	0.03	
fluorene	0.15		0.10		0.55		0.14		0.05	J	0.03	J	0.08	J	0.12		0.14		0.15		0.14		0.09	J	ND	ND	0.03	ND
C1 fluorenes	0.35		0.20		0.98		0.23		0.15		0.11		0.21		0.44		0.40		0.34		0.41		0.21		0.10		0.10	
C2 fluorenes	0.64		0.27		1.77		0.26			ND		ND	0.31		1.01		0.48		0.45		0.74		0.21	J	0.05	J	0.15	
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	1.78		0.64		5.02		0.89		0.12	J	0.26		0.67		0.74		0.92		0.80		1.07		0.52		0.08	J	0.11	
anthracene	0.92		0.34		2.25		0.50		0.24		0.15		0.33		0.21		0.78		0.62		0.86		0.41		0.06	J	0.09	
C1 phenanthrenes/anthracenes	2.13		0.80		4.48		0.92		0.39		0.30		0.88		1.60		1.57		1.12		1.69		0.78		0.13		0.20	
C2 phenanthrenes/anthracenes	4.75		1.93		8.89		2.30		1.38		0.95		2.59		4.71		3.88		2.67		3.75		2.06			ND		ND
C3 phenanthrenes/anthracenes	2.71		0.88		5.13		1.45		0.64	J	0.28	J	1.61		3.15		2.50		1.41		2.73		1.22			ND		ND
C4 phenanthrenes/anthracenes	0.46		0.08		1.04		0.31			ND		ND	0.61		0.88		0.39		0.23		0.57		0.28			ND		ND
fluoranthene	3.73		1.02		6.74		1.27		0.86		0.41		1.03		0.41		2.31		1.47		2.15		1.00		0.17		0.31	
pyrene	3.38		0.92		5.70		1.15		0.71		0.47		0.87		0.36		1.65		1.10		1.65		0.82		0.12		0.19	
C1 fluoranthenes/pyrenes	2.36		0.68		4.41		0.85		0.65		0.32		0.88		0.54		2.09		1.24		2.07		0.91		0.11		0.19	
benz[a]anthracene	1.90		0.55		3.11		0.65		0.42		0.27		0.57		0.18		1.23		0.72		1.27		0.56		0.09		0.14	
chrysene	1.75		0.53		2.89		0.61		0.35		0.23		0.58		0.25		1.06		0.62		1.05		0.50		0.07		0.11	
C1 chrysenes	5.95		1.17		6.84		1.31		0.78		0.56		3.19		0.77		2.68		1.48		4.68		1.32		0.13	J	0.22	
C2 chrysenes	2.68		0.47		4.84		0.39			ND		ND	0.90		1.48		1.60		0.75		2.15		0.62			ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene	2.19		0.72		3.78		0.81		0.51		0.37		0.83		0.26		1.42		0.89		1.54		0.73		0.15		0.20	
benzo[e]pyrene	0.84		0.27		1.41		0.31		0.17		0.16		0.29		0.10		0.48		0.30		0.52		0.26		0.05		0.08	
benzo[a]pyrene	1.73		0.55		3.28		0.60		0.38		0.28		0.60		0.18		1.14		0.67		1.24		0.56		0.11		0.12	
perylene	0.54		0.24		0.82		0.24		0.48		0.64		0.23		0.12		0.55		0.32		0.42		0.28		0.34		0.42	
indeno[1,2,3-cd]pyrene	1.13		0.34		2.00		0.38		0.21		0.10		0.40		0.12		0.63		0.36		0.65		0.30		0.01		0.04	
dibenz[ah]anthracene	0.20		0.07		0.38		0.07		0.05		0.03		0.08		0.03		0.13		0.09		0.13		0.06			ND		ND
benzo[ghi]perylene	0.76		0.26		1.33		0.26		0.13		0.10		0.24		0.08		0.38		0.23		0.40		0.21		0.03		0.05	
Total PAH_{16} (mg/Kg)	20.19		6.36		38.47		7.88		4.16		2.82		6.62		3.21		12.23		8.31		12.53		6.01		0.95		1.46	
Mean - PAH_{16}	13.27				23.17				3.49				4.91				10.27				9.27				1.21			
Total PAH_{34} (mg/Kg)	45.93		14.71		83.71		18.21		9.36		6.71		19.88		26.89		30.35		20.02		33.98		15.50		2.14		3.17	
Mean - PAH_{34}	30.32				50.96				8.03				23.38				25.19				24.74				2.66			
% Alkylated PAHs	53		53		51		54		49		46		64		87		56		55		60		58		38		38	
Mean - % Alkylated PAHs	53.2				52.6				47.3				75.7				55.9				59.1				37.8			
Total organic carbon (TOC) (%)	1.91				2.72				0.85				1.94				0.99				1.11				0.35			
Soot organic carbon (SOC) (%)	1.72				0.61				0.12				0.35				0.44				0.22				0.09			
Fraction SOC/TOC	0.90				0.22				0.14				0.18				0.45				0.20				0.24			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate

Table 4-1
Sediment Total PAH Concentrations and Organic Carbon

Sediment PAHs (µg/L)	HD108				HD109				HD110				HD111				HD112				HD113				HD114			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	0.50		0.70		1.64		1.64			ND		ND	0.15		0.11		0.62		0.72		0.62		1.44		2.71		2.65	
2-methylnaphthalene	0.58		0.75		0.73		1.35			ND	0.01	**J**	0.08		0.07		0.31		0.39		0.34		0.52		1.23		0.97	
1-methylnaphthalene	0.37		0.52		0.43		0.53			ND	0.01	**J**	0.04	**J**	0.03	**J**	0.14		0.37		0.13		0.37		0.87		0.21	
C2 naphthalenes	2.28		2.96		2.77		2.48		0.08		0.11		0.51		0.47		1.05		1.53		1.10		2.98		7.34		1.37	
C3 naphthalenes	1.68		2.28		1.87		1.39			ND		ND	0.31		0.38		0.78		1.19		1.37		4.14		10.12		1.33	
C4 naphthalenes	1.64		2.25		2.13		1.13			ND		ND	0.50		0.28	**J**	0.97		1.18		1.78		4.48		10.23		1.61	
acenaphthylene	0.11		0.21		0.26		0.28			ND		ND	0.03	**J**	0.02	**J**	0.23		0.26		0.41		1.19		2.45		0.33	
acenaphthene	0.31		0.41		1.24		0.71		0.03	**J**	0.03	**J**	0.08	**J**	0.08	**J**	0.23		0.54		0.69		2.38		2.40		0.43	
fluorene	0.32		0.40		1.46		0.83			ND		ND	0.14		0.12		0.27		0.36		0.77		2.17		4.60		0.41	
C1 fluorenes	0.65		0.92		1.27		1.07		0.06		0.08		0.22		0.23		0.70		0.90		1.61		4.88		13.11	**E**	1.39	
C2 fluorenes	1.03		1.67		3.07		1.54			ND		ND		ND		ND	1.81		1.82		2.68		7.86		21.99		2.69	
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	1.36		1.84		4.46		3.11			ND		ND	0.58		0.52		1.69		2.89		2.31		10.14		43.40		2.97	
anthracene	0.66		0.88		2.65		2.24			ND		ND	0.30		0.26		1.29		1.84		2.39		10.44		51.23		2.46	
C1 phenanthrenes/anthracenes	2.19		3.02		3.84		3.66		0.07		0.07		0.84		0.64		2.67		3.66		4.32		18.17		61.94	**E**	4.97	
C2 phenanthrenes/anthracenes	5.85		7.63		10.62		7.89		0.52		0.47		2.05		1.63		6.04		7.11		11.38		36.18	**E**	106.59	**E**	11.00	
C3 phenanthrenes/anthracenes	4.44		5.86		7.46		5.15			ND		ND	1.40		0.92		5.76		4.58		8.39		27.34		63.57		7.67	
C4 phenanthrenes/anthracenes	1.30		1.85		1.87		1.37			ND		ND		ND		ND	2.60		0.85		2.19		5.34		9.74		1.83	
fluoranthene	1.19		1.75		3.90		5.26			ND		ND	0.62		0.38		3.10		4.60		8.70		31.06		109.11	**E**	8.81	
pyrene	1.25		1.77		3.02		3.82			ND	0.04	**J**	0.57		0.33		2.90		3.76		6.72		22.21		52.73		4.65	
C1 fluoranthenes/pyrenes	1.61		2.26		3.46		4.13			ND	0.03	ND	0.65		0.35		3.35		3.90		7.32		26.45	**E**	68.39	**E**	5.93	
benz[a]anthracene	0.62		0.82		1.70		2.44		0.01	**J**	0.02	**J**	0.35		0.17		1.90		2.38		4.51		17.90		38.25		3.41	
chrysene	0.67		0.89		1.59		2.19		0.01	**J**	0.02	**J**	0.31		0.14		1.70		2.03		3.29		13.07		32.20		2.81	
C1 chrysenes	2.40		3.09		5.12		5.78			ND		ND	0.82		0.47		6.53		7.18		9.63		33.66		76.96		7.99	
C2 chrysenes	2.06		2.83		3.67		3.57			ND		ND		ND		ND	3.63		3.41		6.29		22.74		65.03		6.30	
C3 chrysenes		ND		ND	0.89		0.58			ND		ND		ND		ND	0.77		0.84		1.38		6.45		14.73		1.64	
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene	0.74		1.01		1.80		2.78			ND		ND	0.44		0.19		2.20		2.59		3.79		16.26		43.45		4.08	
benzo[e]pyrene	0.29		0.41		0.64		1.01			ND		ND	0.16		0.07		0.86		0.90		1.29		5.06		11.47		1.24	
benzo[a]pyrene	0.61		0.90		1.66		2.68			ND		ND	0.30		0.12		1.94		2.19		3.71		15.17		31.54		2.99	
perylene	0.76		1.03		0.55		0.68			ND		ND	1.90		1.84		0.54		0.58		0.90		3.43		6.92		0.81	
indeno[1,2,3-cd]pyrene	0.36		0.55		0.96		1.54			ND		ND	0.14		0.05		1.20		1.33		1.90		8.85	**E**	19.30	**E**	1.62	
dibenz[ah]anthracene	0.09		0.11		0.19		0.31			ND		ND		ND		ND	0.23		0.30		0.40		1.83		3.97		0.33	
benzo[ghi]perylene	0.25		0.38		0.58		0.99			ND		ND	0.10		0.04		0.79		0.76		1.20		5.11		11.24		1.03	
Total PAH_{16} (mg/Kg)	9.05		12.61		27.11		30.82		0.04		0.10		4.11		2.53		20.28		26.56		41.42		159.23		448.59		38.98	
Mean - PAH_{16}	10.83				28.97				0.07				3.32				23.42				100.32				243.78			
Total PAH_{34} (mg/Kg)	38.19		51.94		77.51		74.12		0.77		0.88		13.58		9.92		58.77		66.93		103.52		369.29		998.81		97.94	
Mean - PAH_{34}	45.06				75.82				0.82				11.75				62.85				236.41				548.37			
% Alkylated PAHs	74		73		63		56		95		88		55		55		63		58		58		55		53		58	
Mean - % Alkylated PAHs	73.2				59.8				91.7				55.0				60.6				56.2				55.7			
Total organic carbon (TOC) (%)	2.54				7.78				0.45				2.92				1.54				0.52				2.28			
Soot organic carbon (SOC) (%)	0.51				2.09				0.12				0.51				0.75				0.15				1.22			
Fraction SOC/TOC	0.20				0.27				0.26				0.18				0.49				0.29				0.54			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate

Table 4-1
Sediment Total PAH Concentrations and Organic Carbon

Sediment PAHs (µg/L)	HD115				HD116				HD117				HD118				HD119				HD120				HD121			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	0.36		0.57		1.27		3.32		0.12		0.05	J	0.12		0.12		6.33		8.20		0.44		0.57			ND	0.10	J
2-methylnaphthalene	0.23		0.26		0.67		1.19		0.07		0.02	J	0.07		0.07		2.83		3.05		0.20		0.25		0.01	J	0.04	J
1-methylnaphthalene	0.11		0.15		0.39		0.46		0.03	J	0.01	J	0.03	J	0.03	J	1.45		1.65		0.13		0.14		0.01	J	0.02	J
C2 naphthalenes	0.77		1.10		2.80		5.74		0.69		0.16		0.42		0.49		6.64		7.26		1.00		0.82		0.12		0.22	
C3 naphthalenes	0.77		0.77		2.11		11.05		1.25		0.16		0.26		0.26		5.26		6.23		1.20		0.58		0.10		0.27	
C4 naphthalenes	1.09		0.98		1.89		11.91		1.02		0.26	J	0.30	J	0.34	J	5.04		6.07		1.50		0.48		0.16	J	0.32	J
acenaphthylene	0.20		0.17		0.36		2.15		0.29		0.02	J	0.03	J	0.04	J	0.89		1.05		0.23		0.09	J		ND	0.09	J
acenaphthene	0.23		0.26		0.90		1.95		0.11		0.03	J	0.07	J	0.07	J	4.31		3.95		0.53		0.47			ND	0.08	J
fluorene	0.25		0.30		0.72		2.97		0.16		0.03	J	0.12		0.15		2.78		3.10		0.57		0.56			ND	0.08	J
C1 fluorenes	0.67		0.32		1.25		13.10	E	1.25		0.11		0.19		0.21		3.82		4.87		1.22		0.47			ND	0.24	
C2 fluorenes	1.43		1.02		2.11		22.40		1.84		0.10	J	0.30		0.25		6.44		8.10		2.67		0.90			ND	0.66	
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	1.38		1.55		3.44		45.79		1.76		0.18		0.51		0.64		12.75		16.62		5.97		3.41		0.06	J	0.51	
anthracene	1.21		1.04		2.19		34.94		1.66		0.14		0.27		0.34		6.50		8.58		2.99		1.94		0.04	J	0.36	
C1 phenanthrenes/anthracenes	2.42		1.62		4.48		57.44	E	4.71		0.33		0.81		0.73		15.17		18.97		6.71		1.90		0.14		0.81	
C2 phenanthrenes/anthracenes	6.22		3.76		8.94		97.16	E	7.58		1.12		1.42		1.48		31.56	E	37.38	E	13.80	E	3.62		0.61		1.74	
C3 phenanthrenes/anthracenes	4.67		3.13		6.44		68.07		3.79		0.62	J	0.99		0.82	J	20.06		23.10		8.72		2.34		0.34	J	0.91	
C4 phenanthrenes/anthracenes	1.13		1.05		1.82		24.45		0.51			ND		ND		ND	4.32		5.16		1.87		0.69			ND	0.18	
fluoranthene	2.52		2.06		3.78		57.64		3.52		0.44		0.50		0.64		20.97		28.96		12.76		3.75		0.11		1.39	
pyrene	1.82		1.46		3.65		43.02		3.74		0.36		0.32		0.38		13.91		16.17		8.46		2.49		0.07	J	0.83	
C1 fluoranthenes/pyrenes	2.55		1.37		4.34		57.60	E	4.43		0.43		0.37		0.43		13.95	E	16.79	E	7.03		1.85		0.08		0.79	
benz[a]anthracene	1.51		0.92		2.19		27.03		1.89		0.24		0.22		0.26		7.73		9.75		4.90		1.40		0.05	J	0.56	
chrysene	1.23		0.79		2.02		22.05		1.50		0.19		0.17		0.20		6.47		8.03		4.10		1.23		0.04	J	0.42	
C1 chrysenes	4.02		2.18		5.77		62.51		5.14		0.48		0.53		0.54		15.89		19.88		9.98		2.73			ND	1.59	
C2 chrysenes	3.20		1.10		4.07		48.52		2.63		0.26	J	ND	ND	ND	ND	11.09		16.22		7.26		1.92			ND		ND
C3 chrysenes		ND		ND	0.91		13.77		0.30	J		ND	ND	ND	ND	ND	3.04		3.56			ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND	ND	ND	ND	ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene	1.40		0.98		2.60		26.20		1.76		0.27		0.29		0.33		9.01		11.41		5.59		1.85		0.07	J	0.68	
benzo[e]pyrene	0.48		0.36		1.01		8.06		0.78		0.09		0.08		0.11		3.06		3.61		2.30		0.69			ND	0.23	
benzo[a]pyrene	1.07		0.79		2.41		22.64		1.91		0.21		0.18		0.20		7.54		9.10		4.90		1.50		0.07		0.47	
perylene	0.85		1.02		0.76		4.73		0.56		0.22		1.24		1.30		1.74		2.02		1.76		0.88		0.15		0.21	
indeno[1,2,3-cd]pyrene	0.53		0.43		1.46		15.43	E	1.03		0.12		0.08		0.08		3.82		4.68		2.66		0.95			ND	0.20	
dibenz[ah]anthracene	0.12		0.10		0.29		3.60		0.22		0.02			ND		ND	0.72		0.94		0.48		0.16			ND	0.04	
benzo[ghi]perylene	0.35		0.30		0.93		7.97		0.74		0.07		0.07		0.07		2.78		3.21		1.86		0.65		0.02		0.16	
Total PAH_{16} (mg/Kg)	14.17		11.71		28.22		316.70		20.40		2.39		2.95		3.54		106.49		133.75		56.45		21.02		0.54		5.96	
Mean - PAH_{16}	12.94				172.46				11.39				3.25				120.12				38.73				3.25			
Total PAH_{34} (mg/Kg)	44.77		31.91		77.98		824.86		56.97		6.75		9.97		10.61		257.86		317.67		123.80		41.28		2.26		14.19	
Mean - PAH_{34}	38.34				451.42				31.86				10.29				287.77				82.54				8.22			
% Alkylated PAHs	65		59		62		60		62		60		57		53		57		56		51		45		69		55	
Mean - % Alkylated PAHs	62.2				60.8				61.0				55.2				56.5				48.2				62.1			
Total organic carbon (TOC) (%)	4.59				3.54				0.43				1.10				2.25				1.92				0.41			
Soot organic carbon (SOC) (%)	1.03				1.65				0.18				0.29				1.40				1.40				0.30			
Fraction SOC/TOC	0.22				0.47				0.43				0.26				0.62				0.73				0.74			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate

Table 4-1
Sediment Total PAH Concentrations and Organic Carbon

Sediment PAHs (µg/L)	HD122				HD123				HD124				HD125				HD126				HD127				HD128			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	2.01		0.30		0.66		0.49		0.35		0.33		0.43		0.20			ND		ND	2.35		2.81		1.85		1.14	
2-methylnaphthalene	0.31		0.16		0.42		0.22		0.13		0.11		0.16		0.08			ND		ND	0.59		1.17		1.03		0.45	
1-methylnaphthalene	0.22		0.08		0.32		0.14		0.06	J	0.06	J	0.06	J	0.03	J	0.01	J		ND	0.30		0.67		0.82		0.51	
C2 naphthalenes	1.76		0.79		1.40		1.03		0.57		1.66		0.50		0.36			ND		ND	1.96		2.64		3.42		3.09	
C3 naphthalenes	1.24		0.49		0.81		0.77		0.63		6.22		0.41		0.44			ND		ND	1.80		1.52		2.81		2.52	
C4 naphthalenes	1.17		0.56		0.78		0.81		0.73		7.21		0.58		0.56			ND		ND	1.49		1.24		2.68		2.30	
acenaphthylene	0.22		0.09		0.19		0.11		0.13		2.20		0.15		0.18			ND		ND	0.13		0.12		0.72		0.50	
acenaphthene	0.98		0.19		0.41		0.41		0.34		0.51		0.17		0.18			ND		ND	0.49		0.58		1.73		1.33	
fluorene	0.45		0.13		0.37		0.24		0.25		0.65		0.17		0.16			ND		ND	0.35		0.49		0.98		0.56	
C1 fluorenes	0.76		0.28		0.66		0.61		0.66		6.94		0.44		0.50			ND		ND	0.75		0.70		2.44		1.57	
C2 fluorenes	1.11		0.46		1.38		0.88		1.40		12.96		0.70		0.88			ND		ND	1.47		1.00		3.98		2.88	
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	2.05		0.50		2.14		1.48		1.29		16.44		0.92		1.07			ND		ND	1.35		1.99		6.11		3.29	
anthracene	1.16		0.34		1.28		0.90		1.03		11.54		0.78		0.81			ND		ND	1.11		1.47		4.37		1.98	
C1 phenanthrenes/anthracenes	1.88		0.61		2.15		2.02		1.96		31.42		1.33		1.66		0.08		0.07		1.40		1.54		8.39		5.01	
C2 phenanthrenes/anthracenes	3.87		1.59		3.81		4.65		4.11		55.06	E	2.86		3.47			ND		ND	2.90		2.62		17.80	E	10.11	
C3 phenanthrenes/anthracenes	2.75		1.35		2.37		2.85		2.98		28.19		1.56		2.12			ND		ND	2.08		1.60		11.38		6.55	
C4 phenanthrenes/anthracenes	0.68		0.23		0.61		0.45		0.66		4.81		0.26		0.35			ND		ND	0.51		0.39		2.17		1.16	
fluoranthene	3.36		0.81		2.84		3.48		3.42		42.09		2.89		3.64			ND		ND	1.76		1.46		18.46		8.24	
pyrene	2.07		0.59		1.81		2.66		2.04		30.83		1.52		1.82			ND		ND	1.10		0.98		9.88		5.52	
C1 fluoranthenes/pyrenes	1.79		0.68		1.76		1.81		2.27		30.91	E	1.55		1.85			ND		ND	0.97		0.81		9.47		4.73	
benz[a]anthracene	1.11		0.50		0.99		0.99		1.32		16.55		1.08		1.28		0.02	J	0.02	J	0.55		0.49		6.21		3.00	
chrysene	0.98		0.47		0.86		0.90		1.10		11.57		0.88		0.98		0.01	J	0.01	J	0.50		0.45		4.74		2.55	
C1 chrysenes	2.55		1.27		2.19		2.02		2.62		29.13		2.06		2.53			ND		ND	1.54		1.72		14.39		8.66	
C2 chrysenes	1.72		0.50		1.52		0.90		1.76		15.09		1.36		1.65			ND		ND		ND		ND	9.88		4.13	
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene	1.41		0.70		1.05		1.00		1.45		15.34		1.24		1.40			ND		ND	1.04		0.57		6.38		3.21	
benzo[e]pyrene	0.56		0.26		0.44		0.42		0.52		6.49		0.43		0.47			ND		ND	0.38		0.23		2.32		1.35	
benzo[a]pyrene	1.12		0.44		0.92		0.83		1.15		16.77		0.98		1.08			ND		ND	0.56		0.40		5.48		2.85	
perylene	0.49		0.20		0.38		0.39		0.37		2.96		0.41		0.40			ND		ND	0.18		0.14		1.38		0.71	
indeno[1,2,3-cd]pyrene	0.67		0.24		0.44		0.42		0.61		8.27	E	0.52		0.55			ND		ND	0.41		0.18		3.26		1.66	
dibenz[ah]anthracene	0.22		0.05		0.10		0.08		0.11		1.54		0.12		0.12			ND		ND	0.09		ND		0.63		0.29	
benzo[ghi]perylene	0.50		0.17		0.35		0.32		0.41		6.23		0.33		0.37			ND		ND	0.29		0.14		2.10		1.20	
Total PAH_{16} (mg/Kg)	18.32		5.51		14.40		14.30		14.99		180.88		12.16		13.83		0.03		0.02		12.07		12.13		72.89		37.31	
Mean - PAH_{16}	11.92				14.35				97.93				13.00				0.03				12.10				55.10			
Total PAH_{34} (mg/Kg)	41.16		15.02		35.43		34.27		36.40		420.10		26.83		31.18		0.12		0.09		30.37		30.13		167.24		93.03	
Mean - PAH_{34}	28.09				34.85				228.25				29.00				0.10				30.25				130.14			
% Alkylated PAHs	53		60		57		56		56		55		52		53		71		73		58		58		54		58	
Mean - % Alkylated PAHs	56.6				56.5				55.5				52.2				72.1				58.5				55.9			
Total organic carbon (TOC) (%)	1.41				5.24				0.39				0.52				0.40				11.65				2.61			
Soot organic carbon (SOC) (%)	0.49				3.19				0.14				0.16				0.13				10.45				2.04			
Fraction SOC/TOC	0.35				0.61				0.36				0.31				0.32				0.90				0.78			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate

Table 4-1
Sediment Total PAH Concentrations and Organic Carbon

Sediment PAHs (µg/L)	HD129				HD130				HD131				HD132				HD133				HD134				HD135			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	2.85		1.54		1.12		2.48		173.57	E	87.71		2.56		2.97		4.09		3.80		0.81		1.72		0.04	J	0.44	
2-methylnaphthalene	1.13		0.47		0.37		1.08		182.62	E	89.19	E	1.00		0.89		1.43		1.33		0.27		0.54		0.04	J	0.13	
1-methylnaphthalene	0.61		0.19		0.18		0.35		146.79	E	77.88	E	0.66		0.52		0.87		0.67		0.08		0.24		0.03	J	0.06	
C2 naphthalenes	4.82		1.55		1.66		2.17		519.95	E	271.22	E	3.57		2.87		10.44		7.71		1.16		3.50		0.22		0.46	
C3 naphthalenes	5.46		1.74		1.81		4.65		265.09	E	135.80	E	3.00		4.09		13.69		10.69		2.45		5.43		0.15		0.49	
C4 naphthalenes	6.90		1.90		1.90		8.27		136.01		68.90		3.44		5.87		11.32		10.46		2.88		5.29			ND	0.61	ND
acenaphthylene	2.29		0.46		0.72		2.50		12.87		6.61		0.84		1.36		3.36		3.32		0.89		1.75		0.04	J	0.33	
acenaphthene	2.56		0.80		1.29		1.05		131.20	E	67.88		1.89		1.65		4.96		5.07		1.56		2.73		0.04	J	0.23	
fluorene	1.94		0.69		0.88		0.67		54.76		29.34		1.47		1.46		6.88		4.68		1.56		2.81		0.04	J	0.19	
C1 fluorenes	5.61		1.79		1.98		6.69		120.52	E	64.09	E	2.98		4.28		16.02	E	11.40	E	3.80		6.64		0.11		0.62	
C2 fluorenes	10.36		2.63		2.72		13.68		126.16		71.53		5.80		9.87		21.03		16.58		5.13		8.58			ND	1.00	
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	10.15		3.72		4.90		1.44		208.31	E	110.90		15.19		10.09		44.20		26.53		5.36		17.57		0.18		0.99	
anthracene	8.77		5.05		3.16		5.58		111.30		56.96		6.00		7.85		35.32		20.36		5.74		13.35		0.16		0.90	
C1 phenanthrenes/anthracenes	19.28		5.82		6.13		22.75		263.37	E	135.92	E	12.92		22.34		59.16	E	38.53	E	11.65		21.87		0.32		1.85	
C2 phenanthrenes/anthracenes	52.22	E	12.99	E	13.25	E	66.56	E	394.17	E	202.75	E	31.12	E	46.27	E	110.28	E	88.86	E	26.40	E	45.73	E	0.80		5.05	
C3 phenanthrenes/anthracenes	29.47		7.18		7.93		33.77		172.47		92.16		19.13		21.63		60.41		51.11		15.97		27.15		0.41	J	3.25	
C4 phenanthrenes/anthracenes	4.24		1.31		1.42		4.59		22.67		14.26		2.69		2.82		9.11		8.35		2.73		4.29			ND	0.39	
fluoranthene	29.86		11.45		13.14		35.77		120.46	E	65.67		37.87		36.92		90.77		70.35		27.43		47.98		0.53		4.47	
pyrene	20.92		6.89		6.98		25.62		115.71	E	63.40		19.99		25.41		45.21		40.32		13.44		23.81		0.32		2.59	
C1 fluoranthenes/pyrenes	27.43	E	6.54		7.04		34.50	E	140.13	E	74.87	E	17.64	E	30.29	E	68.11	E	48.59	E	14.76	E	25.89	E	0.30		2.73	
benz[a]anthracene	13.65		4.37		4.77		16.64		40.62		22.81		12.75		16.75		36.52		27.40		9.64		16.82		0.24		2.00	
chrysene	10.35		3.40		3.49		12.79		35.33		19.13		12.11		13.22		26.57		19.98		6.96		11.63		0.18		1.44	
C1 chrysenes	31.70		8.55		10.73		38.76		126.71		74.42		24.60		30.29		78.51		56.21		18.79		32.87		0.41		5.25	
C2 chrysenes	19.64		5.62		7.22		23.26		85.97		49.54		20.18		20.29		53.73		38.05		13.53		22.73			ND	2.23	
C3 chrysenes	4.61		1.10		1.88		6.23		19.18		8.25		4.16		3.42		15.98		14.31		3.46		7.14			ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene	11.18		4.33		4.46		14.18		29.45		17.92		15.19		15.33		32.20		23.63		8.69		15.12		0.23		2.05	
benzo[e]pyrene	4.34		1.54		1.51		5.38		13.47		8.25		6.07		6.93		10.56		8.09		2.75		4.80		0.08		0.73	
benzo[a]pyrene	12.53		4.04		4.05		15.87		37.34		22.03		12.46		18.52		29.29		23.87		7.86		13.91		0.19		1.87	
perylene	3.00		1.47		2.34		4.68		6.82		4.21		3.49		3.34		5.70		4.85		3.09		4.15		0.32		0.67	
indeno[1,2,3-cd]pyrene	6.29		2.12		2.16		8.33	E	16.97	E	10.02	E	9.24	E	10.19	E	19.26	E	14.70	E	4.46		8.10	E	0.07		0.92	
dibenz[ah]anthracene	1.29		0.40		0.46		1.66		3.49		1.73		1.93		1.96		5.00		3.20		0.97		1.79			ND	0.19	
benzo[ghi]perylene	4.36		1.42		1.33		5.52		13.87		7.95		6.36		7.43		10.97		8.85		2.57		4.64		0.06		0.62	
Total PAH_{16} (mg/Kg)	138.98		50.68		52.91		150.11		1,105.24		590.05		155.85		171.10		394.60		296.05		97.93		183.72		2.33		19.25	
Mean - PAH_{16}	94.83				101.51				847.65				163.48				345.32				140.82				10.79			
Total PAH_{34} (mg/Kg)	369.79		113.09		122.97		427.48		3,847.33		2,033.30		318.29		387.12		940.96		711.85		226.82		410.57		5.52		44.76	
Mean - PAH_{34}	241.44				275.23				2,940.32				352.71				826.40				318.70				25.14			
% Alkylated PAHs	60		53		54		63		71		70		48		53		56		57		54		53		51		54	
Mean - % Alkylated PAHs	56.5				58.2				70.6				50.6				56.5				53.7				52.2			
Total organic carbon (TOC) (%)	1.16				1.35				1.35				3.75				1.18				0.94				0.21			
Soot organic carbon (SOC) (%)	0.86				0.44				0.44				3.02				0.45				0.24				0.14			
Fraction SOC/TOC	0.74				0.33				0.33				0.81				0.38				0.25				0.65			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate

Table 4-1
Sediment Total PAH Concentrations and Organic Carbon

Sediment PAHs (µg/L)	HD136				HD137				HD138				HD139				HD140				HD141				HD142			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	0.03	**J**	0.04	**J**	4.54		2.59		14.60		5.68		2.99		1.02		0.75		1.32		7.00		8.32		8.34		5.36	
2-methylnaphthalene		ND	0.01	**J**	2.28		1.66		4.99		2.18		0.80		0.32		0.24		0.52		1.97		2.76		3.85		2.70	
1-methylnaphthalene	0.01	**J**	0.01	**J**	1.49		0.89		1.75		0.96		0.33		0.10		0.35		0.28		2.44		1.78		2.89		1.89	
C2 naphthalenes		ND		ND	8.39		6.32		87.52	**E**	27.09		5.64		0.99		3.37		0.81		10.46		6.14		13.37		9.47	
C3 naphthalenes		ND		ND	6.94		5.36		57.89	**E**	17.31		9.69		1.95		2.68		0.50		8.37		3.43		9.32		6.75	
C4 naphthalenes		ND		ND	6.35		5.41		37.02		11.06		8.80		2.40		2.02		0.78		6.99		2.71		7.06		5.38	
acenaphthylene		ND		ND	0.89		1.32		6.66		1.81		3.37		1.06		0.81		0.13		5.95		1.04		2.46		1.98	
acenaphthene		ND		ND	2.25		1.65		57.43		19.41		4.04		0.72		2.08		0.43		7.00		3.13		7.52		3.47	
fluorene		ND		ND	1.64		1.10		50.22		15.74		3.84		0.74		2.10		0.27		3.64		1.27		2.94		1.74	
C1 fluorenes		ND		ND	3.31		2.97		48.58	**E**	13.66	**E**	10.55	**E**	2.67		2.68		0.43		6.94		1.99		7.29		5.00	
C2 fluorenes		ND		ND	6.69		5.23		55.18		15.47		14.01		3.86		3.04		0.63		10.42		2.84		10.30		7.79	
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	0.04	**J**		ND	7.48		5.31		191.26	**E**	61.08		29.67		4.38		9.71		1.58		38.77		4.49		12.31		8.32	
anthracene	ND	ND		ND	3.70		3.10		128.98	**E**	39.37		18.90		4.18		5.94		0.90		29.02		2.93		8.87		6.19	
C1 phenanthrenes/anthracenes	0.07		0.05		10.11		8.12		147.57	**E**	42.30	**E**	35.84		9.06		7.88		1.46		38.51	**E**	4.80		19.17		14.28	
C2 phenanthrenes/anthracenes	ND	ND		ND	19.95	**E**	19.81	**E**	292.77	**E**	58.83	**E**	63.86	**E**	18.16	**E**	13.03	**E**	2.78		60.81	**E**	9.04		36.76	**E**	31.26	**E**
C3 phenanthrenes/anthracenes	ND	ND		ND	16.23		16.43		149.59		40.95		41.84		13.20		8.64		1.55		37.32		6.76		23.86		21.87	
C4 phenanthrenes/anthracenes	ND	ND		ND	3.01		3.56		25.66		6.77		6.00		2.10		1.33		0.22		6.51		1.46		4.11		3.67	
fluoranthene	0.04	**J**		ND	6.67		4.86		178.27	**E**	59.00		68.06		19.19		13.45		2.79		78.95		7.48		19.88		12.45	
pyrene	0.04	**J**		ND	6.49		5.24		106.33	**E**	32.76		39.24		11.39		7.86		1.86		49.10		6.08		17.81		12.51	
C1 fluoranthenes/pyrenes		ND		ND	7.26		8.36		137.56	**E**	36.88	**E**	42.22	**E**	12.28	**E**	7.82		1.38		30.31	**E**	4.96		21.77	**E**	17.90	**E**
benz[a]anthracene		ND		ND	3.16		3.59		74.16	**E**	20.76		28.29		8.58		5.43		1.07		33.28		3.27		10.82		8.57	
chrysene		ND		ND	2.69		3.14		59.21		15.47		19.08		5.91		3.73		0.79		25.51		2.92		8.33		6.80	
C1 chrysenes		ND		ND	11.02		13.28		151.71	**E**	42.22		52.13		16.77		10.17		1.80		56.67		7.70		27.11		25.71	
C2 chrysenes		ND		ND	7.40		10.89		112.12		31.20		54.10		11.53		7.15		0.70		37.78		5.06		18.32		17.01	
C3 chrysenes		ND		ND	2.70		3.14		35.57		9.37		10.65		3.34		1.70		ND		13.82		1.65		4.50		4.70	
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND	3.00		3.59		65.50		16.92		25.13		7.58		4.93		0.83		30.30		3.67		9.81		7.70	
benzo[e]pyrene		ND		ND	1.22		1.58		20.33	**E**	5.22		8.45		2.48		1.59		0.28		10.46		1.44		3.87		3.23	
benzo[a]pyrene		ND		ND	2.99		4.06		62.82	**E**	15.46		24.30		6.97		4.40		0.61		26.61		3.39		10.97		9.15	
perylene		ND		ND	1.20		1.36		12.57		3.29		5.78		1.95		1.22		0.33		6.47		0.85		2.15		1.82	
indeno[1,2,3-cd]pyrene		ND		ND	1.97		2.44		44.31	**E**	9.23	**E**	14.98	**E**	3.69		2.28		0.26		19.48	**E**	2.28		5.88		4.86	
dibenz[ah]anthracene		ND		ND	0.40		0.51		10.36		2.15		3.01		0.79		0.47		0.06		3.97		0.52		1.21		1.01	
benzo[ghi]perylene		ND		ND	1.38		1.77		23.93	**E**	5.04		8.90		2.16		1.38		0.19		11.74		1.55		3.97		3.44	
Total PAH_{16} (mg/Kg)	0.15		0.04		49.26		44.28		1,074.03		319.86		293.81		78.36		65.32		13.11		370.33		52.35		131.12		93.55	
Mean - PAH_{16}	0.09				46.77				696.94				186.08				39.21				211.34				112.33			
Total PAH_{34} (mg/Kg)	0.23		0.11		164.81		158.63		2,452.41		684.63		664.52		181.52		140.22		27.57		716.60		117.72		346.81		273.99	
Mean - PAH_{34}	0.17				161.72				1,568.52				423.02				83.89				417.16				310.40			
% Alkylated PAHs	34		65		69		70		55		52		54		54		51		50		46		54		60		64	
Mean - % Alkylated PAHs	49.6				69.4				53.5				54.0				50.8				49.8				62.2			
Total organic carbon (TOC) (%)	0.26				3.84				1.34				0.40				0.20				2.20				4.45			
Soot organic carbon (SOC) (%)	0.19				1.19				0.43				0.15				0.06				0.96				2.48			
Fraction SOC/TOC	0.75				0.31				0.32				0.38				0.32				0.44				0.56			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate

Table 4-1
Sediment Total PAH Concentrations and Organic Carbon

Sediment PAHs (µg/L)	HD143				HD144				HD145				HD146				HD147				HD148				HD149			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	706.80	E	634.85	E	5.15		5.71		4.01		2.56		628.05	E	746.30	E	417.50	E	351.21	E	2436.34	E	2190.38	E	1.19		0.47	
2-methylnaphthalene	443.96	E	391.41	E	2.09		1.98		1.13		0.75		290.12	E	309.81	E	179.28	E	148.95	E	966.58	E	853.07	E	0.50		0.17	
1-methylnaphthalene	344.54	E	310.70	E	2.04		2.01		0.34		0.49		183.15	E	193.22	E	115.47	E	95.71	E	550.78	E	486.06	E	0.35		0.12	
C2 naphthalenes	1058.73	E	954.52	E	17.72		22.48		3.23		5.26		467.15	E	479.84	E	274.25	E	227.69	E	1333.13	E	1179.01	E	3.29		1.36	
C3 naphthalenes	486.17	E	443.02	E	16.42		25.09		7.62		7.67		192.72	E	196.32	E	110.86	E	92.17	E	557.12	E	493.25	E	3.12		1.24	
C4 naphthalenes	255.53		231.95		12.51		19.41		9.92		7.38		104.67		109.90		61.32		51.44		318.60		280.07		2.57		1.11	
acenaphthylene	52.83		45.74		4.79		7.08		3.97		2.98		20.22		22.17		12.14		9.43		194.89	E	172.79	E	0.97		0.48	
acenaphthene	504.06	E	446.48	E	11.27		14.30		2.15		3.37		278.17	E	311.87	E	209.55	E	176.95	E	704.46	E	626.74	E	2.03		0.85	
fluorene	307.28	E	269.66	E	11.50		15.73		2.30		3.41		196.53	E	219.91	E	113.11	E	92.79		579.73	E	528.68	E	2.05		0.75	
C1 fluorenes	314.73	E	282.33	E	16.13	E	25.82	E	10.32	E	8.51		150.85	E	165.48	E	93.16	E	75.51	E	455.92	E	411.38	E	3.30		1.25	
C2 fluorenes	297.58	E	268.15	E	19.10		30.06		16.80		12.07		145.63		162.77		89.63		72.49		456.78	E	414.76	E	4.06		1.57	
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	1102.26	E	979.14	E	58.90		79.71		19.73		25.57		504.69	E	592.04	E	354.30	E	293.63	E	1568.70	E	1446.90	E	10.64		4.00	
anthracene	615.13	E	539.46	E	34.02		49.44		16.88		16.50		346.16	E	392.26	E	221.56	E	177.00	E	1289.57	E	1116.54	E	7.28		2.77	
C1 phenanthrenes/anthracenes	832.63	E	744.04	E	52.34	E	79.08	E	40.21	E	31.07		352.49	E	390.93	E	240.33	E	194.64	E	1057.97	E	955.55	E	10.27		4.06	
C2 phenanthrenes/anthracenes	1356.65	E	1219.35	E	103.98	E	162.94	E	98.08	E	69.83	E	602.67	E	615.28	E	340.91	E	276.66	E	1850.78	E	1727.36	E	21.65	E	8.44	
C3 phenanthrenes/anthracenes	624.17		574.61		57.37		86.09		54.44		39.56		305.13		360.28		186.19		149.61		1008.30	E	925.72	E	12.21		5.02	
C4 phenanthrenes/anthracenes	91.63	E	80.54	E	9.77		14.17		8.53		6.73		49.07	E	55.20	E	29.54	E	23.72		165.30	E	158.31	E	1.96		0.65	
fluoranthene	2488.79	E	1620.23	E	98.44		135.20	E	82.00		71.13		331.84	E	259.14	E	259.14	E	191.82	E	2250.64	E	2422.75	E	18.90		8.53	
pyrene	508.69	E	372.35	E	51.75		77.93		47.95		37.67		280.39	E	237.48	E	190.62	E	138.93	E	775.17	E	709.81	E	10.68		4.65	
C1 fluoranthenes/pyrenes	571.51	E	412.77	E	57.47	E	86.41	E	53.36	E	39.30	E	348.97	E	288.80	E	210.46	E	148.46	E	1027.93	E	924.02	E	11.34	E	4.68	
benz[a]anthracene	302.75	E	249.37	E	34.82		51.32		33.77		26.41		166.29	E	184.03	E	99.36	E	79.63	E	401.60	E	366.58	E	7.58		3.33	
chrysene	242.00	E	218.04	E	25.62		36.92		24.20		18.72		135.97	E	149.43	E	78.69	E	62.67		363.77	E	325.95	E	5.53		2.43	
C1 chrysenes	601.64	E	501.01	E	69.32		99.55		64.51		50.12		331.11	E	361.37	E	189.16	E	150.61	E	842.22	E	767.09	E	15.22		6.85	
C2 chrysenes	394.35	E	326.44	E	56.83		69.59		44.09		51.41		235.73		260.40		124.10		97.72		608.76	E	563.22	E	10.76		4.40	
C3 chrysenes	111.34		92.05		14.30		21.18		13.48		10.79		69.83		110.21		63.94		24.84		191.26		176.44			ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene	236.01	E	210.69	E	32.37		45.27		30.64		24.45		137.54	E	149.58	E	79.52		63.85		261.46	E	249.11	E	6.58		3.08	
benzo[e]pyrene	81.62	E	73.43	E	10.43		14.60		10.16		7.89		44.45	E	48.11	E	28.60	E	23.41	E	81.30	E	77.61	E	2.08		1.02	
benzo[a]pyrene	239.97	E	215.87	E	26.83		40.91		28.36		21.55		132.44	E	144.77	E	86.95	E	70.33	E	247.26	E	235.67	E	5.97		2.75	
perylene	42.33	E	37.99	E	6.21		8.87		6.28		5.02		29.32	E	31.15	E	17.07		13.55		48.42	E	45.12	E	1.87		1.10	
indeno[1,2,3-cd]pyrene	163.84	E	150.44	E	18.44	E	28.38	E	18.17	E	14.05	E	104.42	E	115.32	E	59.49	E	44.21	E	261.43	E	227.94	E	3.58		1.46	
dibenz[ah]anthracene	33.89	E	31.18	E	4.03		6.17		3.82		2.95		23.24	E	30.66	E	12.74		11.13		56.59	E	49.76	E	0.80		0.31	
benzo[ghi]perylene	99.38	E	91.62	E	10.61		16.28		10.77		8.19		58.60	E	64.29	E	36.43	E	27.61	E	142.58	E	123.91	E	2.04		0.88	
Total PAH_{16} (mg/Kg)	7,603.69		6,075.09		428.52		610.34		328.71		279.52		3,344.56		3,619.25		2,231.12		1,791.19		11,534.19		10,793.52		85.84		36.74	
Mean - PAH_{16}	6,839.39				519.43				304.12				3,481.90				2,011.15				11,163.85				61.29			
Total PAH_{34} (mg/Kg)	15,512.80		13,019.41		952.55		1,379.67		771.21		633.36		7,247.63		7,758.31		4,585.40		3,658.36		23,055.33		21,231.56		190.37		79.77	
Mean - PAH_{34}	14,266.11				1,166.11				702.28				7,502.97				4,121.88				22,143.44				135.07			
% Alkylated PAHs	50		52		53		54		55		54		53		52		50		50		49		49		53		51	
Mean - % Alkylated PAHs	51.3				53.7				54.5				52.6				50.2				49.0				52.1			
Total organic carbon (TOC) (%)	5.00				0.47				0.49				5.38				3.88				8.06				0.41			
Soot organic carbon (SOC) (%)	0.54				0.29				0.22				0.57				1.42				0.91				0.20			
Fraction SOC/TOC	0.11				0.61				0.46				0.11				0.37				0.11				0.50			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate

Table 4-1
Sediment Total PAH Concentrations and Organic Carbon

Sediment PAHs (µg/L)	HD150				HD151				HD152				HD153				HD154				HD155				HD156			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	1.19		0.47		7.26		5.29		0.48		0.50		0.37		0.25			ND	0.13			ND		ND		ND		ND
2-methylnaphthalene	0.50		0.17		5.18		1.53		0.16		0.15		0.17		0.11		0.01	**J**	0.06			ND		ND		ND		ND
1-methylnaphthalene	0.35		0.12		4.03		1.12		0.07		0.07		0.07		0.06	**J**	0.01	**J**	0.03	**J**		ND		ND		ND		ND
C2 naphthalenes	3.29		1.36		22.83		19.63		0.62		0.58		0.73		0.65		0.13		0.27			ND		ND	0.24		0.07	
C3 naphthalenes	3.12		1.24		15.02		24.83		0.89		0.87		0.59		0.57		ND	ND	0.34			ND		ND		ND	0.05	
C4 naphthalenes	2.57		1.11		9.52		18.39		1.21		0.92		0.66		0.57		ND	ND	0.32	**J**		ND		ND	0.09	**J**	0.06	**J**
acenaphthylene	0.97		0.48		4.14		7.16		0.61		0.38		0.27		0.21		ND	ND	0.13		0.02	**J**		ND		ND		ND
acenaphthene	2.03		0.85		17.17		19.15		0.72		0.70		0.14		0.13		0.02	**J**	0.06	**J**		ND		ND		ND		ND
fluorene	2.05		0.75		15.78		19.02		0.62		0.71		0.12		0.13			ND	0.07	**J**		ND		ND		ND		ND
C1 fluorenes	3.30		1.25		15.00	**E**	26.34	**E**	1.19		1.09		0.53		0.48			ND	0.30			ND		ND		ND		ND
C2 fluorenes	4.06		1.57		15.90		29.92		1.99		1.46		0.83		0.65			ND	0.52			ND		ND		ND		ND
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	10.64		4.00		66.13		101.03		1.25		1.53		0.70		0.61		0.06	**J**	0.61			ND		ND		ND		ND
anthracene	7.28		2.77		40.93		65.83		1.57		1.66		0.54		0.59		0.05	**J**	0.85			ND	ND	ND		ND		ND
C1 phenanthrenes/anthracenes	10.27		4.06		45.09	**E**	85.48	**E**	3.03		2.68		1.02		0.89		0.12		1.17		0.10		0.11		0.06		0.05	
C2 phenanthrenes/anthracenes	21.65	**E**	8.44		62.89	**E**	148.62	**E**	10.15		7.43		3.61		2.45		0.52		2.62		0.60		0.52			ND		ND
C3 phenanthrenes/anthracenes	12.21		5.02		43.19		87.94		6.11		4.15		4.03		1.54			ND	1.70			ND		ND		ND		ND
C4 phenanthrenes/anthracenes	1.96		0.65		6.77		13.57		0.84		0.50		1.22		0.32			ND	0.14			ND		ND		ND		ND
fluoranthene	18.90		8.53		72.75		151.97	**E**	9.25		7.12		1.36		1.16		0.11		2.36			ND		ND		ND		ND
pyrene	10.68		4.65		45.53		90.71		5.49		4.35		1.29		1.11		0.07	**J**	1.29			ND		ND		ND		ND
C1 fluoranthenes/pyrenes	11.34	**E**	4.68		45.31	**E**	93.20	**E**	5.84		3.93		1.43		1.10		0.07		1.40			ND		ND		ND		ND
benz[a]anthracene	7.58		3.33		30.73		60.62		4.37		2.97		0.80		0.71		0.05	**J**	1.05		0.01	**J**		ND	0.01	**J**	0.01	**J**
chrysene	5.53		2.43		20.63		44.30		3.23		2.13		0.63		0.57		0.04	**J**	1.08		0.01	**J**	0.01	**J**	0.01	**J**	0.01	**J**
C1 chrysenes	15.22		6.85		55.63		109.50		9.20		5.50		1.90		1.77			ND	2.47		ND	ND		ND		ND		ND
C2 chrysenes	10.76		4.40		37.63		74.45		5.46		3.30		1.50		1.28			ND	0.79			ND		ND		ND		ND
C3 chrysenes		ND		ND	15.05		34.88			ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene	6.58		3.08		27.40		53.68		4.31		2.87		0.90		0.90		0.03	**J**	1.22			ND		ND		ND		ND
benzo[e]pyrene	2.08		1.02		8.90		17.39	**E**	1.48		0.97		0.35		0.36		0.02		0.43			ND		ND		ND		ND
benzo[a]pyrene	5.97		2.75		25.36		50.37	**E**	4.07		2.56		0.87		0.72		0.03	**J**	0.96			ND		ND		ND		ND
perylene	1.87		1.10		5.96		11.43		1.29		0.92		0.24		0.23		0.15		0.39			ND		ND		ND		ND
indeno[1,2,3-cd]pyrene	3.58		1.46		15.88	**E**	34.05	**E**	2.22		1.40		0.56		0.59			ND	0.46			ND		ND		ND		ND
dibenz[ah]anthracene	0.80		0.31		3.28		7.13		0.45		0.28		0.11		0.14			ND	0.10			ND		ND		ND		ND
benzo[ghi]perylene	2.04		0.88		9.31		19.60		1.42		0.91		0.39		0.40			ND	0.32			ND		ND		ND		ND
Total PAH_{16} (mg/Kg)	85.84		36.74		402.27		729.89		40.03		30.07		9.04		8.23		0.46		10.69		0.03		0.01		0.02		0.02	
Mean - PAH_{16}	61.29				566.08				35.05				8.64				5.58				0.02				0.02			
Total PAH_{34} (mg/Kg)	190.37		79.77		816.17		1,528.09		89.54		64.61		27.94		21.26		1.49		23.64		0.74		0.63		0.41		0.25	
Mean - PAH_{34}	135.07				1172.13				77.08				24.60				12.57				0.68				0.33			
% Alkylated PAHs	53		51		49		50		52		51		66		59		57		51		96		99		96		94	
Mean - % Alkylated PAHs	52.1				49.6				51.4				62.0				54.3				97.2				94.6			
Total organic carbon (TOC) (%)	2.14				0.56				0.43				0.78				1.03				0.55				0.16			
Soot organic carbon (SOC) (%)	1.83				0.10				0.11				0.29				0.52				0.11				0.07			
Fraction SOC/TOC	0.86				0.17				0.25				0.37				0.51				0.20				0.47			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate

Table 4-1
Sediment Total PAH Concentrations and Organic Carbon

Sediment PAHs (µg/L)	HD157				HD158				HD159				HD160				HD161				HD162			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	0.04	J	0.03	J	0.04	J		ND		ND		ND	0.10	J	0.06	J	0.03	J		ND		ND		ND
2-methylnaphthalene	0.03	J	0.02	J	0.02	J	0.01	J	0.01	J		ND	0.06		0.04	J	0.01	J		ND		ND		ND
1-methylnaphthalene	0.02	J	0.01	J	0.01	J	0.01	J	0.01	J		ND	0.02	J	0.02	J	0.01	J	0.01	J		ND		ND
C2 naphthalenes	0.17		0.18		0.14		0.15		0.10		0.14		0.32		0.29		0.13		0.18			ND		ND
C3 naphthalenes	0.10		0.15		0.14		0.06			ND		ND	0.25		0.27		0.09		0.10			ND		ND
C4 naphthalenes		ND		ND	0.25	J	0.29	J		ND		ND	0.36	J	0.35	J		ND		ND		ND		ND
acenaphthylene		ND		ND	0.02	J	0.02	J		ND		ND	0.06	J	0.03	J	0.01	J		ND		ND		ND
acenaphthene		ND		ND	0.04	J		ND		ND		ND	0.04	J	0.05	J	0.02	J		ND		ND		ND
fluorene		ND		ND	0.03	J	0.02	J		ND		ND	0.05	J	0.05	J		ND		ND		ND		ND
C1 fluorenes	0.08		0.06		0.09		0.10		0.10		0.08		0.19		0.16		0.10		0.11			ND		ND
C2 fluorenes		ND		ND		ND	ND	ND		ND		ND	0.52		0.38			ND		ND		ND		ND
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	0.09	J	0.05	J	0.14		0.11	J		ND		ND	0.42		0.28		0.10	J	0.05	J		ND		ND
anthracene	0.04	J	0.03	J	0.09	J	0.06	J		ND		ND	0.32		0.17		0.05	J	0.03	J		ND		ND
C1 phenanthrenes/anthracenes	0.10		0.09		0.22		0.16		0.10		0.12		0.97		0.49		0.22		0.16		0.05		0.05	
C2 phenanthrenes/anthracenes		ND		ND	0.97		0.63			ND		ND	2.80		1.39		0.78		0.67			ND		ND
C3 phenanthrenes/anthracenes		ND		ND	0.79	J	0.21	J		ND		ND	1.68		0.61	J		ND		ND		ND		ND
C4 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND	0.25		0.12			ND		ND		ND		ND
fluoranthene	0.08	J		ND	0.17		0.14			ND		ND	1.17		0.56		0.23		0.06	J		ND		ND
pyrene	0.06	J		ND	0.12		0.10			ND		ND	0.96		0.46		0.20		0.04	J		ND		ND
C1 fluoranthenes/pyrenes		ND		ND	0.22		0.09			ND		ND	1.29		0.37		0.18		0.05			ND		ND
benz[a]anthracene		ND		ND	0.19		0.07	J	0.01	J		ND	0.69		0.22		0.14		0.02	J		ND		ND
chrysene		ND		ND	0.21		0.06	J	0.01	J	0.01	J	0.63		0.20		0.11		0.02	J		ND		ND
C1 chrysenes		ND		ND	1.92		0.21			ND		ND	1.73		0.33		0.24			ND		ND		ND
C2 chrysenes		ND		ND	3.02		0.29			ND		ND	1.06		0.29			ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND	0.21		0.08			ND		ND	0.80		0.22		0.21		0.03	J		ND		ND
benzo[e]pyrene		ND		ND	0.26		0.03			ND		ND	0.27		0.09		0.08		0.02			ND		ND
benzo[a]pyrene		ND		ND	0.28		0.07			ND		ND	0.65		0.19		0.12		0.03	J		ND		ND
perylene		ND		ND	1.30		0.87			ND		ND	0.29		0.19			ND		ND		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND	0.13		0.01			ND		ND	0.31		0.10			ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND	0.11			ND		ND		ND	0.08		0.02			ND		ND		ND		ND
benzo[ghi]perylene		ND		ND	0.18		0.03			ND		ND	0.21		0.07			ND		ND		ND		ND
Total PAH_{16} (mg/Kg)	0.31		0.11		1.96		0.78		0.02		0.01		6.49		2.67		1.23		0.28		0.00		0.00	
Mean - PAH_{16}	0.21				1.37				0.01				4.58				0.75				0.00			
Total PAH_{34} (mg/Kg)	0.80		0.61		11.31		3.91		0.33		0.34		18.56		8.05		3.07		1.57		0.05		0.05	
Mean - PAH_{34}	0.70				7.61				0.34				13.31				2.32				0.05			
% Alkylated PAHs	62		82		69		57		95		97		62		63		57		81		NA		NA	
Mean - % Alkylated PAHs	71.6				62.9				96.0				62.8				69.2				NA			
Total organic carbon (TOC) (%)	0.27				0.77				0.76				1.00				0.94				0.48			
Soot organic carbon (SOC) (%)	0.20				0.09				0.10				0.41				0.10				0.07			
Fraction SOC/TOC	0.76				0.11				0.13				0.41				0.10				0.16			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate

Table 4-2
Sediment SPME Pore Water PAH Concentrations

Sediment PAHs (ng/g)	HD101				HD102				HD103				HD104				HD105				HD106				HD107			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
2-methylnaphthalene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1-methylnaphthalene		ND		ND		ND		ND	0.108	J	0.112	J	0.117	J	0.112		0.156	J	0.149	J	0.117	J	0.112	J		ND		ND
C2 naphthalenes	0.266	J	0.293	J	0.257	J	0.243	J	0.274	J	0.321	J	0.360	J	0.410		0.445	J	0.398	J	0.329	J	0.377	J		ND		ND
C3 naphthalenes	0.203	J	0.170	J	0.281	J	0.261	J	0.124	J	0.103	J	0.252	J	0.252		0.388	J	0.385	J	0.275	J	0.288	J		ND		ND
C4 naphthalenes		ND		ND		ND		ND		ND		ND		ND		ND	0.285	J	0.349	J	0.184	J		ND		ND		ND
acenaphthylene		ND		ND		ND		ND		ND		ND		ND		ND				ND		ND		ND		ND		ND
acenaphthene		ND	0.101	J	0.128	J	0.130	J	0.141	J	0.137	J		ND		ND	0.232	J	0.236	J	0.127	J	0.126	J		ND		ND
fluorene	0.041	J			0.065	J	0.064	J		ND		ND		ND		ND	0.105	J	0.106	J	0.053	J	0.052	J		ND		ND
C1 fluorenes	0.044	J	0.031	J	0.050	J	0.048	J		ND		ND		ND		ND	0.118	J	0.116	J	0.062	J	0.072	J		ND		ND
C2 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	0.115	J	0.115	J	0.196	J	0.200	J		ND		ND		ND		ND	0.196	J	0.190	J		ND		ND		ND		ND
anthracene		ND		ND		ND		ND		ND		ND		ND		ND	0.060	J	0.063	J		ND		ND		ND		ND
C1 phenanthrenes/anthracenes	0.072	J	0.078	J	0.102	J	0.110	J		ND		ND	0.034	J	0.039		0.123	J	0.140	J	0.077	J	0.081	J		ND		ND
C2 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
fluoranthene	0.064	J	0.055	J	0.086	J	0.089	J		ND		ND	0.022	J	0.023		0.122	J	0.125	J	0.064	J	0.062	J		ND		ND
pyrene	0.059	J	0.057	J	0.085	J	0.101	J	0.023	J	0.021	J	0.022	J	0.023		0.109	J	0.093	J	0.062	J	0.059	J		ND		ND
C1 fluoranthenes/pyrenes		ND			0.030	J	0.024	J		ND		ND		ND		ND	0.039	J	0.038	J	0.015	J	0.020	J		ND		ND
benz[a]anthracene	0.003	J	0.003	J	0.004	J	0.006	J		ND		ND		ND		ND	0.006	J	0.004	J	0.003	J	0.003	J		ND		ND
chrysene	0.004	J	0.003	J	0.005	J	0.007	J		ND		ND		ND		ND	0.005	J	0.005	J	0.004	J	0.005	J		ND		ND
C1 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C2 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[e]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[a]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[ghi]perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
SPME Pore Water PAH_{34} (µg/L)	0.87		0.91		1.29		1.28		0.67		0.70		0.81		0.86		2.39		2.40		1.37		1.26		ND		ND	
Mean - SPME Pore Water PAH_{34}	0.89				1.29				0.68				0.83				2.39				1.31				ND			
SPME Pore Water TU_{34}	0.06		0.06		0.10		0.10		<0.1		<0.1		<0.1		<0.1		0.21		0.22		0.12		0.08		<0.1		<0.1	
Mean - SPME Pore Water TU_{34}	0.06				0.10				<0.1				<0.1				0.22				0.10				<0.1			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
µg/L - micrograms/liter
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate
TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units using the USEPA (2003)

Table 4-2
Sediment SPME Pore Water PAH Concentrations

Sediment PAHs (ng/g)	HD108				HD109				HD110				HD111				HD112				HD113				HD114			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	0.725	J	0.719	J		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
2-methylnaphthalene	0.388	J	0.373	J		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1-methylnaphthalene	1.141	J	1.101	J	0.181	J	0.189	J	0.153	J	0.148	J	0.163	J	0.159	J	0.184	J	0.186	J	0.319	J	0.332	J	0.316	J	0.308	J
C2 naphthalenes	3.081		2.807	J	1.343	J	1.191	J	0.364	J	0.348	J	0.394	J	0.367	J	0.419	J	0.503	J	2.516	J	2.499	J	1.459	J	1.502	J
C3 naphthalenes	3.866	J	3.522	J	1.807	J	1.632	J	0.172	J	0.212	J	0.216	J	0.212	J	0.354	J	0.365	J	7.012		6.942		1.387	J	1.651	J
C4 naphthalenes	2.147	J	1.876	J	1.800	J	1.667	J		ND		ND		ND		ND	0.274	J	0.291	J	8.817		8.473		0.821	J	1.022	J
acenaphthylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	0.486	J	0.452	J		ND		ND
acenaphthene	1.040	J	1.009	J	2.282		2.244			ND		ND		ND		ND	0.191	J	0.183	J	6.913		6.901		0.862	J	0.885	J
fluorene	0.304	J	0.308	J	0.866		0.849			ND	0.042	J	0.047	J	0.044	J	0.091	J	0.089	J	3.111		3.129		0.262	J	0.307	J
C1 fluorenes	0.433	J	0.438	J	0.471	J	0.448	J		ND		ND		ND		ND	0.069	J	0.071	J	3.297		3.454		0.411	J	0.430	J
C2 fluorenes	0.333	J	0.333	J	0.340	J	0.366	J		ND		ND		ND		ND	ND	ND	0.065	J	2.163		1.460		0.313	J	0.404	J
C3 fluorenes						ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	0.682	J	0.681	J	1.109	J	1.112	J		ND		ND		ND		ND	0.185	J	0.190	J	1.180	J	1.183	J	0.460	J	0.483	J
anthracene	0.069	J	0.068	J	0.210		0.201			ND		ND		ND		ND		ND		ND	0.531		0.547		0.099	J	0.124	J
C1 phenanthrenes/anthracenes	0.739	J	0.714	J	0.713	J	0.635	J		ND		ND		ND		ND	0.158	J	0.178	J	2.119	J	2.119	J	0.630	J	0.652	J
C2 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	0.258	J	0.237	J		ND	0.086	J
C3 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	0.393	J	0.367	J		ND		ND
C4 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
fluoranthene	0.204	J	0.204	J	0.482		0.490			ND		ND		ND		ND	0.120	J	0.115	J	3.220		3.242		0.263	J	0.286	J
pyrene	0.281		0.287		0.489		0.493			ND		ND		ND		ND	0.143	J	0.133	J	3.036		3.039		0.317		0.330	
C1 fluoranthenes/pyrenes	0.109	J	0.103	J	0.151	J	0.133	J		ND		ND		ND		ND	0.045	J	0.048	J	0.916		0.907		0.143	J	0.143	J
benz[a]anthracene	0.008	J	0.010	J	0.014	J	0.014	J		ND		ND		ND		ND	0.006	J	0.008	J	0.092	J	0.093	J	0.014	J	0.018	J
chrysene	0.015	J	0.013	J	0.016	J	0.017	J		ND		ND		ND		ND	0.008	J	0.009	J	0.095		0.093		0.016	J	0.019	J
C1 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	0.013	J	0.011	J		ND		ND
C2 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[e]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[a]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[ghi]perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
SPME Pore Water PAH_{34} (µg/L)	15.56		14.57		12.28		11.68		0.69		0.75		0.82		0.78		2.25		2.43		46.49		45.48		7.77		8.65	
Mean - SPME Pore Water PAH_{34}	15.07				11.98				0.72				0.80				2.34				45.98				8.21			
SPME Pore Water TU_{34}	1.35		1.24		1.14		1.08		<0.1		<0.1		<0.1		<0.1		0.20		0.23		5.56		5.31		0.72		0.85	
Mean - SPME Pore Water TU_{34}	1.30				1.11				<0.1				<0.1				0.22				5.44				0.78			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
µg/L - micrograms/liter
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate
TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units using the USEPA (2003)

Table 4-2
Sediment SPME Pore Water PAH Concentrations

Sediment PAHs (ng/g)	HD115				HD116				HD117				HD118				HD119				HD120				HD121			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
2-methylnaphthalene		ND		ND	ND	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1-methylnaphthalene	0.209	J	0.204	J	0.250	J	0.240	J	0.183	J	0.185	J		ND		ND		ND		ND		ND		ND		ND		ND
C2 naphthalenes	0.457	J	0.486	J	2.859		2.774	J	0.520	J	0.522	J		ND		ND	2.600	J	2.481	J	0.713	J	0.539	J		ND		ND
C3 naphthalenes	0.296	J	0.327	J	2.989	J	2.828	J	0.275	J	0.326	J		ND		ND	10.478		10.197		ND	ND		ND		ND		ND
C4 naphthalenes	0.159	J		ND	1.584	J	1.539	J		ND		ND		ND		ND	9.240		9.124			ND		ND		ND		ND
acenaphthylene		ND		ND		ND		ND		ND		ND		ND		ND	0.536	J	0.483	J		ND		ND		ND		ND
acenaphthene	0.153	J	0.141	J	2.561		2.517		0.184	J	0.186	J		ND		ND	5.353		5.330		0.126	J	0.116	J		ND		ND
fluorene	0.067	J	0.066	J	0.608	J	0.618	J	0.064	J	0.062	J		ND		ND	1.037		1.007			ND		ND		ND		ND
C1 fluorenes	0.043	J	0.034	J	0.452	J	0.433	J	0.051	J	0.069	J		ND		ND	2.067		2.145			ND		ND		ND		ND
C2 fluorenes		ND		ND	0.283	J	0.270	J		ND		ND		ND		ND	2.406		2.523			ND		ND		ND		ND
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene		ND		ND	1.057	J	1.065	J		ND		ND		ND		ND	2.032		1.966			ND		ND		ND		ND
anthracene		ND		ND	0.172	J	0.186	J		ND		ND		ND		ND	0.173	J	0.166	J		ND		ND		ND		ND
C1 phenanthrenes/anthracenes	0.051	J	0.050	J	0.758	J	0.744	J	0.059	J	0.062	J		ND		ND	3.915		3.958			ND		ND		ND		ND
C2 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND	0.334	J	0.249	J		ND		ND		ND		ND
C3 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND	1.152	J	1.000	J		ND		ND		ND		ND
C4 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND				ND		ND		ND		ND		ND
fluoranthene	0.028	J	0.027	J	0.236	J	0.239	J	0.031	J	0.033	J		ND		ND	1.458		1.421		0.021	J		ND		ND		ND
pyrene	0.027	J	0.027	J	0.277		0.280		0.037	J	0.038	J		ND		ND	2.280		2.233		0.023	J	0.025	J		ND		ND
C1 fluoranthenes/pyrenes		ND		ND	0.094	J	0.097	J		ND		ND		ND		ND	0.748		0.752			ND		ND		ND		ND
benz[a]anthracene		ND		ND	0.010	J	0.010	J	0.002	J	0.003	J		ND		ND	0.076	J	0.077	J		ND		ND		ND		ND
chrysene		ND		ND	0.011	J	0.010	J	0.003	J	0.003	J		ND		ND	0.090		0.083			ND		ND		ND		ND
C1 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND	0.049	J	0.050	J		ND		ND		ND		ND
C2 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[e]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[a]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[ghi]perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
SPME Pore Water PAH_{34} (µg/L)	1.49		1.36		14.20		13.85		1.41		1.49		ND		ND		46.02		45.25		0.88		0.68		ND		ND	
Mean - SPME Pore Water PAH_{34}	1.43				14.03				1.45				ND				45.63				0.78				ND			
SPME Pore Water TU_{34}	0.11		0.07		1.16		1.13		0.07		0.08		<0.1		<0.1		6.42		6.23		0.03		0.02		<0.1		<0.1	
Mean - SPME Pore Water TU_{34}	0.09				1.14				<0.1				<0.1				6.33				0.03				<0.1			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
µg/L - micrograms/liter
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate
TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units using the USEPA (2003)

Table 4-2
Sediment SPME Pore Water PAH Concentrations

Sediment PAHs (ng/g)	HD122				HD123				HD124				HD125				HD126				HD127				HD128			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
2-methylnaphthalene		ND		ND	0.290	J	0.284	J		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1-methylnaphthalene		ND		ND	0.538	J	0.534	J	0.403	J	0.435	J	0.120	J	0.107	J		ND		ND		ND		ND		ND		ND
C2 naphthalenes		ND		ND	14.027		13.392		4.937		5.230		0.789	J	0.859	J		ND		ND	0.552	J	0.507	J	1.046	J	1.003	J
C3 naphthalenes		ND		ND	25.244		24.581		8.492		9.084		0.574	J	0.568	J		ND		ND	0.313	J	0.263	J	1.008	J	1.056	J
C4 naphthalenes		ND		ND	12.299		12.159		5.650	J	5.880			ND		ND		ND		ND		ND		ND	0.622	J	0.573	J
acenaphthylene		ND		ND	0.492	J	0.485	J	0.338	J	0.367	J		ND		ND		ND		ND		ND		ND		ND		ND
acenaphthene	0.167	J	0.179	J		ND		ND	3.577		3.722		0.519	J	0.545	J		ND		ND	0.150	J	0.146	J	1.884		1.883	
fluorene	0.044	J	ND		2.127		2.078		1.308		1.320		0.216	J	0.215	J		ND		ND	0.115	J	0.117	J	0.108	J	0.113	J
C1 fluorenes		ND		ND	4.817		4.948		1.929		1.955		0.163	J	0.139	J		ND		ND	0.041	J	0.034	J	0.267	J	0.286	J
C2 fluorenes		ND		ND	2.825		2.996		1.379		1.277	J		ND		ND		ND		ND		ND		ND	0.174	J	0.198	J
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene		ND		ND		ND		ND	1.952		1.997		0.311		0.318	J		ND		ND	0.171	J	0.156	J	0.190	J	0.190	J
anthracene		ND		ND	1.706		1.660		0.653		0.675		0.092	J	0.080	J		ND		ND	0.186		0.164	J	0.063	J	0.053	J
C1 phenanthrenes/anthracenes		ND		ND	7.380		7.279		2.170	J	2.260	J	0.259	J	0.239	J		ND		ND	0.181	J	0.128	J	0.318	J	0.271	J
C2 phenanthrenes/anthracenes		ND		ND	0.220	J	0.337	J	0.128	J	0.150	J		ND		ND		ND		ND		ND		ND		ND		ND
C3 phenanthrenes/anthracenes		ND		ND	0.411	J	0.423	J		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
fluoranthene	0.030	J	0.029	J	0.966		0.959		0.714		0.741		0.099	J	0.104	J		ND		ND	0.066	J	0.053	J		ND	0.135	J
pyrene	0.035	J	0.041	J	1.467		1.447		0.748		0.792		0.082	J	0.081	J		ND		ND	0.074	J	0.060	J	0.191	J	0.196	J
C1 fluoranthenes/pyrenes		ND		ND	0.444		0.453		0.311	J	0.329	J	0.030	J	0.030	J		ND		ND	0.040	J	0.038	J	0.064	J	0.055	J
benz[a]anthracene		ND		ND	0.040	J	0.041	J	0.031	J	0.031	J	0.004	J	0.004	J		ND		ND	0.006	J	0.005	J	0.007	J	0.009	J
chrysene		ND		ND	0.041	J	0.042	J	0.030	J	0.030	J	0.004	J	0.005	J		ND		ND	0.006	J	0.004	J	0.008	J	0.009	J
C1 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C2 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[e]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[a]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[ghi]perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
SPME Pore Water PAH_{34} (µg/L)	0.28		0.25		75.33		74.10		34.75		36.27		3.26		3.29		ND		ND		1.90		1.68		5.95		6.03	
Mean - SPME Pore Water PAH_{34}	0.26				74.72				35.51				3.28				ND				1.79				5.99			
SPME Pore Water TU_{34}	<0.1		<0.1		8.60		8.56		3.56		3.70		0.19		0.19		<0.1		<0.1		0.13		0.11		0.46		0.47	
Mean - SPME Pore Water TU_{34}	<0.1				8.58				3.63				0.19				<0.1				0.12				0.47			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
µg/L - micrograms/liter
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate
TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units using the USEPA (2003)

Table 4-2
Sediment SPME Pore Water PAH Concentrations

Sediment PAHs (ng/g)	HD129				HD130				HD131				HD132				HD133				HD134				HD135			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene		ND				ND		ND	618.000		599.458			ND		ND	1.026	J	1.010	J		ND		ND		ND		ND
2-methylnaphthalene		ND				ND		ND	319.862		305.836			ND		ND	0.254	J	0.252	J		ND		ND		ND		ND
1-methylnaphthalene		ND		v		ND		ND	426.701		410.400		0.129	J	0.118	J	0.822	J	0.857	J		ND		ND		ND		ND
C2 naphthalenes	0.848	J	1.034	J	1.072	J	1.079	J	684.055		673.341		1.096	J	0.966	J	5.861		5.293		0.793	J	1.025	J	0.560	J	0.615	J
C3 naphthalenes	2.254	J	1.989	J	1.176	J	1.184	J	454.503		453.019		1.544	J	1.419	J	14.293		13.127		0.520	J	0.649	J	0.118	J	0.165	J
C4 naphthalenes	1.766	J	1.614	J	0.861	J	0.919	J	145.019		147.261		1.045	J	0.893	J	11.936		12.376		0.540	J	0.714	J		ND		ND
acenaphthylene		ND		ND	0.211	J		ND	21.190		20.410			ND		ND	0.740	J	0.813	J	0.224	J		ND		ND		ND
acenaphthene	1.489		1.536		2.244		2.282		237.478		231.309		0.541	J	0.539	J	10.295		10.420		2.504		2.409		0.173	J	0.154	J
fluorene	0.264	J	0.279	J	0.258	J	0.278	J	54.190		53.356		0.135	J	0.136	J	4.332		4.526		0.186	J	0.195	J	0.042	J	0.047	J
C1 fluorenes	0.751	J	0.758	J	0.512	J	0.457	J	68.765		68.793		0.341	J	0.334	J	4.644		4.514		0.591	J	0.561	J		ND		ND
C2 fluorenes	0.534	J	0.642	J	0.465	J	0.381	J	27.865		28.596			ND		ND	2.756		3.488			ND		ND		ND		ND
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	0.228	J	0.238	J	0.163	J	0.154	J	75.079		74.164		0.301	J	0.315	J	4.645		4.726		0.117	J	0.111	J		ND		ND
anthracene	0.084	J	0.085	J	ND		ND		11.812		11.740		0.084	J	0.083	J	0.759		0.785			ND	ND			ND		ND
C1 phenanthrenes/anthracenes	0.519	J	0.543	J	0.346	J	0.403	J	69.580		69.691		0.505	J	0.495	J	4.890		5.332		0.200	J	0.202	J	0.141	J	0.114	J
C2 phenanthrenes/anthracenes	0.092	J	0.098	J		ND		ND	2.666	J	2.590	J		ND		ND	0.382	J	0.447	J		ND		ND		ND		ND
C3 phenanthrenes/anthracenes		ND		ND		ND		ND	3.574	J	3.917	J		ND		ND	0.585	J	0.597	J		ND		ND		ND		ND
C4 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
fluoranthene	0.263	J	0.263	J	0.172	J	0.165	J	5.948		6.172		0.158	J	0.158	J	2.503		2.561		0.123	J	0.130	J	ND	ND		ND
pyrene	0.295		0.307		0.244		0.240		9.915		10.253		0.208	J	0.202	J	2.452		2.470		0.157	J	0.163	J	0.060	J	0.082	J
C1 fluoranthenes/pyrenes	0.113	J	0.121	J	0.078	J	0.086	J	4.339		4.874		0.091	J	0.085	J	0.830		0.923		0.030	J	0.042	J	0.038	J	0.037	J
benz[a]anthracene	0.011	J	0.011	J	0.007	J	0.007	J	0.313		0.393		0.010	J	0.009	J	0.076	J	0.077	J	0.004	J	0.004	J	0.004	J	0.005	J
chrysene		ND		ND	0.005	J	0.006	J	0.329		0.404		0.009	J	0.009	J	0.077		0.073		0.003	J	0.003	J	0.003	J	0.004	J
C1 chrysenes		ND		ND		ND		ND	0.105	J	0.131			ND		ND		ND		ND		ND		ND		ND		ND
C2 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND		ND		ND	0.050	J	0.074			ND		ND		ND		ND		ND		ND		ND		ND
benzo[e]pyrene		ND		ND		ND		ND	0.062	J	0.080			ND		ND		ND		ND		ND		ND		ND		ND
benzo[a]pyrene		ND		ND		ND		ND	0.132		0.132			ND		ND		ND		ND		ND		ND		ND		ND
perylene		ND		ND		ND		ND	0.021	J	0.024	J		ND		ND		ND		ND		ND		ND		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[ghi]perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
SPME Pore Water PAH_{34} (µg/L)	9.51		9.52		7.81		7.64		3,241.56		3,176.42		6.20		5.76		74.16		74.67		5.99		6.21		1.14		1.22	
Mean - SPME Pore Water PAH_{34}	9.51				7.73				3,208.99				5.98				74.41				6.10				1.18			
SPME Pore Water TU_{34}	1.06		1.04		0.65		0.65		149.52		149.64		0.63		0.57		7.96		8.20		0.37		0.44		0.07		0.07	
Mean - SPME Pore Water TU_{34}	1.05				0.65				149.58				0.60				8.08				0.41				0.07			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
µg/L - micrograms/liter
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate
TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units using the USEPA (2003)

Table 4-2
Sediment SPME Pore Water PAH Concentrations

Sediment PAHs (ng/g)	HD136				HD137				HD138				HD139				HD140				HD141				HD142			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene		ND		ND	3.587	J	4.120			ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
2-methylnaphthalene		ND		ND	0.906	J	0.919	J	0.802	J	0.767	J		ND		ND		ND		ND	0.349	J	0.328	J	6.255		6.116	
1-methylnaphthalene		ND		ND	1.578		1.601		2.746		2.707			ND		ND	0.420	J	0.405	J	4.816		4.666		8.962		8.900	
C2 naphthalenes		ND		ND	4.097		4.568		91.217		88.682		0.584	J	0.537	J	1.289	J	0.968	J	10.678		10.325		15.034		14.692	
C3 naphthalenes		ND		ND	7.443		9.332		70.339		71.150		0.688	J	0.603	J	0.998	J	0.731	J	10.188		9.932		14.033		13.436	
C4 naphthalenes		ND		ND	4.723	J	6.679		61.553		66.256		1.149	J	0.911	J	0.545	J	0.365	J	4.831	J	5.043	J	6.773		5.879	
acenaphthylene		ND		ND	0.402	J	0.418	J	7.840		7.828			ND		ND		ND		ND	1.261		1.235		1.165		1.234	
acenaphthene		ND		ND	3.506		3.483		120.246		119.611		1.470		1.464		1.335		1.215		16.436		15.756		13.413		13.353	
fluorene		ND		ND	0.918		0.932		53.876		54.124		0.141	J	0.147	J	0.589	J	0.521	J	3.065		2.916		3.086		3.104	
C1 fluorenes		ND		ND	1.342		1.365		19.440		19.695		0.615	J	0.537	J	0.342	J	0.282	J	1.958		2.097		3.246		3.073	
C2 fluorenes		ND		ND	1.713		2.036		7.658		10.149		0.445	J	0.382	J	0.139	J	0.104	J	1.538		1.168	J	2.049		2.328	
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene		ND		ND	1.721		1.658		74.193		74.080		0.299	J	0.215	J	0.644	J	0.588	J	2.891		2.804		4.367		4.402	
anthracene		ND		ND	0.202		0.182	J	14.272		14.303		0.077	J	0.052	J	0.156	J	0.138	J	0.486		0.477		0.603		0.589	
C1 phenanthrenes/anthracenes		ND		ND	2.153	J	2.100	J	29.279		30.394		0.381	J	0.270	J	0.413	J	0.391	J	2.013	J	2.087	J	3.249		3.361	
C2 phenanthrenes/anthracenes		ND		ND	0.091	J	0.120	J	1.412	J	1.318	J		ND		ND		ND		ND		ND		ND		ND		ND
C3 phenanthrenes/anthracenes		ND		ND	0.511	J	0.546	J	1.991	J	2.392	J		ND		ND		ND		ND		ND		ND		ND		ND
C4 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
fluoranthene		ND		ND	0.308	J	0.286	J	9.085		9.277		0.268	J	0.232	J	0.161	J	0.149	J	0.830		0.803		0.955		0.965	
pyrene		ND		ND	0.444		0.411		7.465		7.403		0.332		0.289		0.136	J	0.129	J	0.897		0.860		1.172		1.177	
C1 fluoranthenes/pyrenes		ND		ND	0.214	J	0.216	J	3.056		3.206		0.137	J	0.093	J	0.042	J	0.050	J	0.298	J	0.287	J	0.462		0.477	
benz[a]anthracene		ND		ND	0.017	J	0.017	J	0.308		0.320		0.017	J	0.014	J	0.009	J	0.009	J	0.045	J	0.035	J	0.059	J	0.060	J
chrysene		ND		ND	0.022	J	0.019	J	0.236		0.242		0.015	J	0.012	J	0.008	J	0.009	J	0.042	J	0.033	J	0.060	J	0.062	J
C1 chrysenes		ND		ND		ND		ND	0.059	J	0.067	J		ND		ND		ND		ND		ND		ND		ND		ND
C2 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND		ND		ND	0.041	J	0.038	J		ND		ND		ND		ND		ND		ND		ND		ND
benzo[e]pyrene		ND		ND		ND		ND	0.029	J	0.023	J		ND		ND		ND		ND		ND		ND		ND		ND
benzo[a]pyrene		ND		ND		ND		ND	0.064		0.046	J		ND		ND		ND		ND		ND		ND		ND		ND
perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[ghi]perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
SPME Pore Water PAH_{34} (µg/L)	ND		ND		35.90		41.01		577.21		584.08		6.62		5.76		7.23		6.05		62.62		60.85		84.94		83.21	
Mean - SPME Pore Water PAH_{34}	ND				38.45				580.64				6.19				6.64				61.74				84.07			
SPME Pore Water TU_{34}	<0.1		<0.1		3.51		4.26		44.65		46.76		0.71		0.58		0.51		0.41		4.09		4.02		5.68		5.45	
Mean - SPME Pore Water TU_{34}	<0.1				3.88				45.70				0.64				0.46				4.06				5.56			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
µg/L - micrograms/liter
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate
TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units using the USEPA (2003)

Table 4-2
Sediment SPME Pore Water PAH Concentrations

Sediment PAHs (ng/g)	HD143				HD144				HD145				HD146				HD147				HD148				HD149			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene	2,658.720	E	2,486.463	E	9.958		9.704		10.024		9.704		1.473	J	1.251	J	2.693	J	2.583	J	3,764.118	E	4,281.806	E	2.490	J	2.413	J
2-methylnaphthalene	456.204	E	454.608	E	2.300		2.211		2.315		2.211		529.173	E	510.622	E	539.292	E	518.730	E	564.883	E	541.837	E	0.464	J	0.513	J
1-methylnaphthalene	396.517		395.118		2.474		2.443		2.491		2.443		352.566		339.720		387.758		376.340		353.469		340.785		0.732	J	0.759	J
C2 naphthalenes	487.722		437.669		5.047		4.885		5.080		4.885		282.885		268.452		335.410		319.915		327.272		327.341		2.941		3.046	
C3 naphthalenes	315.857		265.362		4.610	J	4.601	J	4.641	J	4.601	J	136.364		131.007		161.542		153.058		160.286		169.670		3.085	J	3.254	J
C4 naphthalenes	175.541		131.834		3.211	J	3.070	J	3.232	J	3.070	J	86.081		88.033		93.394		87.090		97.493		113.054		2.072	J	2.264	J
acenaphthylene	20.471		24.267		0.616	J	0.596	J	0.620	J	0.596	J	26.432		24.355		28.099		26.755		52.870		48.958		0.377	J	0.332	J
acenaphthene	313.753		312.268		6.373		6.214		6.415		6.214		386.194		379.676		453.747	E	449.353	E	253.979		248.464		4.024		3.947	
fluorene	109.695		106.053		2.958		2.944		2.978		2.944		120.819		119.778		115.562		115.275		127.492		122.669		1.450		1.442	
C1 fluorenes	59.610		56.929		1.591		1.549		1.601		1.549		35.701		36.067		38.305		38.052		37.586		38.360		0.889	J	0.997	J
C2 fluorenes	26.707		23.184		0.768	J	0.681	J	0.773	J	0.681	J	15.524		12.680		18.274		19.238		15.239		16.051		0.277	J	0.272	J
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	139.600		139.984		3.298		3.248		3.320		3.248		133.604		133.002		143.165		144.645		122.366		121.389		1.705		1.666	
anthracene	21.338		21.833		0.681		0.667		0.685		0.667		19.837		20.031		21.697		22.093		25.883		25.088		0.401		0.419	
C1 phenanthrenes/anthracenes	77.107		73.583		1.956	J	1.811	J	1.969	J	1.811	J	47.462		48.844		55.815		56.603		45.178		46.852		0.882	J	1.047	J
C2 phenanthrenes/anthracenes	3.155	J	3.005	J		ND		ND		ND		ND	2.369	J	2.415	J	1.997	J	2.181	J	2.606	J	2.778	J		ND		ND
C3 phenanthrenes/anthracenes	4.753	J	4.040	J		ND		ND		ND		ND	3.280	J	3.462	J	3.003	J	3.316	J	3.057	J	3.587	J		ND		ND
C4 phenanthrenes/anthracenes	1.223	J	0.990	J		ND		ND		ND		ND	0.698	J	0.621	J	0.622	J	0.650	J	1.384	J	1.670	J		ND		ND
fluoranthene	14.541		14.643		0.898		0.888		0.904		0.888		14.590		14.328		14.144		14.575		14.896		15.117		0.479		0.482	
pyrene	15.172		15.346		0.714		0.723		0.719		0.723		12.568		12.087		14.746		15.356		11.983		11.908		0.388		0.391	
C1 fluoranthenes/pyrenes	6.029		6.000		0.321	J	0.303	J	0.323	J	0.303	J	4.993		4.906		5.008		5.471		5.130		5.602		0.122	J	0.150	J
benz[a]anthracene	0.621		0.658		0.034	J	0.032	J	0.035	J	0.032	J	0.711		0.651		0.676		0.777		0.615		0.675		0.016	J	0.019	J
chrysene	0.563		0.594		0.041	J	0.038	J	0.041	J	0.038	J	0.499		0.462		0.507		0.588		0.509		0.531		0.014	J	0.017	J
C1 chrysenes	0.158		0.140			ND		ND		ND		ND	0.135		0.124		0.140		0.163		0.140		0.168			ND		ND
C2 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene	0.116		0.109			ND		ND		ND		ND	0.130		0.121		0.113		0.173		0.113		0.158			ND		ND
benzo[e]pyrene	0.074		0.067			ND		ND		ND		ND	0.055	J	0.052	J	0.075		0.114		0.053	J	0.072			ND		ND
benzo[a]pyrene	0.170		0.146			ND		ND		ND		ND	0.123		0.114		0.133		0.203		0.115		0.139			ND		ND
perylene	0.021	J	0.021	J		ND		ND		ND		ND		ND		ND		ND		ND	0.019	J	0.021	J		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[ghi]perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
SPME Pore Water PAH_{34} (µg/L)	5,305.44		4,974.92		47.85		46.61		48.17		46.61		2,214.26		2,152.86		2,435.92		2,373.30		5,988.74		6,484.75		22.81		23.43	
Mean - SPME Pore Water PAH_{34}	5,140.18				47.23				47.39				2,183.56				2,404.61				6,236.74				23.12			
SPME Pore Water TU_{34}	162.69		142.32		2.71		2.61		2.73		2.61		94.83		93.27		104.44		102.34		119.69		127.97		1.51		1.62	
Mean - SPME Pore Water TU_{34}	152.51				2.66				2.67				94.05				103.39				123.83				1.56			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
µg/L - micrograms/liter
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate
TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units using the USEPA (2003)

Table 4-2
Sediment SPME Pore Water PAH Concentrations

Sediment PAHs (ng/g)	HD150				HD151				HD152				HD153				HD154				HD155				HD156			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene		ND		ND	6.188		5.859		1.145	J	1.152	J		ND		ND		ND		ND		ND		ND		ND		ND
2-methylnaphthalene	0.350	J	0.363	J	1.189		1.079			ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1-methylnaphthalene	0.347	J	0.339	J	2.538		2.454		0.327	J	0.316	J		ND		ND		ND		ND		ND		ND		ND		ND
C2 naphthalenes	1.470	J	1.262	J	8.001		7.586		1.369	J	1.206	J	1.363	J	1.205	J		ND		ND		ND		ND		ND		ND
C3 naphthalenes	1.539	J	1.574	J	10.924		9.933		1.866	J	1.742	J	2.333	J	2.108	J		ND		ND		ND		ND		ND		ND
C4 naphthalenes	1.727	J	1.719	J	8.120		7.316		2.476	J	2.036	J	1.072	J	0.989	J		ND		ND		ND		ND		ND		ND
acenaphthylene		ND		ND	1.360		1.365		0.396	J	0.513	J		ND		ND		ND		ND		ND		ND		ND		ND
acenaphthene	0.973	J	0.987	J	17.676		17.041		5.813		5.293		0.682	J	0.689	J		ND		ND		ND		ND		ND		ND
fluorene	0.497	J	0.498	J	6.455		6.184		0.967		0.923		0.253	J	0.264	J		ND		ND		ND		ND		ND		ND
C1 fluorenes	0.474	J	0.426	J	3.387		3.143		1.039	J	0.989	J	0.618	J	0.654	J		ND		ND		ND		ND		ND		ND
C2 fluorenes	0.519	J	0.697	J	1.778		1.528		0.704	J	0.527	J		ND		ND		ND		ND		ND		ND		ND		ND
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene	0.932	J	0.827	J	7.186		6.726		0.458	J	0.424	J	0.415	J	0.422	J		ND		ND		ND		ND		ND		ND
anthracene	0.178	J	0.159	J	1.724		1.652		0.195		0.175	J	0.080	J	0.077	J		ND		ND		ND		ND		ND		ND
C1 phenanthrenes/anthracenes	1.152	J	1.074	J	4.208		3.749		0.479	J	0.487	J	0.352	J	0.358	J		ND		ND		ND		ND		ND		ND
C2 phenanthrenes/anthracenes		ND		ND	0.298	J	0.293	J		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 phenanthrenes/anthracenes		ND		ND	0.449	J	0.387	J		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
fluoranthene	0.444		0.356		2.685		2.485		0.720		0.666		0.135	J	0.133	J		ND		ND		ND		ND		ND		ND
pyrene	0.542		0.476		2.017		1.801		0.728		0.690		0.135	J	0.151	J		ND		ND		ND		ND		ND		ND
C1 fluoranthenes/pyrenes	0.302	J	0.259	J	0.841		0.664		0.237	J	0.253	J	0.055	J	0.043	J		ND		ND		ND		ND		ND		ND
benz[a]anthracene	0.051	J	0.035	J	0.117	J	0.086	J	0.026	J	0.029	J	0.008	J	0.007	J		ND		ND		ND		ND		ND		ND
chrysene	0.058	J	0.039	J	0.107		0.093		0.028	J	0.027	J	0.006	J	0.005	J		ND		ND		ND		ND		ND		ND
C1 chrysenes		ND		ND	0.053	J	0.035	J		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C2 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[e]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[a]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[ghi]perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
SPME Pore Water PAH_{34} (µg/L)	11.55		11.09		87.30		81.46		18.97		17.44		7.51		7.11		ND		ND		ND		ND		ND		ND	
Mean - SPME Pore Water PAH_{34}	11.32				84.38				18.21				7.31				ND				ND				ND			
SPME Pore Water TU_{34}	1.23		1.19		6.79		6.13		1.52		1.34		0.71		0.66		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1	
Mean - SPME Pore Water TU_{34}	1.21				6.46				1.43				0.68				<0.1				<0.1				<0.1			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
µg/L - micrograms/liter
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate
TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units using the USEPA (2003)

Table 4-2
Sediment SPME Pore Water PAH Concentrations

Sediment PAHs (ng/g)	HD157				HD158				HD159				HD160				HD161				HD162			
	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual	Rep 1	Qual	Rep 2	Qual
naphthalene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
2-methylnaphthalene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1-methylnaphthalene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C2 naphthalenes		ND		ND		ND		ND		ND		ND	0.204	J	0.237	J		ND		ND		ND		ND
C3 naphthalenes		ND		ND		ND		ND		ND		ND	0.102	J	0.118	J		ND		ND		ND		ND
C4 naphthalenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
acenaphthylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
acenaphthene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
fluorene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C1 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C2 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 fluorenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
phenanthrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C1 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND	0.033	J	0.045	J		ND		ND		ND		ND
C2 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 phenanthrenes/anthracenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
fluoranthene		ND		ND		ND		ND		ND		ND	0.022	J	0.022	J		ND		ND		ND		ND
pyrene		ND		ND		ND		ND		ND		ND	0.028	J	0.025	J		ND		ND		ND		ND
C1 fluoranthenes/pyrenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benz[a]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
chrysene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C1 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C2 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C3 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
C4 chrysenes		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[b+k]fluoranthene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[e]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[a]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
indeno[1,2,3-cd]pyrene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
dibenz[ah]anthracene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
benzo[ghi]perylene		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
SPME Pore Water PAH_{34} (µg/L)	ND		ND		ND		ND		ND		ND		0.39		0.45		ND		ND		ND		ND	
Mean - SPME Pore Water PAH_{34}	ND				ND				ND				0.42				ND				ND			
SPME Pore Water TU_{34}	<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1		<0.1	
Mean - SPME Pore Water TU_{34}	<0.1				<0.1				<0.1				<0.1				<0.1				<0.1			

Qualifiers:
E - values exceeding the highest calibration concentration
J - values estimated below the lowest calibration concentrations
µg/L - micrograms/liter
ND - non detected
PAH_{34} - 34 National Oceanographic and Atmospheric Administration PAHs
Rep - replicate
TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units using the USEPA (2003)

Table 4-3
General Chemical and Physical Characteristics

Sample	HD113	HD118	HD119	HD120	HD122	HD123	HD124	HD127	HD128	HD129	HD130	HD131	HD132	HD133	HD134	HD137	HD138	HD139	HD140	HD141	HD142
Grain Size Data[1]																					
Gravel (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coarse Sand (%)	4	0	3	14	45	52	2	52	27	7	5	19	15	8	2	8	4	10	2	28	11
Medium Sand (%)	9	2	9	23	31	27	6	32	31	15	10	28	26	13	11	14	17	25	4	34	28
Fine Sand (%)	75	49	72	30	16	13	88	7	33	54	40	36	50	70	46	32	54	55	88	27	44
Silt (%)	7	36	12	23	7	8	3	9	6	19	35	11	5	6	29	28	17	6	4	7	10
Clay (%)	4	13	4	10	1	2	1	1	3	6	10	6	4	3	13	19	8	4	2	4	8
Sand (%)	88	51	84	68	92	91	96	90	91	76	55	83	91	91	58	53	75	90	94	89	82
Fines (%)	12	49	16	33	8	9	4	10	9	25	45	17	9	9	42	47	25	10	6	11	18
Percent Solids																					
Solids (%)	72	67	68	62	81	80	81	83	71	75	73	59	69	71	73	57	69	75	72	72	76
Basic Chemistry																					
Ammonia (mg/Kg)	19.8	87.9	67.3	93.3	42.6	37.8	18.6	48.1	46.6	81.2	74.7	158.0	54.8	60.1	68.5	227.0	88.5	59.3	20.4	57.0	72.8
pH	7.8	7.0	7.5	7.3	7.6	7.6	8.0	7.5	7.7	7.5	7.1	8.0	7.7	7.8	7.5	7.8	7.1	7.7	7.6	7.6	7.2

Note 1:

Gravel is defined as > 2,000 µm
Coarse sand is defined as between 2,000 and 850 µm
Medium sand is defined as between 850 and 425 µm
Fine sand is defined as between 425 and 75 µm
Silt is defined as between 75 and 6.6 µm
Clay is defined as < 6.6 µm
Sand = Coarse + Medium + Fine Sand
Fines = Silt + Clay

All of the sediment samples were field-screened through a #5-mesh (4-mm openings) screen; therefore, samples described as "gravel" in the field (Table 2-1) do not have correlated companion laboratory measurements of "gravel" in Table 4-3. However, the distributions of coarse- and medium-grained sand in these samples were captured in the laboratory grain size analysis.

Table 4-3
General Chemical and Physical Characteristics

Sample	HD143	HD144	HD145	HD146	HD147	HD148	HD149	HD150	HD151	HD152	HD153	HD154	HD155	HD156	HD157	HD158	HD159	HD160	HD161	HD162
Gravel (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coarse Sand (%)	4	2	6	1	2	2	1	45	1	3	6	10	1	8	0	0	0	9	5	1
Medium Sand (%)	13	6	11	3	8	7	4	32	11	10	27	20	1	46	1	1	1	25	16	7
Fine Sand (%)	68	84	74	11	17	38	81	17	80	75	60	63	92	43	95	76	63	60	48	74
Silt (%)	15	7	7	50	43	42	11	4	6	9	5	6	5	3	3	18	28	4	20	13
Clay (%)	1	2	2	35	31	11	3	2	2	3	2	2	2	1	1	5	7	2	11	5
Sand (%)	85	91	91	15	27	47	86	94	92	88	93	92	93	97	96	77	64	94	70	82
Fines (%)	15	9	9	85	74	53	14	6	8	12	7	8	7	3	4	23	36	6	30	18
Solids (%)	65	71	73	55	59	63	73	70	73	73	73	76	72	80	71	69	69	74	72	72
Ammonia (mg/Kg)	77.3	25.6	32.8	277.0	230.0	122.0	25.5	50.4	44.6	28.1	50.3	40.5	25.2	25.1	37.6	87.1	87.7	37.7	39.9	38.9
pH	7.4	7.6	7.9	7.0	7.1	7.2	7.7	8.1	7.7	7.7	8.0	7.8	7.4	7.9	6.8	6.8	6.8	7.7	7.3	7.4

Note 1:

Gravel is defined as > 2,000 µM
Coarse sand is defined as between 2,000 and 850 µM
Medium sand is defined as between 850 and 425 µM
Fine sand is defined as between 425 and 75 µM
Silt is defined as between 75 and 6.6 µM
Clay is defined as < 6.6 µM
Sand = Coarse + Medium + Fine Sand
Fines = Silt + Clay

All of the sediment samples were field-screened through a #5-mesh (4-mm openings) screen; therefore, samples described as "gravel" in the field (Table 2-1) do not have correlated companion laboratory measurements of "gravel" in Table 4-3. However, the distributions of coarse- and medium-grained sand in these samples were captured in the laboratory grain size analysis.

Table 4-4
***Hyalella azteca* Toxicity Test Data**

Sample Type	Sample ID	Sediment Total PAH_{16}	SPME Pore Water PAH_{34}	*Hyalella azteca* (28 day)							
				Survival (%)				Growth (mg dry wt./organism)			
		(mg/Kg)	(TU_{34})	Sig	Mean	Std. Dev.	N	Sig	Mean	Std. Dev.	N
CONTROL	JAM0901	NA	NA		100	0	4		0.522	0.055	4
CONTROL	JAM0902	NA	NA		100	0	4		0.500	0.006	4
REFERENCE	HD154	6	< 0.01		100	0	4		0.404	0.049	4
REFERENCE	HD155	< 1	< 0.01		100	0	4		0.303	0.096	4
REFERENCE	HD156	< 1	< 0.01		100	0	4		0.442	0.061	4
REFERENCE	HD157	0	< 0.01		100	0	4		0.436	0.020	4
REFERENCE	HD158	1	< 0.01		100	0	4		0.344	0.047	4
REFERENCE	HD159	< 1	< 0.01		100	0	4		0.355	0.018	4
REFERENCE	HD160	5	0.03		100	0	4		0.377	0.139	4
REFERENCE	HD161	1	< 0.01		100	0	4		0.378	0.039	4
REFERENCE	HD162	< 1	< 0.01		100	0	4		0.398	0.023	4
TEST	HD113	100	5.4		100	0	4		0.317	0.014	4
TEST	HD118	3	0.0		100	0	4	*	0.296	0.025	4
TEST	HD119	120	6.3		100	0	4		0.379	0.034	4
TEST	HD120	39	0.0		100	0	4		0.375	0.026	4
TEST	HD122	12	0.0		100	0	4		0.395	0.035	4
TEST	HD123	14	8.6		100	0	4		0.319	0.034	4
TEST	HD124	98	3.6		100	0	4		0.288	0.095	4
TEST	HD127	12	0.1		80	18	4		0.486	0.040	4
TEST	HD128	55	0.5		100	0	4		0.426	0.034	4
TEST	HD129	95	1.1		100	0	4		0.388	0.018	4
TEST	HD130	102	0.7		100	0	4		0.387	0.018	4
TEST	HD131	848	150	*	0	0	4		NA	NA	4
TEST	HD132	163	0.6		100	0	4		0.441	0.039	4
TEST	HD133	345	8.1		100	0	4		0.422	0.033	4
TEST	HD134	141	0.4		100	0	4		0.321	0.007	4
TEST	HD137	47	3.9		70	24	4		0.320	0.031	4
TEST	HD138	697	46	*	13	5	4		NA	NA	4
TEST	HD139	186	0.6		100	0	4	*	0.274	0.027	4
TEST	HD140	39	0.5		100	0	4		0.401	0.036	4
TEST	HD141	211	4.1		100	0	4		0.348	0.037	4
TEST	HD142	112	5.6	*	18	10	4		NA	NA	4
TEST	HD143	6,839	153	*	0	0	4		NA	NA	4
TEST	HD144	519	2.7		100	0	4		0.352	0.053	4
TEST	HD145	304	2.7		93	10	4		0.387	0.035	4
TEST	HD146	3,482	94	*	0	0	4		NA	NA	4
TEST	HD147	2,011	103	*	0	0	4		NA	NA	4
TEST	HD148	11,164	124	*	0	0	4		NA	NA	4
TEST	HD149	61	1.6		100	0	4		0.316	0.065	4
TEST	HD150	19	1.2		100	0	4		0.325	0.030	4
TEST	HD151	566	6.5		100	0	4		0.347	0.017	4
TEST	HD152	35	1.4		100	0	4		0.355	0.044	4
TEST	HD153	9	0.7		95	6	4		0.351	0.013	4

Notes:

mg/kg - milligram/kilogram

N = the number of replicate beakers per treatment (sample ID)

NA (not applicable) - Statistically significant for survival and therefore not included in statistical analysis of growth.

PAH_{16} - 16 U.S. Environmental Protection Agency priority pollutant PAHs

Sig = statistical significance as defined below

TU_{34} - SPME pore water PAH_{34} expressed in terms of toxic units (U.S. EPA, 2003)

% - percent

Comparisons of survival and dry weights among treatments were conducted with the Wilcoxon Rank Sum Test with Bonferroni Adjustment (U.S. EPA, 2000). Samples determined to have statistically significant reductions in survival or growth as compared to the field reference samples are marked with an asterisk "*".

Table 4-5
Benthic Macroinvertebrate Survey Indices

SID	Type	Total N[1]	Total S[2]	Shannon Diversity[3]	Margalef Richness[4]	Dominance[5]	10-Dominance	Hilsenhoff Biotic Index[6]	10-HBI
HD113	TEST	37	11	3.0	2.8	2.7	7.3	7.1	2.9
HD118	TEST	97	19	3.8	3.9	1.6	8.4	7.5	2.5
HD119	TEST	45	13	2.9	3.2	4.4	5.6	6.4	3.6
HD120	TEST	124	18	3.2	3.5	3.2	6.8	7.0	3.0
HD122	TEST	182	22	3.4	4.0	2.3	7.7	7.2	2.8
HD123	TEST	54	13	3.0	3.0	3.3	6.7	7.4	2.6
HD124	TEST	171	13	2.7	2.3	3.1	6.9	7.6	2.4
HD127	TEST	39	9	2.0	2.2	6.2	3.8	9.5	0.5
HD128	TEST	47	8	2.4	1.8	3.2	6.8	8.2	1.8
HD129	TEST	186	16	3.3	2.9	2.3	7.7	8.2	1.8
HD130	TEST	109	16	3.1	3.2	3.2	6.8	7.4	2.6
HD131	TEST	40	12	2.9	3.0	4.0	6.0	7.3	2.7
HD132	TEST	157	16	3.1	3.0	3.3	6.7	7.4	2.6
HD133	TEST	192	12	2.9	2.1	2.7	7.3	8.4	1.6
HD134	TEST	128	12	2.5	2.3	4.1	5.9	7.2	2.8
HD137	TEST	18	8	2.8	2.4	2.8	7.2	7.4	2.6
HD138	TEST	32	8	2.0	2.0	5.9	4.1	9.2	0.8
HD139	TEST	130	13	3.1	2.5	2.4	7.6	8.0	2.0
HD140	TEST	222	16	3.1	2.8	3.4	6.6	8.5	1.5
HD141	TEST	137	20	3.1	3.9	2.7	7.3	8.1	1.9
HD142	TEST	161	22	3.1	4.1	3.2	6.8	7.7	2.3
HD143	TEST	10	2	0.5	0.4	9.0	1.0	8.0	2.0
HD144	TEST	679	25	2.0	3.7	6.4	3.6	6.7	3.3
HD145	TEST	85	13	3.1	2.7	2.2	7.8	7.5	2.5
HD146	TEST	8	5	2.2	1.9	3.8	6.3	7.2	2.8
HD147	TEST	200	23	2.8	4.2	4.2	5.8	7.5	2.5
HD148	TEST	4	1	0.0	0.0	10.0	0.0	8.0	2.0
HD149	TEST	105	15	3.2	3.0	2.8	7.2	8.4	1.6
HD150	TEST	27	11	3.0	3.0	3.0	7.0	8.4	1.6
HD151	TEST	239	16	2.2	2.7	5.7	4.3	6.9	3.1
HD152	TEST	325	14	1.9	2.2	6.7	3.3	6.7	3.3
HD153	TEST	169	18	3.1	3.3	3.4	6.6	7.3	2.7
HD154	REFERENCE	206	18	3.1	3.2	2.4	7.6	7.9	2.1
HD155	REFERENCE	339	20	2.7	3.3	3.7	6.3	7.6	2.4
HD156	REFERENCE	40	7	2.0	1.6	5.5	4.5	7.4	2.6
HD157	REFERENCE	18	5	0.9	1.4	8.3	1.7	9.9	0.1
HD158	REFERENCE	11	5	2.1	1.7	3.6	6.4	8.2	1.8
HD159	REFERENCE	10	8	2.8	3.0	3.0	7.0	8.7	1.3
HD160	REFERENCE	192	8	2.1	1.3	4.6	5.4	7.4	2.6
HD161	REFERENCE	90	9	2.5	1.8	4.3	5.7	8.0	2.0
HD162	REFERENCE	414	16	2.1	2.5	4.6	5.4	7.2	2.8

[1]Total N is the total number of organisms identified in a sample.

[2]Total S is the total number of taxons identified in a sample.

[3]Shannon's diversity index (Diversity) was computed according to Shannon (1948).

[4]Margalef's species richness index (Richness) was computed according to Margalef (1958).

[5]Dominance was the percent contribution of the most numerous taxon (NYSDEC, 2002).

[6]Hilsenhoff Biotic Index (HBI) was computed according to Hilsenhoff (1987) with species tolerance values take from NYSDEC (2002).

Table 5-1
Logistic Regression Summary

Method	β_0	β_1	Likelihood R-squared	LD_{20}	95% Confidence Interval (LCL_{95} - UCL_{95})	Goodman-Kruskal Gamma
Total PAH_{16} (mg/kg)	-12.1	1.9	0.44	300 mg/kg	200 - 650 mg/kg	0.92
Total PAH_{34} (mg/kg)	-15.0	2.1	0.46	700 mg/kg	300 - 3,000 mg/kg	0.93
SPME Pore Water PAH_{34} (TU)	-6.7	2.6	0.53	7.8 TU	5.4 - 10 TU	0.97

β_0 - Regression intercept

β_1 - Regression slope

LD_{20} - Lethal Dose, 20% - the concentration required to kill 20% of the test organism population after 28 days

LCL_{95} - Lower 95% confidence limit

UCL_{95} - Upper 95% confidence limit

Table 5-2
Sediment Quality Triad (SQT) Matrix

Sample ID	Sample Type	Greater Than ERL 4.0 mg/kg (NYSDEC, 1999)	Greater Than ERM 44.8 mg/kg (NYSDEC, 1999)	Greater Than 5.4 SPME Pore Water TU_{34} (LCL_{95} for LD_{20})	Significantly Reduced Compared to Reference Sediments *H. azteca* Survival	Significantly Reduced Compared to Reference Sediments Benthic Multimetric
HD113	Site	*	*	*		
HD118	Site					
HD119	Site	*	*	*		
HD120	Site	*				
HD122	Site	*				
HD123	Site	*		*		
HD124	Site	*	*			
HD127	Site	*				
HD128	Site	*	*			
HD129	Site	*	*			
HD130	Site	*	*			
HD131	Site	*	*	*	*	
HD132	Site	*	*			
HD133	Site	*	*	*		
HD134	Site	*	*			
HD137	Site	*	*			
HD138	Site	*	*	*	*	
HD139	Site	*	*			
HD140	Site	*				
HD141	Site	*	*			
HD142	Site	*	*	*	*	
HD143	Site	*	*	*	*	*
HD144	Site	*	*			
HD145	Site	*	*			
HD146	Site	*	*	*	*	
HD147	Site	*	*	*	*	
HD148	Site	*	*	*	*	*
HD149	Site	*	*			
HD150	Site	*	*			
HD151	Site	*	*	*		
HD152	Site	*				
HD153	Site	*				
HD154	REFERENCE	*				
HD155	REFERENCE					
HD156	REFERENCE					
HD157	REFERENCE					
HD158	REFERENCE					
HD159	REFERENCE					
HD160	REFERENCE	*				
HD161	REFERENCE					
HD162	REFERENCE					

Note: * = Satisfies indicated criteria

Figures



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HUDSON WATER STREET/NATIONAL GRID

SITE OVERVIEW MAP

SCALE: 0 100 200 Feet

PROJECT ID: 09G027

DATE: 3-10-10

PREPARED BY: NAA

CHECKED BY: SGL

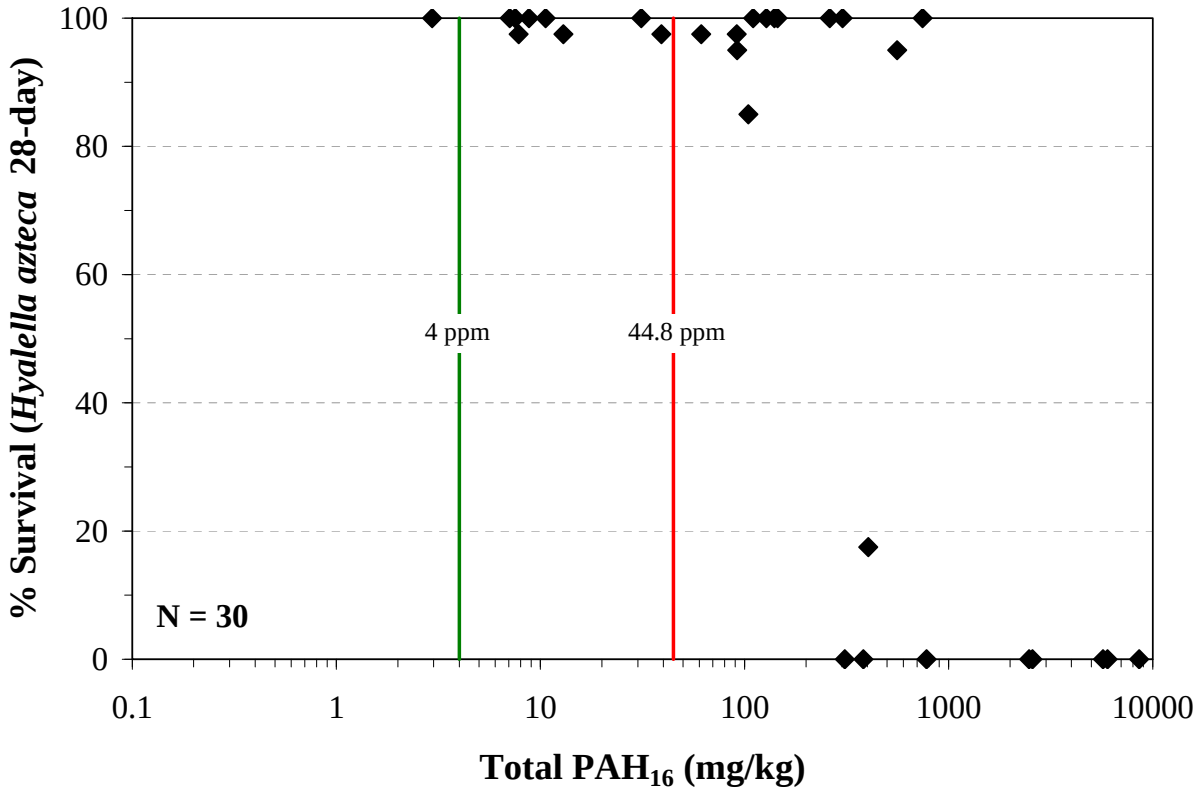
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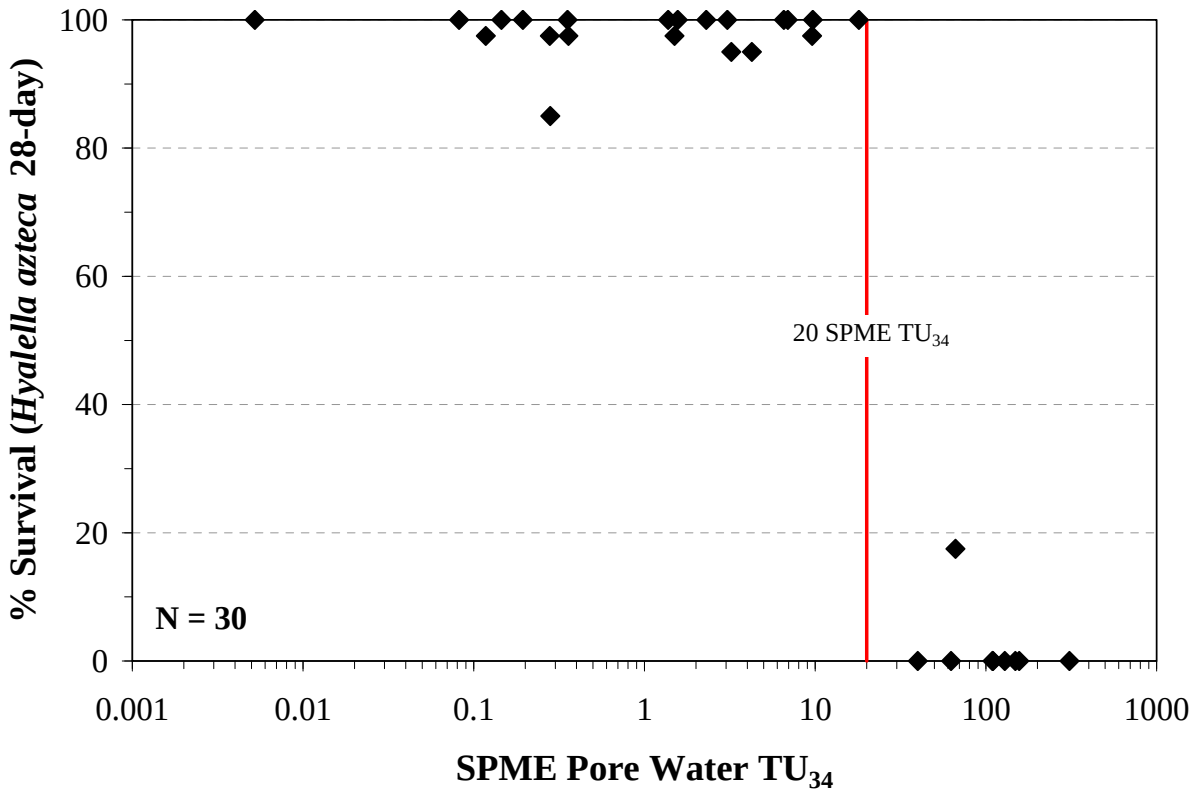
FIGURE NO. 1-1

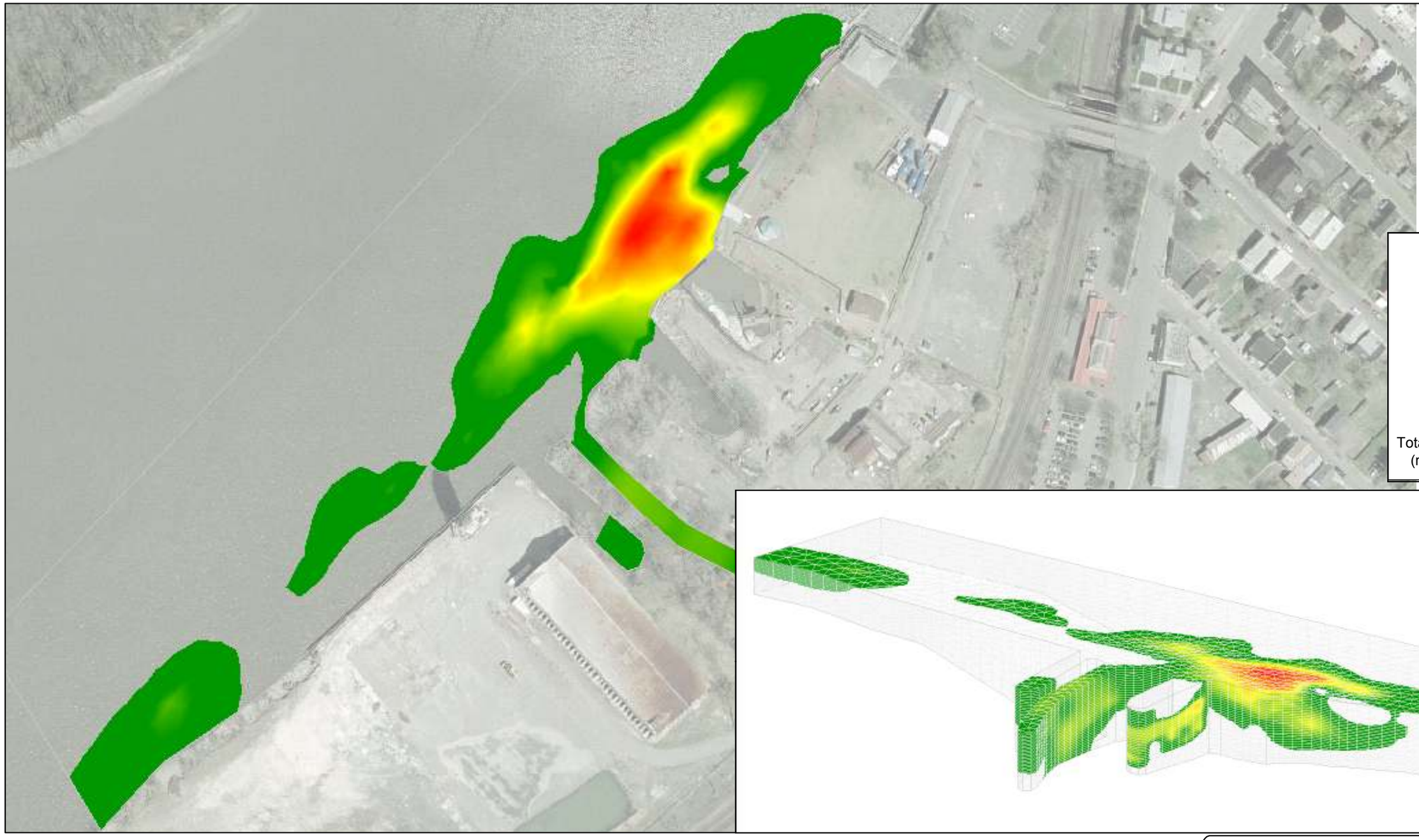
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Figure 1-2. *Hyalella azteca* Survival vs. Total PAH_{16} (top) and SPME Pore Water TU_{34} (bottom) Concentrations (2003 to 2006 data only).







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HUDSON WATER STREET/NATIONAL GRID

GMS-SED
TOTAL PAH16 INTERPOLATIONS

SCALE:	PROJECT ID: 09G027
DATE: 3-10-10	FIGURE NO. 1-3
PREPARED BY: NAA	Foth
CHECKED BY: SGL	

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HD027, SPME TU34 = 39.9

HD030, SPME TU34 = 109

HD008, SPME TU34 = 129
HD042, SPME TU34 = 157
HD048, SPME TU34 = 149

HD029, SPME TU34 = 62.6

HD036, SPME TU34 = 66.3

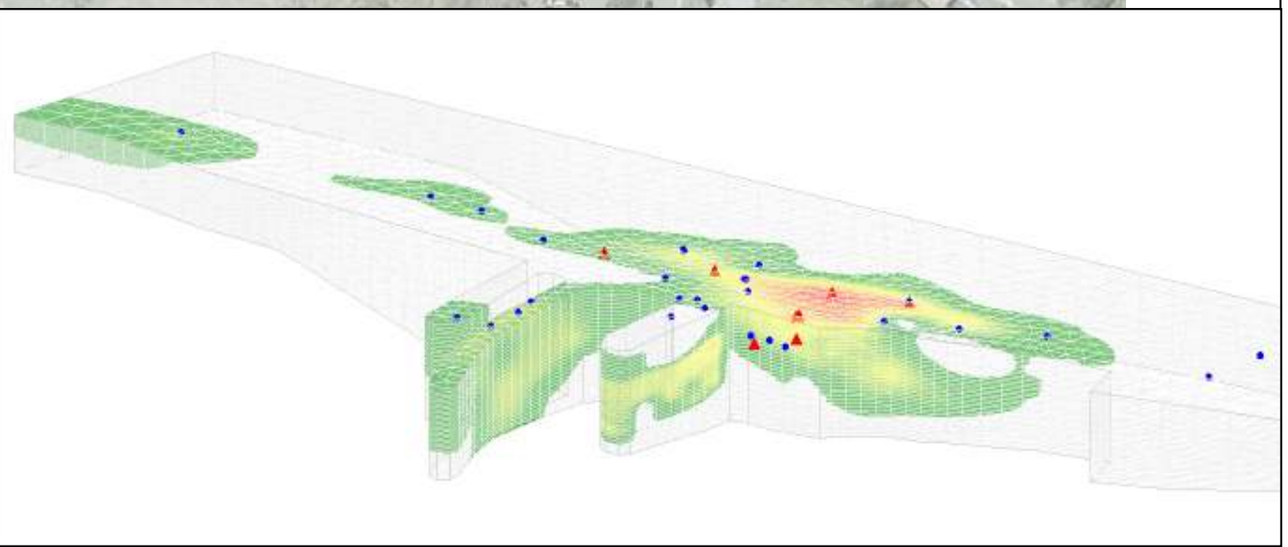
> 1,000

100 to 1,000

10 to 100

< 10

Total PAH_{16} (mg/kg)



▲ = SPME TU34 > 20

● = SPME TU34 < 20

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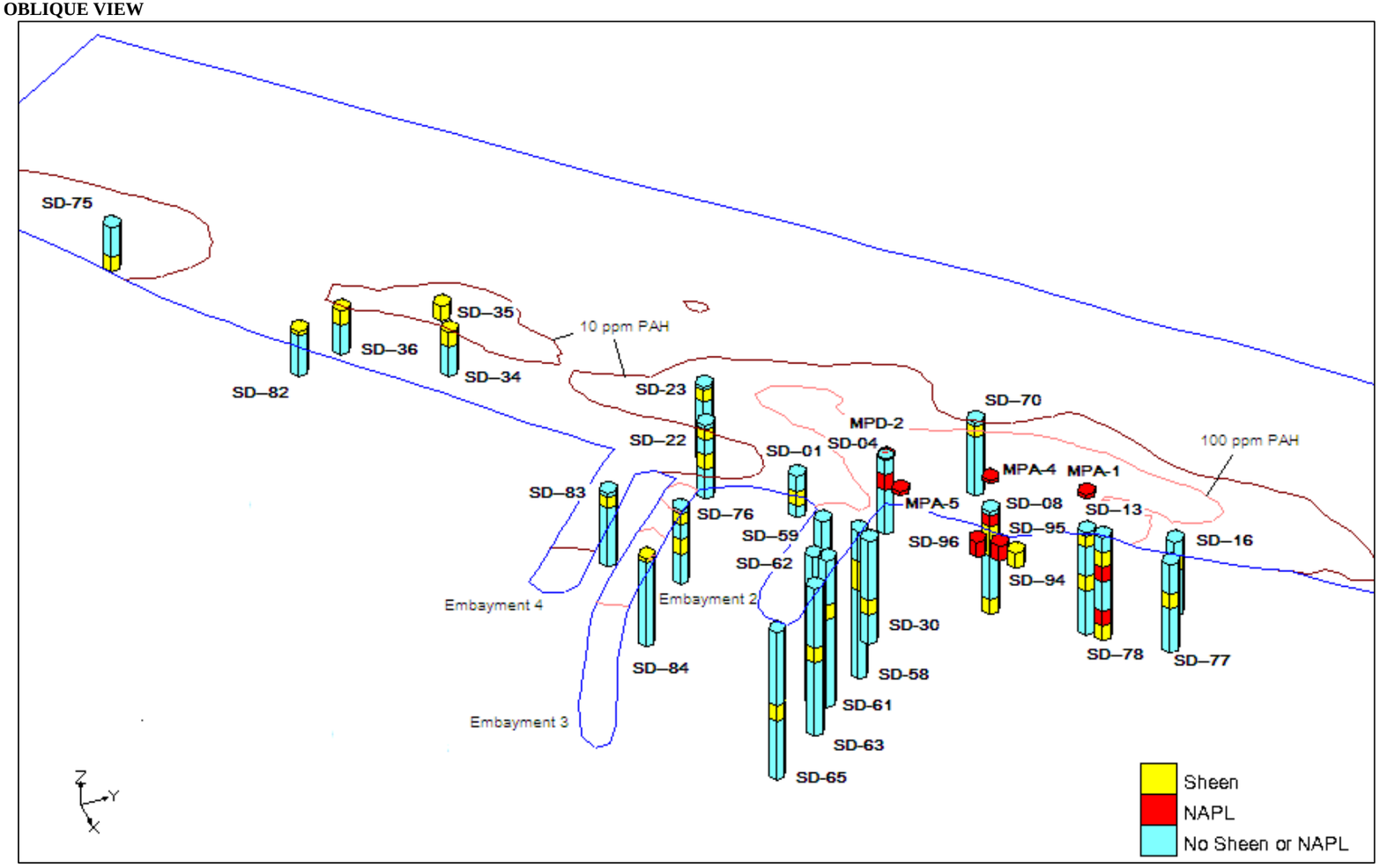
HUDSON WATER STREET/NATIONAL GRID

GMS-SED
TOTAL PAH16 INTERPOLATIONS
WITH SPME PORE WATER OVERLAY

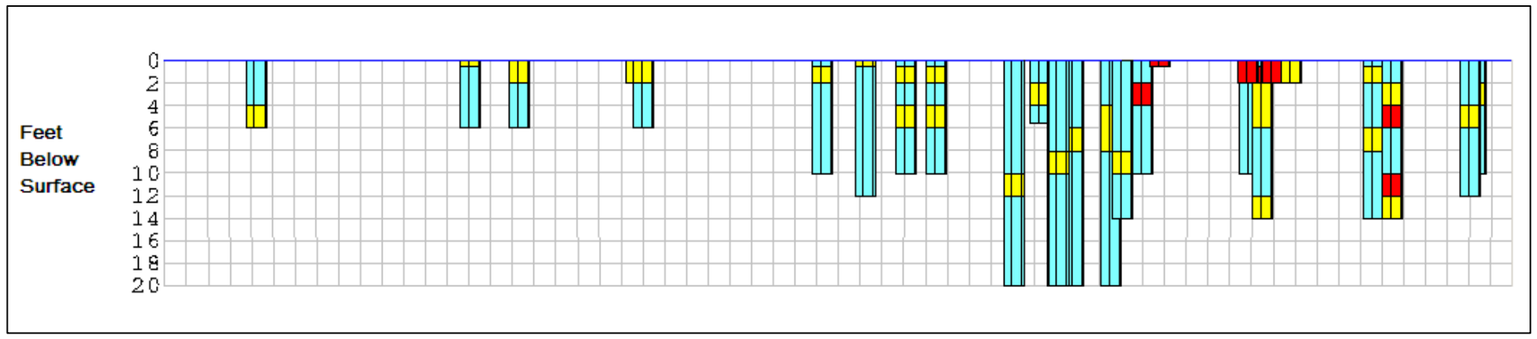
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DATE: 3-10-10	FIGURE NO. 1-4
PREPARED BY: NAA	Foth
CHECKED BY: SGL	

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OBLIQUE VIEW



SIDE VIEW



HUDSON WATER STREET/NATIONAL GRID

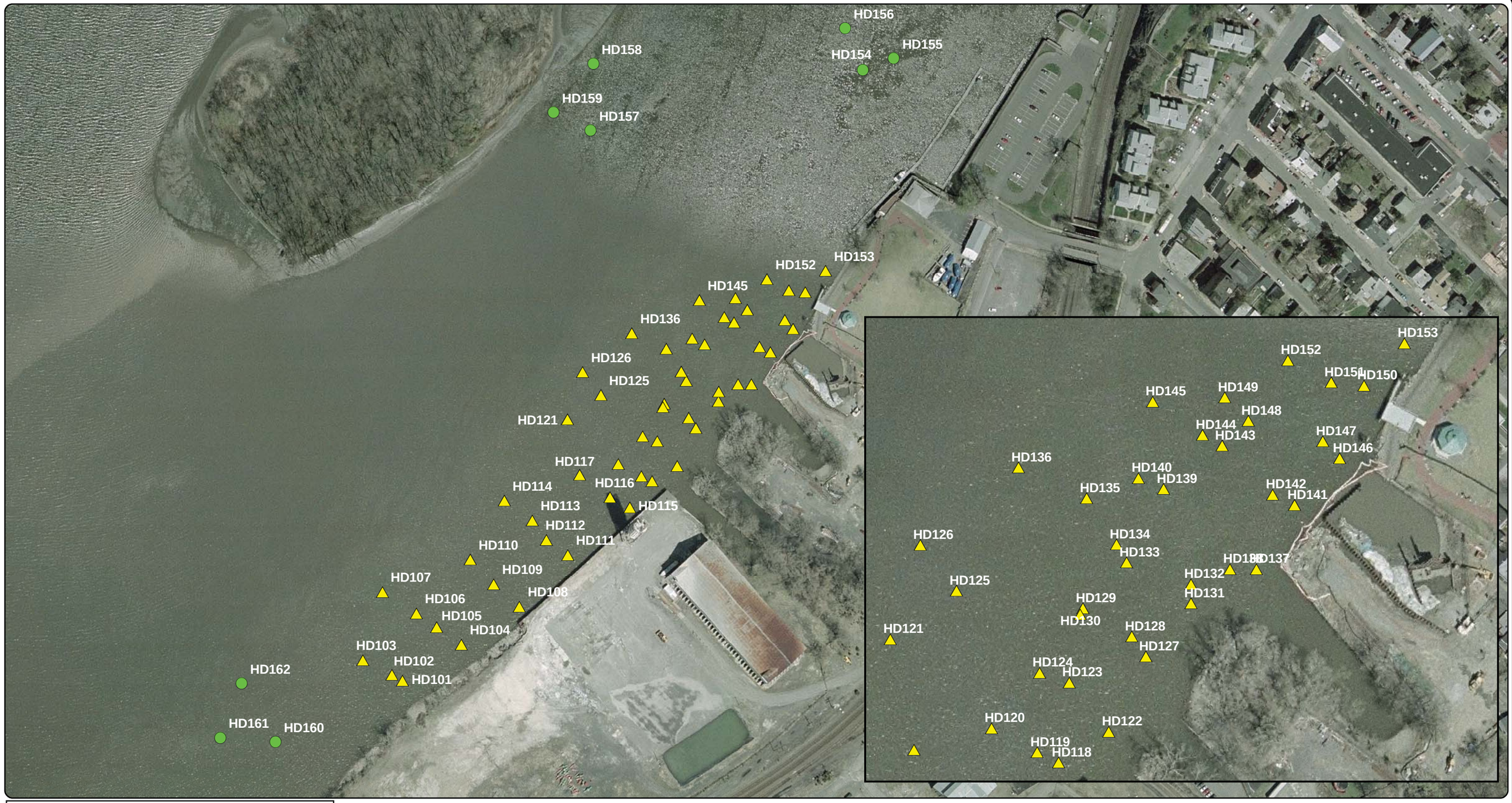
RI SEDIMENT CORES:

VISIBLE SHEEN AND NAPL

SCALE: NTS	PROJECT ID: 09G027
Date: 4-7-10	FIGURE NO. 1-5
PREPARED BY: SG	
CHECKED BY: NAA	

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Legend

2009 Sediment Sampling Locations

- Reference
- Site

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HUDSON WATER STREET/NATIONAL GRID

2009
SEDIMENT SAMPLING LOCATIONS

SCALE: 0 100 200 Feet

PROJECT ID: 09G027

DATE: 3-10-10

PREPARED BY: NAA

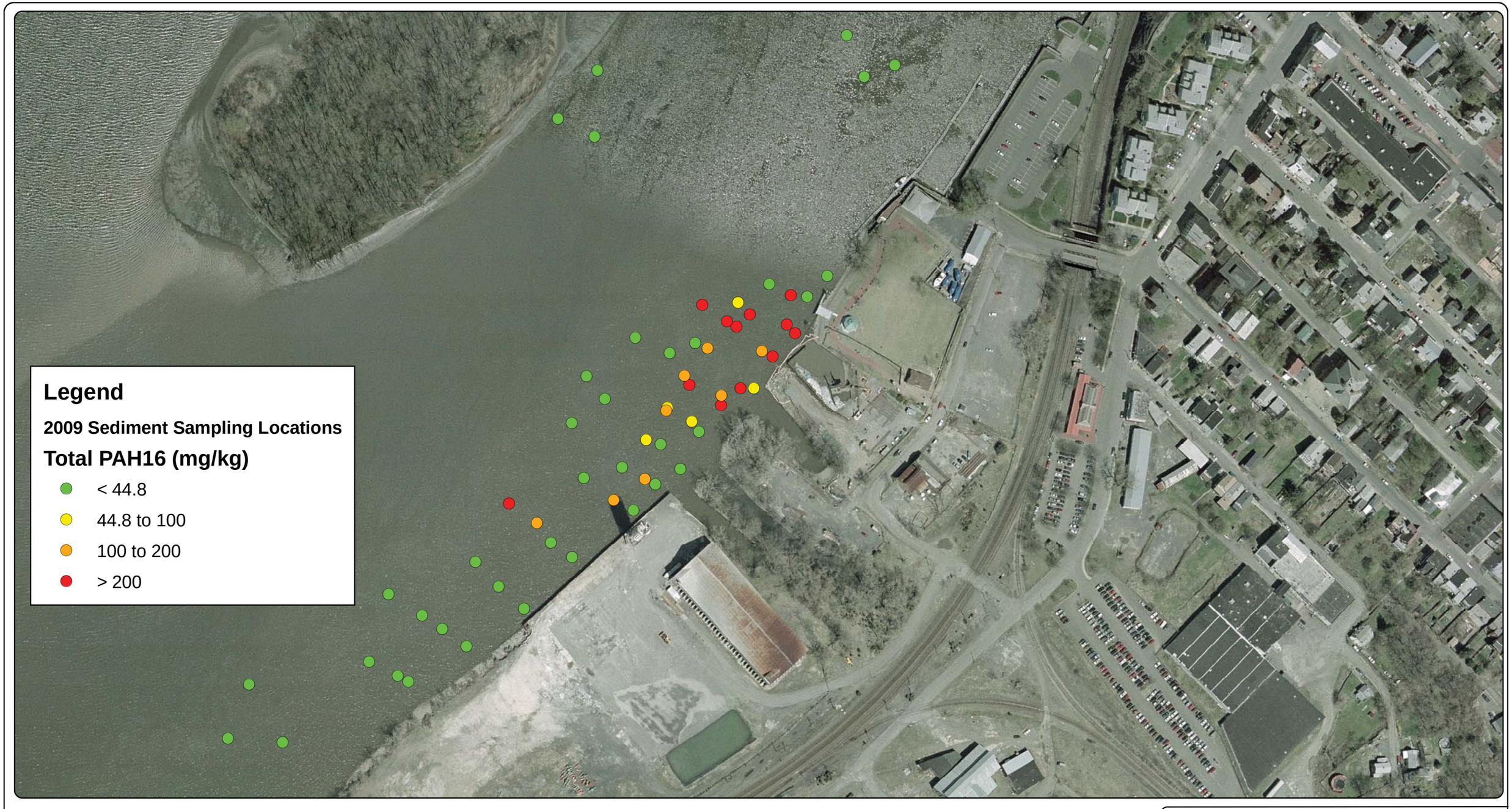
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FIGURE NO. 2-1

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HUDSON WATER STREET/NATIONAL GRID

2009
SEDIMENT TOTAL PAH16 CONCENTRATIONS

SCALE: 0 100 200 Feet

PROJECT ID: 09G027

DATE: 3-10-10

PREPARED BY: NAA

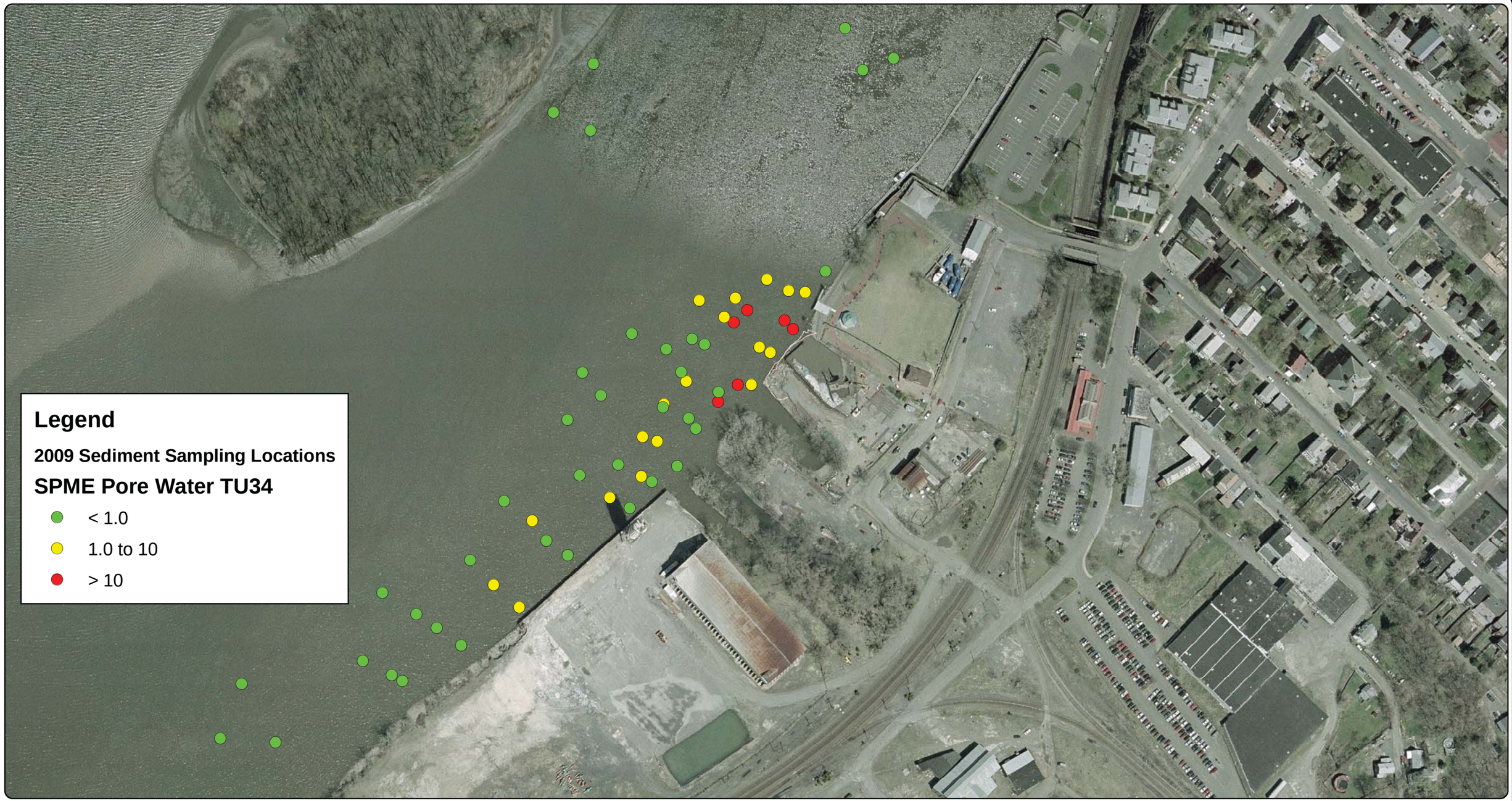
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FIGURE NO. 4-1

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HUDSON WATER STREET/NATIONAL GRID

2009
SPME PORE WATER
TU34 CONCENTRATIONS

SCALE: 0 100 200 Feet

PROJECT ID: 09G027

DATE: 3-10-10

PREPARED BY: NAA

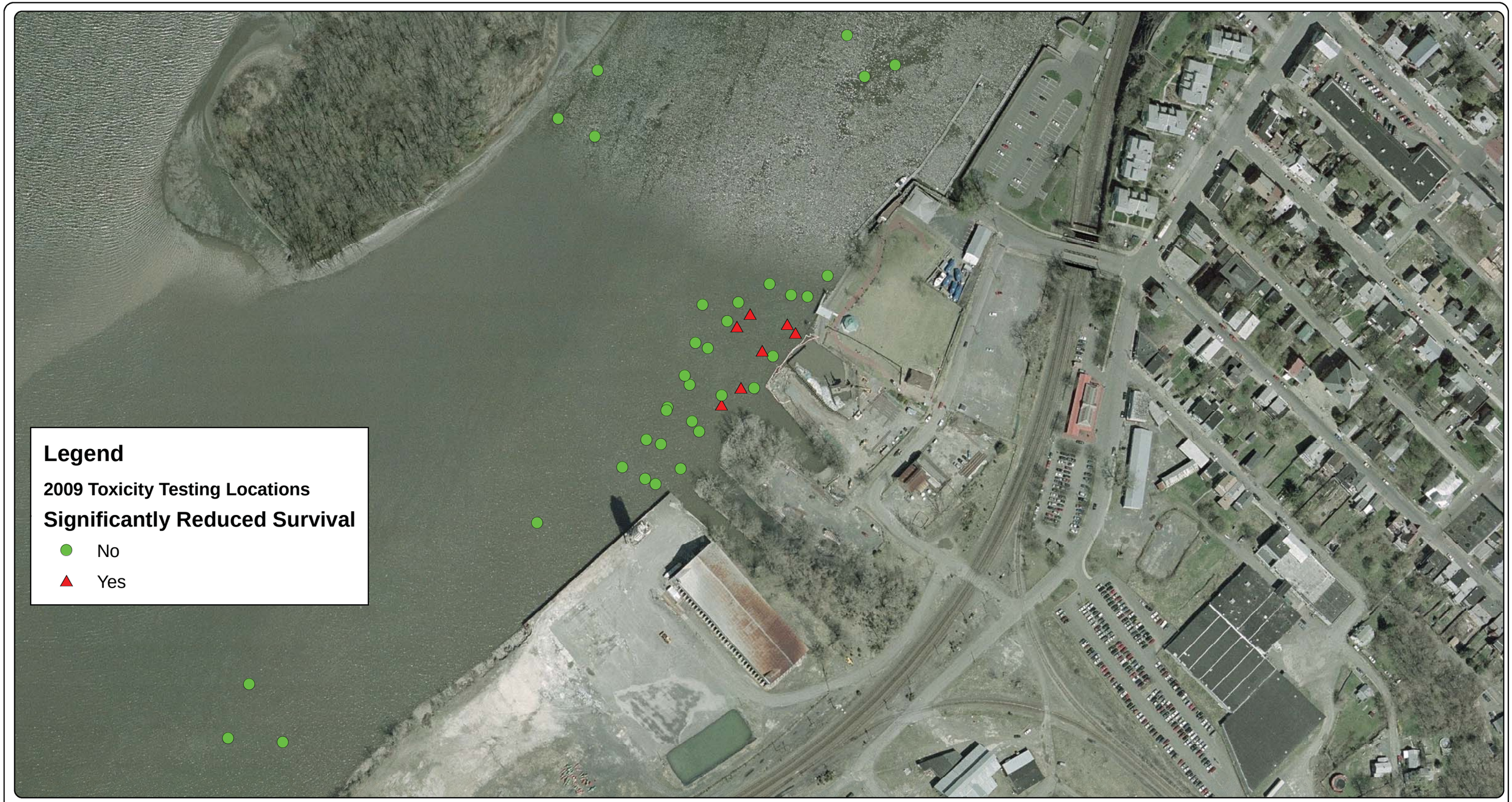
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FIGURE NO. 4-2

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HUDSON WATER STREET/NATIONAL GRID

2009
SEDIMENT TOXICITY TESTING RESULTS
H. AZTECA SURVIVAL

SCALE: 0 100 200 Feet

PROJECT ID: 09G027

DATE: 3-10-10

PREPARED BY: NAA

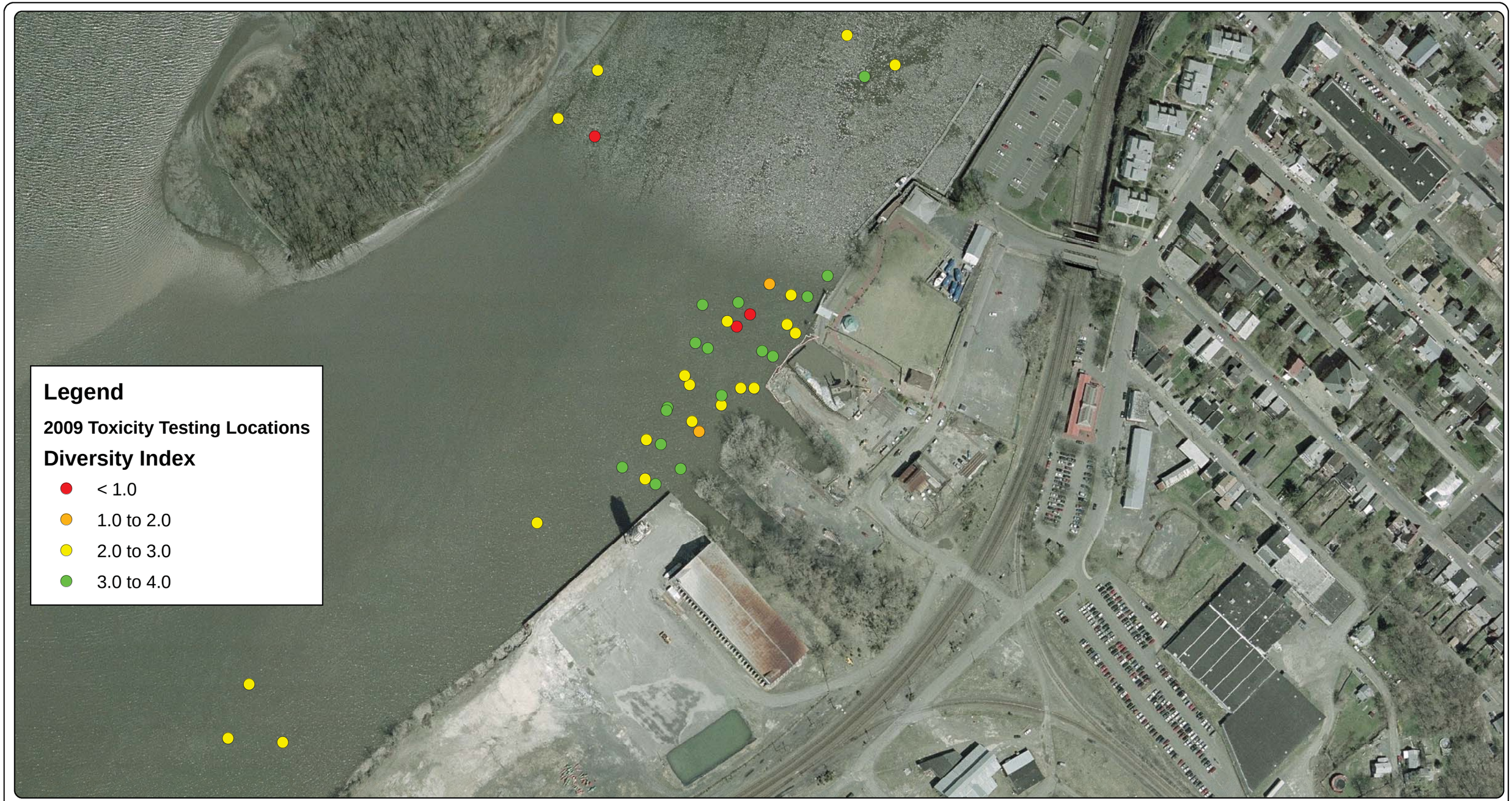
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FIGURE NO. 4-3

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HUDSON WATER STREET/NATIONAL GRID

2009 BENTHIC MACROINVERTEBRATE SURVEY - DIVERSITY

SCALE: 0 100 200 Feet

PROJECT ID: 09G027

DATE: 3-10-10

PREPARED BY: NAA

CHECKED BY: SGL

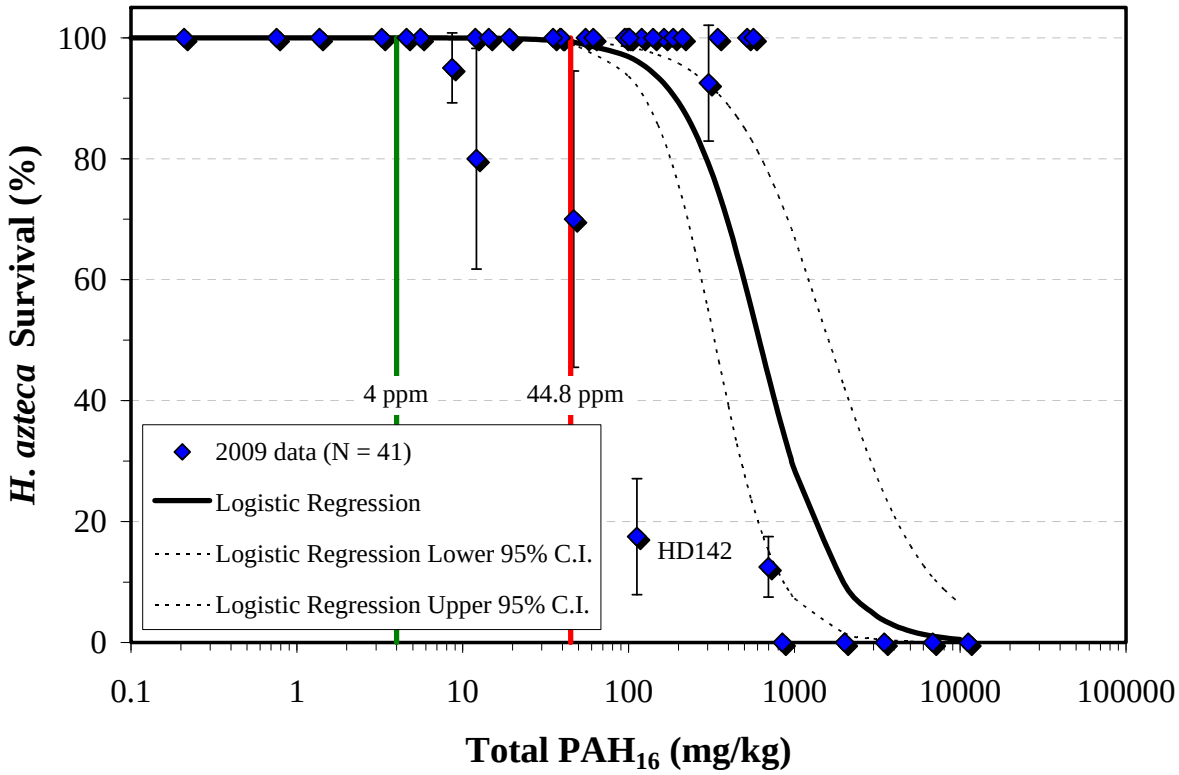
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FIGURE NO. 4-4

X:\GB\IE\2009\09G027\GIS\mxd\HD_2009Benthic_11x17_NAA.mxd March 10, 2010

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Figure 5-1. *Hyalella azteca* Survival vs. Total PAH_{16} (top) and SPME Pore Water TU_{34} (bottom) Concentrations (2009 data only).



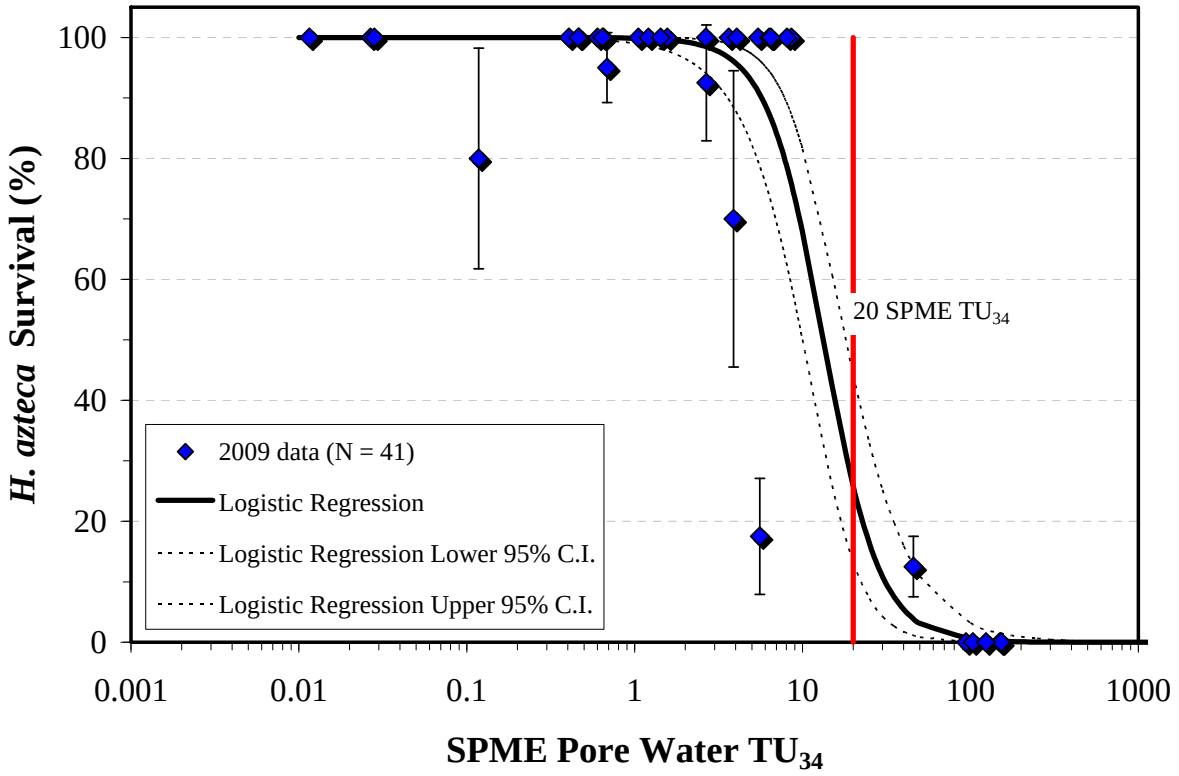
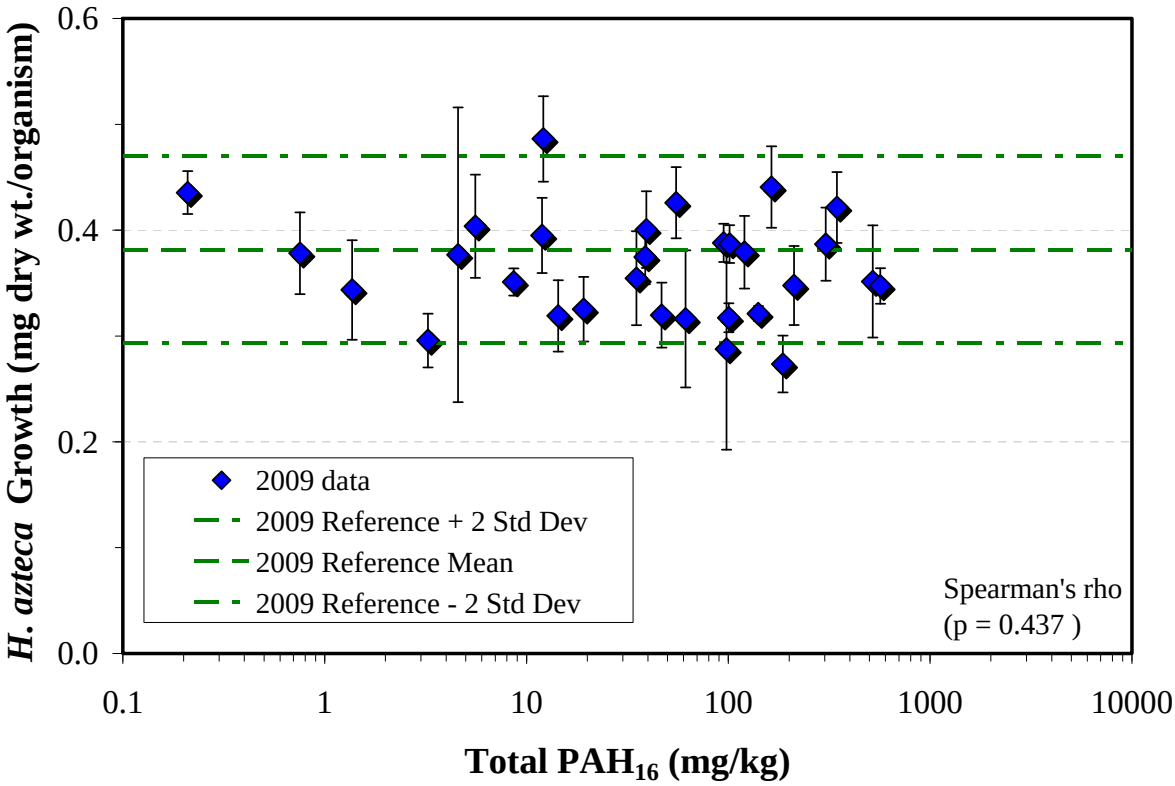


Figure 5-2. *Hyalella azteca* Growth vs. Total PAH_{16} (top) and SPME Pore Water TU_{34} (bottom) Concentrations (2009 data only).



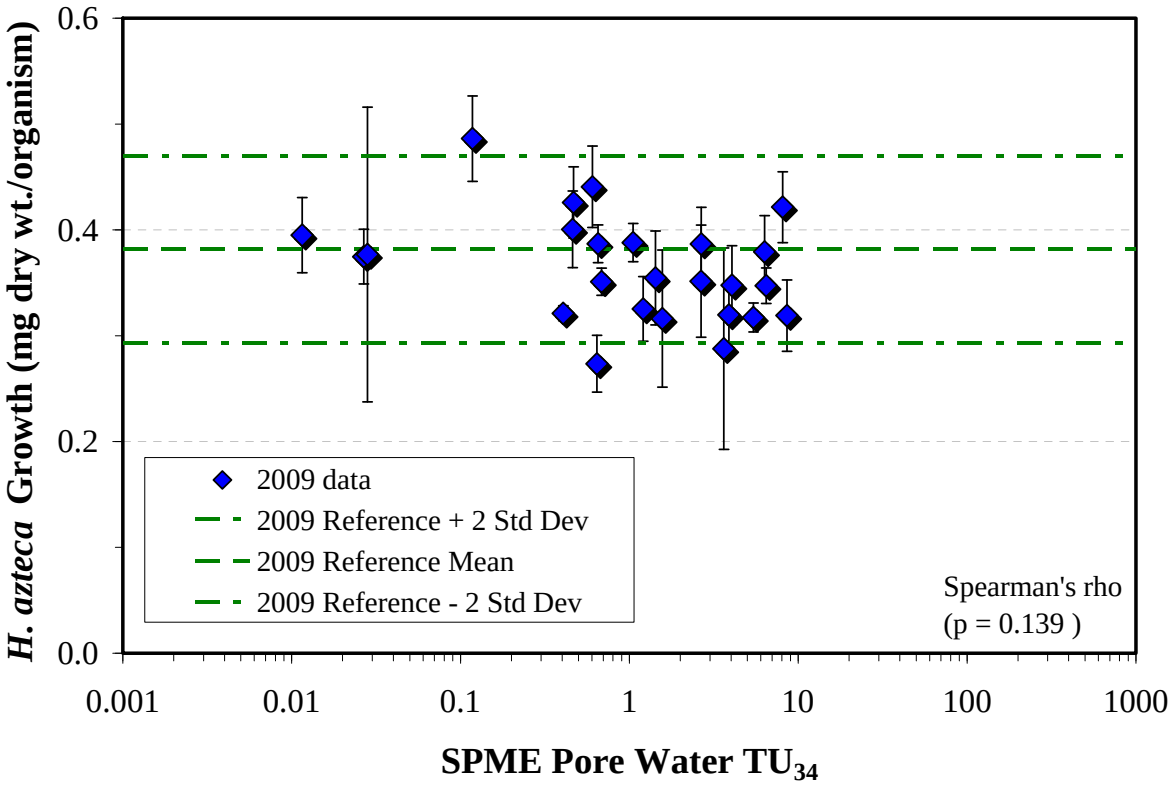


Figure 5-3. Total PAH_{16} (top) and SPME Pore Water TU_{34} (bottom) Concentrations Versus Benthic Macroinvertebrate Indices.

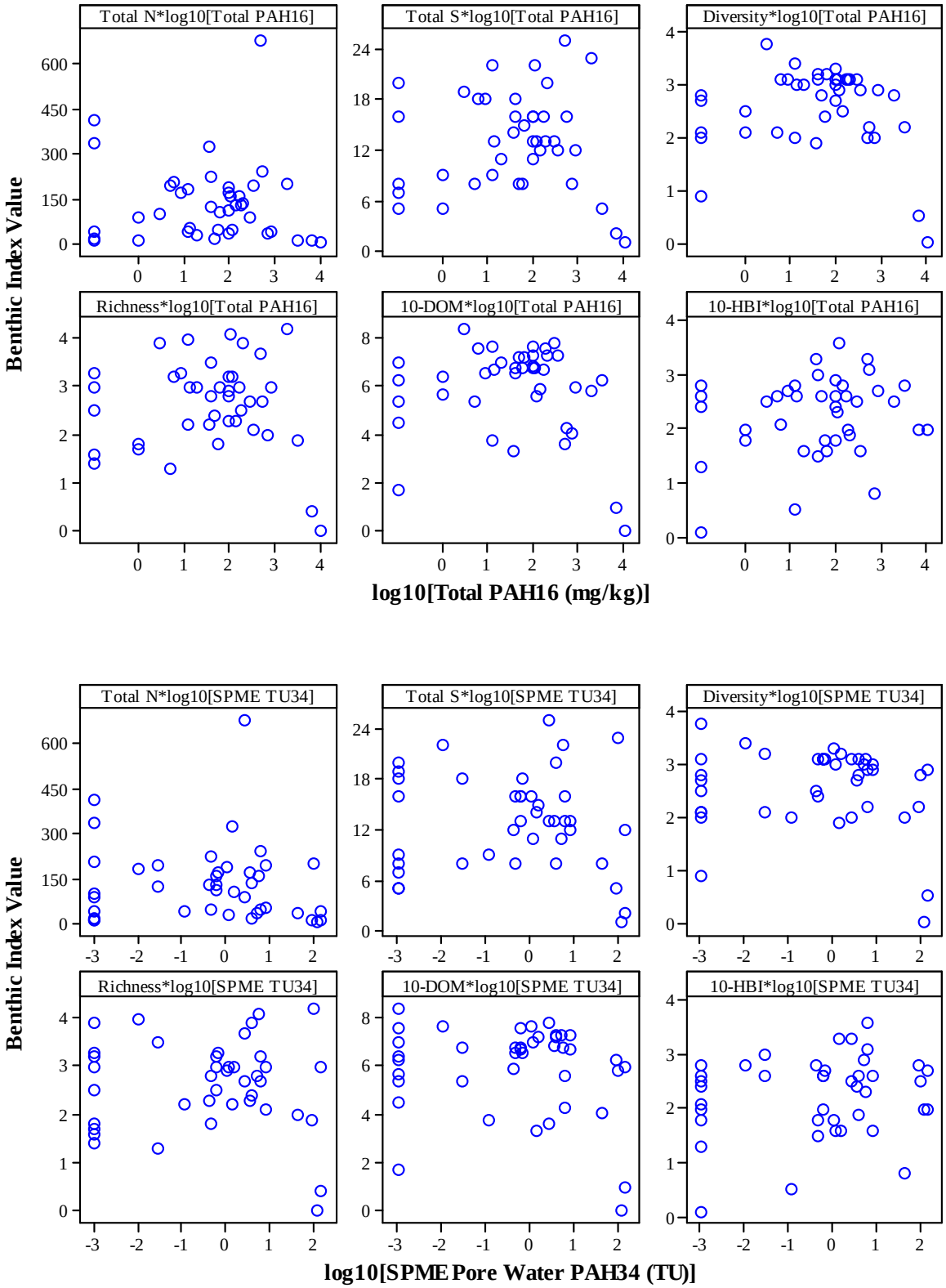
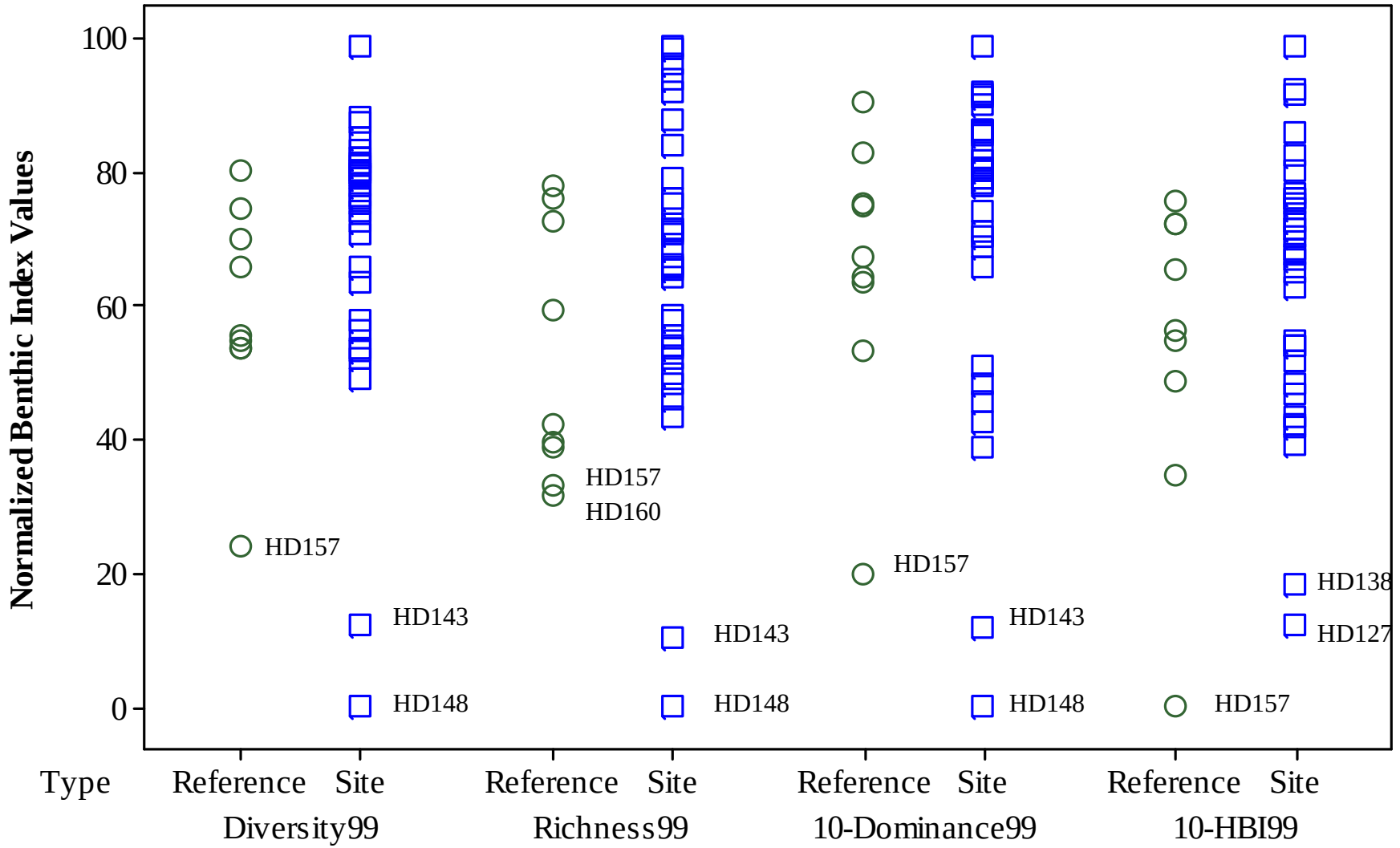


Figure 5-4. Normalized Benthic Macroinvertebrate Indices for Reference and Site Sediment Samples.





Legend

- 2009 SQT Samples with 2 of 3 Metrics Exceeded

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

Source: New York State High Resolution Digital Ortho-imagery 2000-2007

N

GEI Consultants

HUDSON WATER STREET/NATIONAL GRID

2009
SEDIMENT SAMPLES WITH
2/3 OF SQT METRICS EXCEEDED

SCALE: 0 100 200 Feet

PROJECT ID: 09G027

DATE: 3-10-10

PREPARED BY: NAA

CHECKED BY: SGL

Foth

FIGURE NO.
5-5

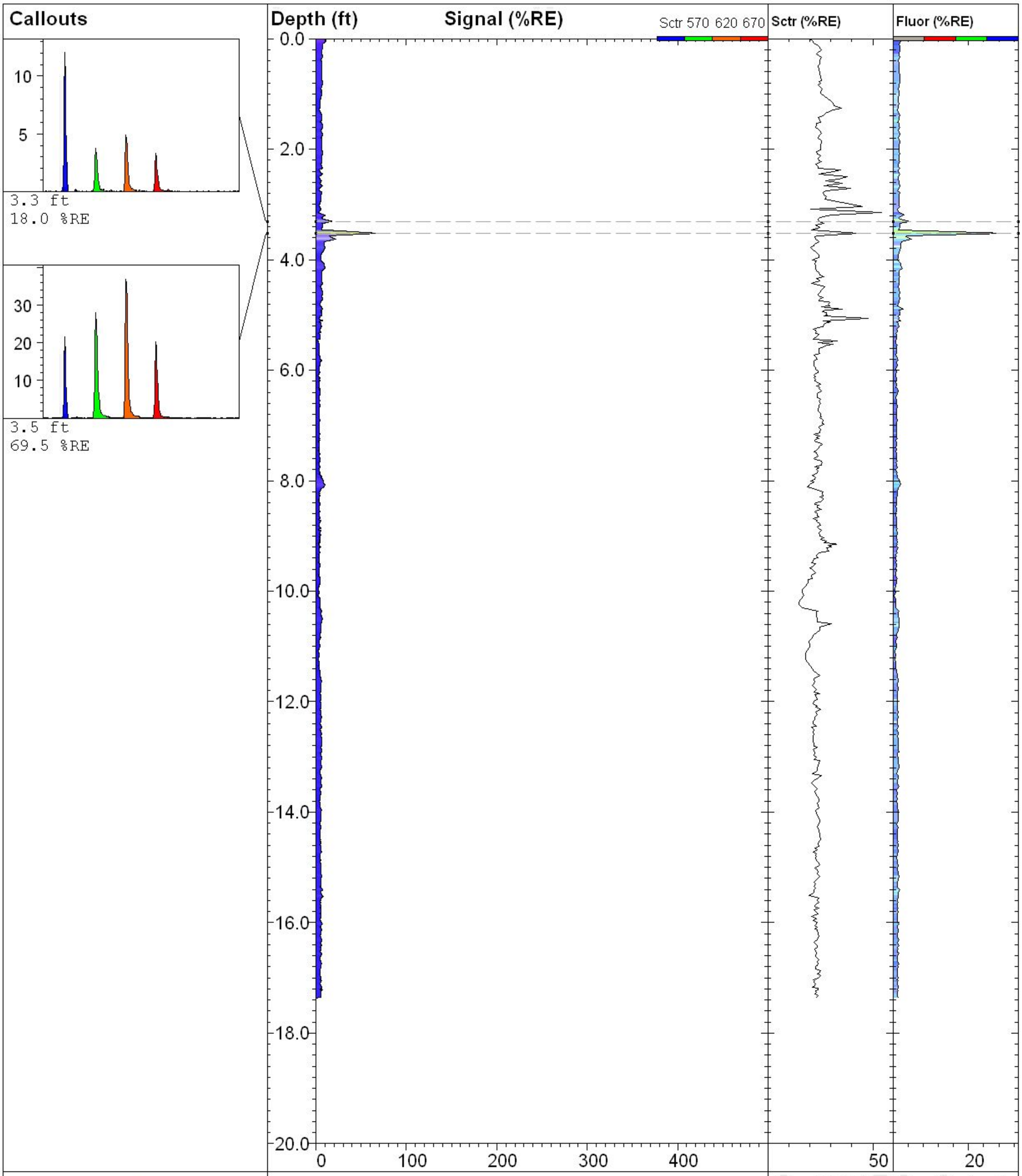
X:\GB\IE\2009\09G027\GIS\mxd\HD_2009SPMESurvival_11x17_NAA.mxd March 10, 2010

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ARCADIS

Appendix B

TarGOST™ and Tar GOST™
Confirmation Boring Logs

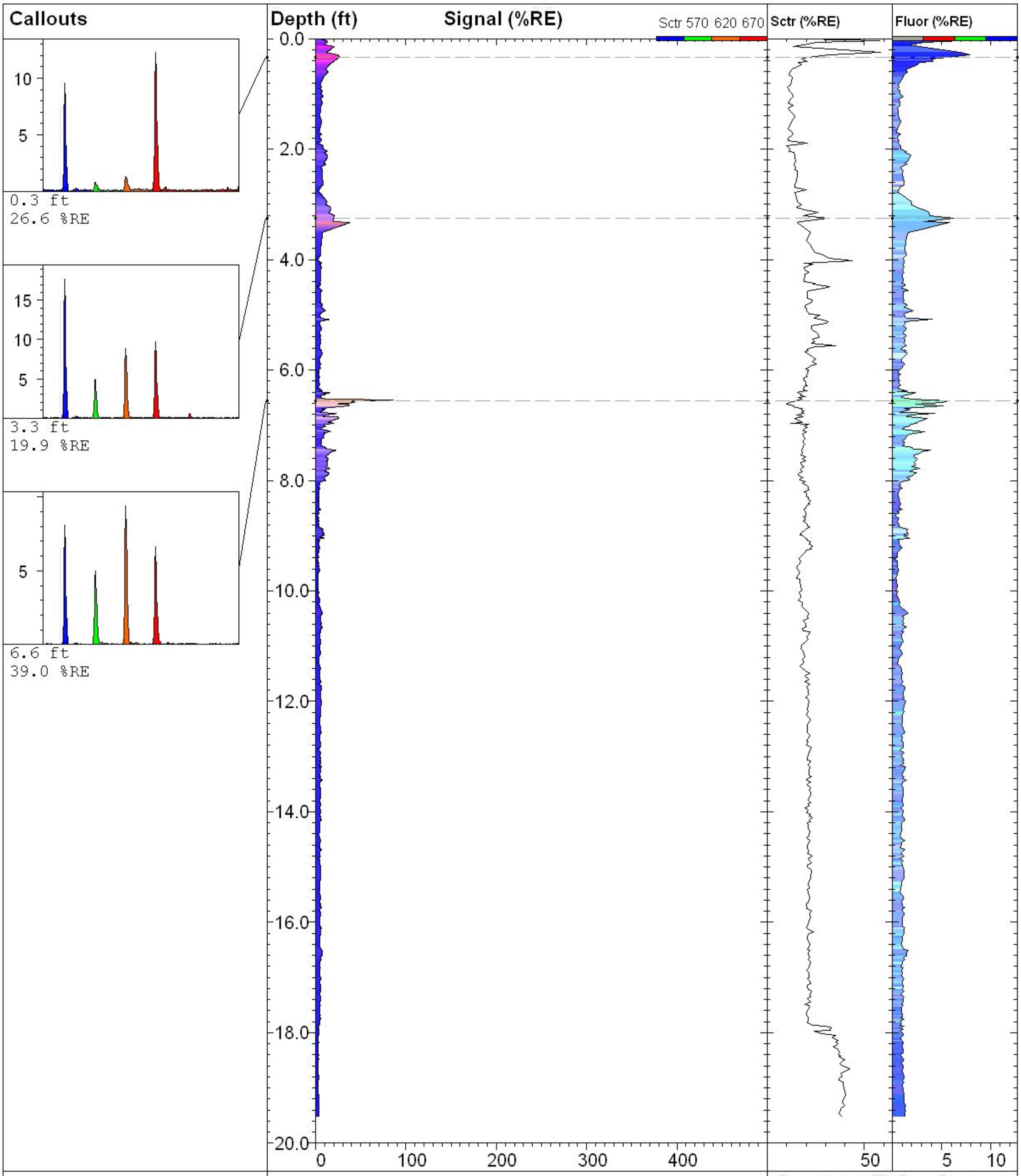


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T1

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **17.36 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **69.5 %RE @ 3.52 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 10:06 EDT**

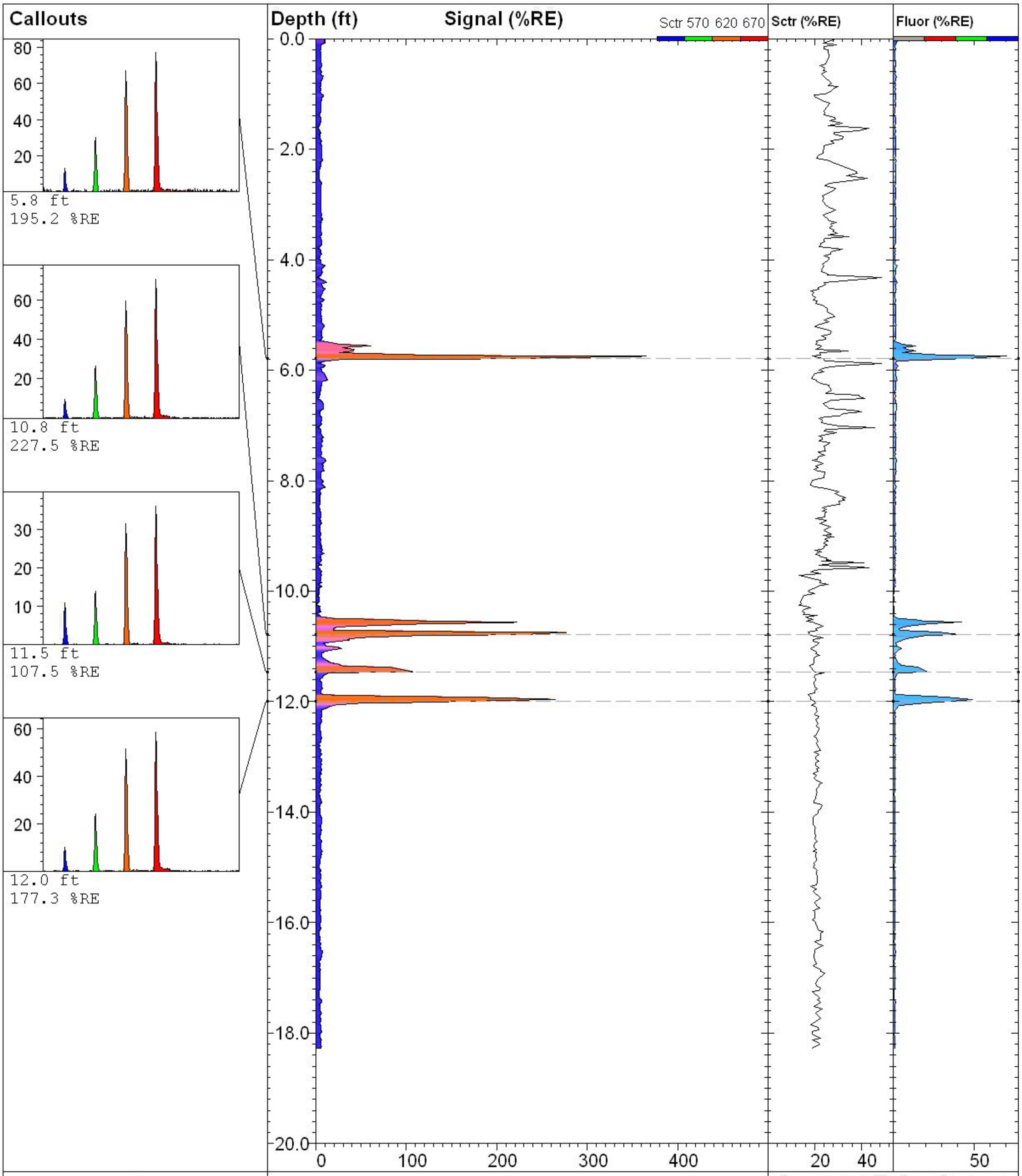


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T2

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **19.51 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **87.0 %RE @ 6.54 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 09:22 EDT**

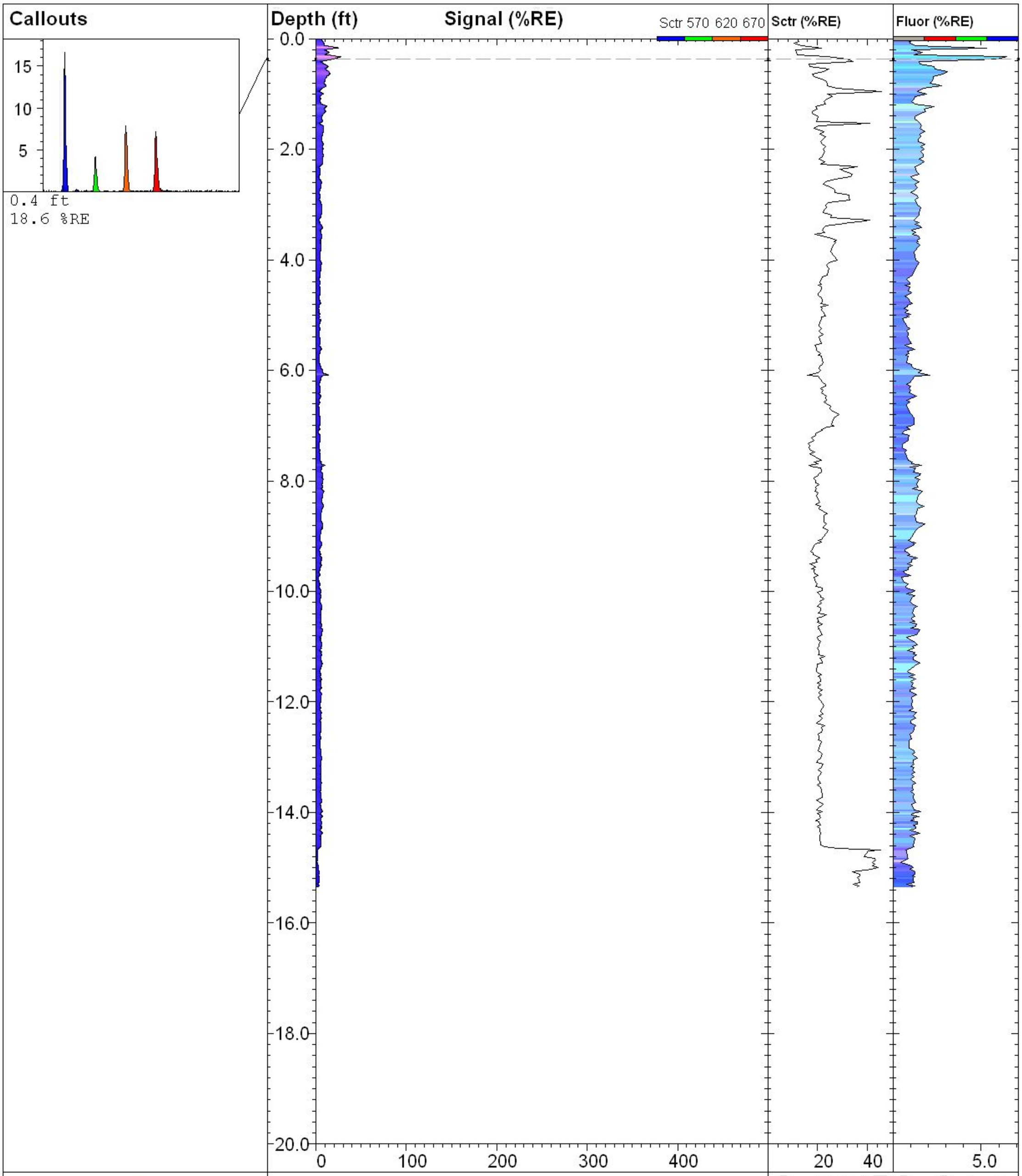


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T3

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **18.28 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **370.8 %RE @ 5.75 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 08:02 EDT**

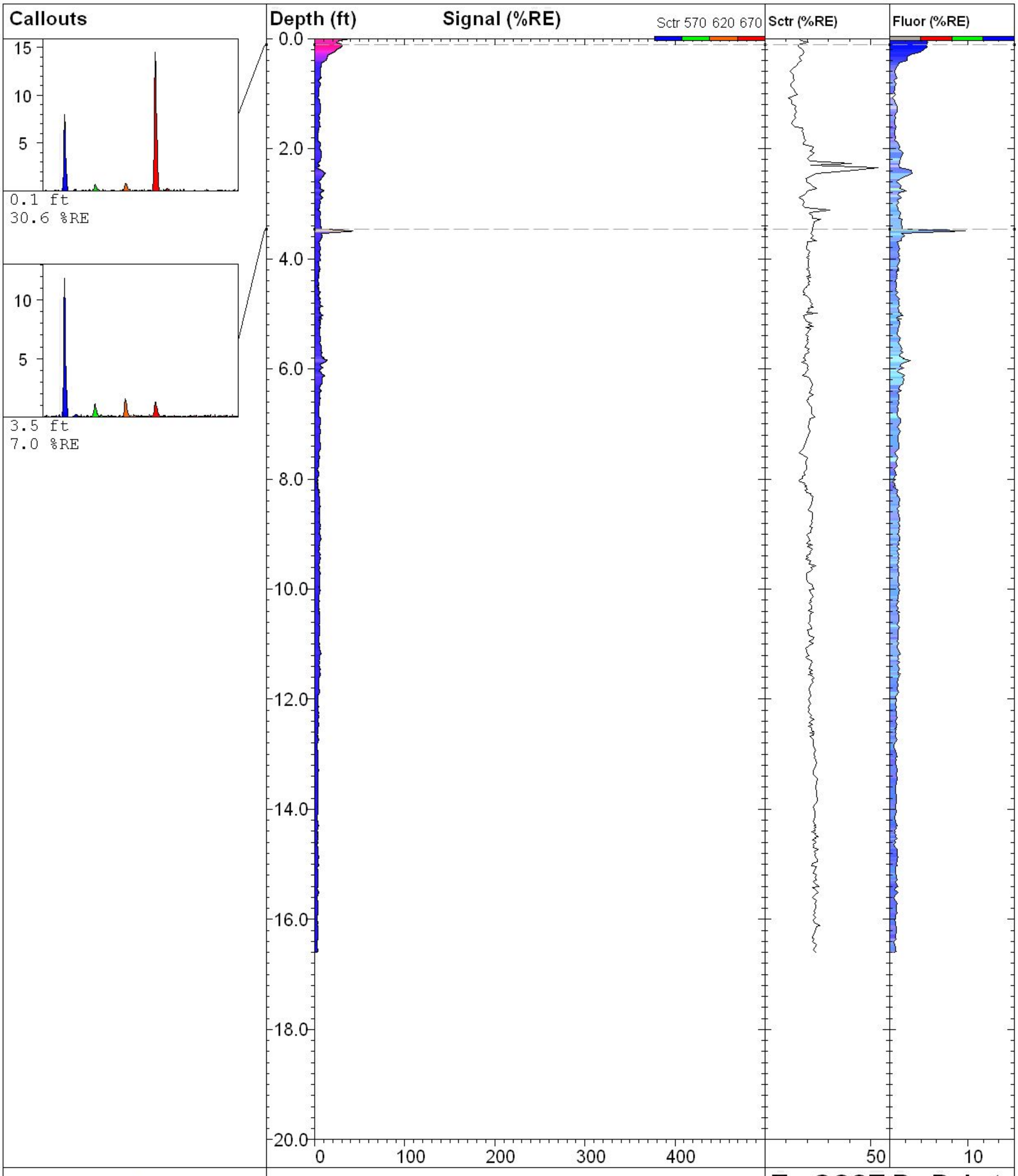


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T4

TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **15.35 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **27.5 %RE @ 0.33 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 16:22 EDT**

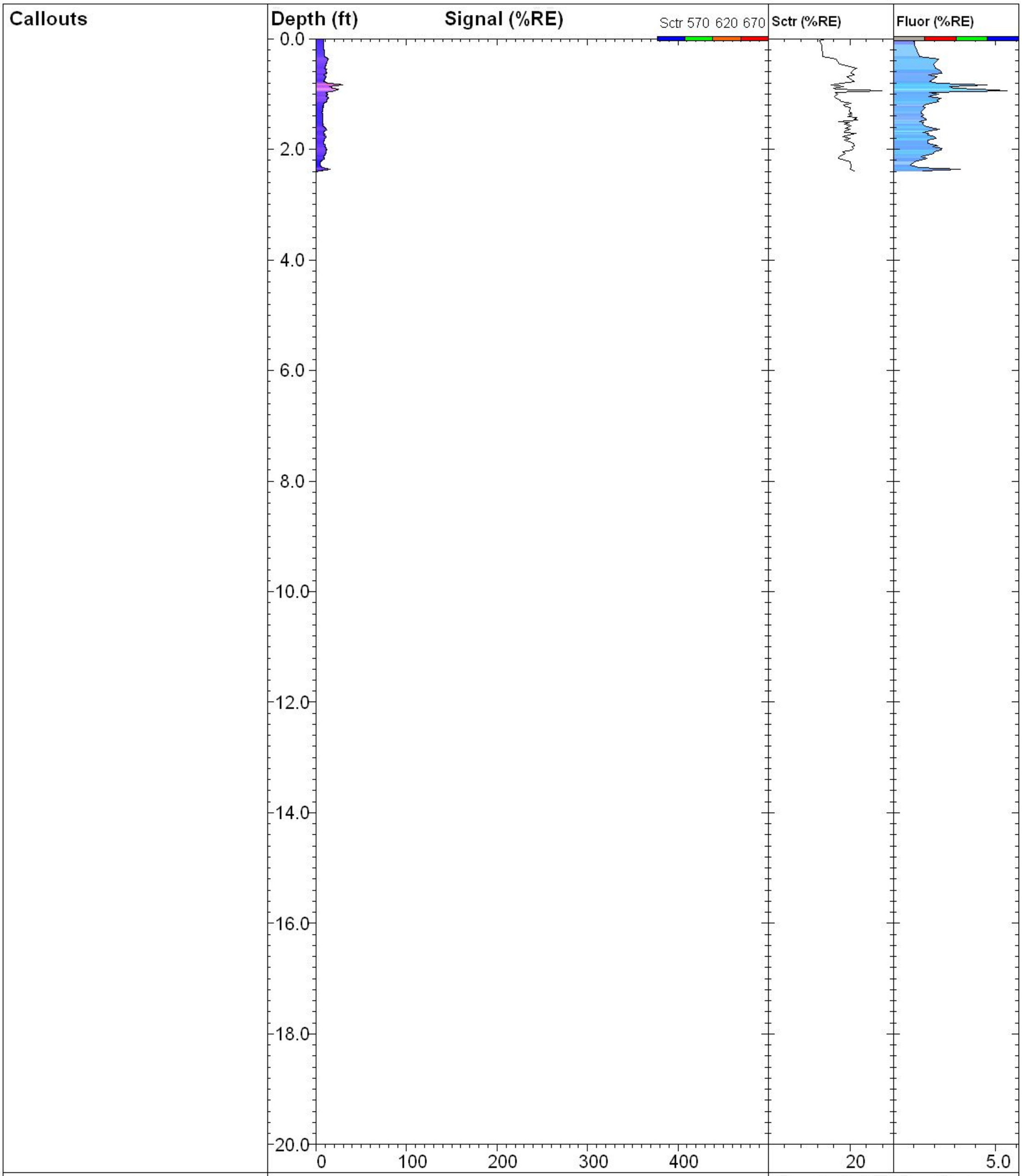


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T5

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **16.60 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **43.0 %RE @ 3.50 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 10:58 EDT**

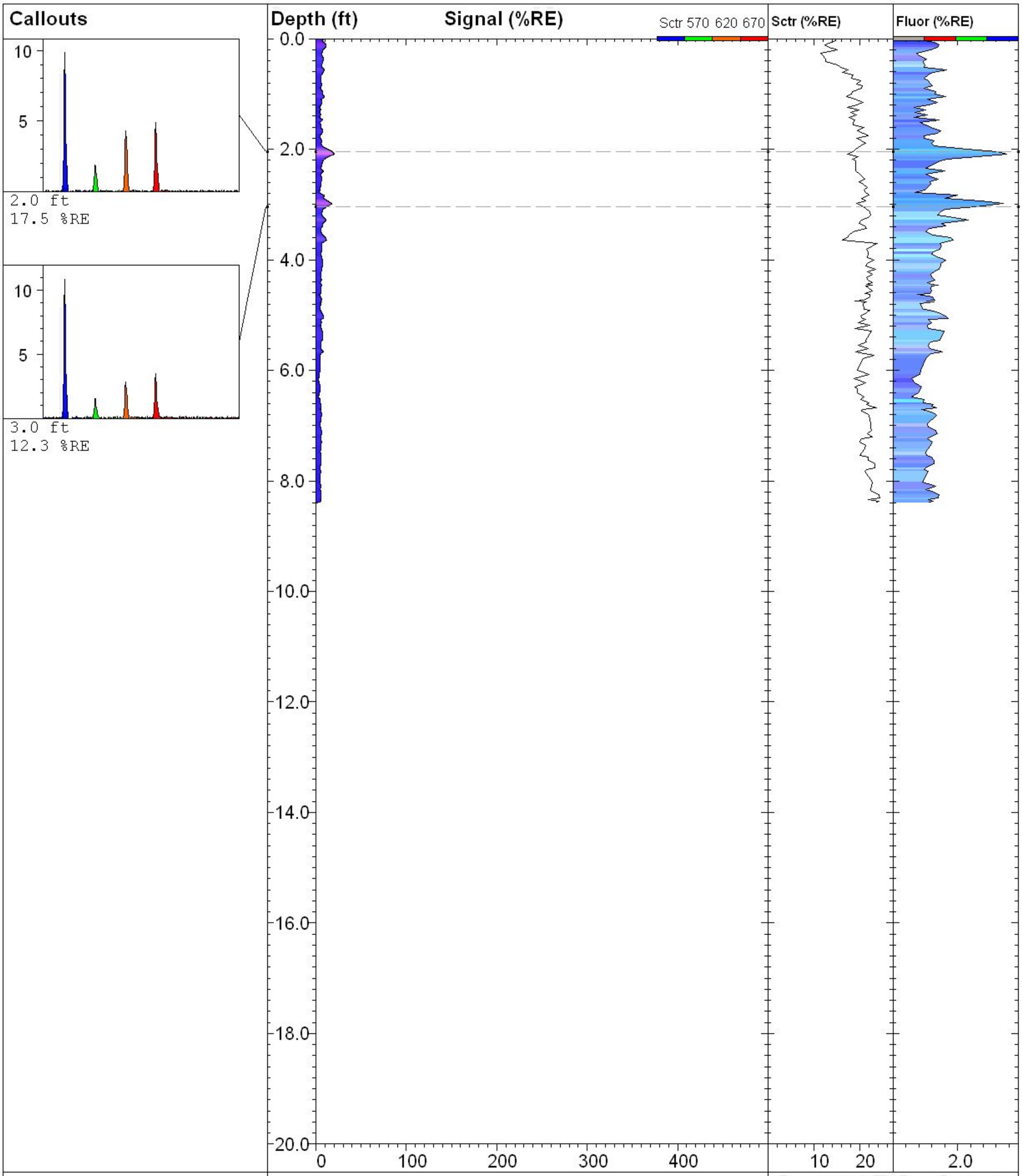


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T6

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **2.40 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **29.9 %RE @ 0.84 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 12:32 EDT**

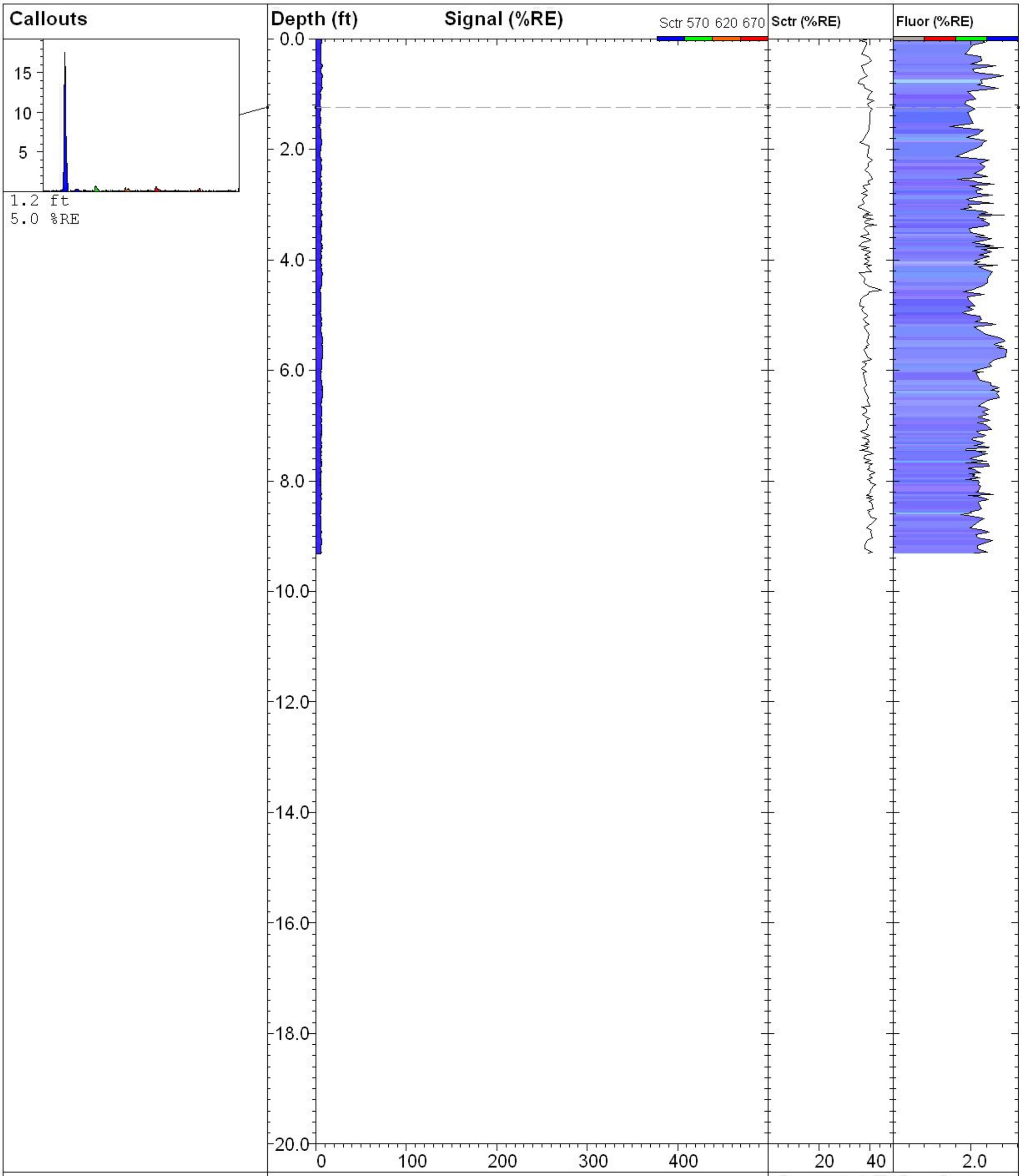


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T6B

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **8.39 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **20.4 %RE @ 2.09 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 13:06 EDT**



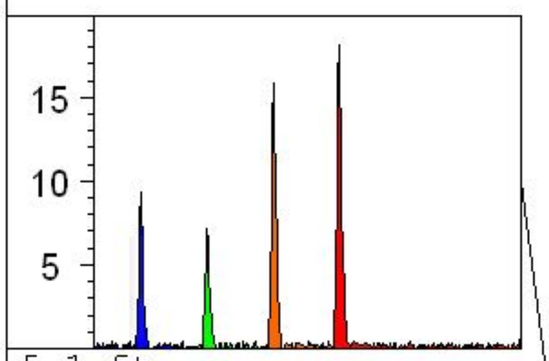
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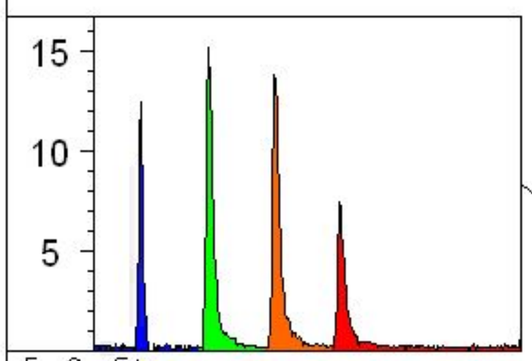
TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **9.32 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **7.7 %RE @ 5.62 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-29 09:05 EDT**

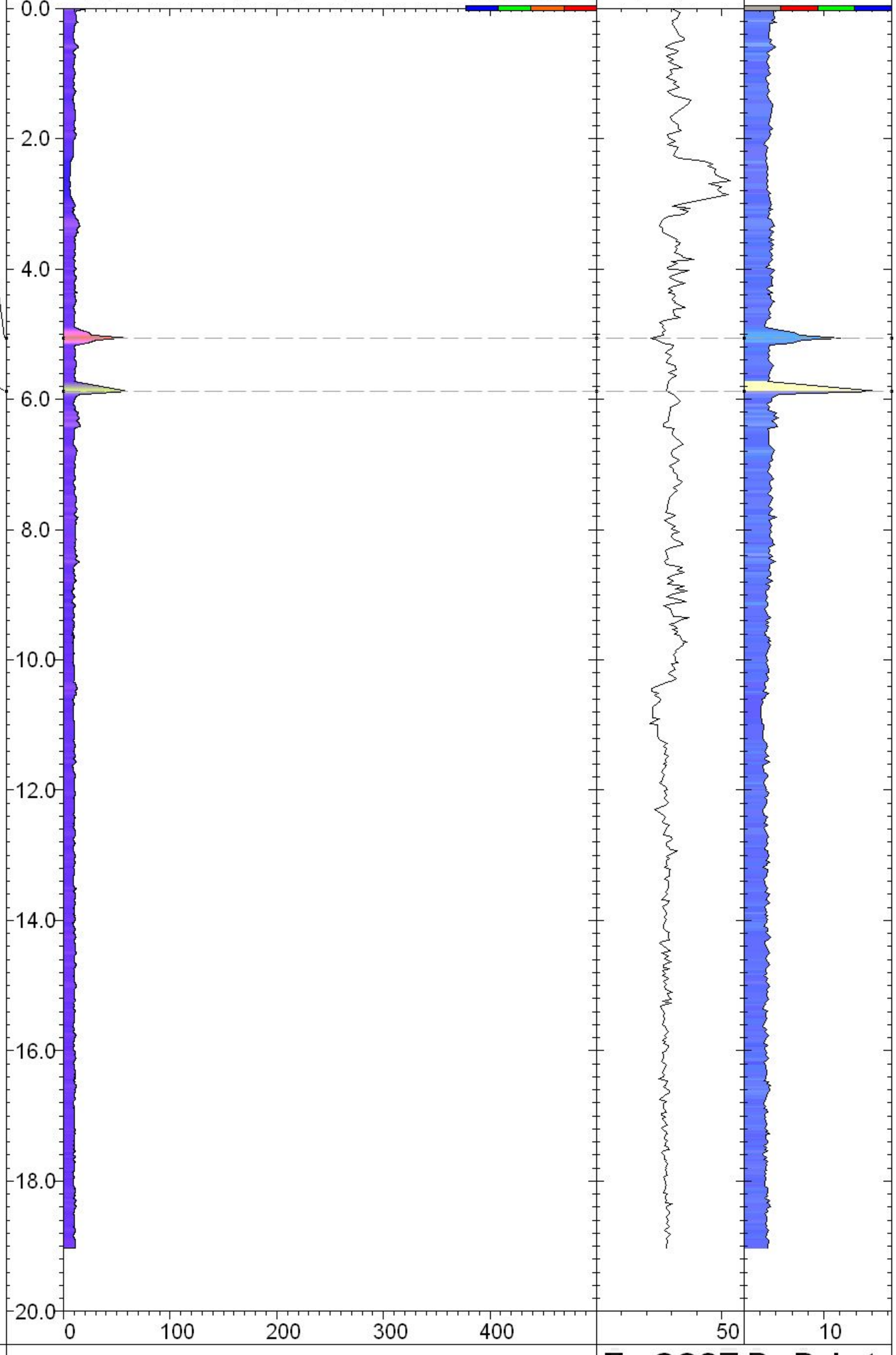
Callouts



5.1 ft
56.0 %RE



5.9 ft
60.5 %RE



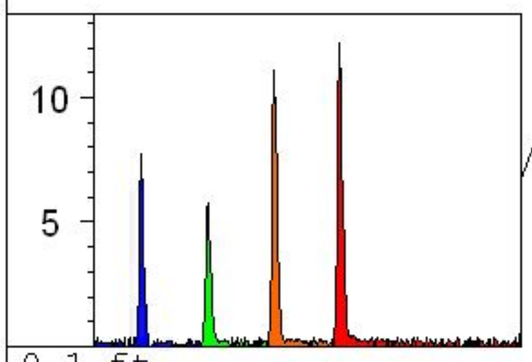
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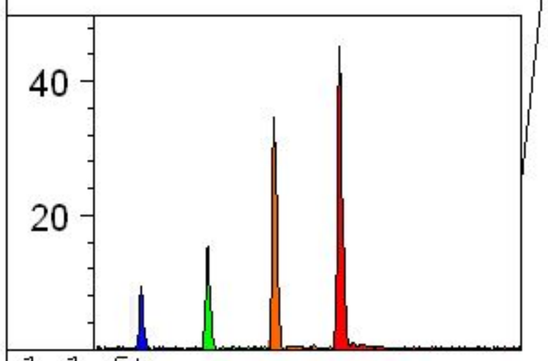
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **19.03 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **60.5 %RE @ 5.88 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-26 13:56 EDT**

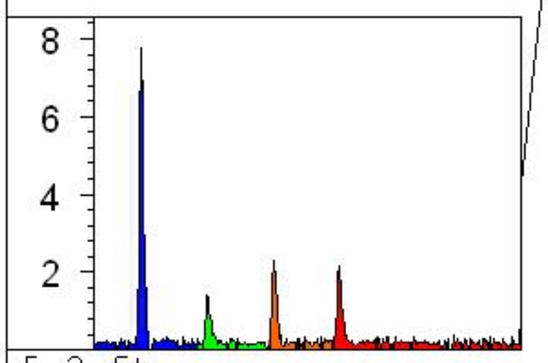
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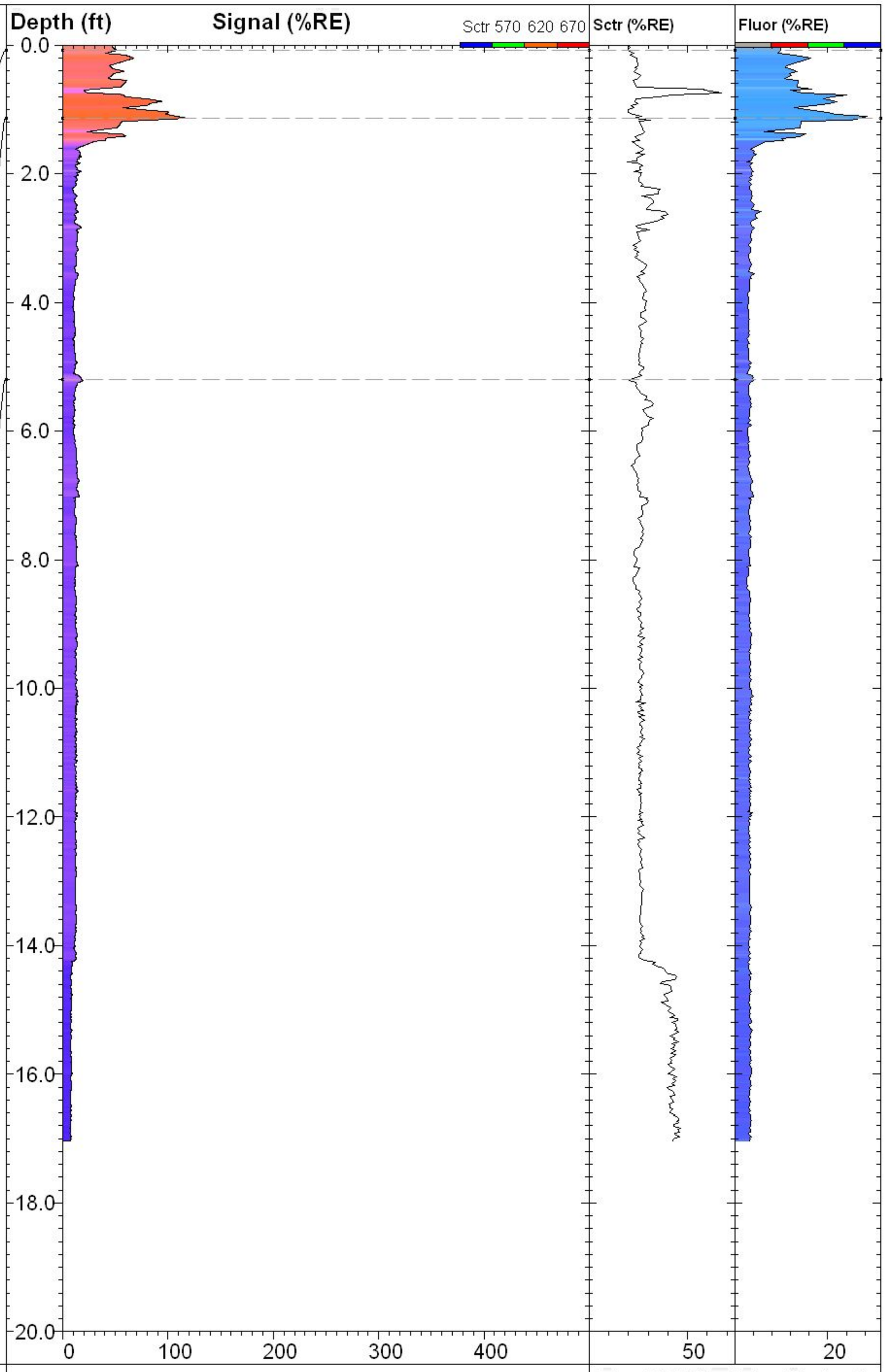
0.1 ft
51.3 %RE



1.1 ft
118.4 %RE



5.2 ft
17.9 %RE



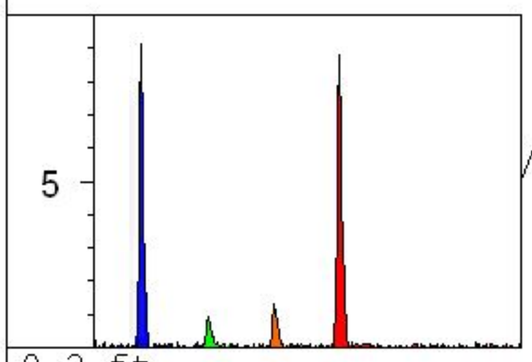
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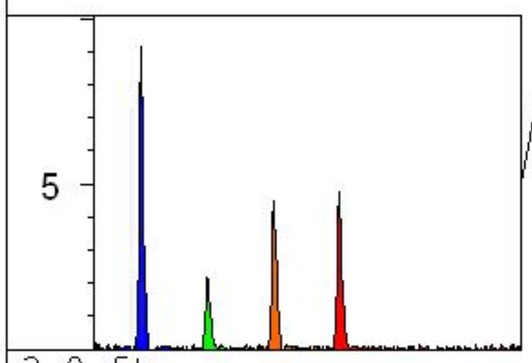
TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **17.03 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **118.4 %RE @ 1.14 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-26 11:52 EDT**

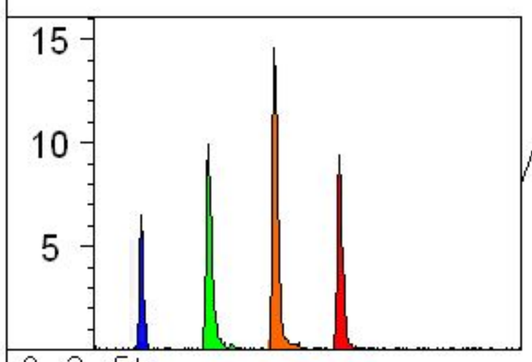
Callouts



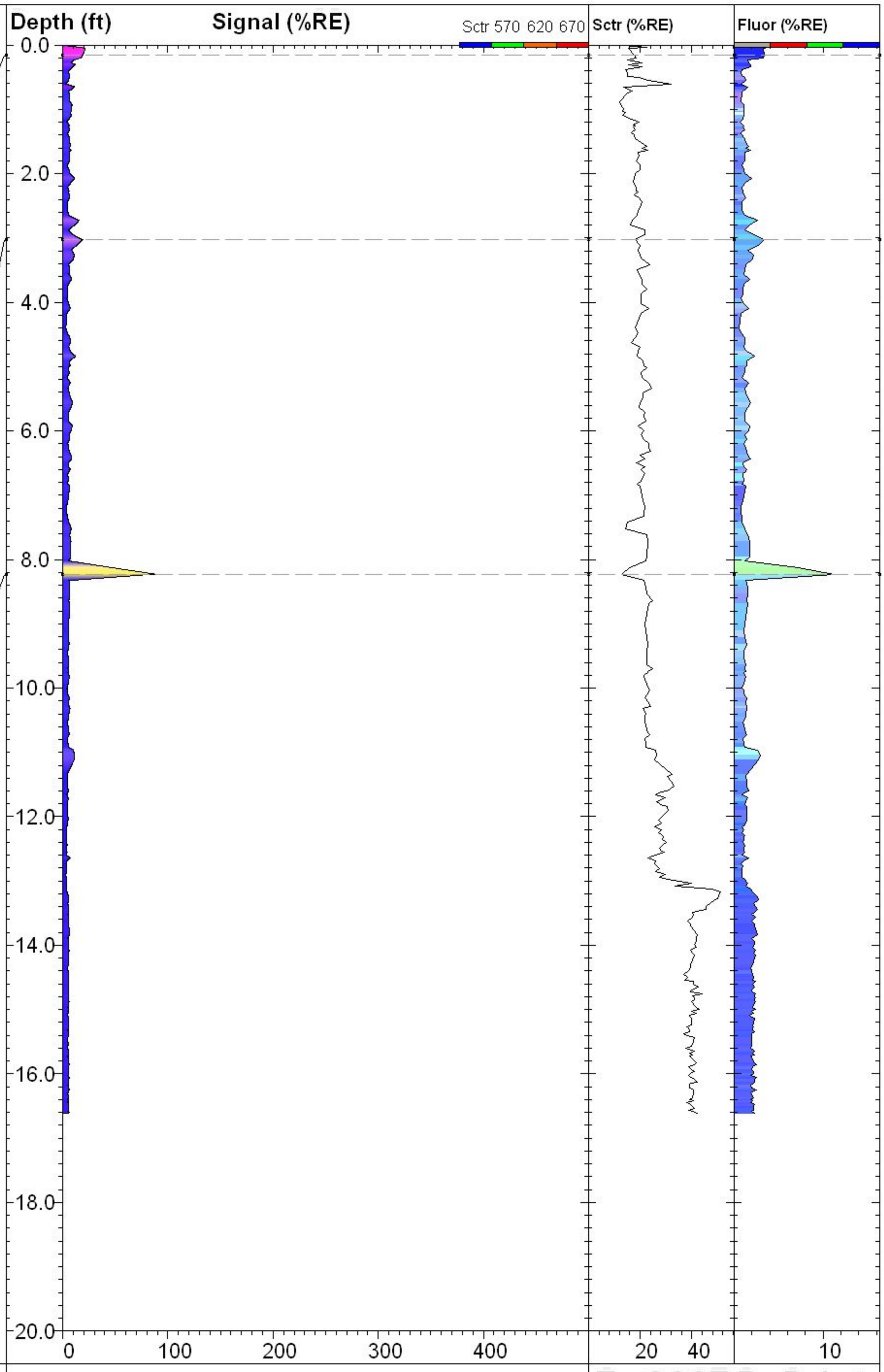
0.2 ft
19.0 %RE



3.0 ft
18.9 %RE



8.2 ft
87.5 %RE



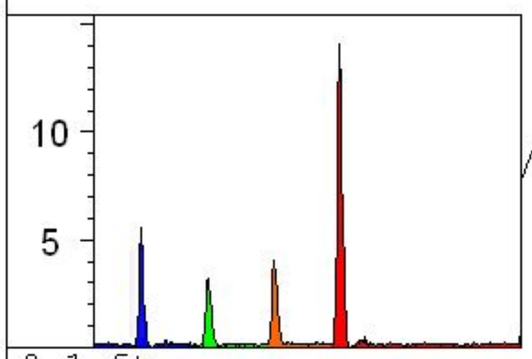
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T10

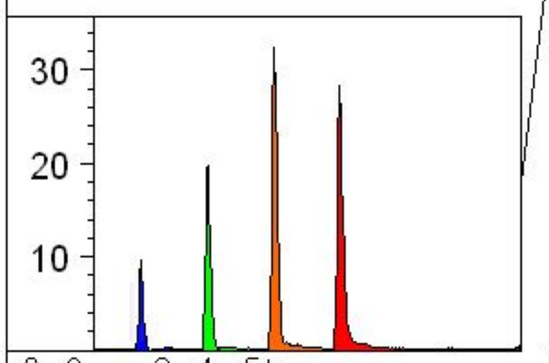
TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **16.61 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **87.5 %RE @ 8.23 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 13:28 EDT**

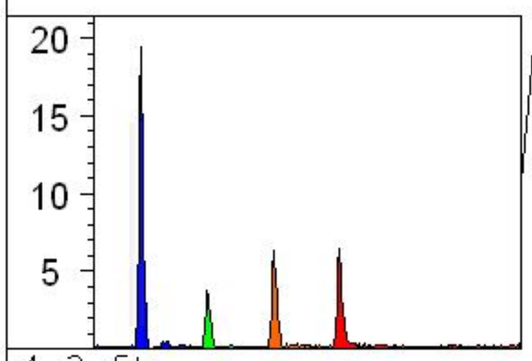
Callouts



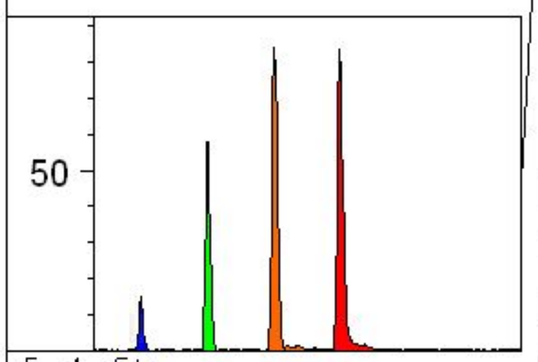
0.1 ft
50.2 %RE



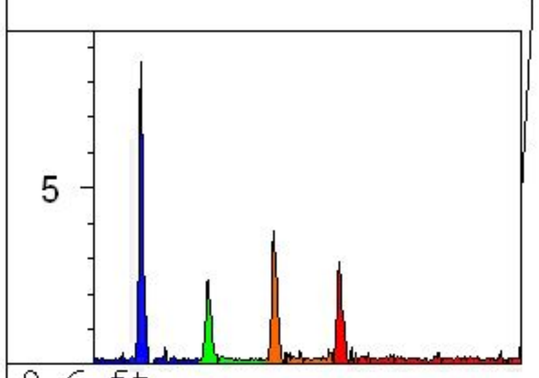
0.8 - 2.4 ft
114.3 %RE (s 69.1)



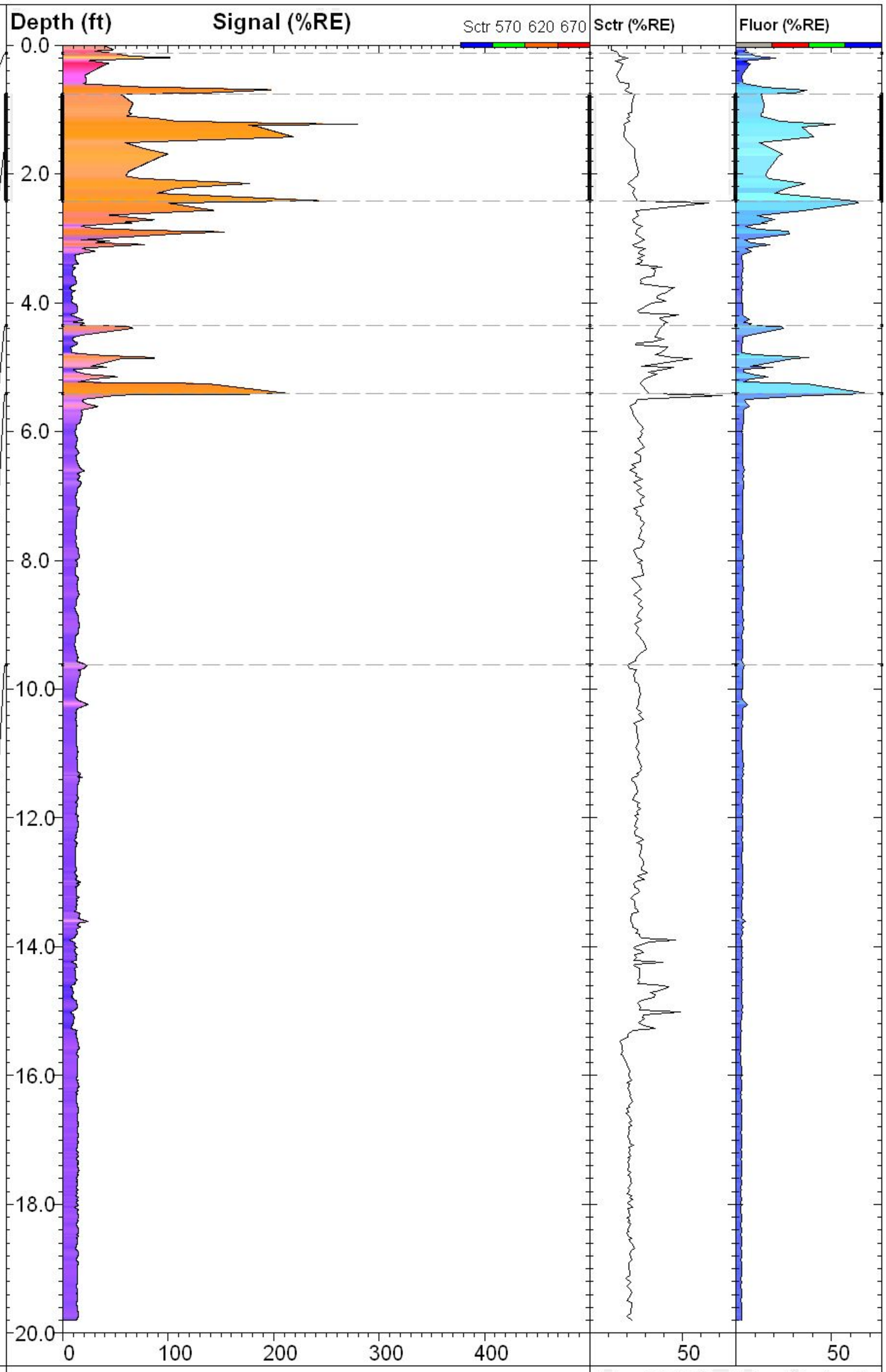
4.3 ft
16.5 %RE



5.4 ft
215.6 %RE



9.6 ft
23.0 %RE



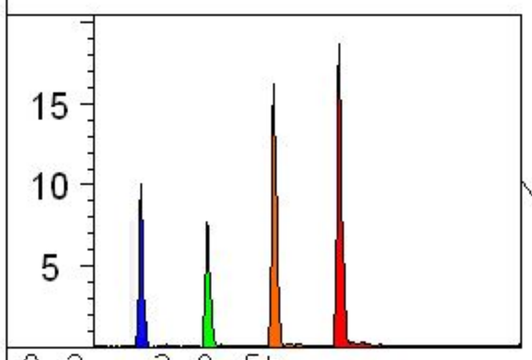
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T11

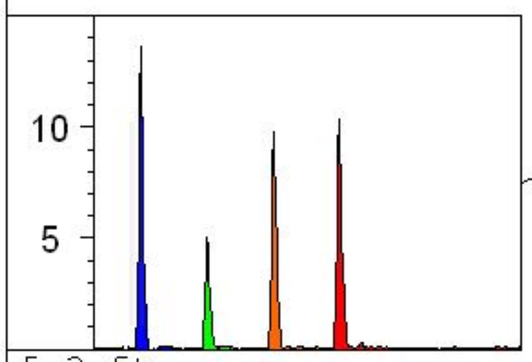
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www.DakotaTechnologies.com

Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **19.80 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **283.4 %RE @ 1.23 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-26 13:03 EDT**

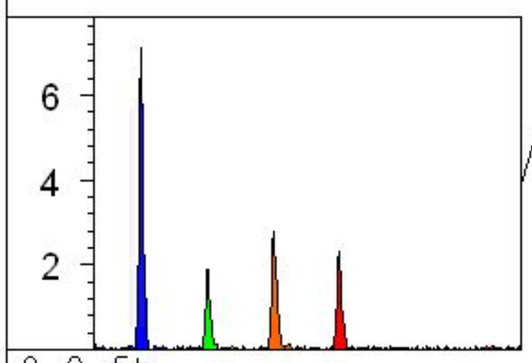
Callouts



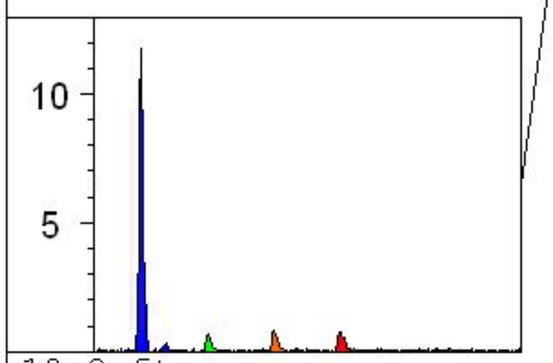
0.2 - 3.8 ft
61.2 %RE (s 29.7)



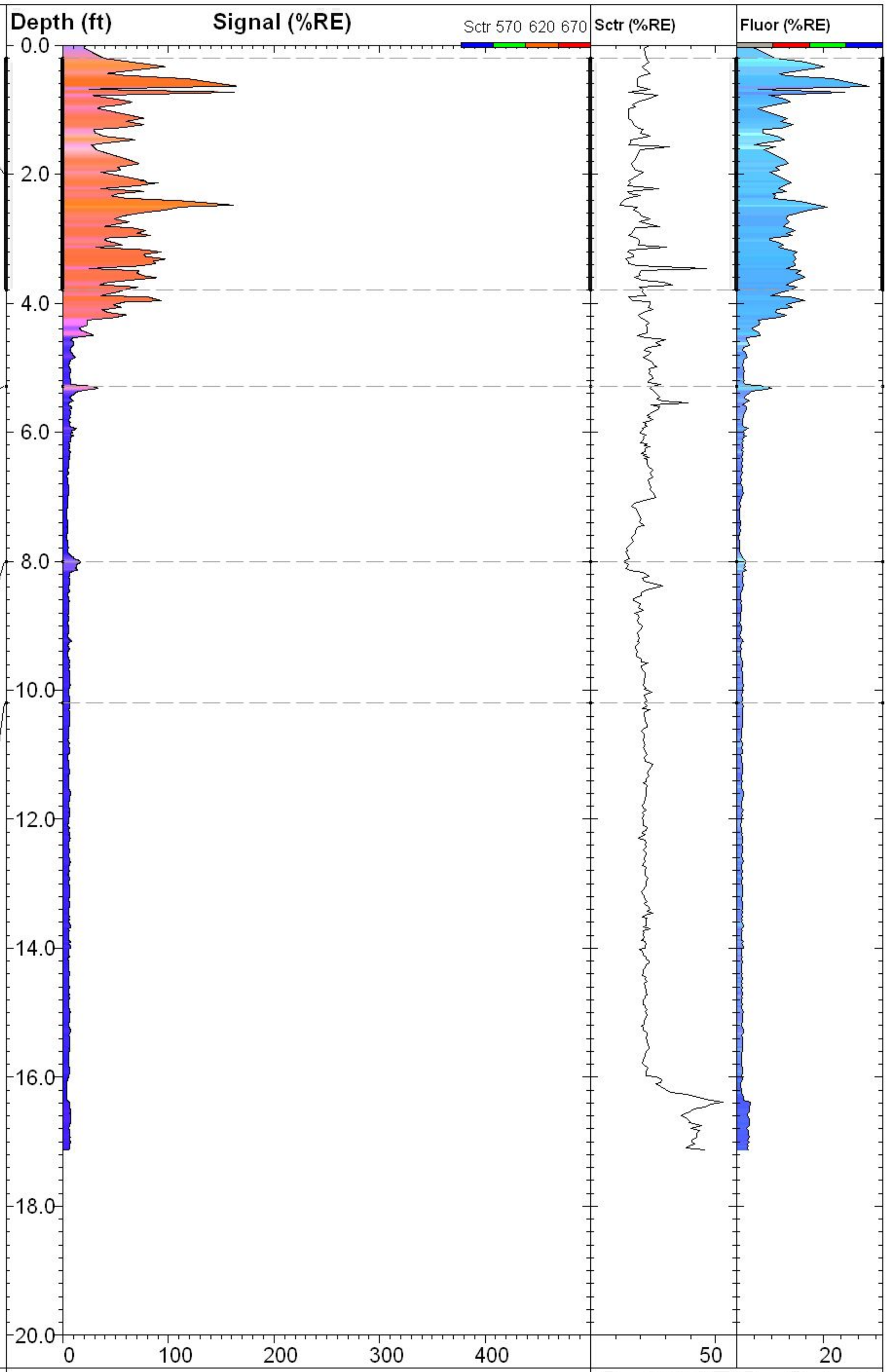
5.3 ft
28.5 %RE



8.0 ft
16.2 %RE



10.2 ft
5.6 %RE

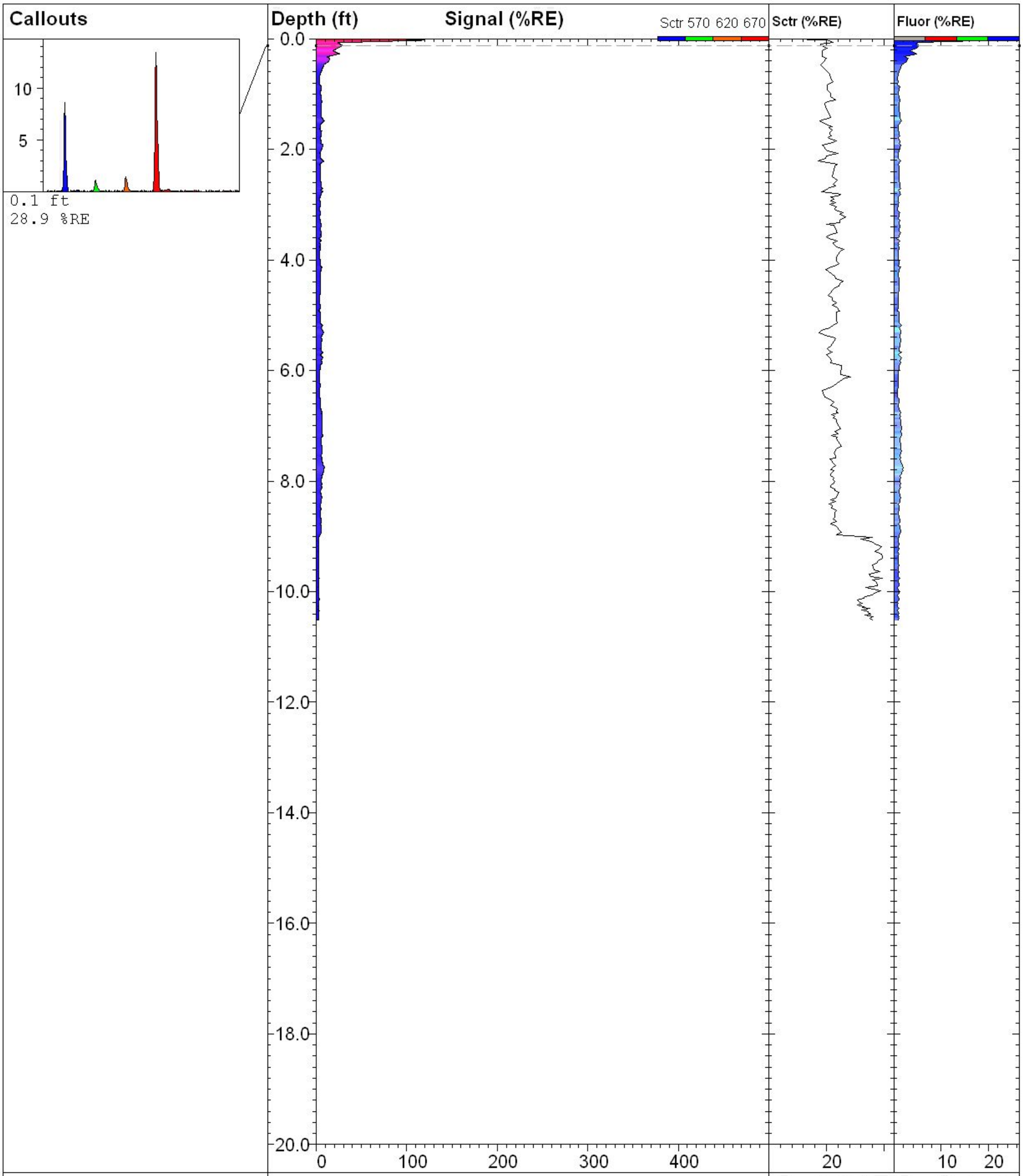


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T12

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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **17.12 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **163.7 %RE @ 0.63 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-26 15:17 EDT**

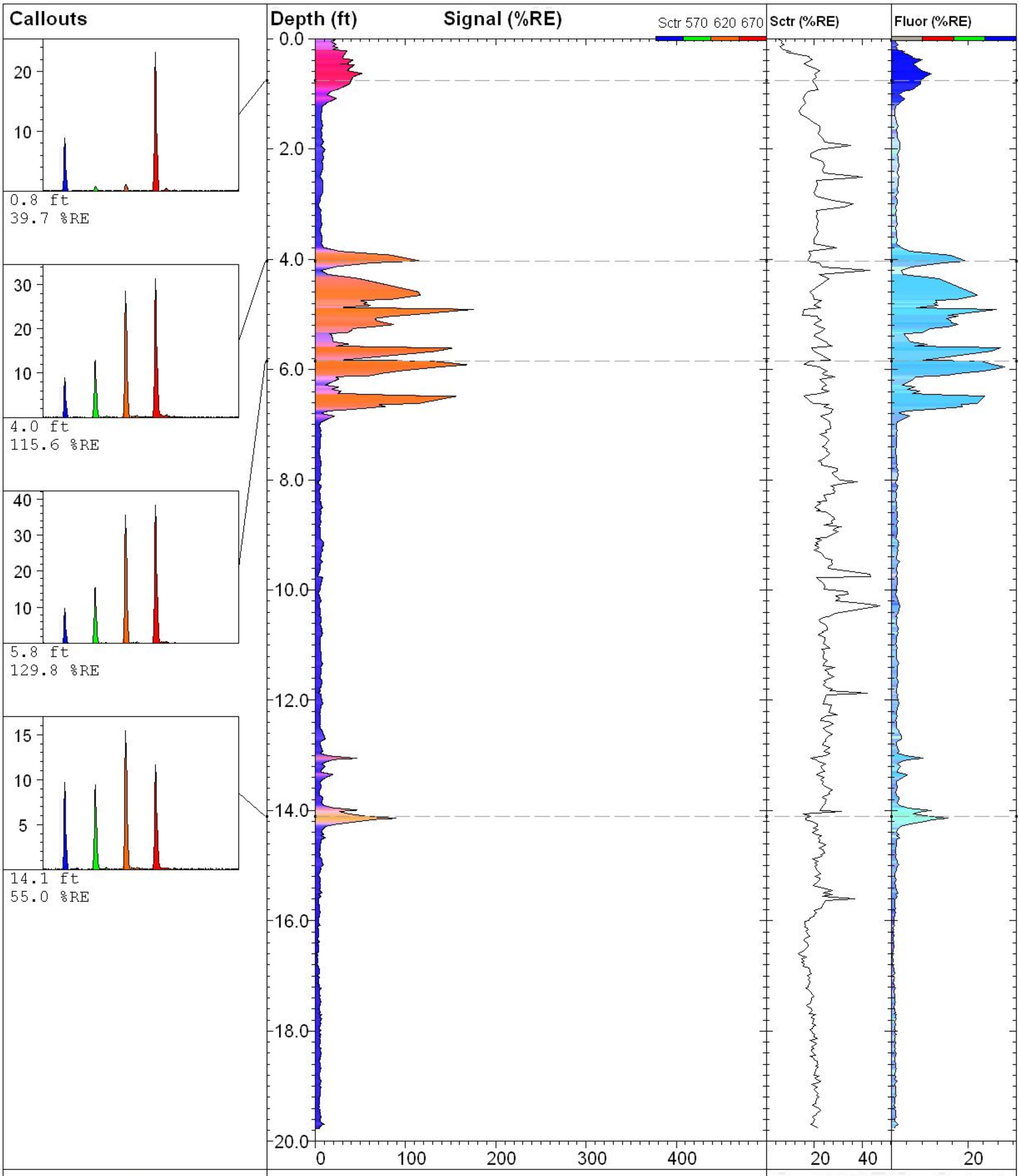


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T13

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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **10.51 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **121.4 %RE @ 0.03 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 14:25 EDT**

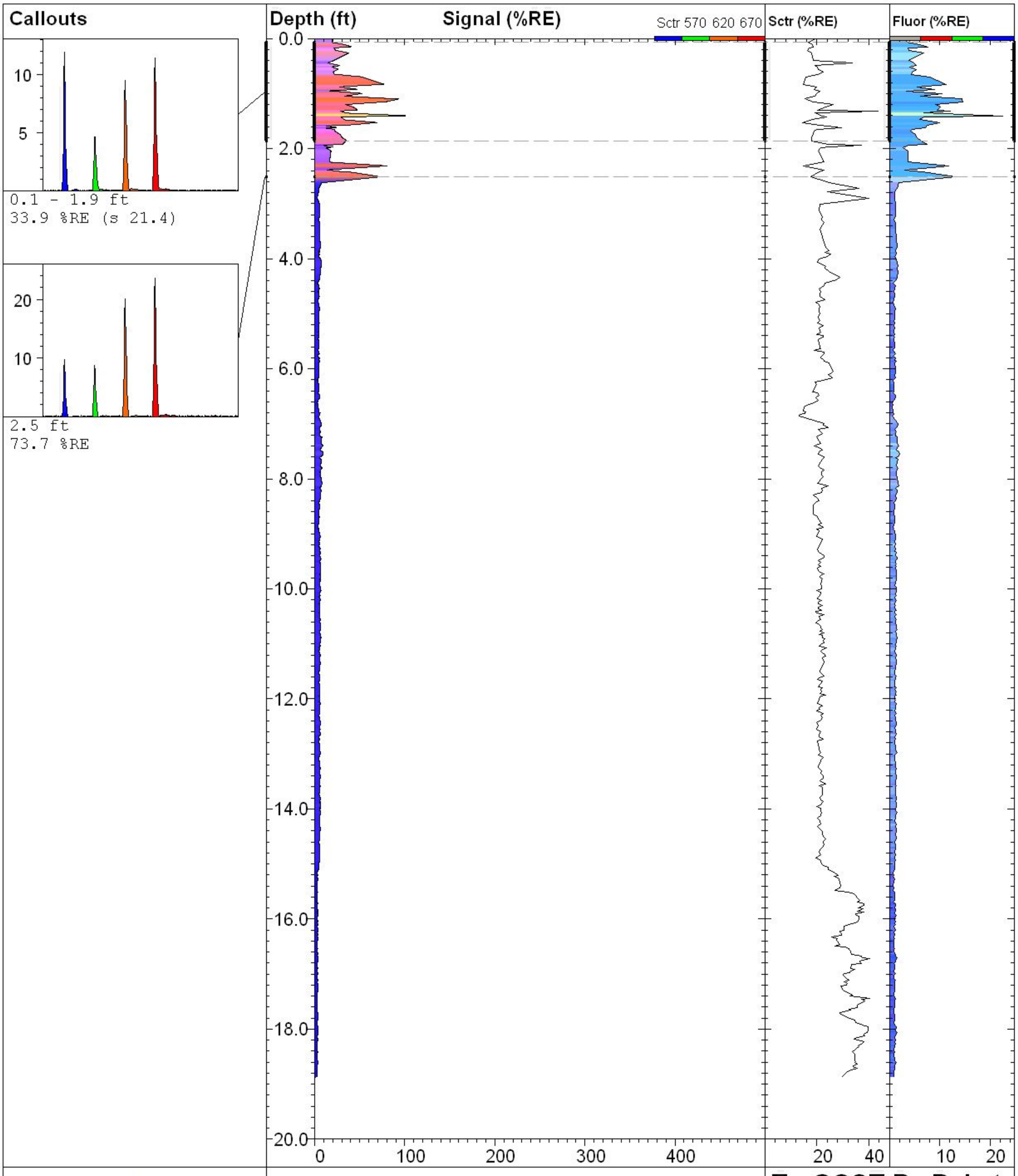


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T14

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **19.76 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **176.0 %RE @ 4.91 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-28 08:52 EDT**

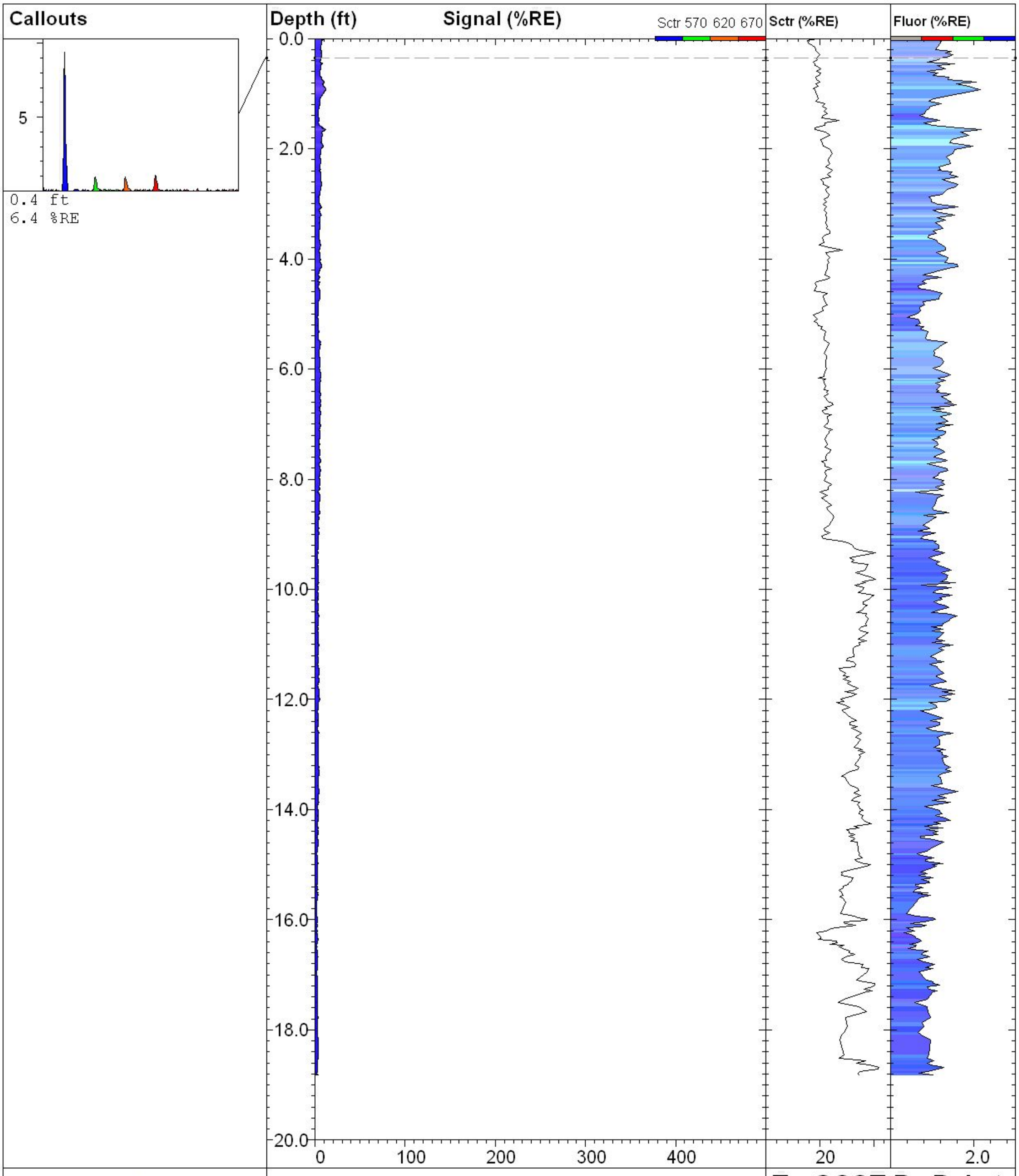


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T15

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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **18.87 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **103.2 %RE @ 1.40 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-26 16:01 EDT**



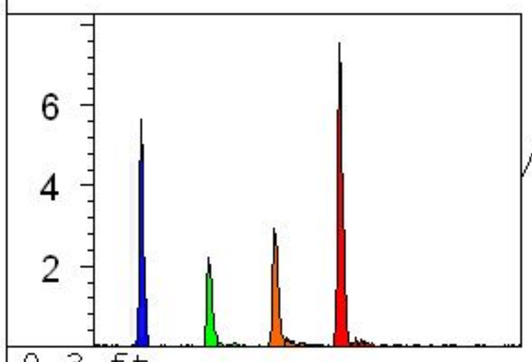
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T16

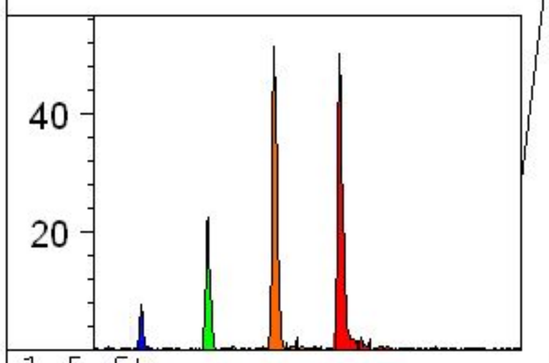
TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **18.81 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **14.2 %RE @ 0.01 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-27 15:21 EDT**

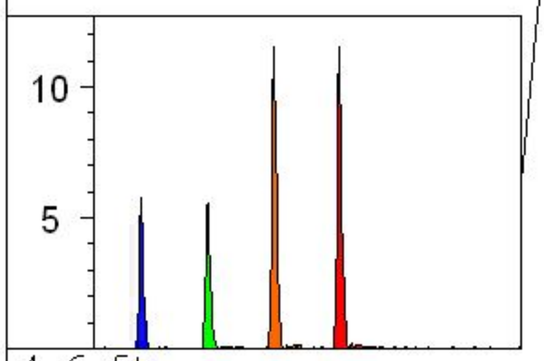
Callouts



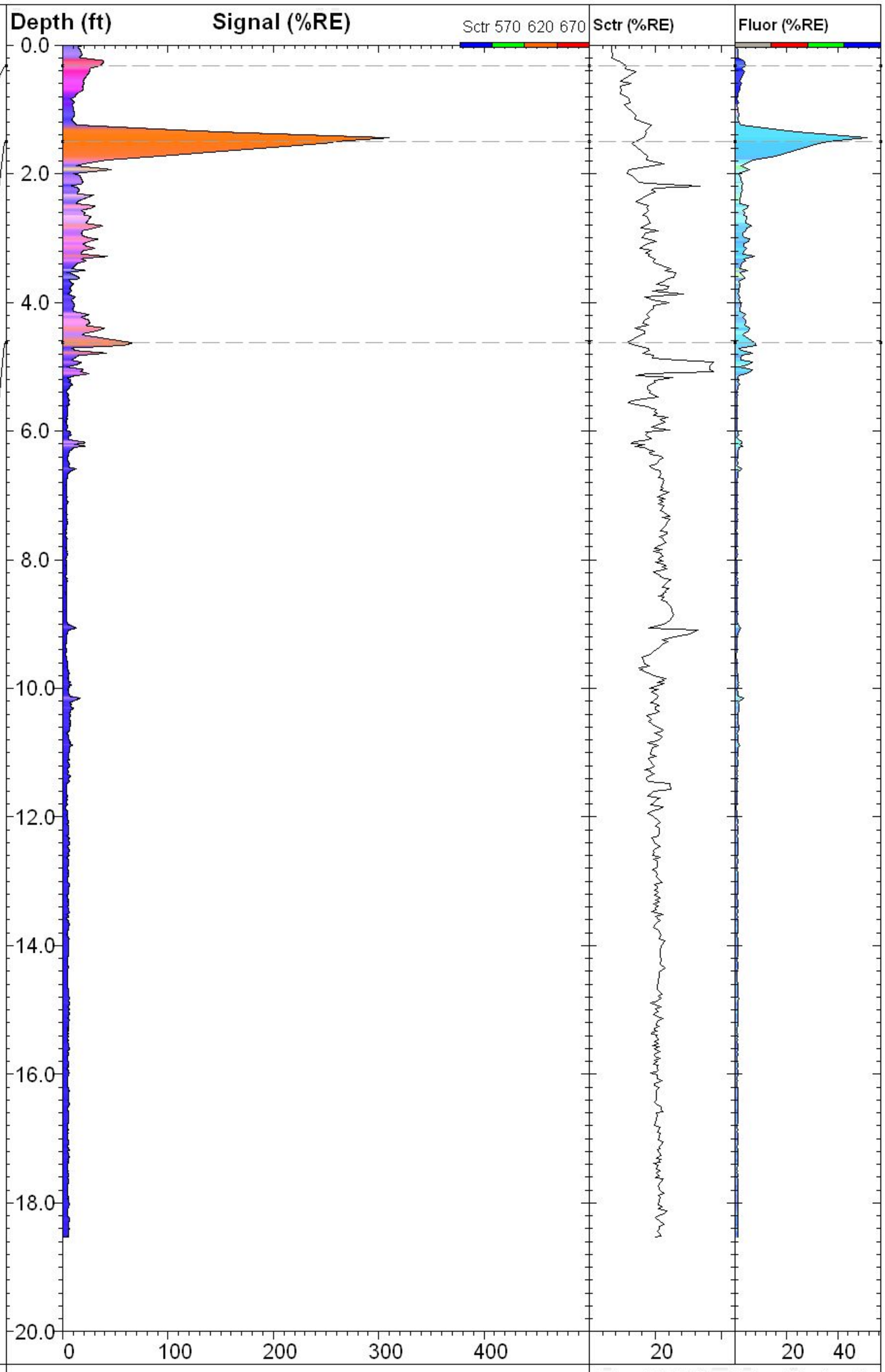
0.3 ft
36.3 %RE



1.5 ft
260.2 %RE



4.6 ft
66.6 %RE



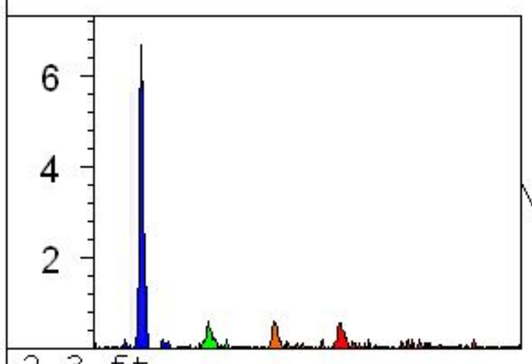
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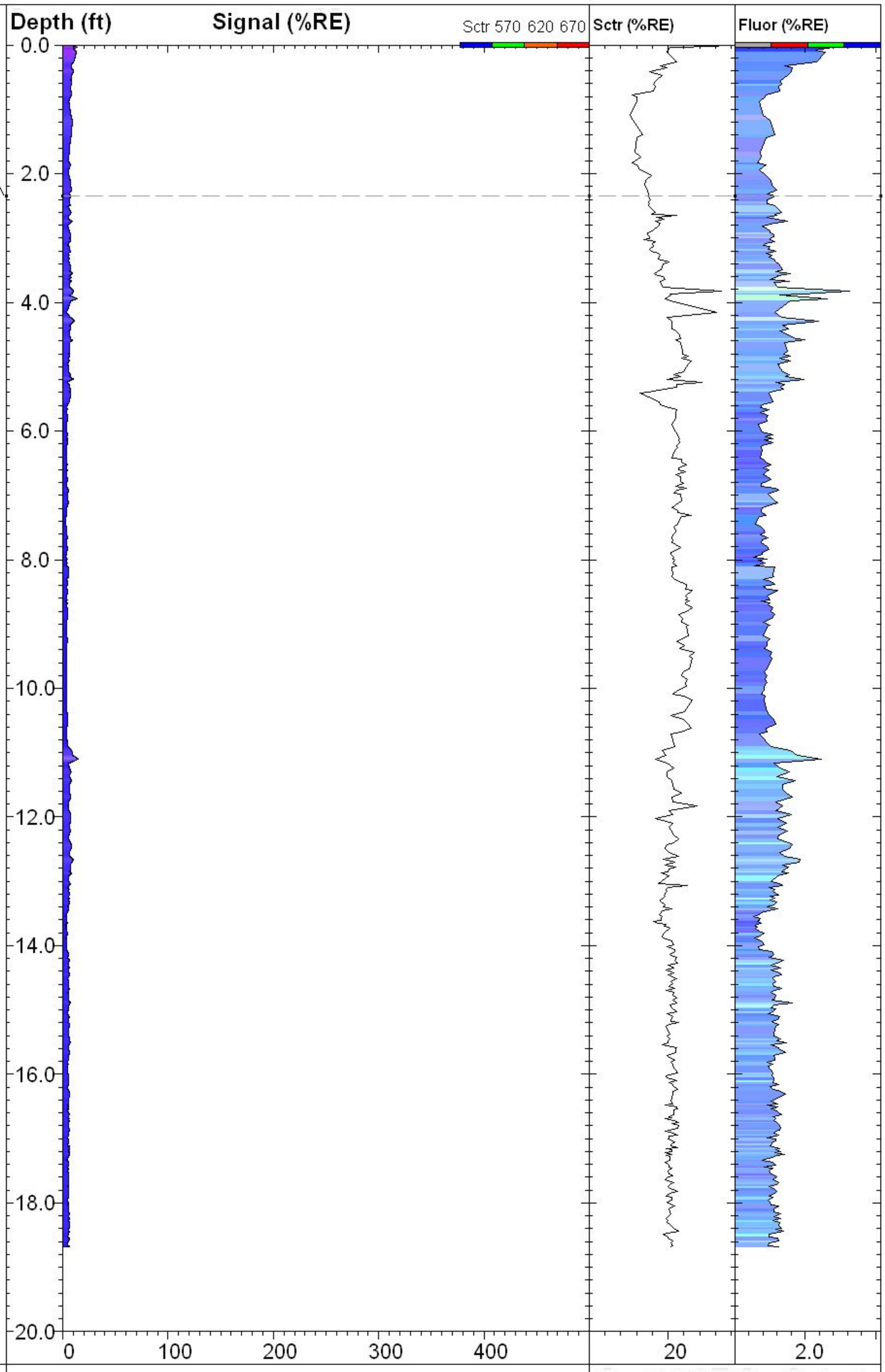
T17

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **18.53 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **310.4 %RE @ 1.44 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-28 09:43 EDT**

Callouts



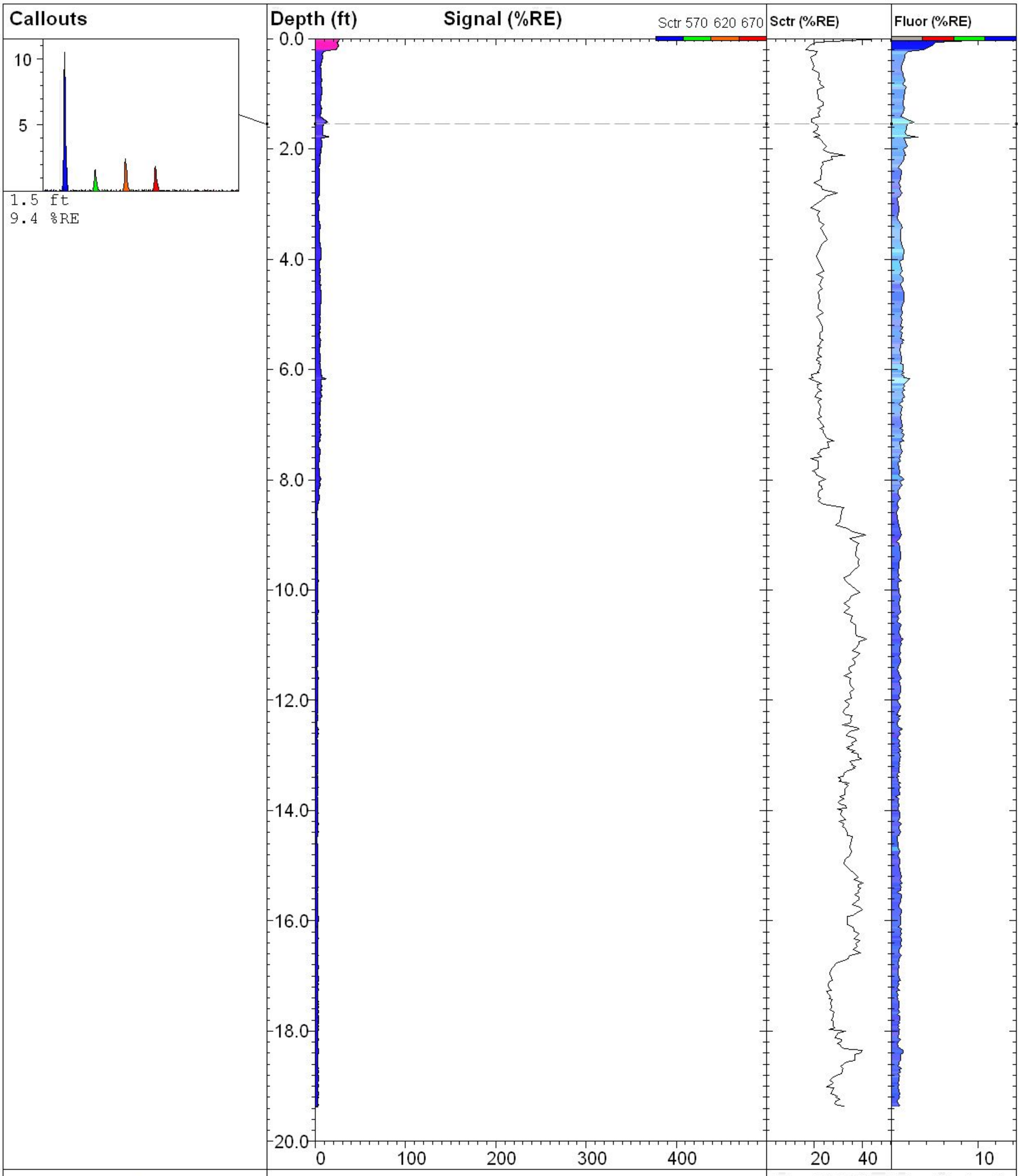


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T18

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **18.68 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **14.6 %RE @ 11.10 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-28 10:50 EDT**

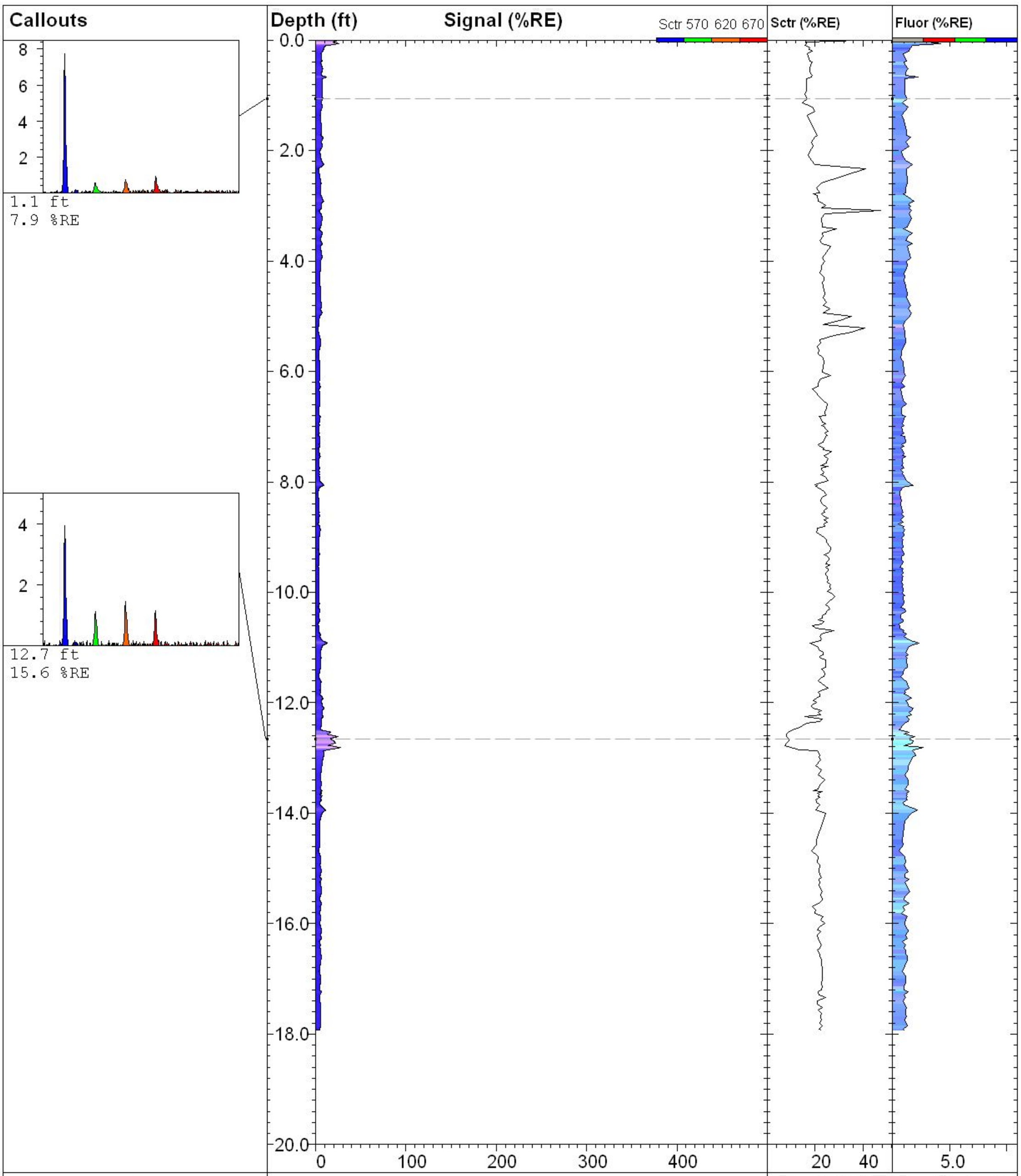


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T19

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **19.37 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **27.4 %RE @ 0.00 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-28 12:42 EDT**

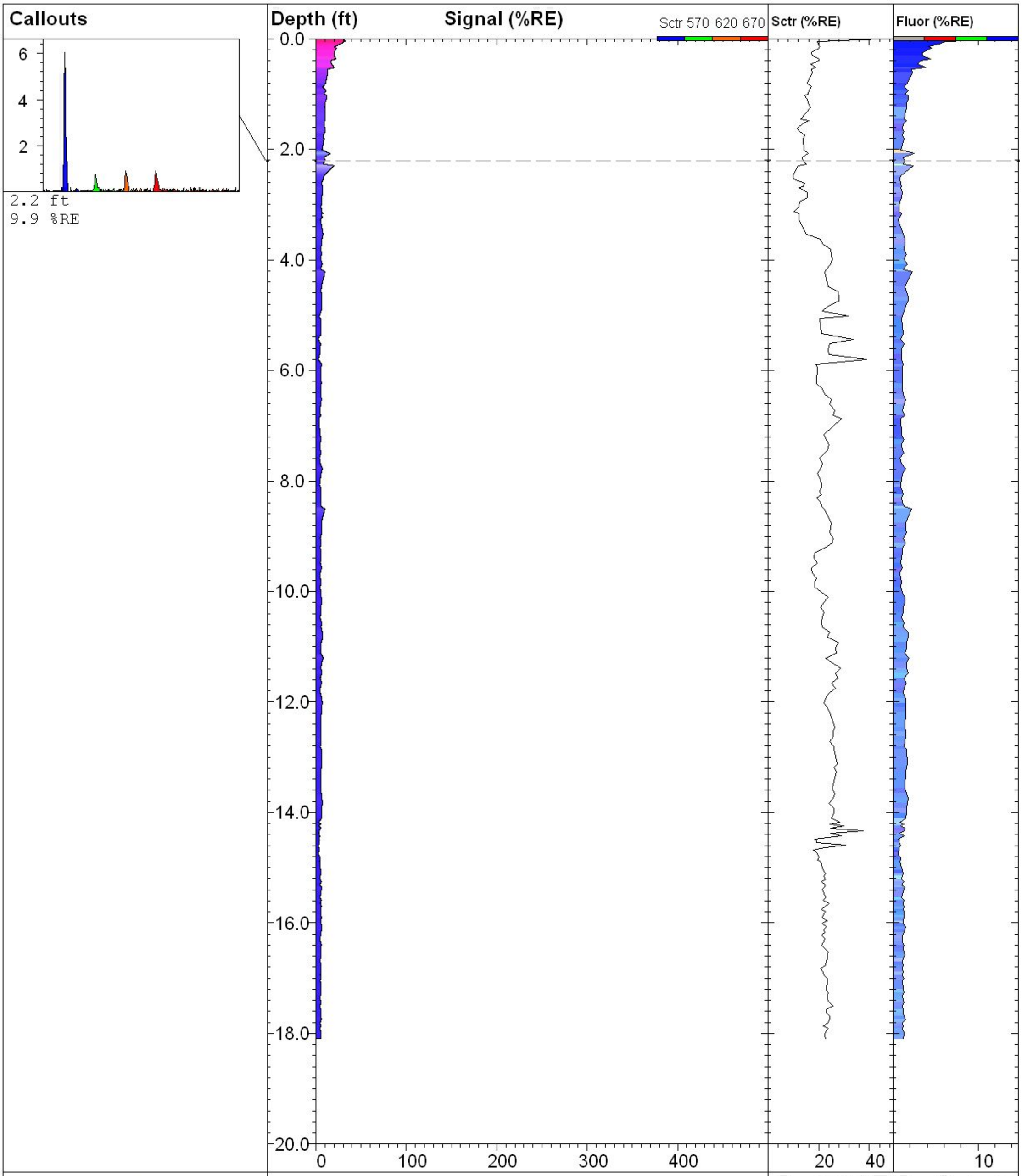


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T20

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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **17.93 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **27.5 %RE @ 12.81 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-28 12:07 EDT**

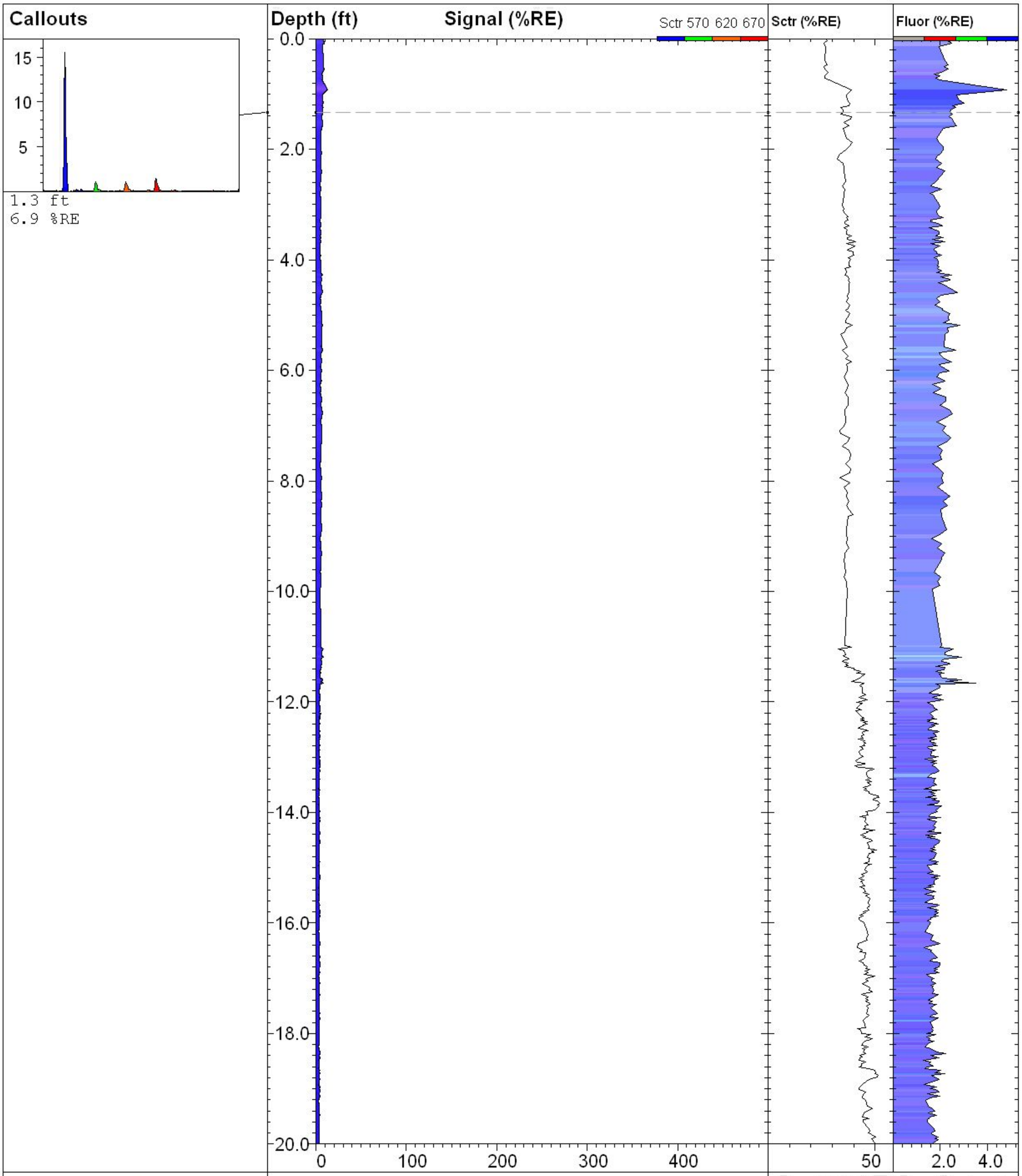


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T21

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **18.10 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **32.1 %RE @ 0.05 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-28 13:59 EDT**

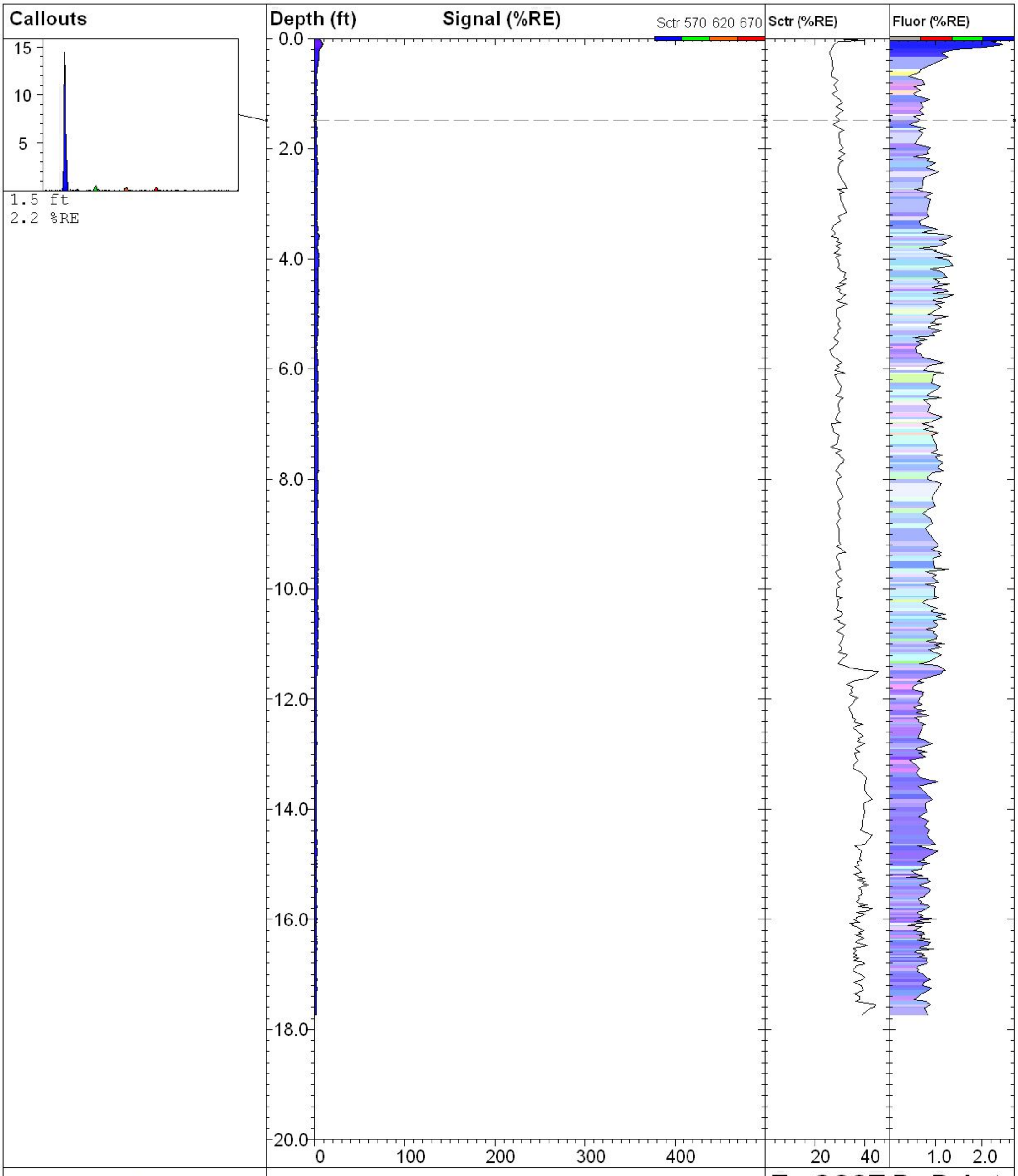


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TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **20.04 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **12.5 %RE @ 0.92 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-28 15:36 EDT**



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T23

TarGOST By Dakota
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Site: **Hudson River - Water Stre**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **17.73 ft**
Client / Job: **ARCADIS /**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **8.9 %RE @ 0.11 ft**
Operator / Unit: **T Olsonawski / TG1001**	*Elevation:* **Unavailable**	*Date & Time:* **2009-10-28 16:41 EDT**

ARCADIS

Appendix C

OSI Geophysical Surveys

MARINE AND FRESHWATER
SURVEY SERVICES

1 June 2002

OCEAN SURVEYS, INC.

91 SHEFFIELD STREET
OLD SAYBROOK, CT 06475

TEL. (860) 388-4631 FAX (860) 388-5879
www.oceansurveys. com

Mr. Bill Lilley
Blasland, Bouck, & Lee, Inc.
6723 Towpath Road
Syracuse, NY 13214-0066

Dear Bill:

On 26 April 2002, Ocean Surveys Inc. (OSI) conducted a marine geophysical survey along a section of the Hudson River located offshore of the town of Hudson, NY (Figure 1). This survey was conducted for Blasland, Bouck & Lee, Inc. (BBL) in support of their Hudson River year 2002 Field Investigation Program. The purpose of the survey was to provide insight into the river bottom and subsurface conditions to assist BBL in assessing the downstream transport potential of sediments from the site.

Summary of the Field Investigation

The main objective of this survey was to acquire hydrographic and subbottom profiler data along a section of the river at 100 foot intervals, from shore out approximately 300 feet. The data were then used to generate cross sectional profiles. Additionally, the field survey crew was asked to complete a series of shore-parallel tracklines in an attempt to locate and identify a buried fiber optic cable known to cross the river in this area.

Surveys operations were conducted from OSI's 26-foot "Parker" survey vessel, with an enclosed cabin and powered by twin Yamaha 150 horsepower outboard engines. The survey vessel was equipped with an array of geophysical survey and support equipment. A summary of the primary equipment installed on the vessel and employed to complete the investigation, and its function, is presented in the following table.

Equipment	Function
Trimble 4000 Differential Global Positioning System (DGPS) and Beacon Receiver interfaced with OSI's PC-based navigation software package "Maretrack II"	Satellite positioning system which tracks up to eight satellites at a time, and applies position correction factors relayed to it via radio link from the nearest DGPS US Coast Guard Beacon to provide reliable, precision (+/- 3 feet) positioning. The system outputs position fixes at a rate of 1 per second to an onboard navigation and data-logging computer which allows the survey vessel helmsman to accurately navigate the vessel along pre-selected survey tracklines throughout the area being investigated.
Innerspace Model 448 Digital Depth Sounder	Microprocessor controlled, high resolution, survey-grade depth sounder that operates at a frequency of 200 kHz, providing precise water depth measurements in both digital and graphic formats.

Equipment	Function
EdgeTech GeoStar full spectrum "Chirp" Subbottom Profiling System	High-resolution subsurface profiler that uses wide band Frequency Modulation (FM) acoustic pulses in the range of 2-16 kHz to detect and measure the depth to reflecting discontinuities in the near subsurface, which if conditions are favorable relate directly to changes in sediment characteristics and sediment thickness

Attachment A provides a detailed description of the equipment used during surveying and the methods used in processing and interpreting the data acquired. Specification sheets for the survey equipment are included in Attachment B.

The horizontal reference used for this project is the New York State Plane Coordinate System, East Zone (3101), NAD 83, in feet. The vertical reference datum is NAVD 88. A temporary tidal bench mark was designated as the top of a tide staff that was already installed at the boat ramp adjacent to the site. BBL later established the elevation of the temporary bench mark. The OSI field team took several tide staff readings throughout the course of the survey in order to measure the tidal range and water levels for referencing the depth sounding data to the datum.

Survey investigations were performed along seventeen parallel tracklines spaced 100 feet apart, and oriented perpendicular to the course of the river centered on Embayment #1 (Line #8). The tracklines were run as close to shore as was safely possible. Several obstacles prevented the survey vessel from accessing water shallower than approximately 12 feet. Many submerged pilings line the shoreline in the vicinity of the three embayments, and floating docks and boats were present at the marina located along the northern half of the survey area. Survey lines extended more than 500 feet from shore. Hydrographic data were acquired concurrently with subbottom profile data along each trackline. Additional tracklines were completed parallel to shore (perpendicular to the main transects) to provide quality control and to attempt to locate a fiber optic cable buried within the site.

Data Discussion

Survey data have been processed and interpreted and are presented both in plan and profile. The plan view drawing includes 2 foot contours and the locations of the presented profiles. Hydrographic data provided insight into the topography of the riverbed. Water depths ranged from 8 to over 48 feet below NAVD 88 in the site. In general the riverbed slopes steeply offshore to approximately -38 feet NAVD 88, then generally flattens out into the shipping channel. The channel side slope is typically less than 15%, however in some areas slopes as much as 30% were measured. The riverbed appeared to be smooth with only a few isolated objects of unknown origin extending less than 5 feet above the bottom.

The Chirp subbottom profiler data provided some insight into the subsurface stratigraphy of the area. Cross-sectional profiles, showing both the riverbed profile and subbottom reflectors, are presented in Attachment C. Although the contracted survey area extended only 300 feet from the shoreline, tracklines were extended 100 to 200 feet farther offshore to provide better correlation

of subbottom reflectors. On the profiles, strong subbottom reflectors are shown as solid lines and weak or discontinuous reflectors are shown as dashed lines. No subbottom reflectors suggestive of bedrock were identified within 30 feet of the riverbed in areas where acoustic signal penetration was achieved. It should be noted that some coarser material (medium-coarse sand, trace fine gravel) was reported in boring SD-51 at approximately –35 feet. Also, the fiber optic cable plan and profile drawing (Barrett, Bonacci, Hyman, and Van Weele, October 13, 1993; Sheet 2 of 2) indicates "rocks" were encountered during the cable installation (near Station 31+00, on the eastern edge of the channel).

In the shallow areas and channel slope areas no strong continuous or semi-continuous reflectors were identified. Some nearsurface features are illustrated in Figure 2 and mapped on the profiles in Attachment C. It is possible that these features represent varying thicknesses of material recently deposited on the riverbed. Borings collected nearshore and in the shallow embayments recovered primarily clay and silt in the upper 30 feet of the stratigraphic column. However, changes in acoustic properties of the subsurface materials produced changes in characteristics of the seismic returns in the upper 10 feet below the riverbed, and prevented acoustic signal penetration in several of those areas. Borings SD-47 and SD-51, located in Embayment #1, contained organics in the shallow subsurface. These organics may be responsible for reduced penetration of the seismic signal in the shallow water areas. Borings SD-8, SD-9 and SD-10, located on the channel slope, contained 8-13 feet of silty fine sand overlying silty clay. During installation of the Hudson-Athens cable bedrock was encountered at –50', approximately 10 feet below the bottom of the boring at SD-9 (personal communication, Bill Lilley).

In the deeper water area of the shipping channel several parallel, mostly flat-lying reflectors have been mapped from 10 to greater than 30 feet below the riverbed. The constructed river profile provided by BBL (based on the borings described above) indicates that varying thicknesses of fine sands, clayey silts, clay and silt may be present in the upper 30 feet below the channel. The relatively thin, parallel seismic reflectors at depth are typical of laminated clay units or interbedded sand, silt, and clay layers common throughout New England. Based on the acoustic characteristics of the reflectors identified in the channel area, some of the structures observed may represent minor changes in composition and/or compaction within these unconsolidated sediments identified in the boring.

Several shore-parallel tracklines were run in an attempt to identify a fiber optic cable known to exist within the survey site. The subbottom profiles revealed a few places where isolated surface features were identified (i.e. small depression, parabolic shaped reflection). However, these features were discontinuous in nature and their locations did not correlate with the expected alignment of the fiber optic cable. Surface and subsurface expressions of submarine cables can be evident on acoustic records as an erosional trench, parabolic reflection from the top of the cable, or bottom scar from the trenching operations if minimal time has passed since installation. Surface and subsurface conditions in the survey area may have prevented the subbottom profiler from detecting the cable. If the cable is buried in the very shallow subsurface (reported as 6 ft below the riverbed) it is possible that any acoustic return from the cable may be masked by the strong reflections from the riverbed interface.

Summary

OSI completed this remote sensing survey to document the riverbed topography and subsurface stratigraphy of an area along the east bank of the Hudson River at Hudson, New York. The survey results indicate that the upper 30 feet below the riverbed in most of the site is comprised primarily of various assemblages of clay, silty clay, silt and fine sand. In the shallow water areas reduced penetration of the seismic signal limited the ability of the subbottom profiler to resolve nearsurface stratigraphy. Direct sampling methods such as vibratory coring or jet probing may provide more detailed information about the nature of the nearsurface materials.

We appreciate the opportunity to work for BBL on this project. If you have any questions regarding any aspect of this survey or if we can be of service on other survey efforts, please do not hesitate to call us.

Sincerely,

OCEAN SURVEYS, INC.

Jeffrey D. Gardner

Jeffrey D. Gardner
Project Manager

JDG/lf
Enclosures

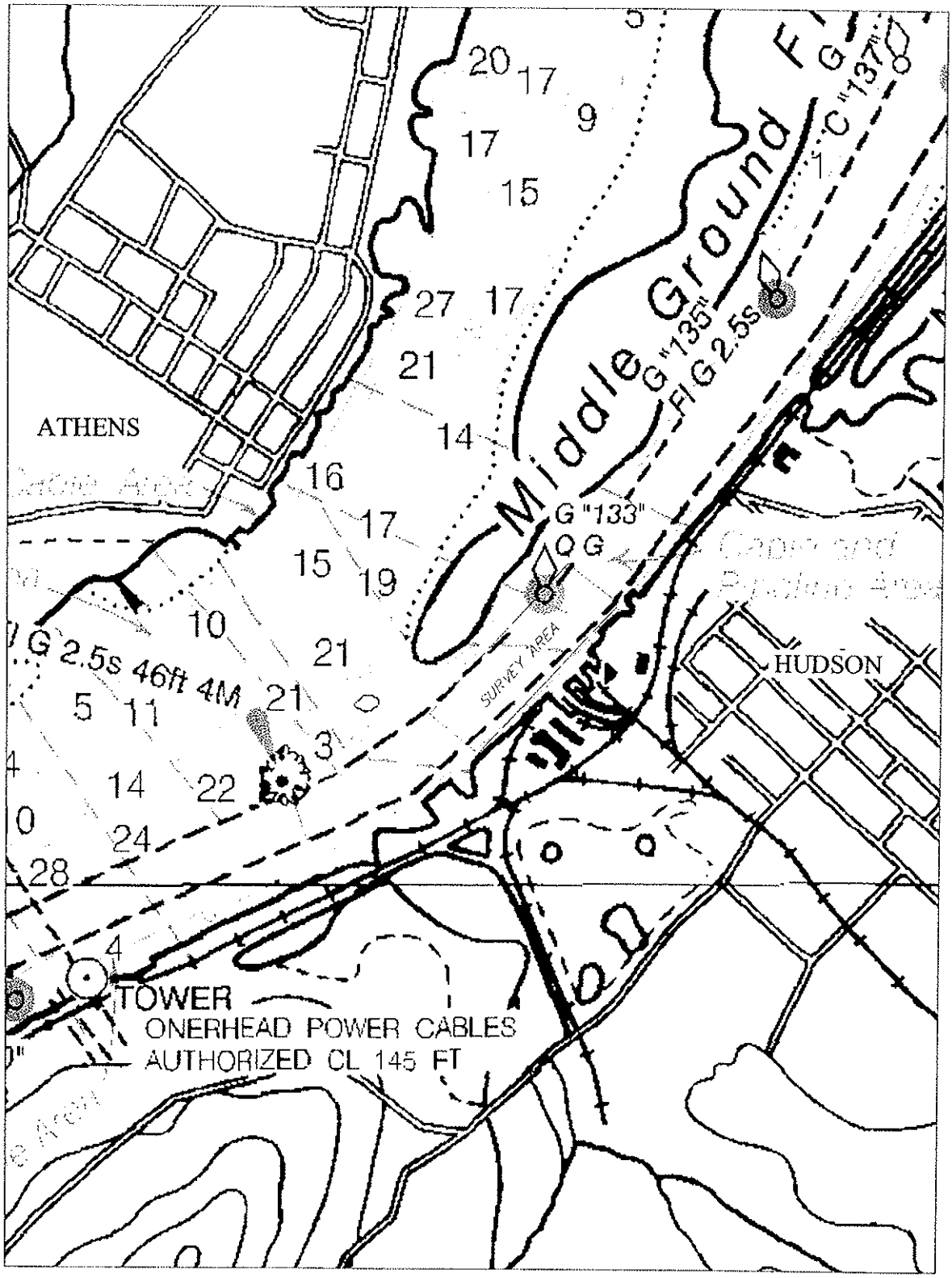


Figure 1. Location map of the survey area.

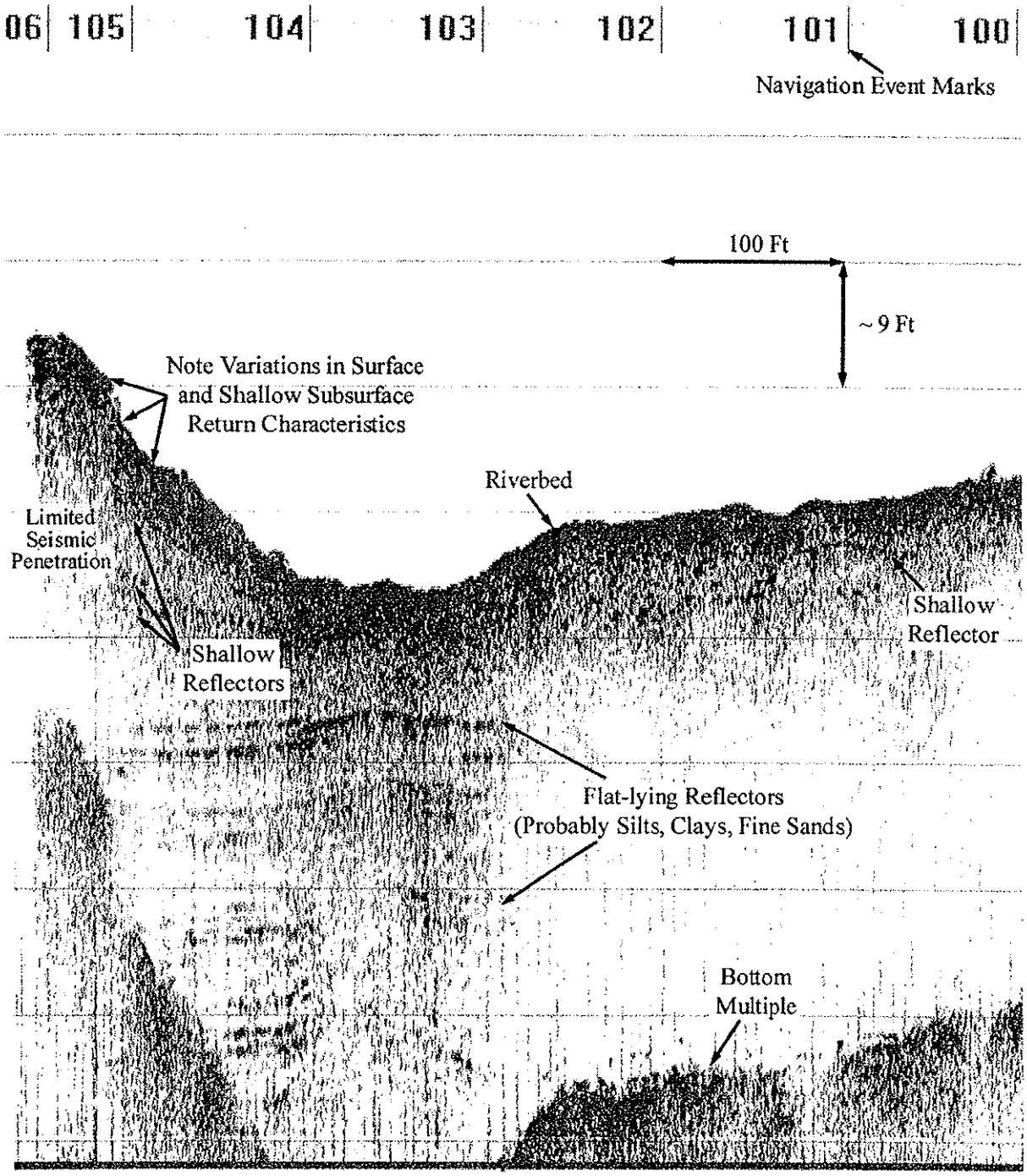


Figure 2. Reproduced Section of Chirp Subbottom Profiler record. (From transect Profile #12)

ATTACHMENT A

Equipment Operations and Procedures

SURVEY INSTRUMENTATION AND PROCEDURES

Navigation

OSI Maretrack Data Logging and Trackline Control System

Survey vessel trackline control and position fixing were obtained by utilizing an OSI computer-based data logging package running a modified version of Coastal Oceanographic's navigation software. Vessel position data from the Trimble 4000RS were updated at 1.0 second intervals and input to the navigation system which processes the geodetic position data into state plane coordinates and are used to guide the survey vessel accurately along preselected tracklines. The incoming data are logged on disk and processed in real time allowing the vessel position to be displayed on a video monitor and compared to each preplotted trackline as the survey progresses. Digitized shoreline and the locations of existing structures, buoys, and control points can also be displayed on the monitor in relation to the vessel position. The OSI computer logging system and navigation software thus provide an accurate visual representation of survey vessel location in real time, combined with highly efficient data logging capability and post-survey data processing and plotting routines.

Prior to commencement of the fieldwork, a trackline file was generated for use with the navigation software, which included the lines to be surveyed with the remote sensing systems. In addition, the shoreline was digitized from the NOAA charts and incorporated into the on-screen display.

Trimble Model 4000 RS/DS GPS Receiver/Trimble Beacon Receiver

The 4000 RS/DS (Reference/Differential Surveyor) GPS receiver interfaced with the Trimble Beacon Receiver provides a reliable, high-precision satellite positioning/navigation system for a wide variety of operations and environments. In operation, the beacon receiver continuously receives differential satellite correction factors via radio link from a DGPS Coast Guard Beacon. The 4000 RS/DS continuously tracks up to 8 satellites accepts the correction factors via the beacon receiver interface, and applies the corrections to obtain a high-accuracy real-time position fix. The 4000 RS/DS provides corrected position fixes at the rate of one fix per second.

A second interface port on the 4000 RS/DS enables the operator to record all position data, raw measurement data, and navigation data onto a personal computer and interface it with a navigation system (OSI Maretrack II software package).

Innerspace Model 448 Depth Sounder

Precision water depth measurements were obtained by employing an Innerspace Model 448 depth sounder with a 200 kHz, 8°-beam transducer. The Model 448 recorder provides precise, high-resolution depth records using a solid-state thermal printer as well as digital data output, that allows integration with the navigation software. The Model 448 also incorporates both tide and draft corrections plus a calibration capability for local water mass sound speed.

Sound speed calibrations were accomplished by performing "bar checks". The bar check procedure consists of lowering an acoustic target on a measured sounding line to the specified project depth. The speed of sound control is adjusted such that the target reflection is printed precisely at this known depth on the recorder. The acoustic target is then raised to successively shallower depths and calibration readings at these depths are recorded. Variations that exist in the indicated depth at these calibration points are incorporated in the sounding data processing to produce maximum accuracy in the resulting depth measurements. Bar checks were performed at the beginning and end of each field day to check the sound speed calibration.

Subbottom Profiling (Seismic Reflection Systems)

Subbottom profiling was accomplished utilizing an EdgeTech Geo-Star Subbottom "Chirp" Profiling system. The Chirp profiling system (lower power, but higher resolution system) was used in the shallow water areas. In operation, both of these systems generate an acoustic pulse in the water column but differ in their operational frequencies, repetition rate, and power settings. Once generated, the acoustic signal propagates downward to the seabed where it is partially reflected at the water-sediment interface. The balance of the signal continues downward and encounters interfaces between materials of differing acoustic properties with successive partial reflections/transmissions of the acoustic energy occurring at each interface. The "interface" to which acoustic signals react is defined primarily by the cross-product of the bulk density and the compressional wave velocity of each material; a quantity called the acoustic impedance. As a first approximation, the percentage of an acoustic signal, which is reflected from an interface, is directly proportional to the change in acoustic impedance across that interface.

The reflected signal consists of a continuous sequence of reflected energy, which has a series of "peaks" correlative in intensity with the magnitude of the change in acoustic impedance of the materials on either side of the interface. The timing of these peaks is also directly proportional to the depth of the interface, (e.g., a reflector at 2t (time) is at 2d (depth)).

During data acquisition, records generated by the profiling system were displayed on thermal paper recorder. During the survey, records were annotated with relevant supporting information, field observations, line number, run number, navigation event marks and numbers for later interpretation and correlation with vessel position data.

DATA PROCESSING AND ANALYSIS

Survey Trackline Reconstruction

Survey tracklines were reconstructed and computer plotted from the x-y coordinates logged at each "fix" point. The trackline plots were then used in the subsequent tasks of data interpretation and construction of the plan view hydrographic contour presentation.

Hydrographic Data

Digitally recorded depth data were first checked against the sounding strip charts for verification of depth quality. Recorded raw depth data were adjusted for the draft of the transducer and changes in water mass sound speed as determined from the bar check information. The depth data were then referenced to North American Vertical Datum of 1988 (NAVD88) based on tide gauge readings taken from an established tide gauge on site.

Contouring of the data set was accomplished using the computer software package "QuickSurf" V. 5.2 (Schreiber Instruments, Inc. (1996). QuickSurf is a general purpose surface modeling system that operates totally within AutoCAD. QuickSurf imports processed survey data points (X,Y,Z) into an AutoCAD drawing and generates surface models from these data. A suite of sophisticated tools allows the user to manipulate modeled surfaces into high-quality finished maps and perform a variety of engineering computations.

Subbottom Profile Data

The geophysical data presented in cross-sectional view were constructed by interpreting data derived from sounding and subbottom profiler records. Prominent acoustical reflectors observed on the seismic records were transferred to the sounding profiles and used to interpret depth to sediment-sediment/sediment-rock interfaces throughout the investigated site. Since the vertical axis of the seismic records is signal travel time and not material thickness, a conversion from time to thickness was performed. The range of sound speeds encountered in unconsolidated marine sediments varies from nominally 5-10 percent below to more than 50 percent above the speed of sound in water (4,800ft/sec.). In areas where cemented and/or consolidated materials are encountered, the speed of sound may exceed twice the speed of sound in water. As these variations in speed of sound translate directly to variations in the computed thickness for the material, the importance of establishing an accurate velocity value for subbottom material becomes apparent. Estimated depths to subbottom reflectors were determined assuming a conservative constant propagation velocity of 4,800 ft/sec. Considering all factors contributing to depth estimates, such as local sediment/velocity variation, ambient noise levels and propagation path effects, the accuracy of the depth estimates presented in this study are anticipated to be approximately +/- 10% of the mapped depths below the seafloor.

ATTACHMENT B

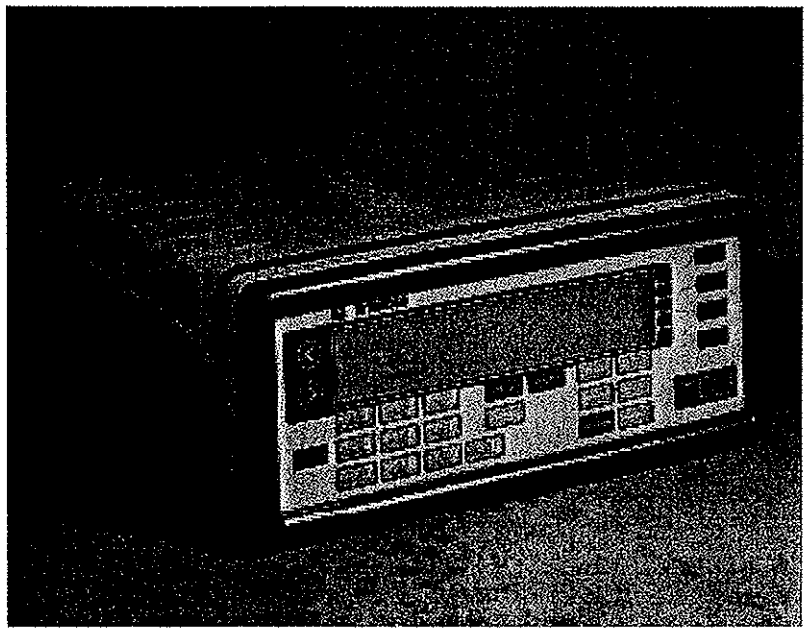
Equipment Specification Sheets

4000RSi & 4000DSi

DGPS Reference Surveyor and Differential Surveyor

Key features and benefits

- **Sub 0.5 meter accuracy**
- **Real time QA/QC**
- **Everest Multipath Rejection Technology**
- **Super-trak Signal Processing Technology**



The 4000RSi™ Reference Surveyor receiver and 4000DSi™ Differential Surveyor receiver incorporate the latest in GPS technology, offering true, real-time positioning accuracy better than 0.5 meter. Based on Trimble's advanced Maxwell processing technology, these DGPS receivers provide the highest level of accuracy even when operating in the most challenging conditions.

The 4000RSi receiver operates as an autonomous reference station, generating DGPS corrections in the RTCM SC-104 standard format for transmission to mobile GPS receivers.

The 4000DSi receiver is designed to use DGPS corrections in the RTCM SC-104 standard format broadcast by the 4000RSi receiver. The 4000DSi's standard NMEA-0183 messages, navigation firmware, data, and 1PPS outputs allow for optimal flexibility for system integration and interfacing with other instruments.

The signal processing of the two receivers incorporates Trimble's Super-trak™ technology. This technology enhances low power satellite signal acquisition, improves signal tracking capabilities under less than ideal conditions and provides increased immunity to signal jamming from radio frequency interference (RFI). These improvements are derived from integrating complex RF circuitry onto a single chip and by using state-of-the-art Surface Acoustic Wave filter technology.

Super-trak technology increases productivity and facilitates continual operations in demanding environments, such as ports, harbors, along riverbanks and near RFI sources that would normally interfere with satellite signals.

The 4000RSi and 4000DSi receivers also incorporate Trimble's latest advance in multipath rejection through enhanced signal processing: the patented EVEREST™ Multipath Rejection Technology. This technology eliminates multipath error before the receiver calculates GPS measurements. When combined with Trimble's advanced carrier-aided filtering and smoothing techniques applied to exceptionally low noise C/A code measurements, the result is real-time positioning accuracy on the order of a few decimeters.

The two receivers are ideal for hydrographic and navigation systems, vessel tracking, dynamic positioning systems, dredging, and other dynamic positioning and navigation applications. Both receivers feature nine channels of continuous satellite tracking (12 channels optional); a lightweight, rugged, weatherproof housing; and low power consumption for extending the field operation time from batteries.

During operation, both receivers can output binary and ASCII data for archiving or post-mission analysis. In addition, the 4000RSi receiver can operate as a mobile receiver with the same features, functionality and options as the 4000DSi receiver. For optimum DGPS performance, combine the receivers with any of Trimble's data communication systems and QA/QC firmware to ensure the integrity of positioning accuracy.

Trimble

4000RSi & 4000DSi

DGPS Reference Surveyor and Differential Surveyor

4000 RSi FEATURES

- RTCM Input
- RTCM Output; filtered and carrier-smoothed RTCM differential corrections (version 1.0 and 2.X) (4000RSi)
- EVEREST Multipath Rejection Technology
- Super-trak Signal Processing Technology
- Better than 0.5 meter DGPS accuracy using 4000RSi receiver corrections
- 0.5 second measurement rate
- Weighted-least squares solution
- Autonomous operation - automatic mode restoration after power-cycle
- Data integrity provision
- 2 RS-232 I/O ports with flow control for data recording and data link (4 RS-232/422 on rack mount)
- Triple DC input
- Low power; lightweight; portable; environmentally protected
- 1 PPS output; NMEA-0183 outputs
- L1 geodetic antenna; 30m antenna cable (4000RSi)
- Compact Dome antenna; 30m antenna cable (4000Dsi)
- 1-year warranty
- Firmware upgrades via serial port

OPTIONS AND ACCESSORIES

- Firmware update service - 1 and 4 year
- Extended hardware warranty
- L1 Carrier Phase
- 12 L1 channels
- L1/L2 Carrier Phase (rackmount)
- 12 L1/L2 channels (rackmount)
- Internal Memory for datalogging
- Event Marker input (requires memory option)
- QA/QC feature
- Rackmount Version
- 4 serial I/O ports (standard on rackmount)
- L1 and L1/L2 Geodetic antennas
- 30m antenna cable extension, with in-line amplifier
- Office Support Module: OSM II (CE Marked)
- Receiver transport case
- TRIMTALK™ Series radio links
- ProBeacon™ MSK receiver
- LEMO to dual BNC sockets adapter

PHYSICAL CHARACTERISTICS

Receiver

Size	9.8" W x 11.0" D x 4.0" H (portable) (24.8cm X 28.0cm x 10.2cm) 16.8" W x 16.0" D x 5.25" H (rackmount) (42.7cm x 40.6cm x 13.3cm)
Weight	6 lbs (2.7kg) (portable), 15 lbs. (6.8kg) (rackmount) 0.5 lbs (0.2kg) compact dome antenna 5.7 lbs (2.6kg) L1 geodetic antenna
Power	Nominal 10.5-35 VDC, 7 Watts (portable) 100, 120, 220, 240 VAC, 40 Watts (rack mount) DC: 10-36 Volts, 30 Watts
Operating temperature	-20°C to +55°C (portable), 0°C to +50°C (rack mount)
Storage temperature	-30°C to +75°C (portable) -20°C to +60°C (rack mount)
Humidity	100%, fully sealed, buoyant (portable) 95%, non-condensing (rack mount)

Geodetic Antenna

Size	16" D x 3.5" H
Weight	5.7 lbs.
Operating temperature	-40°C to +65°C
Storage temperature	-55°C to +75°C
Humidity	100%, fully sealed

Interface

Keyboard	Alphanumeric, function and softkey entry
Display	Backlit LCD, four lines of forty alphanumeric characters; Large, easy-to-read– 2.8mm x 4.9mm; Viewing area: 32 cm²; adjustable backlight and viewing angle
Serial Ports	Port 1 and 3: up to 57600 bps, software flow control Port 2 and 4: up to 57600 bps, hardware/software flow control RS-232 / RS-422 user configurable (rack mount)
Data recording	RTCM and GPS data available via serial port
Remote control	Trimble Data Collector Interface
Antenna	External, LEMO socket connector (portable), N-Type Socket connector (rack mount)
RTCM Messages	Types 1, 2, 3, 6, 9, 16; Version 1.0 and 2.X
1 PPS	LEMO 7-pin, adapter to BNC available (portable) BNC socket (rack mount)
Event Marker	LEMO 7-pin, adapter to BNC available (portable) BNC socket (rack mount)
NMEA-0183	ALM, BWC, GGA, GLL, GRS, GSA, GST, GSV, RMB, RMC, VTG, WPL, ZDA

PERFORMANCE CHARACTERISTICS

Signal Processing	Multibit Super-trak technology; Maxwell architecture with EVEREST Multipath Rejection Technology; very low noise C/A code processing
Tracking (Standard)	9 channels L1 C/A code and carrier
(Optional)	12 L1, 12 L1 + 12 L2; C/A, P and/or cross-correlation code and carrier (rack mount)
Startup time	< 2 minutes after cold start
Measurement rate	0.5 second per independent measurement
Accuracy	Typically better than 0.5 m RMS: assumes at least 5 satellites, PDOP less than 4, and using 4000RSi corrections.
RTCM Corrections	4000RSi corrections can be applied to all differential-equipped RTCM compatible GPS receivers.

ORDERING INFORMATION

4000RSi Reference Surveyor	P/N 29443-75
4000RSi Reference Surveyor pair	P/N 29561-00
4000DSi Differential Surveyor	P/N 29443-70
4000RSi Reference Surveyor Rackmount	P/N 26541-80

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Trimble
THE GPS SOLUTION

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Trimble Navigation
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Singapore 079906
SINGAPORE
+65-325-5668
+65-225-9989 Fax

OCEAN SURVEYS, INC.

MARETRACK-MAREPLOT II

The OSI Maretrack/Mareplot system is the result of more than a decade of integrated software/hardware evolution and development. Initially starting as a programmable calculator-based system, capability has been progressively increased with greatly expanded task abilities, processing speed, expanded display of real-time data, simultaneous multi-terminal output, redundant real-time data logging and most recently a full stand-alone remote site data processing ability.

The present version of the OSI Maretrack/Mareplot II survey vessel navigation, trackline control, data logging and post-processing system operates on high speed AT and 80386-based portable micro-computers. The OSI Maretrack® system accepts position data input from an extensive range of instrumentation including:

Racal "Micro-Fix" Falcon
Motorola "IV"
Del Norte "540"
Cubic "Autotape"
Navitrack "Rho-Theta"
Krup Atlas "Polarfix"
IMC "Hydro I"
Northstar 800 Loran-C
Trimble 4000 GPS
Magnavox 1101& 4200 GPS

and offers the following real-time outputs:

Numerical Outputs

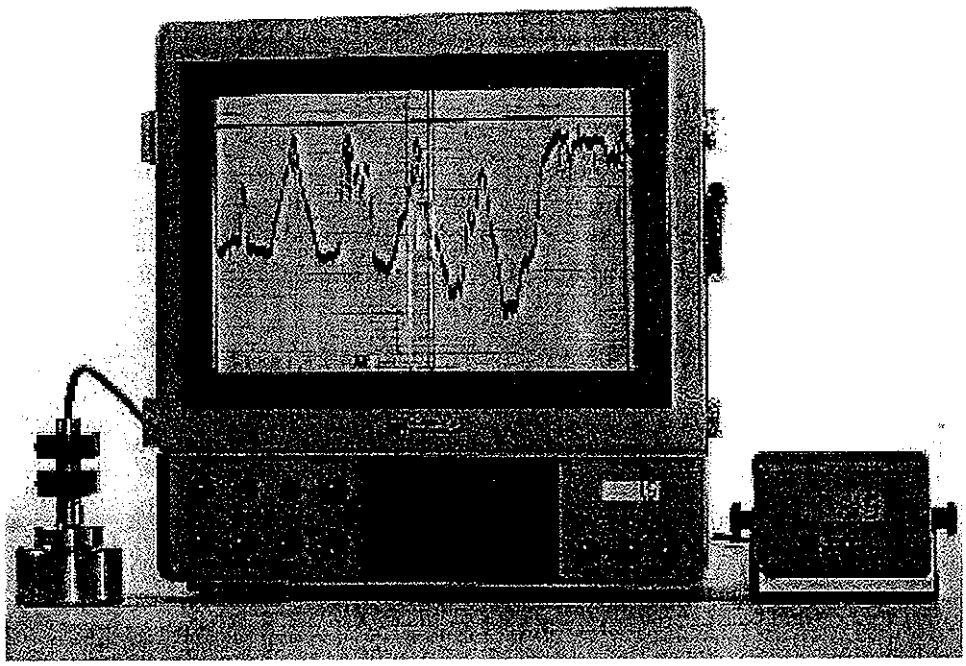
Line number and azimuth/heading
Distance to go start/end of line
Depth, Fix No., Vessel Speed, Time
Range data (R1, R2, R3, R4,...R8)
Data Acquisition Status (on/off)

Graphical Outputs

- Labelled tracklines with fixes and vessel location
- Vessel icon shown on selectable scale left/right "off-line" bar display
- Grid North Arrow

Post processing capability include full data analysis and editing through generation of both profile and "boat" or "smooth" sheet presentations at any desired scale, complete drawing labelling including graphic scales and title blocks, project location and survey site inset and generation of ASCII or DFX format (AutoCad) 5¼" or 3½" IBM diskettes.

INNERSPACE TECHNOLOGIES

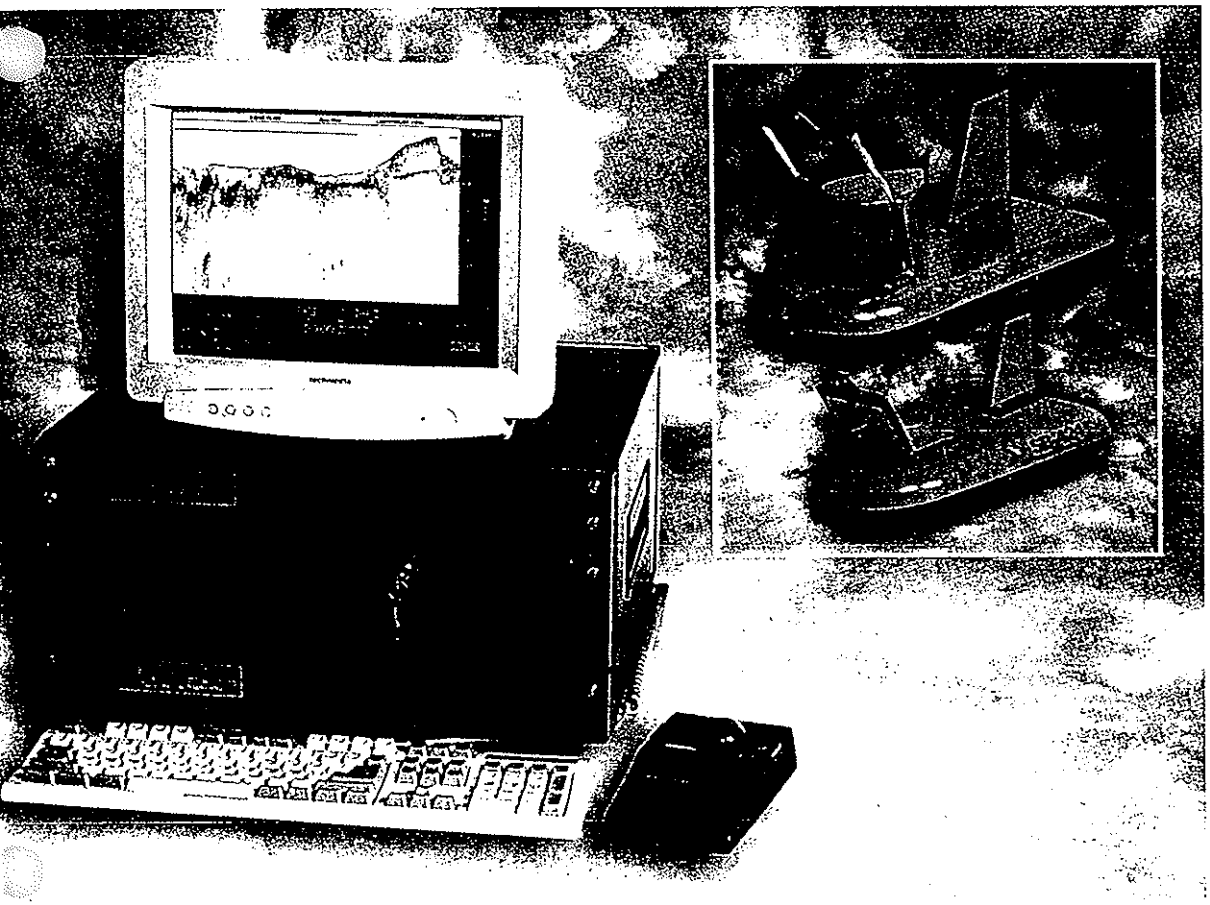


MODEL 448 THERMAL DEPTH SOUNDER RECORDER

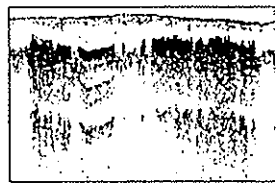
The 448 Thermal Depth Sounder Recorder provides survey precision, high resolution depth recordings using solid state thermal printing. The lightweight, portable unit is designed for use in small boat surveying as required for nautical chart production, engineering surveys, harbor and channel maintenance, pre and post dredge surveys, etc. The Model 448 TDSR uses a thermal printing technique pioneered by Innerspace for depth sounding which provides the high resolution and accuracy required by groups such as the U.S. Army Corps of Engineers, dredging companies, survey companies, port administrations, etc. The design allows easy integration into hydrographic data collection systems.

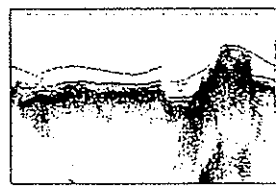
There are more 448's in service in the USA than any other precision depth sounder. It is widely used by private survey companies, the National Oceanic and Atmospheric Administration and the U.S. Army Corps of Engineers. In the Corps of Engineers alone, there are over fifty 448's in service at 18 district offices and a number of 449's as well.

GEO-STAR™
Full Spectrum™ Sub-Bottom Profiler











Portable, High Resolution Sub-Bottom Profiler Generates High Definition Images Of The Seabed

A portable, high resolution sub-bottom profiler, GEO-STAR is one in a series of Full Spectrum™ Sub-Bottom Profilers offered by EdgeTech. It is field-proven to deliver high resolution sub-bottom imaging performance for diverse applications that range from hazardous waste target location to archeological surveys.

In a typical operating mode, GEO-STAR transmits an FM pulse with special amplitude and phase weighting functions. Transmission is linearly swept over a frequency range of 4-24 kHz for 20 milliseconds. The acoustic return received at the hydrophone is digitized by a 16 bit A/D and then passed through a digital correlation filter. This improves the signal to noise ratio by approximately 20 dB and compresses the FM pulse, resulting in a high resolution image of sub-bottom stratigraphy. The processing gain over the background noise is approximately ten times the log of the time-bandwidth product.

To equal the typical performance of the GEO-STAR Full Spectrum™ Pulse, a conventional sub-bottom profiler would need to operate at a peak pulse power 100 times greater than the GEO-STAR.

GEO-STAR allows the user to select 2 overlapping frequency bands within the total bandwidth of the tow vehicle. The sonar display shows two sub-bottom images, one for each of the selected bands. EdgeTech proprietary technology allows for these overlapping frequency bands, and enables the user to observe sediment structure of the sub-bottom in different frequency bands.

Features

- Economical sub-bottom profiling
- Resolve layers to 4 cm
- 20 dB improved SNR using swept FM pulse
- No spatial side-lobes
- Dual overlapping frequencies
- Digital Correlation Filter

Applications

- Bridge erosion surveys
- Scour/erosion surveys in rivers and streams
- Hazardous waste target location
- Dredging studies
- Geological surveys
- Buried pipeline and cable location
- Archeological surveys
- Beach renourishment

EdgeTech

ATTACHMENT C

Geologic Cross Sections

MIDDLE GROUND FLATS
(SPOIL ISLAND)

N

HUDSON RIVER

SHIPPING CHANNEL

17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

38 40 42 46 44 46 46 40 30 20 14 20 14 48

SD-10
SB-09
SD-08
SD-47
SD-51

SUBMERGED PILINGS
SUBMERGED PILINGS
SUBMERGED PILINGS

EMBAYMENT #1

FLOATING DOCK WITH VESSELS

MARINA DOCKS

SHIPPING CHANNEL

HUDSON,
NEW YORK

NOTES FOR PLAN AND PROFILES:

1. COORDINATES ARE IN FEET IN THE NEW YORK STATE PLANE COORDINATE SYSTEM, EASTERN ZONE, NAD 83.
2. DEPTHS ARE IN FEET AND ARE REFERENCED TO NAVD 88. CONTOUR INTERVAL IS 2 FEET. CONTOURS WERE COMPUTER GENERATED USING "QUICKSURF" VERSION 5.1 (SCHREIBER INSTRUMENTS, INC.), OPERATING WITHIN "AUTOCAD" VERSION 14 (AUTODESK).
3. SHORELINE AND ON SHORE FEATURES WERE TAKEN FROM DRAWING NO. 36613B08, DATED 29 MAY 2002, PROVIDED BY BLAISLAND, BOUCK & LEE, INC.
4. THE INFORMATION PRESENTED ON THIS CHART REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY OCEAN SURVEYS, INC. ON 26 MAY 2002 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IS WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO OSI.

LEGEND

1 —— —— —— PROFILE LOCATION

SD-47 BORING LOCATION

SCALE: 1"=150'

150 0 150

OCEAN SURVEYS, INC.
OLD SAYBROOK, CONNECTICUT
(860) 388-4631
www.oceansurveys.com

PREPARED FOR: BLASLAND, BOUCK & LEE, INC.

HYDROGRAPHY & PROFILE LOCATIONS
HUDSON RIVER
HUDSON, NEW YORK

MIDDLE GROUND FLATS
(SPOIL ISLAND)

N

HUDSON RIVER

SHIPPING CHANNEL

17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

38 40 42 44 46 48 20 30 14 18

SD-10
SD-09
SD-08
SD-47
SD-51

SUBMERGED PILINGS
SUBMERGED PILINGS
SUBMERGED PILINGS

EMBAYMENT #1

FLOATING DOCK WITH VESSELS

MARINA DOCKS

SHIPPING CHANNEL

HUDSON, NEW YORK

NOTES FOR PLAN AND PROFILES:

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4. THE INFORMATION PRESENTED ON THIS CHART REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY OCEAN SURVEYS, INC. ON 26 MAY 2002 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IS WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO OSI.

SCALE: 1"=150'

150 0 150

LEGEND

1 — — — — PROFILE LOCATION

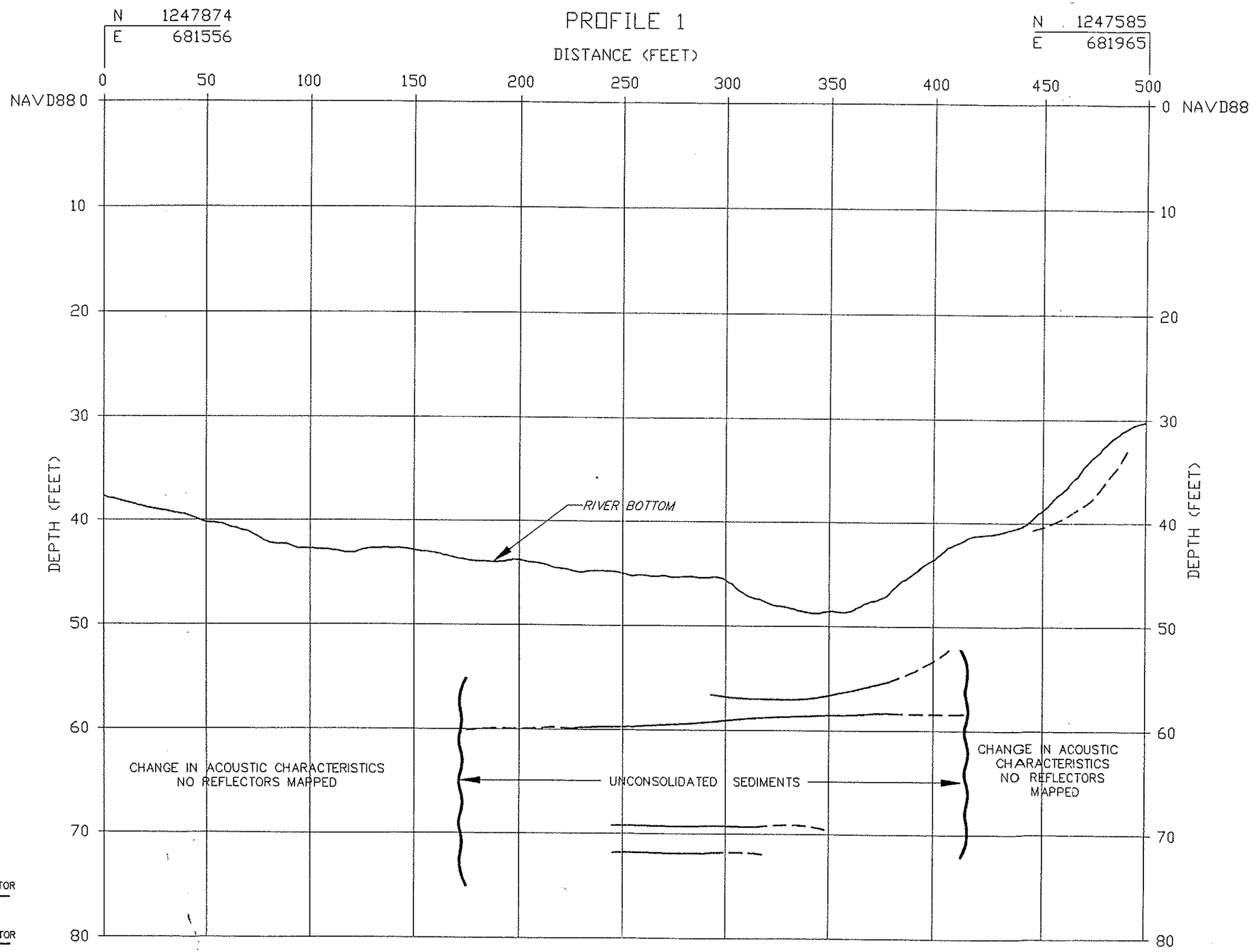
SD-47 BORING LOCATION

OCEAN SURVEYS, INC.
OLD SAYBROOK, CONNECTICUT
(860) 388-4631
www.oceansurveys.com

PREPARED FOR: BLASLAND, BOUCK & LEE, INC.

HYDROGRAPHY & PROFILE LOCATIONS
HUDSON RIVER
HUDSON, NEW YORK

PROFILE 1



LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 2

N 1247792
E 681499

N 1247503
E 681907

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED SEDIMENTS

CHANGE IN ACOUSTIC
CHARACTERISTICS
NO REFLECTORS
MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 3

N 1247710
E 681441

N 1247422
E 681849

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 5

N 1247547
E 681326

N 1247258
E 681734

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

DEPTH (FEET)

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 7

N 1247371
E 681226

N 1247083
E 681634

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

DEPTH (FEET) 40 — 40 DEPTH (FEET)

50 — 50

60 — 60

70 — 70

80 — 80

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED
SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 8

N 1247294
E 681164

N 1247006
E 681572

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 10 20 30 40 50 60 70 80

0 10 20 30 40 50 60 70 80 NAVD88

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED
SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 9

N 1247216
E 681100

N 1246927
E 681509

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED
SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 10

N 1247138
E 681037

N 1246850
E 681446

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 10 20 30 40 50 60 70 80

0 10 20 30 40 50 60 70 80 NAVD88

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 11

N 1247057
E 680980

N 1246768
E 681388

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED SEDIMENTS

CHANGE IN ACOUSTIC
CHARACTERISTICS
NO REFLECTORS
MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 12

N 1247019
E 680861

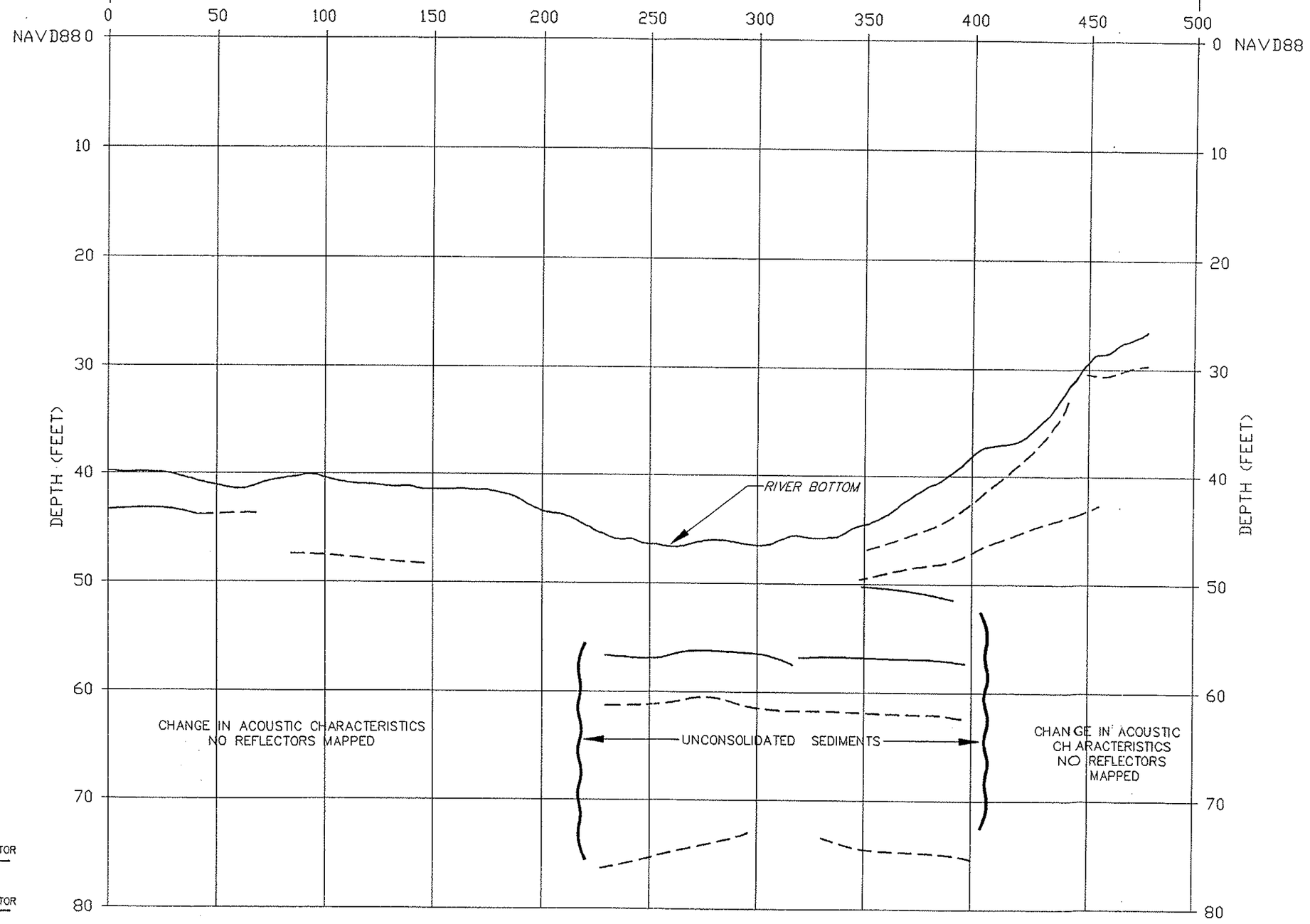
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E 681269

DISTANCE (FEET)

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NAVD88 0 10 20 30 40 50 60 70 80

DEPTH (FEET)



LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

PROFILE 13

N 1246946
E 680790

N 1246658
E 681198

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

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30 — 30

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED SEDIMENTS

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 14

N 1246876
E 680719

N 1246587
E 681127

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 15

N 1246794
E 680658

N 1246506
E 681066

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 16

N 1246717
E 680594

N 1246428
E 681002

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

DEPTH (FEET) — DEPTH (FEET)

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED
SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

PROFILE 17

N 1246638
E 680536

N 1246350
E 680944

DISTANCE (FEET)

0 50 100 150 200 250 300 350 400 450 500

NAVD88 0 — 0 NAVD88

10 — 10

20 — 20

30 — 30

40 — 40

50 — 50

60 — 60

70 — 70

80 — 80

DEPTH (FEET)

DEPTH (FEET)

RIVER BOTTOM

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

UNCONSOLIDATED SEDIMENTS

CHANGE IN ACOUSTIC CHARACTERISTICS
NO REFLECTORS MAPPED

LEGEND

STRONG SEMICONTINUOUS REFLECTOR

WEAK OR DISCONTINUOUS REFLECTOR

OSI

ARCADIS

Appendix D

Physical Characterization Testing Results

September 10, 1996

L-96005
Laboratory Testing
Niagara Mohawk
Hudson, New York
Project # 36468.002

NATURAL MOISTURE CONTENT ASTM D2216

Lab ID#	Sample I.D.	Depth (feet)	Moisture Content as a Percent of Dry Weight
9211	TB40	6.0 - 8.0	24.7
9212	MW-10	25.0 - 27.0	30.9
9213	SD4	0.0 - 0.5	33.0
9214	SD11	0.0 - 0.5	28.1
9215	SD5	0.0 - 0.5	26.5
9216	SD30	0.0 - 0.5	154.0
9217	SD16	0.0 - 0.5	22.4
9218	SD15	0.0 - 0.5	28.6
9219	SD22	4.0 - 6.0	32.5
9220	SD29	0.5 - 2.0	20.5
9221	SD30	6.0 - 8.0	63.9
9222	SD25	4.0 - 6.0	31.8

SIEVE ANALYSIS OF SOIL/AGGREGATE

PROJECT TITLE Laboratory Testing Niagara Mohawk Power Corporation
Hudson Water Street Project # 36468

PROJECT # L-96005
TEST METHOD ASTM D422 & D1140

REPORT # 1
REPORT DATE January 29, 1996

Lab ID#	Composite Sample I.D.	2"	1 1/2"	1"	3/4"	1/2"	3/8"	1/4"	#4	#10	#30	#40	#60	#100	#200			
8390	SD06A and SD06B				--	--	100	99.2	99.2	98.2	94.5	93.0	89.6	85.8	78.7			
8391	SD10A and SD04D				--	--	100	99.1	99.0	98.2	92.4	85.8	66.4	21.8	10.2			
8392	SD19B and SD09B				--	--	100	98.2	96.2	91.9	83.1	80.4	59.6	46.5	21.3			
8393	SD02B and SD09A				100	98.8	97.5	93.6	90.1	78.9	63.8	60.1	51.5	38.0	26.4			
8394	SD17A, SD03A, SD01A, SD13A, and SD15A				100	92.0	78.9	63.3	55.8	42.8	32.8	29.9	19.4	7.8	3.5			

Sample mass, as received, meets minimum requirements of test method: Yes ____ No X

Prewashed: Yes X No ____

Remarks: ____

Performed By DW

Checked By VJT

January 29, 1996

L-96005
Laboratory Testing
Niagara Mohawk Power Corporation
Hudson Water Street
Project # 36468

NATURAL MOISTURE CONTENT ASTM D2216

Lab ID#	Composite Sample I.D.	Moisture Content as a Percent of Dry Weight
8390	SD06A and SD06B	83.1
8391	SD10A and SD04D	25.1
8392	SD19B and SD09B	31.5
8393	SD02B and SD09A	33.0
8394	SD17A, SD03A, SD01A, SD13A, and SD15A	27.8

January 29, 1996

L-96005
Laboratory Testing
Niagara Mohawk Power Corporation
Hudson Water Street
Project # 36468

Atterberg Limits
ASTM D4318

Lab ID#	Sample	Plastic Limit	Liquid Limit	Plasticity Index
8390	SD06A and SD06B	37	52	15
8391	SD10A and SD04D	Non-Plastic	-	-
8392	SD19B and SD09B	Non-Plastic	-	-
8393	SD02B and SD09A	Non-Plastic	-	-
8394	SD17A, SD03A, SD01A, SD13A, and SD15A	Non-Plastic	-	-

Phase II Moisture Content, Atterberg Limits, and Grain Size Analyses

September 10, 1996

L-96005
Laboratory Testing
Niagara Mohawk
Hudson, New York
Project # 36468.002

ATTERBERG LIMITS
ASTM D4318

Lab ID#	Sample	Depth (feet)	Plastic Limit	Liquid Limit	Plasticity Index
9211	TB40	6.0 - 8.0	15	37	22
9212	MW-10	25.0 - 27.0	20	28	8
9215	SD5	0.0 - 0.5	Non-Plastic	--	--
9216	SD30	0.0 - 0.5	28	55	27
9217	SD16	0.0 - 0.5	Non-Plastic	--	--
9218	SD15	0.0 - 0.5	Non-Plastic	--	--
9219	SD22	4.0 - 6.0	Non-Plastic	--	--
9220	SD29	0.5 - 2.0	Non-Platic	--	--
9221	SD30	6.0 - 8.0	28	56	28
9222	SD25	4.0 - 6.0	Non-Plastic	--	--

SIEVE ANALYSIS OF SOIL/AGGREGATE

PROJECT TITLE Laboratory Testing - Niagara Mohawk, Hudson, New York - Project No. 36468.002

ROJECT # L-96005
'EST METHOD ASTM D422 & D1140

REPORT # 1
REPORT DATE September 10, 1996

Lab ID#	Location	Depth (feet)	1 1/2"	1"	3/4"	1/2"	3/8"	1/4"	#4	#10	#30	#40	#60	#100	#200		
9211	TB40	6.0 - 8.0	--	100	98.8	98.8	98.6	98.1	98.0	97.7	97.3	97.2	96.3	92.7	86.5		
9212	MW10	25.0 - 27.0	--	--	--	--	100	99.8	99.6	99.5	98.8	98.2	96.3	93.7	83.6		
9213	SD4	0.0 - 0.5	--	100	95.4	85.5	77.9	67.3	63.5	56.6	49.2	46.6	33.4	12.3	4.5		
9214	SD11	0.0 - 0.5	100	97.3	96.8	93.0	89.4	85.1	82.8	79.0	74.9	73.7	67.3	14.2	4.7		
9215	SD5	0.0 - 0.5	100	95.9	85.9	66.0	50.4	30.7	23.1	14.5	9.9	9.0	7.5	5.8	4.0		
9216	SD30	0.0 - 0.5	--	--	100	98.8	98.5	97.1	96.0	94.3	93.0	92.7	92.1	91.1	88.0		
9217	SD16	0.0 - 0.5	100	96.1	91.8	84.2	80.3	74.7	70.8	61.4	48.3	44.7	36.9	28.4	19.9		
9218	SD15	0.0 - 0.5	100	95.6	92.2	85.5	81.1	72.6	69.3	61.9	49.1	43.0	25.7	8.7	2.6		
9219	SD22	4.0 - 6.0	100	97.8	97.7	97.6	97.1	96.1	95.7	94.7	91.9	90.2	85.9	58.6	38.1		
9220	SD29	0.5 - 2.0	100	97.7	97.7	96.9	95.8	95.1	94.4	93.1	90.2	88.1	79.2	26.7	9.6		
9221	SD30	6.0 - 8.0	--	--	100	98.4	98.3	97.5	97.2	96.7	95.6	95.2	94.4	93.4	89.2		
9222	SD25	4.0 - 6.0	--	100	92.0	90.5	90.0	89.1	88.9	87.7	84.8	83.6	80.2	61.3	44.4		

Sample mass, as received, meets minimum requirements of test method: Yes ____ No X

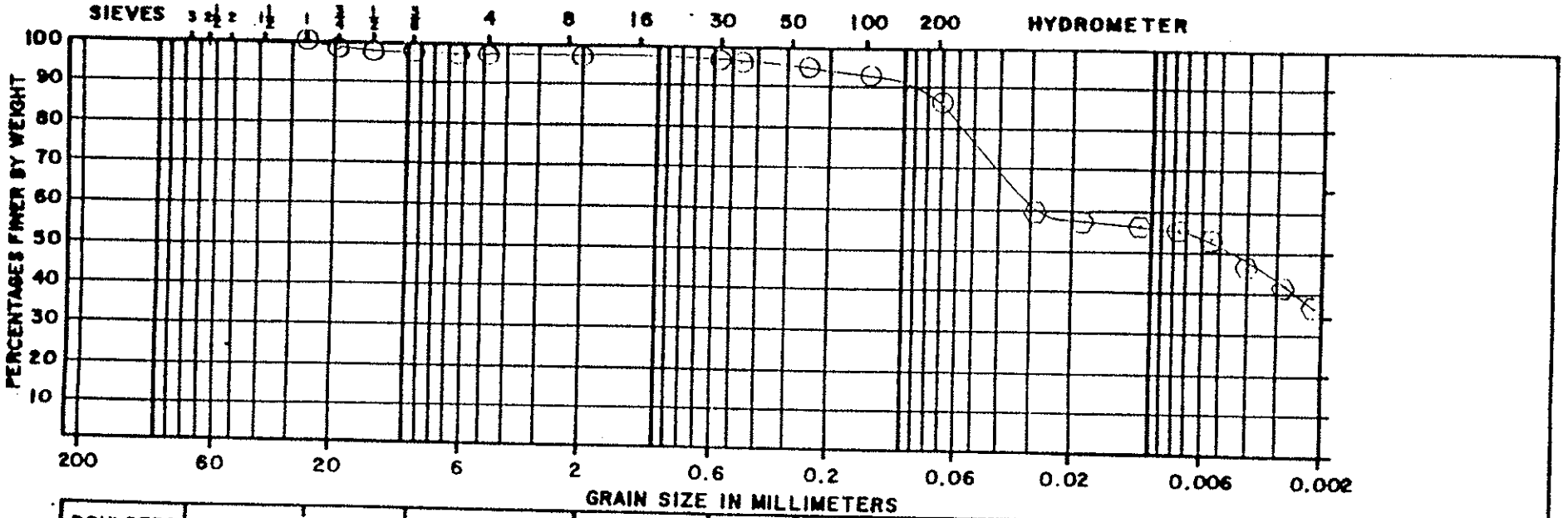
Prewashed: Yes X No ____

Remarks: ____

Performed By DEW, JLO, AM

Checked By VJT

GRAIN SIZE ANALYSIS



L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9211

Sample: TB40

Depth: 6.0'-8.0'

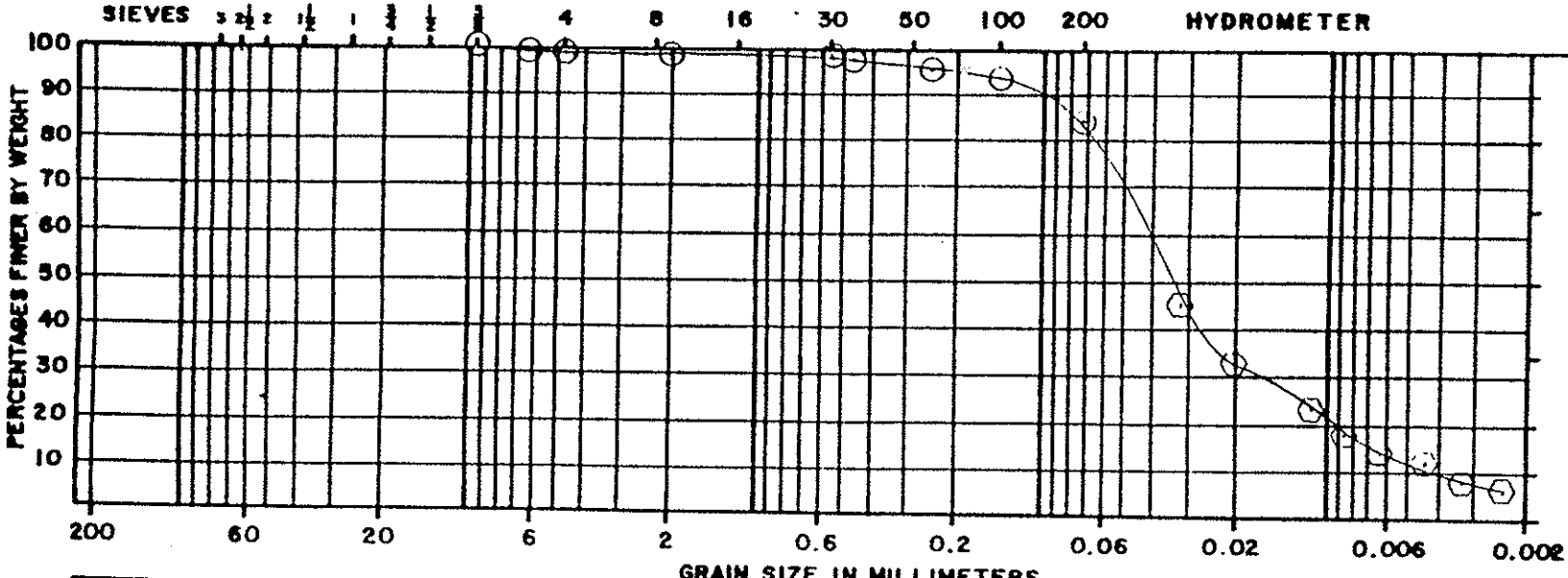
⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

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TELEPHONE AREA CODE 315 437 1429

JOB NO L-9600
REPORT NO. 1
September 10, 1

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL
228	76.2	25.4	9.52	2.0	0.59	0.25	0.074 MM. OPENING
9 in.	3 in.	1 in.	3/8 in.	Nos. 10	30	60	200 SIEVE

L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9212

Sample: MW10

Depth: 25.0' - 27.0'

⊙ Sieve Analysis ASTM D422 & D1140

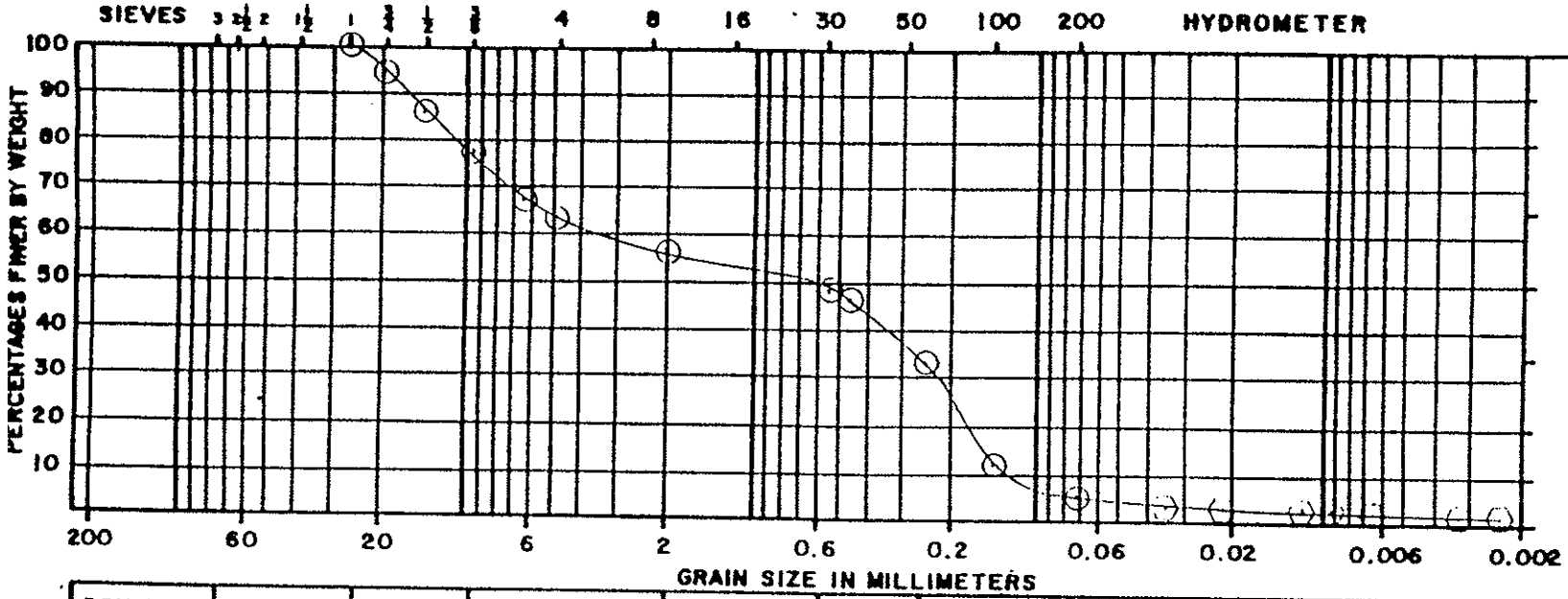
⊙ Hydrometer Analysis ASTM D422

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JOB NO L-96005
REPORT NO. 2

September 10, 199

GRAIN SIZE ANALYSIS



L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9213

Sample: SD4

Depth: 0.0' - 0.5'

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

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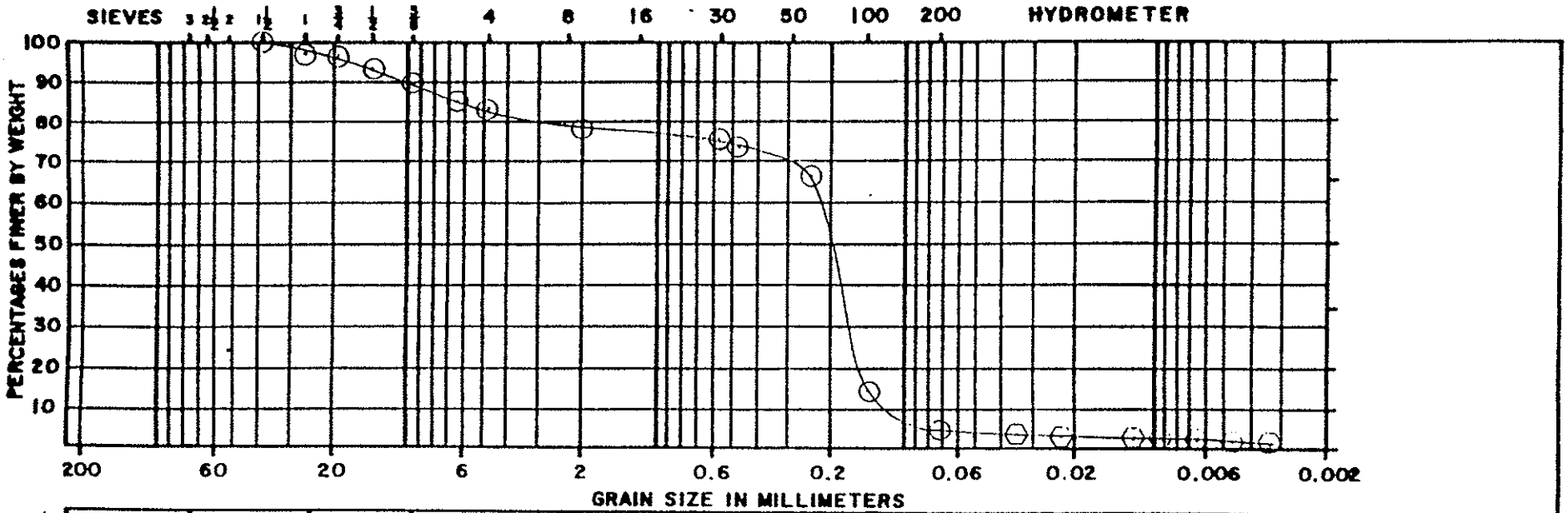
TELEPHONE AREA CODE 315/437 1429

JOB NO L-96005

REPORT NO 3

September 10, 1996

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT - CLAY SOIL
228	76.2	25.4	9.52	2.0	0.59	0.25	0.074 MM. OPENING
9 In.	3 In.	1 In.	3/8 In.	Nos. 10	30	60	200 SIEVE

L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9214

Sample: SD11

Depth: 0.0' - 0.5'

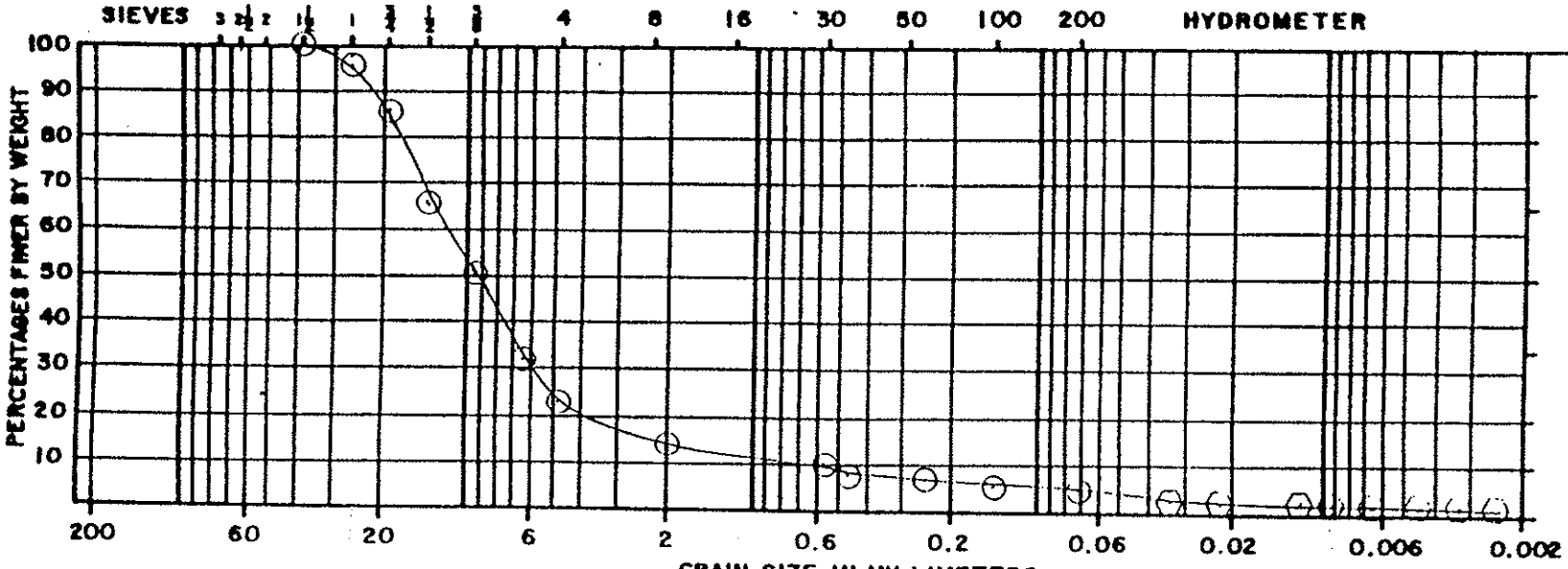
⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

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TELEPHONE AREA CODE 315 437 1429

JOB NO L-96005
REPORT NO 4
September 10, 1996

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT - CLAY SOIL
228	76.2	25.4	9.52	2.0	0.59	0.25	0.074 MM. OPENING
9 in.	3 in.	1 in.	3/8 in.	Nos. 10	30	60	200 SIEVE

L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9215

Sample: SD5

Depth: 0.0' - 0.5'

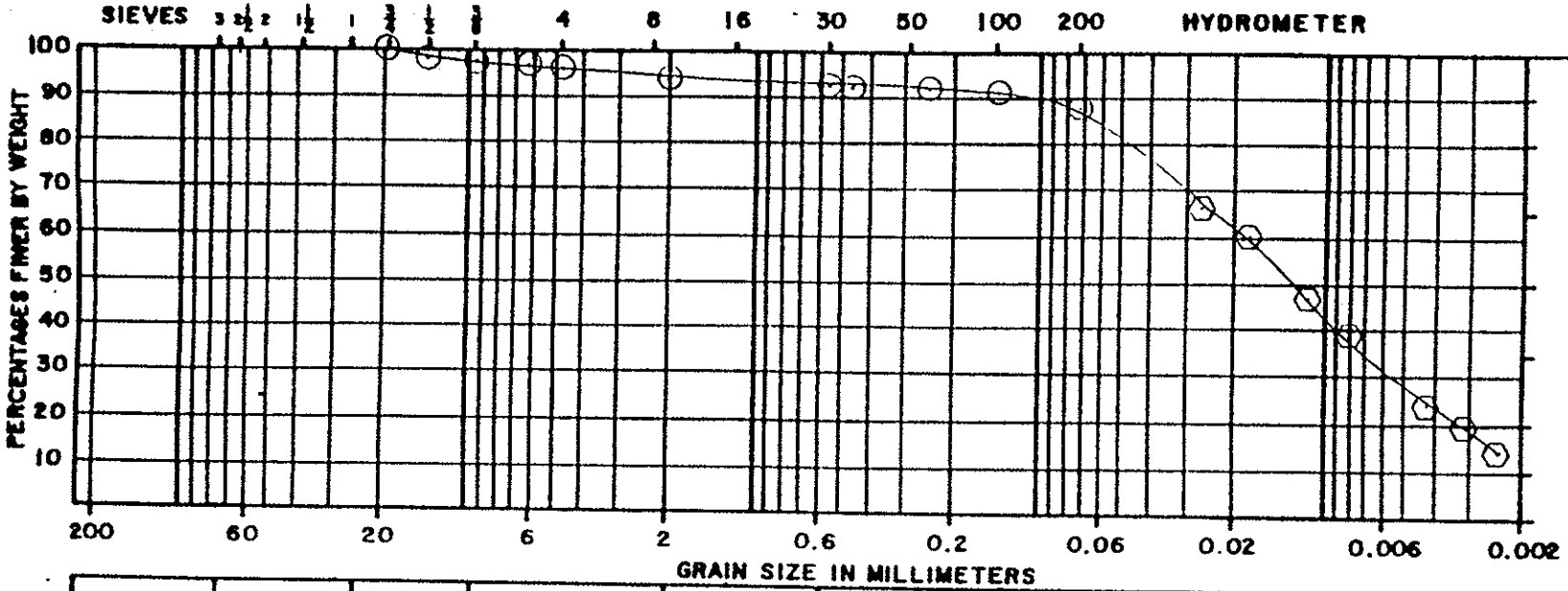
⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

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JOB NO L-96005
REPORT NO 5
September 10, 199

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT - CLAY SOIL
228	76.2	25.4	9.52	2.0	0.59	0.25	0.074 MM. OPENING
9 In.	3 In.	1 In.	3/8 In.	Nos. 10	30	60	200 SIEVE

L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9216

Sample: SD30

Depth: 0.0' - 0.5'

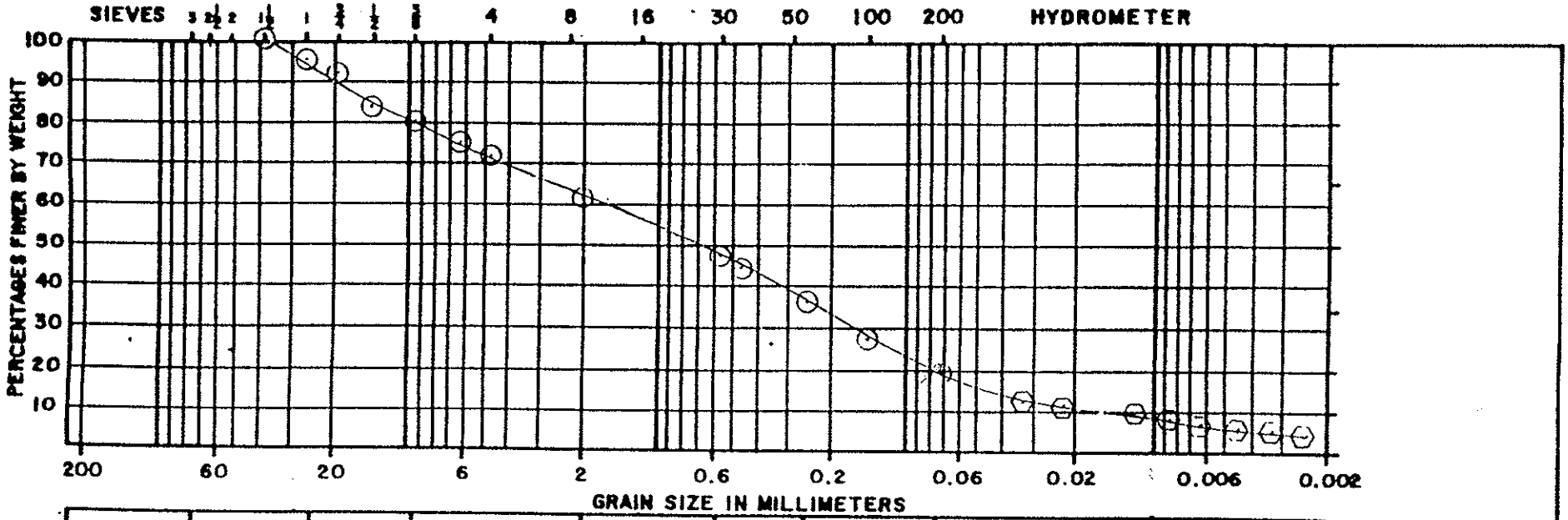
⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

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JOB NO L-96005
REPORT NO. 6
September 10, 199

GRAIN SIZE ANALYSIS



L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9217

Sample: SD16

Depth: 0.0' - 0.5'

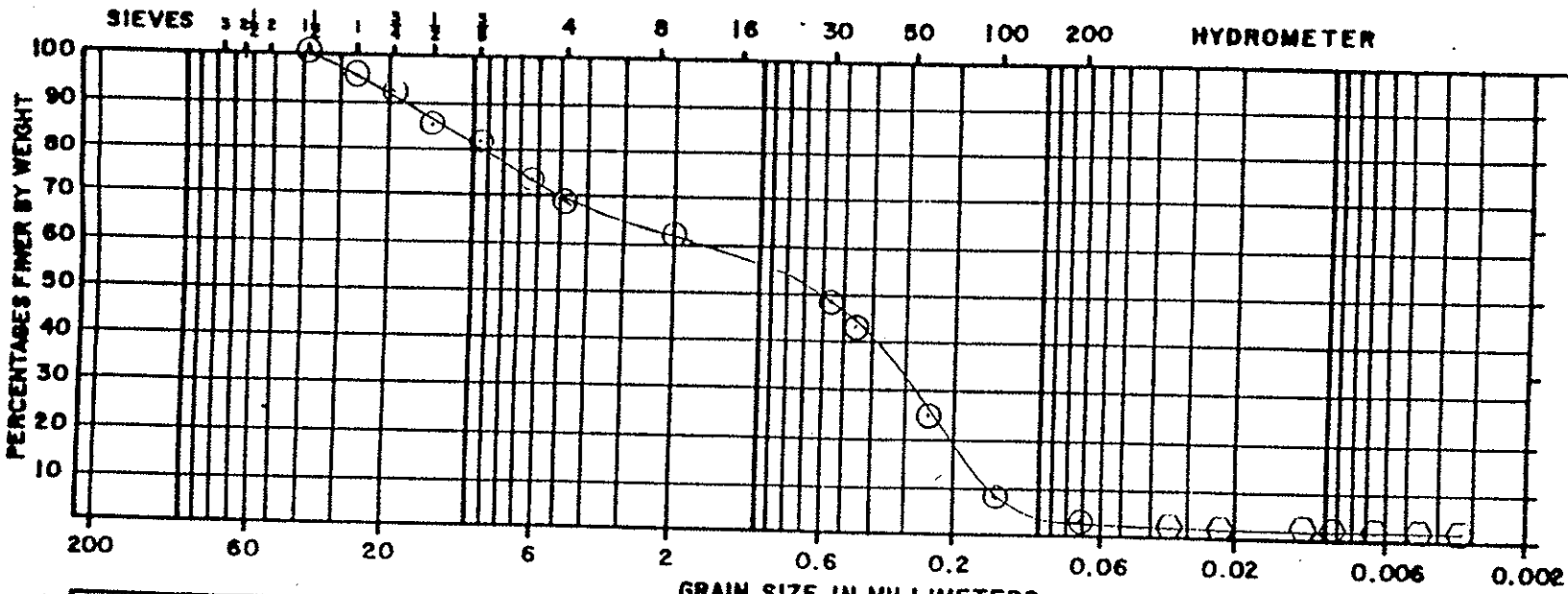
- Sieve Analysis ASTM D422 & D1140
- Hydrometer Analysis ASTM D422

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JOB NO L-96005
REPORT NO 7

September 10, 1996

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL
228	76.2	25.4	9.52	2.0	0.59	0.25	0.074 MM. OPENING
9 in.	3 in.	1 in.	3/8 in.	Nos. 10	30	60	200 SIEVE

L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9218

Sample: SD15

Depth: 0.0' - 0.5'

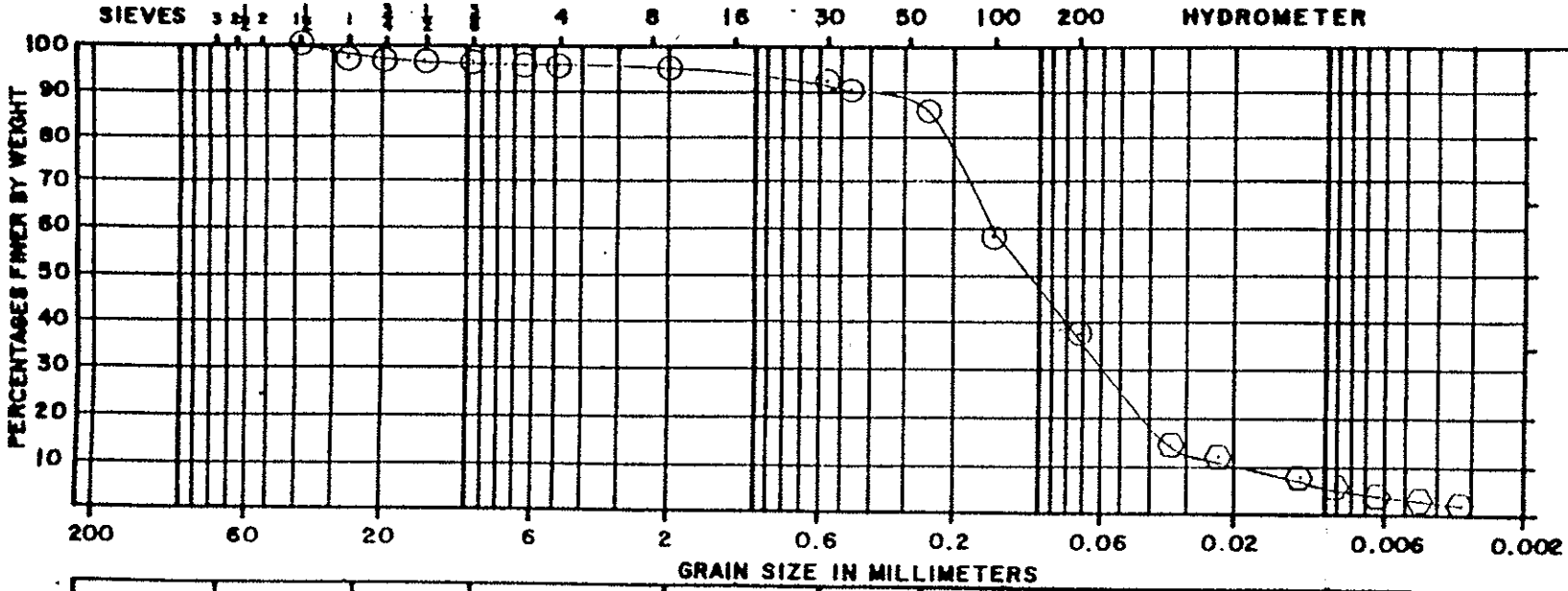
⊙ Sieve Analysis ASTM D422 & D1140

⊘ Hydrometer Analysis ASTM D422

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JOB NO. L-96005
REPORT NO. 8
September 10, 1996

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL
228	76.2	25.4	9.52	2.0	0.59	0.25	0.074 MM. OPENING
9 In.	3 In.	1 In.	3/8 In.	Nos. 10	30	60	200 SIEVE

L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9219

Sample: SD22

Depth: 4.0' - 6.0'

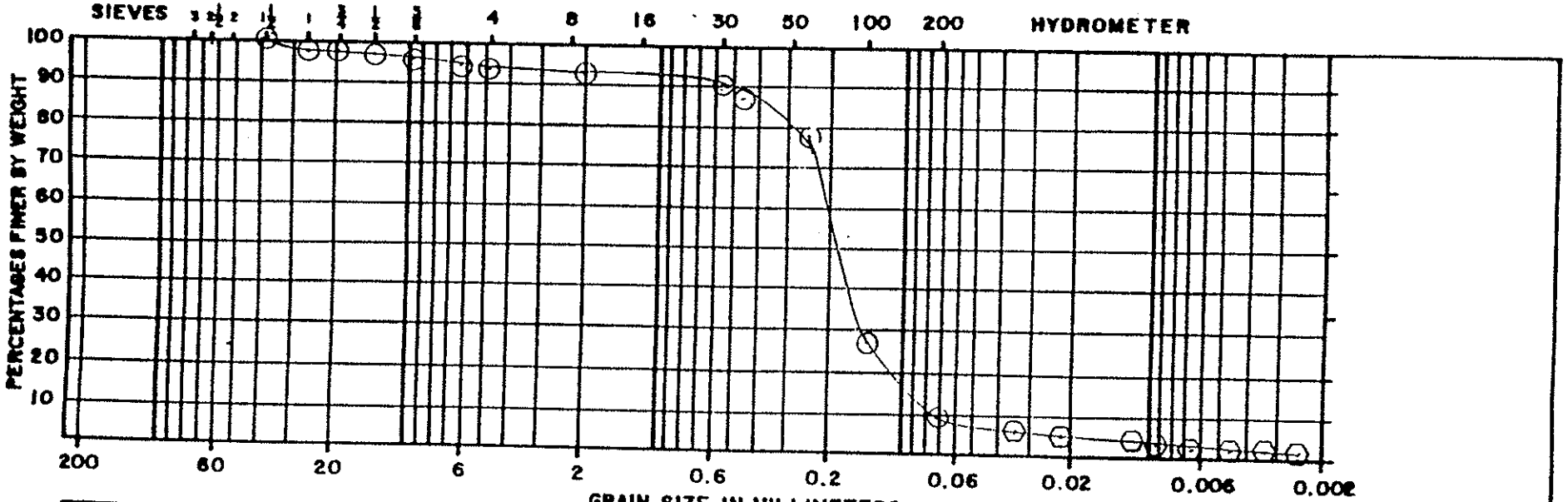
⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

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JOB NO L-96005
REPORT NO. 9
September 10, 199

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT - CLAY SOIL
228	76.2	25.4	9.52	2.0	0.59	0.25	0.074 MM. OPENING
9 In.	3 In.	1 In.	3/8 In.	Nos. 10	30	60	200 SIEVE

L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9220

Sample: SD29

Depth: 0.5' - 2.0'

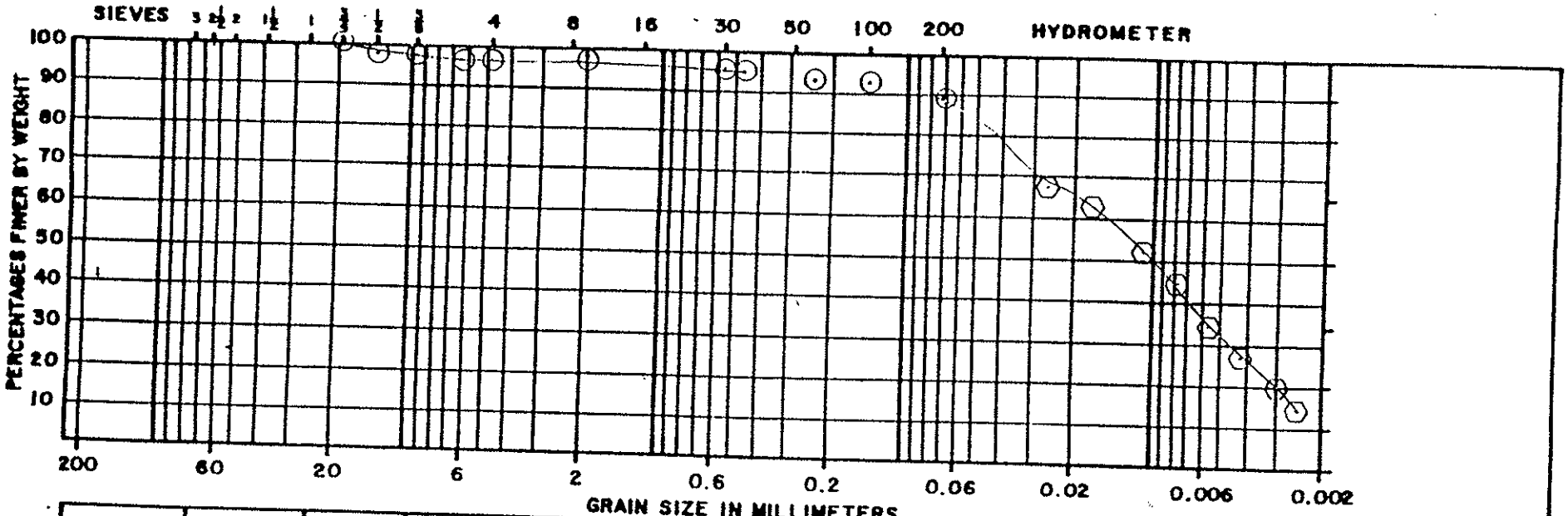
⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

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JOB NO L-96005
REPORT NO 10
September 10, 1996

GRAIN SIZE ANALYSIS



L-96005

Laboratory Testing

Niagara Mohawk Power Corp.

Hudson, New York

Project No. 36468.002

Lab I.D. #: 9221

Sample: SD30

Depth: 4.0' - 6.0'

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

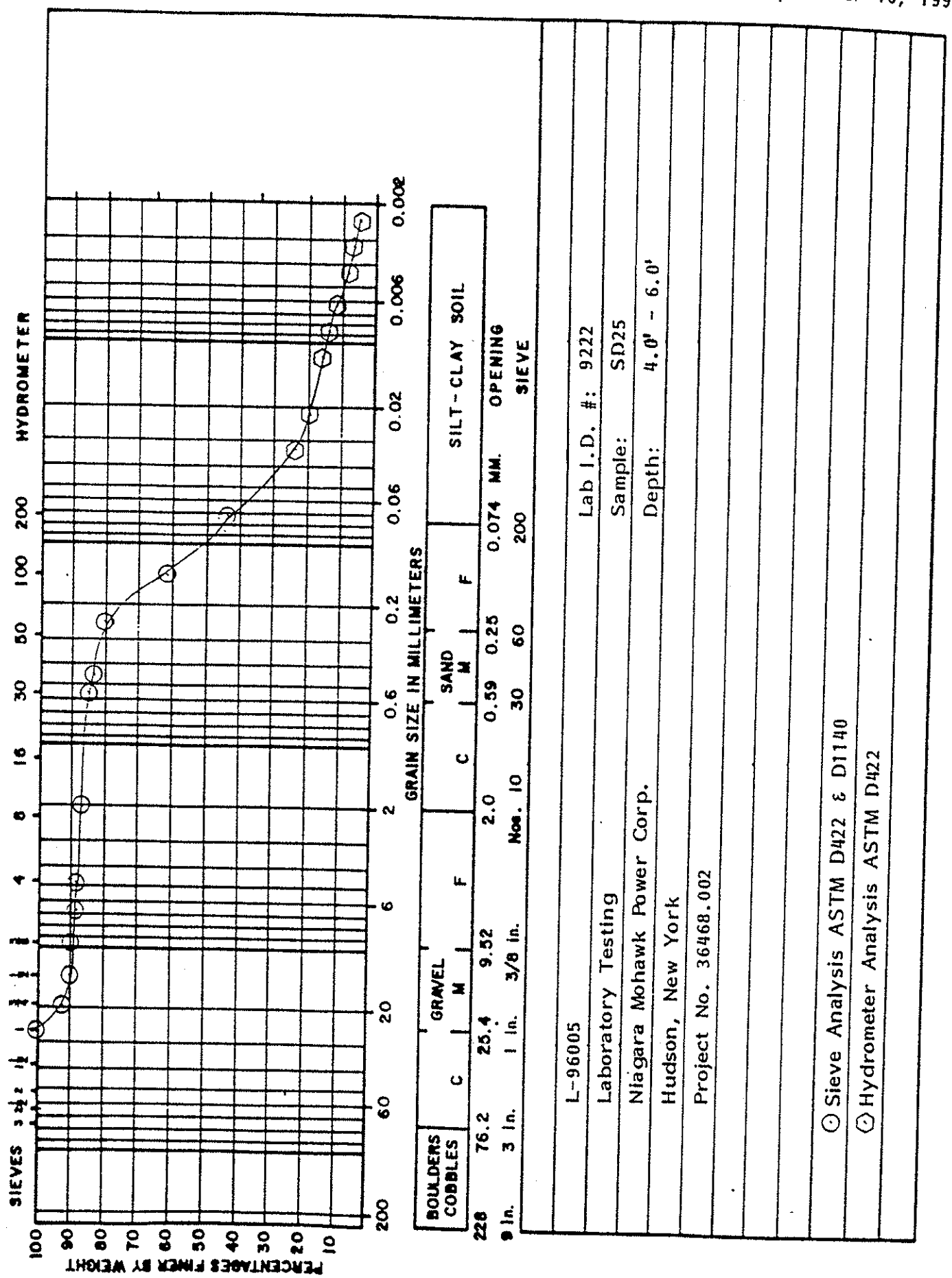
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JOB NO L-96005
REPORT NO 11
September 10, 1996

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JOB NO. L-96005
REPORT NO. 12
September 10, 1996

GRAIN SIZE ANALYSIS



L-96005
Lab I.D. #: 9222
Laboratory Testing
Sample: SD25
Niagara Mohawk Power Corp.
Depth: 4.0' - 6.0'
Hudson, New York
Project No. 36468.002

⊙ Sieve Analysis ASTM D422 & D1140
⊙ Hydrometer Analysis ASTM D422

PW LABORATORIES INC.
P.O. BOX 56, 5879 FISHER ROAD, EAST SYRACUSE, NY 13057
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July 11, 2002

L-02053
Laboratory Testing
Hudson River
Hudson, New York
Project No.: 366.13.008

NATURAL MOISTURE CONTENT
ASTM D2216

Lab I.D. #	Sample.	Depth (feet)	Moisture Content as a Percent of Dry Weight
15937	HWS-SD-12	0.0 – 0.5	25.9
15938	HWS-SD-13	0.0 – 0.5	25.7
15939	HWS-SD-13	0.5 – 2.0	15.8
15940	HWS-SD-80	0.0 – 0.5	35.8
15941	HWS-SD-22	0.0 – 0.5	31.0
15942	HWS-SD-22	0.5 – 2.0	26.6
15943	HWS-SD-23	0.0 – 0.5	18.9
15944	HWS-SD-73	0.0 – 0.5	23.2
15945	HWS-SD-66	0.0 – 0.5	27.9
15946	HWS-SD-69	0.0 – 0.5	22.5
15947	HWS-SD-79	0.0 – 0.5	33.1
15948	HWS-SD-45	0.0 – 0.5	28.9
15949	HWS-SD-13	2.0 – 4.0	16.7
15950	HWS-SD-22	2.0 – 4.0	36.2
15951	HWS-SD-73	4.0 – 6.0	29.0
15952	HWS-SD-73	2.0 – 4.0	16.6
15953	HWS-SD-12	0.5 – 2.0	37.2
15964	HWS-B-SD-09	--	24.9
15965	HWS-B-SD-05	--	44.9
15966	HWS-B-SD-34	--	25.9
15967	HWS-B-SD-16	--	20.9
15968	HWS-B-SD-36	--	28.0

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SIEVE ANALYSIS OF SOIL / AGGREGATE

PROJECT TITLE Laboratory Testing - Hudson River Site
Hudson, New York, Project No.: 366.13.008

PROJECT # L-02053
TEST METHOD ASTM D422 & D1140

REPORT # 1
REPORT DATE July 11, 2002

			Sieve Size - Percent Passing Sieve														
Lab I.D. #	Sample	Depth (feet)	3"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	1/4"	#4	#10	#30	#40	#60	#100	#200
15937	HWS-SD-12	0.0 - 0.5	--	--	--	100	98.6	96.0	92.8	90.6	89.6	86.3	80.6	77.9	68.2	30.8	13.5
15938	HWS-SD-13	0.0 - 0.5	100	83.5	77.1	70.9	69.1	67.8	67.5	66.0	64.2	59.6	49.5	45.9	36.9	13.5	5.3
15939	HWS-SD-13	0.5 - 2.0	--	100	86.8	81.2	65.8	56.5	49.2	43.7	39.7	32.1	21.9	19.3	14.2	9.2	4.4
15940	HWS-SD-80	0.0 - 0.5	--	--	--	100	97.5	90.2	85.4	80.3	77.9	73.0	68.3	66.9	64.4	60.3	47.4
15941	HWS-SD-22	0.0 - 0.5	--	100	91.6	91.6	90.7	89.1	86.5	83.9	82.6	79.3	75.1	73.6	70.0	47.4	20.1
15942	HWS-SD-22	0.5 - 2.0	100	77.9	77.9	77.9	77.1	75.4	74.2	72.5	71.4	69.5	66.2	64.7	61.0	43.9	30.3
15943	HWS-SD-23	0.0 - 0.5	--	100	95.7	92.0	88.2	81.0	76.4	71.5	69.8	65.2	58.8	55.9	43.1	17.0	7.2
15944	HWS-SD-73	0.0 - 0.5	--	--	--	100	97.2	96.9	95.7	94.1	93.1	88.8	80.4	75.8	62.4	17.0	6.2
15945	HWS-SD-66	0.0 - 0.5	--	--	--	100	98.7	94.1	88.0	78.6	73.4	65.0	59.5	58.3	51.8	23.9	8.9
15946	HWS-SD-69	0.0 - 0.5	--	--	--	100	99.3	97.3	95.0	91.8	89.8	85.0	78.9	75.9	66.9	22.4	8.6
15947	HWS-SD-79	0.0 - 0.5	--	--	--	--	100	98.6	98.6	97.9	97.6	96.2	94.0	92.9	86.0	34.4	19.2

Sample mass, as received, meets minimum requirements of test method: Yes ____ No X

Prewashed: Yes X No ____

Remarks:

Performed By: SR, CP

Checked By: V.J. Thoma

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SIEVE ANALYSIS OF SOIL / AGGREGATE

PROJECT TITLE Laboratory Testing - Hudson River Site
Hudson, New York, Project No.: 366.13.008

PROJECT # L-02053
TEST METHOD ASTM D422 & D1140

REPORT # 1
REPORT DATE July 11, 2002

			Sieve Size - Percent Passing Sieve														
Lab I.D. #	Sample	Depth (feet)	3"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	1/4"	#4	#10	#30	#40	#60	#100	#200
15948	HWS-SD-45	0.0 - 0.5	--	--	--	100	99.5	99.3	98.4	96.7	95.7	93.2	88.4	84.9	71.8	33.7	17.5
15949	HWS-SD-13	2.0 - 4.0	100	70.3	70.3	70.3	70.3	70.3	70.0	69.1	68.6	67.0	63.8	61.7	55.3	20.0	8.8
15950	HWS-SD-22	2.0 - 4.0	--	--	--	--	--	100	99.6	97.2	95.7	92.5	88.7	87.3	84.0	69.7	47.6
15951	HWS-SD-73	4.0 - 6.0	--	--	--	--	--	--	--	--	--	100	99.8	99.8	99.8	99.8	99.7
15952	HWS-SD-73	2.0 - 4.0	--	--	--	--	--	100	99.2	99.1	98.8	91.8	38.7	35.5	31.9	19.4	10.6
15953	HWS-SD-12	0.5 - 2.0	--	--	--	--	100	99.9	99.6	99.5	99.5	98.9	97.3	96.5	91.8	55.3	32.5
15964	HWS-B-SD-09	--	--	--	100	98.2	96.3	90.4	84.3	73.4	67.4	55.9	41.6	37.1	26.0	12.4	6.3
15965	HWS-B-SD-05	--	--	--	--	100	97.6	94.8	93.7	91.8	90.7	86.8	81.0	79.1	75.1	62.5	37.7
15966	HWS-B-SD-34	--	--	--	100	97.9	97.9	96.7	95.0	92.6	91.4	90.0	87.9	86.8	76.3	18.7	3.0
15967	HWS-B-SD-16	--	--	--	100	89.9	88.9	86.2	83.5	78.6	75.3	67.4	56.4	52.0	26.7	7.3	3.0
15968	HWS-B-SD-36	--	100	81.6	81.6	78.7	75.1	68.7	65.4	60.5	58.0	51.5	44.5	42.3	34.1	15.0	7.2

Sample mass, as received, meets minimum requirements of test method: Yes ____ No X

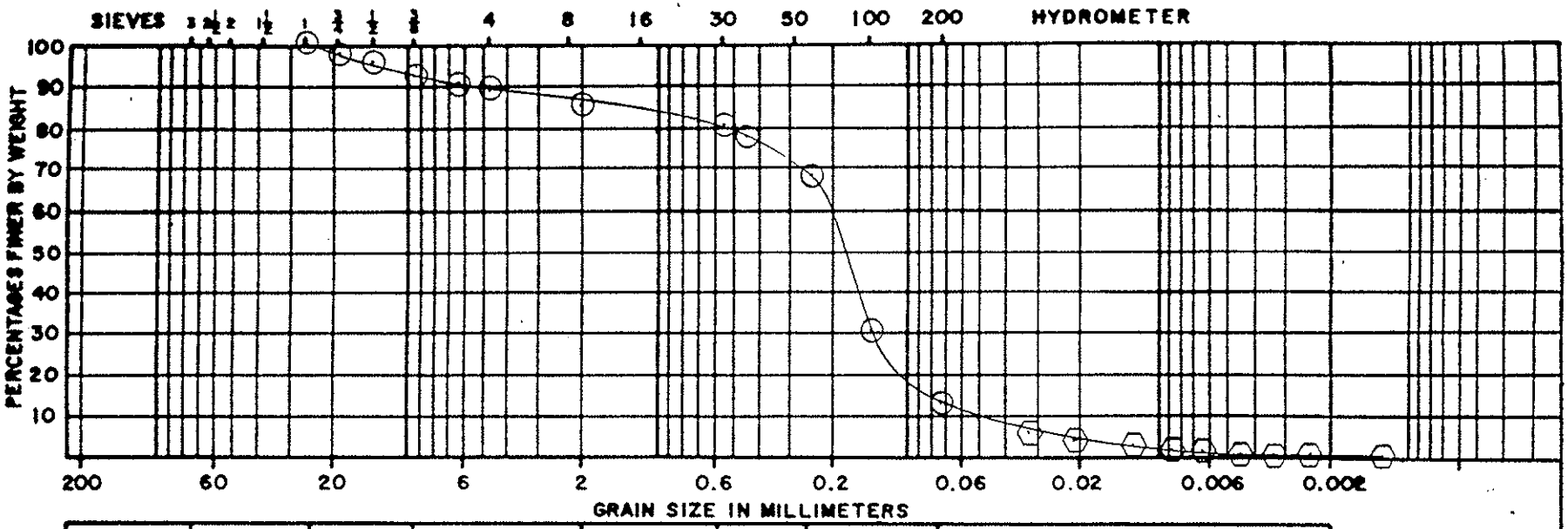
Prewashed: Yes X No ____

Remarks:

Performed By: SR, CP

Checked By: V.J. Thoma

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT - CLAY SOIL
228	76.2	25.4	9.52	2.0	0.59	0.25	0.074 MM. OPENING
9 in.	3 in.	1 in.	3/8 in.	Nos. 10	30	60	200 SIEVE

L-02053 Lab I.D. #: 15937

Laboratory Testing Sample: HWS-SD-12

Hudson River Site Depth: 0.0' - 0.5'

Hudson, New York

Project No.: 366.13.008

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

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Job No.: L-02053

Report No: 1

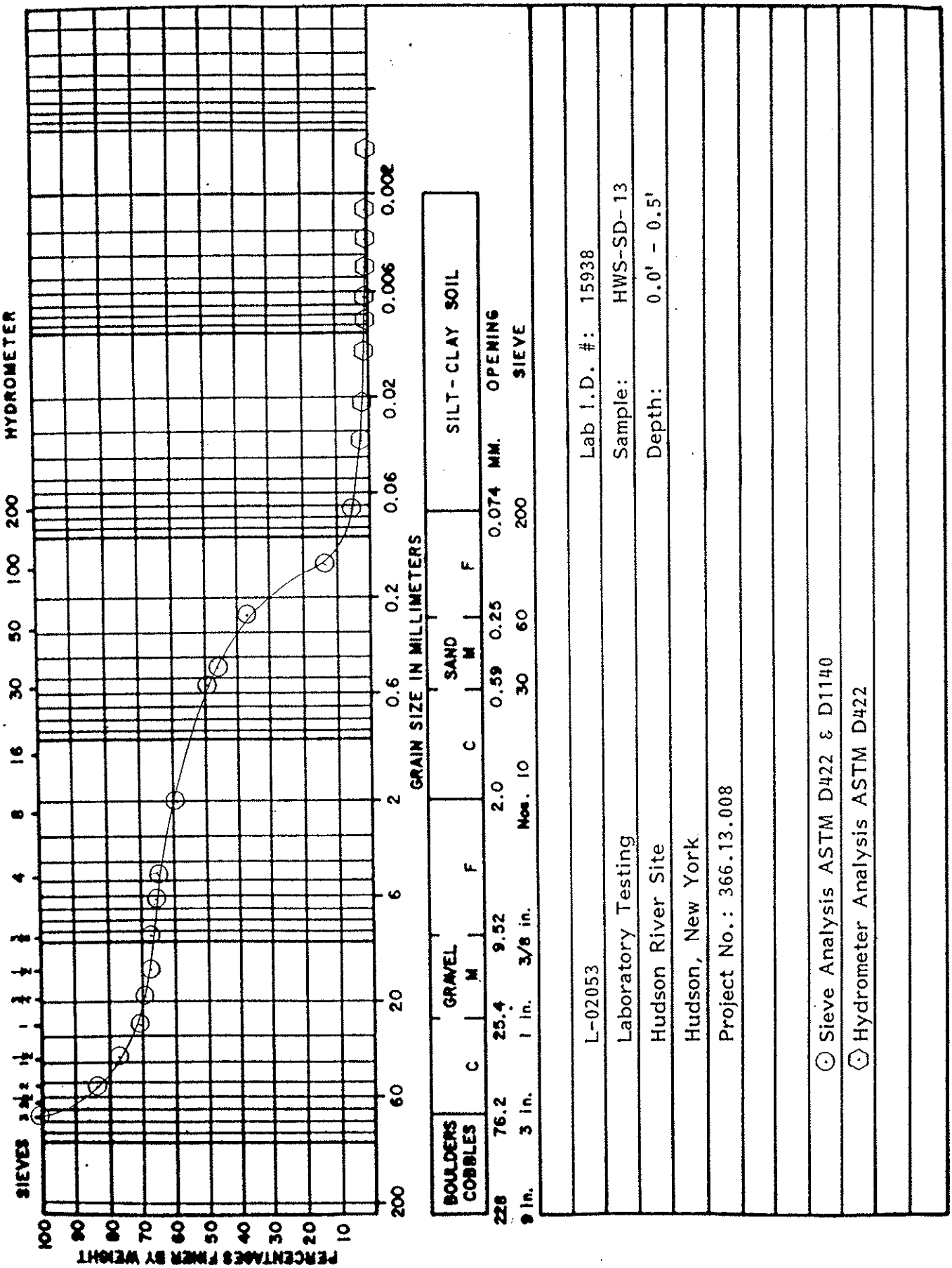
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Job No.: L-02053

Report No: 2

July 11, 2002

GRAIN SIZE ANALYSIS



Lab I.D. #: 15938

Sample: HWS-SD-13

Depth: 0.0' - 0.5'

L-02053

Laboratory Testing

Hudson River Site

Hudson, New York

Project No.: 366.13.008

⊙ Sieve Analysis ASTM D422 & D1140

⬡ Hydrometer Analysis ASTM D422

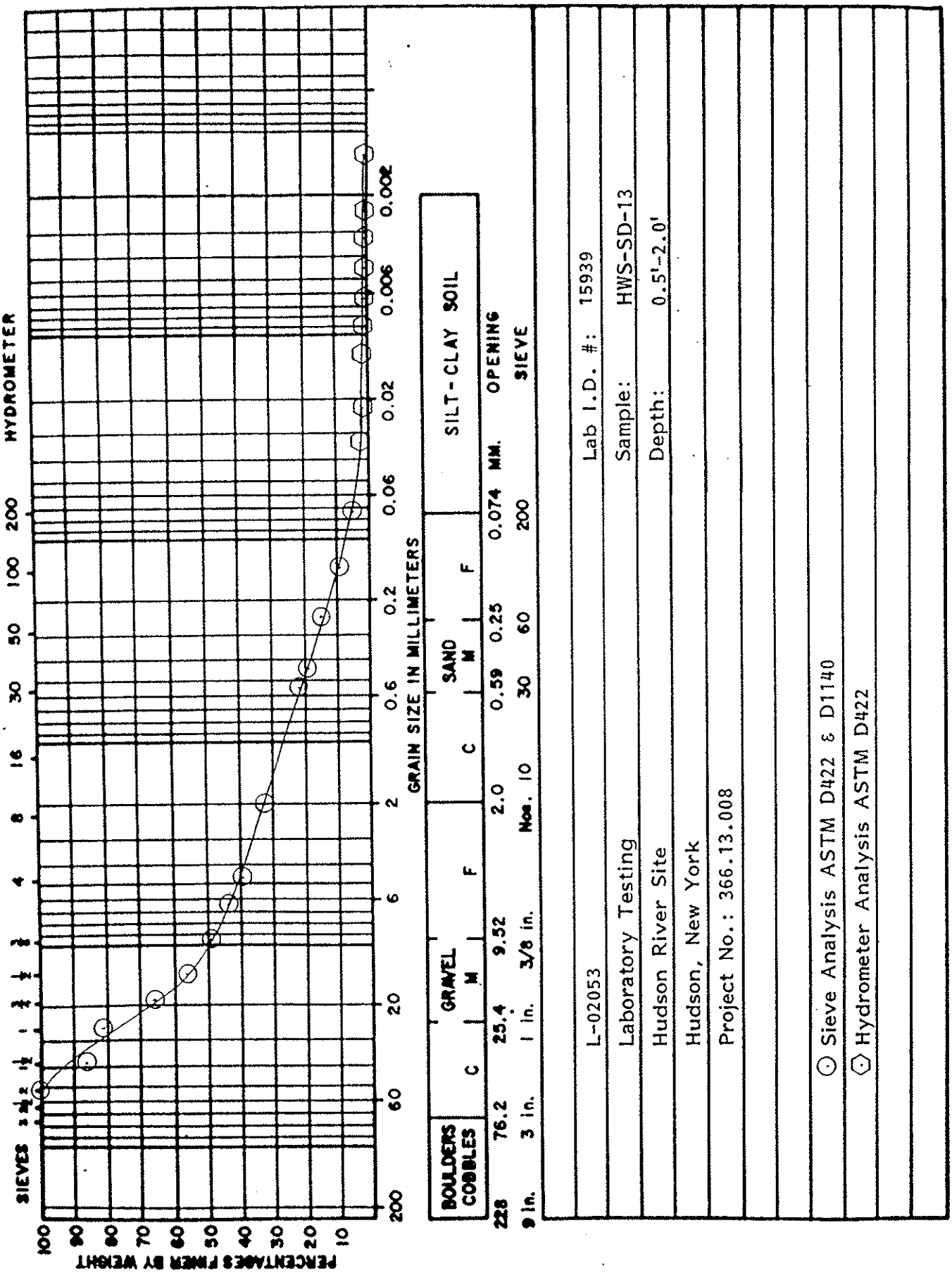
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Job No.: L-02053

Report No: 3

July 11, 2002

GRAIN SIZE ANALYSIS



Lab I.D. #: 15939

Sample: HWS-SD-13

Depth: 0.5'-2.0'

L-02053

Laboratory Testing

Hudson River Site

Hudson, New York

Project No.: 366.13.008

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

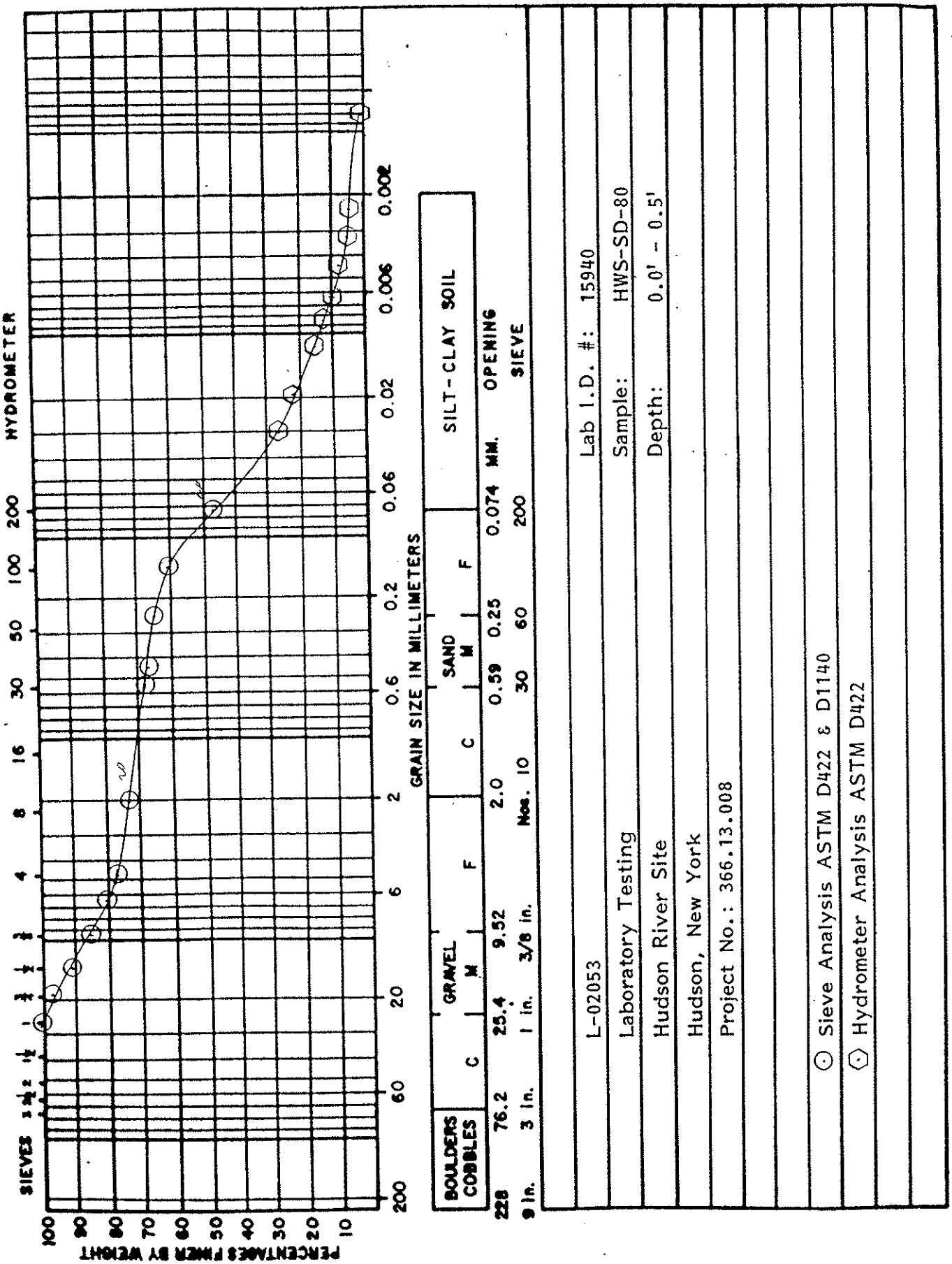
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Job No.: L-02053

Report No: 4

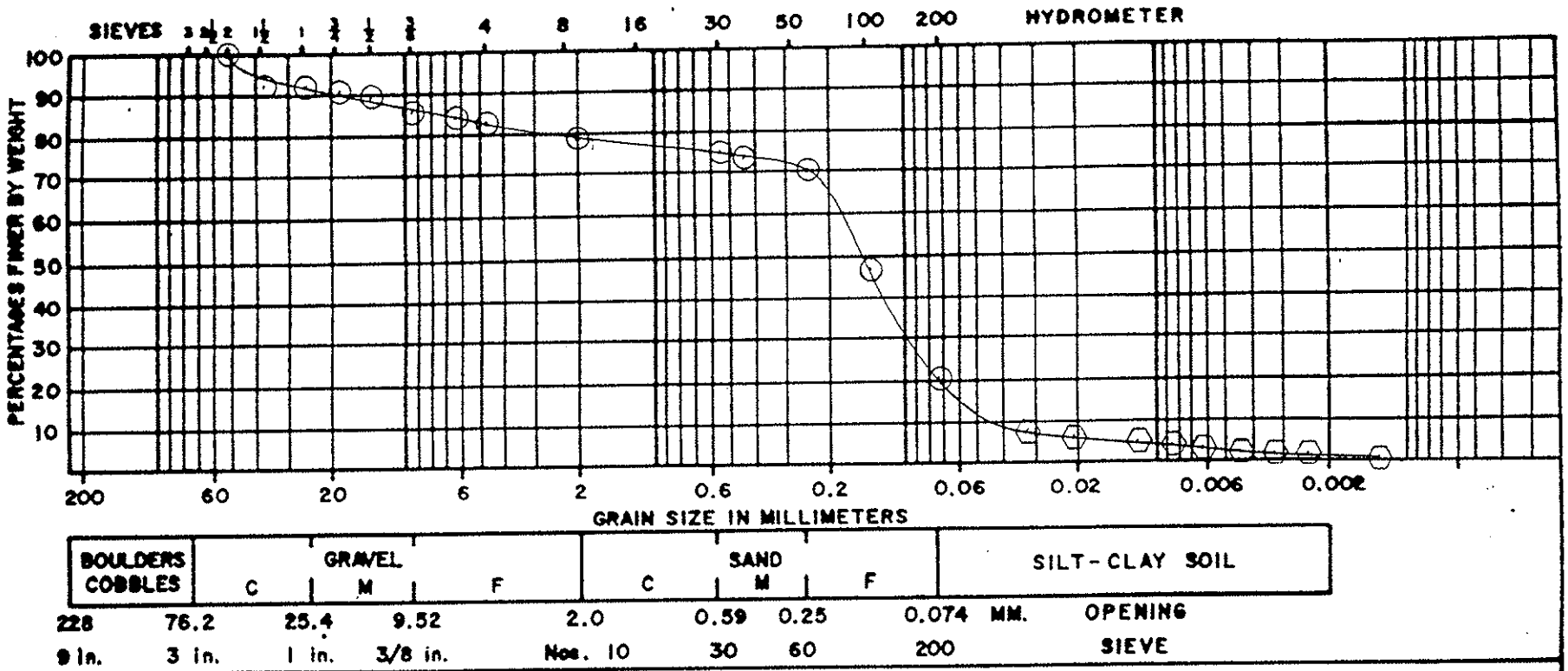
July 11, 2002

GRAIN SIZE ANALYSIS



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tpw labs



L-02053	Lab I.D. #: 15941
Laboratory Testing	Sample: HWS-SD-22
Hudson River Site	Depth: 0.0' - 0.5'
Hudson, New York	
Project No.: 366.13.008	

⊙ Sieve Analysis ASTM D422 & D1140

⬡ Hydrometer Analysis ASTM D422

Job No.: L-02053
Report No: 5
July 11, 2002

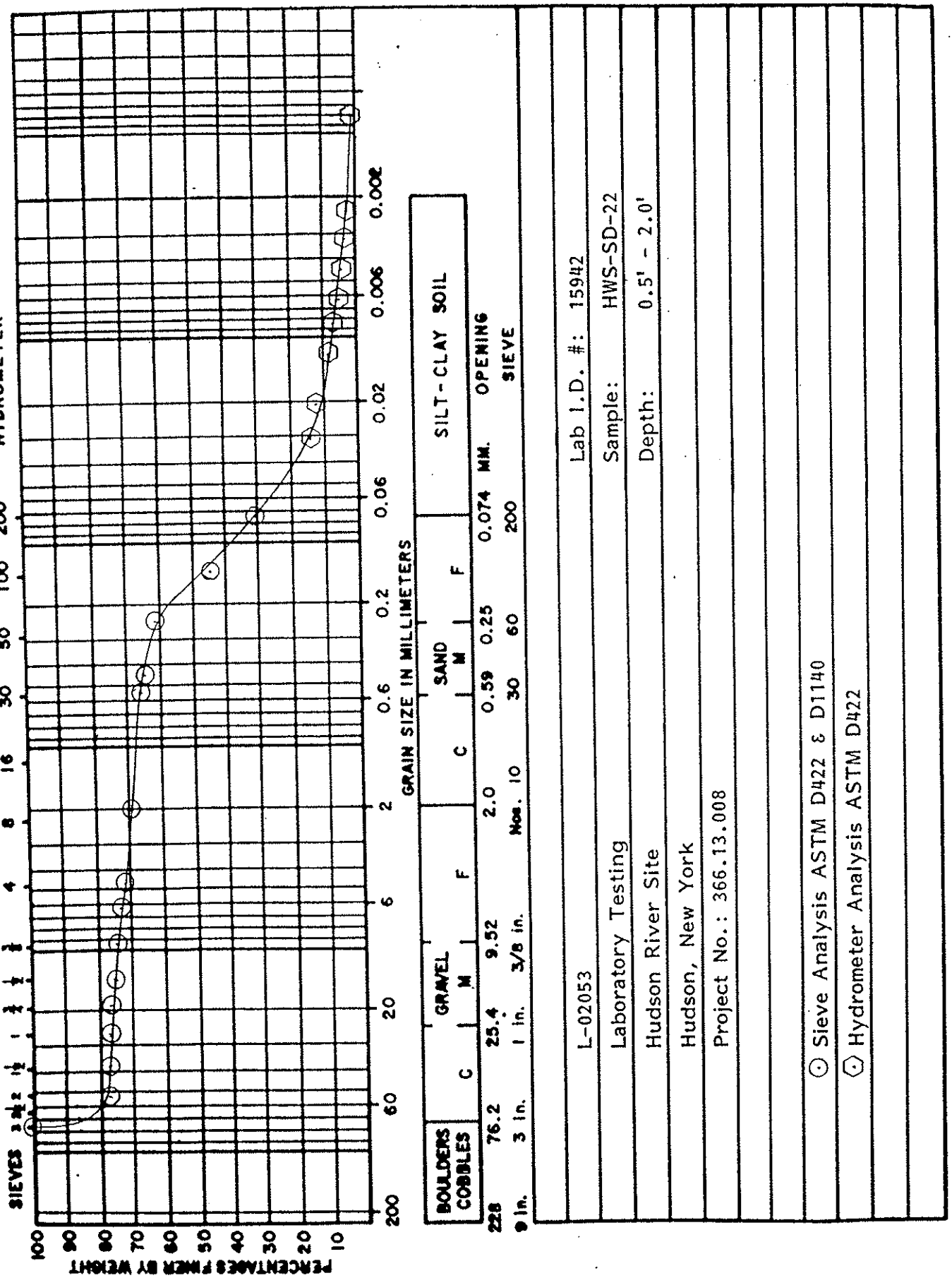
PW LABORATORIES INC.
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Job No.: L-02053

Report No: 6

July 11, 2002

GRAIN SIZE ANALYSIS



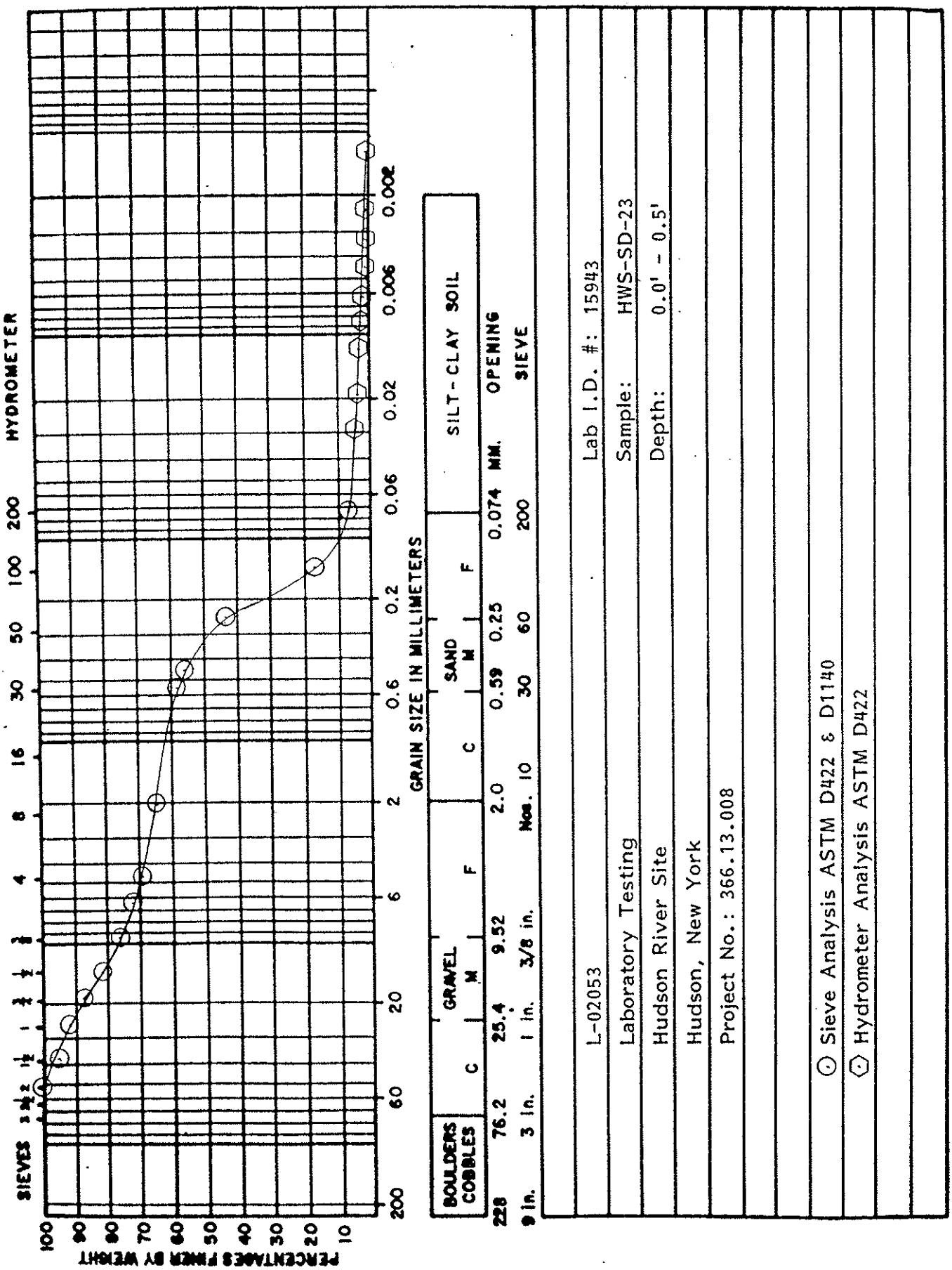
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Job No.: L-02053

Report No: 7

July 11, 2002

GRAIN SIZE ANALYSIS



Lab I.D. #: 15943

L-02053

Laboratory Testing

Sample: HWS-SD-23

Hudson River Site

Depth: 0.0' - 0.5'

Hudson, New York

Project No.: 366.13.008

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

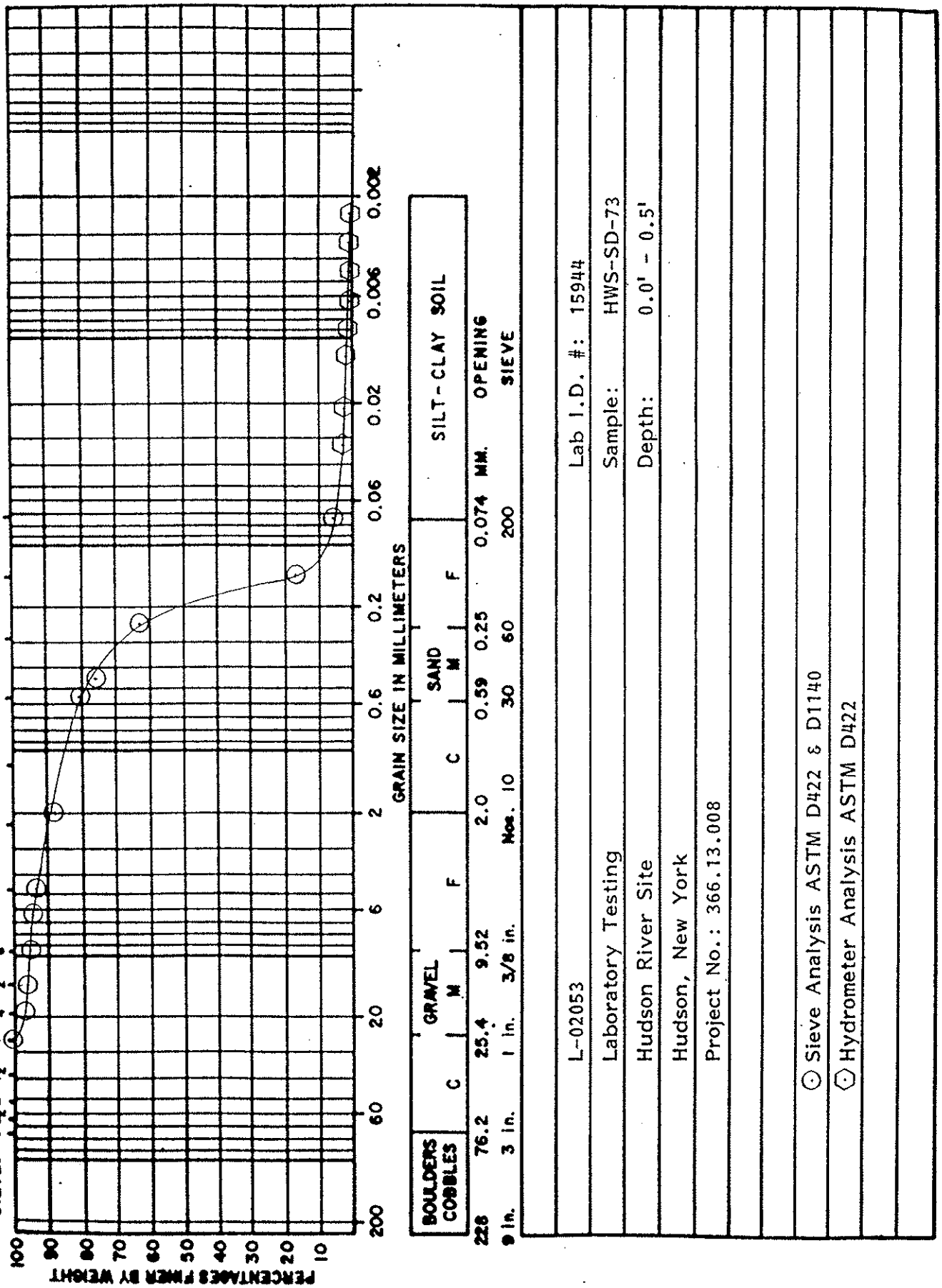
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Job No.: L-02053

Report No: 8

July 11, 2002

GRAIN SIZE ANALYSIS



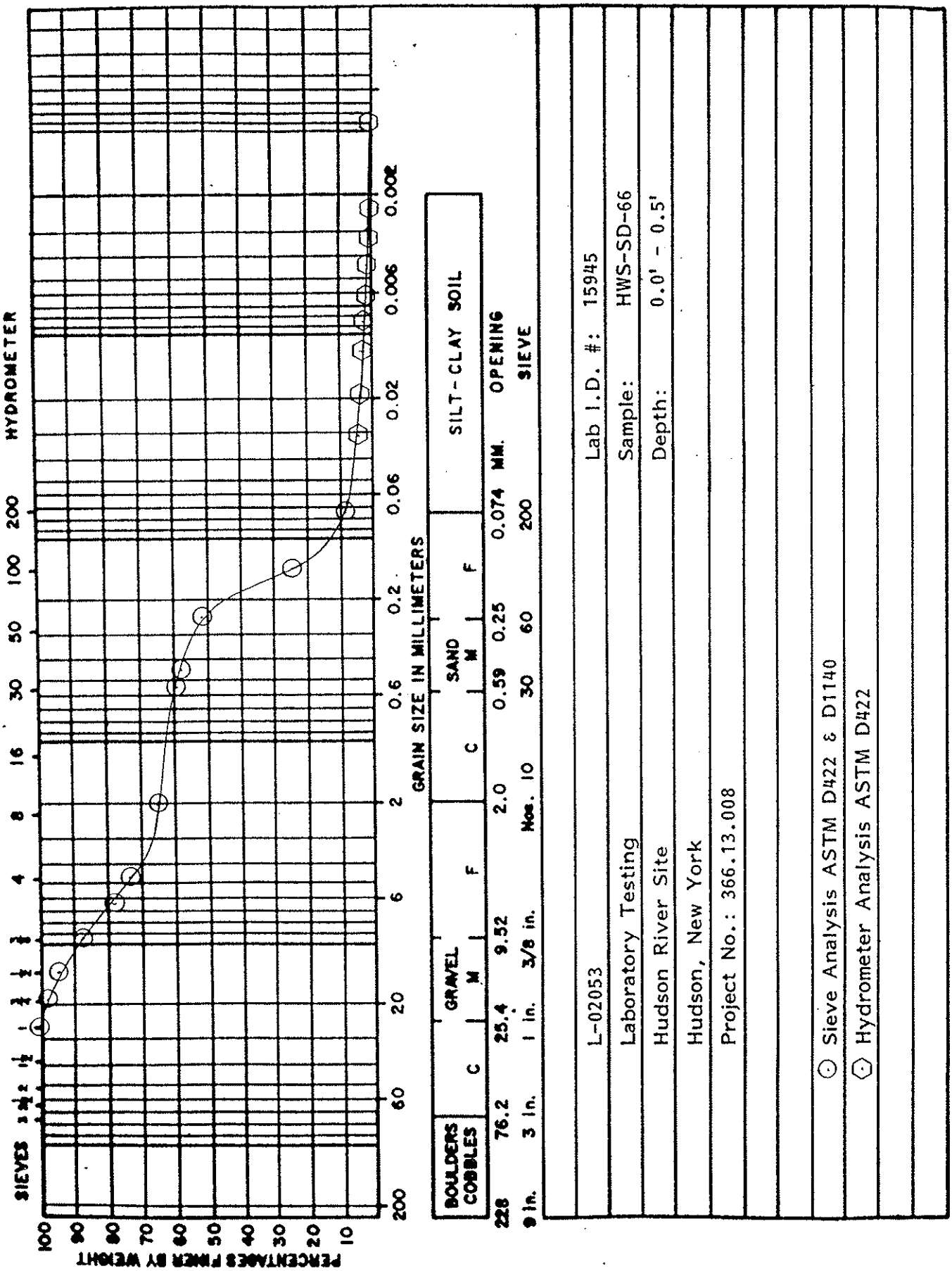
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Job No.: L-02053

Report No: 9

July 11, 2002

GRAIN SIZE ANALYSIS



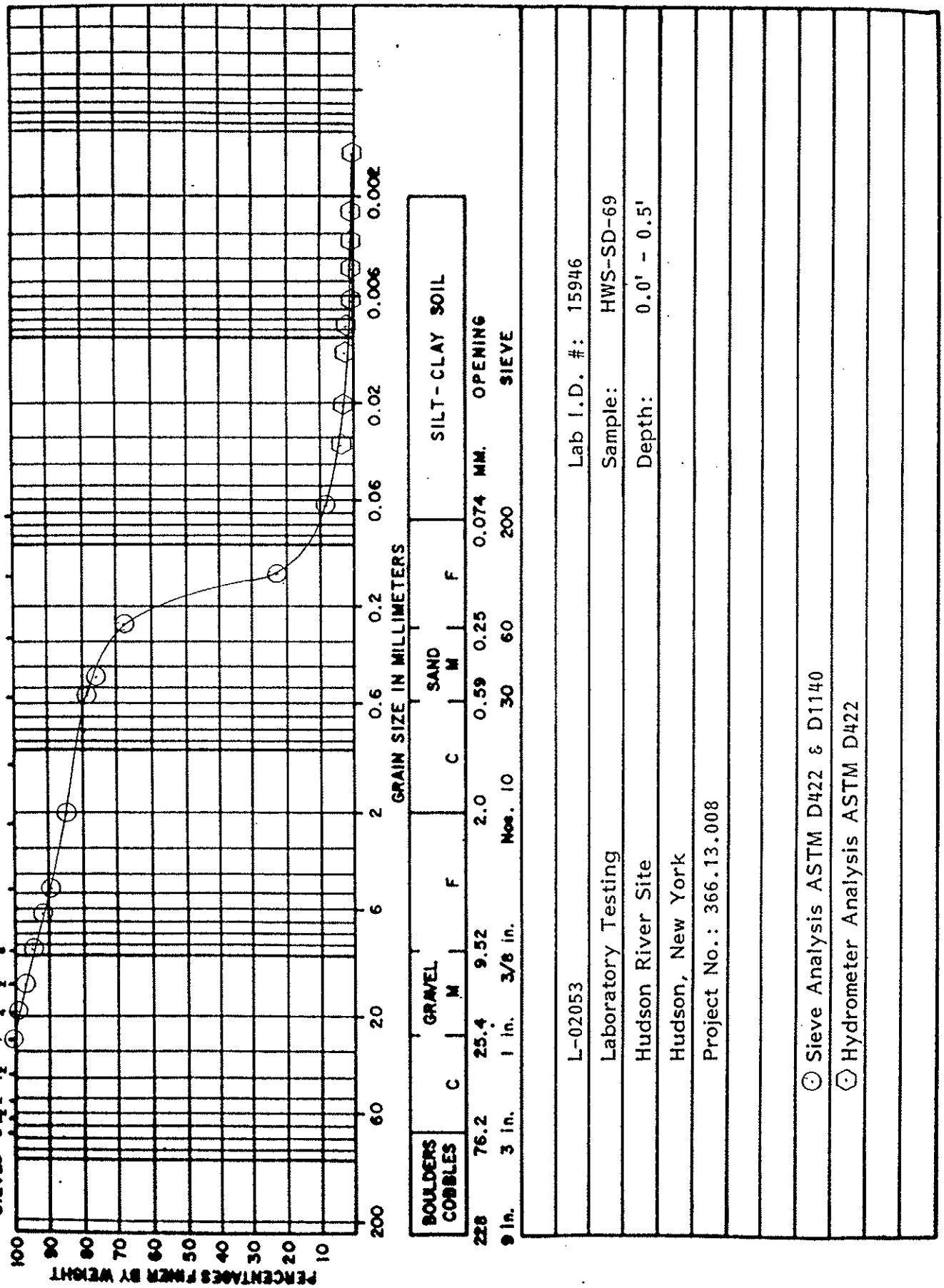
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Job No.: L-02053

Report No: 10

July 11, 2002

GRAIN SIZE ANALYSIS



L-02053

Lab I.D. #: 15946

Laboratory Testing

Sample: HWS-SD-69

Hudson River Site

Depth: 0.0' - 0.5'

Hudson, New York

Project No.: 366.13.008

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

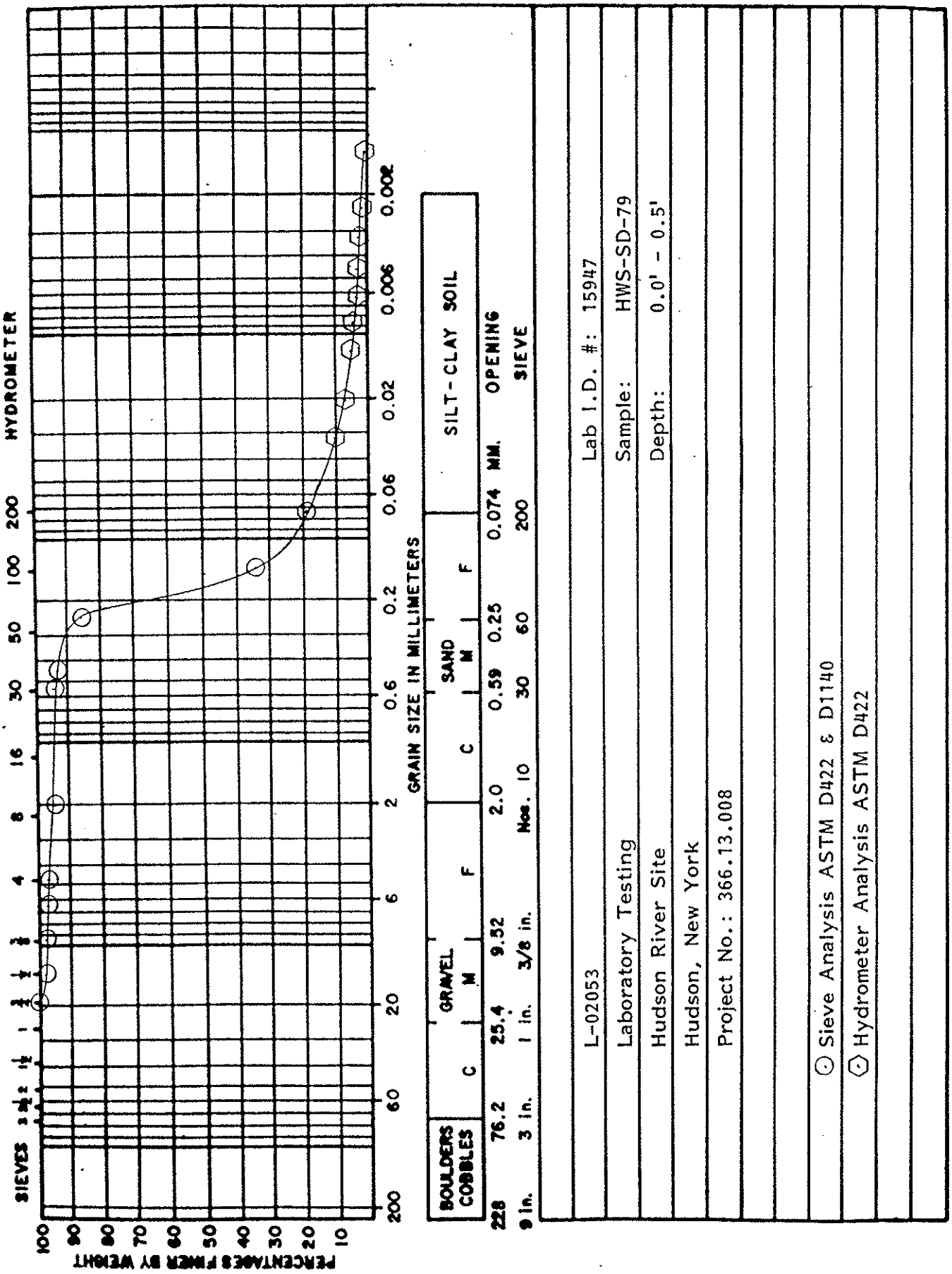
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Job No.: L-02053

Report No: 11

July 11, 2002

GRAIN SIZE ANALYSIS



L-02053

Lab I.D. #: 15947

Laboratory Testing

Sample: HWS-SD-79

Hudson River Site

Depth: 0.0' - 0.5'

Hudson, New York

Project No.: 366.13.008

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

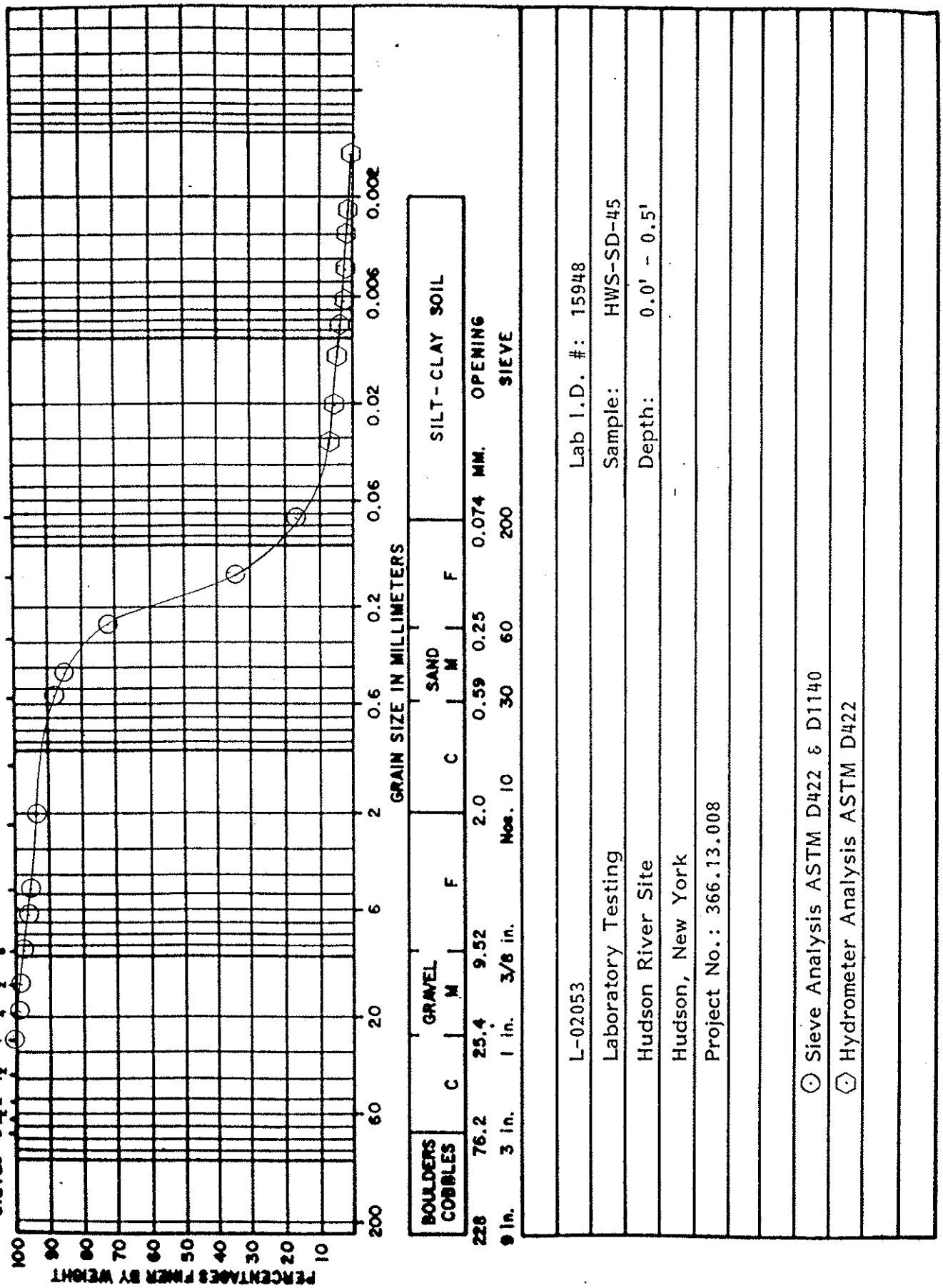
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Job No.: L-02053

Report No: 12

July 11, 2002

GRAIN SIZE ANALYSIS



L-02053

Lab I.D. #: 15948

Laboratory Testing

Sample: HWS-SD-45

Hudson River Site

Depth: 0.0' - 0.5'

Hudson, New York

Project No.: 366.13.008

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

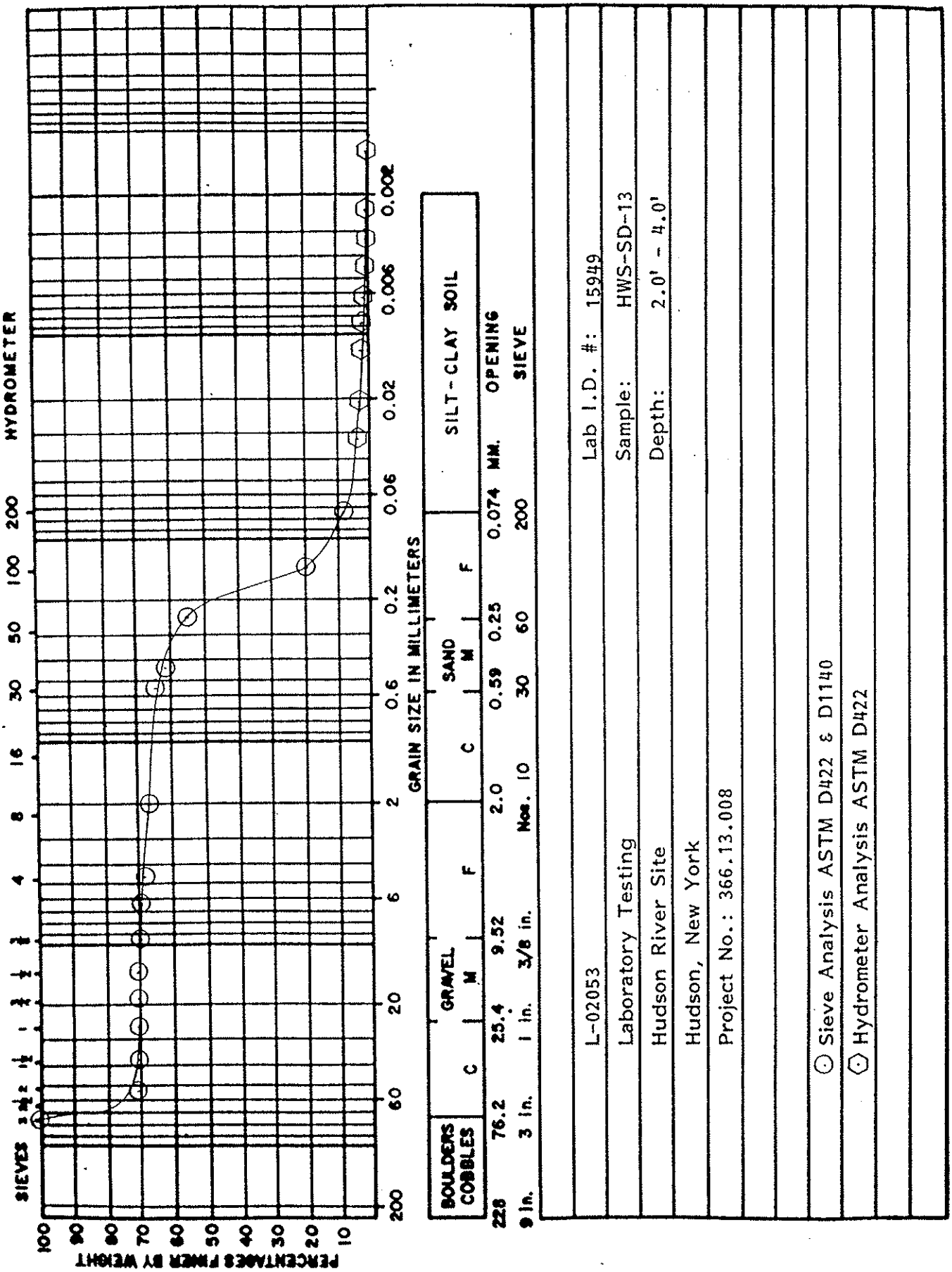
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Job No.: L-02053

Report No: 13

July 11, 2002

GRAIN SIZE ANALYSIS



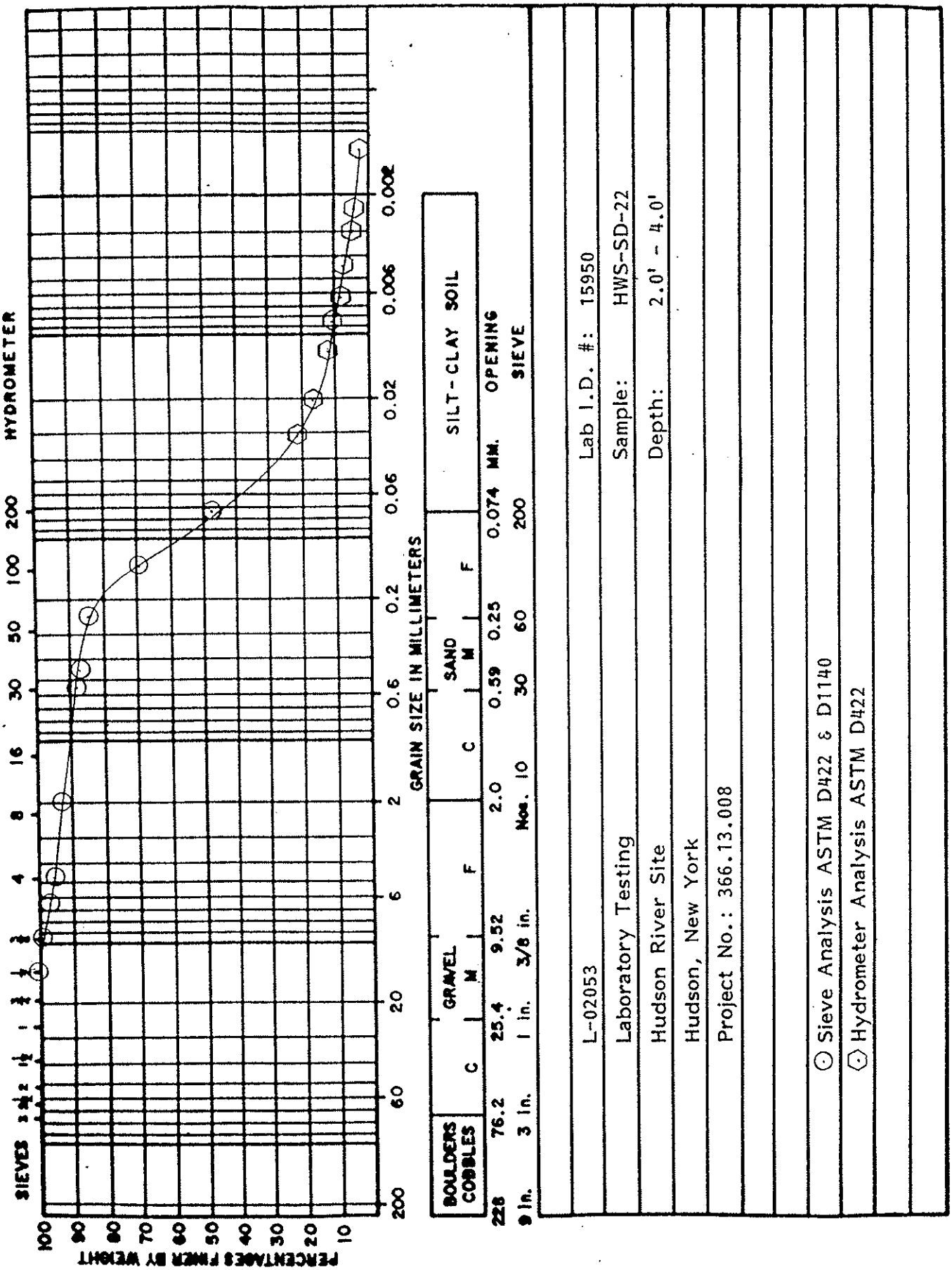
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Job No.: L-02053

Report No: 14

July 11, 2002

GRAIN SIZE ANALYSIS



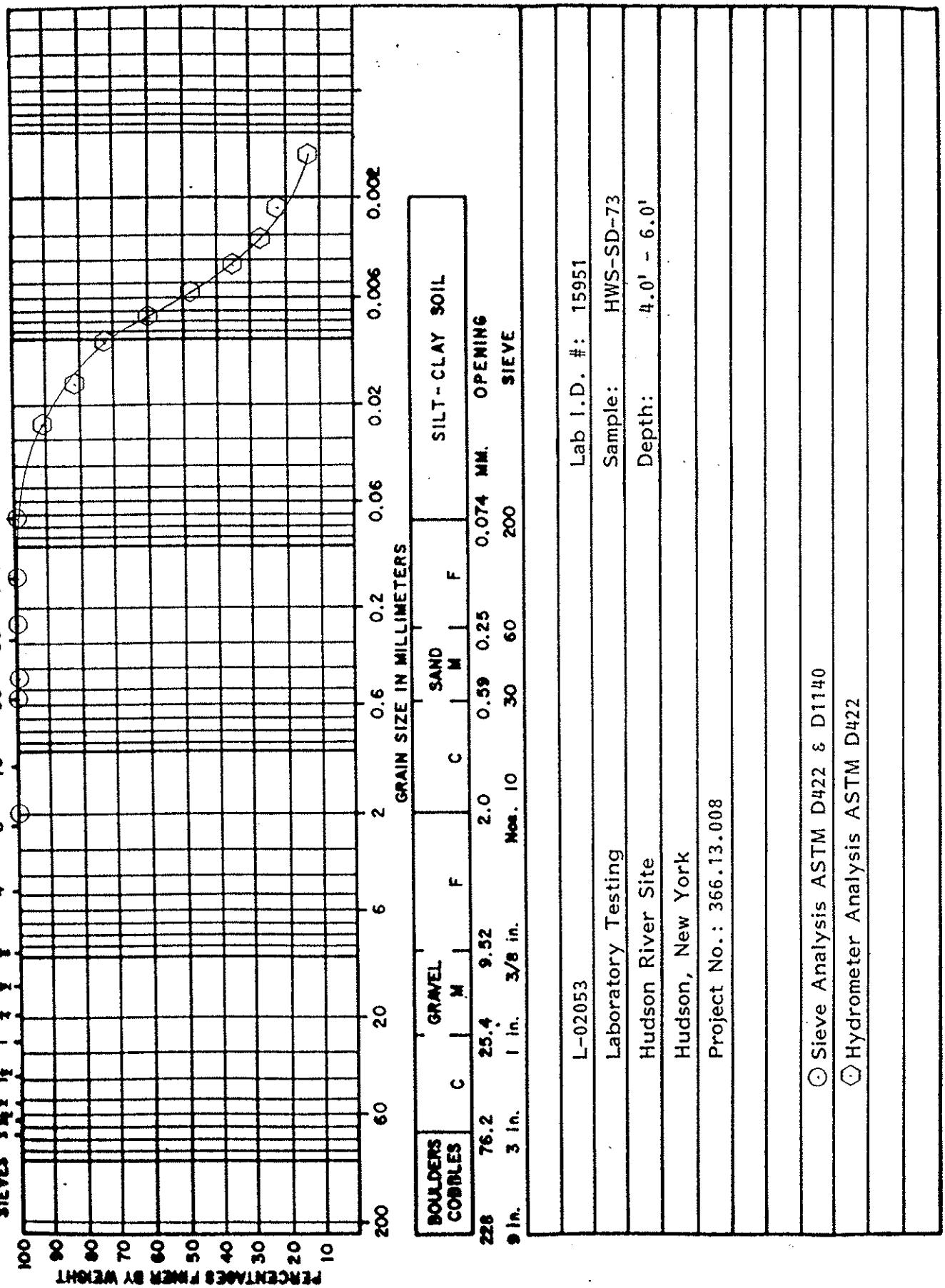
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Job No.: L-02053

Report No: 15

July 11, 2002

GRAIN SIZE ANALYSIS



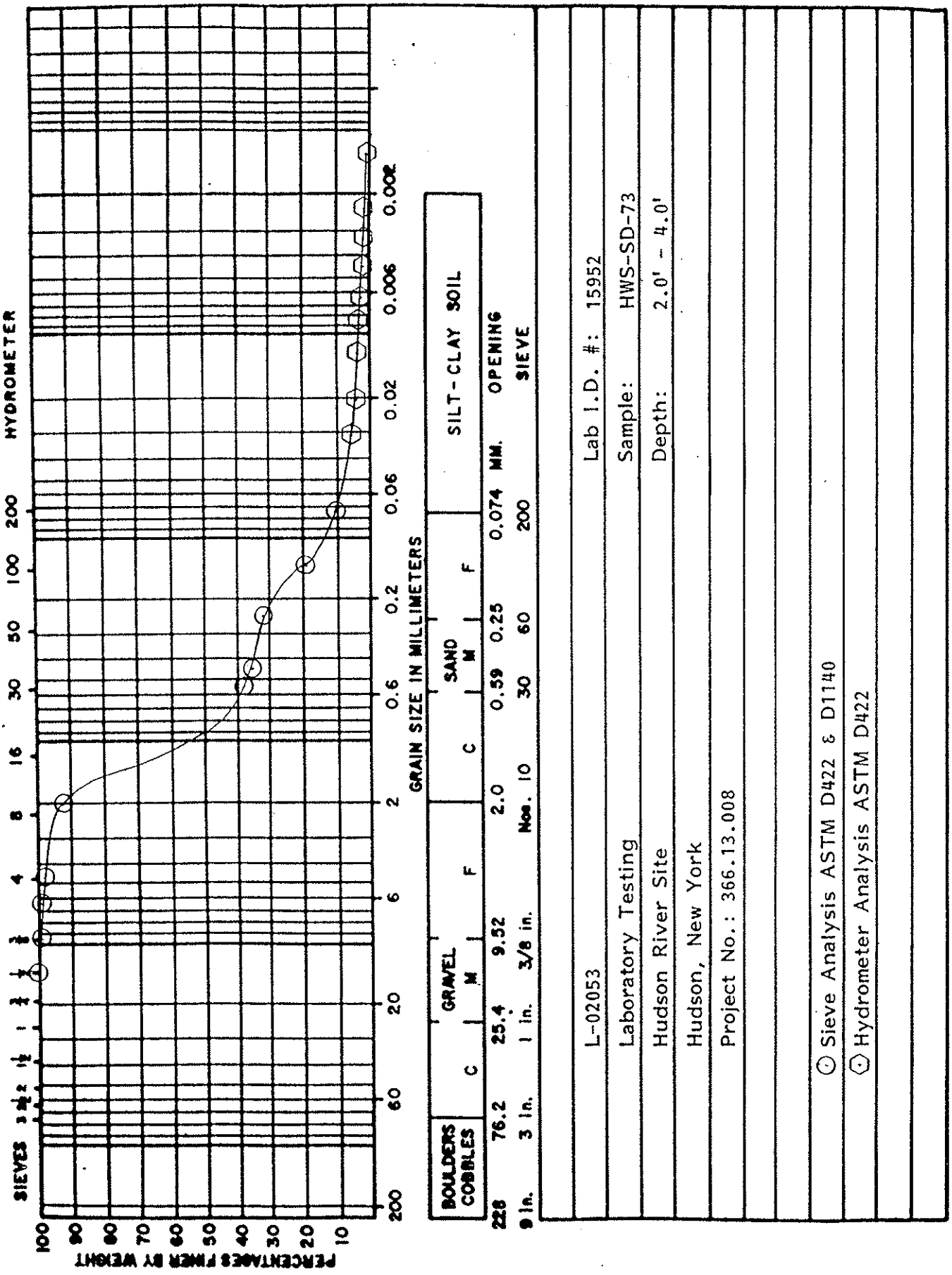
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Job No.: L-02053

Report No: 16

July 11, 2002

GRAIN SIZE ANALYSIS



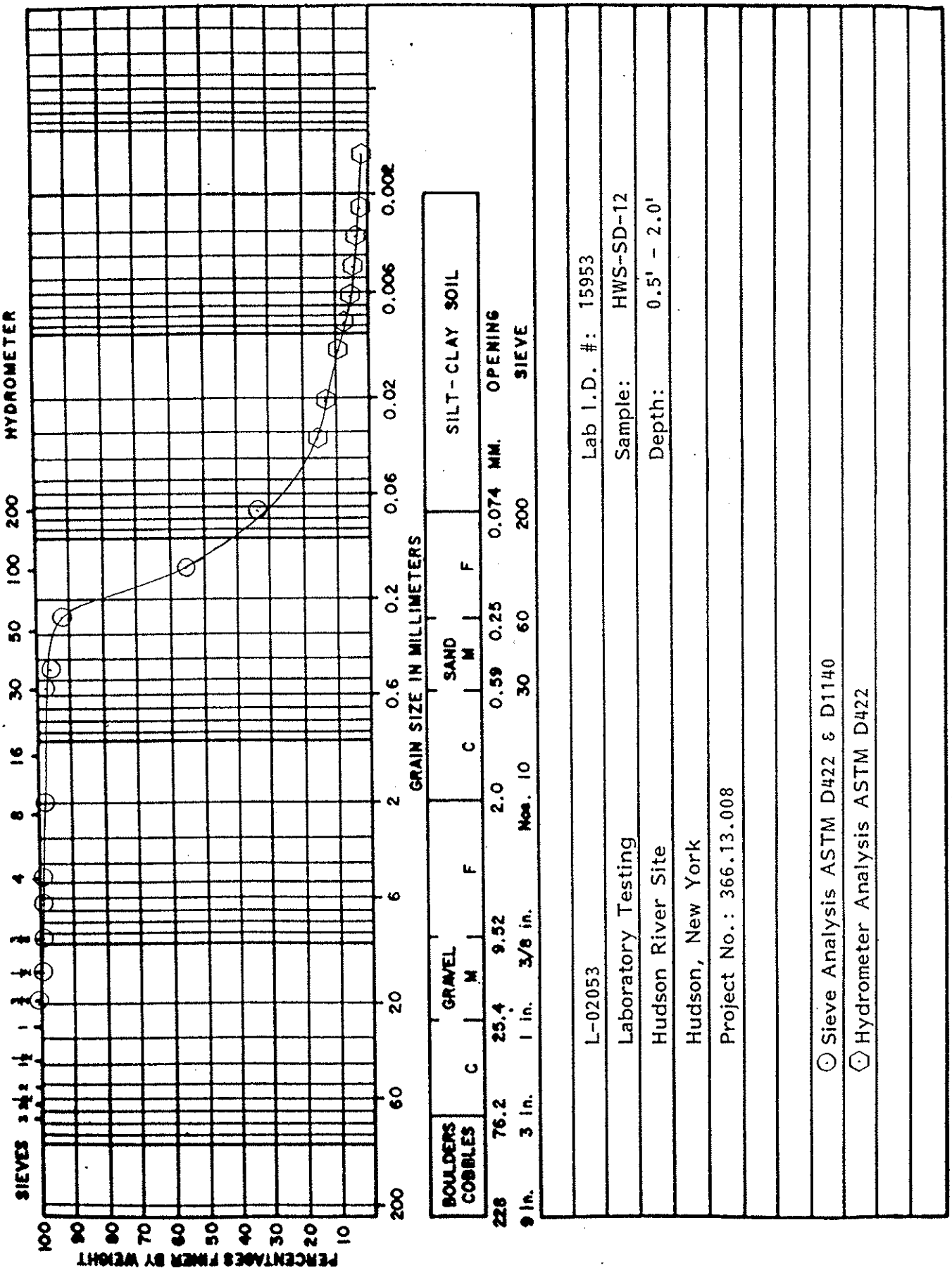
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Job No.: L-02053

Report No: 17

July 11, 2002

GRAIN SIZE ANALYSIS



L-02053

Lab I.D. #: 15953

Laboratory Testing

Sample: HWS-SD-12

Hudson River Site

Depth: 0.5' - 2.0'

Hudson, New York

Project No.: 366.13.008

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

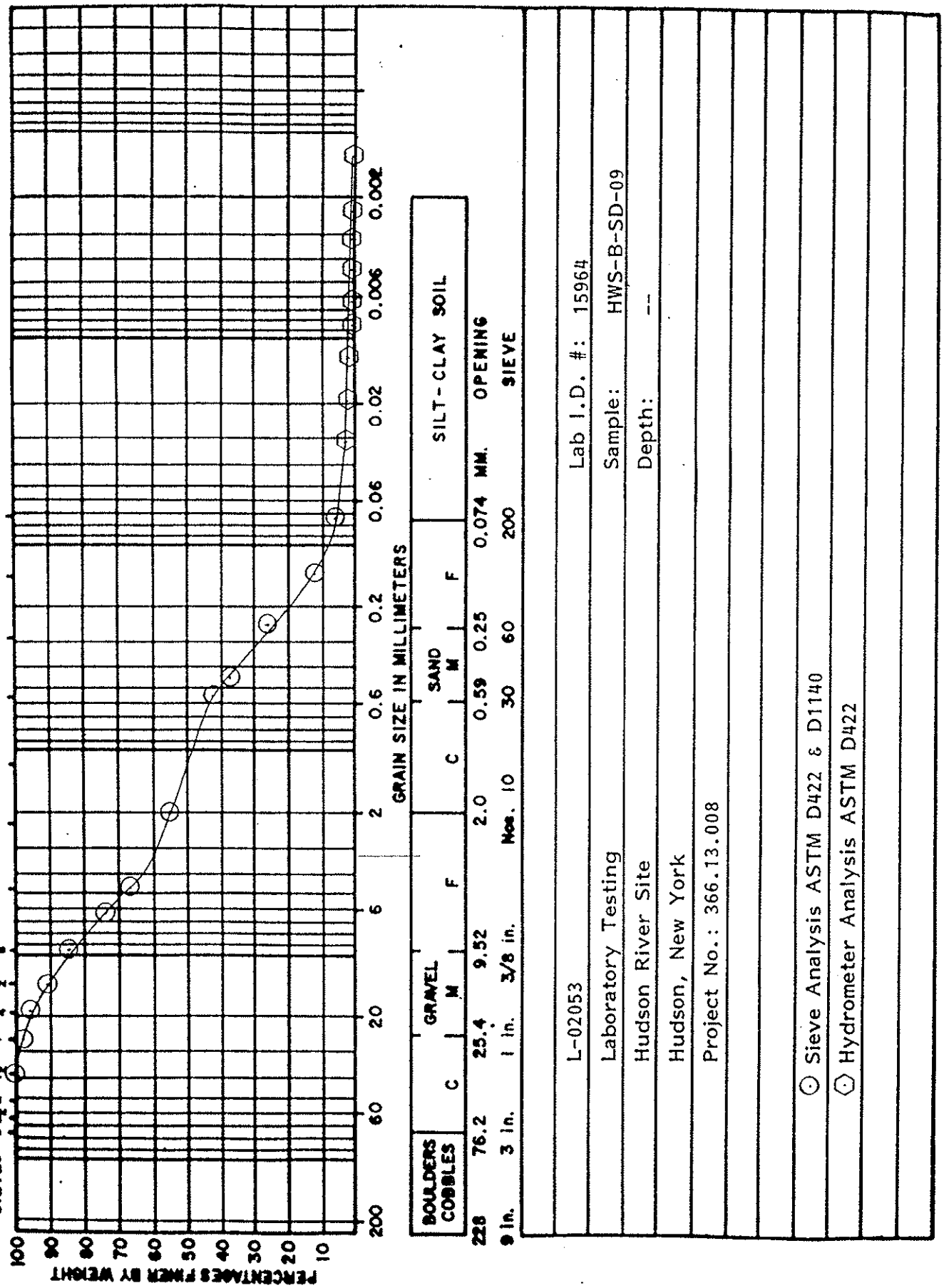
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Job No.: L-02053

Report No: 18

July 11, 2002

GRAIN SIZE ANALYSIS



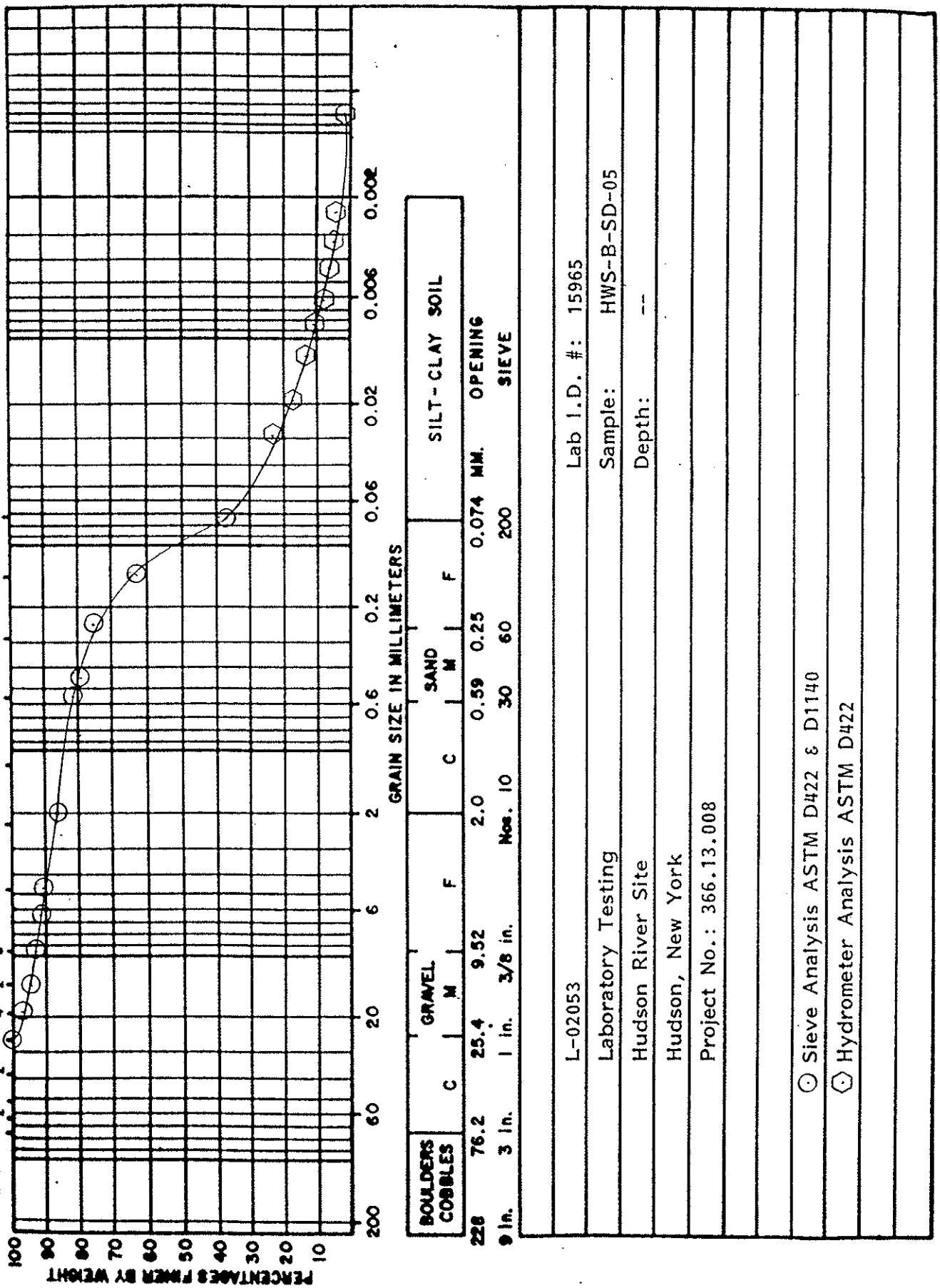
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Job No.: L-02053

Report No: 19

July 11, 2002

GRAIN SIZE ANALYSIS



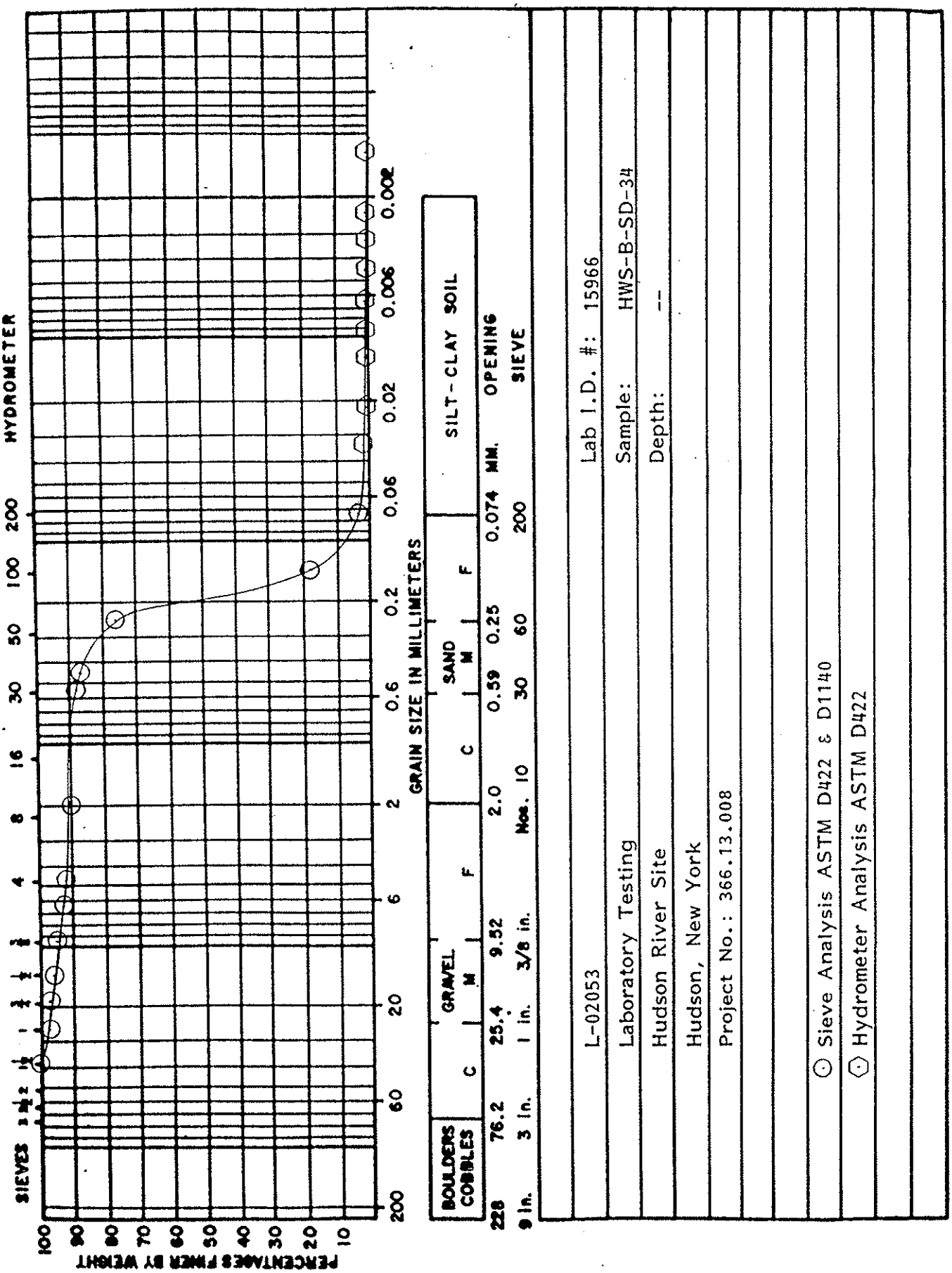
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Job No.: L-02053

Report No: 20

July 11, 2002

GRAIN SIZE ANALYSIS



L-02053

Lab I.D. #: 15966

Laboratory Testing

Sample: HWS-B-SD-34

Hudson River Site

Depth: --

Hudson, New York

Project No.: 366.13.008

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

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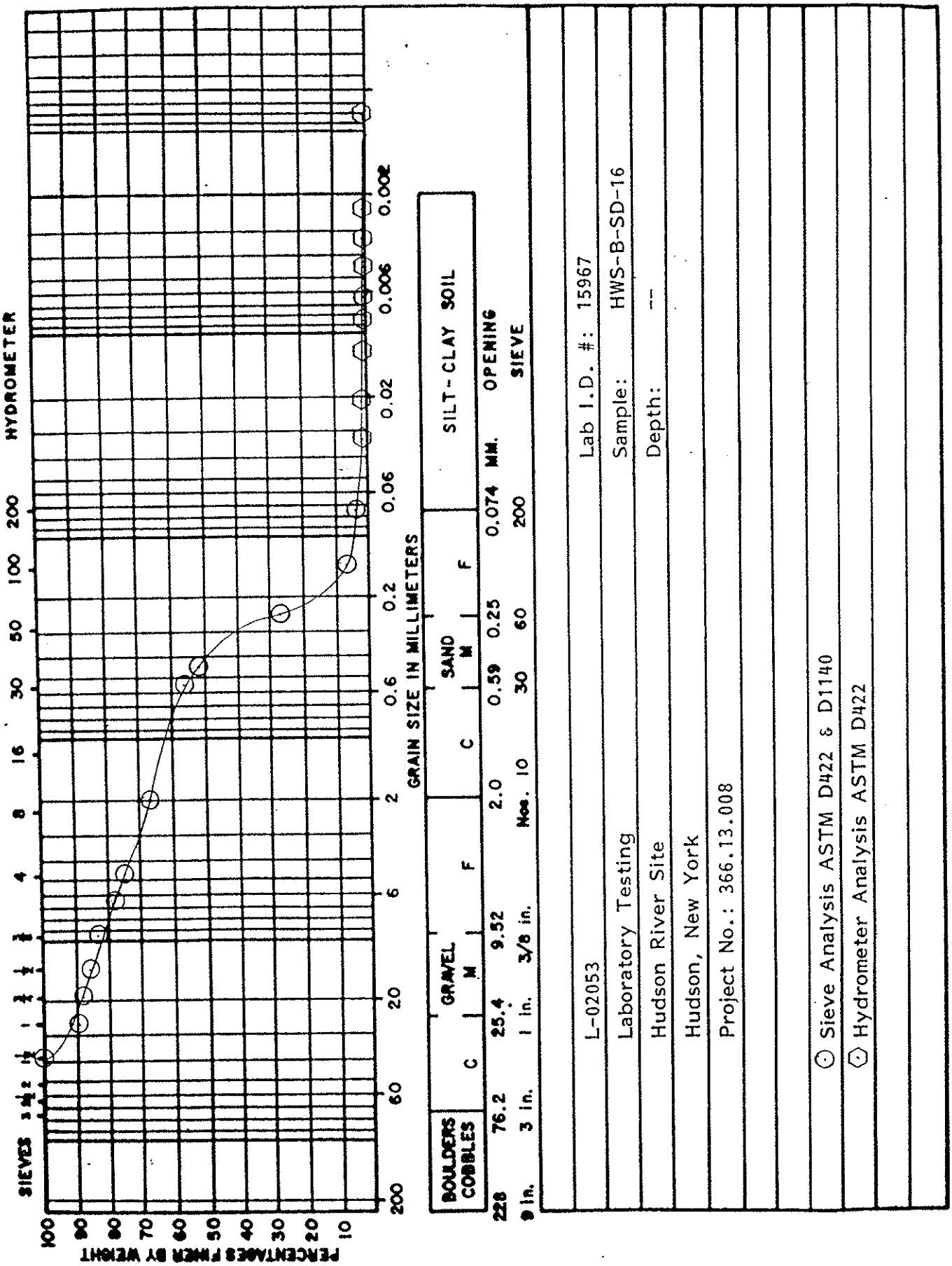
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Job No.: L-02053

Report No: 21

July 11, 2002

GRAIN SIZE ANALYSIS



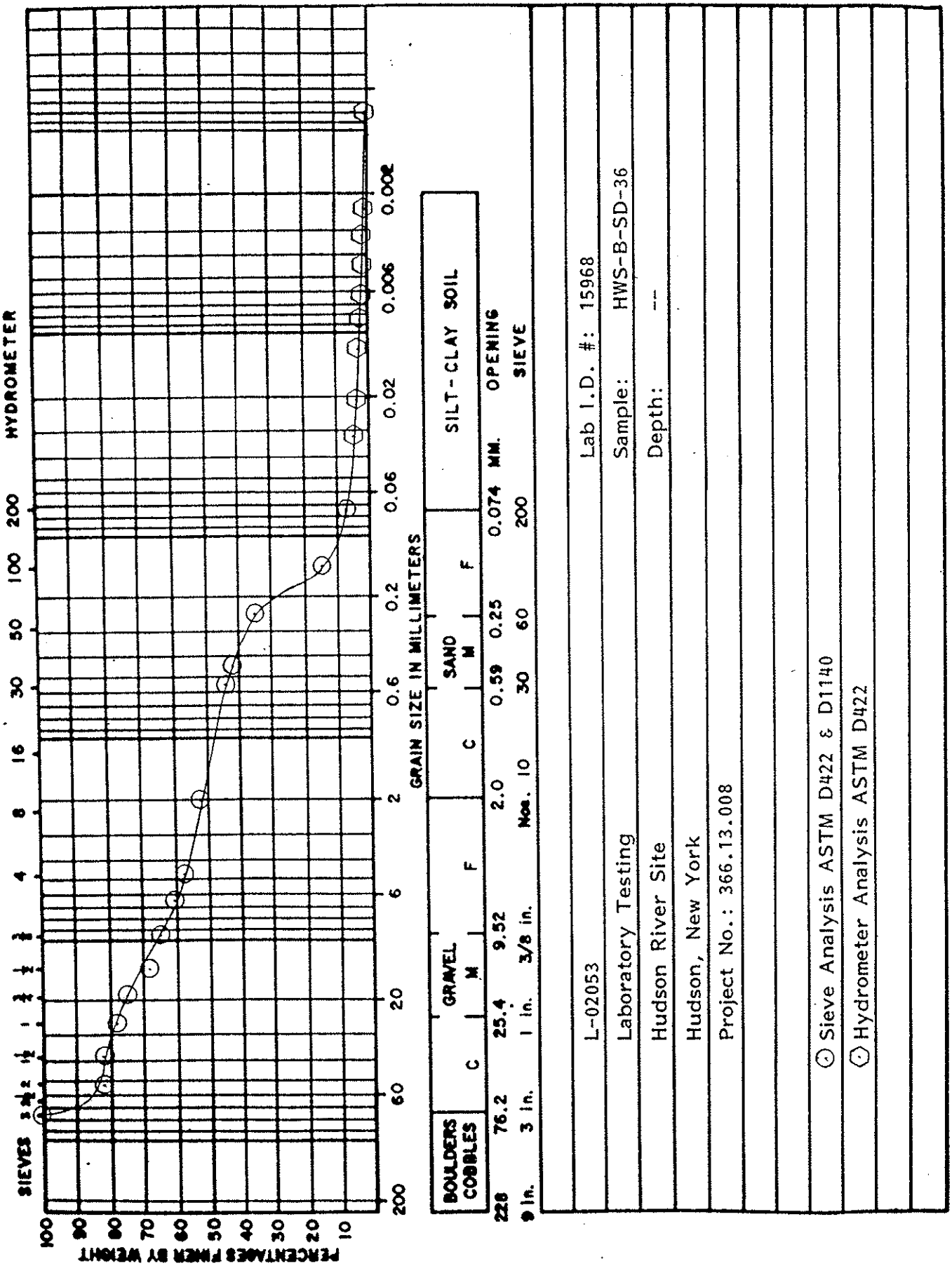
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Job No.: L-02053

Report No: 22

July 11, 2002

GRAIN SIZE ANALYSIS



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July 11, 2002

L-02053
Laboratory Testing
Hudson River
Hudson, New York
Project No.: 366.13.008

ATTERBERG LIMITS
ASTM D4318

Lab ID#	Sample.	Depth (feet)	Plastic Limit	Liquid Limit	Plasticity Index
15937	HWS-SD-12	0.0 – 0.5	Non-Plastic	--	--
15938	HWS-SD-13	0.0 – 0.5	Non-Plastic	--	--
15939	HWS-SD-13	0.5 – 2.0	Non-Plastic	--	--
15940	HWS-SD-80	0.0 – 0.5	Non-Plastic	--	--
15941	HWS-SD-22	0.0 – 0.5	Non-Plastic	--	--
15942	HWS-SD-22	0.5 – 2.0	Non-Plastic	--	--
15943	HWS-SD-23	0.0 – 0.5	Non-Plastic	--	--
15944	HWS-SD-73	0.0 – 0.5	Non-Plastic	--	--
15945	HWS-SD-66	0.0 – 0.5	Non-Plastic	--	--
15946	HWS-SD-69	0.0 – 0.5	Non-Plastic	--	--
15947	HWS-SD-79	0.0 – 0.5	Non-Plastic	--	--
15948	HWS-SD-45	0.0 – 0.5	Non-Plastic	--	--
15949	HWS-SD-13	2.0 – 4.0	Non-Plastic	--	--
15950	HWS-SD-22	2.0 – 4.0	19	28	9
15951	HWS-SD-73	4.0 – 6.0	Non-Plastic	--	--
15952	HWS-SD-73	2.0 – 4.0	Non-Plastic	--	--
15953	HWS-SD-12	0.5 – 2.0	Non-Plastic	--	--
15964	HWS-B-SD-09	--	Non-Plastic	--	--
15965	HWS-B-SD-05	--	Non-Plastic	--	--
15966	HWS-B-SD-34	--	Non-Plastic	--	--
15967	HWS-B-SD-16	--	Non-Plastic	--	--
15968	HWS-B-SD-36	--	Non-Plastic	--	--

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July 11, 2002

L-02053
Laboratory Testing
Hudson River
Hudson, New York
Project No.: 366.13.008

SPECIFIC GRAVITY OF SOILS ASTM D854

Lab I.D. #	Sample	Depth (feet)	Minus No. 4 Fraction Specific Gravity of Solids (G)
15937	HWS-SD-12	0.0 – 0.5	2.64
15938	HWS-SD-13	0.0 – 0.5	2.68
15939	HWS-SD-13	0.5 – 2.0	2.63
15940	HWS-SD-80	0.0 – 0.5	2.58
15941	HWS-SD-22	0.0 – 0.5	2.65
15942	HWS-SD-22	0.5 – 2.0	2.69
15943	HWS-SD-23	0.0 – 0.5	2.69
15944	HWS-SD-73	0.0 – 0.5	2.65
15945	HWS-SD-66	0.0 – 0.5	2.51
15946	HWS-SD-69	0.0 – 0.5	2.69
15947	HWS-SD-79	0.0 – 0.5	2.69
15948	HWS-SD-45	0.0 – 0.5	2.74
15949	HWS-SD-13	2.0 – 4.0	2.68
15950	HWS-SD-22	2.0 – 4.0	2.65
15951	HWS-SD-73	4.0 – 6.0	2.75
15952	HWS-SD-73	2.0 – 4.0	2.72
15953	HWS-SD-12	0.5 – 2.0	2.66
15964	HWS-B-SD-09	--	2.55
15965	HWS-B-SD-05	--	2.62
15966	HWS-B-SD-34	--	2.74
15967	HWS-B-SD-16	--	2.70
15968	HWS-B-SD-36	--	2.67

PW LABORATORIES INC.
P.O. BOX 56, 5879 FISHER ROAD, EAST SYRACUSE, NY 13057
315-437-1420 • (866) 7PW-LABS • FAX 315-437-1752

July 11, 2002

L-02053
Laboratory Testing
Hudson River
Hudson, New York
Project No.: 366.13.008

BULK(NATURAL) SOIL DENSITY (PCF)
CORPS OF ENGINEERS EM-1110-2-1906
APPENDIX II, VOLUMETRIC METHOD

Lab I.D. #	Sample.	Depth (feet)	Bulk (Natural) Soil Density (PCF) Dry Density	Moist Density
15954	HWS-SD-13	0.0 – 2.0	110.0	130.9
15955	HWS-SD-79	0.0 – 2.0	85.6	106.8
15956	HWS-SD-73	0.0 – 2.0	106.5	128.8
15957	HWS-SD-69	0.0 – 2.0	102.9	125.0
15958	HWS-SD-12	0.0 – 2.0	106.1	127.8
15959	HWS-SD-22	0.0 – 2.0	83.8	109.4
15960	HWS-SD-23	0.0 – 2.0	108.6	129.1
15961	HWS-SD-45	0.0 – 2.0	91.3	112.8
15962	HWS-SD-66	0.0 – 0.5	91.0	114.7
15963	HWS-SD-66	0.5 – 2.0	99.3	123.1

ARCADIS

Appendix E

Geochronological Analytical Reports (isotopes)

TELEDYNE
BROWN ENGINEERING
Environmental Services

Margaret Carrillo
Blasland, Bouck & Lee, Inc.
6723 Towpath Road PO Box 66
Syracuse, NY 13214-0066

10 October 1996

CASE NARRATIVE

Teledyne Work Order 4-0300

Received 12 sediment samples in glass bottles on 19 August 1996 and signed the custody document. The samples were derived from three sediment cores. Assigned Teledyne sample numbers 23615 through 23626 to the samples on Teledyne Work Order 4-0300. Also assigned sample numbers 23627 through 23629 for chronology interpretations of the cores.

Dried samples in a laboratory oven near 110 °C for 2 days. Pulverized and mixed the dried samples using a mortar and pestle. Weighed aliquots of 10 grams into glass beakers for Pb-210 analysis.

Performed Pb-210 analyses by procedure PRO-032-30. Separated the Bi-210 daughter products from the samples by radiochemical means and counted them on low level beta detectors. Recorded gravimetric yielding information in the Pb-210 laboratory data book. All chemical yields were greater than 70%. Calculated Pb-210 activities and 2 sigma counting uncertainty bands by computer. Quality control check source counts were within acceptance limits during the period when the beta analyses were performed.

Analytical results are tabulated in the enclosed Report of Analysis. Interpreted the data to determine sedimentation rates (see enclosed reports). A good logarithmic trend of Pb-210 results was found for core SD-31, leading to a calculated sedimentation rate of 1.1 inch/year. In cores SD-23 and SD-27, no excess Pb-210 was found which could be attributed to fallout. No sedimentation rates could be calculated for these two cores. Several possible reasons for this are discussed in the enclosed reports.

The original Chain of Custody document is enclosed, along with a copy of the Report of Analysis and the chronology interpretations. Also enclosed are copies of detector system printouts and data sheets for these samples, and pages from the laboratory notebook. Quality Control documents are enclosed which pertain to the performance, backgrounds, and calibration of the detection system.

H. Jeter

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

REPORT OF ANALYSIS

RUN DATE 10/10/96

WORK ORDER NUMBER	CUSTOMER P.O. NUMBER	DATE RECEIVED	DELIVERY DATE	PAGE
4-0300	364.68.002	08/19/96	09/18/96	1

MS MARGARET CARRILLO
BLASLAND BOUCK & LEE INC
6723 TOWPATH ROAD PO BOX 66
SYRACUSE NY 13214-0066

SEDIMENT/SILT

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/GM DRY)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
23615	CORE SD-23 6-7 IN		08/14				PB-210	2.8 +-0.8 E-01		09/28			3
23616	CORE SD-23 25-26 IN		08/14				PB-210	3.1 +-0.9 E-01		09/28			3
23617	CORE SD-23 42-43 IN		08/14				PB-210	5.4 +-1.0 E-01		09/28			3
23618	CORE SD-23 59-60 IN		08/14				PB-210	2.3 +-0.8 E-01		09/28			3
23619	CORE SD-27 6-7 IN		08/14				PB-210	5.5 +-1.1 E-01		09/28			3
23620	CORE SD-27 25-26 IN		08/14				PB-210	4.3 +-0.9 E-01		09/28			3
23621	CORE SD-27 42-43 IN		08/14				PB-210	3.7 +-0.9 E-01		09/28			3
23622	CORE SD-27 59-60 IN		08/14				PB-210	3.7 +-1.0 E-01		09/28			3
23623	CORE SD-31 6-7 IN		08/15				PB-210	2.7 +-0.2 E 00		09/28			3
23624	CORE SD-31 25-26 IN		08/15				PB-210	2.0 +-0.2 E 00		09/28			3
23625	CORE SD-31 42-43 IN		08/15				PB-210	1.6 +-0.2 E 00		09/28			3
23626	CORE SD-31 59-60 IN		08/15				PB-210	8.6 +-1.3 E-01		09/28			3
23627	INTERPRET SD-23		/				INTERPRT	DONE					3
23628	INTERPRET SD-27		/				INTERPRT	DONE					3
23629	INTERPRET SD-31		/				INTERPRT	DONE					3

LAST PAGE OF REPORT

SEND 1 COPIES TO BLO53S MS MARGARET CARRILLO

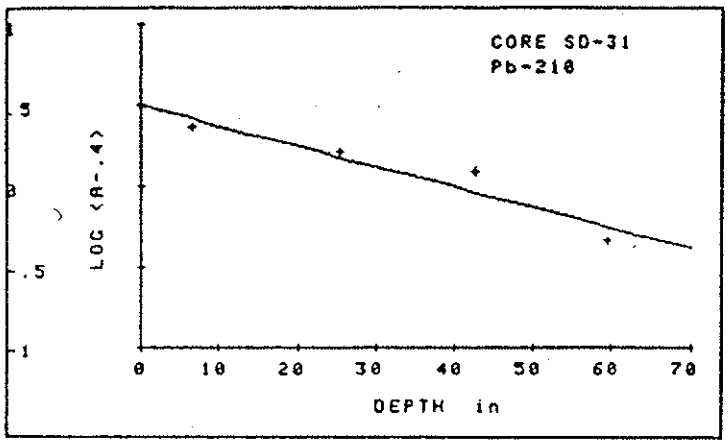
APPROVED BY J. GUENTHER 10/10/96

2 - GAS LAB. 3 - RADIO CHEMISTRY LAB. 4 - GE(LI) GAMMA SPEC LAB. 5 - TRITIUM GAS/L.S. LAB. 6 - ALPHA SPEC LAB.

TELEDYNE
BROWN ENGINEERING
Environmental Services

Margaret Carrillo
Blasland, Bouck & Lee, Inc.
6723 Towpath Road PO Box 66
Syracuse, NY 13214-0066

10 October 1996



CORE SD-31 : Pb-210 Chronology

Supported Pb-210 assumed 0.4 pCi/gm dry

Fitted curve: Y= -0.0126X + 0.498 Correlation R square: 0.91

Inferred sedimentation rate: 1.1 in/yr

Teledyne Sample No.	Depth inches	Pb-210 pCi/gm	Description
23623	6 - 7	2.7 +- .2	silt + fine sand + pebbles + cinders + glass
23624	25 - 26	2.0 +- .2	silt + fine sand + pebbles + cinders + glass
23625	42 - 43	1.6 +- .2	silt + fine sand + pebbles + cinders
23626	59 - 60	.86 +- .13	silt

H. Jeter

TELEDYNE
BROWN ENGINEERING
Environmental Services

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Syracuse, NY 13214-0066

10 October 1996

CORE SD-23 : Pb-210 Chronology

All Pb-210 measurements are near the usual supported level of 0.4 pCi/gram. No elevated values were found which could be attributed to natural fallout. Consequently, no sedimentation rate can be calculated from the data.

There are several ways that measurements of this kind could be produced, such as:

1. Sediment has been dredged or dumped in this area.
2. A flood or fast current event has scoured and removed the surface sediments, or has deposited a load of sediment derived from upstream.
3. The sedimentation rate is so slow that elevated Pb-210 lies above the shallowest sample at 6 - 7 inches (sedimentation rate less than .07 inches/year).

Teledyne Sample No.	Depth inches	Pb-210 pCi/gm	Description
23615	6 - 7	.28 +- .08	silt + fine sand
23616	25 - 26	.31 +- .09	silt + fine sand
23617	42 - 43	.54 +- .10	silt
23618	59 - 60	.23 +- .08	silt + fine sand + one 1.5 cm cinder

H. Jeter

TELEDYNE
BROWN ENGINEERING
Environmental Services

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Syracuse, NY 13214-0066

10 October 1996

CORE SD-27 : Pb-210 Chronology

All Pb-210 measurements are near the usual supported level of 0.4 pCi/gram. No elevated values were found which could be attributed to natural fallout. Consequently, no sedimentation rate can be calculated from the data.

There are several ways that measurements of this kind could be produced:

1. Sediment has been dredged or dumped in this area.
2. A flood or fast current event has scoured and removed the surface sediments, or has deposited a load or sediment derived from upstream.
3. The sedimentation rate is so slow that elevated Pb-210 lies above the shallowest sample at 6 - 7 inches (sedimentation rate less than .07 inches/year).

Teledyne Sample No.	Depth inches	Pb-210 pCi/gm	Description
23619	6 - 7	.55 +- .11	silt
23620	25 - 26	.43 +- .09	silt + one 1.5 cm sliver of white glass or porcelain
23621	42 - 43	.37 +- .09	silt
23622	59 - 60	.37 +- .10	silt

H. Jeter

Hud - River - Sediment sampling

BLASLAND, BOUCK & LEE, INC. engineers & scientists
6723 Towpath Road, P.O. Box 66
Syracuse, New York 13214-0066
TEL: (315) 446-9120

CHAIN OF CUSTODY RECORD

Attn: Hewith Jeter

PROJ. NO. | PROJECT NAME: Niagara Mohawk - Hudson, N.Y.

SAMPLERS: (Signature) Todd E. Mlawski

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	Number of Containers	Pb-210	REMARKS
	8/14/96	-		X	SD-23 (6"-7")	1	X	* - Standard Turnaround Time
		-			SD-23 (25"-26")	1	X	- Deliverable data package
		-			SD-23 (42"-43")	1	X	- Provide Chronology
		-			SD-23 (59"-60")	1	X	Interpretation
		-			SD-27 (6"-7")	1	X	
		-			SD-27 (25"-26")	1	X	
		-			SD-27 (42"-43")	1	X	
	↓	-			SD-27 (59"-60")	1	X	
	8/15/96	-			SD-31 (6"-7")	1	X	
		-			SD-31 (25"-26")	1	X	
		-			SD-31 (42"-43")	1	X	
	↓	-		↓	SD-31 (59"-60")	1	X	

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	Relinquished by: (Signature)	DATE	TIME	Relinquished by: (Signature)
Todd E. Mlawski	8/16/96	1500					
Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	Relinquished by: (Signature)	DATE	TIME	Relinquished by: (Signature)
	8/16/96	1144					
Relinquished by: (Signature)	DATE	TIME	Received for Laboratory by: (Signature)	DATE	TIME	Remarks:	

10/23/95
5951186L.CDR

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Blasland, Bauck & Lee

Pb-210

"B"

9/28/96 @ 1440

Sample name : sam Mode : beta 28/09/96 16:19:49
Ranges b [com] I < 50.00 II = (50.00 ... 5000.00) III > 5000.00
Measuring time beta [min :sec] elapsed 100 : 00 Preset 100 : 00
Measurement results: GUARD [cpm] 760.24

Det#	Spl#	Cat	cpmb	1-S-cpm	Bq-b	1-S-%Er	
1	11	I	1.290	.114	.022	8.805	23615
2	12	I	1.280	.113	.021	8.839	23616
3	13	I	1.930	.139	.032	7.198	23617
4	14	I	1.020	.101	.017	9.901	23618
5	15	I	2.000	.141	.033	7.071	23619
6	16	I	.190	.044	.003	22.94	
7	17	I	.400	.063	.007	15.81	
8	18	I	1.670	.129	.028	7.738	23620
9	19	I	.270	.052	.005	19.25	
10	20	I	1.600	.126	.027	7.906	23621

"B" Counter Printouts

Blasland, Bouck & Lee

PB-210

"B" 9/28 @ 1630

Sample name : sam Mode : beta 28/09/96 18:12:48
Ranges b [cpm] I < 50.00 II = (50.00 ... 5000.00) III > 5000.00
Measuring time beta [min :sec] elapsed 100 : 00 Preset 100 : 00
Measurement results: GUARD [cpm] 749.07

Det#	Spl#	Cat	comb	1-S-cpm	Bq-b	1-S-%Er	
1	21	I	1.440	.120	.024	8.333	23622
2	22	I	8.330	.292	.142	3.424	23623
3	23	I	6.260	.250	.104	3.997	23624
4	24	I	5.180	.228	.086	4.394	23625
5	25	I	2.850	.169	.048	5.923	23626
6	26	I	.240	.049	.004	20.41	
7	27	I	.410	.064	.007	15.62	
8	28	I	.160	.040	.003	25.00	
9	29	I	.220	.047	.004	21.32	
10	30	I	.400	.063	.007	15.81	

Pb-210

12/5/96 BLASCHKE, BOUCK & LEE

2 1200 HJ SS 10 gm ÷ .0383

					Yield	
D	23615	.0395	.0708	.0313	.82	
D	23616	.0393	.0684	.0291	.76	
D	23617	.0382	.0675	~~.0313~~ .0293	~~.82~~ .76	HJ
(4)	23618	.0391	.0669	.0278	.73	
(5)	23619	.0398	.0711	.0313	.82	
(6)	23620	.0389	.0689	.0300	.78	
(7)	23621	.0397	.0691	.0294	.77	
(8)	23622	.0398	.0683	.0285	.74	
(9)	23623	.0402	.0700	.0298	.78	
(10)	23624	.0397	.0688	.0291	.76	
(11)	23625	.0397	.0689	.0292	.76	
(12)	23626	.0402	.0708	.0306	.80	
	~~23627~~					

Checked 9/30/96 HJ

Laboratory Notebook

SAMPLE NUMBER	NUCLIDE
23615	PB-210

CUSTOMER Bjorklund, Bouck, & Lee COLLECTION DATE 08/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .82 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR .647 (MILK TO COUNT) ASH WT. / WET WT. (100) = _____ %

COUNTING Date	COUNTING Time	COUNTER	N (Counts)	Δt (min)	N/Δt (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1440	B1	129	100	1.29	.39	.90	.27	2.8±0.8E-01

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL
2.8 ± 0.8 E-01

UNITS pCi CALC. BY KT DATE 10/7

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM INL-3A Revised 3/15/81

SAMPLE NUMBER	NUCLIDE
23616	PB-210

CUSTOMER Blasland, Bouck, & Lee COLLECTION DATE 8/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .76 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR .647 (MILK TO COUNT) ASH WT. / WET WT. (100) = _____ %

COUNTING Date	COUNTING Time	COUNTER	N (Counts)	Δt (min)	N/Δt (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1440	B2	128	100	1.28	.37	.91	.27	3.1 ± 0.9 E-01

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL: 3.1 ± 0.9 E-01

UNITS pCi CALC. BY HJ DATE 10/7

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM IWL-3A Revised 3/15/91

SAMPLE NUMBER	NUCLIDE
23617	PB-210

CUSTOMER Blasland, Bouck & Lee COLLECTION DATE 9/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .76 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR .647 (MILK TO COUNT) ASH WT. / WET WT. (100) = _____ %

COUNTING Date	Time	COUNTER	N (Counts)	Δt (min)	N/Δt (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/25	1440	B3	193	100	1.93	.35	1.58	.27	5.4 ± 1.0E-01

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL: 5.4 ± 1.0 E-01

UNITS pCi CALC. BY HJ DATE 10/7

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM INL-3A Revised 3/15/81

SAMPLE NUMBER	NUCLIDE
23618	PB-210

CUSTOMER Blasland, Bouck, & Lee COLLECTION DATE 08/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .73 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR (MILK TO COUNT) .647 $\frac{\text{ASH WT.}}{\text{WET WT.}}$ (100) = _____ %

COUNTING Date	COUNTING Time	COUNTER	N (Counts)	Δt (min)	$\frac{N}{\Delta t}$ (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1440	B4	102	100	1.02	.38	.64	.27	$2.3 \pm 0.8 E-01$

Decay Factor	INTERVAL Collin to Ct	INTERVAL Ct to Ct

ACTIVITY OR MDL: $2.3 \pm 0.8 E-01$

UNITS pCi CALC. BY HJ DATE 10/7

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM INL-3A Revised 3/15/81

SAMPLE NUMBER	NUCLIDE
23619	PB-210

CUSTOMER Bgsl, Bouck & Lee COLLECTION DATE 8/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .82 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR (MILK TO COUNT) .647 ASH WT. / WET WT. (100) = _____ %

COUNTING Date	COUNTING Time	COUNTER	N (Counts)	At (min)	N/At (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1440	B5	200	100	2.00	.39	1.61	.25	5.5 ± 1.1E-01

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL: 5.5 ± 1.1 E-01

UNITS pCi CALC. BY HJ DATE 10/7

ENTERED _____ CHECKED BY JM DATE 10-8-96

FORM INL-3A Revised 3/15/81

SAMPLE NUMBER: 23620

NUCLIDE: PB-210

CUSTOMER Blasland, Bouck & Lee COLLECTION DATE 9/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .78 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR (MILK TO COUNT) .647 $\frac{\text{ASH WT.}}{\text{WET WT.}}$ (100) = _____ %

COUNTING Date	Time	COUNTER	N (Counts)	At (min)	$\frac{N}{At}$ (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1440	B-5	167	100	1.67	.36	1.31	.27	4.3 ± 0.9E-01

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL: 4.3 ± 0.9 E-01

UNITS pCi CALC. BY HJ DATE 10/2

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM IWL-3A Revised 3/15/81

SAMPLE NUMBER	NUCLIDE
23621	PB-210

CUSTOMER Blasland, Bouck, & Lee COLLECTION DATE 08/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .72 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR (MILK TO COUNT) .647 ASH WT. / WET WT. (100) = _____ %

COUNTING Date	COUNTING Time	COUNTER	N (Counts)	At (min)	N/At (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1440	B-10	160	100	1.60	.44	1.16	.28	3.7 ± 0.9 E-01

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL: 3.7 ± 0.9 E-01

UNITS pCi CALC. BY HJ DATE 10/7

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM INL-3A Revised 3/15/81

SAMPLE NUMBER	NUCLIDE
23622	PB-210

CUSTOMER Blasland, Bouck, & Lee COLLECTION DATE 08/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .74 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR (MILK TO COUNT) .641 $\frac{\text{ASH WT.}}{\text{WET WT.}}$ (100) = _____ %

COUNTING Date	COUNTING Time	COUNTER	N (Counts)	Δt (min)	$\frac{N}{\Delta t}$ (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1630	B-1	144	100	1.44	.39	1.05	.27	3.7 ± 1.0 E-01

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL
3.7 ± 1.0 E-01

UNITS pCi CALC. BY HT DATE 10/2

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM IWL-3A Revised 3/15/81

SAMPLE NUMBER	NUCLIDE
23623	PB-210

CUSTOMER Bagdad, Bouck, Lee COLLECTION DATE 8/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .78 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR (MILK TO COUNT) .641 $\frac{\text{ASH WT.}}{\text{WET WT.}}$ (100) = _____ %

COUNTING Date	Time	COUNTER	N (Counts)	Δt (min)	$\frac{N}{\Delta t}$ (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1630	B-2	853	100	8.53	.37	8.16	.27	2.7±0.2 E 00

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL
2.7 ± 0.2 E 00

UNITS pCi CALC. BY HJ DATE 10/7

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM RWL-3A Revised 3/15/81

SAMPLE NUMBER	NUCLIDE
23624	PB-210

CUSTOMER Blodgett, Bouck & Lee COLLECTION DATE 08/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .76 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR (MILK TO COUNT) .641 $\frac{\text{ASH WT.}}{\text{WET WT.}}$ (100) = _____ %

COUNTING Date	COUNTING Time	COUNTER	N (Counts)	At (min)	$\frac{N}{At}$ (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1630	B-3	626	100	6.26	.35	5.91	.27	2.0 ± 0.2 E 00

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL: 2.0 ± 0.2 E 00

UNITS pCi CALC. BY HT DATE 10/7

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM INL-3A Revised 3/15/91

SAMPLE NUMBER	NUCLIDE
23625	PB-210

CUSTOMER Blasland, Bouck, & Lee COLLECTION DATE 08/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .76 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR (MILK TO COUNT) .641 $\frac{\text{ASH WT.}}{\text{WET WT.}}$ (100) = _____ %

COUNTING Date	Time	COUNTER	N (Counts)	At (min)	$\frac{N}{At}$ (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1630	B-4	518	100	5.18	.38	4.80	.27	$1.6 \pm 0.2 \in 00$ -HJ

Decay Factor	INTERVAL Coll to Ct	Ct to Ct

ACTIVITY OR MDL: 1.6 ± 0.2 E -00

UNITS pCi CALC. BY HJ DATE 10/7

ENTERED _____ CHECKED BY [illegible] DATE 10/8/96

FORM INL-3A Revised 3/15/81

SAMPLE NUMBER	NUCLIDE
23626	PB-210

CUSTOMER Blasland, Bouck, & Lee COLLECTION DATE 08/1

MOUNTING DATE 9/27/96 SAMPLE TYPE SS

VOLUME _____ UNITS _____ ALIQUOT 10gm

SCAVENGE DATE _____ TIME _____ YIELD .80 NUCLIDE Bi ASH WT. _____ gms

MILKING DATE 9/25/96 TIME 1200 YIELD _____ NUCLIDE _____ WET WT. _____ gms

ANALYST HJ INGROWTH FACTOR _____ DECAY FACTOR (MILK TO COUNT) .641 ASH WT. / WET WT. (100) = _____ %

COUNTING Date	Time	COUNTER	N (Counts)	At (min)	N/At (cpm)	Bkg. (cpm)	A (cpm)	E (eff.)	
9/28	1630	B-5	285	100	2.85	.39	2.46	.25	8.6 ± 1.3 E-01

Decay Factor	INTERVAL Collin to Ct	Ct to Ct

ACTIVITY OR MDL: 8.6 ± 1.3 E-01

UNITS pCi CALC. BY HJ DATE 10/7

ENTERED _____ CHECKED BY _____ DATE 10-8-96

FORM RWL-3A Revised 3/15/91

RADIOCHEMISTRY

B COUNTERS

BACKGROUNDS - CHECKSOURCES

SEPTEMBER 1996

B1

	Blank			Bkg. Avg.	Bkg. Abs.	Cs-137 Cks.	
Date	N	Δt	CPM			262 - 295	
1							
2							
3		800	.19			272.8	(200).165
4						264.8	
5						270.3	
6						274.6	
7							
8							
9		800	.184	.18		262.1	200(.160)
10		800			.147	266.8	
11						269.7	
12						258.1 *	RS.(269.4)
13						281.9	
14							
15		800	.168	.17			
16						277.7	200(.200)
17						275.0	
18						280.9	
19						270.0	
20						280.9	
21						276.0	CG
22		800	.183	.18			
23						275.0	200(.150)
24						273.8	
25						279.4	
26						267.7	
27						274.4	
28		800			.137		
29							
30		800	.194	.19		282.3	200(.165)
31							

KEY
* = Outside Control Limits
RS = Restart
CG = Change Gas

B2

	Blank			Bkg. Avg.	Bkg. Abs.	Cs-137 Cks.	
Date	N	Δt	CPM			198-229	
1							
2							
3		800	.15			203.3	200(.150)
4						212.2	
5						204.6	
6						212.8	
7							
8							
9		800	.153	.15		216.3	200(.150)
10		800			.34	208.6	
11						208.6	
12						204.2	
13						216.9	
14							
15		800	.151	.15			
16						201.6	200(.150)
17						198.9	
18						210.9	
19						208.9	
20						205.7	
21						220.5	CG
22		800	.170	.17			
23						211.4	200(.165)
24						211.5	
25						214.5	
26						200.2	
27						223.8	
28		800			.45		
29							
30		800	.174	.17		213.1	200(.235)
31							

CFY
* = Outside Control Limits
RS = Restart
CG = Change Gas

B3

Date	Blank N	Blank Δt	Blank CPM	Bkg. Avg.	Bkg. Abs.	Cs-137 Cks. 229 - 254	
1							
2							
3		800	.17			245.9	200(.155)
4						242.5	
5						231.3	
6						232.0	
7							
8							
9		800	.150	.15		237.2	200(.100)
10		800			.39	237.1	
11						241.6	
12						235.7	
13						233.7	
14							
15		800	.158	.16			
16						238.7	200(.160)
17						238.6	
18						235.3	
19						227.6*	RS. 237.8
20						249.8	
21						243.5	CG
22		800	.160	.16			
23						240.0	200(.160)
24						232.8	
25						243.9	
26						242.5	
27						232.5	
28		800			.38		
29							
30		800	.151	.15		242.2	200(.110)
31							

Y = Outside Control Limits
RS = Restart
CG = Change Gas

B4

	Blank			Bkg. Avg.	Bkg. Abs.	Cs-137 Cks. 248-292	
Date	N	Δt	CPM				
1							
2							
3		800	.16			266.6	200(.155)
4						277.5	
5						259.1	
6						275.6	
7							
8							
9		800	.168	.17		277.9	200(.200)
10		800			.45	274.9	
11						268.9	
12						250.4	
13						275.7	
14							
15		800	.175	.18			
16						271.3	200(.170)
17						261.8	
18						275.2	
19						269.3	
20						281.5	
21						261.2	CG
22		800	.170	.17			
23						270.6	200(.165)
24						277.8	
25						270.1	
26						270.9	
27						261.6	
28		800			.47		
29							
30		800	.178	.18		273.0	200(.110)
31							

EY
= Outside Control Limits
RS = Restart
CG = Change Gas

B5

Date	Blank N	Blank Δt	Blank CPM	Bkg. Avg.	Bkg. Abs.	Cs-137 Cks. 246 - 305	
1							
2							
3		800	.21			276.0	200(.175)
4						280.1	
5						279.2	
6						284.2	
7							
8							
9		800	.200	.20		284.1	200(.190)
10		800			.41	293.2	
11						304.6	
12						278.6	
13						281.0	
14							
15		800	.190	.19			
16						286.7	200(.185)
17						273.7	
18						284.2	
19						284.2	
20						283.4	
21						284.5	CG
22		800	.213	.21			
23						289.6	200(.230)
24						276.4	
25						286.1	
26						278.6	
27						279.7	
28		800			.36		
29							
30		800	.194	.19		271.1	200(.120)
31							

KEY

- = Outside Control Limits
RS = Restart
CG = Change Gas

B6

Date	Blank N	Blank Δt	Blank CPM	Bkg. Avg.	Bkg. Abs.	Cs-137 Cks. 286 - 325	
1							
2							
3		800	.22			283.8 *	RS 294.4
4						310.2	
5						1895. *	RS. 291.7
6						286.4	
7							
8							
9		800	.213	.21		296.5	200(.175)
10		800			.40	290.1	
11						283.6	
12						285.9 *	
13						281.4 *	
14							
15		800	.199	.20			
16						290.0	200(.165)
17						289.7	
18						289.6	
19						308.1	
20						292.9	
21						299.4	CC
22		800	.181	.18			
23						300.1	200(.180)
24						306.5	
25						298.0	
26						300.6	
27						298.1	
28		800			.45		
29							
30		800	.201	.20		303.4	200(.170)
31							

200(47.
NOT 50

KEY

- * = Outside Control Limits
- = Restart
- = Change Gas

B7

Date	Blank N	Blank Δt	Blank CPM	Bkg. Avg.	Bkg. Abs.	Cs-137 Cks. 272-308	
1							
2						NOT	IN USE
3		800	.18			310.1	200 (.150)
4						285.5	
5						269.8 *	
6						272.9	
7							
8							
9		800	.181	.18		285.1	200(.165)
10		800			.37	289.4	
11						295.5	
12						270.6 *	
13						288.6	
14							
15		800	.184	.18			
16						292.4	200(.185)
17						279.9	
18						286.6	
19						286.8	
20						292.6	
21						280.4	CG
22		800	.190	.19			
23						286.4	200 (.180)
24						294.6	
25						294.8	
26						281.4	
27						288.8	
28		800			.38		
29							
30		800	.209	.21		295.9	200(.155)
31							

KEY

- = Outside Control Limits
- = Restart
- CG = Change Gas

B8

Date	Blank N	Blank Δt	Blank CPM	Bkg. Avg.	Bkg. Abs.	Cs-137 Cks. 246 - 291	
1							
2							
3		800	.18			263.7	200 (.200)
4						261.8	
5						265.7	
6						269.9	
7							
8							
9		800	.166	.17		258.2	200(.145)
10		800			.38	262.4	
11						267.6	
12						261.8	
13						269.7	
14							
15		800	.163	.16			
16						262.4	200(.180)
17						277.1	
18						266.8	
19						262.3	
20						283.1	
21						265.1	HT
22		800	.189	.19			
23						283.7	200(.260)
24						273.0	
25						279.0	
26						264.0	
27						279.6	
28		800			.40		
29							
30		800	.164	.16		278.3	200(.145)
31							

KEY

= Outside Control Limits

= Restart

CG = Change Gas

B9

Date	Blank N	Blank Δt	Blank CPM	Bkg. Avg.	Bkg. Abs.	Cs-137 Cks. 284 - 335	
1							NOT IN USE
2							
3		800	4.01			303.7	200 (2.87)
4						291.2	
5						307.5	
6						297.3	
7							
8							
9		800	.195	.20		300.7	200 (.170)
10		800			.138	303.1	
11						303.1	
12						308.0	
13						305.9	
14							
15		800	.223	.22			
16						307.5	200 (.270)
17						312.7	
18						309.0	
19						296.0	
20						312.4	
21						290.4	HT
22		800	.185	.19			
23						291.0	200 (.245)
24						306.5	
25						307.6	
26						307.2	
27						297.6	
28		800			.43		
29							
30		800	.220	.22		299.4	200 (.235)
31							

EY = Outside Control Limits
RS = Restart
CG = Change Gas

B10

Date	Blank N	Blank Δt	Blank CPM	Bkg. Avg.	Bkg. Abs.	Cs-137 Cks. 292 - 344	
1							
2							
3		800	.28			315.5	200(.255)
4						316.2	
5						299.9	
6						314.9	
7							
8							
9		800	.204	.20		329.5	200(.215)
10		800			.40	319.7	
11						305.6	
12						302.2	
13						313.0	
14							
15		800	.273	.27			
16						310.9	200(.220)
17						309.4	
18						324.7	
19						307.1	
20						308.6	
21						320.4	HJCG
22		800	.250	.25			
23						330.8	200(.250
24						327.0	
25						324.9	
26						313.8	
27						319.5	
28		800			.44		
29							
30		800	.236	.24		315.1	200(.210)
31							

Y
= Outside Control Limits
RS = Restart
CG = Change Gas

ISOTOPES

INVENTORY OF CERTIFIED STANDARD

Standardized Solution 0146
Nominal Activity 20kBq,0-54μCi
For Laboratory Use Only POISON

NUCLIDE: Pb-210

PURCHASED FROM: Amersham

CERTIFICATE NUMBER: (RBZ.24) 0146 DATE: 7/1/91 (Ref)

PURCHASE ORDER NO: 58351 DATE: 7/28/93

DATE	DISPOSITION	COMMENTS
(I) 9/3/93	Diluted 5.3095 gm to 100 ml in 1M HNO_3. H. Jeter	Primary Dilution 5935 pCi/ml on 9/3/93 JMM 9-7-93
(II) 9/3/93	Diluted 1 ml of (I) to 100 ml in 1M HNO_3. H. Jeter	Secondary Dilution 59.35 pCi/ml on 9/3/93 JMM 9-7-93

CERTIFICATE ATTACHED

Certificate of calibration of absolutely standardized radioactive solution

P 3062

NAMAS
CALIBRATION
No. 0146

escription

Principal radionuclide: Lead-210

Product code: RBZ.24

Daughter radionuclide: Bismuth-210 + Polonium-210

Solution number: S1/23/133

easurement

Reference time:	1200 GMT on 1 July 1991	
Radioactive concentration of lead-210:	4.426	kilobecquerels per gram of solution
which is equivalent to:	119.6	nanocuries per gram of solution
Mass of solution:	5.3634	grams
Total activity of lead-210:	23.74	kilobecquerels
which is equivalent to:	642	nanocuries

Method of measurement:
Repeated 4-pi alpha counting over a period of 63 days

ccuracy

Overall uncertainty in the radioactive concentration quoted above: ± 2.4 %

Random uncertainty: ± 0.6 %

Systematic uncertainty: ± 1.8 %

Overall uncertainty is defined on the reverse of the certificate.

uclidic
ity

The estimated activities of any radioactive impurities are listed below expressed as percentages of the activity of the principal radionuclide at the reference time.

Other radionuclides less than 0.02 %

emical
position

2M HNO_3 containing 100 micrograms of lead and 100 micrograms of bismuth per ml.

sical
a

Recommended half life: 22.3 ± 0.2 years

Lead-210: 100% beta particle emission.
Bismuth-210: 100% beta particle emission. Half life 5.01 ± 0.01 days.
Polonium-210: 100% alpha particle emission. Half life 138.38 ± 0.01 days.

arks

The ratio of the activity of bismuth-210 to the activity of lead-210 = 1.0006
At the reference time polonium-210 was in radioactive equilibrium with lead-210.
The ratio of the activity of polonium-210 to the activity of lead-210 was 1.0179
There is no guarantee that all the polonium-210 will remain in solution.
Tests made over 4 years on standardized solutions of lead-210 stored in glass ampoules have shown that loss of lead-210 from solution is negligible other than by radioactive decay.

This product meets the quality assurance requirements of NRC Regulatory Guide 4.15 for achieving implicit NIST traceability as defined in NCRP 58 (1985).

oved
atory

B D D Singleton

Amersham

Amersham Corporation
2636 South Clearbrook Drive
Arlington Heights, Illinois 60005-4692
(708) 593-6300

Amersham

TRACEABILITY TO NIST
(NOTE: NIST was formerly the National Bureau of Standards)

This product satisfies the quality assurance requirements of USNRC Regulatory Guide 4.15, Revision 1, February 19, 1979, for achieving NIST traceability, as defined in NCRP 58 (1985), through Amersham's participation in the USCEA/NIST Measurements Assurance Program of the Nuclear Power Industry.

2780048
12/21/88

Pb-210 Standards
Bi-210 Counting

7/21/93 @ 1020 milking time
Used 5.00 ml EPA/NBS Pb-210 standard solution (primary dilution, 10/11/91) for each standard. Processed per PRO-032-30, step 4.0(i) et seq, using carriers as per step 4.0(e).

÷ .0384

STD	Tare	Final	Δ	Yield
1	.0398	.0598	.0200	.521
2	.0405	.0624	.0219	.570
3	.0404	.0620	.0216	.563
4	.0405	.0632	.0227	.591
5	.0407	.0609	.0202	.526

Uniformity Check
Counted Bi-210 standards in BS counter for 10 minutes each on 7/22/93 afternoon:

STD	N	$3\sqrt{N}$	3σ range	N/yield	3σ range/yield	
1	2686	155	2531-2841	5155	4858-5453	
2	2938	163	2775-3101	5154	4868-5440	
3	2702	156	2546-2858	4799	4522-5076	Low REJECT
4	3037	165	2872-3202	5138	4860-5418	
5	2806	159	2647-2965	5335	5032-5637	

Avg 5116

Rejected STD 3 because its range of 4522-5076 does not include the average value 5116. H. Jeter 7/22/93

The ~~Bio~~ Bi-210 standards are covered with aluminum foil in the same manner that samples are prepared in PRO-032-30. H. Jeter

Bi-210 Calibration

7/22/93

Counted new Bi-210 standards described on facing page:

All counts ave. 40 minutes.

Measurement results:

Std #	Det#	Spl#	Cat	cpmb	
1	1	1	II	255.5	} started 1420
2	2	2	II	286.1	
4	3	3	II	304.8	
5	4	4	II	294.6	
1	5	5	I	262.6	} 1510
2	6	6	I	292.8	
4	7	7	I	310.0	
5	8	8	I	306.3	
1	9	9	I	275.9	} 1550
2	10	10	I	290.3	

DF1 7/21/93 @ 1020 – 7/22/93 @ 1440 : 28.33 hr

$DF1 = e^{(-.00576)(28.33\,hr)} = \boxed{.849}$

DF2 7/21/93 @ 1020 – 7/22/93 @ 1530: 29.17 hr

$DF2 = e^{(-.00576)(29.17\,hr)} = \boxed{.845}$

DF3 7/21/93 @ 1020 – 7/22/93 @ 1610: 29.83 hr

$DF3 = e^{(-.00576)(29.83)} = \boxed{.842}$

7/23/93

Calculation of Bi-210 Efficiencies

Counter	Std #	Gross cpm	Bkg	DPM	ϵ_{Bi-210}
B1	1	258.5	.39	951.0	.271
B2	2	286.1	.35	1040	.275
B3	4	306.6	.38	1079	.284
B4	5	294.5	HJ ~~39~~ .35	960.1	.306
B5	1	263.5	.39	946.5	.278
B6	2	292.5	HJ ~~40~~ .39	1036	.282
B7	4	310.8	HJ ~~39~~ .40	1074	.289
B8	5	306.3	.39	955.6	.320
B9	1	275.9	.38	943.2	.292
B10	2	290.3	.44	1032	.281

$$\epsilon_{Bi-210} = (\text{Gross cpm} - \text{bkg}) / \text{DPM}$$

$$\text{DPM} = (2150)(\text{yield})(DF)$$

DPM on 7/~~23~~21/93 HJS (5 ml Std)

from milking of Bi-210 mid- to Count Time

H. Jeter

7/23/93

Efficiency Ratio

$\epsilon_{Bi-210} / \epsilon_{Cs-137}$

B1	.928
B2	.952
B3	.963
B4	1.041
B5	.924
B6	.959
B7	.951
B8	1.042
B9	.954
B10	.901

.962 Avg.

H. Jeter

TELEDYNE ISOTOPES

RADIOACTIVE MATERIAL
SOLN 2437-4 wt. ~5.0g
AMT. 14.05 nanoCi/g
ISOTOPE Cs-137
DATE 12/6/91;0400PST
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY-LAS VEGAS

INVENTORY OF CERTIFIED STANDARD

NUCLIDE: Cs-137

PURCHASED FROM: EPA

third ampoule of this std

CERTIFICATE NUMBER: 2437-4 (3) DATE: 12/6/91 (ReA)

PURCHASE ORDER NO: NA DATE: NA

	DATE	DISPOSITION	COMMENTS	
I	8/5/94	Diluted 4.9538 gm to 100 ml including 10 drops HNO_3. H. Jeter	Primary dilution 654.6 pCi/ml on 8/9/94	JMV 8-23-
	8/8/94	Used 16 aliquots of 1ml each for beta standards evaporated in 2 inch planchets with residue for self absorption curve. H. Jeter	654.6 pCi each on 8/9/94 = 1453 dpm each	JMV 8-23-4
I	1/26/95	Diluted 3.406 ml to 100 ml including a few drops HNO_3 H. Jeter	22.1 nCi/ml ref 12/27/94 For β spikes	JMV 3-1-9
	3/27/95	Used 7 aliquots of (I), 1.00 ml each, to make Cs-137 standards in 1 inch geometry, precip. as Cs_2PtCl_6. H. Jeter	1432 dpm ref 3/29/95 each	

CERTIFICATE ATTACHED

TELEDYNE ISOTOPES

INVENTORY OF CERTIFIED STANDARD

NUCLIDE: Cs-137

PURCHASED FROM: EPA

[third ampoule of this std

CERTIFICATE NUMBER: 2437-4 (3) DATE: 12/6/91 (ref)

PURCHASE ORDER NO: NA DATE: NA

depleted 6/14/96

DATE	IRS DISPOSITION	COMMENTS
10/31/95	Diluted 3.465 ml To 100 ml including ~10 drops 1% HNO_3. H. Jeter	22.1 pCi/ml ref 9/25/95 For β spikes	J.W. 11-15-95
10/30/95	Used 16 aliquots of 1 ml each (1) for/ beta Detects evaporated in 2 inch planchets with residue for self-absorption curve. H. Jeter	1413 dpm each on 10/31/95	J.W. 11-15-95
6/20/96	Diluted 3.526 ml To 100 ml including ~10 drops HNO_3. H. Jeter	22.1 pCi/ml ref 7/1/96 For β spikes.	J.W. 7/1/96

CERTIFICATE ATTACHED

5/6/92

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide: Cesium-137 Half-life: 30.17 years

Nominal activity: 70 nano curies

Nominal volume: 5 ml in ampoule/bottle number: 2437-4

Measurement

Activity of principal radionuclide

Activity per gram of this solution

14.05 nano curies of Cesium-137

at 0400 hours PST on December 6, 1991

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

13.29 nano curies Per gram

of the daughter nuclide Barium-137m

Total mass of this solution

Approx. 5.0 grams

Method of measurement

The activity of the primary solution was measured using four pi efficiency tracing.

The activity of the dilution was measured using gamma spectroscopy counting.

Useful Life

This radionuclide has decayed through 0.1 half lives since it was assayed by EMSL-LV

We recommend that this solution should not be used after January 1997

2/28/96 Cs-137 Calibration - 1996 50

EPA Cs-137 stds 2437-4(3) Prepared 3/27/95.

Mode : beta 28/02/96 12:04:5
= (50.00 ... 5000.00) III > 5000.00
elapsed 30 : 00 Preset 30 : 00
GUARD [cpm] 803.53

Sample name : Cs-137
Ranges b [cpm] I < 50.00 II
Measuring time beta [min :sec]
Measurement results:

Det#	Spl#	Det	cpmb	Bkg cpm.	ϵ_{Cs-137}
1	1	11	II 388.1	.17	.277
2	2	12	II 393.9	.17	.281
3	4	13	II 392.3	.15	.280
4	5	14	II 393.6	.18	.281
5	7	15	II 371.5	.22	.265
6	1	16	II 379.7	.18	.271
7	2	17	II 388.7	.18	.277
8	4	18	II 388.3	.27	.277
9	5	19	II 384.9	.20	.274
10	7	20	II 402.6	.28	.287

$$\epsilon_{Cs-137} = \frac{cpm - bkg}{1402\ dpm}$$

K. Carrick

EPA 2437-4(3)

3/27/95 Cs-137 Standards 1 inch, ppt

2/28/96

Prepared 7 Cs-137 standards as 1 inch precipitated mounts as follows: into 7 tubes containing approx 25 ml water, delivered 1.00 ml Cs carrier (standardized 0.0399 gm Cs_2PtCl_6/ml), 5 drops HCl, and 1.00 ml EPA Cs-137 2437-4(3), primary dilution, 1437 dpm/ml ref 3/23/95. Stirred and chilled in an ice bath. Added 1 ml 10% platinum chloride solution and stirred to precipitate Cs_2PtCl_6. Chilled further, stirred again, allowed to settle. Filtered by vacuum onto tared fiberglass filter disks. Dried in hot air oven, reweighed for yield, mounted on 1 inch nylon ring and disk. Covered with mylar and labelled each planchet.

Std	Tare	final	A	Yield (÷.0399)	
1	.0432	.0840	.0408	1.023	
2	.0432	.0842	.0410	1.028	
3	.0437	.0839	.0402	1.008	
4	.0436	.0846	.0410	1.028	
5	.0434	.0838	.0404	1.013	
6	.0432	.0836	.0404	1.013	Discard. Some ppt lost after yielding.
7	.0436	.0835	.0409	1.025	

All yields interpreted as 100%. H. Lofer

EPA 2437-4(3.

Uniformity Check (Cs-137)

Counted Cs-137 standards in B1 counter for 10 minutes each on 3/27/95 afternoon.

STD	Counts	
1	3782	
2	3944	
3	~~4185~~	reject; offcenter deposit
4	3915	
5	3885	
7	3913	

Average of 1, 2, 4, 5, 7 : 3888
3s tolerance = $3\sqrt{3888} = 187$
Acceptance range : 3701 – 4075

Accept standards 1, 2, 4, 5, 7 H. Lofer

2/29/96 Other Nuclide Efficiencies

. obtained by scaling Cs-137 efficiencies (2/28/96) using empirical ratios.

	y-90	y-90/abs	sr.89/abs	I-131	P-32	Tc-99	Bi-214
	1.34/1 1993	.816/1 1993	.593/1 1993	1.02/1 1995	$\epsilon_{cs} + .678(\epsilon_{y90} - \epsilon_{cs})$	.691/1 1993	.962/1 199
B1	.37	.23	.16	.28	.34	.19	.27
B2	.38	.23	.17	.29	.35	.19	.2
B3	.38	.23	.17	.29	.35	.19	.2
B4	.38	.23	.17	.29	.35	.19	.2
B5	.36	.22	.16	.27	.33	.18	.2
B6	.36	.22	.16	.28	.33	.19	.2
B7	.37	.23	.16	.28	.34	.19	.2
B8	.37	.23	.16	.28	.34	.19	.2
B9	.37	.22	.16	.28	.34	.19	.2
B10	.38	.23	.17	.29	.35	.20	.2

K. Carrick

Control Lines 1996

Analyzed cks readings from 2/9/96 - 3/15/96, surrounding the Cs-137 calibration date of 2/28/96.

	$\bar{X}$ Avg cpm	S Std dev
B1	281.98	5.696
B2	216.16	5.428
B3	244.50	4.404
B4	273.70	7.485
B5	289.63	6.696
B6	309.73	6.710
B7	293.87	6.316
B8	271.76	7.737
B9	313.78	8.649
B10	322.28	9.029

There were 25 check source readings analyzed for each detector.

K. Carcich

MASS SPEC SERVICES
Division of Geonuclear, Inc.
P.O. Box 163
Orangeburg, NY 10962

William Lilley
Blasland, Bouck & Lee, Inc.
6723 Towpath Road, P.O. Box 66
Syracuse, New York 13214-0066

08/13/02

REPORT NARRATIVE

Project 366.13
Niagara Mohawk – Hudson River – Hudson, NY
MSS Work Order Pb0026

Received 4 sediment cores, 3 inches in diameter, in plastic liners, by hand delivery on 06/19/02. Some of the cores were cut in sections for ease in delivery. They were accompanied by a chain-of-custody document which was signed upon receipt. Assigned MSS Work Order Number Pb0026 to the sample group. The samples were to analyzed for Pb-210, Cs-137, and Be-7 for purposes of determining the sediment chronology.

Cut 0.2 foot thick transverse segments from the cores at various depths specified by BBL and assigned sample numbers to the segments. Placed the sediment samples in beakers marked with the sample numbers and dried the samples for two days in a laboratory oven at 105 °C. Pulverized the dried samples to a fine powder with a mortar and pestle.

There was sufficient sample weight to take separate portions for the Pb-210 and the gamma spectral analyses. Weighed aliquots between 5 and 10 grams into numbered beakers for Pb-210 analyses. Other portions of the dried and pulverized samples were shipped to the Environmental Incorporated Midwest Laboratory on 06/26/02 for direct gamma spectral analysis of Cs-137 and Be-7. These analyses were performed from 07/02/02 to 07/15/02.

Radiochemical separations for the Pb-210 analyses were performed at Mass Spec Services on 07/11, 07/12, 07/18, and 07/19/02. The resulting mounted precipitates were analyzed on beta detectors at this laboratory. Two quality control blank samples and two matrix spike samples were included in the Pb-210 analytical groups. These quality control samples produced satisfactory results. Three quality control duplicates were analyzed at the by gamma spectral methods at the Midwest Laboratory, also producing satisfactory results. Check source performance tests of both the beta and the gamma detectors at the two laboratories were satisfactory during the analysis period. Standard calibration and quality control procedures were observed during all phases of the analyses. Documentation of the analyses is included in the accompanying data package.

A summary report of analytical results was sent to BBL by FAX on 08/08/02 including a chronology interpretation of core SD88. Chronology interpretation reports for all 4 cores were by FAX on 08/12/02 including a revised report for core SD88. The complete data package was assembled and sent on 08/13/02. The data package includes a data summary report, the 4 reports of sediment chronology interpretations, chain-of-custody documents, and a 3.5 inch disk containing results and supporting data in Excel format. Also included in the data package are calculation sheets and detector printouts for the Pb-210 analyses, as well as calibration information and performance tests of the beta detectors used for that analysis. The package also includes gamma detector printouts for the Cs-137 and Be-7 analyses, as well as calibration data and performance tests for the gamma spectrometry system.

Hewitt W. Jeter, Ph.D.
Project Manager

MASS SPEC SERVICES

P.O. Box 163, Orangeburg, NY 10962

Report of Analysis

Blasland, Bouck & Lee, Inc.
6723 Towpath Road, P.O. Box 66
Syracuse, New York 13214-0066

Attn: William Lilley

Sediments

collected 5/2/02

Report Date:	08/08/02
MSS No.:	Pb0026
Purchase Order:	366.13
Project:	NM Hudson R
Date Rec'd:	06/19/02
Task Supervisor:	H. Jeter

Analytical Results in pCi/ g dry

MSS No.	Description	Station	Depth ft	Pb-210	Cs-137	Be-7	Beta Count	Gamma Count
Pb0026-1	silt	SD88	0.0 - 0.2	2.53 ± 0.20	0.321 ± 0.079	3.90 ± 1.19	07/11/02	07/02/02
Pb0026-2	silt	SD88	0.4 - 0.6	1.70 ± 0.16	0.252 ± 0.064	< 0.96	07/11/02	07/02/02
Pb0026-3	silt	SD88	0.9 - 1.1	1.58 ± 0.19	0.282 ± 0.059	< 0.56	07/11/02	07/02/02
Pb0026-4	silt	SD88	1.4 - 1.6	1.23 ± 0.14	4.626 ± 0.117	< 0.72	07/11/02	07/02/02
Pb0026-5	silt	SD88	1.9 - 2.1	0.84 ± 0.13	0.079 ± 0.028	< 0.51	07/11/02	07/03/02
Pb0026-6	silt, petrol.	SD88	2.4 - 2.6	0.74 ± 0.13	< 0.041	< 0.58	07/11/02	07/03/02
Pb0026-7	silt, petrol.	SD88	2.9 - 3.1	0.71 ± 0.12	< 0.071	< 1.52	07/11/02	07/04/02
Pb0026-8	silt, petrol.	SD88	3.4 - 3.6	0.74 ± 0.11	< 0.044	< 0.70	07/11/02	07/10/02
Pb0026-9	silt	SD88	3.9 - 4.1	0.68 ± 0.12	< 0.040	< 0.81	07/11/02	07/03/02
Pb0026-10	silt, petrol.	SD88	4.4 - 4.6	0.62 ± 0.12	< 0.030	< 0.68	07/12/02	07/03/02
Pb0026-11	silt	SD88	5.4 - 5.6	0.61 ± 0.11	< 0.035	< 0.74	07/12/02	07/03/02
Pb0026-12	silt	SD88	6.2 - 6.4	0.53 ± 0.11	0.046 ± 0.027	< 0.67	07/12/02	07/10/02
Pb0026-13	silt, sand, rocks, coal	SD5	2.0 - 2.2	0.50 ± 0.08	< 0.058	< 0.84	07/12/02	07/05/02
Pb0026-14	silt, sand, rocks, slag	SD5	4.0 - 4.2	0.49 ± 0.08	< 0.025	< 0.46	07/12/02	07/11/02
Pb0026-15	mostly silt, glass, coal	SD5	6.0 - 6.2	0.37 ± 0.14	< 0.023	< 0.29	07/12/02	07/11/02
Pb0026-16	silt, rocks, petrol.	SD5	7.8 - 8.0	0.39 ± 0.09	< 0.033	< 0.66	07/18/02	07/05/02
Pb0026-17	silt	SD5	9.8 - 10.0	0.41 ± 0.10	< 0.017	< 0.33	07/18/02	07/07/02
Pb0026-18	sand, coal, petrol.	SD12	0.0 - 2.0	0.43 ± 0.09	0.093 ± 0.036	< 0.60	07/18/02	07/07/02
Pb0026-19	sand, coal, petrol.	SD12	2.0 - 4.0	0.40 ± 0.07	0.075 ± 0.039	< 0.48	07/18/02	07/07/02
Pb0026-20	silt, sand	SD12	4.0 - 4.2	0.33 ± 0.09	< 0.028	< 0.43	07/18/02	07/07/02
Pb0026-21	silt, sand, rocks	SD12	5.8 - 6.0	0.27 ± 0.09	< 0.027	< 0.51	07/18/02	07/07/02
Pb0026-22	sand, coal	SD12	6.0 - 8.0	0.24 ± 0.09	< 0.030	< 0.58	07/18/02	07/06/02
Pb0026-23	silt	SD12	9.8 - 10.0	0.47 ± 0.08	< 0.021	< 0.45	07/18/02	07/14/02
Pb0026-24	silt	SD13	2.0 - 2.2	1.50 ± 0.12	0.137 ± 0.033	< 0.74	07/18/02	07/14/02
Pb0026-25	sand, coal	SD13	2.4 - 2.6	0.46 ± 0.12	0.096 ± 0.030	< 0.64	07/22/02	07/07/02
Pb0026-26	sand, rocks, coal	SD13	2.9 - 3.1	0.59 ± 0.13	0.062 ± 0.023	< 0.37	07/22/02	07/14/02
Pb0026-27	sand, rocks, coal	SD13	3.4 - 3.6	0.63 ± 0.12	0.041 ± 0.022	< 0.57	07/22/02	07/14/02
Pb0026-28	sand, rocks, coal	SD13	3.9 - 4.1	0.87 ± 0.12	< 0.044	< 0.68	07/22/02	07/15/02
Pb0026-29	sand, rocks, coal	SD13	4.4 - 4.6	0.98 ± 0.16	< 0.045	< 0.81	07/22/02	07/15/02
Pb0026-30	sand, rocks	SD13	5.4 - 5.6	0.98 ± 0.15	< 0.041	< 0.47	07/22/02	07/11/02

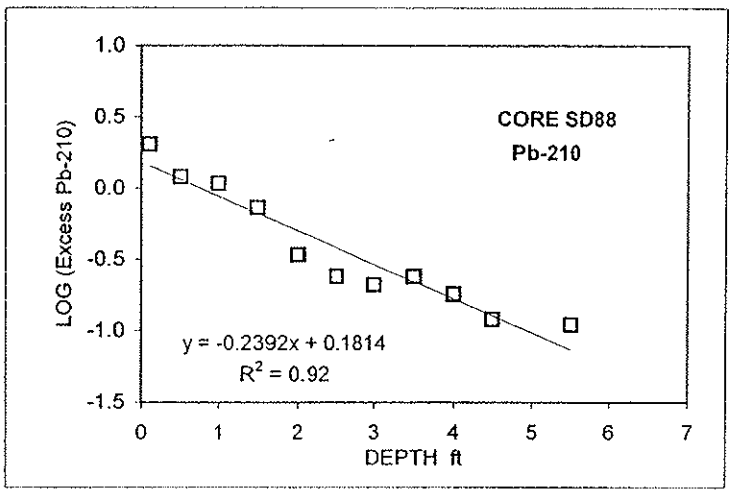
Report is technically accurate and complete.
Tolerances are 2 sigma counting uncertainties.
Detection limits are at the 4.66 sigma level.

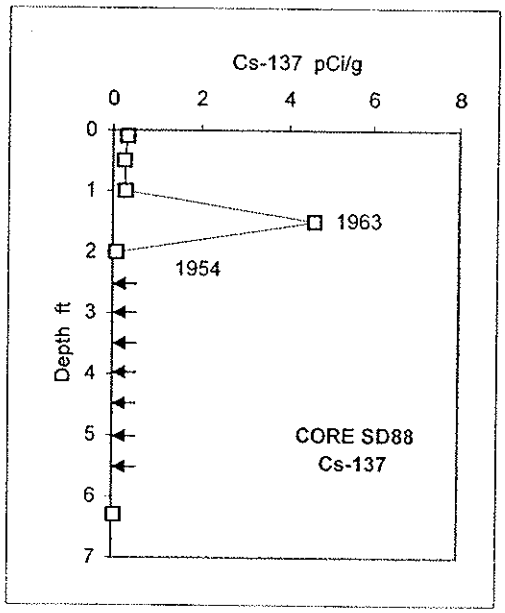
Senior Scientist Associate

Laboratory Manager

Blasland, Bouck & Lee, Inc.
Project Number 366.13
Niagara Mohawk, Hudson River, Hudson NY

MASS SPEC SERVICES
Division of Geonuclear, Inc.





CORE SD88 Pb-210 Chronology

Supported Pb-210: 0.5 pCi/g dry (found at deeper levels in 3 cores)

Fitted curve: Y=-0.2392X + 0.1814 Correlation R square: 0.92

Inferred sedimentation rate: -0.01352 / -0.2392 = **0.057 ft/y**

CORE SD88 Cs-137 Chronology (notice Be-7 in surface sample)

A 1963 maximum is found near 1.5 ft. Sedimentation rate: 1.5 ft / 39 y = **0.038 ft/y**

A 1954 horizon is found near 2.25 ft. Sedimentation rate: 2.25 ft / 48 y = **0.047 ft/y**

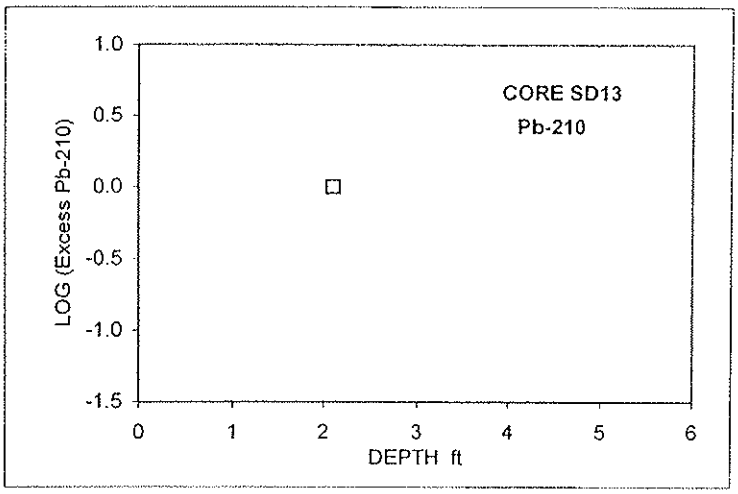
Sample	Depth ft	Description	Pb-210	Cs-137	Be-7
Pb0026-1	0.0 - 0.2	silt	2.53 ± 0.20	0.321 ± 0.079	3.90 ± 1.19
Pb0026-2	0.4 - 0.6	silt	1.70 ± 0.16	0.252 ± 0.064	< 0.96
Pb0026-3	0.9 - 1.1	silt	1.58 ± 0.19	0.282 ± 0.059	< 0.56
Pb0026-4	1.4 - 1.6	silt	1.23 ± 0.14	4.626 ± 0.117	< 0.72
Pb0026-5	1.9 - 2.1	silt	0.84 ± 0.13	0.079 ± 0.028	< 0.51
Pb0026-6	2.4 - 2.6	silt, petrol	0.74 ± 0.13	< 0.041	< 0.58
Pb0026-7	2.9 - 3.1	silt, petrol	0.71 ± 0.12	< 0.071	< 1.52
Pb0026-8	3.4 - 3.6	silt, petrol	0.74 ± 0.11	< 0.044	< 0.70
Pb0026-9	3.9 - 4.1	silt	0.68 ± 0.12	< 0.040	< 0.81
Pb0026-10	4.4 - 4.6	silt, petrol	0.62 ± 0.12	< 0.030	< 0.68
Pb0026-11	5.4 - 5.6	silt	0.61 ± 0.11	< 0.035	< 0.74
Pb0026-12	6.2 - 6.4	silt	0.53 ± 0.11	0.046 ± 0.027	< 0.67

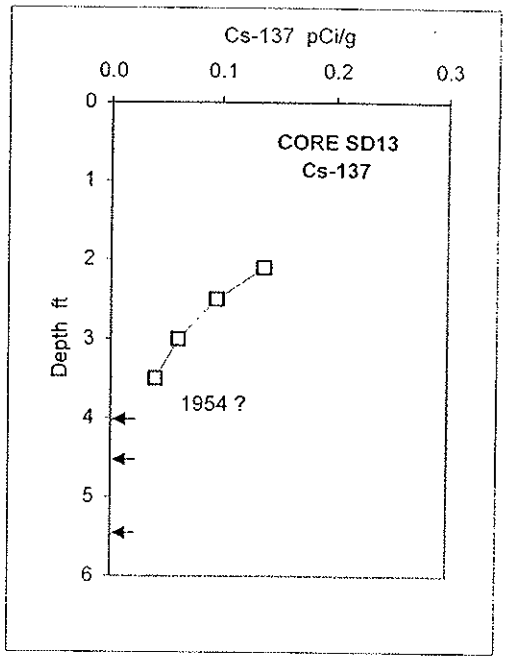
Radioactive concentrations are in pCi/g dry.

H. Jeter 08/09/02

Blasland, Bouck & Lee, Inc.
Project Number 366.13
Niagara Mohawk, Hudson River, Hudson NY

MASS SPEC SERVICES
Division of Geonuclear, Inc.





CORE SD13 Pb-210 Chronology

Supported Pb-210: Assumed near 0.5 pCi/g dry (found at deeper levels in 3 cores)

Reliable excess Pb-210 is found only in the shallowest sample (2.0 - 2.2 ft depth) which is composed of silt. The presence of sand at deeper levels prevents construction of a reliable Pb-210 profile. No sedimentation rate can be calculated by the Pb-210 method.

CORE SD13 Cs-137 Chronology

A questionable 1954 horizon is found between 3.5 and 4.0 ft., giving a sedimentation rate: **Between 0.07 and 0.08 ft/y**

The sand content of the samples makes this result uncertain, however.

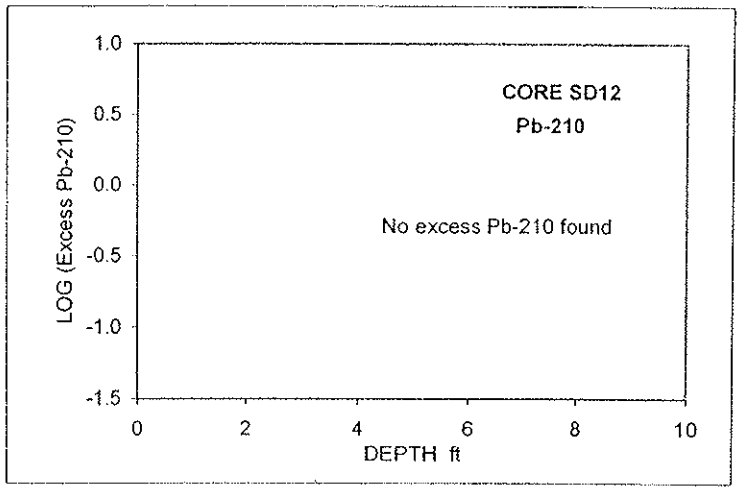
Sample	Depth ft	Description	Pb-210	Cs-137	Be-7
Pb0026-24	2.0 - 2.2	silt	1.50 ± 0.12	0.137 ± 0.033	< 0.74
Pb0026-25	2.4 - 2.6	sand, coal	0.46 ± 0.12	0.096 ± 0.030	< 0.64
Pb0026-26	2.9 - 3.1	sand, rocks, coal	0.59 ± 0.13	0.062 ± 0.023	< 0.37
Pb0026-27	3.4 - 3.6	sand, rocks, coal	0.63 ± 0.12	0.041 ± 0.022	< 0.57
Pb0026-28	3.9 - 4.1	sand, rocks, coal	0.87 ± 0.12	< 0.044	< 0.68
Pb0026-29	4.4 - 4.6	sand, rocks, coal	0.98 ± 0.16	< 0.045	< 0.81
Pb0026-30	5.4 - 5.6	sand, rocks	0.98 ± 0.15	< 0.041	< 0.47

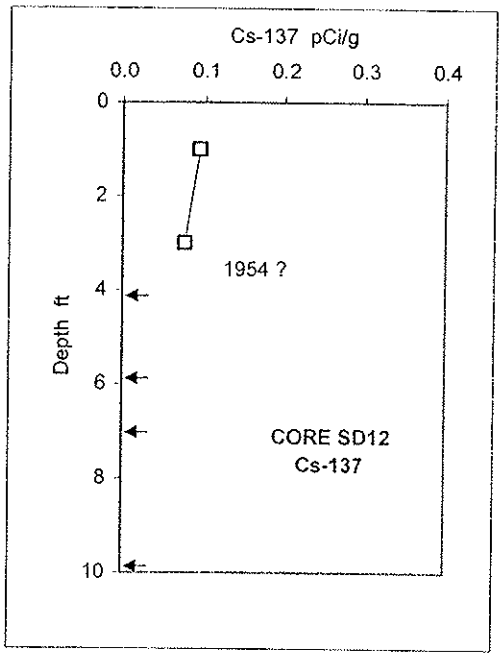
Radioactive concentrations are in pCi/g dry

H. Jeter 08/11/02

Blasland, Bouck & Lee, Inc.
Project Number 366.13
Niagara Mohawk, Hudson River, Hudson NY

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Division of Geonuclear, Inc.





CORE SD12 Pb-210 Chronology

Supported Pb-210: near 0.5 pCi/g dry (found at deeper levels in 3 cores)

No excess Pb-210 (from fallout) was found. No sedimentation rate can be calculated by the Pb-210 method.

CORE SD12 Cs-137 Chronology

A questionable 1954 horizon is found between 3.0 and 4.1 ft.,
giving a sedimentation rate: **Between 0.06 and 0.09 ft/y**

The sand content of the samples makes this result uncertain, however.

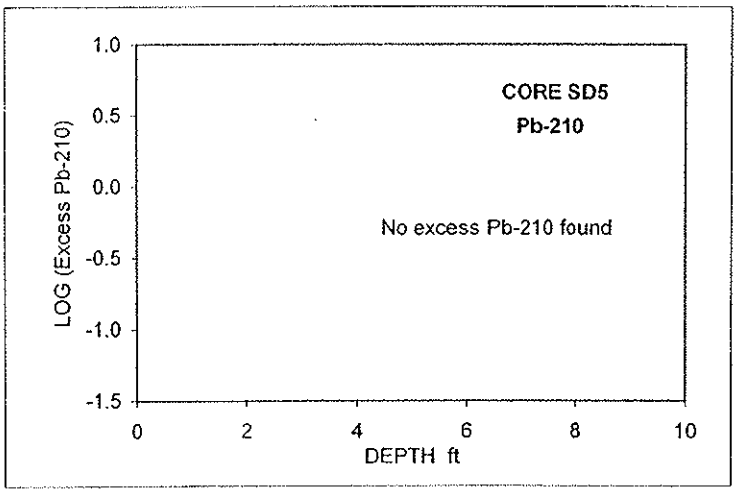
Sample	Depth ft	Description	Pb-210	Cs-137	Be-7
Pb0026-18	0.0 - 2.0	sand, coal, petrol.	0.43 ± 0.09	0.093 ± 0.036	< 0.60
Pb0026-19	2.0 - 4.0	sand, coal, petrol.	0.40 ± 0.07	0.075 ± 0.039	< 0.48
Pb0026-20	4.0 - 4.2	silt, sand	0.33 ± 0.09	< 0.028	< 0.43
Pb0026-21	5.8 - 6.0	silt, sand, rocks	0.27 ± 0.09	< 0.027	< 0.51
Pb0026-22	6.0 - 8.0	sand, coal	0.24 ± 0.09	< 0.030	< 0.58
Pb0026-23	9.8 - 10.0	silt	0.47 ± 0.08	< 0.021	< 0.45

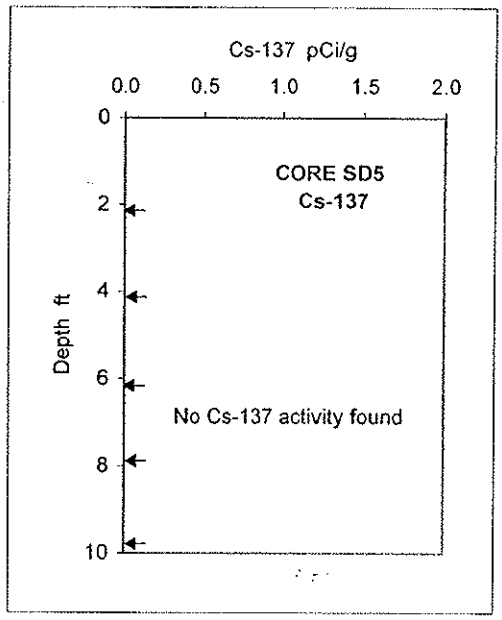
Radioactive concentrations are in pCi/g dry

H. Jeter 08/09/02

Blasland, Bouck & Lee, Inc.
Project Number 366.13
Niagara Mohawk, Hudson River, Hudson NY

MASS SPEC SERVICES
Division of Geonuclear, Inc.





CORE SD5 Pb-210 Chronology

Supported Pb-210: near 0.5 pCi/g dry (found at deeper levels in 3 cores)

No excess Pb-210 (from fallout) was found. No sedimentation rate can be calculated by the Pb-210 method.

CORE SD5 Cs-137 Chronology

No Cs-137 was detected in the core. No sedimentation rate can be calculated by the Cs-137 method.

Sample	Depth ft	Description	Pb-210	Cs-137	Be-7
Pb0026-13	2.0 - 2.2	silt, sand, rocks, coal	0.50 ± 0.08	< 0.058	< 0.84
Pb0026-14	4.0 - 4.2	silt, sand, rocks, slag	0.49 ± 0.08	< 0.025	< 0.46
Pb0026-15	6.0 - 6.2	mostly silt, glass, coal	0.37 ± 0.14	< 0.023	< 0.29
Pb0026-16	7.8 - 8.0	silt, rocks, petrol.	0.39 ± 0.09	< 0.033	< 0.66
Pb0026-17	9.8 - 10.0	silt	0.41 ± 0.10	< 0.017	< 0.33

Radioactive concentrations are in pCi/g dry

H. Jeter 08/08/02

Mass Spect

BLASLAND, BOUCK & LEE, INC.
engineers & scientists
6723 Towpath Road, P.O. Box 66
Syracuse, New York 13214-0066
TEL: (315) 446-9120

CHAIN OF CUSTODY RECORD

Geochronological Dating

PROJ. NO. 366.13 | PROJECT NAME: Niagara Mohawk - Hudson River, Hudson, NY.

SAMPLERS: (Signature) Todd P. Mount

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	Number of Containers	Geochronological Dating	REMARKS
								Recovery
	5/02	—		X	HWS-SD 88	1	X	Intact Core (0-6.4')
	↓	—		X	HWS-SD 13	1	X	Intact Core (2-7.2')
		—		X	HWS-SD5 (2-4')	1	X	3" Split Spoon liner 0.85'
		—		X	HWS-SD5 (4-6')	1	X	0.5'
		—		X	HWS-SD5 (6-8')	1	X	1.0'
	↓	—		X	HWS-SD5 (8-10')	1	X	↓ 0.65'
	5/02	—		X	HWS-SD12 (0-2')	1	X	3" split spoon liner 0.35'
	↓	—		X	HWS-SD12 (2-4')	1	X	0.3'
		—		X	HWS-SD12 (4-6')	1	X	1.1'
		—		X	HWS-SD12 (6-8')	1	X	0.3'
	↓	—		X	HWS-SD12 (8-10')	1	X	↓ 0.75'

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)	Relinquished by: (Signature)	DATE	TIME	Relinquished by: (Signature)
Todd P. Mount	6/18/02	1400	Mark Kelly				
Mark Kelly	6/19/02	11:41	E. H.				
Relinquished by: (Signature)	DATE	TIME	Received for Laboratory by: (Signature)	DATE	TIME	Remarks: Delivery by BBL	

10/23/95
5951188L.CDR

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

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Appendix F

Chemical Analysis Data Tables and Statistical Evaluation

Appendix F-1
Background Sediment Sample Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
Inorganics	Aluminum	mg/kg	6	6	0	6	7940	5920	10400	1690	7790	7710	100.0%
Inorganics	Antimony	mg/kg	6	6	0	6	0.97	0.86	1.1	0.0839	0.967	0.98	100.0%
Inorganics	Arsenic	mg/kg	6	6	0	6	2.59	0.85	4.8	1.28	2.31	2.45	100.0%
Inorganics	Barium	mg/kg	6	6	0	6	46.6	27.5	73.6	15.5	44.6	43.95	100.0%
Inorganics	Beryllium	mg/kg	6	6	0	6	0.42	0.29	0.56	0.116	0.406	0.415	100.0%
Inorganics	Cadmium	mg/kg	6	6	0		0.0692	0.06	0.08	0.00665	0.0689	0.07	0.0%
Inorganics	Calcium	mg/kg	6	6	0	6	4100	1800	7230	1970	3710	3740	100.0%
Inorganics	Chromium	mg/kg	6	6	0	6	11.3	8.1	14	2.63	11.1	11.6	100.0%
Inorganics	Cobalt	mg/kg	6	6	0	6	8.45	6.6	10.8	1.66	8.32	8.1	100.0%
Inorganics	Copper	mg/kg	6	6	0	6	12.5	5.9	18	4.97	11.5	12.75	100.0%
Inorganics	Cyanide	mg/kg	6	6	0		0.328	0.295	0.37	0.0268	0.327	0.33	0.0%
Inorganics	Iron	mg/kg	6	6	0	6	16300	13000	19900	2830	16000	15700	100.0%
Inorganics	Lead	mg/kg	6	6	0	6	13.3	4.2	25.6	7.88	11.3	10.9	100.0%
Inorganics	Magnesium	mg/kg	6	6	0	6	4040	2610	6410	1400	3860	3640	100.0%
Inorganics	Manganese	mg/kg	6	6	0	6	257	155	348	71.2	248	245.5	100.0%
Inorganics	Mercury	mg/kg	6	6	0	2	0.0833	0.03	0.27	0.0954	0.0557	0.035	33.3%
Inorganics	Nickel	mg/kg	6	6	0	6	16.1	12.1	20.4	3.62	15.8	15.15	100.0%
Inorganics	Potassium	mg/kg	6	6	0	6	746	540	1040	224	719	689	100.0%
Inorganics	Selenium	mg/kg	6	6	0	3	0.36	0.185	0.63	0.178	0.325	0.3225	50.0%
Inorganics	Silver	mg/kg	6	6	0		0.139	0.12	0.16	0.0136	0.139	0.14	0.0%
Inorganics	Sodium	mg/kg	6	6	0	4	91.9	36.2	152	46.6	80.4	96.05	66.7%
Inorganics	Thallium	mg/kg	6	6	0		0.349	0.305	0.405	0.0348	0.348	0.3525	0.0%
Inorganics	Vanadium	mg/kg	6	6	0	6	12.7	9.4	16.5	3.18	12.4	12	100.0%
Inorganics	Zinc	mg/kg	6	6	0	6	53	37.8	64.1	10.5	52.1	54.9	100.0%
Miscellaneous	Solids, Total	%	23	23	0	23	76.7	68.2	83.4	3.61	76.6	77.5	100.0%
PCBs	Aroclor-1016	mg/kg	2	2	0		0.0168	0.0155	0.018	0.00177	0.0167	0.01675	0.0%
PCBs	Aroclor-1221	mg/kg	2	2	0		0.0168	0.0155	0.018	0.00177	0.0167	0.01675	0.0%
PCBs	Aroclor-1232	mg/kg	2	2	0		0.0168	0.0155	0.018	0.00177	0.0167	0.01675	0.0%
PCBs	Aroclor-1242	mg/kg	2	2	0	1	0.0303	0.0155	0.045	0.0209	0.0264	0.03025	50.0%
PCBs	Aroclor-1248	mg/kg	2	2	0		0.0168	0.0155	0.018	0.00177	0.0167	0.01675	0.0%
PCBs	Aroclor-1254	mg/kg	2	2	0		0.0168	0.0155	0.018	0.00177	0.0167	0.01675	0.0%
PCBs	Aroclor-1260	mg/kg	2	2	0		0.0168	0.0155	0.018	0.00177	0.0167	0.01675	0.0%
PCBs	Total PCBs	mg/kg	2	2	0	1	0.0303	0.0155	0.045	0.0209	0.0264	0.03025	50.0%
SVOCs	Acenaphthene	ug/kg	26	26	0	2	208	44	275	49.2	196	215	7.7%
SVOCs	Acenaphthylene	ug/kg	26	26	0		220	200	275	15.6	219	215	0.0%
SVOCs	Anthracene	ug/kg	26	26	0	3	210	75	275	36.4	205	215	11.5%
SVOCs	Benzo(a)anthracene	ug/kg	26	26	0	4	244	99	790	122	228	215	15.4%
SVOCs	Benzo(a)pyrene	ug/kg	26	26	0	3	248	205	770	112	236	217.5	11.5%
SVOCs	Benzo(b)fluoranthene	ug/kg	26	26	0	3	239	160	730	102	229	215	11.5%
SVOCs	Benzo(g,h,i)perylene	ug/kg	26	26	0	2	236	200	630	81.8	229	215	7.7%
SVOCs	Benzo(k)fluoranthene	ug/kg	26	26	0	3	237	180	640	84.5	229	215	11.5%
SVOCs	Chrysene	ug/kg	26	26	0	4	251	92	1000	160	229	215	15.4%
SVOCs	Dibenzo(a,h)anthracene	ug/kg	26	26	0	2	214	62	275	34.9	209	215	7.7%
SVOCs	Fluoranthene	ug/kg	26	26	0	5	314	56	2100	395	239	215	19.2%
SVOCs	Fluorene	ug/kg	26	26	0	2	208	42	275	49.2	196	215	7.7%
SVOCs	Indeno(1,2,3-cd)pyrene	ug/kg	26	26	0	2	231	180	530	63.2	226	215	7.7%
SVOCs	Naphthalene	ug/kg	26	26	0		220	200	275	15.6	219	215	0.0%

Appendix F-1
Background Sediment Sample Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
SVOCs	Phenanthrene	ug/kg	26	26	0	4	255	100	1000	173	229	215	15.4%
SVOCs	Pyrene	ug/kg	26	26	0	5	303	50	1800	337	239	215	19.2%
SVOCs	Total PAHs	ug/kg	26	26	0	5	870	106	10409	2180	314	217.5	19.2%
SVOCs	Total SVOCs	ug/kg	26	26	0	5	693	0	10400	2230	1460	1960	19.2%
TOC	Total Organic Carbon	mg/kg	25	25	0	25	9500	2900	36000	8120	7790	7340	100.0%
VOCs	1,1,1-Trichloroethane	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	1,1,2,2-Tetrachloroethane	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	1,1,2-Trichloroethane	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	1,1-Dichloroethane	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	1,1-Dichloroethene	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	1,2-Dichloroethane	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	1,2-Dichloroethene (total)	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	1,2-Dichloropropane	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	2-Butanone	ug/kg	6	6	0	4	9.58	4	20.5	5.83	8.37	8.5	66.7%
VOCs	2-Hexanone	ug/kg	6	6	0		9	6	20.5	5.65	8.06	7	0.0%
VOCs	4-Methyl-2-pentanone	ug/kg	6	6	0		9	6	20.5	5.65	8.06	7	0.0%
VOCs	Acetone	ug/kg	6	6	0	6	42.2	24	60	14.9	39.8	43.5	100.0%
VOCs	Benzene	mg/kg	6	6	0	1	0.00525	0.003	0.015	0.00478	0.00424	0.0035	16.7%
VOCs	Bromodichloromethane	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Bromoform	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Bromomethane	ug/kg	6	6	0		9	6	20.5	5.65	8.06	7	0.0%
VOCs	Carbon Disulfide	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Carbon Tetrachloride	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Chlorobenzene	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Chloroethane	ug/kg	6	6	0		9	6	20.5	5.65	8.06	7	0.0%
VOCs	Chloroform	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Chloromethane	ug/kg	6	6	0		9	6	20.5	5.65	8.06	7	0.0%
VOCs	cis-1,3-Dichloropropene	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Dibromochloromethane	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Ethylbenzene	mg/kg	6	6	0		0.00442	0.003	0.01	0.00275	0.00396	0.0035	0.0%
VOCs	Methylene Chloride	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Styrene	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Tetrachloroethene	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Toluene	mg/kg	6	6	0	1	0.0045	0.003	0.01	0.00272	0.00405	0.0035	16.7%
VOCs	Total BTEX	mg/kg	6	6	0	2	0.00533	0.003	0.015	0.00475	0.00433	0.0035	33.3%
VOCs	trans-1,3-Dichloropropene	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Trichloroethene	ug/kg	6	6	0		4.42	3	10	2.75	3.96	3.5	0.0%
VOCs	Vinyl Acetate	ug/kg	6	6	0		9	6	20.5	5.65	8.06	7	0.0%
VOCs	Vinyl Chloride	ug/kg	6	6	0		9	6	20.5	5.65	8.06	7	0.0%
VOCs	Xylenes (total)	mg/kg	6	6	0		0.00442	0.003	0.01	0.00275	0.00396	0.0035	0.0%

Appendix F-2
Hudson River Sediment Sample Statistics 1995 to 2007
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
Inorganics	Aluminum	mg/kg	71	71	0	71	7310	2820	19500	3240	6720	6230	100.00%
Inorganics	Antimony	mg/kg	71	71	0	68	1.03	0.44	2.8	0.413	0.965	0.91	95.77%
Inorganics	Arsenic	mg/kg	99	99	0	96	3.85	0.38	23.1	3.76	2.78	2.7	96.97%
Inorganics	Barium	mg/kg	71	71	0	71	62.6	18.1	287	44.3	52.1	47.1	100.00%
Inorganics	Beryllium	mg/kg	71	71	0	69	0.49	0.0675	2.3	0.337	0.42	0.38	97.18%
Inorganics	Cadmium	mg/kg	71	71	0	42	0.383	0.06	2.8	0.442	0.23	0.32	59.15%
Inorganics	Calcium	mg/kg	71	71	0	71	7460	1060	92000	12400	4550	4450	100.00%
Inorganics	Chromium	mg/kg	71	71	0	71	12.8	4.8	59.1	9.61	10.9	9.6	100.00%
Inorganics	Cobalt	mg/kg	71	71	0	71	8.42	3.7	30.9	3.58	7.94	7.6	100.00%
Inorganics	Copper	mg/kg	71	71	0	71	16.1	3	55.4	13	12.1	11.9	100.00%
Inorganics	Cyanide	mg/kg	99	99	0	4	0.443	0.235	6.8	0.719	0.35	0.31	4.04%
Inorganics	Iron	mg/kg	71	71	0	71	17700	7040	32300	6280	16700	15450	100.00%
Inorganics	Lead	mg/kg	99	99	0	99	102	3.2	6660	667	21.9	18	100.00%
Inorganics	Magnesium	mg/kg	71	71	0	71	3420	1190	6780	1310	3180	3040	100.00%
Inorganics	Manganese	mg/kg	71	71	0	71	497	120	3420	552	371	308.5	100.00%
Inorganics	Mercury	mg/kg	99	99	0	59	0.133	0.025	0.9	0.144	0.0866	0.09	59.60%
Inorganics	Nickel	mg/kg	71	71	0	71	14.9	6.4	30.3	5.42	14.1	13.1	100.00%
Inorganics	Potassium	mg/kg	71	71	0	71	869	278	5500	660	758	719	100.00%
Inorganics	Selenium	mg/kg	71	71	0	36	1.03	0.185	27	3.19	0.496	0.44	50.70%
Inorganics	Silver	mg/kg	71	71	0	1	0.195	0.12	0.65	0.0811	0.184	0.19	1.41%
Inorganics	Sodium	mg/kg	71	71	0	56	121	25.7	881	112	95.6	103	78.87%
Inorganics	Thallium	mg/kg	71	71	0	4	0.296	0.11	2	0.277	0.234	0.23	5.63%
Inorganics	Vanadium	mg/kg	71	71	0	71	11.6	4.7	26.5	5.13	10.7	9.8	100.00%
Inorganics	Zinc	mg/kg	98	98	0	98	72	27.3	555	65.6	59.9	51.3	100.00%
Miscellaneous	Solids, Total	%	120	120	0	120	76.1	57.2	86.3	4.49	75.9	76.7	100.00%
PCBs	Aroclor-1016	mg/kg	38	38	0		0.0285	0.0135	0.115	0.0234	0.0242	0.0225	0.00%
PCBs	Aroclor-1221	mg/kg	38	38	0		0.0491	0.0135	0.235	0.0442	0.0388	0.04375	0.00%
PCBs	Aroclor-1232	mg/kg	38	38	0		0.0285	0.0135	0.115	0.0234	0.0241	0.0225	0.00%
PCBs	Aroclor-1242	mg/kg	38	38	0	16	0.417	0.0135	9	1.46	0.0689	0.025375	42.11%
PCBs	Aroclor-1248	mg/kg	38	38	0	1	0.0378	0.0135	0.37	0.0601	0.0261	0.02275	2.63%
PCBs	Aroclor-1254	mg/kg	38	38	0		0.0285	0.0135	0.115	0.0234	0.0241	0.0225	0.00%
PCBs	Aroclor-1260	mg/kg	38	38	0	3	0.0401	0.0135	0.45	0.0721	0.0263	0.0225	7.89%
PCBs	Total PCBs	mg/kg	38	38	0	17	0.45	0.0135	9.45	1.53	0.0956	0.05	44.74%
SVOCs	1,2,4-Trichlorobenzene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	1,2-Dichlorobenzene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	1,3-Dichlorobenzene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	1,4-Dichlorobenzene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2,2'-Oxybis(1-Chloropropane)	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2,4,5-Trichlorophenol	ug/kg	5	5	0		206000	525	950000	417000	12600	19500	0.00%
SVOCs	2,4,6-Trichlorophenol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2,4-Dichlorophenol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2,4-Dimethylphenol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2,4-Dinitrophenol	ug/kg	5	5	0		206000	525	950000	417000	12600	19500	0.00%
SVOCs	2,4-Dinitrotoluene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2,6-Dinitrotoluene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2-Chloronaphthalene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2-Chlorophenol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2-Methylnaphthalene	ug/kg	5	5	0	3	1350000	210	5700000	2470000	27200	60000	60.00%

Appendix F-2
Hudson River Sediment Sample Statistics 1995 to 2007
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
SVOCs	2-Methylphenol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	2-Nitroaniline	ug/kg	5	5	0		206000	525	950000	417000	12600	19500	0.00%
SVOCs	2-Nitrophenol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	3,3'-Dichlorobenzidine	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	3-Nitroaniline	ug/kg	5	5	0		206000	525	950000	417000	12600	19500	0.00%
SVOCs	4,6-Dinitro-2-methylphenol	ug/kg	5	5	0		206000	525	950000	417000	12600	19500	0.00%
SVOCs	4-Bromophenyl-phenylether	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	4-Chloro-3-Methylphenol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	4-Chloroaniline	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	4-Chlorophenyl-phenylether	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	4-Methylphenol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	4-Nitroaniline	ug/kg	5	5	0		206000	525	950000	417000	12600	19500	0.00%
SVOCs	4-Nitrophenol	ug/kg	5	5	0		206000	525	950000	417000	12600	19500	0.00%
SVOCs	Acenaphthene	ug/Kg	224	224	0	116	48200	46	5100000	354000	714	230	51.79%
SVOCs	Acenaphthylene	ug/Kg	224	224	0	92	3900	56	370000	26100	353	220	41.07%
SVOCs	Anthracene	ug/kg	224	224	0	132	35400	43	3200000	232000	760	235	58.93%
SVOCs	Benzo(a)anthracene	ug/kg	224	224	0	147	25600	0	2200000	161000	877	300	65.63%
SVOCs	Benzo(a)pyrene	ug/Kg	224	224	0	145	19900	44	1700000	124000	818	290	64.73%
SVOCs	Benzo(b)fluoranthene	ug/kg	224	224	0	127	12400	56	1000000	74300	670	235	56.70%
SVOCs	Benzo(g,h,i)perylene	ug/kg	224	224	0	118	7480	47	560000	42000	574	225	52.68%
SVOCs	Benzo(k)fluoranthene	ug/kg	224	224	0	129	17700	48	1500000	112000	751	240	57.59%
SVOCs	Benzoic Acid	ug/kg	5	5	0		206000	525	950000	417000	12600	19500	0.00%
SVOCs	Benzyl Alcohol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	bis(2-Chloroethoxy)methane	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	bis(2-Chloroethyl)ether	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	bis(2-Ethylhexyl)phthalate	ug/kg	5	5	0	1	82700	140	380000	167000	4680	8000	20.00%
SVOCs	Butylbenzylphthalate	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Carbazole	ug/kg	5	5	0	4	180000	100	680000	293000	8170	12000	80.00%
SVOCs	Chrysene	ug/kg	224	224	0	144	21800	44	1800000	133000	827	260	64.29%
SVOCs	Dibenzo(a,h)anthracene	ug/kg	224	224	0	51	2940	48	380000	25700	327	215	22.77%
SVOCs	Dibenzofuran	ug/kg	5	5	0	4	479000	212.5	1800000	777000	16800	27000	80.00%
SVOCs	Diethylphthalate	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Dimethylphthalate	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Di-n-Butylphthalate	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Di-n-Octylphthalate	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Fluoranthene	ug/kg	224	224	0	154	58000	45	4900000	363000	1230	595	68.75%
SVOCs	Fluorene	ug/kg	224	224	0	117	37900	52	3800000	271000	672	230	52.23%
SVOCs	Hexachlorobenzene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Hexachlorobutadiene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Hexachlorocyclopentadiene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Hexachloroethane	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Indeno(1,2,3-cd)pyrene	ug/kg	224	224	0	111	7720	53	590000	44300	570	230	49.55%
SVOCs	Isophorone	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Naphthalene	ug/kg	224	224	0	103	138000	53	17000000	1160000	619	220	45.98%
SVOCs	Nitrobenzene	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	N-Nitroso-di-n-propylamine	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	N-Nitrosodiphenylamine	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Pentachlorophenol	ug/kg	5	5	0		206000	525	950000	417000	12600	19500	0.00%

Appendix F-2
Hudson River Sediment Sample Statistics 1995 to 2007
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
SVOCs	Phenanthrene	ug/Kg	224	224	0	152	100000	47	9200000	662000	1300	380	67.86%
SVOCs	Phenol	ug/kg	5	5	0		82700	210	380000	167000	5080	8000	0.00%
SVOCs	Pyrene	ug/kg	224	224	0	151	51200	47	4600000	332000	1250	484	67.41%
SVOCs	Total PAHs	ug/kg	224	224	0	173	613000	45	63220000	4440000	4660	3876	77.23%
SVOCs	Total SVOCs	ug/kg	224	224	0	173	629000	0	65700000	4610000	11000	13100	77.23%
TOC	Total Organic Carbon	mg/kg	116	116	0	116	12900	1050	126000	17900	7570	7130	100.00%
TOC	Total Organic Carbon (Run 1)	%	11	11	0	11	0.883	0.28	1.3	0.305	0.82	0.89	100.00%
TOC	Total Organic Carbon (Run 2)	%	11	11	0	11	0.886	0.25	1.2	0.282	0.825	0.96	100.00%
VOCs	1,1,1-Trichloroethane	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	1,1,2,2-Tetrachloroethane	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	1,1,2-Trichloroethane	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	1,1-Dichloroethane	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	1,1-Dichloroethene	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	1,2-Dichloroethane	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	1,2-Dichloroethene (total)	ug/kg	71	70	1		159	2.5	4450	552	10.9	3.5	0.00%
VOCs	1,2-Dichloropropane	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	2-Butanone	ug/kg	71	70	1	35	240	4	2600	470	31	14	49.30%
VOCs	2-Hexanone	ug/kg	71	70	1	1	205	5.5	1200	381	21.9	7	1.41%
VOCs	4-Methyl-2-pentanone	ug/kg	71	70	1		204	5.5	1200	381	21.7	7	0.00%
VOCs	Acetone	ug/kg	71	71	0	43	233	5	1200	373	60.5	45	60.56%
VOCs	Benzene	mg/kg	99	98	1	19	0.289	0.0025	7	1.06	0.00954	0.0035	19.19%
VOCs	Bromodichloromethane	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Bromoform	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Bromomethane	ug/kg	71	70	1		204	5.5	1200	381	21.7	7	0.00%
VOCs	Carbon Disulfide	ug/kg	71	70	1	1	102	3	600	190	10.7	3.5	1.41%
VOCs	Carbon Tetrachloride	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Chlorobenzene	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Chloroethane	ug/kg	71	70	1		204	5.5	1200	381	21.7	7	0.00%
VOCs	Chloroform	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Chloromethane	ug/kg	71	70	1	3	204	5	1200	381	21.2	7	4.23%
VOCs	cis-1,3-Dichloropropene	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Dibromochloromethane	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Ethylbenzene	mg/kg	99	98	1	23	1.68	0.0004	50	6.65	0.0126	0.0035	23.23%
VOCs	Methylene Chloride	ug/kg	71	71	0	2	105	2.5	600	189	11.8	3.5	2.82%
VOCs	Styrene	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Tetrachloroethene	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Toluene	mg/kg	99	98	1	36	0.371	0.001	12	1.56	0.0106	0.0035	36.36%
VOCs	Total BTEX	mg/kg	98	98	0	40	5.27	0.001	131.2	20.6	0.0195	0.0035	40.82%
VOCs	trans-1,3-Dichloropropene	ug/kg	71	70	1		102	2.5	600	190	10.6	3.5	0.00%
VOCs	Trichloroethene	ug/kg	71	70	1	2	102	3	600	190	10.6	3.5	2.82%
VOCs	Vinyl Acetate	ug/kg	71	64	7	1	223	3.5	1200	393	24.7	7	1.41%
VOCs	Vinyl Chloride	ug/kg	71	70	1		204	5.5	1200	381	21.7	7	0.00%
VOCs	Xylenes (total)	mg/kg	99	98	1	22	3	0.003	71	12.1	0.0141	0.0035	22.22%

Appendix F-3
Embayment #2 Sediment Sample Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York – National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
Inorganics	Aluminum	mg/kg	9	9	0	9	9760	3950	14500	2920	9270	9810	100.0%
Inorganics	Antimony	mg/kg	9	9	0	9	1.28	0.68	2.1	0.53	1.18	1.2	100.0%
Inorganics	Arsenic	mg/kg	45	45	0	45	7.02	1	16.3	3.72	5.94	6.6	100.0%
Inorganics	Barium	mg/kg	45	45	0	45	116	25	437	72.3	101	111	100.0%
Inorganics	Beryllium	mg/kg	9	9	0	9	0.519	0.27	1	0.22	0.482	0.5	100.0%
Inorganics	Cadmium	mg/kg	45	45	0	27	0.784	0.135	4.5	1.03	0.427	0.41	60.0%
Inorganics	Calcium	mg/kg	9	9	0	9	7460	2930	9260	2060	7100	7810	100.0%
Inorganics	Chromium	mg/kg	45	45	0	45	37.4	6.5	137	32.5	28.1	26.6	100.0%
Inorganics	Cobalt	mg/kg	9	9	0	9	10.8	4.8	14.6	2.76	10.4	11	100.0%
Inorganics	Copper	mg/kg	9	9	0	9	38	7.1	69.6	20.7	31.1	39.8	100.0%
Inorganics	Cyanide	mg/kg	9	9	0		0.393	0.275	0.625	0.117	0.38	0.335	0.0%
Inorganics	Iron	mg/kg	9	9	0	9	22500	9220	34100	7010	21400	22300	100.0%
Inorganics	Lead	mg/kg	45	45	0	45	74.5	7.3	211	58.2	47.1	56.7	100.0%
Inorganics	Magnesium	mg/kg	9	9	0	9	5490	2690	7160	1230	5330	5470	100.0%
Inorganics	Manganese	mg/kg	9	9	0	9	564	160	1225	328	482	521	100.0%
Inorganics	Mercury	mg/kg	45	45	0	32	0.373	0.0335	1.3	0.348	0.202	0.265	71.1%
Inorganics	Nickel	mg/kg	9	9	0	9	21.3	9.2	31.8	6.27	20.3	21	100.0%
Inorganics	Potassium	mg/kg	9	9	0	9	1500	576	2090	476	1410	1460	100.0%
Inorganics	Selenium	mg/kg	45	27	18	26	1.55	0.27	5.2	1.07	1.29	1.4	57.8%
Inorganics	Silver	mg/kg	45	45	0	6	0.265	0.12	1.5	0.257	0.212	0.17	13.3%
Inorganics	Sodium	mg/kg	9	9	0	8	271	99.2	726	198	222	246	88.9%
Inorganics	Thallium	mg/kg	9	9	0		0.225	0.135	0.33	0.0693	0.215	0.225	0.0%
Inorganics	Vanadium	mg/kg	9	9	0	8	17	8.1	22.5	4.12	16.4	18.1	88.9%
Inorganics	Zinc	mg/kg	45	45	0	45	153	28.7	358	86.1	128	153	100.0%
PCBs	Aroclor-1016	mg/kg	17	17	0		0.0426	0.011	0.3	0.0677	0.0274	0.024	0.0%
PCBs	Aroclor-1221	mg/kg	17	17	0		0.0553	0.011	0.3	0.0678	0.0365	0.0445	0.0%
PCBs	Aroclor-1232	mg/kg	17	17	0		0.0426	0.011	0.3	0.0677	0.0274	0.024	0.0%
PCBs	Aroclor-1242	mg/kg	17	17	0	9	0.551	0.011	5.8	1.41	0.092	0.095	52.9%
PCBs	Aroclor-1248	mg/kg	17	17	0		0.0426	0.011	0.3	0.0677	0.0274	0.024	0.0%
PCBs	Aroclor-1254	mg/kg	17	17	0		0.0426	0.011	0.3	0.0677	0.0274	0.024	0.0%
PCBs	Aroclor-1260	mg/kg	17	17	0	2	0.089	0.011	0.65	0.165	0.0367	0.025	11.8%
PCBs	Total PCBs	mg/kg	17	17	0	9	0.608	0.011	5.8	1.42	0.117	0.095	52.9%
SVOCs	1,2,4-Trichlorobenzene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	1,2-Dichlorobenzene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	1,3-Dichlorobenzene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	1,4-Dichlorobenzene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	2,2'-Oxybis(1-Chloropropane)	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	2,4,5-Trichlorophenol	ug/kg	1	1	0		625	625	625	0	625	625	0.0%
SVOCs	2,4,6-Trichlorophenol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	2,4-Dichlorophenol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	2,4-Dimethylphenol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	2,4-Dinitrophenol	ug/kg	1	1	0		625	625	625	0	625	625	0.0%
SVOCs	2,4-Dinitrotoluene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	2,6-Dinitrotoluene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	2-Chloronaphthalene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	2-Chlorophenol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%

Appendix F-3
Embayment #2 Sediment Sample Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York – National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
SVOCs	2-Methylnaphthalene	ug/kg	1	1	0	1	31500	31500	31500	0	31500	31500	100.0%
SVOCs	2-Methylphenol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	2-Nitroaniline	ug/kg	1	1	0		625	625	625	0	625	625	0.0%
SVOCs	2-Nitrophenol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	3,3'-Dichlorobenzidine	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	3-Nitroaniline	ug/kg	1	1	0		625	625	625	0	625	625	0.0%
SVOCs	4,6-Dinitro-2-methylphenol	ug/kg	1	1	0		625	625	625	0	625	625	0.0%
SVOCs	4-Bromophenyl-phenylether	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	4-Chloro-3-Methylphenol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	4-Chloroaniline	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	4-Chlorophenyl-phenylether	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	4-Methylphenol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	4-Nitroaniline	ug/kg	1	1	0		625	625	625	0	625	625	0.0%
SVOCs	4-Nitrophenol	ug/kg	1	1	0		625	625	625	0	625	625	0.0%
SVOCs	Acenaphthene	ug/kg	46	45	1	30	8860	52	85000	17600	1150	355	65.2%
SVOCs	Acenaphthylene	ug/kg	46	45	1	27	547	47	4200	868	312	235	58.7%
SVOCs	Anthracene	ug/kg	46	45	1	32	4450	46	47000	9060	758	350	69.6%
SVOCs	Benzo(a)anthracene	ug/kg	46	46	0	36	2990	63	33000	5810	800	525	78.3%
SVOCs	Benzo(a)pyrene	ug/kg	46	46	0	35	2420	98	25000	4440	751	575	76.1%
SVOCs	Benzo(b)fluoranthene	ug/kg	46	46	0	33	2100	100	26000	4220	744	600	71.7%
SVOCs	Benzo(g,h,i)perylene	ug/kg	46	46	0	31	1270	82	10000	1970	545	345	67.4%
SVOCs	Benzo(k)fluoranthene	ug/kg	46	45	1	33	1020	35	10000	1840	390	235	71.7%
SVOCs	Benzoic Acid	ug/kg	1	1	0		625	625	625	0	625	625	0.0%
SVOCs	Benzyl Alcohol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	bis(2-Chloroethoxy)methane	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	bis(2-Chloroethyl)ether	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	bis(2-Ethylhexyl)phthalate	ug/kg	1	1	0		270	270	270	0	270	270	0.0%
SVOCs	Butylbenzylphthalate	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Carbazole	ug/kg	1	1	0	1	855	855	855	0	855	855	100.0%
SVOCs	Chrysene	ug/kg	46	46	0	36	2440	92	24000	4370	770	530	78.3%
SVOCs	Dibenzo(a,h)anthracene	ug/kg	46	42	4	9	926	160	14500	2430	382	282.5	19.6%
SVOCs	Dibenzofuran	ug/kg	1	1	0	1	2350	2350	2350	0	2350	2350	100.0%
SVOCs	Diethylphthalate	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Dimethylphthalate	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Di-n-Butylphthalate	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Di-n-Octylphthalate	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Fluoranthene	ug/kg	46	46	0	40	5900	56	69000	12300	1080	880	87.0%
SVOCs	Fluorene	ug/kg	46	45	1	30	4170	50	39000	8420	746	330	65.2%
SVOCs	Hexachlorobenzene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Hexachlorobutadiene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Hexachlorocyclopentadiene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Hexachloroethane	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Indeno(1,2,3-cd)pyrene	ug/kg	46	46	0	31	1090	68	9900	1810	461	290	67.4%
SVOCs	Isophorone	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Naphthalene	ug/kg	46	45	1	32	14700	43	160000	34800	878	330	69.6%
SVOCs	Nitrobenzene	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%

Appendix F-3
Embayment #2 Sediment Sample Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York – National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
SVOCs	N-Nitroso-di-n-propylamine	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	N-Nitrosodiphenylamine	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Pentachlorophenol	ug/kg	1	1	0		625	625	625	0	625	625	0.0%
SVOCs	Phenanthrene	ug/kg	46	46	0	40	15500	91	160000	31300	1680	920	87.0%
SVOCs	Phenol	ug/kg	1	1	0		248	247.5	247.5	0	248	247.5	0.0%
SVOCs	Pyrene	ug/kg	46	46	0	40	9190	84	91000	17000	1760	1700	87.0%
SVOCs	Total PAHs	ug/kg	46	46	0	41	75700	180	739820	151000	8730	8496	89.1%
SVOCs	Total SVOCs	ug/kg	46	46	0	41	75700	0	740000	151000	13100	11700	89.1%
TOC	Total Organic Carbon	mg/kg	24	24	0	24	45000	2120	113000	24800	37200	42100	100.0%
VOCs	1,1,1-Trichloroethane	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	1,1,2,2-Tetrachloroethane	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	1,1,2-Trichloroethane	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	1,1-Dichloroethane	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	1,1-Dichloroethene	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	1,2-Dichloroethane	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	1,2-Dichloroethene (total)	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	1,2-Dichloropropane	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	2-Butanone	ug/kg	9	9	0	6	35.3	10.5	75	21.1	29	36	66.7%
VOCs	2-Hexanone	ug/kg	9	9	0		26.4	7	75	22.8	19	13.75	0.0%
VOCs	4-Methyl-2-pentanone	ug/kg	9	9	0		26.4	7	75	22.8	19	13.75	0.0%
VOCs	Acetone	ug/kg	9	9	0	6	121	12.5	300	82.6	92.5	120	66.7%
VOCs	Benzene	mg/kg	46	46	0	15	0.191	0.002	2.6	0.462	0.0154	0.0045	32.6%
VOCs	Bromodichloromethane	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Bromoform	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Bromomethane	ug/kg	9	9	0		18.9	7	41.5	14.3	14.7	11.5	0.0%
VOCs	Carbon Disulfide	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Carbon Tetrachloride	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Chlorobenzene	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Chloroethane	ug/kg	9	9	0		18.9	7	41.5	14.3	14.7	11.5	0.0%
VOCs	Chloroform	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Chloromethane	ug/kg	9	9	0		18.9	7	41.5	14.3	14.7	11.5	0.0%
VOCs	cis-1,3-Dichloropropene	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Dibromochloromethane	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Ethylbenzene	mg/kg	46	46	0	22	1.58	0.001	31	5.18	0.0241	0.00475	47.8%
VOCs	Methylene Chloride	ug/kg	9	9	0		14.5	3.5	38.5	11	11.1	11.5	0.0%
VOCs	Styrene	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Tetrachloroethene	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Toluene	mg/kg	46	46	0	5	0.0716	0.002	0.55	0.169	0.00967	0.0045	10.9%
VOCs	Total BTEX	mg/kg	46	46	0	28	3.6	0.002	71.6	12	0.0432	0.0085	60.9%
VOCs	trans-1,3-Dichloropropene	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Trichloroethene	ug/kg	9	9	0		13.3	3.5	38.5	11.7	9.51	6.75	0.0%
VOCs	Vinyl Acetate	ug/kg	9	6	3		23.6	7	41.5	15.5	18.8	22.75	0.0%
VOCs	Vinyl Chloride	ug/kg	9	9	0		18.9	7	41.5	14.3	14.7	11.5	0.0%
VOCs	Xylenes (total)	mg/kg	46	46	0	26	1.85	0.002	38	6.47	0.0283	0.00575	56.5%

Appendix F-4
Embayment #3 Sediment Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
Inorganics	Aluminum	mg/kg	6	6	0	6	8870	6440	14300	2790	8570	8380	100.00%
Inorganics	Antimony	ug/kg	6	6	0	1	1020	420	2800	908	796	650	16.67%
Inorganics	Arsenic	mg/kg	6	6	0	6	6.28	3.1	9.9	2.21	5.94	6.35	100.00%
Inorganics	Barium	mg/kg	6	6	0	6	156	90	257	63.8	145	149	100.00%
Inorganics	Beryllium	mg/kg	6	6	0	6	0.625	0.4	1.1	0.25	0.591	0.56	100.00%
Inorganics	Cadmium	mg/kg	6	6	0	6	3.17	0.57	9.6	3.47	1.9	1.895	100.00%
Inorganics	Calcium	mg/kg	6	6	0	6	23600	11900	47900	14000	20600	18950	100.00%
Inorganics	Chromium	mg/kg	6	6	0	6	92.7	23.1	352	128	55.7	41.55	100.00%
Inorganics	Cobalt	mg/kg	6	6	0	6	13.5	8.2	23.3	5.25	12.8	12	100.00%
Inorganics	Copper	mg/kg	6	6	0	6	127	30.4	192	55.4	110	140	100.00%
Inorganics	Cyanide	mg/kg	6	6	0		0.433	0.295	0.75	0.172	0.41	0.3675	0.00%
Inorganics	Iron	mg/kg	6	6	0	6	21200	15300	31000	5550	20600	19000	100.00%
Inorganics	Lead	mg/kg	6	6	0	6	350	132	645	197	302	321.5	100.00%
Inorganics	Magnesium	mg/kg	6	6	0	6	6290	3720	12100	3080	5790	5260	100.00%
Inorganics	Manganese	mg/kg	6	6	0	6	260	175	507	124	242	224	100.00%
Inorganics	Mercury	mg/kg	6	6	0	6	2.04	0.19	6.5	2.29	1.23	1.265	100.00%
Inorganics	Nickel	mg/kg	6	6	0	6	56.5	25	98.6	24.3	52.1	54.8	100.00%
Inorganics	Potassium	mg/kg	6	6	0	6	1290	856	2140	448	1230	1220	100.00%
Inorganics	Selenium	mg/kg	6	6	0	6	1.32	0.73	2.3	0.558	1.23	1.25	100.00%
Inorganics	Silver	mg/kg	6	6	0	6	1.75	0.51	2.9	0.969	1.46	2	100.00%
Inorganics	Sodium	mg/kg	6	6	0	6	340	249	527	107	327	297.5	100.00%
Inorganics	Thallium	mg/kg	6	5	1		0.206	0.14	0.34	0.083	0.194	0.175	0.00%
Inorganics	Vanadium	mg/kg	6	6	0	6	20.6	15	33.3	6.58	19.9	19.15	100.00%
Inorganics	Zinc	mg/kg	6	6	0	6	404	184	714	192	368	361.5	100.00%
Miscellaneous	Number of TICs	count	6	6	0	6	2.67	0	8	3.2	2.99	3.5	100.00%
Miscellaneous	Solids, Total	%	26	26	0	26	61	49.8	79.8	9.5	60.3	57.25	100.00%
PCBs	Aroclor-1016	mg/kg	6	6	0	5	0.273	0.095	0.51	0.141	0.241	0.24	83.33%
PCBs	Aroclor-1221	mg/kg	6	6	0		0.29	0.195	0.5	0.116	0.274	0.245	0.00%
PCBs	Aroclor-1232	mg/kg	6	6	0		0.144	0.095	0.255	0.0604	0.135	0.12	0.00%
PCBs	Aroclor-1242	mg/kg	6	6	0	5	0.199	0.095	0.29	0.0699	0.188	0.195	83.33%
PCBs	Aroclor-1248	mg/kg	6	6	0		0.144	0.095	0.255	0.0604	0.135	0.12	0.00%
PCBs	Aroclor-1254	mg/kg	6	6	0		0.144	0.095	0.255	0.0604	0.135	0.12	0.00%
PCBs	Aroclor-1260	mg/kg	6	6	0		0.144	0.095	0.255	0.0604	0.135	0.12	0.00%
PCBs	Total PCBs	mg/kg	6	6	0	5	0.216	0.16	0.29	0.0488	0.211	0.1975	83.33%
Pesticides	4,4'-DDD	ug/kg	6	6	0		14.4	9.5	25.5	6.04	13.5	12	0.00%
Pesticides	4,4'-DDE	ug/kg	6	6	0	4	15.3	9.5	25.5	5.71	14.6	13.5	66.67%
Pesticides	4,4'-DDT	ug/kg	6	6	0		14.4	9.5	25.5	6.04	13.5	12	0.00%
Pesticides	Aldrin	ug/kg	6	6	0		7.5	5	13	3.07	7.06	6.25	0.00%
Pesticides	Alpha-BHC	ug/kg	6	6	0		7.5	5	13	3.07	7.06	6.25	0.00%
Pesticides	Alpha-Chlordane	ug/kg	6	6	0	1	7.53	5	13	3.04	7.1	6.35	16.67%
Pesticides	Beta-BHC	ug/kg	6	6	0		7.5	5	13	3.07	7.06	6.25	0.00%
Pesticides	Delta-BHC	ug/kg	6	6	0		7.5	5	13	3.07	7.06	6.25	0.00%
Pesticides	Dieldrin	ug/kg	6	6	0		14.4	9.5	25.5	6.04	13.5	12	0.00%
Pesticides	Eldrin	ug/kg	6	6	0		14.8	9.5	25.5	5.87	13.9	13	0.00%
Pesticides	Endosulfan I	ug/kg	6	6	0		7.5	5	13	3.07	7.06	6.25	0.00%
Pesticides	Endosulfan II	ug/kg	6	6	0		14.4	9.5	25.5	6.04	13.5	12	0.00%

Appendix F-4
Embayment #3 Sediment Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
Pesticides	Endosulfan Sulfate	ug/kg	6	6	0		14.4	9.5	25.5	6.04	13.5	12	0.00%
Pesticides	Endrin Aldehyde	ug/kg	6	6	0		14.4	9.5	25.5	6.04	13.5	12	0.00%
Pesticides	Endrin Ketone	ug/kg	6	6	0	3	18.2	9.5	25.5	5.63	17.4	17.5	50.00%
Pesticides	Gamma-BHC (Lindane)	ug/kg	6	6	0		7.5	5	13	3.07	7.06	6.25	0.00%
Pesticides	Gamma-Chlordane	ug/kg	6	6	0	2	7.53	5	13	3.04	7.1	6.35	33.33%
Pesticides	Heptachlor	ug/kg	6	6	0		7.5	5	13	3.07	7.06	6.25	0.00%
Pesticides	Heptachlor Epoxide	ug/kg	6	6	0		7.5	5	13	3.07	7.06	6.25	0.00%
Pesticides	Methoxychlor	ug/kg	6	6	0		75	50	130	30.7	70.6	62.5	0.00%
Pesticides	Toxaphene	ug/kg	6	6	0		750	500	1300	307	706	625	0.00%
SVOCs	1,2,4-Trichlorobenzene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	1,2-Dichlorobenzene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	1,3-Dichlorobenzene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	1,4-Dichlorobenzene	ug/kg	6	6	0	6	363	170	600	166	330	365	100.00%
SVOCs	2,2'-Oxybis(1-Chloropropane)	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	2,4,5-Trichlorophenol	ug/kg	6	6	0		1600	490	6500	2400	900	600	0.00%
SVOCs	2,4,6-Trichlorophenol	ug/kg	6	6	0		607	75	2550	956	299	237.5	0.00%
SVOCs	2,4-Dichlorophenol	ug/kg	6	6	0		607	75	2550	956	299	237.5	0.00%
SVOCs	2,4-Dimethylphenol	ug/kg	6	6	0		607	75	2550	956	299	237.5	0.00%
SVOCs	2,4-Dinitrophenol	ug/kg	6	6	0		1600	490	6500	2400	900	600	0.00%
SVOCs	2,4-Dinitrotoluene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	2,6-Dinitrotoluene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	2-Chloronaphthalene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	2-Chlorophenol	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	2-Methylnaphthalene	ug/kg	6	6	0	5	628	140	2550	949	330	230	83.33%
SVOCs	2-Methylphenol	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	2-Nitroaniline	ug/kg	6	6	0		1600	490	6500	2400	900	600	0.00%
SVOCs	2-Nitrophenol	ug/kg	6	6	0		607	75	2550	956	299	237.5	0.00%
SVOCs	3,3'-Dichlorobenzidine	ug/kg	6	6	0	6	4320	1500	9100	2700	3690	3550	100.00%
SVOCs	3-Nitroaniline	ug/kg	6	6	0		1600	490	6500	2400	900	600	0.00%
SVOCs	4,6-Dinitro-2-methylphenol	ug/kg	6	6	0		1600	490	6500	2400	900	600	0.00%
SVOCs	4-Bromophenyl-phenylether	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	4-Chloro-3-Methylphenol	ug/kg	6	6	0		607	75	2550	956	299	237.5	0.00%
SVOCs	4-Chloroaniline	ug/kg	6	6	0	6	344	76	640	243	263	300	100.00%
SVOCs	4-Chlorophenyl-phenylether	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	4-Methylphenol	ug/kg	6	6	0	5	571	78	2550	972	252	200	83.33%
SVOCs	4-Nitroaniline	ug/kg	6	6	0		1600	490	6500	2400	900	600	0.00%
SVOCs	4-Nitrophenol	ug/kg	6	6	0		1600	490	6500	2400	900	600	0.00%
SVOCs	Acenaphthene	ug/kg	32	32	0	30	625	63	3200	604	427	485	93.75%
SVOCs	Acenaphthylene	ug/kg	32	32	0	28	1210	79	5250	1270	650	657.5	87.50%
SVOCs	Anthracene	ug/kg	32	32	0	32	1650	250	6650	1450	1160	1250	100.00%
SVOCs	Benzo(a)anthracene	ug/kg	32	32	0	27	5040	195	24500	5510	2570	3200	84.38%
SVOCs	Benzo(a)pyrene	ug/kg	32	32	0	32	5300	660	21500	4780	3520	4100	100.00%
SVOCs	Benzo(b)fluoranthene	ug/kg	32	32	0	32	5100	460	22000	4920	3190	3500	100.00%
SVOCs	Benzo(g,h,i)perylene	ug/kg	32	32	0	32	3460	440	15000	3390	2230	2250	100.00%
SVOCs	Benzo(k)fluoranthene	ug/kg	32	32	0	32	4400	520	19500	4280	2830	3100	100.00%
SVOCs	bis(2-Chloroethoxy)methane	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%

Appendix F-4
Embayment #3 Sediment Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
SVOCs	bis(2-Chloroethyl)ether	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	bis(2-Ethylhexyl)phthalate	ug/kg	6	6	0		1680	600	3100	935	1430	1750	0.00%
SVOCs	Butylbenzylphthalate	ug/kg	6	6	0	3	262	140	570	158	233	217.5	50.00%
SVOCs	Carbazole	ug/kg	6	6	0	6	698	310	1300	382	617	585	100.00%
SVOCs	Chrysene	ug/kg	32	32	0	32	6770	670	30500	6680	4270	4650	100.00%
SVOCs	Dibenzo(a,h)anthracene	ug/kg	32	32	0	25	1270	150	5500	1270	763	860	78.13%
SVOCs	Dibenzofuran	ug/kg	6	6	0	5	569	65	2550	974	242	200	83.33%
SVOCs	Diethylphthalate	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	Dimethylphthalate	ug/kg	6	6	0	1	587	79	2550	964	281	217.5	16.67%
SVOCs	Di-n-Butylphthalate	ug/kg	6	6	0	2	585	62	2550	967	264	202.5	33.33%
SVOCs	Di-n-Octylphthalate	ug/kg	6	6	0	2	329	210	540	125	311	305	33.33%
SVOCs	Fluoranthene	ug/kg	32	32	0	32	11800	1200	47500	10500	7810	8550	100.00%
SVOCs	Fluorene	ug/kg	32	32	0	31	743	110	2650	658	522	567.5	96.88%
SVOCs	Hexachlorobenzene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	Hexachlorobutadiene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	Hexachlorocyclopentadiene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	Hexachloroethane	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	Indeno(1,2,3-cd)pyrene	ug/kg	32	32	0	32	3310	420	14000	3170	2160	2200	100.00%
SVOCs	Isophorone	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	Naphthalene	ug/kg	32	32	0	27	957	110	4100	986	625	640	84.38%
SVOCs	Nitrobenzene	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	N-Nitroso-di-n-propylamine	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	N-Nitrosodiphenylamine	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	Pentachlorophenol	ug/kg	6	6	0		1600	490	6500	2400	900	600	0.00%
SVOCs	Phenanthrene	ug/kg	32	32	0	32	6290	840	19500	4950	4540	5150	100.00%
SVOCs	Phenol	ug/kg	6	6	0		632	195	2550	941	359	245	0.00%
SVOCs	Pyrene	ug/kg	32	32	0	32	10000	1000	40000	9060	6620	7550	100.00%
SVOCs	Total PAHs	ug/kg	32	32	0	32	66900	7649	276800	61000	44400	47755	100.00%
SVOCs	Total SVOCs	ug/kg	32	32	0	32	68100	7650	277000	61000	45600	49250	100.00%
TOC	Total Organic Carbon	mg/kg	8	8	0	8	62700	13600	135000	36800	52400	61600	100.00%
VOCs	1,1,1-Trichloroethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	1,1,2,2-Tetrachloroethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	1,1,2-Trichloroethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	1,1-Dichloroethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	1,1-Dichloroethene	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	1,2-Dichloroethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	1,2-Dichloroethene (total)	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	1,2-Dichloropropane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	2-Butanone	ug/kg	6	6	0	5	4.17	2	8	2.56	3.53	3.5	83.33%
VOCs	2-Hexanone	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	4-Methyl-2-pentanone	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Acetone	ug/kg	6	6	0	6	18	8	46	15.3	14	10	100.00%
VOCs	Benzene	mg/kg	6	6	0		0.00883	0.006	0.0155	0.00366	0.00831	0.00725	0.00%
VOCs	Bromochloromethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Bromoform	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Bromomethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%

Appendix F-4
Embayment #3 Sediment Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
VOCs	Carbon Disulfide	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Carbon Tetrachloride	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Chlorobenzene	ug/kg	6	6	0	2	7.75	2	15.5	4.82	6.38	7.25	33.33%
VOCs	Chloroethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Chloroform	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Chloromethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	cis-1,3-Dichloropropene	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Dibromochloromethane	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Ethylbenzene	mg/kg	6	6	0		0.00883	0.006	0.0155	0.00366	0.00831	0.00725	0.00%
VOCs	Methylene Chloride	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Styrene	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Tetrachloroethene	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Toluene	mg/kg	6	6	0		0.00883	0.006	0.0155	0.00366	0.00831	0.00725	0.00%
VOCs	Total BTEX	mg/kg	6	6	0		0.00883	0.006	0.0155	0.00366	0.00831	0.00725	0.00%
VOCs	trans-1,3-Dichloropropene	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Trichloroethene	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Vinyl Chloride	ug/kg	6	6	0		8.83	6	15.5	3.66	8.31	7.25	0.00%
VOCs	Xylenes (total)	mg/kg	6	6	0		0.00883	0.006	0.0155	0.00366	0.00831	0.00725	0.00%

Appendix F-5
Embayment #4 Sediment Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
Inorganics	Aluminum	mg/kg	3	3	0	3	14300	11800	17800	3120	14100	13300	100.00%
Inorganics	Antimony	ug/kg	3	3	0		700	650	800	86.6	697	650	0.00%
Inorganics	Arsenic	mg/kg	3	3	0	3	9.27	6	15.8	5.66	8.29	6	100.00%
Inorganics	Barium	mg/kg	3	3	0	3	141	115	174	30.1	139	134	100.00%
Inorganics	Beryllium	mg/kg	3	3	0	3	0.887	0.77	1	0.115	0.882	0.89	100.00%
Inorganics	Cadmium	mg/kg	3	3	0	3	1.02	0.85	1.2	0.176	1.01	1	100.00%
Inorganics	Calcium	mg/kg	3	3	0	3	30400	13000	61900	27300	23600	16300	100.00%
Inorganics	Chromium	mg/kg	3	3	0	3	33.5	31.6	36.4	2.53	33.5	32.6	100.00%
Inorganics	Cobalt	mg/kg	3	3	0	3	12.5	10.8	14.7	1.99	12.4	12.1	100.00%
Inorganics	Copper	mg/kg	3	3	0	3	55.1	48.3	65.3	9	54.6	51.7	100.00%
Inorganics	Cyanide	mg/kg	3	3	0		0.483	0.44	0.55	0.0586	0.481	0.46	0.00%
Inorganics	Iron	mg/kg	3	3	0	3	28100	23600	34800	5920	27700	25900	100.00%
Inorganics	Lead	mg/kg	3	3	0	3	78.7	51.6	115	32.7	74.4	69.4	100.00%
Inorganics	Magnesium	mg/kg	3	3	0	3	6600	5090	8100	1510	6490	6620	100.00%
Inorganics	Manganese	mg/kg	3	3	0	3	639	578	746	92.7	635	594	100.00%
Inorganics	Mercury	mg/kg	3	3	0	3	0.553	0.34	0.9	0.303	0.505	0.42	100.00%
Inorganics	Nickel	mg/kg	3	3	0	3	28.1	24.8	31.7	3.46	27.9	27.7	100.00%
Inorganics	Potassium	mg/kg	3	3	0	3	1970	1600	2700	629	1910	1620	100.00%
Inorganics	Selenium	mg/kg	3	3	0	2	0.798	0.325	1.1	0.415	0.703	0.97	66.67%
Inorganics	Silver	mg/kg	3	3	0	3	0.68	0.59	0.73	0.0781	0.677	0.72	100.00%
Inorganics	Sodium	mg/kg	3	3	0	3	492	285	864	323	432	328	100.00%
Inorganics	Thallium	mg/kg	3	3	0		0.215	0.195	0.245	0.0265	0.214	0.205	0.00%
Inorganics	Vanadium	mg/kg	3	3	0	3	25.6	21.9	30	4.1	25.4	24.8	100.00%
Inorganics	Zinc	mg/kg	3	3	0	3	213	175	252	38.5	211	212	100.00%
Miscellaneous	Number of TICs	count	3	3	0	3	0.667	0	2	1.15	2	2	100.00%
Miscellaneous	Solids, Total	%	6	6	0	6	68.5	61.5	79	7.42	68.1	65.15	100.00%
PCBs	Aroclor-1016	mg/kg	3	3	0	2	0.267	0.15	0.36	0.107	0.25	0.29	66.67%
PCBs	Aroclor-1221	mg/kg	3	3	0		0.325	0.295	0.37	0.0397	0.323	0.31	0.00%
PCBs	Aroclor-1232	mg/kg	3	3	0		0.158	0.145	0.18	0.0189	0.158	0.15	0.00%
PCBs	Aroclor-1242	mg/kg	3	3	0	2	0.557	0.15	1.2	0.564	0.386	0.32	66.67%
PCBs	Aroclor-1248	mg/kg	3	3	0		0.158	0.145	0.18	0.0189	0.158	0.15	0.00%
PCBs	Aroclor-1254	mg/kg	3	3	0		0.158	0.145	0.18	0.0189	0.158	0.15	0.00%
PCBs	Aroclor-1260	mg/kg	3	3	0		0.158	0.145	0.18	0.0189	0.158	0.15	0.00%
PCBs	Total PCBs	mg/kg	3	3	0	2	0.61	0.31	1.2	0.511	0.492	0.32	66.67%
Pesticides	4,4'-DDD	ug/kg	3	3	0		15.8	14.5	18	1.89	15.8	15	0.00%
Pesticides	4,4'-DDE	ug/kg	3	3	0		15.8	14.5	18	1.89	15.8	15	0.00%
Pesticides	4,4'-DDT	ug/kg	3	3	0		15.8	14.5	18	1.89	15.8	15	0.00%
Pesticides	Aldrin	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%
Pesticides	Alpha-BHC	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%
Pesticides	Alpha-Chlordane	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%
Pesticides	Beta-BHC	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%
Pesticides	Delta-BHC	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%
Pesticides	Dieldrin	ug/kg	3	3	0		15.8	14.5	18	1.89	15.8	15	0.00%
Pesticides	Eldrin	ug/kg	3	3	0		15.8	14.5	18	1.89	15.8	15	0.00%
Pesticides	Endosulfan I	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%

Appendix F-5
Embayment #4 Sediment Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
Pesticides	Endosulfan II	ug/kg	3	3	0		15.8	14.5	18	1.89	15.8	15	0.00%
Pesticides	Endosulfan Sulfate	ug/kg	3	3	0		15.8	14.5	18	1.89	15.8	15	0.00%
Pesticides	Endrin Aldehyde	ug/kg	3	3	0		15.8	14.5	18	1.89	15.8	15	0.00%
Pesticides	Endrin Ketone	ug/kg	3	3	0		15.8	14.5	18	1.89	15.8	15	0.00%
Pesticides	Gamma-BHC (Lindane)	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%
Pesticides	Gamma-Chlordane	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%
Pesticides	Heptachlor	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%
Pesticides	Heptachlor Epoxide	ug/kg	3	3	0		8.33	7.5	9.5	1.04	8.29	8	0.00%
Pesticides	Methoxychlor	ug/kg	3	3	0		83.3	75	95	10.4	82.9	80	0.00%
Pesticides	Toxaphene	ug/kg	3	3	0		833	750	950	104	829	800	0.00%
SVOCs	1,2,4-Trichlorobenzene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	1,2-Dichlorobenzene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	1,3-Dichlorobenzene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	1,4-Dichlorobenzene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2,2'-Oxybis(1-Chloropropane)	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2,4,5-Trichlorophenol	ug/kg	3	3	0		800	750	900	86.6	797	750	0.00%
SVOCs	2,4,6-Trichlorophenol	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2,4-Dichlorophenol	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2,4-Dimethylphenol	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2,4-Dinitrophenol	ug/kg	3	3	0		800	750	900	86.6	797	750	0.00%
SVOCs	2,4-Dinitrotoluene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2,6-Dinitrotoluene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2-Chloronaphthalene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2-Chlorophenol	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2-Methylnaphthalene	ug/kg	3	3	0	2	303	160	380	124	282	370	66.67%
SVOCs	2-Methylphenol	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	2-Nitroaniline	ug/kg	3	3	0		800	750	900	86.6	797	750	0.00%
SVOCs	2-Nitrophenol	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	3,3'-Dichlorobenzidine	ug/kg	3	3	0	3	1030	280	1900	816	788	920	100.00%
SVOCs	3-Nitroaniline	ug/kg	3	3	0		800	750	900	86.6	797	750	0.00%
SVOCs	4,6-Dinitro-2-methylphenol	ug/kg	3	3	0		800	750	900	86.6	797	750	0.00%
SVOCs	4-Bromophenyl-phenylether	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	4-Chloro-3-Methylphenol	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	4-Chloroaniline	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	4-Chlorophenyl-phenylether	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	4-Methylphenol	ug/kg	3	3	0	2	283	160	370	110	267	320	66.67%
SVOCs	4-Nitroaniline	ug/kg	3	3	0		800	750	900	86.6	797	750	0.00%
SVOCs	4-Nitrophenol	ug/kg	3	3	0		800	750	900	86.6	797	750	0.00%
SVOCs	Acenaphthene	ug/kg	9	9	0	3	242	60	495	128	210	215	33.33%
SVOCs	Acenaphthylene	ug/kg	9	9	0	4	259	53	495	158	204	215	44.44%
SVOCs	Anthracene	ug/kg	9	9	0	6	286	140	760	195	247	210	66.67%
SVOCs	Benzo(a)anthracene	ug/kg	9	9	0	6	312	51	540	161	248	370	66.67%
SVOCs	Benzo(a)pyrene	ug/kg	9	9	0	8	676	76	2500	744	440	440	88.89%
SVOCs	Benzo(b)fluoranthene	ug/kg	9	9	0	8	527	65	1800	534	360	310	88.89%
SVOCs	Benzo(g,h,i)perylene	ug/kg	9	9	0	7	274	54	790	210	218	230	77.78%

Appendix F-5
Embayment #4 Sediment Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
SVOCs	Benzo(k)fluoranthene	ug/kg	9	9	0	7	429	60	1400	397	315	310	77.78%
SVOCs	bis(2-Chloroethoxy)methane	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	bis(2-Chloroethyl)ether	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	bis(2-Ethylhexyl)phthalate	ug/kg	3	3	0		248	145	305	89.6	235	295	0.00%
SVOCs	Butylbenzylphthalate	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Carbazole	ug/kg	3	3	0	1	250	84	370	148	209	295	33.33%
SVOCs	Chrysene	ug/kg	9	9	0	9	661	45	2500	764	379	400	100.00%
SVOCs	Dibenzo(a,h)anthracene	ug/kg	9	9	0	2	258	84	495	130	224	260	22.22%
SVOCs	Dibenzofuran	ug/kg	3	3	0	1	268	140	370	117	248	295	33.33%
SVOCs	Diethylphthalate	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Dimethylphthalate	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Di-n-Butylphthalate	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Di-n-Octylphthalate	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Fluoranthene	ug/kg	9	9	0	8	843	160	2800	785	619	640	88.89%
SVOCs	Fluorene	ug/kg	9	9	0	5	222	71	495	147	180	210	55.56%
SVOCs	Hexachlorobenzene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Hexachlorobutadiene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Hexachlorocyclopentadiene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Hexachloroethane	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Indeno(1,2,3-cd)pyrene	ug/kg	9	9	0	7	276	47	920	252	210	220	77.78%
SVOCs	Isophorone	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Naphthalene	ug/kg	9	9	0	5	244	62	495	170	189	210	55.56%
SVOCs	Nitrobenzene	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	N-Nitroso-di-n-propylamine	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	N-Nitrosodiphenylamine	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Pentachlorophenol	ug/kg	3	3	0		800	750	900	86.6	797	750	0.00%
SVOCs	Phenanthrene	ug/kg	9	9	0	8	576	140	1800	510	437	450	88.89%
SVOCs	Phenol	ug/kg	3	3	0		323	295	370	40.7	322	305	0.00%
SVOCs	Pyrene	ug/kg	9	9	0	8	879	160	2800	821	625	670	88.89%
SVOCs	Total PAHs	ug/kg	9	9	0	9	5640	96	19880	5930	2980	4233	100.00%
SVOCs	Total SVOCs	ug/kg	9	9	0	9	6060	96	22300	6720	3080	4230	100.00%
TOC	Total Organic Carbon	mg/kg	1	1	0	1	7160	7160	7160	0	7160	7160	100.00%
VOCs	1,1,1-Trichloroethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	1,1,2,2-Tetrachloroethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	1,1,2-Trichloroethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	1,1-Dichloroethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	1,1-Dichloroethene	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	1,2-Dichloroethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	1,2-Dichloroethene (total)	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	1,2-Dichloropropane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	2-Butanone	ug/kg	3	3	0	2	7.83	6	9.5	1.76	7.7	8	66.67%
VOCs	2-Hexanone	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	4-Methyl-2-pentanone	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Acetone	ug/kg	3	3	0	3	29.7	13	54	21.5	24.9	22	100.00%
VOCs	Benzene	mg/kg	3	3	0		0.00983	0.009	0.011	0.00104	0.0098	0.0095	0.00%

Appendix F-5
Embayment #4 Sediment Statistics
Revised Comprehensive Sediment Investigation Report for Operable Unit 2
Hudson (Water Street) Site, Hudson, New York - National Grid

Parameter Group	Analyte	Result Units	Total Count	Valid	Rejected	Detects	Average	MIN	MAX	Std Dev	GeoMean	Median	Frequency Of Detects
VOCs	Bromochloromethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Bromoform	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Bromomethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Carbon Disulfide	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Carbon Tetrachloride	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Chlorobenzene	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Chloroethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Chloroform	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Chloromethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	cis-1,3-Dichloropropene	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Dibromochloromethane	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Ethylbenzene	mg/kg	3	3	0		0.00983	0.009	0.011	0.00104	0.0098	0.0095	0.00%
VOCs	Methylene Chloride	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Styrene	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Tetrachloroethene	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Toluene	mg/kg	3	3	0		0.00983	0.009	0.011	0.00104	0.0098	0.0095	0.00%
VOCs	Total BTEX	mg/kg	3	3	0		0.00983	0.009	0.011	0.00104	0.0098	0.0095	0.00%
VOCs	trans-1,3-Dichloropropene	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Trichloroethene	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Vinyl Chloride	ug/kg	3	3	0		9.83	9	11	1.04	9.8	9.5	0.00%
VOCs	Xylenes (total)	mg/kg	3	3	0		0.00983	0.009	0.011	0.00104	0.0098	0.0095	0.00%

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Appendix G

First and Second Year Results of the OU2 Sediment Monitoring Program

ARCADIS

First Year Results of the OU2
Sediment Monitoring Program
(dated April 22, 2008)

ARCADIS
Infrastructure, environment, facilities

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ENVIRONMENT

Mr. Anthony Karwiel
New York State Department of Environmental Conservation
Remedial Bureau C, 11th Floor
625 Broadway
Albany, New York, 12233-7014

Subject:
National Grid- Hudson (Water Street) Site
Hudson, New York
NYSDEC Site No. 4-11-005
First Year Results of the OU2 Sediment Monitoring Program

Date:
April 22, 2008

Contact:
Mark Gravelding, P.E.

Phone:
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mark.gravelding@
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Our ref:
B0036682.0000

Dear Mr. Karwiel:

This letter report has been prepared by ARCADIS on behalf of National Grid to summarize the results of the 2007 sediment sampling and laboratory analyses performed for the first round of the Operable Unit Two (OU2) sediment monitoring program for the Hudson (Water Street) Former Manufactured Gas Plant (MGP) Site, located in Hudson, Columbia County, New York (Site). The work was performed in accordance with the New York State Department of Environmental Conservation (NYSDEC)-approved Monitoring Plan for Operable Unit 2 Sediments (ARCADIS BBL, 2007). NYSDEC personnel provided regulatory oversight during the field activities. This letter report presents a summary of:

- project background
- the overall objectives of the OU2 monitoring program and the specific objectives of the 2007 sediment sampling activities
- the field activities and laboratory analyses performed to achieve the objectives
- the results of the field activities and laboratory analyses
- the schedule for future monitoring activities

Project Background

The Site consists of two OUs: the former MGP and Embayment #1 (OU1), and the Hudson River adjacent to the Site, including Embayments #2, #3, and #4 sediments (OU2). Four major sediment sampling programs were conducted at the Site from 1995 to 2002. The most comprehensive of these investigations was completed in

2002 to delineate sediments containing MGP-related constituents adjacent to the Site. As part of that investigation, the spatial distribution of polycyclic aromatic hydrocarbons (PAHs) and the principal chemicals of concern in sediments were evaluated in locations upstream of, adjacent to, and downstream of Embayment #1. In 2003, a Comprehensive Sediment Investigation Report for Operable Unit 2, Hudson (Water Street) Site, Hudson, New York (CSIR) (BBL, 2003) was submitted to the NYSDEC. The following were among the observations and conclusions made in the CSIR:

- sediments immediately adjacent to, near upstream (tidally influenced), and downstream of Embayment #1 contained Site-related PAHs

- in those sediments containing elevated concentrations of Site-related PAHs, there was evidence of PAH compositional alterations that could be attributed to ongoing natural attenuation processes (combined physical, chemical, and biological degradation processes)

- in Embayment #3 and #4, PAH concentrations and compositions indicated that the PAHs present are characteristic of urban/industrial background sources, and similar to PAHs found in upstream Hudson River sediment

- in Embayment #3, PAHs are likely attributable to a local stormwater outfall, as total PAH concentrations were higher than those found in the river sediments far upstream of Embayment #1 and downstream of Embayment #2

- surface sediment total PAH concentrations in Embayment #2 were low (less than 10 milligrams per kilogram (mg/kg))

Following submittal of the CSIR to the NYSDEC, remedial activities for OU1 were completed from April 2004 to September 2005, and consisted of the following activities:

- excavation and off-site disposal of sediments from Embayment #1

- excavation and off-site disposal of soils within the former gas holder area and former tar tank area on the SBD Warehouse Property

- restoration of the Embayment #2 shoreline and the north wall of the warehouse on the SBD Warehouse Property

Since it was expected that natural attenuation of Site-related PAHs in the OU2 sediments would be accelerated as a result of the OU1 remediation activities, NYSDEC and National Grid agreed to postpone development of a Feasibility Study for OU2 sediments. Moreover, National Grid agreed to monitor the OU2 sediments for a two-year period (i.e., three monitoring events over a two-year period) following completion of the OU1 remediation efforts to monitor the progress of natural attenuation of MGP-related PAHs in OU2 sediments.

In September 2005, National Grid submitted a Monitoring Plan for Operable Unit 2 Sediments (ARCADIS BBL, 2007) (Monitoring Plan) to the NYSDEC for review and comment. A revised Monitoring Plan was submitted to the NYSDEC in July 2007 to address NYSDEC's comments on the initial submittal. The NYSDEC approved the revised Monitoring Plan in July 2007. As presented in the Monitoring Plan, following the completion of each monitoring event, a brief letter report is to be prepared to summarize completion of the sampling activities, note any deviations from the Monitoring Plan, and identify any data findings warranting changes to subsequent monitoring events.

Objectives of the OU2 Sediment Monitoring Program and the 2007 Activities

The overall objectives of the two-year monitoring program for OU2 sediments, as identified in the NYSDEC-approved Monitoring Plan, are presented below.

1. document baseline chemical conditions (PAH concentrations and compositions) in OU2 surficial sediments and visually characterize non-aqueous-phase liquid (NAPL) distribution in near-surface sediment following the OU1 remediation and source mitigation

2. measure/document changes in chemical and visual (NAPL) conditions in OU2 sediments over time

3. identify background PAHs entering the OU2 area that may contribute to PAH loading and concentrations in OU2 sediments

4. document the effectiveness of natural attenuation in reducing concentrations of MGP-related PAHs in OU2 sediments

5. estimate the timeframe to reach the limits of MGP-related PAH concentration reductions in OU2 sediments

6. utilize the results of the monitoring program as a basis for determining sediments within OU2 that may require consideration for remediation in a feasibility study (FS)

As described more fully in the sections below, the 2007 field activities and laboratory analyses were intended to provide data to satisfy Objective 1, and to provide data to be used, in conjunction with future rounds of monitoring data, to satisfy Objectives 2 through 6.

Following completion of the 2-year monitoring program, a Final Report will be prepared to document the effectiveness of natural attenuation in reducing concentrations of MGP-related PAHs in OU2 sediments (i.e., Objective 4), estimate the timeframe to reach the limits of MGP-related PAH concentration reductions in OU2 sediments (Objective 5), and identify sediments, if any, that may require consideration for remediation in an FS (Objective 6).

Field Activities and Laboratory Analyses

This section describes the 2007 field activities and laboratory analyses performed to address the objectives identified above.

Field Activities

As presented in the Monitoring Plan, sediment samples were proposed to be collected from 19 monitoring stations (refer to Figure 1) for the first round of OU2 sediment monitoring. The 19 monitoring stations were selected to correspond with certain sampling locations from previous sediment investigations which appeared to contain Site-related PAHs (i.e., for continuity and use of data from previous work). The objective of selecting locations for the monitoring program that were previously sampled was to establish initial post-OU1 remediation conditions in the OU2 area (Objective 1 above). The monitoring station locations were also selected to spatially represent sediments in the three major areas of OU2: upstream of OU1, adjacent to OU1, and downstream of OU1 (including Embayment #2).

Despite their best efforts, which included on-site meetings and other correspondence, National Grid was unable to obtain clearance from the utility companies (Verizon, Mid-Hudson Cable, and Cablevision) to collect samples at two of the proposed upstream monitoring stations (MPU-1 and MPU-2) due to the presence of an underwater fiber optic cable that traverses the Hudson River as shown on Figure 1. Consequently, sediment samples could not be collected at monitoring stations MPU-1 and MPU-2.

Sediment core samples were collected by ARCADIS, on behalf of National Grid, from October 1 through October 4, 2007 from 17 monitoring stations, as follows (the monitoring station locations are shown on the attached Figure 1):

- one monitoring station located upstream of OU1 (MPU-3)

- five monitoring stations adjacent to OU1 (MPA-1 through MPA-5)
- eight monitoring stations downstream of OU1 (MPD-1 through MPD-8)
- three locations within Embayment #2 (MPE2-1 through MPE2-3)

Each of the 17 monitoring stations was located in the field using survey-grade global positioning system (GPS) equipment. The sediment cores were collected by advancing a split-spoon sampling device to a depth of approximately 1 foot below the sediment-water interface using a barge-mounted drill rig. In areas where Site conditions (i.e., water depth, limited access, and the location of privately-owned watercraft) prevented the collection of sediment cores using the barge-mounted drill rig (e.g., MPE2-1 through MPE2-3, and MPA-2), sediment cores were collected from a smaller boat by manually advancing a Lexan tube into the sediment using a slide hammer. In accordance with the Monitoring Plan, 4-foot cores were collected at Monitoring Stations MPA-1, MPA-3, MPA-4 and MPA-5, located outside the mouth of Embayment #1, to characterize NAPL distribution in this area following the completion of the OU1 remediation and source mitigation activities.

Upon extraction, each sediment core was transported to an on-shore processing area for subsequent visual characterization and sampling, consistent with Objective 1 identified above. The recovered sediment cores were visually characterized by ARCADIS' field representative for evidence of NAPL, and the sediment was screened for the presence of volatile organic compounds (VOCs) using a photoionization detector (PID) equipped with an 11.4eV lamp. Observations regarding the probing conditions, sediment characteristics, presence of debris (i.e., brick, glass, slag), and water depth were recorded in a field log book. No community complaints were received during the completion of the field activities.

As described in the Monitoring Plan, and consistent with Objective 1 identified above, the sampling and laboratory analysis program was to focus on the upper 6 inches of sediment (i.e., surficial sediment in the biologically active zone). Therefore, following visual characterization of the cores, sediment samples were collected from each core from the 0- to 6-inch depth interval using stainless steel sampling equipment. The samples were containerized in clean laboratory-supplied glassware, packaged and in a cooler with ice, and shipped to the analytical laboratory under chain-of-custody for analyses as described below.

Laboratory Analyses

A total of 19 sediment samples from the 17 monitoring stations (included two quality assurance/quality control (QA/QC) samples) were analyzed by Alpha Woods Hole

Laboratories, Inc. for priority pollutant PAHs (Total PAHs) and total organic carbon (TOC) in accordance with EPA Methods 8270C and 9060, respectively. As part of the Total PAH analyses, a total ion chromatogram was generated which was used as a fingerprint of overall hydrocarbon composition for the samples ('GC fingerprint'). The TOC analyses were performed to provide information to better understand PAH distribution in the sediment.

Based on the evaluation of Total PAH concentrations and hydrocarbon compositional characteristics (i.e., PAH distribution and GC fingerprints) performed using the initial data, samples with similar concentrations and fingerprints were grouped together and 1 or 2 representative samples from each group were selected for second tier "forensic hydrocarbon analyses" to provide additional data to support the objectives of the monitoring program. The forensic analyses included the following:

- extended list of PAHs by Modified Method 8270C ("forensic PAHs")
- Total Petroleum Hydrocarbons (TPH) by EPA Method 8015

Nine samples from the monitoring program and 6 samples from the supplemental sediment sampling program[1] were selected for forensic analyses. The forensic PAHs analysis includes a more complete list of PAHs than the standard 8270C PAH analysis; the extended PAH list includes the alkyl homologues of two-, three-, and four-ringed PAHs and sulfur heterocyclic compounds (Sauer and Boehm, 1995; Stout et al. 2002). This extended list of PAHs is necessary to characterize possible other sources of hydrocarbons entering the OU2 area (Objective 3 above) (Sauer and Uhler 1995; Stout et al 2002), and to provide information on compositional changes to Site-related PAHs resulting from natural attenuation processes in the river (Bragg et al. 1993; Douglas et al. 1993).. Specifically, alterations in PAH composition reveal the degree to which a PAH residue has degraded through a combination of physical-chemical weathering (primarily dissolution and evaporation) and biodegradation when the original composition is known. Such compositional analysis has been widely used for evaluating weathering and biodegradation of petroleum and

[1] As presented in the Monitoring Plan, the supplemental sediment sampling program was completed concurrent with the first year of sediment monitoring for OU2. A preliminary assessment of the laboratory data associated the supplemental sediment samples indicated that some of the supplemental sediment samples exhibited PAH compositional characteristics similar to the PAHs identified in the monitoring program samples. Therefore, it was determined that the supplemental sediment samples would be useful in evaluating the effectiveness of natural attenuation of MGP-related PAHs in OU2 sediments. The results of the supplemental sediment sampling activities were presented in detail in a separate letter to NYSDEC, dated April 17, 2008.

pyrogenic tar residues (Sauer at al. 1993). As part of the forensic PAH analysis, total ion chromatograms and specific mass ion chromatograms, representing particular hydrocarbon groups (e.g., mass ion 85 represents alkanes in the sample), were generated for each sample.

In addition to the extended PAH analysis, the sediment samples were analyzed for TPH as noted above. As part of the TPH analysis, a gas chromatogram ('GC fingerprint') was generated for each sample, and total hydrocarbons, n-alkane and isoprenoid concentrations were determined for the carbon range from C10 to C40 to help characterize any petroleum contributions in the sediment (Objective 3 above).

Results of the Field Activities and Laboratory Analyses

This section presents the results of the field activities and laboratory analyses described above.

Documentation of Post-OU1 Remediation Baseline Conditions and Identification of Background PAHs

The sediment conditions encountered during the collection of the OU2 monitoring program samples generally consisted of medium to coarse sand, with varying proportions of gravel, silt, clay and organic material (i.e., wood, shells). Table 1 presents a summary of the post-OU1 remediation observations regarding the presence of NAPL for each of the monitoring stations. As indicated in Table 1, visible NAPL was observed at 4 of the 17 monitoring locations (MPD-2, MPA-3, MPA-4, and MPA-5) at depths ranging from approximately 0 to 16 inches below the sediment-water interface.

Results of the Total Priority Pollutant PAH analyses by Method 8270C and the TOC analyses for the 17 monitoring program samples are presented in Table 2. Table 3 presents the specific 2007 samples selected for forensic analyses and the sample groups represented by those samples. The Total PAHs as determined by the forensic PAH analysis (Modified 8270C) are also presented in Table 3. The complete results of the forensic analysis of PAHs (i.e., individual PAH compounds) for each sample are presented in Appendix A. To help display the forensic PAH data, PAH concentrations of each sample were plotted as a PAH fingerprint to show the PAH compositional signature of each sample. As noted above, these PAH distributions are valuable in evaluating similarities/differences in compositional characteristics among the samples due to potential source contributions in addition to Site-related PAHs, and are also useful in assessing changes in composition of Site-related PAHs resulting from natural attenuation processes. The PAH fingerprints are provided in Appendix B. The GC fingerprints from the TPH analyses described

above are provided in Appendix C; these GC fingerprints are useful in identifying types of petroleum products (e.g., diesel) and other hydrocarbons in the sediments.

The PAH fingerprints and the GC fingerprints of the samples, as presented in Appendices B and C respectively, were evaluated to identify the types and sources of hydrocarbons, particularly PAHs, in the samples. Despite the large variety of industries, products, and release pathways associated with historical and ongoing sources to sediments, PAHs can generally be grouped into the following common types:

1. pyrogenic PAHs from:
   - by-products of incomplete combustion (burning)
   - by-product tars from pyrolysis (heating in an oxygen-free environment) processes
2. petrogenic PAHs (i.e., petroleum PAHs) from crude oils, refined oils, and coal
3. biogenic PAHs from chemical transformation of biological precursors, such as plant pigments.

The predominant types of PAHs present in all of the samples from the first round of monitoring were pyrogenic PAHs. Pyrogenic PAHs formed from incomplete combustion have both an anthropogenic origin (burning of petroleum, coal, wood) and a natural origin (burning of natural materials such as forest fires). Pyrogenic PAHs from incomplete combustion processes are generally associated with soot or similar particulate matter, are often transported and deposited through the atmosphere, and are the major contributors to industrial/urban background PAHs (Sauer and Uhler 1995, Stout et al 2002). PAHs from pyrolysis processes are generally byproducts (e.g., coal- and oil-derived tars) of manufacturing processes such as coal gasification or coking. Although these tars are commonly associated with wastes from former MGP operations, they can be reprocessed (distilled) for use in various commercial products such as creosote, roofing tar, and pavement. Pyrogenic PAH compositions are characterized by the dominance of the parent PAH with decreasing abundance of the alkyl groups as alkyl group size increases (C0 > C1 > C2 > C3 > C4). The 16 priority pollutant PAHs are particularly abundant in a pyrogenic PAH composition. Phenanthrene and the 4- through 6-ringed parent PAHs are the most abundant pyrogenic PAHs in soot, road dust, and the atmosphere in urban/industrial areas. Depending on the extent of weathering, pyrolytic PAHs such as unweathered coal tar have more of the 2- and 3-ringed PAHs [see PAH distribution of SD-95 (0-6) provided in Appendix B].

Concentrations of PAHs indicative of Site-related PAHs (EPRI, 2002; McCarthy et al 2000) in river sediments were found at MPA-1 through MPA-5, MPD-2, MPD-3, and the SD samples (except at SD-94). The PAH fingerprints of these samples (see Appendix B) showed various stages of weathered coal tar material, as evidenced by the relative decrease of the less weather-resistant 2- and 3-ringed PAHs (e.g., naphthalenes, phenanthrenes) compared to the higher molecular weight 4- and 5-ringed PAHs (e.g., pyrenes, benzo(a)pyrene). The PAH fingerprints of samples MPA-3 and MPA-5 provided in Appendix B illustrate the contrast.

The other samples, especially downriver of MPD-4 and in Embayment #2 (MPE2 samples), had low PAH concentrations and compositions indicative of background pyrogenic PAHs typical for river sediments (Stout et al. 2004; Costa et al. 2004).

As noted previously, only 1 of the three sediment samples could be obtained from the proposed locations upriver of the OU1 area (MPU-3). Based on review of the field observations and the analytical results, MPU-3 has characteristics similar to the Site-related material from the OU1 area, consistent with the conclusions drawn in the CSIR.

A slight contribution of petroleum PAHs was evident in only 4 samples. Petroleum PAHs (e.g., crude oil, refined oils) are characterized by a “bell shape” distribution of the homologous series of alkyl-substituted PAHs, where the C_2- or C_3-substituted PAH abundance predominates within a ‘family’ of PAHs (e.g., phenanthrene, C_1-phenanthrenes, C_2-phenanthrenes, etc.). Also, petroleum usually contains relatively low amounts of 5- and 6-ringed PAHs, such as benzo(a)anthracene and benzo(a)pyrene, unlike pyrogenic tars and combustion residues, in which the presence of these compounds is relatively high (Sauer and Uhler 1995; Stout et al., 2002). Trace levels of petroleum PAHs were evident in samples SD-94 (0-6), SD-95 (6-24), MPE2-2, and MPD-8. With the slight ‘bell-shape’ pattern, dibenzothiophenes was the only PAH group that provided evidence for trace levels of petroleum PAHs in the samples.

The GC fingerprints from the TPH analyses (Appendix C) helped to demonstrate the presence of residual petroleum in samples not easily evident in the PAH compositional distribution (PAH fingerprint). Petroleum-containing sediments are characterized by the unresolved complex mixture (UCM) or ‘hump’ in the GC fingerprint. Petroleum hydrocarbons can be present in sediments without being reflected in the PAH distribution when pyrogenic PAHs dominate the total PAHs in the sample. The GC fingerprint of the TPH analysis accounts for nearly all the hydrocarbons in a sample whether they originate from pyrogenic, petrogenic or biogenic sources. Because PAHs account for only a small percentage of the total hydrocarbons of petroleum, the contribution of petroleum will be most evident in the TPH results. From the TPH GC fingerprints provided in Appendix C, residual

petroleum was most evident by the UCM in samples SD-94 (0-6), MPE2-2, and MPD-8, and to a much lesser extent in samples SD-95 (6-24), MPD-3, and MPD-4. The type of petroleum, which was similar in each sample, was a weathered heavy oil-type petroleum product (e.g., motor oil, No. 6 fuel oil). None of these samples showed a fresh or weathered gasoline or mid-distillate oil in the sediment.

Based on the PAH compositional and TPH GC fingerprints, a summary of probable sources for the hydrocarbons in the monitoring program sediment samples is provided in Table 3.

Selection of Representative Samples for Future Use in Calculating PAH Depletion

One of the purposes of the first year of monitoring was to identify sediments containing coal tar residual that could be used in the future for calculating PAH depletion over time (i.e., Objectives 4 and 5 of the overall OU2 monitoring program). The approach to be used for the depletion calculations was presented in the Monitoring Plan.

Based on the PAH concentrations and compositional characteristics described above, the surface samples that have been identified as containing MGP-related PAHs and appropriate for depletion evaluation are: MPA-1, MPA-3, MPA-4, MPA-5, MPD-2, MPD-3, SD-87 (0-6), and either SD-95 (0-6) or SD-96 (0-6). These samples represent an appropriate range of high to low PAH concentrations for Site-related tar residuals in surface sediments.

With the results of the second survey in 2008, PAH depletions of both this first (2007) and the second survey results will be calculated for the above sample locations and compared for the purpose of evaluating the extent of natural attenuation of PAHs over time. For samples where pre-remediation PAH data exists, those data will also be included in these depletion determinations. At the end of the Monitoring Program (i.e., after the third round of monitoring), an evaluation of PAH natural attenuation will be performed that includes preliminary estimates of PAH concentration endpoints (i.e., the predicted total PAH concentration when natural attenuation has reached its limit) and timeframes for reaching those endpoints.

Preliminary Assessment of Weathering of Site-related PAHs

Although PAH depletions will not be calculated until after the second year of monitoring (2008) data are available, the degree of weathering of PAHs (percent weathering) was calculated for the 2007 samples containing Site-related PAHs. The percent weathering diagnostic provides an estimate of the relative degree of weathering of coal tar residual in the 2007 samples. To determine the percent weathering, concentrations of the more weathering-susceptible PAHs (i.e., the 2- and

3-ringed PAHs) are compared, as a percent, to concentrations of all the PAHs, including the less weathering-susceptible higher-molecular-weight 4- and 5-ringed PAHs (Brenner et al., 2002). A fresh coal tar product would have a percent weathering value of approximately 85%. Percent weathering values (i.e., 2- and 3-ringed PAHs divided by Total PAHs from the forensic analysis) for the 2007 samples are provided in Table 3 and compared in Figure 2.

The PAH distributions (see Appendix B) and the percent weathering values (Figure 2 and Table 3) of the samples show that the Site-related tar residuals in the surface sediments at the mouth of Embayment #1 are less weathered (i.e., fresher) than those in the other tar residual-containing river sediments. The Site-related material at the mouth of Embayment #1 has a weathering value fairly close to that of fresh coal tar. The other samples containing coal tar show more and variable degrees of weathering, which appear to be correlated with PAH concentration.

Following collection of future rounds of monitoring data and completion of depletion calculations as described in the Monitoring Plan, a more complete picture of the extent of natural weathering of PAHs occurring in OU2 sediments will be determined.

Schedule for Future Monitoring Activities

As presented in the Monitoring Plan, the second and third rounds of monitoring are tentatively scheduled for fall 2008 and fall 2009, respectively. Since the first-round forensic data indicated the presence of coal tar material in sediments at supplemental locations SD-87, SD-95, and SD-96, it is recommended that the surface samples at SD-87 and either SD-95 or SD-96 be included in the sediment monitoring program. These samples represent Site-related material which would be useful in demonstrating natural attenuation of Site-related PAHs over time.

A final report presenting the results of the PAH natural attenuation determination and identifying any sediments that may require consideration for remediation in an FS will be prepared subsequent to the end of the 2-year Monitoring Program (i.e., after the third round of monitoring) in accordance with the schedule presented in the Monitoring Plan.

If you have any questions, please contact me at 315.671.9235, or Mr. William Jones of National Grid at 315.428.5690.

Sincerely,

ARCADIS

Mark O. Gravelding, P.E.
Vice President

Copies:
William Jones, P.E., National Grid
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ARCADIS

Tables

National Grid
Hudson (Water Street) Site, Hudson, New York
2007 Monitoring Program for Operable Unit Two (OU2) Sediments

Table 1 –2007 Sediment Core Descriptions and NAPL Observations

Sample ID	Sample Date	Water Depth (ft)	Penetration Depth (ft)	Sample Recovery (ft)	Sample Depth (ft)	PID Reading (ppm)	Core Description
River Area Upstream of OU 1							
MPU-3	10/04/2007	28	2	1	0 - 0.5	33	Black Gravel, some shells, trace medium fine Sand (sheen observed)
					0.5 – 1	0.0	Black Gravel, some shells, some medium fine Sand
River Area Adjacent to OU 1							
MPA-1	10/03/2007	37	5	2.9	0 – 0.5	14.5	Black medium fine Sand and Gravel, little shell fragments, trace wood (slight odor, NAPL blebs)
					0.5 – 2.9	34	Black medium fine Sand, trace shell fragments, trace Gravel, trace Silt (slight odor)
MPA-2	10/03/2007	22	0.7	0.5	0 – 0.5	0.0	Gray to black Gravel, and Shell fragments, trace medium fine Sand, trace Debris (i.e., glass, wood)
MPA-3	10/02/2007	23	5	1.8	0-0.5	24	Black medium fine Sand, little Shell fragments, trace NAPL (slight odor)
					0.5 – 1.8	10	Black medium fine Sand, trace Organic (rootlets), trace Silt (slight odor, staining)
MPA-4	10/02/2007	28	4	2	0 – 0.6	63	Black medium fine Sand, some Shell fragments, trace Organics (wood), trace Gravel (sheen and trace NAPL from 4-7 inches)
					0.6 - 2	160	Black medium fine Sand, trace Shell fragments
MPA-5	10/02/2007	23	4	2	0 – 0.2	0.0	Black medium fine Sand, some Shell fragments (slight odor)
					0.2 – 0.4	0.0	Black medium fine Sand, trace Shell fragments, trace Silt, trace Gravel
					0.4 – 0.7	33	Black medium fine Sand, trace Shell Fragments (sheen, slight odor)
					0.7 – 2	13	Black medium fine Sand, trace Shell fragments, trace Silt, trace Gravel (slight odor, NAPL observed from 8-16 inches)
River Area Downstream of OU 1							
MPD-1	10/03/2007	37	2	2	0 - 2	0.0	Black medium fine Sand, trace Organics (wood, shells), trace Gravel

Table 1 –Sediment Core Descriptions and NAPL Observations

Sample ID	Sample Date	Water Depth (ft)	Penetration Depth (ft)	Sample Recovery (ft)	Sample Depth (ft)	PID Reading (ppm)	Core Description
MPD-2	10/02/2007	27	2	1.2	0 – 0.2	0.0	Black medium fine Sand, some Shell fragments, trace Gravel
					0.2 – 1.2	25	Black medium fine Sand, trace Shell Fragments (NAPL observed from 3-4 inches)
MPD-3	10/02/2007	30	2	0.8	0 – 0.5	0.0	Black medium fine Sand, some Shell fragments, some Organics (trace organic odor)
					0.5 – 0.8	0.0	Black medium fine Sand, little Silt, trace Shell fragments, trace Organics
MPD-4	10/02/2007	27	2	1.4	0 – 0.2	0.0	Black medium fine Sand, some Shell fragments, trace Gravel, trace Organics (wood)
					0.2 – 0.5	0.0	Black medium fine Sand, some Shell fragments, trace Gravel,
					0.5 – 1.4	0.0	Black Silt, trace medium fine Sand, trace Shell fragments
MPD-5	10/02/2007	27	2	0.8	0 – 0.8	0.0	Black medium fine Sand, trace Shell fragments (slight organic odor)
MPD-6	10/02/2007	32	2	1.1	0 – 0.3	0.0	Black medium fine Sand and Gravel, some Shell fragments, little Debris (glass)
					0.3 – 1.1	0.0	Black medium fine Sand, trace Shell fragments
MPD-7	10/02/2007	31	2	0.7	0 – 0.1	0.0	Black Gravel, little medium fine Sand, little Shell fragments
					0.1 – 0.3	0.0	Black Gravel, some Organics (wood) little medium fine Sand, little Shell fragments
					0.3 – 0.7	0.0	Black medium fine Sand, trace Gravel
MPD-8	10/02/2007	32	2	1.2	0 – 0.2	0.0	Black medium fine Sand, some Shell Fragments, trace Debris (glass)
					0.2 - 1.2	0.0	Black medium fine Sand, trace Shell Fragments, trace Debris (glass)

Table 1 –2007 Sediment Core Descriptions and NAPL Observations

Sample ID	Sample Date	Water Depth (ft)	Penetration Depth (ft)	Sample Recovery (ft)	Sample Depth (ft)	PID Reading (ppm)	Core Description
Embayment #2							
MPE2-1	10/01/2007	8.9	2	1.5	0 – 1.5	0.0	Dark brown to black Silt, trace Organics (roots) (slight organic odor, sheen observed while probing)
MPE2-2	10/01/2007	5.4	1.5	1.3	0 – 0.5	0.0	Dark brown to black Silt, (slight organic odor)
					0.5 – 1.3	0.0	Dark brown to black Silt, trace Organics (roots, leaves)
MPE2-3	10/21/2007	3.8	3	2.3	0 – 0.5	3	Black Silt, little Organics (roots, leaves, shells
					0.5 – 2.3	3	Black medium fine Sand, some Silt, trace Gravel (slight odor, saturated, sheen observed when probing)

Notes:

1. Sample locations MPA-2, and MPE2-1 through MPE2-3 were collected manually with Lexan tubing advanced using a slide hammer. All other samples were collected using a barge-mounted drill and split spoon sampling device.

ft – feet

PID – photoionization detector

ppm – part per million

NAPL – non-aqueous phase liquid

National Grid
Hudson (Water Street) Site, Hudson, New York
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Table 2 - Total Priority Pollutant PAHs by Method 8270C and Total Organic Carbon by Method 9060

Location ID:		MPA-1	MPA-2	MPA-3	MPA-4	MPA-5	MPD-1	MPD-2	MPD-3	MPD-4	MPD-5	MPD-6	MPD-7	MPD-8	MPE2-1	MPE2-2	MPE2-3	MPU-3
Sample Depth(Inches):		0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6
Date Collected:	Units	10/03/07	10/03/07	10/02/07	10/02/07	10/02/07	10/03/07	10/02/07	10/02/07	10/02/07	10/02/07	10/02/07	10/02/07	10/02/07	10/01/07	10/01/07	10/01/07	10/04/07
PAHs																		
Acenaphthene	mg/kg	550 D	0.23 U	180 D	640 D	21 D	0.24 U	460 D	3.5	1.4	3.8	0.23 U	0.77	0.35	0.41 U	0.41 U [0.41 U]	0.56 U	12 D [25 D]
Acenaphthylene	mg/kg	58	0.23 U	12	86	1.1	0.24 U	47	0.41	0.26 U	0.32	0.23 U	0.27 U	0.34	0.41 U	0.41 U [0.41 U]	0.56 U	1.5 [2.2]
Anthracene	mg/kg	540 D	0.31	140 D	660 D	14 D	0.24 U	410 D	2.0	0.94	1.9	0.35	0.52	1.8	0.41 U	0.41 U [0.62]	0.56 U	14 DJ [14 D]
Benzo(a)anthracene	mg/kg	420 DJ	0.47	99	400 D	12	0.24 U	270 D	3.9	1.8	2.2	0.86	0.57	6.6	0.41 U	0.57 [2.0]	0.86	15 DJ [16 D]
Benzo(a)pyrene	mg/kg	340 D	0.47	79	320 D	6.3 D	0.24 U	210 D	2.4	1.3	1.6	0.56	0.43	4.3	0.41 U	0.41 U [1.3]	0.61	11 DJ [12 D]
Benzo(b)fluoranthene	mg/kg	290 D	0.46	63 J	270 DJ	7.6 J	0.24 U	160 DJ	2.9 J	1.5 J	1.5 J	0.61 J	0.44 J	6.0 J	0.50 J	0.58 J [2.9 J]	0.90 J	11 J [9.7 D]
Benzo(g,h,i)perylene	mg/kg	140 D	0.28	40	130 D	3.3	0.24 U	86	1.3	0.74	1.0	0.33	0.27 U	3.1	0.41 U	0.41 U [0.96]	0.56 U	5.7 [6.6]
Benzo(k)fluoranthene	mg/kg	210 D	0.28	55	220 D	4.9 D	0.24 U	150 D	2.0	1.2	0.91	0.49	0.29	3.4	0.41 U	0.57 [0.48]	0.73	5.6 DJ [9.0 D]
Chrysene	mg/kg	380 D	0.47	82	380 D	8.8 D	0.24 U	220 D	3.3	1.5	2.1	0.75	0.52	6.0	0.42	0.63 [1.8]	0.93	14 DJ [15 D]
Dibenzo(a,h)anthracene	mg/kg	19	0.23 U	4.9	17	1.3	0.24 U	13	0.48	0.27	0.36	0.23 U	0.27 U	1.4	0.41 U	0.41 U [0.41 U]	0.56 U	0.63 J [0.80]
Fluoranthene	mg/kg	1,100 D	0.70	240 D	1,000 D	25 D	0.24 U	700 D	8.7	3.7	5.7	1.5	1.4	12	0.82	1.2 J [4.3 J]	1.6	39 DJ [35 D]
Fluorene	mg/kg	510 D	0.23 U	120	580 D	14 D	0.24 U	350 D	2.0	0.94	2.4	0.23 U	0.27 U	0.50	0.41 U	0.41 U [0.41 U]	0.56 U	8.7 D [15 D]
Indeno(1,2,3-cd)pyrene	mg/kg	140 D	0.26	41	140 D	3.2	0.24 U	87	1.2	0.72	0.82	0.33	0.27 U	3.1	0.41 U	0.41 U [0.96]	0.56 U	5.1 [6.3]
Naphthalene	mg/kg	840 D	0.54	620 D	1,600 D	22 D	0.24 U	610 D	1.5	2.9	5.1	0.23 U	0.27 U	0.26	0.41 U	0.41 U [0.61]	0.56 U	6.1 J [3.6]
Phenanthrene	mg/kg	1,600 D	0.39	370 D	1,600 D	47 D	0.24 U	1,100 D	7.0	3.6	11	0.83	1.3	7.2	0.41 U	0.54 J [2.3 J]	0.72	42 DJ [53 D]
Pyrene	mg/kg	790 D	0.73	180 D	770 D	23 D	0.24 U	540 D	8.6	3.5	6.6	1.2	1.1	11	0.66	0.98 J [3.4 J]	1.4	38 DJ [33 D]
Total PAHs	mg/kg	7,900 J	5.4	2,300 J	8,800 J	220 J	ND	5,400 J	51 J	26 J	47 J	7.8 J	7.3 J	67 J	2.4 J	5.1 J [22 J]	7.8 J	230 J [260]
Miscellaneous																		
Total Organic Carbon (Run 1)	%	2	1	0.91	6.4	0.58	0.32	2.3	0.51	0.4	0.3	0.14	0.29	0.44	0.97	1.1 [1]	1.6	0.6 [0.6]
Total Organic Carbon (Run 2)	%	2.4	1.2	0.94	5.9	0.52	0.31	2.8	0.42	0.48	0.31	0.11	0.31	0.36	1.1	1 [0.8]	1.3	0.55 [0.54]

Notes:
PAH- Polycyclic aromatic hydrocarbons
mg/kg - milligram per kilogram

Data Qualifiers:
D - Compound quantitated using a secondary dilution.
J - Indicates an estimated value
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

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Table 3 - Summary of Forensic PAH Analysis, Percent Weathering and Probable Hydrocarbon Sources

Samples Selected for Forensic Analysis	Samples Represented[1]	Total PAHs (mg/kg)	Forensic 2-& 3-ring PAHs	Percent Weathering[2]	Summary of Probable Hydrocarbon Sources in Monitoring Program Sample Locations[3]
River Area Upstream of Embayment #1					
MPU-3 and DUP		508 (385)			MGP-related PAHs. Petroleum not evident
River Area Upstream of OU1					
MPA-1		22,400	12,500	56%	MGP-related PAHs. Petroleum not evident
MPA-3	SD-95 (24-48)	5,300	3,500	66%	MGP-related PAHs. Petroleum not evident
MPA-5		692	375	54%	MGP-related PAHs. Petroleum not evident
"The Spirit of the Hudson" Dock Area					
SD-87 (0-6)	SD-87 (6-24), MPA-4	10,600	6,700	63%	MGP-related PAHs. Petroleum not evident
SD-87(24-28)		164	115	70%	Probable MGP-related PAHs. Petroleum not evident
SD-94 (0-6)	SD-94 (6-24), MPA-2	26	15		Background PAHs with trace residual petroleum
Mouth of Embayment #1					
SD-95 (0-6)		6,050	4,700	78%	MGP-related PAHs. Petroleum not evident
SD-95 (6-24)		29			Background PAHs with trace residual petroleum
SD-96 (0-6)	SD-96 (24-48)	4,300	3,500	81%	MGP-related PAHs. Petroleum not evident
Embayment #2					
MPE2-2	MPE2-1, MPE2-3	18			Background PAHs with residual heavy oil
River Area Outside Embayment #2					
MPD-2		19,600	11,500	59%	MGP-related PAHs. Petroleum not evident
River Area Downstream of OU1					
MPD-3		292	114	39%	MGP-related PAHs with trace residual petroleum
MPD-4	MPD-5	49			Background and possibly some MGP-related PAHs with trace residual petroleum
MPD-8		17			Background PAHs with residual heavy oil

Notes:

1. Based on the Total PAH concentrations and hydrocarbon compositional characteristics (i.e., PAH and GC fingerprints) as part of a preliminary assessment of the data, samples were grouped together and 1 or 2 representative samples from each group were selected for forensic analysis.

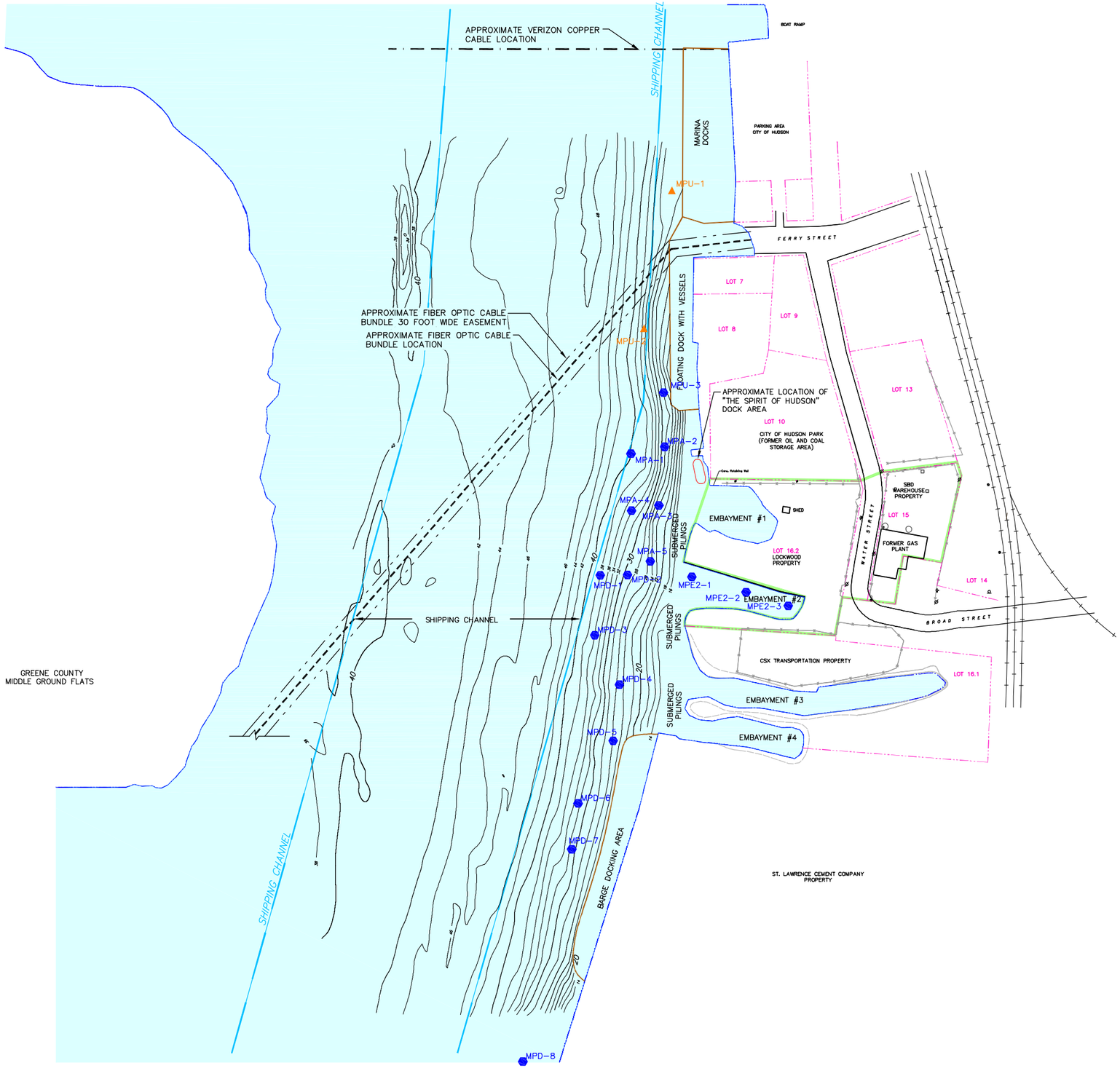
2. Percent Weathering = 2- & 3-ringed PAHs/TPAH

Over time, there are a certain physical, chemical and biological processes that contribute to the alteration of the composition of hydrocarbons in the environment. The term for these altering processes is "Weathering" and includes evaporation, dissolution, photo-oxidation and biodegradation. The resistance to alteration is based on a combination of hydrocarbon boiling point solubility and chemical structure. Most of the alteration proclivities for hydrocarbons are based on chemical structure.

3. As part of the TPH analysis, a gas chromatogram ("GC fingerprint") was generated for each sample, and total hydrocarbons, n-alkane and isoprenoid concentrations were determined for the ca range from C10 to C40 to help characterize any petroleum contributions in the sediment. The presence of petroleum in each sample was determined from the GC fingerprint.

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Figures



LEGEND:

- CHAIN–LINK FENCE
- MPD–8 — MONITORING STATION LOCATION
- MPU–1 — PROPOSED MONITORING STATION FOR WHICH SAMPLES COULD NOT BE COLLECTED (SEE NOTE 8)
- BOUNDARY OF OPERABLE UNIT 1
- PROPERTY LINE
- BATHYMETRIC CONTOUR (2–FOOT INTERVAL)
- AREAS NOT ACCESSIBLE BY BATHYMETRIC SURVEY BOAT
- APPROXIMATE FIBER OPTIC CABLE EASEMENT
- APPROXIMATE FIBER OPTIC CABLE LOCATION (SEE NOTE #5)
- APPROXIMATE VERIZON COPPER CABLE LOCATION (SEE NOTE #6)
- APPROXIMATE BOUNDARY OF THE SHIPPING CHANNEL

NOTES:

1. BASE MAP FROM TOPOGRAPHIC SURVEY BY BOSK ASSOCIATES, DRAWING FILE HUDSONDL.DWG, DATED 3/24/95.
2. MONITORING STATIONS AND PORTIONS OF THE RIVER SHORELINE ARE BASED ON BBL SURVEYS CONDUCTED IN DECEMBER 1995, AUGUST 1996, MARCH 1998, AND SPRING 2002.
3. MONITORING STATION LOCATIONS FOR 2007 MONITORING ACTIVITIES WERE LOCATED USING GLOBAL POSITIONING SYSTEM EQUIPMENT.
4. ADDITIONAL LOT AND SHORELINE INFORMATION NORTHEAST OF LOT 10 WAS TAKEN FROM CITY OF HUDSON TAX MAP, 109.11, DATED MARCH 1987.
5. APPROXIMATE LOCATION OF BURIED FIBER OPTIC CABLES SCANNED FROM SHEET 2 OF 2 "PLAN & PROFILE HUDSON RIVER CROSSING BETWEEN HUDSON AND ATHENS, COLUMBIA AND GREEN COUNTIES, NEW YORK" BARRETT, BONACCI, HYMAN AND VANWEELE, P.C., 175 A COMMERCE DRIVE, HAUPPAUGE, NEW YORK, OCTOBER 13, 1993. RECEIVED FROM DAVID FINGER, CHIEF ENGINEER, MID–HUDSON CABLE, CATSKILL, NEW YORK.
6. APPROXIMATE LOCATION OF VERIZON UNBURIED COPPER CABLE POINTED OUT BY GERALD DALY CONTRACT INSPECTOR, VERIZON SOUTH CAIRO, NEW YORK ON APRIL 17, 2002.
7. BATHYMETRIC SURVEY CONDUCTED BY OCEAN SURVEYS INC., ON APRIL 26, 2002.
8. SEDIMENT SAMPLES COULD NOT BE COLLECTED AT MONITORING STATIONS MPU–1 AND MPU–2 DUE TO THE PRESENCE OF UNDERWATER FIBER OPTIC CABLE; CLEARANCE COULD NOT BE OBTAINED FROM UTILITY COMPANIES (VERIZON, MID–HUDSON CABLE, AND CABLE VISION).

0 200' 400'

GRAPHIC SCALE

NATIONAL GRID
HUDSON (WATER STREET) SITE, HUDSON, NEW YORK

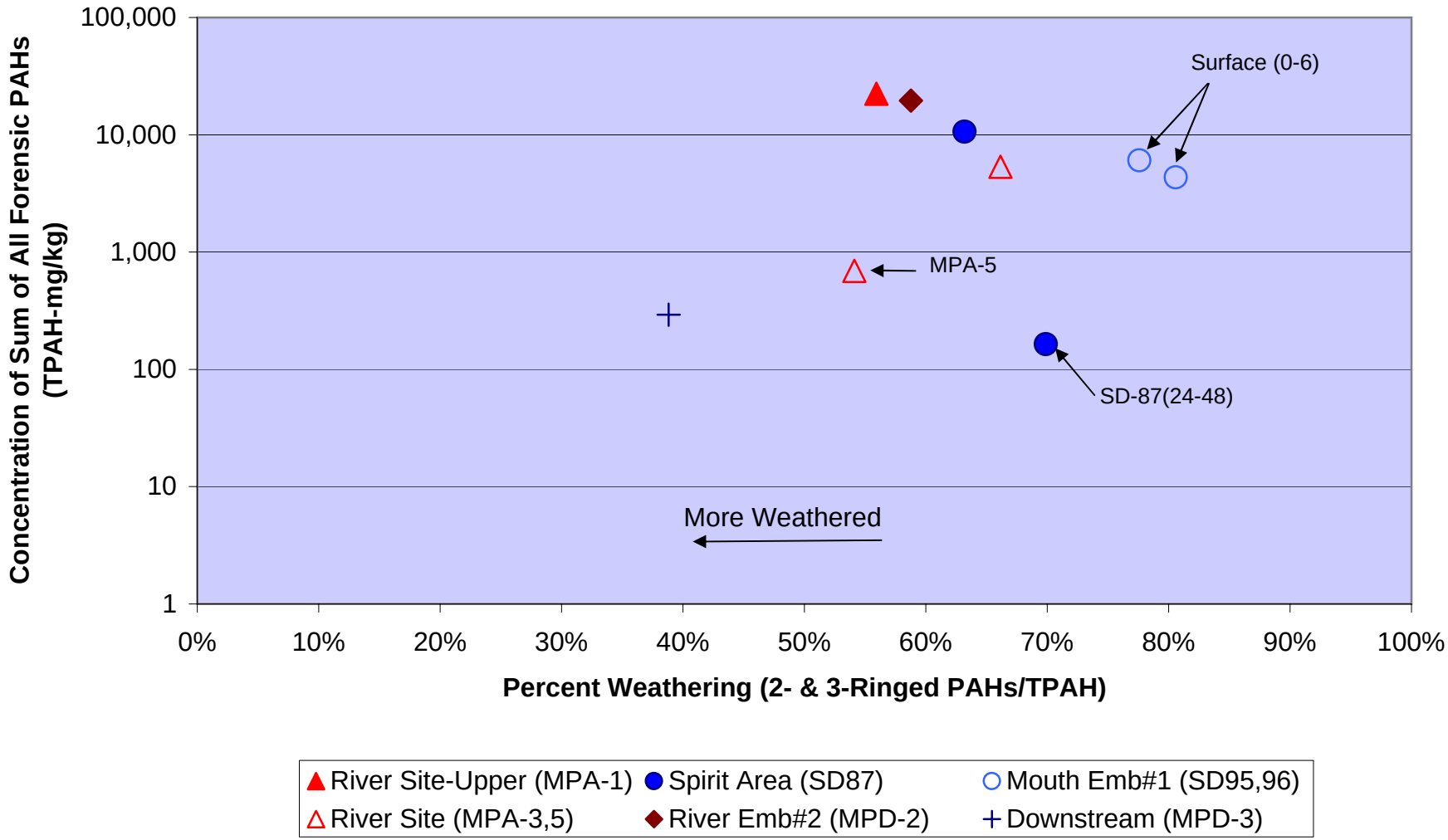
2007 OPERABLE UNIT TWO MONITORING STATION LOCATIONS

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FIGURE 1

CITY:SYRACUSE DIV/GROUP:141 DB:SMS BGP:BKD LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\CADACT\B003\6822\000\000\002\DWG\366822C03.DWG LAYOUT: 1 SAVED: 4/7/2008 4:49 PM ACADVER: 17.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/11/2008 9:44 AM BY: DECLERCQ,BRIAN
XREFS: IMAGES: PROJECTNAME: ---
366822X01

Figure 2. 2007 First Survey PAH Extent of Weathering
NG Hudson River Monitoring Program



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Appendix A

Forensic PAH Data

National Grid
Hudson (Water Street) Site, Hudson, New York
2007 Monitoring Program For Operable Unit Two (OU2) Sediments

2007 Monitoring Program Forensic PAH Results

SAMPLE ID		MPE2-2		MPE2-2		MPD-2		MPD-2		SD-96 (0-6")		SD-96 (0-6")		SD-94 (0-6")		SD-94 (0-6")		MPA-1	
SAMPLING DATE		10/1/2007		10/1/2007		10/2/2007		10/2/2007		10/3/2007		10/3/2007		10/3/2007		10/3/2007		10/3/2007	
LAB SAMPLE ID		0801067-01		0801067-01E		0801067-02		0801067-02E		0801067-03		0801067-03E		0801067-04		0801067-04E		0801067-05	
	Units		Qual		Qual		Qual		Qual		Qual		Qual		Qual		Qual		Qual
Alkylated Polynuclear Aromatic Hydrocarbons																			
Decalin	µg/Kg	**5.92**		8.23	U	600	U	6000	U	**552**		1700	U	**6.15**		5.86	U	856	U
C1-Decalins	µg/Kg	**10.2**		8.23	U	**854**		6000	U	**2080**		1700	U	**13.8**		5.86	U	**869**	
C2-Decalins	µg/Kg	**21.8**		8.23	U	**1270**		6000	U	**3780**		1700	U	**23.0**		5.86	U	**1600**	
C3-Decalins	µg/Kg	**23.7**		8.23	U	**1040**		6000	U	**2810**		1700	U	**21.7**		5.86	U	**1610**	
C4-Decalins	µg/Kg	**52.7**		8.23	U	**1010**		6000	U	**3580**		1700	U	**41.4**		5.86	U	**2400**	
Naphthalene	µg/Kg	**245**		8.23	U	**1040000**	E	**1550000**		**561000**	E	**880000**		**1050**		5.86	U	**1300000**	E
C1-Naphthalenes	µg/Kg	**114**		8.23	U	**754000**	E	**1010000**		**475000**	E	**660000**		**400**		5.86	U	**802000**	
C2-Naphthalenes	µg/Kg	**136**		8.23	U	**499000**		6000	U	**327000**		1700	U	**420**		5.86	U	**587000**	
C3-Naphthalenes	µg/Kg	**131**		8.23	U	**201000**		6000	U	**127000**		1700	U	**362**		5.86	U	**264000**	
C4-Naphthalenes	µg/Kg	**105**		8.23	U	**54900**		6000	U	**28600**		1700	U	**192**		5.86	U	**72400**	
2-Methylnaphthalene	µg/Kg	**113**		8.23	U	**724000**	E	**950000**		**431000**	E	**598000**		**348**		5.86	U	**778000**	
1-Methylnaphthalene	µg/Kg	**57.6**		8.23	U	**415000**		6000	U	**287000**	E	**387000**		**256**		5.86	U	**431000**	
Benzothiophene	µg/Kg	**18.1**		8.23	U	**35000**		6000	U	**16000**		1700	U	**56.6**		5.86	U	**41300**	
Biphenyl	µg/Kg	**34.8**		8.23	U	**151000**		6000	U	**42800**		1700	U	**145**		5.86	U	**158000**	
2,6-Dimethylnaphthalene	µg/Kg	**74.9**		8.23	U	**217000**		6000	U	**129000**		1700	U	**212**		5.86	U	**273000**	
Dibenzofuran	µg/Kg	**62.9**		8.23	U	**417000**		6000	U	**17600**		1700	U	**270**		5.86	U	**535000**	
Acenaphthylene	µg/Kg	**226**		8.23	U	**80900**		6000	U	**12700**		1700	U	**253**		5.86	U	**82600**	
Acenaphthene	µg/Kg	**62.4**		8.23	U	**824000**	E	**1150000**		**206000**	E	**274000**		**383**		5.86	U	**838000**	
2,3,5-Trimethylnaphthalene	µg/Kg	**17.5**		8.23	U	**36700**		6000	U	**17100**		1700	U	**50.7**		5.86	U	**43600**	
Fluorene	µg/Kg	**87.8**		8.23	U	**598000**		6000	U	**85900**		1700	U	**339**		5.86	U	**760000**	
C1-Fluorenes	µg/Kg	**64.3**		8.23	U	**158000**		6000	U	**56700**		1700	U	**232**		5.86	U	**208000**	
C2-Fluorenes	µg/Kg	**115**		8.23	U	**75900**		6000	U	**34000**		1700	U	**251**		5.86	U	**102000**	
C3-Fluorenes	µg/Kg	**168**		8.23	U	**38900**		6000	U	**12700**		1700	U	**143**		5.86	U	**48100**	
Dibenzothiophene	µg/Kg	**46.4**		8.23	U	**186000**		6000	U	**28800**		1700	U	**135**		5.86	U	**168000**	
C1-Dibenzothiophenes	µg/Kg	**67.4**		8.23	U	**80000**		6000	U	**34400**		1700	U	**200**		5.86	U	**76400**	
C2-Dibenzothiophenes	µg/Kg	**103**		8.23	U	**43000**		6000	U	**25600**		1700	U	**221**		5.86	U	**42100**	
C3-Dibenzothiophenes	µg/Kg	**89.1**		8.23	U	**20000**		6000	U	**11000**		1700	U	**126**		5.86	U	**20200**	
C4-Dibenzothiophenes	µg/Kg	**47.2**		8.23	U	**5570**		6000	U	**2830**		1700	U	**43.2**		5.86	U	**5940**	
Anthracene	µg/Kg	**348**		8.23	U	**740000**	E	**977000**		**104000**		1700	U	**722**		5.86	U	**858000**	E
1-Methylphenanthrene	µg/Kg	**119**		8.23	U	**145000**		6000	U	**48000**		1700	U	**332**		5.86	U	**183000**	
Phenanthrene	µg/Kg	**673**		**727**		**2080000**	E	**2890000**		**286000**	E	**377000**		**1660**	E	**1980**		**2470000**	E
C1-Phenanthrenes/Anthracenes	µg/Kg	**554**		8.23	U	**754000**		6000	U	**210000**		1700	U	**1480**		5.86	U	**957000**	
C2-Phenanthrenes/Anthracenes	µg/Kg	**502**		8.23	U	**292000**		6000	U	**85000**		1700	U	**910**		5.86	U	**395000**	
C3-Phenanthrenes/Anthracenes	µg/Kg	**251**		8.23	U	**94200**		6000	U	**21700**		1700	U	**336**		5.86	U	**122000**	
C4-Phenanthrenes/Anthracenes	µg/Kg	**125**		8.23	U	**23500**		6000	U	**4160**		1700	U	**102**		5.86	U	**33800**	
Fluoranthene	µg/Kg	**1770**		**2000**		**1310000**	E	**1790000**		**110000**		1700	U	**1750**	E	**2130**		**1740000**	E
Pyrene	µg/Kg	**1640**		**1870**		**1110000**	E	**1500000**		**160000**		1700	U	**2070**	E	**2500**		**1370000**	E
C1-Fluoranthenes/Pyrenes	µg/Kg	**1080**		8.23	U	**733000**		6000	U	**135000**		1700	U	**1700**		5.86	U	**970000**	
C2-Fluoranthenes/Pyrenes	µg/Kg	**584**		8.23	U	**196000**		6000	U	**42800**		1700	U	**628**		5.86	U	**277000**	
C3-Fluoranthenes/Pyrenes	µg/Kg	**265**		8.23	U	**71900**		6000	U	**12000**		1700	U	**224**		5.86	U	**102000**	
C4-Fluoranthenes/Pyrenes	µg/Kg	**163**		8.23	U	**35300**		6000	U	**3950**		1700	U	**93.4**		5.86	U	**51300**	
Naphthobenzothiophene	µg/Kg	**163**		8.23	U	**63400**		6000	U	**7070**		1700	U	**108**		5.86	U	**66300**	
C1-Naphthobenzothiophenes	µg/Kg	**159**		8.23	U	**53400**		6000	U	**9800**		1700	U	**145**		5.86	U	**59200**	
C2-Naphthobenzothiophenes	µg/Kg	**113**		8.23	U	**20500**		6000	U	**4680**		1700	U	**77.7**		5.86	U	**24600**	
C3-Naphthobenzothiophenes	µg/Kg	**84.0**		8.23	U	**11800**		6000	U	**2450**		1700	U	**48.9**		5.86	U	**13100**	
Benz[a]anthracene	µg/Kg	**818**		**906**		**608000**	E	**705000**		**60300**		1700	U	**1030**		5.86	U	**775000**	
Chrysene	µg/Kg	**866**		**952**		**457000**		6000	U	**49900**		1700	U	**845**		5.86	U	**557000**	
C1-Chrysenes	µg/Kg	**400**		8.23	U	**223000**		6000	U	**37800**		1700	U	**630**		5.86	U	**284000**	
C2-Chrysenes	µg/Kg	**189**		8.23	U	**84000**		6000	U	**15000**		1700	U	**269**		5.86	U	**117000**	
C3-Chrysenes	µg/Kg	**143**		8.23	U	**62800**		6000	U	**6790**		1700	U	**164**		5.86	U	**81100**	
C4-Chrysenes	µg/Kg	**67.7**		8.23	U	**22000**		6000	U	**2120**		1700	U	**50.8**		5.86	U	**29700**	
Benzo[b]fluoranthene	µg/Kg	**772**		8.23	U	**332000**		6000	U	**24400**		1700	U	**598**		5.86	U	**388000**	
Benzo[k]fluoranthene	µg/Kg	**757**		8.23	U	**326000**		6000	U	**26300**		1700	U	**683**		5.86	U	**460000**	
Benzo[e]pyrene	µg/Kg	**576**		8.23	U	**228000**		6000	U	**22500**		1700	U	**538**		5.86	U	**282000**	
Perylene	µg/Kg	**623**		8.23	U	**114000**		6000	U	**8820**		1700	U	**298**		5.86	U	**145000**	
Benzo[a]pyrene	µg/Kg	**907**		**988**		**509000**		6000	U	**51200**		1700	U	**1100**		5.86	U	**620000**	
Indeno[1,2,3-cd]pyrene	µg/Kg	**634**		8.23	U	**271000**		6000	U	**21800**		1700	U	**589**		5.86	U	**329000**	
Dibenz[a,h]anthracene	µg/Kg	**151**		8.23	U	**65300**		6000	U	**5090**		1700	U	**143**		5.86	U	**80200**	
Benzo[g,h,i]perylene	µg/Kg	**532**		8.23	U	**195000**		6000	U	**20100**		1700	U	**467**		5.86	U	**236000**	
17a(H),21B(H)-hopane - C30H52	µg/Kg	**179**		8.23	U	**657**		6000	U	**1010**		1700	U	**76.0**		5.86	U	856	U
Carbazole	µg/Kg	**55.1**		8.23	U	**121000**		6000	U	**7520**		1700	U	**123**		5.86	U	**146000**	

National Grid
Hudson (Water Street) Site, Hudson, New York
2007 Monitoring Program For Operable Unit Two (OU2) Sediments

2007 Monitoring Program Forensic PAH Results

SAMPLE ID		MPA-1		MPD-3		MPD-3		MPD-8		MPD-8		MPA-5		MPA-5		SD-95 (0-6")		SD-95 (0-6")	
SAMPLING DATE		10/3/2007		10/2/2007		10/2/2007		10/2/2007		10/2/2007		10/2/2007		10/2/2007		10/3/2007		10/3/2007	
LAB SAMPLE ID		0801067-05E		0801067-06		0801067-06E		0801067-07		0801067-07E		0801067-08		0801067-08E		0801067-09		0801067-09E	
	Units		Qual		Qual		Qual		Qual		Qual		Qual		Qual		Qual		Qual
Alkylated Polynuclear Aromatic Hydrocarbons																			
Decalin	µg/Kg	8560	U	**12.5**		32.1	U	**1.44**		1.87	U	30.7	U	307	U	**430**		1900	U
C1-Decalins	µg/Kg	8560	U	**33.9**		32.1	U	**2.68**		1.87	U	**68.2**		307	U	**1530**		1900	U
C2-Decalins	µg/Kg	8560	U	**62.4**		32.1	U	**4.67**		1.87	U	**132**		307	U	**2960**		1900	U
C3-Decalins	µg/Kg	8560	U	**56.4**		32.1	U	**5.27**		1.87	U	**132**		307	U	**2350**		1900	U
C4-Decalins	µg/Kg	8560	U	**90.1**		32.1	U	**8.85**		1.87	U	**148**		307	U	**2820**		1900	U
Naphthalene	µg/Kg	**1810000**		**3140**	E	**5120**		**144**		1.87	U	**6730**		307	U	**684000**	E	**1290000**	
C1-Naphthalenes	µg/Kg	8560	U	**1980**	E	**2890**		**95.4**		1.87	U	**7810**		307	U	**474000**	E	**717000**	
C2-Naphthalenes	µg/Kg	8560	U	**5300**	E	**7540**		**152**		1.87	U	**24500**		307	U	**350000**		1900	U
C3-Naphthalenes	µg/Kg	8560	U	**3560**		32.1	U	**157**		1.87	U	**12800**		307	U	**149000**		1900	U
C4-Naphthalenes	µg/Kg	8560	U	**1310**		32.1	U	**72.3**		1.87	U	**3540**		307	U	**34900**		1900	U
2-Methylnaphthalene	µg/Kg	8560	U	**1780**	E	**2600**		**98.4**		1.87	U	**6790**		307	U	**431000**	E	**656000**	
1-Methylnaphthalene	µg/Kg	8560	U	**1210**		32.1	U	**44.0**		1.87	U	**5020**		307	U	**286000**	E	**406000**	
Benzothiophene	µg/Kg	8560	U	**118**		32.1	U	**6.48**		1.87	U	**607**		307	U	**24100**		1900	U
Biphenyl	µg/Kg	8560	U	**352**		32.1	U	**28.2**		1.87	U	**1110**		307	U	**62300**		1900	U
2,6-Dimethylnaphthalene	µg/Kg	8560	U	**2320**	E	**3290**		**66.0**		1.87	U	**11200**		307	U	**134000**		1900	U
Dibenzofuran	µg/Kg	8560	U	**1250**		32.1	U	**77.4**		1.87	U	**11700**		307	U	**37300**		1900	U
Acenaphthylene	µg/Kg	8560	U	**1320**		32.1	U	**56.5**		1.87	U	**1870**		307	U	**15400**		1900	U
Acenaphthene	µg/Kg	8560	U	**6800**	E	**10500**		**146**		1.87	U	**33000**	E	**48300**		**292000**	E	**400000**	
2,3,5-Trimethylnaphthalene	µg/Kg	8560	U	**461**		32.1	U	**28.7**		1.87	U	**1710**		307	U	**17700**		1900	U
Fluorene	µg/Kg	8560	U	**4340**	E	**6530**		**136**		1.87	U	**20800**		307	U	**130000**		1900	U
C1-Fluorenes	µg/Kg	8560	U	**2520**		32.1	U	**92.5**		1.87	U	**7830**		307	U	**78700**		1900	U
C2-Fluorenes	µg/Kg	8560	U	**1920**		32.1	U	**95.7**		1.87	U	**4290**		307	U	**44600**		1900	U
C3-Fluorenes	µg/Kg	8560	U	**849**		32.1	U	**103**		1.87	U	**1800**		307	U	**17400**		1900	U
Dibenzothiophene	µg/Kg	8560	U	**1550**		32.1	U	**77.7**		1.87	U	**7560**		307	U	**42300**		1900	U
C1-Dibenzothiophenes	µg/Kg	8560	U	**1500**		32.1	U	**73.1**		1.87	U	**5060**		307	U	**44400**		1900	U
C2-Dibenzothiophenes	µg/Kg	8560	U	**1220**		32.1	U	**71.4**		1.87	U	**3040**		307	U	**31700**		1900	U
C3-Dibenzothiophenes	µg/Kg	8560	U	**604**		32.1	U	**64.8**		1.87	U	**1320**		307	U	**13500**		1900	U
C4-Dibenzothiophenes	µg/Kg	8560	U	**180**		32.1	U	**40.1**		1.87	U	**370**		307	U	**3400**		1900	U
Anthracene	µg/Kg	**1070000**		**7520**	E	**9680**		**451**		1.87	U	**30400**		307	U	**160000**		1900	U
1-Methylphenanthrene	µg/Kg	8560	U	**2500**	E	**3860**		**138**		1.87	U	**7560**		307	U	**64600**		1900	U
Phenanthrene	µg/Kg	**3200000**		**16700**	E	**26100**		**1100**	E	**1090**		**76100**	E	**110000**		**436000**	E	**580000**	
C1-Phenanthrenes/Anthracenes	µg/Kg	8560	U	**12500**	E	**17400**		**768**		1.87	U	**38600**		307	U	**296000**		1900	U
C2-Phenanthrenes/Anthracenes	µg/Kg	8560	U	**6610**		32.1	U	**466**		1.87	U	**15200**		307	U	**116000**		1900	U
C3-Phenanthrenes/Anthracenes	µg/Kg	8560	U	**2250**		32.1	U	**237**		1.87	U	**4770**		307	U	**29100**		1900	U
C4-Phenanthrenes/Anthracenes	µg/Kg	8560	U	**577**		32.1	U	**110**		1.87	U	**2190**		307	U	**5740**		1900	U
Fluoranthene	µg/Kg	**2230000**		**19500**	E	**31700**		**1830**	E	**1860**		**47100**	E	**63100**		**187000**		1900	U
Pyrene	µg/Kg	**1710000**		**18600**	E	**30400**		**1760**	E	**1770**		**46500**	E	**62700**		**254000**	E	**311000**	
C1-Fluoranthenes/Pyrenes	µg/Kg	8560	U	**14600**		32.1	U	**968**		1.87	U	**35700**		307	U	**209000**		1900	U
C2-Fluoranthenes/Pyrenes	µg/Kg	8560	U	**4640**		32.1	U	**480**		1.87	U	**9700**		307	U	**60200**		1900	U
C3-Fluoranthenes/Pyrenes	µg/Kg	8560	U	**1670**		32.1	U	**205**		1.87	U	**3200**		307	U	**16400**		1900	U
C4-Fluoranthenes/Pyrenes	µg/Kg	8560	U	**744**		32.1	U	**117**		1.87	U	**1510**		307	U	**5300**		1900	U
Naphthobenzothiophene	µg/Kg	8560	U	**1070**		32.1	U	**97.2**		1.87	U	**2700**		307	U	**11300**		1900	U
C1-Naphthobenzothiophenes	µg/Kg	8560	U	**1120**		32.1	U	**108**		1.87	U	**2760**		307	U	**14300**		1900	U
C2-Naphthobenzothiophenes	µg/Kg	8560	U	**500**		32.1	U	**78.6**		1.87	U	**1110**		307	U	**6210**		1900	U
C3-Naphthobenzothiophenes	µg/Kg	8560	U	**285**		32.1	U	**54.2**		1.87	U	**646**		307	U	**3340**		1900	U
Benz[a]anthracene	µg/Kg	8560	U	**11300**	E	**15700**		**911**		1.87	U	**22500**		307	U	**91600**		1900	U
Chrysene	µg/Kg	8560	U	**8570**	E	**12100**		**794**		1.87	U	**17800**		307	U	**73700**		1900	U
C1-Chrysenes	µg/Kg	8560	U	**5090**		32.1	U	**396**		1.87	U	**9800**		307	U	**52300**		1900	U
C2-Chrysenes	µg/Kg	8560	U	**2050**		32.1	U	**194**		1.87	U	**3940**		307	U	**19100**		1900	U
C3-Chrysenes	µg/Kg	8560	U	**1450**		32.1	U	**148**		1.87	U	**2720**		307	U	**9300**		1900	U
C4-Chrysenes	µg/Kg	8560	U	**457**		32.1	U	**59.8**		1.87	U	**978**		307	U	**2890**		1900	U
Benzo[b]fluoranthene	µg/Kg	8560	U	**7550**	E	**8510**		**613**		1.87	U	**11800**		307	U	**36700**		1900	U
Benzo[k]fluoranthene	µg/Kg	8560	U	**5140**	E	**9030**		**593**		1.87	U	**12000**		307	U	**42500**		1900	U
Benzo[e]pyrene	µg/Kg	8560	U	**4560**	E	**6310**		**451**		1.87	U	**8770**		307	U	**35900**		1900	U
Perylene	µg/Kg	8560	U	**2370**	E	**3280**		**535**		1.87	U	**4360**		307	U	**13800**		1900	U
Benzo[a]pyrene	µg/Kg	8560	U	**10300**	E	**14100**		**869**		1.87	U	**19800**		307	U	**81300**		1900	U
Indeno[1,2,3-cd]pyrene	µg/Kg	8560	U	**5360**	E	**6980**		**504**		1.87	U	**9930**		307	U	**33500**		1900	U
Dibenz[a,h]anthracene	µg/Kg	8560	U	**1620**	E	**1670**		**128**		1.87	U	**2550**		307	U	**8100**		1900	U
Benzo[g,h,i]perylene	µg/Kg	8560	U	**3890**	E	**5440**		**397**		1.87	U	**7580**		307	U	**30200**		1900	U
17a(H),21B(H)-hopane - C30H52	µg/Kg	8560	U	**76.4**		32.1	U	**328**		1.87	U	**36.3**		307	U	**735**		1900	U
Carbazole	µg/Kg	8560	U	**105**		32.1	U	**63.7**		1.87	U	**2380**		307	U	**17800**		1900	U

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2007 Monitoring Program Forensic PAH Results

SAMPLE ID		SD-87 (0-6")		SD-87 (0-6")		MPU-3		MPU-3		MPD-4		MPD-4		MPA-3		MPA-3		SD-95 (6-24")	
SAMPLING DATE		10/3/2007		10/3/2007		10/4/2007		10/4/2007		10/2/2007		10/2/2007		10/2/2007		10/2/2007		10/3/2007	
LAB SAMPLE ID		0801067-10		0801067-10E		0801067-11		0801067-11E		0801067-12		0801067-12E		0801067-13		0801067-13E		0801067-14	
	Units		Qual		Qual		Qual		Qual		Qual		Qual		Qual		Qual		Qual
Alkylated Polynuclear Aromatic Hydrocarbons																			
Decalin	µg/Kg	278	U	2780	U	30.2	U	302	U	**6.09**		8.93	U	164	U	1640	U	**6.28**	
C1-Decalins	µg/Kg	**297**		2780	U	**56.5**		302	U	**12.6**		8.93	U	**203**		1640	U	**10.5**	
C2-Decalins	µg/Kg	**612**		2780	U	**91.8**		302	U	**15.3**		8.93	U	**355**		1640	U	**20.0**	
C3-Decalins	µg/Kg	**385**		2780	U	**57.7**		302	U	**11.2**		8.93	U	**386**		1640	U	**19.9**	
C4-Decalins	µg/Kg	**846**		2780	U	**108**		302	U	**18.0**		8.93	U	**357**		1640	U	**44.4**	
Naphthalene	µg/Kg	**997000**	E	**2000000**		**4520**		302	U	**1310**	E	**1610**		**532000**	E	**1120000**		**2500**	E
C1-Naphthalenes	µg/Kg	**396000**	E	**603000**		**2400**		302	U	**421**		8.93	U	**194000**	E	**304000**		**847**	
C2-Naphthalenes	µg/Kg	**229000**		2780	U	**7170**		302	U	**920**		8.93	U	**109000**		1640	U	**632**	
C3-Naphthalenes	µg/Kg	**91000**		2780	U	**5950**		302	U	**738**		8.93	U	**47600**		1640	U	**360**	
C4-Naphthalenes	µg/Kg	**24600**		2780	U	**2290**		302	U	**286**		8.93	U	**13800**		1640	U	**163**	
2-Methylnaphthalene	µg/Kg	**378000**	E	**565000**		**2030**		302	U	**436**		8.93	U	**188000**	E	**292000**		**772**	
1-Methylnaphthalene	µg/Kg	**221000**		2780	U	**1610**		302	U	**200**		8.93	U	**105000**		1640	U	**507**	
Benzothiophene	µg/Kg	**38200**		2780	U	**288**		302	U	**50.5**		8.93	U	**23200**		1640	U	**117**	
Biphenyl	µg/Kg	**77100**		2780	U	**922**		302	U	**144**		8.93	U	**35500**		1640	U	**238**	
2,6-Dimethylnaphthalene	µg/Kg	**90800**		2780	U	**2470**		302	U	**248**		8.93	U	**45000**		1640	U	**313**	
Dibenzofuran	µg/Kg	**177000**		2780	U	**2030**		302	U	**186**		8.93	U	**97100**		1640	U	**474**	
Acenaphthylene	µg/Kg	**31200**		2780	U	**1560**		302	U	**189**		8.93	U	**12300**		1640	U	**252**	
Acenaphthene	µg/Kg	**465000**	E	**688000**		**12300**		302	U	**1730**	E	**2200**		**220000**	E	**337000**		**627**	
2,3,5-Trimethylnaphthalene	µg/Kg	**13500**		2780	U	**852**		302	U	**114**		8.93	U	**6730**		1640	U	**53.2**	
Fluorene	µg/Kg	**270000**		2780	U	**8760**		302	U	**898**	E	**1120**		**133000**		1640	U	**546**	
C1-Fluorenes	µg/Kg	**69600**		2780	U	**4230**		302	U	**448**		8.93	U	**33500**		1640	U	**229**	
C2-Fluorenes	µg/Kg	**35800**		2780	U	**2990**		302	U	**340**		8.93	U	**17400**		1640	U	**207**	
C3-Fluorenes	µg/Kg	**16300**		2780	U	**1570**		302	U	**200**		8.93	U	**9040**		1640	U	**144**	
Dibenzothiophene	µg/Kg	**69100**		2780	U	**3230**		302	U	**338**		8.93	U	**32600**		1640	U	**164**	
C1-Dibenzothiophenes	µg/Kg	**32400**		2780	U	**2470**		302	U	**252**		8.93	U	**15000**		1640	U	**164**	
C2-Dibenzothiophenes	µg/Kg	**18800**		2780	U	**1780**		302	U	**180**		8.93	U	**8900**		1640	U	**206**	
C3-Dibenzothiophenes	µg/Kg	**8890**		2780	U	**895**		302	U	**92.5**		8.93	U	**4330**		1640	U	**130**	
C4-Dibenzothiophenes	µg/Kg	**2510**		2780	U	**307**		302	U	**31.4**		8.93	U	**1300**		1640	U	**39.6**	
Anthracene	µg/Kg	**274000**		2780	U	**17400**		302	U	**1140**	E	**1450**		**167000**	E	**220000**		**751**	
1-Methylphenanthrene	µg/Kg	**66100**		2780	U	**4810**		302	U	**434**		8.93	U	**30300**		1640	U	**281**	
Phenanthrene	µg/Kg	**920000**	E	**1350000**		**43200**	E	**60100**		**3570**	E	**4640**		**434000**	E	**648000**		**1950**	E
C1-Phenanthrenes/Anthracenes	µg/Kg	**345000**		2780	U	**24400**		302	U	**2150**		8.93	U	**162000**		1640	U	**1290**	
C2-Phenanthrenes/Anthracenes	µg/Kg	**134000**		2780	U	**12300**		302	U	**1140**		8.93	U	**65300**		1640	U	**894**	
C3-Phenanthrenes/Anthracenes	µg/Kg	**41600**		2780	U	**4270**		302	U	**426**		8.93	U	**21000**		1640	U	**382**	
C4-Phenanthrenes/Anthracenes	µg/Kg	**10800**		2780	U	**1360**		302	U	**133**		8.93	U	**5820**		1640	U	**125**	
Fluoranthene	µg/Kg	**623000**	E	**861000**		**47800**	E	**67300**		**3490**	E	**4890**		**299000**	E	**420000**		**1680**	E
Pyrene	µg/Kg	**541000**	E	**747000**		**42600**	E	**59700**		**3490**	E	**4760**		**250000**	E	**349000**		**1800**	E
C1-Fluoranthenes/Pyrenes	µg/Kg	**350000**		2780	U	**30000**		302	U	**2330**		8.93	U	**160000**		1640	U	**1650**	
C2-Fluoranthenes/Pyrenes	µg/Kg	**90200**		2780	U	**8930**		302	U	**772**		8.93	U	**42900**		1640	U	**696**	
C3-Fluoranthenes/Pyrenes	µg/Kg	**31200**		2780	U	**3300**		302	U	**333**		8.93	U	**15300**		1640	U	**240**	
C4-Fluoranthenes/Pyrenes	µg/Kg	**15100**		2780	U	**1660**		302	U	**175**		8.93	U	**7940**		1640	U	**92.2**	
Naphthobenzothiophene	µg/Kg	**26800**		2780	U	**2370**		302	U	**196**		8.93	U	**12100**		1640	U	**94.7**	
C1-Naphthobenzothiophenes	µg/Kg	**21000**		2780	U	**2140**		302	U	**189**		8.93	U	**9770**		1640	U	**134**	
C2-Naphthobenzothiophenes	µg/Kg	**8520**		2780	U	**919**		302	U	**97.9**		8.93	U	**3870**		1640	U	**70.8**	
C3-Naphthobenzothiophenes	µg/Kg	**5210**		2780	U	**535**		302	U	**57.7**		8.93	U	**2380**		1640	U	**40.2**	
Benz[a]anthracene	µg/Kg	**279000**	E	**306000**		**22700**		302	U	**2010**	E	**2460**		**129000**		1640	U	**939**	
Chrysene	µg/Kg	**199000**		2780	U	**18000**		302	U	**1610**	E	**1990**		**99300**		1640	U	**767**	
C1-Chrysenes	µg/Kg	**97400**		2780	U	**8950**		302	U	**866**		8.93	U	**44800**		1640	U	**641**	
C2-Chrysenes	µg/Kg	**37000**		2780	U	**3790**		302	U	**381**		8.93	U	**18000**		1640	U	**294**	
C3-Chrysenes	µg/Kg	**26200**		2780	U	**2680**		302	U	**277**		8.93	U	**12800**		1640	U	**162**	
C4-Chrysenes	µg/Kg	**9080**		2780	U	**1130**		302	U	**96.2**		8.93	U	**4290**		1640	U	**50.5**	
Benzo[b]fluoranthene	µg/Kg	**165000**		2780	U	**14100**		302	U	**1210**	E	**1500**		**75900**		1640	U	**546**	
Benzo[k]fluoranthene	µg/Kg	**164000**		2780	U	**13500**		302	U	**1250**	E	**1560**		**72100**		1640	U	**510**	
Benzo[e]pyrene	µg/Kg	**119000**		2780	U	**9840**		302	U	**885**		8.93	U	**52000**		1640	U	**430**	
Perylene	µg/Kg	**63100**		2780	U	**5290**		302	U	**844**		8.93	U	**28000**		1640	U	**291**	
Benzo[a]pyrene	µg/Kg	**264000**		2780	U	**21900**		302	U	**1900**	E	**2350**		**116000**		1640	U	**876**	
Indeno[1,2,3-cd]pyrene	µg/Kg	**150000**		2780	U	**12000**		302	U	**1090**	E	**1340**		**65200**		1640	U	**440**	
Dibenz[a,h]anthracene	µg/Kg	**34700**		2780	U	**2810**		302	U	**309**		8.93	U	**14800**		1640	U	**111**	
Benzo[g,h,i]perylene	µg/Kg	**114000**		2780	U	**9070**		302	U	**810**		8.93	U	**48800**		1640	U	**334**	
17a(H),21B(H)-hopane - C30H52	µg/Kg	278	U	2780	U	**59.9**		302	U	**14.8**		8.93	U	**180**		1640	U	**36.9**	
Carbazole	µg/Kg	**63900**		2780	U	**376**		302	U	**20.2**		8.93	U	**48800**		1640	U	**186**	

National Grid
Hudson (Water Street) Site, Hudson, New York
2007 Monitoring Program For Operable Unit Two (OU2) Sediments

2007 Monitoring Program Forensic PAH Results

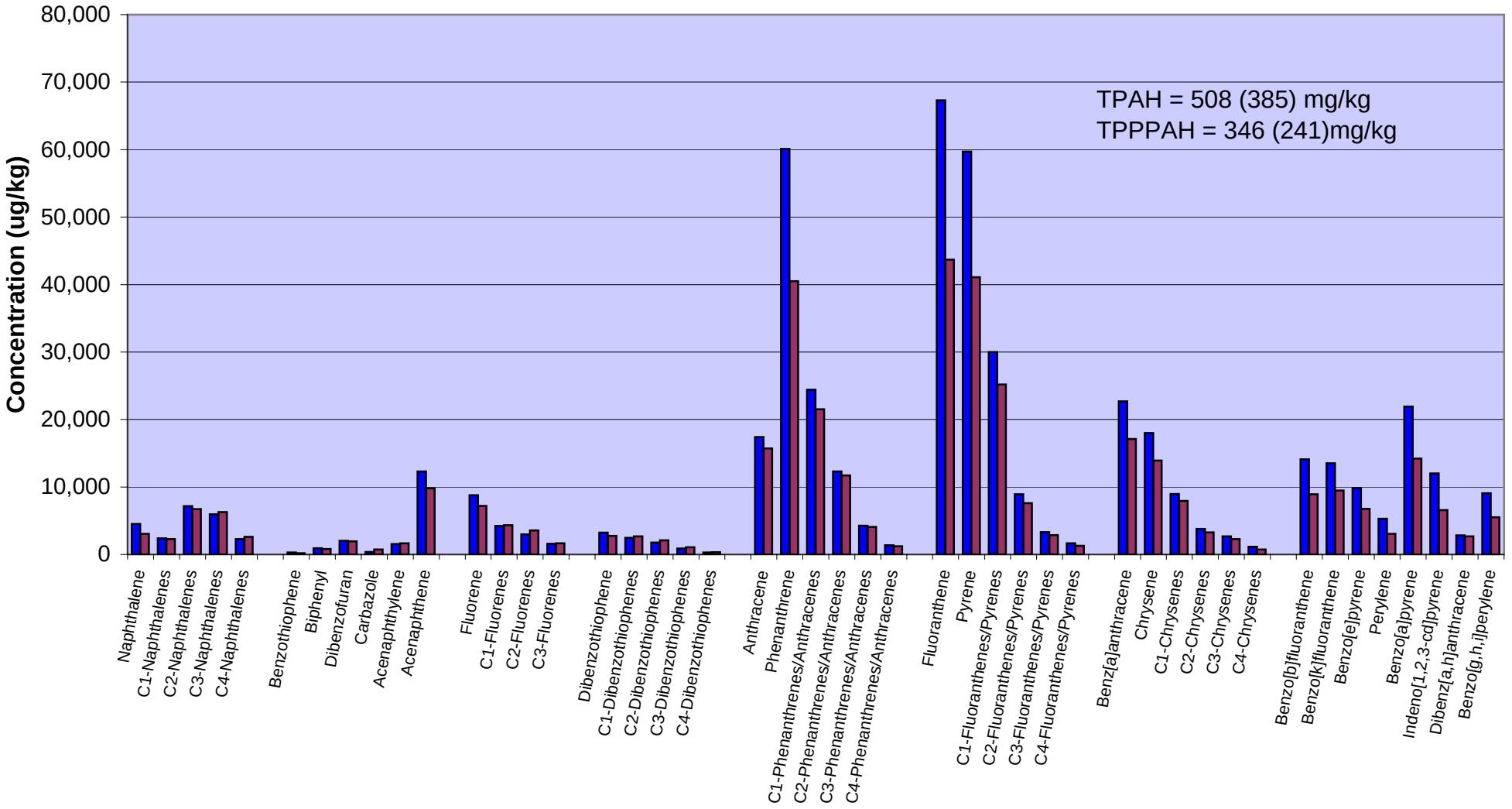
SAMPLE ID		SD-95 (6-24")		SD-87 (24-48")		SD-87 (24-48")		DUP-2		DUP-2	
SAMPLING DATE		10/3/2007		10/3/2007		10/3/2007		10/3/2007		10/3/2007	
LAB SAMPLE ID		0801067-14E		0801067-15		0801067-15E		0801067-16		0801067-16E	
	Units		Qual		Qual		Qual		Qual		Qual
Alkylated Polynuclear Aromatic Hydrocarbons											
Decalin	µg/Kg	12.5	U	**7.62**		26.2	U	**26.8**		145	U
C1-Decalins	µg/Kg	12.5	U	**7.75**		26.2	U	**78.1**		145	U
C2-Decalins	µg/Kg	12.5	U	**10.0**		26.2	U	**151**		145	U
C3-Decalins	µg/Kg	12.5	U	**7.63**		26.2	U	**117**		145	U
C4-Decalins	µg/Kg	12.5	U	**11.2**		26.2	U	**172**		145	U
Naphthalene	µg/Kg	**3140**		**13100**	E	**17400**		**3400**	E	**3050**	
C1-Naphthalenes	µg/Kg	12.5	U	**5720**	E	**6860**		**2290**		145	U
C2-Naphthalenes	µg/Kg	12.5	U	**5900**		26.2	U	**6730**		145	U
C3-Naphthalenes	µg/Kg	12.5	U	**2320**		26.2	U	**6270**		145	U
C4-Naphthalenes	µg/Kg	12.5	U	**577**		26.2	U	**2610**		145	U
2-Methylnaphthalene	µg/Kg	12.5	U	**4040**	E	**4860**		**1900**		145	U
1-Methylnaphthalene	µg/Kg	12.5	U	**4560**	E	**5510**		**1560**		145	U
Benzothiophene	µg/Kg	12.5	U	**941**		26.2	U	**182**		145	U
Biphenyl	µg/Kg	12.5	U	**698**		26.2	U	**802**		145	U
2,6-Dimethylnaphthalene	µg/Kg	12.5	U	**2560**		26.2	U	**2220**		145	U
Dibenzofuran	µg/Kg	12.5	U	**4960**	E	**6300**		**1960**		145	U
Acenaphthylene	µg/Kg	12.5	U	**302**		26.2	U	**1660**		145	U
Acenaphthene	µg/Kg	12.5	U	**10600**	E	**13400**		**10300**	E	**9810**	
2,3,5-Trimethylnaphthalene	µg/Kg	12.5	U	**324**		26.2	U	**890**		145	U
Fluorene	µg/Kg	12.5	U	**6400**	E	**8020**		**7870**	E	**7180**	
C1-Fluorenes	µg/Kg	12.5	U	**1370**		26.2	U	**4340**		145	U
C2-Fluorenes	µg/Kg	12.5	U	**594**		26.2	U	**3560**		145	U
C3-Fluorenes	µg/Kg	12.5	U	**383**		26.2	U	**1650**		145	U
Dibenzothiophene	µg/Kg	12.5	U	**1870**		26.2	U	**2930**	E	**2760**	
C1-Dibenzothiophenes	µg/Kg	12.5	U	**533**		26.2	U	**2680**		145	U
C2-Dibenzothiophenes	µg/Kg	12.5	U	**252**		26.2	U	**2110**		145	U
C3-Dibenzothiophenes	µg/Kg	12.5	U	**112**		26.2	U	**1050**		145	U
C4-Dibenzothiophenes	µg/Kg	12.5	U	**40.9**		26.2	U	**317**		145	U
Anthracene	µg/Kg	12.5	U	**5710**	E	**7380**		**16600**	E	**15700**	
1-Methylphenanthrene	µg/Kg	12.5	U	**1060**		26.2	U	**4400**	E	**4260**	
Phenanthrene	µg/Kg	**2620**		**18200**	E	**23700**		**37800**	E	**40500**	
C1-Phenanthrenes/Anthracenes	µg/Kg	12.5	U	**5100**		26.2	U	**23600**	E	**21500**	
C2-Phenanthrenes/Anthracenes	µg/Kg	12.5	U	**1960**		26.2	U	**11700**		145	U
C3-Phenanthrenes/Anthracenes	µg/Kg	12.5	U	**1710**		26.2	U	**4060**		145	U
C4-Phenanthrenes/Anthracenes	µg/Kg	12.5	U	**3460**		26.2	U	**1200**		145	U
Fluoranthene	µg/Kg	**2350**		**8310**	E	**12000**		**37600**	E	**43700**	
Pyrene	µg/Kg	**2510**		**6440**	E	**9180**		**35600**	E	**41100**	
C1-Fluoranthenes/Pyrenes	µg/Kg	12.5	U	**4300**		26.2	U	**25200**		145	U
C2-Fluoranthenes/Pyrenes	µg/Kg	12.5	U	**1240**		26.2	U	**7590**		145	U
C3-Fluoranthenes/Pyrenes	µg/Kg	12.5	U	**475**		26.2	U	**2860**		145	U
C4-Fluoranthenes/Pyrenes	µg/Kg	12.5	U	**239**		26.2	U	**1280**		145	U
Naphthobenzothiophene	µg/Kg	12.5	U	**311**		26.2	U	**1850**		145	U
C1-Naphthobenzothiophenes	µg/Kg	12.5	U	**287**		26.2	U	**1780**		145	U
C2-Naphthobenzothiophenes	µg/Kg	12.5	U	**121**		26.2	U	**800**		145	U
C3-Naphthobenzothiophenes	µg/Kg	12.5	U	**69.7**		26.2	U	**458**		145	U
Benz[a]anthracene	µg/Kg	12.5	U	**3290**	E	**4200**		**19000**	E	**17100**	
Chrysene	µg/Kg	12.5	U	**2580**		26.2	U	**14900**	E	**13900**	
C1-Chrysenes	µg/Kg	12.5	U	**1340**		26.2	U	**7920**		145	U
C2-Chrysenes	µg/Kg	12.5	U	**588**		26.2	U	**3260**		145	U
C3-Chrysenes	µg/Kg	12.5	U	**451**		26.2	U	**2260**		145	U
C4-Chrysenes	µg/Kg	12.5	U	**136**		26.2	U	**744**		145	U
Benzo[b]fluoranthene	µg/Kg	12.5	U	**1680**		26.2	U	**11800**	E	**8930**	
Benzo[k]fluoranthene	µg/Kg	12.5	U	**1950**		26.2	U	**8820**	E	**9480**	
Benzo[e]pyrene	µg/Kg	12.5	U	**1210**		26.2	U	**7560**	E	**6750**	
Perylene	µg/Kg	12.5	U	**992**		26.2	U	**3830**	E	**3030**	
Benzo[a]pyrene	µg/Kg	12.5	U	**2660**	E	**3260**		**16800**	E	**14200**	
Indeno[1,2,3-cd]pyrene	µg/Kg	12.5	U	**1460**		26.2	U	**8860**	E	**6570**	
Dibenz[a,h]anthracene	µg/Kg	12.5	U	**398**		26.2	U	**2680**		145	U
Benzo[g,h,i]perylene	µg/Kg	12.5	U	**1010**		26.2	U	**6650**	E	**5500**	
17a(H),21B(H)-hopane - C30H52	µg/Kg	12.5	U	**5.11**		26.2	U	**43.4**		145	U
Carbazole	µg/Kg	12.5	U	**2920**	E	**3670**		**741**		145	U

ARCADIS

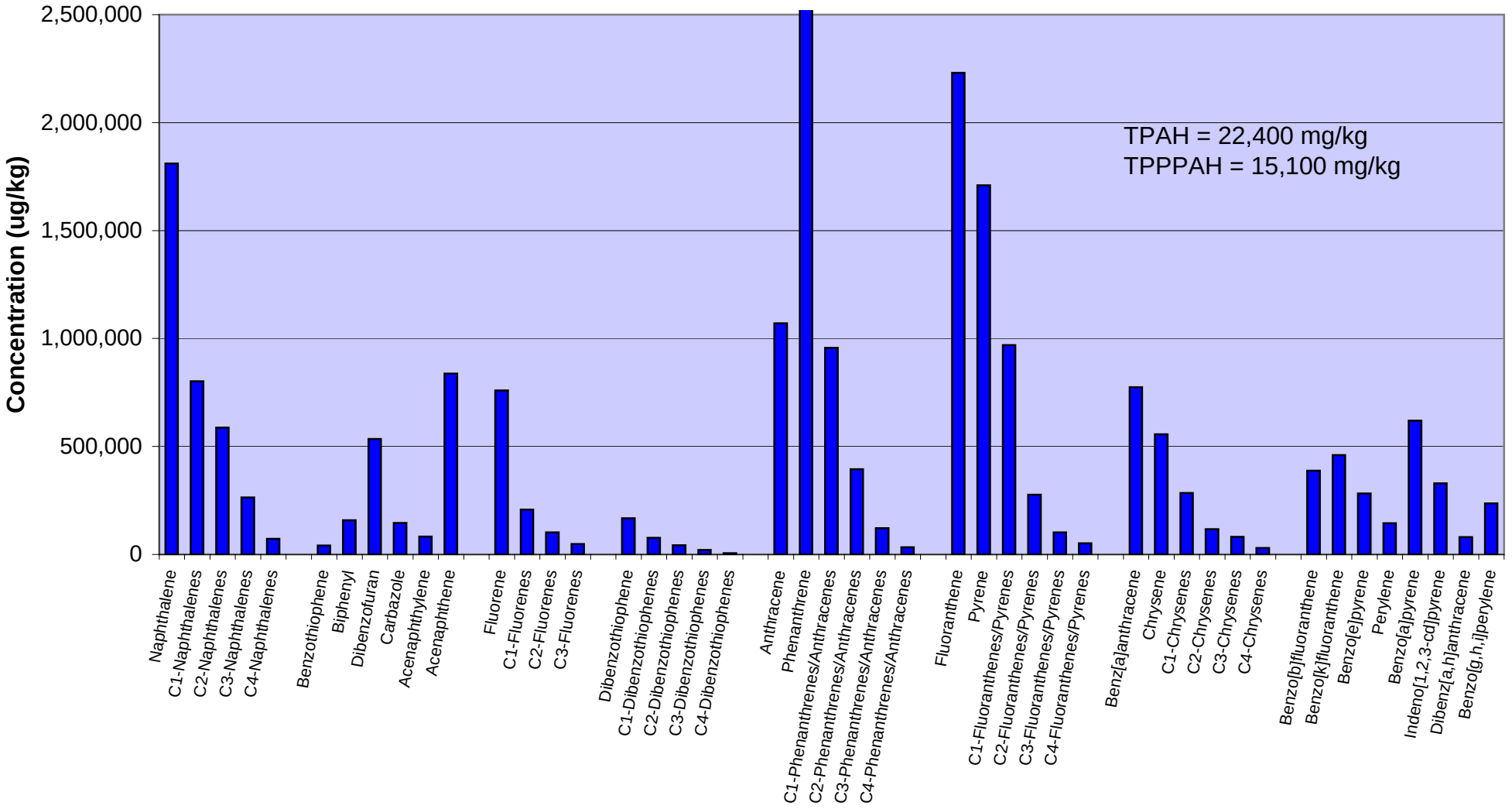
Appendix B

PAH Fingerprints

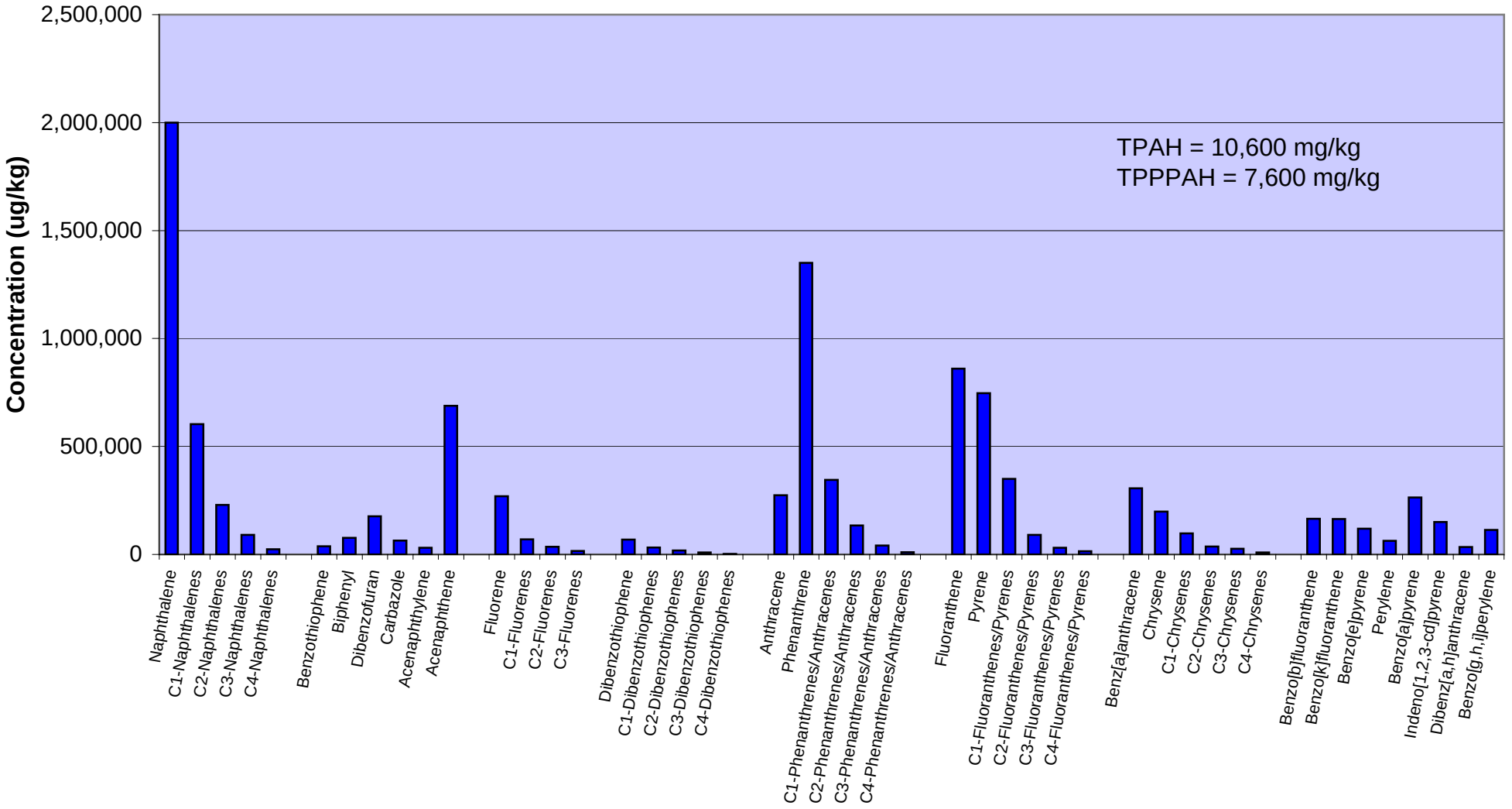
MPU-3 and DUP (MPU-3)



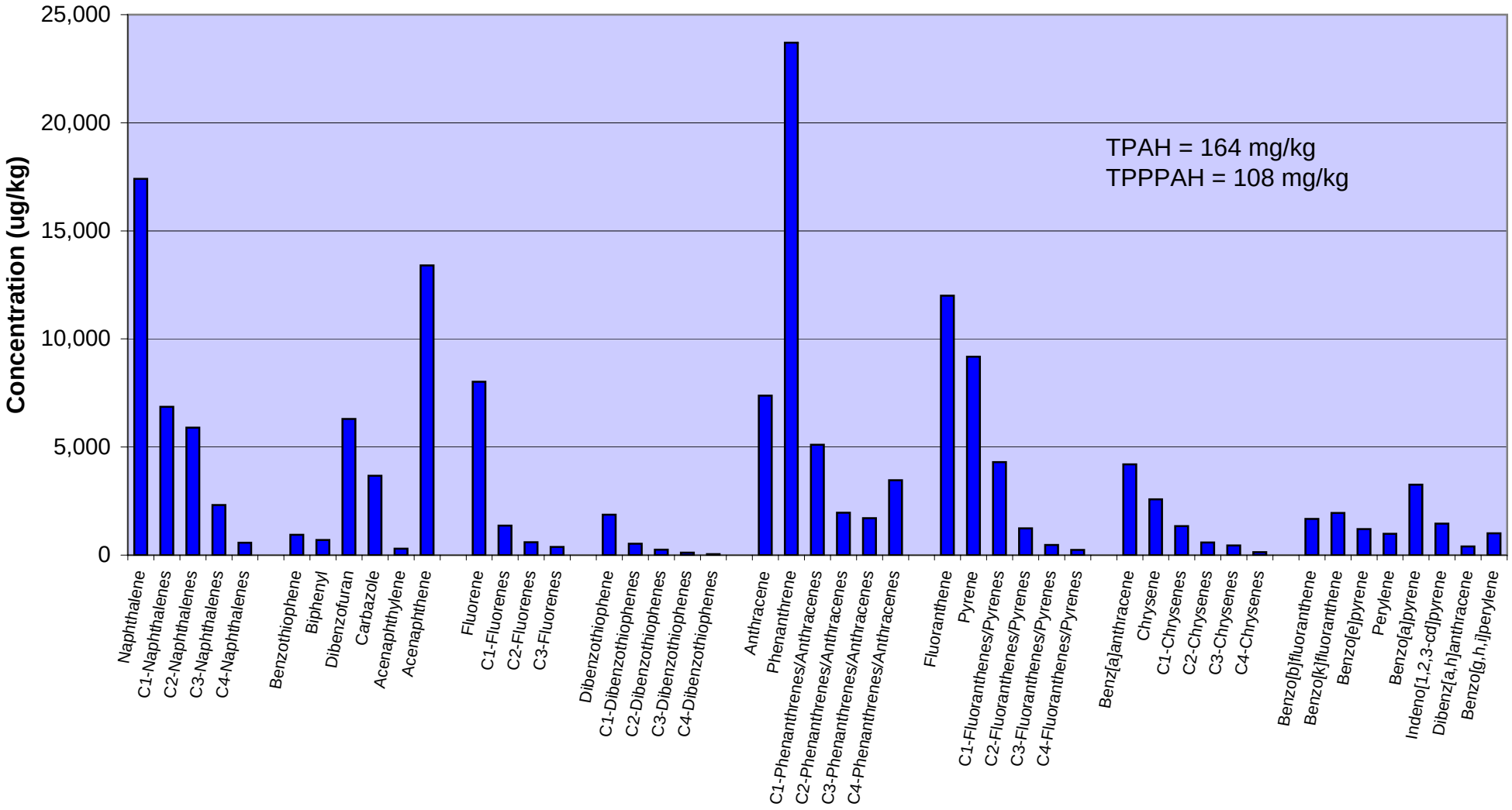
MPA-1


Concentration (ug/kg)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
TPAH = 22,400 mg/kg
TPPPAH = 15,100 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

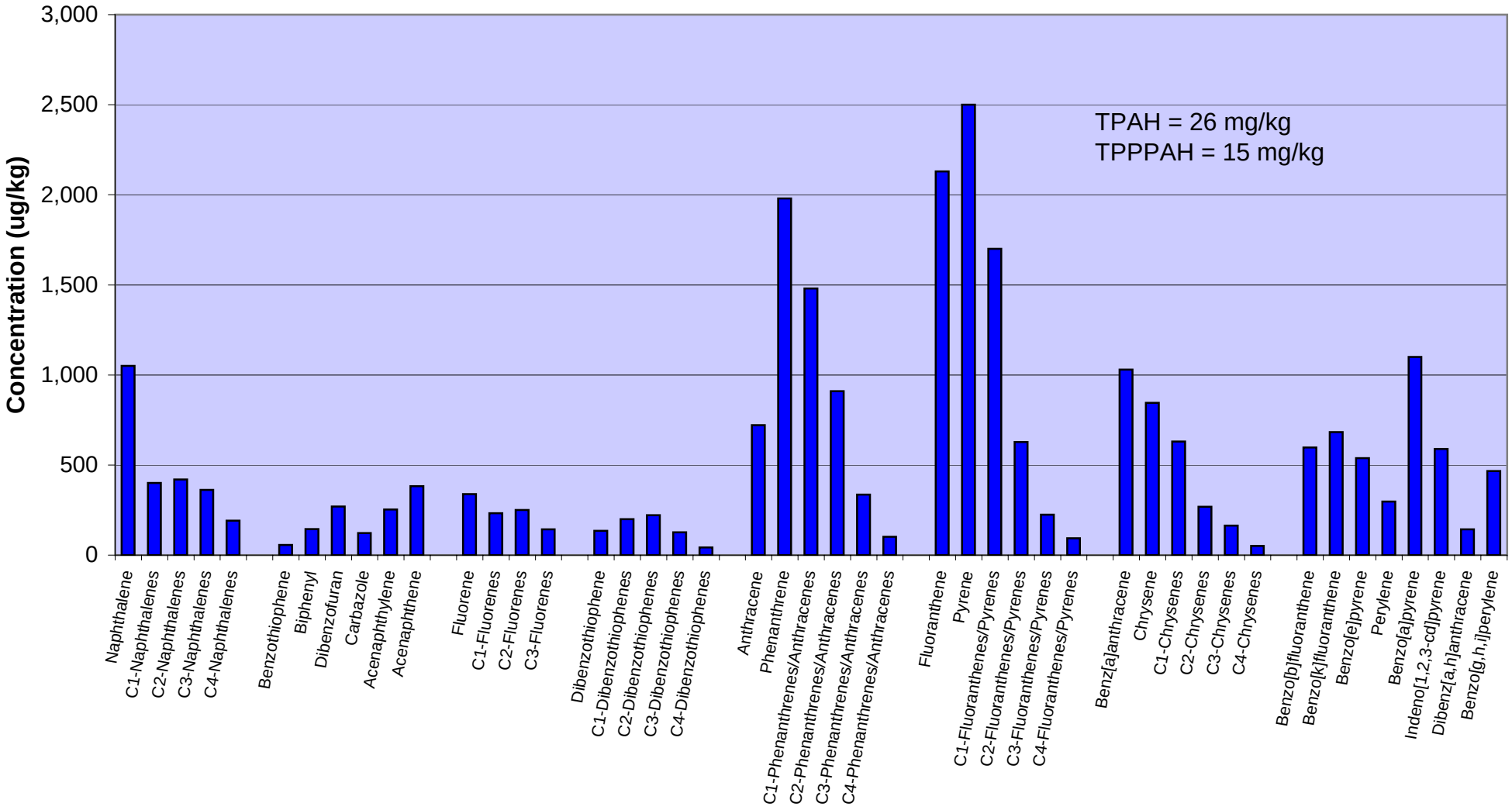
SD-87 (0-6)


Concentration (ug/kg)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
TPAH = 10,600 mg/kg
TPPPAH = 7,600 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

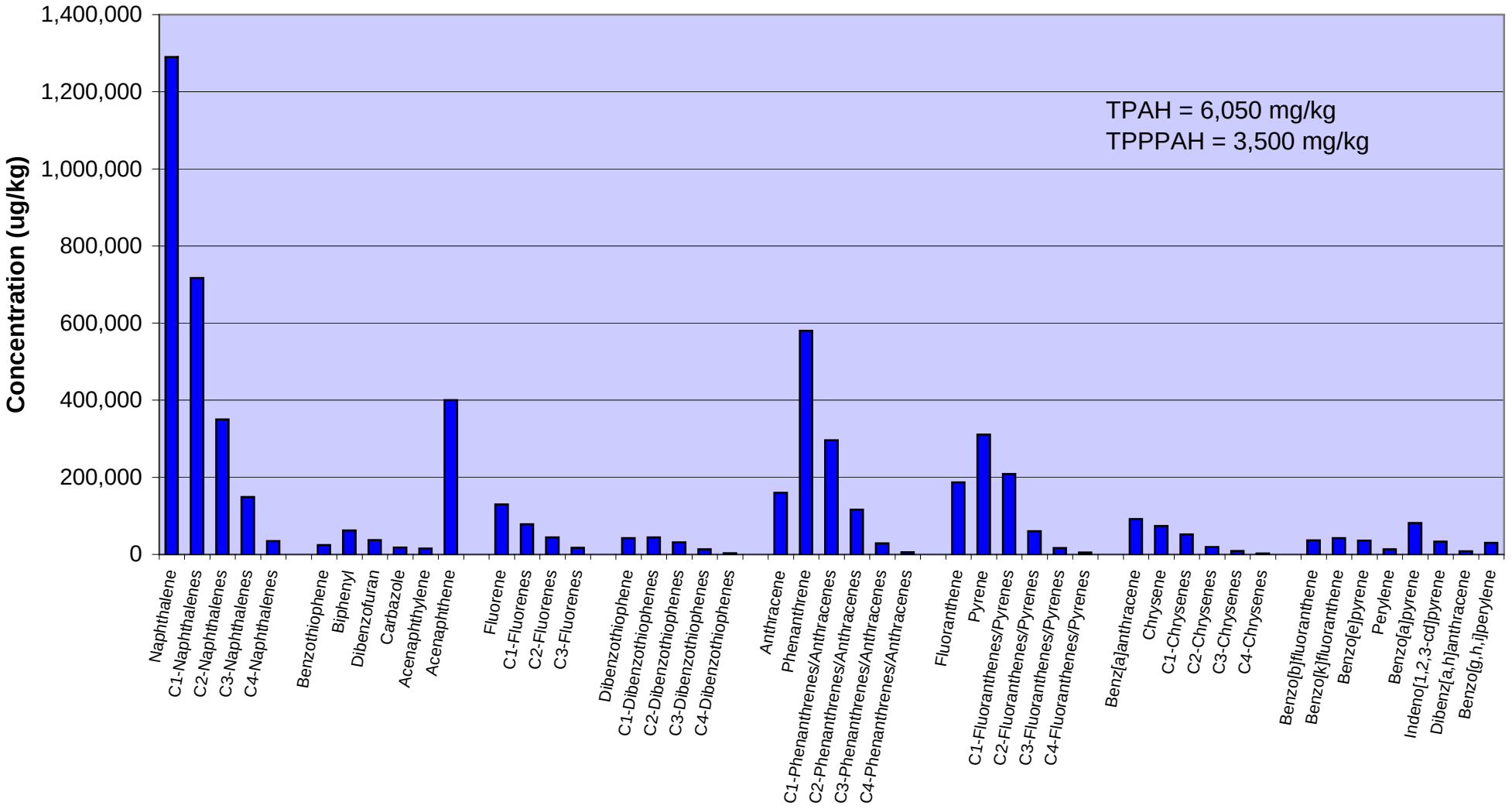
SD-87 (24-48)


Concentration (ug/kg)
25,000
20,000
15,000
10,000
5,000
0
TPAH = 164 mg/kg
TPPPAH = 108 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

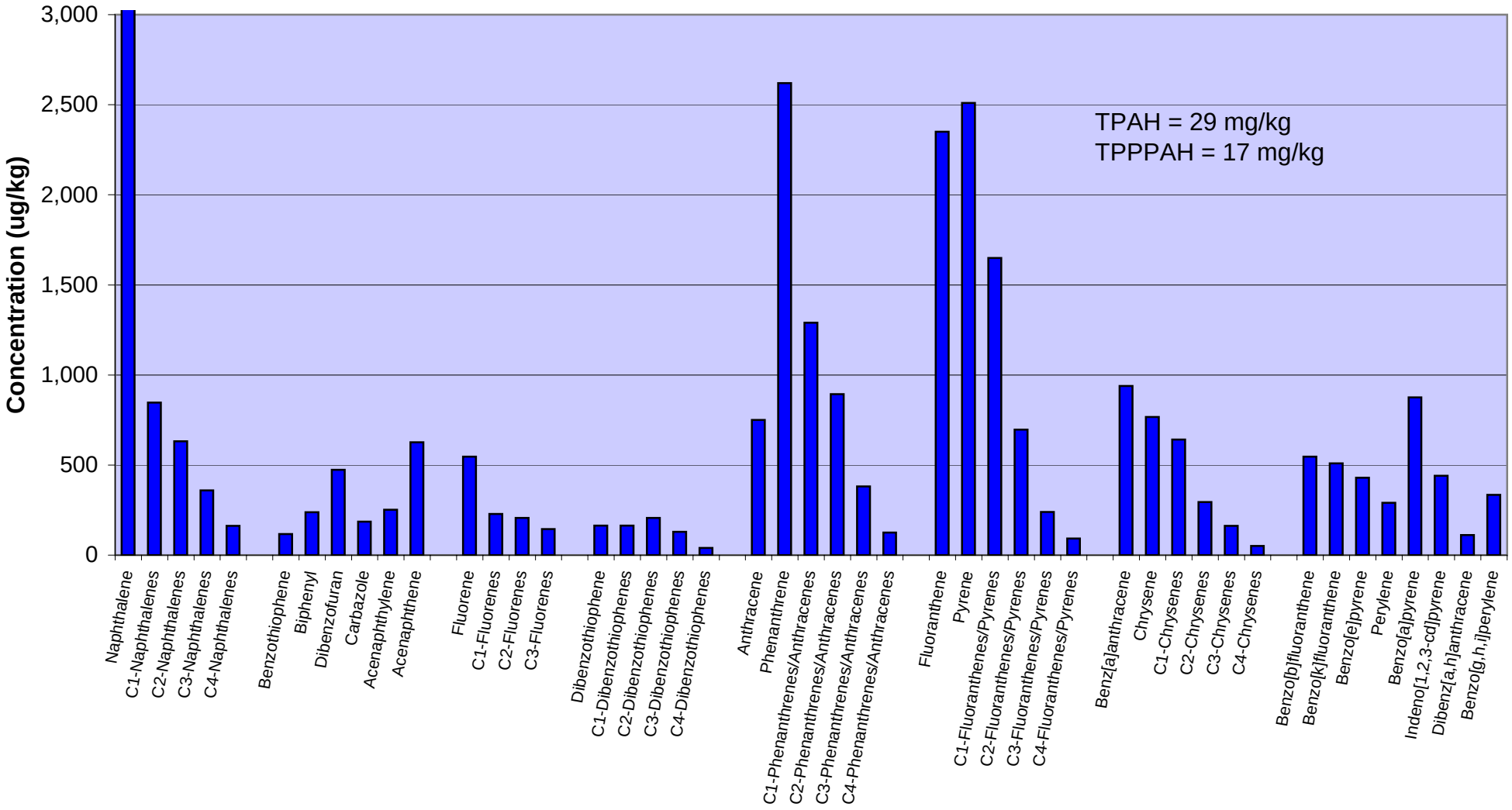
SD-94 (0-6)


Concentration (ug/kg)
3,000
2,500
2,000
1,500
1,000
500
0
TPAH = 26 mg/kg
TPPPAH = 15 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

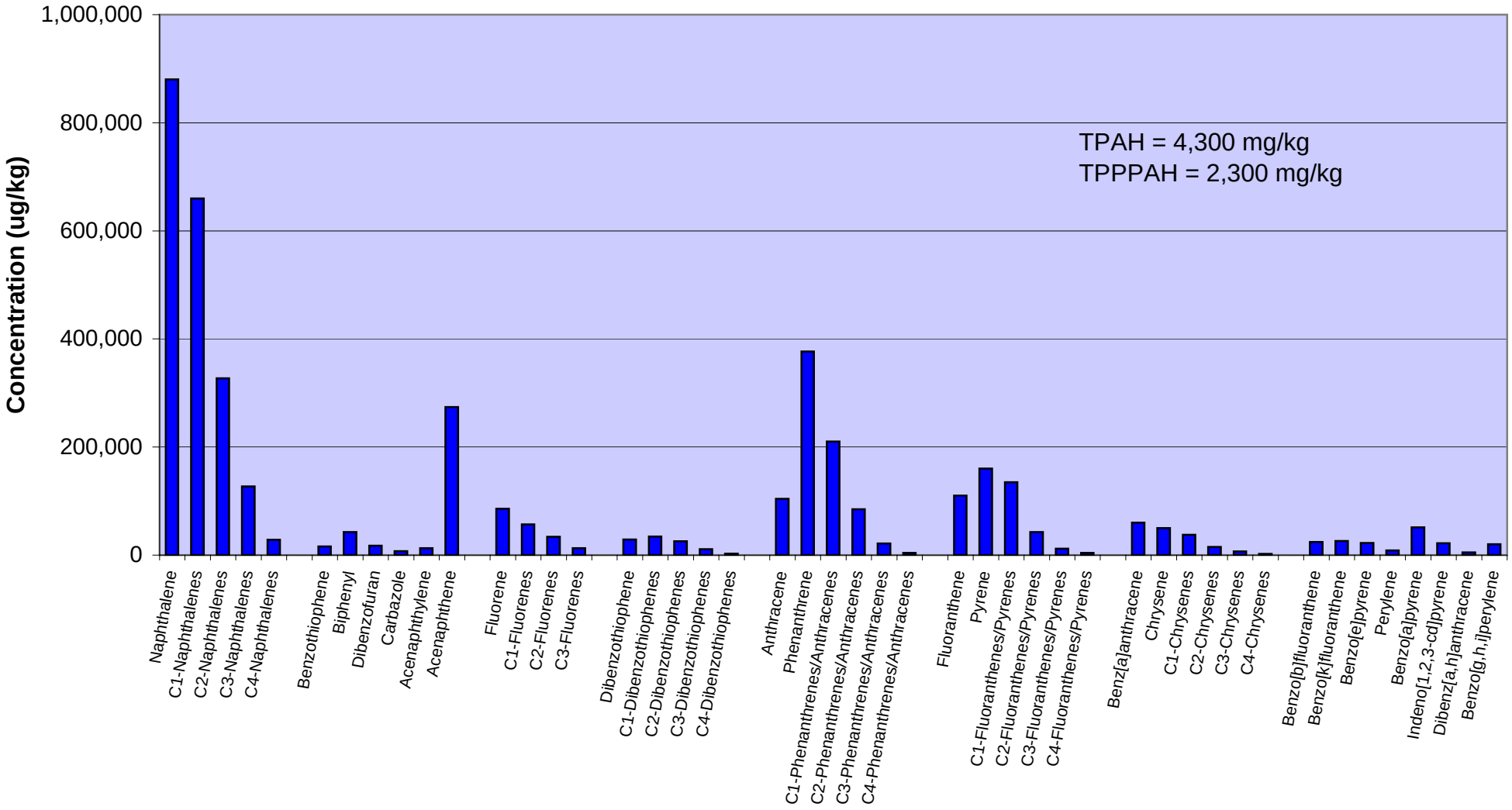
SD-95 (0-6)


Concentration (ug/kg)
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
TPAH = 6,050 mg/kg
TPPPAH = 3,500 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

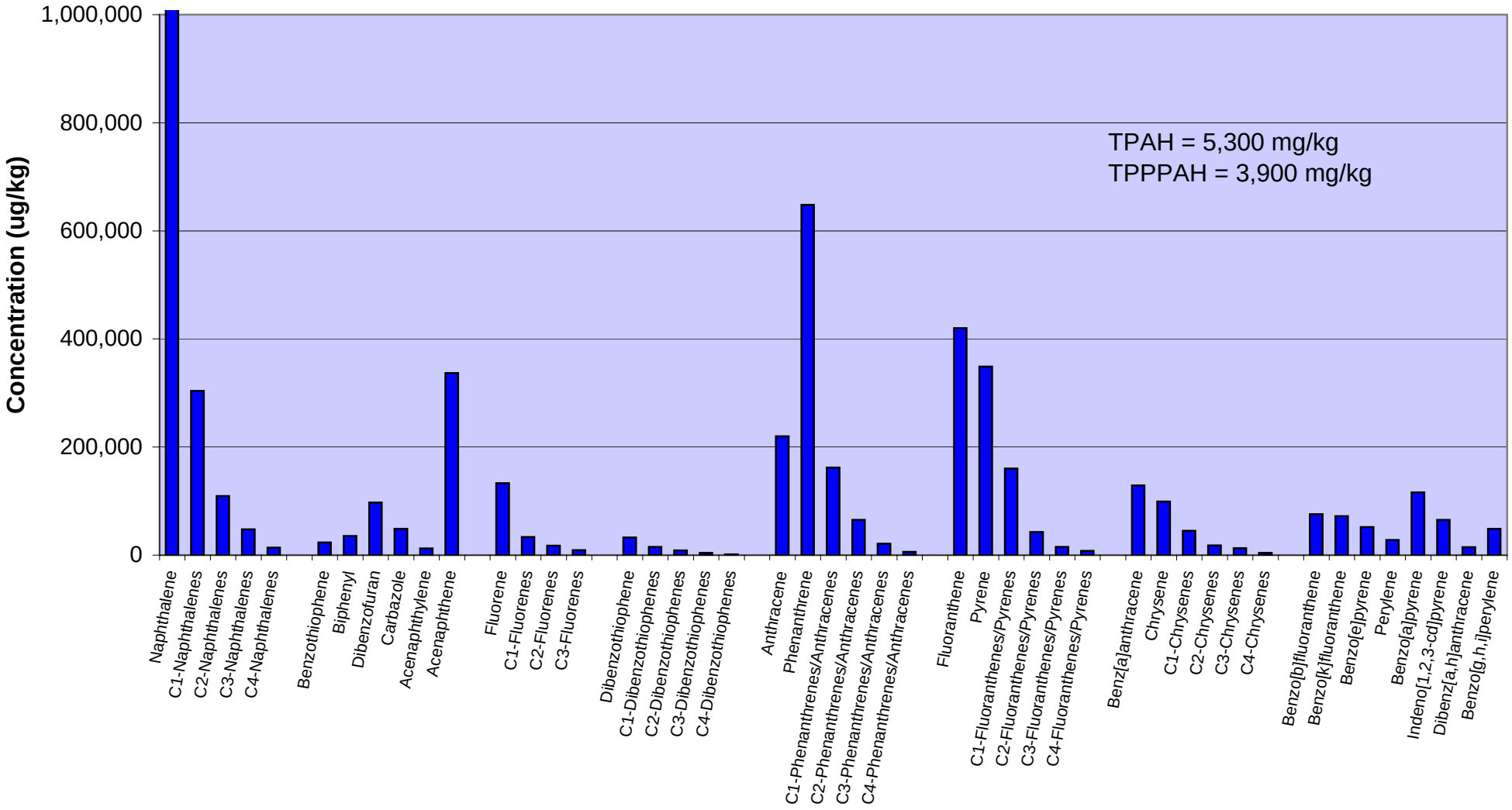
SD-95 (6-24)


Concentration (ug/kg)
3,000
2,500
2,000
1,500
1,000
500
0
TPAH = 29 mg/kg
TPPPAH = 17 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

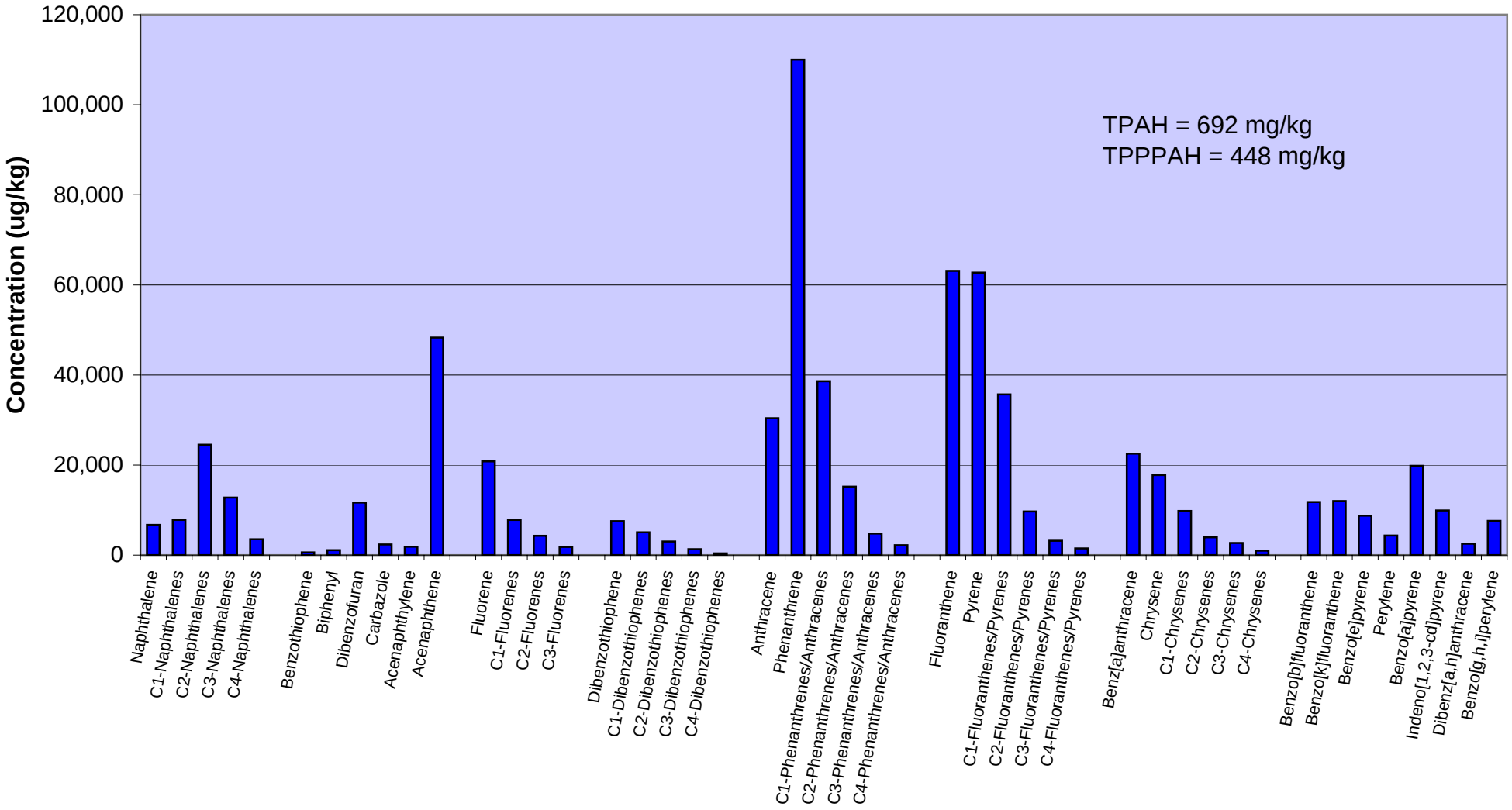
SD-96 (0-6)


Concentration (ug/kg)
1,000,000
800,000
600,000
400,000
200,000
0
TPAH = 4,300 mg/kg
TPPPAH = 2,300 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

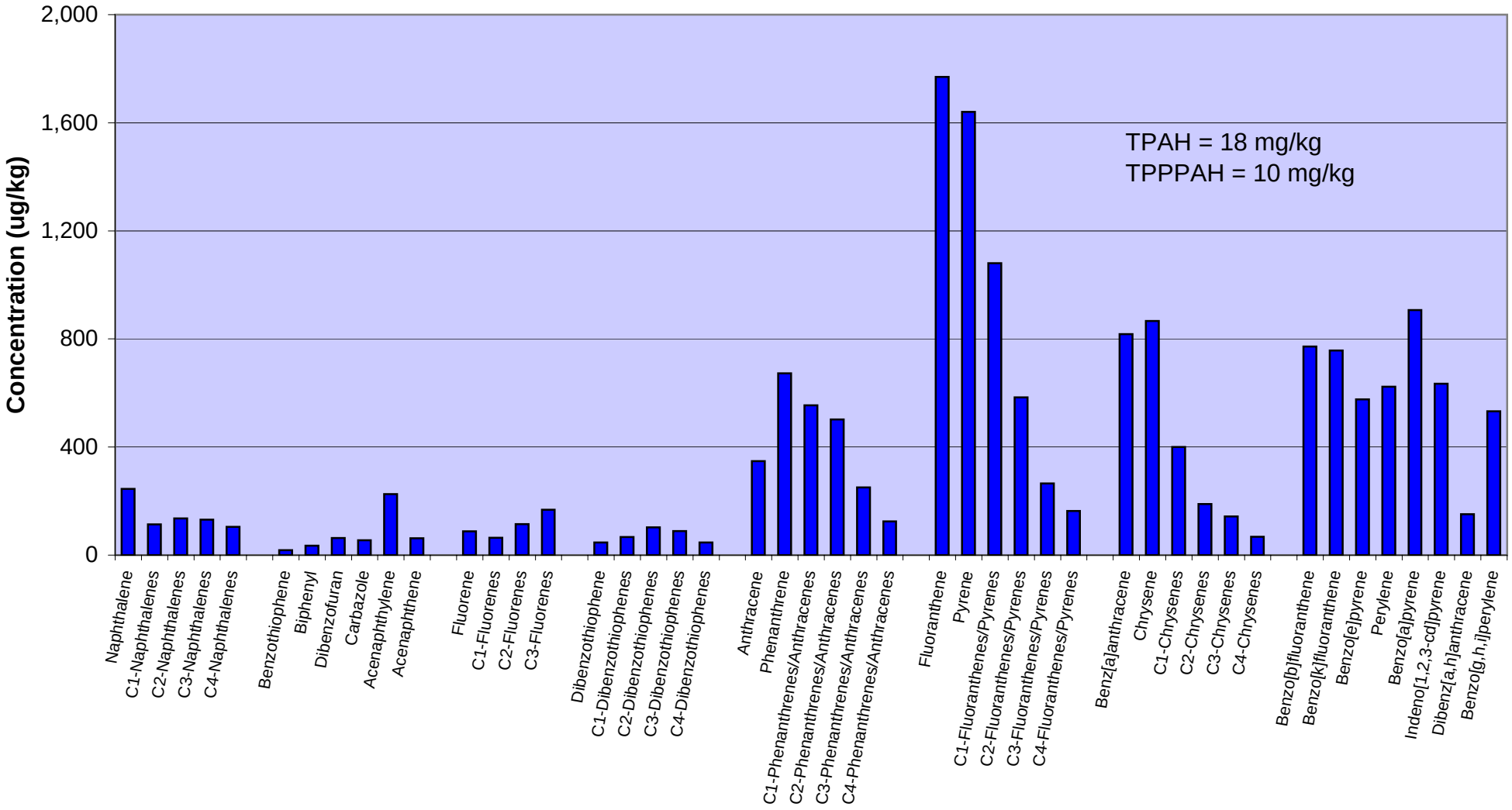
MPA-3


Concentration (ug/kg)
1,000,000
800,000
600,000
400,000
200,000
0
TPAH = 5,300 mg/kg
TPPPAH = 3,900 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

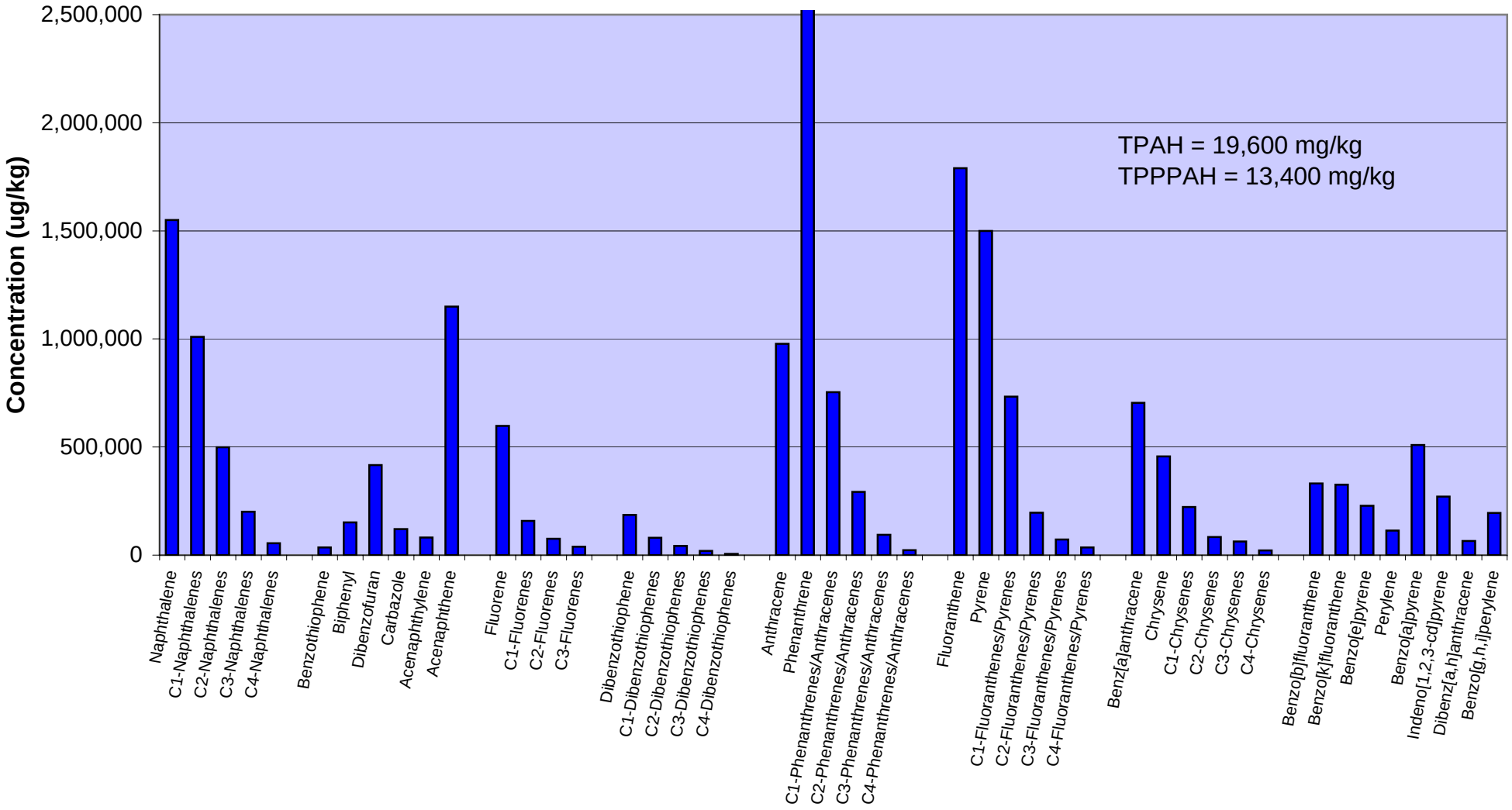
MPA-5


Concentration (ug/kg)
120,000
100,000
80,000
60,000
40,000
20,000
0
TPAH = 692 mg/kg
TPPPAH = 448 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

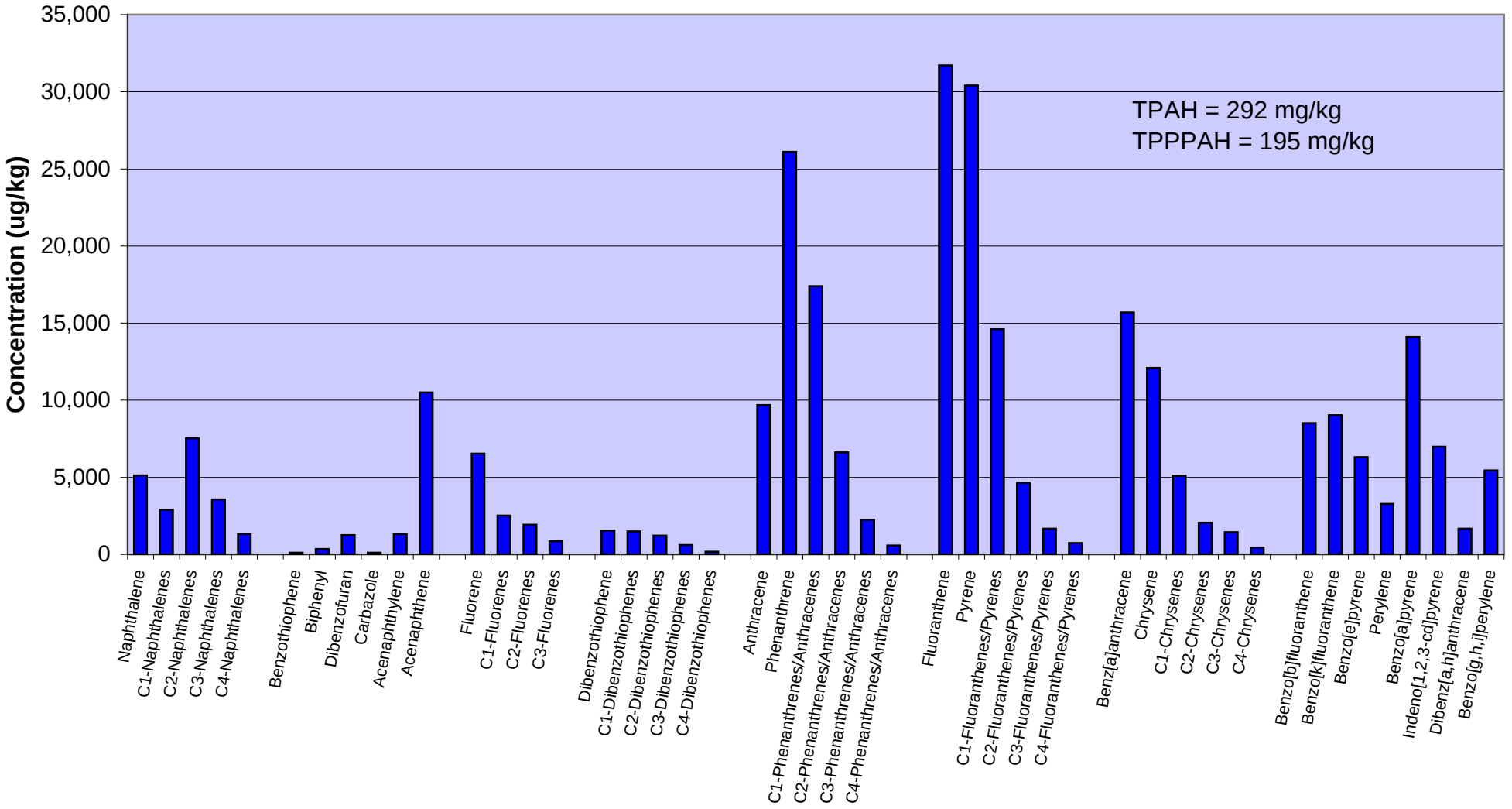
MPE2-2


Concentration (ug/kg)
2,000
1,600
1,200
800
400
0
TPAH = 18 mg/kg
TPPPAH = 10 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

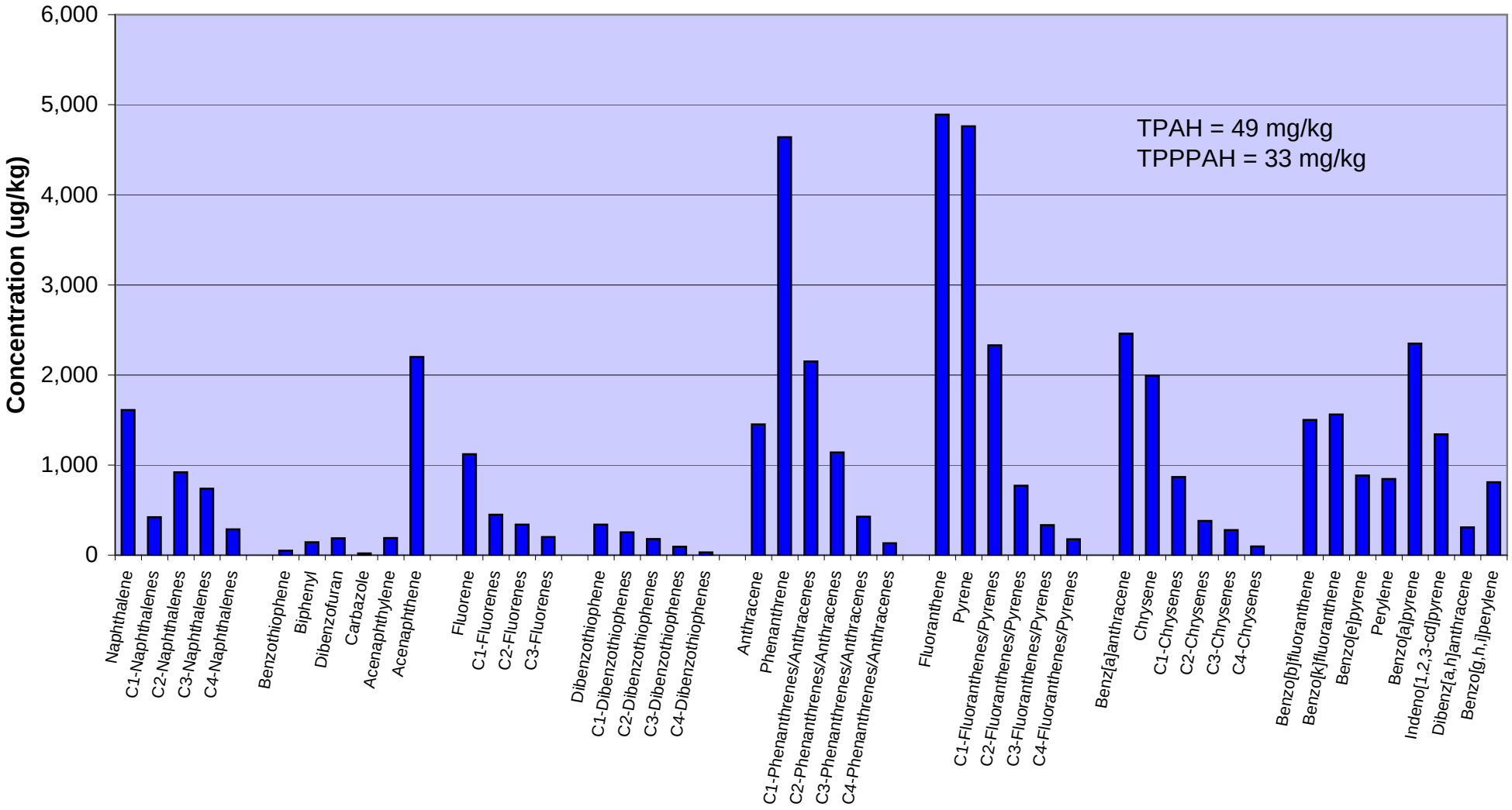
MPD-2


Concentration (ug/kg)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
TPAH = 19,600 mg/kg
TPPPAH = 13,400 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

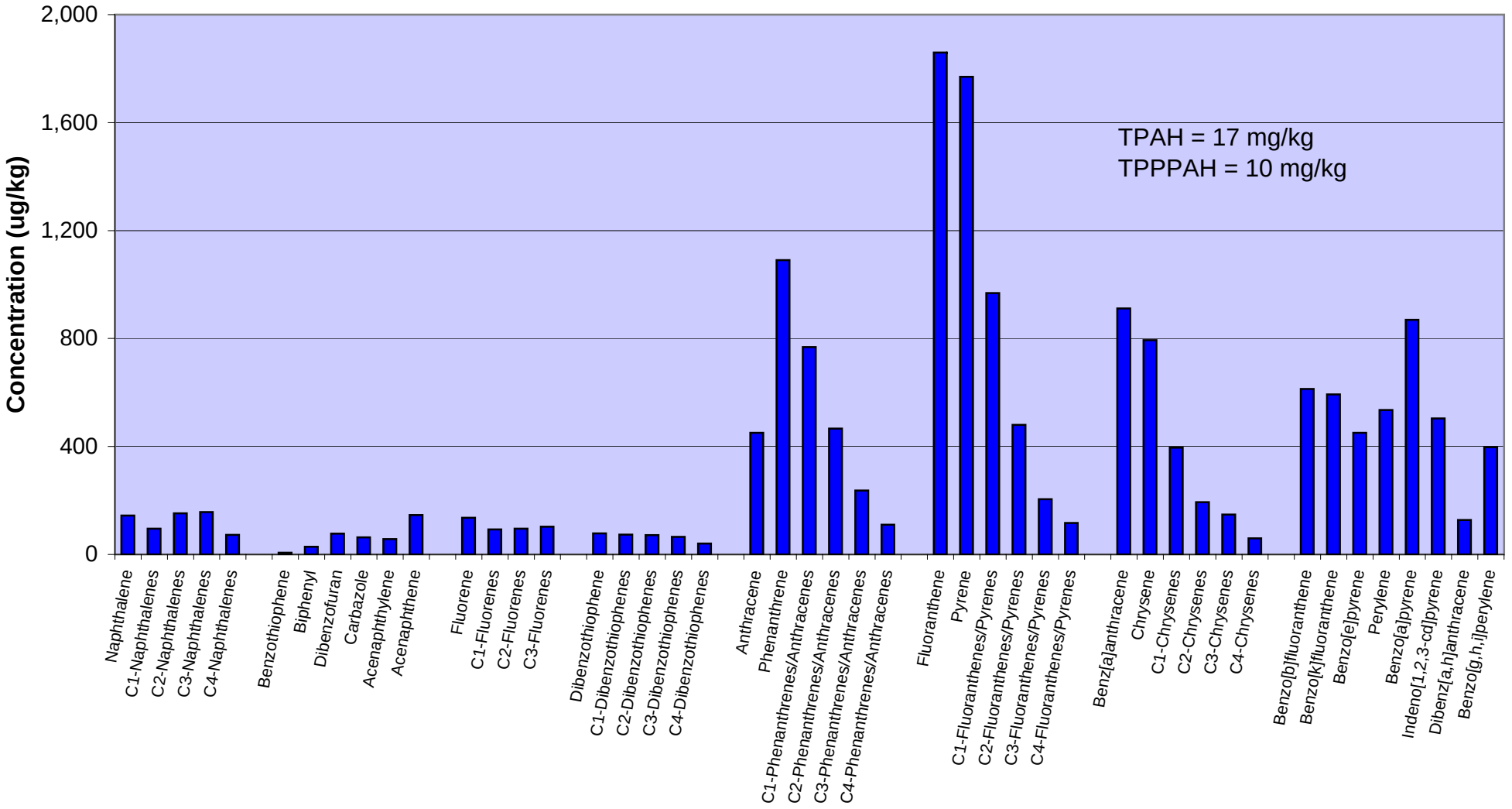
MPD-3


Concentration (ug/kg)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
TPAH = 292 mg/kg
TPPPAH = 195 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

MPD-4


Concentration (ug/kg)
6,000
5,000
4,000
3,000
2,000
1,000
0
TPAH = 49 mg/kg
TPPPAH = 33 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

MPD-8


Concentration (ug/kg)
2,000
1,600
1,200
800
400
0
TPAH = 17 mg/kg
TPPPAH = 10 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

ARCADIS

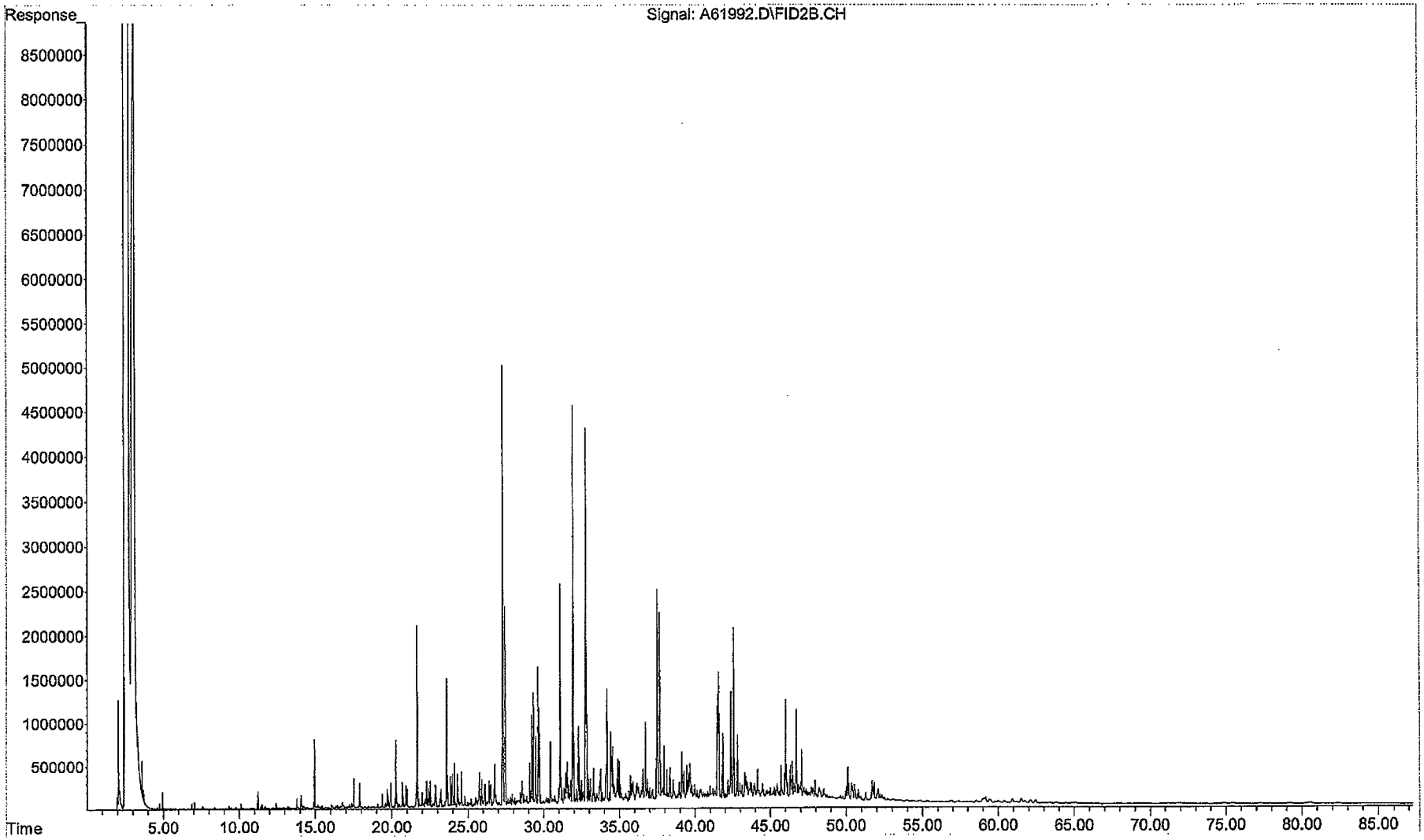
Appendix C

GC Fingerprints

GC FINGERPRINTS FROM TPH ANALYSIS

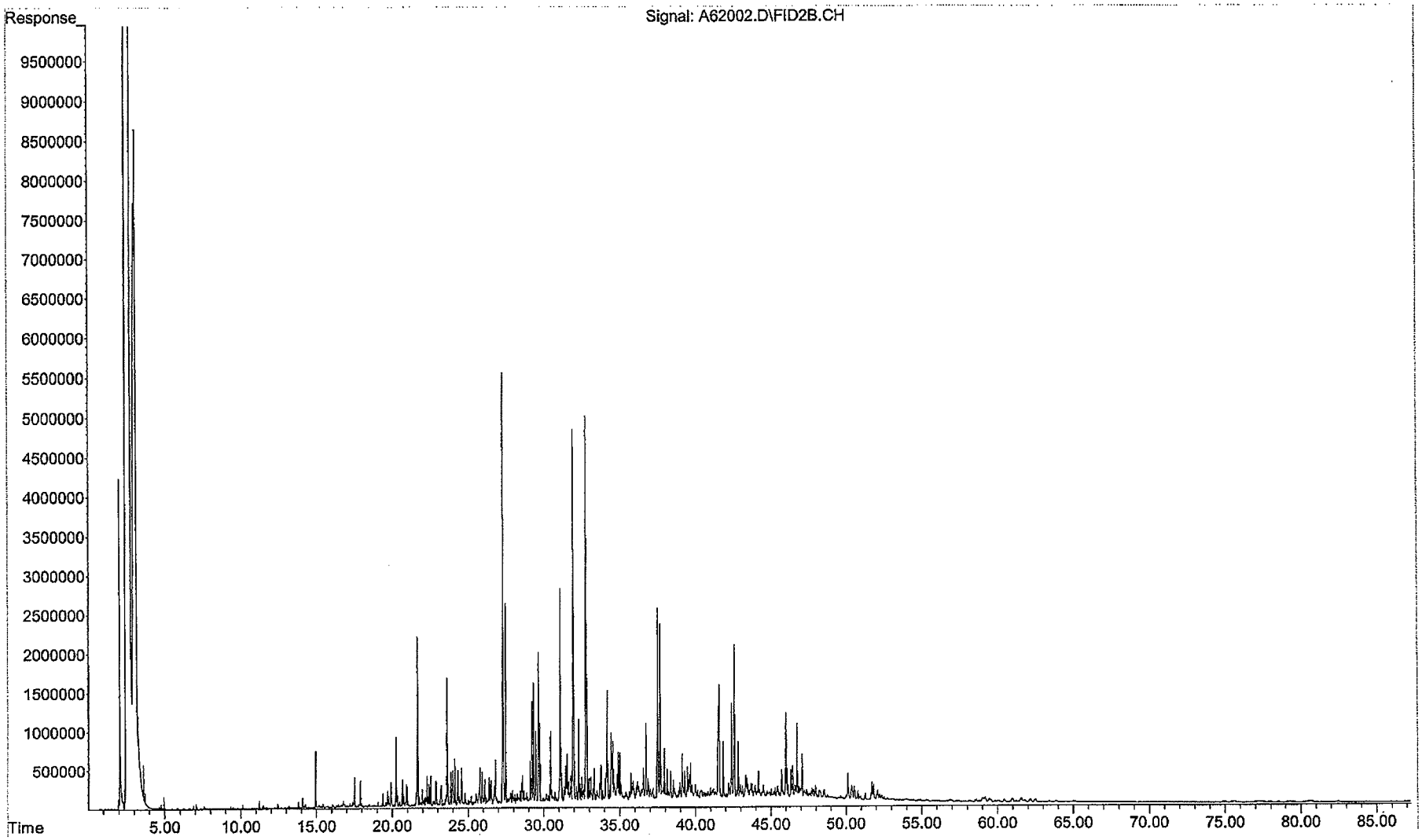
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Operator : NLJr
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Instrument : FID6
Sample Name: 0801067-11
Misc Info : 1X
Vial Number: 72

MPU-3



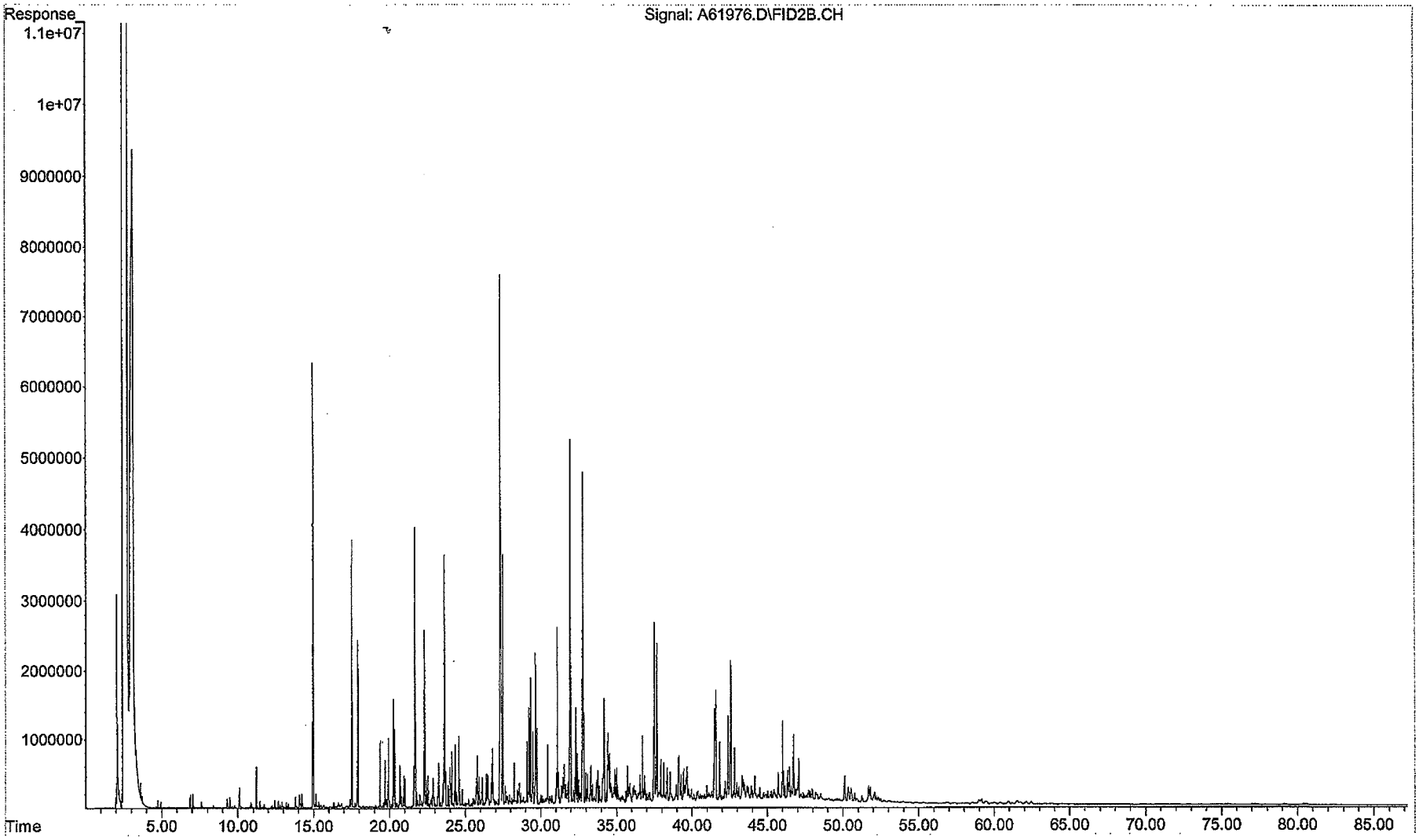
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Operator : NLJr
Acquired : 13 Feb 2008 6:06 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-16
Misc Info : 1X
Vial Number: 77

MPU-3 (DHP-2)



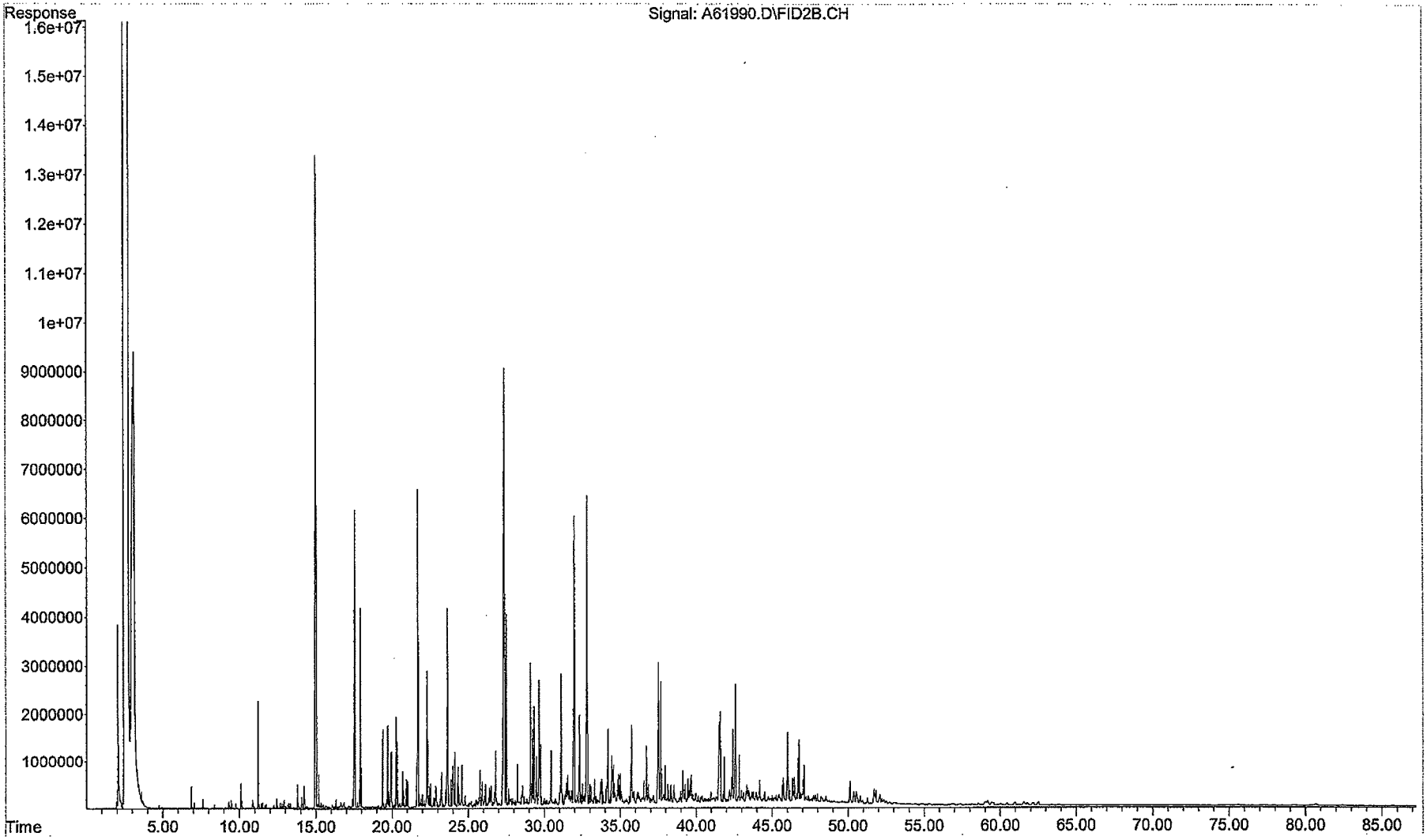
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Operator : NLJr
Acquired : 12 Feb 2008 8:39 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-05
Misc Info : 1X
Vial Number: 64

MPA-1



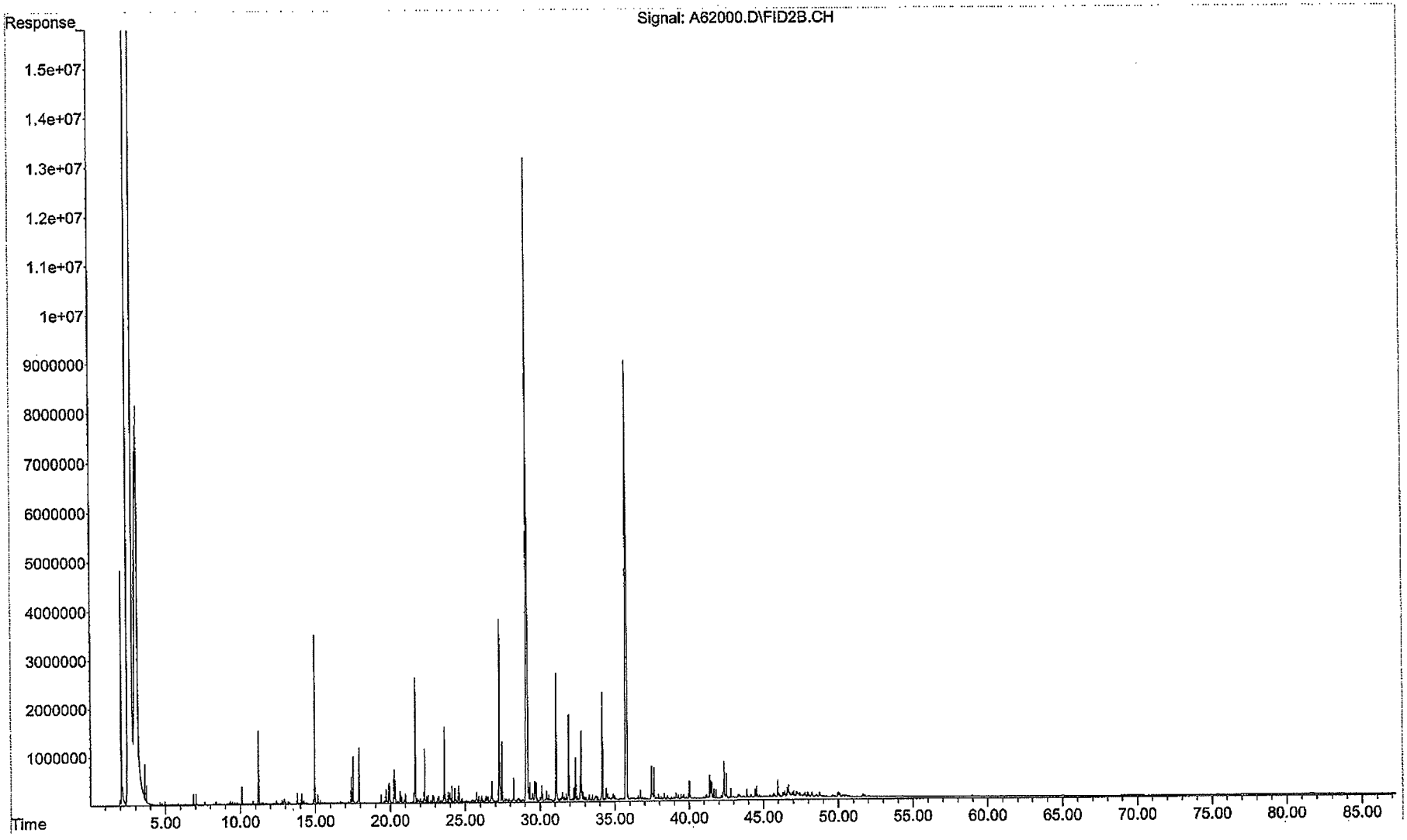
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Operator : NLJr
Acquired : 12 Feb 2008 8:13 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-10
Misc Info : 1X
Vial Number: 71

SD-87(0-6)



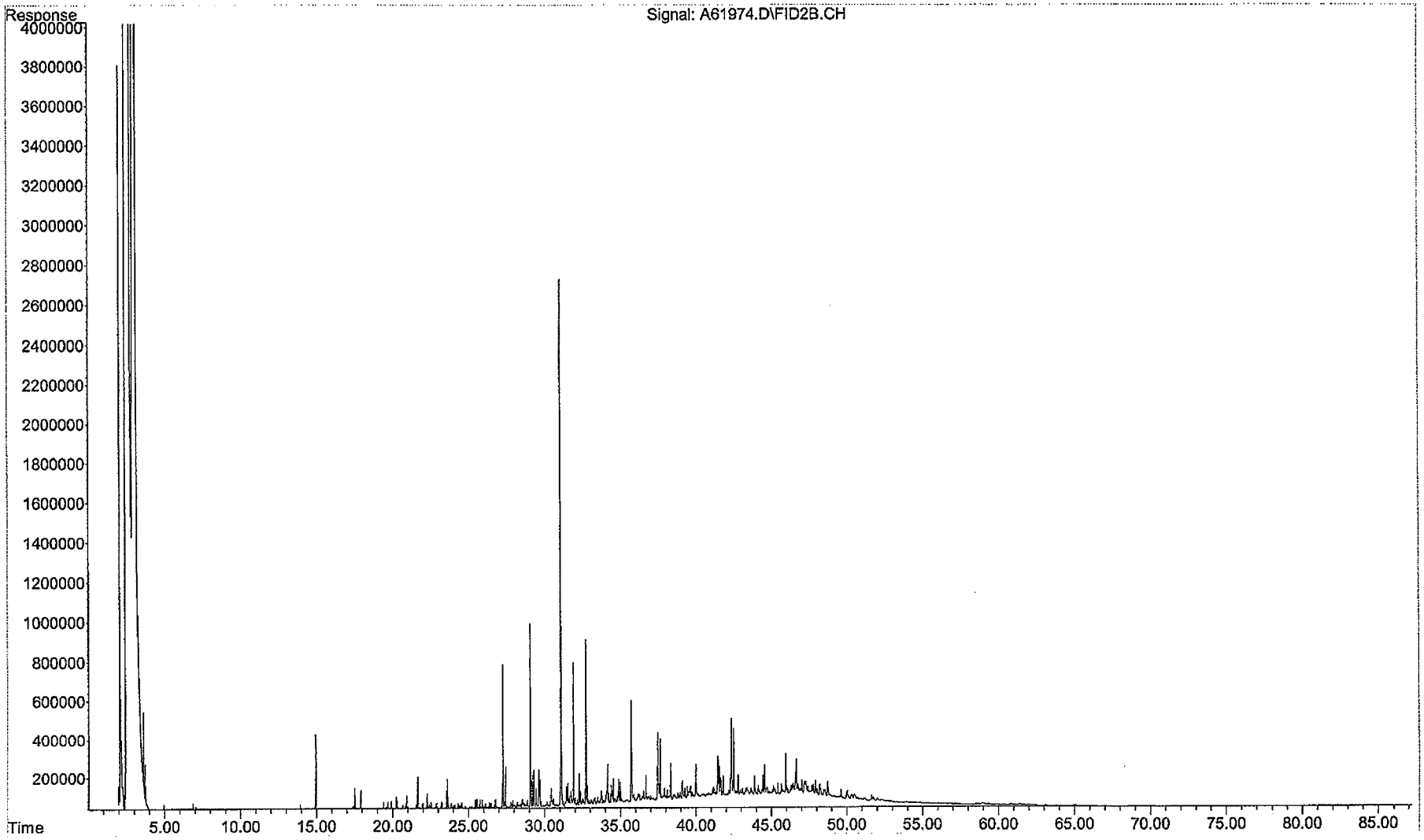
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Operator : NLJr
Acquired : 13 Feb 2008 4:27 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-15
Misc Info : 1X
Vial Number: 76

SD-87 (24-48)



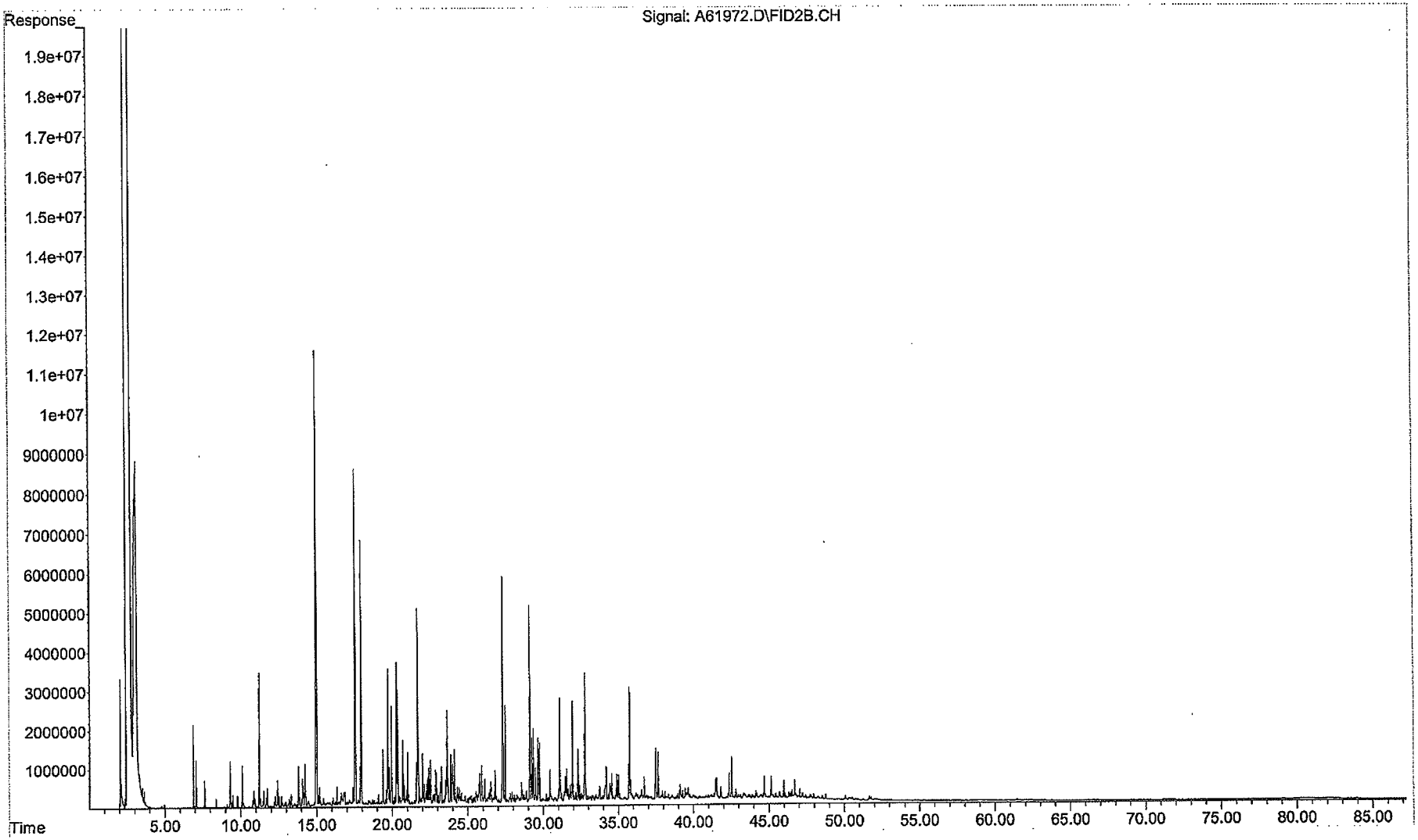
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Operator : NLJr
Acquired : 12 Feb 2008 7:00 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-04
Misc Info : 1X
Vial Number: 63

SD-94(0-6)



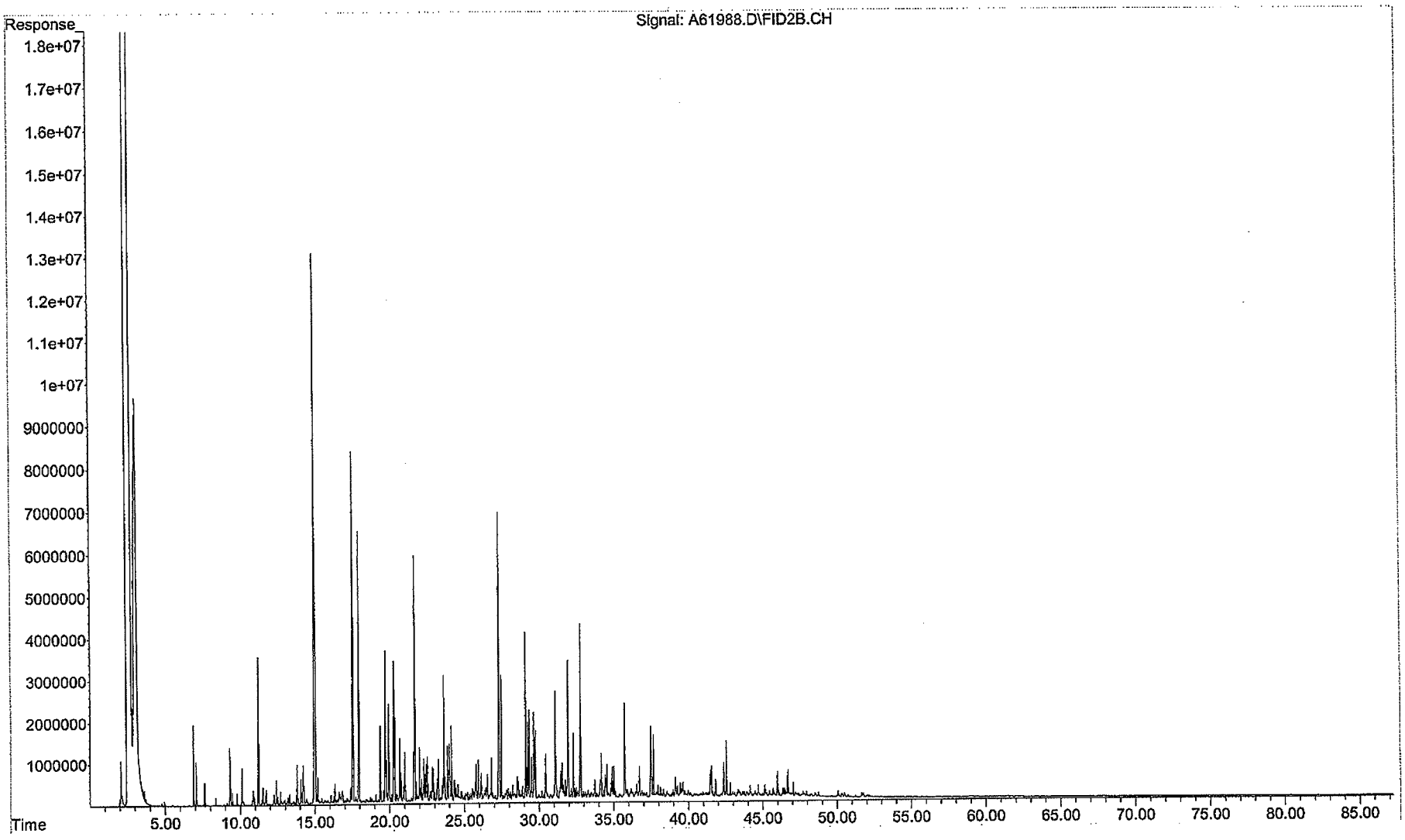
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Operator : NLJr
Acquired : 12 Feb 2008 5:21 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-03
Misc Info : 1X
Vial Number: 62

SD-96(0-6)



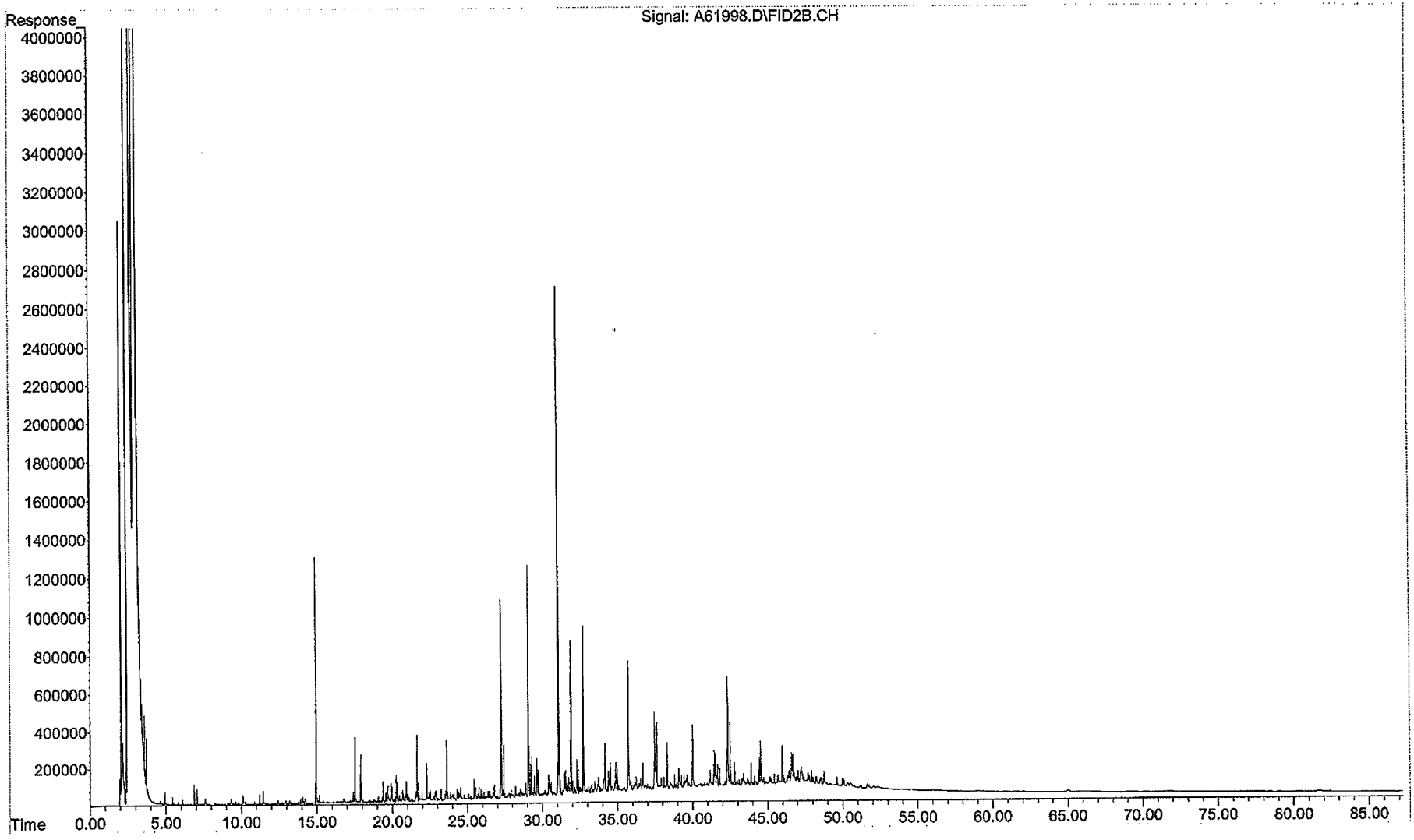
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Operator : NLJr
Acquired : 12 Feb 2008 6:33 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-09
Misc Info : 1X
Vial Number: 70

SD-95(0-6)



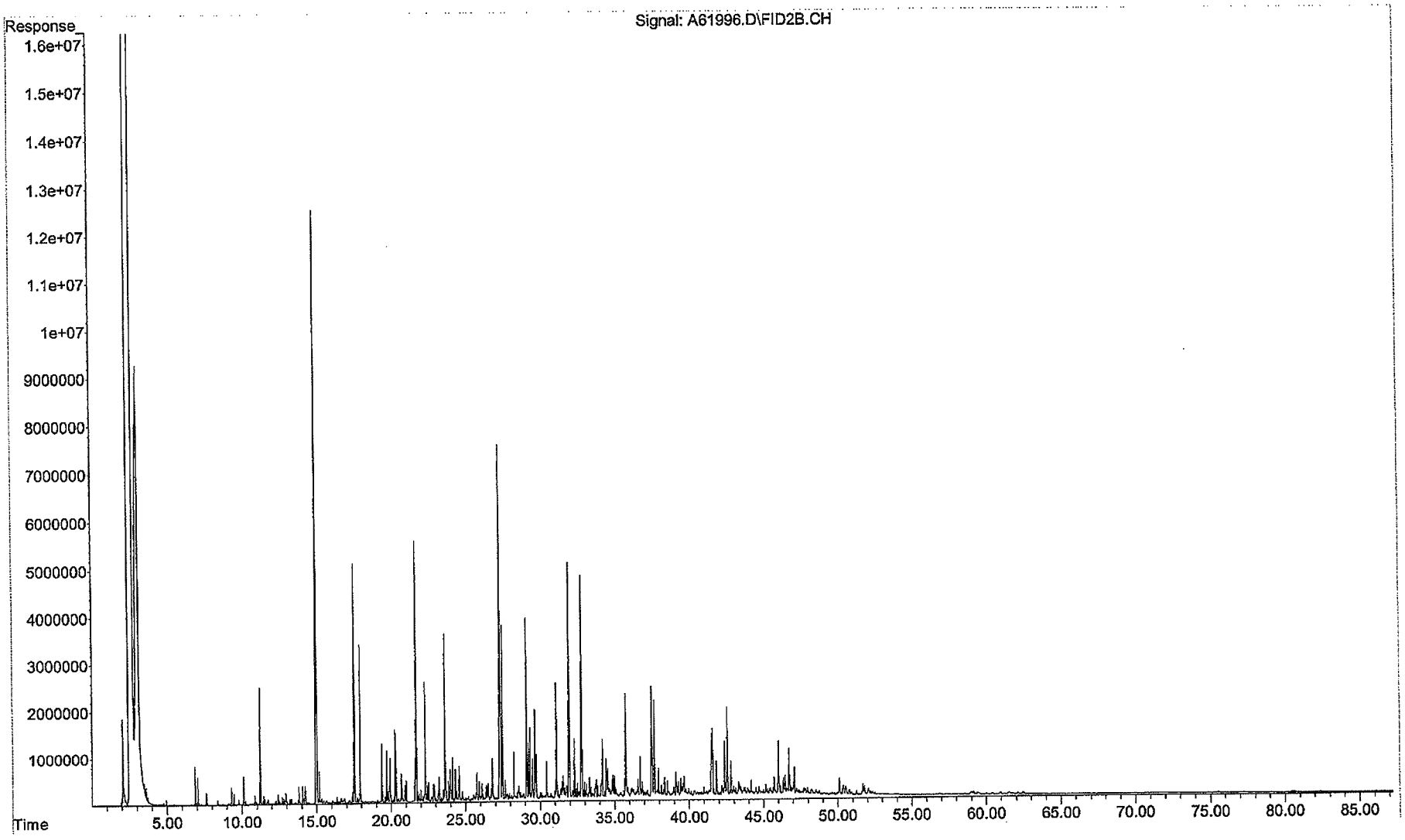
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Operator : NLJr
Acquired : 13 Feb 2008 2:48 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-14
Misc Info : 1X
Vial Number: 75

SD-95 (6-24)



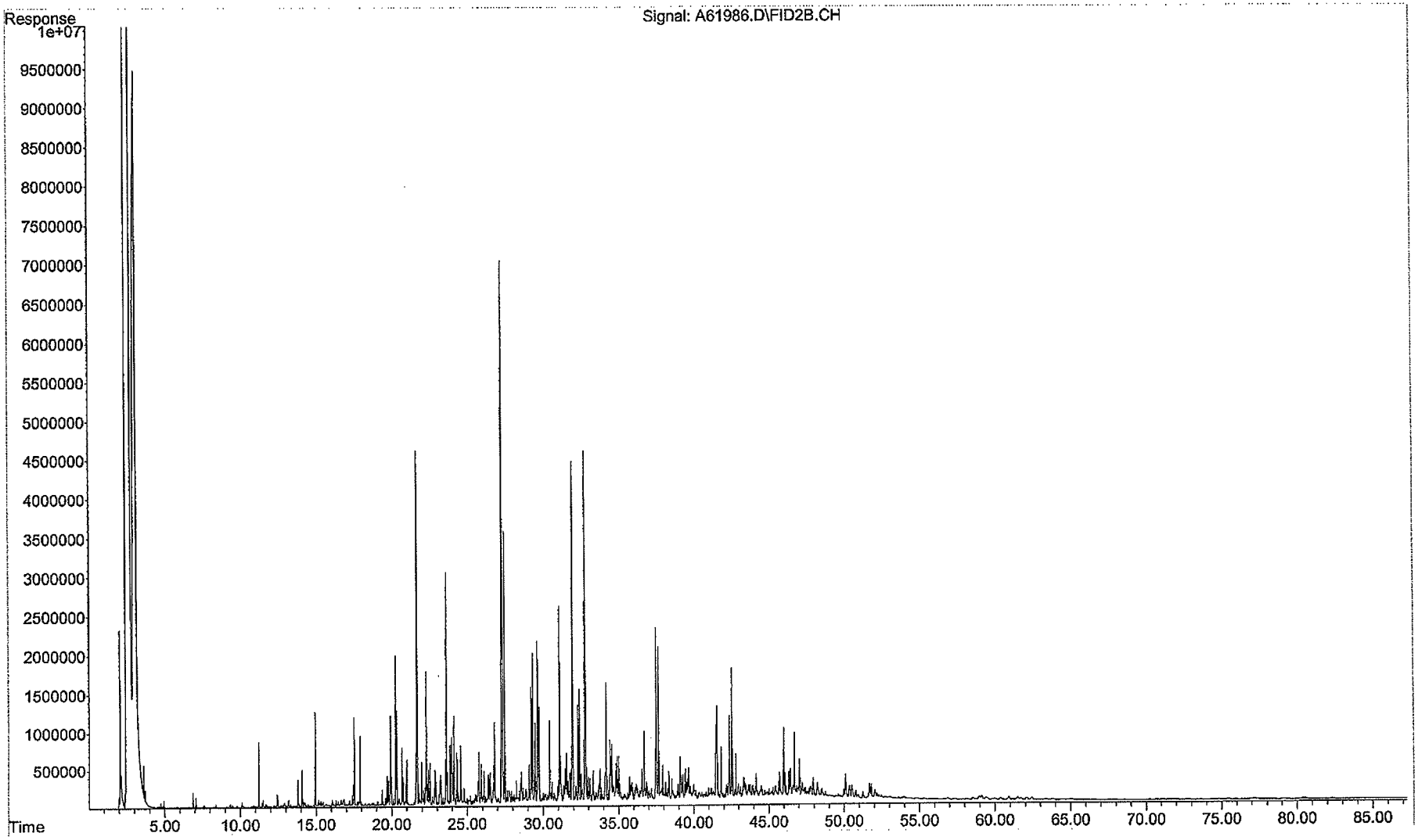
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Operator : NLJr
Acquired : 13 Feb 2008 1:09 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-13
Misc Info : 1X
Vial Number: 74

MPA-3



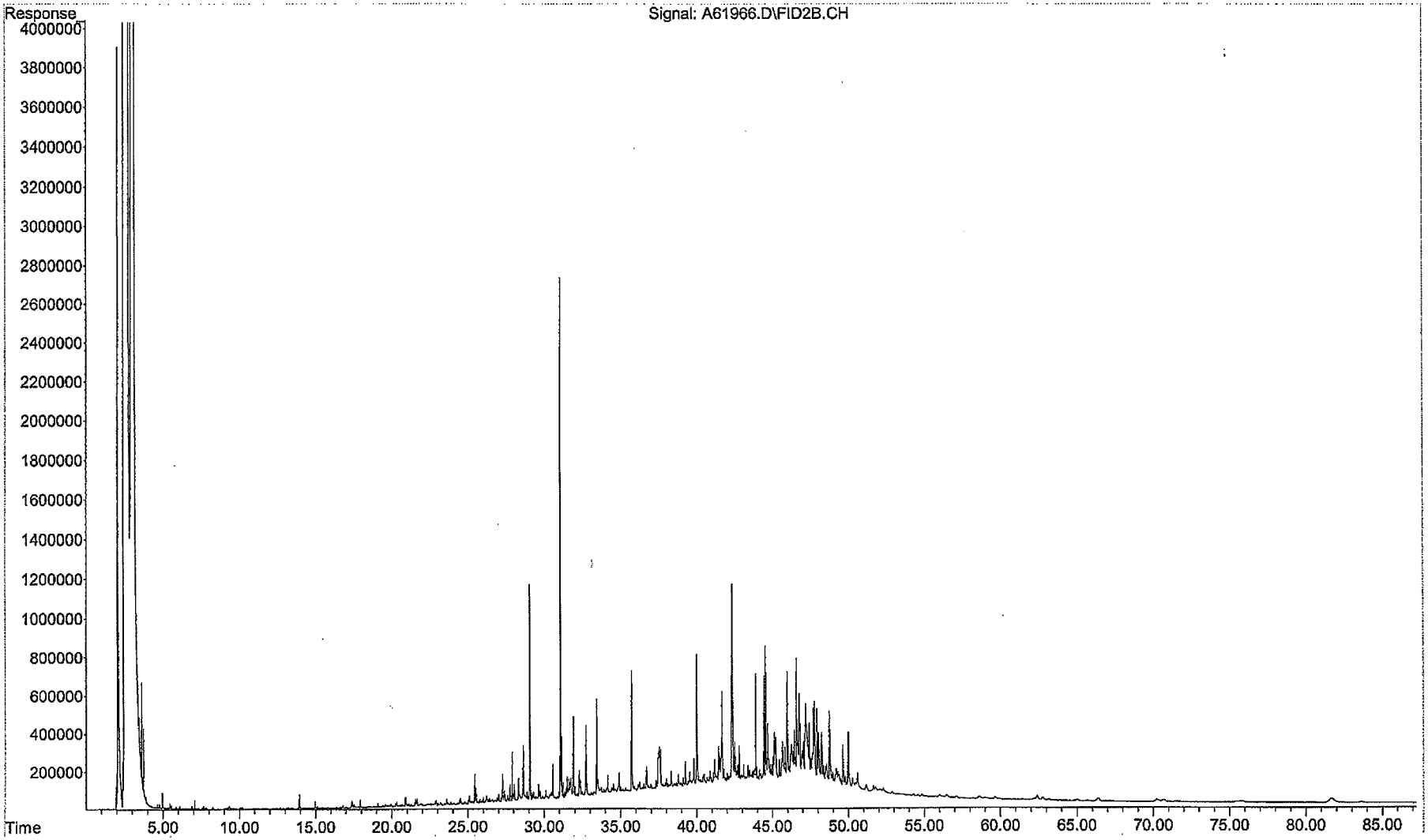
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MPA-5



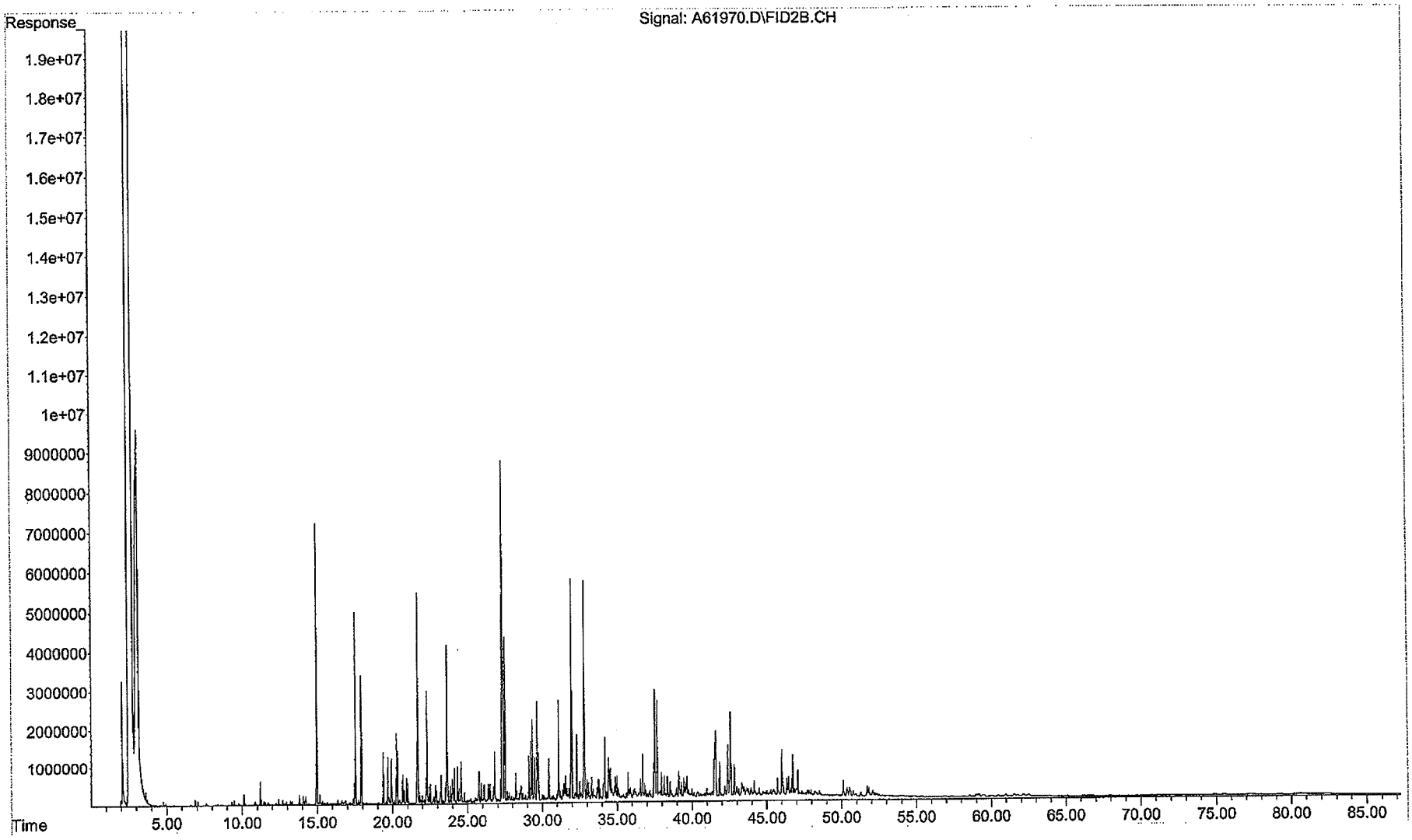
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MPE2-2



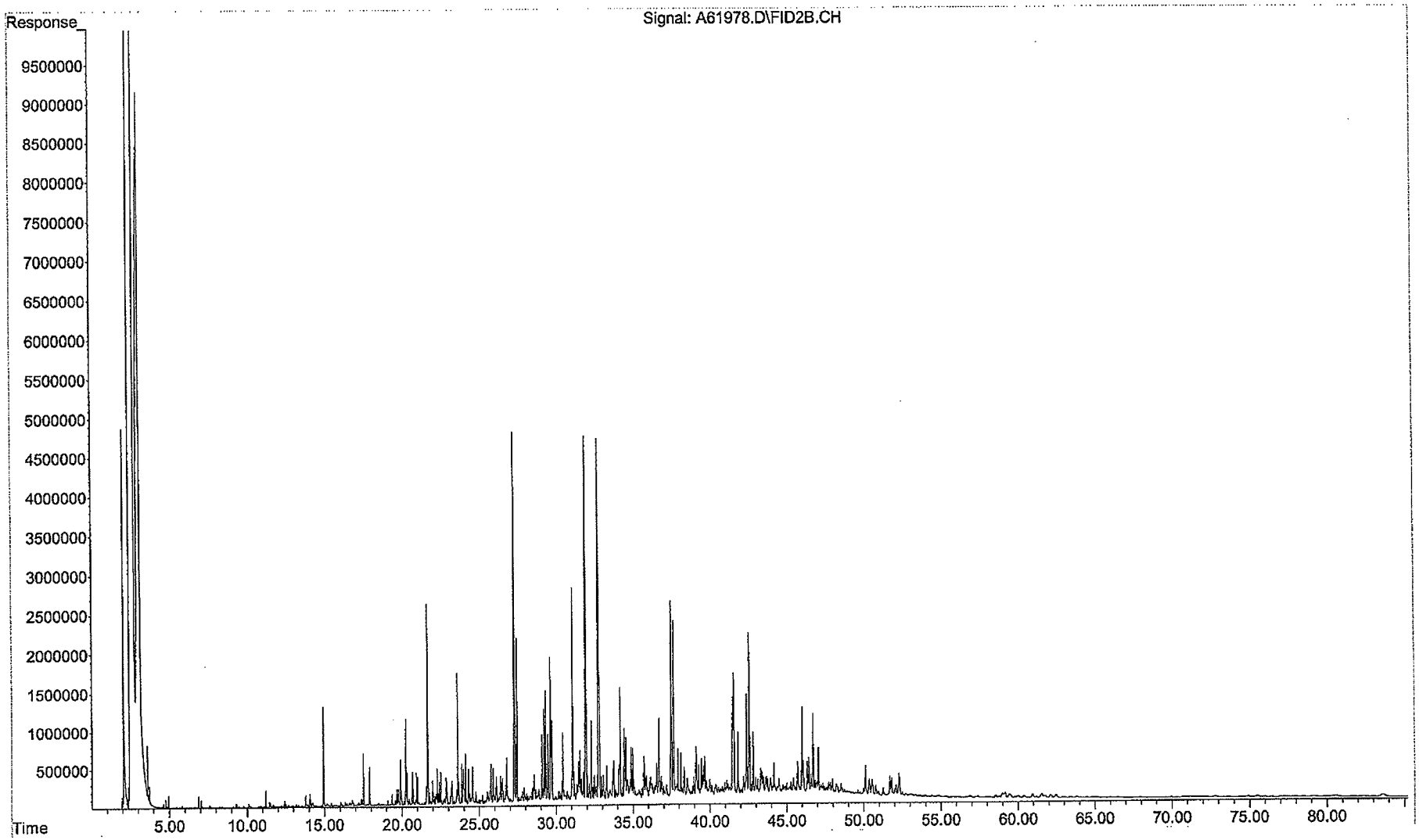
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Sample Name: 0801067-02
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MPD-2



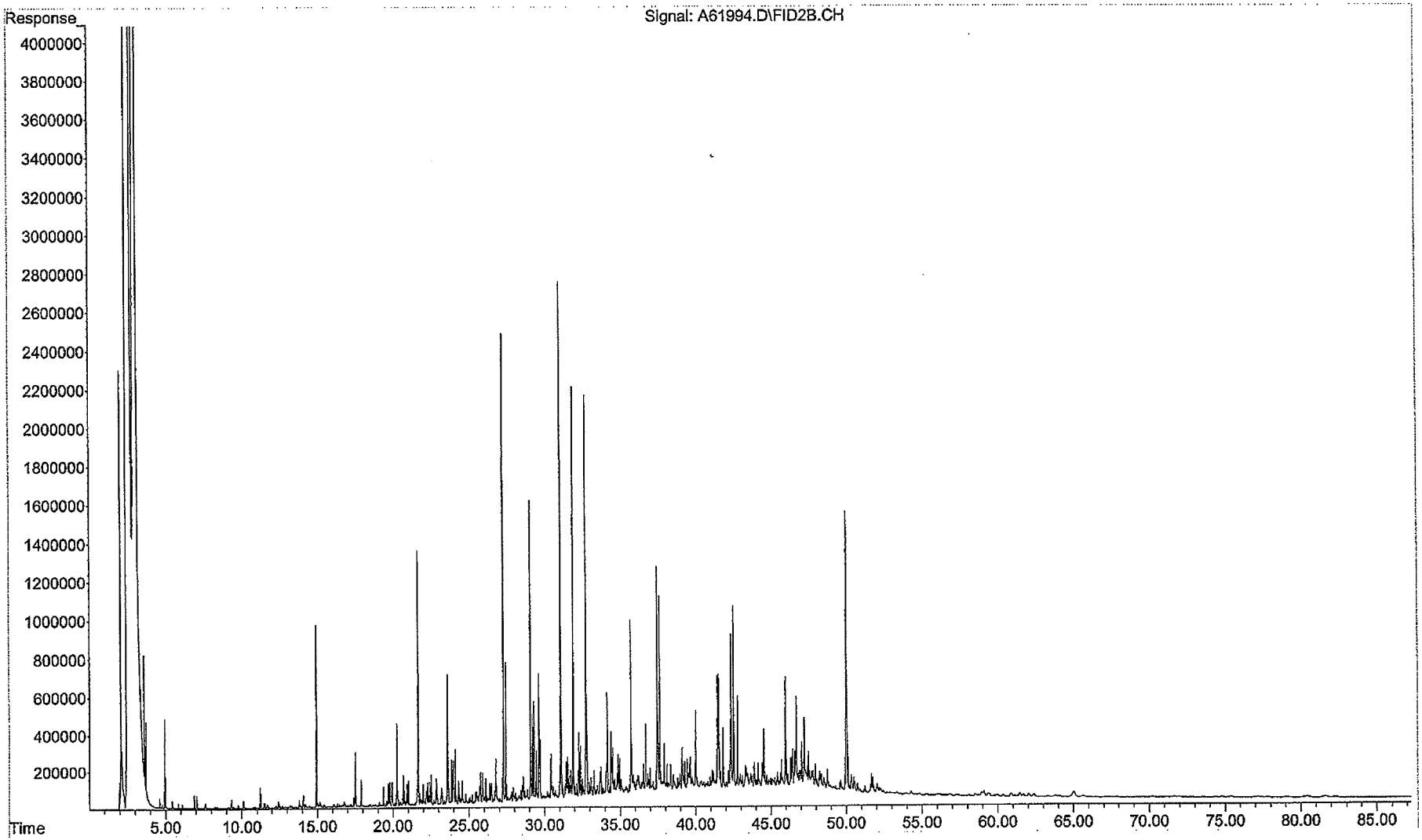
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Sample Name: 0801067-06
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Vial Number: 65

MPD-3



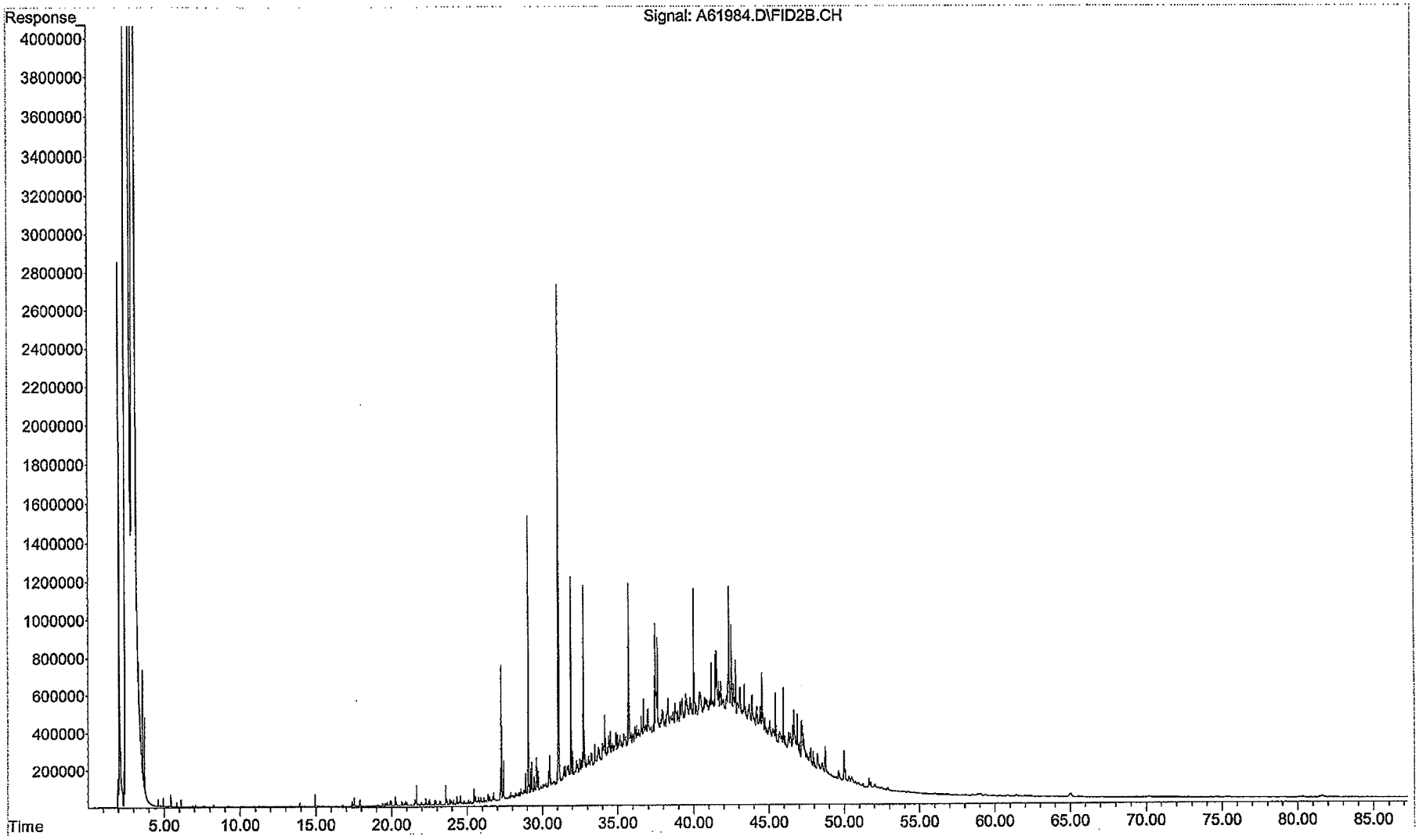
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Instrument : FID6
Sample Name: 0801067-12
Misc Info : 1X
Vial Number: 73

MPD-4



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Operator : NLJr
Acquired : 12 Feb 2008 3:15 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-07
Misc Info : 1X
Vial Number: 68

MPD-8



ARCADIS

Appendix D

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ARCADIS

Second Year Results of the OU2
Sediment Monitoring Program
(dated March 31, 2009)

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Subject:
National Grid - Hudson (Water Street) Site
Hudson, New York
NYSDEC Site No. 4-11-005
Second Year Results of the OU2 Sediment Monitoring Program

Date:
March 31, 2009

Contact:
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Our ref:
B0036702.0000

Dear Mr. Karwiel:

This letter report has been prepared by ARCADIS on behalf of National Grid to present the results of the second round (i.e., 2008 sediment sampling and laboratory analyses) of the Operable Unit Two (OU2) sediment monitoring program for the Hudson (Water Street) Former Manufactured Gas Plant (MGP) Site, located in Hudson, Columbia County, New York (Site). The work was performed in accordance with the New York State Department of Environmental Conservation (NYSDEC)-approved Monitoring Plan for Operable Unit 2 Sediments (Monitoring Plan; ARCADIS BBL, 2007) and a September 30, 2008 letter from ARCADIS (on behalf of National Grid) to the NYSDEC entitled Additional Changes to Monitoring Program. This letter report presents a summary of:

- the project background
- the objectives of the OU2 sediment monitoring program
- the field activities and laboratory analyses performed for the 2008 sampling event
- the results of the 2008 field activities and laboratory analyses
- the progress of natural attenuation of Site-related polycyclic aromatic hydrocarbons (PAHs) in the river sediments by using both the first round (2007) and second round (2008) PAH results
- recommendations for the 2009 monitoring activities

- the schedule for the 2009 monitoring and reporting activities

Project Background

The Site consists of two OUs: the former MGP and Embayment #1 (OU1), and the Hudson River adjacent to the Site, including Embayments #2, #3, and #4 sediments (OU2). From 1995 to 2002, four major sediment sampling programs were conducted at the Site. The most comprehensive of these investigations was completed in 2002 to delineate sediments containing MGP-related constituents adjacent to the Site. As part of that investigation, the spatial distribution of PAHs in sediments were evaluated in locations upstream of, adjacent to, and downstream of Embayment #1. In 2003, a Comprehensive Sediment Investigation Report for Operable Unit 2, Hudson (Water Street) Site, Hudson, New York (CSIR) (BBL, 2003) was submitted to the NYSDEC. The following were among the observations and conclusions made in the CSIR:

- sediments immediately adjacent to, near upstream (tidally influenced), and downstream of Embayment #1 contained Site-related PAHs

- in those sediments containing elevated concentrations of Site-related PAHs, there was evidence of PAH compositional alterations that could be attributed to ongoing natural attenuation processes (combined physical, chemical, and biological degradation processes)

- in Embayment #3 and #4, PAH concentrations and compositions indicated that the PAHs present are characteristic of urban/industrial background sources

- in Embayment #3, PAHs are likely attributable to a local stormwater outfall which discharges directly to the embayment, as total PAH concentrations were higher than those found in the river sediments far upstream of Embayment #1 and downstream of Embayment #2

- surface sediment total PAH concentrations in Embayment #2 were low (less than 10 milligrams per kilogram (mg/kg))

Following submittal of the CSIR to the NYSDEC, remedial activities for OU1 were completed from April 2004 to September 2005, and consisted of the following:

- excavation and off-site disposal of sediments from Embayment #1

- excavation and off-site disposal of soils within the former gas holder area and former tar tank area on the SBD Warehouse Property

- restoration of the Embayment #2 shoreline and the north wall of the warehouse on the SBD Warehouse Property

Since it was expected that natural attenuation of Site-related PAHs in the OU2 sediments would be accelerated as a result of the OU1 remediation activities, NYSDEC and National Grid agreed to postpone development of a Feasibility Study (FS) for OU2 sediments. Moreover, National Grid agreed to monitor the OU2 sediments for a two-year period (i.e., three monitoring events over a two-year period) following completion of the OU1 remediation efforts to monitor the progress of natural attenuation of MGP-related PAHs.

In September 2005, National Grid submitted a Monitoring Plan for Operable Unit 2 Sediments (BBL, 2005) to the NYSDEC for review and comment. A revised Monitoring Plan for Operable Unit 2 Sediments was submitted to the NYSDEC in July 2007 (ARCADIS BBL, 2007) to address comments received from NYSDEC through various correspondences from April 19, 2006 to January 2007 on the initial submittal. The NYSDEC approved the revised Monitoring Plan in July 2007. As presented in the Monitoring Plan, following the completion of each monitoring event, a brief letter report is to be prepared to summarize the sampling activities, note any deviations from the Monitoring Plan, and identify any data findings warranting changes to subsequent monitoring events.

The first of the three monitoring events associated with the monitoring program for OU2 was completed by National Grid in October 2007. The results of the first round of monitoring were presented in a letter report entitled First Year Results of the OU2 Sediment Monitoring Program (First Year Letter Report; ARCADIS, 2008a). In conjunction with the first round of sediment monitoring, National Grid also completed supplemental sediment sampling activities at three areas including:

- sediments immediately outside Embayment #1

- sediments in the “The Spirit of Hudson” dock area

- sediments between Embayment #1 and Embayment #2

The results of the supplemental sediment investigation were presented in an April 11, 2008 letter report entitled 2007 Supplemental Sediment Sampling (ARCADIS 2008b).

Objectives of the OU2 Sediment Monitoring Program

The objectives of the monitoring program for OU2 sediments are to:

1. document baseline chemical conditions (PAH concentrations and compositions) in OU2 surficial sediments and visually characterize NAPL distribution in near-surface sediment following the OU1 remediation and source mitigation activities

2. measure/document changes in chemical and visual (NAPL) conditions in OU2 sediments over time

3. identify background PAHs entering the OU2 area that may contribute to PAH loading and concentrations in OU2 sediments

4. document the effectiveness of natural attenuation in reducing concentrations of MGP-related PAHs in OU2 sediments

5. estimate the timeframe to reach the limits of MGP-related PAH concentration reductions in OU2 sediments

6. utilize the results of the monitoring program as one criterion for determining sediments within OU2 that may require consideration for remediation in a feasibility study (FS)

As described more fully below, the 2008 field activities and laboratory analyses were intended to provide additional data that will be used in conjunction with the previous (i.e., 2007) OU2 sediment data, as well as data to be collected in 2009, to satisfy the objectives listed above.

Following completion of the monitoring program, a Final Report will be prepared addressing the objectives noted above.

2008 Field Activities and Laboratory Analyses

This section describes the 2008 field activities and laboratory analyses that were performed.

Field Activities

As presented in the Monitoring Plan, sediment samples were proposed to be collected from a total of 19 monitoring stations (refer to Figure 1) for the OU2 sediment monitoring program. The 19 monitoring stations were selected to correspond with certain sampling locations from previous sediment investigations which appeared to contain Site-related PAHs (i.e., for continuity and use of data from previous work). The objective of selecting locations for the monitoring program that were previously sampled was to establish post-OU1 remediation conditions in the OU2 area (Objective 1 above). The monitoring station locations were also selected to spatially represent sediments in the three major areas of OU2: upstream of OU1, adjacent to OU1, and downstream of OU1 (including Embayment #2). As stated in the First Year Letter Report, two of the originally proposed upstream locations (MPU-1 and MPU-2) were eliminated from the monitoring program due to the presence of an underwater fiber optic line and the fact that the utility owners (i.e., Verizon, Mid-Hudson Cable) would not grant access to National Grid to complete the sampling. In addition, two of the 2007 supplemental sediment sample locations (SD-87 and SD-96) were added to the OU2 monitoring program as the 2007 data indicated the presence of coal tar material in those two samples.

The 2008 sediment monitoring field activities were performed by ARCADIS, on behalf of National Grid, from October 13 to October 15, 2008. As required by the NYSDEC, written notification of the field activities schedule was provided in the September 30, 2008 letter. Sediment cores were collected from 19 monitoring stations as follows (the monitoring station locations are shown on the attached Figure 1):

- one monitoring station located upstream of OU1 (MPU-3)
- seven monitoring stations adjacent to OU1 (MPA-1 through MPA-5, SD-87, and SD-96)
- eight monitoring stations downstream of OU1 (MPD-1 through MPD-8)
- three locations within Embayment #2 (MPE2-1 through MPE2-3)

Each of the 19 monitoring stations was located in the field using survey-grade global positioning system (GPS) equipment. The sediment cores were collected by advancing a split-spoon sampling device to a depth of approximately 1 to 2 feet

below the sediment-water interface using a barge-mounted drill rig. In accordance with the Monitoring Plan, and consistent with the 2007 monitoring activities, 4-foot cores were collected at Monitoring Stations SD-87, SD-96, MPA-1, MPA-3, MPA-4, and MPA-5, located outside the mouth of Embayment #1, to characterize NAPL distribution in this area following the completion of the OU1 remediation and source mitigation activities.

The recovered sediment cores were visually characterized by ARCADIS' field representative for evidence of NAPL, and the sediment was screened using a photoionization detector (PID) equipped with an 11.4eV lamp. Observations regarding sediment characteristics, presence of debris (i.e., brick, glass, slag, etc.), and water depth were recorded in a field log book.

As described in the Monitoring Plan, and consistent with Objective 1 identified above, the sampling and laboratory analysis program was to focus on surficial sediment (i.e., the upper 6 inches of sediment). Therefore, following visual characterization of the cores, sediment samples were collected from each core from the 0- to 6-inch depth interval using stainless steel and/or disposable (i.e., plastic bags) sampling equipment. The samples were containerized in clean laboratory-supplied glassware, packaged in a cooler with ice, and shipped to the analytical laboratory under chain-of-custody for analysis as described below.

As proposed in the September 30, 2008 letter to NYSDEC, ARCADIS attempted to collect a NAPL sample from one of the on-site recovery wells for analysis for TPH and PAHs. This NAPL sample was intended to serve as potential source material that would be used as the basis for assessing the extent of natural attenuation of Site-related PAHs in the river sediments. On October 13, 2008, each of the on-Site recovery wells was gauged to determine the presence of NAPL; however, no NAPL was detected in any of the on-site recovery wells. Since NAPL was not present in any of the recovery wells at the Site at the time of the 2008 sampling activities, NAPL contained in the subsurface sediments collected at monitoring locations MPE2-1 and SD-96 was collected and analyzed, and the results were used to represent the source material for purposes of assessing the extent of natural attenuation of Site-related PAHs. Specifically, the results for the PAH results for the NAPL samples collected from MEP2-1 and SD-96 were averaged, and the resulting concentration was used to represent the source material for the depletion calculations (further rdiscussion of depletion calculations provided later in this report).

Laboratory Analyses

A total of 21 surface sediment samples (included two quality assurance/quality control (QA/QC) samples) and two NAPL samples were collected from the 19 monitoring stations shown on Figure 1 and analyzed by Alpha Woods Hole Laboratories, Inc. Ten of the samples (including 1 QA/QC sample) were analyzed for the 16 'priority pollutant' PAHs (see analytes labeled with '*' in Table 1) in accordance with EPA Method 8270C (i.e., first tier PAH analysis). The remaining 11 sediment samples (including 1 QA/QC sample) were analyzed for "forensic PAHs" (see Table 1) and total petroleum hydrocarbons (TPH) in accordance with modified EPA Method 8270C and Method 8015, respectively (i.e., second tier forensic analysis). As described in the aforementioned September 30, 2008 letter from ARCADIS to NYSDEC, since the second tier forensic PAH analytical suite includes the compounds that are included in the first tier PAH analysis, the first tier PAH analysis was not performed on the samples that were subject to second tier forensic analysis.

The second tier forensic analysis (i.e., extended list of PAHs) was performed for the sediment monitoring program for two reasons:

1. To facilitate characterization of other potential sources of hydrocarbons entering the OU2 area (Objective 3 of the Monitoring Program) (Sauer and Uhler 1995; Stout et al 2002), and

2. To provide information regarding compositional changes to Site-related PAHs resulting from natural attenuation processes in the river sediments (Bragg et al. 1993; Douglas et al. 1993).

With respect to evaluating potential PAH sources, differences in PAH compositions from one river area to another may occur due to the presence of multiple source(s) of PAHs to the river system. Changes in PAH composition can also result and be an indication of the extent to which residual PAHs have been affected by the processes of weathering, which include a combination of physical (e.g., dissolution, evaporation), chemical, and biodegradation processes occurring in surface sediment.

As noted above, the sediment samples selected for the second tier PAH analyses were also analyzed for TPH. As part of the TPH analysis, a gas chromatogram ('GC fingerprint') was generated for each sample, and total hydrocarbons, n-alkane, and isoprenoid concentrations were determined for the carbon range from C10 to C40 to

assist in characterizing any petroleum contributions in the sediment (Objective 3 above).

Finally, all of the sediment samples were analyzed for total organic carbon (TOC) in accordance with EPA Method 9060 to aid in understanding PAH distribution in the sediment. Table 2 summarizes the analyses that were performed on each of the samples collected in 2008.

Results of the Field Activities and Laboratory Analyses

This section presents the results of the field activities and laboratory analyses, including a discussion of the sediment PAH concentrations and composition.

Results of Field Activities

During the 2008 sampling activities, field personnel documented observations of sediment characteristics and presence of NAPL in the sample cores collected at each monitoring station. The physical characteristics of the sediment encountered during the collection of the 2008 samples were similar to those observed in the 2007 samples. Sediments generally consisted of fine to coarse sand, with varying proportions of gravel, silt, clay, organic material (i.e., wood, shells), and debris (glass, slag, brick). As indicated in Table 3, NAPL was observed in 5 of the 19 monitoring stations including MPA-2, MPA-3, MPA-4, SD-96, and MPE2-1, at depths ranging from approximately 0.5 to 3 feet below the sediment/water interface. A summary of the 2008 sediment core descriptions, as well as NAPL observations recorded during the 2008 monitoring activities is presented in Table 3 (note the table also includes NAPL observations from the 2007 monitoring event for comparison purposes).

Sediment PAH Concentrations

Table 4 presents a summary of the Total PAH concentrations for the 2008 sediment samples (note that for comparison purposes, this table also includes the PAH results of the 2007 samples collected at the corresponding monitoring station location). As presented in Table 4, concentrations of 'Total PAHs' are defined as the sum of all the forensic PAHs (Table 1). 'Total PPPAHs' concentrations are defined as the sum of the 16 priority pollutant PAHs, whether they were determined by the first or second tier analysis.

The results of the analyses of the 2008 sediment samples are also provided in Attachment A. Table A1 (Attachment A) presents the results for the 2008 samples analyzed for second tier PAH analysis (i.e., Modified EPA Method 8270C). PAH concentrations for 2008 samples determined by the first tier PAH analysis (i.e., EPA Method 8270) are shown in Table A2. Results of the TOC analysis and TPH analysis are provided in Tables A3 and A4, respectively. The sample GC fingerprints produced as part of the 2008 TPH analysis are provided in Attachment B.

As indicated in Table 4, PAH concentrations decreased in many samples from year 2007 to 2008, in some cases by one to three orders of magnitude (i.e., samples MPU-3, SD-87, MPA-1, and MPD-2). Total PAH concentrations were within the range of background concentrations for monitoring stations MPU-3, SD-87, and MPA-1. The sample collected at location MPD-2 contained PAH concentrations above background levels; however they were approximately 20 times less than those in 2007. Only one sample location, MPD-8, which is the furthest downstream sample location from the Site, had PAH concentrations which were higher in 2008 than in 2007.

Sediment PAH Composition

Similar to the presentation of PAH composition provided for the 2007 samples in the First Year Letter Report, PAH concentrations of the 2008 forensic samples were plotted as PAH fingerprints to show the PAH compositional signatures of the samples. The PAH fingerprints are provided in Attachment C. These PAH distributions are valuable in evaluating similarities/differences in compositional characteristics among the samples due to potential source contributions from alternate sources (i.e., non-Site-related PAHs), and are also useful in assessing changes in the composition of Site-related PAHs resulting from natural attenuation processes. A detailed discussion of the particular compositional characteristics associated with different sources of hydrocarbons (pyrogenic, petrogenic, and biogenic sources) was provided in the First Year Letter Report and therefore is not repeated herein.

The predominant type of PAHs present in the 2008 sediment samples was pyrogenic PAHs. Unlike 2007, however, where samples MPA-1 through MPA-5, MPD-2, MPD-3, SD-87, and SD-96 contained PAH concentrations indicative of Site-related PAHs, the 2008 samples collected from MPA-1 and SD-87 contained PAH concentrations characteristic of background PAH ranges (Table 4). As indicated in Table 4, these and other samples (i.e., downriver of MPD-4 and in Embayment #2) had

compositions indicative of background pyrogenic PAHs typical for river sediments (Stout et al. 2004; Costa et al. 2004).

The PAH fingerprints of samples containing the Site-related PAHs (see Attachment C) showed various stages of weathered coal tar material, as evidenced by the relative decrease of the less weather-resistant 2- and 3-ringed PAHs (e.g., naphthalenes, phenanthrenes) compared to the higher molecular weight 4- and 5-ringed PAHs (e.g., pyrenes, benzo(a)pyrene).

Similar to 2007 samples, trace levels of petroleum PAHs were evident in samples MPE2-2 and MPD-8. The 'bell-shape' pattern of the alkyl groups in a PAH family, which is characteristic of petroleum, was present in the dibenzothiophenes. The presence of residual petroleum in MPE2-2 and MPD-8 was also evident in the TPH GC fingerprints (Attachment C) where the characteristic unresolved complex mixture (UCM) or 'hump' in the GC fingerprint was present. The type of petroleum, which was similar in each sample, was a weathered heavy oil-type petroleum product (e.g., motor oil, No. 6 fuel oil). None of these samples indicated a fresh or weathered gasoline or mid-distillate oil in the sediment.

Estimate of the Extent of PAH Natural Attenuation

This section presents a discussion of the extent of PAH natural attenuation, including the identification of the source material to be used as a basis for determining the extent of natural attenuation, changes in PAH composition relative to the source material, and PAH depletion calculations and results.

<u>Identification of Source Material for the Purpose of Determining the Extent of Natural Attenuation</u>

Based on the PAH analytical results of the 2007 sediment samples, two different types of coal tar residuals were present in the samples: one associated with sediments in a small area around SD-95 and SD-96 outside Embayment #1, which had a carburetor water gas (CWG) type coal tar signature (Fluoranthene/Pyrene ratio < 1); and the other associated with sediments in the other parts of the river which had a coal carbonization (CC) type coal tar signature (Fluoranthene/Pyrene ratio > 1). In considering all the PAHs, there are only a few PAHs such as fluoranthene where the relative PAH concentrations are different in CWG than in CC coal tars.

For this project, the source material is an unweathered or nearly unweathered coal tar material from the Site. The selected source material, which consists of the only NAPLs found at the Site (collected just outside Embayment #1), had the CWG signature. Since most of the sediments containing Site-related material had the CC residual coal tar, a few of the PAHs such as fluoranthene and benzo(a)anthracene did not match appropriately between the source material and sediment samples, as discussed below.

It should be noted that alternative candidate source materials were evaluated by examining the PAH compositions of some of the 2007 high PAH concentration sediment samples with the CC PAH characteristic (Figure 6), but in each case the PAH compositions showed that the residual coal tar in the samples had experienced considerable weathering (loss of the 2- and 3-ring PAHs). As a result, these samples were not representative of original source material. The NAPL samples collected in 2008 were the best choice at this time, given the available data. National Grid will continue to attempt to find representative NAPL which indicates the CC PAH characteristic during the 2009 (final) monitoring event.

PAH Compositional Changes

The relative loss of Site-related PAHs in the Hudson River sediments over time is best illustrated by comparing the relative concentrations of PAHs of the source material (i.e., at this point, NAPL contained in the subsurface sediments collected at monitoring locations MPE2-1 and SD-96) with the PAH concentrations of the sediment samples containing the Site-related material. The PAH concentrations of each sample are normalized to the conservative compound benzo(a)pyrene (BAP). Due to the large amount of PAH data, the PAH compositions of the samples are presented graphically. Comparison of PAH compositional changes of source material and sediments is shown for locations SD-96, MPA-5, MPD-2, and MPD-3 (the same locations selected for depletion calculations, as further discussed below) in Figures 2, 3, 4, and 5, respectively.

As indicated in Figures 2 though 5, PAHs show decreasing relative concentrations over time. PAHs of source materials have the highest normalized values. For some PAHs, including many of the 5- and 6-ring PAHs and PAHs of low concentrations, the source material PAHs exhibit a lower normalized value than the Site sediment samples. Also, in most of the sediment samples compared to the source material, fluoranthene and benzo(a)anthracene normalized values are lower in the source material then in the sediment samples. This is noted in the figures by circles for

these two PAHs. Ideally when the source material truly represents the original composition of the residual material found in the sediment, the normalized PAH values of the source material should be equal to (if no weathering of the source material PAH had occurred) or greater than (if weathering had occurred) the PAH values in the sediment samples. Considering that the normalized values for fluoranthene and benzo(a)anthracene are consistently lower in the source material than in the sediment samples, as noted above, the source material NAPL (i.e., coal tar) may not be for these PAHs (i.e., fluoranthene and benzo(a)anthracene) representative of original material. However, the source material used is the best representation of Site-related PAHs contributing to the residual coal tar material in the sediments at this time.

With the exception of MPD-2, the PAH compositional change plots of Figures 2 though 5 indicate a relative decrease in PAHs concentrations over time. For almost all PAHs, the 2008 PAH concentrations are less than the 2007 PAH concentrations in samples SD-96 (Figure 2), MPA-5 (Figure 3), and MPD-3 (Figure 5). In MPD-2 (Figure 4), most of the PAH alkyl groups of the PAH families, show the opposite trend. This trend is mostly limited to those alkyl PAHs with low relative concentrations.

PAH Depletion Calculations and Results

Following the first round of monitoring (i.e., 2007 sampling activities), the 2007 sample results were evaluated for sediments containing Site-related materials, and seven monitoring locations were identified as appropriate for PAH depletion evaluation (First Year Letter Report). These locations, which represented surface sediment with an appropriate range of high to low PAH concentrations of Site-related tar residuals, were MPA-1, MPA-3, MPA-5, MPD-2, MPD-3, SD-87, and SD-96.

Surface sediment samples were collected at these seven locations again in 2008, and the PAH results were used in conjunction with the 2007 analytical results to estimate the extent of natural attenuation of Site-related PAHs by determining the depletion of PAHs over time (Objective 4). Although seven locations were selected for PAH depletion evaluation in 2007, the 2008 PAH data only allowed for such an evaluation at four of the locations. At MPA-1 and SD-87, where 2007 total PAH concentrations were in the tens of thousands mg/kg, the 2008 total PAH concentrations were only in the tens mg/kg (Table 4). Since the 2008 concentrations of these samples were at or near background PAH concentrations, PAH depletions were not calculated for these locations (i.e., PAH depletions would not be

representative of MGP-related PAHs. In addition, as described in the September 2008 letter, the sediment collected from sample location MPA-3 was not analyzed for the second tier analysis; therefore, depletions were not calculated for this location.

The method of calculating PAH depletion for this project (equation 1 below) follows the method found in the literature (Brenner et al. 2002, EPRI, 2008). In this method a source material (and conservative compound within the source material) is identified (see above) which possess the original chemical (PAH) characteristics of the material being evaluated in the sediment. As noted above, for this project, the results for the two NAPL samples collected from MEP2-1 and SD-96 were averaged, and the resulting concentrations were used to represent the source material for the depletion calculations. The compound selected for this project is the 5-ring PAH BAP, which is a commonly used conservative compound for coal tar type material (Brenner et al. 2002, EPRI, 2008).

PAH depletions were calculated using the following equation:

Percent PAH Depletion = $[1 – ((C_1/C_0) \times (H_0/H_1))] \times 100$ where:

- C_1 is the PAH concentration the residual source material
- C_0 is the PAH concentration of the original source material
- H_1 is the concentration of BAP in the residual source material
- H_0 is the concentration of BAP in the original source material

For this project, depletions of all the major forensic PAHs including the priority pollutant PAHs (Table 1) were calculated. In addition, depletions were also calculated for Total PAHs and Total PPPAHs determined by forensic methods. Forensic PAHs with low concentrations in the source material were not included in the calculations because analytical variability commonly associated with compounds of low concentration is manifested in high variability in the depletion values. As a result, depletions were not calculated for the low concentration PAH families dibenzothiophenes and naphthobenzothiophenes, and individual PAHs dibenzofuran, and carbazole. These compounds make up only approximately five percent of the total PAHs in the source material, and therefore their contribution to the Total PAH depletion values would be minimal.

PAH depletions were calculated using the 2007 and 2008 analytical data for monitoring locations SD-96, MPA-5, MPD-2, and MPD-3, the same locations where the PAH compositional changes were determined. The results are presented graphically in Figures 7, 8, 9, and 10, respectively. For simplicity, the low concentration PAHs of the source material, such as dibenzothiophenes, were not included in the graphic displays of the depletion results. The figures include the priority pollutant PAHs and the major alkyl PAH groups of the source material and compose approximately 95 percent by concentration of all the forensic PAHs. In discussion of PAH compositional changes above, it was noted that some of the PAH concentrations in the source material were relatively lower than those in the sediment samples. When completing depletion calculations, this situation will produce negative depletion values for the sediment samples. Negative analyte depletions in the sediment samples are theoretically not possible when sediment analytes are compared directly to analytes of the source material, but are possible when there is an additional source of analytes to the sediment. In any case, negative values are set to zero. In considering the sensitivity of the depletion calculations from low concentration analytes and variability in analysis, absolute depletion values have an accuracy of plus or minus 10 to 20 percent. Depletion values less than 20 percent may be considered as zero percent. Important in this exercise is the relative change in depletion values from one time period to the next.

For each of the samples in which depletion calculations were performed, depletion values of most of the individual PAHs increased from 2007 to 2008 indicating the loss of PAHs from natural attenuation processes. Monitoring location MPD-2 was the only location where depletion values of some of the alkyl PAH groups of low concentration did not increase with time. At this location there was significant variability in total PAH concentrations between the samples collected in 2007 and 2008 (see Table 4).

Evaluation of general patterns of depletion values from the two-ring naphthalenes to the four-ring chrysenes indicates that the extent of PAH depletions in sediments at the representative locations were fairly similar, except at location SD-96. Higher depletion values were associated with the more weathering-susceptible PAHs, such as the naphthalenes, and, as expected, progressively decreased with increasing ring size; the more weather-resistant PAHs such as the 5- and 6-ring PAH had the least depletion. At location SD-96, the depletion values for all PAH groups were low, indicating that weathering of PAHs at this location was minimal.

Percent PAH depletions were also calculated at those locations where only the standard method PAHs were determined. These locations contained elevated PAH concentrations that would indicate Site-related material in the sediments. Depletions of total PPPAHs were calculated for samples at locations, MPA-3, MPA-4, and MPD-1 (Figure 11). Again, depletion values generally increased from 2007 to 2008 indicating the loss of PAHs from natural attenuation processes. At location MPA-4, the depletion values were approximately the same, and upon closer review of the individual PAH results, the depletion values of the most weathering-susceptible PAH (i.e., naphthalene) were nearly the same, signifying that the residual material had not weathered from 2007 to 2008.

At almost all locations, the depletion values of total PAHs (sum of the forensic PAHs) and the total PPPAHs (sum of 16 priority pollutant PAHs) increased from 2007 to 2008. These results indicate that the process of natural attenuation of Site-related PAHs is occurring in the OU2 river sediments.

Summary of Preliminary Findings

Overall, the PAH results for the 2007 and 2008 monitoring events show that for monitoring locations where Site-related materials are present, natural attenuation of PAHs in OU2 sediments is occurring. PAH compositional changes in representative sediment samples taken in 2007 and 2008 show a relative decrease in PAH concentrations from year to year and when compared to the NAPL source material. From depletion calculations, total PAH concentrations and most individual PAH concentrations in river sediments were shown to be decreasing with time from 2007 to 2008. Moreover, the depletions of individual PAHs and PAH groups are generally following the expected pattern for depletion; specifically, the more weathering-susceptible PAHs (e.g., naphthalenes) are lost or depleted more quickly than the more weathering-resistant PAHs (e.g., higher molecular weight PAHs). Depletions progressively decreased with increasing ring size. At only one location (SD-96) was the pattern of PAH depletion values different. At SD-96 the depletion values of all the PAH groups, irrespective of the ring size, were low in 2007 and 2008, indicating that weathering of PAHs at this location is not as extensive as at the other locations.

In addition to providing another temporal PAH depletion data point, the results from the third round of sampling (planned for fall 2009) will provide sufficient data to estimate PAH concentration endpoints (i.e., the predicted total PAH concentration when natural attenuation has reached its limit) and timeframes for reaching those endpoints.

Recommendations for 2009 Monitoring Activities

Based on the findings contained in the First Year Letter Report, as well as the results of the 2008 monitoring activities described herein, National Grid will, once again, attempt to collect a NAPL sample from the on-site recovery wells in 2009 that has the CC coal tar characteristic. If a NAPL sample cannot be collected form the on-site recovery wells, National Grid will attempt to collect a NAPL sample at or near monitoring stations SD-87, MPA-1, or MPD-2. In addition, the surface sediment samples at MPA-3 and MPA-4 will be included in the forensic analysis and depletion calculations in 2009.

Schedule for Future Monitoring and Reporting Activities

The third round of sediment monitoring is currently planned for fall 2009. Following completion of the third round of monitoring a Final Report will be prepared (in lieu of a letter report) that will include a final evaluation of PAH natural attenuation, estimates of PAH concentration endpoints, and timeframes for reaching those endpoints. The Final Report will be prepared approximately 16 weeks subsequent to the completion of the field activities.

If you have any questions, please contact me at 315.671.9235 or Mr. William Jones of National Grid at 315.428.5690.

Sincerely,

ARCADIS



Mark O. Gravelding, P.E.
Vice President

Copies:
William Jones, National Grid
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ARCADIS

Appendix H

OU2 Sediment Monitoring
Program – 2009 Laboratory Data

Appendix H
Summary of Sediment Sample Analytical Results
Revised Comprehensive Sediment Investigation Report for OU2
Hudson (Water Street) Site, Hudson, New York - National Grid

Location ID:		MPA-1	MPA-1	MPA-2	MPA-3	MPA-4	MPA-5
Sample Name:		MPA-1 (0-0.5)	MPA-1 (0-0.5)-DL	MPA-2 (0-0.5)	MPA-3 (0-0.5)	MPA-4 (0-0.5)	MPA-5
Lab Sample ID:		0910018-12	0910018-12E	0910018-06	0910018-05	0910018-07	0810073-05
Sample Depth Interval (Feet):		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Date Collected:	Units	10/08/09	10/08/09	10/08/09	10/08/09	10/08/09	10/08/09
TPH							
Dilution Factor:		**1**					**1**
n-Nonane (C9)	mg/kg	0.00575 J	NA	NA	NA	NA	0.0177 J
n-Decane (C10)	mg/kg	0.00976 J	NA	NA	NA	NA	0.0214 J
n-Undecane (C11)	mg/kg	0.0258 J	NA	NA	NA	NA	0.0383 J
n-Dodecane (C12)	mg/kg	0.0348 J	NA	NA	NA	NA	0.0648 J
n-Tridecane (C13)	mg/kg	0.0928 J	NA	NA	NA	NA	0.194 J
n-Tetradecane (C14)	mg/kg	0.0253 J	NA	NA	NA	NA	0.0869 J
n-Pentadecane (C15)	mg/kg	1.44 G	NA	NA	NA	NA	4.43 G
n-Hexadecane (C16)	mg/kg	1.09 G	NA	NA	NA	NA	2.93 G
n-Heptadecane (C17)	mg/kg	0.0445 J	NA	NA	NA	NA	0.143 J
n-Octadecane (C18)	mg/kg	3.74 G	NA	NA	NA	NA	0.736 U
n-Nonadecane (C19)	mg/kg	0.0583 J	NA	NA	NA	NA	0.151 J
n-Eicosane (C20)	mg/kg	0.25 U	NA	NA	NA	NA	0.225 J
n-Heneicosane (C21)	mg/kg	0.06 J	NA	NA	NA	NA	0.144 J
n-Docosane (C22)	mg/kg	0.0698 J	NA	NA	NA	NA	0.178 J
n-Tricosane (C23)	mg/kg	0.492	NA	NA	NA	NA	1.05
n-Tetracosane (C24)	mg/kg	0.187 J	NA	NA	NA	NA	0.469 J
n-Pentacosane (C25)	mg/kg	0.386 G	NA	NA	NA	NA	0.712 J
n-Hexacosane (C26)	mg/kg	0.0976 J	NA	NA	NA	NA	0.172 J
n-Heptacosane (C27)	mg/kg	0.824	NA	NA	NA	NA	0.586 J
n-Octacosane (C28)	mg/kg	0.122 J	NA	NA	NA	NA	0.436 J
n-Nonacosane (C29)	mg/kg	0.282	NA	NA	NA	NA	0.629 J
n-Triacontane (C30)	mg/kg	0.175 J	NA	NA	NA	NA	0.456 J
n-Hentriacontane (C31)	mg/kg	0.124 J	NA	NA	NA	NA	0.507 J
n-Dotriacontane (C32)	mg/kg	0.173 J	NA	NA	NA	NA	0.521 J
n-Tritriacontane (C33)	mg/kg	0.496	NA	NA	NA	NA	1.17
n-Tetratriacontane (C34)	mg/kg	0.0478 J	NA	NA	NA	NA	0.139 J
n-Pentatriacontane (C35)	mg/kg	0.132 J	NA	NA	NA	NA	0.363 J
n-Hexatriacontane (C36)	mg/kg	0.066 J	NA	NA	NA	NA	0.121 J
n-Heptatriacontane (C37)	mg/kg	0.151 J	NA	NA	NA	NA	0.324 J
n-Octatriacontane (C38)	mg/kg	0.011 J	NA	NA	NA	NA	0.736 U
n-Nonatriacontane (C39)	mg/kg	0.055 J	NA	NA	NA	NA	0.736 U
n-Tetracontane (C40)	mg/kg	0.0315 J	NA	NA	NA	NA	0.736 U
2,6,10 Trimethyldodecane (1380)	mg/kg	0.019 J	NA	NA	NA	NA	0.0537 J
2,6,10 Trimethyltridecane (1470)	mg/kg	0.339 G	NA	NA	NA	NA	0.427 J
Norpristane (1650)	mg/kg	0.492 G	NA	NA	NA	NA	1.03 G
Phytane	mg/kg	0.0515 J	NA	NA	NA	NA	0.736 U
Pristane	mg/kg	0.0305 J	NA	NA	NA	NA	0.736 U
Total Petroleum Hydrocarbons (C9-C44)	mg/kg	189	NA	NA	NA	NA	514
Total Saturated Hydrocarbons	mg/kg	11.5	NA	NA	NA	NA	17.8
PAHs							
Dilution Factor:				**10**	**10**	**10**	
Acenaphthene	ug/kg	NA	NA	132,000	7,270	1,180,000	NA
Acenaphthylene	ug/kg	NA	NA	14,800	110	186,000	NA
Anthracene	ug/kg	NA	NA	120,000	228	1,790,000	NA
Benzo(a)anthracene	ug/kg	NA	NA	77,400	551	1,130,000	NA
Benzo(a)pyrene	ug/kg	NA	NA	68,400	524	922,000	NA
Benzo(b)fluoranthene	ug/kg	NA	NA	35,800	380	514,000	NA
Benzo(g,h,i)perylene	ug/kg	NA	NA	24,500	243	296,000	NA
Benzo(k)fluoranthene	ug/kg	NA	NA	46,600	405	700,000	NA
Chrysene	ug/kg	NA	NA	63,400	504	863,000	NA
Dibenzo(a,h)anthracene	ug/kg	NA	NA	7,330	67	105,000	NA
Fluoranthene	ug/kg	NA	NA	196,000	1,080	2,900,000	NA
Fluorene	ug/kg	NA	NA	82,900	1,480	1,230,000	NA
Indeno(1,2,3-cd)pyrene	ug/kg	NA	NA	27,700	273	371,000	NA
Naphthalene	ug/kg	NA	NA	261,000	961	1,480,000	NA
Phenanthrene	ug/kg	NA	NA	315,000	957	4,180,000	NA
Pyrene	ug/kg	NA	NA	183,000	914	2,220,000	NA
Total PAHs	ug/kg	NA	NA	1,660,000	15,900	20,100,000	NA
Forensic PAHs							
Dilution Factor:		**1**	**10**				**10**
1-Methyldibenzothiophene	ug/kg	34	25 U	NA	NA	NA	96
1-Methylnaphthalene	ug/kg	72	25 U	NA	NA	NA	223
1-Methylphenanthrene	ug/kg	397	25 U	NA	NA	NA	903
2,3,5-Trimethylnaphthalene	ug/kg	85	25 U	NA	NA	NA	207
2,6-Dimethylnaphthalene	ug/kg	153	25 U	NA	NA	NA	846
2/3-Methyldibenzothiophene	ug/kg	92	25 U	NA	NA	NA	256
2/4-Methylphenanthrene	ug/kg	745	25 U	NA	NA	NA	1,760
2-Methylanthracene	ug/kg	427	25 U	NA	NA	NA	1,080
2-Methylnaphthalene	ug/kg	116	25 U	NA	NA	NA	498
3-Methylphenanthrene	ug/kg	565	25 U	NA	NA	NA	1,280
4-Methyldibenzothiophene	ug/kg	61	25 U	NA	NA	NA	171
9-Methylphenanthrene	ug/kg	538	25 U	NA	NA	NA	1,220

Appendix H
Summary of Sediment Sample Analytical Results
Revised Comprehensive Sediment Investigation Report for OU2
Hudson (Water Street) Site, Hudson, New York - National Grid

Location ID:		MPA-1	MPA-1	MPA-2	MPA-3	MPA-4	MPA-5
Sample Name:		MPA-1 (0-0.5)	MPA-1 (0-0.5)-DL	MPA-2 (0-0.5)	MPA-3 (0-0.5)	MPA-4 (0-0.5)	MPA-5
Lab Sample ID:		0910018-12	0910018-12E	0910018-06	0910018-05	0910018-07	0810073-05
Sample Depth Interval (Feet):		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Date Collected:	Units	10/08/09	10/08/09	10/08/09	10/08/09	10/08/09	10/08/09
Forensic PAHs (continued)							
Dilution Factor:		1	10				10
Acenaphthene	ug/kg	1,360	25 U	NA	NA	NA	4,190
Acenaphthylene	ug/kg	442	25 U	NA	NA	NA	546
Anthracene	ug/kg	1,580	25 U	NA	NA	NA	4,040
Benzo(a)anthracene	ug/kg	2,910	25 U	NA	NA	NA	5,730
Benzo(a)pyrene	ug/kg	2,470	25 U	NA	NA	NA	4,950
Benzo(b)fluoranthene	ug/kg	1,820	25 U	NA	NA	NA	3,140
Benzo(b)fluorene	ug/kg	1,250	25 U	NA	NA	NA	2,600
Benzo(g,h,i)perylene	ug/kg	1,080	25 U	NA	NA	NA	1,900
Benzo(k)fluoranthene	ug/kg	1,800	25 U	NA	NA	NA	3,740
Benzo[a]fluoranthene	ug/kg	603	25 U	NA	NA	NA	1,250
Benzo[e]pyrene	ug/kg	1,210	25 U	NA	NA	NA	2,260
Benzothiophene	ug/kg	22	25 U	NA	NA	NA	160
Biphenyl	ug/kg	50	25 U	NA	NA	NA	110
C1-Benzo(b)thiophenes	ug/kg	21	25 U	NA	NA	NA	120
C1-Chrysenes	ug/kg	1,200	25 U	NA	NA	NA	2,750
C1-Decalins	ug/kg	3.9	25 U	NA	NA	NA	12
C1-Dibenzothiophenes	ug/kg	249	25 U	NA	NA	NA	702
C1-Fluoranthenes/Pyrenes	ug/kg	3,950	25 U	NA	NA	NA	8,270
C1-Fluorenes	ug/kg	506	25 U	NA	NA	NA	1,050
C1-Naphthalenes	ug/kg	125	25 U	NA	NA	NA	482
C1-Naphthobenzothiophenes	ug/kg	332	25 U	NA	NA	NA	946
C1-Phenanthrenes/Anthracenes	ug/kg	2,710	25 U	NA	NA	NA	6,290
C2-Benzo(b)thiophenes	ug/kg	41	25 U	NA	NA	NA	171
C2-Chrysenes	ug/kg	532	25 U	NA	NA	NA	1,300
C2-Decalins	ug/kg	7.1	25 U	NA	NA	NA	19
C2-Dibenzothiophenes	ug/kg	189	25 U	NA	NA	NA	537
C2-Fluoranthenes/Pyrenes	ug/kg	1,360	25 U	NA	NA	NA	3,040
C2-Fluorenes	ug/kg	350	25 U	NA	NA	NA	782
C2-Naphthalenes	ug/kg	410	25 U	NA	NA	NA	1,860
C2-Naphthobenzothiophenes	ug/kg	142	25 U	NA	NA	NA	437
C2-Phenanthrenes/Anthracenes	ug/kg	1,500	25 U	NA	NA	NA	3,430
C3-Benzo(b)thiophenes	ug/kg	38	25 U	NA	NA	NA	111
C3-Chrysenes	ug/kg	414	25 U	NA	NA	NA	998
C3-Decalins	ug/kg	5.5	25 U	NA	NA	NA	18
C3-Dibenzothiophenes	ug/kg	119	25 U	NA	NA	NA	338
C3-Fluoranthenes/Pyrenes	ug/kg	529	25 U	NA	NA	NA	1,270
C3-Fluorenes	ug/kg	227	25 U	NA	NA	NA	503
C3-Naphthalenes	ug/kg	559	25 U	NA	NA	NA	1,390
C3-Naphthobenzothiophenes	ug/kg	85	25 U	NA	NA	NA	243
C3-Phenanthrenes/Anthracenes	ug/kg	557	25 U	NA	NA	NA	1,380
C4-Benzo(b)thiophenes	ug/kg	17	25 U	NA	NA	NA	52
C4-Chrysenes	ug/kg	138	25 U	NA	NA	NA	364
C4-Decalins	ug/kg	12	25 U	NA	NA	NA	35
C4-Dibenzothiophenes	ug/kg	59	25 U	NA	NA	NA	161
C4-Fluoranthenes/Pyrenes	ug/kg	293	25 U	NA	NA	NA	679
C4-Naphthalenes	ug/kg	237	25 U	NA	NA	NA	566
C4-Naphthobenzothiophenes	ug/kg	38	25 U	NA	NA	NA	109
C4-Phenanthrenes/Anthracenes	ug/kg	162	25 U	NA	NA	NA	483
Carbazole	ug/kg	48	25 U	NA	NA	NA	157
Chrysene/Triphenylene	ug/kg	2,250	25 U	NA	NA	NA	4,720
cis/trans-Decalin	ug/kg	1.3 J	25 U	NA	NA	NA	5.9 J
Dibenzo(a,h)anthracene	ug/kg	381	25 U	NA	NA	NA	736
Dibenzofuran	ug/kg	339	25 U	NA	NA	NA	1,220
Dibenzothiophene	ug/kg	330	25 U	NA	NA	NA	968
Fluoranthene	ug/kg	6,820 E	7,150	NA	NA	NA	11,600
Fluorene	ug/kg	1,040	25 U	NA	NA	NA	2,770
Indeno(1,2,3-cd)pyrene	ug/kg	1,340	25 U	NA	NA	NA	2,430
Naphthalene	ug/kg	326	25 U	NA	NA	NA	1,640
Naphthobenzothiophenes	ug/kg	605	25 U	NA	NA	NA	1,470
Perylene	ug/kg	826	25 U	NA	NA	NA	1,250
Phenanthrene	ug/kg	3,680	25 U	NA	NA	NA	11,300
Pyrene	ug/kg	5,400 E	5,630	NA	NA	NA	9,540
Retene	ug/kg	35	25 U	NA	NA	NA	571

Appendix H
Summary of Sediment Sample Analytical Results
Revised Comprehensive Sediment Investigation Report for OU2
Hudson (Water Street) Site, Hudson, New York - National Grid

Location ID:		MPD-1	MPD-2	MPD-2	MPD-3	MPD-3	MPD-4
Sample Name:		MPD-1 (0-0.5)	MPD-2 (0-0.5)	MPD-2 (0-0.5)-DL	MPD-3 (0-0.5)	MPD-3 (0-0.5)-DL	MPD-4 (0-0.5)
Lab Sample ID:		0910018-08	0910018-09	0910018-09E	0910018-10	0910018-10E	0910018-11
Sample Depth(Feet):		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Date Collected:	Units	10/08/09	10/08/09	10/08/09	10/08/09	10/08/09	10/08/09
TPH							
Dilution Factor:			1		1		1
n-Nonane (C9)	mg/kg	NA	6.12 J	NA	0.0312 J	NA	0.0251 J
n-Decane (C10)	mg/kg	NA	14.6 J	NA	0.0547 J	NA	0.037 J
n-Undecane (C11)	mg/kg	NA	40.2 G	NA	0.0979 J	NA	0.0469 J
n-Dodecane (C12)	mg/kg	NA	23.4 J	NA	0.113 J	NA	0.0574 J
n-Tridecane (C13)	mg/kg	NA	55.7 G	NA	0.29 J	NA	0.136 J
n-Tetradecane (C14)	mg/kg	NA	24.8 J	NA	0.188 J	NA	0.0819 J
n-Pentadecane (C15)	mg/kg	NA	330 G	NA	6.68 G	NA	0.53 G
n-Hexadecane (C16)	mg/kg	NA	182 G	NA	5.55 G	NA	0.681 G
n-Heptadecane (C17)	mg/kg	NA	26.5 U	NA	0.636 U	NA	0.134 J
n-Octadecane (C18)	mg/kg	NA	26.5 U	NA	0.636 U	NA	4.97 G
n-Nonadecane (C19)	mg/kg	NA	30.9	NA	0.275 J	NA	0.127 J
n-Eicosane (C20)	mg/kg	NA	15 J	NA	0.359 J	NA	0.175 J
n-Heneicosane (C21)	mg/kg	NA	15.6 J	NA	0.24 J	NA	0.159 J
n-Docosane (C22)	mg/kg	NA	23 J	NA	0.389 J	NA	0.164 J
n-Tricosane (C23)	mg/kg	NA	119	NA	0.636 U	NA	0.753
n-Tetracosane (C24)	mg/kg	NA	26.6	NA	0.811	NA	0.303
n-Pentacosane (C25)	mg/kg	NA	26.5 U	NA	0.603 J	NA	0.443 G
n-Hexacosane (C26)	mg/kg	NA	26.5 U	NA	0.237 J	NA	0.084 J
n-Heptacosane (C27)	mg/kg	NA	4.32 J	NA	0.636 U	NA	0.595
n-Octacosane (C28)	mg/kg	NA	24 J	NA	0.413 J	NA	0.299
n-Nonacosane (C29)	mg/kg	NA	20.1 J	NA	0.644	NA	0.504
n-Triacontane (C30)	mg/kg	NA	26.5 U	NA	0.712	NA	0.383
n-Hentriacontane (C31)	mg/kg	NA	41.4	NA	0.498 J	NA	0.169 J
n-Dotriacontane (C32)	mg/kg	NA	43.7	NA	0.752	NA	0.32
n-Tritriacontane (C33)	mg/kg	NA	114	NA	1.84	NA	0.943
n-Tetratriacontane (C34)	mg/kg	NA	8.01 J	NA	0.223 J	NA	0.155 J
n-Pentatriacontane (C35)	mg/kg	NA	38.6	NA	0.565 J	NA	0.239 J
n-Hexatriacontane (C36)	mg/kg	NA	9.07 J	NA	0.194 J	NA	0.0927 J
n-Heptatriacontane (C37)	mg/kg	NA	34.9	NA	0.58 J	NA	0.295
n-Octatriacontane (C38)	mg/kg	NA	4.48 J	NA	0.0464 J	NA	0.0397 J
n-Nonatriacontane (C39)	mg/kg	NA	11 J	NA	0.209 J	NA	0.0636 J
n-Tetracontane (C40)	mg/kg	NA	7.21 J	NA	0.146 J	NA	0.0542 J
2,6,10 Trimethyldodecane (1380)	mg/kg	NA	18.8 J	NA	0.315 J	NA	0.0347 J
2,6,10 Trimethyltridecane (1470)	mg/kg	NA	108 G	NA	1.12 G	NA	0.409 G
Norpristane (1650)	mg/kg	NA	176 G	NA	2.61 G	NA	0.389 G
Phytane	mg/kg	NA	26.5 U	NA	0.636 U	NA	1.69 G
Pristane	mg/kg	NA	26.5 U	NA	0.636 U	NA	0.161 J
Total Petroleum Hydrocarbons (C9-C44)	mg/kg	NA	64,200	NA	794	NA	355
Total Saturated Hydrocarbons	mg/kg	NA	1,570	NA	26.8	NA	15.7
PAHs							
Dilution Factor:		10					
Acenaphthene	ug/kg	7,390	NA	NA	NA	NA	NA
Acenaphthylene	ug/kg	2,260	NA	NA	NA	NA	NA
Anthracene	ug/kg	10,500	NA	NA	NA	NA	NA
Benzo(a)anthracene	ug/kg	16,600	NA	NA	NA	NA	NA
Benzo(a)pyrene	ug/kg	14,600	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	ug/kg	7,910	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	ug/kg	5,240	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	ug/kg	10,300	NA	NA	NA	NA	NA
Chrysene	ug/kg	12,600	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	ug/kg	1,540	NA	NA	NA	NA	NA
Fluoranthene	ug/kg	40,400	NA	NA	NA	NA	NA
Fluorene	ug/kg	4,230	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	ug/kg	6,040	NA	NA	NA	NA	NA
Naphthalene	ug/kg	13,500	NA	NA	NA	NA	NA
Phenanthrene	ug/kg	22,700	NA	NA	NA	NA	NA
Pyrene	ug/kg	36,500	NA	NA	NA	NA	NA
Total PAHs	ug/kg	212,000	NA	NA	NA	NA	NA
Forensic PAHs							
Dilution Factor:			1	10	1	10	1
1-Methyldibenzothiophene	ug/kg	NA	23,300	2,650 U	211	64 U	37
1-Methylnaphthalene	ug/kg	NA	1,200,000 E	1,000,000	1,500	64 U	129
1-Methylphenanthrene	ug/kg	NA	229,000	2,650 U	2,170	64 U	451
2,3,5-Trimethylnaphthalene	ug/kg	NA	69,100	2,650 U	483	64 U	75
2,6-Dimethylnaphthalene	ug/kg	NA	578,000 E	446,000	1,730	64 U	163
2/3-Methyldibenzothiophene	ug/kg	NA	70,100	2,650 U	603	64 U	112
2/4-Methylphenanthrene	ug/kg	NA	429,000	2,650 U	3,510	64 U	1,010
2-Methylanthracene	ug/kg	NA	253,000	2,650 U	2,350	64 U	608
2-Methylnaphthalene	ug/kg	NA	1,800,000 E	1,580,000	1,590	64 U	299
3-Methylphenanthrene	ug/kg	NA	371,000	2,650 U	2,970	64 U	738
4-Methyldibenzothiophene	ug/kg	NA	69,000	2,650 U	510	64 U	82
9-Methylphenanthrene	ug/kg	NA	358,000	2,650 U	2,860	64 U	714

Appendix H
Summary of Sediment Sample Analytical Results
Revised Comprehensive Sediment Investigation Report for OU2
Hudson (Water Street) Site, Hudson, New York - National Grid

Location ID:		MPD-1	MPD-2	MPD-2	MPD-3	MPD-3	MPD-4
Sample Name:		MPD-1 (0-0.5)	MPD-2 (0-0.5)	MPD-2 (0-0.5)-DL	MPD-3 (0-0.5)	MPD-3 (0-0.5)-DL	MPD-4 (0-0.5)
Lab Sample ID:		0910018-08	0910018-09	0910018-09E	0910018-10	0910018-10E	0910018-11
Sample Depth(Feet):		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Date Collected:	Units	10/08/09	10/08/09	10/08/09	10/08/09	10/08/09	10/08/09
Forensic PAHs (continued)							
Dilution Factor:			1	10	1	10	1
Acenaphthene	ug/kg	NA	1,720,000 E	1,480,000	5,940	64 U	415
Acenaphthylene	ug/kg	NA	161,000	2,650 U	1,410	64 U	511
Anthracene	ug/kg	NA	1,240,000 E	1,110,000	8,420	64 U	2,120
Benzo(a)anthracene	ug/kg	NA	725,000 E	684,000	10,900	64 U	4,730
Benzo(a)pyrene	ug/kg	NA	678,000 E	598,000	9,730	64 U	4,560
Benzo(b)fluoranthene	ug/kg	NA	351,000	2,650 U	5,900	64 U	2,950
Benzo(b)fluorene	ug/kg	NA	345,000	2,650 U	4,580	64 U	1,780
Benzo(g,h,i)perylene	ug/kg	NA	259,000	2,650 U	3,740	64 U	2,130
Benzo(k)fluoranthene	ug/kg	NA	417,000	2,650 U	6,530	64 U	3,270
Benzo[a]fluoranthene	ug/kg	NA	165,000	2,650 U	2,390	64 U	1,030
Benzo[e]pyrene	ug/kg	NA	286,000	2,650 U	4,290	64 U	2,180
Benzothiophene	ug/kg	NA	45,400	2,650 U	171	64 U	45
Biphenyl	ug/kg	NA	310,000	2,650 U	473	64 U	91
C1-Benzo(b)thiophenes	ug/kg	NA	85,500	2,650 U	205	64 U	25
C1-Chrysenes	ug/kg	NA	336,000	2,650 U	4,890	64 U	1,880
C1-Decalins	ug/kg	NA	3,470	2,650 U	34	64 U	12
C1-Dibenzothiophenes	ug/kg	NA	205,000	2,650 U	1,680	64 U	302
C1-Fluoranthenes/Pyrenes	ug/kg	NA	1,430,000	2,650 U	16,500	64 U	5,840
C1-Fluorenes	ug/kg	NA	416,000	2,650 U	2,860	64 U	440
C1-Naphthalenes	ug/kg	NA	1,980,000 E	1,720,000	2,050	64 U	285
C1-Naphthobenzothiophenes	ug/kg	NA	113,000	2,650 U	1,470	64 U	530
C1-Phenanthrenes/Anthracenes	ug/kg	NA	1,650,000	2,650 U	14,000	64 U	3,570
C2-Benzo(b)thiophenes	ug/kg	NA	99,100	2,650 U	326	64 U	28
C2-Chrysenes	ug/kg	NA	144,000	2,650 U	2,150	64 U	882
C2-Decalins	ug/kg	NA	6,330	2,650 U	72	64 U	17
C2-Dibenzothiophenes	ug/kg	NA	142,000	2,650 U	1,170	64 U	278
C2-Fluoranthenes/Pyrenes	ug/kg	NA	428,000	2,650 U	5,340	64 U	2,020
C2-Fluorenes	ug/kg	NA	228,000	2,650 U	1,980	64 U	489
C2-Naphthalenes	ug/kg	NA	1,490,000 E	1,160,000	3,910	64 U	381
C2-Naphthobenzothiophenes	ug/kg	NA	50,600	2,650 U	639	64 U	244
C2-Phenanthrenes/Anthracenes	ug/kg	NA	651,000	2,650 U	7,030	64 U	2,250
C3-Benzo(b)thiophenes	ug/kg	NA	52,500	2,650 U	306	64 U	29
C3-Chrysenes	ug/kg	NA	93,700	2,650 U	1,620	64 U	666
C3-Decalins	ug/kg	NA	5,380	2,650 U	67	64 U	15
C3-Dibenzothiophenes	ug/kg	NA	72,500	2,650 U	653	64 U	203
C3-Fluoranthenes/Pyrenes	ug/kg	NA	155,000	2,650 U	2,170	64 U	889
C3-Fluorenes	ug/kg	NA	80,000	2,650 U	1,040	64 U	375
C3-Naphthalenes	ug/kg	NA	577,000	2,650 U	3,550	64 U	509
C3-Naphthobenzothiophenes	ug/kg	NA	27,800	2,650 U	376	64 U	158
C3-Phenanthrenes/Anthracenes	ug/kg	NA	207,000	2,650 U	2,550	64 U	965
C4-Benzo(b)thiophenes	ug/kg	NA	16,100	2,650 U	135	64 U	20
C4-Chrysenes	ug/kg	NA	30,500	2,650 U	560	64 U	234
C4-Decalins	ug/kg	NA	6,730	2,650 U	107	64 U	26
C4-Dibenzothiophenes	ug/kg	NA	22,800	2,650 U	280	64 U	102
C4-Fluoranthenes/Pyrenes	ug/kg	NA	70,900	2,650 U	1,090	64 U	502
C4-Naphthalenes	ug/kg	NA	144,000	2,650 U	1,420	64 U	305
C4-Naphthobenzothiophenes	ug/kg	NA	11,100	2,650 U	168	64 U	59
C4-Phenanthrenes/Anthracenes	ug/kg	NA	49,000	2,650 U	770	64 U	341
Carbazole	ug/kg	NA	104,000	2,650 U	148	64 U	62
Chrysene/Triphenylene	ug/kg	NA	562,000 E	542,000	8,520	64 U	3,890
cis/trans-Decalin	ug/kg	NA	1,360	2,650 U	12	64 U	5.7
Dibenzo(a,h)anthracene	ug/kg	NA	81,800	2,650 U	1,300	64 U	675
Dibenzofuran	ug/kg	NA	447,000	2,650 U	1,420	64 U	302
Dibenzothiophene	ug/kg	NA	269,000	2,650 U	2,030	64 U	319
Fluoranthene	ug/kg	NA	1,810,000 E	1,740,000	24,800 E	25,600	9,700 E
Fluorene	ug/kg	NA	976,000 E	794,000	4,880	64 U	564
Indeno(1,2,3-cd)pyrene	ug/kg	NA	309,000	2,650 U	4,640	64 U	2,550
Naphthalene	ug/kg	NA	1,910,000 E	1,930,000	3,820	64 U	1,010
Naphthobenzothiophenes	ug/kg	NA	162,000	2,650 U	2,390	64 U	989
Perylene	ug/kg	NA	134,000	2,650 U	2,070	64 U	1,190
Phenanthrene	ug/kg	NA	2,720,000 E	3,070,000	19,000 E	18,200	4,890
Pyrene	ug/kg	NA	1,780,000 E	1,690,000	22,400 E	23,000	8,540 E
Retene	ug/kg	NA	265 U	2,650 U	252	64 U	201

Appendix H
Summary of Sediment Sample Analytical Results
Revised Comprehensive Sediment Investigation Report for OU2
Hudson (Water Street) Site, Hudson, New York - National Grid

Location ID:		MPD-4	MPD-5	MPD-6	MPD-7	MPD-8	MPE-2-1	MPE-2-2
Sample Name:		MPD-4 (0-0.5)-DL	MPD-5 (0-0.5)	MPD-6 (0-0.5)	MPD-7 (0-0.5)	MPD-8 (0-0.5)	MPE-2-1	MPE-2-2
Lab Sample ID:		0910018-11E	0910018-01	0910018-03	0910018-02	0910018-04	0910018-19	0910018-18
Sample Depth(Feet):		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Date Collected:	Units	10/08/09	10/07/09	10/08/09	10/08/09	10/08/09	10/09/09	10/09/09
TPH								
Dilution Factor:						**1**		**1**
n-Nonane (C9)	mg/kg	NA	NA	NA	NA	0.0212 J	NA	0.0428 J
n-Decane (C10)	mg/kg	NA	NA	NA	NA	0.0606 J	NA	0.124 J
n-Undecane (C11)	mg/kg	NA	NA	NA	NA	0.0918 J	NA	0.195 J
n-Dodecane (C12)	mg/kg	NA	NA	NA	NA	0.116 J	NA	0.126 J
n-Tridecane (C13)	mg/kg	NA	NA	NA	NA	0.171 J	NA	0.28 J
n-Tetradecane (C14)	mg/kg	NA	NA	NA	NA	0.128 J	NA	0.24 J
n-Pentadecane (C15)	mg/kg	NA	NA	NA	NA	0.282 G	NA	0.423 J
n-Hexadecane (C16)	mg/kg	NA	NA	NA	NA	0.331 G	NA	0.269 J
n-Heptadecane (C17)	mg/kg	NA	NA	NA	NA	0.158 J	NA	0.502 J
n-Octadecane (C18)	mg/kg	NA	NA	NA	NA	1.47 G	NA	1.52 G
n-Nonadecane (C19)	mg/kg	NA	NA	NA	NA	0.144 J	NA	0.202 J
n-Eicosane (C20)	mg/kg	NA	NA	NA	NA	0.197 J	NA	0.401 J
n-Heneicosane (C21)	mg/kg	NA	NA	NA	NA	0.155 J	NA	0.599 J
n-Docosane (C22)	mg/kg	NA	NA	NA	NA	0.148 J	NA	0.0984 J
n-Tricosane (C23)	mg/kg	NA	NA	NA	NA	0.29	NA	0.579 J
n-Tetracosane (C24)	mg/kg	NA	NA	NA	NA	0.157 J	NA	0.911 U
n-Pentacosane (C25)	mg/kg	NA	NA	NA	NA	0.281	NA	2.2 G
n-Hexacosane (C26)	mg/kg	NA	NA	NA	NA	0.108 J	NA	0.428 J
n-Heptacosane (C27)	mg/kg	NA	NA	NA	NA	0.175 J	NA	2.79
n-Octacosane (C28)	mg/kg	NA	NA	NA	NA	0.21 J	NA	1.06
n-Nonacosane (C29)	mg/kg	NA	NA	NA	NA	0.242 J	NA	1.42
n-Triacontane (C30)	mg/kg	NA	NA	NA	NA	0.232 J	NA	0.789 J
n-Hentriacontane (C31)	mg/kg	NA	NA	NA	NA	0.181 J	NA	1.16
n-Dotriacontane (C32)	mg/kg	NA	NA	NA	NA	0.177 J	NA	1.76
n-Tritriacontane (C33)	mg/kg	NA	NA	NA	NA	0.268 J	NA	0.735 J
n-Tetratriacontane (C34)	mg/kg	NA	NA	NA	NA	0.15 J	NA	1.08
n-Pentatriacontane (C35)	mg/kg	NA	NA	NA	NA	0.0522 J	NA	0.686 J
n-Hexatriacontane (C36)	mg/kg	NA	NA	NA	NA	0.0595 J	NA	0.174 J
n-Heptatriacontane (C37)	mg/kg	NA	NA	NA	NA	0.0592 J	NA	0.911 U
n-Octatriacontane (C38)	mg/kg	NA	NA	NA	NA	0.0204 J	NA	0.181 J
n-Nonatriacontane (C39)	mg/kg	NA	NA	NA	NA	0.0215 J	NA	0.911 U
n-Tetracontane (C40)	mg/kg	NA	NA	NA	NA	0.279 U	NA	0.911 U
2,6,10 Trimethyldodecane (1380)	mg/kg	NA	NA	NA	NA	0.0653 J	NA	0.816 J
2,6,10 Trimethyltridecane (1470)	mg/kg	NA	NA	NA	NA	0.0821 J	NA	0.385 J
Norpristane (1650)	mg/kg	NA	NA	NA	NA	0.416 G	NA	1.1 G
Phytane	mg/kg	NA	NA	NA	NA	0.0475 J	NA	1.01 G
Pristane	mg/kg	NA	NA	NA	NA	0.198 J	NA	2.28 G
Total Petroleum Hydrocarbons (C9-C44)	mg/kg	NA	NA	NA	NA	171	NA	2,000
Total Saturated Hydrocarbons	mg/kg	NA	NA	NA	NA	6.96	NA	25.7
PAHs								
Dilution Factor:			**10**	**10**	**1**		**1**	
Acenaphthene	ug/kg	NA	822	4,500	1,300	NA	162	NA
Acenaphthylene	ug/kg	NA	488	766	170	NA	242	NA
Anthracene	ug/kg	NA	2,570	11,600	878	NA	359	NA
Benzo(a)anthracene	ug/kg	NA	4,590	10,700	1,520	NA	993	NA
Benzo(a)pyrene	ug/kg	NA	3,700	7,830	1,310	NA	1,160	NA
Benzo(b)fluoranthene	ug/kg	NA	2,330	4,820	816	NA	861	NA
Benzo(g,h,i)perylene	ug/kg	NA	1,400	2,590	565	NA	686	NA
Benzo(k)fluoranthene	ug/kg	NA	2,950	6,430	987	NA	921	NA
Chrysene	ug/kg	NA	3,780	7,700	1,270	NA	997	NA
Dibenzo(a,h)anthracene	ug/kg	NA	461	1,140	170	NA	184	NA
Fluoranthene	ug/kg	NA	9,870	23,800	3,070	NA	1,820	NA
Fluorene	ug/kg	NA	853	8,480	487	NA	142	NA
Indeno(1,2,3-cd)pyrene	ug/kg	NA	1,730	3,090	638	NA	728	NA
Naphthalene	ug/kg	NA	1,440	557	786	NA	287	NA
Phenanthrene	ug/kg	NA	6,320	31,600	1,940	NA	895	NA
Pyrene	ug/kg	NA	8,350	18,500	2,930	NA	1,790	NA
Total PAHs	ug/kg	NA	51,700	144,000	18,800	NA	12,200	NA
Forensic PAHs								
Dilution Factor:		**10**				**1**		**1**
1-Methyldibenzothiophene	ug/kg	29 U	NA	NA	NA	13	NA	22
1-Methylnaphthalene	ug/kg	29 U	NA	NA	NA	423	NA	102
1-Methylphenanthrene	ug/kg	29 U	NA	NA	NA	199	NA	156
2,3,5-Trimethylnaphthalene	ug/kg	29 U	NA	NA	NA	84	NA	63
2,6-Dimethylnaphthalene	ug/kg	29 U	NA	NA	NA	292	NA	160
2/3-Methyldibenzothiophene	ug/kg	29 U	NA	NA	NA	43	NA	70
2/4-Methylphenanthrene	ug/kg	29 U	NA	NA	NA	339	NA	264
2-Methylanthracene	ug/kg	29 U	NA	NA	NA	94	NA	110
2-Methylnaphthalene	ug/kg	29 U	NA	NA	NA	326	NA	224
3-Methylphenanthrene	ug/kg	29 U	NA	NA	NA	248	NA	217
4-Methyldibenzothiophene	ug/kg	29 U	NA	NA	NA	40	NA	81
9-Methylphenanthrene	ug/kg	29 U	NA	NA	NA	271	NA	230

Appendix H
Summary of Sediment Sample Analytical Results
Revised Comprehensive Sediment Investigation Report for OU2
Hudson (Water Street) Site, Hudson, New York - National Grid

Location ID:		MPD-4	MPD-5	MPD-6	MPD-7	MPD-8	MPE-2-1	MPE-2-2
Sample Name:		MPD-4 (0-0.5)-DL	MPD-5 (0-0.5)	MPD-6 (0-0.5)	MPD-7 (0-0.5)	MPD-8 (0-0.5)	MPE-2-1	MPE-2-2
Lab Sample ID:		0910018-11E	0910018-01	0910018-03	0910018-02	0910018-04	0910018-19	0910018-18
Sample Depth(Feet):		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Date Collected:	Units	10/08/09	10/07/09	10/08/09	10/08/09	10/08/09	10/09/09	10/09/09
Forensic PAHs (continued)								
Dilution Factor:		**10**				**1**		**1**
Acenaphthene	ug/kg	29 U	NA	NA	NA	143	NA	100
Acenaphthylene	ug/kg	29 U	NA	NA	NA	102	NA	388
Anthracene	ug/kg	29 U	NA	NA	NA	349	NA	457
Benzo(a)anthracene	ug/kg	29 U	NA	NA	NA	709	NA	941
Benzo(a)pyrene	ug/kg	29 U	NA	NA	NA	702	NA	1,110
Benzo(b)fluoranthene	ug/kg	29 U	NA	NA	NA	476	NA	942
Benzo(b)fluorene	ug/kg	29 U	NA	NA	NA	218	NA	275
Benzo(g,h,i)perylene	ug/kg	29 U	NA	NA	NA	350	NA	691
Benzo(k)fluoranthene	ug/kg	29 U	NA	NA	NA	508	NA	881
Benzo[a]fluoranthene	ug/kg	29 U	NA	NA	NA	136	NA	286
Benzo[e]pyrene	ug/kg	29 U	NA	NA	NA	432	NA	713
Benzothiophene	ug/kg	29 U	NA	NA	NA	11	NA	17
Biphenyl	ug/kg	29 U	NA	NA	NA	56	NA	63
C1-Benzo(b)thiophenes	ug/kg	29 U	NA	NA	NA	14	NA	54
C1-Chrysenes	ug/kg	29 U	NA	NA	NA	478	NA	688
C1-Decalins	ug/kg	29 U	NA	NA	NA	25	NA	120
C1-Dibenzothiophenes	ug/kg	29 U	NA	NA	NA	116	NA	194
C1-Fluoranthenes/Pyrenes	ug/kg	29 U	NA	NA	NA	1,080	NA	1,480
C1-Fluorenes	ug/kg	29 U	NA	NA	NA	146	NA	162
C1-Naphthalenes	ug/kg	29 U	NA	NA	NA	494	NA	217
C1-Naphthobenzothiophenes	ug/kg	29 U	NA	NA	NA	181	NA	346
C1-Phenanthrenes/Anthracenes	ug/kg	29 U	NA	NA	NA	1,160	NA	1,010
C2-Benzo(b)thiophenes	ug/kg	29 U	NA	NA	NA	16	NA	30
C2-Chrysenes	ug/kg	29 U	NA	NA	NA	319	NA	431
C2-Decalins	ug/kg	29 U	NA	NA	NA	24	NA	285
C2-Dibenzothiophenes	ug/kg	29 U	NA	NA	NA	108	NA	389
C2-Fluoranthenes/Pyrenes	ug/kg	29 U	NA	NA	NA	727	NA	970
C2-Fluorenes	ug/kg	29 U	NA	NA	NA	258	NA	385
C2-Naphthalenes	ug/kg	29 U	NA	NA	NA	767	NA	330
C2-Naphthobenzothiophenes	ug/kg	29 U	NA	NA	NA	116	NA	335
C2-Phenanthrenes/Anthracenes	ug/kg	29 U	NA	NA	NA	830	NA	1,140
C3-Benzo(b)thiophenes	ug/kg	29 U	NA	NA	NA	13	NA	31
C3-Chrysenes	ug/kg	29 U	NA	NA	NA	293	NA	385
C3-Decalins	ug/kg	29 U	NA	NA	NA	16	NA	272
C3-Dibenzothiophenes	ug/kg	29 U	NA	NA	NA	76	NA	481
C3-Fluoranthenes/Pyrenes	ug/kg	29 U	NA	NA	NA	484	NA	607
C3-Fluorenes	ug/kg	29 U	NA	NA	NA	240	NA	545
C3-Naphthalenes	ug/kg	29 U	NA	NA	NA	511	NA	484
C3-Naphthobenzothiophenes	ug/kg	29 U	NA	NA	NA	73	NA	277
C3-Phenanthrenes/Anthracenes	ug/kg	29 U	NA	NA	NA	390	NA	815
C4-Benzo(b)thiophenes	ug/kg	29 U	NA	NA	NA	9.1	NA	84
C4-Chrysenes	ug/kg	29 U	NA	NA	NA	132	NA	195
C4-Decalins	ug/kg	29 U	NA	NA	NA	25	NA	533
C4-Dibenzothiophenes	ug/kg	29 U	NA	NA	NA	39	NA	310
C4-Fluoranthenes/Pyrenes	ug/kg	29 U	NA	NA	NA	296	NA	404
C4-Naphthalenes	ug/kg	29 U	NA	NA	NA	222	NA	484
C4-Naphthobenzothiophenes	ug/kg	29 U	NA	NA	NA	34	NA	161
C4-Phenanthrenes/Anthracenes	ug/kg	29 U	NA	NA	NA	152	NA	415
Carbazole	ug/kg	29 U	NA	NA	NA	82	NA	54
Chrysene/Triphenylene	ug/kg	29 U	NA	NA	NA	722	NA	975
cis/trans-Decalin	ug/kg	29 U	NA	NA	NA	35	NA	32
Dibenzo(a,h)anthracene	ug/kg	29 U	NA	NA	NA	102	NA	204
Dibenzofuran	ug/kg	29 U	NA	NA	NA	151	NA	78
Dibenzothiophene	ug/kg	29 U	NA	NA	NA	95	NA	82
Fluoranthene	ug/kg	10,000	NA	NA	NA	1,440	NA	1,770
Fluorene	ug/kg	29 U	NA	NA	NA	187	NA	134
Indeno(1,2,3-cd)pyrene	ug/kg	29 U	NA	NA	NA	374	NA	727
Naphthalene	ug/kg	29 U	NA	NA	NA	271	NA	280
Naphthobenzothiophenes	ug/kg	29 U	NA	NA	NA	201	NA	300
Perylene	ug/kg	29 U	NA	NA	NA	289	NA	803
Phenanthrene	ug/kg	29 U	NA	NA	NA	1,390	NA	866
Pyrene	ug/kg	8,820	NA	NA	NA	1,340	NA	1,860
Retene	ug/kg	29 U	NA	NA	NA	66	NA	240

Appendix H
Summary of Sediment Sample Analytical Results
Revised Comprehensive Sediment Investigation Report for OU2
Hudson (Water Street) Site, Hudson, New York - National Grid

Location ID:		MPE-2-3	MPU-3	SD-87	SD-87	SD-96	SD-96	SD-96
Sample Name:		MPE-2-3	MPU-3	SD-87	SD-87-DL	SD-96	SD-96-DUP	SD-96-DUP-DL
Lab Sample ID:		0910018-17	0810073-06	0810073-20	0910018-13E	0810073-18	0910018-16	0910018-16E
Sample Depth(Feet):		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Date Collected:	Units	10/09/09	10/09/09	10/08/09	10/08/09	10/08/09	10/09/09	10/09/09
TPH								
Dilution Factor:			1	1		1	1	
n-Nonane (C9)	mg/kg	NA	0.0111 J	0.6 J	NA	0.502 J	0.238 J	NA
n-Decane (C10)	mg/kg	NA	0.02 J	1.17 J	NA	1.13 J	0.566 J	NA
n-Undecane (C11)	mg/kg	NA	0.0513 J	3.72 G	NA	2.88 J	1.6 G	NA
n-Dodecane (C12)	mg/kg	NA	0.0744 J	1.92 J	NA	1.98 J	1.06 J	NA
n-Tridecane (C13)	mg/kg	NA	0.221 J	6.08 G	NA	5.74 G	2.35 G	NA
n-Tetradecane (C14)	mg/kg	NA	0.234 J	2.32 J	NA	1.98 J	0.978 J	NA
n-Pentadecane (C15)	mg/kg	NA	1.09 G	51.8 G	NA	46.1 G	26.3 G	NA
n-Hexadecane (C16)	mg/kg	NA	0.785 G	30.3 G	NA	107 G	58.6 G	NA
n-Heptadecane (C17)	mg/kg	NA	0.294	2.59 U	NA	3.51 U	1.39 U	NA
n-Octadecane (C18)	mg/kg	NA	0.228 J	2.59 U	NA	3.51 U	1.39 U	NA
n-Nonadecane (C19)	mg/kg	NA	0.352	2.08 J	NA	1.63 J	1.11 J	NA
n-Eicosane (C20)	mg/kg	NA	0.308	1.9 J	NA	2.65 J	1.26 J	NA
n-Heneicosane (C21)	mg/kg	NA	0.195 J	1.81 J	NA	1.98 J	0.936 J	NA
n-Docosane (C22)	mg/kg	NA	0.119 J	2.17 J	NA	2.26 J	1.27 J	NA
n-Tricosane (C23)	mg/kg	NA	0.352	13.6	NA	11.6	6.67	NA
n-Tetracosane (C24)	mg/kg	NA	0.109 J	4.88	NA	3.8	1.91	NA
n-Pentacosane (C25)	mg/kg	NA	0.205 J	2.59 U	NA	3.33 J	1.78 G	NA
n-Hexacosane (C26)	mg/kg	NA	0.0441 J	1.03 J	NA	3.51 U	0.391 J	NA
n-Heptacosane (C27)	mg/kg	NA	0.0698 J	2.59 U	NA	3.51 U	2.27	NA
n-Octacosane (C28)	mg/kg	NA	0.0672 J	3.13	NA	3.33 J	2.48	NA
n-Nonacosane (C29)	mg/kg	NA	0.104 J	4.71	NA	4.53	3.78	NA
n-Triacontane (C30)	mg/kg	NA	0.136 J	8.77	NA	3.51 U	3.7	NA
n-Hentriacontane (C31)	mg/kg	NA	0.0629 J	2.59 U	NA	1.17 J	1.74	NA
n-Dotriacontane (C32)	mg/kg	NA	0.268	7.8	NA	5.03	2.86	NA
n-Tritriacontane (C33)	mg/kg	NA	0.181 J	19.6	NA	15.2	8.45	NA
n-Tetratriacontane (C34)	mg/kg	NA	0.0385 J	1.89 J	NA	1.91 J	1.07 J	NA
n-Pentatriacontane (C35)	mg/kg	NA	0.159 J	4.94	NA	3.86	2.66	NA
n-Hexatriacontane (C36)	mg/kg	NA	0.241 U	1.6 J	NA	1.49 J	0.687 J	NA
n-Heptatriacontane (C37)	mg/kg	NA	0.0927 J	5.96	NA	5.19	2.62	NA
n-Octatriacontane (C38)	mg/kg	NA	0.241 U	1.07 J	NA	0.365 J	0.426 J	NA
n-Nonatriacontane (C39)	mg/kg	NA	0.241 U	1.89 J	NA	1.29 J	0.843 J	NA
n-Tetracontane (C40)	mg/kg	NA	0.241 U	1.23 J	NA	0.889 J	0.484 J	NA
2,6,10 Trimethyldodecane (1380)	mg/kg	NA	0.149 J	0.892 J	NA	0.896 J	0.574 J	NA
2,6,10 Trimethyltridecane (1470)	mg/kg	NA	0.293 G	13.6 G	NA	11 G	5.46 G	NA
Norpristane (1650)	mg/kg	NA	0.128 J	38.4 G	NA	27.2 G	15 G	NA
Phytane	mg/kg	NA	0.289	2.59 U	NA	3.51 U	1.39 U	NA
Pristane	mg/kg	NA	0.458	2.59 U	NA	3.51 U	1.39 U	NA
Total Petroleum Hydrocarbons (C9-C44)	mg/kg	NA	289	8,510	NA	7,130	4,050	NA
Total Saturated Hydrocarbons	mg/kg	NA	7.19	241	NA	278	162	NA
PAHs								
Dilution Factor:		1						
Acenaphthene	ug/kg	366	NA	NA	NA	NA	NA	NA
Acenaphthylene	ug/kg	926	NA	NA	NA	NA	NA	NA
Anthracene	ug/kg	989	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	ug/kg	2,440	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	ug/kg	2,510	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	ug/kg	1,900	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	ug/kg	1,430	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	ug/kg	1,970	NA	NA	NA	NA	NA	NA
Chrysene	ug/kg	2,260	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	ug/kg	416	NA	NA	NA	NA	NA	NA
Fluoranthene	ug/kg	4,840	NA	NA	NA	NA	NA	NA
Fluorene	ug/kg	369	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	ug/kg	1,510	NA	NA	NA	NA	NA	NA
Naphthalene	ug/kg	901	NA	NA	NA	NA	NA	NA
Phenanthrene	ug/kg	2,080	NA	NA	NA	NA	NA	NA
Pyrene	ug/kg	4,900	NA	NA	NA	NA	NA	NA
Total PAHs	ug/kg	29,800	NA	NA	NA	NA	NA	NA
Forensic PAHs								
Dilution Factor:			1	1	20	100	1	10
1-Methyldibenzothiophene	ug/kg	NA	29	2,130	517 U	1,160	825	139 U
1-Methylnaphthalene	ug/kg	NA	534	92,200 E	71,400	64,900	39,500 E	35,900
1-Methylphenanthrene	ug/kg	NA	247	20,900	517 U	12,400	8,870	139 U
2,3,5-Trimethylnaphthalene	ug/kg	NA	98	5,680	517 U	3,870	2,760	139 U
2,6-Dimethylnaphthalene	ug/kg	NA	497	47,100	517 U	28,700	19,400	139 U
2/3-Methyldibenzothiophene	ug/kg	NA	81	6,920	517 U	3,120	2,560	139 U
2/4-Methylphenanthrene	ug/kg	NA	365	45,600	517 U	26,900	18,400	139 U
2-Methylanthracene	ug/kg	NA	175	27,600	517 U	12,700	10,600	139 U
2-Methylnaphthalene	ug/kg	NA	582	176,000 E	145,000	122,000	66,800 E	64,600
3-Methylphenanthrene	ug/kg	NA	334	36,100	517 U	20,700	14,700	139 U
4-Methyldibenzothiophene	ug/kg	NA	84	4,510	517 U	2,140	1,690	139 U
9-Methylphenanthrene	ug/kg	NA	363	30,500	517 U	17,300	12,700	139 U

Appendix H
Summary of Sediment Sample Analytical Results
Revised Comprehensive Sediment Investigation Report for OU2
Hudson (Water Street) Site, Hudson, New York - National Grid

Location ID:		MPE-2-3	MPU-3	SD-87	SD-87	SD-96	SD-96	SD-96
Sample Name:		MPE-2-3	MPU-3	SD-87	SD-87-DL	SD-96	SD-96-DUP	SD-96-DUP-DL
Lab Sample ID:		0910018-17	0810073-06	0810073-20	0910018-13E	0810073-18	0910018-16	0910018-16E
Sample Depth(Feet):		0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Date Collected:	Units	10/09/09	10/09/09	10/08/09	10/08/09	10/08/09	10/09/09	10/09/09
Forensic PAHs (continued)								
Dilution Factor:			1	1	20	100	1	10
Acenaphthene	ug/kg	NA	782	191,000 E	158,000	152,000	90,800 E	85,600
Acenaphthylene	ug/kg	NA	306	18,600	517 U	8,960	6,750	139 U
Anthracene	ug/kg	NA	676	163,000 E	134,000	88,600	58,600 E	54,300
Benzo(a)anthracene	ug/kg	NA	1,260	111,000 E	96,800	82,700	47,500 E	45,300
Benzo(a)pyrene	ug/kg	NA	1,390	101,000 E	78,100	71,400	46,800 E	40,900
Benzo(b)fluoranthene	ug/kg	NA	972	72,100 E	46,600	42,000	29,600 E	24,100
Benzo(b)fluorene	ug/kg	NA	368	56,400 E	35,500	29,100	20,700	139 U
Benzo(g,h,i)perylene	ug/kg	NA	754	40,500	517 U	29,900	19,700	139 U
Benzo(k)fluoranthene	ug/kg	NA	996	59,000 E	58,900	55,200	29,000 E	28,400
Benzo[a]fluoranthene	ug/kg	NA	325	25,200	517 U	14,800	11,000	139 U
Benzo[e]pyrene	ug/kg	NA	767	45,800	517 U	33,000	20,500	139 U
Benzothiophene	ug/kg	NA	17	20,000	517 U	15,500	8,700	139 U
Biphenyl	ug/kg	NA	146	34,100	517 U	21,000	13,100	139 U
C1-Benzo(b)thiophenes	ug/kg	NA	37	9,790	517 U	6,290	3,960	139 U
C1-Chrysenes	ug/kg	NA	773	45,100	517 U	27,900	19,200	139 U
C1-Decalins	ug/kg	NA	30	119	517 U	184 J	67	139 U
C1-Dibenzothiophenes	ug/kg	NA	229	19,100	517 U	8,480	6,930	139 U
C1-Fluoranthenes/Pyrenes	ug/kg	NA	1,920	176,000 E	120,000	95,500	69,200	139 U
C1-Fluorenes	ug/kg	NA	340	35,600	517 U	19,400	14,300	139 U
C1-Naphthalenes	ug/kg	NA	738	178,000 E	145,000	124,000	70,400 E	67,000
C1-Naphthobenzothiophenes	ug/kg	NA	251	17,600	517 U	6,710	5,610	139 U
C1-Phenanthrenes/Anthracenes	ug/kg	NA	1,500	162,000	517 U	91,600	65,800	139 U
C2-Benzo(b)thiophenes	ug/kg	NA	82	6,420	517 U	3,960	2,830	139 U
C2-Chrysenes	ug/kg	NA	377	19,400	517 U	11,700	8,800	139 U
C2-Decalins	ug/kg	NA	66	233	517 U	252 J	151	139 U
C2-Dibenzothiophenes	ug/kg	NA	244	11,300	517 U	4,950	4,320	139 U
C2-Fluoranthenes/Pyrenes	ug/kg	NA	919	52,900	517 U	27,100	21,500	139 U
C2-Fluorenes	ug/kg	NA	291	17,700	517 U	9,430	7,890	139 U
C2-Naphthalenes	ug/kg	NA	1,260	103,000	517 U	65,100	44,900	139 U
C2-Naphthobenzothiophenes	ug/kg	NA	138	7,520	517 U	2,850	2,530	139 U
C2-Phenanthrenes/Anthracenes	ug/kg	NA	940	64,100	517 U	38,200	27,700	139 U
C3-Benzo(b)thiophenes	ug/kg	NA	56	2,680	517 U	1,770	1,490	139 U
C3-Chrysenes	ug/kg	NA	239	15,500	517 U	8,820	6,630	139 U
C3-Decalins	ug/kg	NA	61	181	517 U	351 U	121	139 U
C3-Dibenzothiophenes	ug/kg	NA	174	6,460	517 U	2,760	2,560	139 U
C3-Fluoranthenes/Pyrenes	ug/kg	NA	389	21,300	517 U	10,100	8,860	139 U
C3-Fluorenes	ug/kg	NA	238	8,120	517 U	5,310	3,830	139 U
C3-Naphthalenes	ug/kg	NA	649	40,900	517 U	25,800	19,100	139 U
C3-Naphthobenzothiophenes	ug/kg	NA	91	3,840	517 U	1,660	1,500	139 U
C3-Phenanthrenes/Anthracenes	ug/kg	NA	400	22,300	517 U	12,700	10,400	139 U
C4-Benzo(b)thiophenes	ug/kg	NA	34	863	517 U	622	442	139 U
C4-Chrysenes	ug/kg	NA	100	5,180	517 U	4,370	2,200	139 U
C4-Decalins	ug/kg	NA	135	283	517 U	351 U	213	139 U
C4-Dibenzothiophenes	ug/kg	NA	76	2,360	517 U	1,230	1,040	139 U
C4-Fluoranthenes/Pyrenes	ug/kg	NA	196	11,000	517 U	5,600	4,630	139 U
C4-Naphthalenes	ug/kg	NA	278	11,600	517 U	7,130	5,670	139 U
C4-Naphthobenzothiophenes	ug/kg	NA	47	1,570	517 U	511	581	139 U
C4-Phenanthrenes/Anthracenes	ug/kg	NA	124	6,440	517 U	3,830	4,210	139 U
Carbazole	ug/kg	NA	72	53,500 E	37,200	27,700	19,200	139 U
Chrysene/Triphenylene	ug/kg	NA	1,160	86,600 E	76,100	61,600	34,400 E	32,800
cis/trans-Decalin	ug/kg	NA	7.4	77	517 U	351 U	38	139 U
Dibenzo(a,h)anthracene	ug/kg	NA	222	15,800	517 U	8,570	6,980	139 U
Dibenzofuran	ug/kg	NA	184	106,000 E	87,000	74,900	44,100 E	40,800
Dibenzothiophene	ug/kg	NA	204	37,500	517 U	21,700	14,100	139 U
Fluoranthene	ug/kg	NA	2,420	256,000 E	264,000	228,000	117,000 E	130,000
Fluorene	ug/kg	NA	482	142,000 E	111,000	91,100	56,600 E	51,200
Indeno(1,2,3-cd)pyrene	ug/kg	NA	841	51,500	517 U	34,800	24,700	139 U
Naphthalene	ug/kg	NA	411	324,000 E	420,000	396,000	139,000 E	188,000
Naphthobenzothiophenes	ug/kg	NA	300	32,400	517 U	14,100	9,120	139 U
Perylene	ug/kg	NA	310	23,000	517 U	16,300	11,200	139 U
Phenanthrene	ug/kg	NA	2,090	333,000 E	387,000	326,000	152,000 E	186,000
Pyrene	ug/kg	NA	2,510	218,000 E	208,000	179,000	99,000 E	103,000
Retene	ug/kg	NA	62	3,060	517 U	3,040	6,780	139 U

Notes:

1. E = Analyte exceeded calibration range.
2. J = An estimated value.
3. ug/kg = microgram per kilogram
4. mg/kg = milligram per kilogram
5. U = The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
6. DL was added ot the Sample IDs to distinguish diluted samples from undluted samples. See Note 1.

ARCADIS

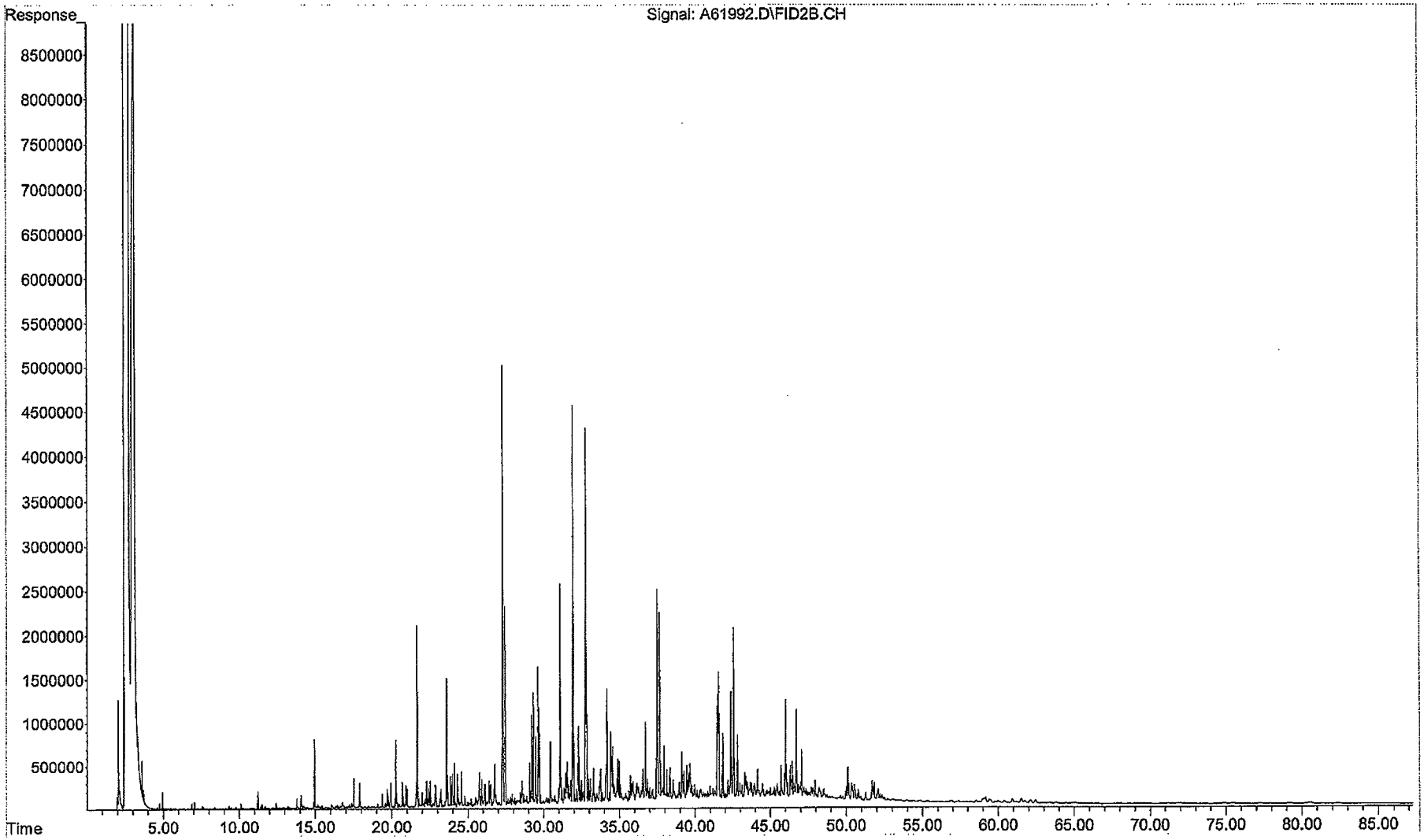
Appendix I

TPH Gas Chromatography

GC FINGERPRINTS FROM TPH ANALYSIS

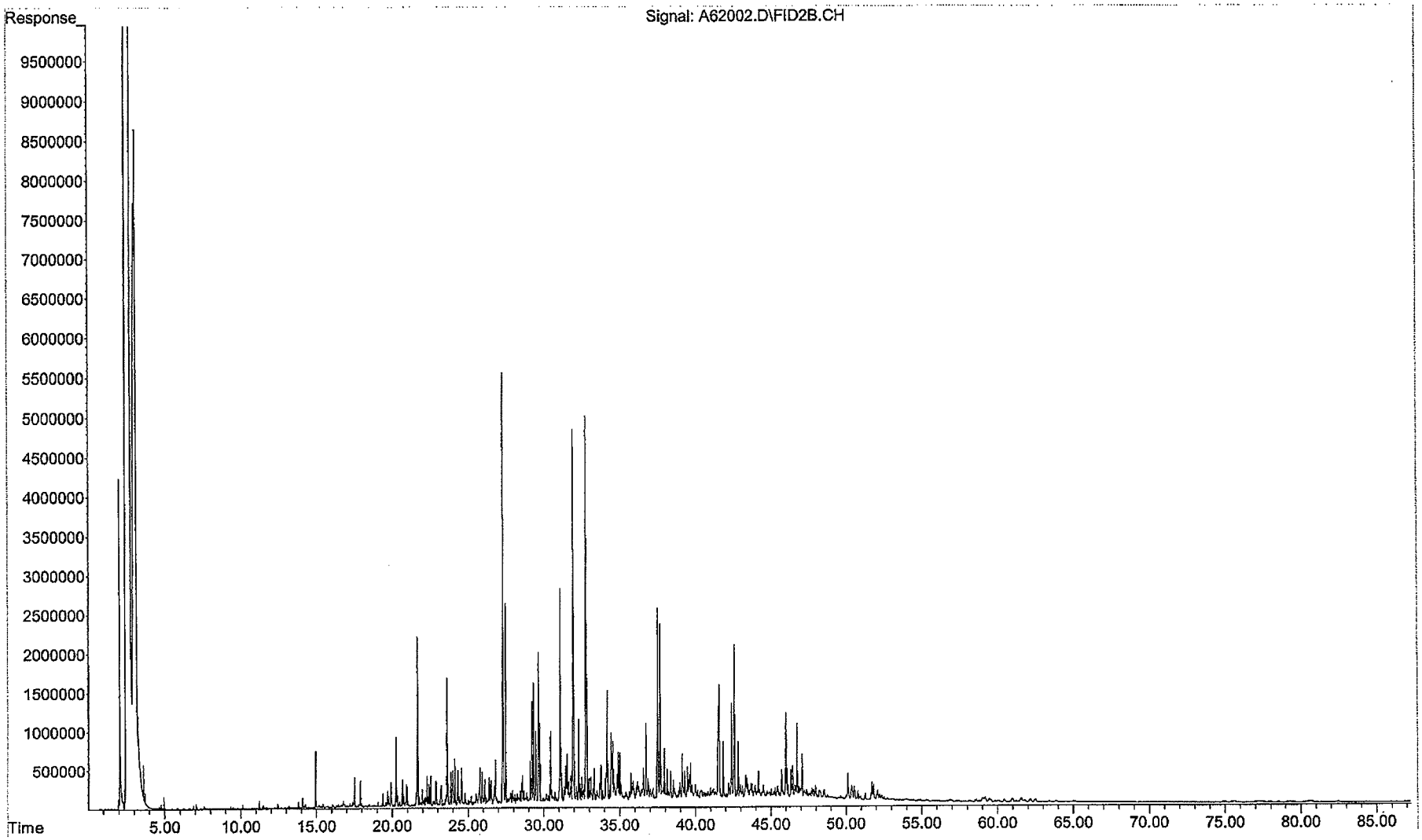
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Instrument : FID6
Sample Name: 0801067-11
Misc Info : 1X
Vial Number: 72

MPU-3



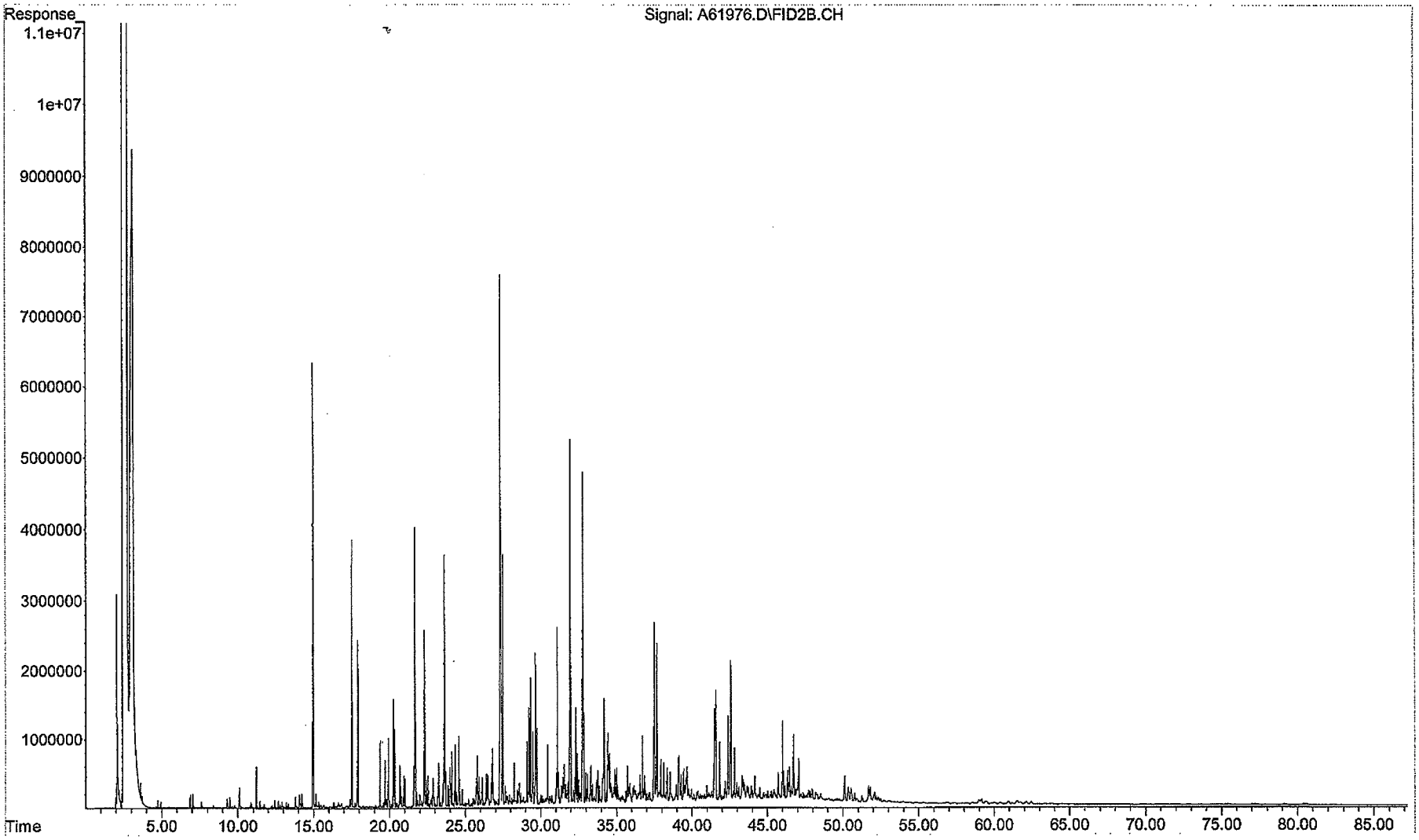
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Instrument : FID6
Sample Name: 0801067-16
Misc Info : 1X
Vial Number: 77

MPU-3 (DHP-2)



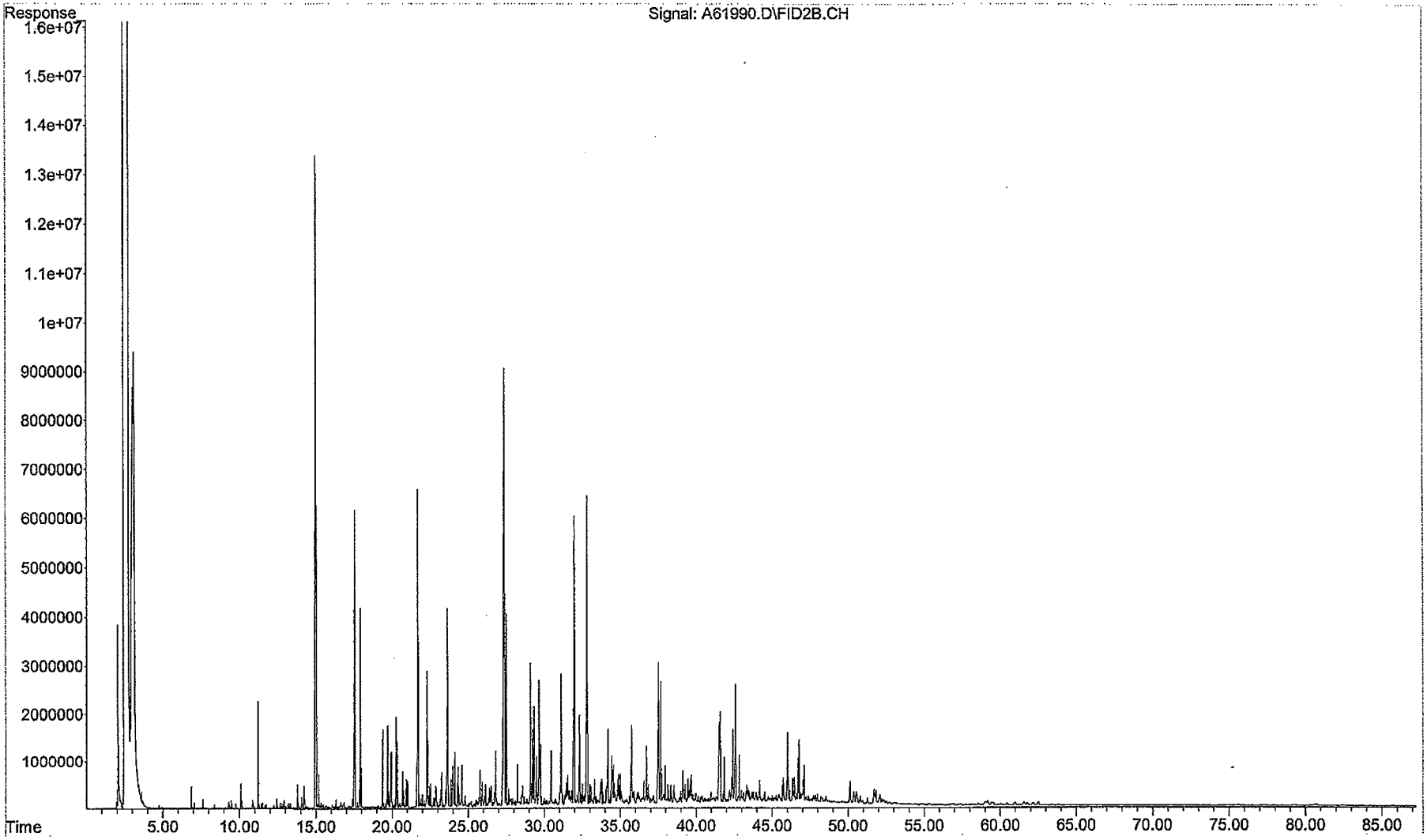
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Instrument : FID6
Sample Name: 0801067-05
Misc Info : 1X
Vial Number: 64

MPA-1



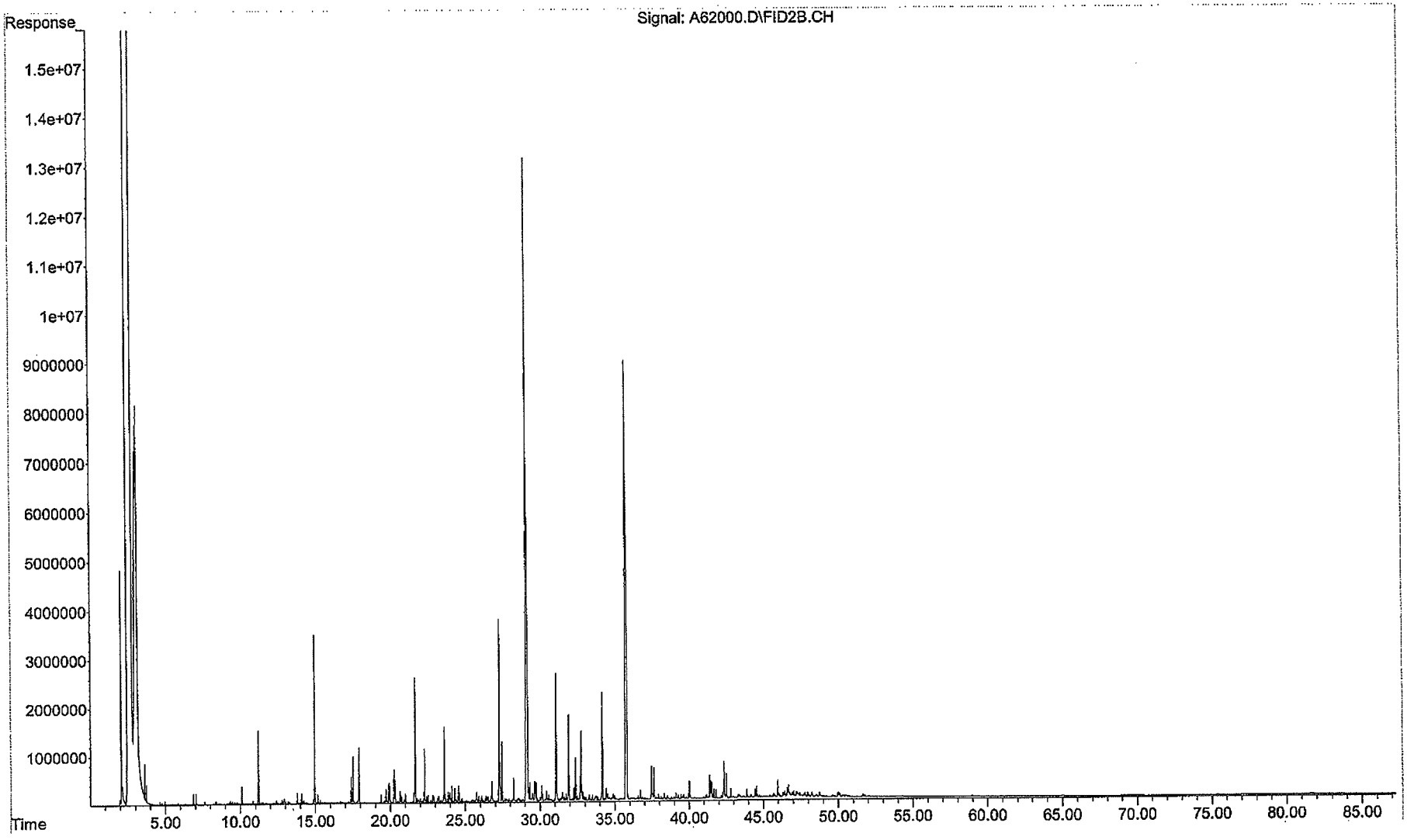
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Sample Name: 0801067-10
Misc Info : 1X
Vial Number: 71

SD-87(0-6)



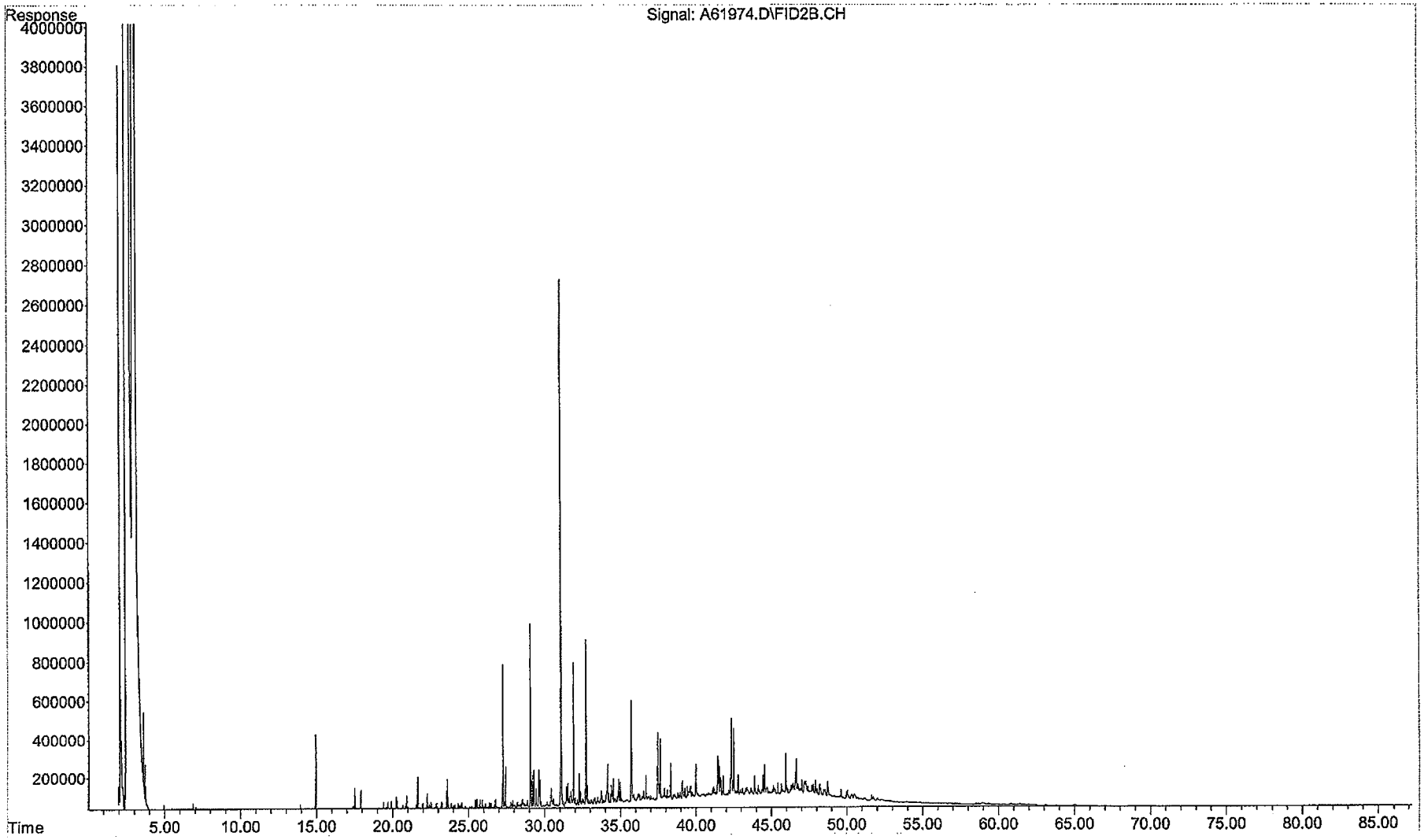
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Instrument : FID6
Sample Name: 0801067-15
Misc Info : 1X
Vial Number: 76

SD-87 (24-48)



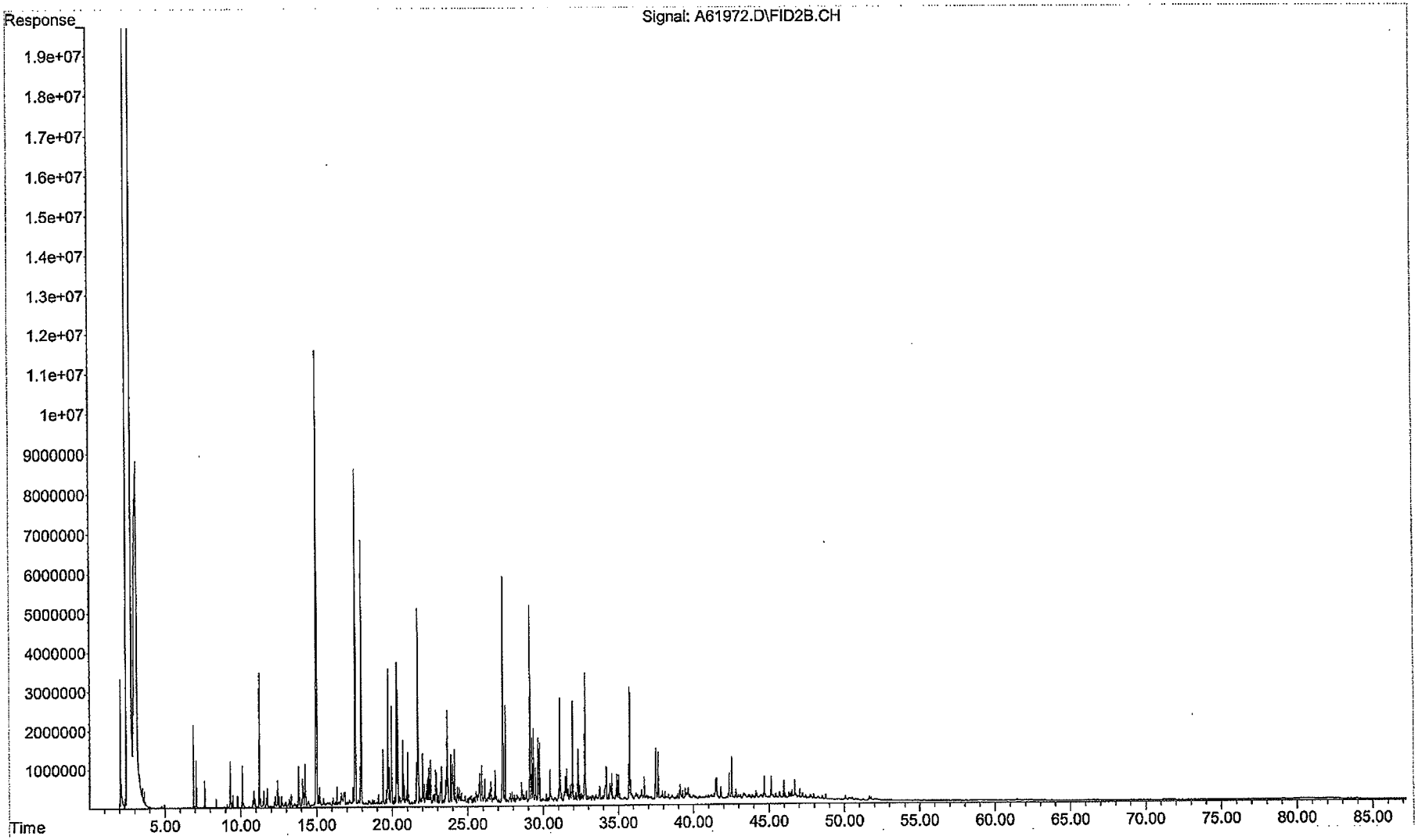
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Sample Name: 0801067-04
Misc Info : 1X
Vial Number: 63

SD-94(0-6)



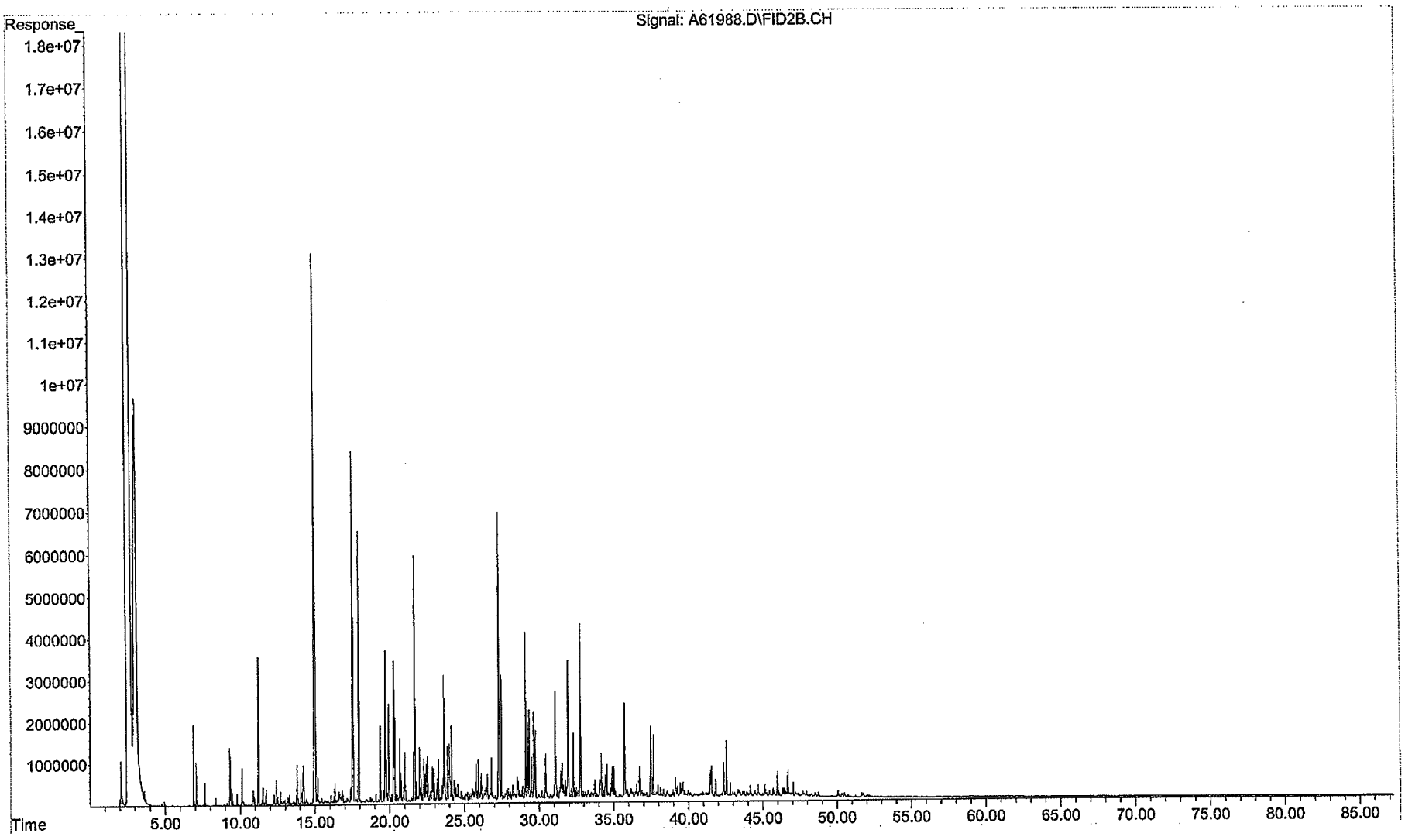
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Instrument : FID6
Sample Name: 0801067-03
Misc Info : 1X
Vial Number: 62

SD-96(0-6)



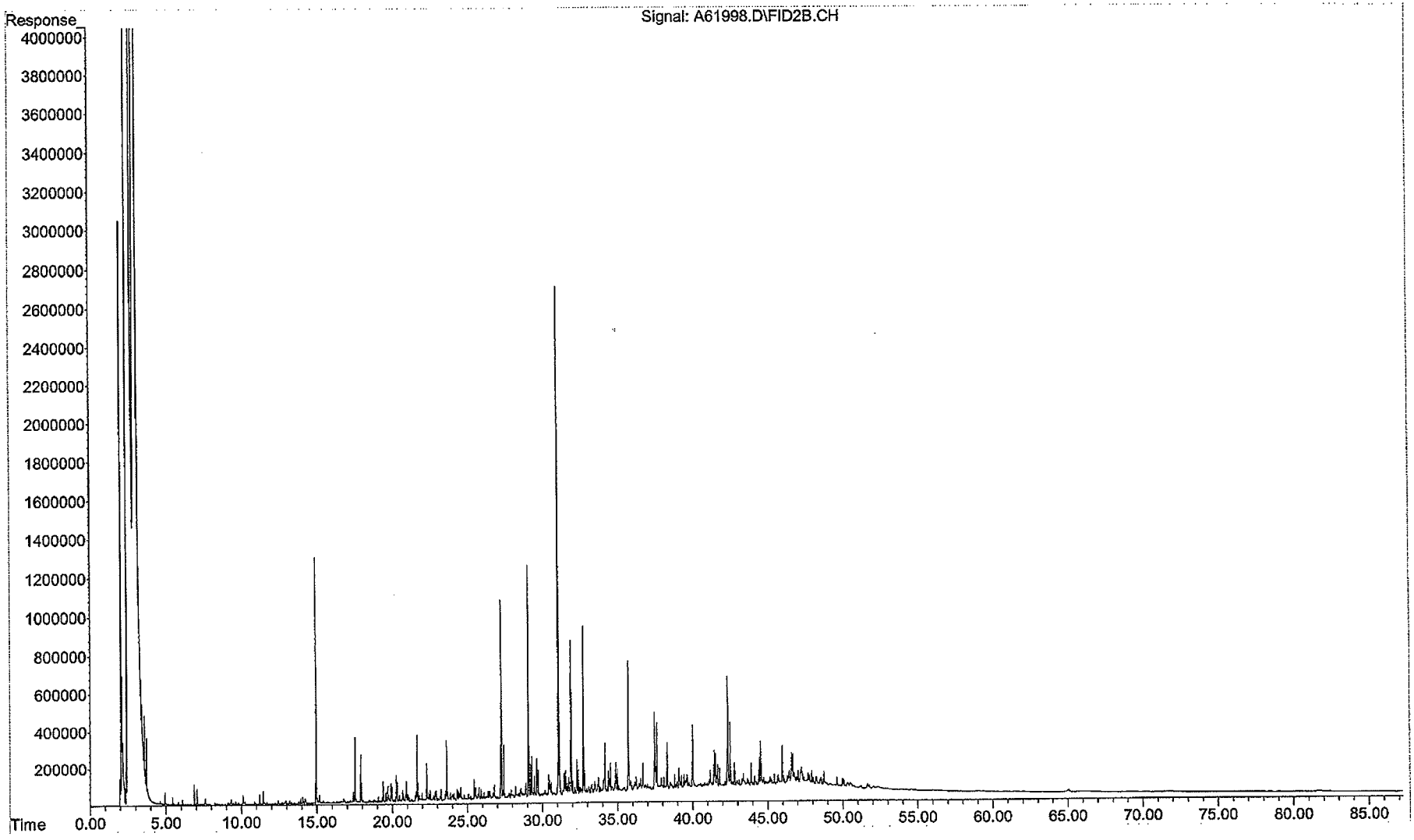
File :O:\Forensics\Data\FID6\fEB08\FEB11.SEC\A61988.D
Operator : NLJr
Acquired : 12 Feb 2008 6:33 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-09
Misc Info : 1X
Vial Number: 70

SD-95(0-6)



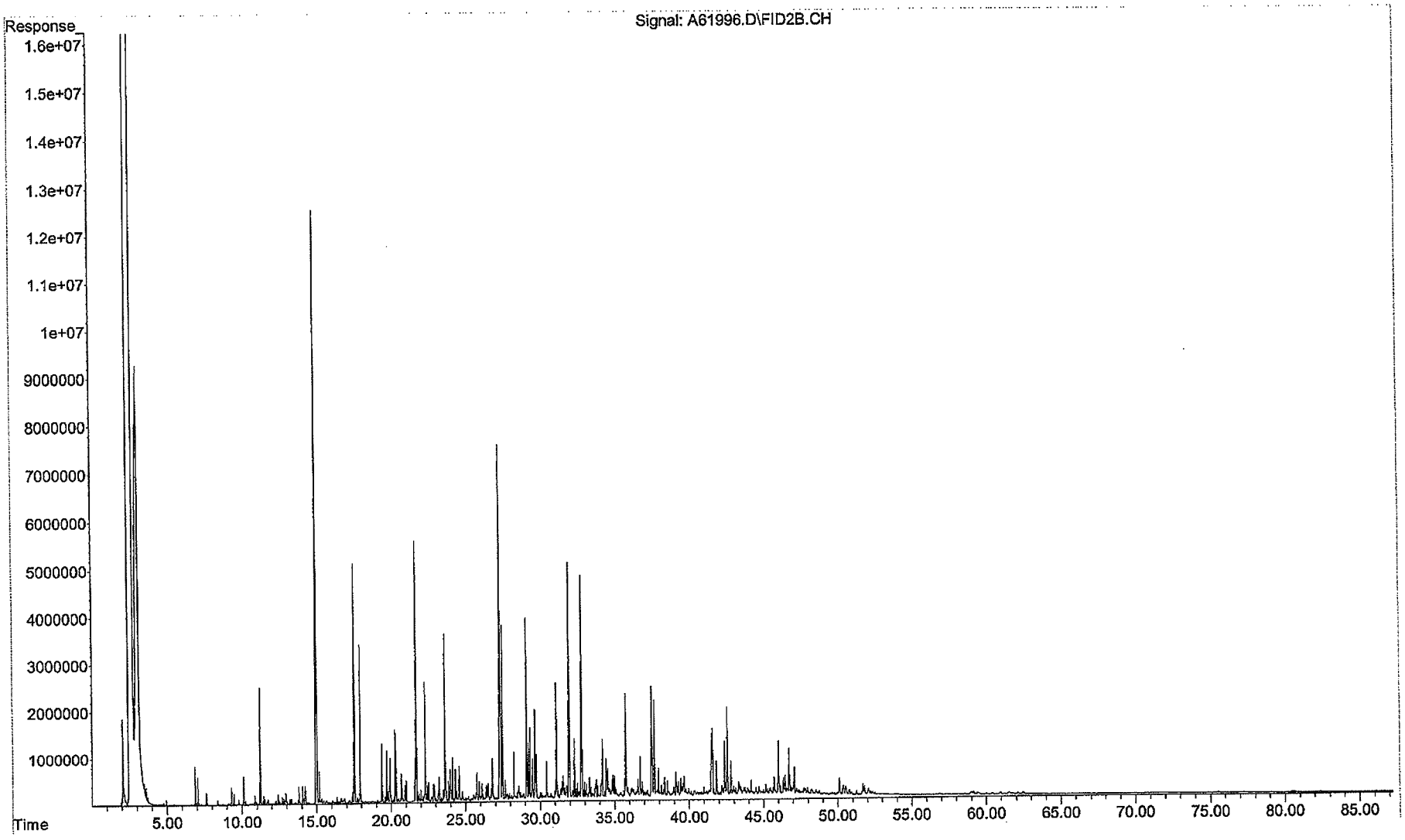
File :O:\Forensics\Data\FID6\fEB08\FEB11.SEC\A61998.D
Operator : NLJr
Acquired : 13 Feb 2008 2:48 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-14
Misc Info : 1X
Vial Number: 75

SD-95 (6-24)



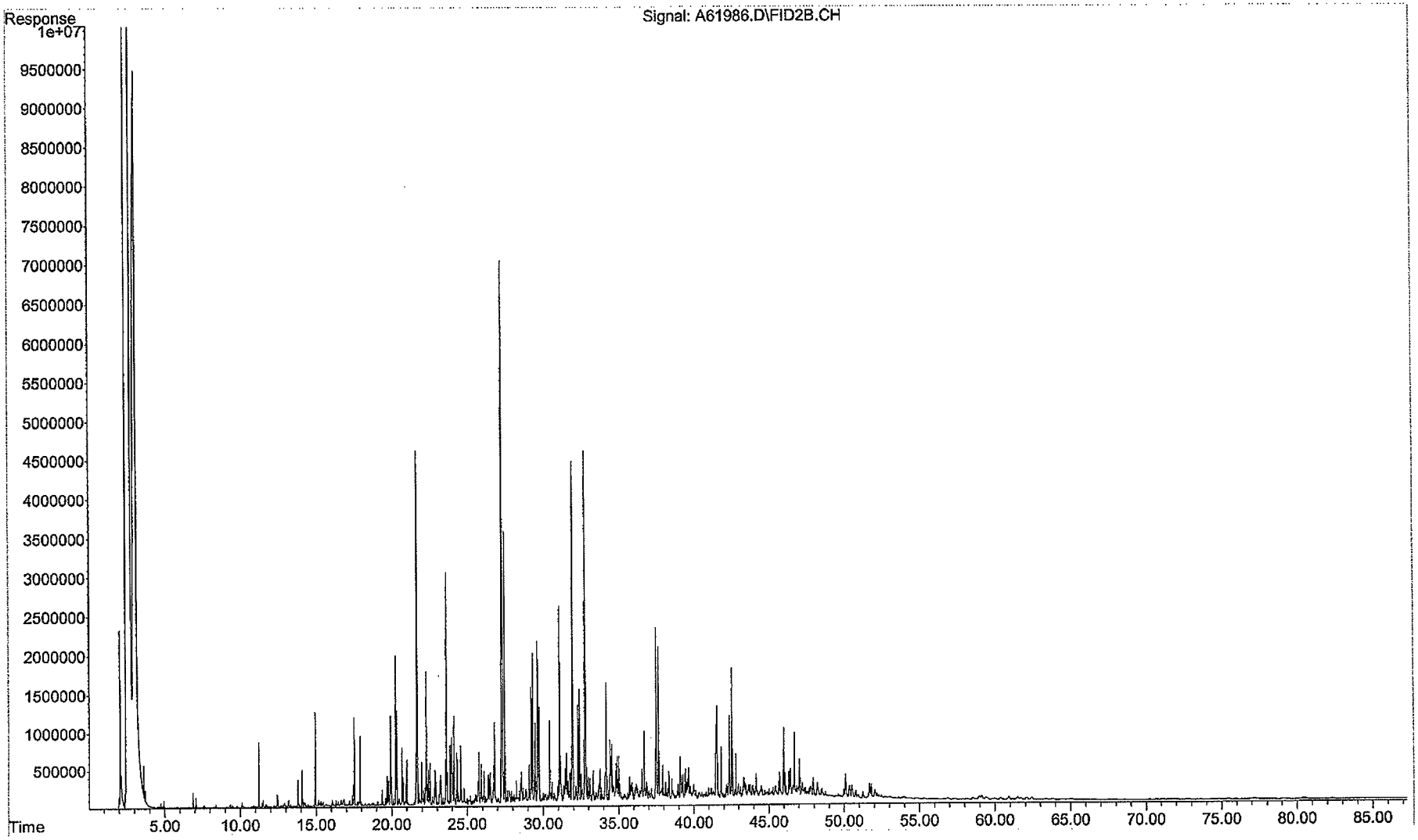
File :O:\Forensics\Data\FID6\fEB08\FEB11.SEC\A61996.D
Operator : NLJr
Acquired : 13 Feb 2008 1:09 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-13
Misc Info : 1X
Vial Number: 74

MPA-3



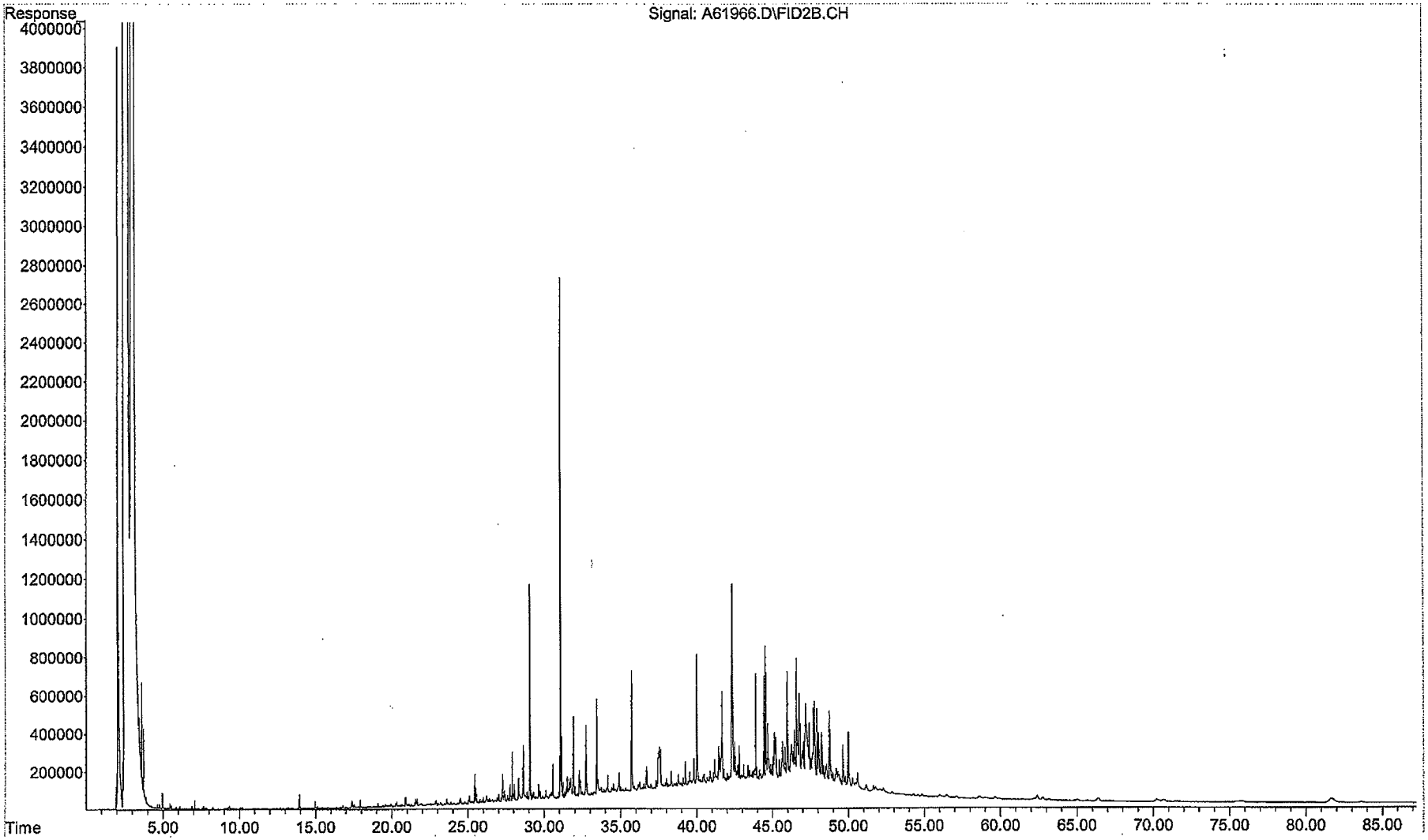
File :O:\Forensics\Data\FID6\fEB08\FEB11.SEC\A61986.D
Operator : NLJr
Acquired : 12 Feb 2008 4:54 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-08
Misc Info : 1X
Vial Number: 69

MPA-5



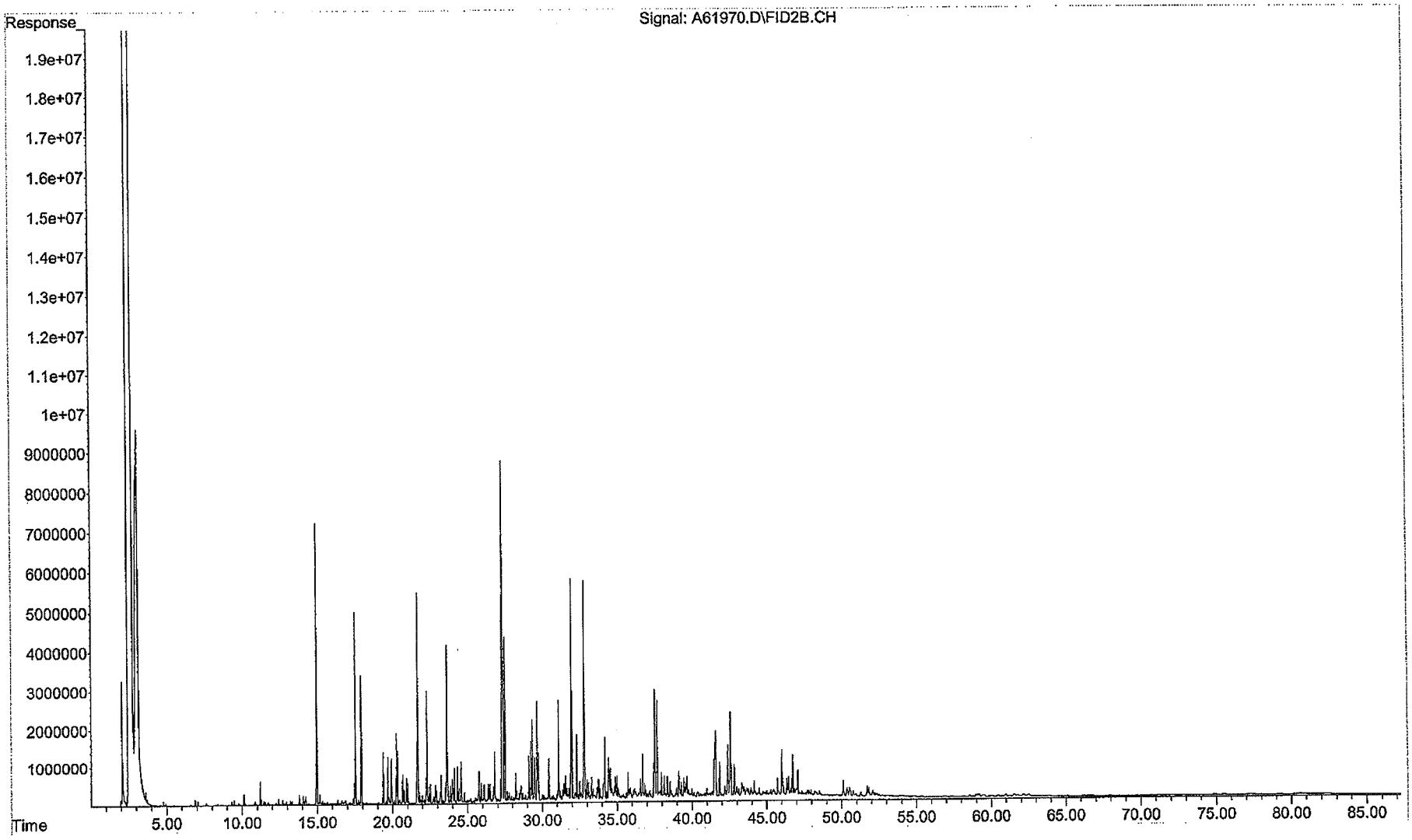
File :O:\Forensics\Data\FID6\fEB08\FEB11.SEC\A61966.D
Operator : NLJr
Acquired : 12 Feb 2008 12:24 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-01
Misc Info : 1X
Vial Number: 59

MPE2-2



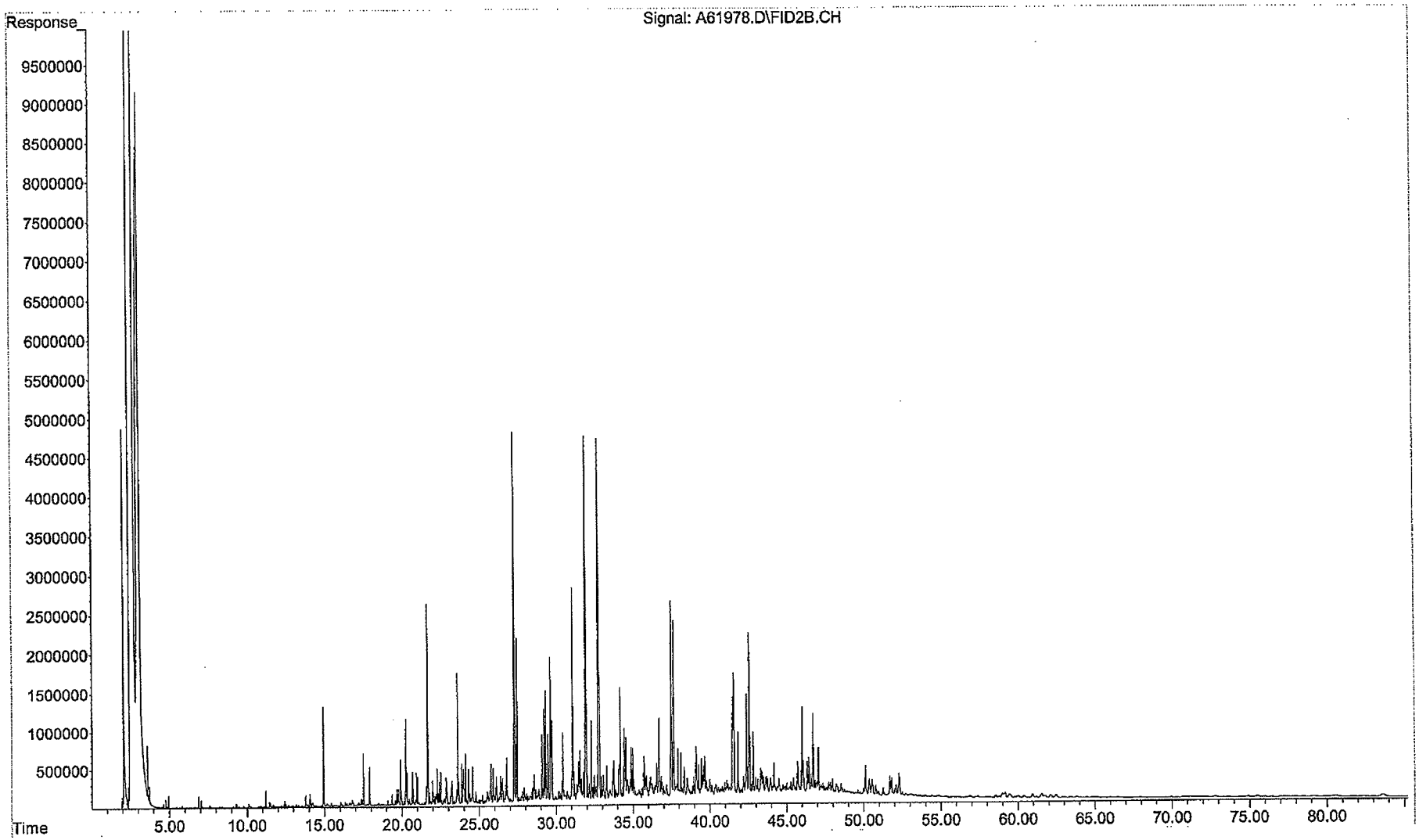
File :O:\Forensics\Data\FID6\fEB08\FEB11.SEC\A61970.D
Operator : NLJr
Acquired : 12 Feb 2008 3:42 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-02
Misc Info : 1X
Vial Number: 61

MPD-2



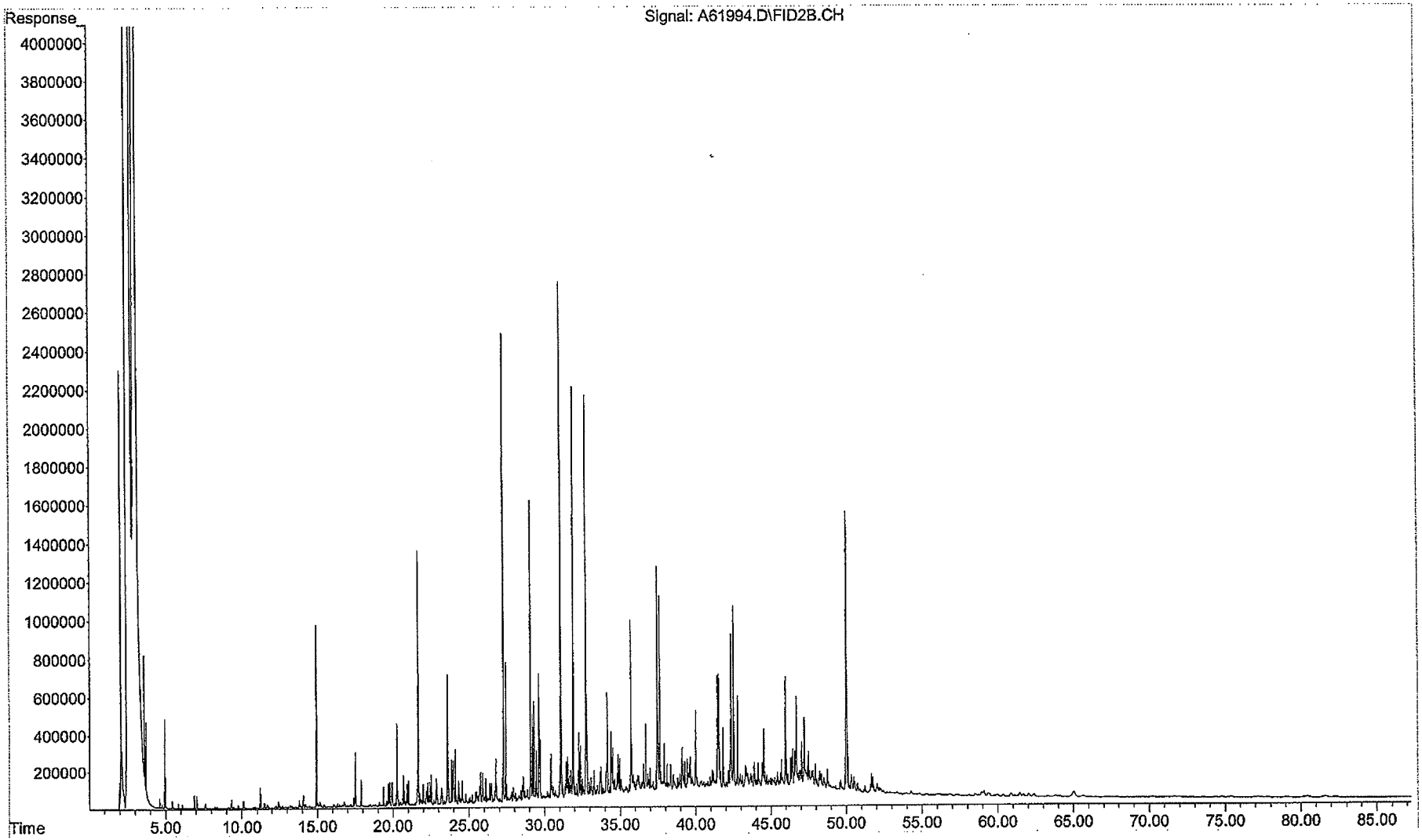
File :O:\Forensics\Data\FID6\fEB08\FEB11.SEC\A61978.D
Operator : NLJr
Acquired : 12 Feb 2008 10:18 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-06
Misc Info : 1X
Vial Number: 65

MPD-3



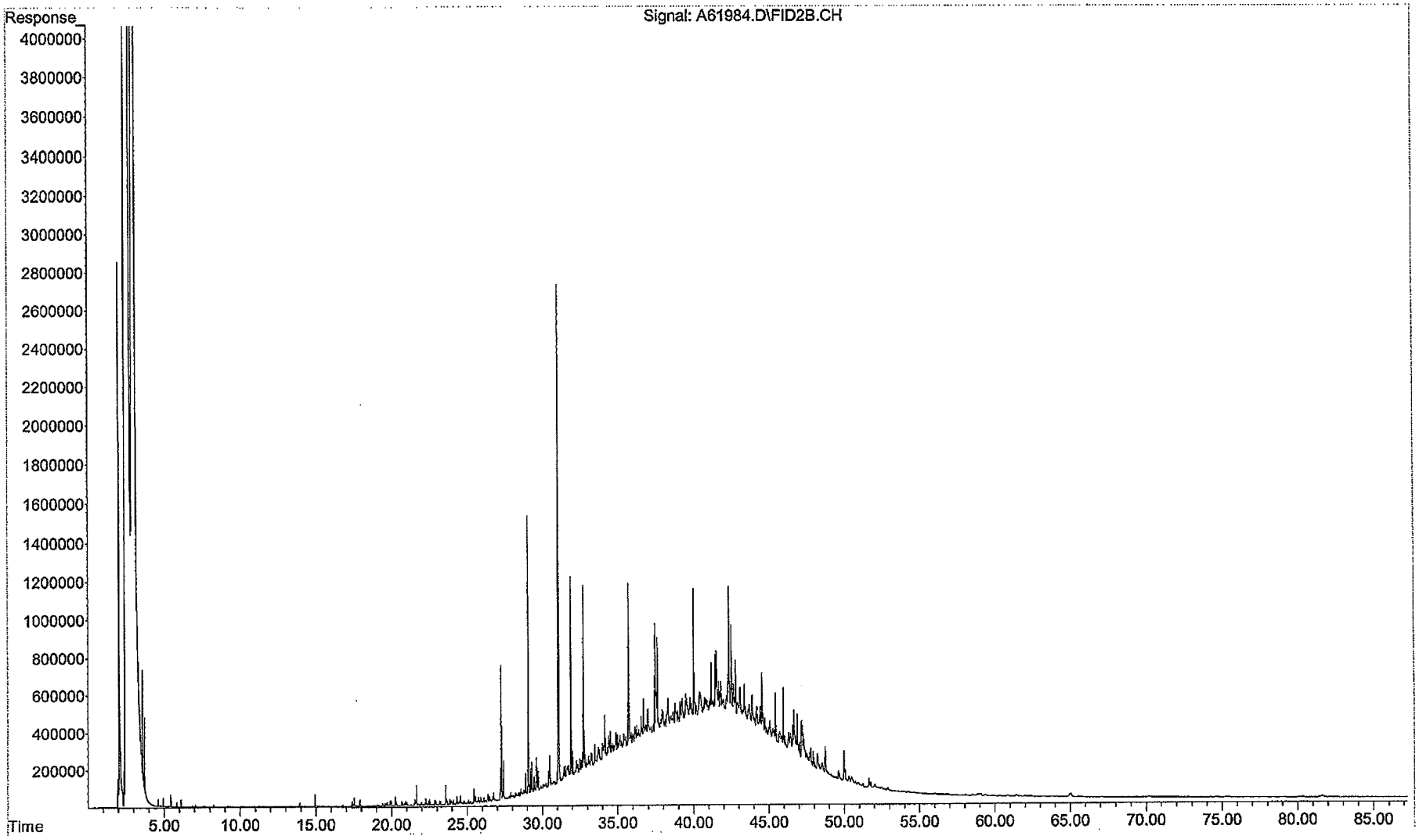
File :O:\Forensics\Data\FID6\fEB08\FEB11.SEC\A61994.D
Operator : NLJr
Acquired : 12 Feb 2008 11:30 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-12
Misc Info : 1X
Vial Number: 73

MPD-4



File :O:\Forensics\Data\FID6\fEB08\FEB11.SEC\A61984.D
Operator : NLJr
Acquired : 12 Feb 2008 3:15 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0801067-07
Misc Info : 1X
Vial Number: 68

MPD-8



PAH FINGERPRINTS

Form IV
Method Blank Summary
Total Saturated Hydrocarbons by GC/FID

Client: **ARCADIS**
Project: **National Grid Water Street**

Case: **N/A** SDG: **N/A**

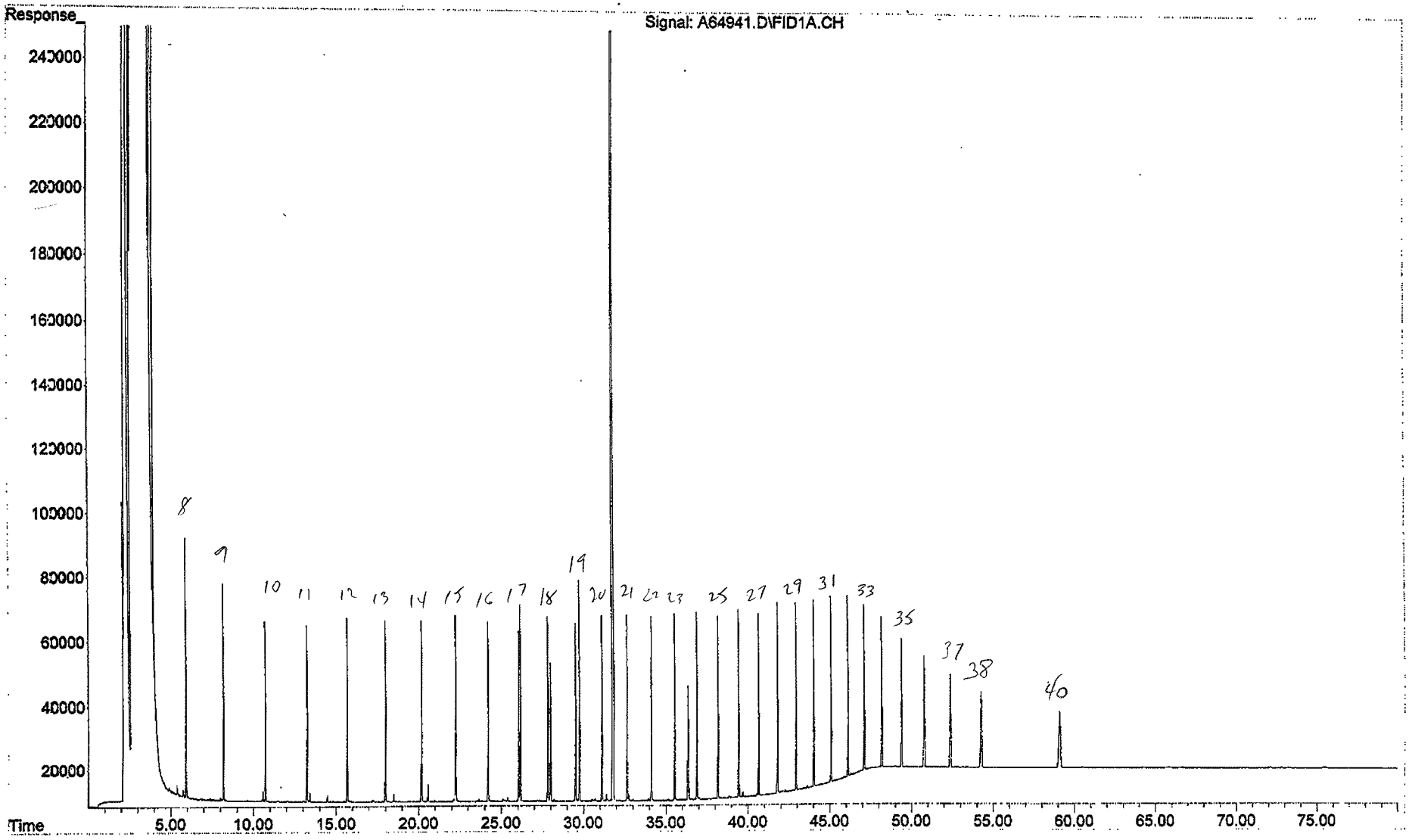
Lab Code: **MA00030**
ETR: **0810073**
Lab ID: **SS101708B08**
Date Analyzed: **10/20/08 18:21**

Client ID	Lab ID	Date/Time Analyzed
LCS	SS101708LCS04	10/20/08 19:53
LCSD	SS101708LCSD03	10/20/08 21:26
MPD-3	0810073-01	10/21/08 00:31
MPE 2-2	0810073-02	10/21/08 02:02
MPA-5	0810073-05	10/21/08 03:33
MPU-3	0810073-06	10/21/08 05:05
MPA-1	0810073-08	10/21/08 06:37
MPA-1	0810073-08 M	10/21/08 08:09
MPA-1	0810073-08 S	10/21/08 14:17
DUP-1	0810073-09	10/21/08 15:49
MPD-4	0810073-12	10/21/08 17:21
MPD-8	0810073-16	10/21/08 18:53
MPD-2	0810073-17	10/21/08 20:26
SD-96	0810073-18	10/21/08 21:59
SD-87	0810073-20	10/21/08 23:31

N/A - Not Applicable

320 Forbes Blvd, Mansfield, MA 02048, (508) 822-9300, Fax (508) 822-3288

File :O:\FORENSICS\DATA\FID6\JULY08\JUL25\A64941.D
Operator : NLJr
Acquired : 25 Jul 2008 10:33 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: I607250801F
Misc Info : Level 1 WHAF92
Vial Number: 6



Form IV
Method Blank Summary
Total Saturated Hydrocarbons by GC/FID

Client: **ARCADIS**
Project: **National Grid Water Street**
Case: **N/A** SDG: **N/A**

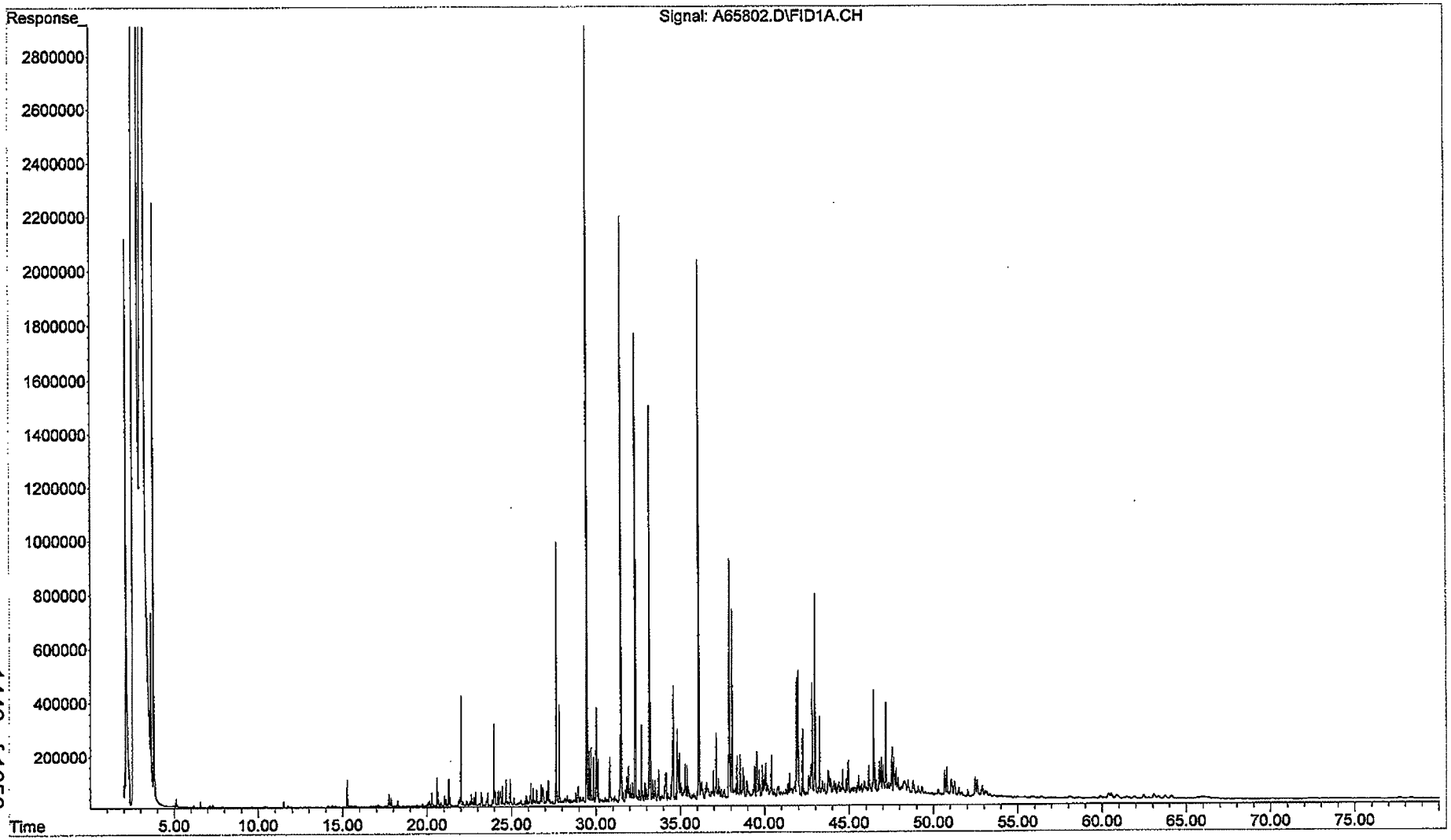
Lab Code: **MA00030**
ETR: **0810073**
Lab ID: **SO102208B01**
Date Analyzed: **10/28/08 15:23**

Client ID	Lab ID	Date/Time Analyzed
LCS	SO102208LCS01	10/23/08 10:41
LCSD	SO102208LCSD01	10/23/08 12:14
MPE2-1 NAPL	0810073-24	10/23/08 13:47
SD-96 NAPL	0810073-25	10/23/08 15:20

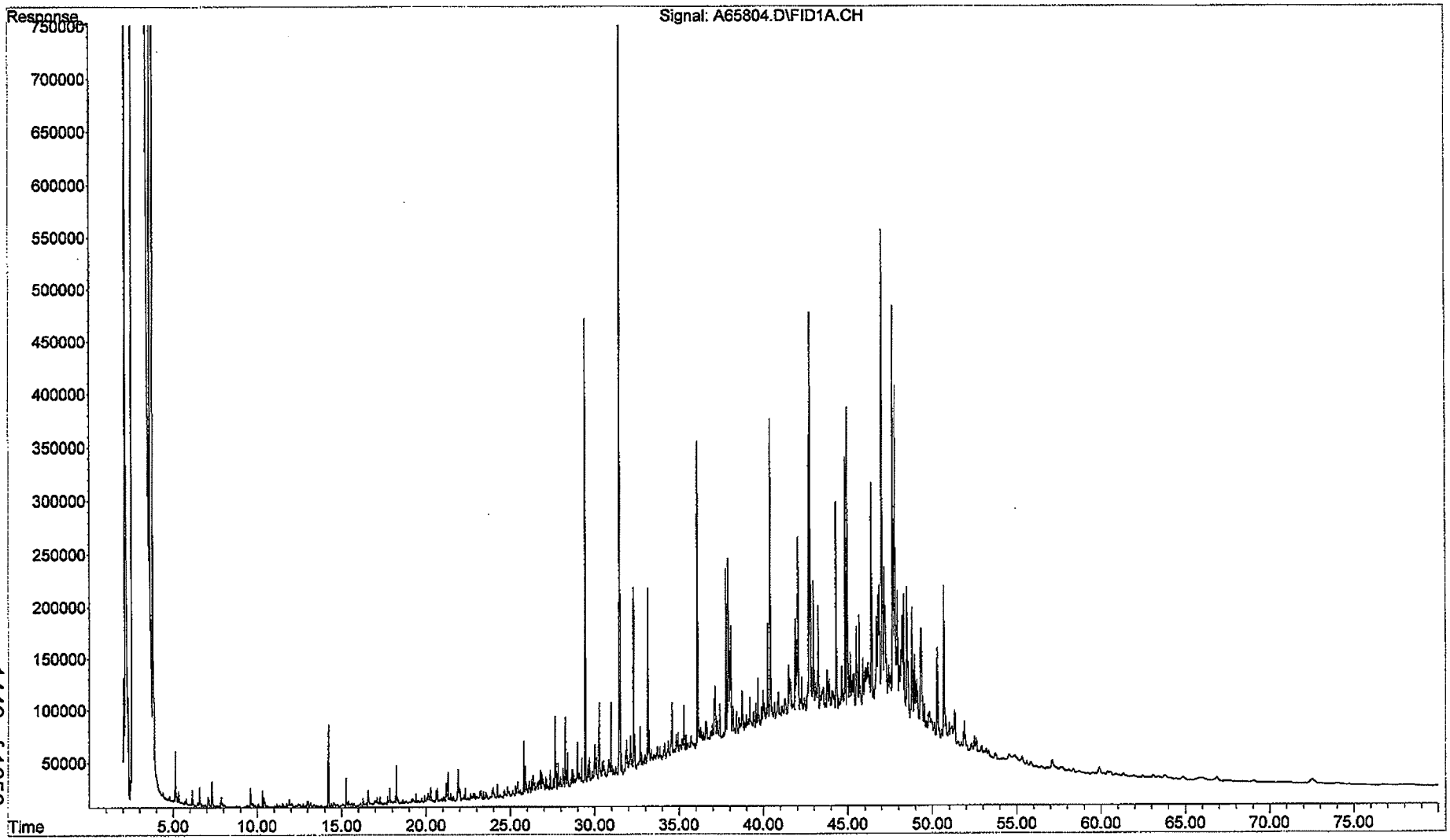
N/A - Not Applicable

320 Forbes Blvd, Mansfield, MA 02048, (508) 822-9300, Fax (508) 822-3288

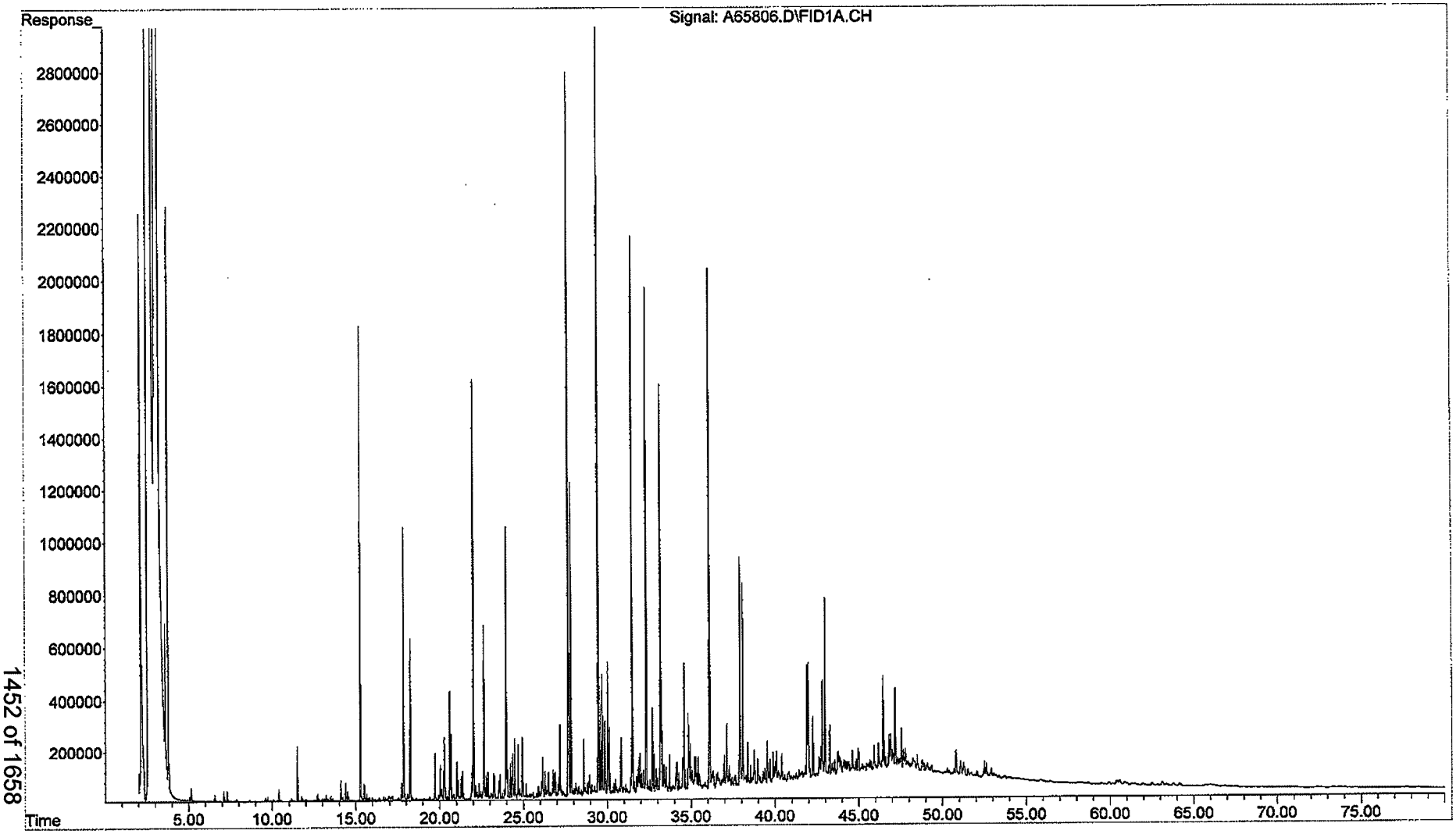
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65802.D
Operator : NLJr
Acquired : 21 Oct 2008 12:31 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-01
Misc Info : 1X
Vial Number: 9



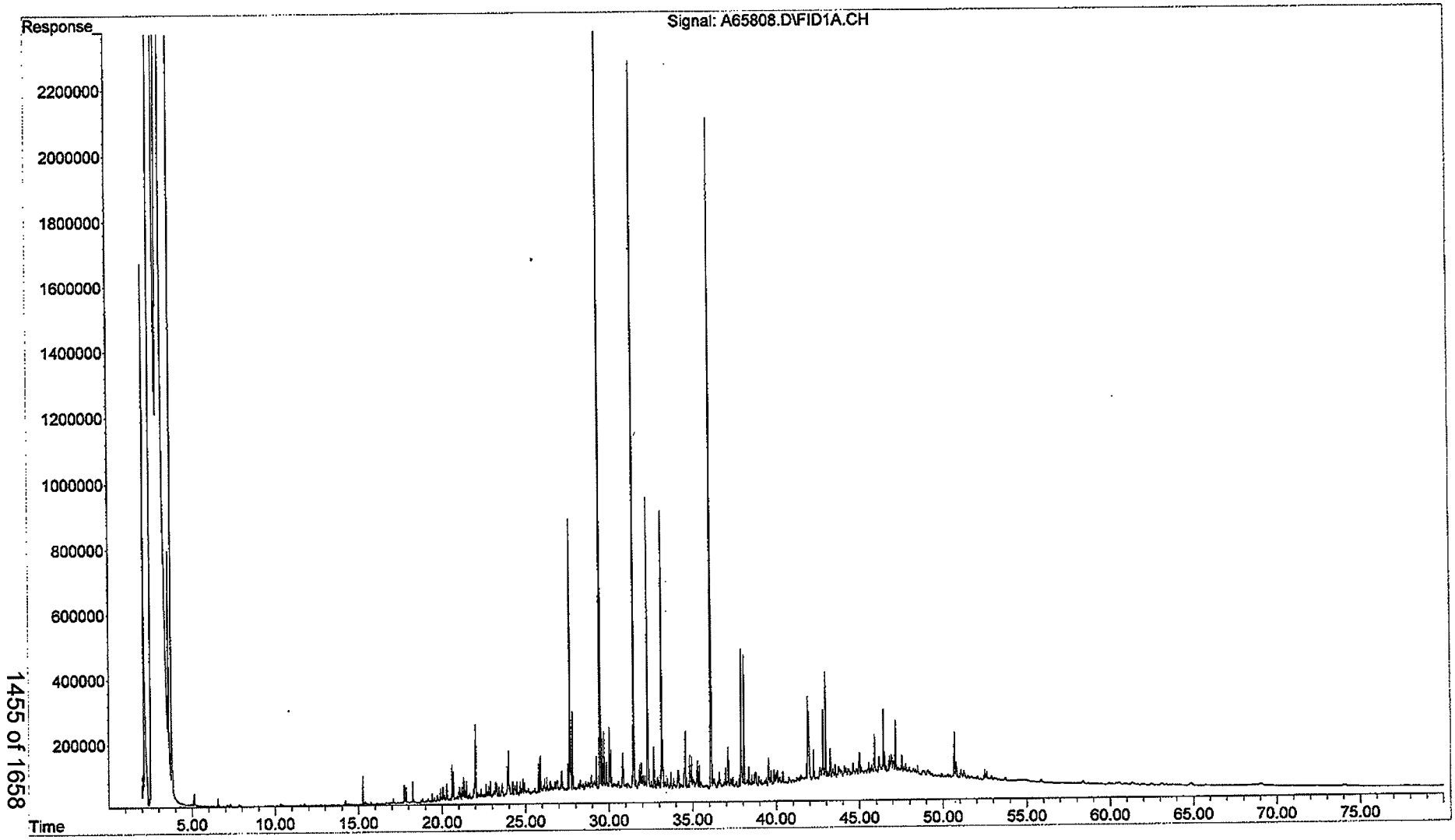
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65804.D
Operator : NLJr
Acquired : 21 Oct 2008 2:02 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-02
Misc Info : 1X
Vial Number: 10



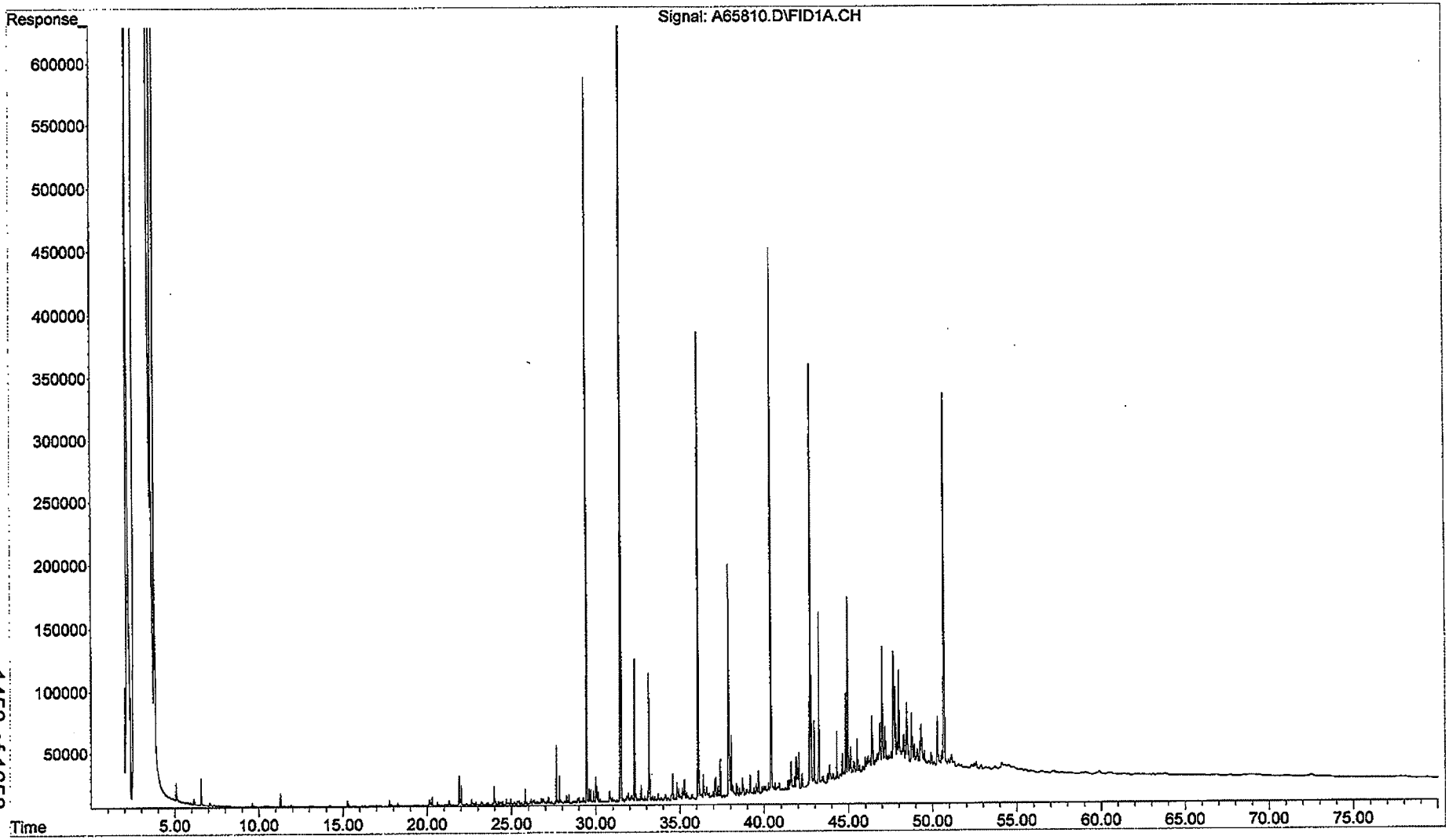
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65806.D
Operator : NLJr
Acquired : 21 Oct 2008 3:33 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-05
Misc Info : 1X
Vial Number: 11



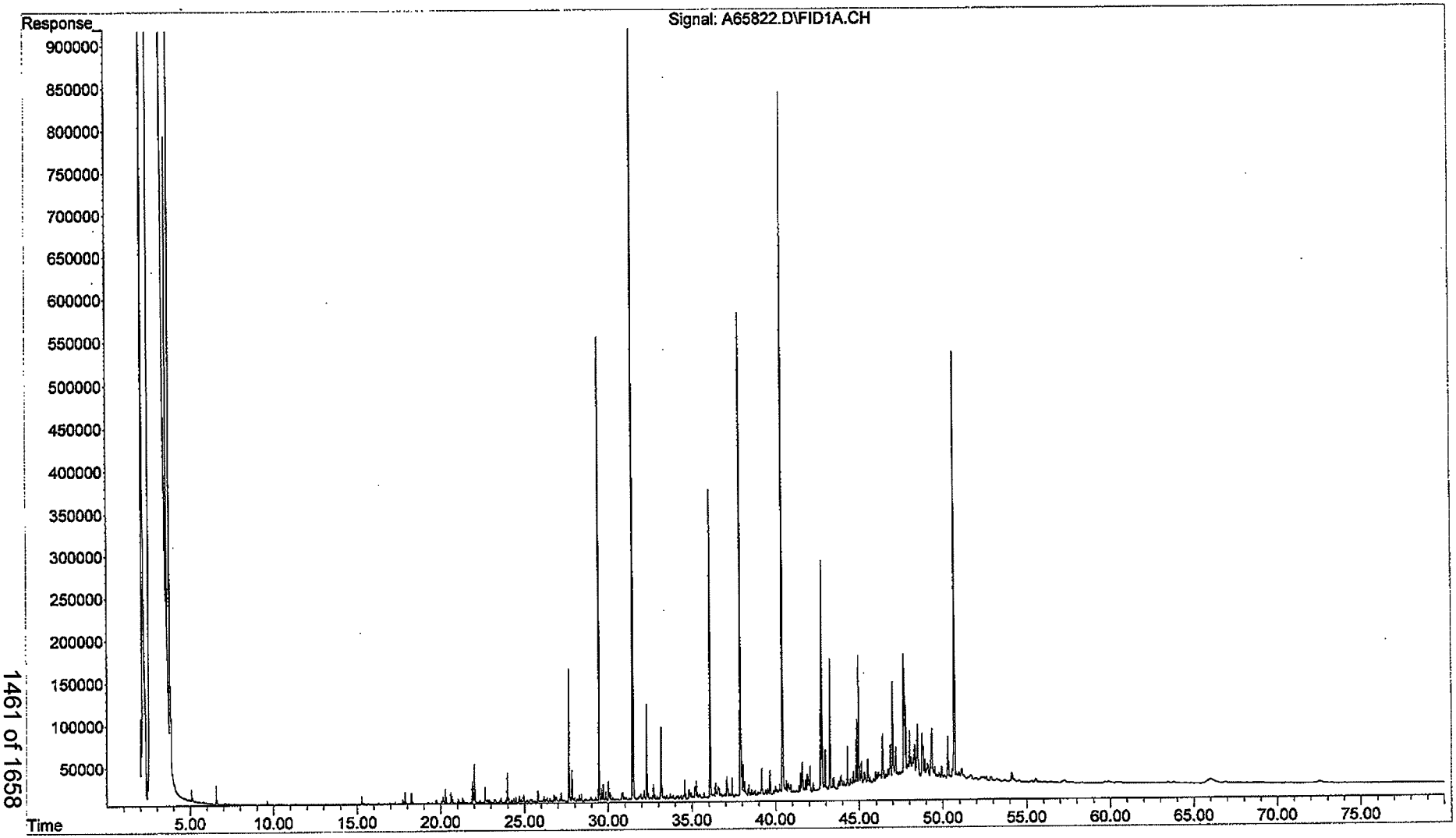
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65808.D
Operator : NLJr
Acquired : 21 Oct 2008 5:05 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-06
Misc Info : 1X
Vial Number: 12



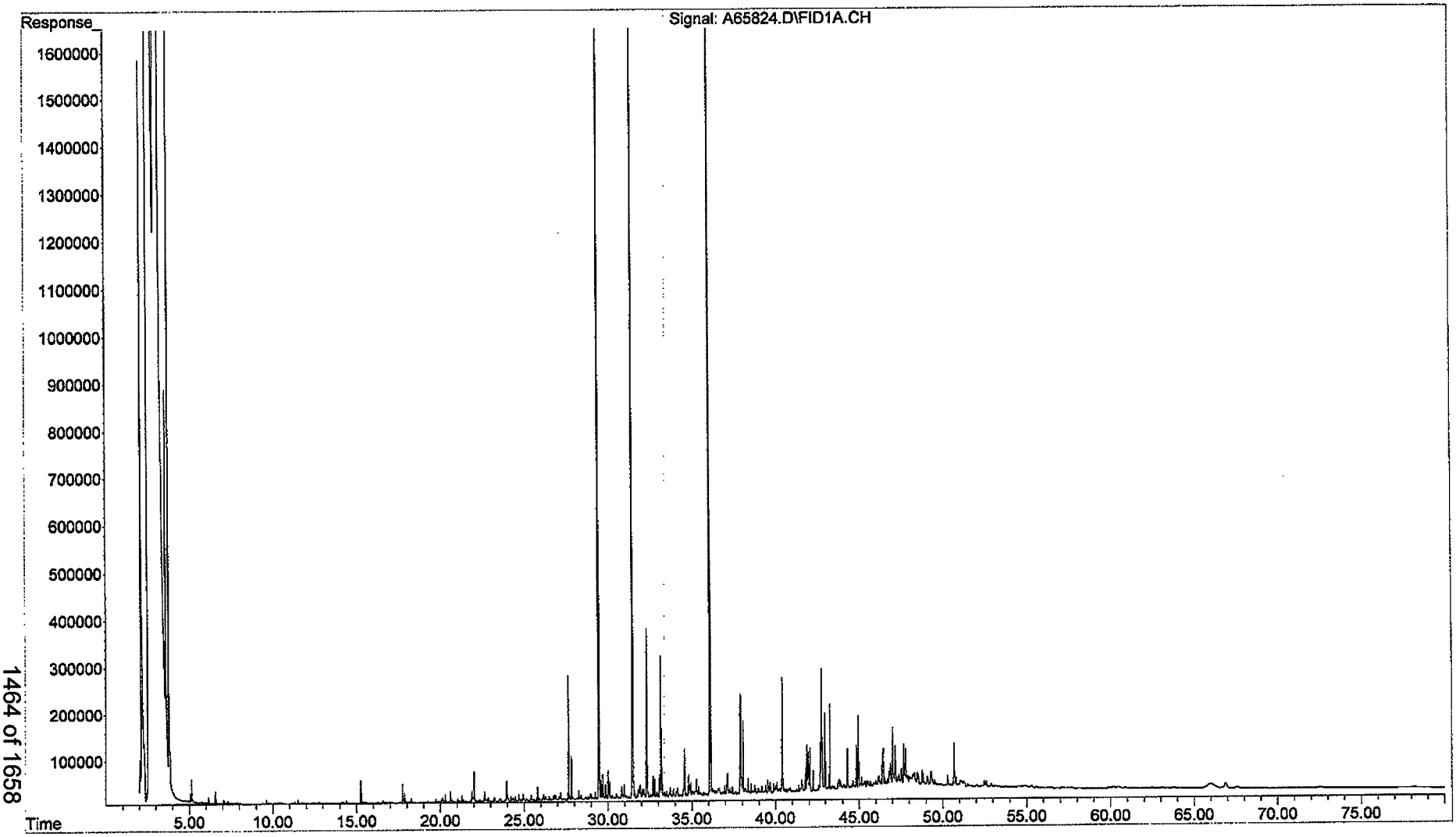
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65810.D
Operator : NLJr
Acquired : 21 Oct 2008 6:37 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-08
Misc Info : 1X
Vial Number: 13



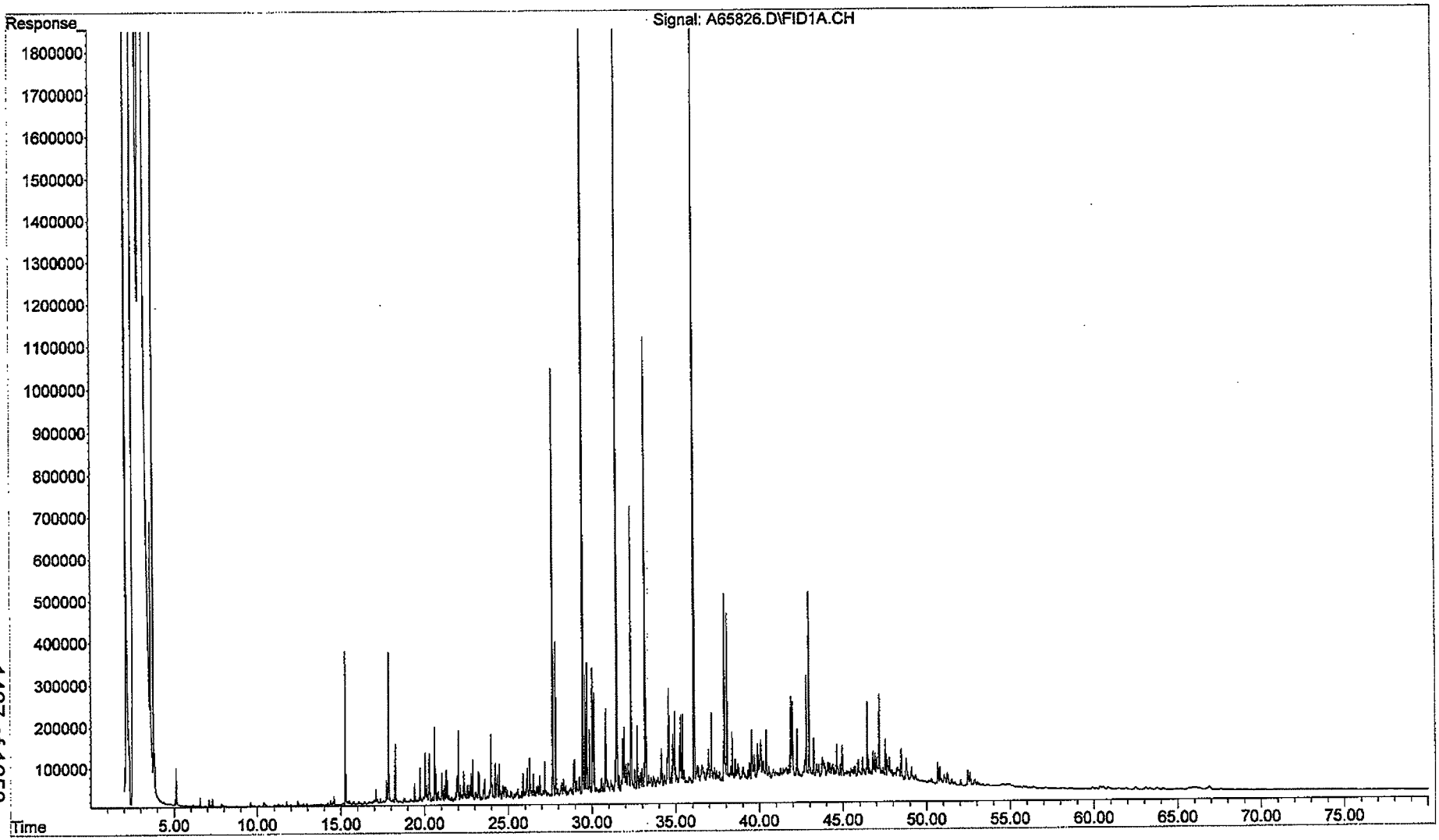
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65822.D
Operator : NLJr
Acquired : 21 Oct 2008 3:49 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-09
Misc Info : 1X
Vial Number: 19



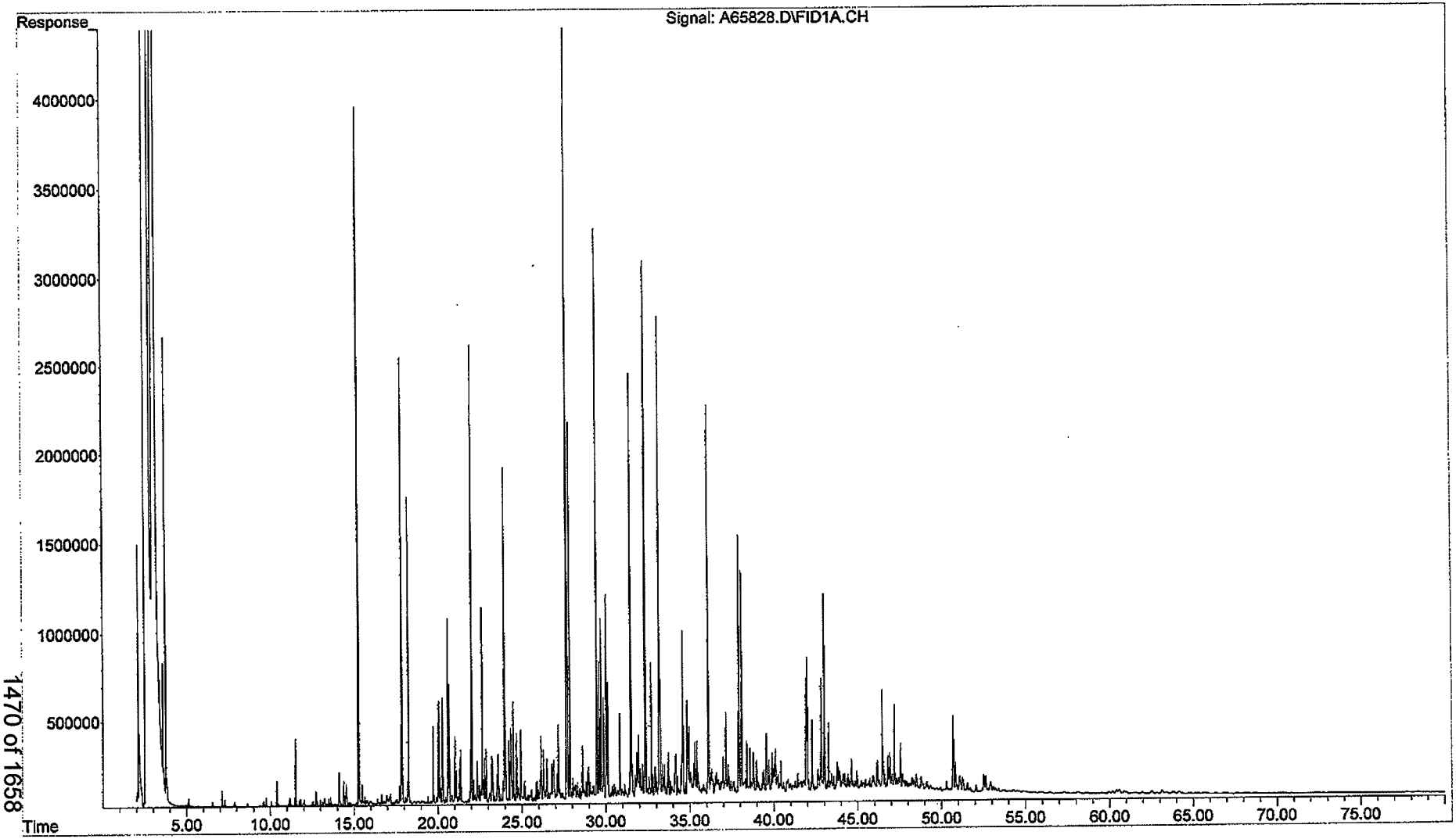
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65824.D
Operator : NLJr
Acquired : 21 Oct 2008 5:21 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-12
Misc Info : 1X
Vial Number: 20



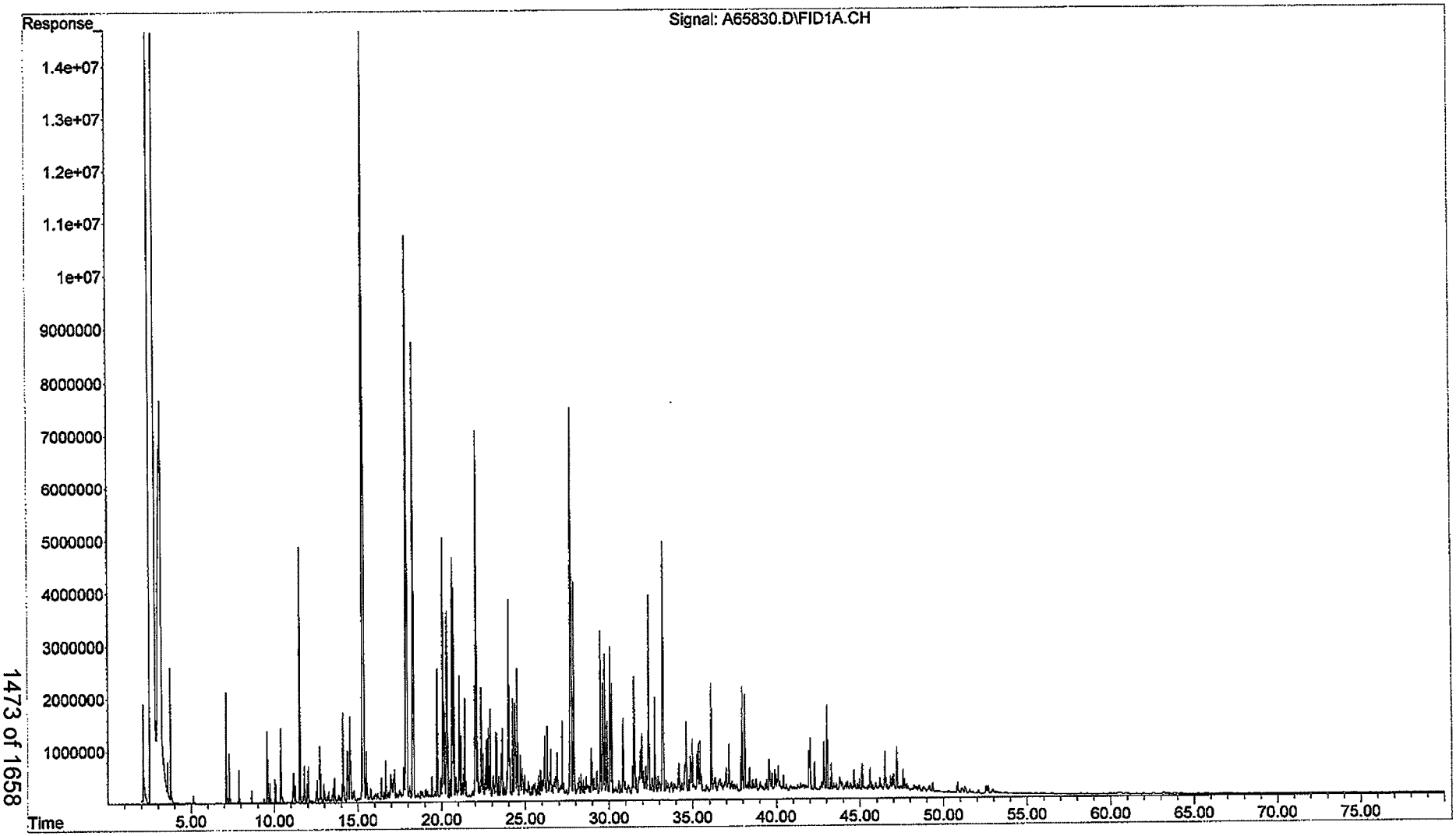
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65826.D
Operator : NLJr
Acquired : 21 Oct 2008 6:53 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-16
Misc Info : 1X
Vial Number: 21



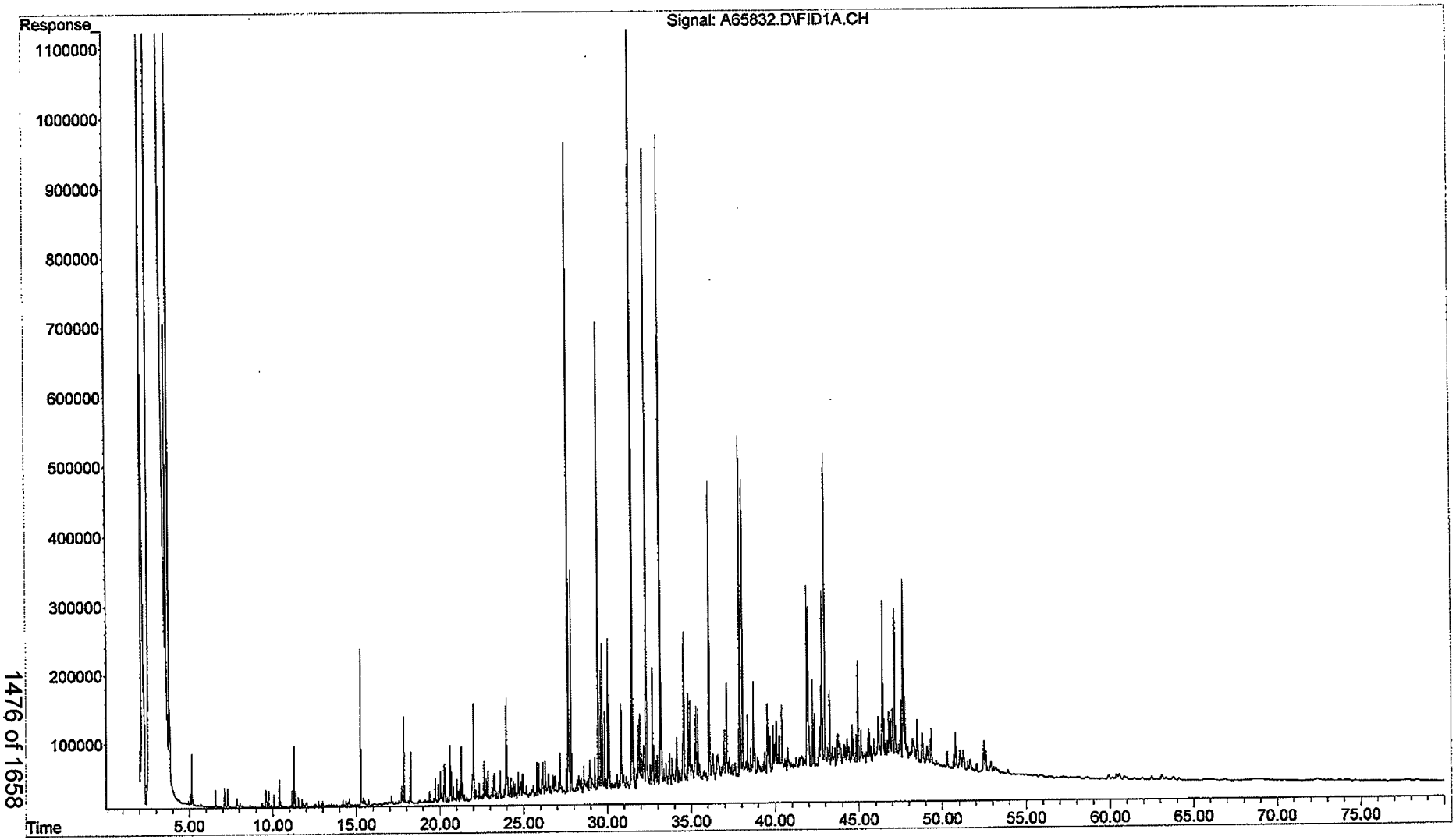
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Operator : NLJr
Acquired : 21 Oct 2008 8:26 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-17
Misc Info : 1X
Vial Number: 22



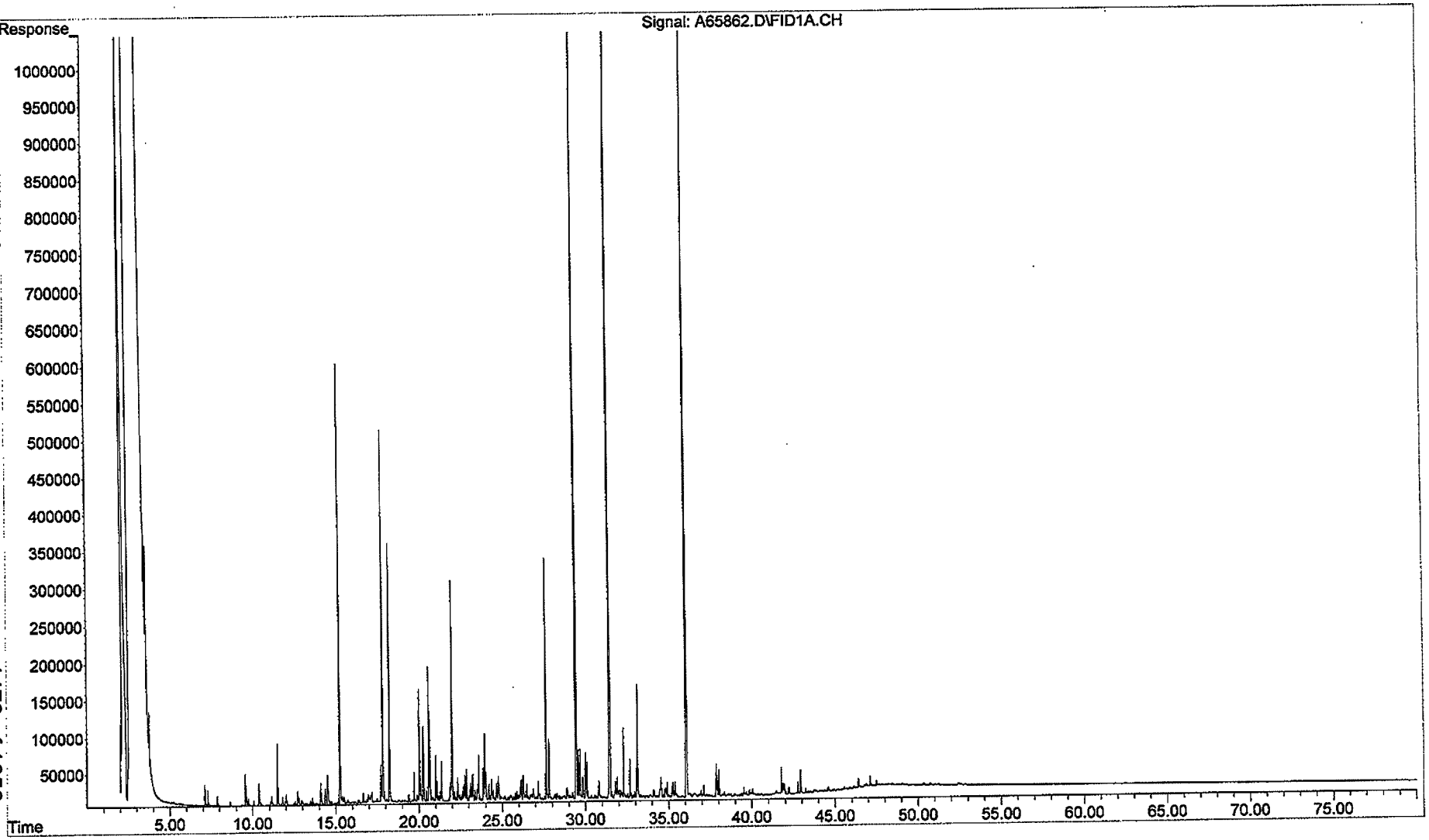
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65830.D
Operator : NLJr
Acquired : 21 Oct 2008 9:59 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-18
Misc Info : 1X
Vial Number: 23



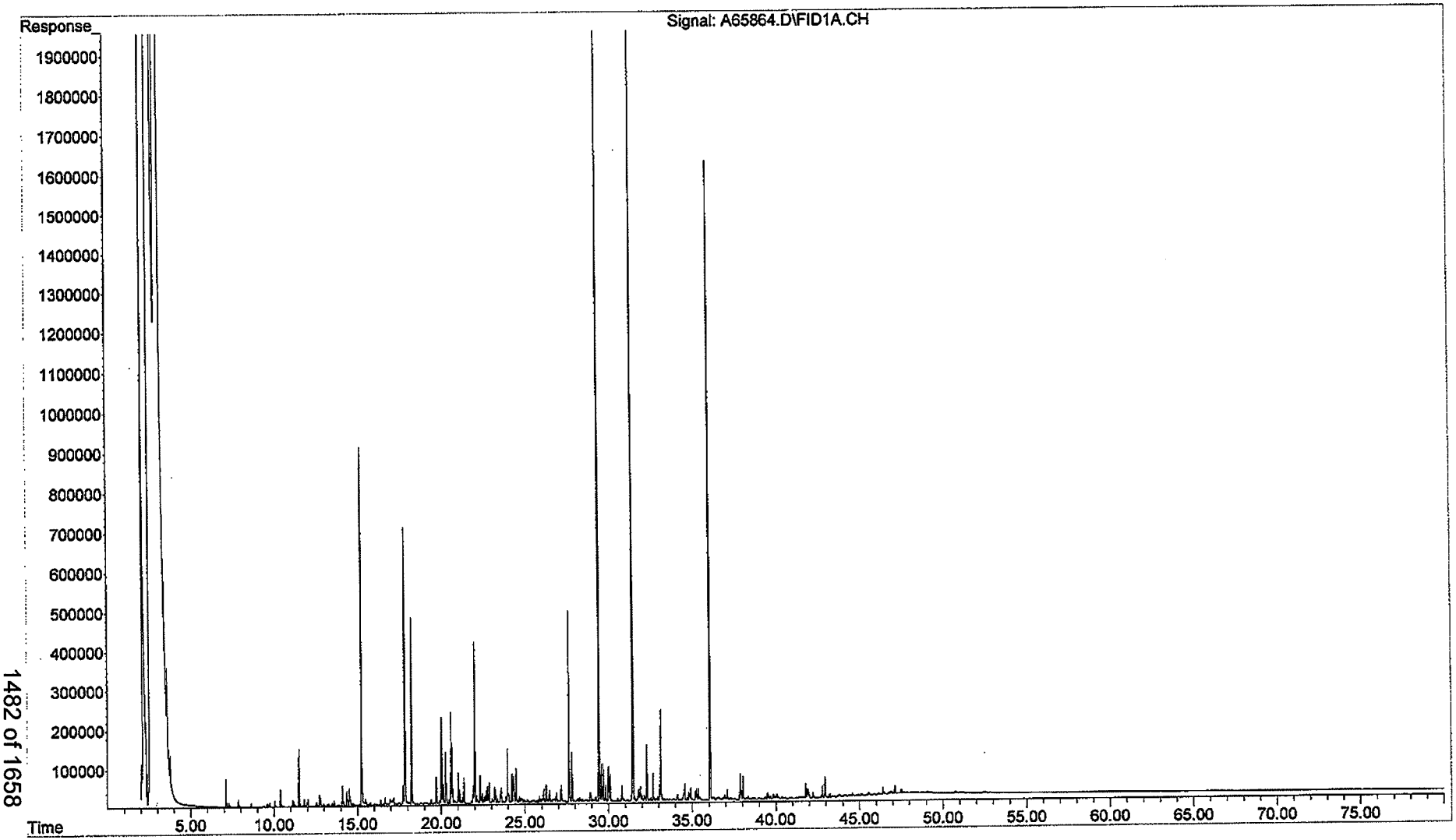
File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65832.D
Operator : NLJr
Acquired : 21 Oct 2008 11:31 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-20
Misc Info : 1X
Vial Number: 24



File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65862.D
Operator : NLJr
Acquired : 23 Oct 2008 1:47 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-24
Misc Info : 1X
Vial Number: 39



File :O:\FORENSICS\DATA\FID6\OCT08\OCT20\A65864.D
Operator : NLJr
Acquired : 23 Oct 2008 3:20 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0810073-25
Misc Info : 1X
Vial Number: 40



Sample ID Cross Reference

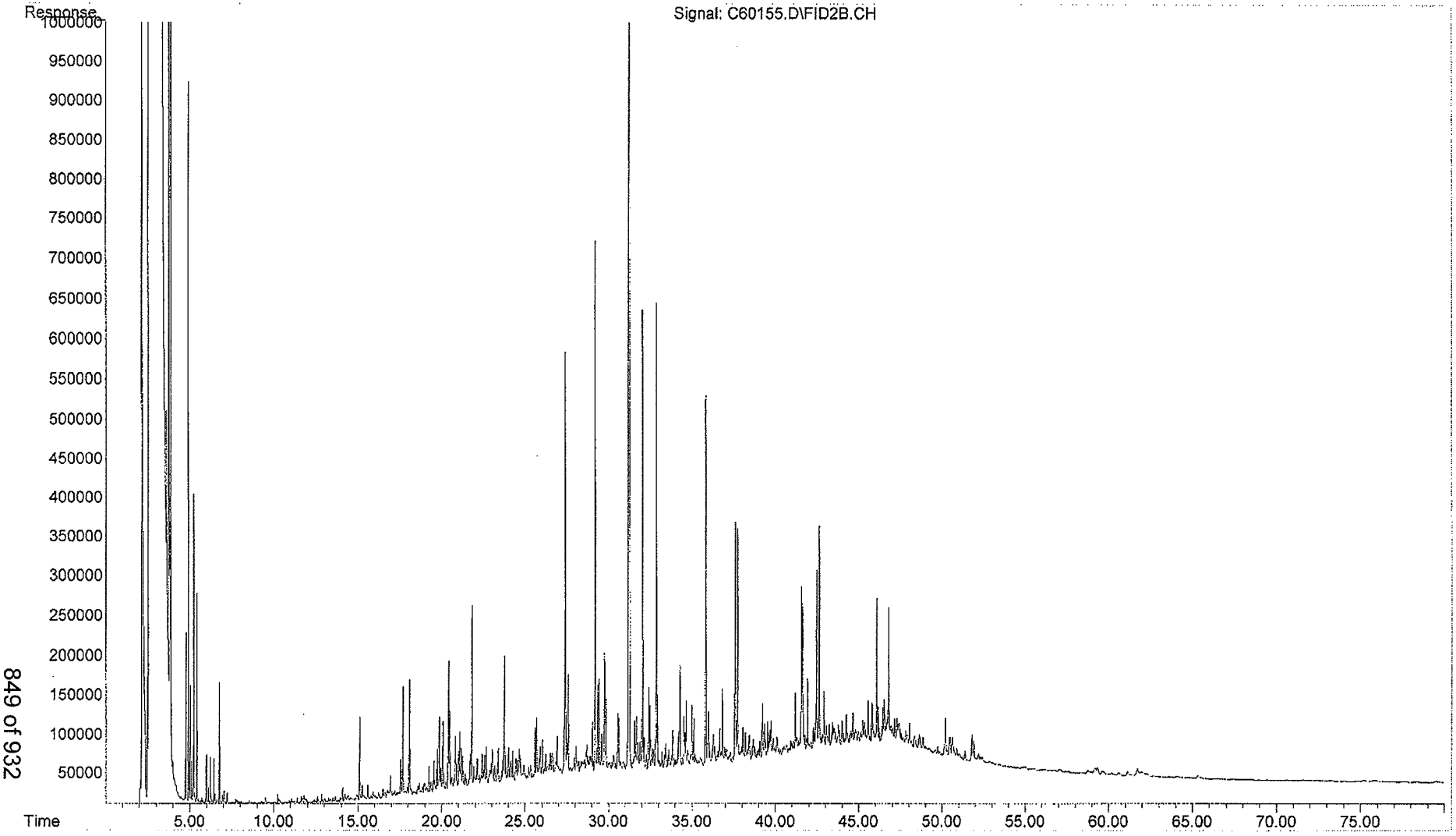
Client: **ARCADIS** Lab Code: **MA00030**

Project: **National Grid Hudson (Water Street) Site - 2009** ETR: **0910018**

Lab Sample ID	Client Sample ID
0910018-01	MPD-5 (0-0.5)
0910018-02	MPD-7 (0-0.5)
0910018-03	MPD-6 (0-0.5)
0910018-04	MPD-8 (0-0.5)
0910018-05	MPA-3 (0-0.5)
0910018-06	MPA-2 (0-0.5)
0910018-07	MPA-4 (0-0.5)
0910018-08	MPD-1 (0-0.5)
0910018-09	MPD-2 (0-0.5)
0910018-10	MPD-3 (0-0.5)
0910018-11	MPD-4 (0-0.5)
0910018-12	MPA-1 (0-0.5)
0910018-13	SD-87
0910018-14	MPA-5
0910018-15	SD-96
0910018-16	DUP-100909
0910018-17	MPE-2-3
0910018-18	MPE-2-2
0910018-19	MPE-2-1
0910018-20	MPU-3

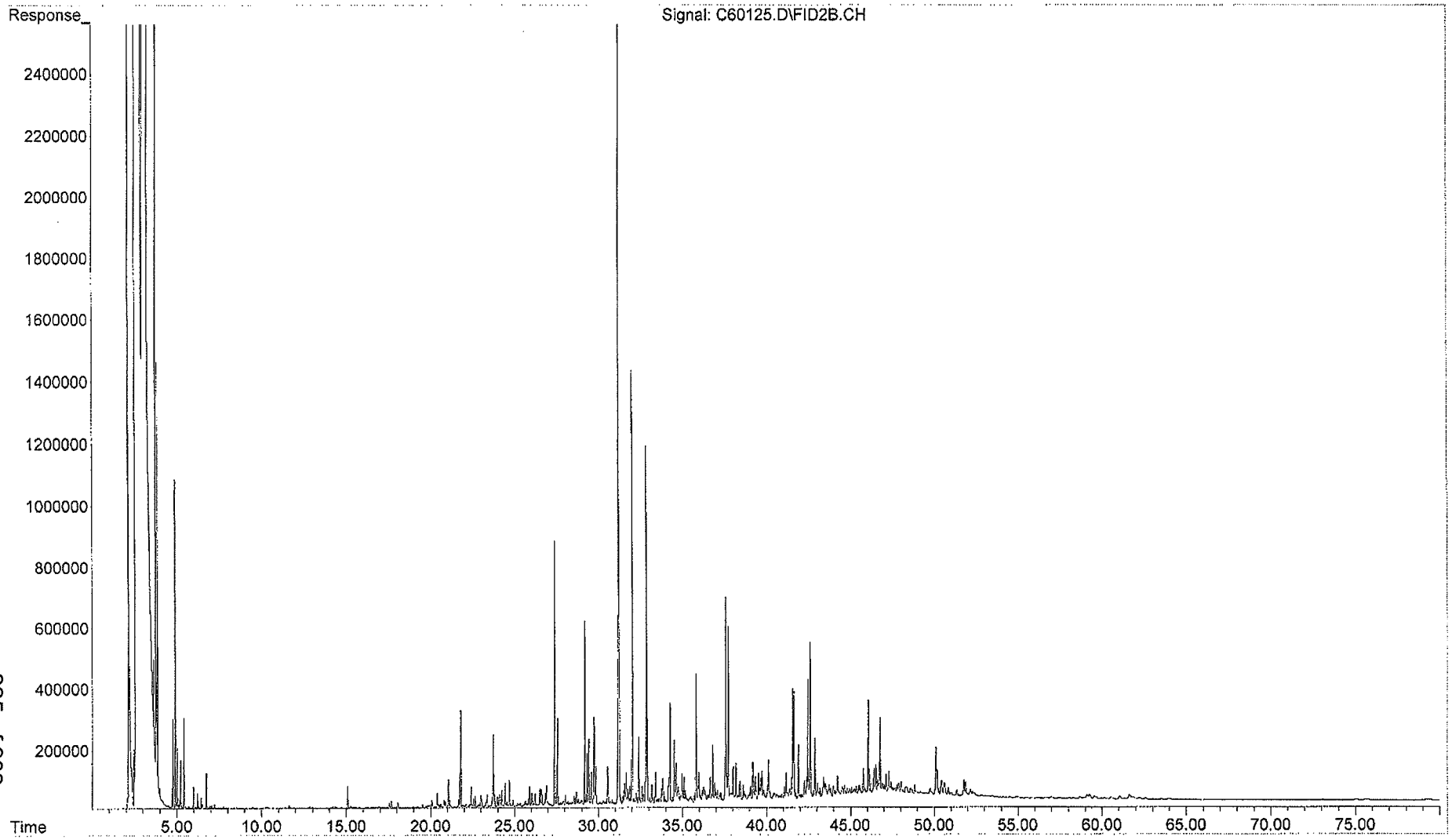
File :O:\FORENSICS\DATA\FID6\2009\OCT09\OCT21.SEC\C60155.D
Operator : NLJr
Acquired : 25 Oct 2009 12:15 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-20
Misc Info : 1X
Vial Number: 87

MPU-3



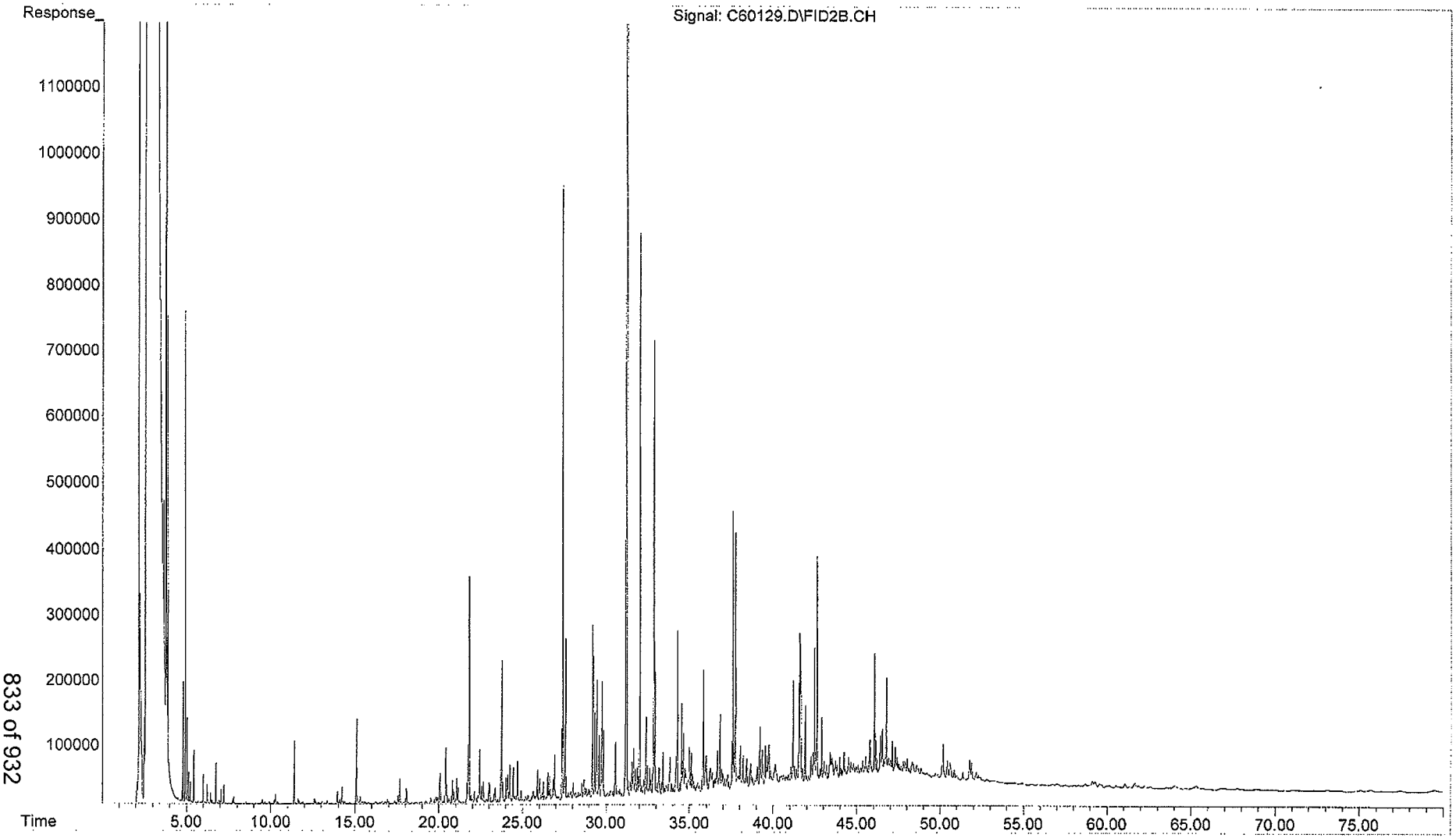
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Operator : NLJr
Acquired : 24 Oct 2009 1:16 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-12
Misc Info : 1X
Vial Number: 72

MPA-1



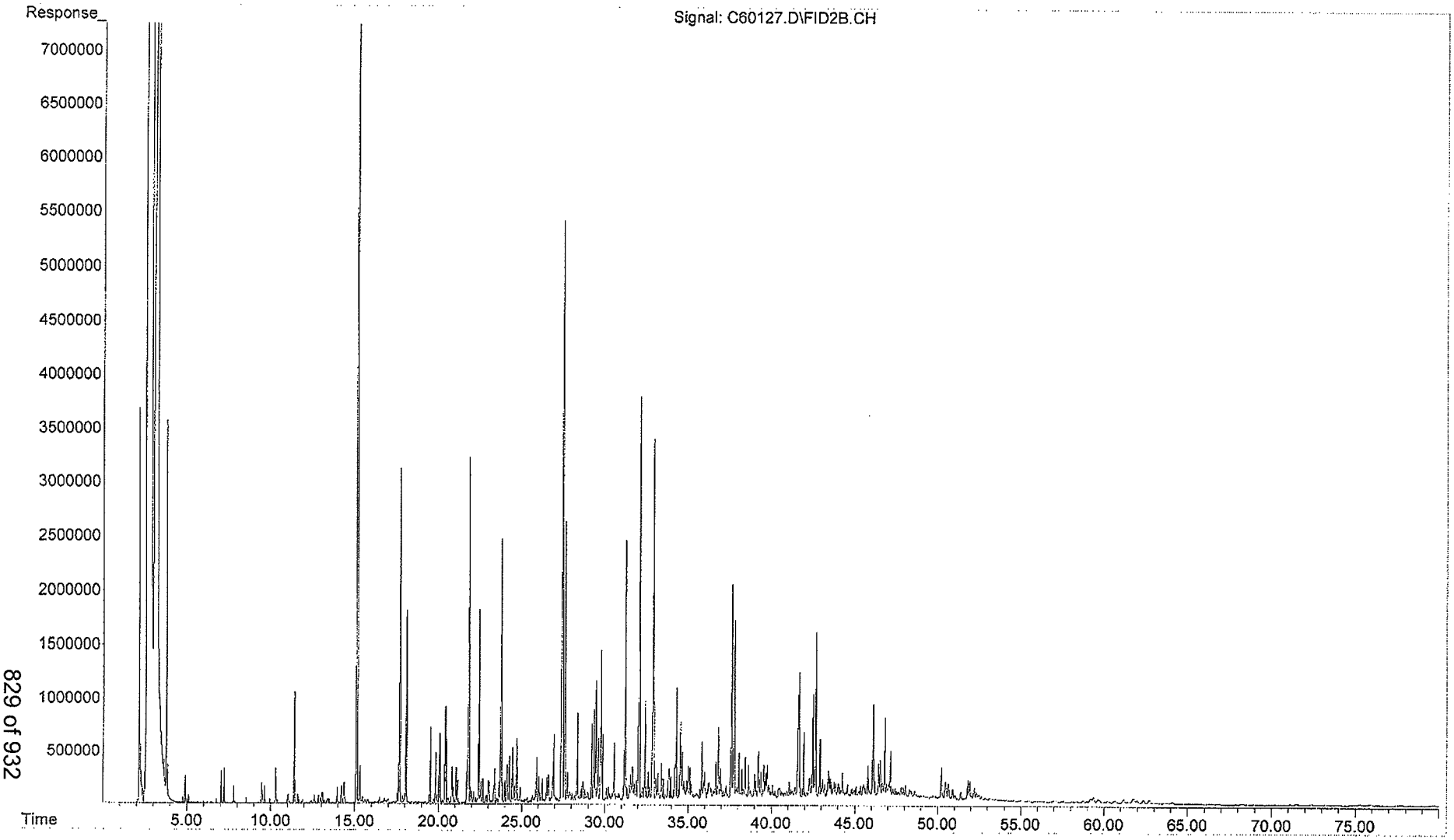
File :O:\FORENSICS\DATA\FID6\2009\OCT09\OCT21.SEC\C60129.D
Operator : NLJr
Acquired : 24 Oct 2009 4:18 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-14
Misc Info : 1X
Vial Number: 74

MPA-5



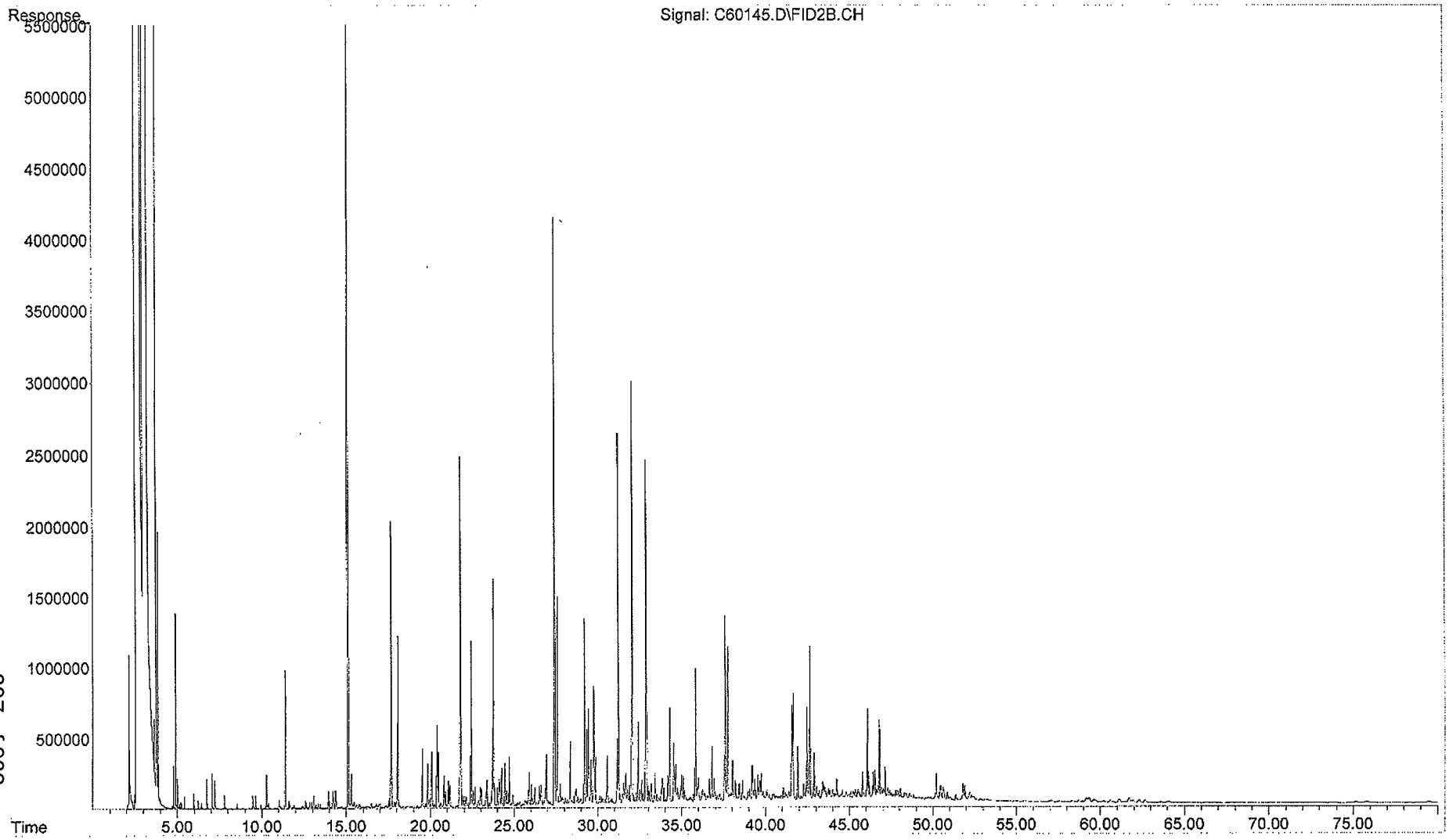
File :O:\FORENSICS\DATA\FID6\2009\OCT09\OCT21.SEC\C60127.D
Operator : NLJr
Acquired : 24 Oct 2009 2:47 am using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-13
Misc Info : 1X
Vial Number: 73

SD-87



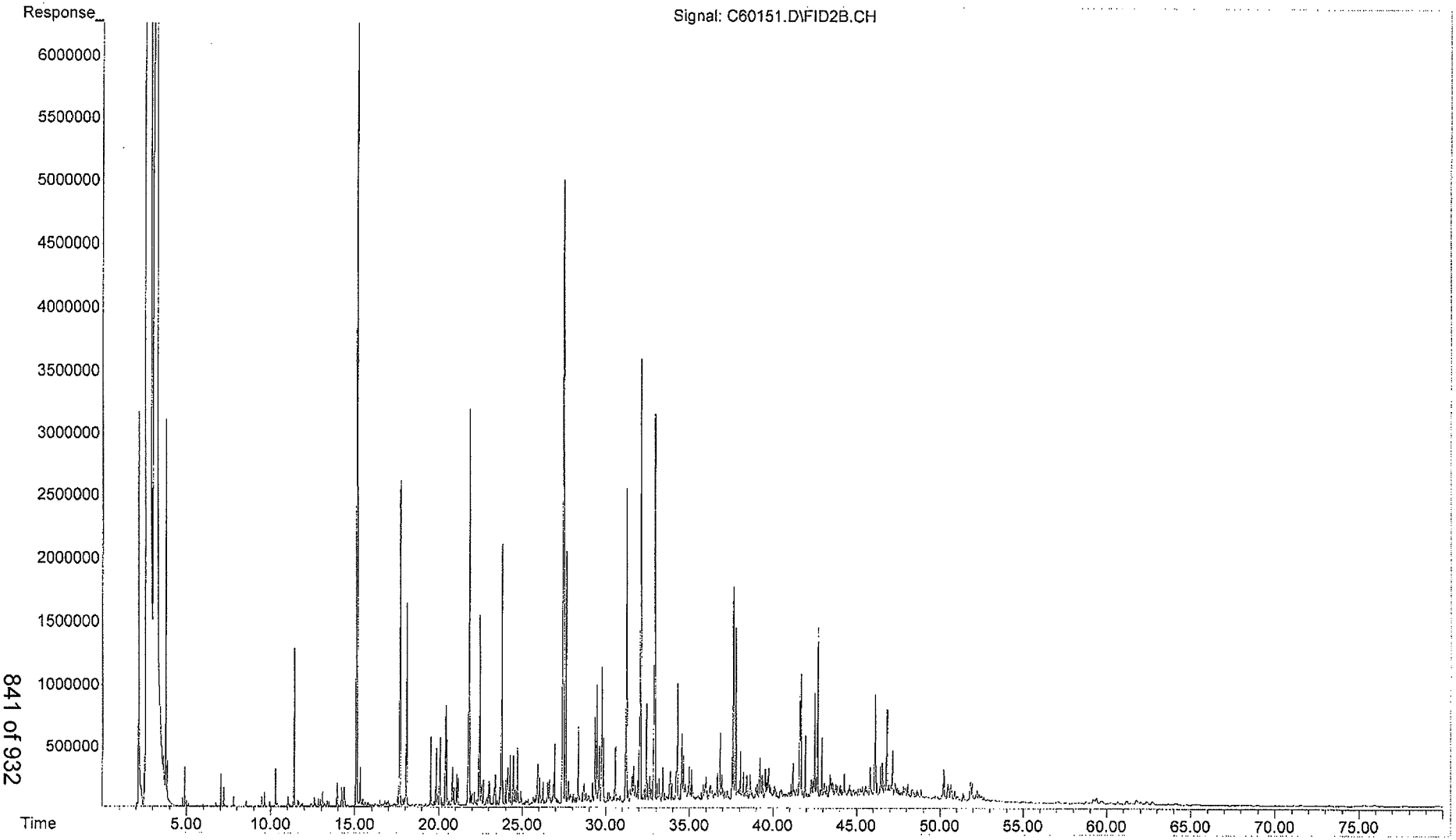
File :O:\FORENSICS\DATA\FID6\2009\OCT09\OCT21.SEC\C60145.D
Operator : NLJr
Acquired : 24 Oct 2009 4:32 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-15
Misc Info : 1X
Vial Number: 82

SD-96



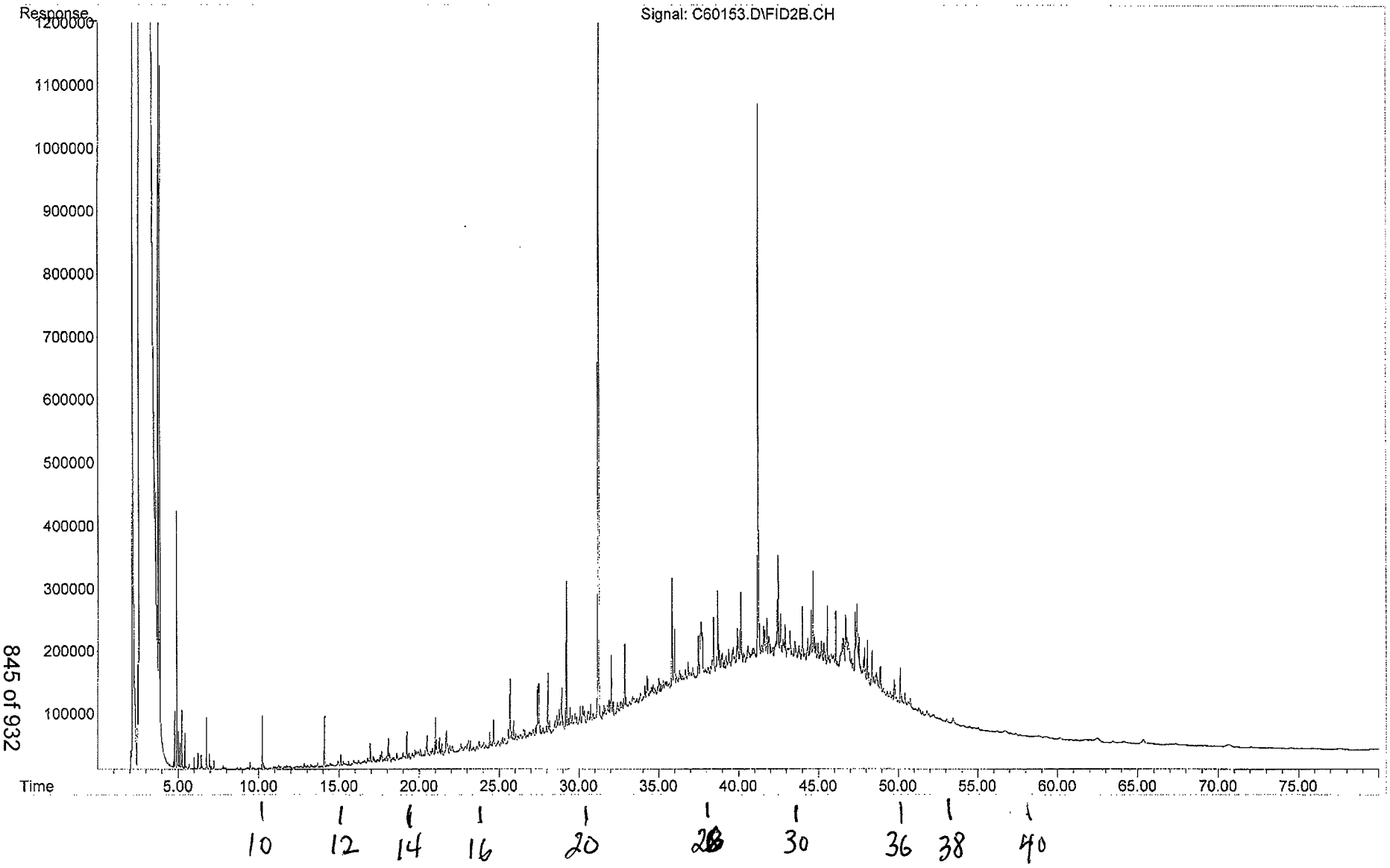
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Operator : NLJr
Acquired : 24 Oct 2009 9:09 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-16
Misc Info : 1X
Vial Number: 85

DUP-100909



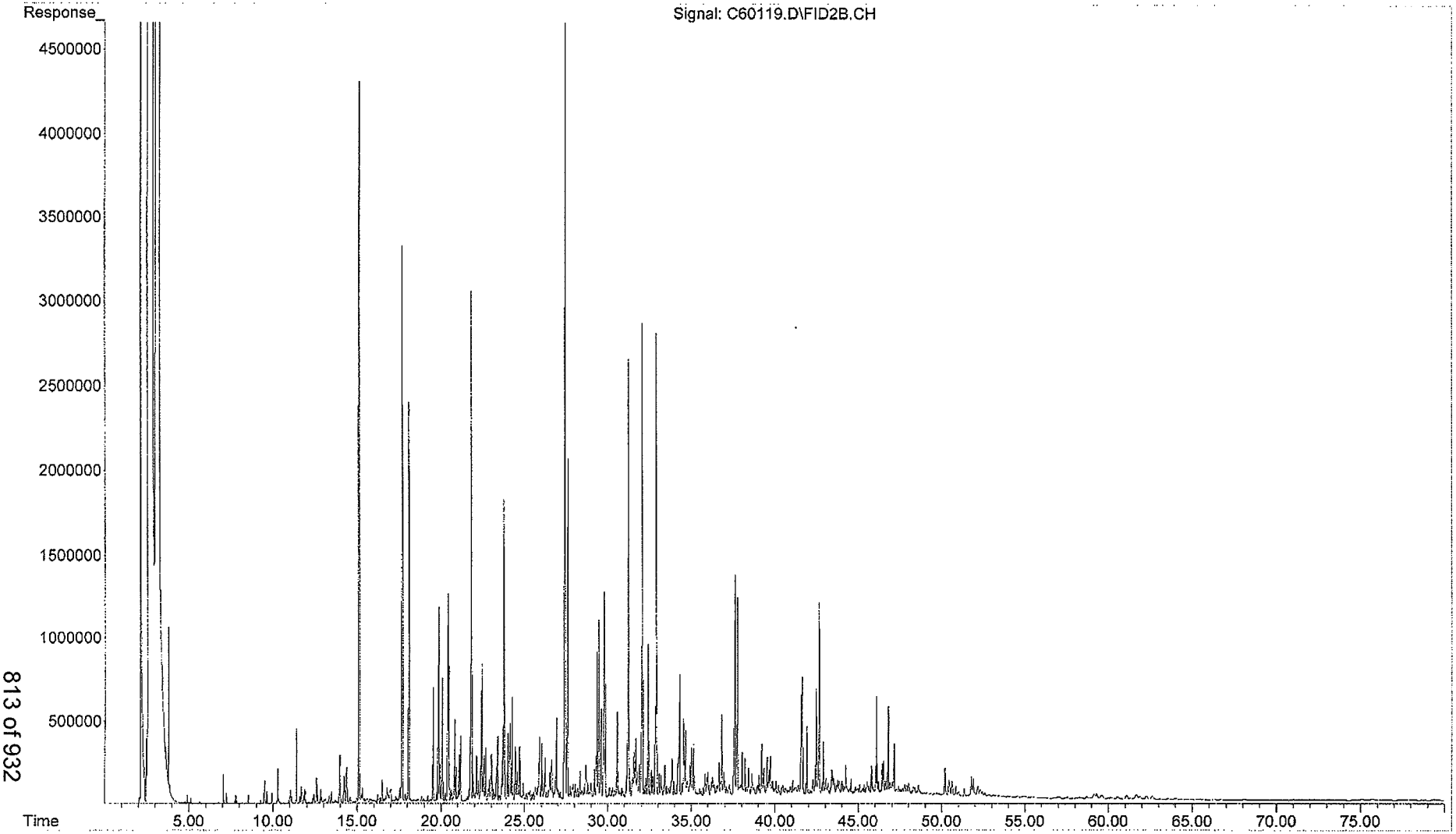
File :O:\FORENSICS\DATA\FID6\2009\OCT09\OCT21.SEC\C60153.D
Operator : NLJr
Acquired : 24 Oct 2009 10:42 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-18
Misc Info : 1X
Vial Number: 86

MPE 2-2



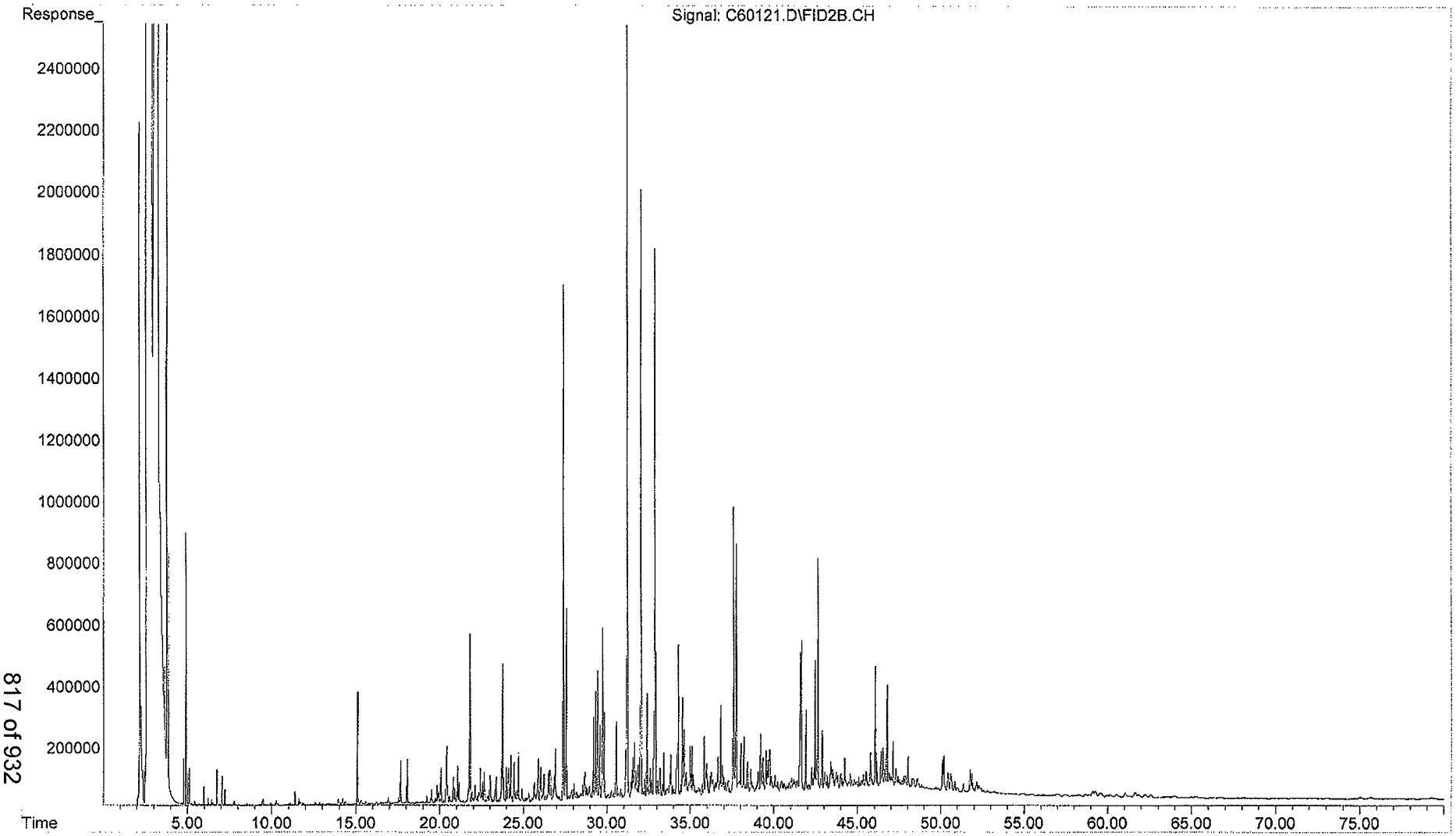
File :O:\FORENSICS\DATA\FID6\2009\OCT09\OCT21.SEC\C60119.D
Operator : NLJr
Acquired : 23 Oct 2009 8:41 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-09
Misc Info : 1X
Vial Number: 69

MPD-2



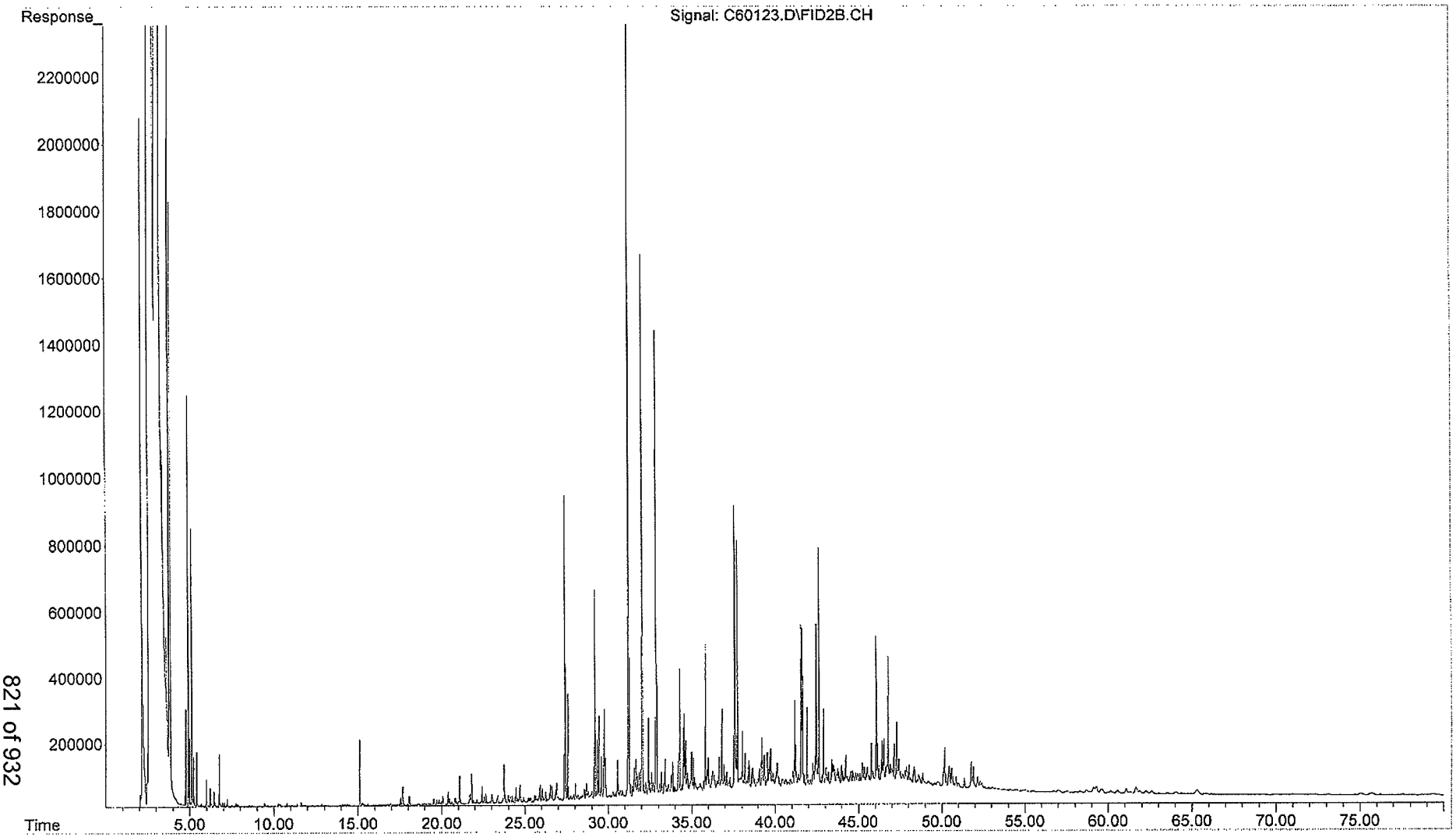
File :O:\FORENSICS\DATA\FID6\2009\OCT09\OCT21.SEC\C60121.D
Operator : NLJr
Acquired : 23 Oct 2009 10:13 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-10
Misc Info : 1X
Vial Number: 70

MPD-3



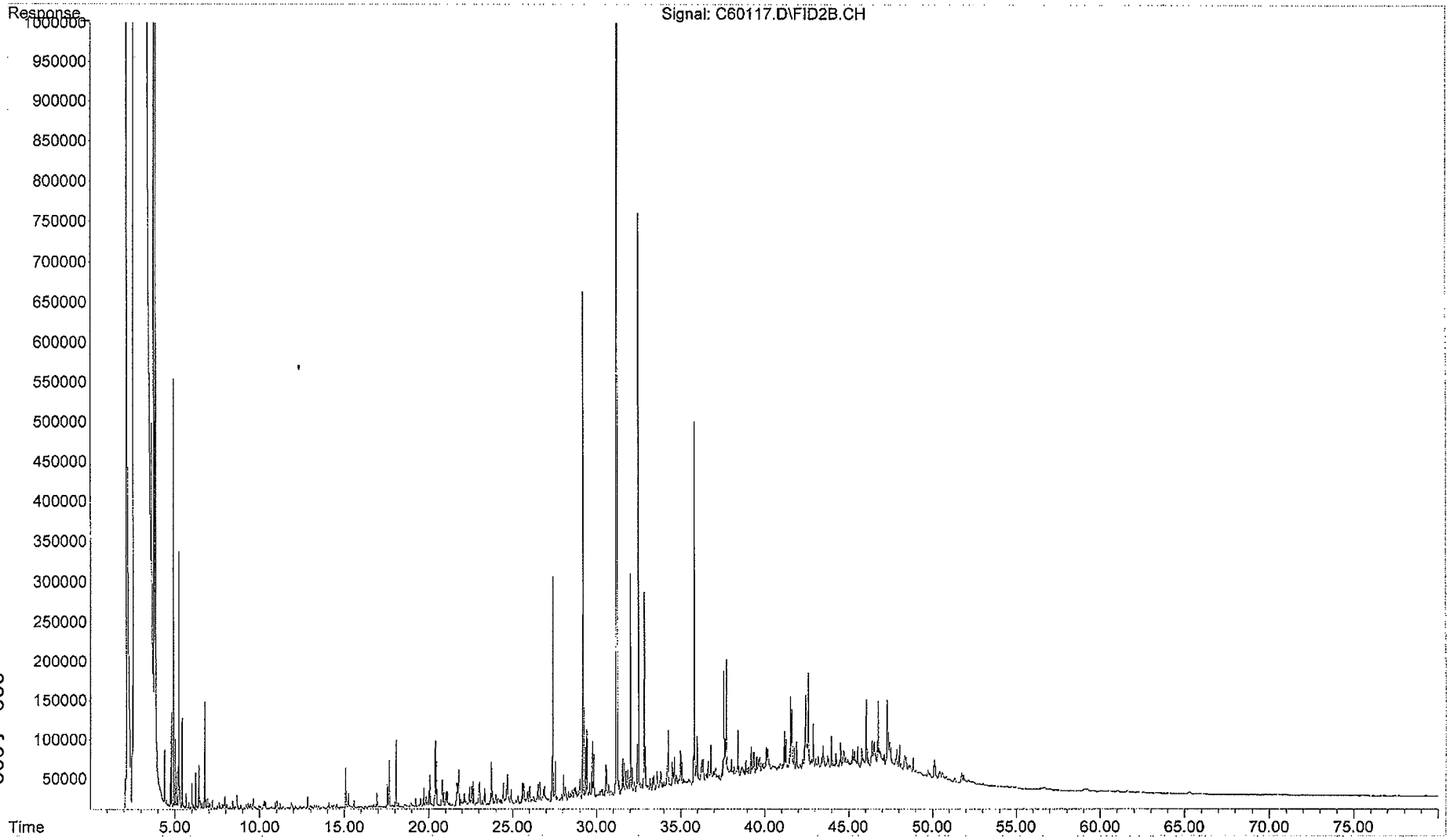
File :O:\FORENSICS\DATA\FID6\2009\OCT09\OCT21.SEC\C60123.D
Operator : NLJr
Acquired : 23 Oct 2009 11:44 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-11
Misc Info : 1X
Vial Number: 71

MPD-84

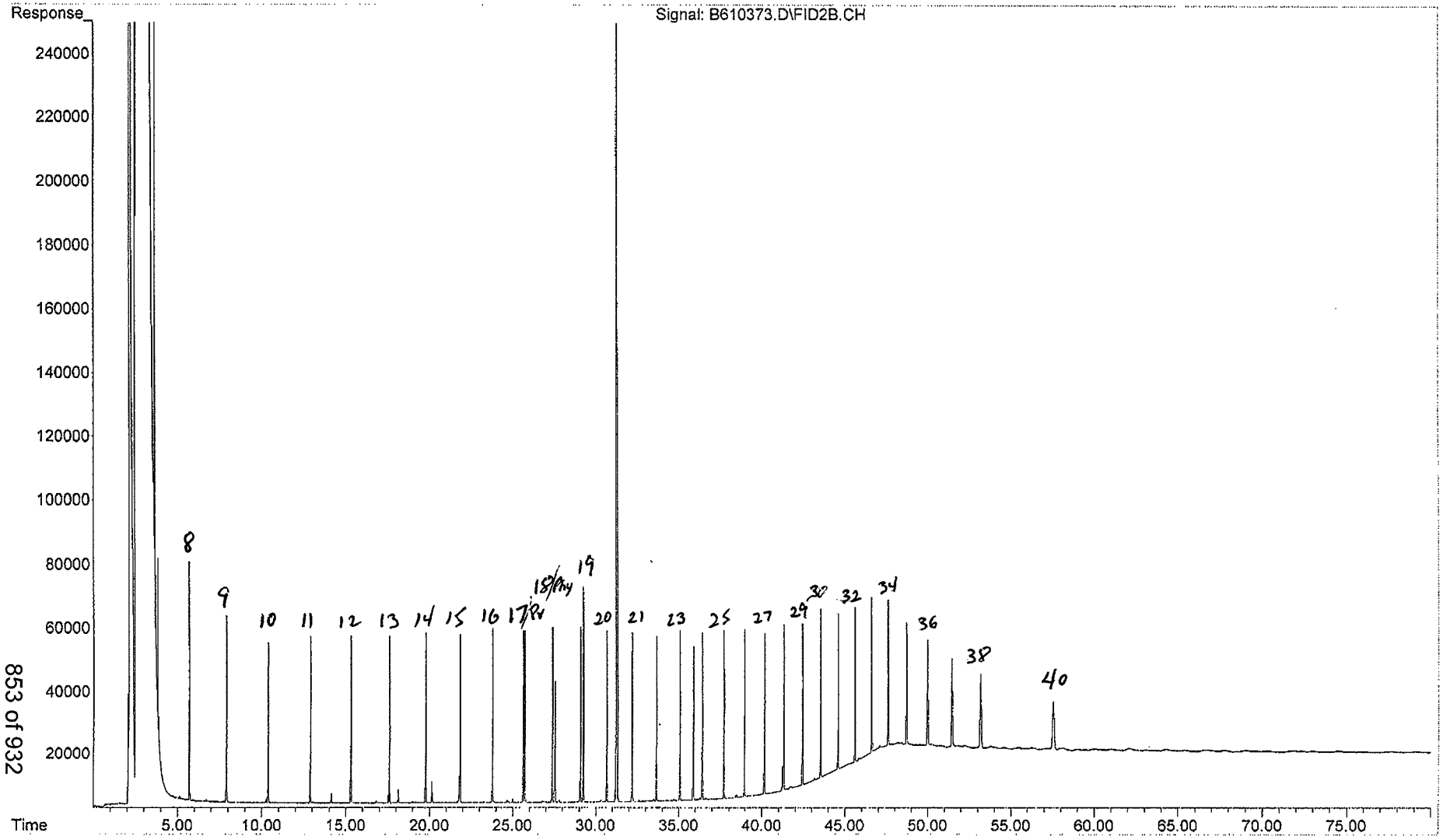


File :O:\FORENSICS\DATA\FID6\2009\OCT09\OCT21.SEC\C60117.D
Operator : NLJr
Acquired : 23 Oct 2009 7:10 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: 0910018-04
Misc Info : 1X
Vial Number: 68

MPD-8
~~MPD~~ 5



File :O:\FORENSICS\DATA\FID6\2009\SEP09\SEPT21.SEC\B610373.D
Operator : NLJr
Acquired : 21 Sep 2009 5:47 pm using AcqMethod FID6A.M
Instrument : FID6
Sample Name: I609210901
Misc Info : LEVEL 1 WHAH88
Vial Number: 56



ARCADIS

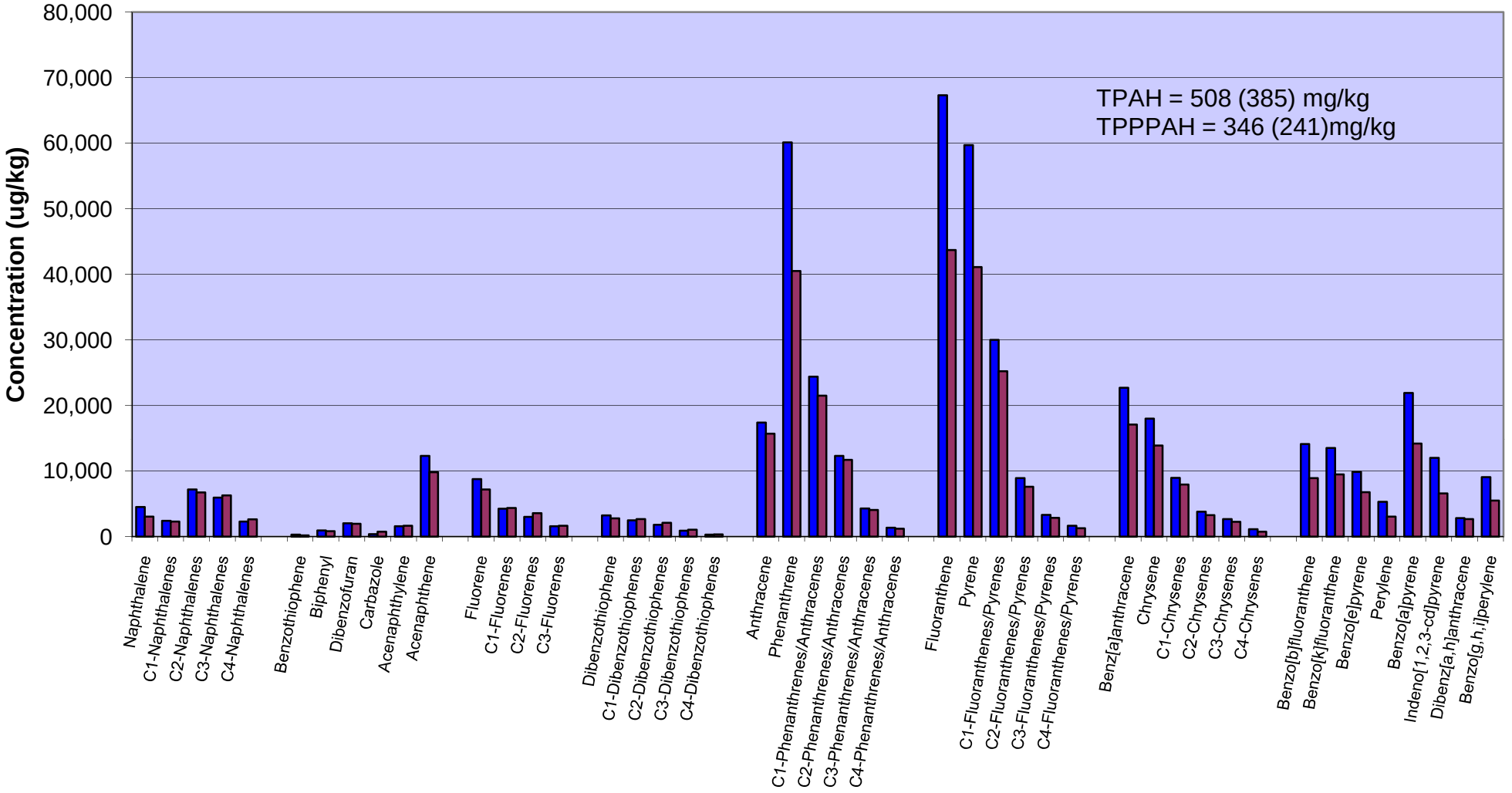
Appendix J

PAH Fingerprints

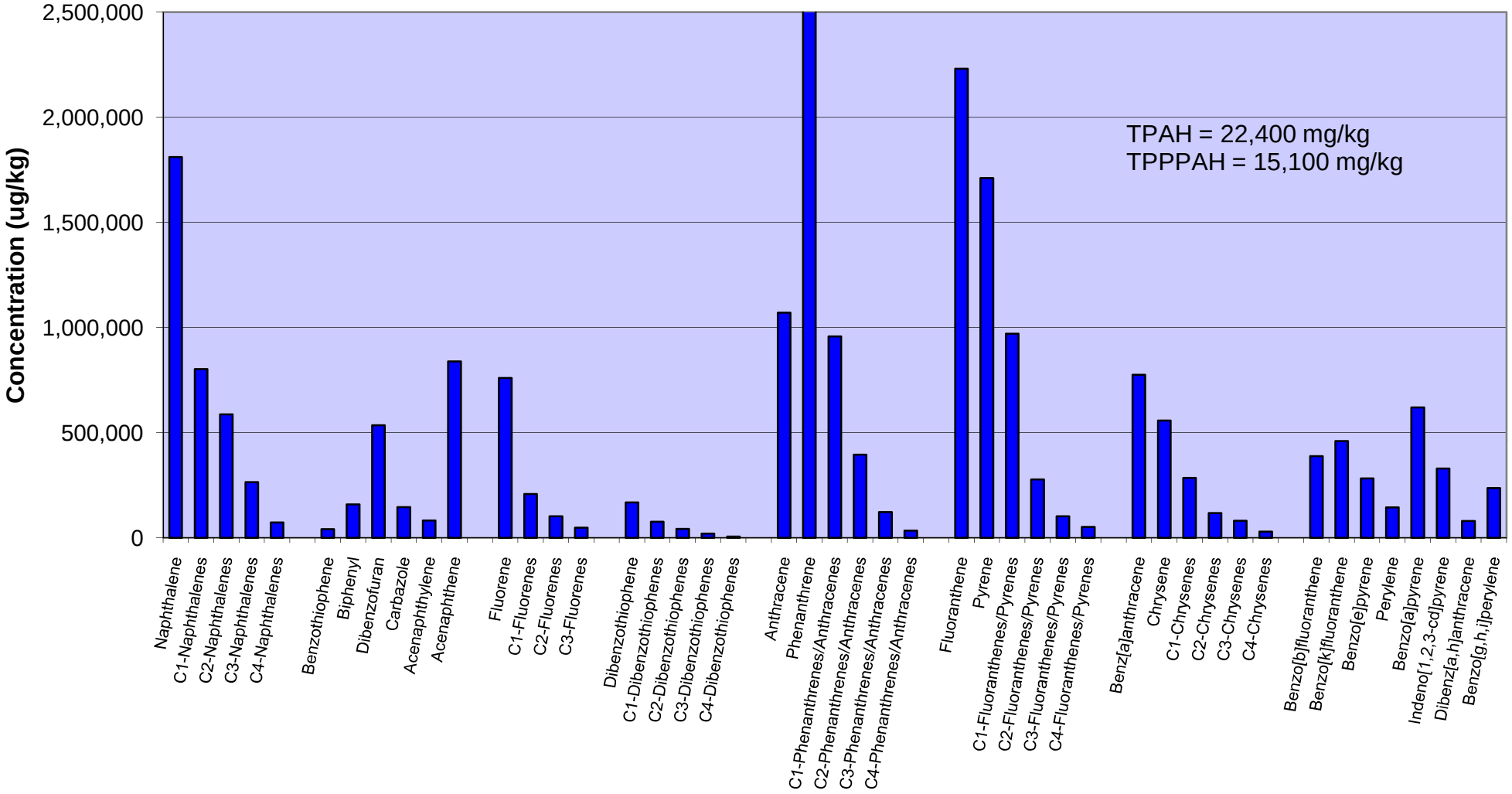
ARCADIS

2007 PAH Fingerprints

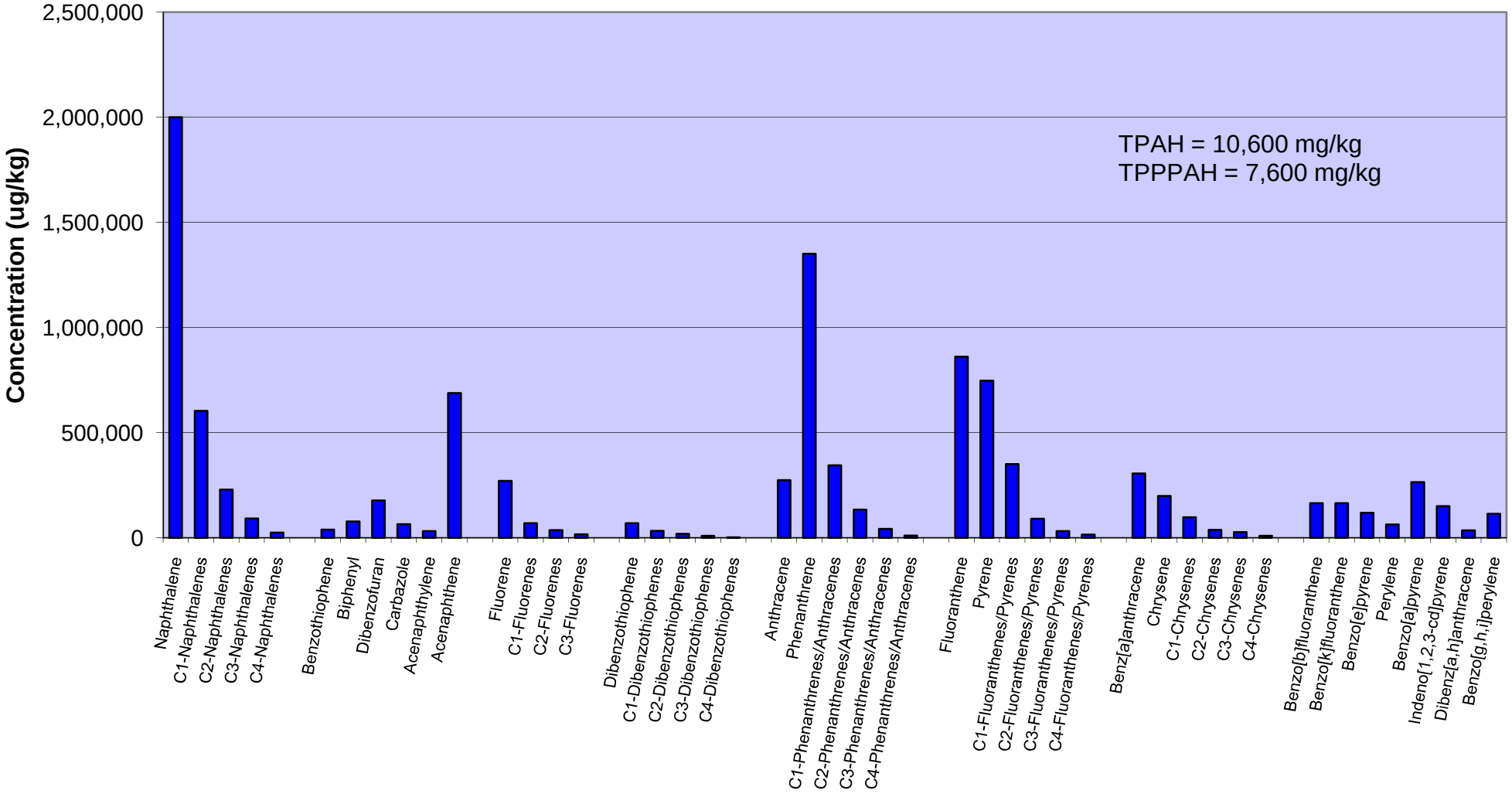
MPU-3 and DUP (MPU-3)



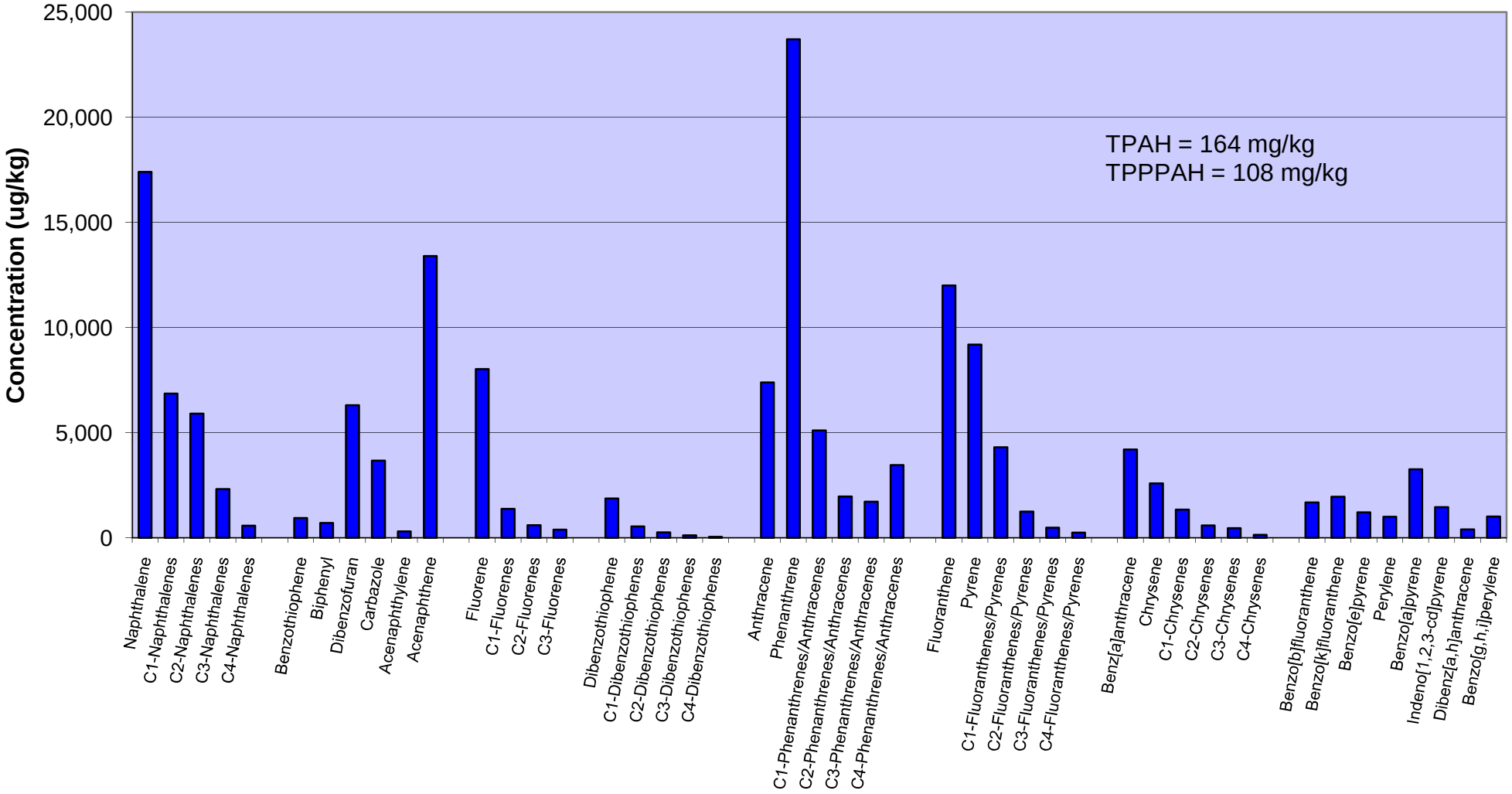
MPA-1


Concentration (ug/kg)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
TPAH = 22,400 mg/kg
TPPPAH = 15,100 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

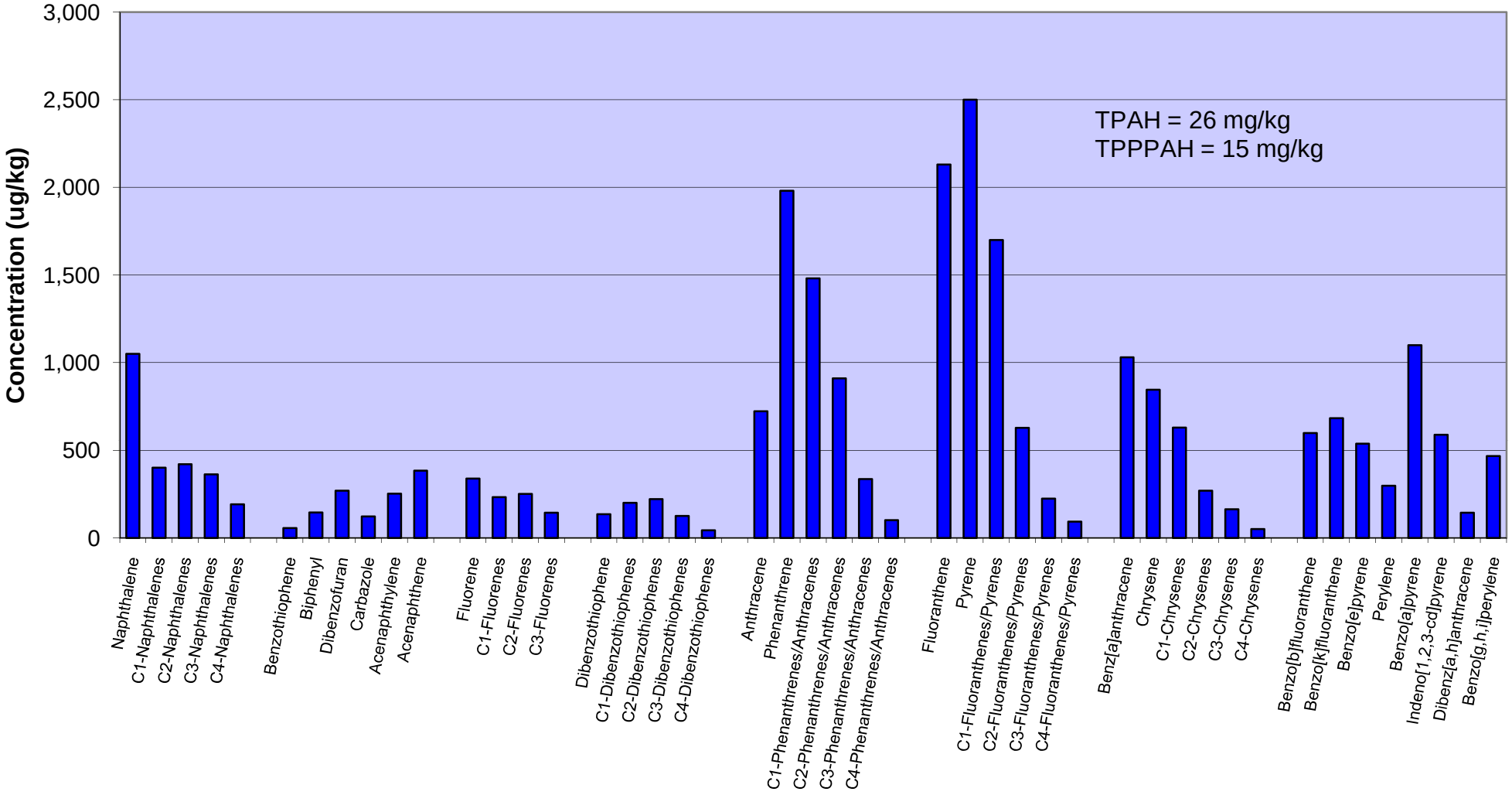
SD-87 (0-6)


Concentration (ug/kg)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
TPAH = 10,600 mg/kg
TPPPAH = 7,600 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

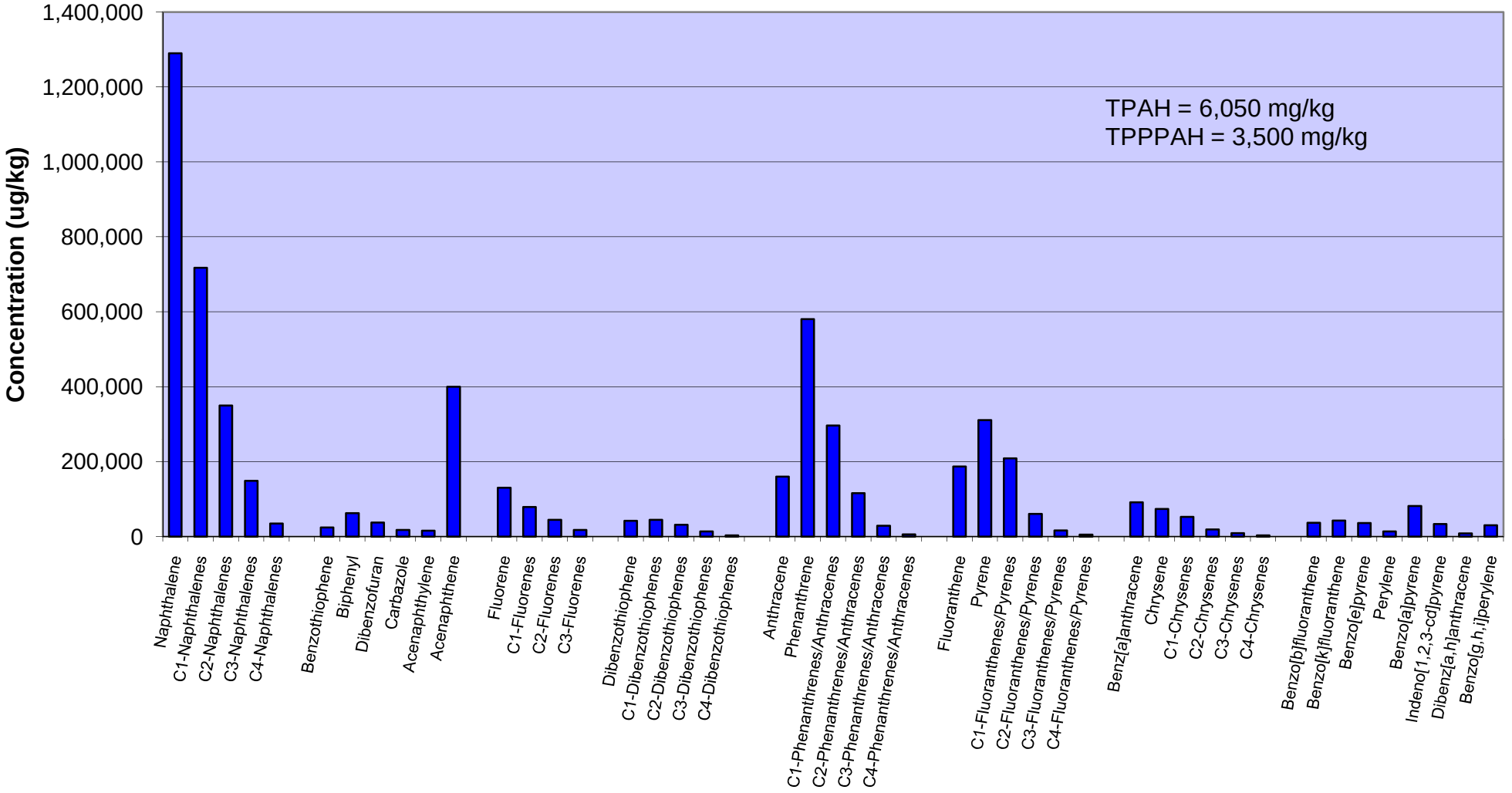
SD-87 (24-48)


Concentration (ug/kg)
25,000
20,000
15,000
10,000
5,000
0
TPAH = 164 mg/kg
TPPPAH = 108 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

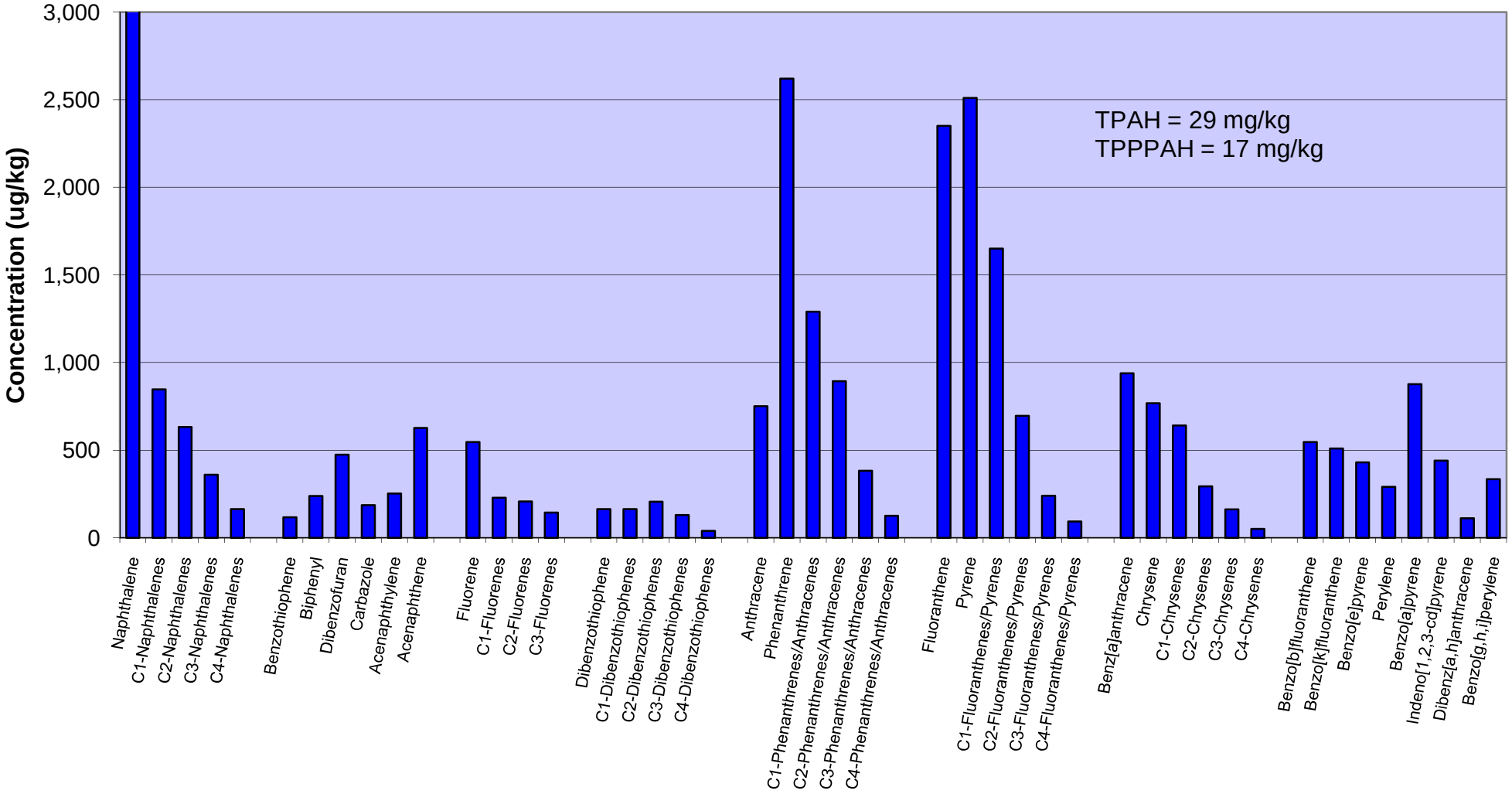
SD-94 (0-6)


Concentration (ug/kg)
3,000
2,500
2,000
1,500
1,000
500
0
TPAH = 26 mg/kg
TPPPAH = 15 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

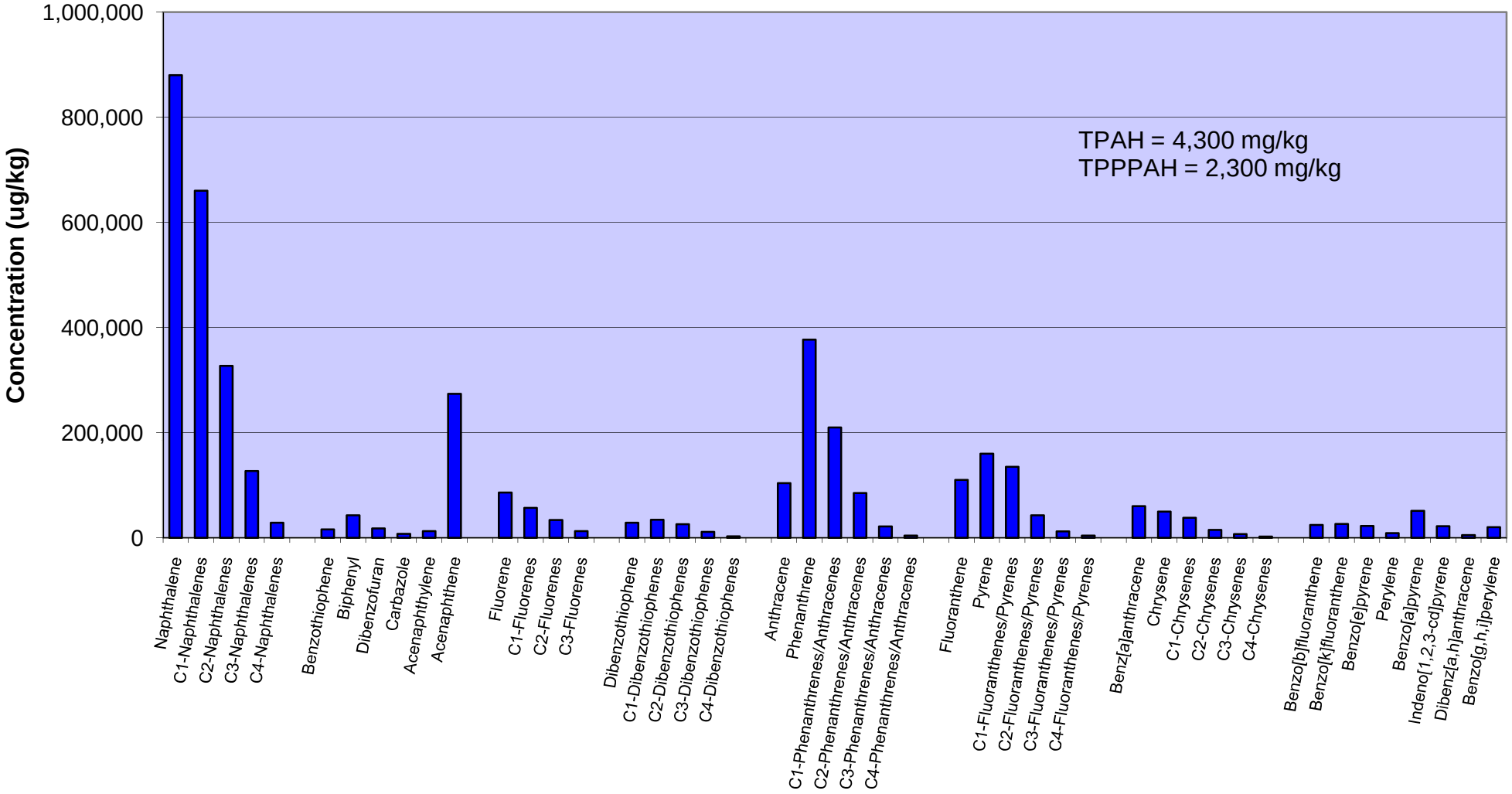
SD-95 (0-6)


Concentration (ug/kg)
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
TPAH = 6,050 mg/kg
TPPPAH = 3,500 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

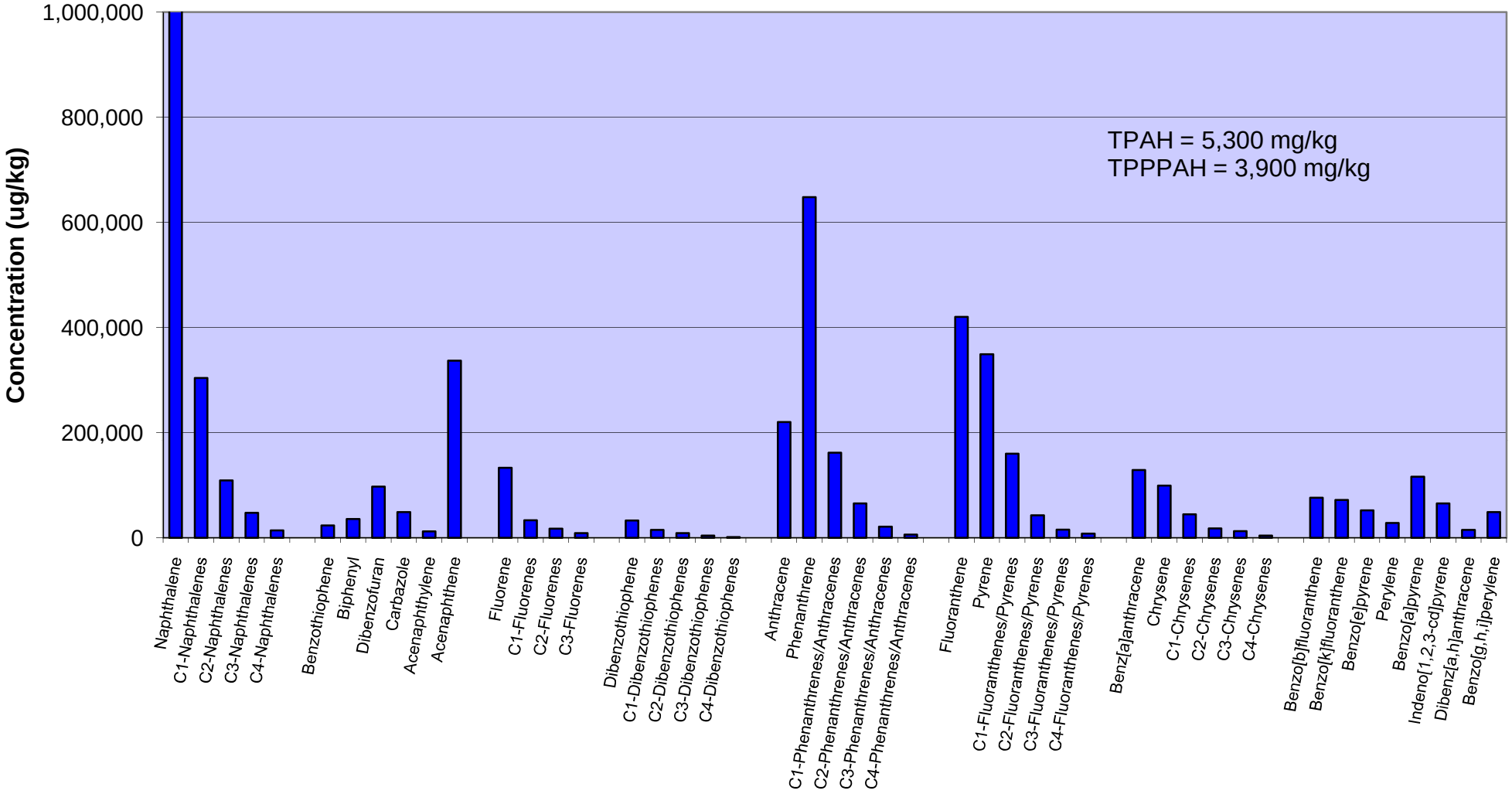
SD-95 (6-24)


Concentration (ug/kg)
3,000
2,500
2,000
1,500
1,000
500
0
TPAH = 29 mg/kg
TPPPAH = 17 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

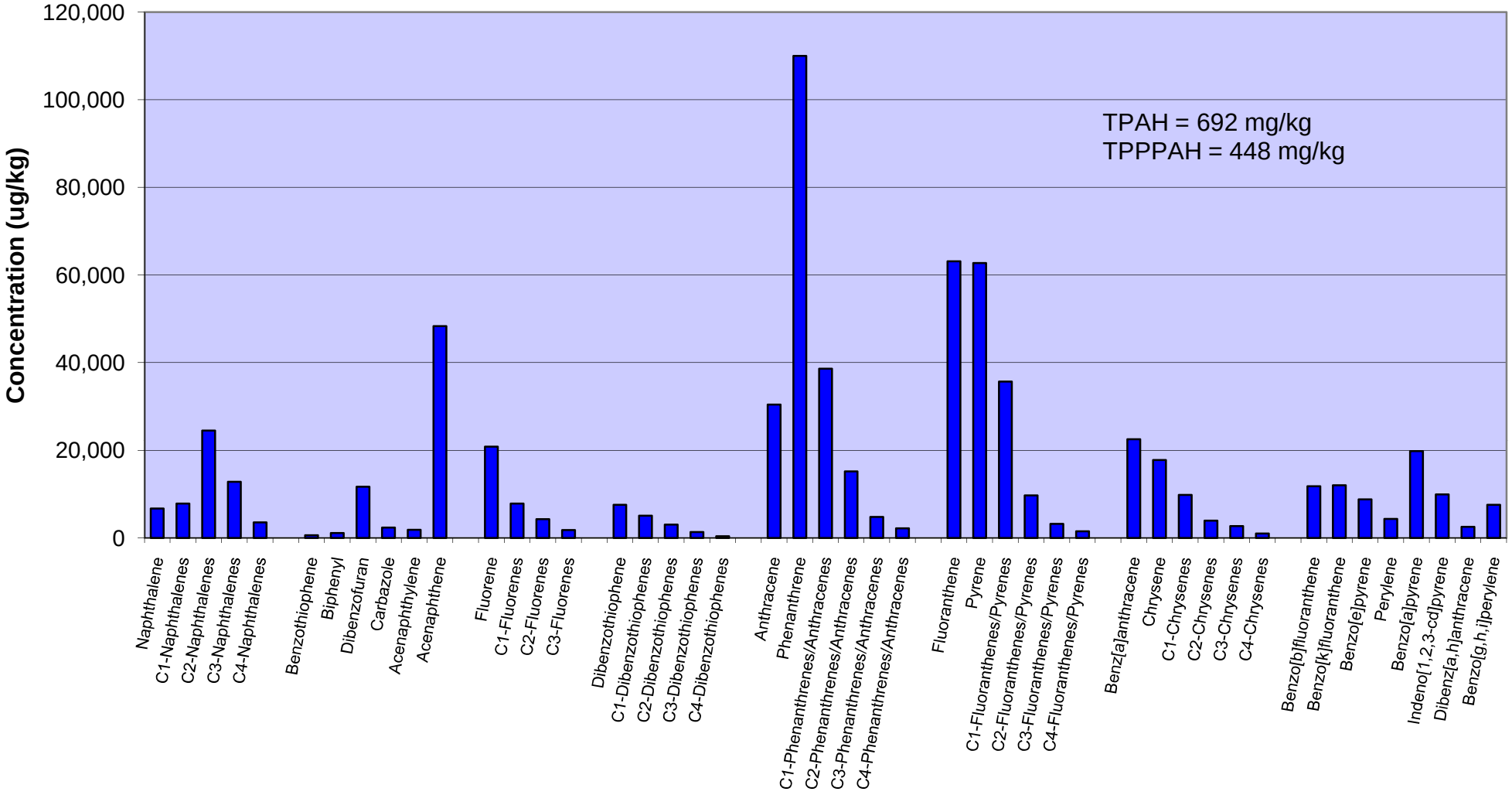
SD-96 (0-6)


Concentration (ug/kg)
1,000,000
800,000
600,000
400,000
200,000
0
TPAH = 4,300 mg/kg
TPPPAH = 2,300 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

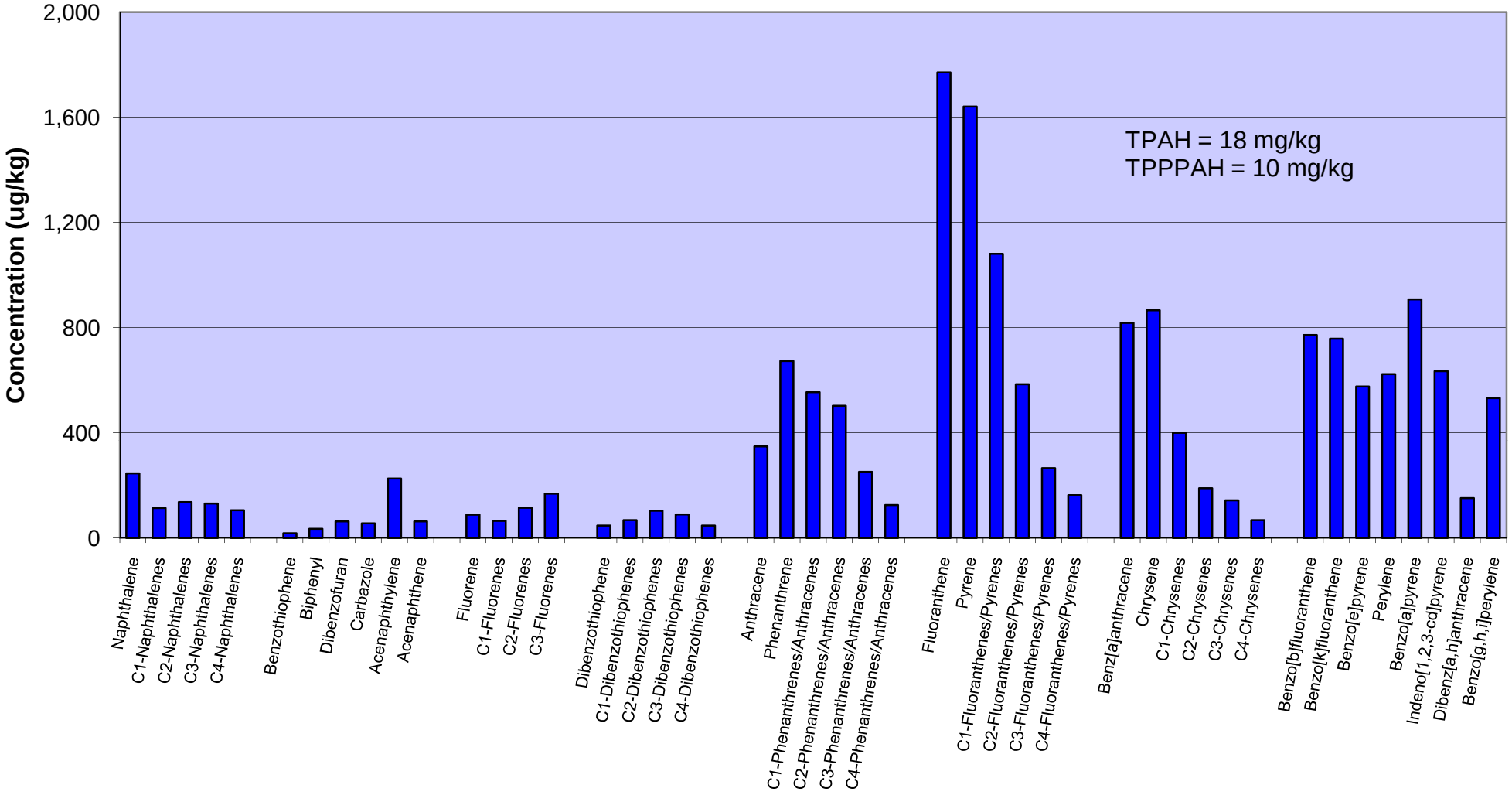
MPA-3


Concentration (ug/kg)
1,000,000
800,000
600,000
400,000
200,000
0
TPAH = 5,300 mg/kg
TPPPAH = 3,900 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

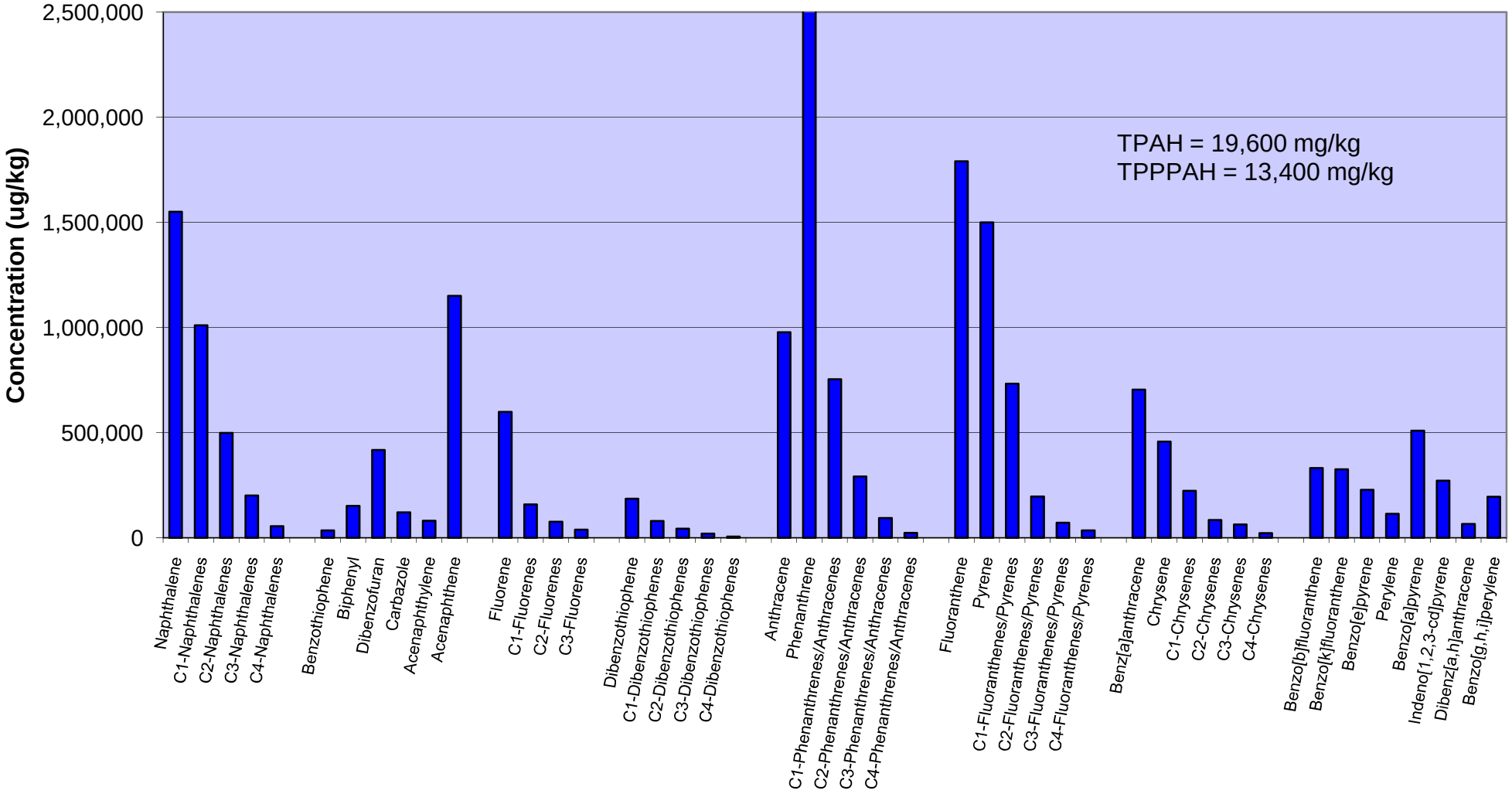
MPA-5


Concentration (ug/kg)
120,000
100,000
80,000
60,000
40,000
20,000
0
TPAH = 692 mg/kg
TPPPAH = 448 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

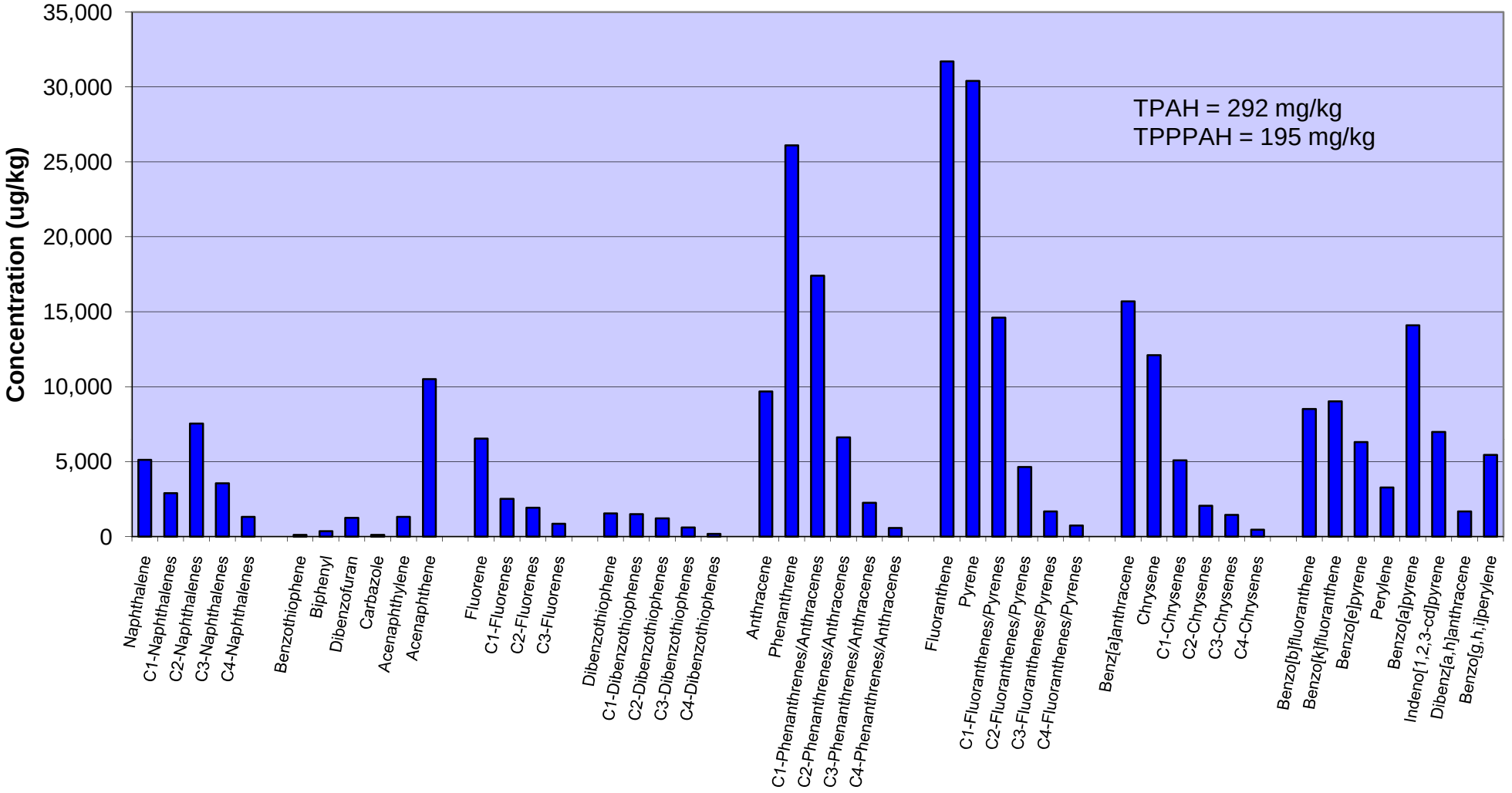
MPE2-2


Concentration (ug/kg)
2,000
1,600
1,200
800
400
0
TPAH = 18 mg/kg
TPPPAH = 10 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

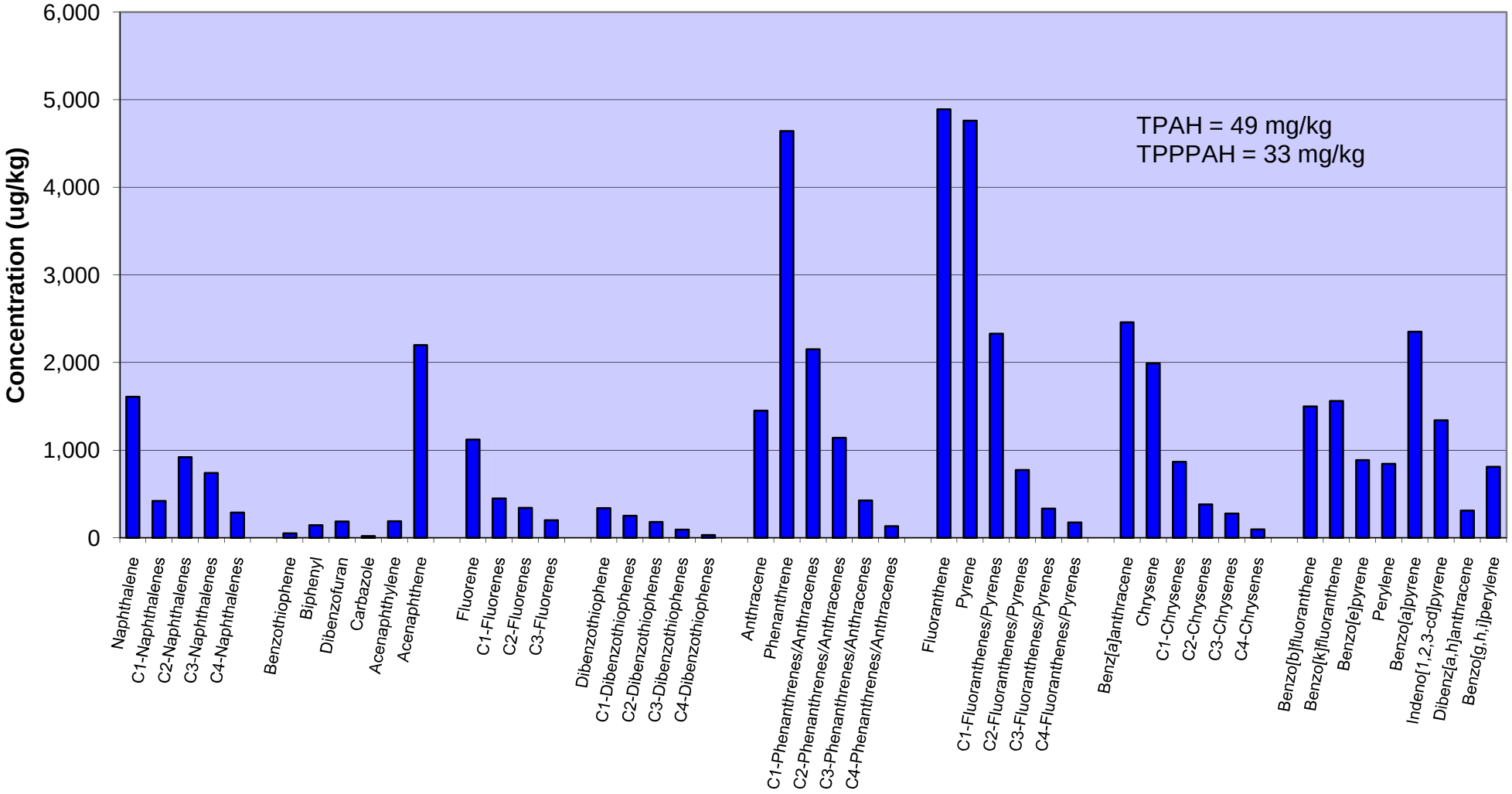
MPD-2


Concentration (ug/kg)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
TPAH = 19,600 mg/kg
TPPPAH = 13,400 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

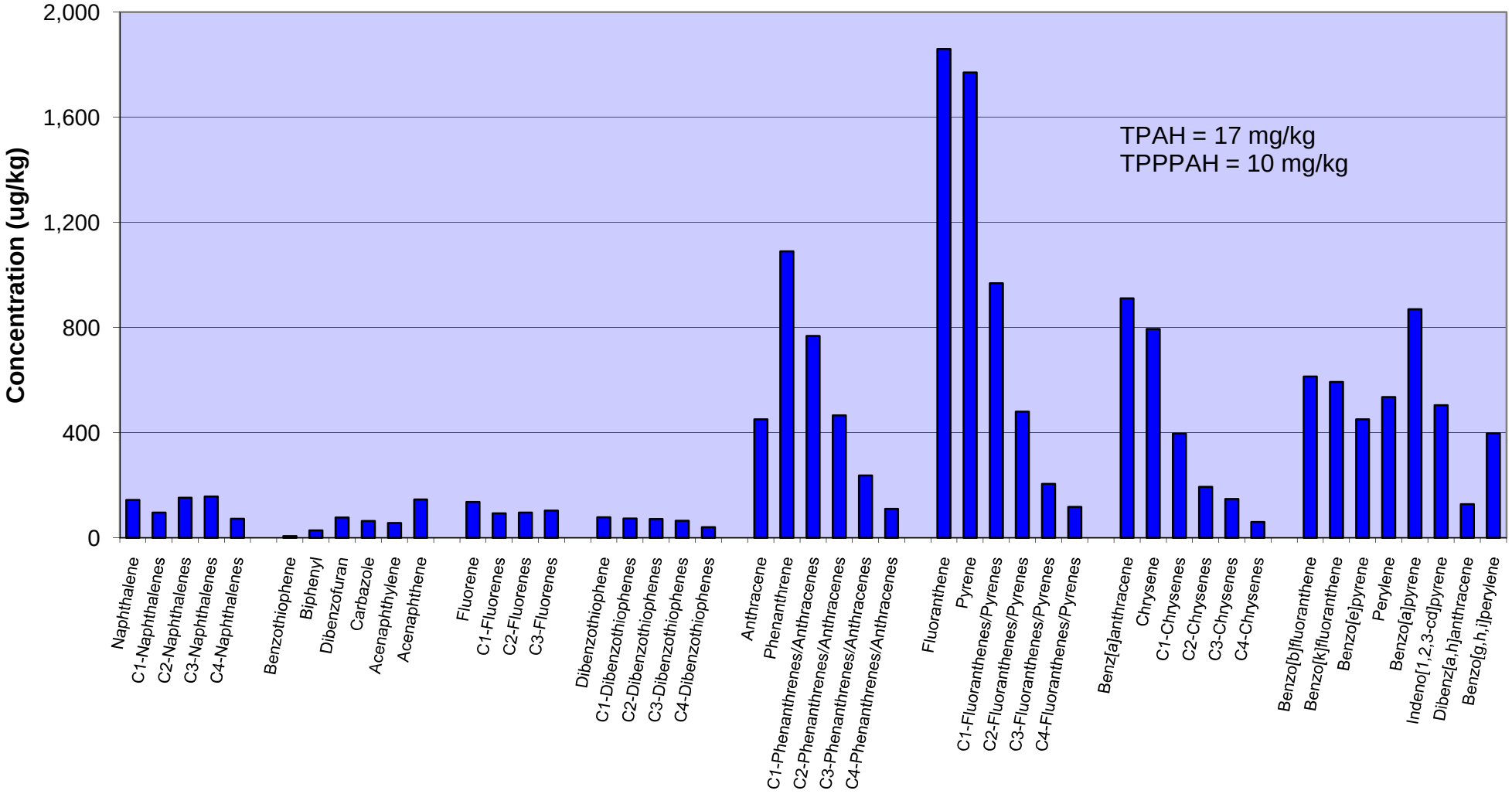
MPD-3


Concentration (ug/kg)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
TPAH = 292 mg/kg
TPPPAH = 195 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

MPD-4


Concentration (ug/kg)
6,000
5,000
4,000
3,000
2,000
1,000
0
TPAH = 49 mg/kg
TPPPAH = 33 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

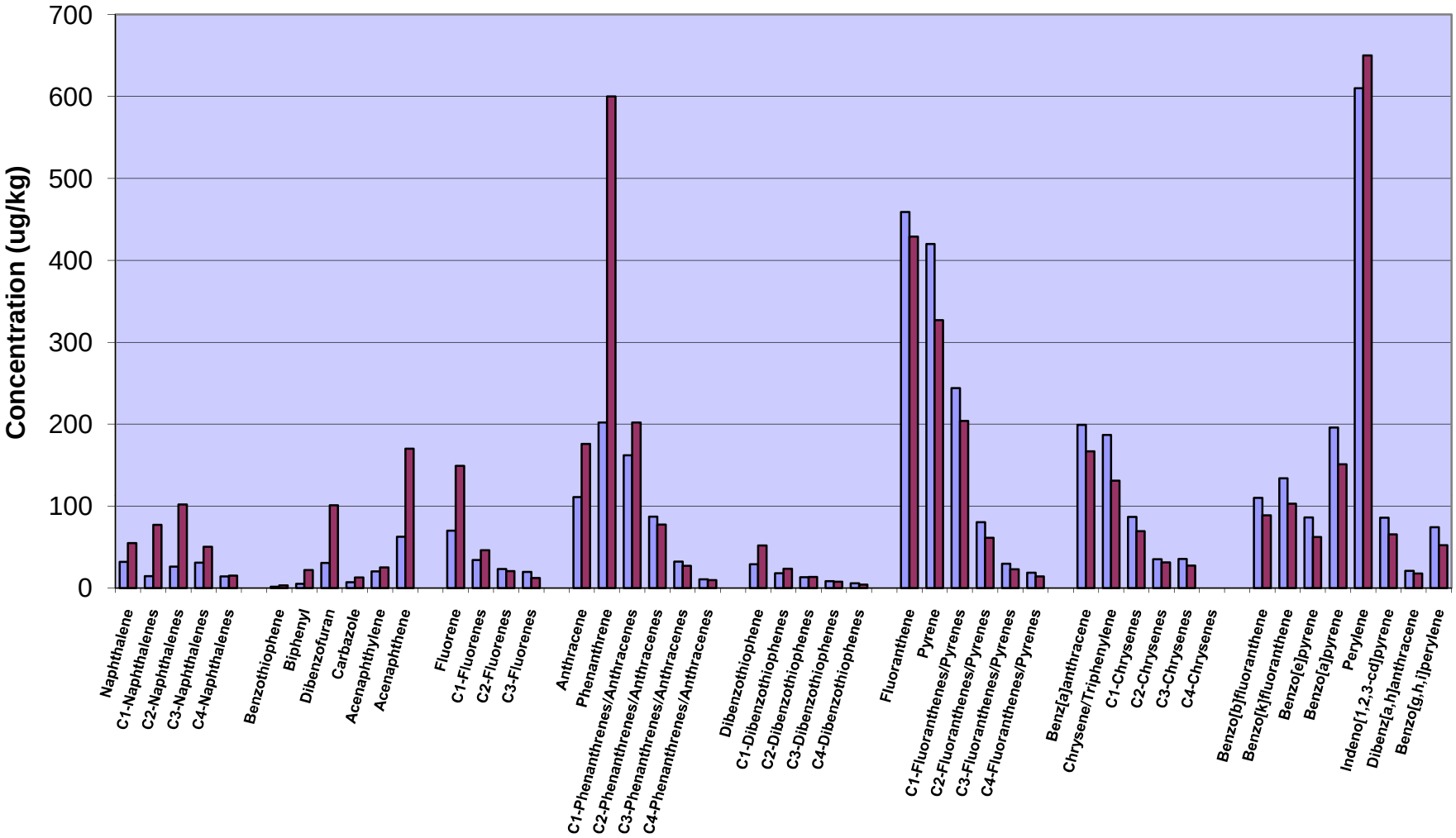
MPD-8


Concentration (ug/kg)
2,000
1,600
1,200
800
400
0
TPAH = 17 mg/kg
TPPPAH = 10 mg/kg
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Perylene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

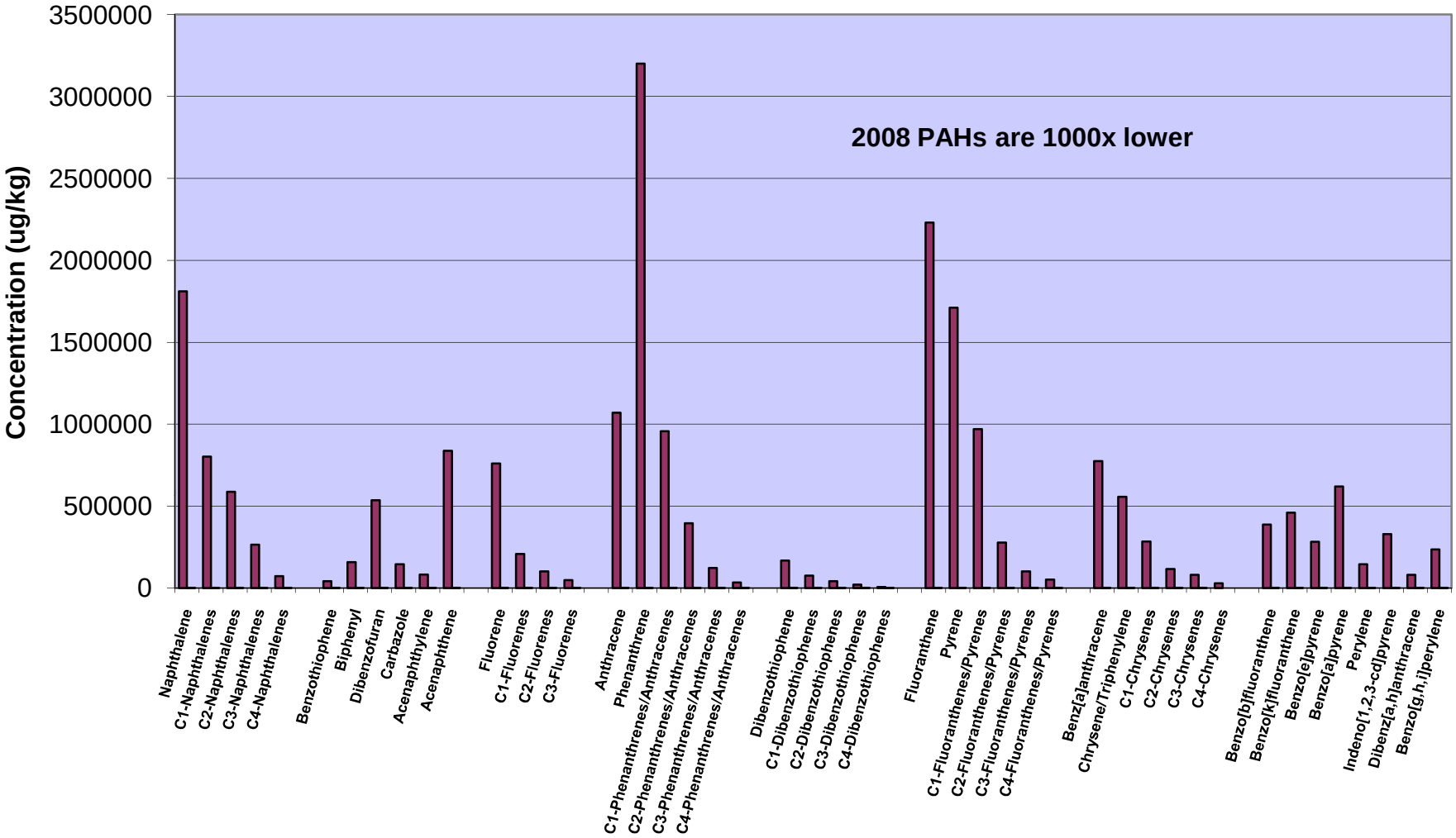
ARCADIS

2008 PAH Fingerprints

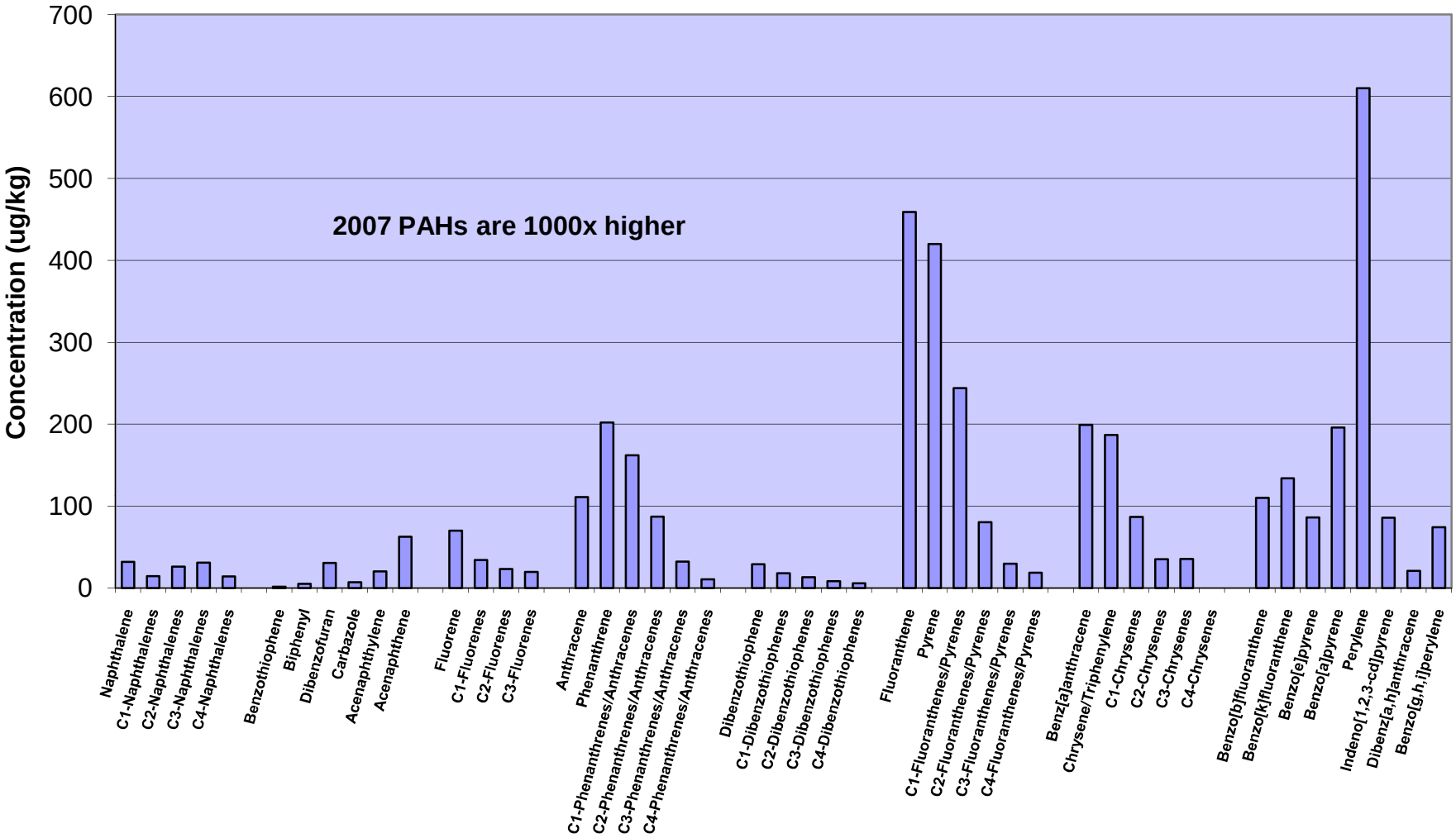
2008 MPA-1 and MPA-1 Dup



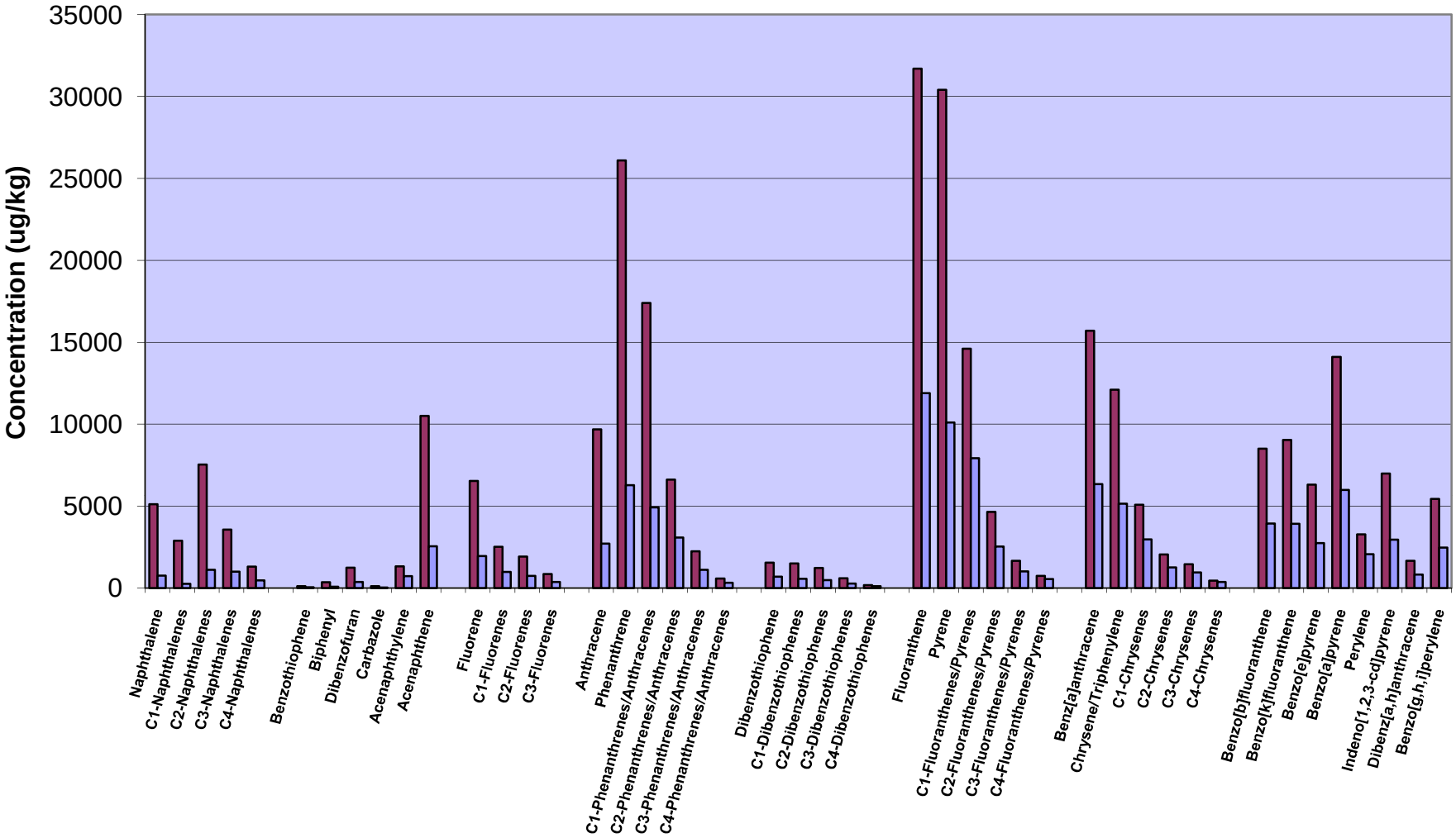
MPA-1 2007 (red) and 2008 (blue)



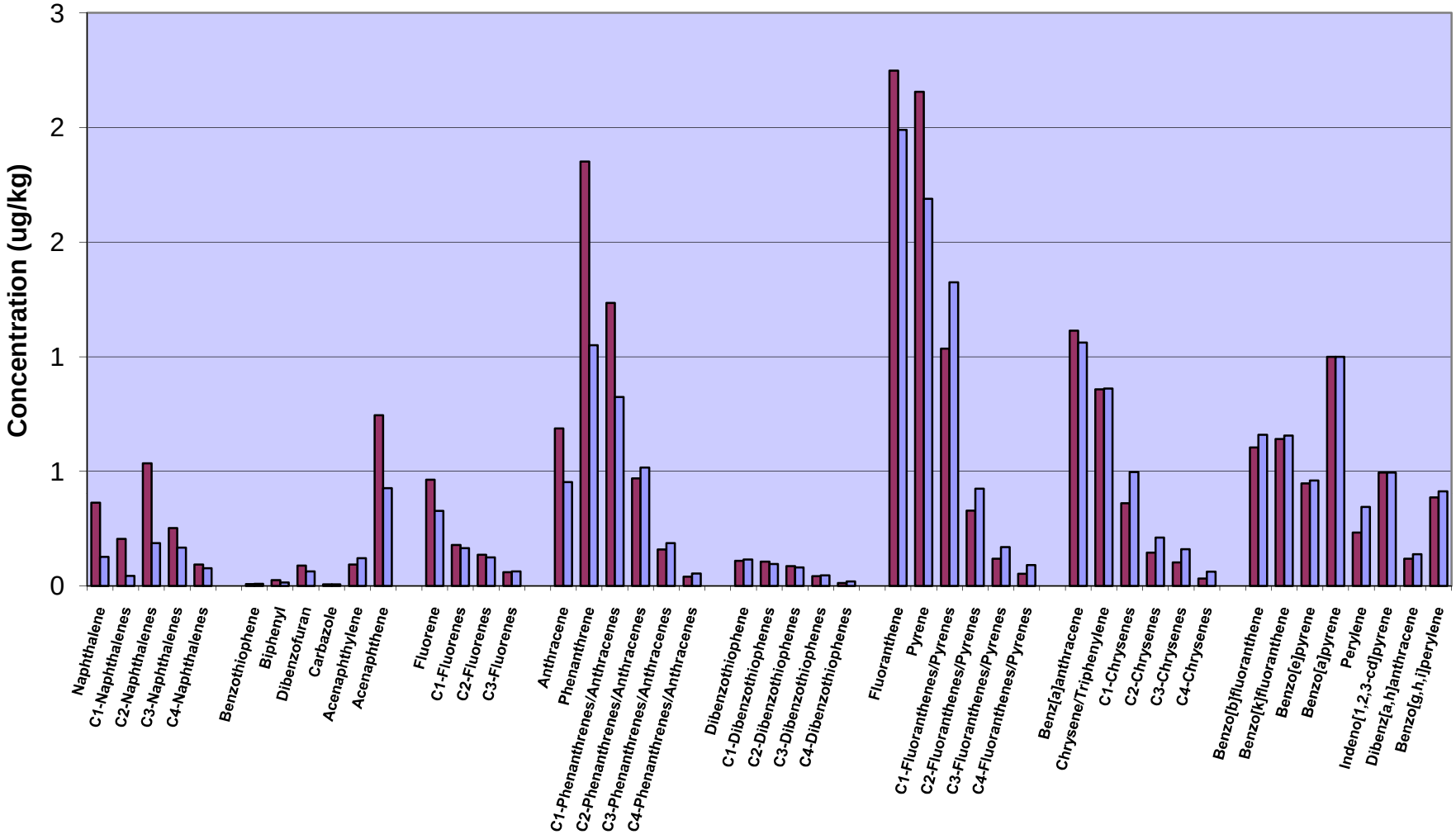
MPA-1 2008


Concentration (ug/kg)
700
600
500
400
300
200
100
0
2007 PAHs are 1000x higher
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Benzothiophene
Biphenyl
Dibenzofuran
Carbazole
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benz[a]anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[e]pyrene
Benzo[a]pyrene
Perylene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene

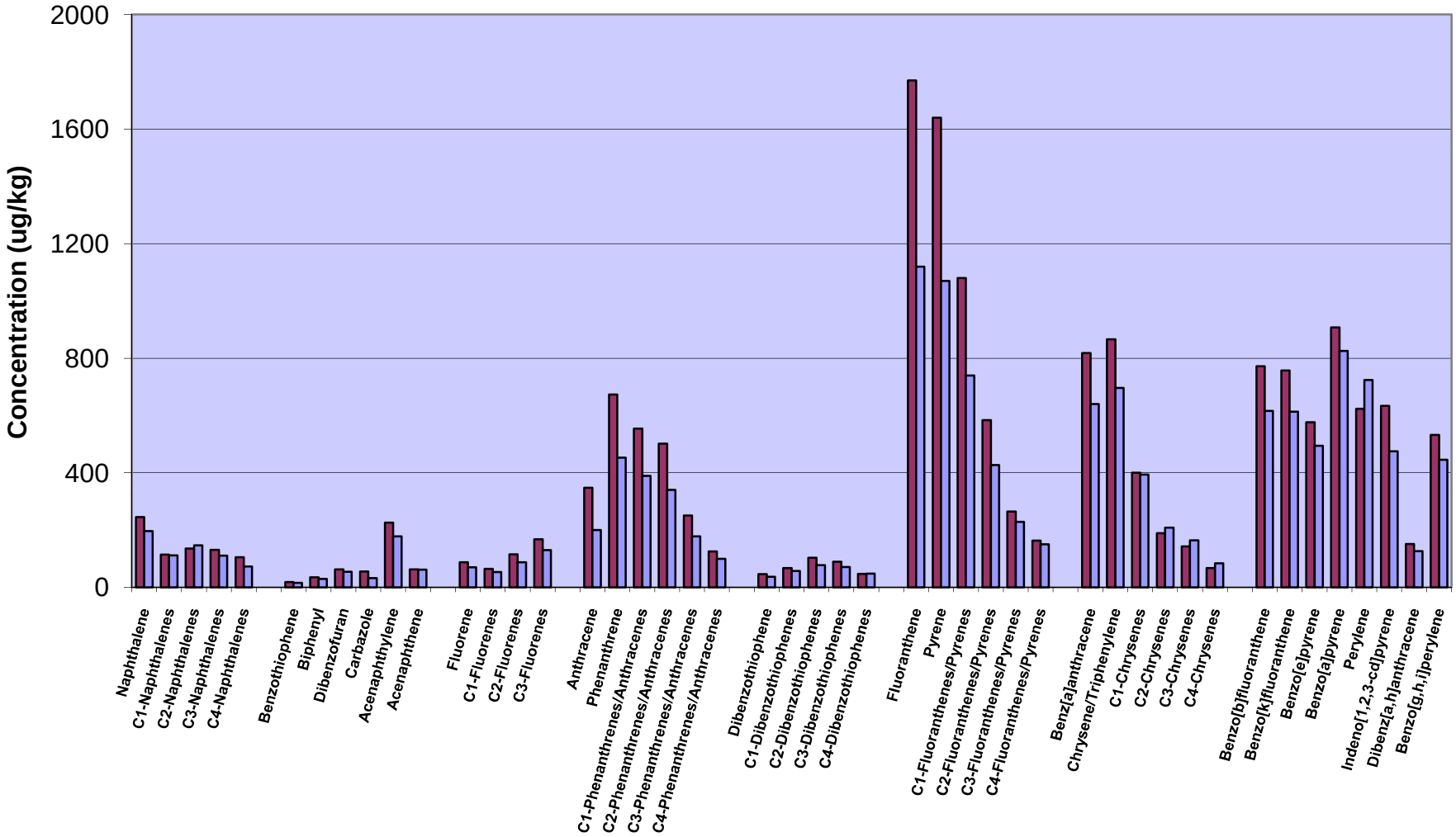
MPD-3 2007 (red) and 2008 (blue)



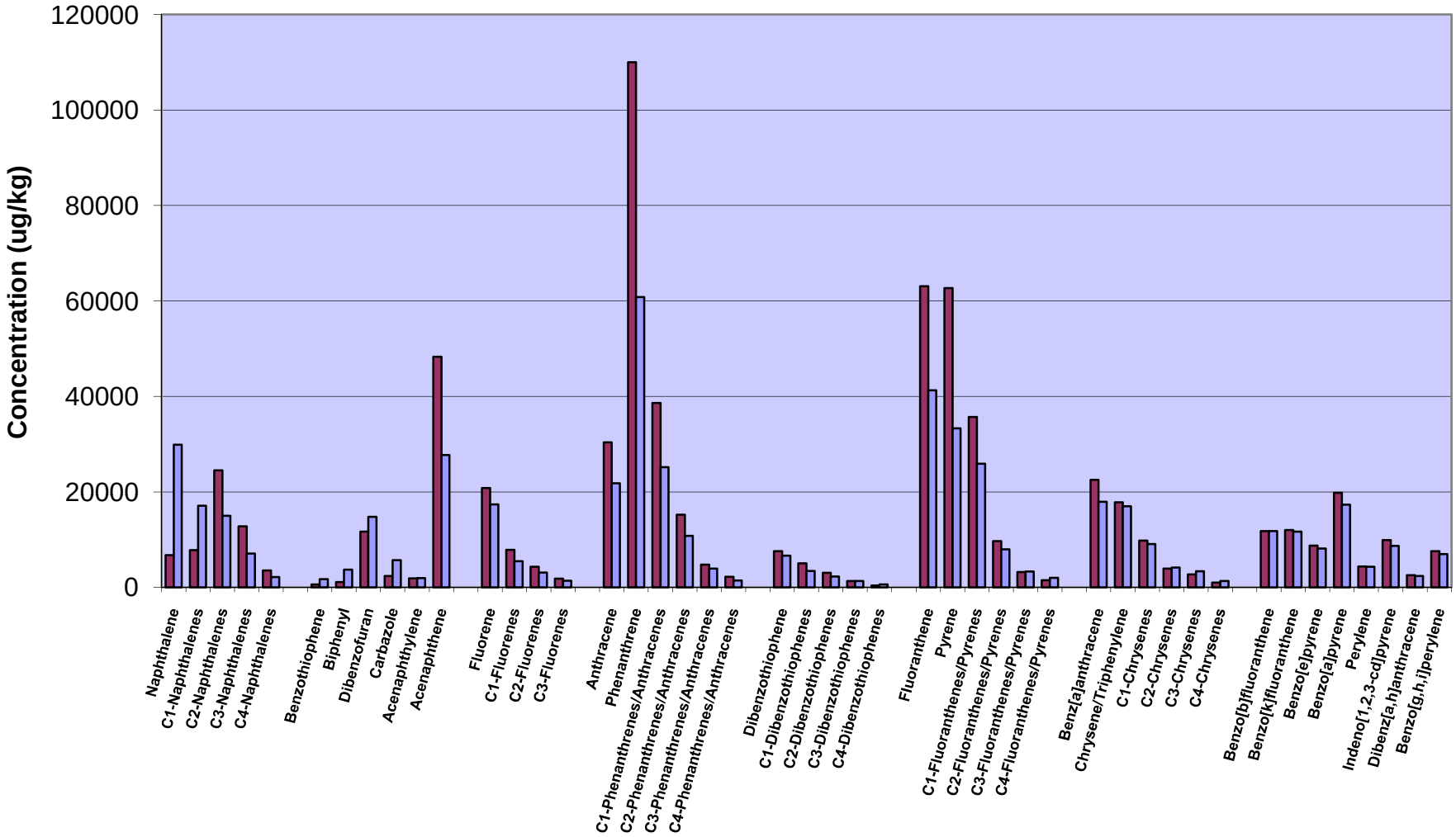
MPD-3 2007 (red) and 2008 (blue)



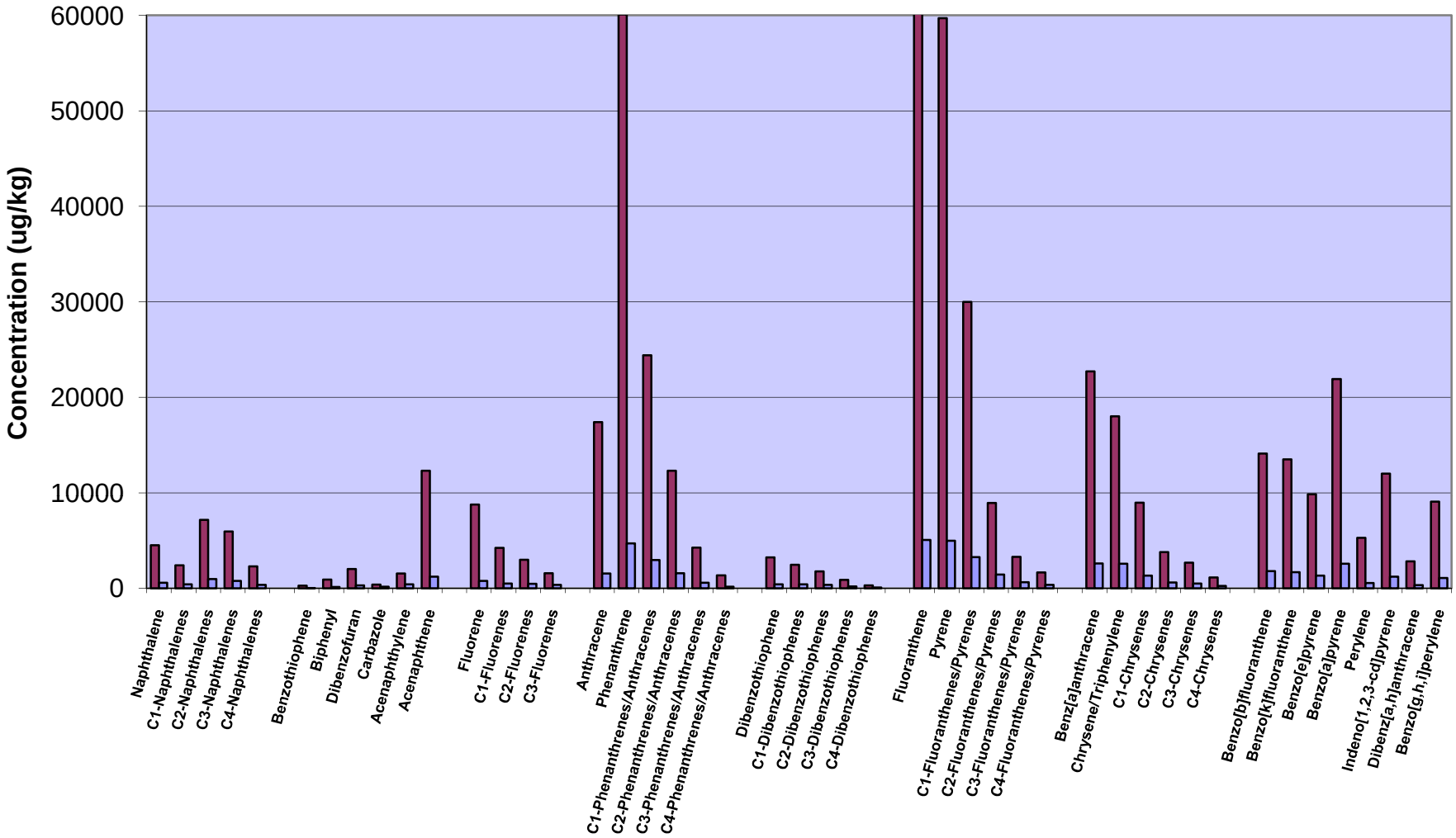
MPE2-2 2007 (red) and 2008 (blue)



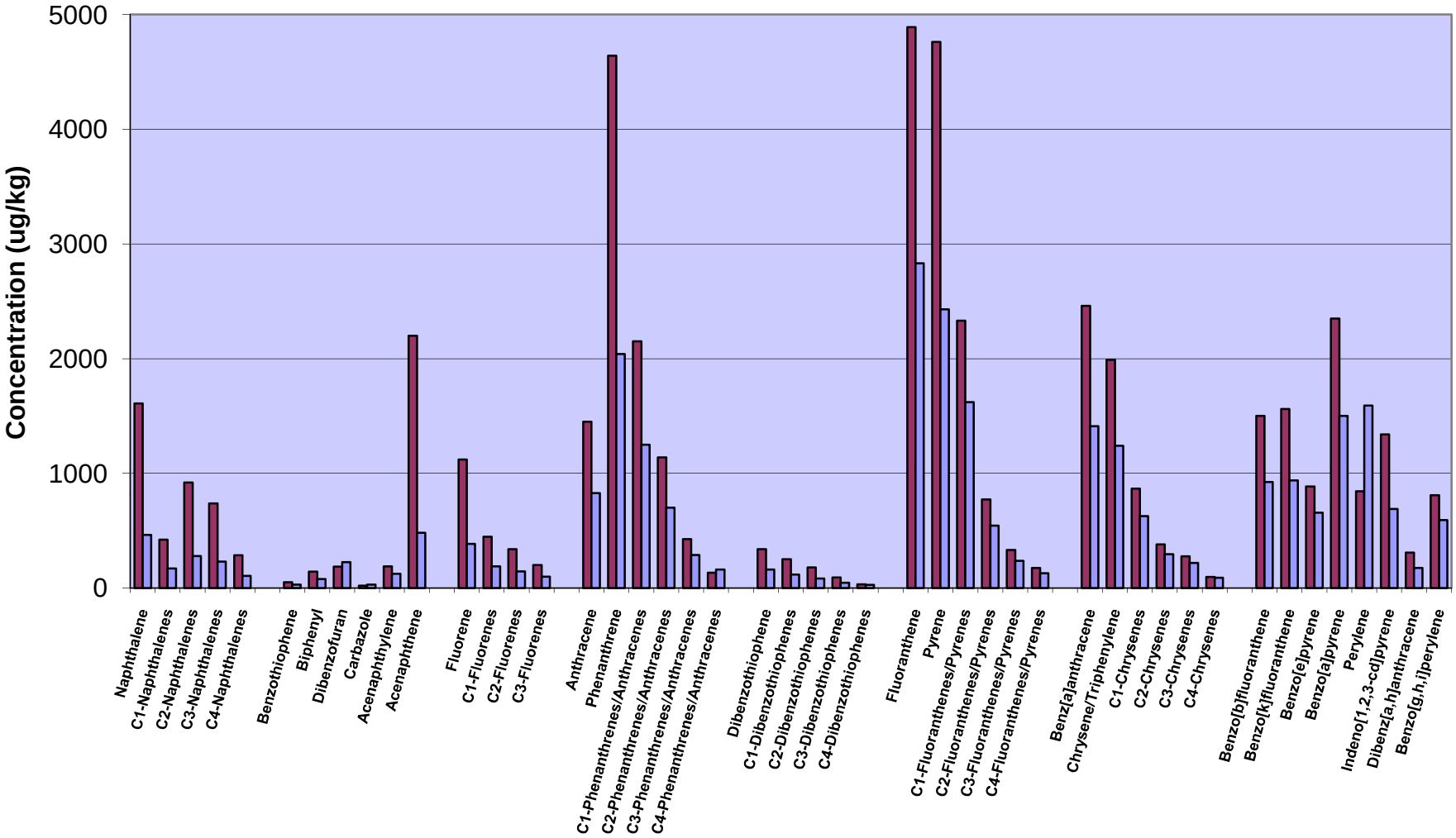
MPA-5 2007 (red) and 2008 (blue)



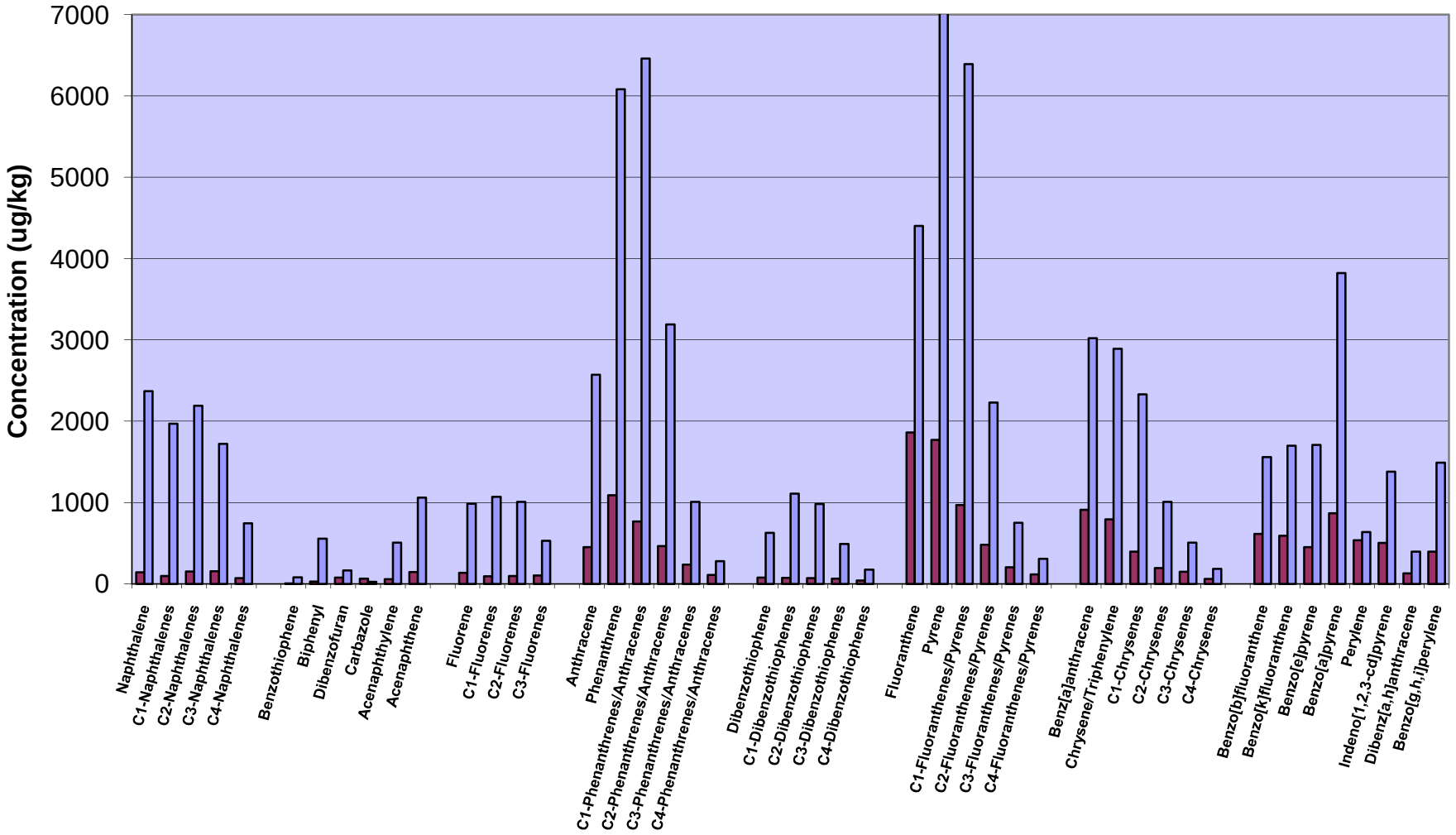
MPU-3 2007 (red) and 2008 (blue)



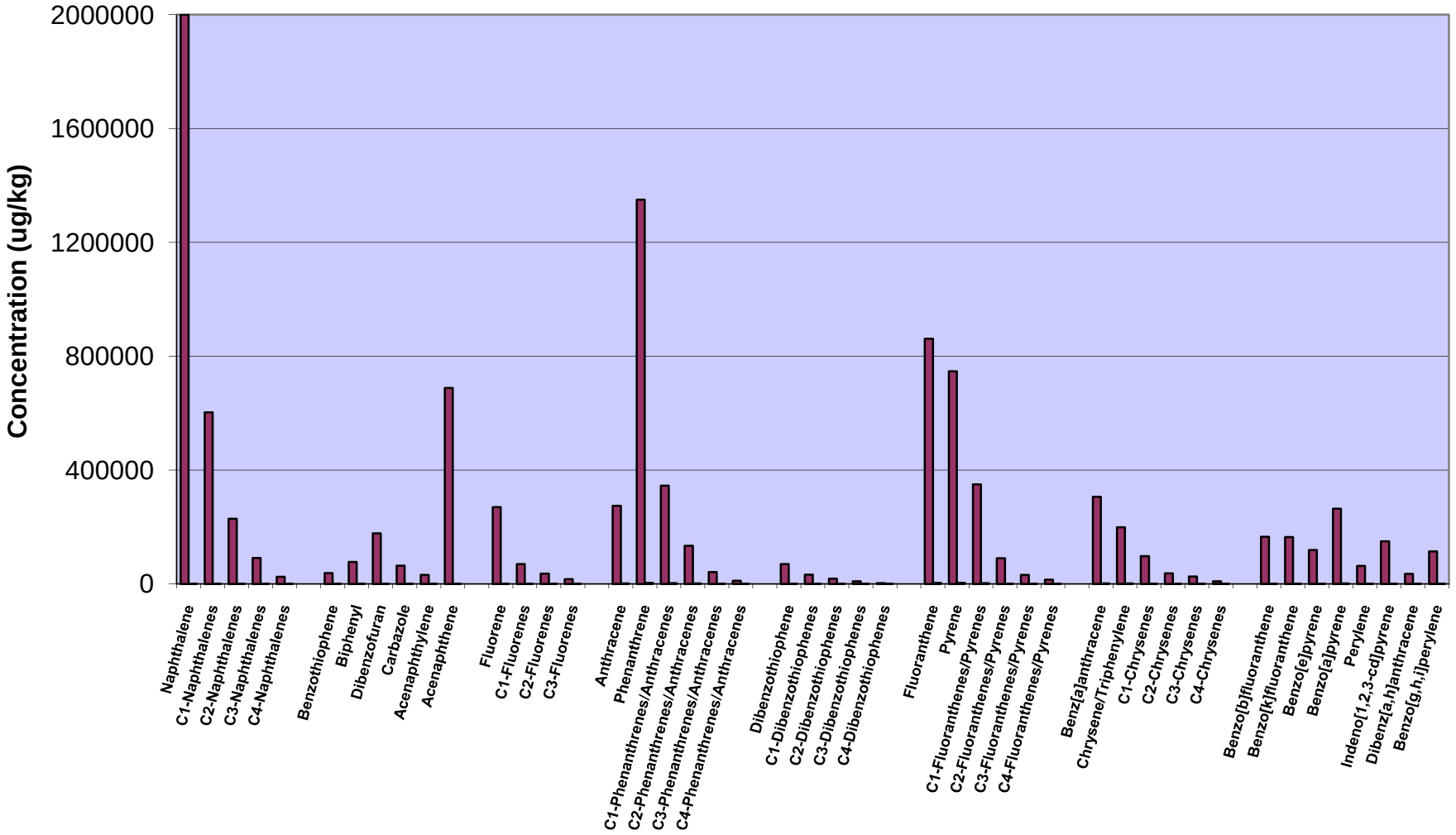
MPD-4 2007 (red) and 2008 (blue)



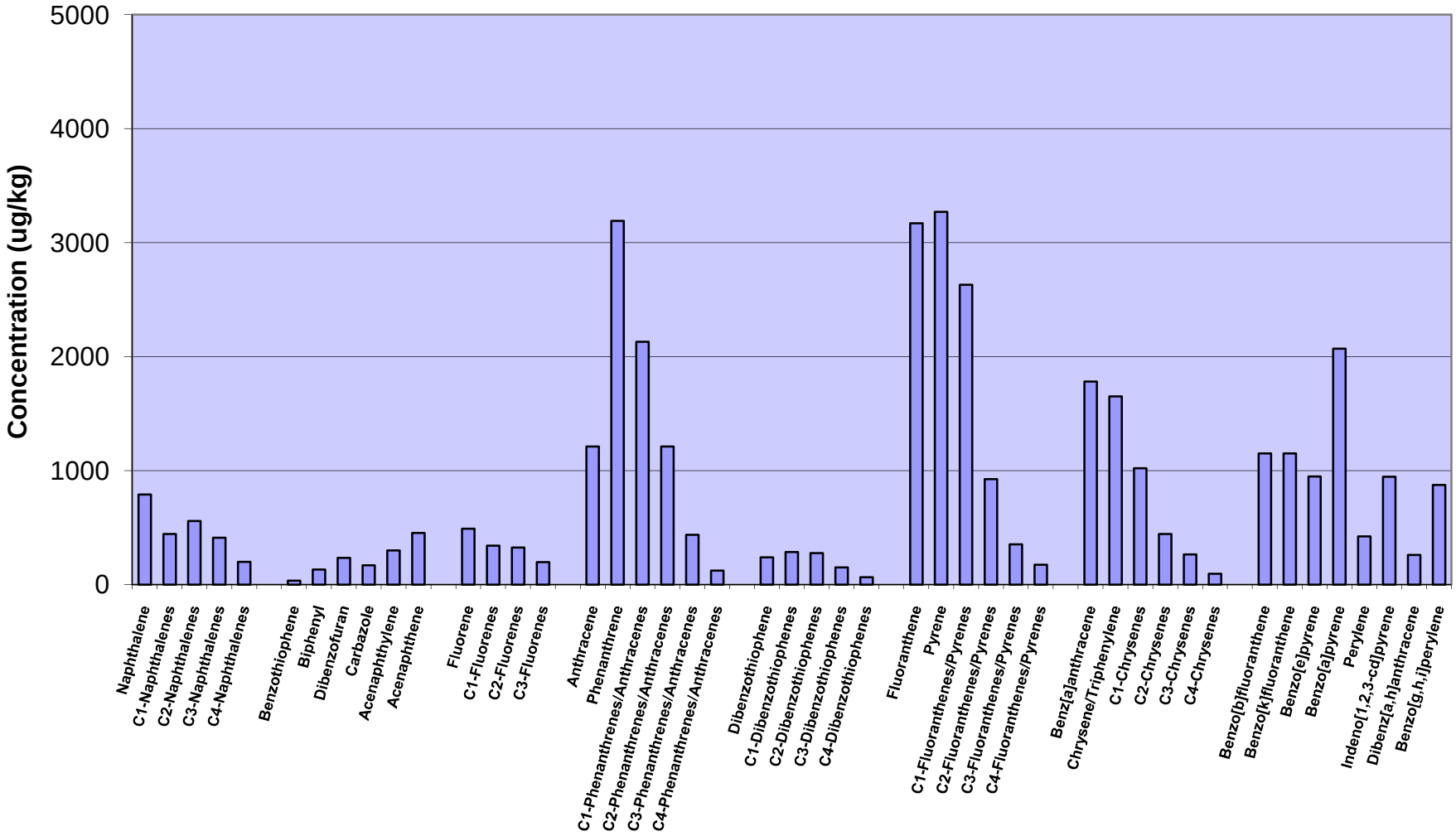
MPD-8 2007 (red) and 2008 (blue)



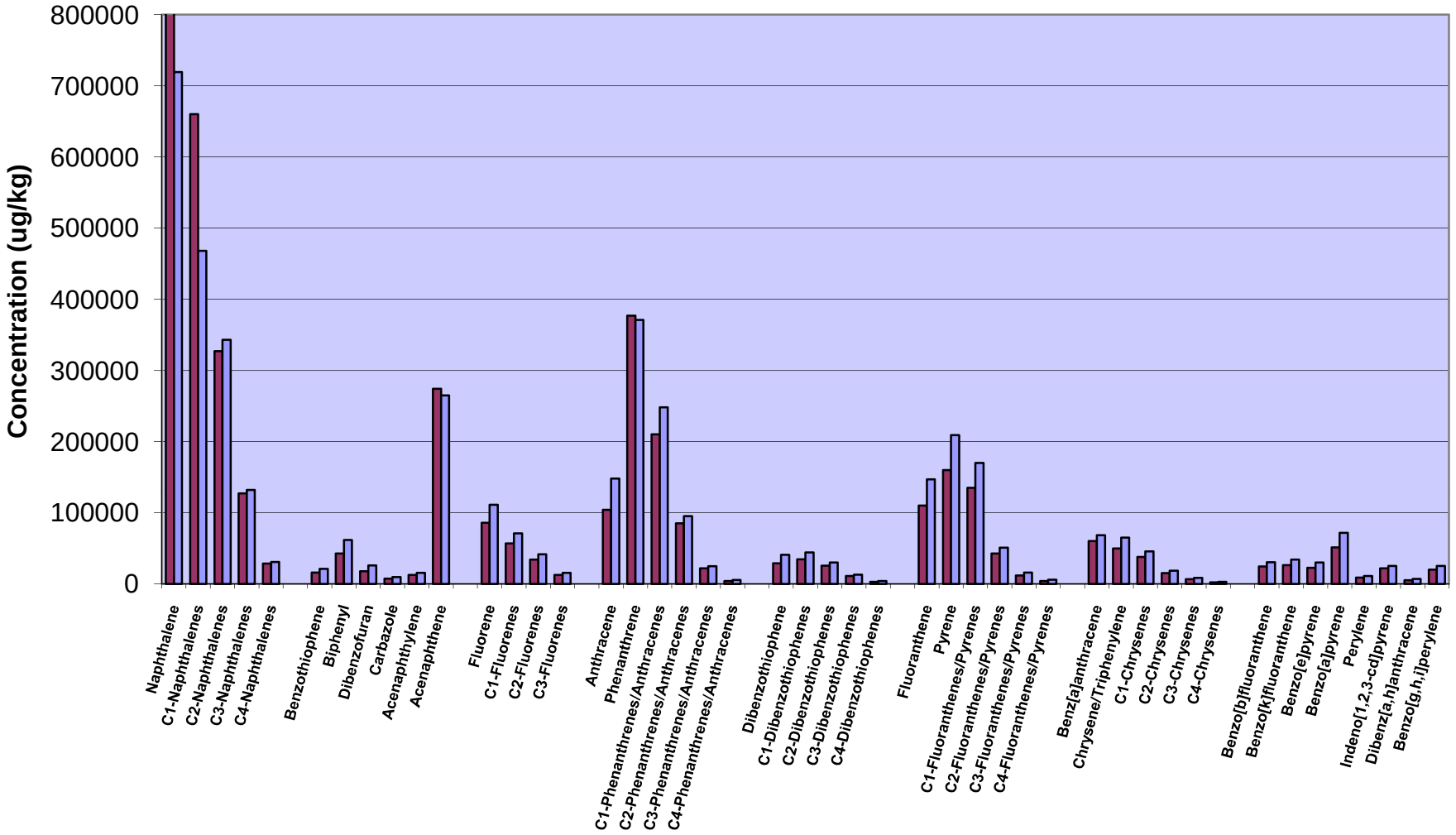
SD-87 2007 (red) and 2008 (blue)



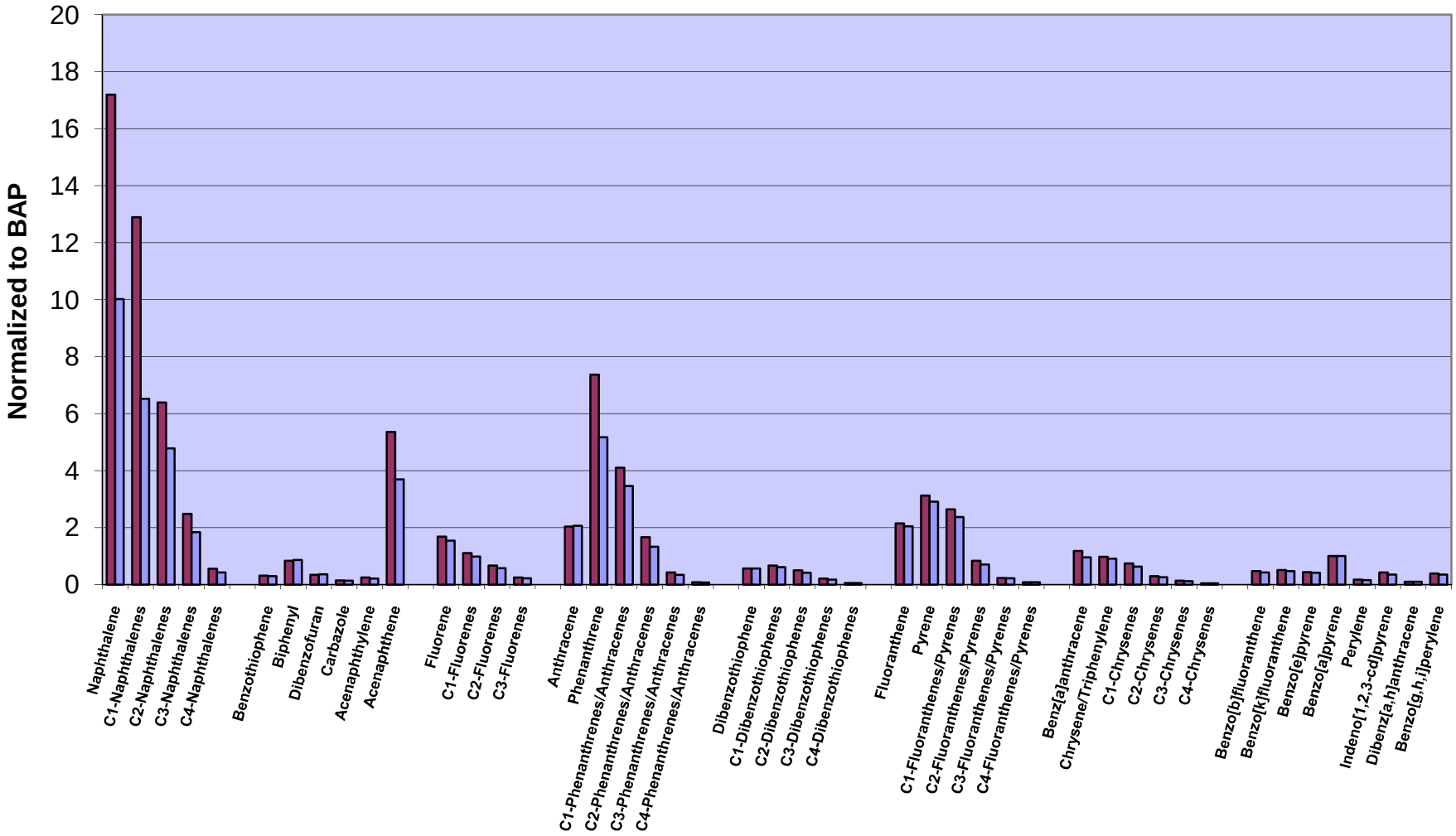
SD-87 2008 (blue)



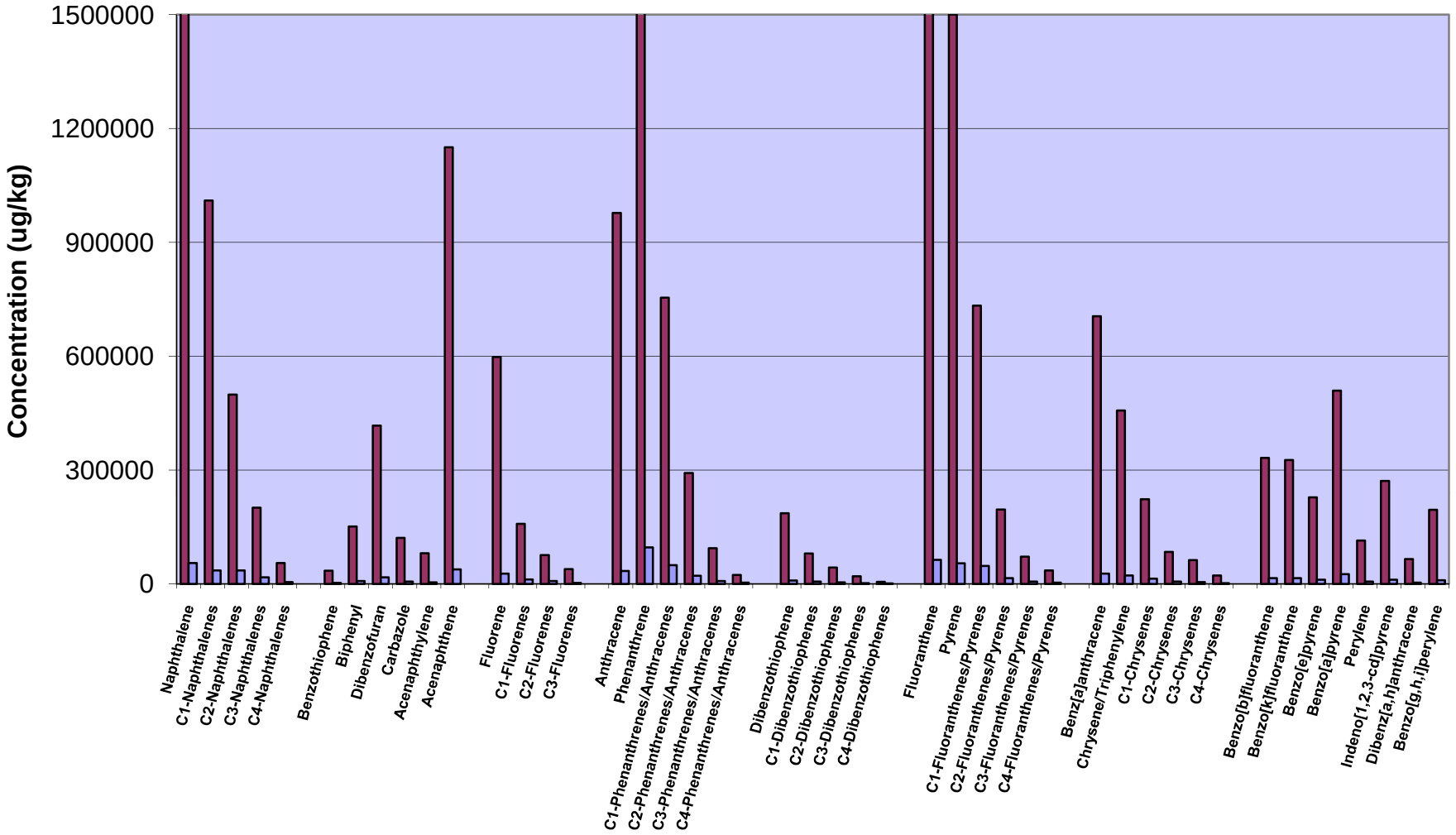
SD-96 2007 (red) and 2008 (blue)



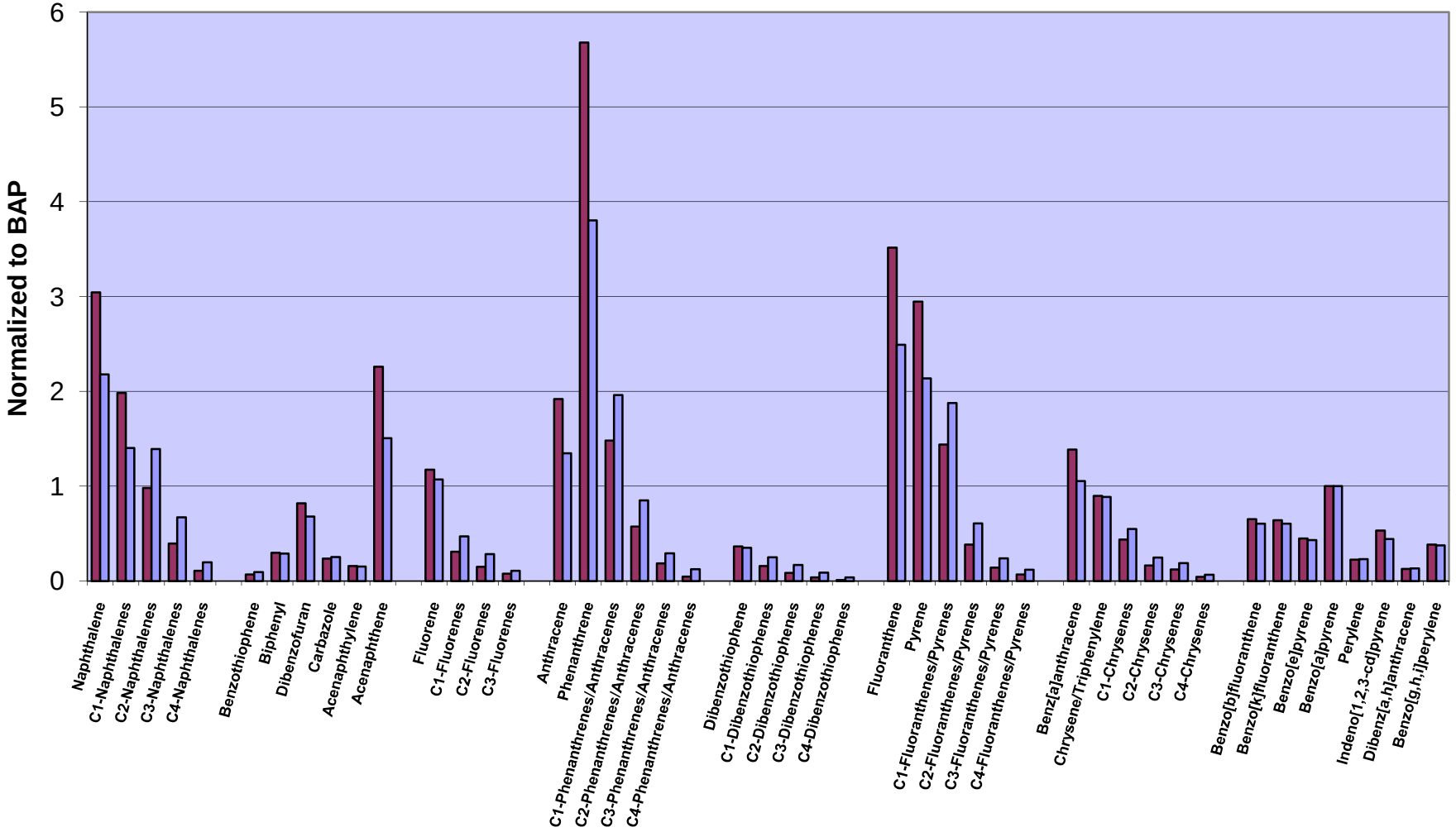
SD-96 2007 (red) and 2008 (blue)



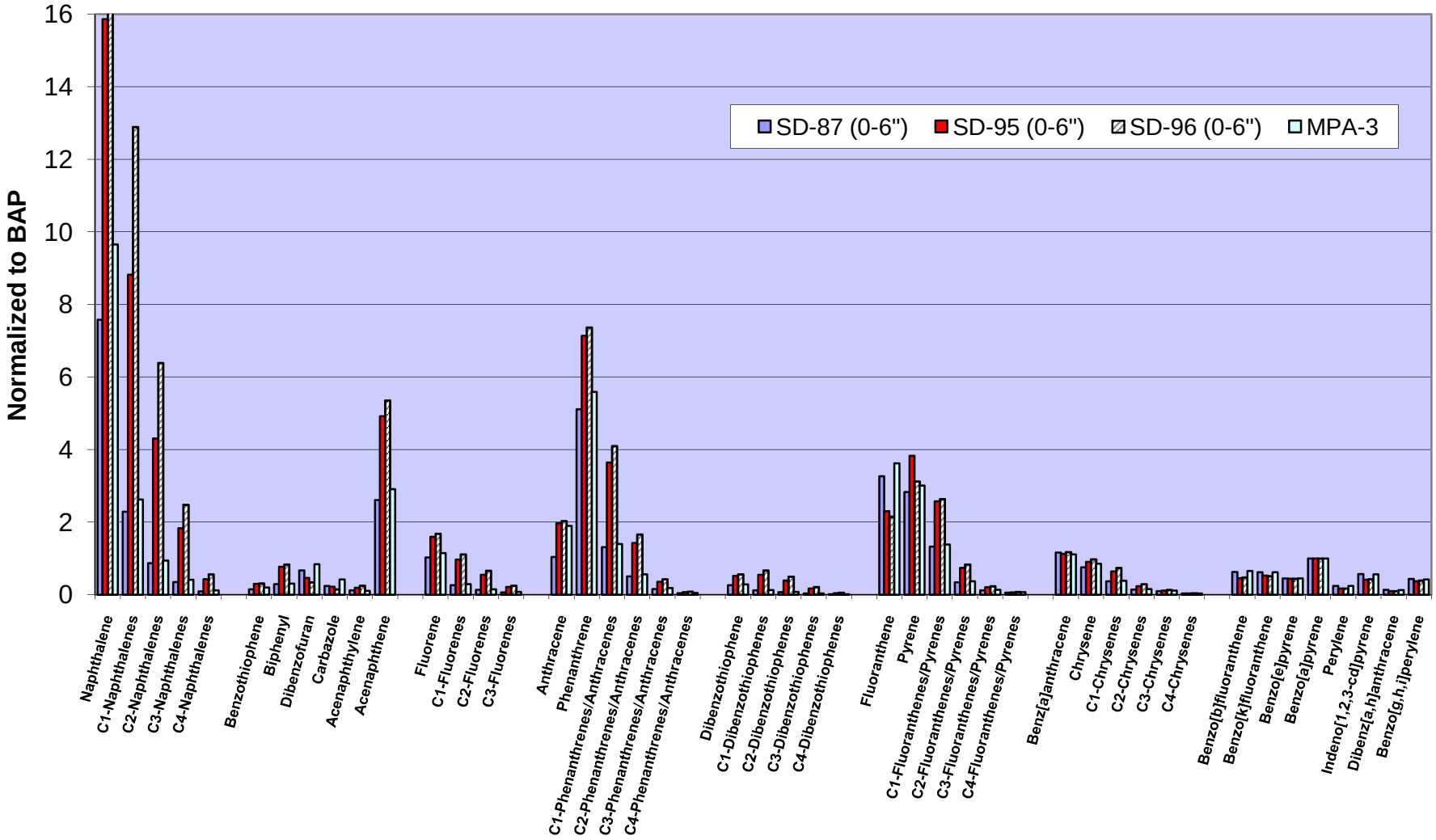
MPD-2 2007 (red) and 2008 (blue)



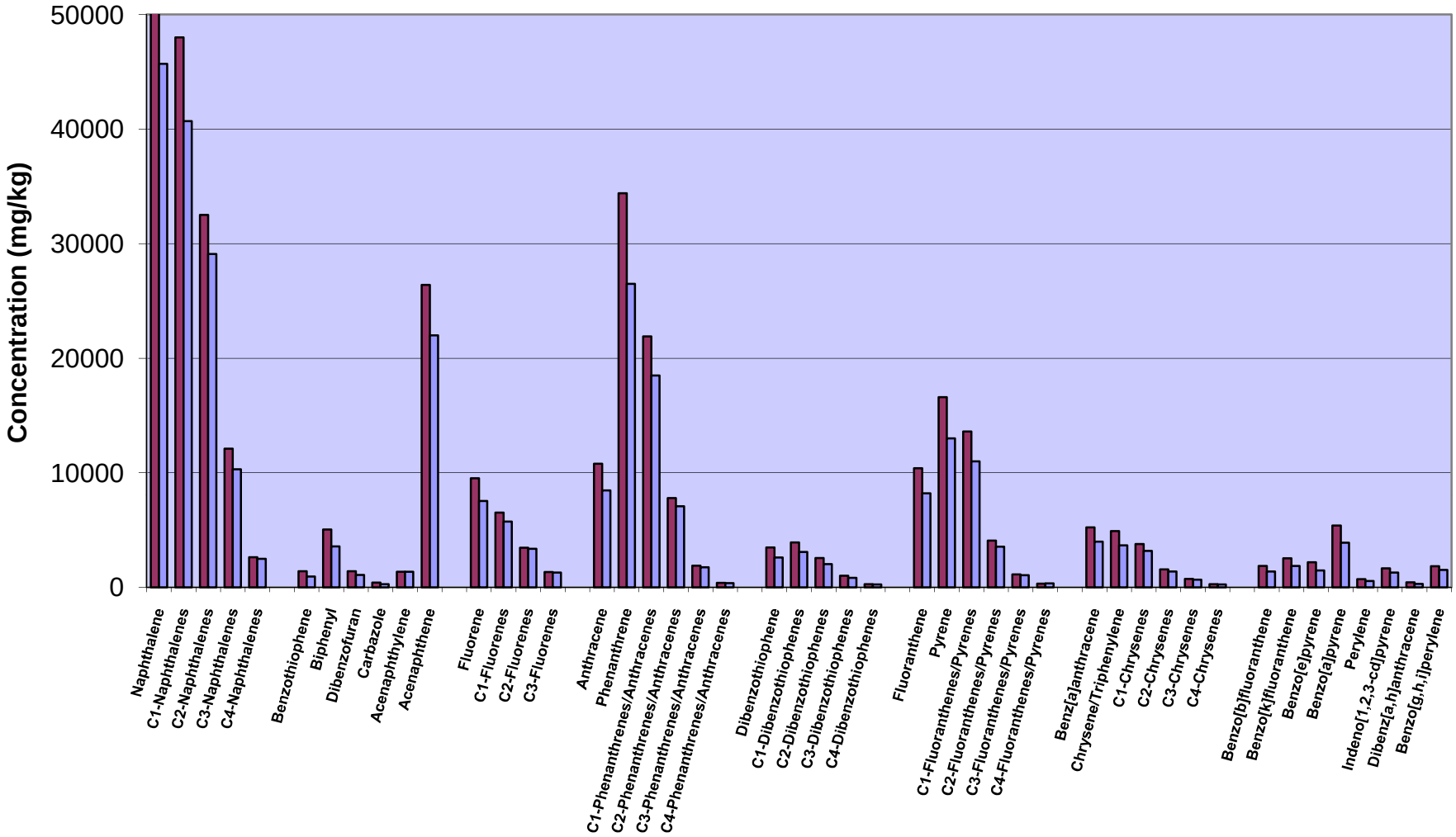
MPD-2 2007 (red) and 2008 (blue)



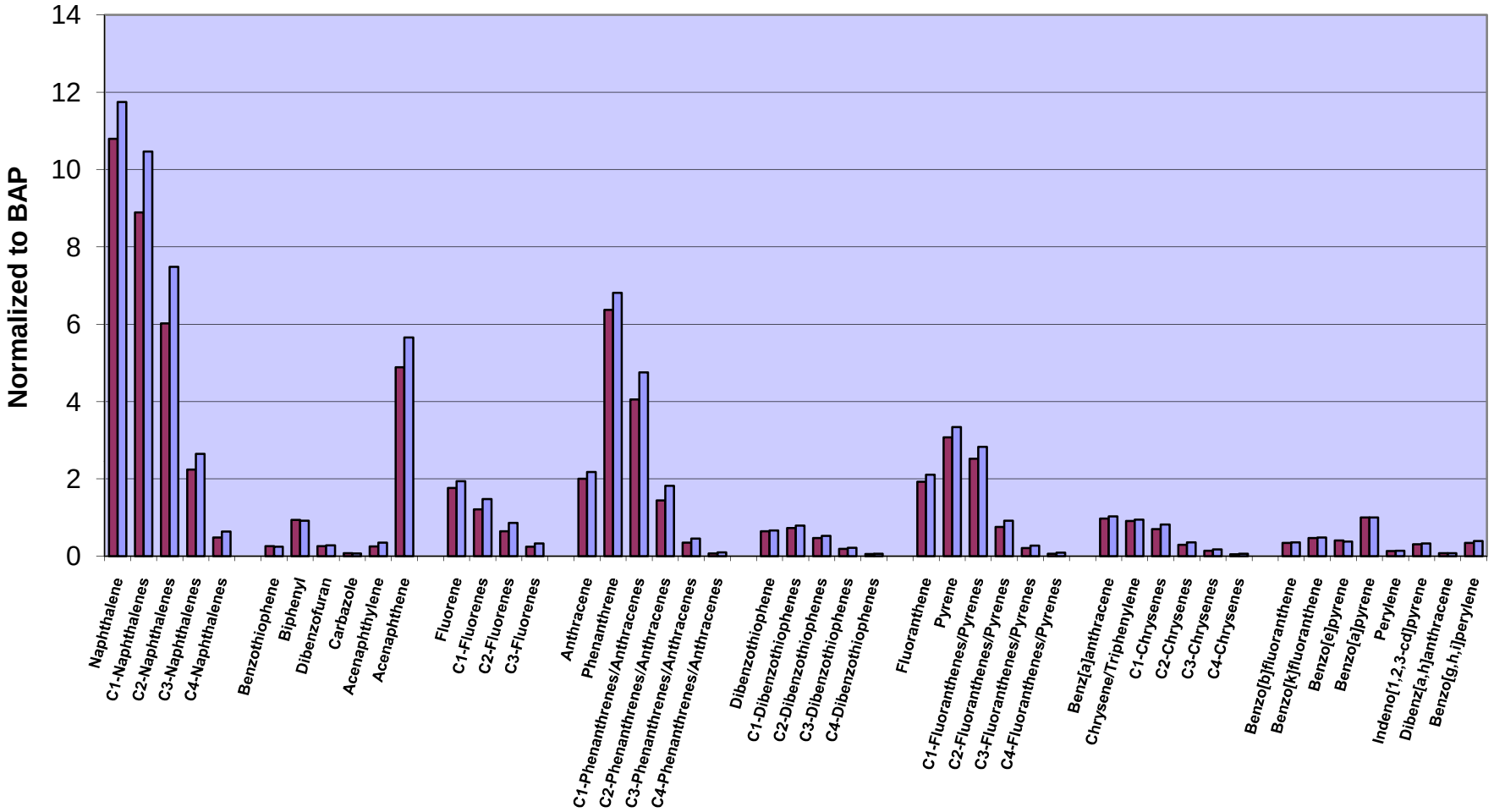
2007 Candidate Site Source Tar For Depletion Calculations



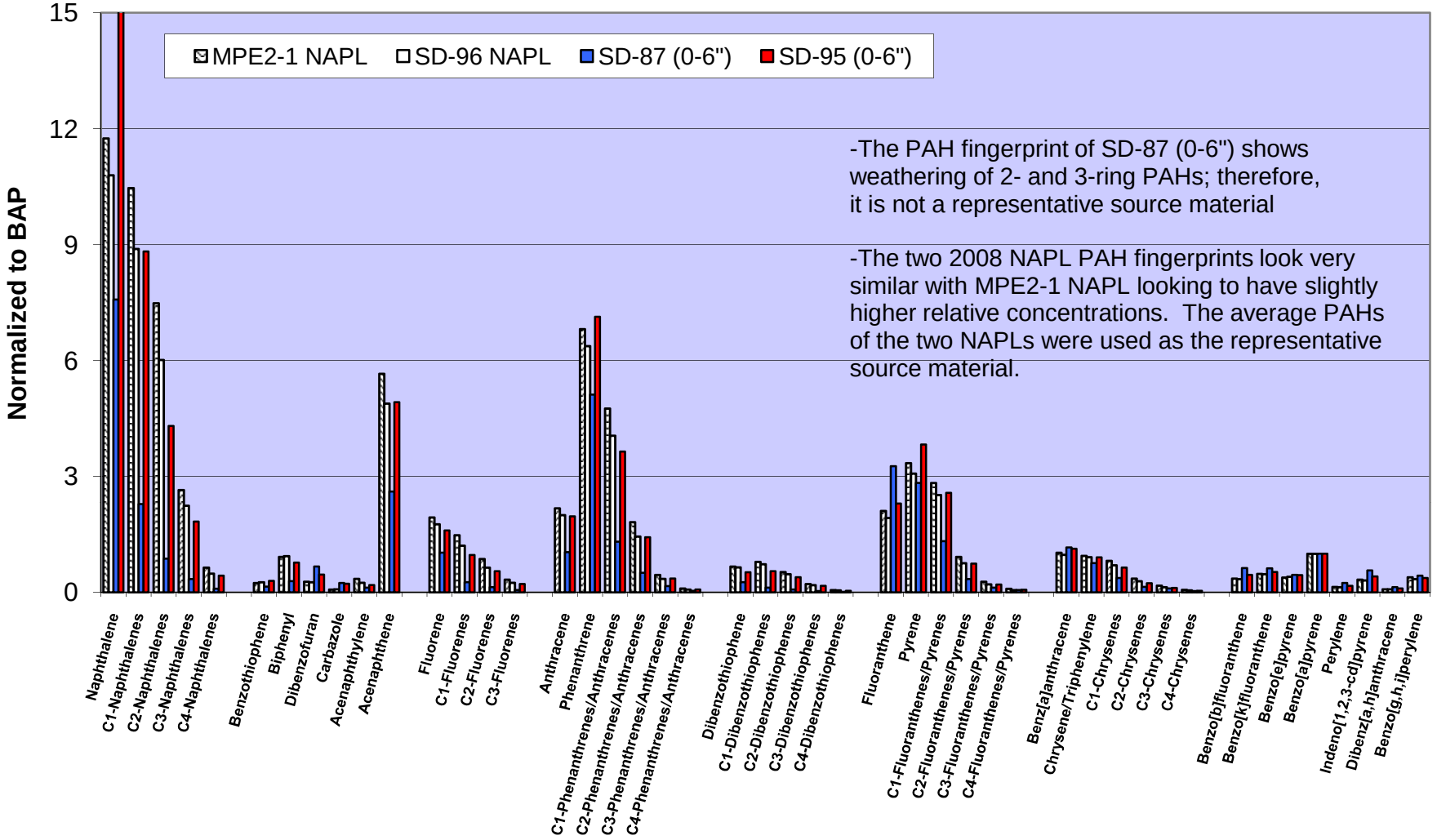
2008 SD-96 NAPL (red) and 2008 MPE-2 NAPL (blue)



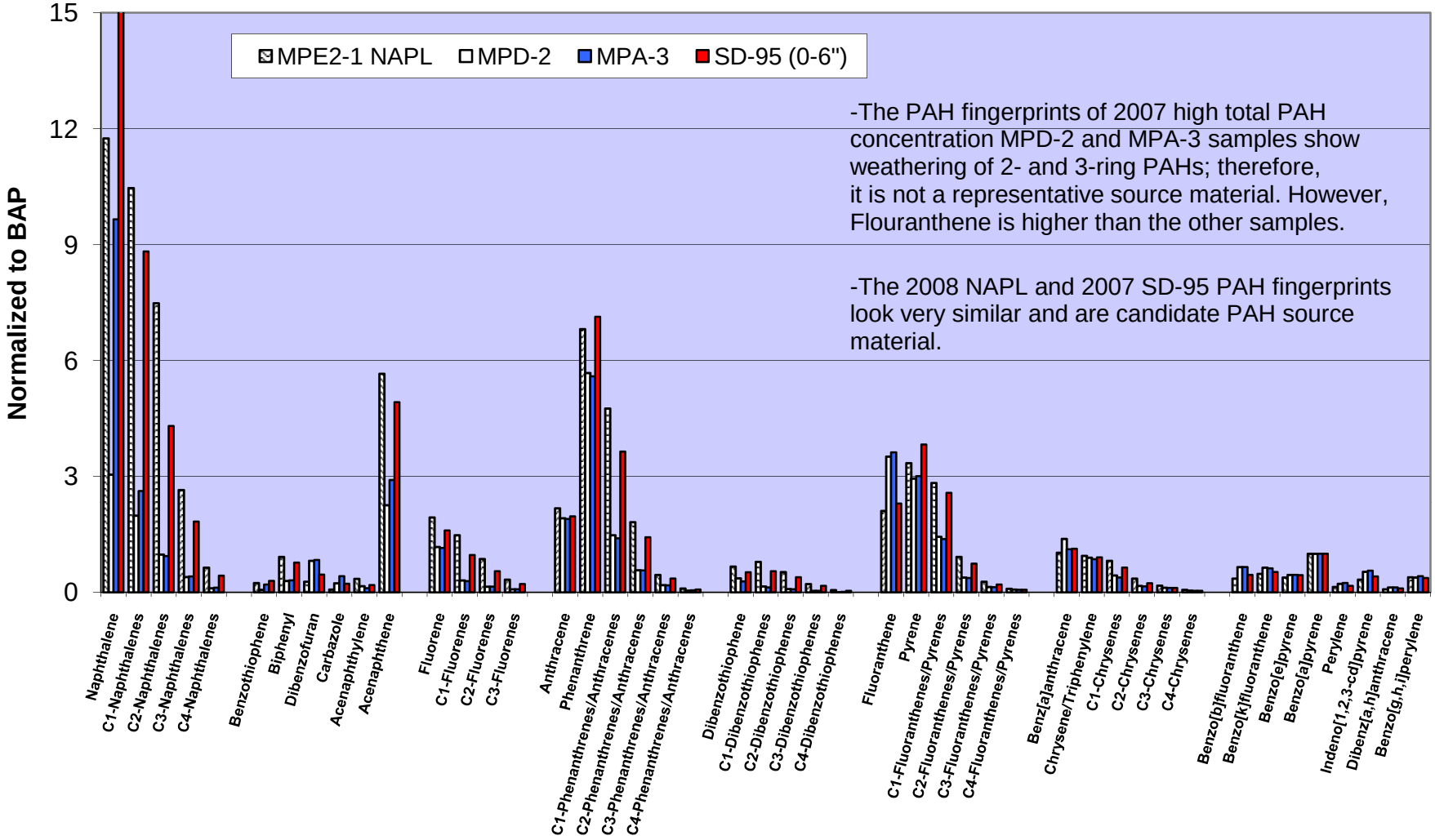
Candidate Source Materials
2008 SD-96 NAPL (red) and MPE-2 NAPL (blue)



Candidate PAH Source Materials
2008 MPE-2 & SD-96 NAPLs and 2007 SD-87 & SD-95 Sed Samples

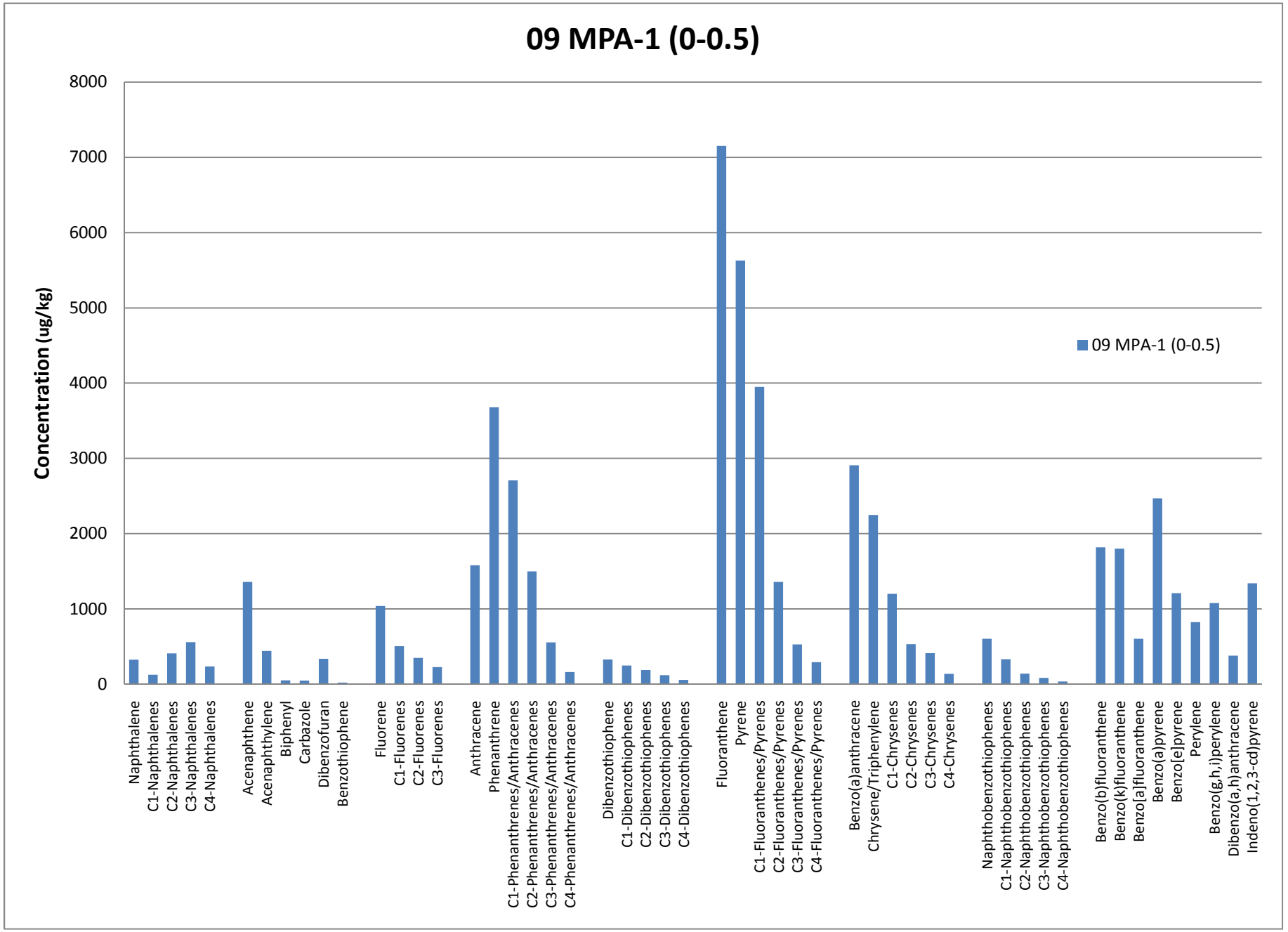


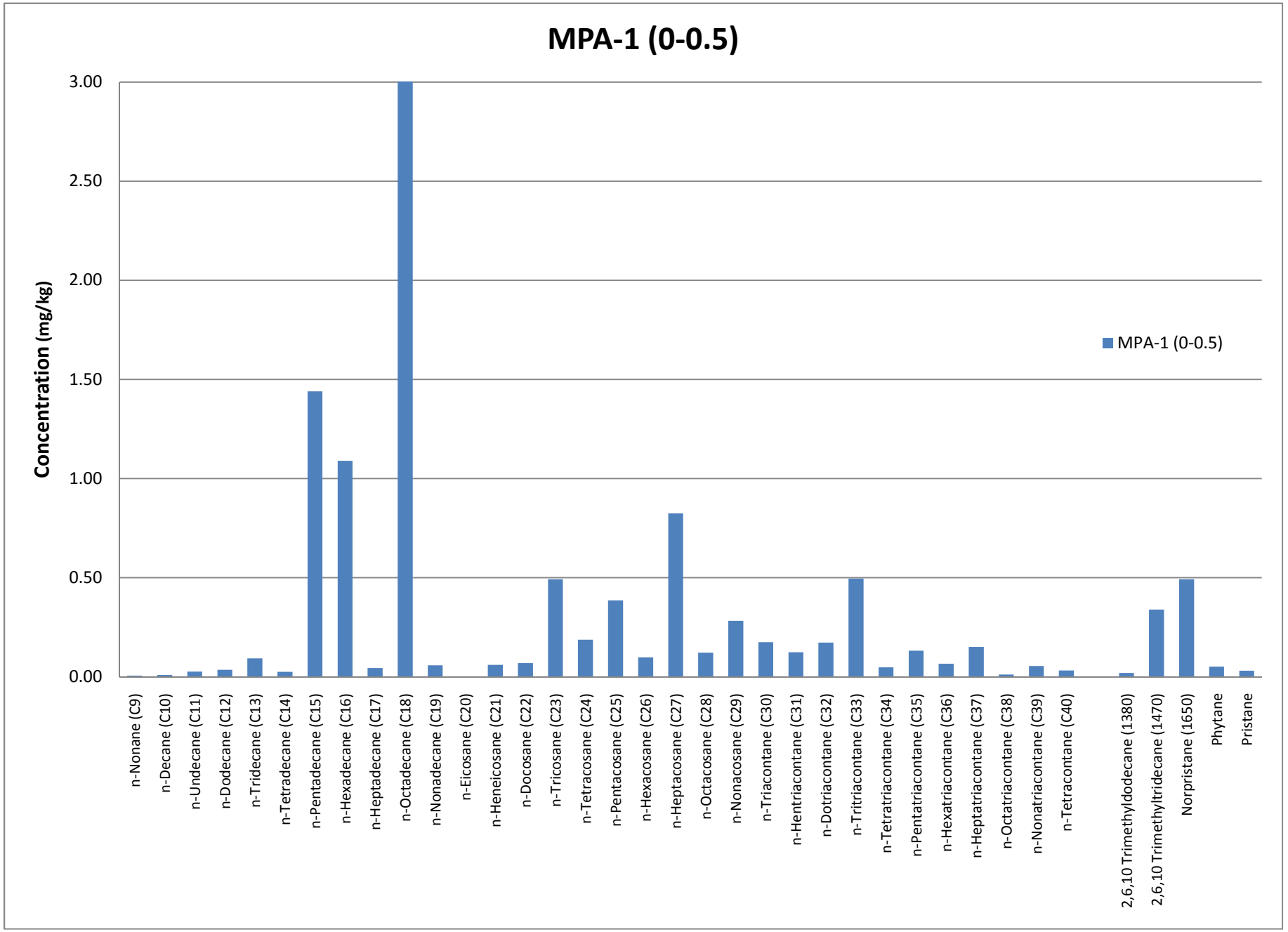
Candidate PAH Source Materials
2008 MPE-2 NAPL and 2007 MPD-2, MPA-3 & SD-95 Sed Samples

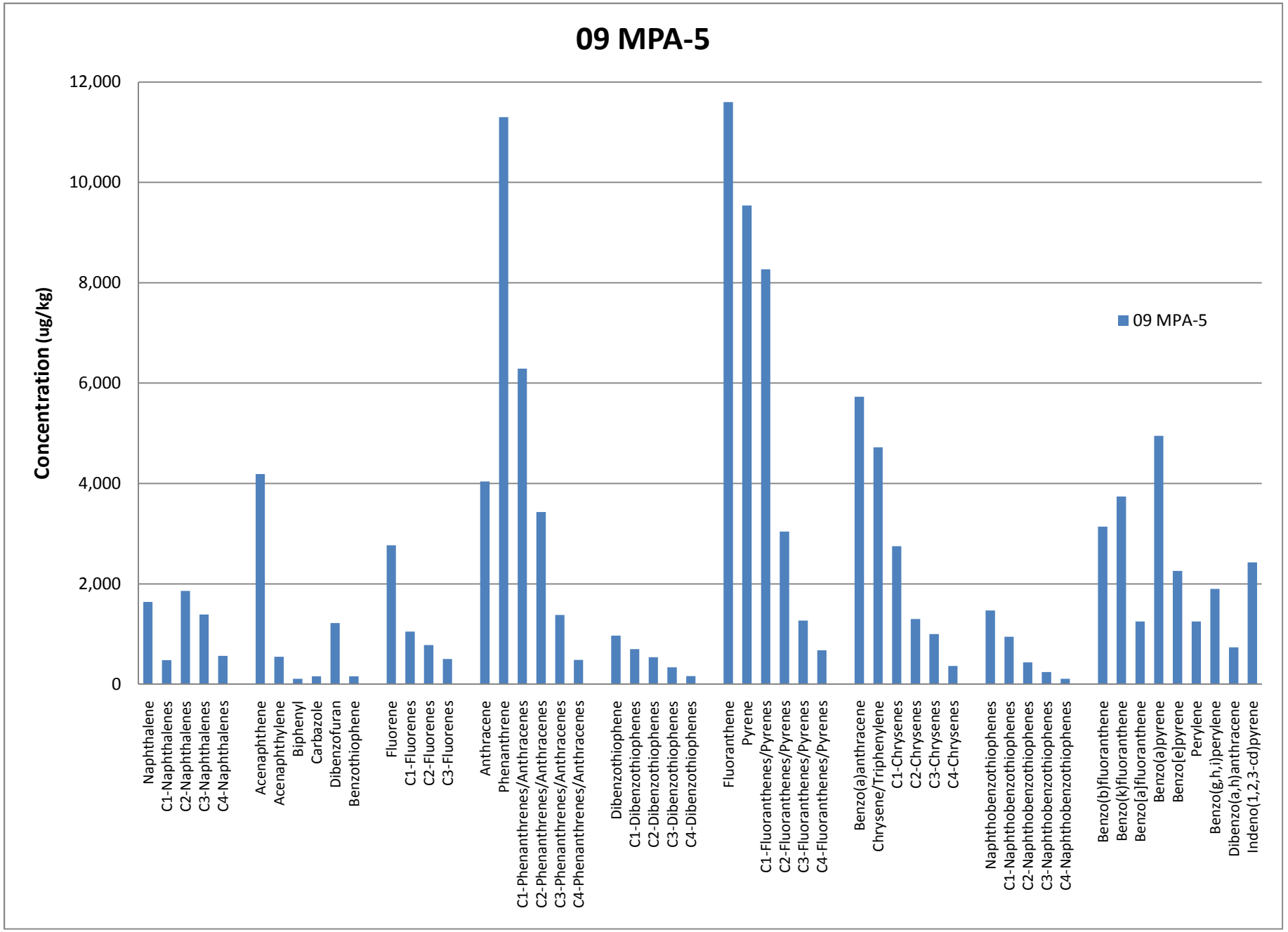


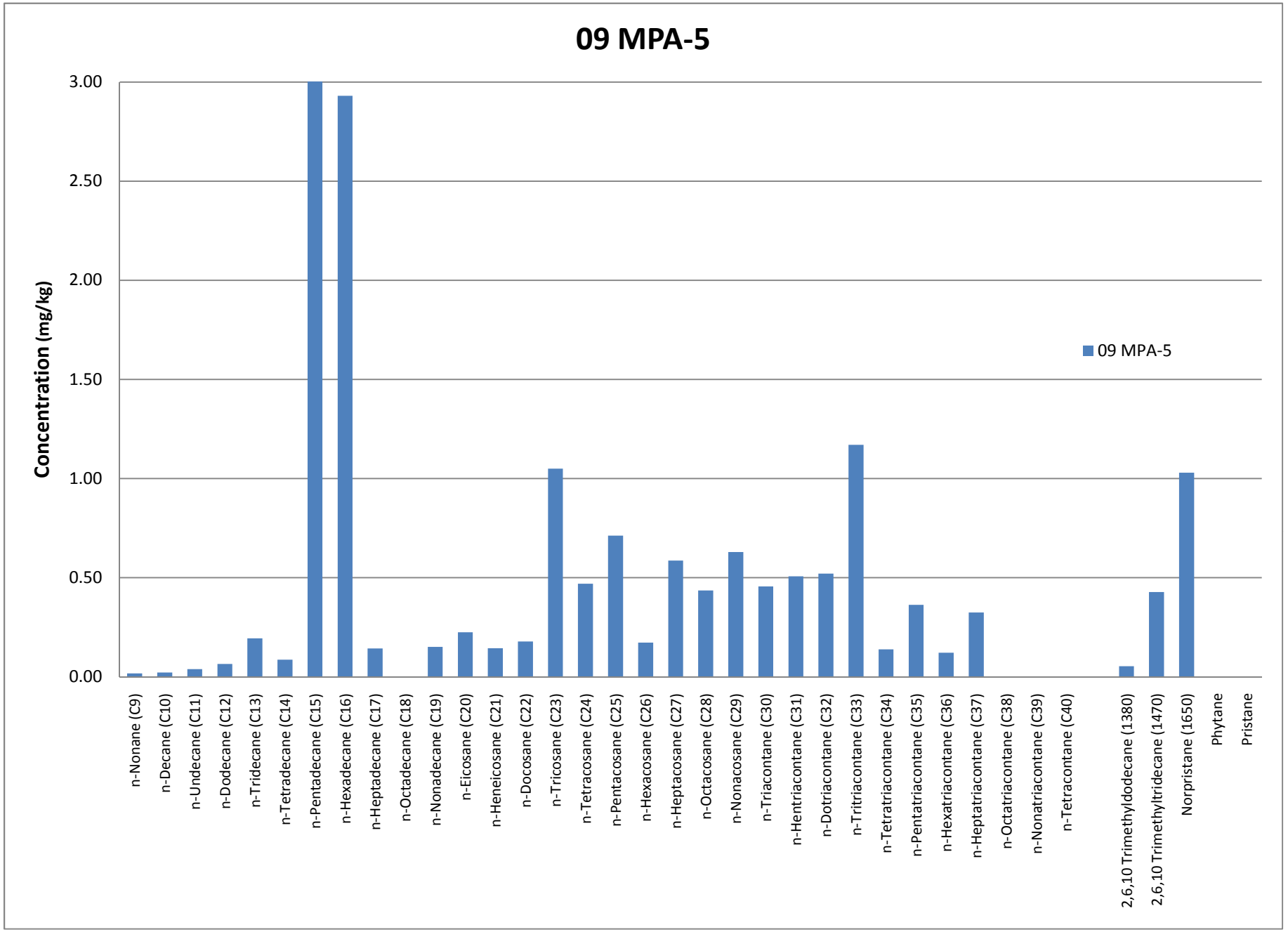
ARCADIS

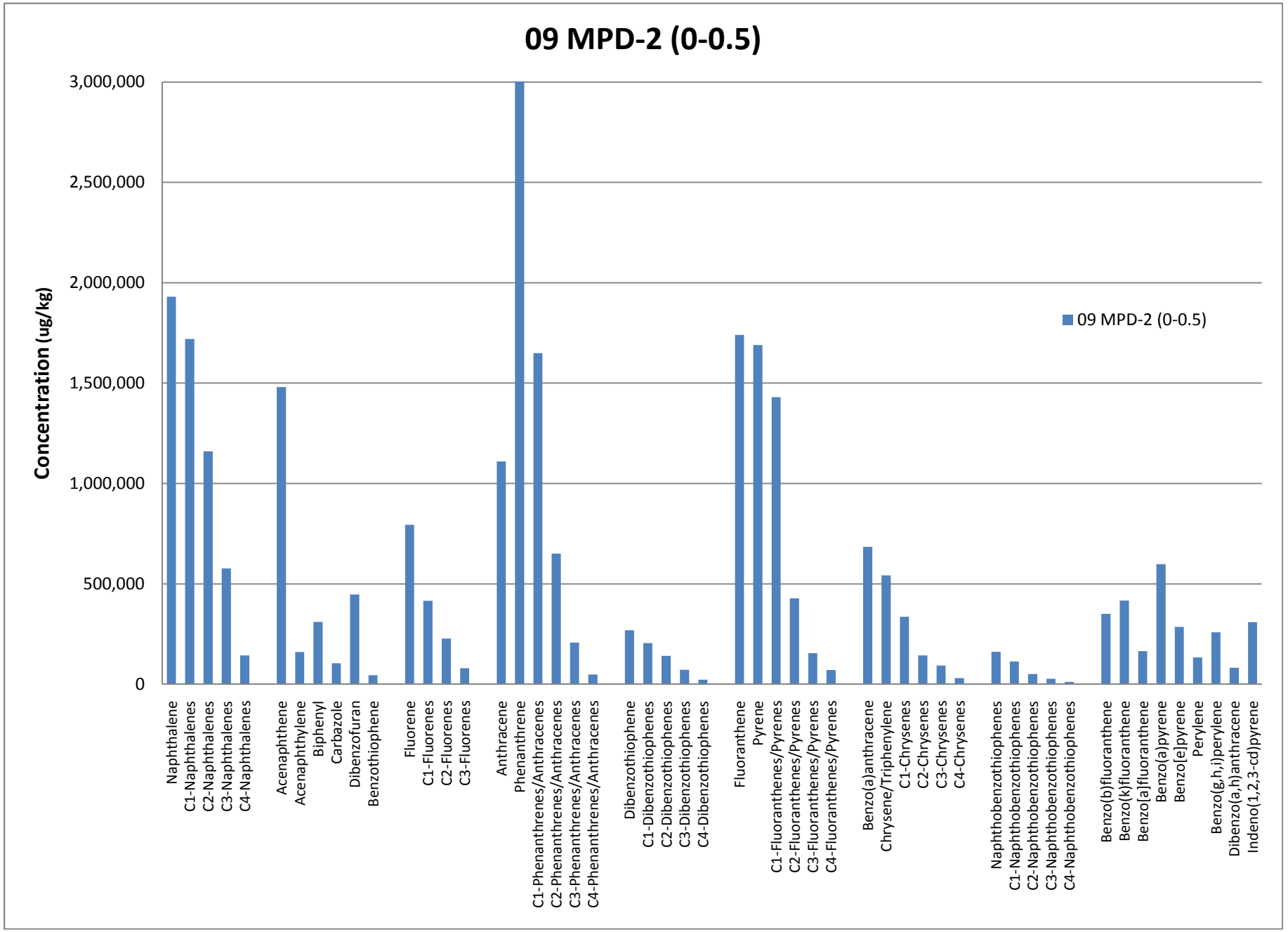
2009 PAH-SHC Fingerprints

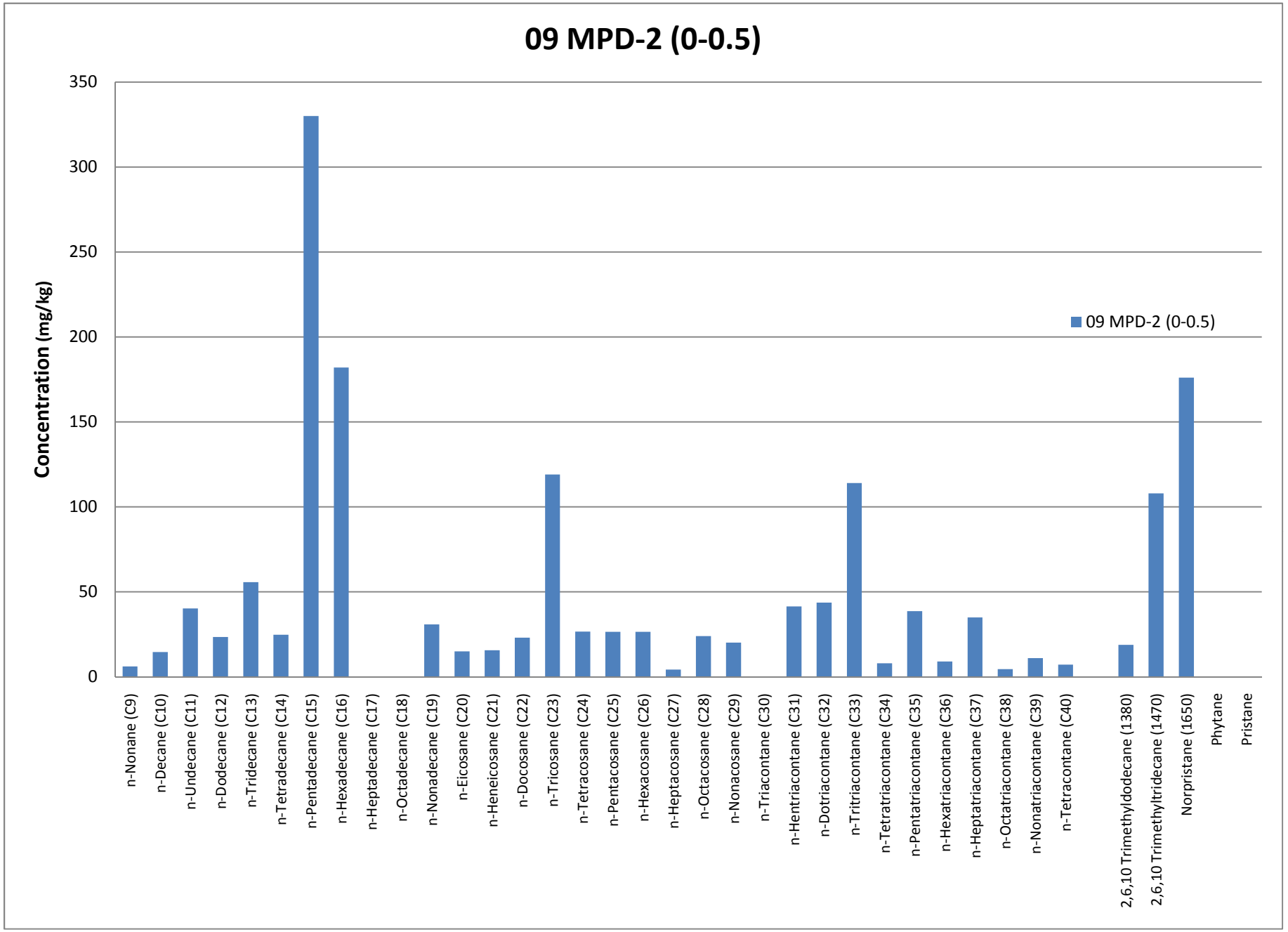

09 MPA-1 (0-0.5)
Concentration (ug/kg)
8000
7000
6000
5000
4000
3000
2000
1000
0
09 MPA-1 (0-0.5)
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

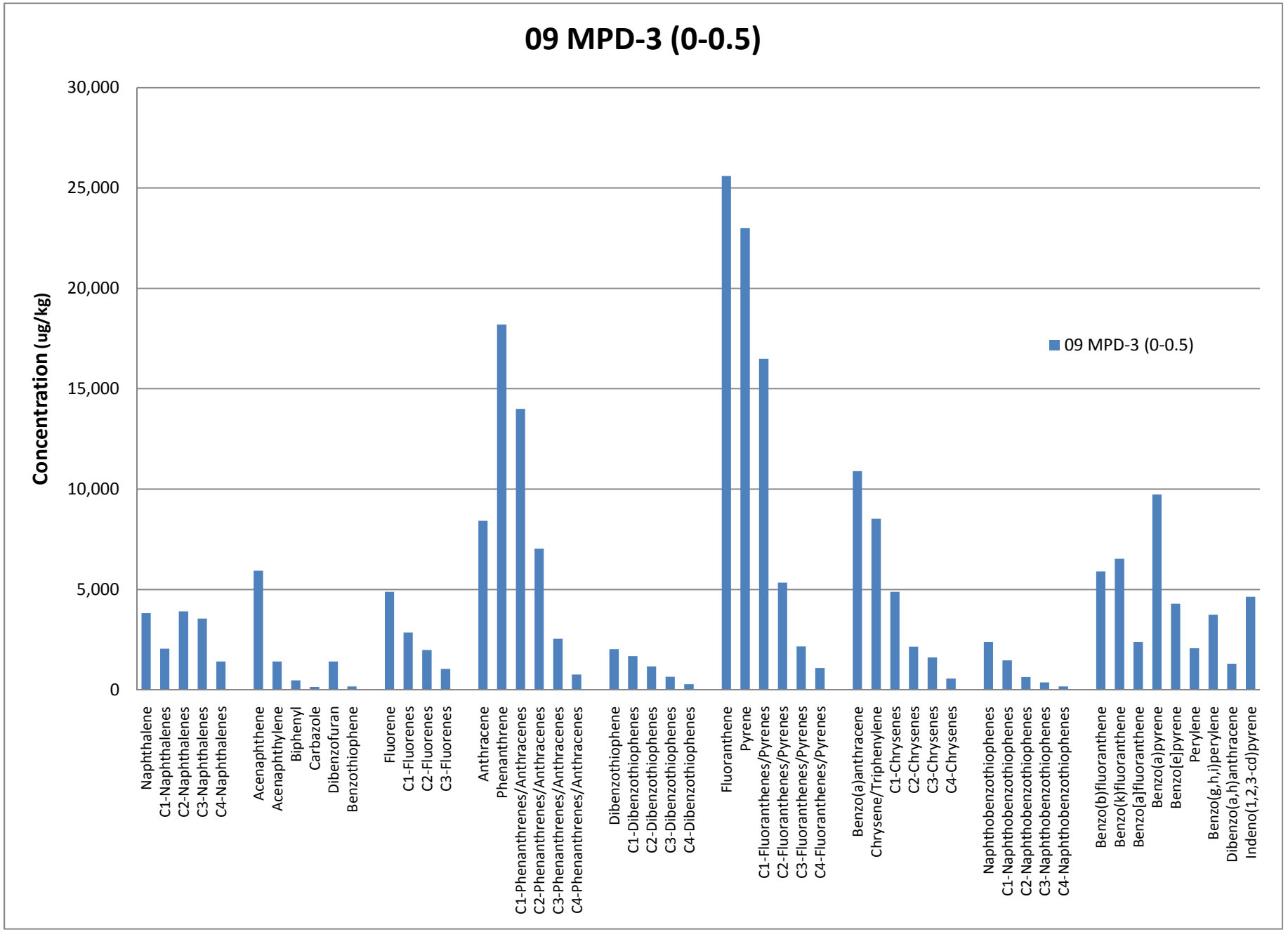

MPA-1 (0-0.5)
Concentration (mg/kg)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
MPA-1 (0-0.5)
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane

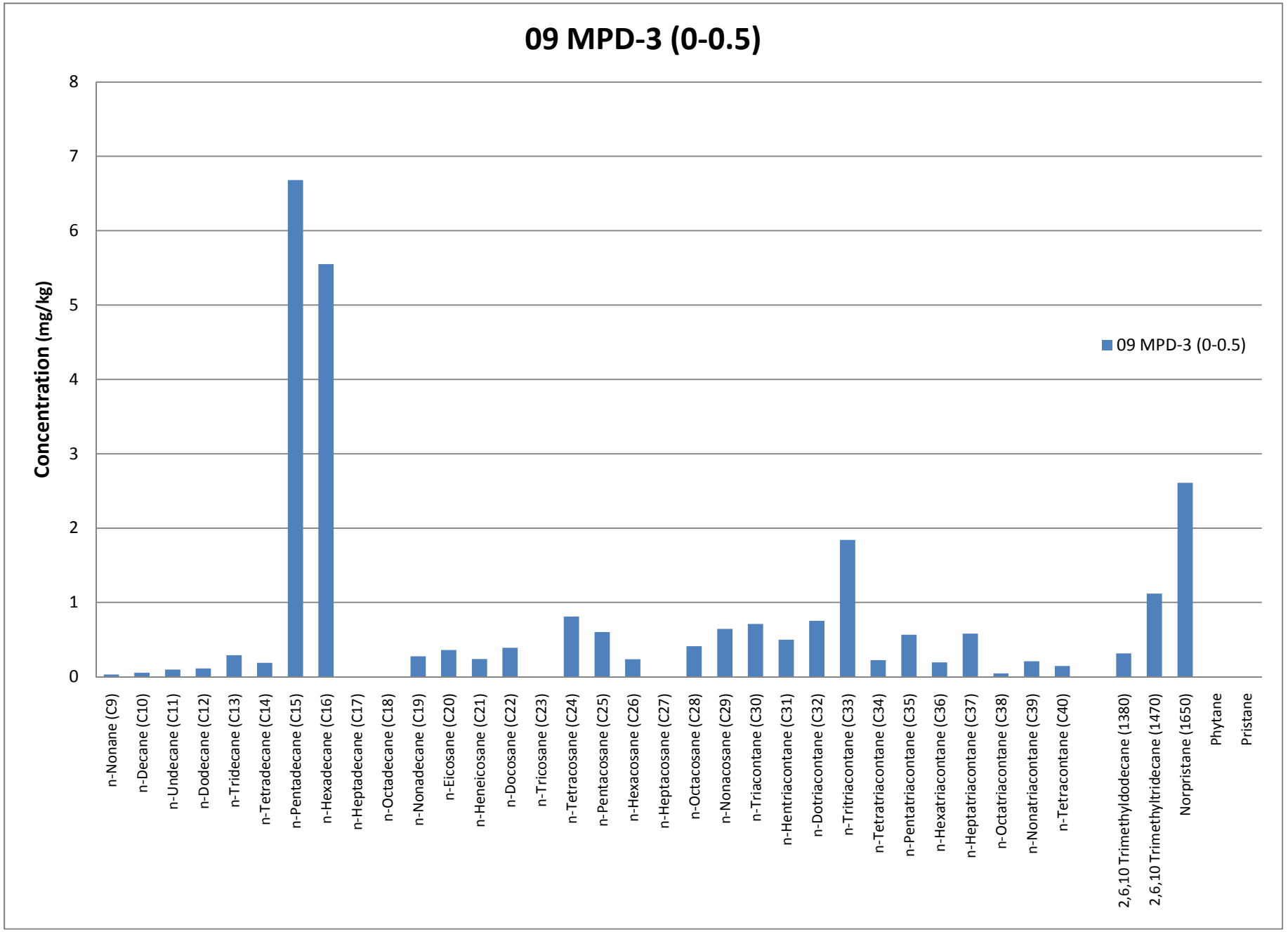

09 MPA-5
Concentration (ug/kg)
12,000
10,000
8,000
6,000
4,000
2,000
0
09 MPA-5
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

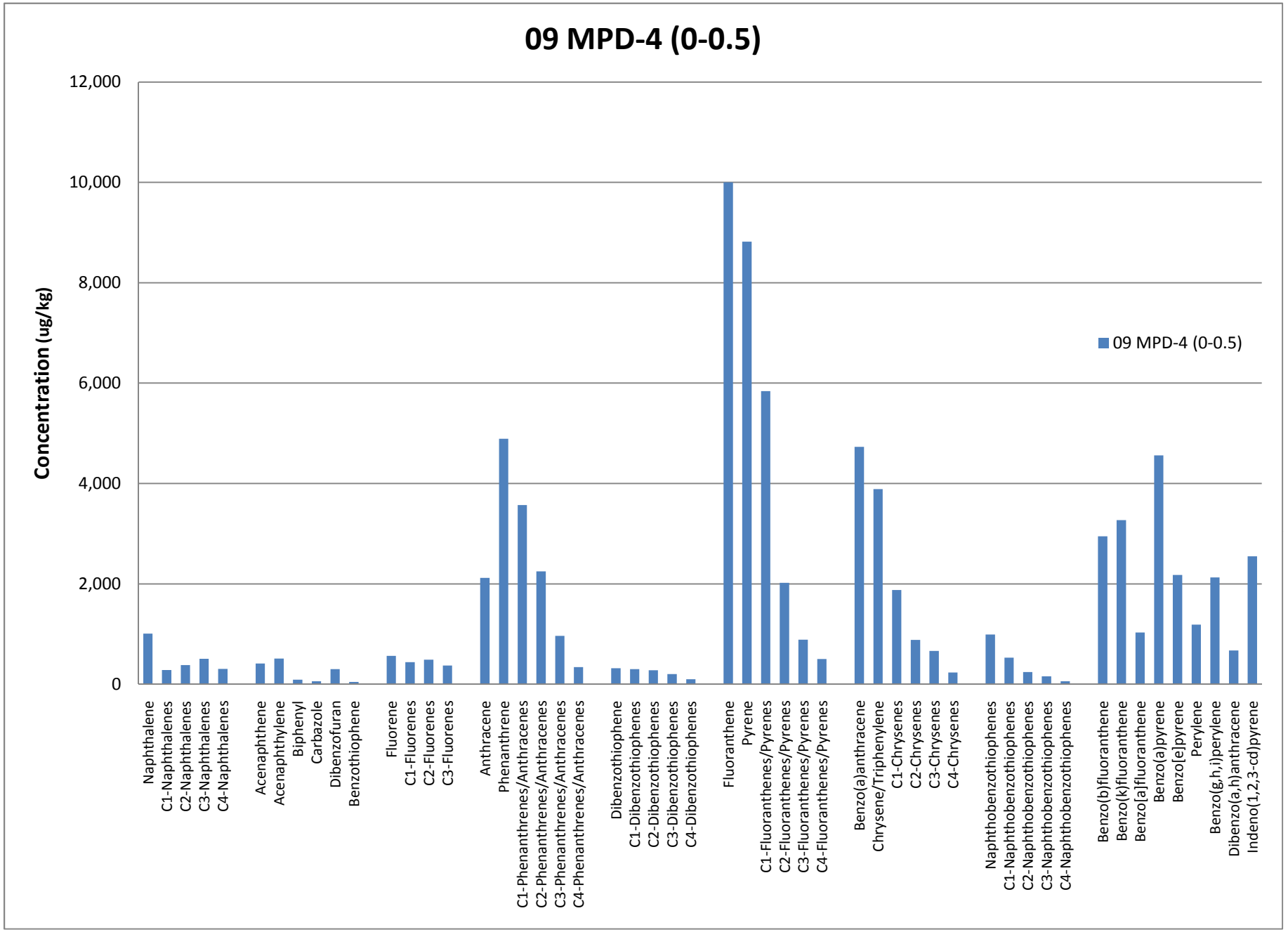

09 MPA-5
Concentration (mg/kg)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
09 MPA-5
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane

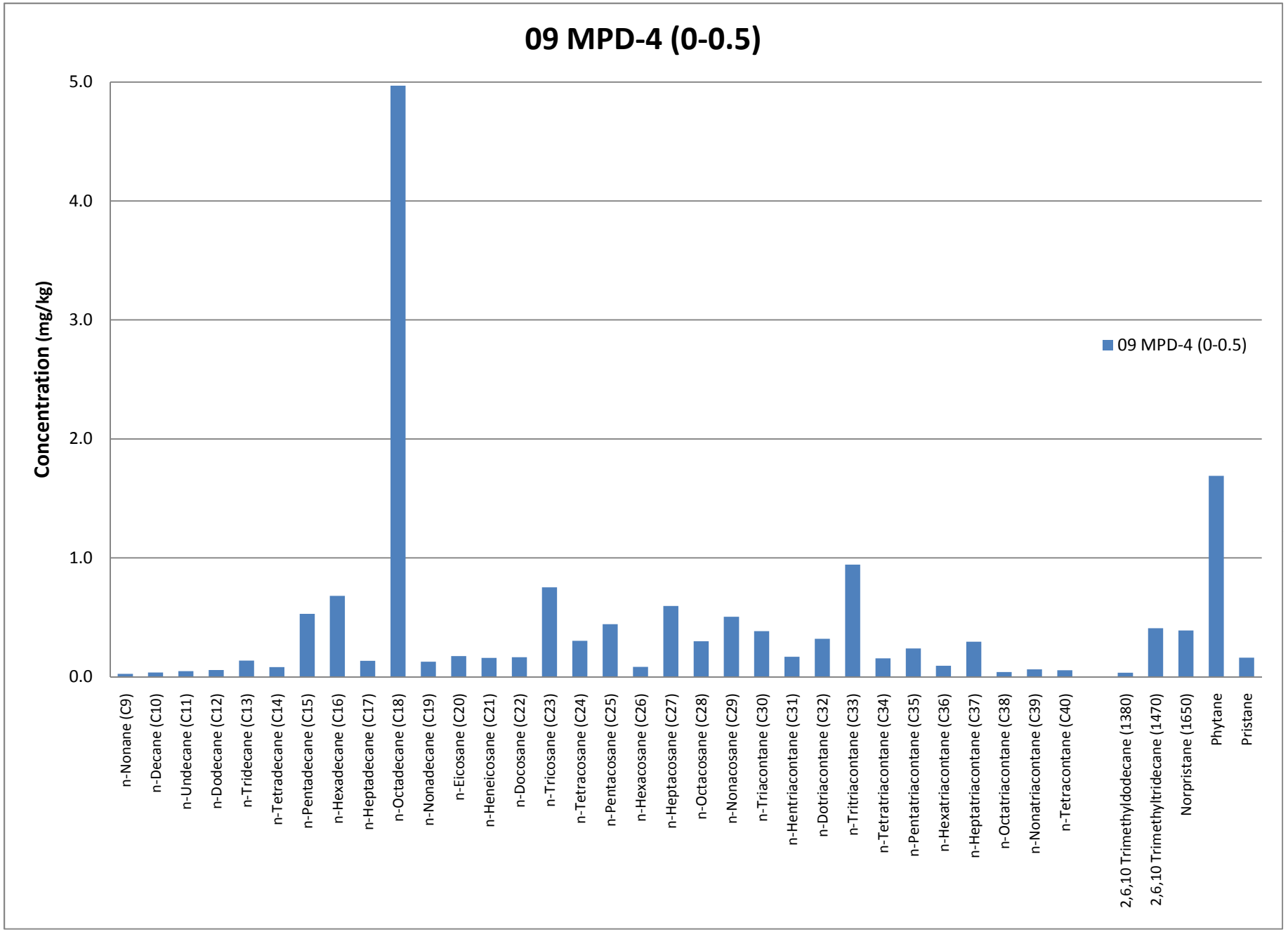

09 MPD-2 (0-0.5)
Concentration (ug/kg)
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
09 MPD-2 (0-0.5)
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

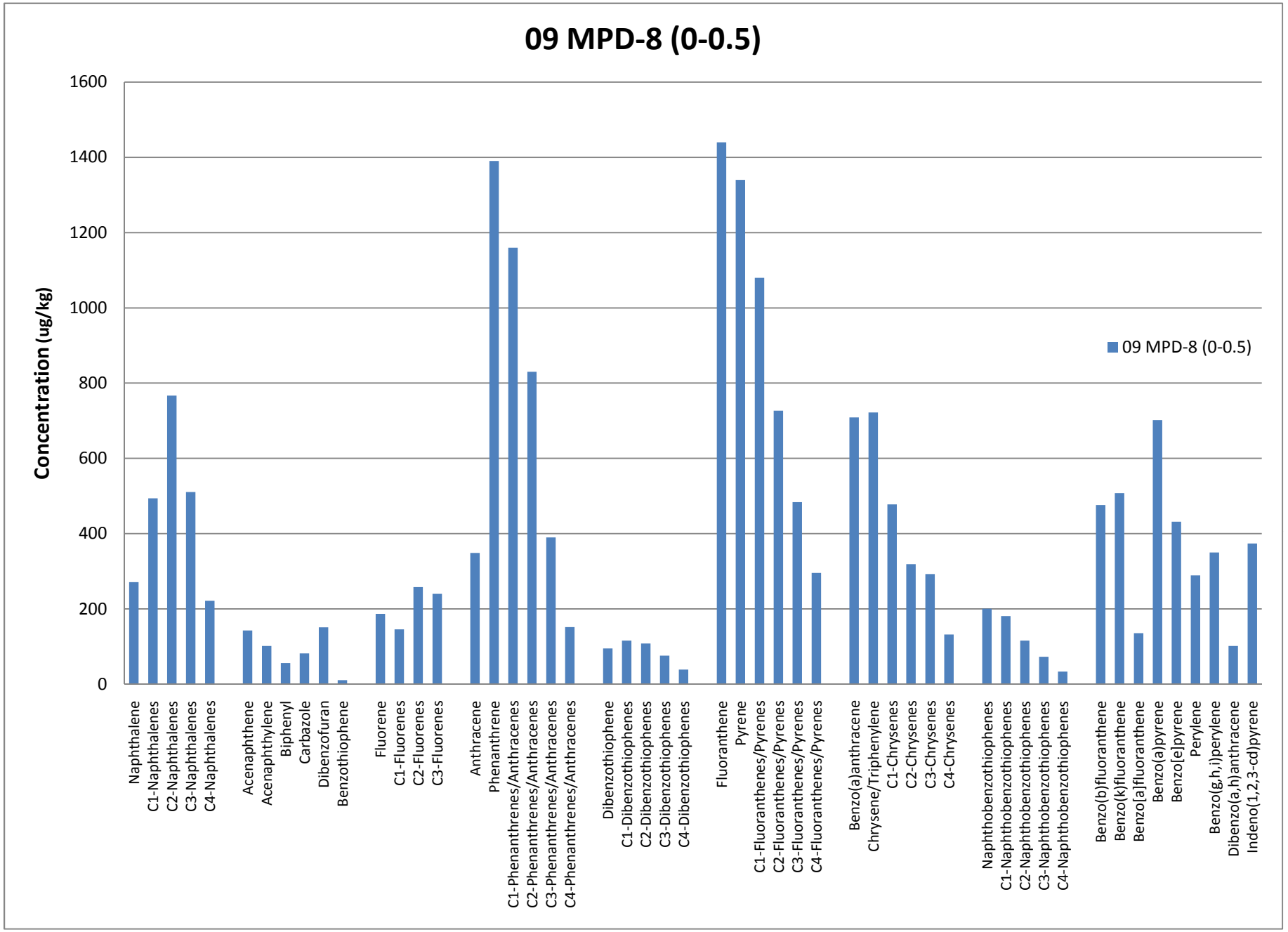

09 MPD-2 (0-0.5)
Concentration (mg/kg)
350
300
250
200
150
100
50
0
09 MPD-2 (0-0.5)
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane

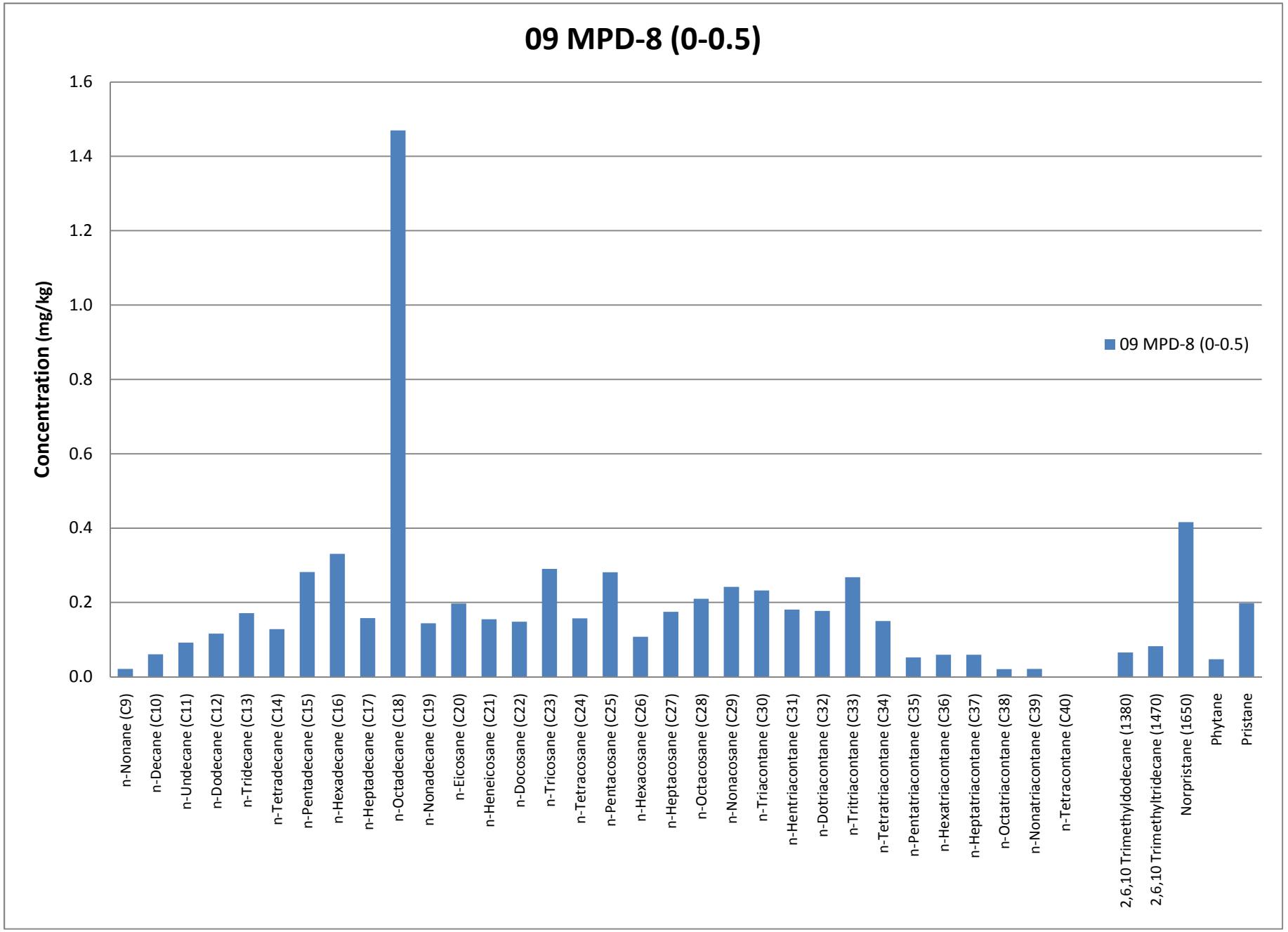

09 MPD-3 (0-0.5)
Concentration (ug/kg)
30,000
25,000
20,000
15,000
10,000
5,000
0
09 MPD-3 (0-0.5)
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

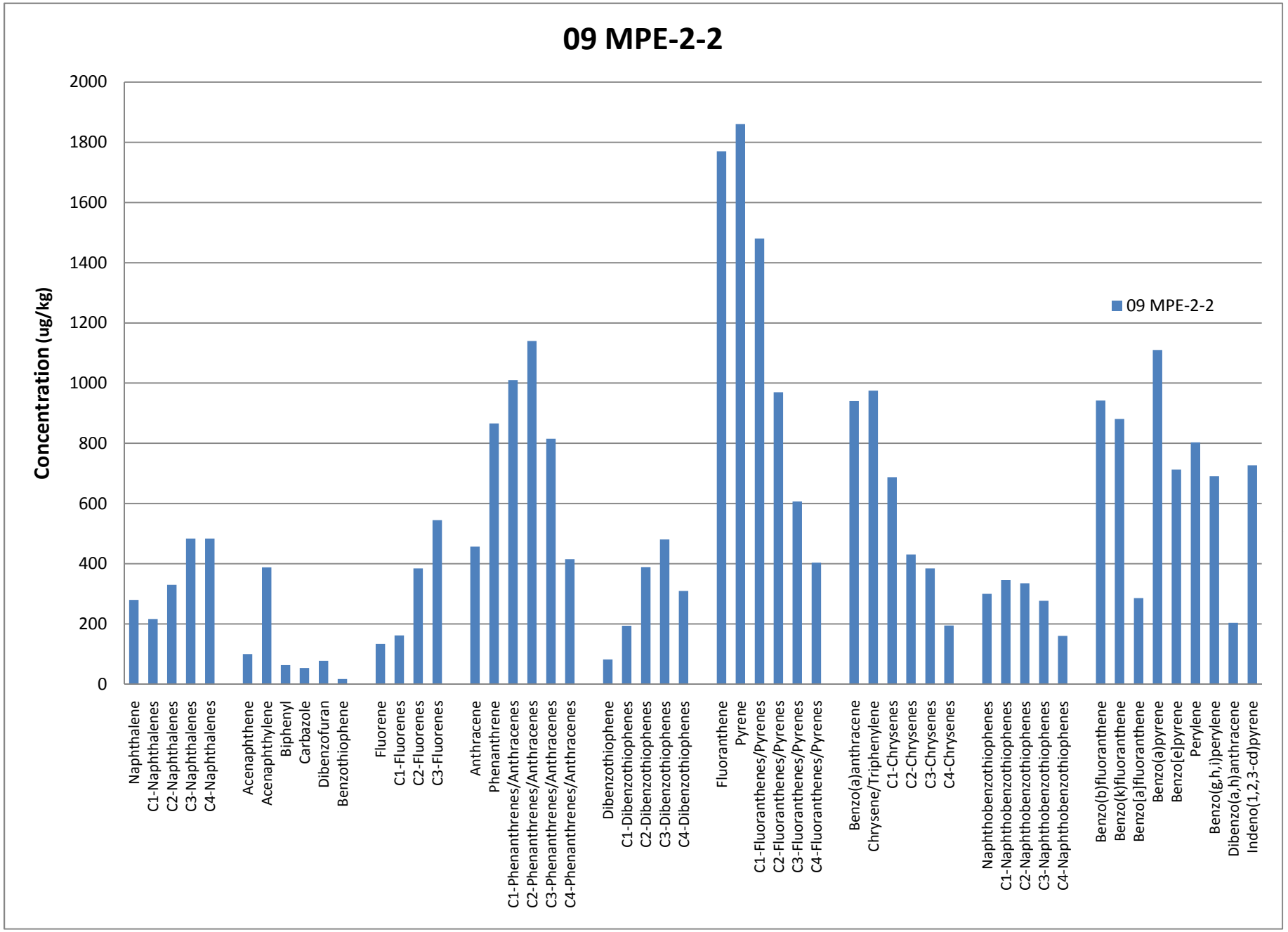

09 MPD-3 (0-0.5)
Concentration (mg/kg)
0
1
2
3
4
5
6
7
8
09 MPD-3 (0-0.5)
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane

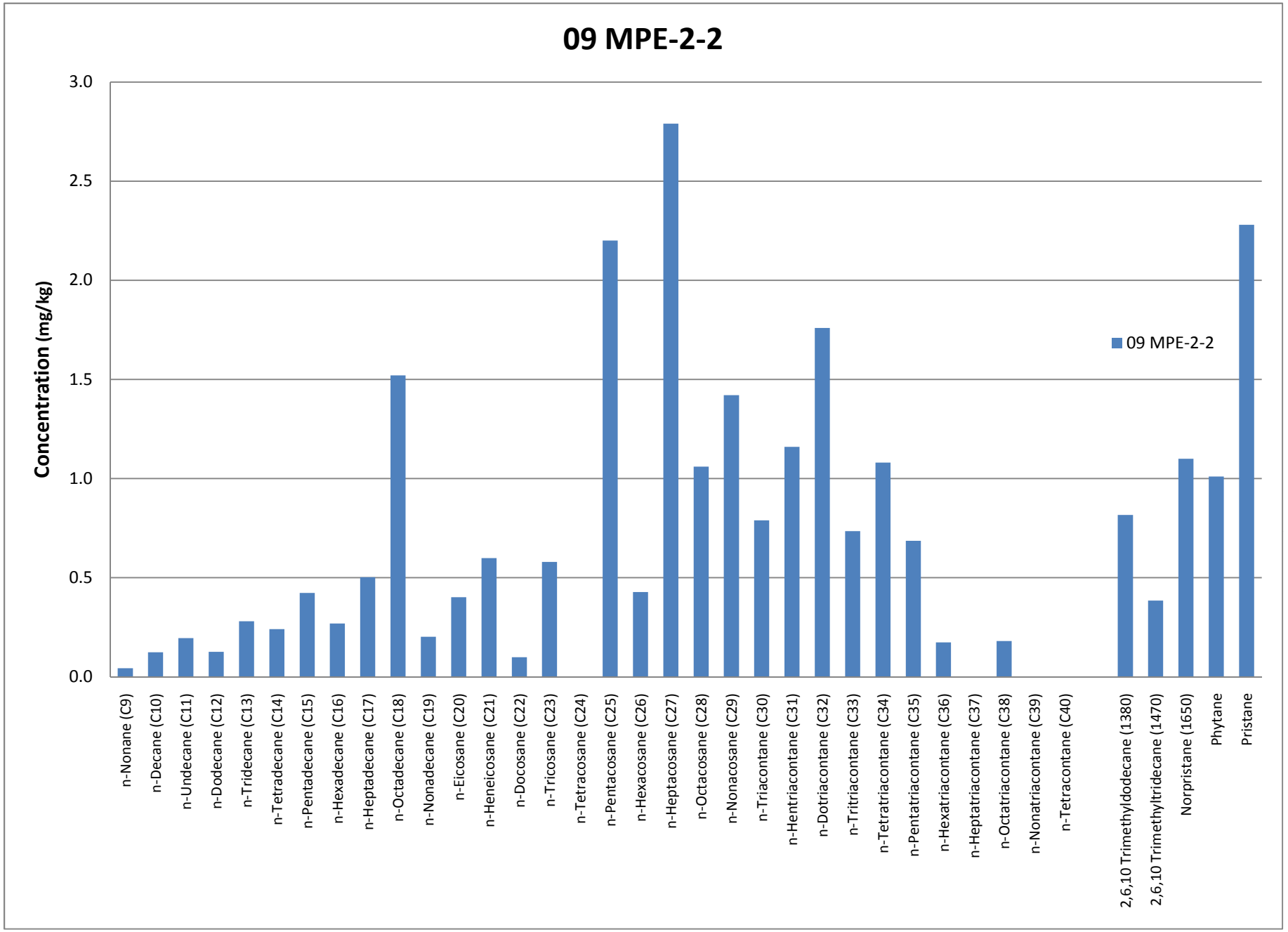

09 MPD-4 (0-0.5)
Concentration (ug/kg)
12,000
10,000
8,000
6,000
4,000
2,000
0
09 MPD-4 (0-0.5)
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

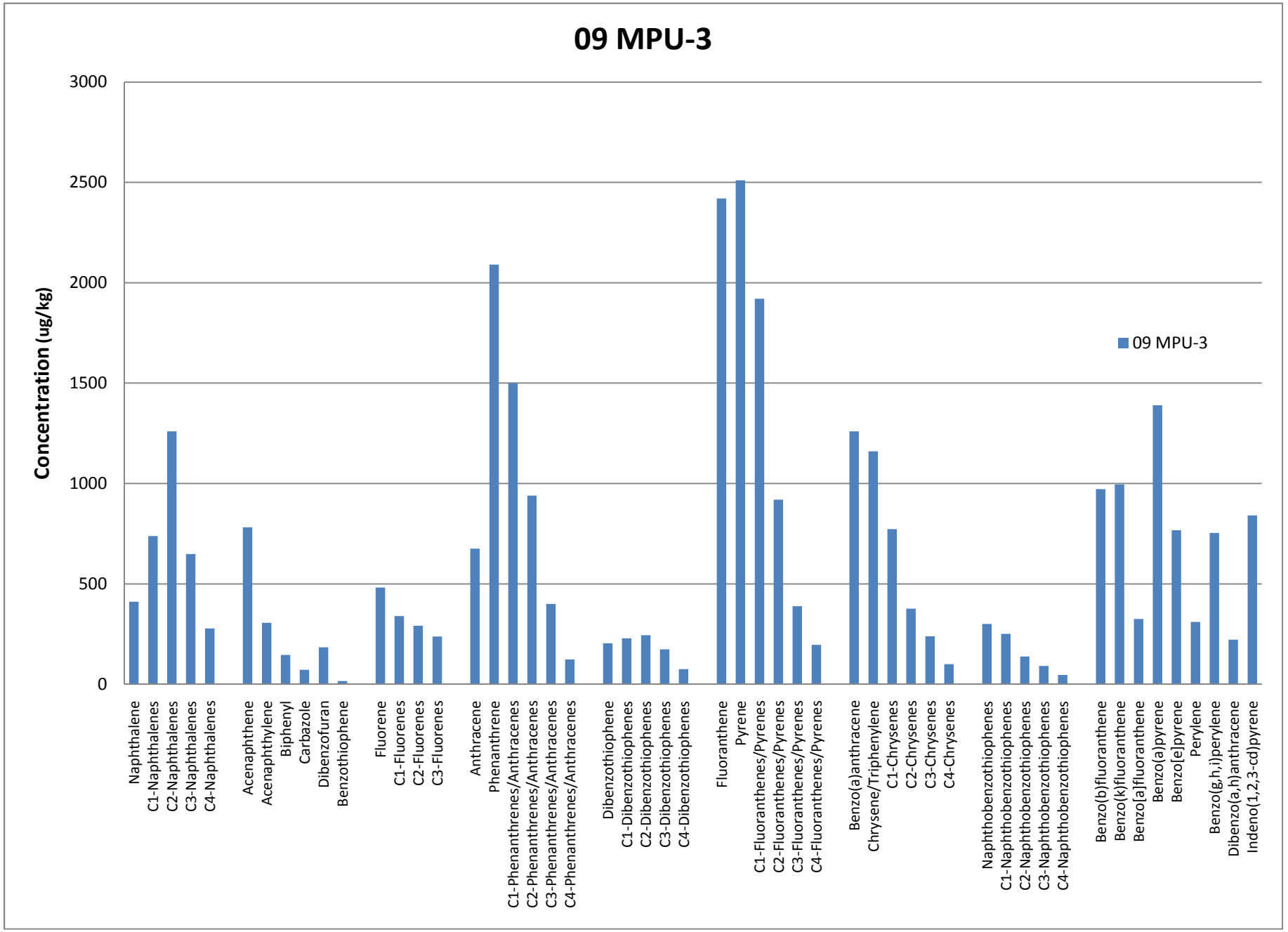

09 MPD-4 (0-0.5)
Concentration (mg/kg)
5.0
4.0
3.0
2.0
1.0
0.0
09 MPD-4 (0-0.5)
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane

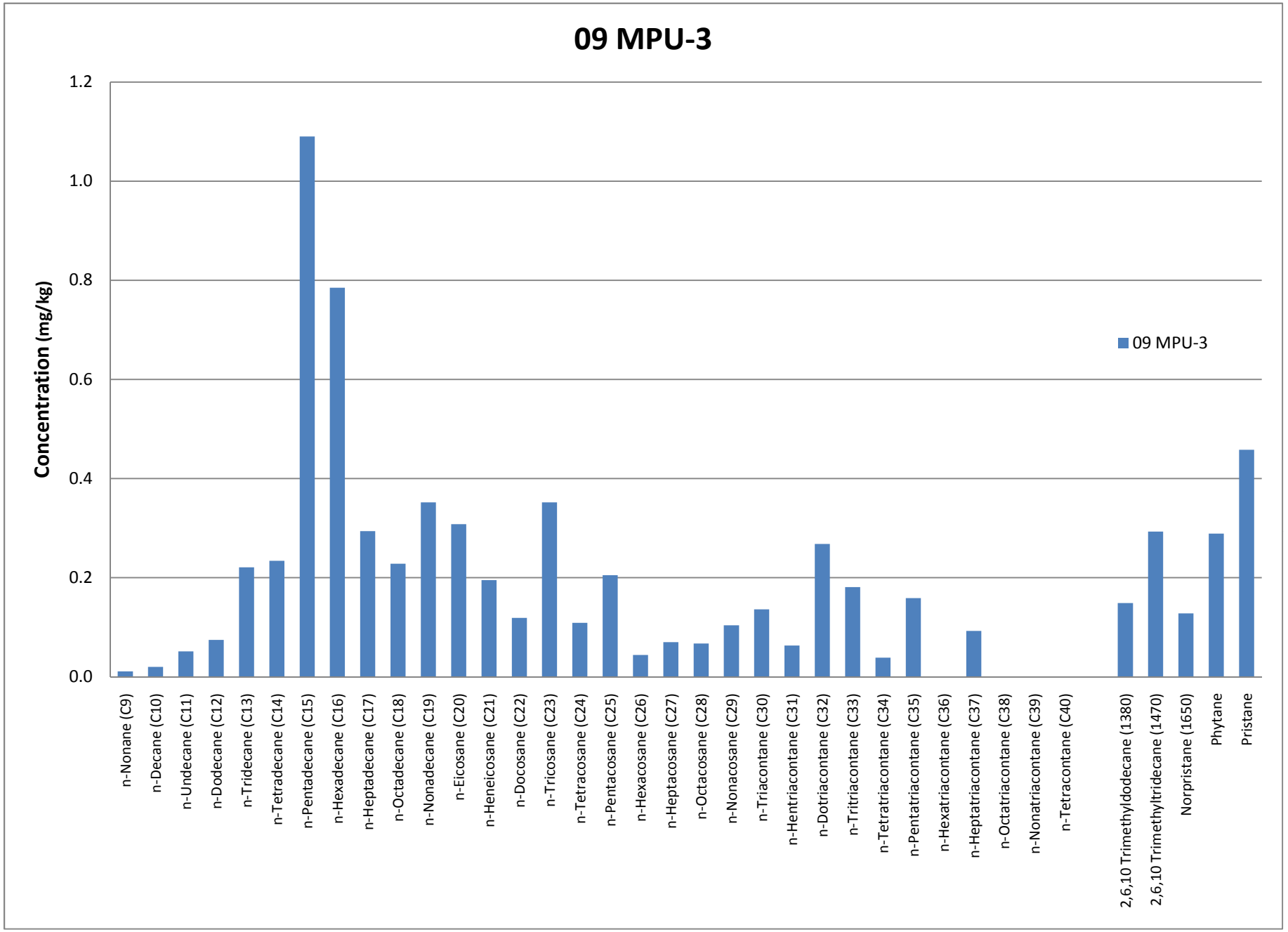

09 MPD-8 (0-0.5)
Concentration (ug/kg)
1600
1400
1200
1000
800
600
400
200
0
09 MPD-8 (0-0.5)
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

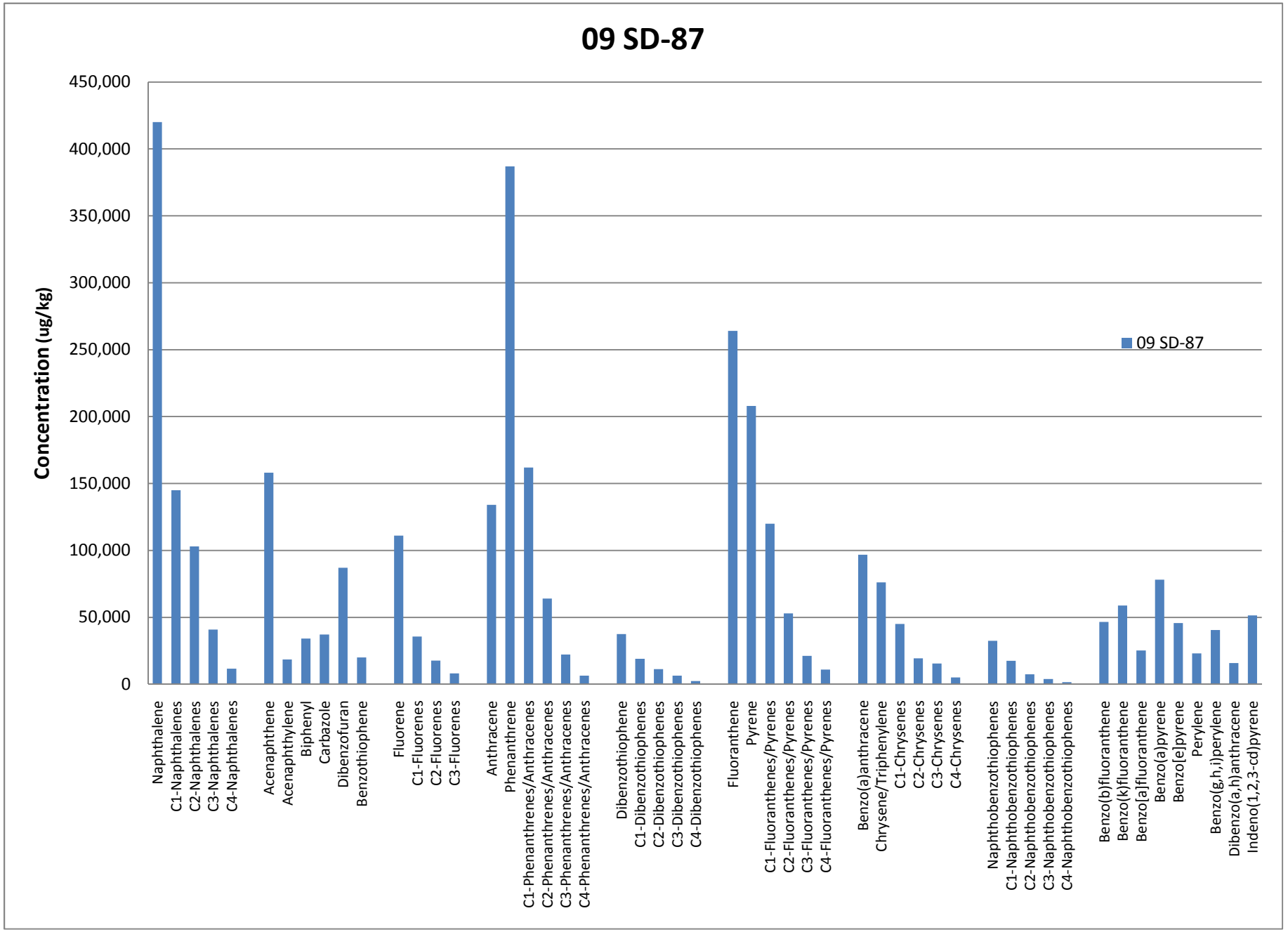

09 MPD-8 (0-0.5)
Concentration (mg/kg)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
09 MPD-8 (0-0.5)
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane

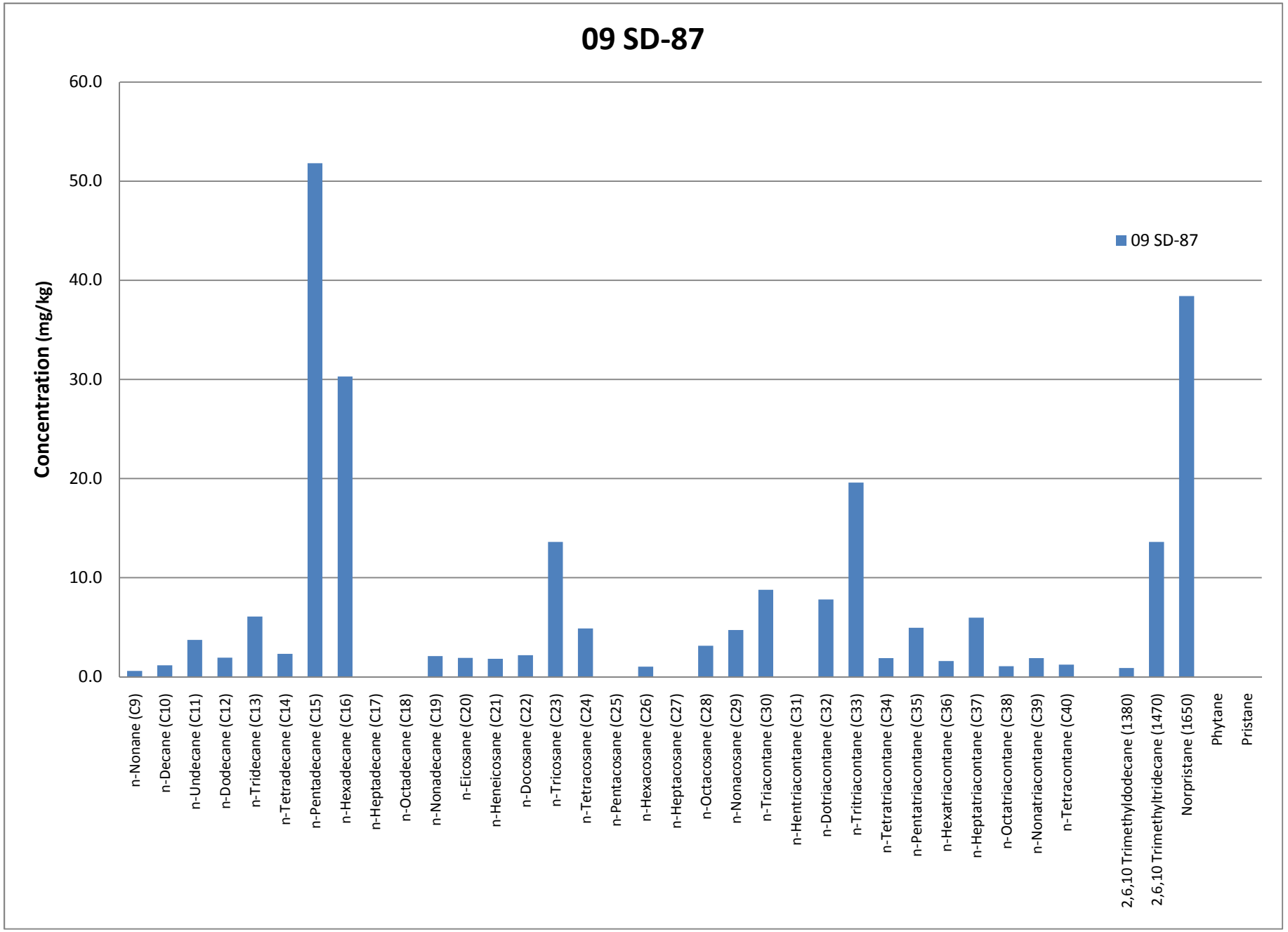

09 MPE-2-2
Concentration (ug/kg)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
09 MPE-2-2
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

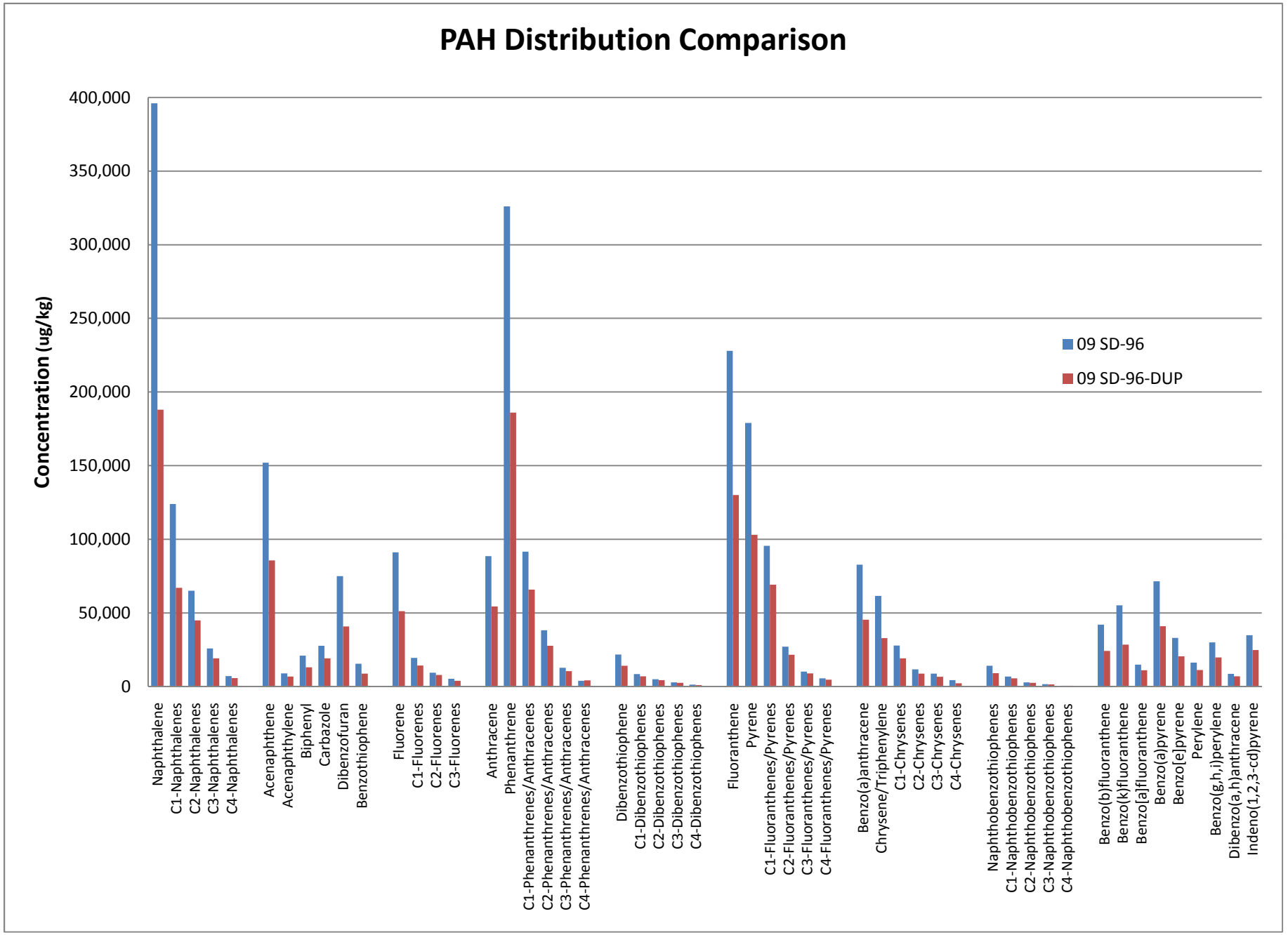

09 MPE-2-2
Concentration (mg/kg)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
09 MPE-2-2
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane

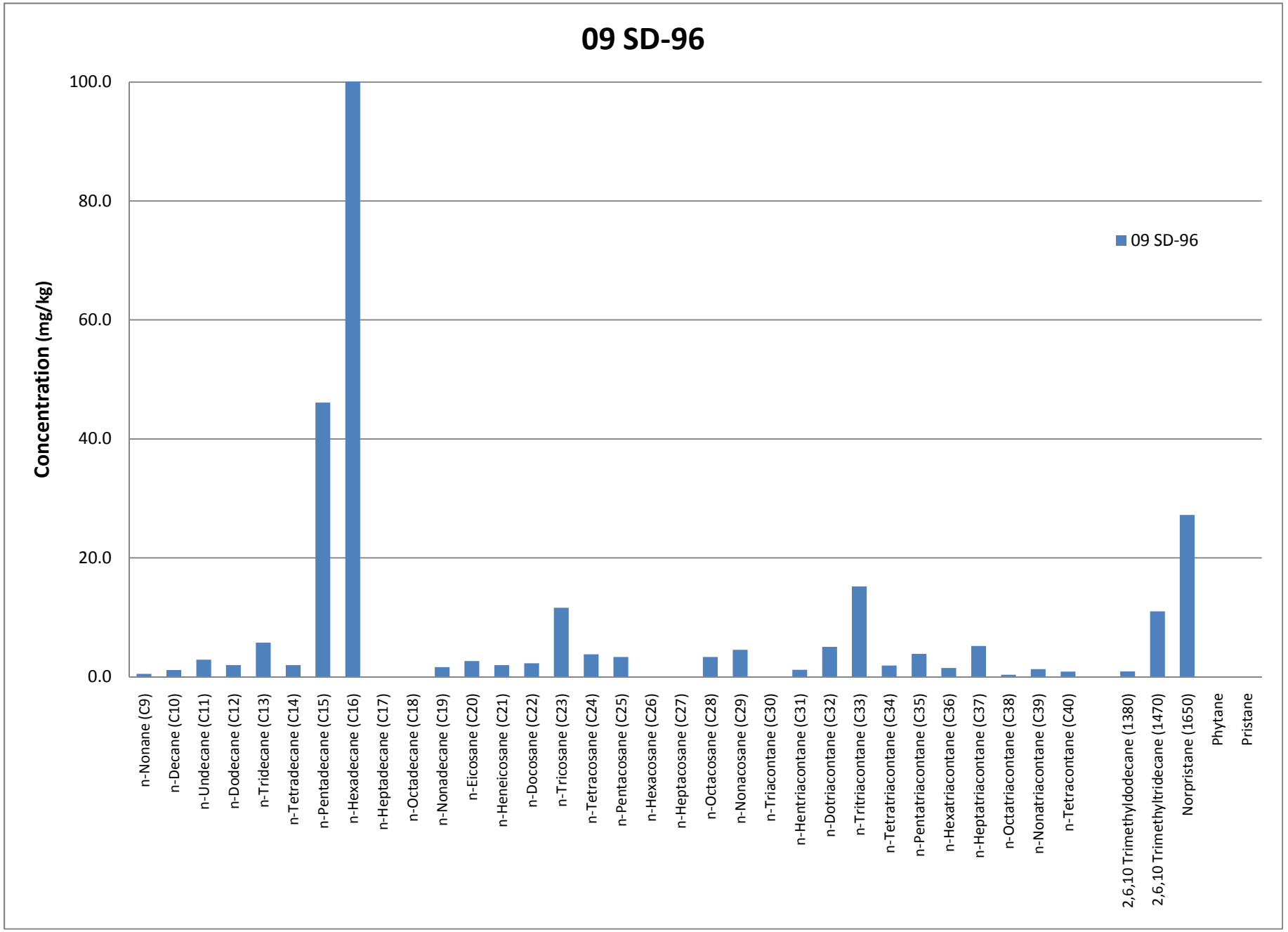

09 MPU-3
Concentration (ug/kg)
3000
2500
2000
1500
1000
500
0
09 MPU-3
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

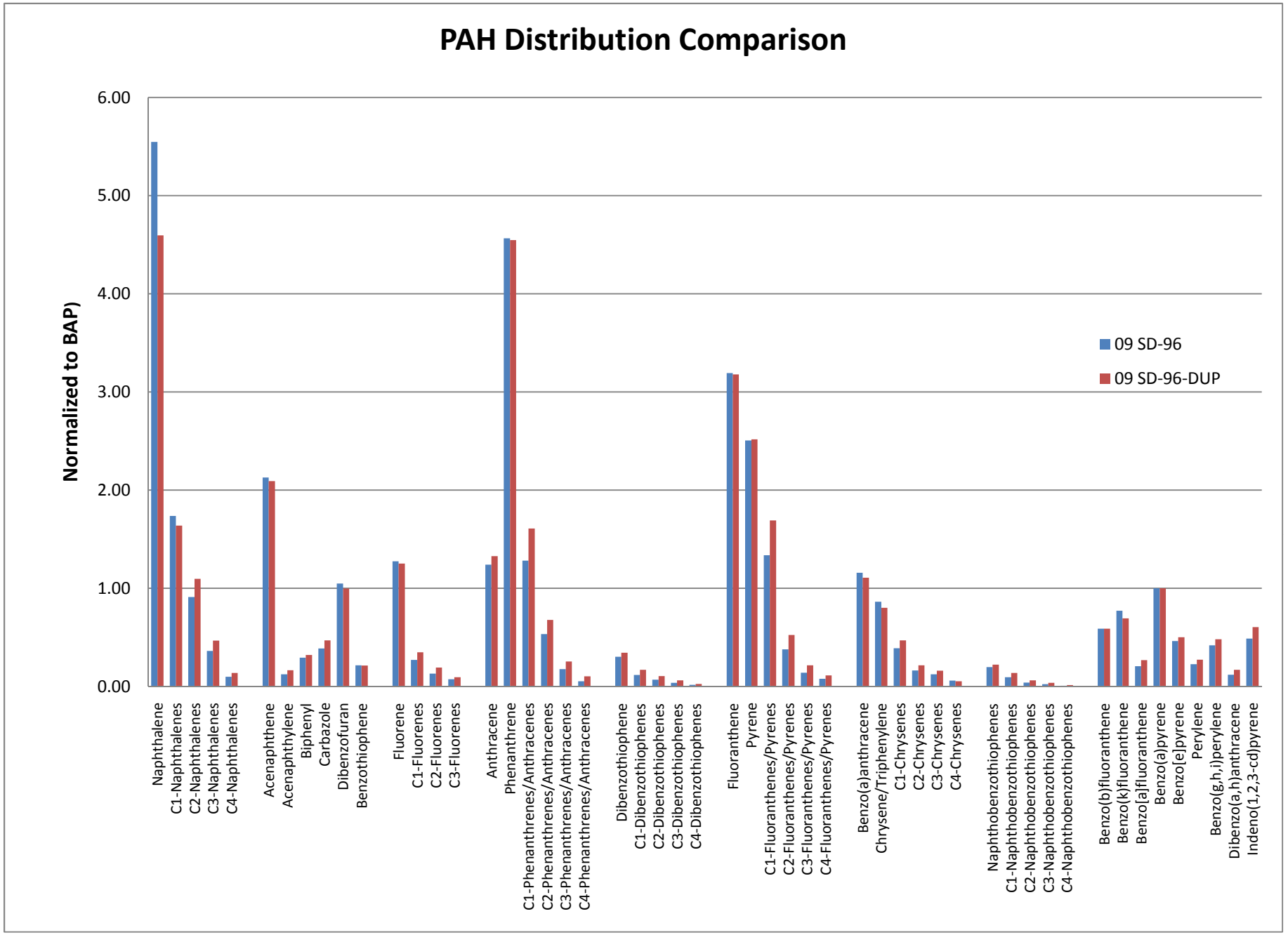

09 MPU-3
Concentration (mg/kg)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
09 MPU-3
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane

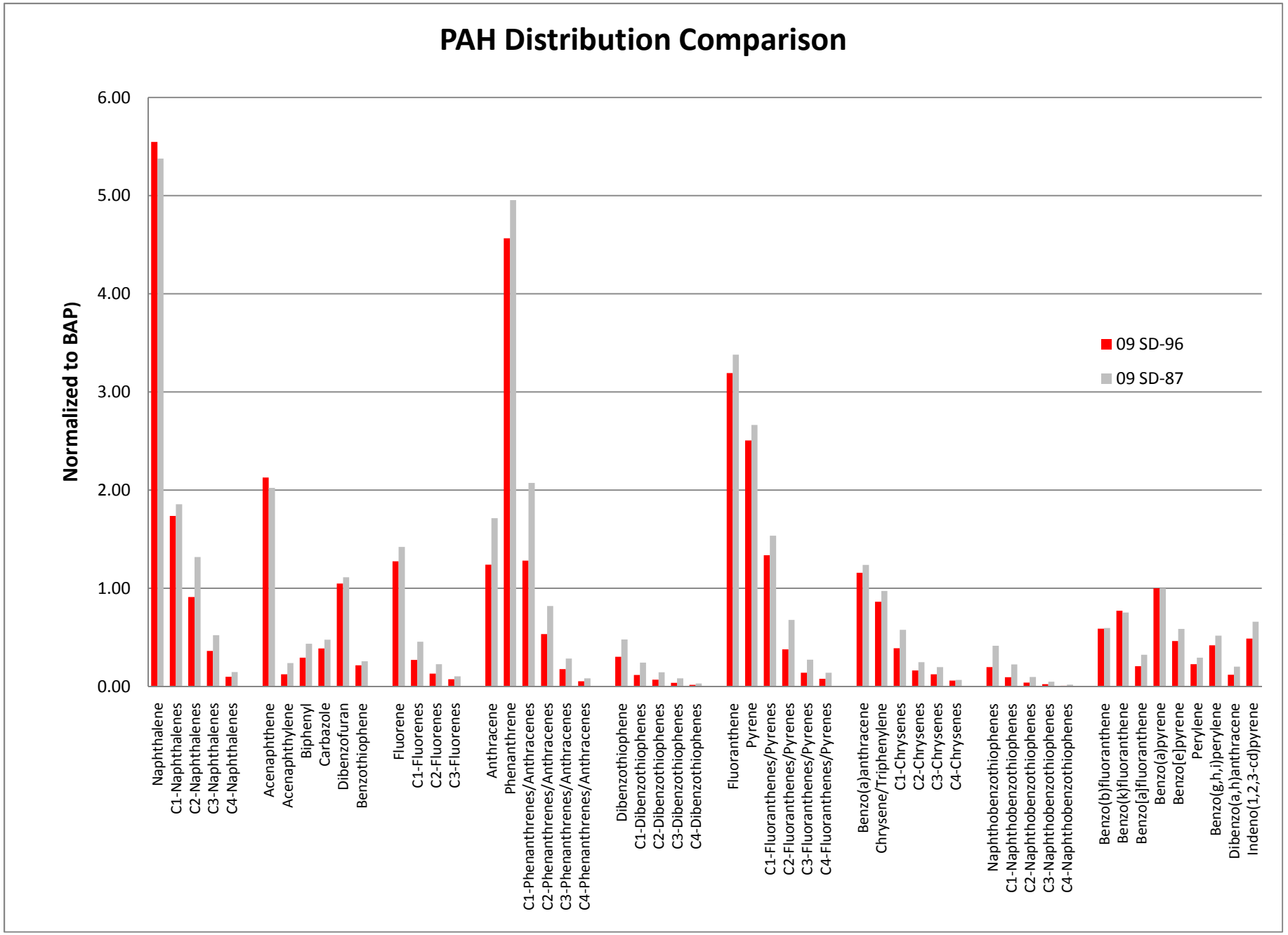

09 SD-87
Concentration (ug/kg)
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
09 SD-87
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

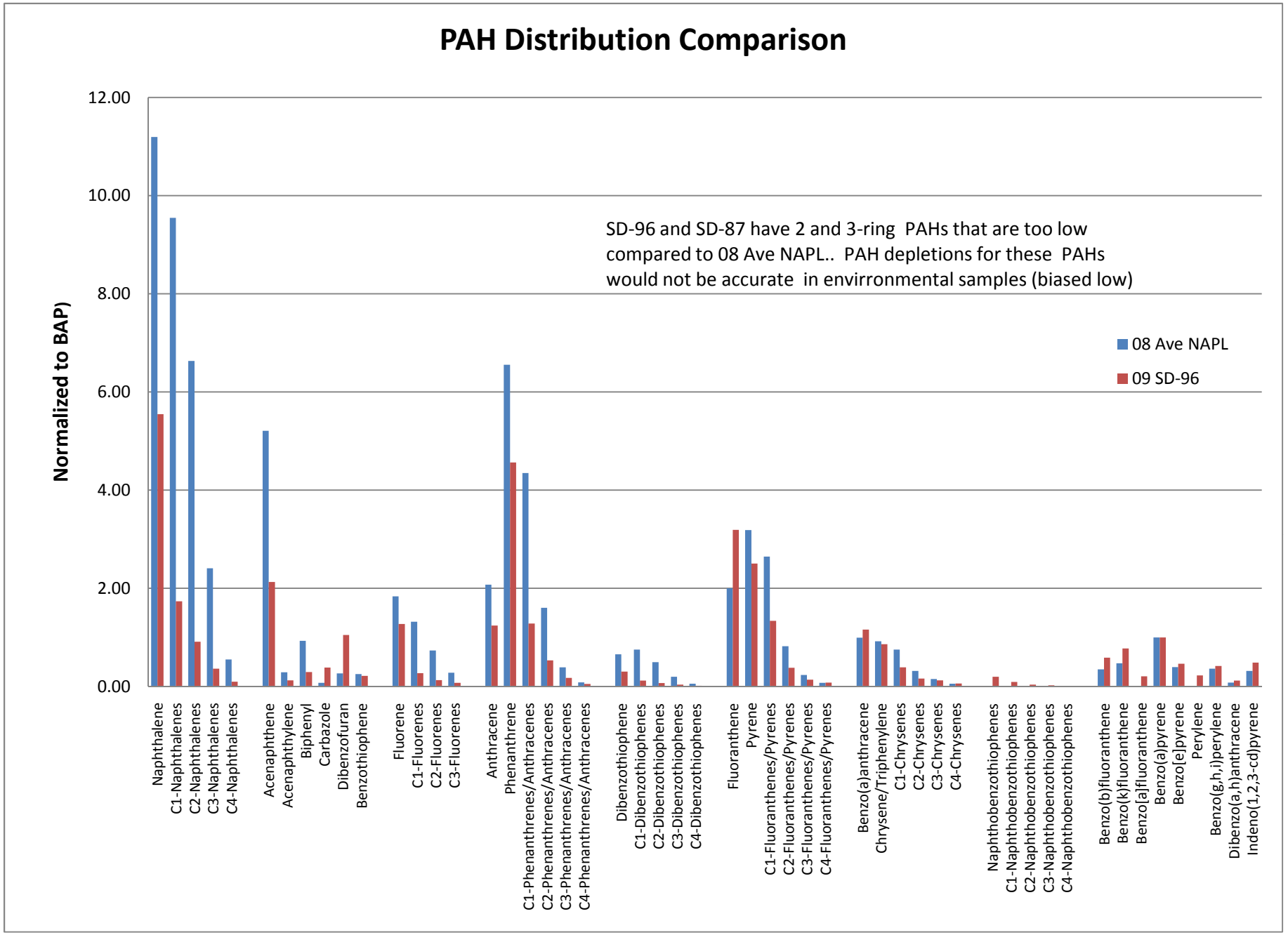

09 SD-87
Concentration (mg/kg)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
09 SD-87
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane


PAH Distribution Comparison
Concentration (ug/kg)
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
09 SD-96
09 SD-96-DUP
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

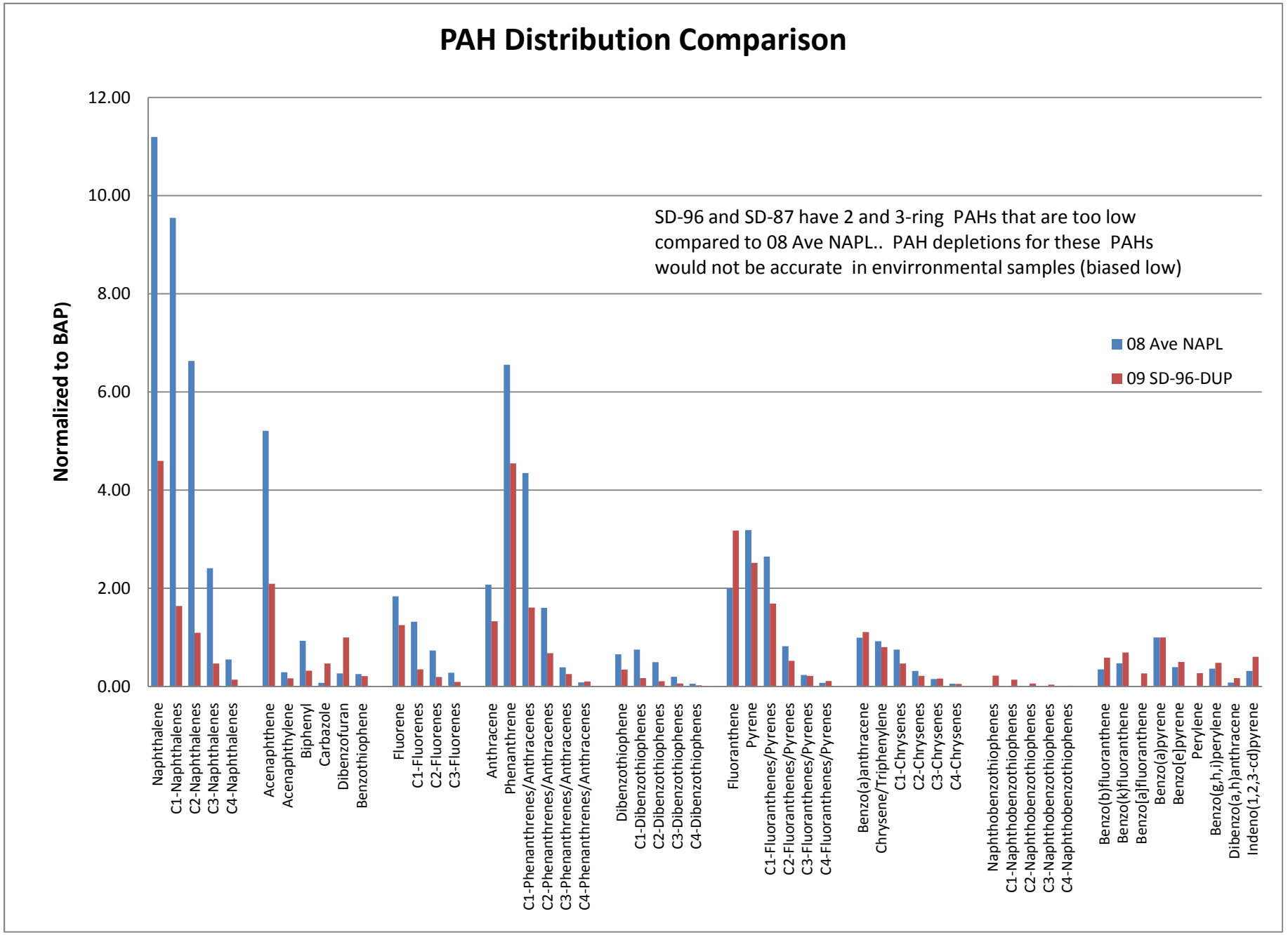

09 SD-96
Concentration (mg/kg)
100.0
80.0
60.0
40.0
20.0
0.0
09 SD-96
n-Nonane (C9)
n-Decane (C10)
n-Undecane (C11)
n-Dodecane (C12)
n-Tridecane (C13)
n-Tetradecane (C14)
n-Pentadecane (C15)
n-Hexadecane (C16)
n-Heptadecane (C17)
n-Octadecane (C18)
n-Nonadecane (C19)
n-Eicosane (C20)
n-Heneicosane (C21)
n-Docosane (C22)
n-Tricosane (C23)
n-Tetracosane (C24)
n-Pentacosane (C25)
n-Hexacosane (C26)
n-Heptacosane (C27)
n-Octacosane (C28)
n-Nonacosane (C29)
n-Triacontane (C30)
n-Hentriacontane (C31)
n-Dotriacontane (C32)
n-Tritriacontane (C33)
n-Tetratriacontane (C34)
n-Pentatriacontane (C35)
n-Hexatriacontane (C36)
n-Heptatriacontane (C37)
n-Octatriacontane (C38)
n-Nonatriacontane (C39)
n-Tetracontane (C40)
2,6,10 Trimethyldodecane (1380)
2,6,10 Trimethyltridecane (1470)
Norpristane (1650)
Phytane
Pristane

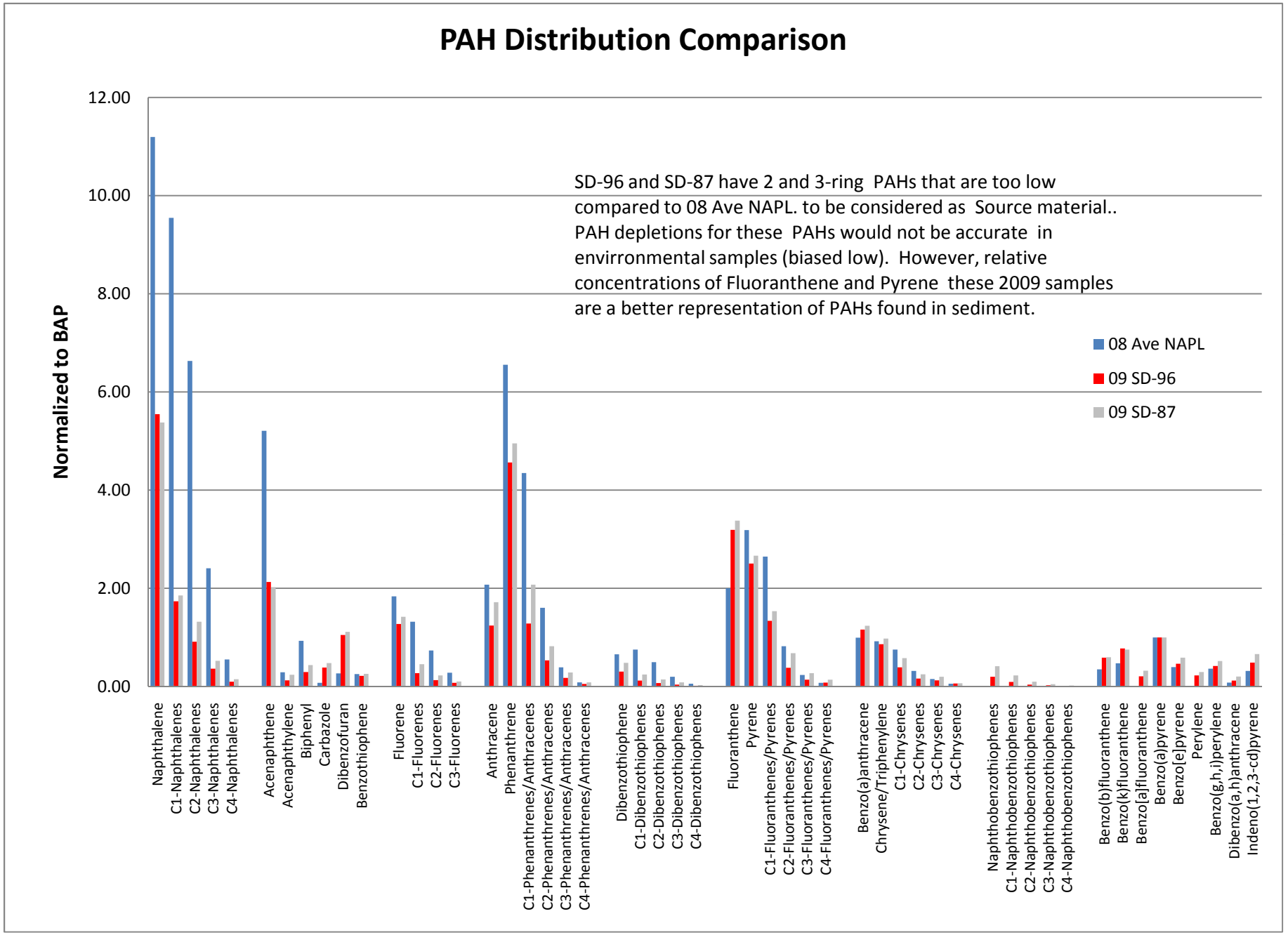

PAH Distribution Comparison
Normalized to BAP)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
09 SD-96
09 SD-96-DUP
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene


PAH Distribution Comparison
Normalized to BAP)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
09 SD-96
09 SD-87
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

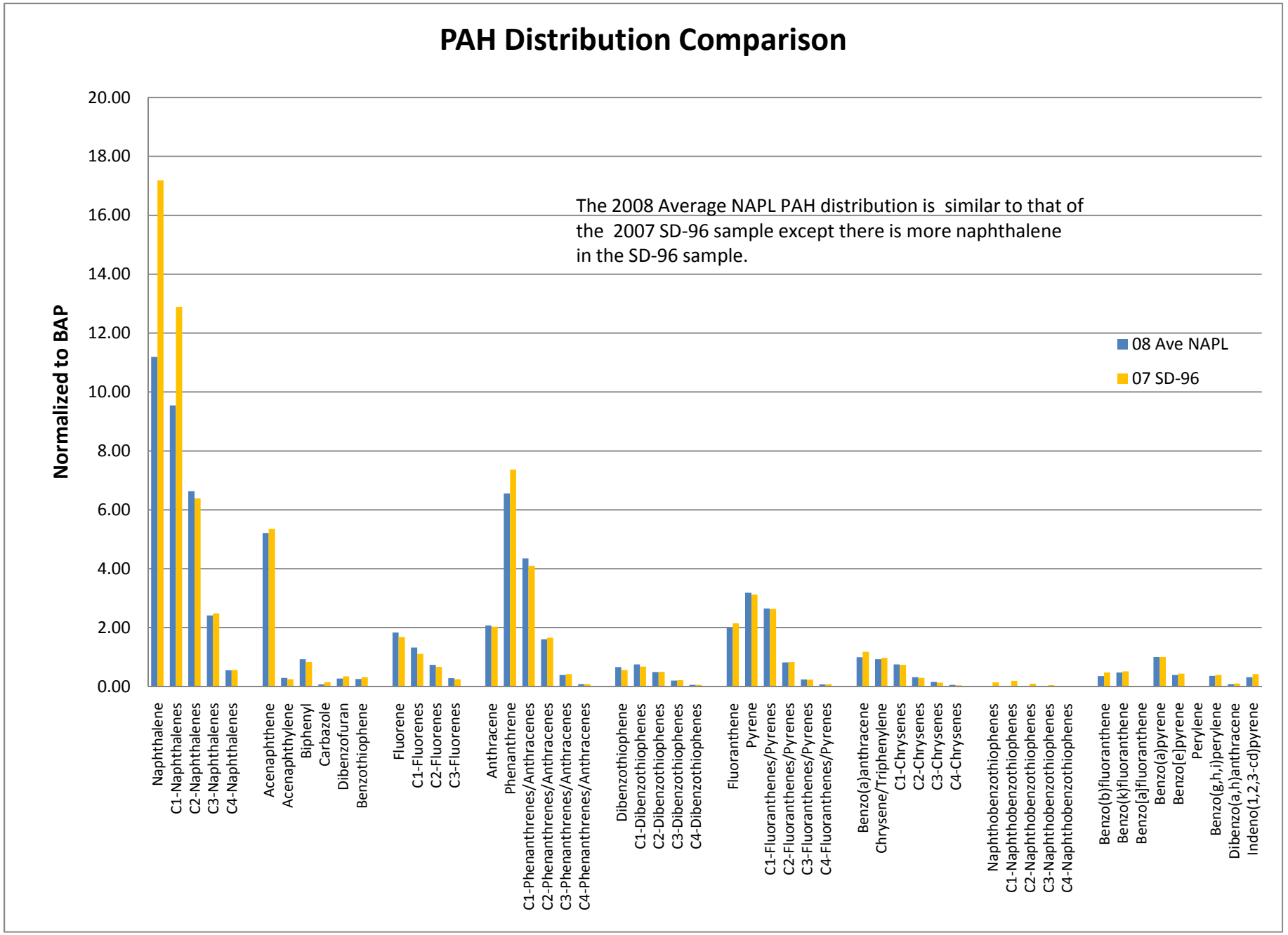

PAH Distribution Comparison
Normalized to BAP)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
SD-96 and SD-87 have 2 and 3-ring PAHs that are too low compared to 08 Ave NAPL.. PAH depletions for these PAHs would not be accurate in envirronmental samples (biased low)
08 Ave NAPL
09 SD-96
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

PAH Distribution Comparison




PAH Distribution Comparison
Normalized to BAP
12.00
10.00
8.00
6.00
4.00
2.00
0.00
SD-96 and SD-87 have 2 and 3-ring PAHs that are too low compared to 08 Ave NAPL. to be considered as Source material.. PAH depletions for these PAHs would not be accurate in envirronmental samples (biased low). However, relative concentrations of Fluoranthene and Pyrene these 2009 samples are a better representation of PAHs found in sediment.
08 Ave NAPL
09 SD-96
09 SD-87
Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
Acenaphthene
Acenaphthylene
Biphenyl
Carbazole
Dibenzofuran
Benzothiophene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Anthracene
Phenanthrene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
C4-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
C4-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene/Triphenylene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Naphthobenzothiophenes
C1-Naphthobenzothiophenes
C2-Naphthobenzothiophenes
C3-Naphthobenzothiophenes
C4-Naphthobenzothiophenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo[a]fluoranthene
Benzo(a)pyrene
Benzo[e]pyrene
Perylene
Benzo(g,h,i)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene

PAH Distribution Comparison



ARCADIS

Appendix K

Fate and Transport Analysis

Appendix K - Fate and Transport Analysis

Diffusion

Diffusion of a chemical may take place by simple passive molecular diffusion or it may be facilitated by the presence of naturally occurring colloids and dissolved organic carbons. The existence of a concentration gradient between pore-water and overlying surface water is sufficient to initiate transport by molecular diffusion. The magnitude of the chemical flux (i.e., the movement of chemicals over a cross-sectional area during a given time period) is quantified by Fick's first law governing diffusion of a dilute contaminant through a porous medium. If the compounds of interest are hydrophobic, as is the case for PAHs, the adsorption equilibrium established between the organic fraction of the sediment and the pore water will retard the apparent rate of diffusion. This process can be modeled using Fick's second law of diffusion.

Using notation and equations from Reible et al (1991), if the depth of contaminated sediment is considered semi-infinite (initial concentrations continue to depth where diffusion is not a significant transport mechanism), the flux of a hydrophobic compound from the sediment to the water column is given by:

$$N_A = \left[\frac{D_S}{\pi t}\right]^{1/2} W_{Ao}\,\rho_b \qquad (1)$$

$$D_S = \frac{D_w\,\varepsilon^{4/3}}{(\varepsilon + \rho_b K_s)} \qquad (2)$$

Where:
- N_A = diffusive flux (g/cm^2/sec)
- D_S = effective transient diffusion coefficient (cm^2/sec)
- D_w = water phase diffusion coefficient (cm^2/sec)
- ε = porosity of sediment
- ρ_b = sediment bulk density (gm/cm^3)
- K_s = sediment-water partitioning coefficient (cm^3/gm)=K_{oc} x f_{oc}
- W_{AO} = concentration of chemical on sediments at time t=o (gm/gm)
- K_{oc} = chemical organic carbon - water partitioning coefficient (cm^3/gm or ℓ/kg)
- f_{oc} = fraction of organic carbon on sediment, and
- t = time (sec)

Hydrophobic compounds that partition onto sediment-bound organic matter will also likely partition onto other organic matter. Just as partitioning onto the stationary sediment phase will result in retardation of movement through the sediment, partitioning onto a potentially mobile colloidal phase could increase the rate of movement. The general flux equation for N_A remains the same, except the colloidal effective transient diffusion coefficient D_{sc} is used in place of D_s.

$$D_{SC} = \frac{D_w \varepsilon^{4/3} + (D_{cw} \varepsilon^{4/3} K_c C_c)}{\varepsilon + \rho_b K_s + \varepsilon K_c C_c} \quad (3)$$

Where: D_{cw} = the diffusion coefficient of colloidal particles in water (cm^2/sec)
K_c = partitioning coefficient of the chemical between water and colloid fraction in water (cm^3/gm)
C_c= dissolved organic carbon concentration (gm/gm)

The diffusion flux was computed for a 1.3 acre area (5600 m^2) encompassing cores SD-5, SD-8, SD-9, SD-12 and SD-13. This grouping of cores was selected based on concentrations, to provide a conservative estimate of diffusion. Surface concentrations of total PAHs averaged 4,750 ppm in this area. For the remaining area, the average surface concentration was 74 ppm, a factor of 65 times less. The average surface concentration for each index compound in the 1.3 acre area is given in the following table.

Table K- 1 Average Surface Sediment Concentrations for Selected PAHs

Parameter	Avg Surface Sediment Concentration (ppm) (0 to 0.5 feet)	Partitioning Coefficient Log Koc
Benzo(a)pyrene	145	6.0
Chrysene	165	5.4
Fluoranthene	580	4.6
Fluorene	345	3.7
Indeno(1,2,3)pyrene	55	7.5
Naphthalene	540	3.1
Pyrene	360	4.7

The following values were used in the computation based on either field data or best estimates from current literature. In the case of pore water DOC a conservatively high value of 100 mg/l was used to present a bound for a worst case estimate, where an expected range would be 5 to 20 mg/l (Thurman, 1985).

sediment porosity	ε = 0.5
sediment bulk density	ρ_b = 1.4 gm/cm^3
sediment organic carbon	f_{oc}= 0.04
pore water DOC concentration	C_c= 100 mg/ℓ
colloidal partitioning coefficient	K_C = 0.2 K_{oc}
colloidal diffusion coefficient	D_{cw} = 2 x 10^{-6} cm^2/sec

The current (t = 1 year) estimate of flux for each compound and the approximate half-life of each compound in the upper 6-inch (15 cm) layer are presented on the following table.

Table K- 2 Diffusive Releases for Selected PAHs

Parameter	Diffusive Release		Six-inch Layer Half-life (yr)
	Non-Colloidal (kg/yr)	Colloidal (kg/ yr)	
Benzo(a)pyrene	0.21	0.65	5,600
Chrysene	0.50	0.85	4,200
Fluoranthene	4.6	5.2	1,400
Fluorene	7.9	8.1	200
Indeno(1,2,3)pyrene	0.014	0.23	6,300
Naphthalene	26.6	26.7	45
Pyrene	2.5	2.9	1,700

For example, based on diffusion alone, 5,600 years would be required for half the benzo(a)pyrene present in the upper 6-inch layer to diffuse from the sediment to the water column. Half-life times presented in the above table are for colloidal facilitated diffusion. Compounds with the greatest potential for diffusive release are those with the lowest K_{oc}, such as naphthalene and fluorene ($\log K_{oc} < 4$). For these compounds, inclusion of colloid facilitated transport does not significantly increase estimated migration rates. The more environmentally sensitive hydrophobic compounds [such as benzo(a)pyrene and indeno(1,2,3-cd)pyrene] have much lower potential for diffusion migration. The relative difference between non-colloidal and colloid-facilitated transport becomes larger in these compounds due to their greater hydrophobic nature ($\log K_{oc} > 6$).

The resultant water column concentration can be estimated from the computed flux rates and the average volume of flow passing over the sediments. The investigation area accounts for approximately ten percent of the total river cross-sectional width. Using the ten percent and the long-term average flow of the Hudson River at Green Island (USGS gaging station 01358000) of 13,700 cubic feet per second (cfs), the flow available for assimilation of the release from the sediments is 1,370 cfs (38,770 liters per second). This was considered a conservative flow because it does not include the much greater flow due to tidal exchange. Based upon this flow, the equivalent water column concentration for a sediment release rate of 1 kg/yr is 0.82 nanograms per liter (parts per trillion, ppt). Using this estimated equivalent water column concentration of 0.82 ppt, the estimated average water column concentrations for each index PAH due to diffusive migration are presented on the table below.

The estimated water column PAH concentrations presented below were compared to the NYSDEC Surface Water Quality Standards presented in TOGS 1.1.1 (NYSDEC, 1998b). A standard was only available for naphthalene, all other constituents had multiple guidance values. Where there was no standard promulgated, the lowest appropriate guidance concentration was used for evaluation purposes and is shown in Table K-3. In summary, each of the estimated concentrations are well below the NYSDEC surface water quality standards or guidance values and indicate that the potential migration of PAHs to the water column through diffusion would be minimal.

Table K-3 Equivalent Water Column Concentrations for Selected PAHs

Parameter	Equivalent Water Column Concentration (ppt)		New York State Water Quality Standard or Guidance (ppt)
	Non-Colloidal	Colloidal	
Benzo(a)pyrene	0.17	0.53	1.2
Chrysene	0.41	0.70	2.0
Fluoranthene	3.77	4.26	50,000
Fluorene	6.48	6.64	540
Indeno(1,2,3-cd)pyrene	0.011	0.19	2.0
Naphthalene	21.81	21.89	10,000
Pyrene	2.05	2.38	4,600

Pore-Water Advection

The movement of groundwater discharging to the river through the sediment bed can result in an advective migration of chemicals from the sediment to the overlying water. Similar to diffusive migration the rate of movement of a hydrophobic compound can be enhanced by the presence of naturally occurring colloids and dissolved organic carbon. The advective migration of the compounds is also affected by the adsorptive equilibrium established between sediment and pore water, which can retard the apparent rate of advection if, as is the case at this site, the overlying sediment generally have lower concentrations than deeper sediments.

The advective flux was computed for the area of highest PAH concentrations, the 1.3 acre area (5,600 m^2) based on the average surface concentrations for each of the seven index compounds and an assumed groundwater velocity of 0.5 m/yr. The mass rate of advective migration unaffected by either adsorptive retardation or colloidal enhancement is given simply by the product of area, groundwater Darcy velocity (specific discharge), and pore water concentration.

$$\text{Flux}_{ADV} = A \cdot V_{gw} \cdot C_{pw} \quad (4)$$

Where: A = area (m^2)
V_{gw} = groundwater Darcy velocity (m/yr)
C_{pw} = equilibrium pore water concentrations (kg/L) = W_{AO} / K_s

The effect of colloids in enhancing the pore water concentration was computed from:

$$C'_{pw} = (W_{Ao} / K_s) + [(C_c * W_{Ao} * K_c) / K_s] \quad (5)$$

C'_{pw} is the pore water concentration of chemical A including the fraction associated with dissolved organic carbon. Calculated rates of advective migration (Table K-4) are in the range of those for diffusive transport, although generally lower. The exception is for naphthalene, for which the advective flux is slightly higher than the diffusive flux. The advective transport rate is greatest for those compounds with the lowest K_{oc}, while the more environmentally sensitive compounds have much lower transport rates.

Table K- 4 Advective Transport for Selected PAHs

Parameter	Advective Transport at Surface (kg/yr)
Benzo(a)pyrene	0.02
Chrysene	0.06
Fluoranthene	1.06
Fluorene	4.86
Indeno(1,2,3-cd)pyrene	0.003
Naphthalene	30.2
Pyrene	0.53

For subsurface sediments, where there were higher concentrations of the index PAH compounds than at the surface, the pore water concentration would be expected to be higher than at the surface; however, due to re-establishment of equilibrium between pore water and overlying sediments and the large retardation coefficients, these higher concentrations would not theoretically be expected to reach the sediment water interface within a reasonable timeframe.

Using a groundwater velocity of 0.5 m/yr, the values of the retardation coefficients shown below represent the number of years for the compound to migrate 0.5 meters upwards through the sediment. For example, it would take 56,000 years for benzo(a)pyrene to migrate 0.5 meters upward through the sediment. Therefore, pore-water advection is not expected to be significant in facilitating the transport of PAHs from the deeper sediment with higher PAH concentrations to the water column within foreseeable time period.

Table I- 5 Retardation Coefficients for Selected PAHs

	Retardation Coefficient	
Parameter	**Non-colloidal**	**Colloidal**
Benzo(a)pyrene	56,000	2,700
Chrysene	14,000	2,300
Fluoranthene	2,200	1,200
Fluorene	280	250
Indeno(1,2,3-cd)pyrene	1.8×10^6	2,800
Naphthalene	71	69
Pyrene	2,800	1,400

Note: R_f noncolloidal - $\rho_b K_s$ R_f colloidal = $1+(\rho_b K_s / (1 + K_c C_c)$

Sediment Resuspension

A potential mechanism of transport for chemicals in sediment to the water column is sediment resuspension. Sediment resuspension is the active transport of the sediments to which the PAHs are adsorbed. Hydraulic conditions in the river were evaluated to determine whether they are sufficient in magnitude to result in sediment resuspension and, thus, lead to the off-site transport of constituents of concern. Potential for sediment resuspension in the river channel was analyzed by modeling several different hydrodynamic forces, which included the following:

- wind generated waves;
- waves generated by navigational watercraft;
- propeller wash from navigational watercraft; and
- river currents.

Each is discussed in further detail below.

Wind Generated Waves

Wave development methodology for wind driven waves, as presented in the Shore Protection Manual (USACE, 1984), was used for this analysis to develop a description of the wave climate, including; wave height, period and wavelength. Existing wind data recorded in Albany County, New York (approximately 30 miles north of the site), were used in the evaluation to characterize both average and extreme winds likely to be experienced at the Site. It is generally assumed that winds experienced at the Albany station over the long-term are comparable to those experienced at the Site. Therefore, to provide an accurate representation of conditions actually experienced at the Site over the long term, a continuous record of wind direction and speed covering a 36 year period (1964 – 2000) was analyzed. A bivariate analysis (speed versus direction) of the long-term record produced a summary table (Table 9 in the *Draft Comprehensive Sediment Investigation Report for Operable Unit 2* (BBL, 2003)) and a corresponding "wind rose" diagram (Figure 7 in the *Comprehensive Sediment Investigation Report for Operable Unit 2* (BBL, 2003)). From analysis of wind records a maximum sustained wind speed, U, of 38 mph (55.73 feet (ft)/second (sec)) was determined.

Next, an effective fetch computation was performed. Fetch is the distance over which wind can blow and develop waves that can travel unobstructed toward the shore. From the Site map and analysis of wind data (1964-2000), the effective fetch, F, for the Site, was determined to be 915 feet (0.17 mile) for a wind direction of 170 degrees. As a conservative measure, because the effective fetch, $F < 0.5$ mile, a default minimum $F = 0.5$ (2,640 feet) was used. Water depth, if shallow enough, can have a significant impact on wave characteristics, and depth effects which are grouped by the ratio of depth/wavelength. For ratios greater than 0.5, water depth is an insignificant factor, and thus, areas with such depth/wavelength ratios are classified as deep water. For depth/wavelength ratios less than 0.04, wave speed is completely a function of water depth. The range between 0.04 and 0.5 is considered as transitional water. Because of uncertainty over the controlling mechanism, both shallow water and fetch limited deep water wave propagation mechanisms [equations (6) to (11)] were considered.

For shallow water conditions the significant wave height, H is given by:

$$H = 0.283\frac{U^2}{g} * \tanh\left[0.53\left(\frac{gh}{U^2}\right)^{0.75}\right] * \tanh\frac{0.00565\left(\frac{gF}{U^2}\right)^{0.5}}{\tanh\left[0.53\left(\frac{gh}{U^2}\right)^{0.75}\right]} \quad (6)$$

Where: h = water depth (ft)

g = 32.2 ft/sec^2

U = wind velocity = 55.7 ft/sec

F = effective fetch = 2640 ft

Wave period,T is given by:

$$T = 7.54\frac{U}{g} * \tanh\left[0.833\left(\frac{gh}{U^2}\right)^{0.375}\right] * \tanh\frac{0.0379\left(\frac{gF}{U^2}\right)^{0.333}}{\tanh\left[0.833\left(\frac{gh}{U^2}\right)^{0.375}\right]} \quad (7)$$

The wave length is given by,

$$L = gT^2/2\pi \quad (8)$$

(Note that although this equation is for deep water conditions, the shallow water correction accounts for less than 1 percent)

The maximum horizontal velocity at the edge of the bottom boundary layer and is described by the equation (Sheng and Lick, 1979):

$$U_m = \pi H/\{T\sinh(2\pi h/L)\} \quad (9)$$

Results for various depths are given in the table below (Table K-6).

For deep water, depth is not a factor and the equations for fetch limited conditions simplify to:

$$H = 2.82 * 10^{-4} \left(UF^{0.5} \right) \text{ and} \tag{10}$$

$$T = 2.825 * 10^{-2} (UF)^{0.33} \tag{11}$$

Since deep water wave characteristics and wave formation are determined independently of the water/sediment layer interaction, there is no calculated bottom water velocity as a result of wave action. The table below (Table K-6) shows calculated wave characteristics.

Table K-6 Wave Characteristics

Water Depth	Height (ft)	Period (sec)	Length (ft)	Bottom Velocity (ft/sec)
6	0.76	1.41	10.3	8.5E-02
8	0.77	1.43	10.4	2.8E-02
10	0.78	1.44	10.6	9.0E-03
15	0.79	1.45	10.8	5.4E-04
20	0.80	1.46	10.9	3.3E-05
25	0.80	1.46	10.9	2.0E-06
30	0.80	1.46	11.0	1.2E-07
40	0.80	1.47	11.0	4.4E-10
Deep Water	0.81	1.49	11.4	NA

In summary, the bottom velocities as a result of wind generated wave action are relatively small (all less than 0.1 ft/sec), and were not considered significant enough to carry through for further analysis regarding the potential for sediment resuspension based on the potential impact of other site-specific resuspension mechanisms and the long established empirical relationship between critical velocity and initiation of motion in sediments.

Impact of Waves Generated by Navigational Watercraft

Some of the watercraft types using the Hudson River are; tow pushing barges, tows without barges, and pleasure crafts such as cabin cruisers and small speed boats. Most of the barges are jumbo barges, but there are some standard size and petroleum barges. The sizes, engine horsepower, and number of the propellers associated with some of the typical watercrafts are summarized in Table K-7 below.

Table K-7 Watercrafts Using the Hudson River

Watercraft	No. of Propellers	Speed (mph)	Length (ft)	Beam (ft)	Draft (ft)	Power (HP)
Pushing Barges	2	11.5	60-400	30-55	31	4000-6500
Tow Barges	2	11.5	60-180	26-52	14	1500-3000
Tugboat	-	2.9-11.5	60	13	6	-
Commercial Fishing Boat	2	6.2-19	40-75	12-20	3-6	300-1100
High Speed Pleasure Boat	-	6-20	-	-	-	-
Cabin Cruiser	-	6.9-19	23	8.3	1.7	-
Ship	-	-	500-600	85-110	31	18000

The maximum wave heights generated by river traffic were computed using the equation given by Hochstein (USACE, 1980):

$$H_{max} = 0.0448V^2 (D/L)^{0.5}(1-bD/Ac)^{-2.5} \quad (12)$$

Where: H_{max} = maximum wave height in ft
L = length of vessel in ft
V = vessel velocity in ft/sec
A_c = the cross sectional area of channel = 70,000 ft^2, (Stedfast, 1980)
D = draft of vessel in ft
b = width of vessel in ft

An orbital velocity analysis was then performed using equation (9) to estimate the bottom velocities that would be generated by the vessel waves. For simplicity, a conservatively short wave period of 1.5 seconds, similar to the wind generated wave period, was assumed for the vessel waves. As a result, the wavelength used for the computation of bottom orbital velocity is 11.5 feet. Table I-8 summarizes the analysis on the vessel generated wave height and bottom current.

Table K-8 Summary Orbital Bottom Velocity Analysis For Shallow Conditions (6 and 10 Foot Depth)

Watercraft	Velocity (mph)	Draft (ft)	Width (ft)	Length (ft)	Maximum Wave Height (ft)	Maximum Velocity for 6 ft. depth (ft/s)	Maximum Velocity for 10 ft. depth (ft/s)
Pushing Barges	8	31	40	400	1.72	0.27	0.030
Tow Barges	8	14	40	180	1.68	0.27	0.030
Tugboat	7.2	6	13	60	1.52	0.24	0.027
Commercial Fishing Boat	12.5	3	17.5	70	3.01	0.48	0.054
High Speed Pleasure Boat	12	3	10	70	2.77	0.44	0.049
Cabin Cruiser	10.5	1.7	8.3	25	2.67	0.42	0.048
Ship	11	31	110	600	2.84	0.45	0.051

The bottom velocity generated in relatively shallow water by these waves ranges from 0.24 to 0.48 ft/sec. With increasing depth the computed bottom velocity decreases rapidly. For example, at a depth of 10 feet the waves generated by a commercial fishing boat results in a bottom velocity of 0.054 ft/sec compared to 0.48 ft/sec at a depth of six feet.

As the vessel induced bottom current velocity in most of the channel is less than 0.1 ft/sec, sediment resuspension due to these waves is not considered significant, in comparison to other possible resuspension mechanisms, and was not carried through for further analysis regarding the potential for sediment resuspension.

Impact of Propeller Wash from Navigational Watercraft

Although the effect of the vessel generated waves is not significant, the potential for navigational watercraft to cause resuspension by propeller wash was also considered. The following calculations are based on the information regarding the vessel types presented above. Equations intended to estimate the maximum velocity at the channel bottom due to watercraft action were initialized from Maynord (1998). Based on the types of watercraft used at the Site and the lack of dock facilities for the larger vessels in the immediate area, the effects of bow and stern thrusters used for maneuvering while docking are not considered.

It was assumed that all boats other than the pleasure boat and cabin cruiser were restricted to the navigation channel. Assumptions regarding the horsepower, propeller diameter and distance from the center of the propeller to the sediment bed are presented in the table below (Table I-9).

Table I-9 Summary of Propeller Wash Assumptions

Vessel	P_d - Applied Horsepower	D_p - Propeller Diameter (ft)	H_p - Distance Propeller Axle to Bed (ft)	U_o - Jet Velocity (ft)	V_b - Maximum Bottom Velocity (ft/s)
Pushing Barges	500	4	8	30.6	3.36
Tow Barges	500	3.5	15	33.4	1.71
Tugboat	500	3	18	37.0	1.35
Commercial Fishing Boat	300	3	18	31.2	1.14
High Speed Pleasure Boat	50	1.4	8	28.6	1.10
Cabin Cruiser	100	2	8	28.4	1.56
Ship	1000	5	10	33.2	3.65

$$V_{b(\max)} = C_1 U_0 D_p / H_p \qquad (13)$$

Where: V_b (max) = maximum bottom velocity

C_1 = 0.22 for non-ducted propeller

$U_0 = C_2 \left[P_d / (D_p)^2 \right]^{1/3}$ = jet velocity exiting propeller in ft/sec

P_d = engine power in HP

D_p = propeller diameter in ft

C_2 = 9.72 for a non-ducted propeller

H_p = Distance from propeller shaft to channel bottom

The maximum bottom velocity due to propeller wash was computed to be 3.65 ft/sec. The corresponding shear stress resulting from the water velocity was computed based upon classical logarithmic resistance relation:

$$\tau = \rho_w f_c U_b^{\ 2} \quad (14)$$

Where: τ = bottom shear stress (dynes/cm^2)
ρ_w = density of water (g/cm^3)
f_c = friction coefficient; and
U_b = velocity (cm/sec)

The friction factor (f_c) is estimated as (van Rijn, 1993)

$$f_c = 0.24 * \ln\left(\frac{12 * H}{K_s}\right) \quad (15)$$

Where: h = water depth (cm)
K_s = effective bed roughness = $3d_{90}$
d_{90} = 2cm

The friction factor was approximately 4 x 10^{-3}, which is consistent with a Manning's roughness coefficient of 0.03 and a depth of 10 meters (approximately 35 feet). The computed shear stress was 51 dynes/cm^2 or 0.11 lb/ft^2. These velocities, and associated shear stresses generated as a result of propeller wash, are considered significant enough to be carried through for further analysis regarding the potential for sediment resuspension (for further discussion below - see "Resuspension Potential" subsection below). Note that these maximum velocities are at points directly in line with the axis of the propeller. Estimated bottom velocities decrease quickly with increasing lateral distance from the propeller.

Impact of River Currents

To estimate the potential for river currents to resuspend sediments, the shear stress associated with a major high flow event plus tide-induced current was used. Based on USGS gaging station records for the Hudson and Mohawk Rivers above the tidal influence, the discharge associated with a 10-year and 100-year recurrence interval flood events for the Hudson River near the Site are approximately 140,000 and 195,000 cfs respectively (Lumia, 1991; Lumia, 1998). Limited direct measurements of flow over a tidal cycle (Stedfast, 1982; De Vries, 2001) indicate that during average conditions the tidal flow of the Hudson River near the Site (based on measurements at Catskill, New York) is approximately 125,000 cfs. The contribution to total flow from the tidal cycle would be diminished during extreme-high flow events; therefore, an estimated discharge of 250,000 cfs was selected for the purpose of computing sediment stability.

The river cross-sectional data for Catskill, New York, were used to represent area as a function of stage adjacent to the Site (Stedfast, 1980). Bathymetric data were obtained from recent surveys conducted in 2002. The 10-year, 50-year, and 100-year flood elevations for the Hudson River adjacent to the Site are 8.3 feet, 10.8 feet, and 12.0 feet, respectively (FEMA, 1989). At 8 feet the cross-sectional area is 73,900 ft^2, while at 10 feet if increases to 81,400 ft^2. A value of 80,000 ft^2 was selected for the purposes of this computation which is approximately representative of the point at which the banks would overtop and maximum channel velocities would be anticipated. The resultant maximum average velocity for the channel was 3.13 ft/sec.

The shear stress was determined from

$$\tau = \gamma RS \tag{16}$$

$$S = \left[\frac{V * n}{1.49} * \frac{1}{R^{0.67}} \right]^2$$

Where: τ = shear stress (lb/ft^2)
γ = specific weight of water (62.2 lb/ft^3)
V = average velocity = 3.13 ft/sec
S = energy gradient slope (ft/ft)
R = hydraulic radius (assumed to equal average depth) (ft)
n = Manning's roughness coefficient (0.030)

Assuming an average depth of 35 feet (assuming hydraulic radius equals depth), and a Manning's roughness coefficient of 0.03, and a computed slope of 3.4 x10^{-5}; the computed shear stress is 0.073 lb/ft^2. Although slightly lower than the shear stress computed for propeller wash, this shear stress is considered significant enough to be carried through for further analysis regarding the potential for sediment resuspension (for further discussion see "Resuspension Potential" subsection below).

Resuspension Potential

For non-cohesive materials, several linear relations between critical shear stress (threshold condition for bed motion) and grain-size have been developed (Julien, 1995) including;

$$\tau_{cr}(lb/\ ft^2) = 0.0164 d_{50}(mm) \tag{17}$$

The computed shear stresses for propeller wash and river currents were 0.11 and 0.073 lb/ft^2, respectively. These shears correspond to the initiation of motion in particle size diameters of 6.7mm (.26 in) and 4.5mm (.18 in), respectively. These sizes are also in general agreement with other empirical relations compiled by Lane (1955), and observations developed by Hjulstrom (1935) for grain-size as a function of velocity.

Based upon the particle size distribution of surface material (0 to 5 feet) in the river, approximately 25% of the material is coarser than6.4 mm (0.25 in.) diameter. This would indicate that at the maximum shear stress computed for either propeller wash or extreme flood events, scour of bed material less than 6.4 mm would occur initially, but that natural armoring would take place soon afterward. Scouring of finer materials from less than 2 inches of the surface material would leave a residual layer of material coarse enough to armor the bed from further erosion.

Sediment resuspension was also shown in the *Site Investigation Summary Report* (BBL, 2000) not to be a significant transport mechanism for constituents residing in the sediment, based on a comparison of calculated shear stresses for the 10- and 100-year floods and surficial sediment physical characteristics. Data collected in 2002 further support that conclusion; in fact, particle-size data in the recent cores indicate the occurrence of sediment armoring over much of the Site, where coarser sands and gravel [(median particle size, grain-size diameter corresponding to 50% passing by weight (D_{50} = 1.04 mm)] overlie the finer silts and sands (D_{50} = 0.3 mm), in effect protecting the deeper, finer sediment from erosive forces.

Multiple lines of evidence presented in the *Site Investigation Summary Report* (BBL, 2000) and confirmed by the 2002 data indicate that migration of PAHs from the sediment bed to the water column and downstream areas is limited. Further, it is likely that embayment #1 historically acted as a source of PAHs to adjacent Hudson River sediment. Previous sampling has shown the presence of NAPL in the sediments of embayment #1 and in the river sediment in the area west of embayment #1. The highest PAH concentrations, both in the surface and subsurface sediment, were observed in the same general area as the NAPL, and correspond to embayment #1. PAH concentrations in the recent samples, both surface and subsurface, exhibit a downward gradient both outward and downstream from the area previously identified as having the highest concentrations. Given the occurrence of sediment deposition over some of this area, the observation of sediment armoring in the deeper areas of the channel, and the distribution of total PAHs in the sediment, remediation of embayment #1 will likely remove the primary historical source of PAHs and stop future transport of PAHs from embayment #1 to other areas of the Hudson River channel.

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